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Terra Australis reports the results of archaeological and related research within the south and east of Asia, though mainly Australia, New Guinea and island Melanesia — lands that remained terra australis incognita to generations of prehistorians. Its subject is the settlement of the diverse environments in this isolated quarter of the globe by peoples who have maintained their discrete and traditional ways of life into the recent recorded or remembered past and at times into the observable present.

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Contextualising the Neolithic Occupation of Southern Vietnam

The Role of Ceramics and Potters at An Son

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List of Abbreviations and Terms

Abbreviations

An Sơn

09AS	2009 An Sơn excavation season
97AS	1997 An Sơn excavation season
AS	An Sơn
FC	Fired clay
UC	Unfired clay
H1	Trench 1
H2	Trench 2
H3	Trench 3
M	Burial (e.g. M1 = burial 1)
TS	Test Square
L	Layer
S	Spit

Most ceramic samples are labelled as: 09AS-H1-A1-L1-S1-1 (2009 An Sơn excavation-Trench 1-square A1-layer 1-spit 1-sample 1 from this context)

Sites

BNW	Ban Non Wat
CCN	Cồn Cổ Ngựa
CLR	Cù Lao Rùa
DB	Đa Bút
DO	Đình Ông
GCV	Giồng Cá Vồ
HD	Hòa Diêm
LG	Lộc Giang
MB	Mán Bạc

Methods

CPCRU	Chemical Paste Compositional Reference Unit
CA	Correspondence Analysis
CV	Coefficient of variation
CVA	Canonical Variate Analysis
EDX	Energy Dispersive X-ray Spectrometry
keV	kiloelectronvolt
µm	micrometre
PCA	Principal Component Analysis
SEM	Scanning Electron Microscope
SG	Subgroup
TG	Temper Group
WDS	Wavelength Dispersive X-ray Spectrometry

Terms

Bleb	Crushed rice and clay fired balls used as temper

Cà ràng	Vietnamese term for earthenware vessel with three projections for resting another vessel on top; used as a stove or earth oven for cooking
Ceramic fabric	The structural and material contents of a pot, includes temper, non-plastic inclusions, and clay
Clay	Naturally occurring material with fine-grained minerals and plastic properties and grain size less than 4μm
Clay matrix	Fabric or paste within pottery vessel that is plastic, i.e. not a non-plastic inclusion or temper
Earthenware	Pottery typically fired between 800 to 1150°C
Fibre temper	Frequently used by Vietnamese archaeologists, this term is applied in this monograph to describe ceramics tempered with organic material. While this was often identified as rice chaff (often rice husk and stem fragments) at An Sơn, the term is used generically to include all plant remains that may have been used as temper
Paddle linear impression	This impression mimics linear incisions created by a comb when a paddle is carved with lines, which are then impressed onto the ceramic surface; paddles with cord wrapped around produce "cord-marked" impressions
Non-plastic inclusion	Can include manually added temper materials or natural minerals within plastic clay
Paddle and anvil	Tools for pot forming. The paddle is often wooden and is used to beat the pot into shape on the outside of the vessel, while the anvil, often ceramic or stone, is held on the inside
Punctate stamping	Decoration formed by impressing dots on ceramic surface
Roulette stamping	Decoration formed by rolling a stamp with an impressed or relief motif around a vessel: stamps can be created by carving a cylindrical item, perhaps wood, or adhering plant weaving or knotted cord around a cylindrical item, in particular motifs that are then impressed onto the ceramic surface; also called "rocker stamping"
Sand	Grain size: very fine, 63 to 125 μm; fine, 125 to 250 μm; medium, 250 μm to 0.5 mm; coarse, 0.5 to 1 mm
Silt	Grain size: fine to medium silt, 4 to 32 μm; coarse silt, 32 to 63 μm
Temper	Manually added materials to potting clays to aid forming and firing of a pot

1

Introduction: Unravelling the Neolithic of Southern Vietnam

Neolithic archaeology in southern Vietnam

Research on the neolithic occupation of Southeast Asia thus far has been predominantly limited to particular regions, especially central and northeast Thailand and northern Vietnam. Multiple excavations in these regions have resulted in a number of significant site reports and comparative publications (e.g. Oxenham *et al.* 2011; Higham and Kijngam 2009; Nguyễn 2006; Higham and Thosarat 1998a; Ciarla 1992; Rispoli 1992; Higham and Bannanurag 1990). Over the past two decades, research, surveys and excavations have increased in southern Vietnam. This monograph focuses on the ceramics from the neolithic occupation in southern Vietnam, with particular reference to those excavated from the mound site of An Sơn in Long An Province. To date An Sơn is the most comprehensively excavated site in southern Vietnam shown to exhibit a neolithic sequence. With this new research, previous overviews of cultural sequences for Southeast Asia (e.g. Higham 1996b: 4, figure 1.2) can now be reworked to include southern Vietnam.

Most researchers accept the appearance of neolithic communities in mainland Southeast Asia in the late third millennium to early second millennium BC. There are currently two main models for the development of neolithic culture in mainland Southeast Asia. One posits that a transition to cultivation took place as farmers expanded into the region from the north and the indigenous hunter-gatherers were replaced or assimilated (Higham 2011: 1; Bellwood and Oxenham 2008). The other focuses on the importance of the adaptability amongst indigenous groups as neolithic farmers entered (Higham 2011: 1). Identified neolithic sites in mainland Southeast Asia are predominantly distributed either along, or near, present or former coastlines and rivers. These environments provide the natural flooding and rainfall required for rice cultivation. Both north and south Vietnam has the prime Red and Mekong River delta areas that are well-suited for wet rice agriculture. In the past these rivers and their tributaries were likely to have been of great importance to the movement of people and ideas. The neolithic occupation of Vietnam exhibits evidence of contact with China and other regions of mainland Southeast Asia, leading to hypotheses that agricultural ideas travelled from the north either via the mainland rivers and/or down the coastline (Higham *et al.* 2011; Fuller *et al.* 2010).

The oldest evidence of cultivation in mainland Southeast Asia appeared in these neolithic communities, including rice and other crops, supported by a hunter-gatherer-fisher economy. Within sedentary village habitation sites people kept domestic pigs and dogs and shared aspects of ceramic traditions, ground and polished stone assemblages, and bone and shell technologies. Some of these communities may have been settled for up to 1000 years. One such settlement was the mound site of An Sơn, located alongside the main course of the Vàm Cỏ Đông River, overlooking alluvial floodplains with rice fields. An Sơn has evidence of a neolithic sedentary occupation at which many generations of people were occupied in rice cultivation and animal husbandry, and utilised ceramic, stone, shell and bone technologies (Piper *et al.* 2012; Bellwood *et al.* 2011).

Many questions about the origins of neolithic people in mainland Southeast Asia remain unanswered; who they were, the routes they used to arrive there, what they brought with them, how they interacted with indigenous groups, and how regionalised neolithic life developed. This monograph explores a small part of these queries, focussing on the neolithic ceramic traditions that were brought to southern Vietnam and the innovations that ensued soon after with the establishment of a local identity.

Past research at An Sơn has explored the connection between the ceramics of this and other sites in southern Vietnam (Nishimura 2002). Nishimura Masanari (2002; also in Bùi *et al.* 1997; Nishimura and Vương 1997) has highlighted the problems in establishing a sequence for southern Vietnam, especially a lack of understanding of stratigraphical relationships between sites and errors in radiocarbon dates. This research (Nishimura *et al.* 2009; Nishimura 2002; Nishimura and Vương 1997) has investigated ways to correlate the various neolithic sites of southern Vietnam with a particular focus on ceramic decoration and form. It is my intention to develop this approach further, supported by analyses of other ceramic and non-ceramic material culture.

While the parallels between the ceramics of sites in southern Vietnam and sites in Cambodia and Thailand (such as Samrong Sen, Ban Chiang, Ban Kao, Tha Kae and Khok Phanom Di) have been noted previously (Bùi *et al.* 1997), detailed analysis of these similarities has not been conducted. Cross-cultural studies within Vietnam have been restricted by a tendency to define 'Cultures' in terms of one or a set of artefacts (Tấn 1984–1985) (see Chapter 2), with little attention paid to issues of social identity and cultural boundaries. In this monograph I analyse data utilising multiple variables to follow pathways of cultural movement that could represent fluid constructions of identity and reveal the complexities of relationships between sites. These ideas are explained later in this chapter.

This chapter firstly introduces the research aims for the monograph, which is followed by a discussion about how to define the 'Neolithic' in Southeast Asia and how the term is used in this monograph. The site of An Sơn and the 2009 excavation are introduced, and the theoretical framework and methods employed in this monograph are presented. This chapter concludes with a chapter breakdown.

Research aims

This monograph focuses on the ceramic evidence from the neolithic site of An Sơn in southern Vietnam in order to establish a sequence of ceramic vessels over time, and to evaluate the relationships between An Sơn and other southern Vietnamese sites of similar date. Comparisons extend to well-documented neolithic sites in other regions of mainland Southeast Asia. The research includes material culture analysis, ceramic characterisation, and an interpretation of the organisation of pottery production and the role of potters within the neolithic community at An Sơn.

The overall objectives of this monograph are:

- to document the neolithic ceramic sequence for An Sơn by means of a detailed analysis of the morphological, decorative and material attributes of the ceramic assemblage excavated in 2009;
- to contextualise the An Sơn assemblage within the neolithic of southern Vietnam, in terms of material culture linkages with other sites, and local instances of stylistic and technological innovation;

- to place southern Vietnam within a wider debate on the transition to cultivation and related neolithic developments in mainland Southeast Asia;
- to investigate the roles of neolithic potters in southern Vietnam in the exchange and transference of items of material culture and ideas;
- to consider the role of potters within the An Sơn community itself, and the local organisation of pottery production;
- to examine the role of ceramic material culture in general in establishing identity for the An Sơn community.

The neolithic expression of Southeast Asia has often been described as a 'package', in which items such as incised and impressed pottery, polished stone tools, stone and shell beads and bracelets, an extended burial posture, and evidence of sedentary life with a transition from hunting and gathering to animal husbandry (especially pigs) and rice cultivation, appeared at approximately the same time across a large area (Rispoli 2007: 235, 238; Bellwood 2005: 131–134; Higham and Thosarat 1998b: 74–75). This research investigates whether An Sơn fits a neolithic package model, reaching southern Vietnam from the north or west in a rapid cultural change.

A major aspect of this neolithic package is the ceramic material culture, and the research objectives address the role of ceramics and potters by investigating the social constructs surrounding the potting occupation and its contribution to relationships between sites. This research is framed around technological theory, particularly in relation to the organisation of production (e.g. Costin 1991), cultural transmission of technology and interactions between groups (Eerkens and Lipo 2007). This enables detailed comparison between sites, in terms of ceramic assemblages, to uncover potential relationships, cultural affinities and differences that may indicate the identity of the potters and the communities involved. The theory of identity for archaeological groups appreciates fluctuating interactions and social meanings of artefacts (e.g. Jones 2007), and may offer hypotheses for the social and cultural reasons for similarities and variations in assemblages between groups. Technological and identity theories also allow for potters to be at the forefront of discussions for neolithic developments in mainland Southeast Asia in both ritualistic and everyday life. The theories applied in this research are described further later in this chapter.

This research will consider several hypotheses for the cultural interactions that took place during the Neolithic, with respect to An Sơn and its ceramic material culture. These include the theory that An Sơn is part of a wider network of sites within southern Vietnam (Nishimura 2002). It considers whether the sites along the various river courses are connected. Furthermore, the alternate hypotheses for the settlement of southern Vietnam are explored: one that posits settlement via the coast from the north, and the other that suggests southern Vietnam was occupied after Neolithic peoples voyaged along inland rivers from Cambodia and Thailand (Higham *et al.* 2011; Fuller *et al.* 2010).

Defining the 'Neolithic'

The term 'Neolithic' has been used in a general Old World context to describe particular economic, technological, settlement and population features. At first, the term was used to describe 'The later or polished Stone Age; a period characterised by beautiful weapons and instruments made of flint and other kinds of stone, in which, however, we find no trace of the knowledge of any metal...' (Lubbock 1865: 2–3). Later on, especially in Europe, the term acquired the implication of a combined use of ground and polished stone tools, pottery and agriculture. However, developing research on neolithic communities has indicated that 'Neolithisation' was regionally specific and that a uniform package is not necessarily to be expected (Thomas 1991: 7). Sites with stone working and pottery technology, and evidence of sedentary occupation, may not actually contain any evidence of cultivation or animal husbandry, nor reveal such without focused archaeozoological and archaeobotanical research. This has been especially the case with excavations in Southeast Asia (Higham 1989: 45–54) (see Chapter 2). Conversely, sites with evidence of cultivation may be aceramic, as in the early Neolithic of the southern Levant (Kuijt and Goring-Morris 2002), the Pre-Formative Period of Mesoamerica, and the Late Preceramic phases in the Andes and New Guinea (Bellwood 2005: 142–145, 165–168).

In modern archaeology, use of the term 'Neolithic' implies cultivation of plants and husbandry of animals, at least in most temperate and tropical regions of Eurasia. 'Neolithic' is a technological term, meaning 'new stone', yet the ultimate criterion for the neolithic age at present commonly rests upon evidence for farming. A uniform 'Neolithic package' will not be found in many regions, such as the Middle East or Mesoamerica/Andes, owing to the non-synchronous appearances of pottery, polished stone, and agriculture. This is to be expected in areas where food production was developed indigenously from local resources, as in the above regions. However, in situations where food production was introduced, either by a migrant population or through rapid adoption by an indigenous population, it can be expected that there was a co-occurrence of items deemed to be neolithic. Such appears to have been the case in mainland Southeast Asia (e.g. Bellwood *et al.* 2011; Higham and Kijngam 2011; Belfiore *et al.* 2010; Bellwood and Oxenham 2008; Rispoli 2007).

There is variability in the terminology applied to issues of food production in archaeology. These terms overlap in their meanings and they must be used explicitly (Harris 1996: 3). For instance, Harris (2009) has described *agriculture* as both the cultivation of crops and the rearing of livestock. *Cultivation* is the interaction between plants and people, and is usually applied to the growing of domesticated crops, although it can also include wild plants. *Husbandry* is the rearing of livestock and *horticulture* describes garden cultivation. The concept of *domestication* is associated with morphological, behavioural and genetic changes in plants and animals due to human selection, whether voluntary or involuntary (Harris 2009).

The role of diffusion in the adoption and establishment of agriculture has been contentious in the past. The modes of diffusion have been described as either demic/primary, such as the migration of people to a new area to spread not only agricultural technologies and related neolithic innovations but also genes and languages, or cultural/secondary, which involves the selective adoption of foreign concepts into indigenous practices (Harris 1996: 7). There is now a prevailing opinion that diffusion in some form was an important part of the 'origin' and 'spread' of agriculture. Opinions can vary greatly in relation to the relative importance of 'diffusion' and 'independent invention'. There was a time of outright rejection of diffusionist explanations for cultural change in the 1960s and 1970s, but this has now been re-evaluated to comprehend the range of ways in which cultural innovations might have spread (Harris 1996: 7).

As stated above, the term 'Neolithic' has been applied to mainland Southeast Asia to describe the appearances of pottery, polished stone adzes, shell and stone body ornaments, extended burials, evidence of sedentism, and a transition from a hunter-gatherer economy to a reliance on rice cultivation and pig and dog domestication (Rispoli 2007: 238; Bellwood 2005: 131–134; Higham and Thosarat 1998b: 74–75). Although coarse cord-marked ceramics were present in earlier hunter-gatherer contexts (e.g. in Hoabinhian and Đa Bút sites in northern Vietnam), Fiorella Rispoli (2007: 235; 1992) has clarified the distinctive pottery component associated with the neolithic in mainland Southeast Asia. This includes decoration comprising impression or incision within incised boundary lines. These incised and impressed motifs on pottery appeared contemporaneously with the remainder of the package associated with neolithic developments. Sites located near major river plains were exposed to similar cultural developments, and the characteristic elements of neolithic occupation do not appear in isolation (Rispoli 2007: 235, 238).

The generalised cultural package identified above is largely understood to have ultimately originated from southern China, specifically the middle and lower Yangtze Basin (Bellwood 2011; Castillo 2011; Lu 2011; Fuller *et al.* 2010; Nakamura 2010; Zhang and Hung 2010; Zhao 2010; Rispoli 2007; Higham 2002a). Higham (2002a) has suggested agricultural groups spread southwards and downstream along major river routes from Yunnan. However, current archaeobotanical evidence from Southeast Asia suggests rice first appeared in the lower reaches of the Red River in northern Vietnam around 2000 BC, and also along the Mekong River in Cambodia and Chao Phraya River in Thailand. Evidence from sites located further inland up these rivers appears to be later, *c.* 1500 BC (Higham and Higham 2009b). The evidence currently suggests that the spread may have been based on movements along coastlines or lower mountain slopes, and *Oryza sativa japonica* first appeared in lowlands and lower slopes in environments with natural flooding and monsoonal rainfall (Fuller *et al.* 2011; Fuller *et al.* 2010).

Incised and impressed sherds have been excavated at Baiyangcun and Dadunzi in Yunnan (Rispoli 2007 cites: Jiaxiang 2003; Xioa 2001; Yong 1985; YNBWG 1981, 1977). Rispoli (2007) expanded her research to identify ceramic parallels between neolithic sites in mainland Southeast Asia and some along the Yangtze River, such as at Daxi. While single cultural traits may have spread from the Yangtze through the Guangxi to northern Vietnam, a 'Neolithic package' may have been a later event (Rispoli 2007). My research does not investigate any precise origin for this neolithic 'cultural package'. Instead, this monograph focuses on regional linkages within neolithic Southeast Asia only. Even though the sources of many neolithic attributes may be traceable to China, I do not follow this trail.

However, it is still important to consider the question of whether or not there was a 'Neolithic package' in Southeast Asia. Zhang and Hung (2010) point to the absence of evidence for any simultaneous introductions of agriculture and domesticated pig and dogs. This may simply reflect scarcity of data and a weakness in observational techniques utilised during excavations. Part of the problem is a lack of direct remains of cultigens in sites and archaeobotanical research (Castillo and Fuller 2010; Higham 1989: 31–45). Agricultural dispersal out of China was not a unitary event southwards to mainland Southeast Asia, and the hypothesis of an independent or simultaneous transition to a neolithic lifestyle in mainland Southeast Asia has not been confirmed (Zhang and Hung 2010).

A strong correlation between the neolithic of Southeast Asia and rice cultivation has often been assumed, due in part to the discovery of rice in pottery fabrics. Conversely, an absence of rice remains in ceramic materials need not imply an absence of rice agriculture. Other plants and possible cultigens in Southeast Asia include foxtail and common millet, and also tubers such as taro and yam (Castillo and Fuller 2010; Weber *et al.* 2010; Dewar 2003). Millet and rice can be cropped in the same field, providing that dry rather than wet rice cultivation took place (Weber *et al.* 2010). Foxtail millet and rice have been found together at Gantuoyan in Guangxi Province, not far north of the Vietnam border, dated to before 3000 BC, and at the Nanguanli sites in Taiwan 2700–2200 cal. BC (Castillo 2011; Castillo and Fuller 2010; Fuller *et al.* 2010; Weber *et al.* 2010; Zhang and Hung 2010).

It has been hypothesised that rice and millet as cultivated crops entered mainland Southeast Asia simultaneously, with the earliest evidence of millet at Non Pa Wai in central Thailand, in neolithic contexts dating to *c.* 2300 BC (Castillo 2011; Castillo and Fuller 2010; Fuller *et al.* 2010; Weber *et al.* 2010). Recent excavations at Rạch Núi in 2012 also indicate that millet was present in some neolithic deposits in southern Vietnam (preliminary identification by Cristina Castillo in the field). It had previously been proposed that foxtail millet arrived in mainland Southeast Asia in the second millennium BC (Kealhofer and Grave 2008; Kealhofer and Piperno 1994), but new evidence presented by Weber *et al.* (2010) indicates that it was present in central Thailand and perhaps also southern Vietnam by the late third millennium BC. While rice and millet may have been introduced together, it has been suggested that there was initially a preference for millet cultivation until rice became prominent as increasing social complexity occurred after the neolithic in Southeast Asia (Castillo 2011; Fuller *et al.* 2011; Weber *et al.* 2010). Fuller (2011) states that it is plausible that multiple rice-millet waves came through mainland Southeast Asia after other cultigens entered, including taro.

In terms of location and food resources, many neolithic settlements in Vietnam (e.g. Mán Bạc and Rạch Núi) were very close to contemporary coastlines and show considerable evidence for ongoing marine fishing and gathering. Conversely, although much closer to the coastline in prehistory than it is today, the economy at An Sơn seems to have been almost entirely terrestrial and riverine (Piper *et al.* 2012; Bellwood *et al.* 2011). For those sites that did exploit marine resources, it is possible that subsistence strategies did not shift as rapidly to agriculture and cultivation in comparison to communities living in inland environments. In these marine environs, neolithic material culture may have been readily incorporated into indigenous hunter-gatherer-fisher life when cultivating cultures came into contact with these groups, and traditional subsistence strategies may have been retained in full- or part-time sedentary coastal occupation (as suggested for Khok Phanom Di) (Higham and Thosarat 2004c).

The ways in which agriculture was introduced and adopted in Southeast Asia appear to have been diverse. Interactions between agriculturalists and hunter-gatherer groups varied substantially in different regions of mainland Southeast Asia and evidence of such interactions are scant, except perhaps in northern Vietnam and in northeast and coastal central Thailand (Higham *et al.* 2011; Matsumura *et al.* 2008; Bentley *et al.* 2007). Factors that should be considered influential to the introduction of agriculture include environmental constraints and opportunities, cross-cultural relations, local innovations towards agriculture, relative demographic profiles, the land requirements of farmers versus hunter-gatherers, and the identities and traditions that existed within indigenous hunter-gatherer-fisher communities. These factors affect the archaeological representation of neolithic life.

An Sơn has been identified as a 'Neolithic' site due to its late third to second millennium BC radiocarbon dates, the presence of incised and impressed ceramics, organic/fibre tempered ceramics, ground stone adzes and domestic fauna, and a lack of any prehistoric metal artefacts (see Chapter 4). The term *neolithic* is used in this monograph in the lower case due to the origin of the term for archaeological contexts in Europe and the Near East, and the need to continually re-evaluate the definition of neolithic in mainland Southeast Asia in current archaeological research. In keeping with recent research in Vietnam (Matsumura and Oxenham 2011; Oxenham and Tayles 2006), neolithic is applied tentatively for 'food-producing communities that lacked evidence for metal' in mainland Southeast Asia (Matsumura and Oxenham 2011: 4). Lowercase palaeolithic, bronze age, iron age and metal age are also used for similar reasons and consistency in this monograph.

The neolithic of An Sơn and southern Vietnam

The neolithic chronology of Southeast Asia

The prehistoric sequence for Vietnam is not as comprehensively understood as that of Thailand. One of the broader chronologies presented for the China/Southeast Asia region has been put forward by Higham (1996b: 4, figure 1.2) (Figure 1.1). This is one of the few chronologies to include Vietnam, but the gap in knowledge of southern Vietnam is noticeable. Higham's (1996b: 4, figure 1.2) sequence places the onset of neolithic cultures at *c.* 2200 BC in Southeast Asia, lasting until the beginning of the bronze age at around 1300 BC.

More recent research at Ban Non Wat has dated the first neolithic phase at this site to the mid-seventeenth century BC and the initiation of the bronze age in northeast Thailand to *c.* 1000 BC (Higham and Higham 2009). Compiling the radiocarbon dates from Ban Non Wat, Ban Lum Khao and Noen U-Loke, Charles and Thomas Higham have presented a new prehistoric sequence for northeast Thailand that positions the time span of neolithic occupation from 1650 cal. BC to 1050 cal BC (Higham and Higham 2009b). This is considerably later than previous chronologies, such as those presented for Khok Phanom Di and Nong Nor (Higham and Hogg 1998; Higham and Bannanurag 1990), and needs to be considered against the dates for neolithic occupation at An Sơn (Chapter 4).

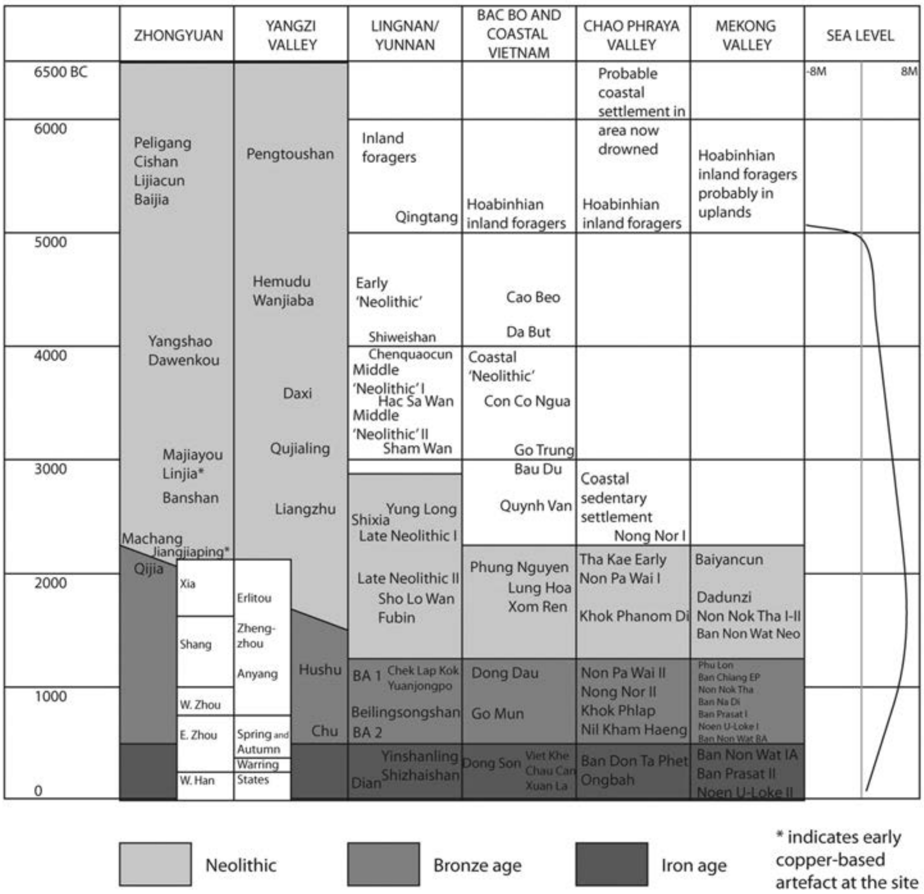


Figure 1.1. C. F. W. Higham's chronological chart showing the cultural sequences in the different regions of Southeast and East Asia. Zhongyuan refers to the lower reaches of the Yellow River, Lingnan refers to southeastern China, and Bắc Bộ refers to northern Vietnam.

Source: After Higham 1996b: 4, figure 1.2; Tha Kae and Ban Non Wat added by C. Sarjeant.

Introduction to the 2009 excavation at An Sơn

The An Sơn mound is a maximum of 170 m in diameter. Its modern flat summit is about 100 m across, and is 6 m higher than the surrounding landscape of rice fields. The site is located on a natural levee in the middle reach of the Vàm Cỏ Đông River, that runs north to south in the western region of Long An Province (Nishimura and Nguyễn 2002: 101) (Figure 1.2, Figure 1.3). The surviving mound has been truncated by road and house cuttings, particularly on the west and south edges, and it is likely that some of its outer flanks have now been destroyed.

An Sơn was initially reported by Louis Malleret and Paul Levy (Malleret 1963: 94–95). Excavations began in 1978 on the top of the mound, and subsequent investigations took place in 1997 (Nishimura and Nguyễn 2002). The 2004 excavation focused on areas with burials located beyond the eastern edge of the main mound, and a small excavation unit was opened in 2007 in the same area. Three 2009 excavation trenches were positioned adjacent to the 2004 trenches, with the intention of uncovering more extended burials. A small test square was also opened at the western side of the mound. The 1997 to 2009 excavations were organised by Hanoi National University and Nishimura Masanari in 1997, the Institute of Archaeology, Hanoi and Nguyễn Kim Dung in 1997 and 2009, the Centre for Archaeological Studies, Southern Institute of Social Sciences, Ho Chi Minh City in all years, Bùi Chí Hoàng in 2009, and The Australian National University in 2009. The 2009 excavation was funded by a Discovery Grant from the Australian Research Council, awarded to Peter Bellwood, Marc Oxenham and Janelle Stevenson. My research focuses on the excavations in which The Australian National University participated during 2009.

This excavation, as part of an ARC project entitled *The Creation of Southeast Asian Peoples and Cultures, 3500 BC to AD 500,* was intended to address the origins of rice agriculture in Southeast Asia in general and in southern Vietnam, as well as information concerning the people from interment practices and human remains. The 2009 excavation at An Sơn revealed evidence for a mixed economy, including domestic pig and dog, the *japonica* subspecies of rice (as husk in pottery), fish and shellfish from brackish estuarine rivers, and hunted animals. Some of the earliest layers contained domestic dog, but it is uncertain whether the earliest pig remains were domesticated or wild. No wild pig remains were identified at An Sơn (Piper *et al.* 2012). Rice chaff was not identified in pottery tempers from the earliest layers of An Sơn, but appeared shortly after. Other material culture at An Sơn included ground and polished stone tools, shell beads, bone fishhooks and worked bone/ivory, ceramic roundels or counters, and baked clay pellets (Chapter 4).

The 2009 excavation revealed an assemblage of 227,231 ceramic sherds, inclusive of 35,723 rim sherds, with a total weight of 2581 kg. Most of this material was recovered from occupation layers, either in discard or activity (e.g. cooking) areas. From these assemblages, a large array of rim forms was identified. Some vessels used as grave goods were found complete. Past research at An Sơn has identified the modifications in ceramics over time (Nishimura 2002; Nishimura and Nguyễn 2002), but with more detailed analysis of form, decoration and fabric, a sequence can be firmly established to compare with sequences from other neolithic sites in Southeast Asia. The 2009 excavation included an assemblage of utilitarian vessels used in cooking contexts, ritual vessels in burial contexts, and other decorated wares that indicate both connections to other neolithic sites in Southeast Asia, as well as localised innovation.

The environment of An Sơn

An Sơn is located in An Ninh Tây commune, Đức Hòa district, close to the northern border of Long An Province. The site is now about 75 km from the sea and about 300 m east of the Vàm Cỏ

Đông River, on a slightly raised Quaternary alluvial terrace, north of the Mekong Delta region (Figure 1.2, Figure 1.3). The coastline around the Mekong Delta has changed substantially over time. The lower Mekong River traverses the Indosinian cratonic block and has been relatively stable since the Jurassic period. However, the development of tectonic and volcanic events during the Quaternary, as well as glacial to interglacial cycles, has resulted in climatic and sea level changes in southern Cambodia and southern Vietnam (Carling 2009: 18–20). The sea level rose from -12.8 to +1.2 m relative to the present level between 8000 and 6000 years ago, and was 2.5 and 5.8 m higher between 5000 and 4000 years ago. The entire Mekong Delta region is likely to have been at sea level and prone to flooding until at least 4000 BP (Sathiamurthy and Voris 2006: Figure 26; Geyh *et al.* 1979).

Figure 1.2. Map of An Sơn and the Southeast Asian sites mentioned in the text.

Source: Map by C. Sarjeant.

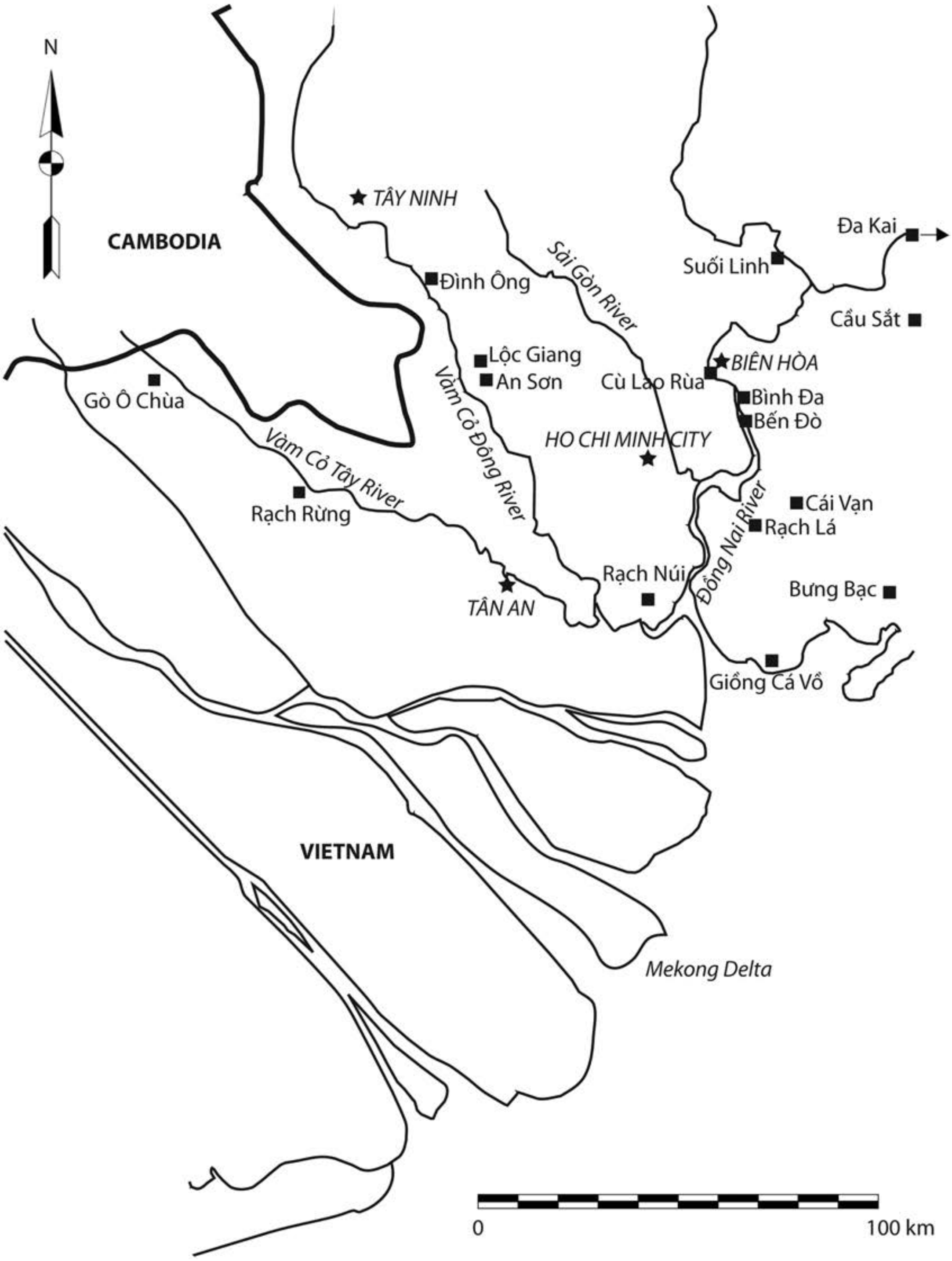


Figure 1.3. Map of An Sơn and neighbouring southern Vietnam archaeological sites.

Source: Map by C. Sarjeant.

The location of the future site of An Sơn was closer to the coastline compared to today during the period of maximum Holocene marine transgression, between 4000 and 3000 cal. BC, when the sea level was at +2.5 to +4.5 m above the present level (Proske *et al.* 2010; Tạ *et al.* 2002; Nguyễn *et al.* 2000). An Sơn may have been under mangrove vegetation at this time. However, by the time the archaeological site was founded, between 2500 and 2000 BC, the sea may have already retreated 40 to 50 km. An Sơn itself contains no strong evidence for marine food consumption and all subsistence resources may be categorised as terrestrial or riverine, although the shellfish are estuarine, so perhaps brackish water extended quite far inland (Piper *et al.* 2012; Bellwood *et al.* 2011).

In recent years, a large number of archaeological sites dating from the neolithic to the iron age have been investigated in the Vàm Cỏ Đông and Vàm Cỏ Tây drainage systems and the adjacent Đồng Nai and Sài Gòn River valleys, all forming the hinterland to Ho Chi Minh City (Figure 1.3). Many date from the bronze and iron ages (1000 BC to AD 500), but the Vàm Cỏ Đông has a concentration of tested neolithic sites dating from the late third and second millennia BC, including An Sơn, nearby Lộc Giang, and Đình Ông further upstream in Tây Ninh Province (Nishimura 2002; Nishimura and Nguyễn 2002).

Introduction to the theoretical framework and research methodology

This section introduces the methods and theoretical framework applied to address the research aims of this monograph.

Characterisation of the An Sơn ceramic assemblage

While all excavated archaeological features and material culture from An Sơn are presented in this monograph, detailed analysis is conducted only on the ceramic assemblage. The entire 2009 assemblage was assessed to identify rim forms, modes of decoration and surface treatment, and types of temper. It was possible to separate sand-tempered sherds macroscopically from fibre-tempered sherds for the whole assemblage. Fibre temper is used in this monograph to describe ceramic fabrics tempered with organic material, often rice chaff (see Chapter 6, Part I). Rim forms were drawn and classified, complete and reconstructed vessels were drawn and photographed, decoration was photographed, and samples of different ceramics over time were collected for further analysis (see Chapter 5).

Ceramic sherds were collected for more detailed analysis from an area of the 2009 excavation that presented the longest sequence. This was square C1 in Trench 1, which was cut into the flank of the 5 metre high main mound. Additional sherds were collected from the basal layers of the Test Square dug into the western flank of the 1997 excavation. Some rim forms and fabrics that were under-represented in Trench 1 C1 were collected from other contexts in the 2009 excavation and analysed. The ceramic fabrics were analysed macroscopically, microscopically, and with scanning electron microscopy (SEM). The fabrics were characterised visually with SEM backscatter micrographs and quantitatively with energy dispersive spectrometry (EDX) on the SEM to characterise the mineral grains and clay matrices of the ceramics. These analyses permitted the characterisation of the variety of fabrics over time at An Sơn (see Chapter 6).

The analysis of the ceramics at An Son introduces a whole host of theoretical approaches from the literature on 'The Anthropology of Technology' (Schiffer 2001). In no way can this monograph encompass all facets of sociotechnical systems. In terms of current literature, these extend to (a) technological processes and the *chaîne opératoire* (e.g. Dobres 1999; Schlanger 1994; Leroi-Gourhan 1964); (b) the organisation of production and the identities of potters (e.g. Neupert 2007; Hurcombe 2000; Senior 2000; Roux and Matarasso 1999; Rice 1996b, 1991; Mills 1995; Costin 1991; Wright 1991); (c) technological change (e.g. Eerkens and Lipo 2007; Roux 2003b; Stark 1991); (d) the influence of function and style on design (e.g. Rice 1996a; Hegmon 1992; Skibo 1992; Mills 1989; Hill 1985; Sackett 1982; Dunnell 1978); (e) potter choices and acts of invention, experimentation and conservatism in manufacture (e.g. Eerkens and Bettinger 2001; Neiman 1995; van der Leeuw and Torrence 1989; Rice 1984; Nicklin 1971); and (f) cultural transmission and learning of technology (e.g. Bowser and Patton 2008; Eerkens and Lipo 2008, 2007, 2005; Roux 2008; Tehrani and Riede 2008; Crown 2007, 2002; Minar and Crown 2001; Eerkens 2000).

In order to simplify matters, I only introduce here the relevant areas of technological research that are utilised in interpreting the ceramic assemblage at An Son, in relation to the research aims. These primarily concentrate on the organisation of production and potter choices to make inferences about identities and the behaviour of potters. Cultural transmission is also discussed, both between potters within the community and between groups, to understand the significance of interaction. Technological theory is linked with theory of identity and material culture (e.g. Hodder 2003; Meskell 2001; Jones and Graves-Brown 1996) in this monograph to illustrate how material culture was utilised at An Son to project concepts of cultural affinity and difference during the neolithic occupation.

Contextualisation of the An Sơn assemblage within the neolithic of southern Vietnam

Cultural comparisons are integral to archaeological inquiry. To understand change over time and interaction, boundaries and cultural groups are defined and sites and assemblages are placed in temporal and spatial order. Presences or absences of defining cultural characteristics for periods of antiquity and specific regions can help to order sites in cultural groups, tied to specific areas and times. The comparative study between An Sơn and other sites with neolithic sequences in southern Vietnam involved the examination of museum collections, excavation reports and other reported information. This comparison once again focused on ceramic assemblages, but also considered other material culture and other occupational and mortuary evidence.

Accumulating this information was more difficult than anticipated, and the comparative analysis was necessarily based on the presence or absence of particular ceramic rim forms, decorations, fabrics when known, and other material culture at each site. While photographs, drawings and descriptions validated the analysis, the presence/absence data were analysed in a correspondence statistical analysis. The difficulty in periodising the most significant neolithic sites of southern Vietnam, especially An Sơn, Lộc Giang, Bình Đa, Rạch Núi and Cầu Sắt, has been discussed before (Nishimura 2002). This is largely due to a lack of cross-comparisons of complete pottery sequences from each of these sites, with the exceptions of attempts to link decorative styles (Nishimura and Vương 1997: 81).

The nature of archaeology in Vietnam so far has resulted in the recognition of a number of cultural groups (e.g. Phùng Nguyên, Sa Huỳnh and Đồng Nai 'Cultures') that are identified by distributions of material culture and the geographical spreads of particular artefacts. There is often an assumption that the material culture of these groups was inextricably linked to shared identity, ethnicity, language, and specific cultural practices. However, group identities are likely to have been highly subjective, fluid, complex and subtle. Describing the cultural or ethnic identity of a prehistoric individual or community beyond the indications in the archaeological record is likely to be ill-informed. The bounded and homogenous groups that some have perceived for the past, and suggested correlations between archaeological cultures and ethnic groups, are necessarily hypothetical (Jones 2007b, 1996: 72; Lucy 2005: 86–87; Hodder 1982). Cultural identity may be inferred from archaeological material to the extent that it was conditioned by factors such as common ancestry, interaction, replacement and extinction, and invention and innovation.

Material culture distributions may only provide a limited indication of the divisions that existed in cultural reality between different groups, who might have had a relatively homogenous material culture, while maintaining distinct identities. Despite movements of people and alterations in material culture, the relations and social boundaries between different groups, or within a single community, and their cultural and/or ethnic identities, may be resistant to change (Lucy 2005: 91; Hodder 1982).

It is presumed there was some structure to the way in which cultures interacted. A commonality of material culture may indicate a process of cultural transmission. Material culture can really only identify possible historical links and separations between cultures, but not shared or different ethnicities. Groups that were separated by great distances as a result of migration may have shared a similar ethnic identity or ancestry, but their material culture changed in response to time, available resources and local cultural interactions. In contrast, similar material culture was perhaps shared amongst groups that had very different linguistic or cultural heritages (Rice 1984: 235; Stanislawski 1978: 226).

Regional divergence in material culture can result from contact with other groups rather than from innovation in isolation (Lucy 2005: 105). Beginning with a detailed analysis at a local level, the complex relationships of artefacts and spatial patterning and the context in which social identities were practiced everyday in the past, may be understood. The next step towards the interpretation of cultural groups is to expand the scale of analysis by observing the overlapping and multiple boundaries that may exist and contribute to the cultural differences in a region (Lucy 2005: 109). The formulation of the various groups of the past may be defined by the exclusion or inclusion of certain characteristics. These are the points that differentiate groups from each other (Hodos 2010: 4).

The comparative analysis in this monograph between An Sơn and eleven other sites in southern Vietnam reveals how An Sơn can be used either to typify the neolithic of southern Vietnam or conversely, how it might be seen as an example of regional diversification. By analysing the presence or absence of certain combinations of material culture, possible prehistoric contacts, relationships between sites and the commonalities of neolithic occupation in southern Vietnam are revealed (see Chapter 8).

The appearance of cultivation and related neolithic developments in southern Vietnam

The appearance of agriculture and related material culture in southern Vietnam require comparison with contexts that are well understood elsewhere in mainland Southeast Asia, for instance coastal central Thailand, northeast Thailand, Cambodia and northern Vietnam. This monograph approaches these comparisons with a focus on ceramic and other material culture items, site formation, occupational and mortuary practices, economy, and inter-site relations.

The traditional view for the onset of domestication was that hunter-gatherers adopted agriculture as a more secure and reliable subsistence was required. It was a choice to adopt farming, which was a labour-intensive occupation. There was great variety in the way agriculture was implemented (Tilley 1996: 57). The reasons for the adoption of such a labour intensive practice must be considered alongside environmental evidence, material culture and economic change, and the consequences for the way in which communities interacted. The processes for the adoption of cultivation and associated neolithic attributes were no doubt complex and require systematic investigation.

This monograph outlines aspects of neolithic sites that were part of a wider neolithic expression as well as features that can be considered regional diversifications in a regional comparison between An Sơn and fourteen other sites across mainland Southeast Asia. The chronological relationship between the studied regions may also indicate the manner in which these neolithic attributes entered and moved around mainland Southeast Asia. The relationship between the introductions that were related to agricultural activities took shape in many ways in the different regions of Southeast Asia and this interaction is of interest here in order to uncover the resulting regional developments (see Chapter 9).

The roles of prehistoric potters in the exchange and transference of neolithic material culture and ideas in southern Vietnam

The interactions between groups during the neolithic and the cultural developments related to agriculture are closely linked to the development of certain craft occupations. The focus of this monograph lends itself to a discussion about neolithic potters. This necessitates an investigation of individuals: how they conduct and organise their craft, how they transport items and ideas, and how they adopt, transform and reject methods of ceramic manufacture.

The role of potters in a community depends not only on the product output but also the nature of their occupation. If a potter is responsible for items that are valued in the community, regardless of whether they have market or ritual values, the organisation of the occupation is important. Costin (1991: 9) states that the organisation of production can be studied with analyses of context, concentration, scale and intensity. Some of these variables can be used to interpret aspects of standardisation and specialisation (see Chapter 7).

The individual choices made by potters, either to adhere to traditions with conservative behaviours or to permit experimentation and invention, are tied to social constraints and requirements. Conservative behaviours in pottery making have been connected to technology (Vincent 2003: 53, 1991: 344) (e.g. raw material source selection, forming methods, etc.) and can also stem from the organisation of the occupation. Pottery production can be highly structured and monitored by an elite, especially in state organisations, or there can be a situation of artistic freedom amongst the potters in household level production (Wright 1991: 203).

The status and importance of potters in any community are likely to be contingent on the social standing of women, and agreed relations between identity, prestige and status, and the ceramic item. Ethnographic work both in Southeast Asia and worldwide has indicated that earthenware forming at an autonomous tribal village level is primarily conducted by women (Lefferts and Cort 1999; Wright 1991: 198–199; Arnold 1985: 102). Archaeological evidence at Khok Phanom Di links women to potting occupations because anvils and burnishing stones were placed as mortuary offerings in female graves (Higham 2002b). The status of potters may be linked into any social perception of status associated with women (Vincentelli 2000: 16; Wright 1991: 204).

By positioning the potters at the forefront in discussions about the movement and development of neolithic technologies, the occupation may be considered with regard to the identity of the potters. Ethnographic and historic research by other academics in relation to ceramic manufacture and other relevant crafts in mainland Southeast Asia is closely examined alongside the ceramic assemblage from An Sơn. In order to interpret the relationship between potters from different sites this investigation will reveal the nature of pottery production at a local level; the mortuary evidence and related ceramic offerings at An Sơn that might demonstrate material culture associations with a particular sex or age group; and potential interactions established from the comparative studies of ceramic material culture in this monograph (see Chapter 10).

Potters were likely to have had an important role in the movement of neolithic features in mainland Southeast Asia, where there would have been interactions where some neolithic features were adopted and others modified or rejected, including ceramic attributes. Although not bound together, the interactions between potters may have had implications for the way in which agricultural practices and other technologies were exchanged in this neolithic setting.

Overview

This chapter has introduced the neolithic context for An Sơn, including the chronology, environment and cultural occurrences, and key research relating to this period of occupation within mainland Southeast Asia. This chapter has provided the background and framework for the research that will address the characterisation of the ceramic assemblage at An Sơn in detail, and expand this into a wider analysis of interaction between sites within southern Vietnam and mainland Southeast Asia in general. This research considers theories of technology and identity, integrating detailed archaeological data from multiple sites, to interpret potential relationships between An Sơn and the studied sites and potentially uncover the routes and features of the initial occupation of southern Vietnam.

The monograph structure involves initially addressing the background of neolithic archaeological sites in mainland Southeast Asia (Chapter 2) to identify which regions and sites are suitable for the comparative research that is reported in Chapters 8 and 9. Some preliminary observations about parallels and differences between An Sơn and these sites are tentatively introduced, and the detailed analyses of Chapters 8 and 9 validate or disprove these previous claims in the literature.

The methodology for the analysis of the An Sơn ceramics and the comparative studies is presented in Chapter 3, inclusive of the excavation strategies, the sampling and analytical methods, and the statistical applications required to interpret the analyses. The complexities in understanding the technical analyses of Chapters 6, 7, 8 and 9 require following the sampling, analytical and statistical procedures outlined in Chapter 3. An overview of the chronology, stratigraphy and material culture findings of the 2009 excavation at An Sơn is provided in Chapter 4 to demonstrate the context from which the ceramic assemblage derives. Chapter 4 introduces the other material culture and site conditions that may be similar or different at other sites in the region and beyond, as discussed in the comparisons of Chapters 8 and 9.

The characterisation of the An Sơn ceramic assemblage begins in Chapter 5 with the morphology and decoration of the vessel forms and their distributions in the site. This chapter identifies that certain ceramic forms predominantly appear in specific contexts and investigates the chronological sequence of both ceramic forms and decorations. This is followed by the results of the ceramic fabric analysis in Chapter 6. The fabric analyses included temper characterisations and employed a number of statistical methods in order to group the sampled ceramics according to clay chemistry, and deduce chronological sequences of ceramic manufacture and fabric recipes for specific forms. This analysis of specific ceramic forms is further developed through study of the degrees of variability and standardisation in Chapter 7. This analysis informs the nature of ceramic manufacture at An Sơn in terms of a recipe exiting for morphology, decoration and surface treatments, and fabric selection of each form.

The comparative component of this research begins with An Sơn in comparison to other neolithic sites in southern Vietnam (Chapter 8). This includes site descriptions with detail of the material culture identified in excavations. These data are applied to a statistical analysis for the comparison with An Sơn to indicate which sites have a stronger relationship in terms of material culture, and the locations of these neolithic interaction spheres are identified. A larger comparison that includes sites in other regions of Southeast Asia is presented in Chapter 9. The approach is similar to Chapter 8, however the site relationships are divided into certain neolithic features, such as the presence of rice cultivation, lithic types, and specific ceramic forms and decorations, due to the analysis of a wide geographic area and greater variety of archaeological data.

Chapter 10 reconstructs pottery production at An Sơn, its organisation and the occupational behaviours of the potters, and extends to a discussion about the identity of the potters and the ways by which ceramic material culture might have been utilised to construct identity at An

Sơn. Chapter 11 summarises the results of this research with conclusions about the ceramics at An Sơn, and comparisons between ceramics across mainland Southeast Asia. It discusses the organisation of production, including the role, status and behaviours of potters at An Sơn, in order to understand the importance of potters in local developments and the dissemination of a widespread neolithic culture. Please refer to the list of abbreviations and terms at the front of this monograph as needed.

2

Neolithic Archaeology in Southeast Asia

Introduction

This chapter is a literature review aimed at identifying viable comparative areas and sites for An Sơn and contextualising the neolithic of southern Vietnam. The targeted sites are well-documented and mostly excavated in the last thirty years. Sites near to An Sơn, such as the Đồng Nai Province sites and the Memot sites of Cambodia, for example, reveal interesting parallels with other sites to the north and northwest of the Mekong Delta, and aid in chronological understanding.

A borderless approach to Southeast Asian prehistory is vital and, unfortunately, archaeological research has been restricted by current political boundaries. Much more detail is available for Thailand than for any other country in mainland Southeast Asia. Thailand and northern Vietnam are known to have been of importance in metal age seafaring trade with other parts of Southeast Asia, and some exchange networks may have been established before the iron age. Whether these potential early connections included southern Vietnam or not is contemplated. It is apparent from this chapter that information about the neolithic of southern Vietnam is scarce and has been largely ignored in past syntheses and comparative studies of mainland Southeast Asia.

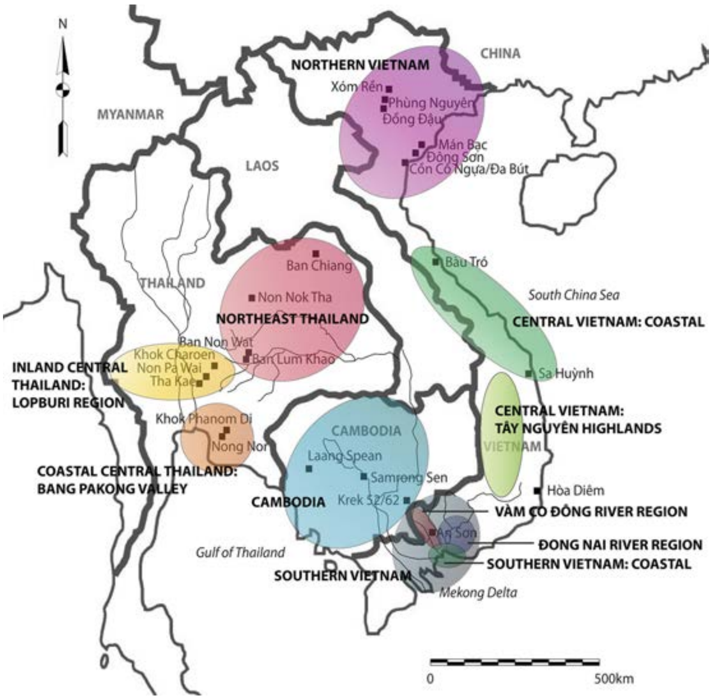


Figure 2.1. Regions of Southeast Asia mentioned in Chapter 2.

Source: Map by C. Sarjeant.

While concerns about the use of the term 'culture' in Vietnamese archaeology have already been raised in Chapter 1, this term is retained in this chapter in connection with earlier literature. Detailed accounts of material culture from relevant sites are omitted here, and are presented in detail in the comparisons with An Sơn of Chapters 8 and 9. This chapter is divided into sections based on regions in Southeast Asia, firstly the transition to agriculture and then a background to the neolithic of Southeast Asia. Past research for southern Vietnam is presented, followed by central Vietnam, northern Vietnam, Cambodia, and Thailand. The regions mentioned in this chapter are shown in the map of Figure 2.1.

The palaeolithic and the transition to agriculture

The transition from hunting and gathering to agriculture is not well defined in mainland Southeast Asia and few sites have revealed much insight. Caves and rock shelters received major attention in the 1960s and 1970s in seeking indigenous transitions from hunting and gathering to cultivation (Gorman 1971). More recent research in northeast and central Thailand has resulted in two suggestions: on the one hand, that agricultural people migrated into the area; or, on the other hand, that indigenous hunter-gatherers adopted agriculture and other foreign innovations (Higham and Thosarat 2004b).

The later palaeolithic industries of mainland Southeast Asia have been broadly defined as Sơn Vi (~18000–9000 BC), Hòa Bình (9000–3000/2000 BC) and Bắc Sơn (8000–3000/2000 BC). The stone tools were typically made from river pebbles or cobbles, and the assemblages lacked blade or microlith technologies, while Bắc Bắc lithic assemblages exhibited edge grinding. Some Hoabinhian and Bacsonian cave and rock shelter sites had pottery in their later layers, and Vietnamese archaeologists identify these cultures as 'Early Neolithic', but no evidence for cultivation has been recovered from any of them. The pottery from the Bắc Bắc sites of northern Vietnam is recorded as cord- or vine-marked, fired at a low temperature, and tempered with coarse mineral grains (Nguyễn *et al.* 2004; Diệp 1997).

The Đa Bút culture identified in Thanh Hóa Province and the Quỳnh Văn culture in Nghệ An Province, both in northern Vietnam, attest to the existence of local and regional variation during the Early Holocene. The Đa Bút culture includes shell midden sites, dated from 6500 to 4000 BP, that contain coarse pottery with basket impressions. Cồn Cổ Ngựa is one site from the Đa Bút culture, dated to approximately 6000–5000 BP, with burials in a squatting position within the shell midden (Oxenham *et al.* 2005; Diệp 1997; Bùi 1991). Shell middens and cord-impressed or comb-marked pottery characterise Quỳnh Văn sites. Many vessels have pointed rather than rounded bases (Diệp 1997).

The mid-Holocene coastal cultures of northern Vietnam, known as Bàu Tró, Hòa Lộc, Hạ Long and Cái Bèo, exhibit evidence of development from Hoabinhian stone technologies into that described in Vietnam as 'Neolithic', due to the presence of putative agricultural items such as axes, adzes and 'hoes'. No actual evidence for plant and animal exploitation has been discussed for these sites, nor is there much information about the settlement patterns, biology and palaeoenvironments (Nguyễn *et al.* 2004; Phạm 2000, 1997; Higham 1989: 31–45; Patte 1924). This area may offer a regional example of a continuation of fishing, even as inland groups transitioned to agriculture and cultivation.

In the northern highlands of Thailand, Chester Gorman undertook excavations at cave sites in the Mae Hong Son Province in the mid 1960s with the intention of recovering information about hunter-gatherers. Spirit Cave is one of the most renowned sites in this region and its lithic assemblage shares similarities with the Hoabinhian sites of the Bắc Bộ area of northern Vietnam. Stone artefacts, food remains and ashy deposits with associated hearths were recovered.

A concentration of pottery sherds and a rectangular-sectioned stone adze were also identified in association with a hearth that was dated to around 6000 BC. The earliest layers were tentatively dated to 11000 BC (Higham 1989: 45–54; Gorman 1972). Once claimed to have the earliest pottery at 7500 BP, more recent AMS radiocarbon dates from organic resin on the ceramic sherds revised this date to 3000 BP (Lampert *et al.* 2003). A wide variety of fauna and plant remains were recovered, however there was no strong evidence of cultivation (Higham 1989: 45–54; Yen 1977).

Banyan Valley Cave was subsequently excavated in order to identify if the Thai uplands was an area of transition from hunting and gathering to agriculture. The sequence was dated to 3500 BC to AD 900, indicating that there was a long tradition of inhabiting caves and practicing hunting and gathering, perhaps in small, mobile groups (Higham 1989: 54–57). Reynolds' (1992) publication of Gorman's findings at Banyan Valley Cave indicated that the earlier Hoabinhian occupation was replaced by a neolithic presence, with ceramic and rice remains. The ceramics were commonly plain or cord marked, while one sherd was decorated with a 'pinched band' and another was red painted. There was no archaeobotanical evidence of domestic rice cultigens during the Hoabinhian occupation of the cave (Reynolds 1992; c.f. Yen 1977).

On the Chao Phraya plains of Thailand, similar evidence to that at Bắc Bộ and northern Thailand was identified. This area included the rock shelter site of Khao Talu, which produced stone beads, polished adzes, potsherds and human bone fragments. The site was originally thought to date as early as the tenth millennium BP, but radiocarbon dates suggest occupation between *c.* 5500 and 1500 BC. Other cave sites, such as Ment Cave contained comparable stone implements (Pookajorn 1990; Higham 1989: 61–65). Laang Spean in Cambodia contained stone artefacts and pottery, including foot ring fragments and decorated sherds with bands and shell impressions. Roland Mourer (1977) concluded that there was no evidence for agriculture at Laang Spean, but research continues at this cave by Heng Sophady and Hubert Forestier (see also Higham 1989: 61–65; Mourer and Mourer 1970). These cave sites are fraught with problems for understanding the stratigraphy and chronology, and the relationship between hunting and gathering cave occupation and neolithic open settlements remains unclear.

There is little reported information about pre-neolithic cultures in southern Vietnam. There has been a general focus on cave and coastal occupation from this phase in Southeast Asia, but southern Vietnam lacks caves. North of Long An Province, it has been suggested that the palaeolithic technologies of Hàng Gòn 6, Dầu Giây 2, Bình Lộc, Núi Đất, Phú Quý, Gia Tân 2 (Dốc Mơ) in Đồng Nai Province, An Lộc in Bình Phước Province, and Vườn Du in Bình Dương Province represent palaeolithic occupations equivalent to the pre-Sơn Vi and Sơn Vi industries of northern Vietnam. These stone assemblages included Acheulian-type bifacial and chopper tools. Discoveries at Suối Quít and Suối Cá (Đồng Nai Province) in 2004 also included stone core tools, choppers and other bifacial tools (Phạm 2005).

More recent summaries of hunter-gatherer archaeology in mainland Southeast Asia have identified three distinct site groups pertaining to this period. The first are the Hoabinhian industries of upland rock shelters, the second are coastal open sites such as Khok Phanom Di and Nong Nor, and the third are cave and open sites inhabited prior to 3000 BC on the inland plains of Guangxi Province in China (Higham 2011). Khok Phanom Di offers evidence of a transitional occupation from hunting and gathering to interactions with neolithic rice farmers and/or related incised and impressed ceramic technologies (Higham *et al.* 2011), which is investigated further in this monograph (see Chapter 9).

While palaeolithic/Hoabinhian technologies were present within the general region, it is possible that the old alluvium of the Mekong Delta region was not favourable for pre-agricultural habitation. Most of the current delta area was still under the high tide zone until 4000 BP, so deltaic archaeological sites that predate this had drowned by the rising Holocene sea level. It is possible that the whole region was simply too inundated for continuous hunter-gatherer settlement (Proske *et al.* 2010; Tạ *et al.* 2002; Nguyễn *et al.* 2000).

The neolithic of Southeast Asia

The identification of cultigens has been an important component in distinguishing palaeolithic and neolithic, pre-farming and farming, sites in Southeast Asia (e.g. Castillo and Fuller 2010) (see Chapter 1). The rice remains of northern and southern Vietnam have been reviewed and the sequence of rice morphology has been described (Nguyễn 1998). Prior to the recent excavations at An Sơn, Rạch Núi and Mán Bạc, carbonised rice remains were collected from thirteen archaeological sites in northern Vietnam and four in southern Vietnam. Sampled sites in the north were Đồng Đậu, Làng Cả, Xương Giang, Từ Sơn, Gò Chiền Vậy, Xuân Kiều, Chợ Ghềnh, Hoa Lư, Bài Cũ, Bãi Màn, Đồng Tiến, Ba Đình and Làng Vạc, and in the south were An Khê, Thanh Điền, Bình Tả and Ba Thê. After the collection of the ten most represented and widely cultivated rice cultivars in the Đồng Đậu area, it was determined the Đồng Đậu kernels were morphologically similar to the Nếp Cái cultivar, a glutinous round-shaped rice. The grain shape (according to the length/width ratio) distribution showed that the majority of the sample from Đồng Đậu was round, Hoa Lư, Xương Giang and Ba Đình were bold, while modern rice is usually long (Nguyễn 1998).

There have been queries as to whether rice, as the current dominant carbohydrate cultigen in Southeast Asia, was initially cultivated as a wet or dry crop. The two different cropping activities would have had an impact on socio-cultural developments. Wet rice cultivation requires constant attention and settled villages near the fields, while dry upland cultivation is usually associated with swidden fields and some settlement mobility. Prehistoric settlement has been found to have taken place in environments that were moderately suited to wet rice agriculture, typically on low terraces or near streams. It is postulated that, from the initial settlement of Ban Chiang, fixed plots for wetland cultivation were established. This type of cultivation can lead to settlement stability, private land tenure, wealth accumulation and social ranking (White 1995).

More recent research on rice origins from the Yangtze region of China has already been described in Chapter 1 (e.g. Bellwood 2011; Castillo 2011; Lu 2011; Fuller *et al.* 2010; Nakamura 2010; Zhang and Hung 2010; Zhao 2010; Rispoli 2007; Higham 2002). The movement of rice was likely to have spread in lowlands, coastlines or lower mountain slopes (Fuller *et al.* 2010; Fuller *et al.* 2011). Related to this, the cultivation practice was likely to have been dry cropping of *Oryza sativa japonica*, and the Yangtze system of lowland paddy fields was not transferred with *japonica* rice during the neolithic. This rice did not appear in Thailand sites until the first millennium AD, together with *indica* rice in wetland cultivation (Castillo 2011).

The review of the neolithic period of Vietnam by Bùi Vinh (1994) summarises and provides a general model. This review does not refer to the southern provinces: it describes the palaeolithic cultures before addressing the Hoabinhian and Bacsonian cultures, and the Đa Bút, Cái Bèo-Hạ Long and Quỳnh Văn-Bàu Tró cultural developments that followed (Bùi 1994). Northern Vietnam provides an earlier setting for neolithic occupation than other areas of mainland Southeast Asia, with the earliest evidence from *c.* 7000–5000 BP at Đa Bút (perhaps late Hoabinhian), Cái Bèo and Quỳnh Văn. The neolithic occupation of these areas is associated with a wide variety of pottery vessels and rectangular-sectioned and unshouldered adzes, dated to approximately 4500 to 3000 BP. The environment of what is today the Red River delta was then under marine or brackish inundation and the only raised land available for occupation was in the inland reaches, with later habitation following the alluviating coastline as it expanded seawards (Nishimura 2005; Bùi 1994).

A more recent review of archaeology in northern Vietnam included Hoabinhian sites in a description of the early neolithic (Nguyễn *et al.* 2004). No equivalent review exists for southern Vietnam. It states that the Hoabinhian developed from the Sơn Vi culture, that these people dwelled in caves and most of the stone tools were flaked from pebbles with some examples of edge-grinding. Pottery is only associated with the later occupation of Hoabinhian sites. The Bacsonian culture is described as the later Hoabinhian culture. The middle neolithic includes the Đa Bút, Cái Bèo and Quỳnh Văn cultures, which had evidence of development in ceramics with comb, basket and cord impressions, incision and punctate decoration, and in stone assemblages with untanged and shouldered axes, adzes and chisels. The late neolithic occupation in northern Vietnam includes Hà Giang, Mai Pha and Hạ Long cultures. The material culture of these cultures included ground stone adzes and axes, D- and T-sectioned stone bangles, bark cloth beaters, and some of the ceramics are decorated with cord marking, comb incision, and 'S'-shaped motifs that have been related to the Phùng Nguyên culture ceramics. The comparable late neolithic cultures in central Vietnam are Bàu Tró, Biển Hồ, and Lung Leng. Bàu Tró and Biển Hồ are described further in the Central Vietnam section of this chapter (Nguyễn *et al.* 2004). In southern Vietnam, Nguyễn, Phạm and Tong (2004) identify Cầu Sắt, Cù Lao Rùa and Bình Đa in the Đồng Nai region as late neolithic sites. More recent research in southern Vietnam has outlined a longer neolithic chronology in the region (see the Southern Vietnam section in this chapter and Chapter 8). This also applies to northern Vietnam with research at Mán Bạc (see the Northern Vietnam section in this chapter and Chapter 9).

In terms of tracing neolithic relationships between regions, pottery has always been used by archaeologists to trace origins and cultural contacts. This has been particularly the case for establishing the initial spread of agricultural technologies in Southeast Asia. There is no evidence of a local transition to agriculture in Thailand, and this probably holds true for southern Vietnam as well as Cambodia. In general, the inland Thai sites of Non Pa Wai, Tha Kae, Non Nok Tha and Ban Chiang have similar ceramics, in comparison to the central Thai coastal sites of Khok Phanom Di and Nong Nor Nor, despite their contemporary radiocarbon chronologies. The exchange systems in the northeast would have differed substantially to those in coastal areas, where shell items were valued. With the material goods, ideas and knowledge were also exchanged. Through this kind of interaction it is possible rice cultivation was transferred to the hunter-gatherers of Khok Phanom Di (Higham and Thosarat 1998b: 88) (see the Central coastal Thailand, Bang Pakong Valley section in this chapter).

The links to southern China via ceramics has been identified with incised and impressed decoration further north in the Yunnan Province of China at Baiyangcun and Dadunzi (Rispoli 2007). These cultural connections have also been extended to the Yangtze Valley, since the actual appearance of incised and impressed sherds in Yunnan is rare, and there is increasing archaeological evidence for the diffusion of some cultural features into southern and southeastern China and mainland Southeast Asia from a Yangtze origin (Rispoli 2007). Whether there was a straightforward transference from southern China, and ultimately from an agricultural origin in the Yangtze Valley, or something more complex is still debateable (Zhang and Hung 2010).

Events of neolithic transference no doubt included some interactions between local indigenous hunter-gatherers and immigrant agriculturalists. For example, there is evidence of contact between inland rice farmers and the inhabitants of Khok Phanom Di in terms of material culture, rice cultivation and isotopes of individuals (Higham *et al.* 2011; Bentley *et al.* 2007; Higham and Thosarat 1998b: 88–89). The flexed burials at Ban Non Wat, northeast Thailand have been hypothesised to be hunter-gatherer individuals, which date to the same time as the early extended neolithic burials (Higham and Wiriyaromp 2011; Higham *et al.* 2011). Morphometric data of human remains indicated that Mán Bạc was occupied by both neolithic immigrants and indigenous groups (Matsumura *et al.* 2008). These examples illustrate that interactions between hunter-gatherers and farmers are likely to have varied regionally.

Southern Vietnam

Issues exist surrounding the establishment of a chronology and relating sites to one another in southern Vietnam. Nishimura and others (Nishimura 2002; Nishimura and Vương 1997) have recounted the problems of using insecure radiocarbon dates from many of these sites and the lack of stratigraphical understanding in the region. By focusing on ceramic form and decoration, Nishimura Masanari (2002: 50–51) has formulated four periods for the neolithic occupation of southern Vietnam (Table 2.1):

- **Neolithic period I**

No prehistoric sites in southern Vietnam predate this period, which is represented by the An Sơn 1997 excavation layer 3–5 and the lowest layers of Đa Kai. The material culture included cord-marked vessels, red-painted vessels, and some vessels with incised wave motifs. There was minimal variety in pottery forms during this period. Nishimura (2002) suggests this period began around 2000 BC.

- **Neolithic period II**

There was an increase in the variety of forms in this period and the first fibre-tempered ceramics appeared. Gentle wave motifs were more prevalent on the shoulders of ceramic vessels than in the earlier period. The shouldered and unshouldered adze types were triangular and trapezoidal shaped with rectangular and trapezoidal cross-sections (Nishimura 2002: 46, figure 13, 51). Based upon radiocarbon dates from An Sơn and Lộc Giang, Nishimura (2002) estimates this period dates to 2000–1500 BC.

- **Neolithic period III**

Zigzag decoration on the shoulders of pottery vessels was prominent in this period and a comb tool was applied to create multi-linear impressions in a 'rocker' type of decoration. The shouldered and unshouldered adzes had more rectangular cross-sectioned adzes than the earlier periods. This period dates to the latter half of the second millennium BC, based on radiocarbon dates from layer 2 of the 1997 excavation at An Sơn (Nishimura 2002).

- **Neolithic period IV**

Flared and extended rim forms appeared at this time. The varieties of 'rocker' decorations within geometric divisions expanded. Unshouldered adzes appeared in greater numbers than shouldered forms. Lithophone specimens were at An Sơn and Đa Kai. The boundary between this period and the succeeding bronze age phases is difficult to ascertain since so few southern Vietnamese sites contain deposits that extend from the neolithic into the bronze age, but this period is estimated to date to around 1000 BC (Nishimura 2002).

Temporal distinctions have been reported for some ceramic features, although these are not always clear. Development of the neolithic sequence will only be resolved with further excavation and an increased understanding of the relationships between the sites.

Table 2.1. Neolithic periods at sites in southern Vietnam.

	Period I	Period II	Period III	Period IV	Later Prehistoric
An Sơn	*	*	*	*	-
Lộc Giang		*	*	*	-
Rạch Rừng			*	?	*
Rạch Núi	-	-	*	*	-
Giồng Cây Trôm	-	-	-	*	?
Đình Ông		*	*	*	-
NDII		*	*	?	-
Bến Đò	?	*	*	*	-
Long Bửu		?	*	*	*
Bình Đa	-	*	*	*	-
Cái Vạn	-	*	*	*	*
Gò Cá Sồi	-	-	*	*	-
Suối Chồn		*	*	*	*
Cầu Sắt	?	*	*	*	-
Suối Linh	?	*	*	*	-
Đốc Chưa		*	*	*	*
Đa Kai	*	*	*	*	-

Source: Nishimura 2002: 50, table 2.

Key: * present, – absent, ? possible

Vàm Cỏ Đông River region

There has been some past research in order to establish a chronological sequence for the Vàm Cỏ Đông River region. Inaccurate radiocarbon dates have exacerbated the chronological confusion, but it has been suggested that a clear ceramic sequence will ease the confusion (Nishimura and Vương 1997: 78). (Refer to Figure 1.3 and Figure 2.1 for the location of this region and the mentioned sites).

The past research at An Sơn is discussed in Chapter 4. Two sites located near An Sơn are considered in site comparisons, these being the nearby site of Lộc Giang and Đình Ông in the upper Vàm Cỏ Đông River. Little information about the excavations at these sites is available. Lộc Giang has a deep neolithic sequence that dates to the second millennium BC (Nishimura and Nguyễn 2002; Quang and Ngô 1994), and it shares material culture with An Sơn, as does Đình Ông. The sites of the Vàm Cỏ Đông River region are discussed further in the ceramics comparison with An Sơn in Chapter 8 (Đình Ông, Gỗ Cao Su, Lộc Giang, and Rạch Rừng, which is located along the Vàm Cỏ Tây River).

Đồng Nai River region

The sites within the area of the Đồng Nai River have been studied on a small scale by Vietnamese archaeologists (sometimes with Japanese colleagues) or by French colonial-era researchers. More synthesis of this region exists in English than for the Vàm Cỏ Đông River region. (Refer to Figure 1.3 and Figure 2.1 for the location of this region and the mentioned sites).

During the early years of research, from the 1880s, many artefacts were collected but little was known about their context. Excavations did not commence in the Đồng Nai region until the 1960s and 1970s. Researchers like Saurin and Fontaine tended to collect a large number of artefacts with very little reporting, covering only their initial observations and minor attempts at analysis (Lê 1986: 58). Cầu Sắt is thought to be one of the earliest sites, dating to about 4500–4000 BP (Lê 1986: 61). Although, there are no radiocarbon dates for Cầu Sắt, the stone adzes are similar to those in the earlier neolithic layers of An Sơn (Hoàng and Nguyễn 1977; Hoàng *et al.* 1976).

The 'Đồng Nai cultural complex', as named by Vietnamese archaeologists, has been differentiated from other cultures for its neolithic period characteristics. The Đồng Nai culture has been described as consisting of four periods: neolithic (Cầu Sắt-Suối Linh, 4500–4000 BP); early bronze (Núi Gốm-Bình Đa-Cù Lao Rùa, second millennium BC); late bronze (Đốc Chưa-Bưng Bạc, first half of first millennium BC); and early iron (Suối Chồn-Phu Hoa, second half of first millennium BC). These periods were not dated with absolute methods (Phạm 1996: 80–86).

The lithic assemblages are most frequently discussed for neolithic Đồng Nai sites. Cầu Sắt contained shouldered adzes and stone armrings with rectangular or trapezoidal cross-sections. The pottery included pedestalled bowls and tall jars with flat bases (Higham 1989: 169; Hoàng and Nguyễn 1977; Hoàng *et al.* 1976). The excavations at Bến Đò, located in the vicinity of Ho Chi Minh City, revealed a large variety of ceramic and stone artefacts, including of clay pellets and stone bangles. Large shouldered adzes were more common than rectangular cross-sectioned and unshouldered varieties (Higham 1989: 169–171; Phạm 1977; Fontaine 1975; Fontaine and Delibrias 1974; Fontaine 1972, 1971).

As at An Sơn, shouldered adzes dominated the assemblages of Bến Đò, Phước Tân and Bình Đa, while unshouldered tools were more frequent at Đốc Chưa, Suối Chồn and Rạch Núi (all sites along or near the Đồng Nai River). The Đồng Nai sites also contained triangular stone adzes, particularly in the earlier period, and shouldered and non-shouldered stone tools with characteristics observed on younger bronze axes (Phạm 1996: 80–86; Phạm and Nguyễn 1993).

Cù Lao Rùa, also located near the Đồng Nai River, was first documented in 1888 by Émile Cartailhac (1890) and excavations were conducted in the early twentieth century. More recent excavations have shown that the site included shouldered and rectangular-sectioned adzes, pottery, stone bracelets, pendants and polishers. Bronze may have also been associated with the later occupation of Cù Lao Rùa (Nguyễn 2008; Higham 1989: 169).

Some of the more recent and reliable research has been undertaken at Đa Kai, located in the upper reaches of the Đồng Nai River. It is a circular and raised site with a central depressed area, similar to those of the Memot area in Cambodia. The site has been dated to approximately 3450 to 3200 cal. BP. There is no evidence of metal, and the site represents a neolithic chronology. Pits and burials were identified, inclusive of a separate mound where the burials were placed. The stone implements included lithophones as surface finds, adzes, debitage, blanks for tool production, hammerstones, cores, polishing and grinding stones, and preforms. The latter were similar to preforms at the workshop site of Suối Linh, Đồng Nai Province. The stone axes and adzes were manufactured from schist and tuff-dacite in both shouldered and unshouldered varieties. The pottery assemblage of Đa Kai is described as sharing similarities with Bình Đa and An Sơn. The fabrics were separated into two categories: one with sand and lime in large and angular particles, and the other with sand and lime in fine particles (Nishimura *et al.* 2009).

It is emphasised in the Đa Kai report that 'In the southeastern part of Vietnam, the prehistoric pottery chronology has not been established in detail, except for several sites in Long An Province' (Nishimura *et al.* 2009: 35) (e.g. Nishimura and Nguyễn 2002; Nishimura 2002). The published data from the Đồng Nai area are very limited, and usually the only person able to understand the assemblage from each site is the individual who conducted the original analysis. This situation gives little scope for further comparative study (Nishimura *et al.* 2009). Much of the research conducted in Đồng Nai Province has had little regard for stratigraphy and relationships between sites (Higham 1989: 172; e.g. Trịnh *et al.* 2003; Phạm and Nguyễn 1993; Hoàng and Nguyễn 1977; Hoàng *et al.* 1976; Fontaine 1972, 1971). The ceramics and material culture of sites in the vicinity of the Đồng Nai River and Ho Chi Minh City (Bến Đò, Bình Đa, Cái Vạn, Cầu Sắt, Cù Lao Rùa, Đa Kai, Rạch Lá, and Suối Linh) are described further in the comparative study in Chapter 8.

Coastal southern Vietnam

There are sites located near to where the Vàm Cỏ Đông and Đồng Nai Rivers filter into the Mekong Delta. The coastal proximity of these sites presumes that these sites may have been under sea level 4000 years ago (see Chapter 1), but the presence of Rạch Núi with neolithic material culture suggests that areas were above sea level for short and long periods. At this stage, the chronology and sea level around the area of Rạch Núi is not known and requires further research.

Rạch Núi (Figure 1.3, Figure 2.1) had a similar period of occupation to Cù Lao Rùa with rectangular-sectioned and shouldered adzes, pottery and possibly some bronze (Higham 1989: 169). The stone tool assemblage presented less variety at Rạch Núi with stone shouldered adzes partly replaced by tortoise-bone shouldered adzes (Bùi *et al.* 1997). It has been suggested that the sea tortoise/turtle-shell tools had been used for handicrafts, such as cutting clay or mixing materials for pottery production (Phạm 1996). More recent research conducted in 2012 at Rạch Núi is discussed in detail in Chapter 8.

Post-neolithic occupation in southern Vietnam

Many of the sites located in the Đồng Nai region had evidence of metallurgy and post-date An Sơn. Sites like Đốc Chưa have casting moulds and bronze and iron age occupation, dated to 2495±50 and 3145±150 BP (uncalibrated). The later occupation of Cù Lao Rùa also had casting mould evidence, suggesting continuity from neolithic to metal age sequences. This period has been associated with technological developments in stone tool, metallurgical and ceramic manufacture, craft specialisation and increasing social complexity (Nguyễn 2005).

The emergence of ranked societies is particularly noticeable in the Đồng Nai archaeological sites, especially in the Xuân Lộc region where cist tombs containing bronze halberds were found at Hàng Gòn, dating to the first century BC (Eiji 2005). Hàng Gòn has evidence of copper metallurgy, however the site was not systematically excavated and Edmond Saurin (1963) collected material in a bulldozer excavation. Three sandstone moulds, two for casting axes and one for three ring-headed pins, were identified. Saurin (1963) suggested there were similarities between the axes of Hàng Gòn and those from the Red River Valley, Luang Prabang in northern Laos, and the Mlu Prei region of north central Cambodia. No glass or iron was recovered from the site (Higham 1989: 169). Clay balls and stone rings and beads were recovered from these metal-bearing Đồng Nai sites (Nguyễn 1980).

At Đốc Chưa, ceramic and sandstone mould fragments were recovered. The implements made on site included tanged arrowheads, axes, bells, socketed spearheads, harpoons and chisels. There are parallels in the metal implements and some of the stone artefacts, including bracelets and adzes, between Đốc Chưa and assemblages in northeast Thailand (Nguyễn 2005; Higham 1989: 171–172).

The mound settlement of Gò Ô Chùa, located on the Vàm Cỏ Tây River to the south of the Vàm Cỏ Đông River, has evidence of metal age occupation and is dated to 900–400 BC. Andreas Reinecke connects the ceramic pedestals, some with three 'horn-shaped' points, to salt production and industrial-scale activity. A burial site dated to 400–100 BC overlays this evidence. It incorporated adult interments and infant jar burials that were associated with briquetage and pedestal remains from the earlier occupation, together with iron, bronze, and ivory, bone and shell offerings (Reinecke 2010). Many of the ceramic vessels were high pedestalled dishes and everted rimmed globular vessels with incised decoration, that were tempered with fibre and fired in a reducing atmosphere to create a black surface, not unlike some pottery of Cambodia and northeast Thailand during the iron age, e.g. Phimai Black wares (personal observation).

Giồng Cá Vồ, southeast of Ho Chi Minh City on the coast of southern Vietnam, was excavated in association with the nearby site of Giong Phet, where seafaring interactions are believed to have taken place about 2000 years ago (Hung *et al.* 2007). These sites have jar burials and evidence of occupation and a range of ornamental items made from nephrite, carnelian, agate, gold, glass, bronze and shell (Nguyễn 2001), as seen in northeast Thailand during the iron age (e.g. at Noen U-Loke, see Higham *et al.* 2007; Talbot 2007; Sarjeant 2006). Some researchers suggest that Giồng Cá Vồ was related culturally to the south-central coastal Vietnam sites, such as Hòa Diêm. Giồng Cá Vồ may be part of a southern Sa Huỳnh tradition that use spherical ceramic jars to contain human remains (Lâm 2011).

The continuity from neolithic to metal age sites has not been so well-documented in southern Vietnam, whereas there is some understanding regarding the development from neolithic sites like Mán Bạc to Phùng Nguyên and the later bronze age Đông Sơn sites in northern Vietnam (Matsumura *et al.* 2008; Nguyễn 1980). The nature of the relationship between the discussed neolithic sites, subsequent metal age developments and Sa Huỳnh in the southern coastal region (e.g. Hòa Diêm), and Óc Eo developments further south, remain unclear (Bùi *et al.* 1997).

This review of the sites of southern Vietnam has been kept brief since more comprehensive site overviews are provided in the comparative analysis with An Sơn in Chapter 8.

Central Vietnam

The sites of the central highlands in Vietnam have been likened to the eastern Nam Bộ sites, such as Cầu Sắt, Bến Đò, Đốc Chưa, Cái Vạn and Cài Lang (around Ho Chi Minh City and in Đồng Nai Province) (see Central Vietnam section in this chapter). Commonalities between the neolithic Tây Nguyên sites of the central highlands and the Bàu Tró sites of Quảng Bình Province further north have also been noted (refer to Figure 2.1 for the location of this region). The research in this region has provided some broad observations about the neolithic to metal age transition. The neolithic is characterised by small rectangular-sectioned adzes/axes (some of which are slightly shouldered) and coarse cord-marked pottery, while appliqué and dot designs are rare. Notable material culture absences are large 'hoes' and bronze casting moulds. Small mouth-to-mouth jar burials (found at Suối Chình, Quảng Ngãi Province), but no large jar burials, were recovered. The neolithic part of the sequence is thought to date to between *c.* 4000 and 3500 BP (Trần 2005).

The later sequence is represented by evidence for metallurgy, including bronze casting moulds, in addition to large shouldered adzes and large jar burials, dating to *c.* 3500–3000 BP (Trần 2005). Trần Quý Thịnh (2005: 143) also suggests that the Tây Nguyên sites influenced Sa Huỳnh developments and the iron age of Trung Bộ (i.e. the south-central coast), such as Hòa Diêm, based on the synthesis of sixty sites identified in the Tây Nguyên region.

Surface material collected from Hòa Vinh, located just north of Phan Thiết on the coast of south-central Vietnam, included large ceramic vessels made with mineral sands, with paddle linear impression and cord-marking on the surfaces, appliqué, incisions over the top of paddle impression, zigzag and wave incisions, and possibly some punctate stamping. Everted rim forms with paddle impressed line markings on the exterior surface of the rim were recovered. Hòa Vinh also had slate rings, shell items and a spindle whorl. Hòa Vinh has been estimated to be an early or proto-Sa Huỳnh site (Fontaine and Davidson 1980).

Vietnamese archaeologists consider the Biển Hồ and Bàu Tró cultures of coastal north-central Vietnam as ancestral to the Sa Huỳnh culture, and there are parallels in northeast Cambodia and southern Laos (Hoàng 1994). The Biển Hồ ceramics appear to be quite distinct from the traditions further south. The archaeological sites associated with the Biển Hồ culture are located on the slopes or foots of hills surrounding lakes or streams and are distributed in clusters in the central highlands. Only a few sites have been identified, including Biển Hồ and Trà Dôm, and this may be due to a lack of viable water sources in the region. The majority of the material culture consisted of axes, adzes and polishing stones, while a few stone ornaments have been recovered, such as the stone bangles at the Biển Hồ site. Most of the stone artefacts were made of basalt at Biển Hồ and of phtanite at Trà Dôm. Silicate-based/silex lithics were quite rare. The stone tools were polished and resharpening was evident. There were a large number of shouldered adzes/axes and few rectangular-sectioned adzes/axes, making this culture quite distinct from those of the southern provinces. Most of the adzes were oval or half-oval in cross-section and these 'buffalo-tooth axes' are a characteristic feature of the Biển Hồ culture (Hoàng 1994).

Complete pottery vessels have not been recovered at the Biển Hồ sites. The pottery is typically coarse and tempered with quartz, either red or grey in appearance, as well as some black pottery in smaller quantities. Hoàng Xuàn Chinh (1994) states that the pottery was wheel-made. Eighty percent of the pottery was undecorated at Biển Hồ and Trà Dôm, however the decoration that was present included fine cord-marking, comb/punctate impressions ('line-dots'), appliqué, and stamped small rings. The rim forms were commonly everted or direct. Bone and copper tools have not been recovered at the Biển Hồ culture sites. Nor have any animal or human bone or teeth been recovered, perhaps due to the acidic soil conditions (Hoàng 1994). The neolithic ceramics at Bàu Tró and related sites are discussed further in Chapter 9.

Northern Vietnam

In northern Vietnam there has been a focus to link indigenous groups of Vietnam to the later bronze age Đông Sơn sites. The research focusing on the transition from palaeolithic to neolithic has already been discussed for northern Vietnam (Refer to Figure 2.1 for the location of this region). This section addresses the site of Mán Bạc, which has evidence of neolithic habitation. Mán Bạc is located in Ninh Bình Province, about 25 km from the coast. Research at this site has not only focused on the link between indigenous groups (Hoabinhian, Bắc Sơn and Đa Bút) but aslo on intrusive agricultural groups from the north. The Mán Bạc site has a wide repertoire of stone tools, semi-precious stone ornaments and jewellery, ceramic net sinkers, high-footed ceramic bowls, clay support stands, and mushroom-shaped ceramic anvils (Matsumura and Oxenham 2011; Oxenham *et al.* 2011; Nguyễn 2006).

Mán Bạc has a neolithic occupation, dated from 3800 to 3500 years ago (Oxenham and Matsumura 2011; Oxenham *et al.* 2008; Nguyễn *et al.* 2004). Some of the pottery at this site also exhibited parallels with the early bronze age Phùng Nguyên culture, as well as unique local developments (Matsumura *et al.* 2008; Trịnh and Hà 2004). More recent interpretations of the site outlined Man Bac as part of the early neolithic demographic expansion from southern China to northern Vietnam with the bioarchaeological evidence for high fertility and population growth in response to the immigration of food producers to the region (Oxenham and Matsumura 2011; Bellwood and Oxenham 2008). The morphometric data of the human remains indicate that the site did not include a population of neolithic immigrants alone, but also individuals with affinities to indigenous groups in the region (Matsumura *et al.* 2008). Some of the ceramic decorations, namely geometric impression, recall that of late neolithic southeastern China and Hong Kong (Jiao 2007: 62–66; Ng *et al.* 2005; Meacham 1978). The ceramics of Mán Bạc are discussed in greater detail in Chapter 9.

The Phùng Nguyên culture sites of the Red River delta region have exhibited material culture evidence that is shared across many sites, including Phùng Nguyên itself and Xóm Rền. The sites have a wide repertoire of stone tools, inclusive of polished rectangular-sectioned adzes and arrowheads. Stone arrowheads were rare in Vietnam during the neolithic, and the Phùng Nguyên examples have been suggested to be precursors to the bronze arrowheads at the later Đông Sơn sites. Stone bracelets and beads, ceramic spindle whorls and clay pellets have also been recovered from Phùng Nguyên sites. The ceramics of the Phùng Nguyên sites are well-known for their incised decorations in 'S' and wave shapes, and there are parallels between these motifs and those on Đông Sơn drums and 'Sa Huỳnh-Kalanay' ceramics (Hán 2009; Nguyễn 1980). Xóm Rền is discussed further in Chapter 9.

Cambodia

Laang Spean in Battambang Province (Figure 2.1) has some of the earliest known ceramics in Cambodia, inclusive of pre-neolithic late Hoabinhian pottery. The stratigraphy at Laang Spean has been difficult to understand in terms of the relationship between the Hoabinhian and neolithic occupations. Recent research indicates intermittent use of the cave since these periods into recent history, with mixed occupational layers (Forestier and Heng 2010). The second layer of occupation at Laang Spean is thought to be neolithic and to date to the mid-third millennium BC. The earlier ceramics from Laang Spean were either cord-marked or plain, while the later ceramics were incised and impressed (Stark 2003).

The Laang Spean excavations primarily revealed lithic and pottery evidence. Mourer (1977; see also Mourer and Mourer 1970) describes most of the stone tools as scrapers, flakes or sumatralith-types. No polished or ground stone tools were found. The ceramic assemblage included coarse sand-tempered fabrics and some organic tempers (Mourer 1977). The vessel forms included globular shapes with everted rims, and ring-footed cups. Decoration covered entire surfaces with combinations of linear and curvilinear incision, punctate impression, and nail impression (Mourer 1977). The sequence of the ceramic assemblage remains unclear and the ceramics of Laang Spean are described further in Chapter 9.

Samrong Sen in Kampong Chhnang Province (Figure 2.1) is a well-known site amongst Southeast Asian prehistorians. Much of the research at Samrong Sen took place in the nineteenth and early twentieth centuries. The material culture from Samrong Sen has been repeatedly transported since then, and loss and misplacement has been an issue. Some of the archaeological fieldwork was published by Henri Mansuy (1923; see also Mansuy 1902). Samrong Sen contained evidence of neolithic and bronze age occupation, with most discussion focusing on the links between the bronze age sequence at Samrong Sen and at sites in Thailand and Vietnam (Heng 2007; Stark 2003; Vanna 2002).

Heng Sophady (2007) has drawn comparisons between Samrong Sen and the circular earthwork sites of eastern Cambodia (discussed further below, in this section), since both have revealed large quantities of stone artefacts. The earthwork sites contained stone flakes and debris and were associated with unfinished tools, fragments, preforms and polishers. Activities related to flaking, grinding and polishing were evident. Samrong Sen exhibited only small amounts of such stone items. Morphologically, the adzes, axes, chisels and shouldered adzes were different in form and size between the circular earthwork sites and Samrong Sen. The Samrong Sen stone tools were generally larger than those at the earthwork sites (Heng 2007: 81–84).

The shouldered adze technology can be traced to part of a tradition that moved through Laos, Thailand, Cambodia and southern Vietnam. The rectangular-sectioned adze technology was widespread throughout Southeast Asia and into the Pacific. It has been suggested by Duff (1970:

126) that this form was transferred from southern coastal China to mainland Southeast Asia by coastal routes and boat movements that also included the Philippines, Taiwan and northeast Indonesia. Inland contacts may also have been important for inland areas of Cambodia, Laos, Thailand and Vietnam, with technologies deriving from southwest China and Yunnan. However, cultural distinctions as argued on the basis of typological variations in lithic tools can be ambiguous (Heng 2007: 84–91; Duff 1970: 126). The ceramics from Samrong Sen are discussed in greater detail in Chapter 9.

Following the earlier Samrong Sen and Laang Spean occupation, the 'Mimotian' circular earthwork sites of eastern Cambodia and southwestern Vietnam have been described as 'Neolithic'. These sites occur quite close together and cover a known area of km2 (Dega 2002: 1). There is contention about the exact chronology of these sites due to the presence of some glass at Krek 52/62 (Haidle 2002). Bernard Philippe Groslier (1966b: 195, 267) suggested the 'Mimotian culture' sites were neolithic after excavations at a circular settlement of Kampong Cham dated to approximately 2500 to 2000 BC. Some of the first radiocarbon dates for the Mimotian sites came from J.P. Carbonnel in 1970, who regarded the mounds as accumulations of discarded waste. A radiocarbon sample of charcoal from within a potsherd was dated to 2130–1150 BP, much later than Groslier had suggested. Carbonnel also believed the sites were occupied continuously until the tenth century AD, into the period of the Angkorian kingdom (Dega 1999).

Groslier (1966a, 1966b) labelled these sites as neolithic 'forts', and Saurin (1969) described the earthwork settlements as late Cambodian neolithic. Carbonnel (1979) continued to investigate several of Malleret's identified sites at Memot and Krek and expanded his work to the west of the circular earthwork sites in Cambodia, noting the neolithic layers. A reappraisal of absolute dates for earthwork sites in Cambodia by Albrecht *et al.* (1999; see also Haidle 2000) deduced that they dated from the first millennium BC. Other researchers have suggested the occupation of the earthworks from 3400 BC to historic times (Mourer 1994), while the absolute dates range from 2300 to 300/200 BC (Latinis and Dega 2011). There is some contemporaneity between the sites, but the youngest and oldest do not have overlapping chronologies.

Dega (1999) has reported similarities between the sites excavated by Albrecht, Albrecht and Haidle at Krek (Malleret's site #15) and that by Dega and Chuch Phourn 7 km to the east at Chi Peang. These similarities extend to landscape settings, architectural components, artefact assemblages and stratigraphic profiles. The youngest site of the Cambodian earthwork settlements was Chi Peang, which was occupied for 790–430 years. All of the sites thought to predate Chi Peang presented a shorter occupation sequence than Chi Peang itself. Greater artefact diversity was also observed at Chi Peang (Dega 2002: 60). The earlier sites are located in the east and the later sites in the west in the Memot District. Chi Peang has a later chronology than Phuom Trameng, 35 km to the east. Phuom Trameng was abandoned prior to any occupation at Chi Peang. Based on the available radiocarbon dates, it has been argued that the circular earthwork sites were initially constructed further east and later in the west. This hypothesis requires testing with further dates. The reasons for such patterning may be the result of land-use strategies, i.e. slash and burn agriculture, or because of inter- or intra-group competition (Dega 2002: 60).

Dega (1999) has commented on the differences between these earthworks and those in northeast Thailand that are described as 'moated', and were constructed in the iron age (McGrath and Boyd 2001). The Memot sites differ in terms of size and the presence of encircling walls and depressions. They were not used as waterways, but perhaps had several functions, including some defensive ones. They are doughnut-shaped with encircling earthen walls with a parallel depression and raised earth platform inside the wall (Dega 2002: 1; 1999). Regardless of their function, whether for water storage, irrigation, cultivation or defence (see McGrath and Boyd 2001;

Higham 1996b; Moore 1988), these Northeast Thailand moated sites have been AMS dated to the later iron age sequences, *c.* AD 200, thereby postdating the earliest Memot sites (Higham and Higham 2009b; McGrath and Boyd 2001).

In northeast Thailand, occupation is known to have pre-dated the formation of some earthworks (Dega 2002: 14–15). This may have been the case for the earthwork sites in Cambodia and Vietnam, which have also been associated with a number of functions and interpretations. Louis Malleret (1959) stated the earthwork sites were fortified settlements that once had palisades on the tops of the outer banks. The analysis of the presence and absence of material culture from Malleret's number 15 site at Krek was conducted by the Royal University of Fine Arts. It was interpreted that the site was occupied twice with periods of abandonment, the first for 500 years and the second for 1000 years (Dega 2002: 17–18; Kojo and Pheng 1998, 1997; Nop *et al.* 1996).

Recent research on the ceramics of earthwork sites in the Kampong Cham area with EDXRF (energy dispersive x-ray fluorescence) analysis has shown that local materials were used in ceramic manufacture. There is no evidence for centralised pottery production, but some trading and interaction are apparent. There is no indication that circular earthwork ceramics were transported to the floodplain sites around the lower Mekong Delta, or vice versa, during the metal age and pre-Angkor/Angkor period (Latinis and Dega 2011). The neolithic ceramics from the Memot sites, particularly Krek, are discussed further in Chapter 9.

Thailand

Central coastal Thailand, Bang Pakong Valley

Settlements with a mixed economy of hunting, gathering, animal husbandry and rice cultivation were probably expanding within Southeast Asia from the third millennium BC. Population growth and sedentary settlements occurred at sites like Khok Phanom Di, a sedentary coastal community in the Bang Pakong Valley of central Thailand (Refer to Figure 2.1 for the location of this region and sites mentioned in this section). Khok Phanom Di has been dated from around 2000 to 1500 BC and the occupants at the site were skilled at pottery manufacture (Higham and Bannanurag 1990: 19; Higham 1989: 80–81).

Coastal zones were attractive areas for habitation and it was once thought communities moved into more marginal zones, further from the coast, following over-population, resource stress and increased social ranking in optimal areas for habitation (Higham 1989: 86–87). One theory posited by Higham and Thosarat (1998b: 69) was that rice cultivation originated in the less suitable coastal environments and then spread north via river systems. Thompson (1996) stated that it is uncertain whether the earliest domesticated rice at Khok Phanom Di was cultivated locally or imported. More recently it has been suggested that the hunter-gatherers of Khok Phanom Di were in contact with inland agricultural groups as evidenced in part of the sequence, and that the Khok Phanom Di inhabitants eventually adopted rice cultivation (Higham *et al.* 2011; Bentley *et al.* 2007; Higham and Thosarat 2004b).

Areas where there were predictable marine resources, such as at Khok Phanom Di, would have been the most preferable environments for settlement by hunter-gatherers who exploited such foods. Neighbouring inland areas were occupied when population increase and resources stresses ensued. While marshlands may be well-suited to rice growing, domestic cattle and pigs were not so well-suited to marshy coastal areas and most likely thrived at sites further inland. In the richest marine settlement of Khok Phanom Di, wealth is indicated and social ranking was illustrated through mortuary rituals and feasting, with pottery, turtle carapaces and shell ornaments appearing as grave goods (Higham *et al.* 1992; Higham 1989: 87, 185).

A site survey at Nong Nor, 14 km south of Khok Phanom Di and located close to brackish water and terrace soils, was conducted in 1984, and excavations commenced the following year. The aims of the excavation were to advance to understanding of coastal adaptations. The lowest layer at the site was a shell midden, dated to 2459±58 BC, with ceramic sherd sheets over burials, and burnt red soil, clay anvil fragments and burnishing stones for ceramic manufacture. The midden was disturbed by later inhumations. The occupation phase pottery included in the midden was decorated with parallel incised lines and curvilinear patterns, and had rim forms paralleling those at Khok Phanom Di. Other Nong Nor material culture included bone fish hooks and small conical clay objects with an unknown function. No rice remains were recovered from this phase, not even as temper in the pottery. This early occupation at Nong Nor has been associated with broad spectrum fishers and foragers (Higham *et al.* 1997: 175–189). It has been hypothesised that Nong Nor was a seasonal site, where the inhabitants exploited marine resources in the dry season and then returned to inland agricultural areas in the wet season (Higham and Thosarat 1998a: 529–530).

Khok Phanom Di and Nong Nor illustrate the complications in understanding the transition from hunting and gathering to cultivation. These coastal regions indicate a complex relationship between adopting agriculture and continued exploitation of local marine resources. Even when groups were exposed to intrusive neolithic groups, there may have been a resistance to adopting new subsistence strategies while neolithic material culture was perhaps more readily adopted. The shared material culture at Khok Phanom Di and Nong Nor indicates contact during the earlier phases of occupation at these sites, although it seems that rice cultivation was only adopted at Khok Phanom Di once the inhabitants came into contact with inland rice farmers, as indicated later in the sequence. The shared expression at Nong Nor and Khok Phanom Di and divergence of subsistence strategies and other local developments after settlement indicates cultural variation, even between nearby sites, after the initial occupation of potentially related groups (Higham *et al.* 2011; Higham and Thosarat 1998a: 529–530). Khok Phanom Di and Nong Nor are discussed further in Chapter 9.

Inland central Thailand, Lopburi region

Archaeological research in the Lopburi region of central Thailand has revealed sites with neolithic to metal age sequences (refer to Figure 2.1 for the location of this region and sites mentioned in this section). Tha Kae and Khok Charoen are two sites in this region with ceramic assemblages that have parallels with other neolithic sites in Southeast Asia. The excavations at Tha Kae in central Thailand revealed five layers, dating from approximately the second millennium BC until the Dvaravati, Angkor and Ayutthaya periods of more recent histories. The basal layer, layer 5, had very little cultural material, while layer 4 consisted of material that was likely to be contemporaneous with neolithic occupation in Southeast Asia at 4000–3000 BP. The decorations on the ceramics from this layer include a zigzag incised pattern, which was uncommon on red, quartz sand-tempered wares in central Thailand, and is comparable to ceramics in the northeast Khorat Plateau sites, such as early period Ban Chiang. The thick red-slipped and burnished wares (TRBW) are characteristic of the early ceramic assemblage at Tha Kae (Ciarla 1992; Rispoli 1992).

The TRBW have simple direct rims with rounded or lightly tapered lips and cord impressions. The fabrics are coarse with 'vegetal' particles. Black wares with 'scale pattern' impressions (SPI) commonly in 'S'- or square-shaped meanders, and were created with incised lines and filled in with a scale pattern (Rispoli 1992: 131). Rispoli (2007, 1992) has observed the wide distribution of this pattern on pottery in Southeast Asia. Correlations with Tha Kae were noted in central Thailand, at Khok Charoen, Sab Takien, Sab Champa II, Non Pha Wai, on the Khorat Plateau, early period Non Nok Tha, and early period Ban Chiang. Similarities have also been observed at Samrong Sen in Cambodia and the Hòa Lộc and Phùng Nguyên sites in Vietnam. The early Tha Kae material was thought to date to between 3000 and 2000 BC, but there are no published radiocarbon dates for this occupation (Rispoli 1992). Tha Kae is discussed in greater detail in Chapter 9.

Khok Charoen is located in the Pasak River Valley and was excavated from 1966–1970 (Ho 1984; Watson 1979). There is evidence for rice cultivation, although no metal was found in the burials. The mortuary ceramics were decorated with burnishing, red slipping and cord-marking, as well as more ornate incised and stamped or impressed designs. The shell jewellery included disc beads, but not in the same quantity as at Khok Phanom Di (Higham and Thosarat 1998b: 81–82). Khok Charoen is described further in Chapter 9.

Northeast Thailand

Farming communities appeared on the Khorat Plateau, northeast Thailand, from *c.* 2300 BC. The earliest inhabitants consumed rice and used rice chaff to temper the pottery. Domestic pig and dog remains have also been recovered from these sites. The people of this earlier settlement phase also hunted and collected freshwater shellfish and caught fish from local streams and lakes (Higham and Thosarat 1998b: 82–85). Over the last decade, moated site of northeast Thailand, Ban Non Wat, has produced unparalleled archaeological discoveries, with cemetery and occupational evidence that extends from the neolithic to the bronze and iron ages. Ban Non Wat offers comparative material for the contemporary developments in southern Vietnam. (Refer to Figure 2.1 for the location of northeast Thailand and the sites mentioned in this section).

Excavations at Ban Non Wat began in 2002. Like An Sơn, this site is situated on riverine alluvium within a system of rivers within the Mun River Valley. Extensive cemeteries with mortuary traditions of the neolithic, bronze and iron ages have been reported from Ban Non Wat in association with developing stone, ceramic and metal technologies. A review of the neolithic assemblage is provided here. Painted, incised and impressed ceramic vessels are present in the neolithic layers, particularly in the burials of Neolithic phase 1, and there was a shift to highly burnished wares and some painting in the bronze age (Higham and Kijngam 2009). The Neolithic phase 2 burials contained simply decorated, cord-marked ceramic vessels, similar to those recovered from the neolithic burials at Ban Lum Khao (Higham and Thosarat 2004a). The neolithic occupation at Ban Lum Khao is discussed further in Chapter 9.

The largest quantity of stone tools was identified in the neolithic layers of Ban Non Wat. The adzes were typically small in size, either shouldered or unshouldered, and were polished and ground. The number of spindle whorls recovered from neolithic contexts was minimal in contrast to the quantity in the bronze and early iron age contexts. Ivory was minimal in the neolithic layers and the ornaments in neolithic burials were usually restricted to cowrie shells and shell beads. The more ornate shell and marble bangles and earrings appear to belong to the bronze age mortuary tradition at Ban Non Wat. Very few ceramic counters or roundels were identified in the neolithic layers, while clay pellets were common. Some sandstone whetstones were also recovered from these neolithic contexts (Higham and Kijngam 2009). Given the comprehensive excavations at Ban Non Wat, the neolithic evidence at the site offers some of the best comparative evidence for An Sơn, and for understanding occupation at this time in Southeast Asia at this time. Ban Non Wat is discussed further in Chapter 9.

North of the Mun River Valley in northeast Thailand, Non Nok Tha and Ban Chiang revealed lower layers without bronze, while the majority of the later occupation was associated with metallurgy. The Non Nok Tha burials were associated with pottery vessels, shell-disc beads, stone adzes, grinding stones, domestic cattle remains, pig remains and bivalve shells. There was no strong evidence for exotic items (Bayard and Solheim 2009; Higham and Thosarat 1998b: 82–85;

Bayard 1996, 1971). Like the neolithic burials at Non Nok Tha, those at Ban Chiang included fine pottery vessels and some jewellery items. The pottery was tempered with rice chaff and there was evidence for domestic cattle, pig and dog at the site. Fish and shellfish remains were also recovered, and deer and other small mammals were hunted (Higham and Thosarat 1998b: 87).

The pottery of Ban Chiang is well known for its painted decoration. Red-slipped vessels were identified with the later burials of the upper layers, the painted vessels associated with the earlier burials. The basal layer included cloth impressions, ash lenses and rice remains. The pottery sequence began with ceramic vessels with cord marking on the bases and burnished and curvilinear incised decorations on the shoulders. These pots with cord-marked and incised curvilinear designs sometimes had foot rings or were globular with a round base. The vessels were interred with adult burials and some contained infant remains. Superimposing the lower layer, the later pottery included incised and painted wares (White 2006, 1997, 1986, 1982; Higham 1989: 106–113; 1983; Gorman and Charoenwongsa 1976). Ban Chiang and Non Nok Tha are discussed in greater detail in Chapter 9.

Summary

The literature review has been presented to show the sites and materials that are available for comparative research. While there is inconsistent evidence for cultivation and secure radiocarbon dates are rare at the discussed sites, some broad similarities and differences between the sites can be identified from the material culture at sites that are identified with neolithic occupation. Within southern Vietnam, parallels between An Sơn and some of the sites can be identified from the literature review. This includes the adzes at Cầu Sắt, which is fitting since Cầu Sắt and An Sơn are thought to be some of the earlier neolithic sites in southern Vietnam. Similarities have also been noted between Cầu Sắt, Bến Đò, Bình Đa and An Sơn with regard to the ceramic and lithic assemblages, such as the presence of shouldered adzes. In contrast, the literature indicates Rạch Núi had greater evidence of unshouldered lithic adzes according to the literature.

Greater differences in the material culture were identified between the sites of southern Vietnam and those in central Vietnam, with the associations with sites in northern Vietnam are clearer. According to the literature, Northern Vietnam sites display vastly different material culture compared to southern Vietnam sites. This includes the presence of geometric-impressed ceramic vessels and a lack of cord-marked vessels, unlike sites like An Sơn which bear commonalities with assemblages in southeastern China and Hong Kong. Cambodian sites share some material culture in common with southern Vietnam, such as cord-marked ceramic vessels and incised and impressed sherds. Thick red burnished wares and scale pattered or 'S'-shaped incised designs on ceramics in central and northeast Thailand are distinctive, and along with red painted wares, have not been identified during the neolithic in southern Vietnam in the literature review. The coastal sites of Thailand, Khok Phanom Di and Nong Nor, demonstrate the need for detailed comparative research, since cultural variation can develop between neighbouring sites even if they may have been related groups at some stage.

Some of the sites mentioned in this chapter are referred to again in the comparisons between An Sơn and related neolithic sites (southern Vietnam in Chapter 8, and the rest of Southeast Asia in Chapter 9). An Sơn has one of the longest occupations for the neolithic of southern Vietnam, and provides an ideal site for comparative research. This monograph explores and expands on the material culture sequence at An Sơn, as previously investigated by Nishimura and others (Nishimura 2002; Nishimura and Nguyễn 2002; Bùi *et al.* 1997; Nishimura and Vương 1997), and provides the findings from the 2009 excavation. There is a need to develop comparative research to establish relationships between sites within southern Vietnam with respect to inconsistencies in the understanding of stratigraphy and chronology. Rather than only concentrating on sequence issues, this research adds fabric analyses of the pottery, discusses the usage of different spatial areas at An Sơn, examines developments in ceramic technology, and discusses the implications of both widespread and locally restricted technologies for inter-site relations.

3

Methodology

Introduction

The 2009 excavation at An Sơn consisted of a large assemblage of ceramic sherds in the occupational layers, some complete or reconstructable vessels in burial contexts and the dense pottery scatter of Trench 1. The morphological and decorative attributes of the ceramics were assessed by examining the entire 2009 assemblage. Since no fabric analysis has previously been conducted on the An Sơn ceramic assemblage, a broad approach has been adopted to uncover the variety of ceramic fabrics, inclusive of both rare and more common rare fabrics. The sampling strategy for the fabric analysis has been designed to characterise the ceramic fabrics over time and to encompass the variety of the assemblage.

The methods described here outline the excavation and sampling strategies used to obtain the ceramic sample from the 2009 An Sơn excavation. The methods for assessing morphology, decoration and fabric of the entire ceramic assemblage are explained, together with the macroscopic and microscopic methods used for close examination of a sample for fabric analysis. This chapter presents the methods for the study of the An Sơn chronological sequence and the different uses of space on site. For the ceramics, it discusses the methods for assessing the function of pottery vessels, standardisation in certain forms, and for the comparisons of forms, decoration and fabrics between An Sơn and other sites, together with the statistical procedures applied to conduct these analyses.

Methods of excavation and ceramic analysis at An Sơn

Excavation strategy at An Sơn, 2009

While the ceramics from the 2009 excavation are the primary focus of this study, a 1997 excavation revealing earlier layers with different ceramics from those present in 2009 are referred to in this monograph. The 1997 Trench 1 was excavated into the top of the mound to a depth of 4 m. The stratigraphy consisted of three main units, with Unit 2 containing a large number of thin and alternating alluvial silt floors and occupation layers (Nishimura and Nguyễn 2002). Some areas of the mound had been levelled by 2009, and the western side had been terraced away from the road to create a steep slope that was 5 m high to the top of the mound. The southern side of the mound had been terraced at an earlier date. The eastern side had been levelled and excavations had previously taken place in this area in 2004 and 2007.

The previous excavations in 2004 and 2007 at the eastern side of the mound revealed extended burials (Văn *et al.* 2008; Phạm 2006). One of the main intentions of the 2009 excavation was to locate more burials, and three long trenches were laid out adjacent to the still open 2004 and 2007 excavation trenches. Trench 1 was 3 x 12 m, Trench 2 was 5 x 5 m and Trench 3 was

2 x 10 m. The trenches were divided into 1 x 1 m squares for recording purposes and were labelled according to an alphanumeric system (Figure 3.1). A 2 x 1 m test square was also excavated into the western side of the mound, where it had been terraced back from the road.

The different trenches presented various usage and depositional contexts that are important for deducing the functions of particular ceramic vessel forms and different areas of the site. Trench 1 intersected the southeastern corner of the mound at square C1, and contained overlapping and sloping deposits that extended away from the mound. These are interpreted as discard layers. Trench 2 also consisted of an independent set of sloping layers that were truncated by recent earthmoving activities. The layers sloped away from a cooking area in the northeast corner of the trench. Trench 3 was largely internally unstratified with clay and small sherd contents thought to be the result of run-off from the main mound during heavy rainfall. A similar run-off effect with clay and small sherds was evident at the southern end of Trench 1. Trench 3 did not provide much archaeological information, except for a cluster of pottery vessels in the basal layer.

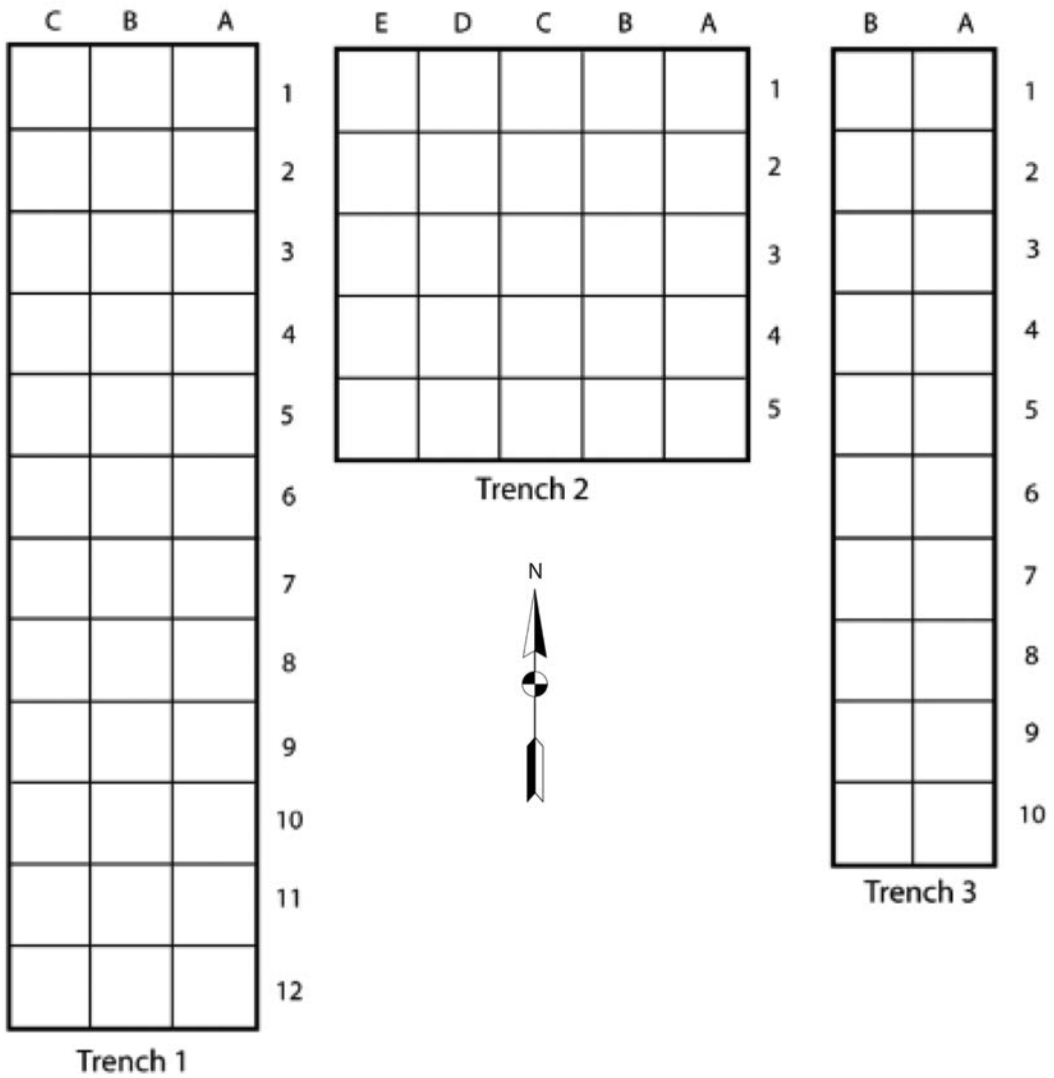


Figure 3.1. Schematic diagram of the three trenches of the 2009 excavation to display the applied alphanumeric system. Each square is 1 x 1 m. This diagram does not correspond to the layout of the site (see Chapter 4).

Source: C. Sarjeant.

Trenches 1 and 3 were excavated in 10 cm spits. The fifteen excavated spits of Trench 1 were translated into eight separate stratigraphic layers, as were the thirteen spits of Trench 3 (see Chapter 4). Trenches 1 and 3 were excavated to the basal alluvium, at a depth of 1.5 m. The complex nature of the lenses in Trench 2 meant that fifteen stratigraphic layers were identified, and 10 cm spits were excavated within these layers (see Chapter 4). The basal alluvium was present in Trench 2 at a depth of 1 m. The western Test Square was excavated in 10 cm spits and the spits were labelled according to depth. The Test Square was excavated to a depth of 2.6 m.

The ceramic assemblage of An Sơn

Before sampling for fabric analyses, a full assessment of the ceramic sherds and vessels that were excavated in 2009 took place. This initially involved dividing the ceramics into basic categories. As this was a large task, it was completed by a team: Bùi Chí Hoàng, Nguyễn Kim Dung, Đặng Ngọc Kinh, Nguyễn Khải Quỳnh, Nguyễn Khánh Trung Kiên, Lê Hoàng Phong, Nguyễn Phương Thảo, Nguyễn Mạnh Quốc, Trần Thị Kim Quy, and myself. The complete or partially complete vessels from deposits and burials were kept separate from the sherds that underwent the sorting process (Figure 3.2). *Tempers* were identified macroscopically, to the best of the team's abilities, into sand or fibre tempered. The 'other' tempers were identified by myself in initial sorting and kept aside for further analysis. *Components* were simply divided into rim or body sherds. The rim sherds also included foot rims, while body sherds also included stems/pedestal stands. All rim and foot rim sherds were kept aside for rim form categorisation. *Surface treatments* were separated into plain, cord-marked/comb incised/lines impressed with a carved paddle (henceforth called 'paddle linear impressed'), and other decorated rim and body sherds. All of the decorated sherds were kept aside for further analysis.

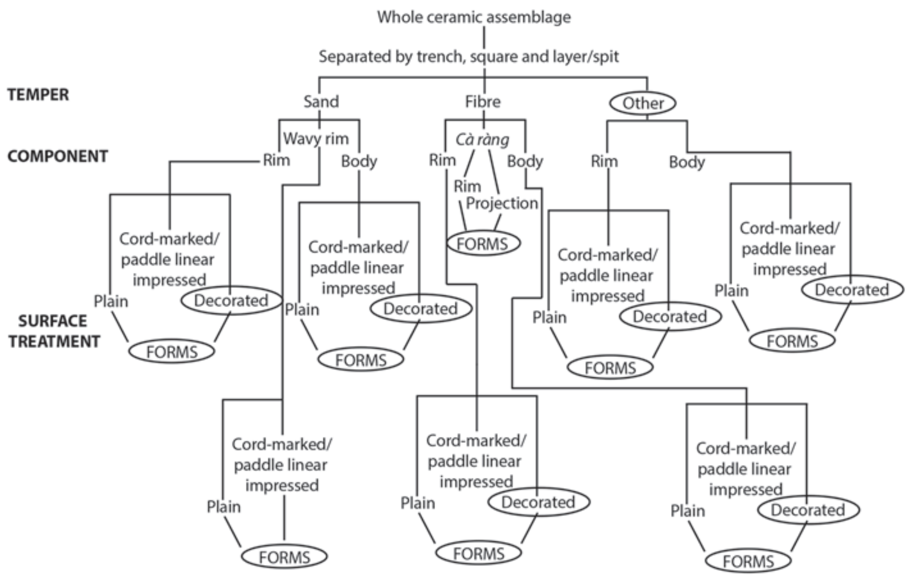


Figure 3.2. Initial sorting of ceramic sherds. The circled categories of ceramic sherds were subjected to further analysis.

Source: C. Sarjeant.

The weight and total number of sherds in each spit were recorded. Both the sand and fibre tempered sherds were counted as rims, wavy rims, cord-marked body sherds, plain body sherds, other decorated rim and body sherds, and foot rims. The fibre tempered *cà ràng* (stove/earth oven cooking vessel) sherds were counted as rims, body sherds, and tripod projections sherds. After these preliminary counts, the circled categories shown in Figure 3.2 were subjected to further analysis.

Sampling the ceramics

The ceramic sample from the 2009 excavation was selected with the aim of characterising the sequence of ceramic technology at An Sơn. The deepest and clearest stratigraphic sequence observed in 2009 was in the 1 x 1 m square closest to the mound, C1, in Trench 1. Sherds were selected for fabric analysis from square C1, in order to consider changes in the ceramic technology over time. Additional sherds were collected from the base of the Test Square and the 1997 excavation, since these earliest layers contained ceramics that were distinguishable from that in the later layers (Nishimura and Nguyễn 2002). These sampled excavation units were deemed representative of the overall ceramic assemblage at An Sơn.

The analysis of morphology and decoration involved assessing the entire assemblage that was excavated in 2009. Close attention was given to the ceramic forms excavated from the Trench 1 squares A1, A2, B1, B2, C1 and C2, because these squares contained clear mound-edge stratigraphy, and Trench 2 indicated coking activities using earth ovens.

The sherds for fabric analysis from square C1 were selected from each spit to include the different rim forms, components, fabrics and surface treatments (i.e. rim sherds, body sherds, sand tempered sherds, fibre tempered sherds, 'other' tempered sherds, plain sherds, cord-marked sherds, decorated sherds, etc.) that were represented. This reflected a stratified random sampling strategy (Drennan 1996: 87). The initial selection process resulted in about 10–20 sherds from each spit, depending on how many sherds were excavated. It was noticed that few wavy rimmed vessels (class D) were present in Trench 1 square C1, and a sample of class D sherds from other trenches for the fabric analysis was acquired. The 10–20 sherds from each spit of Trench 1 square C1 were reduced in number before removal from Vietnam due to weight restrictions in transportation. Therefore, ten sherds were selected randomly from each set of sorted sherds: five sand-tempered, five fibre-tempered. The 'other' fabric sherds were kept in the sample, adding to the ten sherds for some spits of Trench 1 square C1. Class D (wavy rimmed) ceramic sherds and basal layer sherds from the Test Square and the 1997 excavation were also kept for analysis.

Once in Australia, the number of sherds from Trench 1 square C1 had to be reduced further for laboratory analysis, owing to the time and cost of SEM-EDX analysis. In most cases this was limited to two sherds per spit (one sand, one fibre, plus 'other' tempered sherds). While the sample chosen for fabric analysis was small, the fabrics from An Sơn appeared macroscopically homogeneous. A microscopic examination of various sherds prior to sampling indicated there was homogeneity in the clay matrix compositions of the primary temper groups of sand and fibre.

The sample chosen for fabric analysis from Trench 1 C1 included 40 sherds. Each spit was sampled with two to seven sherds, based on the above criteria (one sand, one fibre, plus 'others'). Additional sherds were sampled from other squares of the 2009 excavation to encompass the variety of fabrics, forms and decoration. These included a further six sherds. Thirteen sherds from the lowest layers of the Test Square and from the 1997 excavation were also sampled. Two surface sherds were studied in the preliminary analysis of fabrics. To confirm local ceramic manufacture nine clay samples were collected for comparison with the pottery fabrics: three unfired samples close to the Vàm Cỏ Đông River channel near An Sơn and six fired clay samples from 2009 archaeological contexts.

Further comparative samples were analysed to confirm the local manufacture of the An Sơn ceramics, including some from other sites in southern Vietnam sites, northern Vietnam and other areas of Southeast Asia. The wide dispersal of the selected sites was necessary to show major relationships and differences in the ceramic fabrics. The majority of the samples were surface finds but they had characteristics of neolithic earthenwares comparable to those at An Sơn. A total of 21 sherds were sampled from nine sites.

The collection of the clays and the samples from other sites was arguably haphazard, but it illustrates the need for further analysis of clays and ceramics from other sites in southern Vietnam. Access to comparative material for fabric analysis was problematic. It was the original intention to acquire provenanced sherds from other southern Vietnam sites, but this was not possible at several museums in southern Vietnam. Such a study must wait until another site is excavated in the region with a similar approach to the An Sơn ceramics.

A list of the samples chosen for fabric analysis, their identification numbers for the statistical analyses, forms, surface treatments and Munsell colours are presented in Appendix A with their temper group (as presented in the analysis of Chapter 6, Part I).

Method for the analysis of morphology and decoration

Morphology and decoration were studied differently when assessing the complete/reconstructed vessels on the one hand and the ceramic sherds on the other. The initial sorting process that has been previously outlined (Figure 3.2) meant that the rim and decorated sherds were set aside and ready for the next analytical step. The complete and reconstructed vessels were photographed and drawn to show the profile and surface treatment. Measurements of rim diameter, rim length, rim thickness, body thickness, height, and foot rim diameter were taken, and temper was identified macroscopically.

Once the rim sherds had been separated from the body sherds, the rims were categorised according to form (see Chapter 5). The variations in rim forms were drawn to scale and any associated surface treatments recorded. Decorated sherds were separated to allow for rubbings and photographs to be taken. Variation in decoration was recorded according to mode of decoration and whether decorations occurred in isolation or in combination. The decorative modes included cord marking, comb incision, paddle linear impression, burnishing, linear incision, geometric incision, spiral and wave incision, punctate stamping, roulette stamping, red painting or slipping, and white lime infill.

As described above, close attention was given to the rim forms from the basal layers of the 1997 excavation and Trench 3, from squares A1, A2, B1, B2, C1 and C2 of 2009 Trench 1, from 2009 Trench 2, and from the Test Square. These areas were identified as important for understanding the stratigraphy and chronological sequence of the site, and the functional uses of different areas of the site.

The more common rim forms were targeted for further measurements and fabric analysis (including concave rim form A2a, forms B1a and C1b, and the wavy and serrated rimmed vessels, class D; see Chapter 5). The measurements of these rim forms included rim diameter, rim length, rim thickness, angle from rim to rim termination, body thickness, and height of vessel when present. Other measurements were taken when relevant. These more frequently observed rim forms and their measurements were applied to a study of standardisation in the An Sơn assemblage (see Chapter 7).

Method for the analysis of fabrics

Ceramic petrography has been a central focus of analytical work and has been integrated with both macroscopic and chemical analysis in many studies. Manual SEM (scanning electron microscopy) with linked EDX (energy dispersive x-ray spectrometry) is routinely used in the analysis of ancient ceramics (Knappett *et al.* 2011; Spataro 2011; Tomber *et al.* 2011). Like any method however, it does have limitations: SEM-EDX cannot differentiate between minerals with very similar chemistry and a complementary technique is required, such as XRD (x-ray diffraction). D.P.S. Peacock (1977; in Knappett *et al.* 2011) has advised against conducting elemental studies without knowledge of the macroscopic and microscopic properties of the ceramic assemblage. The macroscopic analysis requires looking at the overall sherd assemblage and a representative sample is then selected for microscopic analysis in thin section in order to identify local fabric groups, working from the local geology and clay sources. SEM may also be applied in order to provide a chemical analysis for an understanding of local or non-local ceramics. A number of different analytical techniques are required to provide the appropriate degree of resolution, although there are advantages in applying methods that retain the mineralogical and textural qualities of the fabrics, such as SEM-EDX, which was utilised in the analyses for this monograph (Knappett *et al.* 2011).

Application of SEM-EDX in recent studies of archaeological ceramics

SEM-EDX has been applied in other ceramic studies in a similar way to that presented in this monograph. For instance, SED was used on neolithic ceramics from south-eastern Europe (Spataro 2011) because the fabrics concerned were often not homogeneous, and had coarse inclusions and porous structures. The SEM-EDX analyst is able to select areas for chemical analysis that are less affected by the presence of mineral temper, and the inclusions can be analysed individually. Petrographic analysis is often conducted on thin sections in combination with SEM in order to characterise the matrix according to clay composition (for example, calcareous or non-calcareous), and to identify vitrified, fossilised and other properties. Inclusions can be identified according to colour, composition, grain size, frequency, rounding and sorting, and can also be used to determine provenance of raw materials (Spataro 2011).

Characterisations of fabrics can include variables such as temper choices, degree of vitrification and firing temperatures. A study of the ceramics from the Alcantara River Valley in northeastern Sicily applied polarising microscopy, x-ray diffraction and SEM (Belfiore *et al.* 2010). Firing temperatures were studied with vitrification structures observed with SEM. This study applied the following methods: petrographic analysis by polarising optical microscopy, micro-morphological analysis by SEM (vitrification and equivalent firing temperatures), x-ray diffraction spectra, x-ray fluorescence of major, minor and trace elements, and SEM-EDX spot analysis of mineral phases for volcanic tempers and lavas. SEM-EDX offers 'detailed information on their chemical composition,' and the SEM results supported the XRD analysis (Belfiore *et al.* 2010: 444).

Testing of SEM-EDX with QEMSCAN® has been conducted by researchers in the Aegean (Knappett *et al.* 2011). QEMSCAN is an automated approach to SEM-EDX, that is, a computer controlled SEM developed for image analysis and mineral analysis by the mining industry. The method is operator independent, apart from the initial selection of the operating mode and the beam stepping interval. QEMSCAN is a bulk chemistry method that is based on the measured modal mineral abundance and the estimated mineral chemistry. The fine grained and amorphous mineral phases and grains/inclusions and matrix/groundmass are all measured together in a single analysis and at the same resolution to provide quantitative data. Despite the importance of introducing elemental analysis after macroscopic and microscopic studies, the integration of all of these techniques can be difficult. According to Knappett *et al.* (2011), this can be remedied somewhat by QEMSCAN, through its combination of textural and mineralogical data based on elemental spectra. It is possible to characterise materials accurately when the rocks and sediments are unaltered, but this is not always the case with fired materials, and additional data are needed on the chemistry of each mineral phase (Knappett *et al.* 2011).

Tomber, Cartwright and Gupta (2011) applied SEM-EDX to a study of Indian Ocean region ceramics that incorporated rice husk (*Oryza sativa*) fabrics. They identified the exact particles that were added as temper as rice spikelet fragments (husk) and stems. Fragments of Poaceae family, i.e. grasses, were also presentbut could not be identified to species due to their fragmentary state. The study employed petrographic, biological and SEM methods. The high variability in the fabrics led to the conclusion that the ceramics were made in small-scale production settings. It may be argued that the presence of rice chaff temper indicates an economic reliance on rice and that it was readily available. However, the technological significance of using this type of temper should not be underestimated, particularly for the use of pots that are under thermal shock during cooking (Tomber *et al.* 2011).

While basic macroscopic and microscopic methods were employed in my research, manual SEM-EDX was also applied. This method was chosen because of my previous experience with the instrument (Sarjeant 2008). Furthermore, SEM-EDX has been recognised as a useful technique for identifying both tempers and clay matrix groups in earthenwares with micrographs and chemical compositional data, thus providing mineralogical and chemical analyses (described further below). I would suggest that, given more time and finances, supplementary samples be included in such an analysis with the addition of comprehensive petrographic study and an analysis of trace elements, which would complement the fabric analyses in this monograph.

Method of SEM-EDX analysis

Macroscopic analysis was conducted on all sherds to separate them into basic fabric groups in the field: sand or fibre tempered. This separation was conducted macroscopically or with low magnification to identify tempers, and recorded for squares A1, A2, B1, B2, C1 and C2 of Trench 1, Trench 2, the basal layers of Trench 3, the Test Square, and the basal layers of 1997 excavation. The macroscopic groups were expanded to include lateritic and shell tempered fabrics. These four major groups (sand, fibre, laterite and shell) then required microscopic analysis, and sherds were sampled from representative areas of the site.

The samples that were collected for fabric analysis were recorded with the following information: rim form (if known), vessel component (body or rim), surface treatment and decoration, macroscopic observation of the fabric, and the Munsell colour of the exterior surface and interior fabric (see Appendix A). The sampled sherds were prepared for SEM-EDX analysis: each sherd was cut and impregnated in a 25 mm circular epoxy resin block with the flat surface of the sherd exposed at the top of the block. The resin blocks were polished with diamond paste to create a flat, polished analytical surface. Note that the texture and structural integrity of the sherd sample remains intact as no crushing of the sample takes place. All of the samples were prepared by Tony Phimphisane or John Vickers in the Research School of Earth Sciences at The Australian National University.

Once this preparation was completed, the samples that were ready for microscopic study were analysed with a lit Zeiss stereoscope, and photographs were taken with the attached camera, an AxioCam ERCc5. The following features were recorded: visual identification of temper, colour of sand grains, size of sand grains, density of sand grains, and colour and texture of the clay matrix. These observations are important for a comprehensive SEM-EDX analysis. The samples were then carbon coated, which ensures conductivity when the sample is in the SEM.

SEM combines a compositional measurement over a range of depth at 1 μm or approximately 10,000 atom layers, therefore SEM is considered a bulk rather than a surface analysis technique (Newbury *et al.* 1986: 244–245). My study utilised the ability of SEM to provide analyses of the sand grains separately from the clay matrices. No bulk analyses were conducted of large areas that may include both temper and clay; these were analysed separately. Therefore, manual SEM-EDX was preferable to the aforementioned automated SEM-EDX with QEMSCAN. Electron microscopy provides separate chemical analyses of the clay matrix and minerals rather than the blend of both that most other techniques provide when samples are crushed in preparation. The smoothly prepared sample can be moved under the electron beam for spot analysis. The obtained chemical results allow the grouping of sherds on the basis of chemical similarity into groups called Chemical Paste Compositional Reference Units (CPCRU) (see Summerhayes 2000: chapter 4).

The sherds were analysed using a JEOL JSM-6400, a regularly calibrated scanning electron microscope with an EDX attachment in the Electron Microprobe Unit, Research School of Biology, The Australian National University. The JEOL JSM-6400 is optimised for quantitative x-ray analysis. Machine conditions used a negative potential of 15 keV accelerating voltage and a constant current of 1nA. In this study, micrographs were taken and EDX quantitative analyses were conducted. Backscatter micrographs were taken at magnifications of x20, 50, 100 and 600 with SpectrumMono software. The x600 micrograph was taken to show the texture of the clay matrix. The micrographs aided the identification of grains and matrix areas with different textures and greyscale colours that were to be selected for EDX quantification.

The EDX quantitative analysis was presented by means of ZAF matrix correction by stoichiometry and all elements were combined with oxygen (valency -2) in a calculation based on 6 anions per formula. The EDX of an SEM is typically applied to measure the characteristic x-rays of major elements (>10 weight %), whereas WDS (wavelength dispersal spectrometry) is used to measure minor elements (<10 weight %). The sample is analysed non-destructively and when flat, polished samples are analysed the accuracy is usually 1–2% of the amount present of a given element (Goldstein *et al.* 2003: 12). The EDX analyses the x-rays emitted by the sample when the electron beam is targeted at the sample in an SEM. Each element has x-rays that are characteristic of the atomic structure which appear as peaks and quantities in EDX analysis that can be identified when compared with reference peak data (Goldstein *et al.* 2003: 356). The JEOL JSM-6400 EDX is linked to Oxford Link ISIS software to identify the characteristic x-rays according to known reference standards (the commonly observed element standards are shown in Table 3.1) and is sensitive down to boron. The combination and concentration of different elements can be used for mineral identification. Each EDX analysis was conducted for 100 seconds livetime.

Two different modes of EDX analysis took place. The first was conducted on the non-plastic sand grains. It is possible to select specific areas for analysis with the SEM since the entire area of analysis appears on the monitor. A spot can be analysed up to x300,000 magnification. This ensured accurate mineral identification and characterisation of specific grains and spots within the ceramic fabrics. Similar principles applied to the analysis of the second component, the clay matrix. Five representative areas of the clay in each sample (areas not inclusive of sand grains that were potentially added temper grains) were selected for EDX analysis. Once again, the area of analysis was observed visually on the monitor. The magnification depended entirely on the sample: some sherds had smaller sand grains than others and some sherds were densely tempered, so the clay matrix analysis of these had to be conducted at a higher magnification. While grain analyses were conducted up to x300,000 magnification, the clay matrices were usually analysed between x500 and x7000 magnification. The elemental oxides of sodium, magnesium, aluminium, silicon, phosphorus, sulfur, potassium, calcium, titanium, vanadium, manganese and iron were analysed. Other elements were added when peaks were identified in grain analyses, e.g. zircon.

Table 3.1. Standards for JEOL JSM-6400 EDX at the Electron Microscopy Unit, The Australian National University. Only the frequently analysed elements of the ceramic samples included.

Element	Standard	Date
Na	albite ($NaAlSi_3O_8$)	26/06/2009
Mg	MgO	26/06/2009
Al	albite ($NaAlSi_3O_8$)	07/04/2009
Si	sanidine ($KAlSi_3O_8$)	26/06/2009
P	$NiPS_3$	03/07/2009
S	PbS	16/04/2009
Cl	NaCl	31/07/2008
K	sanidine ($KAlSi_3O_8$)	26/06/2009
Ca	diopside ($CaMgSi_2O_6$)	26/09/2008
Ti	TiO_2	25/06/2009
V	pure V	31/07/2008
Mn	pure Mn	31/07/2008
Fe	Fe_2O_3	11/05/2009
Zr	pure Zr	05/02/2009

Source: The Australian National University Electron Microscopy Unit lab manual.

Identifying tempers from compositional data and micrographs

Tempers must be distinguished from natural non-plastic inclusions in ceramic fabric characterisations. Non-plastic inclusions are the components of a ceramic fabric that are not the clay paste, and include natural and human-added inclusions. Tempers are non-plastic additives added by potters to improve the ceramic fabric in forming and firing. While it may seem straightforward to analyse a non-plastic grain within a ceramic fabric with the SEM-EDX since the readings offer compositional data that relates to known minerals, differentiating the non-plastic natural inclusions from tempers can be difficult. It is important to consider what materials occur naturally in clays. Organic materials, pottery sherds, igneous, sedimentary and metamorphic rock fragments, coarse sands and pumice are common tempers. Grain sizes and relative abundances of the non-plastic grains aid the confirmation of tempers. The abundance of natural quartz in clays and its use as a sand temper can make differentiation difficult. Fine silt quartz is common as a natural inclusion, whereas coarse, waterworn quartz grains are likely to be temper additives. Coarse grains may be present naturally but waterworn grains do not occur naturally in clays (Shepard 1965: 161–162).

Visual observations aided the selection of different grains for analysis. The non-plastic inclusions that were analysed with the EDX were identified as minerals utilising reference materials (Severin 2004; Deer *et al.* 1992). Some of the non-plastic inclusions were not identifiable minerals, and their compositions represented calcareous and phosphate materials, such as shell and bioclasts. Organic plant materials could only be analysed visually, as the EDX cannot read botanical remains. Temper groups were established from the identified non-plastic inclusions that were manually added by the potters (see Chapter 6, Part I).

Statistical methods for clay matrix compositional data

Compositional data and the selection of elements

Using the EDX data from the clay matrix analyses, multivariate statistics were applied to identify clusters and to define CPCRUs. A primary aim in the quantitative elemental characterisation of pottery is to define groupings that make chemical and archaeological sense (Summerhayes and Allen 2007: 111–112). Compositional data are relative, so if one element increases in value, others will decrease. In order to make the matrix data comparable between different samples, and to obtain averaged compositional data for each sample, the raw data were normalised. Thus, the compositional data totalled to a constant value (100%). The data were always positive, between 0 and 100 (Pawlowsky-Glahn and Egozcue 2006). The EDX analysis produced negative values when a particular element was undetectable and these were rounded to zero to avoid affecting the statistical analyses.

Some of the analysed elemental oxides were undetectable across most of the samples. The selection of elements to include in statistical analyses requires consideration with regard to the absence of certain elements in the samples. The compositions can also be affected by environmental conditions, including post-depositional effects, which have the potential to alter the chemical composition of archaeological ceramics. This has been particularly noted for the concentrations of phosphorus (Freestone *et al.* 1985). In the samples from An Sơn, the concentrations of SO_3 and V_2O_5 were very low and consistently undetectable, so it was appropriate to exclude these elemental oxides from the statistical analyses. Additionally, there are problems with including MnO in statistical analyses of compositional data. Anna Shepard (1966) has identified manganese as highly migratory, and cautions against including it. These four elements are assessed in bivariate plots and by principal components analyses (PCA) in Chapter 6 to establish whether they should be included in further statistical analyses. The remaining elemental oxides, MgO, Na_2O, Al_2O_3, SiO_2, K_2O, CaO, TiO_2 and FeO were all important components of the clay matrices that were included in the statistical analyses.

If certain elements are excluded from the statistical analysis, a sub-composition is adopted and the values must be re-normalised. There have been concerns over the habitual use of inappropriate methods of statistical analysis for compositional data, specifically for compositional and sub-compositional data (Pawlowsky-Glahn and Egozcue 2006). Some researchers question this concern, given that 'reasonable and interpretable results arise from the application of conventional techniques' (Pawlowsky-Glahn and Egozcue 2006: 2). However, there have been methods developed for compositional data that illustrate how log ratios can be used to acknowledge the relative magnitudes and variations of the components that are necessary to analyse compositional data. Log ratios transform the data from a simplex space, i.e. compositional data in a restricted space in which the values are only between 0 and 100, to Euclidean real space which is applied to conventional multivariate statistical analyses, like PCA (e.g. Pawlowsky-Glahn and Egozcue 2006; Aitchison *et al.* 2002; Aitchison 1986).

To prepare the compositional data for statistical analyses, each set of data for each analysed area was examined for errors (low total values or inconsistencies with the other readings). Each matrix area was normalised to a total of 100%, inclusive of only the elements that were to be analysed in the subsequent statistical processes. Once normalised, the multiple matrix area readings were averaged to give a single set of compositional data for each sample. The averaged values were applied to a log ratio transformation. The log ratio was applied against one of the common and least variable elemental oxides in the clay matrices, aluminium oxide. The basis for the selection of Al_2O_3 for the log ratio transformation is presented in Chapter 6. The above calculations can be summarised as:

$N[x] = 100(x/\sum x)$

Normalised value of each element of each reading = (element compositional value/sum of compositional values for reading) multiplied by 100

$\mu[x] = \sum N[x]/n$

Mean value of each element of each sample = sum of normalised element compositional values of each element of each reading/number of readings for each sample

$\log(\mu[x]/\mu[Al_2O_3])$

log (mean value of each element of each sample/mean value of Al_2O_3 of each sample)

where x is the compositional value for an element of a reading, n is the number of compositional readings for one sample, N is the normalised value for a compositional value (the sum of all normalised compositional values for each reading is 100), and μ is the mean compositional value of all of the readings for a sample.

Log ratio transformed values were used for all statistical analyses for the clay matrix data (PCA, hierarchical cluster analysis and canonical variate analysis).

Principal components analysis (PCA)

The compositional data from SEM-EDX analysis produced values for each analysed elemental oxide, resulting in a large number of variables. PCA was employed to reduce the variables into principal components. From the PCA, compositional groups and clusters can be identified to determine which ceramic samples are the most and least chemically similar to each other. It is common practice to apply PCA to compositional data, as a dimension-reducing technique for the multiple elemental variables. In PCA, the elements are reduced to principal components, which can then be plotted against each other to identify compositional groupings. Michelaki and Hancock (2011) report the need to formulate bivariate plots before leaping into PCA or CLR-PCA (centred log ratio-principal component analysis) plots to identify elements that may diminish the chemical variation. It may only be necessary to include a few of the elements in a PCA. Bivariate plots are explored in this monograph before PCA to identify the variables that have the most weight in the variability exhibited in the PCA (Chapter 6).

Two main difficulties exist in the application of compositional data in PCA. The first is the curvature that may be displayed by compositional data, and this nonlinear data is applied to linear PCA. Therefore a method of PCA needs to be used that will accommodate both nonlinear and linear data. The second difficulty is the use of a Euclidean sample space in PCA when the compositional data are simplex, and Aitchison (1983) proposed that log ratio transformations overcome these difficulties.

The PCA itself reduces the elemental variables into a few manageable dimensions to show the chemical elements that are highly associated to each other. PCA was conducted to transform the compositional data into three principal components in this analysis. The first principal component exhibits the most variability within the compositional data, while the second exhibits the second most variability, and so on. PCA was completed to three principal components in this study. A percentage of variation for each component is given in PCA. The weighting of the variation of each principal component is dependent on the elemental variables that exhibit the greatest variation amongst the latent vectors, known as loadings. The PCA produces values for each sample with a first, second and third principal component that can be plotted to reveal clusters and outliers. The CPCRUs are identified from the clusters. Outliers may be removed from the PCA in order to clarify the samples that group together, as strong outliers in a biplot may cause the remaining samples to cluster tightly in comparison to the outlier.

The bivariate plots, log ratio transformations and PCAs were conducted with GenStat software for the analyses shown in Chapters 6 and 7. PCA biplots and plots of the first three principal components (or dimensions) are presented in this monograph. The biplots show the variability of the ceramic samples in relation to specific elements, while the PCA plots show the variability of the ceramic samples in relation to the PCA loadings. A table of the PCA loadings for each analysis is also provided for the first three principal components, inclusive of the total percentage variability for each principal component in parentheses. The loading values in bold in the table indicate the elements that contribute the greatest variability to the PCA plots.

Hierarchical cluster analysis

PCA can be supported by cluster analyses. Cluster analyses illustrate homogeneous groups or clusters in a dataset. Hierarchical agglomerative clustering was employed, in which each sample is viewed as an individual. Samples are then successively grouped into clusters until there is a single cluster. Average-linkage hierarchical clustering is most frequently applied in archaeology and the resulting dendrograms, while not always easy to understand, are often a realistic representation of the data. Clusters can be discerned from the dendrogram by 'cutting' the dendrogram at a single or several points based on the groupings that result (Baxter 2003: 92–95). Various clustering methods were investigated and the average-linkage method was most consistent with the PCA and therefore applied in this study.

The hierarchical cluster analyses were conducted with GenStat software for the analyses shown in Chapters 6 and 7. The cluster analyses are presented with dendrograms and interpretive tables to identify the groups when cut at a logical specified point on the plot.

Canonical variate analysis (CVA)

Canonical variate analysis (CVA) is a form of canonical correlation analysis and is a suitable multivariate statistical method for dealing with the simultaneous analyses of several sampling levels (e.g. from different stratigraphic layers) (Reyment 2006). CVA is essentially a PCA of the group mean vectors. Like PCA, CVA is a dimension-reducing technique that transforms a multivariate dataset into two or more dimensions. However, *a priori* information about the dataset can be implemented and the differences between these *a priori* groups are maximised in CVA. CVA can be used when the dataset includes three or more *a priori* groups, while discriminant analysis is applied to only two groups. PCA and CVA biplots are directly analogous (Hammer and Harper 2006: 100; Tofallis 1999; Greenacre and Underhill 1982: 205).

The ability to input *a priori* archaeological groupings, such as sites, layers or vessel forms, in a statistical analysis provides the opportunity to validate whether the chemical compositional data have any relationship to other archaeological knowledge. This is an exploratory technique and it is applied in this monograph on several occasions. In relation to the clay matrix compositional data, CVA plots are formulated to investigate the compositional relationship between groups based on separate sites (An Sơn, Cù Lao Rùa, Đình Ông, Giồng Cá Vồ, Lộc Giang, Hòa Diêm, Ban Non Wat, Mán Bạc, Đa Bút and Cồn Cổ Ngựa), on the stratigraphic layers at An Sơn, the tempers in the An Sơn ceramic fabrics, the vessel forms at An Sơn, and pottery versus clay fabrics at An Sơn.

The CVAs were conducted with GenStat software for the analyses shown in Chapters 6 and 7. The CVA results are presented as biplots to show the variability of the first two dimensions in the CVA plots that follow. Many of the CVA plots are shown with 95% confidence circles around the specified *a priori* group mean. A table of the CVA loadings for each analysis is also provided for the first two or three canonical variates, inclusive of the total percentage variability for each canonical variate in parentheses.

Methods for contextualising An Sơn ceramic production

The original aims of this monograph (Chapter 1) were to contextualise the An Sơn ceramic assemblage within the neolithic of southern Vietnam. This section describes the methods used to understand how the An Sơn assemblage, with specific analyses related to the ceramic sequence, the usage of different areas of the site based on the material culture evidence, and the nature of ceramic production on site. Methods for comparing An Sơn with other sites in southern Vietnam and elsewhere in mainland Southeast Asia are discussed.

An Sơn ceramic production

Sequence and spatial distribution of the ceramic assemblage

The sequence and chronological relationships (the vertical positioning) of the different ceramic forms applied the data from the morphological and surface and fabric analyses of the sherds. The sequence was assessed by separating the ceramics into their originating cultural layers when possible, rather than spits. The clearest sequences were derived from Trench 1 and the lowest layers of the Test Square. The sequences of vessel morphology and surface treatment are outlined in Chapter 5, while those of temper choices and clay matrix chemistry are presented in Chapter 6.

The spatial distribution (the horizontal positioning) of the different ceramic forms over the site was informative with respect to the function of specific forms. This analysis primarily focused on the sherds from Trench 2, since the stratigraphy offered a series of roughly contemporaneous layers (see Chapter 4) with multiple forms of archaeological evidence existing alongside the sherds themselves. The results of the spatial distribution of ceramic forms are discussed in Chapter 5.

Ceramic production and standardisation

Studies of specialisation, standardisation, distribution and other issues relating to the organisation of production are underdeveloped in mainland Southeast Asian ceramics research. There is increased understanding of the way in which pottery is produced, thourgh studies of raw material selection, forming, decoration and use (all of which require more attention in Southeast Asian prehistory but are steadily developing). It is appropriate to expand on this research to understand the organisation of pottery production. The social status and identity of potters, and of groups associated with potting, along with the organisation of production may be inferred by examining ceramic evidence in terms of context, concentration, scale and intensity (see Costin 1991).

Direct evidence for ceramic manufacture is rare in the archaeological record, but debris from manufacture and unfinished items can be compared to finished products to assess these questions. Craft specialisation can be inferred when a high intensity, low scale, low concentration occupation is practiced, and when one type of vessel made in a standardised manner may be more common than others. Standardisation is an indirect way to infer specialised production, if vessels are made in a uniform way. Standardisation is one of the easiest variables to deal with in the study of ceramic production organisation. However, ceramics are subjected to a great deal of variation in manufacture and the variation evidenced in ceramic morphology may be the result of many factors (Costin 1991).

To begin an analysis of pottery production organisation at An Sơn, I conducted a study of standardisation across the major ceramic forms. Following this I undertook a more thorough study of the common and distinctive forms of ceramics: A2a, B1a, C1b and D1a. With little direct evidence for production areas at An Sơn, much of the discussion about specialisation, context, concentration, scale and intensity has to be derived from indirect evidence. The standardisation study involved focusing on morphology and dimensions. The dimensional measurements were assessed with a PCA, a hierarchical cluster analysis and a CVA (as previously as described), and with coefficient of variation (described below), in order to identify which vessels were similar within a particular vessel form group. These results can lead to the inference of the degree of standardisation and, with other indirect evidence, may provide information about specialisation and organisation in pottery production at An Sơn.

Coefficient of variation (CV)

Dimensional measurements are frequently tested statistically for variability with the coefficient of variation (CV) to deduce whether the sample is less or more variable, i.e. more or less standardised (Roux 2003a; Eerkens and Bettinger 2001; Foias and Bishop 1997; Costin and Hagstrum 1995; Blackman *et al.* 1993; Junker 1993). The CV calculation is:

CV = standard deviation/mean

All CV values are expressed as percentages in this monograph (i.e. the above calculation multiplied by 100).

Without an independent scale, it can be difficult to deduce the level of variability when comparing different assemblages. However, Eerkens and Bettinger (2001) have tested CV to identify a constant that represents the highest degree of standardisation at 1.7% and the lowest degree of standardisation at 57.7%. The higher the CV, the more variable and less standardised the sample. Studies have shown that full-time specialists manufacture products with a CV between 5 and 10%, while part-time producers manufacture small, household-level products with a CV of 15% (Foias and Bishop 1997; see also Blackman *et al.* 1993; Longacre *et al.* 1988). Issues arise in the calculation of a CV when archaeological groupings of a ceramic assemblage include a variety of sizes, which result in high coefficients of variation (as observed in Longacre *et al.* 1988). It may be beneficial to divide these groups into finer classes according to size, for example, to produce different results where the coefficient of variation is smaller (Kvamme *et al.* 1996).

The CV values were calculated with GenStat software and are summarised in plots in Chapter 7. The CV calculations consider variation within different vessel/rim forms and across different provenance contexts. The analysis of the A2a, B1a, C1b and D1a forms include PCA, cluster analysis, CVA, and CV calculations for the dimensional attributes. Decorative attributes were added to the study of standardisation of the A2a form with CV calculations, and the fabric attributes are provided with a PCA of the clay matrix compositional data. Closer examination of the dimensional, decorative and fabric attributes of these forms was undertaken in order to show changes in homogeneity and variability over time, and in different contexts, in the manufacture of these common vessel forms at An Sơn.

An Sơn in context

Southern Vietnam

Correspondence analysis (CA)

Past comparative research between sites in southern Vietnam, and Southeast Asia in general, has relied upon broad descriptive and illustrated presentations of data. The final statistical analysis employed in this monograph, a correspondence analysis, aims to establish a systematic and intensive method for comparing the ceramics and other material culture from different sites. Systematic comparative studies typically employ statistical methods and there is greater confidence in the results when such methods are utilised (see Smith and Peregrine 2012). A correspondence analysis (CA) is an exploratory analytical technique that is essentially a principal component analysis for tables of counts. A CA results in a graphical plot of the relationship between the rows and columns of a table (Baxter 2003: 137). A CA is used for categorical rather than continuous data.

The process of accumulating data for the comparative analysis involved identifying which sites contained 'Neolithic' material culture, particularly sufficient information about the ceramics, to compare with the material from An Sơn. This required a detailed collection of information about the comparative sites from reports and my own observations of collections where possible. Given the variable nature of the available information about archaeological sites in southern Vietnam, limited data are available and this analysis is based solely on photographs, illustrations and personal observations. Some descriptive information from English, French and Vietnamese documentation was also utilised, however, these documents posed problematic differences in identification and terminology. Each material culture variable was scored as present (1) or absent (0) in the neolithic occupation of each site. Accurate quantitative data were not available for most sites and so this binary approach was implemented for the statistical analysis. The correspondence analysis resulted in values for a number of dimensions, of which two were then plotted. The correspondence scores for the sites and variables were plotted to identify the sites that are most similar or different in terms of material culture, and also the material culture variables that resulted in these similarities and differences.

The sites of Bến Đò, Cù Lao Rùa, Cầu Sắt, Cái Vạn, Bình Đa, Rạch Núi, Đa Kai, Lộc Giang, Suối Linh, Rạch Lá, and Đình Ông were included in the comparison with An Sơn. Gỗ Cao Su and Rạch Rừng also had neolithic occupation, but insufficient information was available to include these sites in the comparative study (Table 3.2). Many sites have been excavated or surveyed in the past in southern Vietnam, but the available reports are sometimes limited to descriptive and pictorial information rather than analysis. The implementation of a correspondence analysis is aimed at utilising even the limited information from these sites. Without future excavation or survey (which is often not possible due to site destruction), few sequence and occupation details can be deduced from these previously reported sites. To relate the chronology of the analysed sites to the sequence at An Sơn, the material culture at An Sơn was divided into early, middle and late phases of occupation.

The correspondence analyses were conducted with GenStat software. Two plots are presented for each analysis, one of the material culture variables and one of the sites. The presence and absence of the analysed variables at each site are listed in Appendix B. The scale on these plots indicates the variability of the sample.

Table 3.2. Sites in southern Vietnam with neolithic sequences included in the comparative study with An Sơn. All sites included in comparative analysis except Gỗ Cao Su and Rạch Rừng.

	Location	Date (uncalibrated dates calibrated with OxCal 4.1.7 IntCal09 to 95.4% probability) (Reimer et al. 2009; Bronk Ramsey 2010)	Location of studied material culture	References
Bến Đò	Ho Chi Minh City	c. 3000 BP (no radiocarbon dates) (Fontaine and Delibrias 1974)	N/A	Phạm 1977; Fontaine 1975, 1972
Bình Đa	An Bình ward, Biên Hòa city, Đồng Nai Province	3180±50 BP (Nishimura, Nguyễn and Nguyễn 2009) 3555–3267 cal. BP	Đồng Nai Provincial Museum, Biên Hòa	Nishimura 2002; Nishimura and Vương 1997; Phạm and Nguyễn 1993
Cái Vạn	Long Thành district, Đồng Nai Province	Neolithic and metal age occupation (no radiocarbon dates)	Đồng Nai Provincial Museum, Biên Hòa	Nishimura 2002
Cầu Sắt	Bình Lộc village, Xuân Lộc district, Đồng Nai Province	Neolithic material culture (no radiocarbon dates)	Đồng Nai Provincial Museum, Biên Hòa	Hoàng and Nguyễn 1977; Hoàng, Nguyễn and Phạm 1976
Cù Lao Rùa	Thạnh Phước village, Tân Uyên district, Bình Dương Province	2230±40 BP (Nguyễn 2008) 2338–2151 cal. BP (Note: this date represents the later phase of occupation with evidence of metal artefact production. The site also includes an earlier neolithic phase of occupation.)	Centre for Archaeological Studies of the Southern Institute of Social Sciences, Ho Chi Minh City	Nguyễn 2008; Fontaine 1975, 1971
Đa Kai	Đa Kai village, Đức Linh district, Bình Thuận Province	3376–3215 cal. BP, 3455–3299 cal. BP (Nishimura, Nguyễn and Nguyễn 2009)	N/A	Nishimura, Nguyễn and Nguyễn 2009
Đình Ông	Gò Dầu district, Tây Ninh Province	Neolithic ceramic forms and decoration (no radiocarbon dates)	Centre for Archaeological Studies of the Southern Institute of Social Sciences, Ho Chi Minh City	N/A
Gỗ Cao Su (insufficient information for comparison)	Đức Hòa district, Long An Province	3370±80 BP, 2650±70 BP (Bùi, Vương and Nishimura 1997) 3833–3445 cal. BP, 2928–2499 cal. BP	N/A	N/A
Lộc Giang	Lộc An hamlet, Lộc Giang village, Đức Hòa district, Long An Province	3950±75 BP (Nishimura and Nguyễn 2002) 4783–4152 cal. BP	Long An Provincial Museum, Tân An	Quang and Ngô 1994
Rạch Núi	Đông Thạnh village, Cần Giuộc district, Long An Province	2400±100 BP (H. Fontaine in Bùi, Vương and Nishimura 1997) 2743–2180 cal. BP	On site at 2012 excavation	Nishimura and Nguyễn 2002

	Location	Date (uncalibrated dates calibrated with OxCal 4.1.7 IntCal09 to 95.4% probability) (Reimer et al. 2009; Bronk Ramsey 2010)	Location of studied material culture	References
Rạch Lá	Quới Thạnh hamlet, Phước An village, Nhơn Trạch district, Đồng Nai Province	3790±60 BP, 3900±60 BP, 3960±85 BP, 4080±90 BP (Unknown author, The excavation of Rạch Lá 2002) 4408–3987 cal. BP, 4515–4152 cal. BP, 4801–4152 cal. BP, 4843–4305 cal. BP	Đồng Nai Provincial Museum, Biên Hòa	Unknown author, The excavation of Rạch Lá 2002
Rạch Rừng (insufficient information for comparison)	Tân Lập village, Mộc Hoá district, Long An Province	2780±40 BP, 2800±45 BP (Bùi, Vương and Nishimura 1997) 2968–2778 cal. BP, 3059–2782 cal. BP	N/A	N/A
Suối Linh	Trị An village, Vĩnh Cửu district, Đồng Nai Province	c. 3500–2500 BP (no radiocarbon dates) (Trịnh 2005)	Đồng Nai Provincial Museum, Biên Hòa	Trịnh 2005; Trịnh et al. 2003

Source: Compiled by C. Sarjeant.

Mainland Southeast Asia

The method of correspondence analysis, described above, was also applied in the comparison between An Sơn and notable sites elsewhere in mainland Southeast Asia. These sites were selected for the presence of neolithic occupation and material culture and available literature resources (and additional information from researchers). In this statistical analysis the presence and absence data for the CA focused on the range of ceramic decorations and non-ceramic cultural material, rather than on vessel forms, since the variability in forms was too great to consider over such a broad geographical region. The slight variations in ceramic forms were only considered in the CA of the southern Vietnam region.

The CA comparion of An Sơn and other sites in mainland Southeast Asia primarily focused on reported information, and personal observations of some collections. The comparison included what might be identified as neolithic cultural material from the sites of Samrong Sen, Laang Spean, Krek, Khok Phanom Di, Nong Nor, Tha Kae, Khok Charoen, Ban Lum Khao, Ban Non Wat, Non Nok Tha, Ban Chiang, Bàu Tró, Mán Bạc, and Xóm Rền (Table 3.3). Some of these sites are better understood than others due to greater attention to dating, stratigraphic sequence, specific studies of material culture, and cultural relationships. To relate the chronology of the analysed sites to the sequence at An Sơn, the material culture at An Sơn was divided into a burial phase and early, middle and late phases of occupation. The presence and absence of the analysed variables at each site are listed in Appendix C.

Table 3.3. Sites in mainland Southeast Asia with neolithic sequences included in the comparative study with An Sơn.

	Location	Date	References
Ban Chiang	Northeast Thailand	c. 2000 BC (Gorman and Charoenwongsa 1976)	McGovern, Vernon and White 1985; Bayard 1977; Gorman and Charoenwongsa 1976; see also Bubpha 2003
Ban Lum Khao	Northeast Thailand	Neolithic occupation: c. 1450–1000 BC (T.F.G. Higham in Higham and Thosarat 2004d: 5)	Chang 2004; Higham and Thosarat 2004a, 2004b
Ban Non Wat	Northeast Thailand	Neolithic occupation: c. 1750–1500 cal. BC Neolithic phase 1 burials: c. 1450–1350 cal. BC Neolithic phase 2 burials: c. 1350–1150 cal. BC (Higham and Higham 2009a, 2009b)	Higham and Kijngam 2011; Higham and Wiriyaromp 2011c, 2011d; Higham 2009a, 2009b, 2009c; Wiriyaromp 2007
Bàu Tró	Central Vietnam	c. 4000–3500 BP (Phạm 1997)	Phạm 1997; Patte 1924
Khok Charoen	Central Thailand	980±450 BC, 1180±300/1080±300 BC (uncalibrated, thermoluminescence) (Watson 1979)	Higham 2011c; Ho 1984; Watson 1979
Khok Phanom Di	Coastal central Thailand	2000 and 1500 BC (Higham and Bannanurag 1990)	Higham and Thosarat 2004c; Vincent 2004; Higham and Bannanurag 1990
Krek	Cambodia	Neolithic material culture (Dega 1999)	Dega 2002; Albrecht et al. 2000
Laang Spean	Cambodia	Possible neolithic deposits: c. 2050 BC (Mourer and Mourer 1970)	Mourer and Mourer 1970
Mán Bạc	Northern Vietnam	2000–1500 cal. BC (Oxenham et al. 2008)	Oxenham, Matsumura and Nguyễn 2011; Nguyễn 2006
Non Nok Tha	Northeast Thailand	c. 2000 BC (Gorman and Charoenwongsa 1976)	Bayard and Solheim 2009; Rispoli 1997; Bayard 1977; Gorman and Charoenwongsa 1976
Nong Nor	Coastal central Thailand	2500–2100 cal. BC (Higham and Hogg 1998)	Higham and Thosarat 1998b, 1998e; O'Reilly 1998b
Samrong Sen	Cambodia	3230±120 BP (Carbonnel and Delebrias 1968)	Heng 2007; Vanna 2002; Mourer 1977
Tha Kae	Central Thailand	Neolithic occupation: end of the third millennium BC–beginning of the second millennium BC, based on ceramic typologies (Ciarla n.d.; Rispoli 1997, 1992)	Ciarla n.d., 1992; Rispoli 1997, 1992
Xóm Rền	Northern Vietnam	Phùng Nguyên phase/early Bronze Age (Nguyễn 2006)	Hán 2009; Nguyễn 2006

Source: Compiled by C. Sarjeant.

Summary

This methodology chapter has outlined the analytical steps undertaken in the remainder of this monograph. Background excavation and material culture details for An Sơn are presented in the following Chapter 4. Chapter 3 has outlined the methods used for analysing ceramic morphology and decoration with respect to stratigraphic and other contextual information. The results of this ceramic analysis of An Sơn are presented in Chapter 5. The analytical results concerning fabric, temper and clay chemistry, using microscopic and SEM-EDX analysis are presented in Chapter 6.

The basic analyses of the An Sơn ceramics are expanded with a study of standardisation, specifically analysing dimensional attributes of the morphology of certain ceramic vessels and/or rim forms. Alongside PCA, hierarchical cluster analysis and CVA, the coefficient of variation (CV) is utilised to interpret the level of homogeneity in the production of morphologically similar ceramic vessels at An Sơn. The results are presented in Chapter 7.

The results from these analyses revealed comprehensive data from which to begin comparisons with neolithic sites in both southern Vietnam (Chapter 8) and the wider Southeast Asian region (Chapter 9), in terms of ceramics and other material culture. A correspondence analysis is undertaken in order to compare An Sơn with other sites and particular material culture variables, in order to contextualise An Sơn in terms of the broader neolithic developments in Southeast Asia, and in southern Vietnam specifically.

The results of these analyses are combined in order to address the research questions listed in Chapter 1 with respect to theoretical approaches in material culture studies, the organisation of craft production, cultural transmission, the identity and role of potters in the community, and the contribution of potters and ceramic material culture to the neolithic identity of An Sơn. This is presented in the discussion and conclusions of Chapters 10 and 11.

4

The An Sơn Excavation of 2009

Introduction

A brief introduction to the 2009 excavation, the geography and the environment at An Sơn was provided in Chapter 1. This chapter introduces the previous excavations at An Sơn, and discusses the stratigraphy, chronology, material culture, burials, and floral and faunal remains recovered from the 2009 excavation.

The 1978 An Sơn trenches were located on top of and east of the mound. The trench on the top of the mound was excavated to a depth of 4.5 m. The subsequent excavation by Nishimura and Nguyễn (2002) in 1997 was located on top of the mound at its eastern end. Like the mound-top trench in 1978, the 1997 Trench 1 was excavated through the mound to a depth of 4.0 m. This trench revealed a series of horizontal layers that were divided into three main stratigraphic units, of which the basal appears to have been created from the alluvial palaeosol that underlies all of the An Sơn excavation trenches. The stratigraphy of the 1997 Trench 1 excavation displayed a large number of alternating alluvial silt floors separated by occupation layers (Figure 4.1). The floors appear to have supported ground level houses with posts set in holes up to 0.5 m deep, although no precise house plans could be reconstructed. Many fired clay lumps were observed in clusters in hearths and were assumed to be from pottery making, although our 2009 observations favour the use of these low-fired clay lumps as heat retainers during cooking.

The excavations of 2004 and 2007 were directed at the eastern margin of the mound, which had revealed promising evidence of burials (Văn *et al.* 2008; Phạm 2006). This was where the subsequent excavations of 2009 were also targeted. In 2009, three trenches were laid out close to the 2004 trenches with the intention of locating and excavating more burials. Trench 1 was 3 by 12 m, Trench 2 was 5 by 5 m, and Trench 3 was 2 by 10 m in size. Each of these trenches was divided into squares of 1 by 1 m for the purposes of recording, as described in Chapter 3. The location of these trenches is shown in the plan of Figure 4.2.

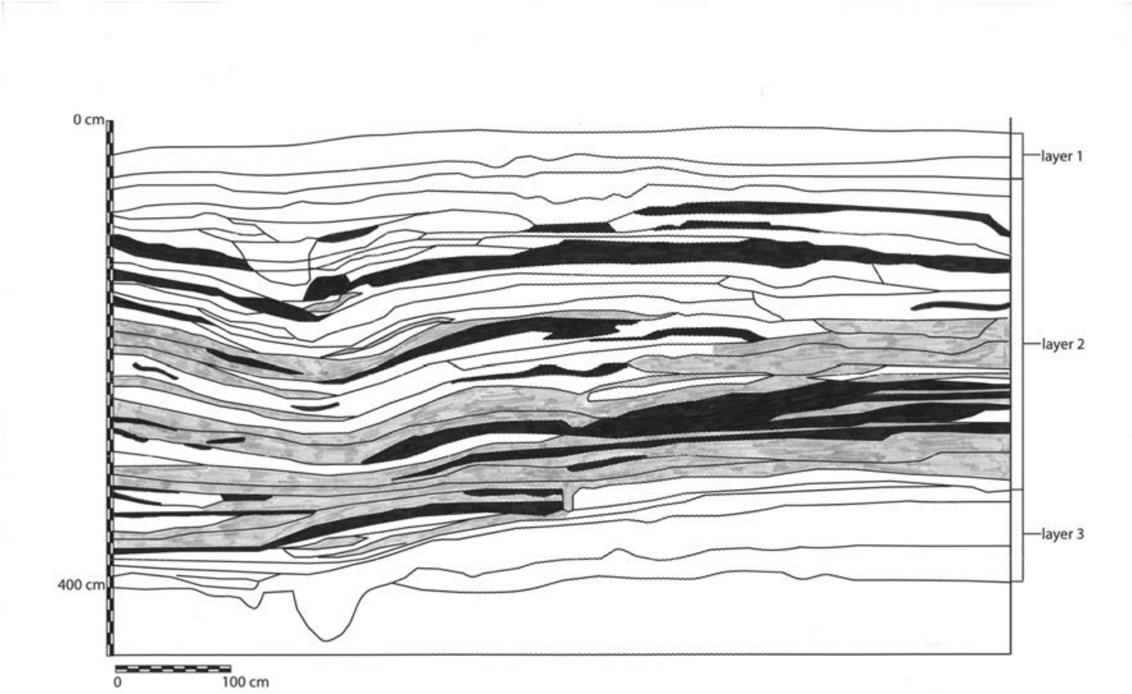


Figure 4.1. Trench 1, 1997 excavation, stratigraphy. Black areas are compact layers. Grey areas are loose layers. White layers are between compact and loose densities.

Source: Illustration, C. Sarjeant (After: Nishimura and Nguyễn 2002: 103, figure 3).

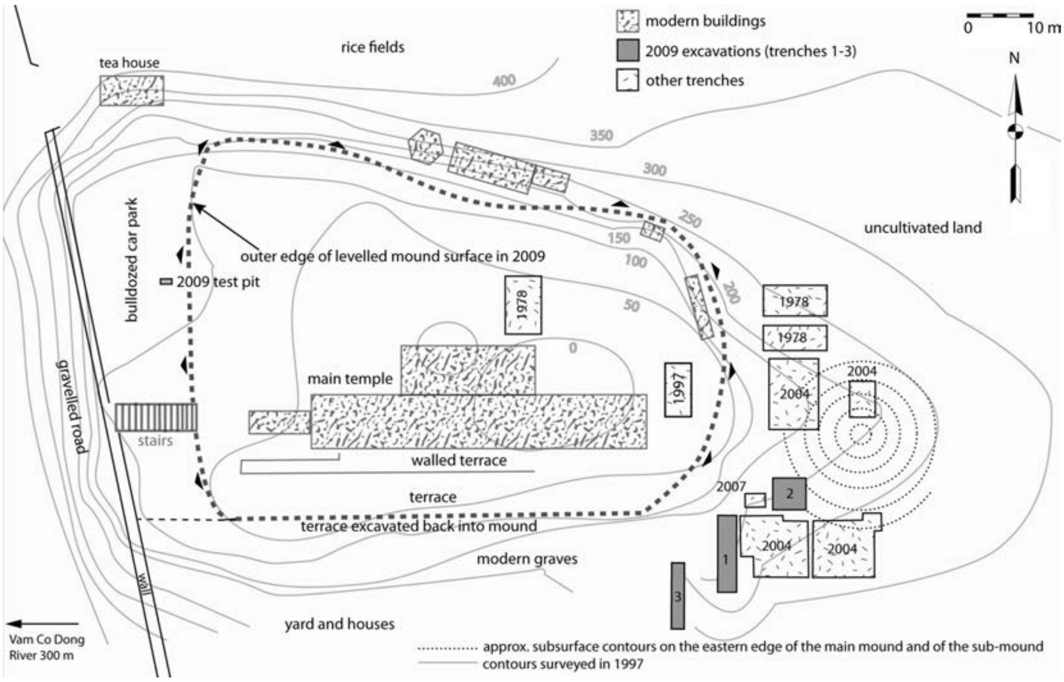


Figure 4.2. Plan of the excavation trenches at the mound of An Sơn.

Source: Illustration, P. Bellwood.

Stratigraphy

This section reports the stratigraphy of the three main 2009 excavation trenches, Trenches 1, 2 and 3. The additional 2 by 2 metre Test Square cut into the western side of the mound displayed similar stratigraphy and ceramic material to the middle and lower layers (layers 5 to 8) in Trench 1. The soil in the lowest deposit of the Test Square changed the colour of some of the ceramics from a red or orange colour to grey or black. The Test Square was deeper than the excavations on the eastern side of the mound, extending to a depth of 2.6 m, but it was cut into the side of the mound rather than from its surface.

The horizontal floors observed in the 1997 excavations (Figure 4.1) into the core of the mound were not visible in the 2009 excavations. The 2009 excavation Trench 1 revealed layers deposited due to dumping of cultural material down the slope of the mound. Most of this material consisted of ceramic sherds, and it is thought that these deposits continue around all sides of the mound. The major deposits in Trench 1 were within layers 4 to 7, over the palaeosol, layer 8 (Figure 4.3, Table 4.1). Some of these layers sloped from north to south at angles of 30 degrees or more.

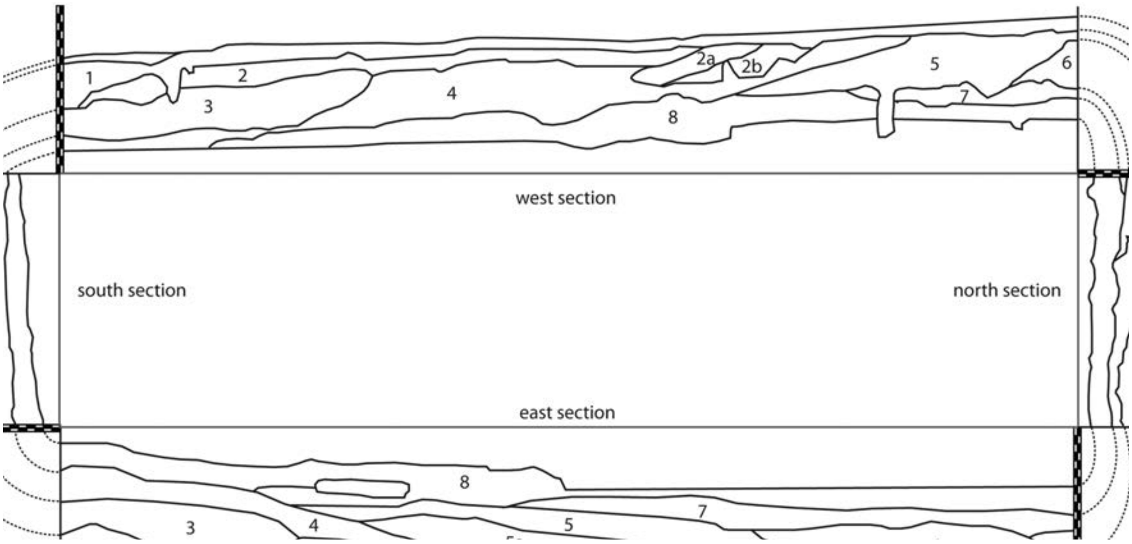


Figure 4.3. Trench 1, stratigraphy. Main mound is towards the northwest.

Source: Illustration, C. Sarjeant (After: Võ Thanh Hương).

Table 4.1. Trench 1, description of layers.

Layer	Munsell soil colour
1	Hue 7.5YR 6/4 dull orange
2	Hue 5YR 3/3 dark reddish brown
3	Hue 5YR 4/6 reddish brown
4	Hue 5YR 4/1 brownish grey
5	Hue 7.5YR 5/4 dull brown
6	Hue 5YR 5/6 bright reddish brown
7	Hue 7YR 6/4 dull orange
8	Hue 5YR 4/2 greyish brown

Source: Compiled by C. Sarjeant.

The upper layers of 2009 Trench 2 had been removed before 2004 during ground-levelling earthwork activities to build unsuccessful and now abandoned rice fields. In the northeastern corner, Trench 2 contained a smaller, subsidiary mound. The western margin of the excavation trench revealed layers that sloped consistently with the main mound that showed clear signs of pyroclastic activity. This was the oldest feature in Trench 2, and was surrounded by sloping layers that had built up around it. This sub-mound indicates that sites like An Sơn may have not accumulated from only one point. In the case of this sub-mound, its original function is suggested by the many concretions of semi-vitreous material in basal layers 14 and 11 (Figure 4.4, Table 4.2), with a virtual absence of any other cultural material. These vitreous materials are presumably cinders of mixed organic material, including fat and bone, produced during intensive cooking in earth ovens. No chemical analysis of these vitreous materials has yet been undertaken but this research is planned.

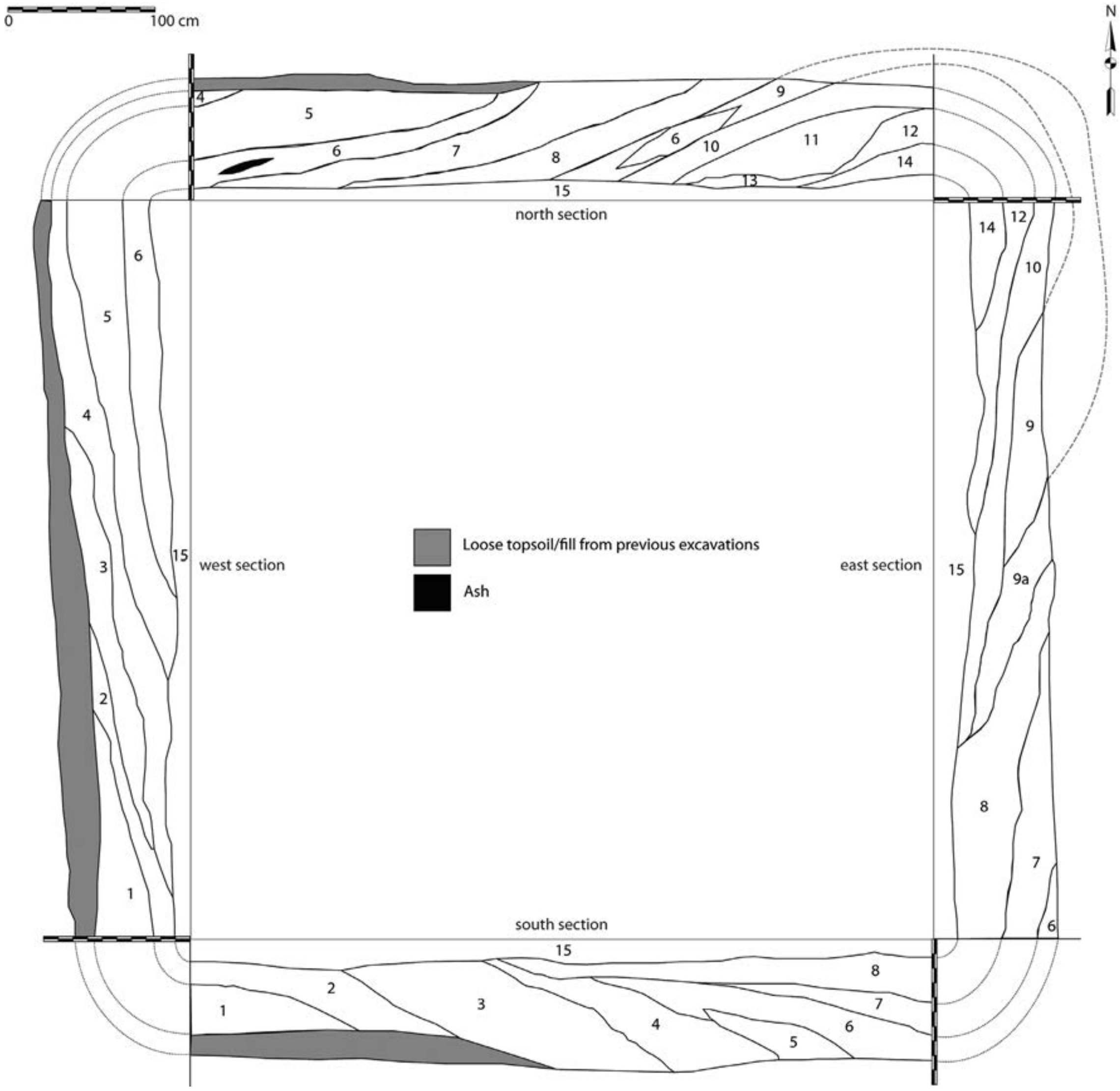


Figure 4.4. Trench 2, stratigraphy. Subsidiary mound is in the northeast corner. Main mound is towards the northwest.

Source: Illustration, C. Sarjeant (After: Võ Thanh Hương).

Table 4.2. Trench 2, description of layers.

Layer	Munsell soil colour
previous excavation fill/topsoil	Hue 7.5YR 8/3 light yellow orange
1	Hue 5YR 4/4 dull reddish brown
2	Hue 5YR 4/4 dull reddish brown
3	Hue 5YR 2/4 very dark reddish brown
4	Hue 5YR 4/3 dull reddish brown
5	Hue 5YR 2/2 brownish black
6	Hue 5YR 4/4 dull reddish brown
7	Hue 5YR 4/6 reddish brown
8	Hue 5YR 4/4 dull reddish brown
9	Hue 5YR 4/5 reddish brown
10	Hue 5YR 3/3 dark reddish brown
11	Hue 5YR 4/4 dull reddish brown
12	Hue 5YR 4/2 greyish brown
13	Hue 5YR 8/2 light grey
14	Hue 5YR 2/2 brownish black
15	Hue 5YR 4/1 brownish grey

Source: Compiled by C. Sarjeant.

Trench 3 contained an internally unstratified deposit, consisting of clay and many small sherds. This deposit had been washed off the main mound by rainfall, with the light particles of clay being transported in suspension and the heavier sand and silt left behind to form the deposit that surfaces the mound today. A similar mass of transported clay and small sherds also occurred in the southern end of Trench 1. No original mound layers intersected Trench 3, with the possible exception of layer 4 (Figure 4.5, Table 4.3). In fact, Trench 3 yielded little archaeological information of value, except for clusters of pots in the basal layer. One of these clusters was associated directly with the sherd residue date of 3880±40 BP (2471–2209 cal. BC) (Table 4.4, Figure 4.6). This date refers to the possible initial settlement in this area of the site, and is similar to the basal dates recovered from Trench 1 in 1997 (Nishimura and Nguyễn 2002: 107, table 1) (Table 4.4). It also parallels a basal date of 3950±75 BP (2834–2203 cal. BC, OxCal 4.1.7, 95.4%) for the nearby site of Lộc Giang, excavated by a team led by Bùi Chí Hoàng in 1988 and 1993 (Nishimura and Nguyễn 2002).

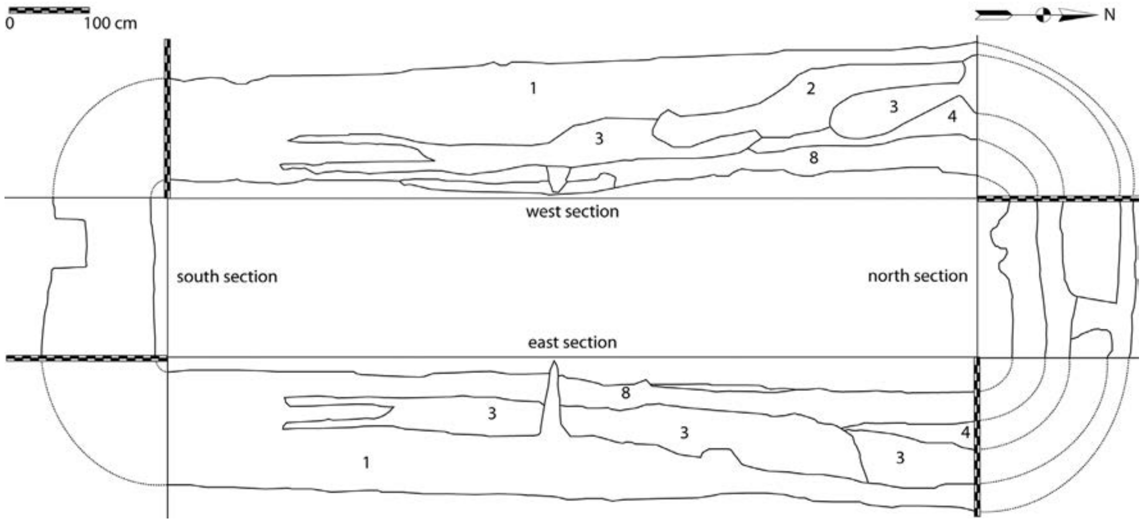


Figure 4.5. Trench 3, stratigraphy. Main mound is towards the north.

Source: Illustration, C. Sarjeant (After: Võ Thanh Hương).

Table 4.3. Trench 3, description of layers.

Layer	Munsell soil colour
1	Hue 5YR 3/2 dark reddish brown
2	Hue 5YR 3/4 dark reddish brown
3	Hue 5YR 3/4 dark reddish brown
4	Hue 7.5YR 4/6 brown
8	Hue 7.5YR 5/4 dull brown

Source: Compiled by C. Sarjeant.

Chronology

The neolithic sequence for An Sơn extended for approximately 1000 years. Initial occupation has been estimated to date to 2500–2200 cal. BC, on the basis of charcoal radiocarbon determinations from palaeosol contexts in Trench 2, and food residue dates from ceramic sherds from the base of Trench 3 (Bellwood *et al.* 2011). The majority of the occupation layers excavated in 1997 (Nishimura and Nguyễn 2002) and observed in 2009 Trench 1 are presumed to date to 1900–1500 cal. BC (Bellwood *et al.* 2011). The excavated burials, which were cut through the supervening layers, were most likely contemporary with the latest recorded phase of occupation. These burials were dated by AMS from tooth enamel and produced a very tight chronology of approximately 1500–1200 cal. BC, with the later dates suggestive of the termination of the neolithic period at An Sơn (Bellwood *et al.* 2011). Two marine shell dates (*Turitella balillum*) of 2775 and 2855 uncalibrated BP, from the 1978 excavations, apparently came from a depth of 3.4 m in the mound-top trench (Lê 1978). However these are much younger than any C14 samples analysed in 1997 or 2009, especially with marine reservoir correction, and are thus very hard to explain unless they relate to disturbance or laboratory error (Table 4.4, Figure 4.6).

Table 4.4. Radiocarbon dates for all excavations at An Sơn, 1978–2009.

An Sơn excavation year	Sample context	Sample identification number	Material	δ13C	% modern carbon	14C age (BP)	OxCal 4.1, 95% cal. age (BC)
2009	09 AS TS 230–240	AMS ANU 9709	residue on sherd	-21.97	60.88±0.57	3990±80	2862–2234
	09 AS H3 L12 B5	AMS ANU 9711	residue on sherd	-35.69	61.72±0.25	3880±40	2471–2209
	09 AS H2 A1 palaeosol	AMS ANU 10105	charcoal	-19.45	62.14±0.26	3825±40	2459–2144
	09 AS H2 C4 palaeosol	AMS ANU 9712	charcoal	-30.13	64.08±0.20	3580±30	2028–1786
	09 AS H2 D5 palaeosol	AMS ANU 13012	charcoal	-28.5	65.12±0.20	3450±30	1880–1688
	09 AS H2 C4 50-60	AMS ANU 9710	freshwater shell	-18.15	65.76±0.22	3370±40	1750–1531
1997	97 Layer 3–5	Tka 11541	charcoal	N/A	N/A	3990±190	3011–1964
	97 Layer 3–5	Tka 11526	charcoal	N/A	N/A	3840±40	2461–2155
	97 Layer 3–4	ANU 10880	charcoal	N/A	N/A	3820±70	2471–2041
	97 Layer 3–5	Tka 11817	charcoal	N/A	N/A	3780±120	2566–1892
	97 Layer 3–5	Tka 11816	charcoal	N/A	N/A	3690±80	2341–1880
	97 Layer 3–1	Tka 11822?	charcoal	N/A	N/A	3390±80	1890–1501
	97 Layer 2–17	ANU 10881	charcoal	N/A	N/A	3370±80	1884–1496
	97 Layer 2–21B	Tka 11821	charcoal	N/A	N/A	3320±130	1946–1316
	97 Layer 3–3	Tka 11823	charcoal	N/A	N/A	3310±110	1890–1387
	97 Layer 3–2	Tka 11824	charcoal	N/A	N/A	3310±90	1874–1414
	97 Layer 2–17	Tka 11820	charcoal	N/A	N/A	3310±90	1874–1414
	97 Layer 2–14	Tka 11822?	charcoal	N/A	N/A	3200±90	1690–1265
	97 Layer 2–12	Tka 11819	charcoal	N/A	N/A	3190±110	1741–1133
Human burials 2004/2009	04 AS H3 M10a	NZA 34102	tooth enamel	-14.2	66.40±0.22	3231±25	1534–1431
	04 AS H3 M14a	NZA 34110	tooth enamel	-13.8	66.58±0.22	3209±25	1518–1429
	04 AS H3 M8a	NZA 34101	tooth enamel	-14.1	66.66±0.23	3199±25	1511–1424
	04 AS H3 M13a	NZA 34109	tooth enamel	-13.6	66.77±0.22	3187±25	1499–1415
	04 AS H3 M3a	NZA 34100	tooth enamel	-13.7	66.93±0.22	3168±25	1495–1408
	09 AS H1 M1a	NZA 34050	tooth enamel (cranium only)	-13.4	67.08±0.22	3149±25	1492–1387
	09 AS H1 M3a	NZA 34173	tooth enamel	-13.5	67.41±0.17	3109±20	1431–1314
	09 AS H1 M2a	NZA 34172	tooth enamel	-14.2	67.83±0.18	3060±20	1397–1267
	07 AS H1 M3a	NZA 34112	tooth enamel	-13.2	68.26±0.22	3009±25	1376–1130
	04 AS H3 M1a	NZA 34092	tooth enamel	-13.2	68.62±0.22	2967±25	1297–1113
	04 AS H3 M17a	NZA 34111	tooth enamel	-13.4	68.72±0.21	2956±25	1264–1054
	09 AS H2 M3a	NZA 34174	tooth enamel	-13.8	68.74±0.17	2953±20	1262–1057
1978	78 AS HII inner fraction	Bln-2091 II	marine shell	N/A	N/A	2855±80	1263–836
	78 AS HII	Bln-2091 I	marine shell	N/A	N/A	2777±80	1189–798

Source: Bellwood et al. 2011; Nishimura and Nguyễn 2002; Lê 1978. Calibrated with OxCal v4.1.7 (Bronk Ramsey 2010; Reimer et al. 2009).

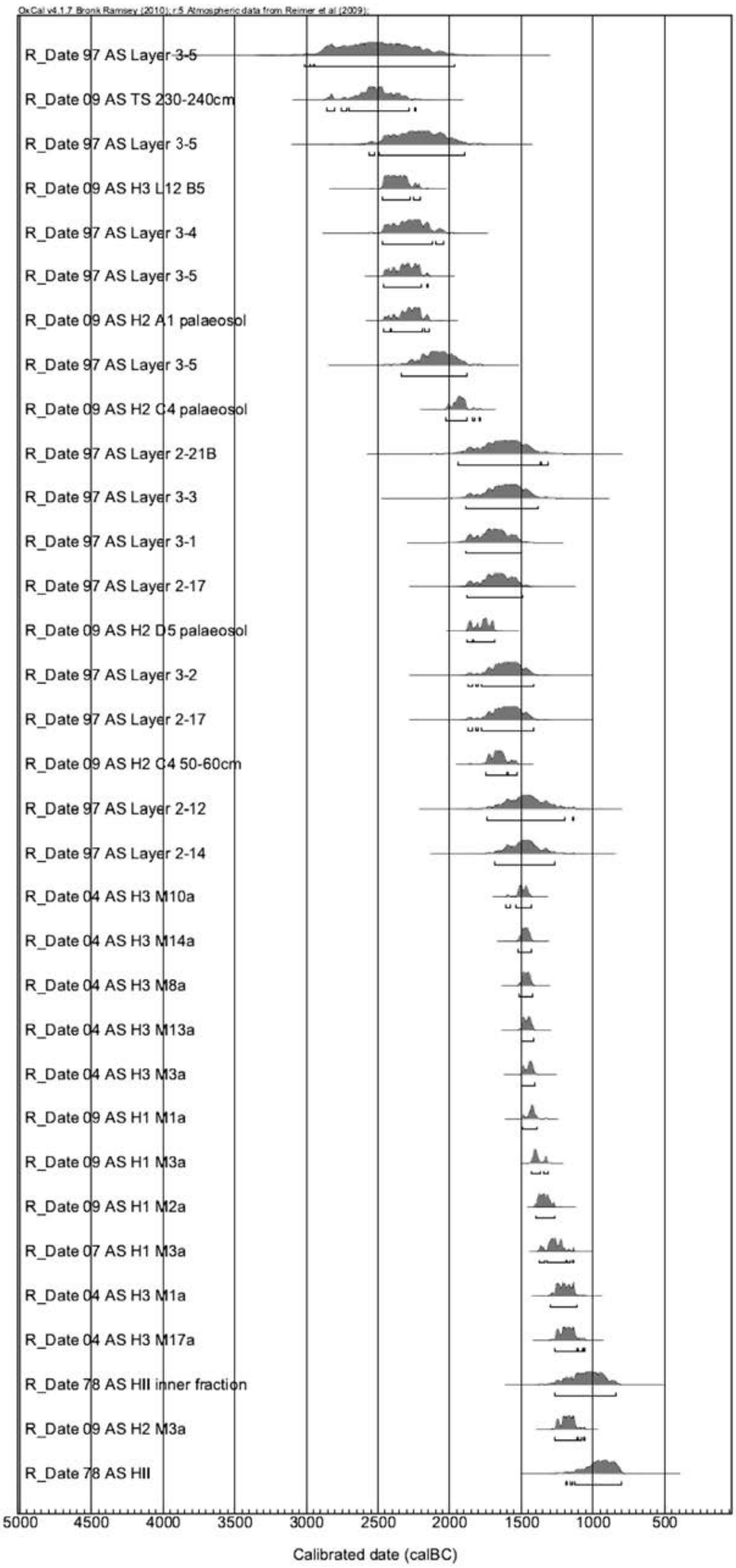


Figure 4.6. Plot of the calibrated radiocarbon dates in Table 4.4.

Source: Calibrated with OxCal 4.1.7 (95% probability) (Bronk Ramsey 2010; Reimer *et al.* 2009).

Material culture

This section discusses the material culture recovered during the 2009 excavation at An Sơn, including pottery, clay artefacts, lithics, shell items, bone, ivory and other items.

Ceramic sherds

While this section introduces the An Sơn ceramic assemblage, in-depth analyses are presented in Chapters 5, 6 and 7. The entire ceramic assemblage weighed 2618 kg (Figure 4.7) and consisted of 230,848 earthenware sherds (Figure 4.8). The majority (1600 kg) of the sherds were excavated from Trench 1. The highest concentration of ceramic sherds was in layer 5 of Trench 1, particularly in squares A1 to A8 and B1 to B7, close to the main mound (Figure 4.9, Figure 4.10, Figure 4.11, Figure 4.12, Figure 4.13, Figure 4.14). The concentrations were less in Trench 2, and were mainly in layers 3 to 4 in squares C3–C5, D3–D5 and E3–E5, and layers 4 to 6 in E1–E3, again close to the main mound (Figure 4.15, Figure 4.16, Figure 4.17, Figure 4.18, Figure 4.19, Figure 4.20, Figure 4.21, Figure 4.22, Figure 4.23, Figure 4.24). The highest concentration of ceramics in Trench 3 was in layers 2 and 6 in A1–A4 and B1–B4, close to the main mound (Figure 4.25, Figure 4.26, Figure 4.27, Figure 4.28).

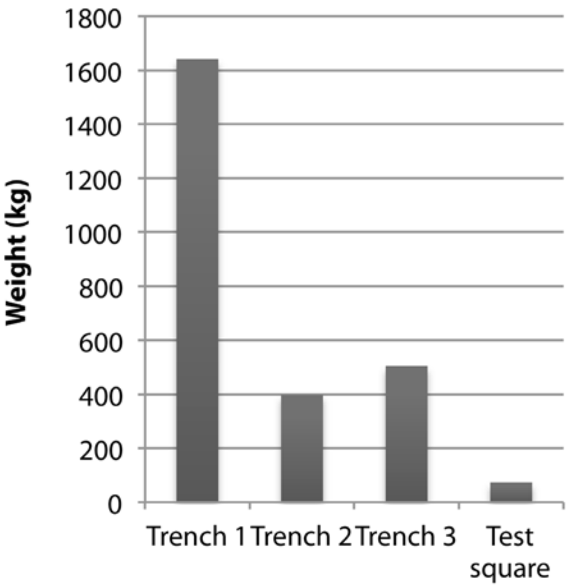


Figure 4.7. Total weight (kg) of ceramic sherds in each trench, total = 2618.13 kg.

Source: C. Sarjeant.

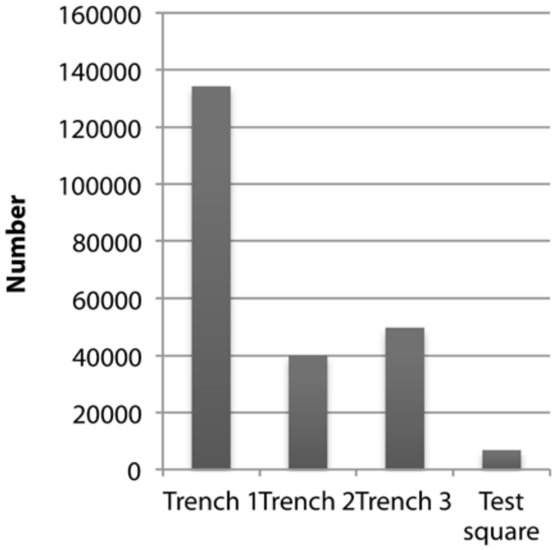


Figure 4.8. Total number of ceramic sherds in each trench, total = 230,848.

Source: C. Sarjeant.

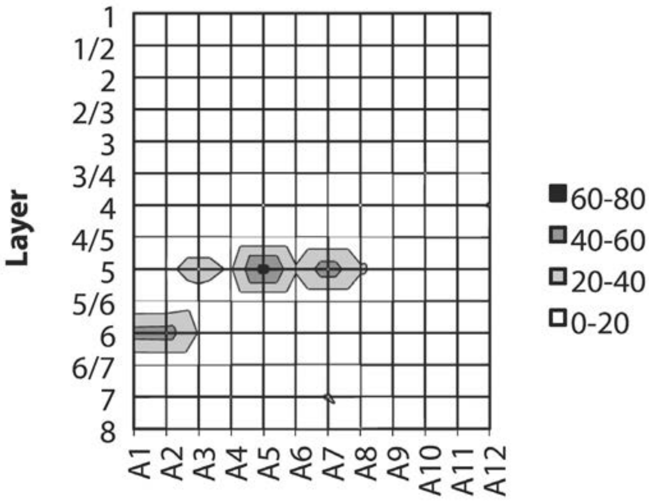


Figure 4.9. Distribution of ceramic sherds, Trench 1, squares A1–A12, weight (kg) per square.

Source: C. Sarjeant.

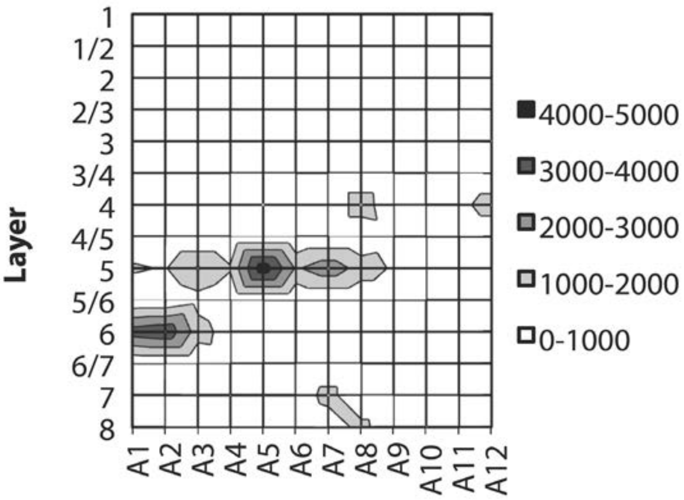


Figure 4.10. Distribution of ceramic sherds, Trench 1, squares A1–A12, number of sherds per square.

Source: C. Sarjeant.

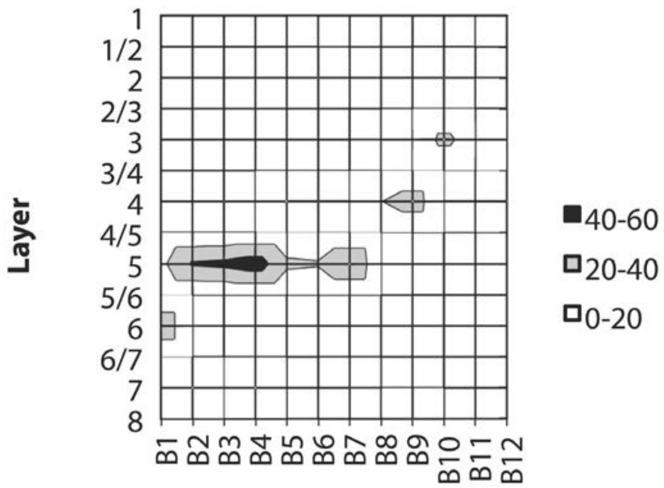


Figure 4.11. Distribution of ceramic sherds, Trench 1, squares B1–B12, weight (kg) per square.

Source: C. Sarjeant.

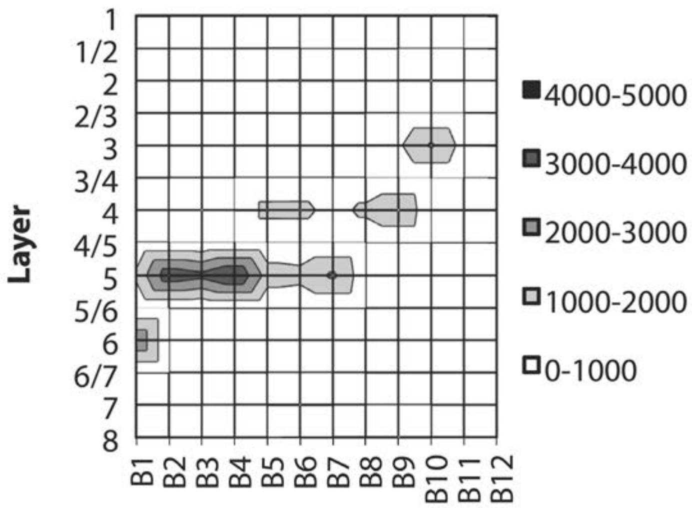


Figure 4.12. Distribution of ceramic sherds, Trench 1, squares B1–B12, number of sherds per square.

Source: C. Sarjeant.

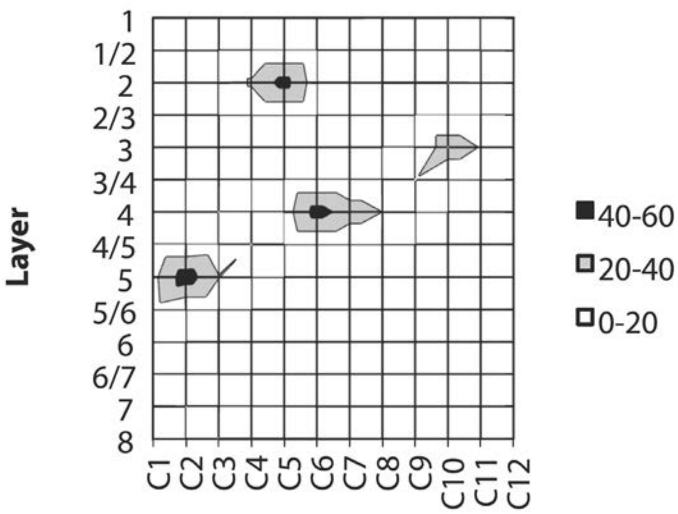


Figure 4.13. Distribution of ceramic sherds, Trench 1, squares C1–C12, weight (kg) per square.

Source: C. Sarjeant.

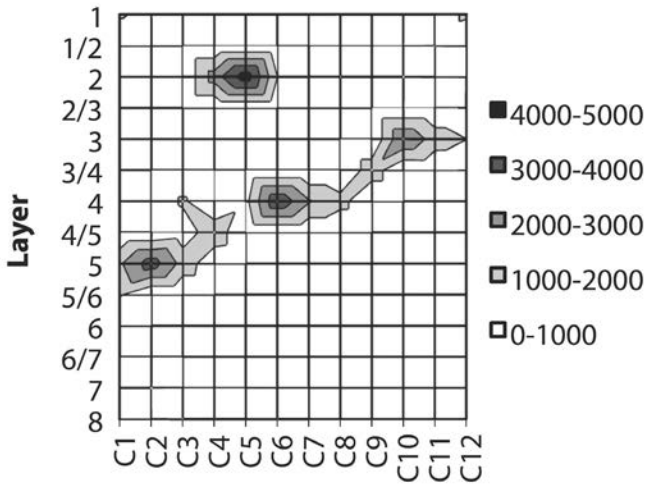


Figure 4.14. Distribution of ceramic sherds, Trench 1, squares C1–C12, number of sherds per square.

Source: C. Sarjeant.

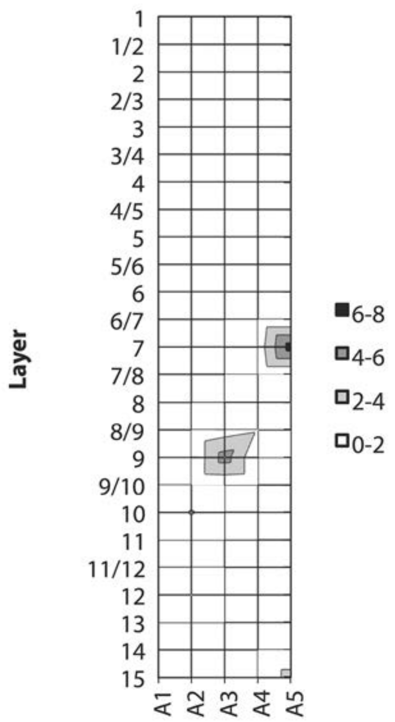


Figure 4.15. Distribution of ceramic sherds, Trench 2, squares A1–A5, weight (kg) per square.

Source: C. Sarjeant.

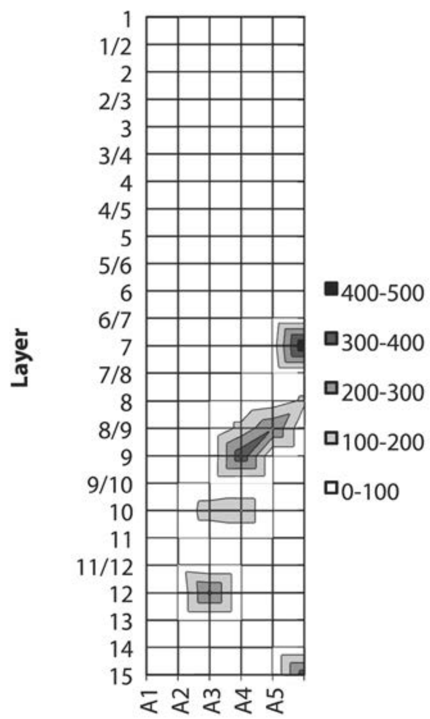


Figure 4.16. Distribution of ceramic sherds, Trench 2, squares A1–A5, number of sherds per square.

Source: C. Sarjeant.

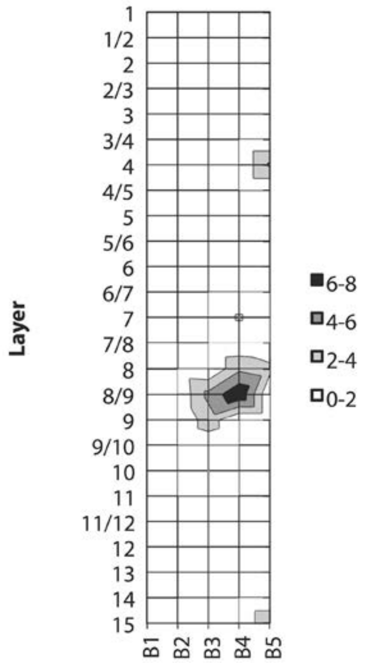


Figure 4.17. Distribution of ceramic sherds, Trench 2, squares B1–B5, weight (kg) per square.

Source: C. Sarjeant.

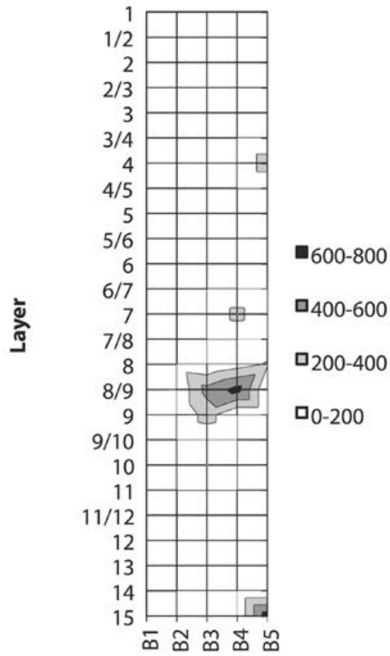


Figure 4.18. Distribution of ceramic sherds, Trench 2, squares B1–B5, number of sherds per square.

Source: C. Sarjeant.

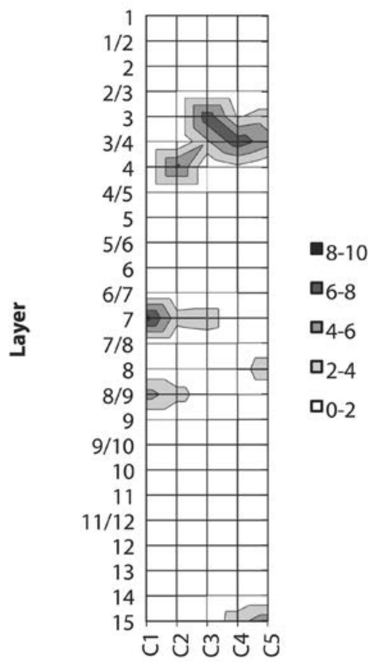


Figure 4.19. Distribution of ceramic sherds, Trench 2, squares C1–C5, weight (kg) per square.

Source: C. Sarjeant.

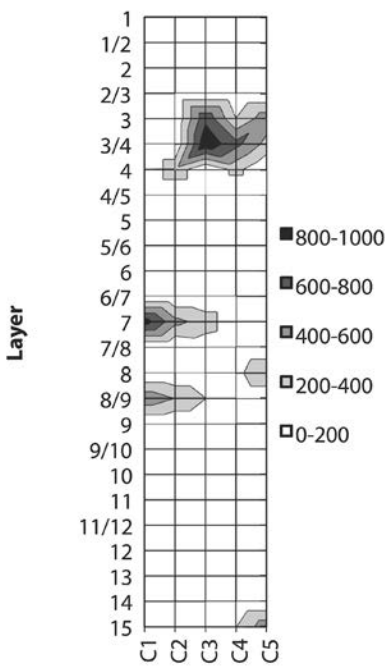


Figure 4.20. Distribution of ceramic sherds, Trench 2, squares C1–C5, number of sherds per square.

Source: C. Sarjeant.

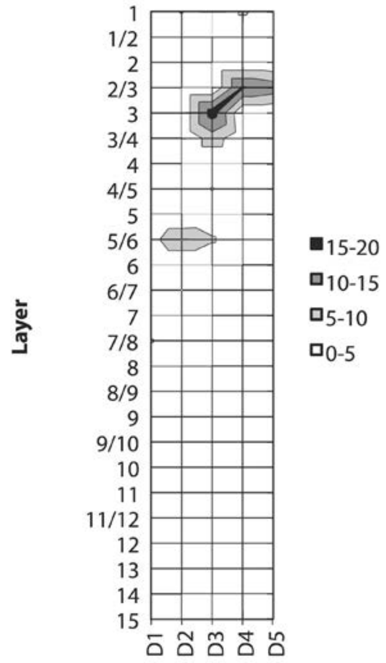


Figure 4.21. Distribution of ceramic sherds, Trench 2, squares D1–D5, weight (kg) per square.

Source: C. Sarjeant.

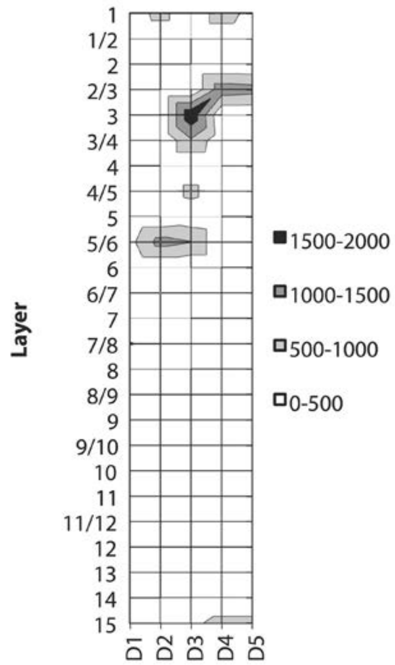


Figure 4.22. Distribution of ceramic sherds, Trench 2, squares D1–D5, number of sherds per square.

Source: C. Sarjeant.

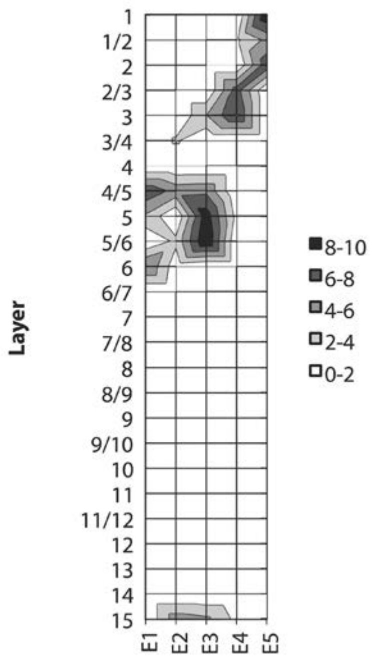


Figure 4.23. Distribution of ceramic sherds, Trench 2, squares E1–E5, weight (kg) per square.

Source: C. Sarjeant.

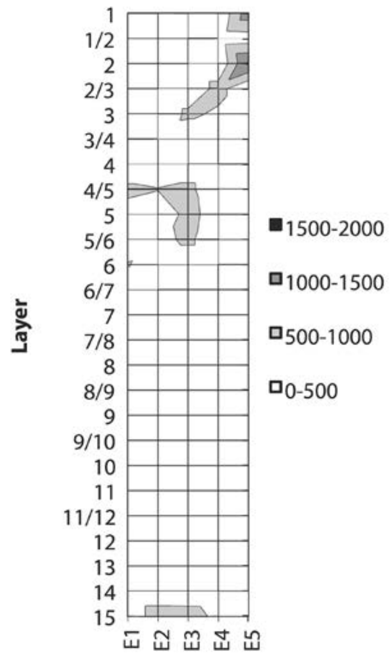


Figure 4.24. Distribution of ceramic sherds, Trench 2, squares E1–E5, number of sherds per square.

Source: C. Sarjeant.

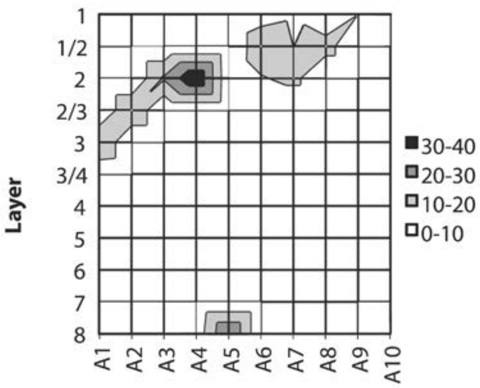


Figure 4.25. Distribution of ceramic sherds, Trench 3, squares A1–A10, weight (kg) per square.

Source: C. Sarjeant.

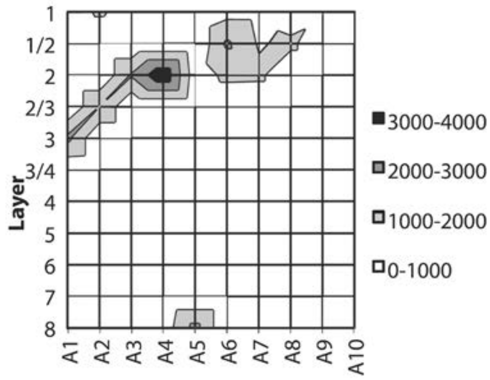


Figure 4.26. Distribution of ceramic sherds, Trench 3, squares A1–A10, number of sherds per square.

Source: C. Sarjeant.

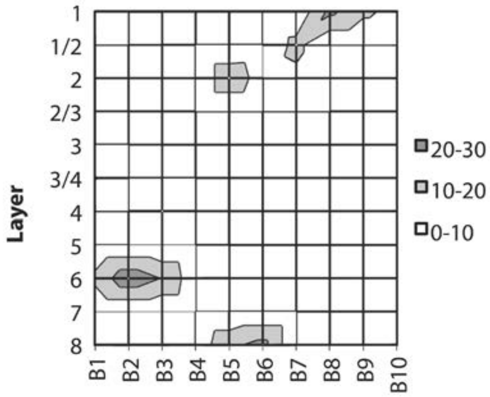


Figure 4.27. Distribution of ceramic sherds, Trench 3, squares B1–B10, weight (kg) per square.

Source: C. Sarjeant.

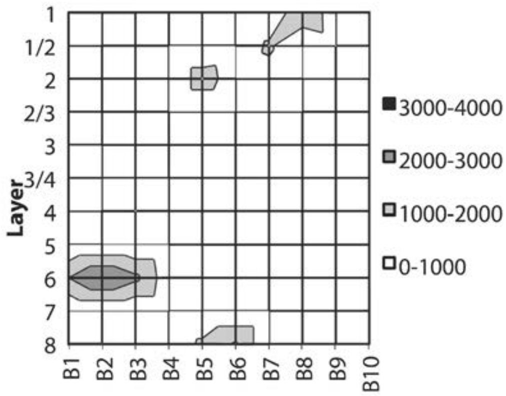


Figure 4.28. Distribution of ceramic sherds, Trench 3, squares B1–B10, number of sherds per square.

Source: C. Sarjeant.

Fired clay lumps

The clay lumps were low-fired, sometimes with fibre temper inclusions, hand-moulded and often about palm-sized. It is likely they were used during cooking activities, due to the presence of *cà ràng* (stove/earth oven cooking) vessels and burnt midden in dense concentrations with the lumps in Trench 2. The clay lumps varied in shape and some had clearly been pressed against *cà ràng* projections before they were fired (Figure 4.29). Other clay lumps had holes and may have been attached or hung in some way. Other evidence to support the use of such clay lumps in cooking activities comes from Çatalhöyük in central Turkey, where Atalay and Hastorf (2006) identified different cooking uses for clay lumps (or balls, as they refer to them). These included processing foods by heating the clay balls to parch and toast seeds, grains and pulses in woven baskets, boiling bones in skins or baskets with the clay balls to extract grease, using the heated balls to transfer heat when boiling in baskets and skins, roasting rhizomes and meat in pits, and baking plant and animal products in enclosed oven environments with heated clay balls (Atalay and Hastorf 2006).

A total of 340.5 kg of clay lumps was collected from Trench 1 (Figure 4.30). These lumps were primarily from layer 5, which was also dense in ceramic sherds. The clay lumps from Trench 2 were primarily from layers 1 to 5 in squares C1 and E4 (Figure 4.31, Figure 4.32). No clay lumps were recovered from Trench 3 or the Test Square.

Figure 4.29. Clay lumps that have been pressed against *cà rang* projections. Top: Trench 1, layer 3–4, A8; bottom: Trench 1, layer 4, A7.

Source: Photos by C. Sarjeant.

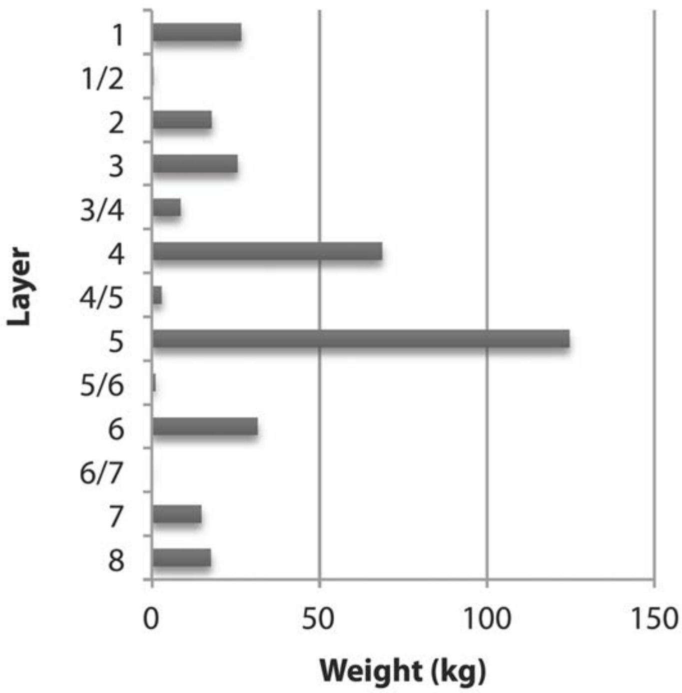


Figure 4.30. Weight (kg) of clay lumps, Trench 1 by layer, total = 340.50 kg.

Source: C. Sarjeant.

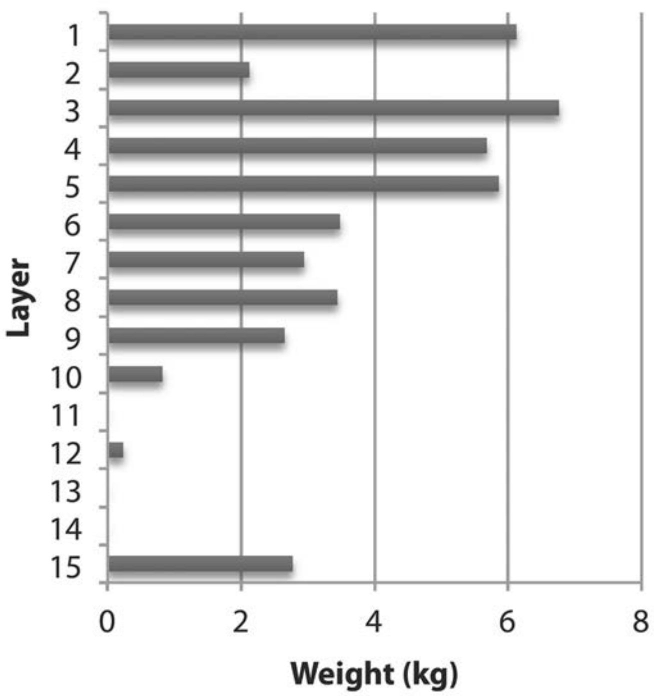


Figure 4.31. Weight (kg) of clay lumps, Trench 2 by layer, total = 42.87 kg.

Source: C. Sarjeant.

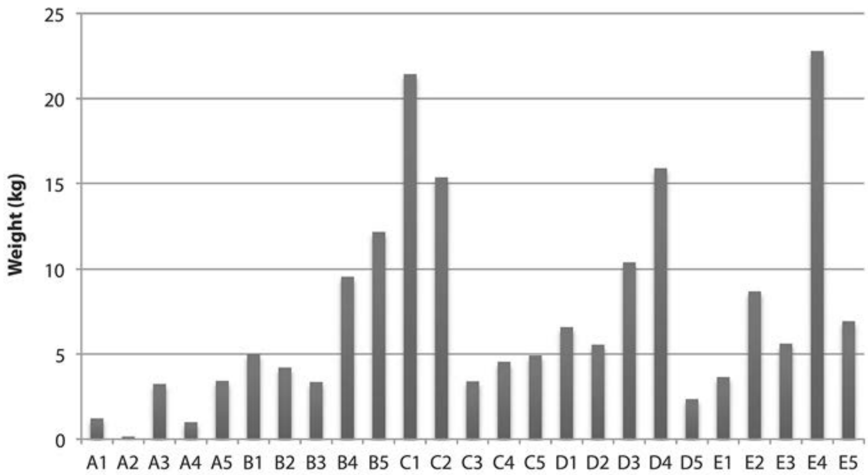


Figure 4.32. Weight (kg) of clay lumps, Trench 2 by square, total = 181.35 kg.

Source: C. Sarjeant.

Clay pellets

The clay pellets were small, rounded, low-fired clay spheres, usually tempered with fine sand (Figure 4.33). Sixty-nine pellets were recovered from An Sơn. In 2009, the majority were excavated from Trenches 1 and 2 (Figure 4.34). Most were between 15 and 20 mm in diameter, with an average of 17.18 mm (Figure 4.35). The pellets were primarily found in layers 1 and 5 in Trench 1, layers 4 and 5 in Trench 2, and layers 1 to 3 in Trench 3 (Figure 4.36). The majority of the pellets in Trench 1 were from square B6 (Figure 4.37) and from the D squares in Trench 2 (50 percent of all the Trench 2 pellets) (Figure 4.38). Similar clay pellets have been recovered from sites all over Southeast Asia and are thought have been propelled by pellet bows or slingshots to catch birds and small game (Higham 2009a: 244). Another possibility is that the pellets were used as toys, like marbles.

Figure 4.33. Clay pellet, Trench 3, layer 1/2, B7.

Source: Photo by C. Sarjeant.

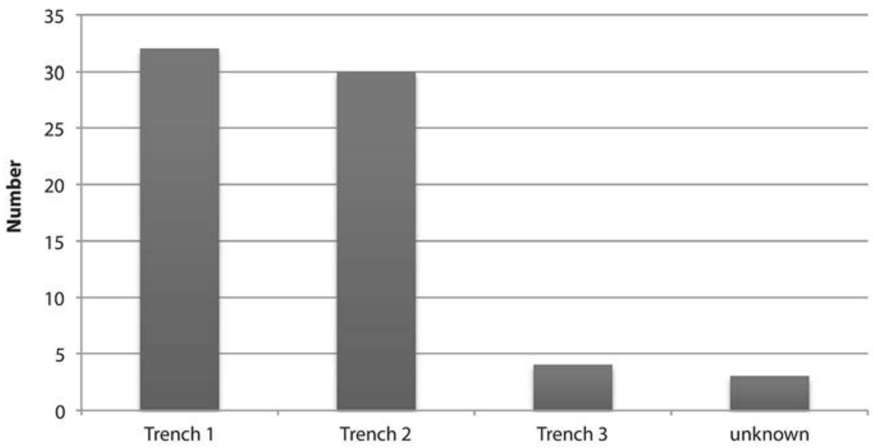


Figure 4.34. Total number of clay pellets in each trench, total = 69.

Source: C. Sarjeant.

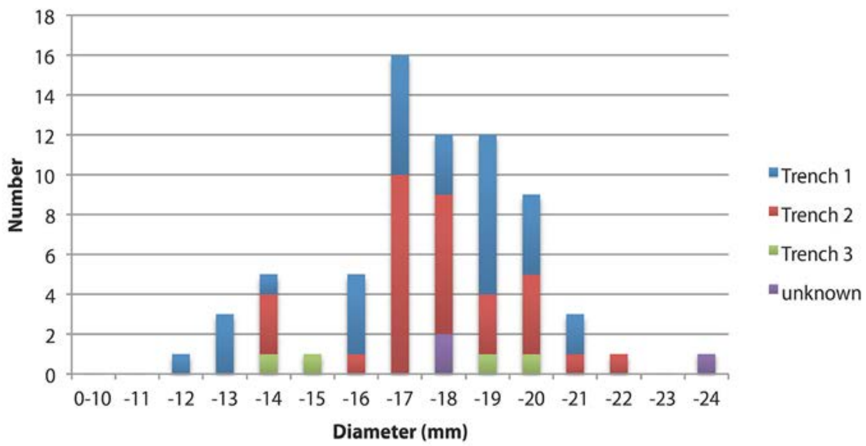


Figure 4.35. Diameter (mm) of clay pellets, total = 69, average = 17.18 mm.

Source: C. Sarjeant.

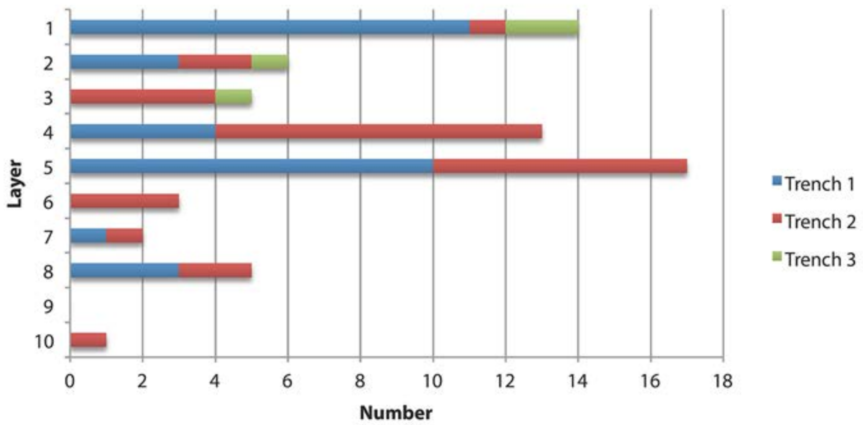


Figure 4.36. Distribution of clay pellets by layer, total = 66.

Source: C. Sarjeant.

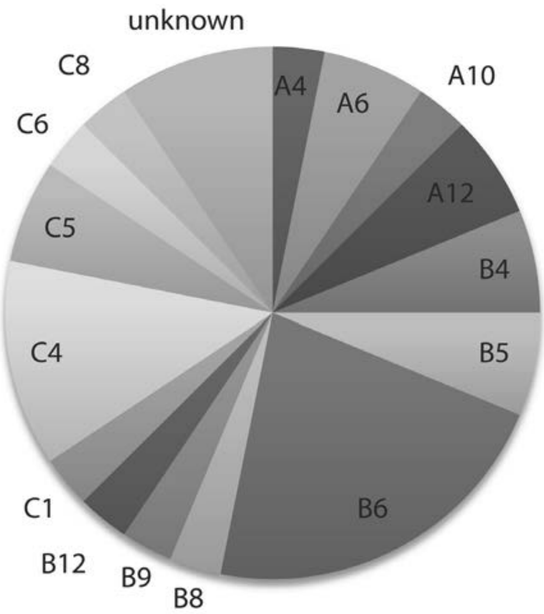


Figure 4.37. Distribution of clay pellets by square, Trench 1, total = 32.

Source: C. Sarjeant.

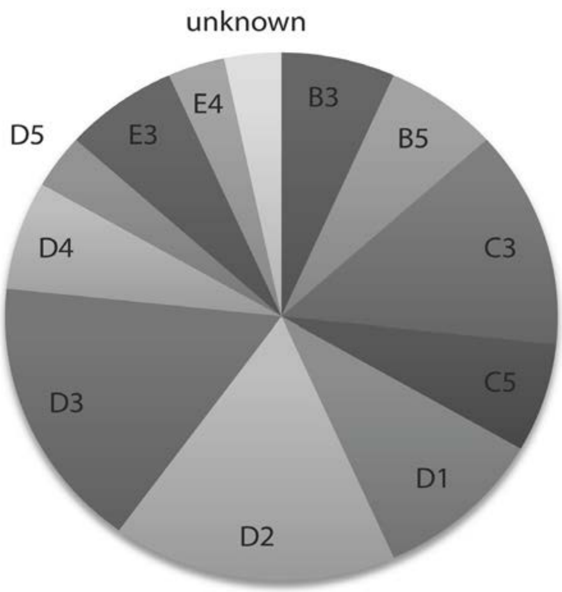


Figure 4.38. Distribution of clay pellets by square, Trench 2, total = 30.

Source: C. Sarjeant.

Ceramic roundels

Ceramic roundels (or perhaps counters) are modified pieces of ceramic sherd. The original pottery vessel surface treatments, such as burnishing, cordmarking and comb incisions are common features of the roundels (Figure 4.39). It appears that sand tempered sherds with surface treatment or decoration were preferred for chipping and grinding sherds into roundels. The use of these items is uncertain (Higham 2009a: 244). The majority were recovered from Trench 1 (Figure 4.40) and were commonly between 35–40 and 45–50 mm in diameter, with an average of 42.4 mm (Figure 4.41). The roundels were mostly about 4–5 mm thick, with an average of 5.17 mm (Figure 4.42, Figure 4.43). The most common occurrences were in layers 4 and 5 of Trench 1, layer 3 of Trench 2, and layer 1 of Trench 3 (Figure 4.44). Thus, roundels were an increasing component of the material culture assemblage at An Sơn in the middle to later phases of occupation. Spatially, they were most frequently identified in A5 and C5 of Trench 1 (Figure 4.45). Only one roundel was perforated (Figure 4.46).

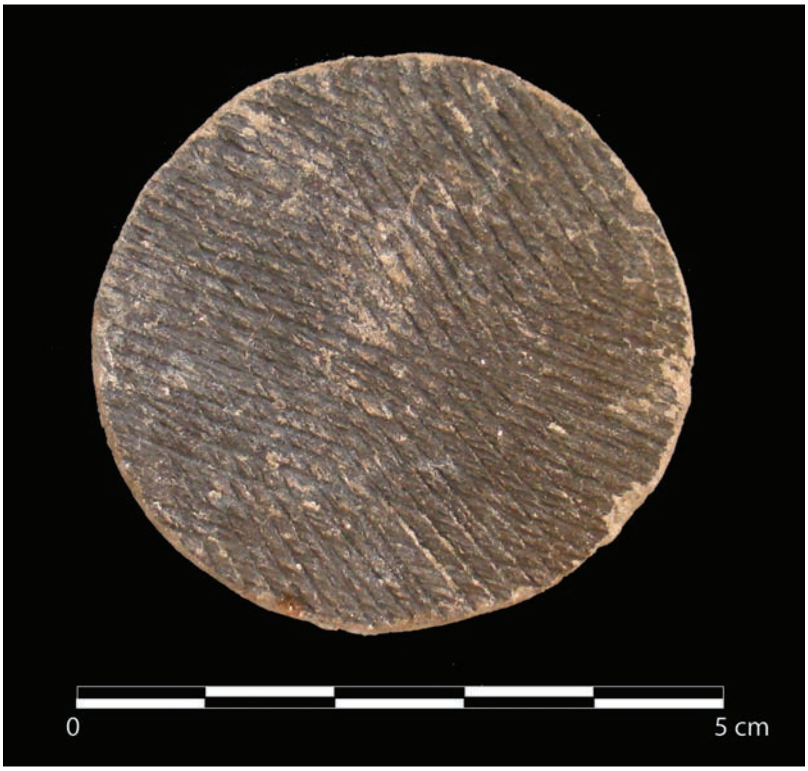


Figure 4.39. Ceramic roundel, Trench 1, layer 5, B5.

Source: Photo, C. Sarjeant.

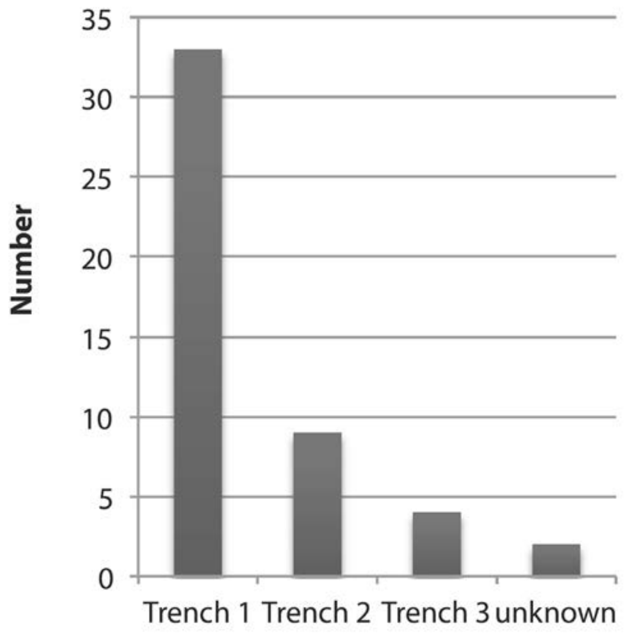


Figure 4.40. Total number of ceramic roundels in each trench, total = 48.

Source: C. Sarjeant.

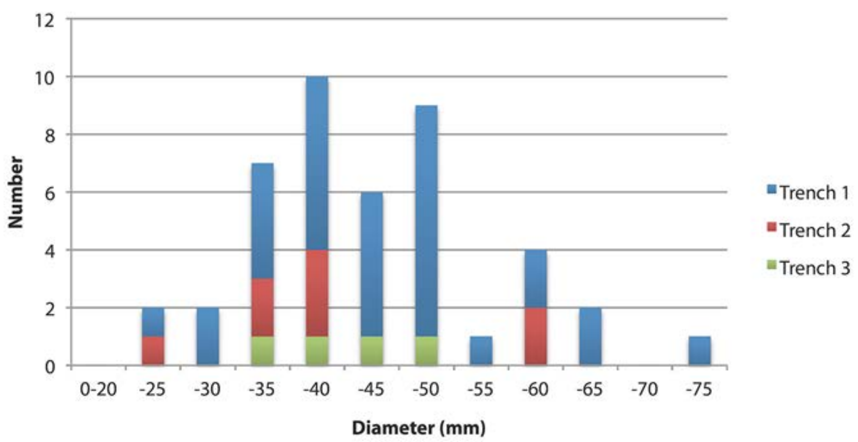


Figure 4.41. Diameter (mm) of ceramic roundels, total = 44, average = 42.4 mm.

Source: C. Sarjeant.

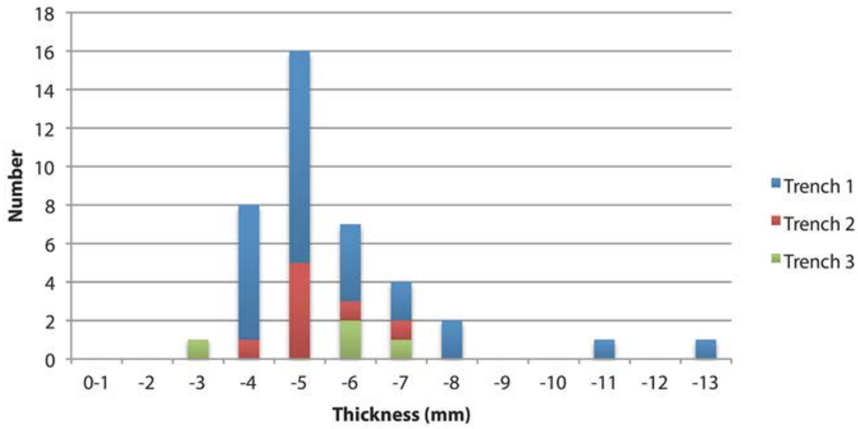


Figure 4.42. Thickness (mm) of ceramic roundels, total = 39, average = 5.17 mm.

Source: C. Sarjeant.

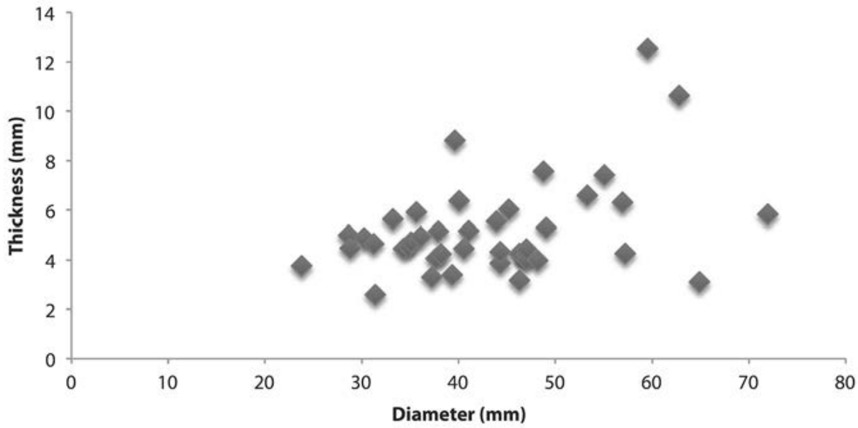


Figure 4.43. Relationship of thickness (mm) versus diameter (mm) of ceramic roundels, total = 41.

Source: C. Sarjeant.

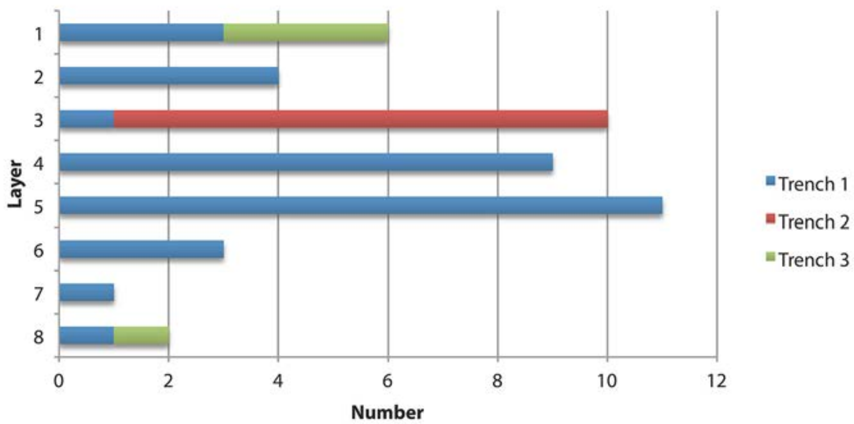


Figure 4.44. Distribution of ceramic roundels by layer, total = 46.

Source: C. Sarjeant.

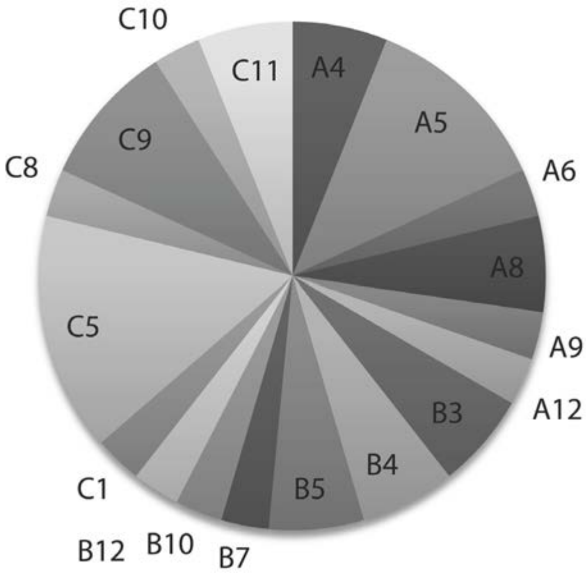


Figure 4.45. Distribution of ceramic roundels by square, Trench 1, total = 33.

Source: C. Sarjeant.

Figure 4.46. Perforated ceramic roundel, Trench 1, layer 6, A3.

Source: Photo, C. Sarjeant.

Lithics

The stone assemblage in the 2009 excavation was primarily restricted to tools, rather than ornaments. One bangle fragment was excavated from Trench 3 (Figure 4.47). The assemblage was dominated by complete but reworked and/or broken rectangular-sectioned adzes, both shouldered and unshouldered (Figure 4.48), and flakes, many of which were polished to indicate reworking of the adzes on site. There was however, a limited presence of cores, unworked raw material, blanks and preforms at the site, suggesting the tools were brought to An Sơn already made, and then reworked and resharpened as needed until the adzes became too small or broke and were non-functional. This explains the presence of whetstones and sandstones at the site, for sharpening and polishing.

The majority of the stone artefacts, *n*>800, were recovered from Trench 1while less than 100 were recovered from Trench 2. A total of 1287 stone artefacts were excavated in 2009 (Figure 4.49). Over 600 were flakes that were most likely debitage from reworking adzes. In further support of this claim, over half of these flakes had polished surfaces. In terms of tools, adzes were the most common artefact in the assemblage, although some symmetrically-profiled axes were identified. One unique item included a large unused spearhead (Figure 4.50). Other stone items included whetstones for grinding and sharpening tools and sandstone for polishing. One burnishing stone was also recovered from a burial (Figure 4.51). Most of the adzes were manufactured from hornfels metamorphic rock, basaltic igneous rock or tuff. The whetstones and polishers were made from fine to coarse-grained sandstone, and the burnishing stones were quartz or quartzite. Detailed analysis of the raw materials remains to be undertaken.

There was a higher proportion of unshouldered adzes than shouldered forms (Figure 4.52). Generally, the unshouldered adzes were more frequently observed in the upper layers and the shouldered types were more commonly recovered from the lower layers of the site (Figure 4.53, Figure 4.54, Figure 4.55, Figure 4.56). The sizes of the unshouldered and shouldered adzes were similar, and the unshouldered adzes had the average dimensions of 70.85 mm long, 38.71 mm wide and 18.06 mm thick, while the shouldered adzes had the average dimensions of 76.02 mm long, 49.74 mm wide and 18.52 mm thick (Figure 4.57, Figure 4.58). This is consistent with the shouldered to unshouldered sequence that was reported by Nishimura and Nguyễn (2002: 106) for the 1997 excavation.

Figure 4.47. Stone bangle fragment, Trench 3, layer 1, B8.

Source: Photo, C. Sarjeant.

Figure 4.48. Selected shouldered and unshouldered lithic adzes. Left to right: Trench 1, layer 4–5, B5; Trench 1, layer 8, B12; Trench 1, layer 5, A9.

Source: Photos, C. Sarjeant.

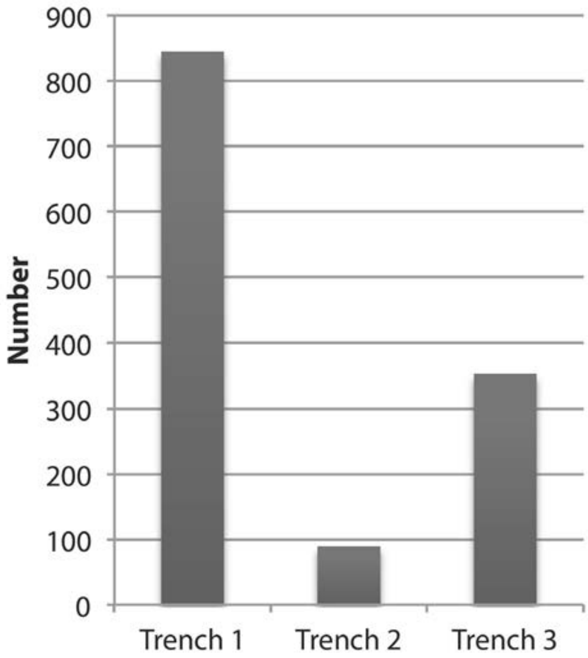


Figure 4.49. Total number of lithic artefacts in each trench, total = 1287.

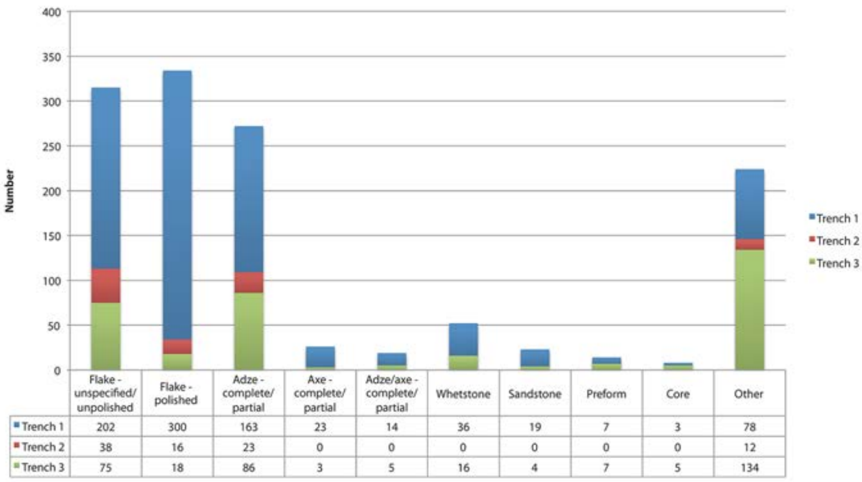
Source: C. Sarjeant.

Figure 4.50. Stone spearhead, Trench 2, layer 2–3, E4.

Source: Photo, C. Sarjeant.

Figure 4.51. Burnishing stone, Trench 1, layer 8, A10, burial 2.

Source: Photo, C. Sarjeant.



	Flake - unspecified/ unpolished	Flake - polished	Adze - complete/ partial	Axe - complete/ partial	Adze/axe - complete/ partial	Whetstone	Sandstone	Preform	Core	Other
Trench 1	202	300	163	23	14	36	19	7	3	78
Trench 2	38	16	23	0	0	0	0	0	0	12
Trench 3	75	18	86	3	5	16	4	7	5	134

Figure 4.52. Number of lithic artefacts in each trench, total = 1287. 'Other' includes general debitage that were not further analysed, and miscellaneous items.

Source: C. Sarjeant.

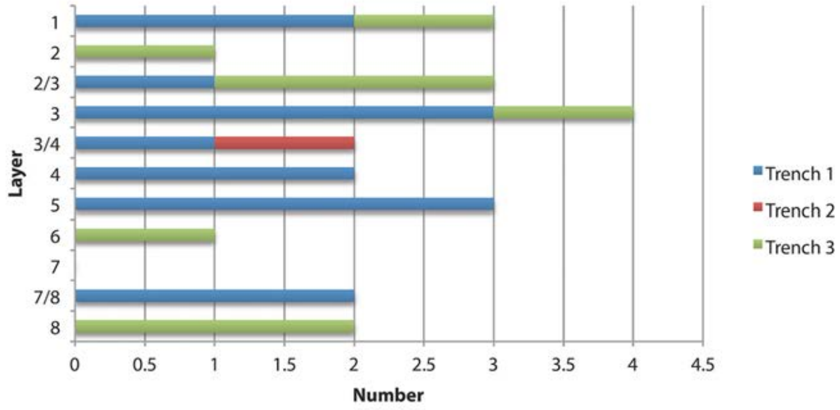


Figure 4.53. Distribution of complete unshouldered adzes by layer, total = 23.

Source: C. Sarjeant.

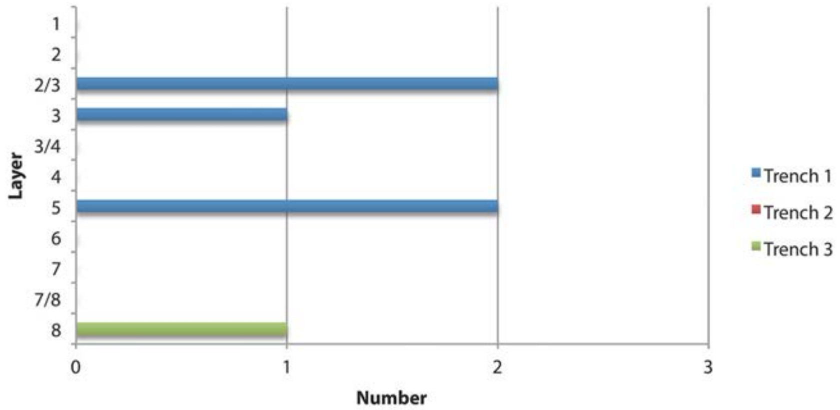


Figure 4.54. Distribution of complete shouldered adzes by layer, total = 6.

Source: C. Sarjeant.

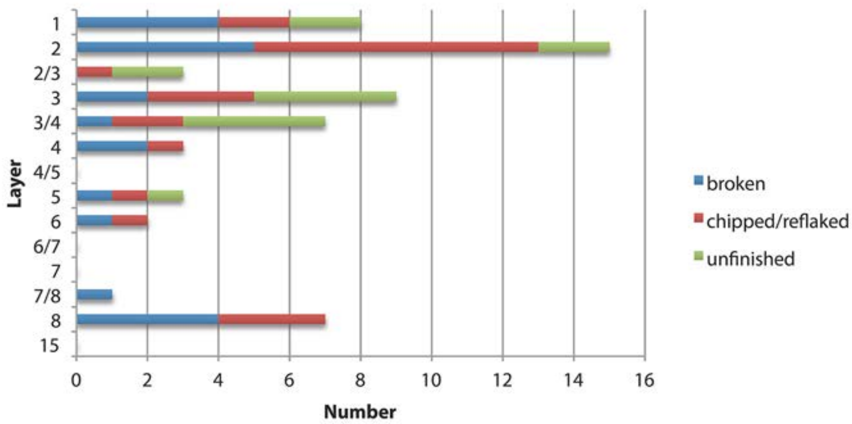


Figure 4.55. Distribution of broken, chipped/reflaked and unfinished unshouldered adzes by layer, total = 58.

Source: C. Sarjeant.

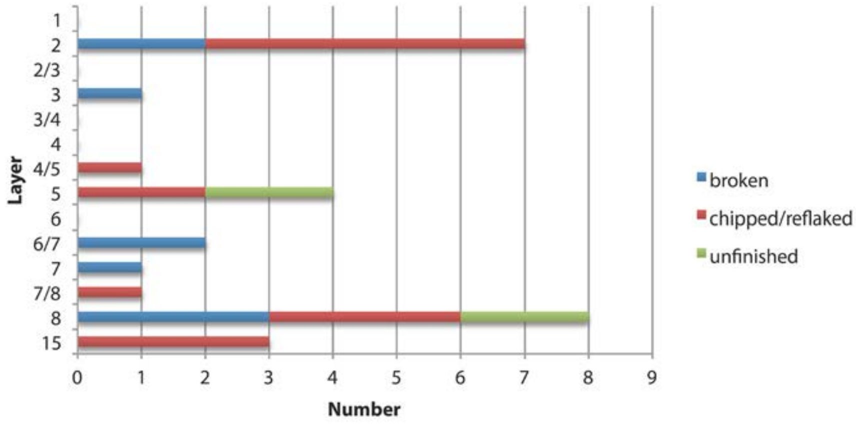


Figure 4.56. Distribution of broken, chipped/reflaked and unfinished shouldered adzes by layer, total = 28.

Source: C. Sarjeant.

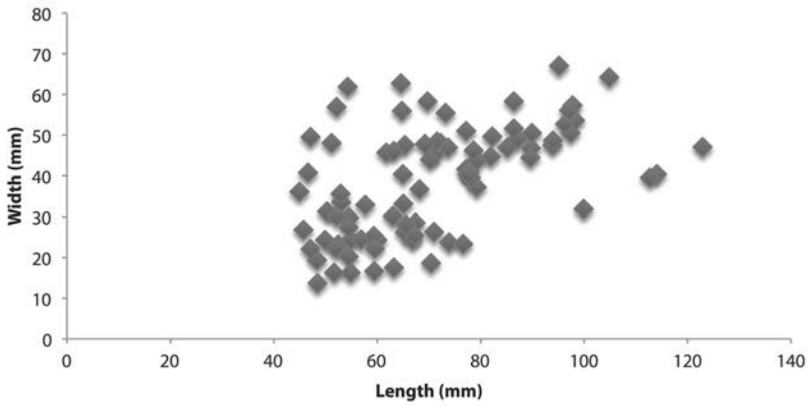


Figure 4.57. Relationship of width (mm) versus length (mm) of unshouldered adzes, total = 86.

Source: C. Sarjeant.

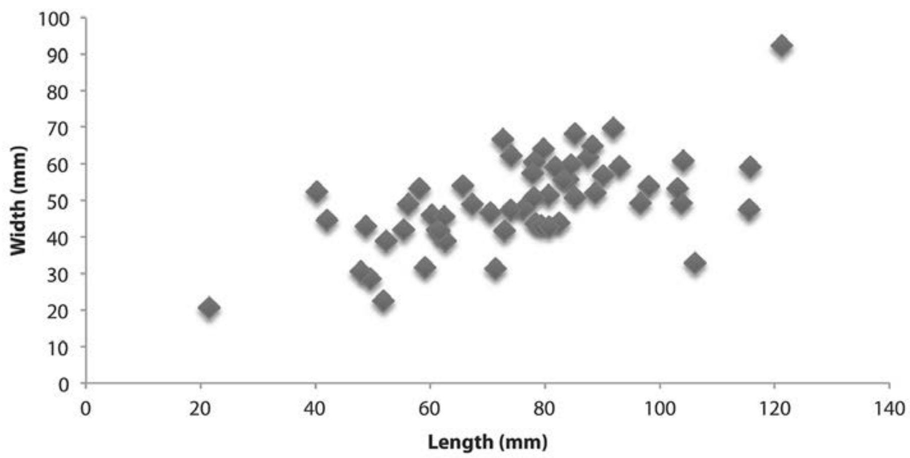


Figure 4.58. Relationship of width (mm) versus length (mm) of shouldered adzes, total = 56.

Source: C. Sarjeant.

Shell artefacts

The most common shell artefacts at An Sơn were beads. The assemblage consisted of 196 beads. These were found only in burial fill and the midden soil of Trench 2, when the soil from this trench was wet sieved through 1.2 mm and 2 mm mesh. The range of shapes was limited to predominantly disc-shaped and rectangular or cylindrical beads, while a few square beads were recovered (Figure 4.59, Figure 4.60). Generally, the beads were small (Figure 4.61). The disc-shaped beads were mostly 3.0 to 4.5 mm in diameter, with an average of 3.18 mm, and their thickness ranging from 0.7 to 1.7 mm. The rectangular/cylindrical beads were mostly 3.5 to 5.0 mm in diameter, with an average of 4.62 mm, and 5.5 to 6.0 mm in length, with an average of 5.65 mm. The thickness ranged from 2.4 to 4.5 mm. The square-shaped beads were on average 3.77 mm wide. The previous An Sơn excavations uncovered more variation in the shell beads, some of which were larger than those in the 2009 collection. A selection of the beads from the 2004 excavation is shown in Figure 4.62.

A bivalve shell was also recovered from burial 3 in Trench 2. It may have been a deliberate mortuary offering, as bivalves have often been found in the burials at Ban Non Wat in northeast Thailand, for example (see Higham and Higham 2009a: 17). The earliest excavation at An Sơn in1978 also uncovered many bivalve shells with glossy usewear, suggesting they may have been used for reaping in rice fields. Similar gloss was identified on the shells from the occupational layers in the 2009 excavation (Peter Bellwood, pers. comm.).

Figure 4.59. Disc-shaped and rectangular/cylindrical shell beads, Trench 2, layer 5/6, D2.

Source: Photo, C. Sarjeant.

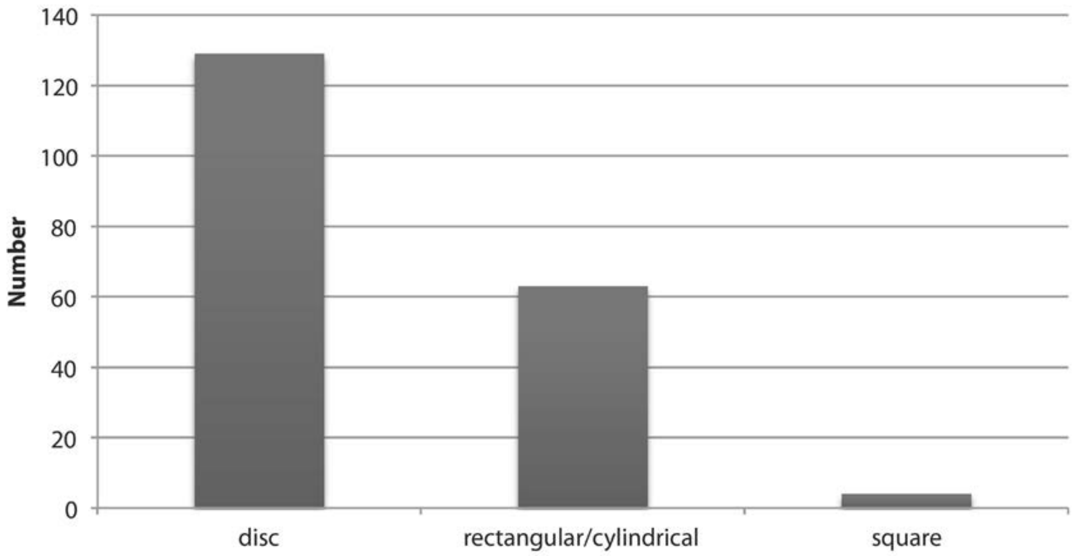


Figure 4.60. Number of shell beads by shape, total = 196.

Source: C. Sarjeant.

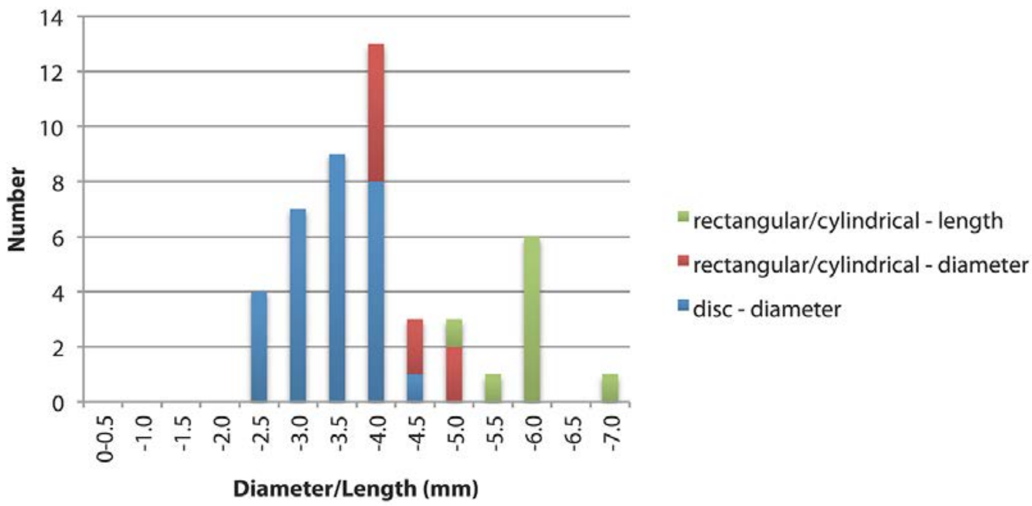


Figure 4.61. Diameter (mm) and length (mm) of rectangular/cylindrical beads and diameter of disc-shaped beads.

Source: C. Sarjeant.

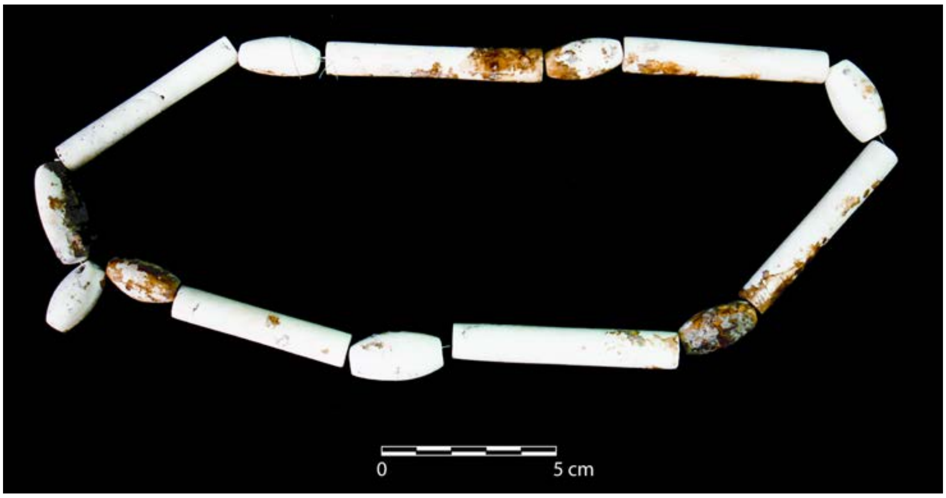


Figure 4.62. Shell bead necklace, 2004 excavation, Trench 3, burial 1.

Source: Photo, C. Sarjeant.

Other artefacts

Other artefacts excavated at An Sơn during the 2009 excavation included bone and ivory items. Only one bone fishhook was recovered (Figure 4.63), but previous excavations have revealed different shapes of fishhooks and preforms (Figure 4.64). The ivory items included bangle fragments or pointed tools (Figure 4.65). Additionally, some unique clay and stone artefacts were recovered, including two possible clay beads. One was round with a perforation and a line was worn around the exterior, and the other was disc-shaped with a perforation (Figure 4.66). There were also some small ceramic cylinders with dense fibre fabric, and petrified rods with fibre impressions and stick-hole impressions. These miscellaneous items were found in Trenches 1 and 2 and it has been suggested they were temper sticks that were then crushed for ceramic manufacture (Nishimura and Nguyễn 2002). A stone implement with a ground circular centre was identified within the vicinity of the midden and cooking area in Trench 2, suggesting another item may have been turned into it to create heat and fire, perhaps for cooking (Figure 4.67).

Figure 4.63. Bone fishhook fragment, Trench 2, layer 15, A2–A5/B2–B5.

Source: Photos, C. Sarjeant.

Figure 4.64. Bone artefacts from 1997 excavation. Left to right: awl, 1997 excavation, Trench 1, layer 3; fishhook preform, 1997 excavation, Trench 1, layer 2; fishhook, 1997 excavation, Trench 1, layer 2; bangle fragment, 1997 excavation, Trench 1, layer 2.

Source: Photos, C. Sarjeant.

Figure 4.65. Ivory bangle fragment (left) and pointed tool (right). Left to right: Trench 2, layer 2–3, D5; Trench 2, layer 1, E4.

Source: Photos, C. Sarjeant.

Figure 4.66. Clay beads. Left to right: Trench 1, layer 5, B3; Trench 1, layer 1, C2.

Source: Photos, C. Sarjeant.

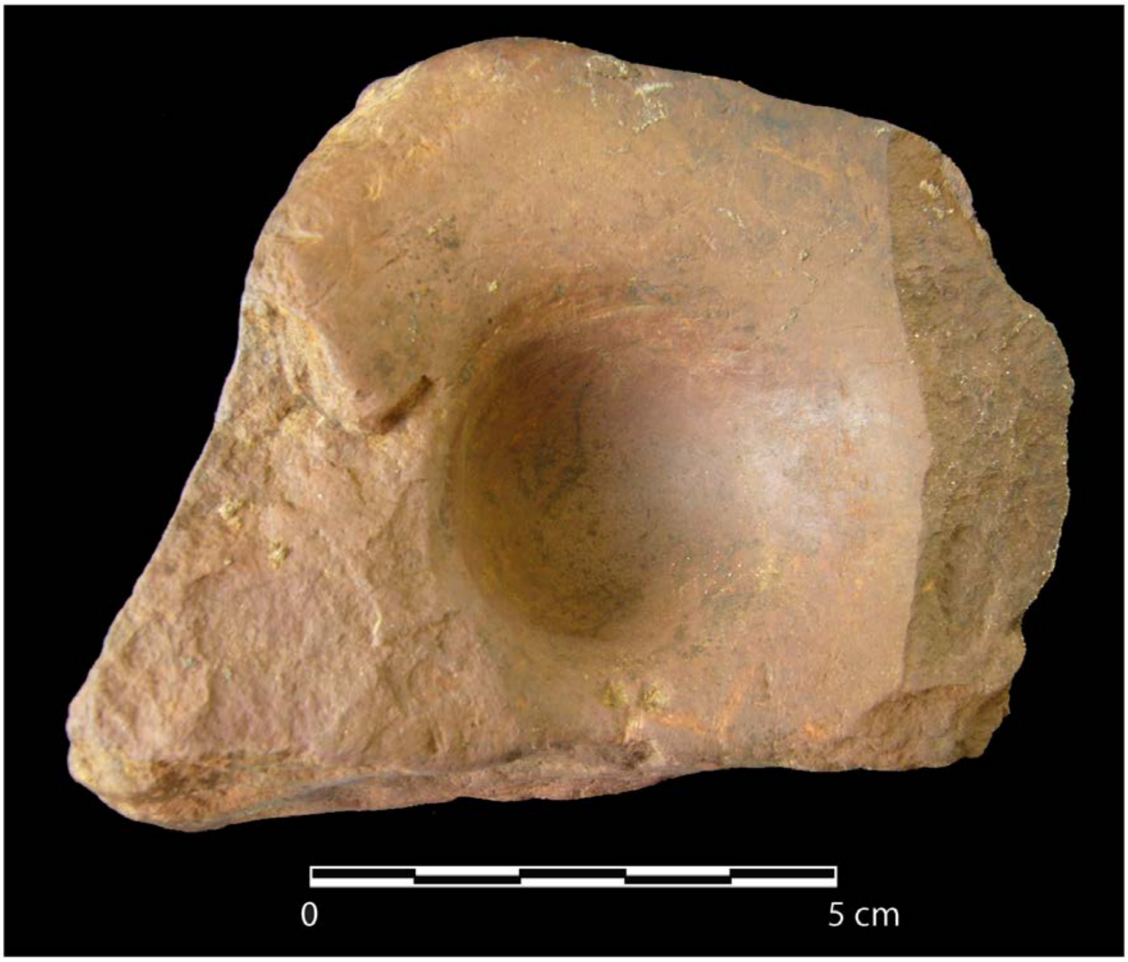


Figure 4.67. Possible stone for lighting fires, Trench 2, layer 3, C5.

Source: Photos, C. Sarjeant.

Burials

The material culture found amongst the 2009 An Sơn burials was quite limited. Complete ceramic vessels were the most common mortuary offering, while additional items included shell beads, stone adzes, and ceramic sherd sheets covering the body (Figure 4.68, Figure 4.69, Figure 4.70, Figure 4.71, Figure 4.72, Figure 4.73, Table 4.5). Infants were very rarely interred with grave goods apart from a single ceramic vessel. The ceramic vessels in the burials are discussed further in Chapter 5. Offerings were more likely to be present in the burials for individuals who were over the age of 10, or adolescents. Two male interments included a higher number of ceramic vessels, although one female individual was interred with the greatest number, nine ceramic vessels. The buried individuals and the mortuary analysis for An Sơn have been studied by Anna Willis, PhD candidate, The Australian National University.

Figure 4.68. Trench 1, burial 1.

Source: Burial photo, A. Willis.

Table 4.5. Identification and mortuary offerings of burials from all excavation seasons at An Sơn.

Excavation year	Burial	Sex	Age range	Orientation	Complete pots	Stone adze	Stone tool	Stone	Shell	Clay pellet	Shell beads	Bangle fragment	Burnishing stone	Turtle carapace	Dog mandible	Ceramic sherd sheet
2004	Trench 1 M1a	Subadult	1–4	North-East/ South-West	0											
	Trench 2 M1a	Subadult	<1	South-West/ North-East	0											
	Trench 3 M1a	Male	30+	North-East/ South-West	8	1					1000					
	Trench 3 M2a	Female	Indeterminate		0									1		
	Trench 3 M3a	Male	30+	North-East/ South-West	0	1										1
	Trench 3 M4a	Subadult	10–14	North-South	1											
	Trench 3 M5a	Female	30+	North-East/ South-West	1											1
	Trench 3 M6a	Subadult	5–9	East-West	0											1?
	Trench 3 M7a	Female	Indeterminate	North-East/ South-West	3											
	Trench 3 M8a	Male	15–29	North-East/ South-West	1							1				1
	Trench 3 M10a	Indeterminate	15–29	North-West/ South-East	3											
	Trench 3 M13a	Male	30+	North-South	5	1										1
	Trench 3 M14a	Indeterminate	15–29	North-East/ South-West	1											
	Trench 3 M16a	Subadult	1–4	North-East/ South-West	0											1?
	Trench 3 M17a	Female	15–29	North-East/ South-West	2											
2007	Trench 1 M1a	Subadult	1–4	North-South	0											
	Trench 1 M2a	Subadult	1–4	North-South	0											
	Trench 1 M3a	Female	15–29	North-East/ South-West	1					1	7					1?
	Trench 1 M3b	Subadult	<1		0											
	Trench 1 M4a	Subadult	1–4		0											

Excavation year	Burial	Sex	Age range	Orientation	Complete pots	Stone adze	Stone tool	Stone	Shell	Clay pellet	Shell beads	Bangle fragment	Burnishing stone	Turtle carapace	Dog mandible	Ceramic sherd sheet
2009	Trench 1 M1a	Female	30+		0										1?	1
	Trench 1 M2a	Female	15–29	North-East/ South-West	9	2?			1?				1?			
	Trench 1 M3a	Male	30+	North-East/ South-West	2	1?										1
	Trench 1 M4a	Subadult	1–4	North-East/ South-West	1											1
	Trench 2 M1a	Subadult	<1	South-East- North-West	0											
	Trench 2 M2a	Subadult	<1	North-East/ South-West	1						2					
	Trench 2 M3a	Subadult	10–14	North-East/ South-West	3	1	1?	2	2		13					

Source: Compiled by A. Willis.

Figure 4.69. Trench 1, burial 2.

Source: Burial photos, A. Willis; artefact photos, C. Sarjeant.

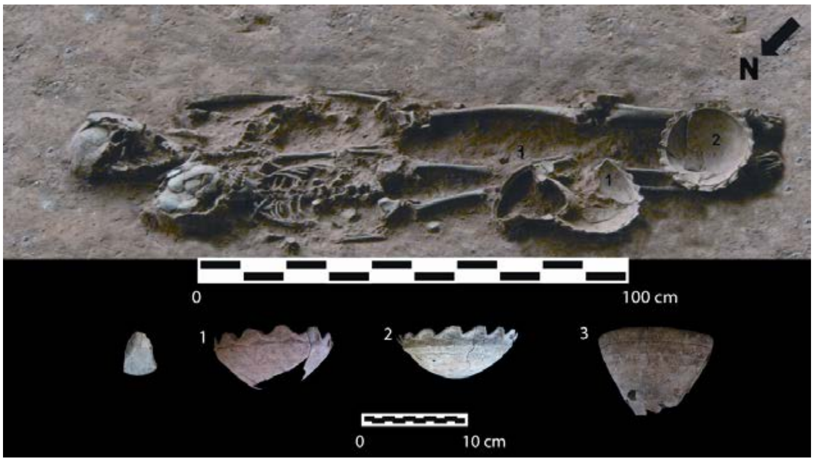


Figure 4.70. Trench 1, burials 3 and 4.

Source: Burial photos, A. Willis; artefact photos, C. Sarjeant.

Figure 4.71. Trench 2, burial 1.

Source: Burial photo, A. Willis.

Figure 4.72. Trench 2, burial 2.

Source: Burial photos, A. Willis; artefact photos, C. Sarjeant.

Figure 4.73. Trench 2, burial 3.

Source: Burial photos, A. Willis; artefact photos, C. Sarjeant.

Flora

Melissa Tan of University College London has analysed phytolith samples from lower deposits in Trenches 2 and 3 and the Test Square at An Sơn. The preliminary findings indicate a presence of diatoms and sponge spicules, which suggest a high frequency of riverine flooding, and silica aggregate which suggests a burnt environment. The burning probably took place mainly as the site was initially settled, since the basal deposits of the Test Square at 2.25 and 2.95 m depth had the most evidence for this (P. Bellwood, pers. comm.). Associate Professor Tetsuro Udatsu of Miyazaki University in Kyushu, Japan also conducted a phytolith analysis and identified *Oryza* in Trench 2 and at a depth of 2.3 m in the Test Square. Tan's results, with the additional analysis by Udatsu, identified other plant remains including grasses, *Cyperaceae* (sedges), *Palmae* (palms), *Panicoideae* (grass), *Chloridoideae* (grass), *Phragmites* (wetland grass), *Andropogonea* (grass), *Commelinaceae* (flowering plants), *Bambusoideae* (bamboo), millet-type grasses, and probably *Oryza* (rice) (P. Bellwood, pers. comm.). The complete archaeobotanical reports for An Sơn are yet to be published.

While it is possible that the fibre temper identified in the ceramics at An Sơn may have included grasses of some kind, the presence of the double peaked glumes in most sherds observed in SEM backscatter images specifically suggest that *Oryza* rice husk was used as temper (see Chapter 6, Part I). Katsunori Tanaka of the Research Institute of Humanity and Nature, Japan identified *Oryza sativa japonica* as temper inclusions in a ceramic sherd. The term 'fibre temper' is used in this monograph to accommodate a variety of organic inclusions, including rice husks, in the ceramics at An Sơn (explained further in Chapter 6, Part I).

Fauna

The fauna from An Sơn has been analysed by Philip Piper and colleagues (Piper *et al.* 2012). The excavation of Trench 2 involved wet sieving midden samples through a 2 mm mesh, and this resulted in the recovery of large and small vertebrates and very small fish bones. Pig and dog were the most frequent mammals, and the earliest evidence of dog was at a depth of 190–200 cm in the Test Square, corresponding to just after the initial occupation of the site. Most, if not all, of the canid remains belonged to domestic dogs (*Canis*), rather than the only native Southeast Asian canids, the golden jackal (*Canis aureus*) or the Asiatic wild dog (*Cuon alpines*). Cut marks were identified on the dog bones and the evidence suggests the dogs were penned, butchered and eaten (Piper *et al.* 2012).

The oldest pig remains were identified at a depth of 230–240 cm in the Test Square, the earliest phase of occupation. None of the excavated remains exceeded two years old at death. Although there may be other reasons for such a young kill-off population, domestic animal management is a likely scenario at An Sơn. While the dentition of the suids at An Sơn is similar in size to that of modern Eurasian wild pigs (*Sus scrofa*), this does not eliminate the possibility of domestication since managed pig populations show no size reduction in dental remains in relation to known domestication events in the northern Philippines, where pigs are known to have been introduced (Piper *et al.* 2012; Piper *et al.* 2009).

Other mammalian remains included either the Asian house rat (*Rattus tanezumi*) or rice field rat (*Rattus argentiventer*). The most common wild animals were pond, box and water turtles (Geomydidae). In addition, Deer (*Rusa unicolour*, *Cervis eldii*), monitor lizard (*Varanus* sp.), mouse deer (*Tragalus napu*), crocodile (*Crocodylus*), and monkey (Cercopithecidae) were all identified. These wild animals were a small component and probably did not provide a major contribution to the diet (Piper *et al.* 2012). The most abundant archaeozoological remains were of fish, including snakehead (Channidae), swamp eel (Synbranchidae) and climbing perch (*Anabus testudineus*), river catfish (Clariidae), Barramundi (Centropomidae), tire track eels (Mastacembelidae), and glassy perchlets (Chandidae) (Piper *et al.* 2012).

Summary

This chapter has aimed to provide an overview of the 2009 excavation at An Sơn, in order to present a context for further discussion of the ceramic assemblage. The stratigraphy and material contents of each of the excavated trenches in the 2009 excavation revealed variable contexts, suggesting different areas of the site had different functions in the past. An Sơn has been dated from 2009 excavation material at 2500–2200 cal. BC to 1500–1200 cal. BC.

Trench 1 in the 2009 excavation yielded the majority of the ceramic material culture, including the highest quantity of ceramic sherds. The greatest density of these sherds was identified in the middle layers. An equal amount of clay pellets were excavated from Trenches 1 and 2, while ceramic roundels were more frequently identified in Trench 1 in the middle to later phases of occupation. Most of the lithic artefacts were polished flakes, identified as debitage from reworking adzes, and were predominantly found in Trench 1. Unshouldered lithic adzes were more common than shouldered adzes, and unshouldered adzes were characteristic of the upper layers, while shouldered adzes were more often in the lower layers.

Shell artefacts at An Sơn were most commonly identified as small beads, although a greater range of sizes and shapes of beads were excavated in 2004. Bone and ivory items were also recovered. Although only one bone fishhook was found in 2009, others have been identified in earlier excavations.

Mortuary offerings were usually only interred with individuals over the age of 10 or adolescence, with few infants interred with grave goods. The floral evidence suggested An Sơn had been burnt for occupation, and the presence of *Oryza sativa japonica*, rice, has been confirmed at the site. In terms of faunal evidence, pig and dog were the most frequently identified mammals, and the presence of domesticates has important implications for characterising neolithic occupation at the time of settlement at An Sơn.

The aspects of neolithic occupation presented in this chapter—the stratigraphy, chronology, material culture, burials, flora and fauna—are re-introduced in the discussion of the socio-technical organisation of ceramic manufacture and the neolithic settlement at An Sơn (Chapters 10 and 11).

5

An Sơn Ceramic Vessel Forms and Surface Treatments

Introduction

This chapter outlines the ceramic assemblage from the 2009 excavation at An Sơn. It describes the ceramic assemblage in all of the trenches excavated in 2009 (Trenches 1, 2 and 3 and the Test Square), as well as the basal layers of the 1997 excavation that presented the earlier part of the sequence, not apparent in 2009. In order to present the sequence of rim forms and surface treatments at An Sơn particular attention was given to squares A1, A2, B1, B2, C1 and C2 of Trench 1, and to the basal layers of the Test Square and of the 1997 excavation.

This chapter presents the quantities and weights of the ceramic assemblage sequentially and across the site. The subsequent analysis of the rim forms and surface treatments indicates trends over time for different forms and modes of decoration. A categorisation for rim forms and surface treatments is presented, and variants within the main rim form categories are also described. A comparison was undertaken between the Trench 1 squares A1, A2, B1, B2, C1 and C2 and Trench 2 to examine different uses of space in the site according to the distribution of certain ceramic rim forms. The categories and sequences established in this chapter, are important for examining the relationship between clay and temper selection and vessel form in the fabric analysis of Chapter 6.

Quantification of the ceramic sherds

The weights and quantities of the ceramic assemblage are presented here, in terms of the basic temper divisions of fibre and sand. The assemblage is divided further into the categories of rim sherds, wavy rim sherds and body sherds, plain or cord-marked, comb incised and paddle linear impressed, *cà ràng* (earthenware stove vessel) sherds, foot rim sherds, and other decorated rim and body sherds. The 'decorated' sherds do not include cord-marked, comb incised or paddle linear impressed sherds. The total counts for all trenches are provided, in addition to a breakdown of the contents of each 2009 excavation trench.

2009 An Sơn ceramic assemblage

The 2009 excavation resulted in approximately equal quantities of fibre and sand tempered sherds, inclusive of rim sherds, although there were slightly more sand tempered sherds in general. The wavy rim sherds were a significant proportion of the sand tempered rim sherds. Generally, the plain sherds outnumbered the cord-marked, comb incised and paddle linear impressed sherds. Decorated sherds were a minor component of the entire assemblage, and most were sand tempered (Table 5.1a and Table 5.1b).

Trench 1

The greatest density of ceramic sherds in Trench 1 was in the mid-sequence layers 4 to 5, and the majority of the sherds were fibre tempered, inclusive of the rim sherds. The majority of the wavy rim and decorated sherds (not including cord-marked, comb incised and paddle linear impressed sherds) across the entire assemblage, were excavated from Trench 1. While the majority of the *cà ràng* sherds of the entire assemblage were found in Trench 1, they compiled a smaller proportion of the Trench 1 assemblage than they did in Trench 2. The quantities of sand and fibre tempered sherds were equal in the lower layers, rather than reflecting a dominance of fibre tempered sherds, as observed in the middle and upper layers of Trench 1 (Table 5.2a and Table 5.2b).

Trench 2

The presence of smaller lenses and midden/cooking areas, and of a horizontal as opposed to a vertical stratigraphical sequence, requires that Trench 2 be considered over horizontal space. This was achieved by assessing each square separately in terms of its cultural layers and spit depths (see stratigraphy in Chapter 4). The frequencies of sherds for each spit, layer and square in Trench 2 are presented in Table 5.3a, Table 5.3b, Table 5.4a, Table 5.4b, Table 5.5a and Table 5.5b.

Counts by depth

The total number of sherds in Trench 2 was relatively low compared to Trench 1, resulting in a higher relative proportion of *cà ràng* sherds within the Trench 2 assemblage than in Trench 1. There were very few decorated sherds in Trench 2. Trench 2 contained a greater proportion of sand tempered sherds than Trench 1 (Table 5.3a and Table 5.3b).

Counts by layer

The distribution of ceramic sherds throughout the layers of Trench 2 is roughly equal, with a concentration of sherds at the interface of the sloping cultural layers and the basal layer 15 (Table 5.4a and Table 5.4b).

Counts by square

The ceramic content of Trench 2 was more concentrated in the southern and western areas. There were minimal numbers of sherds in the eastern area, particularly in the northeast corner (Table 5.5a and Table 5.5b).

Trench 3

Very few diagnostic sherds were collected from Trench 3 compared to Trenches 1 and 2, and the numbers of *cà ràng* and decorated sherds were minimal (Table 5.6a and Table 5.6b). Compared to Trench 1, the quantity of sherds in Trench 3 was quite low considering the excavation areas and depths were similar between the two trenches.

Test Square

The Test Square displayed a clearer picture of the lower layers of An Sơn than the main 2009 trenches, and showed that fibre tempered sherds were relatively rare in the lower deposits of the site. Plain sherds were also in higher quantities than cord-marked, comb incised or paddle linear impressed sherds in these lower deposits (Table 5.7a and Table 5.7b).

Table 5.1a. Weight and quantity of all Fibre temper and total of all An Sơn ceramic sherds, 2009 excavation.

Total		**Fibre temper**										
Weight (kg)	Quantity	Quantity	Rim		Body		Foot rim	Decorated	Cà ràng			
			Rim	Wavy	Cord- mark/ paddle linear	Plain			Rim	Body	Projection	Total
2622.73	231224	111815	17477	3	43684	49427	617	17	302	115	173	590

Source: Compiled by C. Sarjeant.

Table 5.1b. Weight and quantity of all Sand temper and total of all An Sơn ceramic sherds, 2009 excavation.

Total		**Sand temper**						
Weight (kg)	Quantity	Quantity	Rim		Body		Foot rim	Decorated
			Rim	Wavy	Cord- mark/ paddle linear	Plain		
2622.73	119409	18547	18547	3847	43295	52442	783	495

Source: Compiled by C. Sarjeant.

Table 5.2a. Weight and quantity of all Fibre temper and total of all An Sơn ceramic sherds, 2009 excavation, Trench 1.

Layer	**Total**		**Fibre temper**									
	Weight (kg)	Quantity	Quantity	Rim		Body		Foot rim	Cà ràng			Decorated
				Rim	Wavy	Cord-mark	Plain		Rim	Body	Projection	
1	72.14	9872	6647	586	0	3091	2966	4	0	0	0	0
1/2	4.83	632	191	10	0	19	162	0	0	0	0	0
2	96.12	10727	7436	925	0	3505	2946	36	7	1	16	0
2/3	9.92	1177	925	114	0	540	257	8	4	1	0	1
3	136.41	11633	5929	667	0	1186	3984	63	20	6	3	0
3/4	66.35	4743	3440	673	0	1357	1374	28	3	1	4	0
4	287.23	24073	15329	2356	0	7177	5661	79	31	7	18	0
4/5	21.85	2195	1242	292	0	512	422	8	5	3	0	0
5	577.70	42312	29587	5967	0	14352	8888	183	115	27	51	4
5/6	18.56	1700	1076	87	0	470	476	35	0	0	0	8
6	156.37	12118	8757	1827	0	4246	2623	26	28	0	4	3
6/7	4.44	239	165	30	0	69	66	0	0	0	0	0
7	91.31	5956	2952	442	0	1331	1160	13	3	0	3	0
8	102.51	7211	3622	644	0	1844	1097	24	3	6	3	1
Total	1645.74	134588	87298	14620	0	39699	32082	507	219	52	102	17

Source: Compiled by C. Sarjeant.

Table 5.2b. Weight and quantity of all Sand temper and total of all An Sơn ceramic sherds, 2009 excavation, Trench 1.

Layer	Total		Sand temper						
	Weight(kg)	Quantity	Quantity	Rim		Body		Foot rim	Decorated
				Rim	Wavy	Cord-mark	Plain		
1	72.14	9872	3225	359	15	1103	1728	2	18
1/2	4.83	632	441	79	0	37	317	2	6
2	96.12	10727	3291	498	2	1170	1590	18	13
2/3	9.92	1177	252	46	0	130	65	2	9
3	136.41	11633	5704	984	184	1794	2623	72	47
3/4	66.35	4743	1303	190	109	595	378	19	12
4	287.23	24073	8744	1292	568	3800	2933	101	50
4/5	21.85	2195	953	121	52	436	300	5	39
5	577.70	42312	12725	1980	673	5785	4045	128	114
5/6	18.56	1700	624	39	7	289	217	2	70
6	156.37	12118	3361	583	214	1474	1074	11	5
6/7	4.44	239	74	8	0	38	23	5	0
7	91.31	5956	3004	304	229	1594	824	25	28
8	102.51	7211	3589	461	278	1691	1061	35	63
Total	1645.74	134588	47290	6944	2331	19936	17178	427	474

Source: Compiled by C. Sarjeant.

Table 5.3a. Weight and quantity of all Fibre temper and total of all An Sơn ceramic sherds, 2009 excavation, Trench 2 by depth.

Depth (cm)	Total		Fibre temper									
	Weight (kg)	Quantity	Quantity	Rim		Body		Foot rim	Cà ràng			Decorated
				Rim	Wavy	Cord-mark	Plain		Rim	Body	Projection	
0–10	47.96	6187	1213	165	0	431	610	1	0	3	3	0
10–20	47.98	4181	824	170	0	208	429	9	1	0	7	0
20–30	77.37	4125	617	113	3	86	377	4	7	19	8	0
30–40	50.52	5706	1029	238	0	143	608	10	8	10	12	0
40–50	27.41	2446	297	58	0	34	175	1	11	12	6	0
50–60	56.51	4341	705	106	0	72	480	9	19	5	14	0
60–70	18.25	2474	263	32	0	144	82	1	1	0	3	0
70–80	39.37	5529	1259	160	0	631	459	5	4	0	0	0
80–90	26.25	3768	927	92	0	454	367	4	10	0	0	0
90–100	7.19	1352	234	21	0	93	118	1	1	0	0	0
Total	398.81	40109	7368	1155	3	2296	3705	45	62	49	53	0

Source: Compiled by C. Sarjeant.

Table 5.3b. Weight and quantity of all Sand temper and total of all An Sơn ceramic sherds, 2009 excavation, Trench 2 by depth.

Depth (cm)	Total		Sand temper						
	Weight (kg)	Quantity	Quantity	Rim		Body		Foot rim	Decorated
				Rim	Wavy	Cord-mark	Plain		
0–10	47.96	6187	4974	420	120	2588	1839	2	5
10–20	47.98	4181	3357	334	42	1771	1202	7	1
20–30	77.37	4125	3508	266	91	1810	1339	1	1
30–40	50.52	5706	4677	435	133	2630	1466	10	3
40–50	27.41	2446	2149	185	46	1091	825	2	0
50–60	56.51	4341	3636	385	116	1795	1337	2	1
60–70	18.25	2474	2211	153	57	1189	809	2	1
70–80	39.37	5529	4270	324	52	2410	1476	8	0
80–90	26.25	3768	2841	185	74	1718	846	18	0
90–100	7.19	1352	1118	45	38	605	421	9	0
Total	398.81	40109	32741	2732	769	17607	11560	61	12

Source: Compiled by C. Sarjeant.

Table 5.4a. Weight and quantity of all Fibre temper and total of all An Sơn ceramic sherds, 2009 excavation, Trench 2 by layer.

Depth (cm)	Total		Fibre temper									
	Weight (kg)	Quantity	Quantity	Rim		Body		Foot rim	Cà ràng			Decorated
				Rim	Wavy	Cord-mark	Plain		Rim	Body	Projection	
1	26.73	3474	979	121	0	299	555	1	0	0	3	0
1/2	7.49	354	123	13	0	25	82	1	1	0	1	0
2	10.46	1510	322	20	0	165	135	1	0	0	1	0
2/3	30.12	3313	597	94	0	183	290	3	17	5	5	0
3	36.98	4779	986	143	0	258	546	1	7	19	12	0
3/4	23.41	2323	542	102	0	191	240	5	0	0	4	0
4	6.25	472	126	10	0	12	104	0	0	0	0	0
4/5	24.00	2887	454	74	0	176	198	2	1	0	3	0
5	8.37	1007	106	34	0	15	55	0	0	0	2	0
5/6	29.75	3706	667	70	0	280	298	6	8	0	5	0
6	8.55	679	179	74	0	10	86	4	0	3	2	0
6/7	3.73	649	129	18	0	68	41	1	1	0	0	0
7	17.83	2111	280	38	0	105	128	1	4	2	2	0
7/8	8.12	995	151	31	0	69	51	0	0	0	0	0
8	48.22	1198	175	23	3	60	89	0	0	0	0	0
8/9	32.28	2862	403	81	0	85	226	9	0	0	2	0
9	11.73	1026	83	27	0	14	40	0	0	1	1	0
9/10	1.98	510	97	6	0	45	45	1	0	0	0	0
10	3.74	382	23	9	0	8	5	1	0	0	0	0

Depth (cm)	Total		Fibre temper										
	Weight (kg)	Quantity	Quantity	Rim		Body		Foot rim	Cà ràng			Decorated
				Rim	Wavy	Cord-mark	Plain		Rim	Body	Projection	
11	0.00	0	0	0	0	0	0	0	0	0	0	0
11/12	0.22	30	0	0	0	0	0	0	0	0	0	0
12	0.36	90	64	0	0	64	0	0	0	0	0	0
13	0.00	0	0	0	0	0	0	0	0	0	0	0
14	0.00	0	0	0	0	0	0	0	0	0	0	0
15	58.49	5752	882	167	0	164	491	8	23	19	10	0
Total	398.81	40109	7368	1155	3	2296	3705	45	62	49	53	0

Source: Compiled by C. Sarjeant.

Table 5.4b. Weight and quantity of all Sand temper and total of all An Sơn ceramic sherds, 2009 excavation, Trench 2 by layer.

Depth (cm)	Total		Sand temper						
	Weight (kg)	Quantity	Quantity	Rim		Body		Foot rim	Decorated
				Rim	Wavy	Cord-mark	Plain		
1	26.73	3474	2495	230	49	1288	927	1	0
1/2	7.49	354	231	7	27	133	60	4	0
2	10.46	1510	1188	55	22	634	469	7	1
2/3	30.12	3313	2716	222	71	1403	1019	1	0
3	36.98	4779	3793	320	119	2047	1298	5	4
3/4	23.41	2323	1781	156	80	874	664	7	0
4	6.25	472	346	54	5	150	136	0	1
4/5	24.00	2887	2433	159	61	1367	836	10	0
5	8.37	1007	901	67	37	417	377	0	3
5/6	29.75	3706	3039	235	29	1763	1001	11	0
6	8.55	679	500	63	31	256	148	1	1
6/7	3.73	649	520	33	3	328	155	0	1
7	17.83	2111	1831	130	22	972	707	0	0
7/8	8.12	995	844	97	17	417	313	0	0
8	48.22	1198	1023	85	18	560	359	1	0
8/9	32.28	2862	2459	246	46	1438	721	8	0
9	11.73	1026	943	120	13	511	298	0	1
9/10	1.98	510	413	15	18	255	123	2	0
10	3.74	382	359	14	5	186	154	0	0
11	0.00	0	0	0	0	0	0	0	0
11/12	0.22	30	30	0	0	20	10	0	0
12	0.36	90	26	2	0	0	24	0	0
13	0.00	0	0	0	0	0	0	0	0

14	0.00	0	0	0	0	0	0	0	0
15	58.49	5752	4870	422	96	2588	1761	3	0
Total	398.81	40109	32741	2732	769	17607	11560	61	12

Source: Compiled by C. Sarjeant.

Table 5.5a. Weight and quantity of all Fibre temper and total of all An Sơn ceramic sherds, 2009 excavation, Trench 2 by square.

Square	**Total** Weight (kg)	**Total** Quantity	**Fibre temper** Quantity	Rim: Rim	Rim: Wavy	Body: Cord-mark	Body: Plain	Foot rim	Cà ràng: Rim	Cà ràng: Body	Cà ràng: Projection	Decorated
A1	0.65	76	8	1	0	5	2	0	0	0	0	0
A2	3.45	470	149	14	0	104	29	2	0	0	0	0
A3	6.53	674	79	21	0	14	42	0	0	1	1	0
A4	3.18	435	59	9	3	28	18	1	0	0	0	0
A5	11.43	974	144	25	0	62	55	0	1	0	1	0
B1	1.74	165	11	0	0	0	11	0	0	0	0	0
B2	38.34	79	0	0	0	0	0	0	0	0	0	0
B3	10.15	1094	73	10	0	16	47	0	0	0	0	0
B4	13.77	1063	102	24	0	21	54	0	0	2	1	0
B5	14.04	1539	240	40	0	76	123	1	0	0	0	0
C1	10.09	999	115	11	0	41	57	1	4	0	1	0
C2	13.65	1462	361	44	0	80	228	8	0	0	1	0
C3	14.2	2206	250	46	0	51	148	1	0	0	4	0
C4	14.53	1430	259	34	0	79	140	4	0	0	2	0
C5	16.38	1791	340	44	0	159	121	2	5	7	2	0
D1	11.85	1115	203	43	0	95	65	0	0	0	0	0
D2	19.88	2710	434	82	0	113	232	4	1	0	2	0
D3	41.21	5239	795	145	0	185	430	0	7	19	9	0
D4	25.94	2585	628	118	0	164	328	4	10	0	4	0
D5	19.48	2167	415	63	0	162	173	1	7	5	4	0
E1	17.75	1487	372	98	0	95	167	5	0	3	4	0
E2	17.23	2050	480	94	0	141	236	2	4	0	3	0
E3	32.92	3472	711	103	0	180	377	6	22	12	11	0
E4	18.87	1763	363	20	0	98	243	1	0	0	1	0
E5	21.55	3064	777	66	0	327	379	2	1	0	2	0
Total	398.81	40109	7368	1155	3	2296	3705	45	62	49	53	0

Source: Compiled by C. Sarjeant.

Table 5.5b. Weight and quantity of all Sand temper and total of all An Sơn ceramic sherds, 2009 excavation, Trench 2 by square.

Square	Total		Sand temper						
	Weight (kg)	Quantity	Quantity	Rim		Body		Foot rim	Decorated
				Rim	Wavy	Cord-mark	Plain		
A1	0.65	76	68	1	1	43	23	0	0
A2	3.45	470	321	20	15	162	124	0	0
A3	6.53	674	595	37	10	337	209	2	0
A4	3.18	435	376	29	8	212	127	0	0
A5	11.43	974	830	110	4	419	296	0	1
B1	1.74	165	154	0	0	78	76	0	0
B2	38.34	79	79	0	0	70	9	0	0
B3	10.15	1094	1021	130	11	583	296	0	1
B4	13.77	1063	961	132	17	470	335	7	0
B5	14.04	1539	1299	142	36	605	514	2	0
C1	10.09	999	884	66	9	529	280	0	0
C2	13.65	1462	1101	52	27	647	375	0	0
C3	14.2	2206	1956	149	39	1064	703	1	0
C4	14.53	1430	1171	72	31	548	519	1	0
C5	16.38	1791	1451	132	43	819	452	5	0
D1	11.85	1115	912	130	14	402	364	2	0
D2	19.88	2710	2276	175	29	1284	788	0	0
D3	41.21	5239	4444	318	128	2423	1562	9	4
D4	25.94	2585	1957	242	56	984	673	2	0
D5	19.48	2167	1752	138	56	802	755	1	0
E1	17.75	1487	1115	134	48	600	331	2	0
E2	17.23	2050	1570	139	21	763	642	1	4
E3	32.92	3472	2761	191	89	1668	801	11	1
E4	18.87	1763	1400	52	19	837	488	4	0
E5	21.55	3064	2287	141	58	1258	818	11	1
Total	398.81	40109	32741	2732	769	17607	11560	61	12

Source: Compiled by C. Sarjeant.

Table 5.6a. Weight and quantity of all Fibre temper and total of all An Sơn ceramic sherds, 2009 excavation, Trench 3.

Layer	Total		Fibre temper									
	Weight (kg)	Quantity	Quantity	Rim		Body		Foot rim	Cà ràng			Decorated
				Rim	Wavy	Cord-mark	Plain		Rim	Body	Projection	
1	87.48	8587	2429	234	0	387	1795	8	2	0	3	0
1/2	61.65	6163	1451	114	0	116	1214	6	0	0	1	0
2	115.66	11574	2781	233	0	148	2373	24	0	0	3	0
2/3	18.84	1981	857	73	0	39	742	2	0	0	1	0
3	34.32	4446	2449	152	0	171	2124	2	0	0	0	0
3/4	16.01	1303	502	80	0	65	355	1	1	0	0	0

Layer	Total		Fibre temper									
	Weight (kg)	Quantity	Quantity	Rim		Body		Foot rim	Cà ràng			Decorated
				Rim	Wavy	Cord-mark	Plain		Rim	Body	Projection	
4	3.84	417	150	12	0	12	125	0	1	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	43.49	4941	1769	148	0	80	1531	5	4	0	1	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	123.81	10351	3894	487	0	411	2980	11	0	0	5	0
Total	505.1	49763	16282	1533	0	1429	13239	59	8	0	14	0

Source: Compiled by C. Sarjeant.

Table 5.6b. Weight and quantity of all Sand temper and total of all An Sơn ceramic sherds, 2009 excavation, Trench 3.

Layer	Total		Sand temper						
	Weight (kg)	Quantity	Quantity	Rim		Body		Foot rim	Decorated
				Rim	Wavy	Cord-mark	Plain		
1	87.48	8587	6158	1153	174	817	4006	7	1
1/2	61.65	6163	4712	1391	52	294	2974	1	0
2	115.66	11574	8793	2131	0	657	5992	13	0
2/3	18.84	1981	1124	205	0	219	700	0	0
3	34.32	4446	1997	311	0	567	1112	7	0
3/4	16.01	1303	801	126	0	167	506	2	0
4	3.84	417	267	32	55	113	65	0	2
5	0	0	0	0	0	0	0	0	0
6	43.49	4941	3172	564	1	599	1997	6	5
7	0	0	0	0	0	0	0	0	0
8	123.81	10351	6457	1284	216	1085	3860	12	0
Total	505.1	49763	33481	7197	498	4518	21212	48	8

Source: Compiled by C. Sarjeant.

Table 5.7a. Weight and quantity of all Fibre temper and total of all An Sơn ceramic sherds, 2009 excavation, Test Square.

Depth (cm)	Total		Fibre temper									
	Weight (kg)	Quantity	Quantity	Rim		Body		Foot rim	Cà ràng			Decorated
				Rim	Wavy	Cord-mark	Plain		Rim	Body	Projection	
0–60 cm	2.09	133	54	0	0	16	38	0	0	0	0	0
60–140 cm	2.35	135	26	8	0	3	14	1	0	0	0	0
140–180 cm	7.74	643	112	14	0	38	60	0	0	0	0	0
150–160 cm	6.86	570	7	6	0	1	0	0	0	0	0	0
160–170 cm	3.75	280	35	5	0	0	30	0	0	0	0	0
170–180 cm	2.28	140	15	9	0	6	0	0	0	0	0	0
180–190 cm	2.56	277	26	1	0	4	18	0	3	0	0	0
190–200 cm	1.96	243	18	3	0	0	15	0	0	0	0	0
200–210 cm	8.26	725	136	25	0	34	75	0	1	0	1	0
210–220 cm	5.4	372	48	4	0	17	5	0	5	14	3	0

Depth (cm)	Total		Fibre temper									
	Weight (kg)	Quantity	Quantity	Rim		Body		Foot rim	Cà ràng			Decorated
				Rim	Wavy	Cord-mark	Plain		Rim	Body	Projection	
220–230 cm	9.2	962	117	30	0	40	42	2	3	0	0	0
230–240 cm	4.97	485	69	29	0	29	10	0	1	0	0	0
240–250 cm	4.41	782	50	18	0	19	13	0	0	0	0	0
250–260 cm	1.2	244	56	8	0	23	25	0	0	0	0	0
unknown	10.05	773	98	9	0	30	56	3	0	0	0	0
Total	73.08	6764	867	169	0	260	401	6	13	14	4	0

Source: Compiled by C. Sarjeant.

Table 5.7b. Weight and quantity of all Sand temper and total of all An Sơn ceramic sherds, 2009 excavation, Test Square.

Depth (cm)	Total		Sand temper						
	Weight (kg)	Quantity	Quantity	Rim		Body		Foot rim	Decorated
				Rim	Wavy	Cord-mark	Plain		
0–60 cm	2.09	133	79	25	0	4	50	0	0
60–140 cm	2.35	135	109	34	0	4	71	0	0
140–180 cm	7.74	643	531	168	0	164	198	0	1
150–160 cm	6.86	570	563	164	3	80	316	0	0
160–170 cm	3.75	280	245	69	2	36	138	0	0
170–180 cm	2.28	140	125	33	5	12	75	0	0
180–190 cm	2.56	277	251	59	4	56	132	0	0
190–200 cm	1.96	243	225	37	0	72	116	0	0
200–210 cm	8.26	725	589	159	22	156	252	0	0
210–220 cm	5.4	372	324	83	5	61	175	0	0
220–230 cm	9.2	962	845	161	112	279	292	1	0
230–240 cm	4.97	485	416	113	12	112	179	0	0
240–250 cm	4.41	782	732	311	64	0	112	245	0
250–260 cm	1.2	244	188	15	18	97	58	0	0
unknown	10.05	773	675	243	2	101	328	1	0
Total	73.08	6764	5897	1674	249	1234	2492	247	1

Source: Compiled by C. Sarjeant.

Characterisation of the ceramic sequence

The total counts of the ceramic assemblage indicate different contents in each excavation trench. Trench 1 displayed the clearest stratigraphic sequence of all the 2009 excavation trenches, and its ceramic contents can be used to characterise the ceramic sequence at An Sơn. Trench 1 did not appear to contain layers contemporary with the earliest known layers identified in the 1997 excavation, and thus the overall sequence was expanded beyond Trench 1 with information about the ceramic assemblages from the lower layers of the Test Square and the 1997 excavation. Trench 2 displayed an assemblage that was more comprehensible when considered over horizontal rather than vertical space. The thin lenses and layers of Trench 2 suggest rapid deposition associated with burning, midden deposition and cooking. While the stratigraphy of Trench 3 was relatively simple, the effects of clay deposition due to runoff from the main mound rendered most of its depth unable to be analysed. Survival of bone and shell was non-existent in Trench 3, and erosion of the ceramic sherds meant that little diagnostic material was recovered.

This section describes the rim form categories and sequences for each trench, the complete vessel forms, and the sequence of decorative modes at An Sơn.

Rim forms

The categorisation of the rim forms is based on the principles and terminology presented by Anna Shepard (1965). Five rim form classes, A, B, C, D and E, were identified in the An Sơn ceramic assemblage. Class A were everted rim forms from independent restricted and unrestricted vessels. Class A was divided into A1, straight everted rims, and A2, concave everted rims. Class B were simple restricted vessels, or bowls. Class C were simple unrestricted, sometimes restricted, vessels, or dishes. Class D were wavy and serrated rimmed unrestricted vessels. Class E, known as *cà ràng* in Vietnamese, were stove vessels with three projections to support another vessel during cooking (Figure 5.1).

The categorisation focuses on the rim form rather than the entire vessel, as few complete vessels were recovered from the 2009 excavation except from burials (shown in Figure 5.14). Thus, the A1 rim forms, in particular, were observed as both restricted and unrestricted when the complete vessel was recovered, but this vessel shape was not identifiable from small rim sherds. Additionally, the scope of variation within the C1 rim forms resulted in some appearing as simple restricted vessels with an inverted rim and others as simple unrestricted vessels with a direct rim (Figure 5.1). Additional features of vessels included pedestals on many of the forms when complete vessels were recovered (Figure 5.14).

The variations within each rim form are displayed in Figure 5.2, although these variant rim forms were not present in large numbers in the 2009 excavation. This variation in specific rim forms is discussed further in the study of standardisation in Chapter 7. The variations were not included in the categorisation presented in Figure 5.1, because of their infrequency in the 2009 assemblage. Foot rims were also not included in this categorisation because they were not diagnostic of specific vessel forms.

The proportion of each rim form in the basic classes A to E is presented for each 2009 excavation trench, and a detailed examination of the rim forms is shown for Trench 1 squares A1, A2, B1, B2, C1 and C2 in the remainder of this section.

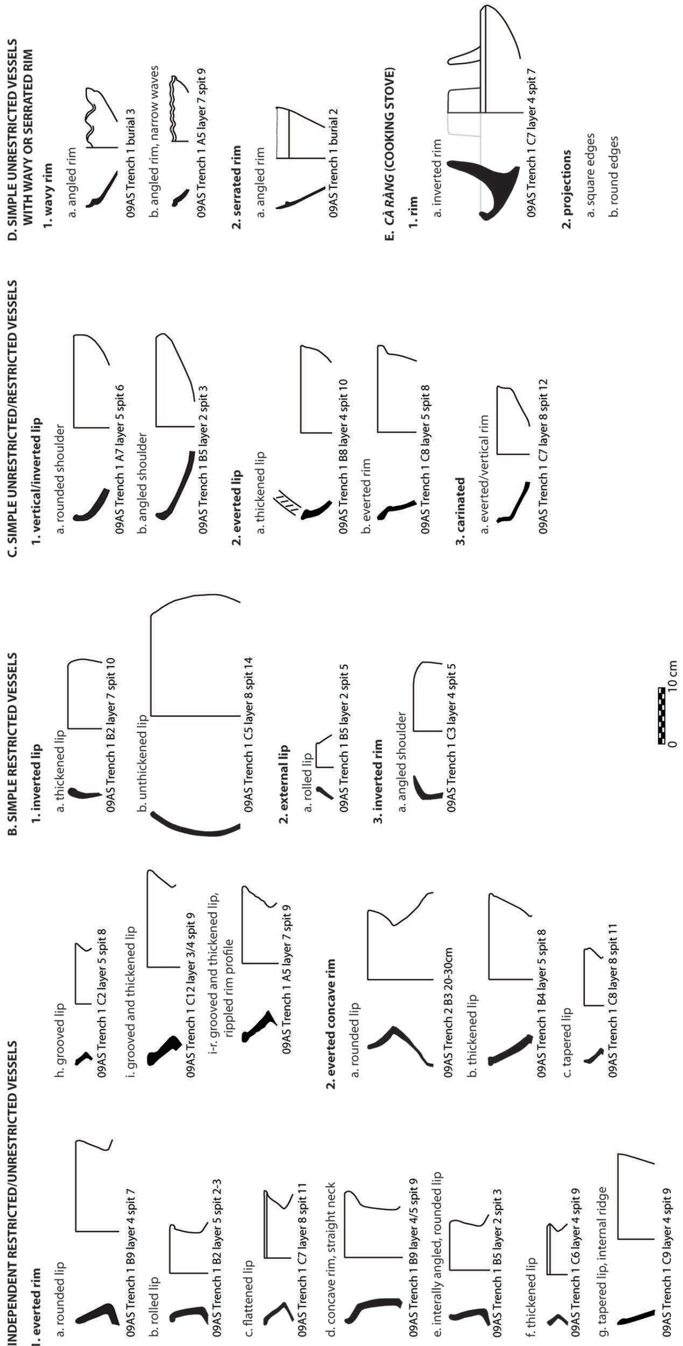


Figure 5.1. Categorisation of An Sơn ceramic rim forms.

Source: C. Sarjeant.

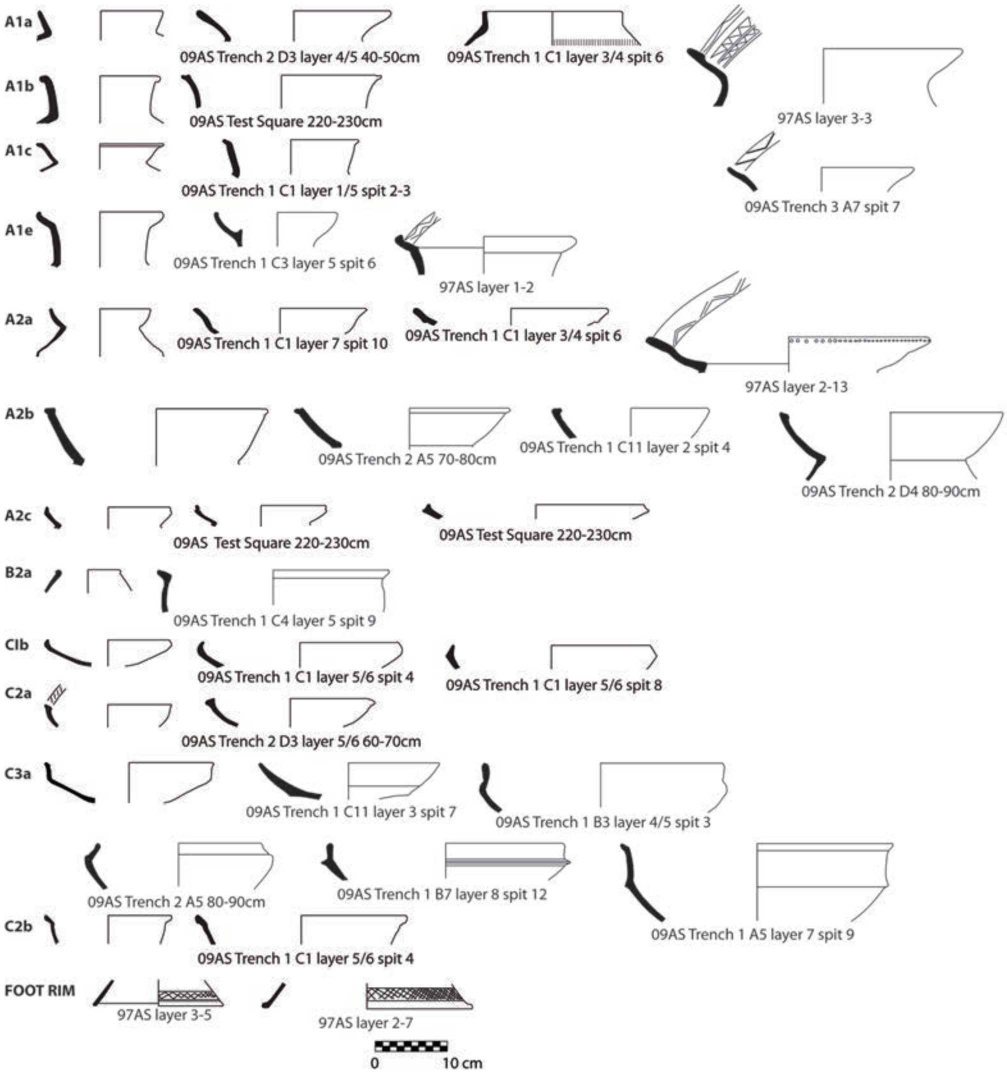


Figure 5.2. Variations within the An Sơn ceramic rim forms categorised in Figure 5.1.

Source: C. Sarjeant.

All squares

In Trench 1, rim form A1a was dominant throughout all of the layers. Form A1b was present in small numbers throughout the layers, occuring mainly in layers 3 to 6. Forms A1c and A1h were present in small numbers throughout all layers. A1d and A1e were present in higher quantities than the other A1 varieties, except for A1a, particularly in layers 3 to 6 for A1d. A1f was present in higher quantities in layer 3. Form A1g was present in higher quantities in layers 1 to 4, and A1i was present in small quantities in layers 3, 7 and 8. The rippled profile variant of A1i (A1i-r) appeared infrequently from layer 6 into the upper layers.

Form A2a was present in all layers. A2b was not present in Trench 1, while A2c was present in small quantities in layers 7 and 8 only. B1a was present in greatest quantities in layer 8. B1b was not present in Trench 1. With the exception of the upper layers, B2a was present throughout, and most commonly in layer 8. B3a was minimal in Trench 1. C1a was present throughout the layers in noticeable quantities. The other class C forms were minimal in numbers, except for C3a, which was present throughout with highest quantities in layers 7 and 8. D1a was also in greatest numbers in layers 7 and 8, but occurred throughout the sequence with a marked decline in layers

1 and 2. D1b was only present in layers 7 and 8, while D2a was minimal in Trench 1. Class E *cà ràng* sherds were identified in each layer, with the largest quantities present mid-sequence (Figure 5.3, Figure 5.4).

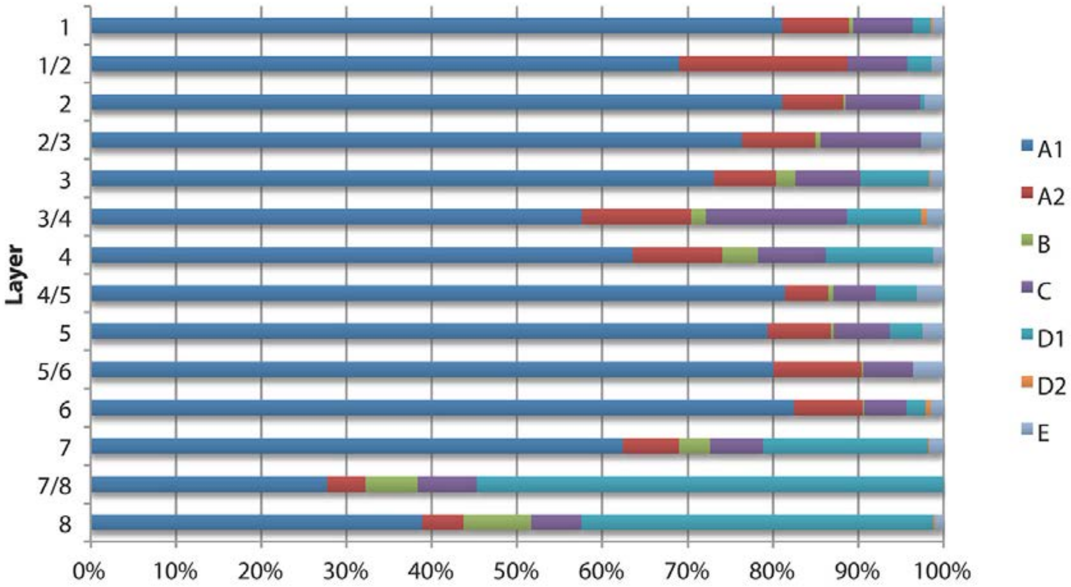


Figure 5.3. Proportion of rim form classes A1, A2, B, C, D1, D2 and E by layers, Trench 1, all squares.

Source: C. Sarjeant.

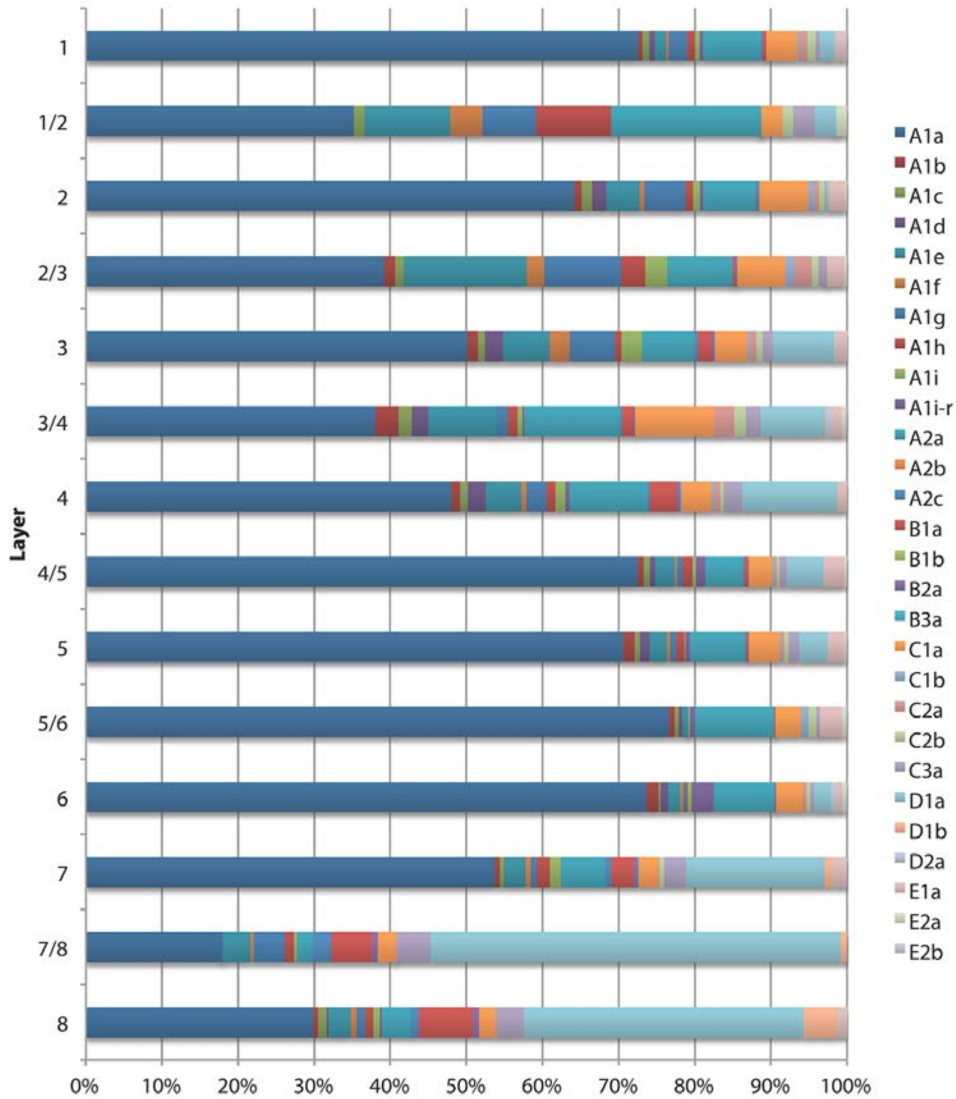


Figure 5.4. Proportion of rim forms by layer, Trench 1, all squares.

Source: C. Sarjeant.

Trench 1: Squares A1, A2, B1, B2, C1 and C2

After observing only the rims in the six squares some patterns became clear in Trench 1 located closest to the main mound, (A1, A2, B1, B2, C1 and C2). Some rim forms were not present in these squares, and the number of A1i-r, B1b, B3a, D1b and D2a forms were minimal. A decline in the occurrence of A1a was marked in layers 7 and 8 compared to the upper layers, where A2a, B1a, and most notably D1a rim sherds were in greater proportions. C1a and C1b rim sherds declined in proportion from the top to the lowest layers. C2b was present in highest numbers mid-sequence. C3a was only present from layers 5 to 7. D1a was present in greatest numbers in layers 7 and 8, but was still present as high as layer 5. D1b and D2a were rare in these six squares of Trench 1. Class E was also rare but occurred in highest quantities mid-sequence (Figure 5.5, Figure 5.6).

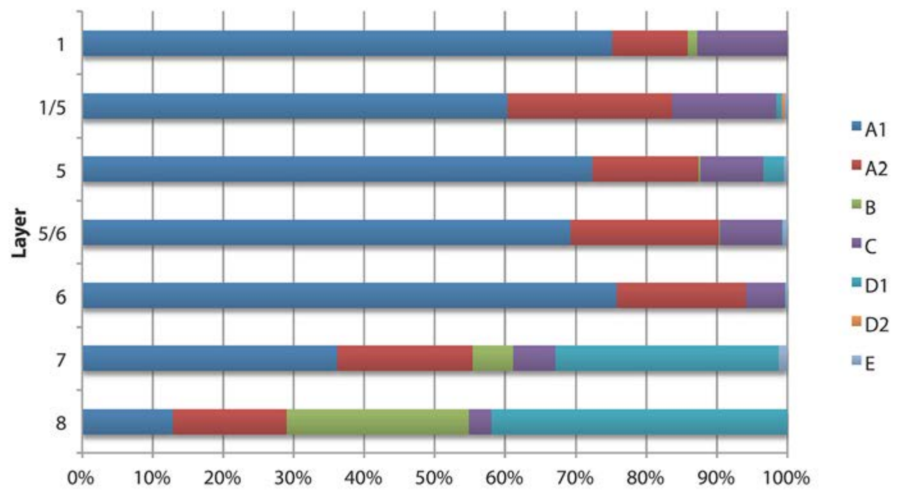


Figure 5.5. Proportion of rim form classes A1, A2, B, C, D1, D2 and E by layer, Trench 1, squares A1, A2, B1, B2, C1, C2.

Source: C. Sarjeant.

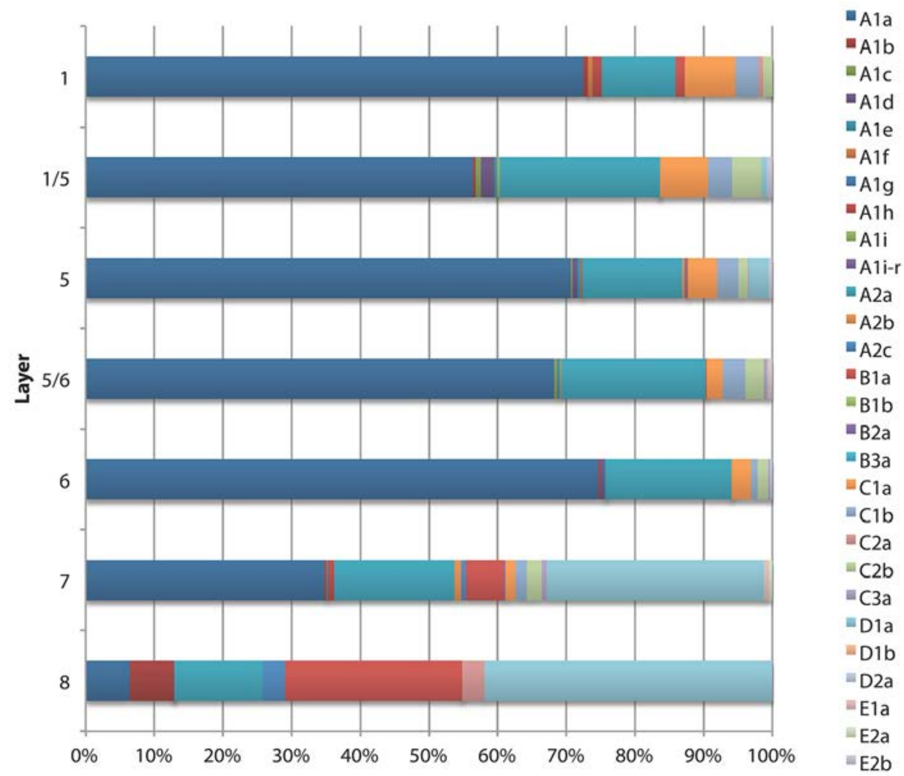


Figure 5.6. Proportion of rim forms by layer, Trench 1, squares A1, A2, B1, B2, C1, C2.

Source: C. Sarjeant.

Trench 2

Trench 2 had a different internal stratigraphy to Trench 1, as it was quite separate from the stratigraphy of the main mound itself (see Chapter 4). The contents of the smaller lenses with concreted ashy midden material and charcoal stained soil suggested that the area of Trench 2 was used as an activity rather than as a dumping area located away from the side of the mound. During excavation it was thought the lenses were deposited horizontally in quick succession, therefore the majority were roughly contemporaneous.

The deposits from Trench 2 20–60 cm contained a similar composition of rim forms to Trench 1. Rim forms A1 and A2 dominated the assemblage of Trench 2, with a greater presence of A1 throughout the spits. Class B rim forms were minimal mid-sequence, from 10–70 cm, with much higher proportions in the 80–100 cm deposits. Class C was present throughout the layers. The wavy rimmed D1 form was present throughout the spits, but in highest proportions in the 40–100 cm spits. The serrated rim form D2a was present in largest quantities at 0–60 cm, with few to none in the lower spits. Class E was a more significant component of each spit in Trench 2 than in the other trenches. Class E *cà ràng* sherds were most common in 20–60 cm deposits, diminishing in the 60–90 cm spits, with none in the basal 90–100 cm spit (Figure 5.7, Figure 5.8).

Very few D2 sherds were identified in Trench 1, and the majority were recovered from Trench 2 in the 2009 excavation. The Trench 2 deposits were contemporaneous with use of the serrated D2 rim. This form is unique to An Sơn and can be used as a temporal marker, when establishing a chronology of the ceramic forms in relation to the well-dated burials (as discussed in Chapter 10).

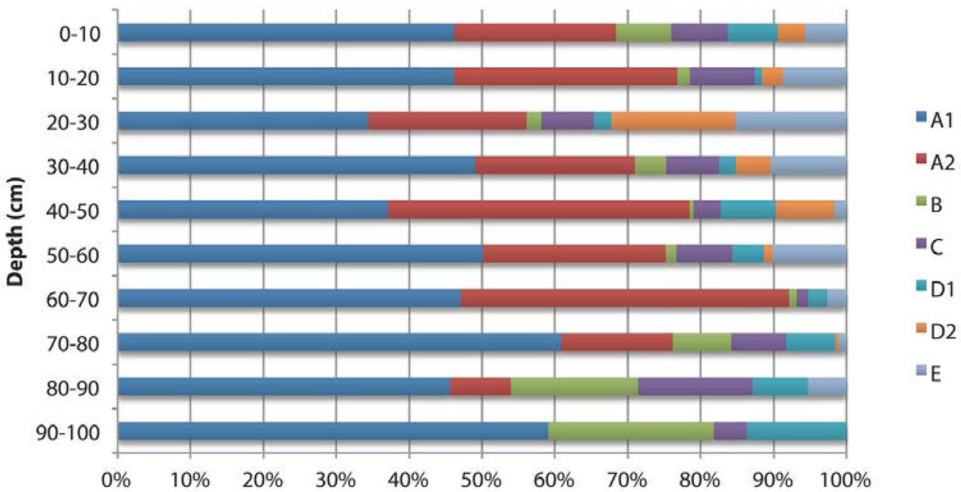


Figure 5.7. Proportion of rim form classes A1, A2, B, C, D1, D2 and E by depth, Trench 2.

Source: C. Sarjeant.

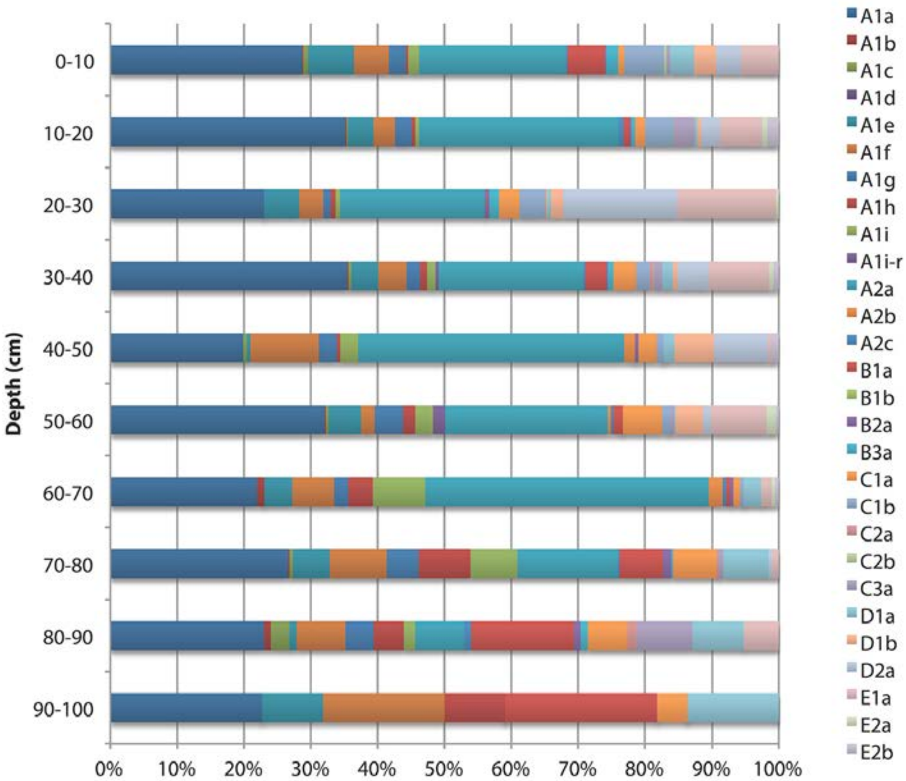


Figure 5.8. Proportion of rim forms by depth, Trench 2.

Source: C. Sarjeant.

Trench 3

The stratigraphy was not as clear in Trench 3 as it was in Trench 1, and this trench offered little information for understanding the ceramic sequence at An Sơn. The plots (Figure 5.9, Figure 5.10) show there was an overwhelming dominance of A1 rim forms throughout the Trench 3 sequence.

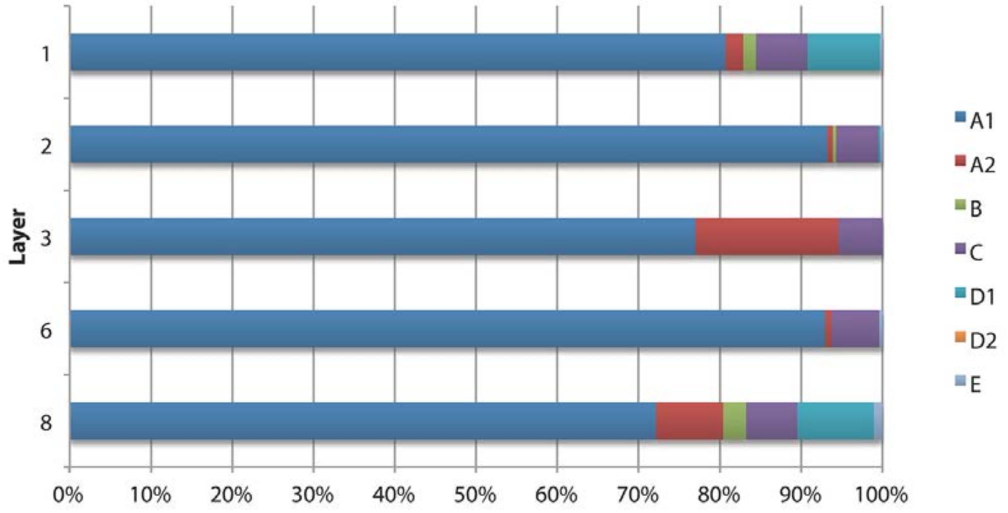


Figure 5.9. Proportion of rim form classes A1, A2, B, C, D1, D2 and E by layer, Trench 3.

Source: C. Sarjeant.

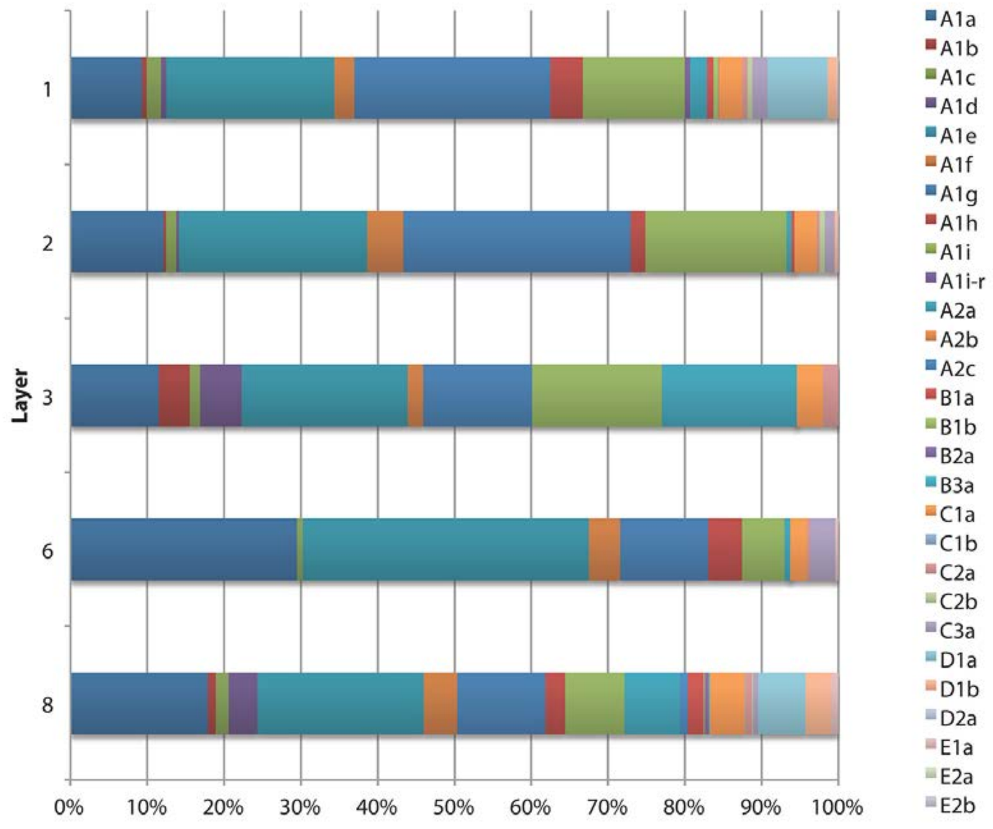


Figure 5.10. Proportion of rim forms by layer, Trench 3.

Source: C. Sarjeant.

Test Square

The Test Square represented the earlier part of the sequence and only the lower spits are reported here (200–260 cm). Due to the small size of the excavation, only dominant rim forms (Figure 5.1) were excavated from this trench. A clear transition in rim forms was observed in the Test Square, with A2 concave rims, present in higher quantities than the A1 everted rims. This trend was also observed in the lower layers of Trench 1 (Figure 5.5). Generally, the A2 rim forms comprised the same proportion of the assemblage in each 10 cm spit. Class B was also important in the earlier sequence in both Trench 1 and the Test Square, especially below 220 cm in the latter. Class C only occurred from 200 to 230 cm in the Test Square. The wavy rimmed D1 forms were present in all of the Test Square layers in notable quantities, except in the basal layer 250–260 cm, while the D2 serrated rims were absent in the Test Square. There were few *cà ràng* class E sherds present in the Test Square, only from 200 to 220 cm (Figure 5.11, Figure 5.12).

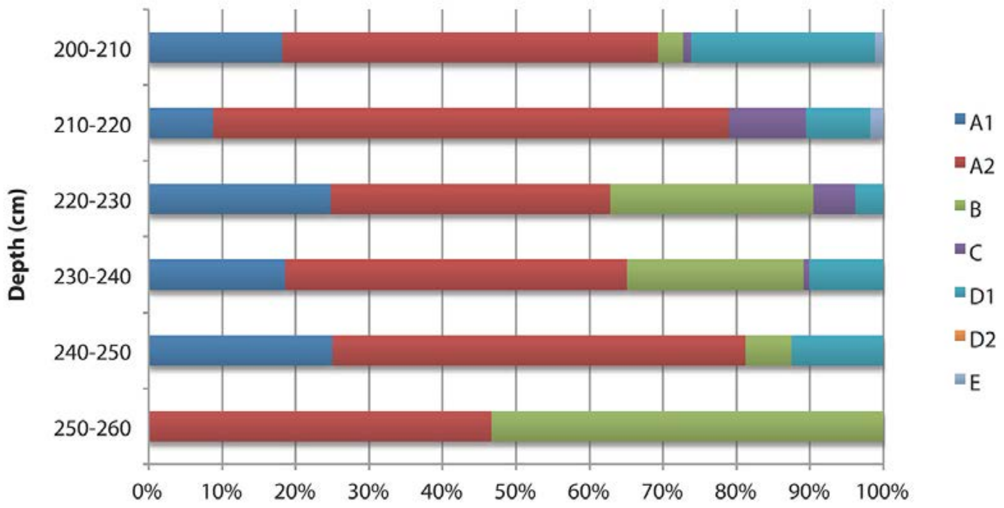


Figure 5.11. Proportion of rim form classes A1, A2, B, C, D1, D2 and E by depth, Test Square.

Source: C. Sarjeant.

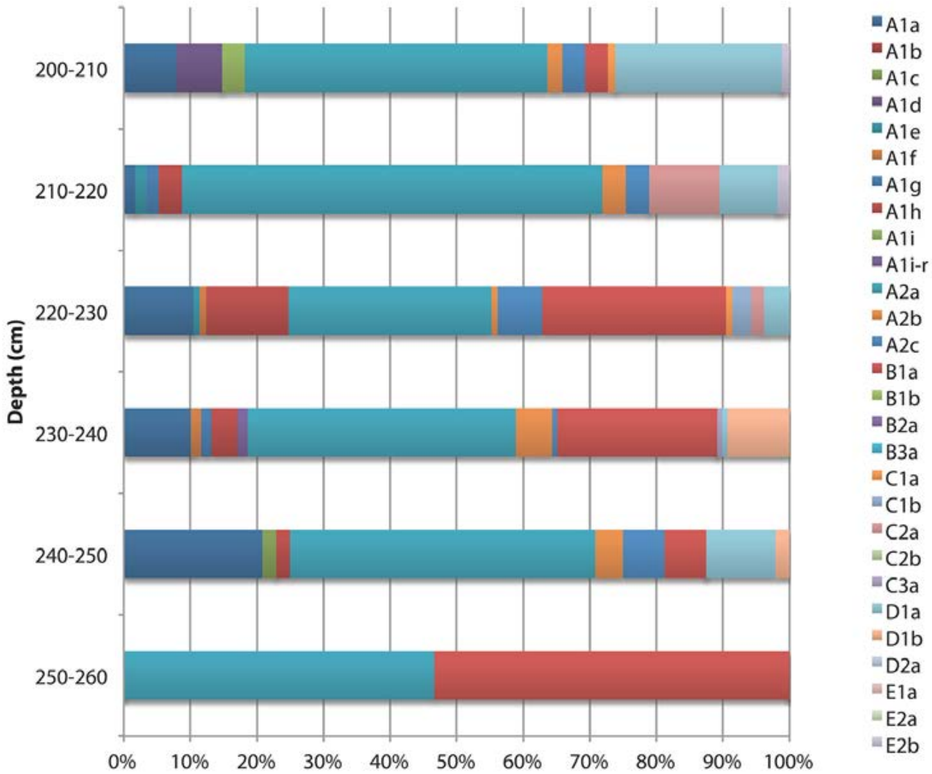


Figure 5.12. Proportion of rim forms by depth, Test Square.

Source: C. Sarjeant.

1997 excavation basal layers

The 1997 excavation layers 3–4 and 3–5 clarify the sequence of rim forms (Figure 5.1) at the inception of occupation at An Sơn. The restricted bowls with unthickened rims (B1b) dominated these lowest layers, along with some A1a and A2a rims. Greater variety appeared in the 1997 layer 3–4, which revealed a dominance of the wavy rim vessels (D1), especially the narrow wave variety (D1b). The other rim forms observed in this layer, in order of frequency, were A2a, A1a, B1a, A2b, C3a, A2c, A1f, B2a and C1b. B1b rim sherds were not present in layer 3–4, so perhaps they were replaced by the thickened rim variety, B1a (Figure 5.13).

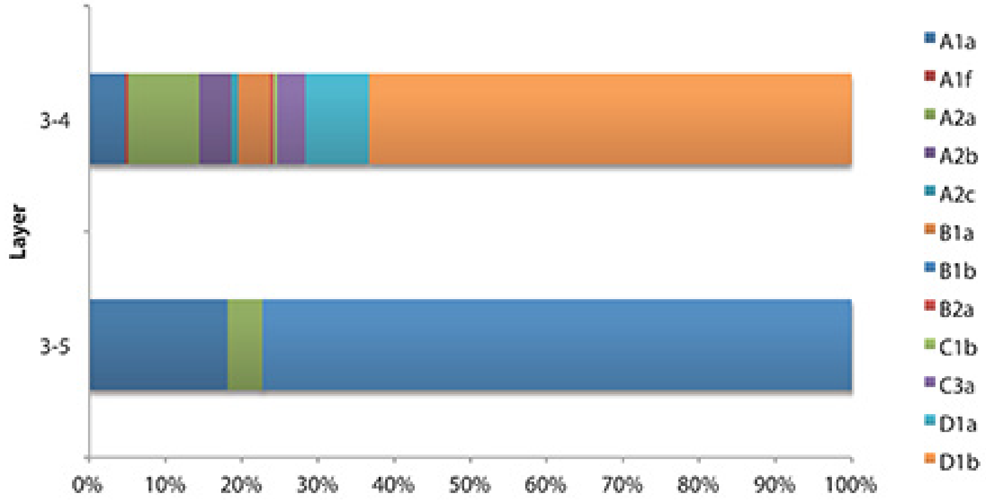


Figure 5.13. Proportion of rim forms by layer, 1997 excavation, base layers. Only rim forms present in layers 3–4 and 3–5 are shown.

Source: C. Sarjeant.

Summary: Sequence of rim forms at An Sơn

Each class of rim form showed transitions throughout the An Sơn sequence. The lowest layers were characterised by a higher proportion of A2 versus A1 forms. This is apparent in the assemblage from 200–260 cm in the Test Square, and layer 8 in Trench 1. The transition to a higher proportion of A1 forms, specifically A1a, occurred between layers 7 and 8 in Trench 1. Conversely, the assemblage of Trench 2 exhibited a higher proportion of A1 in its basal layer 15, while A2 was only in higher proportions in layers 6 and 12. This further supports the observation that the area of Trench 2 was not in use during the earliest occupation at An Sơn.

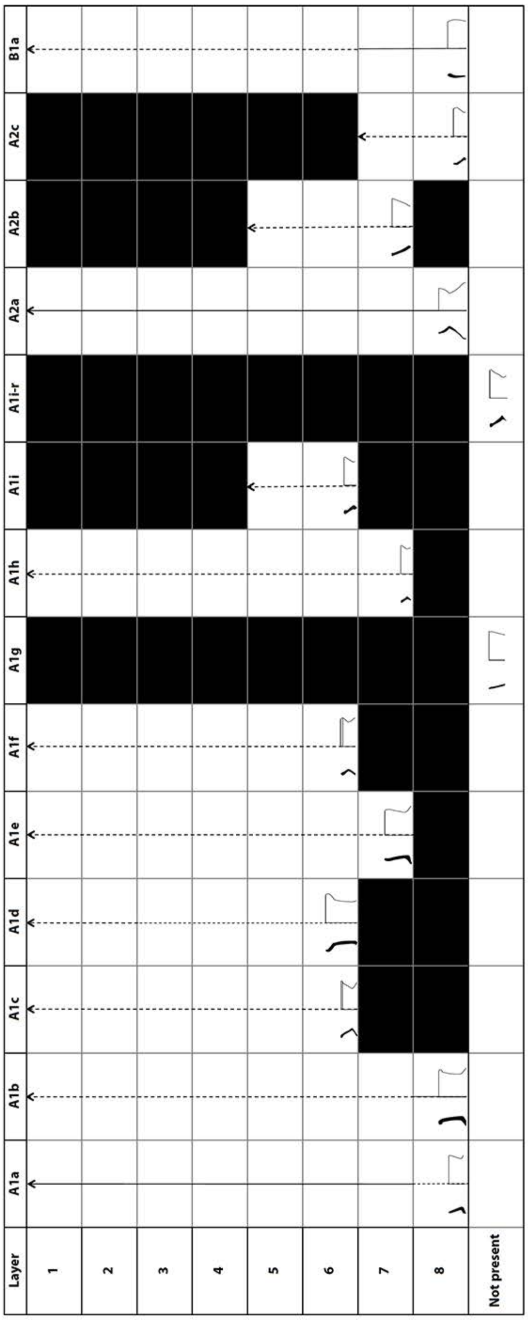
Class B forms were important in the earlier layers at An Sơn, and reveal a transition from B1b to B1a forms in the 1997 layers 3–5 to 3–4. The thickened rim of B1a was introduced during layer 3–4 and was common in the lower layers of Trenches 1 and 2 and the Test Square, where B1b ceased to be present. The class C ceramic forms diversified mid-sequence, but they were rare in the base layers and more common in Trench 1 layers 1 to 5.

Class D rim forms underwent some of the clearest morphological transitions through the An Sơn sequence. The early to middle layers were characterised by the D1 form with a wavy rim and round base, and the later sequence was characterised by a lack of D1, which was replaced by the D2 form with a serrated rim and conical-shaped base. The initial settlement at An Sơn is unlikely to have included class D, as they were absent in the lowest spit of the 2009 Test Square, at 250–260 cm, and the 1997 layer 3–5. Form D1 first appeared in layer 3–4 of the 1997 excavation. D2 were rare in 2009 Trench 1 and only occurred in layers 1 to 5, but were dominant in Trench 2 layer 3. The transition between the characteristic D1 and D2 forms was rapid with a period of experimentation when waves were transformed into serrations at the rim. This transition in rim form is shown in Figure 10.1 and is further discussed in terms of chronology and ceramic markers, and innovative behaviours amongst potters in Chapter 10.

Class E forms were rare in the earliest layers, with no *cà ràng* sherds from 200–260 cm in the Test Square. However, there was a change in the shapes of *cà ràng* projections in Trench 1, where square-shaped projections (E2a) were in higher proportions in the lower to mid layers, and rounded projections (E2b) in greater proportions in the middle to upper layers. In Trench 2, class E sherds were most commonly identified in layers 3, 7, 8 and 15, i.e. mid-sequence, with both square and round projections present. Very few *cà ràng* sherds were identified in layers 1 and 2 of Trench 2.

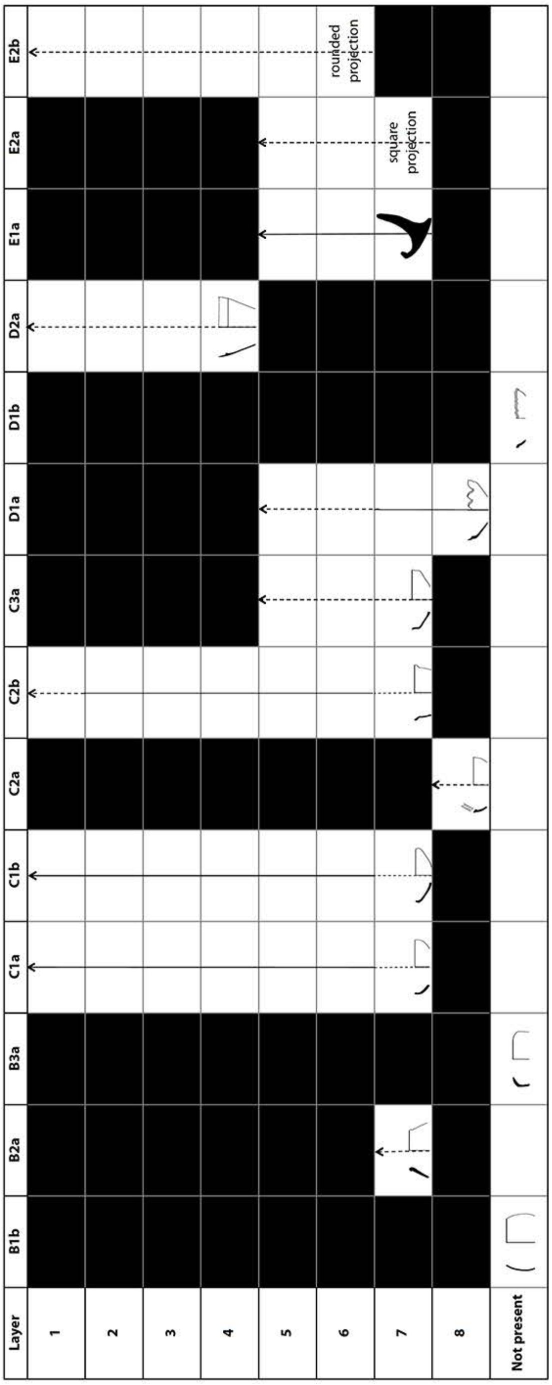
Table 5.8 presents the sequence of rim forms from the An Sơn 2009 excavation season, based on the above observations, and in particular the stratigraphic sequence of rim forms in Trench 1.

Table 5.8. part A Sequence of rim forms, Trench 1. Forms A1g, A1i-r, B1b, B3a, and D1b were not present in Trench 1. Key: rim form image = first appearance of form in Trench 1, – rim form present in layer, - - diminishing proportion of rim form, blacked out areas = none of the rim form in layer.



Source: Compiled by C. Sarjeant.

Table 5.8. part B Sequence of rim forms, Trench 1. Forms A1g, A1i-r, B1b, B3a, and D1b were not present in Trench 1. Key: rim form image = first appearance of form in Trench 1, – rim form present in layer, - - diminishing proportion of rim form, blacked out areas = none of the rim form in layer.



Source: Compiled by C. Sarjeant.

Complete vessels

The complete or reconstructed vessels predominantly originated from burial contexts in the 2009 excavation. Given the small number of burials exposed in 2009, the number of complete vessels is accordingly small. While the complete vessels correspond to the rim forms shown in the categorisation in Figure 5.1, these vessels give further information about the body and base forms (Figure 5.14).

Mortuary vessels

A total of sixteen mortuary vessels were excavated in 2009, with one burial containing nine vessels. The burials at An Sơn most consistently included at least one class D vessel, which varied between the wavy and serrated forms (Figure 5.15). The burials that did not include a class D vessel were interred either with an A1a rim form vessel with a small, globular body, or with no vessels at all. Infant burials rarely included ceramic vessels (see Chapter 4). While there was some consistency in the selection of a class D vessel for burial, no other forms were obviously manufactured to be mortuary vessels. The one burial with many vessels included a variety of rim form classes: A1, A2, C and D, with the A2a vessel highly decorated with incised and impressed designs (09AS Trench 1 burial 2 (vessel #1) in Figure 5.14, Figure 5.16). Another burial included a unique vessel form in addition to D1a vessels (09AS Trench 2 burial 3 (vessel #1) in Figure 5.14).

Occupational vessels

The few complete vessels from occupational contexts were derived predominantly from the refuse disposal of damaged pots in Trench 1. These dense deposition layers consisted mostly of small sherds, but there were also a few reconstructable vessels. These included some large, decorated, probably ritualistic vessels (e.g. 09AS Trench 1 A6 layer 5 spit 6–7 in Figure 5.14, Figure 5.16), as well as more common utilitarian vessels that match the rim forms in Figure 5.1.

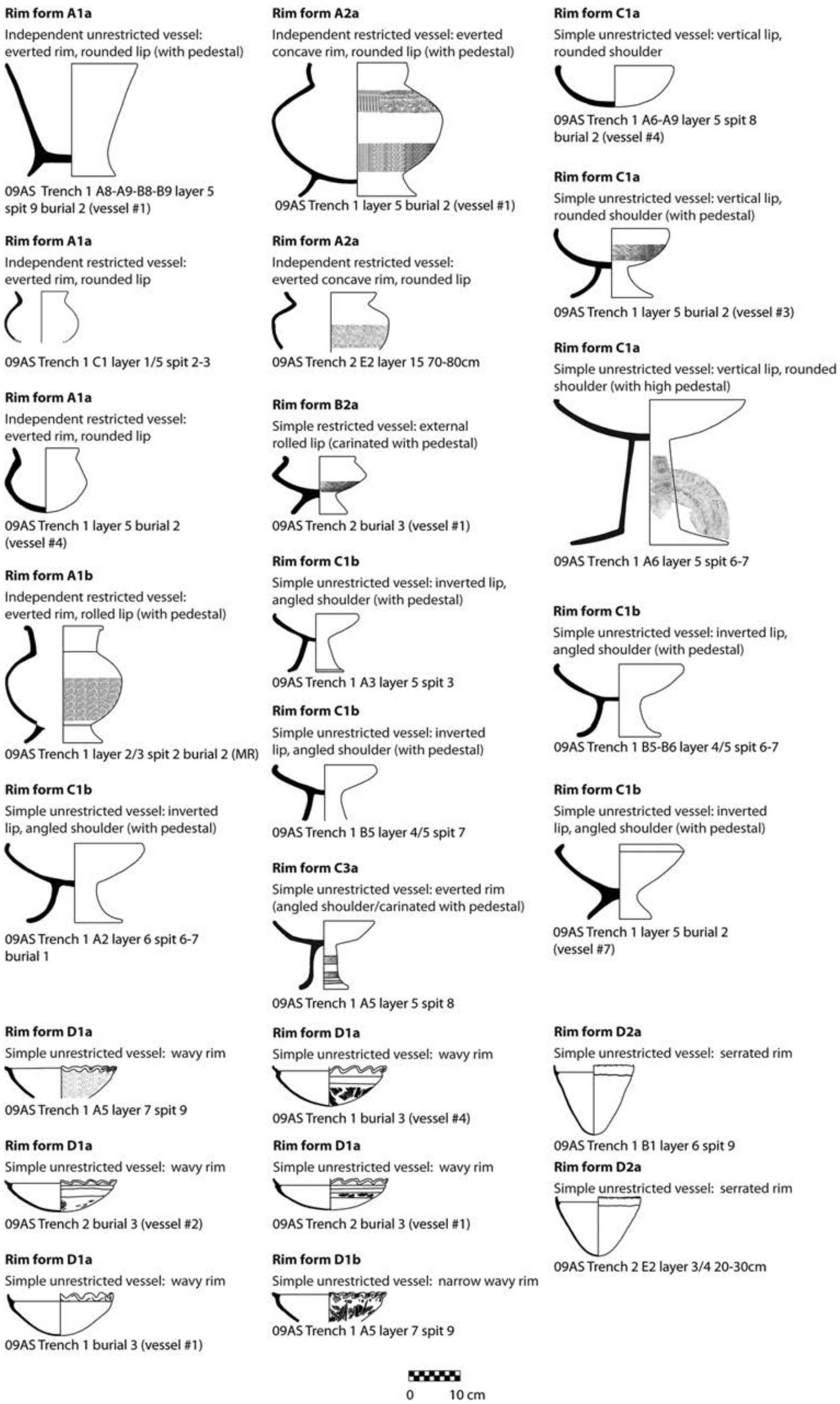


Figure 5.14. Complete ceramic vessel forms at An Sơn.

Source: C. Sarjeant.

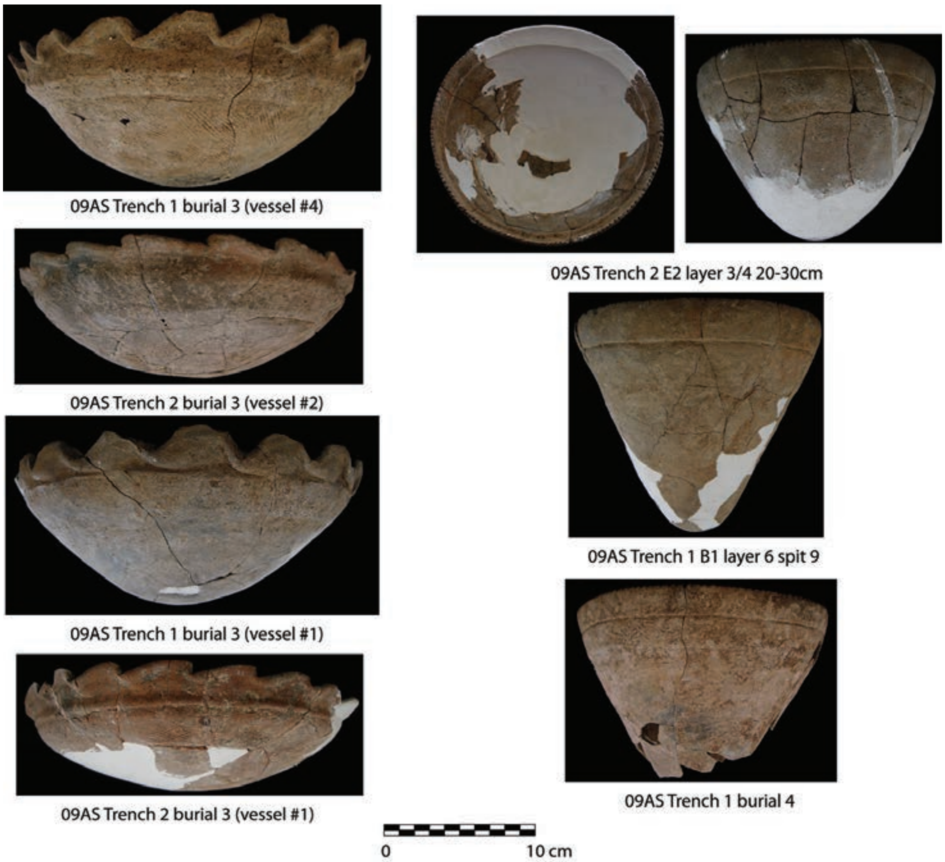


Figure 5.15. Complete class D vessels, wavy and serrated rims.

Source: C. Sarjeant.

Figure 5.16. Complete decorated vessels with detail images of incised and impressed motifs (not to scale).

Source: C. Sarjeant.

Surface treatment and decoration

While modes of decoration varied considerably, decorated sherds were generally uncommon across the entire assemblage. The greatest quantity of decorated sherds came from Trench 1. Recorded decorative methods and/or surface treatments included coarse cordmarking, comb incision/paddle impression, burnishing, incision, red painting, punctate stamping, roulette stamping, appliqué, and white lime infill (examples shown in Figure 5.17). The term 'roulette stamping' is applied here to describe impressions that have been rolled onto the ceramic surface with a stamp tool. Nishimura and Nguyễn (2002) have stated these impressions were created by a 'rocker stamp', but with closer examination this seems unlikely due to the lack of overlap and gaps in the panels of impressions and the presence of continuously rolled motifs. 'Punctate stamping' describes repeated impression using the end of a toothed tool.

Roulette stamping was far more common than punctate stamping at An Sơn, and there was great variety in the motifs. Southeast Asian researchers are most familiar with the Indian rouletted wares and their importance for trade across the region later in prehistory. The An Sơn ceramic motifs share similarities with the Arikamedu ceramics from southern India that date to much later, from the second to first century BC (see Begley 1986: Figure 4; Wheeler, Ghosh and Deva 1946: plate XXVA). These motifs are not isolated to India and roulette impressions using knotted cord are also present in Africa (Soper 1985). Recent research at Nabta Playa in the Nubian Desert of Egypt has indicated that early ceramics were impressed with a wheel-stamp, dated to *c.* 9000 BP. Ceramic roulette disks were identified at Nabta Playa that had chipping on the outer edge and it has been proposed that the outer edge of these disks was rolled on the ceramic surface to create the impressions (Jórdeczka *et al.* 2011).

For the analysis of decoration and surface treatments, the categories of cordmarking, comb incision/paddle linear impression and burnishing were only recorded when in combination with another decorative mode, since at least one of these features appeared on most of the sherds in the assemblage. Very few decorated sherds were identified outside of Trench 1 in the 2009 excavation, therefore only this excavation trench and the basal layers of the 1997 excavation are included in this section.

Figure 5.17. Modes of decoration at An Sơn.

Source: C. Sarjeant.

Trench 1

There were 491 decorated sherds from the 2009 Trench 1 included in this analysis. A high proportion of sherds had a single mode of surface treatment/decoration on rim sherds in the earliest layers, whereas combination motifs on body sherds dominated the later layers (Figure

5.18, Figure 5.19). The majority of the decorated sherds were tempered with fine or mixed-grade sands. In the earliest layers, a higher proportion of the decorated sherds were tempered with coarse sand (Figure 5.20).

Coarse cordmarking was only present in the earliest layers. Horizontal line incision was identified throughout the sequence, but vertical line incision was less frequent and occurred in higher proportions in the earlier layers. Triangular-shaped incision was more numerous mid-sequence. Criss-cross incision was in higher proportions in the earlier layers, but was generally rare. Other geometric (curvilinear and diamond-shaped) incision was identified mid-sequence and in layer 8. Wavy incision was present throughout the sequence, except in layer 1, but zigzag incision was only present in the middle and lower layers. Concentric circle incision was infrequent throughout the sequence.

Red paint was rarely identified, but was present in low quantities throughout the sequence, although absent in layer 8. Coarse punctate stamping was in higher proportions in layer 8. Other kinds of punctate stamping were generally rare, and most stamping was created by rouletting, which was present throughout the layers. The different kinds of roulette stamps are discussed further in Chapter 7. Other modes of decoration were rare at An Sơn, and comb incision/ paddle linear impression, cordmarking and burnishing were present throughout the sequence in association with other decorative modes (Figure 5.21). Examples of these modes of decoration are shown in Figure 5.17.

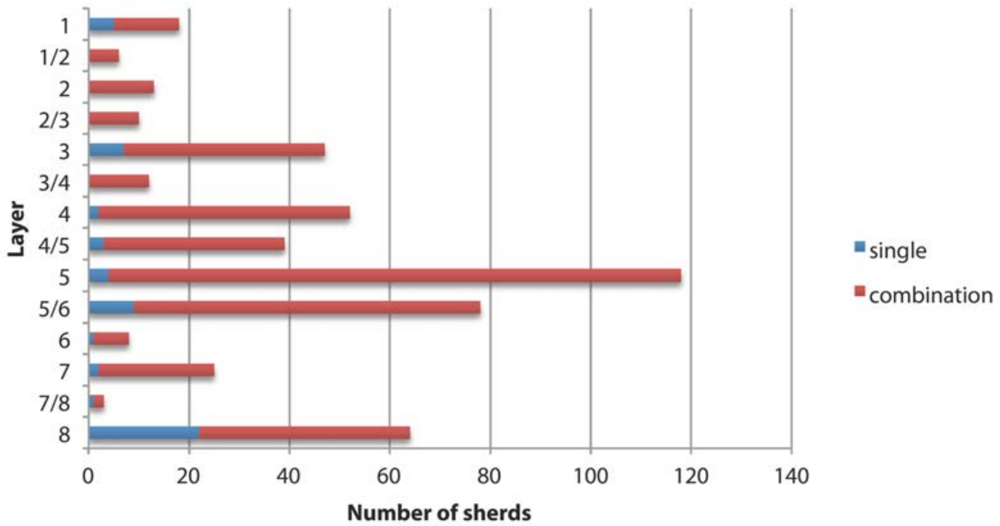


Figure 5.18. Quantity of sherds with a single decorative mode or a combination of multiple decorative modes by layer, Trench 1.

Source: C. Sarjeant.

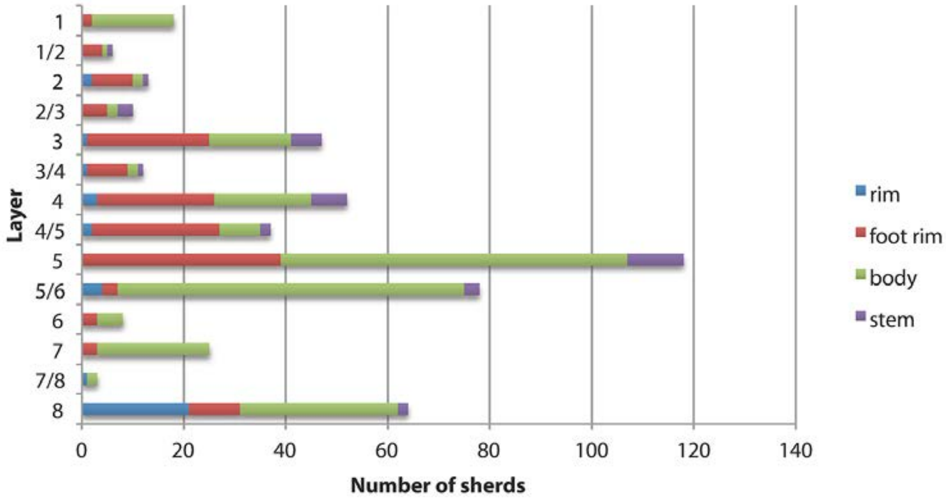


Figure 5.19. Quantity of sherds with surface treatments on each portion of the vessel by layer, Trench 1.

Source: C. Sarjeant.

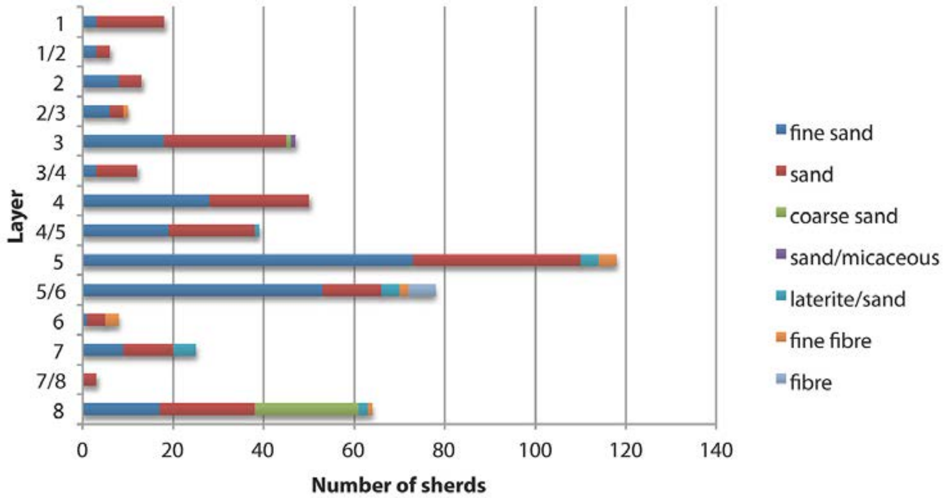


Figure 5.20. Quantity of sherds with each macroscopically observed temper group by layer, Trench 1.

Source: C. Sarjeant.

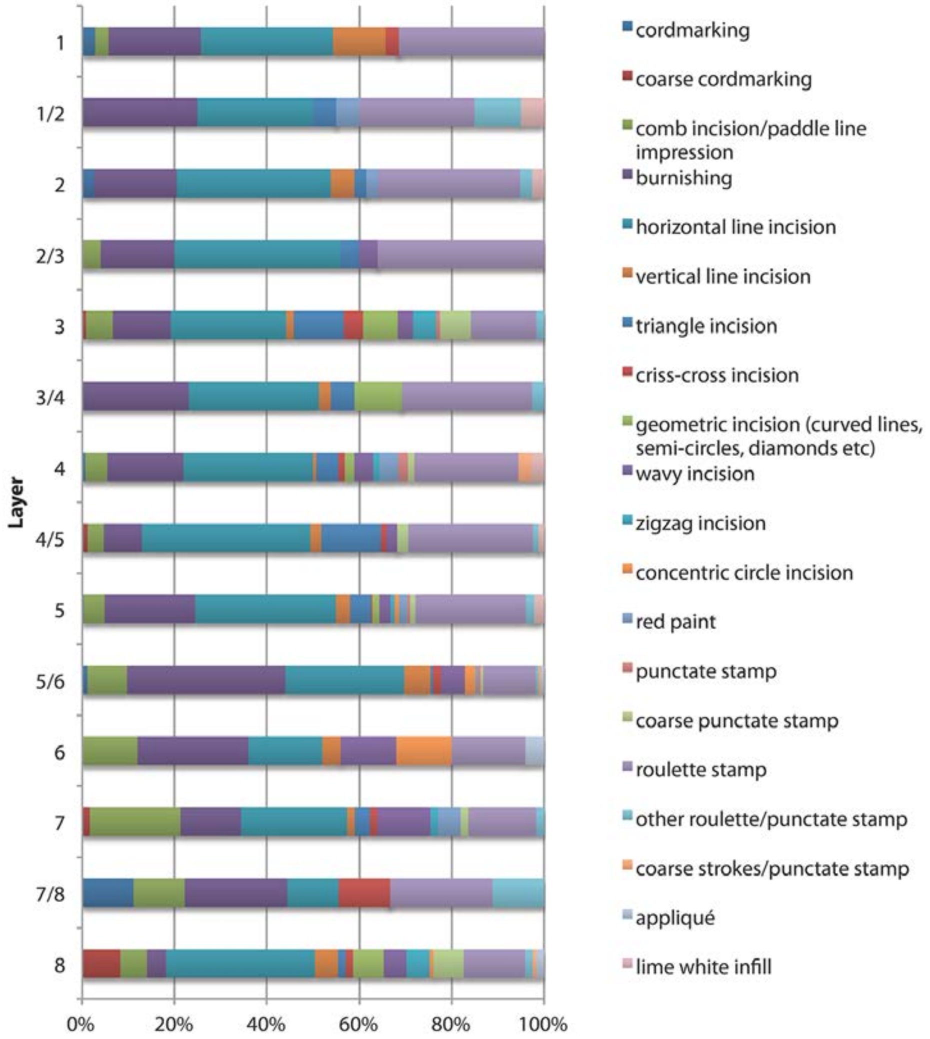


Figure 5.21. Proportion of each surface treatment/decoration by layer, Trench 1.

Source: C. Sarjeant.

1997 excavation basal layers

Once again, the lowest layers of the 1997 excavation were included to expand the sequence identified in 2009 Trench 1 to include the earliest known layers at An Sơn. The total number of decorated sherds examined from the basal layers of the 1997 excavation was 95: 43 from layer 3–4 and 52 from layer 3–5.

In layers 3–4 and 3–5, a higher proportion of the decorated sherds had a single mode of decoration in layers 3–4 and 3–5 than was observed in the 2009 Trench 1 (Figure 5.22). The majority of the decorated sherds from layer 3–5 were foot rim, while mostly pedestals, and body portions occurred in layer 3–4 (Figure 5.23). None of the decorated sherds were tempered with fibre in layers 3–4 or 3–5. Almost all of the decorated sherds from layer 3–5 were tempered with fine sand, while the sherds of layer 3–4 were tempered with mixed-sized sand grains (Figure 5.24).

The majority of the decorated sherds from layer 3–5 had horizontal incision, while a number were decorated with wavy incision, roulette stamping, vertical/diagonal incision, and punctate stamping. A number of sherds were cord-marked and burnished in association with other modes of decoration. However, a different mode of decoration was observed on some rim sherds: cordmarking in horizontal rows on the external surface. This mode of decoration was unique to layer 3–5. Modes of decoration became more varied by layer 3–4, with many of the decorated sherds painted or having horizontal incision. The other represented modes of decoration were coarse cordmarking, vertical/diagonal incision, wavy incision, roulette stamping, and appliqué. Burnishing and comb incision/paddle linear impression were also identified in association with some other modes of decoration (Figure 5.25). Examples of these modes of decorations are shown in Figure 5.17.

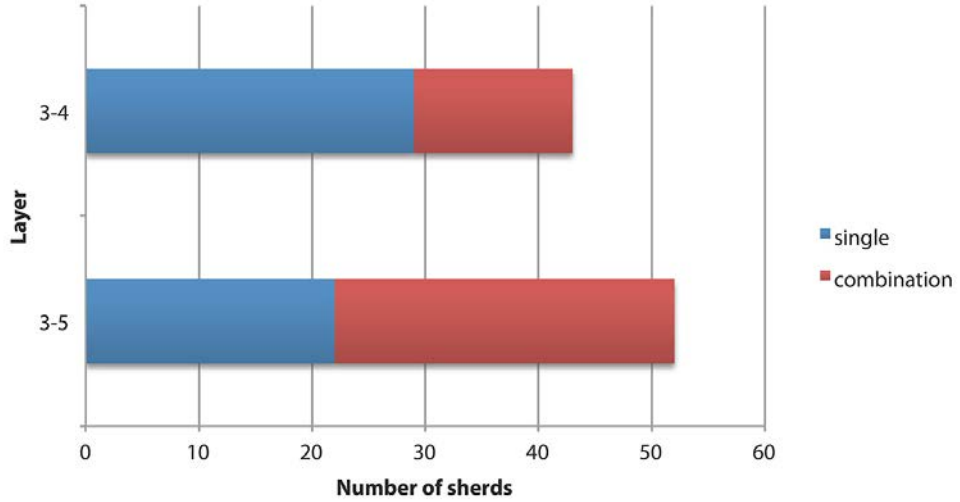


Figure 5.22. Quantity of sherds with a single decorative mode or a combination of multiple decorative modes by layer, 1997 excavation, layers 3–4 and 3–5.

Source: C. Sarjeant.

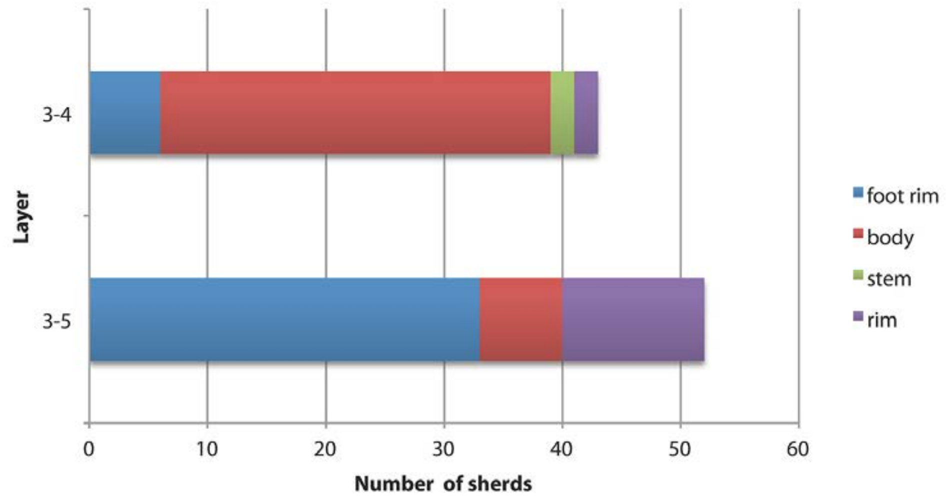


Figure 5.23. Quantity of sherds with surface treatments on each portion of the vessel by layer, 1997 excavation, layers 3–4 and 3–5.

Source: C. Sarjeant.

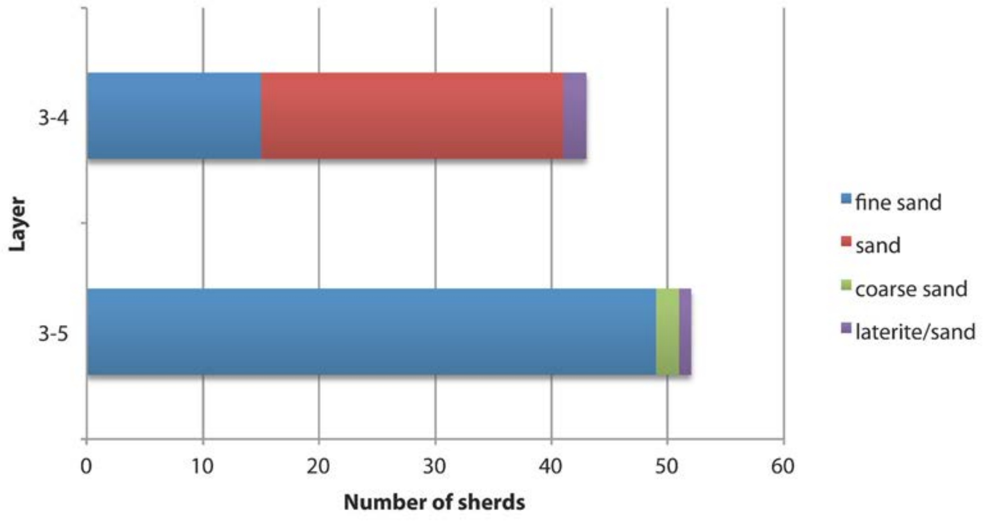


Figure 5.24. Quantity of sherds with each macroscopically observed temper group by layer, 1997 excavation, layers 3–4 and 3–5.

Source: C. Sarjeant.

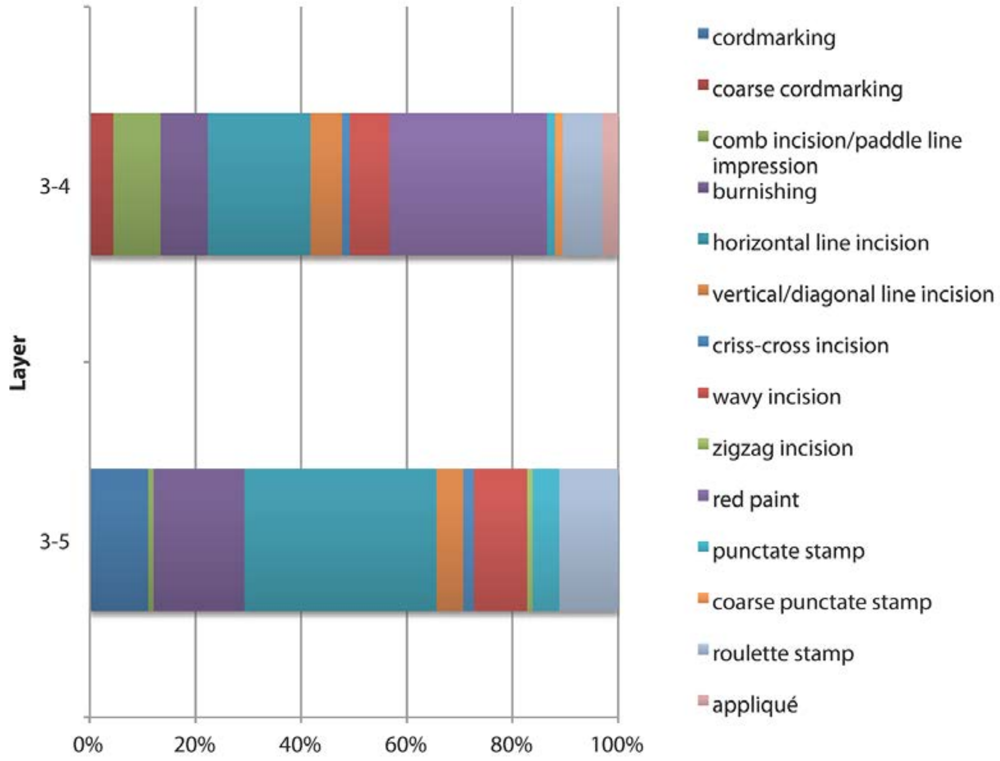


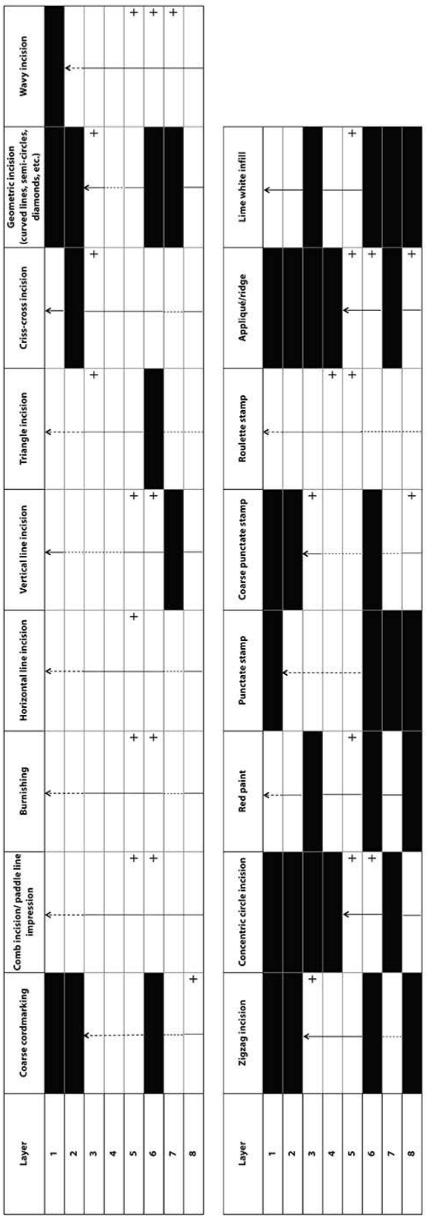
Figure 5.25. Proportion of each surface treatment/decoration by layer, 1997 excavation, layers 3–4 and 3–5.

Source: C. Sarjeant.

Summary: Sequence of surface treatment and decoration

Table 5.9 presents the sequence of surface treatment and decoration from the An Sơn 2009 excavation season. It is based particularly on the stratigraphic sequence of Trench 1. The highest number of decorated sherds appeared mid-sequence in Trench 1, layers 5 and 5/6, where most of these sherds were sand tempered. The basic sequence over time shows that the earliest decorative modes were punctate stamped, particularly coarse punctate, and coarse cord-marked. Horizontal incision, vertical/diagonal incision, criss-cross incision, wavy incision, and roulette stamping were also present in the lowest layers, layer 8 in 2009 Trench 1 and layers 3–5 and 3–4 in the 1997 excavation. These modes of decoration were closely followed by red paint and appliqué in layer 3–4 of the 1997 excavation. Red paint was present in higher quantities in layers 4 to 7 in Trench 1, wavy and zigzag incision in layers 3 to 8, concentric circle incision in layers 5 to 6, lime infill in layers 4 to 6, and triangle incisions in layers 1 to 5. Punctate stamping was present in Trench 1 from layers 3 to 5/6, while roulette stamping was present throughout the sequence.

Table 5.9. Sequence of surface treatment and decoration at An Sơn, all 2009 excavation trenches. See examples of decorative modes in Figure 5.17. Key: – decorative mode present in layer, + highest proportion of decorative mode, - - diminishing proportion of decorative mode, blacked out areas = none of the decorative mode in layer.



Source: Compiled by C. Sarjeant.

Spatial distribution of rim forms

The spatial distributions of the rim forms in Trench 1, squares A1, A2, B1, B2, C1 and C2, are compared here with those in Trench 2. Trenches 1 and 2 were located close together, but presented rather different evidence for usage. While Trench 1 contained a straightforward sequence of dumping layers off the main mound, Trench 2 consisted of many small lenses and layers with a decidedly horizontal distribution, with dense midden deposits in some layers. The two trenches are described, and a comparison and discussion of spatial distribution follows.

Trench 1: Squares A1, A2, B1, B2, C1 and C2

The layers represented in squares A1, A2, B1, B2, C1 and C2 were recorded in the northern wall of Trench 1. They are labelled 1 to 8 from the surface downwards (Figure 5.26), and are characterised in Table 5.10 according to soil matrices, the presence of ceramic rim forms (Figure 5.1 and Figure 5.6), and other items of material culture.

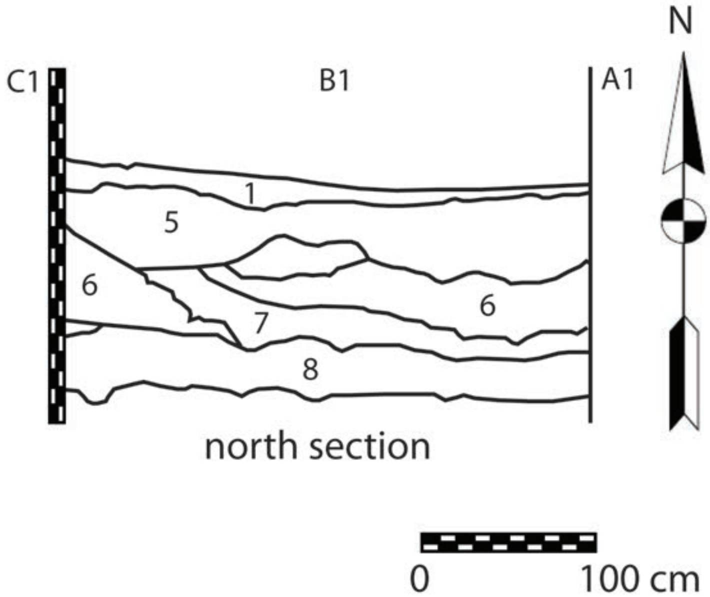


Figure 5.26. Stratigraphy of the north wall, Trench 1, squares A1, B1, C1.

Source: C. Sarjeant.

Table 5.10. Characterisation of soil matrices, ceramic rim forms (in Figure 5.1) and material culture in each layer, Trench 1, squares A1, A2, B1, B2, C1, C2.

Layer	Soil matrix description	Ceramic rim forms present (see Figure 5.1)	Material culture present
1	mid-brown with very little cultural material	• everted rims: A1a, A1b, A1c, A1d, A1e, A1f, A1h, A1i • concave rims: A2 • arestricted vessels: B1a • unrestricted vessels: C1a, C1b, C2a, C2b • wavy and serrated rimmed unrestricted vessels: D1a, D2a • cà ràng projections: E2b	• unpolished and polished stone flakes • stone adze fragments • well-worn unshouldered stone adzes
2	dark brown with two lenses of a dark brown to black colour and cultural material	Layer not present in A1, A2, B1, B2, C1 and C2 squares	Layer not present in A1, A2, B1, B2, C1 and C2 squares
3	light brown with dense pottery	Layer not present in A1, A2, B1, B2, C1 and C2 squares	Layer not present in A1, A2, B1, B2, C1 and C2 squares
4	orange to brown with cultural material	Layer not present in A1, A2, B1, B2, C1 and C2 squares	Layer not present in A1, A2, B1, B2, C1 and C2 squares
5	red to brown with a lot of cultural material	• everted rims: A1a, A1b, A1c, A1d, A1e, A1f, A1h, A1i • concave rims: A2a, A2b, A2c • restricted vessels: B1a • unrestricted vessels: C1b, C2b, C3a • wavy and serrated rimmed unrestricted vessels: D1a, D2a • cà ràng rims and projections: E1a, E2a, E2b	• ceramic roundels • clay pellets • baked clay lumps • whetstones • unpolished and polished stone flakes • stone adze fragments • shouldered stone adzes • unshouldered stone adzes • reflaked shouldered stone adzes and axes • broken unshouldered and shouldered stone adzes
6	light brown with cultural material	• everted rims: A1a, A1b, A1c, A1d, A1e, A1f, A1h, A1i • concave rims: A2a and A2b • restricted vessels: B1a • unrestricted vessels: C1a, C1b, C2b, C3a • wavy and serrated rimmed unrestricted vessels: D1a, D2a • cà ràng rims and projections: E1a, E, E2b	• ceramic roundels • baked clay lumps • sandstones • whetstones • polished stone flakes • shouldered stone axes • broken shouldered stone adzes
7	light brown with cultural material	• everted rims: A1a, A1b, A1c, A1e, A1h, A1i • concave rims: A2a, A2b, A2c • restricted vessels: B1a, B2a • unrestricted vessels: C1a, C1b, C2b, C3a • a large number of wavy rimmed unrestricted vessels (D1a), as well as some serrated rimmed vessels (D2a) • cà ràng rims and projections: E1a, E2a	• sandstone • polished stone flakes • broken shouldered stone adzes

Layer	Soil matrix description	Ceramic rim forms present (see Figure 5.1)	Material culture present
8	grey to brown with very little cultural material	• everted rims: A1a, A1b • concave rims: A2a, A2c • restricted vessels: B1a • unrestricted vessels: C2a • wavy rimmed unrestricted vessels: D1a	None

Source: Compiled by C. Sarjeant.

Trench 2

Previously, sherd quantities have been plotted according to 10 cm spits for Trench 2 (Figure 5.7 and Figure 5.8). In this section, the cultural layers within Trench 2, labelled from 1 to 15 from the surface downwards (Figure 4.4), are characterised in Table 5.11, according to soil matrices, ceramic rim forms (Figures 5.1 and 5.27), and other items of material culture. Layers 11, 13 and 14 contained very little cultural material and are not included.

Table 5.11. Characterisation of soil matrices, ceramic rim forms (in Figure 5.1) and material culture in each layer, Trench 2.

Layer	Soil matrix description	Ceramic rim forms present (see Figure 5.1)	Material culture present
1	dark grey	• everted rims: A1a, A1e, A1f, A1g, A1i • concave rims: A2a • restricted vessels: B3a • unrestricted vessels: C1a, C1b, C2a • wavy and serrated rimmed unrestricted vessels: D1b, D2a • cà ràng rims: E1a	• clay pellets • baked clay lumps • gastropod shells
2	yellow to brown	• everted rims: A1a, A1c, A1e, A1f, A1g, A1h, A1i • concave rims: A2a • restricted vessels: B3a • unrestricted vessels: C1a, C1b, C3a • serrated rimmed unrestricted vessels: D2a • cà ràng rims and projections: E1a, E2a, E2b	• clay pellets • shell beads • stone flakes • stone adze fragments, broken shouldered stone adzes • baked clay lumps • gastropod shells
3	light brown	• everted rims: A1a, A1b, A1c, A1e, A1f, A1g, A1h, A1ic • oncave rims: A2a, A2c • restricted vessels: B1a, B2a, B3a • unrestricted vessels: C1a, C1b, C2a, C3a • wavy and serrated rimmed unrestricted vessels: D1a, D1b, but more D2a • cà ràng rims and projections: E1a, E2a, E2b	• ceramic roundels • clay pellets • shell beads • unpolished and polished stone flakes • stone implement with a ground hole in the centre (Figure 4.67) • baked clay lumpsgastropod shells

Layer	Soil matrix description	Ceramic rim forms present (see Figure 5.1)	Material culture present
4	dark red to brown	• everted rims: A1a (but notably not in squares E3, E4 and E5), A1b, A1c, A1f, A1g, A1h, A1i • concave rims: A2a (but notably not in squares E3, E4 and E5), A2c • restricted vessels: B1a, B2a, B3a • unrestricted vessels: C1a, C1b, C2a, C3a • wavy and serrated rimmed unrestricted vessels: D1a, D1b, but more D2a • cà ràng rims and projections: E1a, E2a	• clay pellets • shell beads • unpolished stone flakes • whetstones • a large polished stone arrowhead • shouldered stone adzes • unshouldered stone adzes • baked clay lumps • gastropod shells
5	light brown to red	• everted rims: A1a, A1c, A1e, A1f, A1g, A1h, A1i, A1i-r • concave rims: A2a (but notably not in squares E3, E4 and E5), A2c • restricted vessels: B3a • unrestricted vessels: C1a, C1b, C3a wavy and serrated rimmed unrestricted vessels: D1a, D1b, D2a • cà ràng rims and projections: E1a, E2a, E2b	• clay pellets • shell beads • unpolished and polished stone flakes • unshouldered stone adzes • baked clay lumps • gastropod shells
6	light brown to dark beige	• everted rims: A1a, A1c, A1e, A1f, A1i, A1i-r • concave rims: A2a, A2b • restricted vessels: B1a, B2a • unrestricted vessels: C1a, C1b, C3a • wavy and serrated rimmed unrestricted vessels: D1a, D1b, D2a • cà ràng rims and projection sherds: E1a, E2a, E2b	• clay pellets • unpolished and polished stone flakes • broken shouldered stone adzes • concretions • baked clay lumps • gastropod shells
7	red to light brown	• everted rims: A1a, A1b, A1c, A1e, A1f, A1g, A1h, A1i • concave rims: A2a, A2c • restricted vessels: B2a, B3a • unrestricted vessels: C1a, C1b, C3a • wavy and serrated rimmed unrestricted vessels: D1a, D1b, D2a • cà ràng rim and projection sherds: E1a, E2a, E2b	• clay pellets • a ceramic bead • concretions • baked clay lumps • gastropod shells
8	light brown	• everted rims: A1a, A1b, A1c, A1e, A1f, A1g, A1h, A1i • concave rims: A2a, A2c • restricted vessels: B1a, B2a • unrestricted vessels: C1a, C1b, C2a, C2b, C3a • wavy and serrated rimmed unrestricted vessels: D1a, D1b, D2a • cà ràng rims and projections: E1a, E2a	• unpolished and polished stone flakes • broken shouldered stone adzes • concretions • baked clay lumps • gastropod shells
9	beige	• everted rims: A1a, A1b, A1c, A1e, A1f, A1g, A1h, A1i • concave rims: A2a, A2c • restricted vessels: B1a, B2a • unrestricted vessels: C1a, C3a • wavy and serrated rimmed unrestricted vessels: D1a, D1b, D2a • cà ràng rims and projections: E1a, E2a, E2b	• clay pellets • polished stone flakes • baked clay lumps • gastropod shells

Layer	Soil matrix description	Ceramic rim forms present (see Figure 5.1)	Material culture present
10	orange to brown	• everted rims: A1a, A1c, A1e, A1f, A1g, A1h, A1i • concave rims: A2a, A2b • restricted vessels: B1a, B2a • unrestricted vessels: C1a • wavy and serrated rimmed unrestricted vessels: D1a, D2a • cà ràng rims: E1a	• unpolished and polished stone flakes • stone adze fragments • notably less baked clay lumps • gastropod shells
11	black with very little contents	everted rims: A1f	minor baked clay and shell contents
12	mid brown to red	everted rims: A1a, A1f	minor baked clay and shell contents
13	beige shallow and short lens with little to cultural material	No cultural material	No cultural material
14	black shallow and short lens with little to no cultural material	No cultural material	No cultural material
15	light grey to beige	• everted rims: A1a, A1b, A1c, A1e, A1f, A1g, A1h, A1i • concave rims: A2a • restricted vessels: B1a, B2a • unrestricted vessels: C1a, C1b, C2a, C3a • wavy rimmed unrestricted vessels: D1a • cà ràng rims and projection sherds: E1a, E2b	None

Source: Compiled by C. Sarjeant.

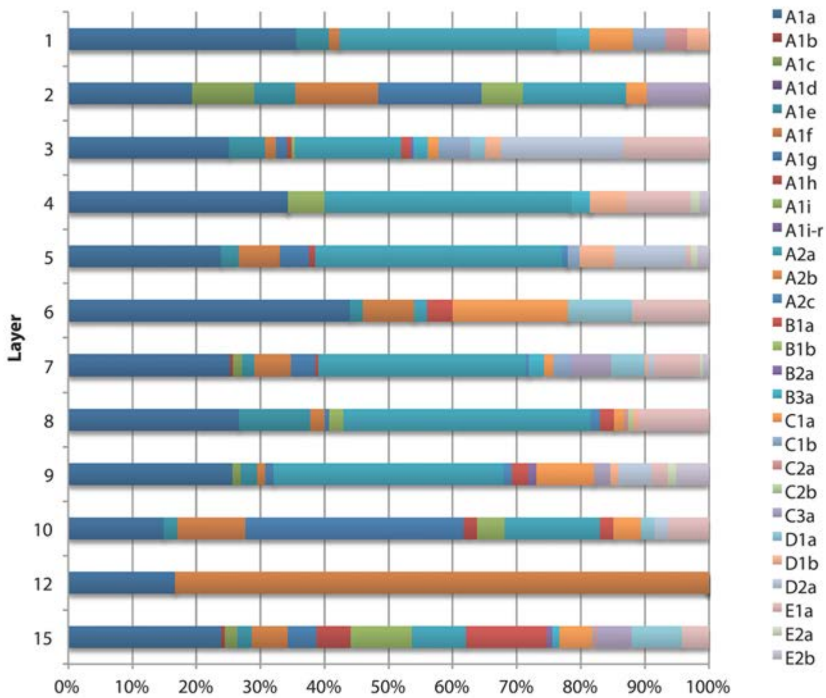


Figure 5.27. Proportion of rim forms by layer, Trench 2. No rim sherds were recovered from layers 11, 13 and 14.

Source: C. Sarjeant.

Discussion of the spatial distribution of ceramic forms

The aim of the comparison between Trenches 1 and 2 was to determine the usage of different spaces on site and the chronology of Trench 2 compared to the more extensive sequence of Trench 1. Comparative pie charts of the proportions of each rim form for Trenches 1 and 2 are presented in Figure 5.28.

Trench 1 displayed a distinct chronological sequence of changing ceramic forms for An Sơn. The forms from Trench 1, squares A1, A2, B1, B2, C1 and C2, showed a progression similar to that presented for Trench 1 in general. All of the everted rim forms were present in the upper and middle layers, except for A1g and A1i-r. The concave rim forms were present throughout the sequence, except for the basal layer 8. A2b was only present in layers 5, 6 and 7, and A2c was absent from layers 1, 6 and 8. The everted rim classes A1 and A2 comprised the majority of the assemblage of these six Trench 1 squares. With the exception of B2a in layer 7, forms B2 and B3 were absent from these six squares, . C1a was present throughout the sequence, except in layers 5 and 8, while C1b was also present throughout the sequence, except in the basal layer 8. C2a was absent in layers 1 and 8, C2b was present throughout the sequence except in layer 8, and C3 forms were present mid-sequence in layers 5, 6 and 7. In terms of the *cà ràng* projections, the square-shaped projections (E2a) were absent in the upper layer 1 and the rounded projections (E2b) were absent from layer 7. D2 forms were generally rare in Trench 1 in comparison to D1 forms. The cà ràng forms, class E, were rare in Trench 1.

Trench 2 contained a wide spread of ceramic rim forms. There was a much higher proportion of cà ràng class E sherds, C3a inverted rimmed restricted vessels, and D2a serrated rim sherds in Trench 2 compared to Trench 1. The everted rippled A1i-r rims were present in layers 5, 6 and 7. A1d was absent from Trench 2. B1 forms were present in layers 3, 4, 6, 8, 9, 10 and 15. B2 forms were rare in Trench 2, while B3 forms were only present in layers 1, 2, 3, 5 and 7. Form C1a was present in all layers, except those with few remains, and C1b was present in all layers except 9 and 10. C2 forms were rare in Trench 2 and were only present in layer 8. The rounded-shaped projections of cà ràng class E vessels were absent from layer 15, and the square projections were absent from layer 4.

Other material culture at An Sơn Trench 1 indicated a use of shouldered stone adzes earlier in the sequence that were later replaced by unshouldered adzes. The transition evidently occurred in Trench 1 layer 5, in which both shouldered and unshouldered adzes were recovered (see Figure 4.53 and Figure 4.54). Ceramic roundels, clay pellets, baked clay lumps, and sandstones and whetstones for maintaining stone tools were only observed mid-sequence in Trench 1, layers 5 and 6. The intensity of occupation at An Sơn was evident in layers 5 and 6 with an increase in the variety of material culture in these layers of Trench 1.

The higher proportion of cà ràng sherds and black, ashy deposited lenses in Trench 2 compared to Trench 1 was suggestive of cooking activities. Additionally a greater quantity of fired clay lumps in Trench 2 (see Chapter 4) suggests that they were related to cooking, perhaps for heat retention in earth ovens. The higher proportion of class B restricted bowls in Trench 2 compared to Trench 1 may also suggest a relationship between these vessels and cooking. Ceramic vessels tempered with plant materials are more resilient to thermal shock in cooking practices. The silica in rice husks, which is frequently used as a temper in the ceramic vessels from An Sơn, survives in environments of high firing and increases the ability of a ceramic vessel to survive repeated heating in cooking processes (Tomber, Cartwright and Gupta 2011). Many of the frequently occurring vessels in Trench 2 were fibre tempered, namely the cà ràng class E, B1a, B3a, C1a and C1b forms. As already shown, a larger number of sand-tempered rather than fibre-tempered sherds were recovered from Trench 2. However, these were largely restricted to the A1a and A2a forms, which were very common forms at the site in general.

A stone item with a ground circle in the centre may have been used to light a fire in Trench 2 (found in square C5, layer 3). Clay pellets, shell beads, gastropod shells and stone flakes were found throughout the layers of Trench 2, while concretions were only present in layers 6, 7 and 8, indicating that burning of shell and/or animal remains took place within these layers. Ceramic roundels were present in higher quantities in Trench 1 compared to Trench 2, indicating a possible spatial separation in their use and discard. In Trench 2 there was a higher proportion of shouldered adzes than unshouldered adzes. The presence of some unshouldered adzes indicates that Trench 2 relates chronologically to layer 5 in Trench 1.

Since rice husk was present in the fabrics of ceramic sherds, it may be presumed that rice was cooked at An Sơn. In particular the subspecies identified to *Oryza sativa japonica* by Katsunori Tanaka from the Research Institute of Humanity and Nature, Japan. The faunal remains indicate that fish (snakehead, swamp eel and climbing perch), pig and dog were cooked in Trench 2, as well as pond, box and water turtles. However, in general, only small numbers of wild mammals and reptiles were recovered from An Sơn, and were probably a small component of the diet in comparison to domestic dog and pig (Piper *et al.* 2012).

The remains from Trench 1 indicate the successive dumping of cultural remains down the side of the mound. Most of these deposits overlaid the burials or the burials were cut through the layers in Trench 1. Conversely, there was a definite restricted area with cooking remains in Trench 2 and this area did not necessarily overlay the one extended burial (burial 3) in this trench. It is possible the cooking activities occurred contemporaneously with the burial or before the burial was interred, and the burial was later cut though the midden.

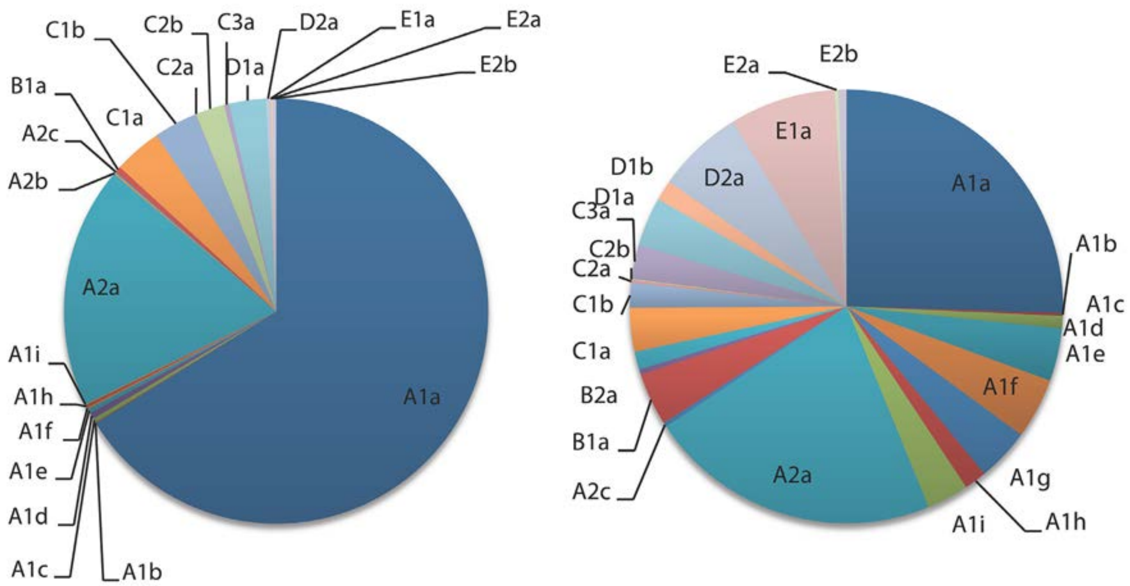


Figure 5.28. Comparison of proportions of each rim form between Trench 1 (squares A1, A2, B1, B2, C1 and C2) (left) and Trench 2 (right).

Source: Compiled by C. Sarjeant.

Summary: The sequence and distribution of ceramics at An Sơn

In this chapter the rim forms and decorations have been categorised and sequences established for the ceramic assemblage at An Sơn (Figure 5.1, Figure 5.17, Table 5.8, Table 5.9). The sequence of rim forms (Table 5.1) in the 2009 and 1997 basal layers excavated at An Sơn showed that there was a dominance of class A2 and B forms at initial occupation. The decorated varieties of A2 forms are likely to have been introduced soon after this initial settlement, with the appearance of roulette stamped shoulder decoration. After this initial phase, the proportion of A2 vessels diminished and the assemblage was composed of A1 forms in the subsequent sequence. Form B1b was initially the most common class B vessel form at An Sơn, and was replaced by form B1a early in the sequence. Class C forms were few in the earliest occupation of the site but increased in variety and numbers mid-sequence, and were present through to the later part of the sequence. Class D forms were absent during the initial occupation, but form D1a appeared soon after and transitioned to form D2a in the mid to late part of the sequence. Class E (the *cà ràng* stove) was absent during initial occupation, but appeared in greater numbers mid-sequence. The square-shaped *cà ràng* projections (form E2a) were representative of the early- to mid-sequence, and the rounded projections (form E2b) were representative of the mid- to late-sequence. The greatest quantity of decorated sherds was observed mid sequence, at which time the variety of decoration increased, much like the number of rim form variants. The earliest decorative modes were coarse cordmarking and coarse punctate stamping. These were followed closely by the introductions of red painting, roulette stamping and various incised motifs (Table 5.9).

Complete vessels were most frequently associated with burial contexts, and thus included some ritualistic decorated vessels, although some reconstructable complete utilitarian and decorated vessels were also recovered from the dumping layers in Trench 1. The distribution of rim forms reinforce the claim that Trench 1 was representative of the entire neolithic sequence at An Sơn, except for the earliest occupation of the site, as represented by the base of the 1997 excavation and the 2009 Test Square. The dumping layers were also associated with adze flakes, and whetstones and polishing stones for the manufacture of stone adzes. Since the majority of the flakes had polished surfaces, it is interpreted that Trench 1 was a location for reworking and retouching stone adzes. A less likely scenario is that Trench 1 was used as a place to discard the debitage created from reworking activities in another area of the site. There is no evidence for manufacturing new adzes from raw materials in the site. Trench 1 was also utilised for the burial of individuals with mortuary offerings, but these interments were not necessarily in direct association with the refuse layers, and appear to have been cut through them.

While Trench 2 also included human burials, the majority of the cultural materials were related to cooking activities. These included a high proportion of sherds from class E *cà ràng* stove vessels in association with many baked clay lumps, concreted faunal remains and ceramic sherds. There were also areas of charcoal in Trench 2 which indicate cooking. Most of the material appeared to be late in the An Sơn sequence, with a high number of D2a sherds compared to earlier localities in the site, such as Trench 1.

This study of rim forms and surface treatment/decoration has been informative for understanding the ceramic sequence at An Sơn. The study of spatial distribution has aided in determining the functions of certain forms, in either utilitarian or ritualistic contexts. Combined with the fabric analysis that follows in Chapter 6, this chapter provides a characterisation of the ceramic assemblage for comparison between An Sơn and other sites in the region (as presented in Chapters 8 and 9).

6

An Sơn Ceramic Fabrics

PART I: FABRIC DESCRIPTIONS AND NON-PLASTIC INCLUSIONS

Introduction: Non-plastic inclusion and temper identification with SEM-EDX

Temper is added to clay in ceramic manufacture to reduce the risk of breakage during drying and firing, as a result of rapid shrinkage and/or expansion by distributing heat evenly. Temper can include a variety of non-plastic materials (Shepard 1965: 24-26). The non-plastic inclusions in the An Sơn ceramics were initially identified as sand, fibre or 'other' tempers, using microscopy. The microscopic observations indicated that grains required further analysis with SEM-EDX in order to characterise the tempers in each sample. The method for analysis by SEM-EDX was described in Chapter 3. The temper grains were differentiated from natural non-plastic inclusions in the clays by size, density and shape, including the presence of a waterworn appearance. Small grains, usually silt to very fine sand-sized, were considered to be naturally occurring in non-plastics in infrequent amounts.

The clays within the vicinity of An Sơn were compared to the clay matrices of the ceramic samples to differentiate between the natural and added non-plastic inclusions. Most clays require some kind of processing if they are to be used for ceramic manufacture, usually with the addition of a tempering agent, but the process may also involve the extraction of larger impurities in the selected clay. The coarse size of many of the sand grains implied the manual addition of these grains to the fabrics. In the SEM-EDX analysis it was apparent that simple sand and fibre categories were not sufficient to encompass all of the temper additives at An Sơn. The tempers, in addition to natural non-plastic inclusions, were identified from the EDX compositional data with reference materials (Severin 2004; Deer, Howie and Zussman 1992), as well as from visual observations and SEM backscatter microphotographs.

Chapter 6, Part I describes the temper groups and inclusions, including the temper density, and mineral grain shapes and sizes. It also describes the plastic clay matrices, including the presence of unmixed clays, identification of silt and very fine sand non-plastic natural inclusions, and texture. The rim forms referred to in this chapter are shown in Figure 5.1. This chapter describes the temper groups in the An Sơn ceramic assemblage. The tempers are characterised for the ceramic samples from An Sơn and for non-local ceramics. The clay samples are described, and the non-plastic inclusions at An Sơn are summarised. Chapter 6, Part II reports the clay matrix compositional data.

Temper groups

Five major temper groups (TG) were identified in the analyses (Figure 6.1):

- *Temper group A: Mineral sand*
  - A1: Quartz and feldspars

    The sands predominantly included feldspars (primarily alkali feldspars) and quartz.
  - A2: Lateritic

    Sometimes the sand tempered vessels also incorporated laterite materials, inclusive of iron-rich minerals, micas and amphiboles.
  - A3: Coarse iron-rich and waterworn

    This category was rare but contained coarse and rounded iron-rich phyllosilicate grains.
- *Temper group B: Fibre*

  'Fibre temper' refers to fabrics tempered with plant remains that in most cases were identified as rice chaff. Often rice chaff tempers included spikelets/husk and stems fragments (see Tomber, Cartwright and Gupta 2011, for comparable images).
- *Temper group C: Phosphate*

  While calcium phosphate minerals are often linked to calcareous tempers (see Dickinson 2006), the presences of iron and calcium phosphate grains together have been identified here as fossilised skeletal remains or bioclasts (see Figure 6.1, image C).
- *Temper group D: Calcareous*

  This group was restricted to angular calcareous sands that were most likely crushed shell.
- *Temper group E: No temper*

  This includes sherds that had a smooth matrix without non-plastic inclusions, and sherds with very fine sand to silt-sized inclusions that appeared to be natural inclusions.

Two temper subgroups were rarely identified in the analyses and were always in association with one of the above temper groups. These are orthodox and bleb grogs, which have been identified in ceramics from other Southeast Asian sites, such as Khok Phanom Di (Vincent 2004; 1988: 88):

- *OG: Orthodox grog*

  Crushed ceramic sherds or crushed pre-fired clay that were added to the clay (Vincent 2003: 54).
- *BG: Bleb grog*

  Crushed fired fibre and clay balls that were added to the clay (Vincent 2003: 54).

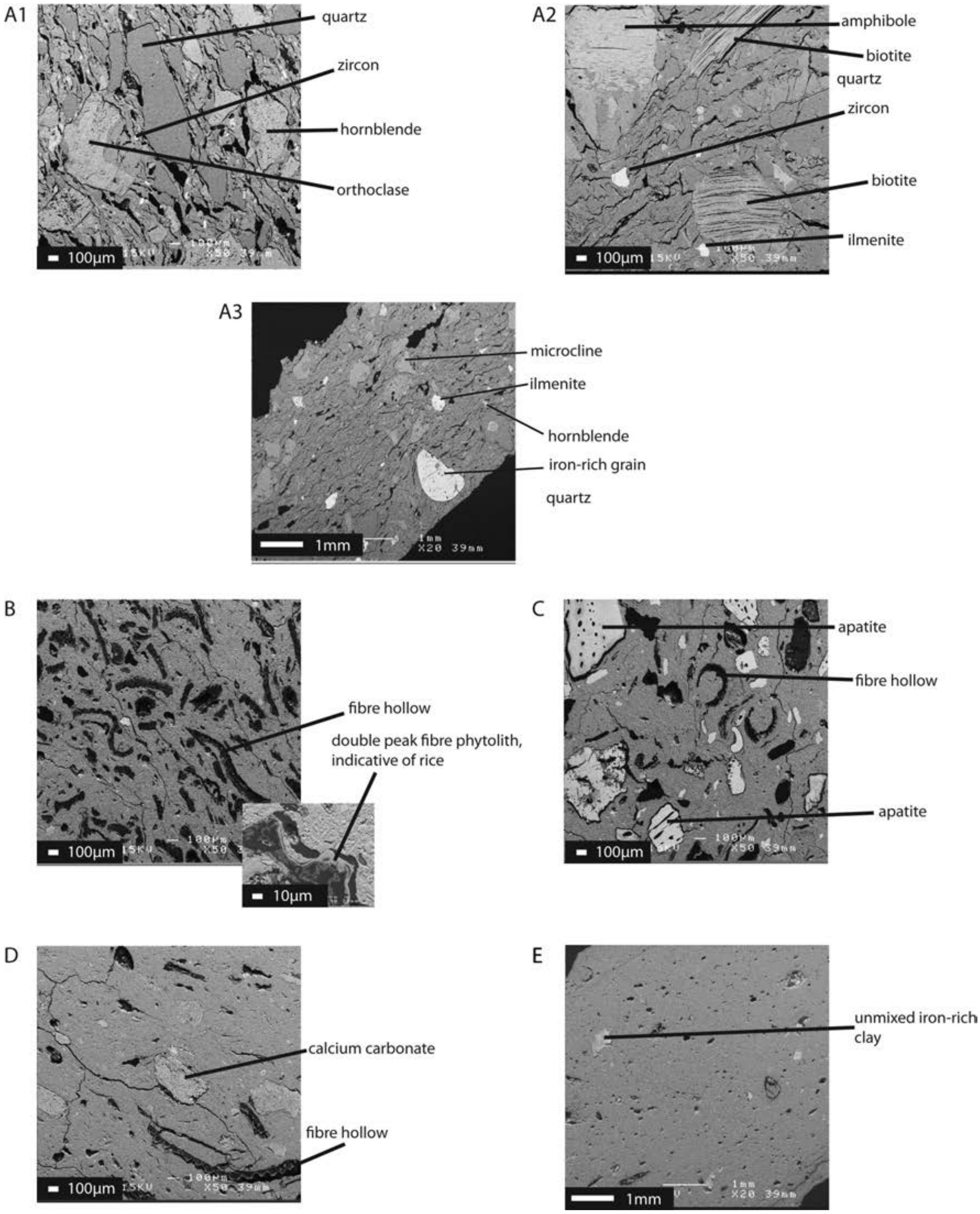


Figure 6.1. SEM backscatter images of the main tempers identified in the An Sơn assemblage. A1. Quartz and feldspar mineral sand (09AS-H1-C1-L1-S1-1). A2. Lateritic mineral sand (09AS-H1-C1-L5/6-S7-3). A3. Iron-rich mineral sand (09AS-H1-C1-L5/6-S9-3). B. Fibre (09AS-H1-C1-L5/6-S9-2). C. Phosphate with fibre (09AS-H1-C1-L1-S1-2). D. Calcareous with fibre (09AS-H1-C1-L5/6-S5-5). E. No temper (09AS-H1-C10-L2-S3-Oc Eo phase-1).

Source: C. Sarjeant.

Discussion of the temper groups

Alongside fibre tempered fabrics, mineral sand was the most prominent temper in the assemblage. Most of the mineral sand tempers consisted of quartz and alkali feldspar grains (TG A1) that were present in a range of sand sizes and were generally angular. Sands were collected by potters as tempers along beaches, rivers and from dug-out deposits. Even though An Sơn's proximity to the ocean may have been much closer in the past, the presence of beach sands as temper has not been recorded since the sands were not uniform in size in the studied ceramics. While fast-flowing rivers can deposit sand, the slow-moving Vàm Cỏ Đông River deposits silt and sand might have been acquired by potters from earlier deposits, such as the Pleistocene alluvial deposits that underlie the site (Ulrike Proske, pers. comm.).

The lateritic fabrics (TG A2) included orange-brown grains of weathered laterite, and consisted of iron oxide, quartz and muscovite. The minerals in the clay matrices associated with the laterite grains included biotite, amphibole, pyroxene, ilmenite, apatite, quartz and alkali feldspar. Macroscopically, the laterite was identified by the presence of iron oxide-stained grains and sometimes shiny inclusions (biotite). 'Lateritic' soils are generally red soils with high clay content as a result of extreme weathering of parent materials and aluminium and iron enrichment; these elements are usually evenly distributed in the soil (Beck and Neupert 2009). TG A2 was differentiated from sand tempered sherds (TG A1) that did not include obvious laterite grains, except as fine-weathered grades in the clay matrix. In fact, most of the sherds in the assemblage included small and large grains that were high in iron: they varied in shape, were orange or red in appearance, and were iron and silicon-rich.

The iron-rich coarse and rounded sand grains (TG A3) were orange to purple in appearance. While they were not pure FeO or Fe_2O_3, they contained more iron oxide than silicon and aluminium oxides and always occurred with other mineral sands in the same sherd (TG A1).

Many sherds were heavily tempered with rice husk (TG B), and these were present from the base of the deposits excavated in 2009, but none were present in the small sample from the very basal layer 3–5 excavated in 1997. Katsunori Tanaka has identified the fibres in some sherds as *Oryza sativa japonica* (pers. comm. to Peter Bellwood). Further species identification is required for the fibres in sherds from the earliest layers of the site to confirm the potential presence of domestic or wild rice species, and other plant remains such as millets and grasses (Tomber, Cartwright and Gupta 2011; Weber *et al.* 2010; Castillo and Fuller 2010). It may be argued that the presence of rice chaff temper indicates an economic reliance on rice and that it was readily available, but the technological significance of using this type of temper should not be underestimated, particularly for the use of pots in cooking that are under thermal shock (Tomber, Cartwright and Gupta 2011; Castillo and Fuller 2010) (see Chapter 5).

Fibre temper was sometimes associated with calcium phosphate (apatite) and iron phosphate (vivianite) grains (TG C), which may have resulted from phosphatic mineralisation of plant fibres (Green 1979) in the temper, or the addition of crushed bone or fossil material (Kuczumow *et al.* 2010; Piga *et al.* 2009) to the clay fabric. Reef debris can consist of skeletal material (bioclasts) which can be found in beach sands as rounded or subrounded particles. While these are often called calcareous tempers, the presence of iron phosphate in association with calcium phosphate has led to a separate phosphate category, independent of the shell calcareous temper category (TG D) (Dickinson 2006: 21, 40). Since reef and possibly beach deposits were not easily accessible from An Sơn, bioclastic deposits were more likely to have been accessed for ceramic tempers by digging into the substrate. The beach was most certainly much closer to An Sơn in the past but the exact relationship the people of An Sơn had with beach resources is not clear: there is no evidence of exploiting marine resources on site or the use of coastal beach sands in the ceramic fabrics. Earlier Pleistocene deposits that may include bioclastic remains in the region were very hard and would not have been a suitable clay material, therefore the bioclasts were most likely dug from a deposit for use as temper (Ulrike Proske, pers. comm.).

Calcareous, shell tempers (TG D) were rare in the analysed sample. The clays themselves frequently included zircon and ilmenite ($FeTiO_3$), regardless of the selected temper. The shell fabric included grains with jagged edges and a composition of calcium carbonate. The shell-tempered fabrics sometimes also included plant fibres, quartz and amphibole. Calcareous tempered ceramics can be identified macroscopically but may be mistaken for prominently quartz sand tempered ceramics.

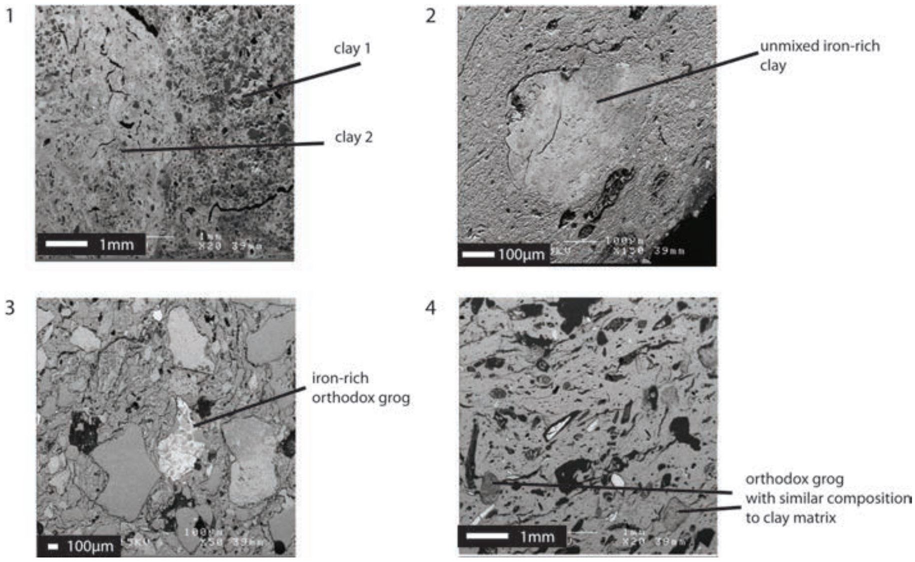


Figure 6.2. SEM backscatter images showing the difference between orthodox grog and iron-rich clay. 1. Unmixed iron-rich clay in raw clay (09-Vàm Cỏ Đông side channel-unfired clay-1). 2. Unmixed iron-rich clay in ceramic sherd (09AS-H1-C1-L7-S10-2). 3. Iron-rich orthodox grog (LG-3-surface). 4. Orthodox grog with similar composition to clay matrix (LG-2-surface).

Source: C. Sarjeant.

Grog was rare and minimal in density (usually only one grain in a sample) when present and was always in association with a primary temper (TG A, B, C and D) in the same sherd. Since it was not a primary temper it was not classified as a group in this analysis but as a subcategory that included orthodox grog (OG) and bleb grog (BG) (Vincent 2004, 1991, 1988). *Orthodox grog* is usually made from crushed ceramic sherds, although it can also include purpose-fired clays. *Bleb grog* is described as 'crushed prefired clay which has been purposefully tempered with rice plant remains, normally featuring varying amounts of rice husk, prior to its initial firing' (Vincent 1988: 88). The appearance and composition of orthodox grog is often similar to iron-rich clay with very fine sand and silt quartz grains that were not always thoroughly mixed into the ceramic paste (Figure 6.2). This iron-rich clay is known to exist locally at An Sơn (Figure 6.2). While bleb grog has been identified in a few ceramic samples from An Sơn, and the technique was undoubtedly present in the ceramic technology of the region, there was little microscopic evidence to substantiate its continuous use. If plant fibre tempers were always added to the ceramic fabric as bleb grog, it was not evident in the studied sherds. There was little evidence of potter investment in creating artificial tempers as grog at An Sơn, suggesting that accessible resources of sand and organic materials were sufficient to meet the needs and traditions of local ceramic production.

Temper characterisation and clay matrix description: An Sơn ceramics

Trench 1: Square C1 ceramic samples

The temper and clay matrices for the sample of sherds analysed from Trench 1 square C1 at An Sơn are described in Table 6.1. Square C1 was selected as a representative square for the 2009 excavation as it was located close to the main mound and contained the main part of the stratigraphic sequence represented in the site. A total of forty sherds were analysed, and this included samples from each 10 cm spit and each layer to represent the entire sequence. The clay matrices are described according to their texture and mineral inclusions. The texture was recorded at high magnification of the clay matrix: 'smooth' matrices had no visible inclusions, 'fibre' matrices incorporated small organic fibres that were remnants of the temper, and 'mineral' matrices included small non-plastic grains, presumably natural components of the clays (Table 6.1).

The majority of the sherds (60%) were purposefully tempered with mineral sand that consisted of quartz and feldspar (TG A1) or laterite (TG A2). The sand grains were most frequently angular, with a mixture of sizes. The lowest layer in square C1 only contained sand tempered ceramics, and no fibre temper (TG B) was observed. In the Trench 1 square C1 sample, only 15% were fibre tempered in all layers, although a further 10% were tempered with mixed fibre and phosphate material (TG B/C), and another 2.5% with mixed calcareous and fibre temper (TG B/D). The remaining C1 sherds were tempered with a mixture of sand and fibre (TG A1/B) (10%), and one sherd with calcareous temper (TG D) (2.5%). In addition to the detailed results in Table 6.1, a summary of the C1 ceramic samples that were analysed and their identified temper groups is presented in Appendix A.1.

Other An Sơn ceramic samples

The temper and clay matrices for each analysed sample from Trench 1 (except the square C1 sample), the Test Square and the 1997 Trench 1, are described in Table 6.2, and the temper groups are characterised for each analysed sample. Once again, fibre temper (TG B) was not present in the lowest layer, layer 3–5 of the 1997 excavation. Bleb grog and untempered wares (TG E) were only observed in more recent layers and in surface sherds, postdating the neolithic occupation of An Sơn. In addition to the detailed results in Table 6.2, a summary of the An Sơn ceramic samples that were analysed and their identified temper groups is presented in Appendix A.2.

Table 6.1. Description of the An Sơn ceramic fabrics, 2009 excavation, Trench 1 square C1.

Layer		Sample ID	Temper	Temper minerals	Density of temper	Mineral grain shape	Mineral grain size	Matrix description
1	1	09AS-H1-C1-L1-S1-1	Mineral sand	Quartz Alkali feldspar Amphibole	High	Angular	0.25–1 mm	Clay Quartz, alkali feldspar and zircon inclusions Smooth texture
1	1	09AS-H1-C1-L1-S1-2	Phosphate Fine fibre	Calcium phosphate	Medium in phosphate sand Low in fibre	Rounded to angular	0.1–1 mm	Clay Quartz and alkali feldspar inclusions Fibre texture
1	2	09AS-H1-C1-L1-S2-1	Mineral sand	Quartz Alkali feldspar	Medium	Subangular	0.25–0.5 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar and zircon inclusions Smooth texture
1	2	09AS-H1-C1-L1-S2-2	Fibre	-	Low	-	-	Clay with unmixed iron-rich clay Quartz and impure iron oxide inclusions Fibre and mineral texture
5	3	09AS-H1-C1-L5-S3-1	Mineral sand	Quartz Alkali feldspar	Medium	Subangular to angular	0.5–1 mm	Clay Quartz, alkali feldspar, garnet and chlorite inclusions Smooth texture
5	3	09AS-H1-C1-L5-S3-2	Phosphate Fine fibre	Calcium phosphate Iron phosphate	Low	Subangular to angular	0.2–0.5 mm	Clay with unmixed iron-rich clay Quartz, impure iron oxide and iron rich phyllosilicate inclusions Mineral texture
5	3	09AS-H1-C1-L5-S3-3	Mineral sand	Quartz Alkali feldspar	Medium	Subrounded to subangular	0.2–0.5 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar, garnet, ilmenite and rutile inclusions Mineral texture
5/6	4	09AS-H1-C1-L5/6-S4-1	Mineral sand	Quartz Amphibole	High	Subangular to angular	0.2–0.5 mm	Clay Quartz, alkali feldspar and ilmenite inclusions Mineral texture
5/6	4	09AS-H1-C1-L5/6-S4-2	Fibre	-	Low	-	-	Clay with unmixed iron-rich clay Quartz and zircon inclusions Mineral texture

Layer		Sample ID	Temper	Temper minerals	Density of temper	Mineral grain shape	Mineral grain size	Matrix description
		09AS-H1-C1-L5/6-S4-3	Mineral sand	Quartz Alkali feldspar	High	Subrounded to subangular	0.2–1.5 mm	Clay Quartz, alkali feldspar, ilmenite and rutile inclusions Mineral texture
	5	09AS-H1-C1-L5/6-S5-1	Mineral sand	Quartz Alkali feldspar	Medium	Subangular to angular	0.2–0.75 mm	Clay Quartz, alkali feldspar, garnet, chlorite, ilmenite and kaolinite inclusions Mineral texture
		09AS-H1-C1-L5/6-S5-2	Fibre	-	Low	-	-	Clay with unmixed iron-rich clay Quartz and impure iron oxide inclusions Fibre and mineral texture
		09AS-H1-C1-L5/6-S5-3	Mineral sand	Quartz Alkali feldspar Amphibole	Medium	Angular	0.5–1 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar, garnet, mica and ilmenite inclusions Smooth and mineral texture
		09AS-H1-C1-L5/6-S5-4	Lateritic mineral sand Orthodox grog	Quartz Alkali feldspar Biotite Muscovite	Medium in sand Very low in grog	Angular sand, subangular grog	0.5–1.5 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar, garnet, mica, calcium phosphate and pyroxene inclusions Mineral texture
		09AS-H1-C1-L5/6-S5-5	Calcareous Fibre	Calcium carbonate	Low	Angular	0.2–0.5 mm	Clay Quartz and pyroxene inclusions Mineral texture
		09AS-H1-C1-L5/6-S5-6	Calcareous	Calcium carbonate	Low	Subangular	~1 mm	Clay Quartz and illite inclusions Mineral texture
		09AS-H1-C1-L5/6-S5-7	Mineral sand	Quartz Alkali feldspar Amphibole	High	Angular	0.2–1.5 mm	Clay Quartz, alkali feldspar, garnet and ilmenite inclusions Mineral texture

Layer		Sample ID	Temper	Temper minerals	Density of temper	Mineral grain shape	Mineral grain size	Matrix description
	6	09AS-H1-C1-L5/6-S6-1	Mineral sand Fibre	Quartz Alkali feldspar	Medium in sand Low in fibre	Subrounded to subangular	0.2–0.5 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar, epidote and zircon inclusions Smooth texture
	6	09AS-H1-C1-L5/6-S6-2	Fibre	-	Medium	-	-	Clay with unmixed iron-rich clay Quartz, plagioclase feldspar and florencite inclusions Fibre texture
	7	09AS-H1-C1-L5/6-S7-1	Mineral sand	Quartz Alkali feldspar	High	Subangular to angular	0.25–1 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar and ilmenite inclusions Mineral texture
	7	09AS-H1-C1-L5/6-S7-2	Fibre	-	Low	-	-	Clay with another unmixed clay Quartz inclusions Fibre texture
	7	09AS-H1-C1-L5/6-S7-3	Lateritic mineral sand	Quartz Plagioclase feldspar Pyroxene Biotite	Medium	Subangular to angular	0.5–1.5 mm	Clay Quartz, plagioclase feldspar, pyroxene, mica, ilmenite and zircon inclusions Mineral texture
	8	09AS-H1-C1-L5/6-S8-1	Mineral sand Fibre	Quartz	Medium in sand Low in fibre	Subangular to angular	0.2–1 mm	Clay Quartz and zircon inclusions Mineral texture
	8	09AS-H1-C1-L5/6-S8-2	Phosphate Fibre	Calcium phosphate Iron phosphate	Medium in phosphate sand Low in fibre	Rounded to angular	0.1–1 mm	Clay Quartz inclusions Fibre and mineral texture
	8	09AS-H1-C1-L5/6-S9-1	Mineral sand	Quartz Alkali feldspar	High	Subangular to angular	0.2–1.5 mm	Clay Quartz, alkali feldspar, ilmenite and zircon inclusions Mineral texture

Layer		Sample ID	Temper	Temper minerals	Density of temper	Mineral grain shape	Mineral grain size	Matrix description
	9	09AS-H1-C1-L5/6-S9-2	Fine fibre	-	High	-	-	Clay with unmixed iron-rich clay Fibre and mineral texture
		09AS-H1-C1-L5/6-S9-3	Mineral sand Iron-rich mineral sand	Quartz Alkali feldspar Impure iron oxide, waterworn	Medium	Rounded to angular	0.2–1 mm	Clay Quartz, alkali feldspar, amphibole and ilmenite inclusions Mineral texture
7	10	09AS-H1-C1-L7-S10-1	Mineral sand	Quartz Alkali feldspar	Medium	Subangular to angular	0.2–1 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar, ilmenite and zircon inclusions Mineral texture
		09AS-H1-C1-L7-S10-2	Phosphate Fibre	Calcium phosphate Iron phosphate	Low	Rounded	0.1–0.5 mm	Clay with another unmixed clay Quartz and mica inclusions Mineral texture
		09AS-H1-C1-L7-S10-3	Lateritic mineral sand	Quartz Alkali feldspar Mica	Medium	Subrounded to subangular	0.2–0.5 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar, mica, garnet and ilmenite inclusions Mineral texture
		09AS-H1-C1-L7-S10-4	Mineral sand	Quartz Alkali feldspar	High	Subrounded to subangular	0.25–0.5 mm	Clay Quartz, alkali feldspar, amphibole and ilmenite inclusions Mineral texture
	11	09AS-H1-C1-L7-S11-1	Mineral sand Fine fibre	Quartz	Medium in sand High in fibre	Angular	0.2–0.5 mm	Clay Quartz and calcium phosphate inclusions Mineral texture
		09AS-H1-C1-L7-S11-2	Lateritic mineral sand	Quartz Alkali feldspar Biotite	High	Angular	0.2–1.5 mm	Clay Quartz, alkali feldspar, amphibole, mica, ilmenite and zircon inclusions Mineral texture

Layer		Sample ID	Temper	Temper minerals	Density of temper	Mineral grain shape	Mineral grain size	Matrix description
		09AS-H1-C1-L7-S11-3	Mineral sand	Quartz Alkali feldspar	High	Quartz is angular Feldspar is subrounded to subangular	0.1–1.5 mm	Clay Quartz, alkali feldspar, ilmenite and zircon inclusions Mineral texture
		09AS-H1-C1-L7-S11-4	Lateritic mineral sand	Quartz Biotite Muscovite	Medium	Subrounded to angular	0.2–1 mm	Clay with unmixed iron-rich clay Quartz, mica, plagioclase feldspar, hornblende, sphene and ilmenite inclusions Mineral texture
8	12	09AS-H1-C1-L8-S12-1	Mineral sand Fibre	Quartz	High in sand Low in fibre	Subrounded to angular	0.1– 0.75 mm	Clay Quartz, calcium phosphate and ilmenite inclusions Fibre and mineral texture
		09AS-H1-C1-L8-S12-2	Mineral sand	Quartz Alkali feldspar Plagioclase feldspar	Medium	Subrounded to angular	0.1–0.5 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar, plagioclase feldspar, ilmenite and illite inclusions Coarse mineral texture
		09AS-H1-C1-L8-S12-3	Mineral sand	Quartz Alkali feldspar	High	Subrounded to angular	0.2–0.75 mm	Clay Quartz, alkali feldspar, garnet and ilmenite inclusions Coarse mineral texture
		09AS-H1-C1-L8-S12-4	Mineral sand	Quartz Alkali feldspar	High	Subangular to angular	0.2–0.75 mm	Clay Quartz, alkali feldspar, garnet and ilmenite inclusions Mineral texture
		09AS-H1-C1-L8-S12-5	Mineral sand	Quartz Alkali feldspar	High	Subangular to angular	0.2–0.8 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar and ilmenite inclusions Mineral texture

Source: Compiled by C. Sarjeant.

Table 6.2. Description of the An Sơn ceramic fabrics, 2009 excavation Trench 1 and Test Square, and 1997 excavation Trench 1. Key: 09AS = An Sơn 2009 excavation, 97AS = An Sơn 1997 excavation, H1 = Trench 1, TS = Test Square, L = Layer, S = Spit, U/S = Unstratified.

Layer	Spit	Sample ID	Temper	Temper minerals	Density of temper	Mineral grain shape	Mineral grain size	Matrix description
Surface	Surface	09AS-U/S-1	Fine fibre (bleb grog)	-	High	-	-	Clay Quartz, amphibole, garnet and iron rich phyllosilicate inclusions Smooth texture
		09AS-U/S-2	Fine fibre (bleb grog)	-	High	Rounded to subrounded	0.2–1 mm	Clay Quartz, amphibole, garnet, ilmenite and iron rich phyllosilicate inclusions Smooth texture
2	3	09AS-H1-C10-L2-S3 -Óc Eo-1	None	-	-	-	-	Clay with unmixed iron-rich clay Quartz and garnet inclusions Smooth texture
		09AS-H1-C5-L2-S3-1	Fibre	-	Low	-	-	Clay with unmixed iron-rich clay Quartz, garnet and ilmenite inclusions Smooth texture
3	10	09AS-H1-C4-L3-S10-1	Mineral sand	Quartz Alkali feldspar	Medium	Rounded to subangular	0.1–0.2 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar, amphibole and ilmenite inclusions Mineral texture
5/6	8	09AS-H1-B2-L5/6-S8-1	Mineral sand	Quartz Alkali feldspar	Medium	Subrounded to subangular	0.1–1 mm	Clay Quartz, alkali feldspar and ilmenite inclusions Mineral texture
		09AS-H1-B2-L5/6-S8-2	Fibre Iron-rich mineral sand	Impure iron oxide, waterworn	Medium in fibre Low in sand	Rounded	1.5 mm	Clay with unmixed iron-rich clay Quartz, iron oxide, ilmenite and iron rich phyllosilicate inclusions Mineral texture

Layer	Spit	Sample ID	Temper	Temper minerals	Density of temper	Mineral grain shape	Mineral grain size	Matrix description
8	10	09AS-H1-C10-L8-S10-1	Mineral sand	Quartz Alkali feldspar	High	Subrounded to subangular	0.1–0.4 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar, plagioclase feldspar, mica, garnet, amphibole and ilmenite inclusions Mineral texture
200-210 cm	200-210 cm	09AS-TS-200-210cm-1	Fibre Mineral sand Phosphate	Quartz Calcium phosphate Amphibole	Medium	Rounded	0.5 mm	Clay Quartz and amphibole inclusions Smooth texture
240-250 cm	240-250 cm	09AS-TS-240-250cm-1	Fibre	-	Low	-	-	Clay with unmixed iron-rich clay Quartz and illite inclusions Fibre texture
		09AS-TS-240-250cm-2	Mineral sand	Quartz	High	Subrounded to subangular	0.2–0.5 mm	Clay Quartz, illite and fibre inclusions Fibre texture
		09AS-TS-240-250cm-3	Mineral sand	Quartz Alkali feldspar	High	Rounded to subrounded	0.1–0.2 mm	Clay Quartz, alkali feldspar, ilmenite and zircon inclusions Coarse texture
		09AS-TS-240-250cm-3b	Mineral sand	Quartz Alkali feldspar Amphibole	High	Subrounded to angular	0.2–1 mm	Clay Quartz, alkali feldspar, amphibole and zircon inclusions Smooth texture
		09AS-TS-240-250cm-4	Fine fibre	-	High	-	-	Clay Quartz, calcium phosphate and illite inclusions Mineral texture
250-260 cm	250-260 cm	09AS-TS-250-260cm-1	Fine fibre	-	High	-	-	Clay Quartz inclusions Fibre and mineral texture
		09AS-TS-250-260cm-2	Lateritic mineral sand	Quartz Alkali feldspar Muscovite	Medium	Subrounded to subangular	0.25–0.5 mm	Clay Quartz, alkali feldspar, mica, amphibole and zircon inclusions Mineral texture

Layer	Spit	Sample ID	Temper	Temper minerals	Density of temper	Mineral grain shape	Mineral grain size	Matrix description
350-360 cm	3-4	97AS-H1-A1-350-360cm-S3-4-1	Fine fibre	-	Medium	-	-	Clay Quartz, calcium phosphate, impure iron oxide, rutile and illite inclusions Fibre texture
		97AS-H1-B2-350-360cm-S3-4-1	Fine fibre Mineral sand	Quartz	Low in fibre High in sand	Subrounded	0.1–0.2 mm	Clay Quartz and calcium phosphate inclusions Fibre and mineral texture
		97AS-H1-350-360cm-S3-4-1	Fibre (bleb grog)	-	Low	-	-	Clay with unmixed iron-rich clay Quartz, plagioclase feldspar and illite inclusions Fibre texture
360-410 cm	3-5	97AS-H1-360-410cm-S3-5-1	Mineral sand	Quartz Alkali feldspar	High	Angular	0.1–2 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar, epidote, ilmenite and zircon inclusions Mineral texture
		97AS-H1-360-410cm-S3-5-2	Mineral sand	Quartz Alkali feldspar	High	Subrounded to subangular	0.2–0.5 mm	Clay Quartz, alkali feldspar and ilmenite inclusions Mineral texture

Source: Compiled by C. Sarjeant.

Temper characterisation and clay matrix description: Non-local ceramic samples

Temper and clay matrices are described in Table 6.3 for samples from various sites in southern Vietnam (Giồng Cá Vồ, Lộc Giang, Đình Ông and Cù Lao Rùa), central Vietnam (Hòa Diêm), northern Vietnam (Cồn Cổ Ngựa, Đa Bút and Mán Bạc) and northeast Thailand (Ban Non Wat) (see Figure 1.2 and Figure 1.3 for site locations). These sites were selected to incorporate pre-neolithic or incipient neolithic phases with Cồn Cổ Ngựa and Đa Bút, and neolithic phases of occupation with Mán Bạc, Ban Non Wat, Lộc Giang, Đình Ông and Cù Lao Rùa. Giồng Cá Vồ in southern Vietnam and Hòa Diêm in central Vietnam were sampled to represent the post-neolithic phase of occupation. Both sites had iron, bronze and jar burials, and have been linked to Sa Huỳnh developments of the central Vietnamese coast (see Lâm 2011; Yamagata 2006; Solheim 1964, 1959) (see Chapter 2). These sites were studied to identify broad similarities over space and time in order to contextualise the ceramic technology at An Sơn.

Fibre temper (TG B) was only identified at Ban Non Wat and at the sites neighbouring An Sơn along the Vàm Cỏ Đông River, Giồng Cá Vồ, Lộc Giang and Đình Ông. The other sites only had sand tempered sherds (TG A1). Less deliberate modes of tempering were evident at early sites, like Đa Bút and Cồn Cổ Ngựa, where large impure iron oxide grains that were natural non-plastic impurities in the clay were not removed in clay preparation, and incidentally acted as a temper (TG A3). In addition to the detailed results in Table 6.3, a summary of the non-local ceramic samples that were analysed and their identified temper groups is presented in Appendix A.4.

Table 6.3. Description of non-local ceramic fabrics. Key: BNW = Ban Non Wat, CCN = Cồn Cổ Ngựa, CLR = Cù Lao Rùa, DB = Đa Bút, DO = Đình Ông, GCV = Giồng Cá Vồ, HD = Hòa Diêm, LG = Lộc Giang, MB = Mán Bạc.

Site	Layer/ Spit	Sample	Temper	Temper minerals	Density of temper	Mineral grain shape	Mineral grain size	Matrix description
Ban Non Wat	9:2 Feature 1	08/09BNW-N100-9:surface2-feature1-1	Fibre	-	Low	-	-	Clay with unmixed iron-rich clay Quartz, alkali feldspar, garnet, rutile and barium sulfate inclusions Mineral texture
Cồn Cổ Ngựa	Surface	CCN-1-surface	Mineral sand Iron-rich mineral sand	Quartz Impure iron oxide, waterworn	Medium	Subrounded to subangular	0.2-1 mm	Clay Quartz, epidote and impure iron oxide inclusions Mineral texture
Cù Lao Rùa	Surface	CLR-1-surface	Mineral sand Iron-rich mineral sand	Quartz Alkali feldspar	High	Subangular to angular	0.25 mm	Clay Quartz, alkali feldspar, impure iron oxide and cacoxenite inclusions Mineral texture
		CLR-2-surface	Mineral sand	Quartz Alkali feldspar	Medium	Subangular to angular	0.2-1 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar, amphibole, rutile, sheet silicate inclusions Strand mineral texture
		CLR-3-surface	Mineral Sand Fibre?	Quartz Alkali feldspar Plagioclase feldspar	Medium in mineral sand Very low in fibre	Subrounded to angular	0.2-1 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar, plagioclase feldspar, cacoxenite, illite, mica, rutile and ilmenite inclusions Mineral texture
		CLR-4-surface	Mineral sand Iron-rich mineral sand	Quartz Alkali feldspar Plagioclase feldspar	Medium	Subrounded to angular	0.25-0.75 mm	Clay Quartz, alkali feldspar, plagioclase feldspar, pyroxene, ilmenite and sheet silicate inclusions Mineral texture

Site	Layer/ Spit	Sample	Temper	Temper minerals	Density of temper	Mineral grain shape	Mineral grain size	Matrix description
Đa Bút	Surface	DB-1-surface	Mineral sand Iron-rich mineral sand	Quartz Impure iron oxide, waterworn	Medium in quartz Low in iron oxide	Rounded to subrounded	0.25-1 mm	Clay with unmixed iron-rich clay Quartz, impure iron oxide and epidote inclusions Mineral texture
Đình Ông	Surface	DO-1-surface	Fibre	-	Medium	-	-	Clay with unmixed iron-rich clay Quartz inclusions Mineral texture
		DO-2-surface	Mineral sand	Quartz Alkali feldspar	Medium	Subrounded to subangular	0.2-1 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar, amphibole, metal oxide and ilmenite inclusions Mineral texture
		DO-3-surface	Mineral sand	Quartz Alkali feldspar Plagioclase feldspar	High	Subrounded	0.1-0.6 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar, plagioclase feldspar, amphibole, epidote and ilmenite inclusions Mineral texture
		DO-4-surface	Mineral sand Orthodox grog	Quartz Alkali feldspar	Medium in sand Low in grog	Subrounded to subangular	0.1-0.5 mm	Clay Quartz, alkali feldspar, amphibole, zircon and ilmenite inclusions Mineral texture
Giồng Cá Vồ	Surface	GCV-1-surface	Mineral sand Iron-rich mineral sand	Quartz Alkali feldspar	Medium	Subangular	0.2-0.5 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar and ilmenite inclusions Mineral texture
		GCV-2-surface	Fine fibre	-	Medium	-	-	Clay with unmixed iron-rich clay Quartz inclusions Fibre texture
		GCV-3-surface	Fine fibre	-	High	-	-	Clay with unmixed iron-rich clay Quartz inclusions Mineral and fibre texture

Site	Layer/ Spit	Sample	Temper	Temper minerals	Density of temper	Mineral grain shape	Mineral grain size	Matrix description
Hòa Diêm	Surface	HD-1-surface	Mineral sand	Quartz Alkali feldspar	Medium	Subangular	0.2-1 mm	Clay Quartz, alkali feldspar, amphibole, garnet, biotite and zircon inclusions Mineral texture
Lộc Giang	Surface	LG-1-surface	Mineral sand	Quartz Alkali feldspar	High	Subrounded to subangular	0.2-0.6 mm	Clay Quartz, alkali feldspar and ilmenite inclusions Mineral texture
		LG-2-surface	Fibre Orthodox grog	-	Low	Subrounded to subangular	0.5 mm	Clay Quartz, plagioclase feldspar and calcium phosphate inclusions Mineral texture
		LG-3-surface	Mineral sand Orthodox grog	Quartz Alkali feldspar	Medium in sand Very low in grog	Subangular sand Angular grog	Sand is 0.2-2 mm Grog is 0.5 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar, amphibole, sphene and ilmenite inclusions Mineral texture
Mán Bạc	Surface	MB-1-surface	None	-	-	-	-	Clay with unmixed iron-rich clay Quartz, plagioclase feldspar, calcium phosphate, amphibole, garnet and rutile inclusions Mineral texture
		MB-2-surface	Mineral sand Lateritic mineral sand	Quartz Impure iron oxide, waterworn	Low	Subrounded to subangular	0.2-0.5 mm	Clay Quartz and impure iron oxide inclusions Mineral texture
		MB-3-surface	Mineral sand Lateritic mineral sand	Quartz Alkali feldspar Plagioclase feldspar	Medium	Subrounded to subangular	0.25-0.5 mm	Clay with unmixed iron-rich clay Quartz, alkali feldspar, plagioclase feldspar, amphibole, garnet, illite, epidote and impure iron oxide inclusions Mineral texture

Source: Compiled by C. Sarjeant.

Description of clay samples

The clay matrices are described in Table 6.4 for each analysed geological clay sample from the Vàm Cỏ Đông River-An Sơn area. The clay samples include unfired clays from natural deposits and fired clay lumps from archaeological contexts (see Chapter 4). The chemical compositions of the clays, averaged and normalised, are presented (Table 6.5). The mineral grains of the raw clays were frequently small and rounded quartz (see image 1 in Figure 6.2), in comparison to the sand grains of ceramic sherd samples which were angular and varied in size. Feldspar was not common in the clay samples in comparison to the ceramic samples, suggesting that the sand temper chosen by potters was selected from a mixed feldspar and quartz sand deposit. Only one sample had alkali feldspar grains. The sample with very high iron content (09-Vàm Cỏ Đông side channel-unfired clay-1) was purple in colour and included quartz. The high iron content is consistent with the presence of small iron oxide grains in the clay matrix of the ceramic samples. Where clays have been identified with 'lateritic' grains (often indicated by the presence of rusty brown-red coloured grains), the clay had higher iron oxide content, as with the sample 09AS-TS-240-250cm-fired clay-2 in Table 6.5. The analysed clays indicate that the tempers identified were all manually added by potters, except for perhaps lateritic sand (TG A2), which may have been a natural presence in the potting clays and acted like a temper. In addition to the detailed results in Table 6.4, a summary of the clay samples that were analysed is presented in Appendix A.3.

Table 6.4. Description of the An Sơn clay fabrics, 2009 excavation Trench 2 and Test Square fired clay lumps, and unfired clay from the Vàm Cỏ Đông River vicinity. Key: 09AS = An Sơn 2009 excavation, H2 = Trench 2, TS = Test Square, L = Layer.

Layer	Spit	Sample	Sand size inclusions	Density of inclusions	Mineral grain shape	Mineral grain size	Matrix description
3–3	30–40 cm	09AS-H2-B2-L3-3(30-40cm)-fired clay-1	None	-	-	-	Clay Quartz, alkali feldspar and chlorite inclusions Strand mineral texture
3–4	3–4	09AS-H2-D4-L3-4-fired clay-1	None	-	-	-	Clay Quartz, pyroxene and mica inclusions Strand and sand mineral texture
240–250 cm	240–250 cm	09AS-TS-240-250cm-fired clay-1	Quartz	High	Subrounded to subangular	0.1–1 mm	Clay, porous Quartz inclusions Mineral texture
240–250 cm	240–250 cm	09AS-TS-240-250cm-fired clay-2	Quartz	High	Subrounded to subangular	0.1–1 mm	Clay, porous Quartz, rutile and zircon inclusions Mineral texture
240–250 cm	240–250 cm	09AS-TS-240-250cm-fired clay-3	Quartz	High	Subrounded to subangular	0.2–1 mm	Clay Quartz and rutile inclusions Mineral texture
-	-	09AS-fired clay lump-1	Quartz	High	Subrounded to subangular	0.1–0.25 mm	Clay, porous Quartz and zircon inclusions Mineral texture
-	-	09-Vàm Cỏ Đông side channel-unfired clay-1	Quartz	Medium	Subrounded to subangular	0.05–0.1 mm	Clay Quartz, iron oxide and zircon inclusions Mineral texture

Layer	Spit	Sample	Sand size inclusions	Density of inclusions	Mineral grain shape	Mineral grain size	Matrix description
-	-	09-Vàm Cỏ Đông side channel-unfired clay-2	Quartz	High	Rounded to subrounded	0.1 mm	Clay Quartz, mica and rutile inclusions Mineral texture
-	-	09AS-1.5m in borrow pit-unfired clay-1	Quartz	High	Subrounded to angular	0.25–0.75 mm	Clay Quartz and zircon inclusions Mineral texture

Source: Compiled by C. Sarjeant.

Table 6.5. The averaged and normalised chemical composition of each clay sample.

Provenance	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	K_2O	CaO	TiO_2	V_2O_5	MnO	FeO	Total
09AS-H2-B2-L3-3(30-40cm)-fired clay-1	1.78	2.10	19.99	63.44	0.33	0.65	4.08	1.40	0.89	0.03	0.08	5.21	100.00
09AS-H2-D4-L3-4-fired clay-1	0.18	0.46	16.81	77.78	0.14	0.44	0.44	0.77	0.83	0.00	0.00	2.17	100.00
09AS-fired clay lump-1	0.18	0.46	16.81	77.78	0.14	0.44	0.44	0.77	0.83	0.00	0.00	2.17	100.00
09AS-TS-240-250cm-fired clay-1	0.52	0.89	20.53	71.89	0.00	0.45	0.68	1.79	0.83	0.02	0.01	2.40	100.00
09AS-TS-240-250cm-fired clay-2	0.25	1.21	19.58	55.57	1.88	0.37	0.58	1.76	0.65	0.10	0.58	17.47	100.00
09AS-TS-240-250cm-fired clay-3	0.83	1.61	20.60	67.47	0.00	0.41	2.87	1.59	0.89	0.02	0.03	3.66	100.00
09-Vàm Cỏ Đông side channel-unfired clay-1	0.30	0.40	11.93	14.25	0.02	0.69	0.33	0.02	0.28	0.04	0.19	71.56	100.00
09-Vàm Cỏ Đông side channel-unfired clay-2	0.34	1.00	30.21	61.48	0.00	1.16	1.68	0.09	1.26	0.04	0.02	2.72	100.00
09AS-1.5m in borrow pit-unfired clay-1	0.43	0.66	33.53	59.38	0.00	0.34	0.67	0.03	1.59	0.06	0.07	3.23	100.00

Source: Compiled by C. Sarjeant.

Summary: Characterisation of the non-plastic inclusions

Temporal differentiations were not immediately clear in regard to temper selection. However, the occurrence of fibre temper (TG B) in the lower layers at An Sơn was minor, and the density of fibres in these fabrics, when present, was lower than in later deposits. There was a clear dominance of mineral sand (quartz and feldspar; TG A1) and fibre (TG B) tempered ceramics in the An Sơn ceramic sample (Figure 6.3).

The following table (Table 6.6) provides the intentional temper inclusions and the natural non-plastic inclusions within the clay matrix associated with each temper group and subgroup. Like the mineral temper grains, the natural non-plastic inclusions of the clay matrices were analysed with EDX and identified with reference materials (Severin 2004; Deer, Howie and Zussman 1992). Common natural inclusions were ilmenite and other titanium and iron oxides, microcline and biotite, amphibole, zircon, and the minerals that were also identified in the sand tempers, particularly quartz. Many of these minerals were identified in the unfired and fired clays that were analysed, with the larger grains always identified as quartz. There was only one clay sample with alkali feldspar present (see Table 6.4), suggesting that sand sources rich in quartz and alkali feldspar were targeted by potters for tempers, since the local clays appeared to lack this combination. The temper groups characterised for the An Sơn ceramic sample were only commonly identified at nearby sites such as Lộc Giang, Đình Ông and Giồng Cá Vồ, those along the Vàm Cỏ Đông River, and only rarely at sites outside southern Vietnam.

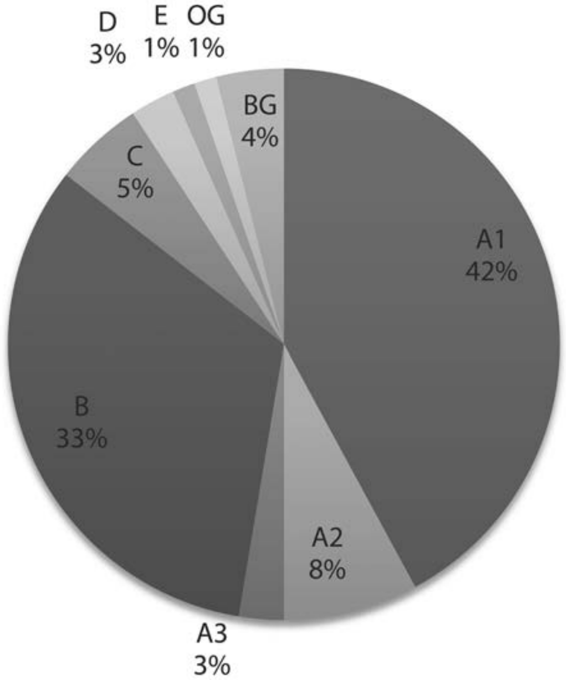


Figure 6.3. Proportion of each temper group in the An Sơn ceramic sample. Key: A1 = mineral sand A2 = lateritic (micaceous) sand, A3 = impure iron oxide (large grains)/almandine sand, B = fibre, C = phosphate, D = calcareous, E = untempered, OG = orthodox grog, BG = bleb grog.

Source: C. Sarjeant.

Table 6.6. Summary of temper groups and samples identified for each group. Key: 09AS = An Sơn 2009 excavation, 97AS = An Sơn 1997 excavation, H1 = Trench 1, H2 = Trench 2, TS = Test Square, L = layer, S = spit, U/S = unstratified, OG = orthodox grog, BG = bleb grog, BNW = Ban Non Wat, CCN = Cồn Cổ Ngựa, CLR = Cù Lao Rùa, DB = Đa Bút, DO = Đình Ông, GCV = Giồng Cá Vồ, HD = Hòa Diêm, LG = Lộc Giang, MB = Mán Bạc.

Temper group	Temper subgroup	Temper	Temper inclusions always include:	Matrix inclusions may include:	An Sơn Trench 1 C1 samples	Other An Sơn samples	Non-An Sơn samples
A1	1	Mineral sand	Quartz Alkali feldspar	Chlorite Epidote Garnet Ilmenite Rutile Zircon	09AS-H1-C1-L1-S2-1 09AS-H1-C1-L5-S3-1 09AS-H1-C1-L5-S3-3 09AS-H1-C1-L5/6-S4-3 09AS-H1-C1-L5/6-S5-1 09AS-H1-C1-L5/6-S7-1 09AS-H1-C1-L5/6-S9-1 09AS-H1-C1-L7-S10-1 09AS-H1-C1-L7-S11-3 09AS-H1-C1-L8-S12-3 09AS-H1-C1-L8-S12-4 09AS-H1-C1-L8-S12-5	09AS-TS-240-250cm-3 09AS-H1-B2-L5/6-S8-1 97AS-H1-360-410cm-S3-5-1 97AS-H1-360-410cm-S3-5-2	LG-1-surface
A1	2	Mineral sand	Quartz Alkali feldspar Plagioclase feldspar	Illite Ilmenite	09AS-H1-C1-L8-S12-2		
A1	3	Mineral sand	Quartz Alkali feldspar Plagioclase feldspar	Amphibole Epidote Ilmenite			DO-3-surface
A1	4	Mineral sand	Quartz Alkali feldspar Plagioclase feldspar	Cacoxenite Illite Ilmenite Garnet Mica Rutile		09AS-H1-C10-L8-S10-1	CLR-3-surface
A1	5	Mineral sand	Quartz Alkali feldspar Amphibole	Garnet Ilmenite Zircon	09AS-H1-C1-L1-S1-1 09AS-H1-C1-L5/6-S4-1 09AS-H1-C1-L5/6-S5-7 09AS-H1-C1-L7-S10-4	09AS-TS-240-250cm-3b 09AS-H1-C4-L3-S10-1	DO-4-surface (OG)
A1	6	Mineral sand	Quartz Alkali feldspar Amphibole	Garnet Ilmenite Mica Rutile Zircon	09AS-H1-C1-L5/6-S5-3		CLR-2-surface DO-2-surface HD-1-surface
A1	7	Mineral sand	Quartz Alkali feldspar	Amphibole Ilmenite Sphene			LG-3-surface (OG)

Temper group	Temper subgroup	Temper	Temper inclusions always include:	Matrix inclusions may include:	An Sơn Trench 1 C1 samples	Other An Sơn samples	Non-An Sơn samples
A1	8	Mineral sand	Quartz	Fibre (trace) Illite		09AS-TS-240-250cm-2	
A1/A3	1	Mineral sand Coarse, waterworn impure iron oxide	Quartz Impure iron oxide	Epidote			CCN-1-surface DB-1-surface MB-2-surface
A1/A3	2	Mineral sand Coarse, waterworn impure iron oxide	Quartz Alkali feldspar Impure iron oxide	Amphibole Cacoxenite Ilmenite	09AS-H1-C1-L5/6-S9-3		CLR-1-surface GCV-1-surface
A1/A3	3	Mineral sand Coarse, waterworn impure iron oxide	Quartz Alkali feldspar Plagioclase feldspar Impure iron oxide	Ilmenite Pyroxene			CLR-4-surface
A1/A3	4	Mineral sand Coarse, waterworn impure iron oxide	Quartz Alkali feldspar Plagioclase feldspar Impure iron oxide	Amphibole Epidote Garnet Illite			MB-3-surface
A1/B	1	Mineral sand Fibre	Fibre Quartz	Zircon	09AS-H1-C1-L5/6-S8-1		
A1/B	2	Mineral sand Fibre	Fibre Quartz	Calcium phosphate Ilmenite	09AS-H1-C1-L7-S11-1 09AS-H1-C1-L8-S12-1	97AS-H1- B2-350-360cm-S3-4-1	
A1/B	3	Mineral sand Fibre	Fibre Quartz Alkali feldspar	Epidote Zircon	09AS-H1-C1-L5/6-S6-1		
A1/B/C	1	Mineral sand Fibre Phosphate	Fibre Quartz Amphibole Calcium phosphate			09AS-TS-200-210cm-1	

Temper group	Temper subgroup	Temper	Temper inclusions always include:	Matrix inclusions may include:	An Sơn Trench 1 C1 samples	Other An Sơn samples	Non-An Sơn samples
A2	1	Lateritic mineral sand	Quartz Alkali feldspar Biotite Muscovite	Amphibole Calcium phosphate Garnet Ilmenite Mica Pyroxene Sphene	09AS-H1-C1-L5/6-S5-4 (OG) 09AS-H1-C1-L7-S11-4 (MS?)		
A2	2	Lateritic mineral sand	Quartz Alkali feldspar Biotite	Amphibole Garnet Ilmenite Zircon	09AS-H1-C1-L7-S10-3 (MS?) 09AS-H1-C1-L7-S11-2	09AS-TS-250-260cm-2 (MS?)	
A2	3	Lateritic mineral sand	Quartz Plagioclase feldspar Biotite Pyroxene	Ilmenite Mica Zircon	09AS-H1-C1-L5/6-S7-3		
B	1	Fibre	Fibre		09AS-H1-C1-L1-S2-2 09AS-H1-C1-L5/6-S4-2 09AS-H1-C1-L5/6-S5-2 09AS-H1-C1-L5/6-S7-2 09AS-H1-C1-L5/6-S9-2	09AS-H1-C5-L2-S3-1 09AS-TS-240-250cm-1 09AS-TS-250-260cm-1	GCV-2-surface GCV-3-surface
B	2	Fibre	Fibre	Florencite Illite Plagioclase feldspar Quartz	09AS-H1-C1-L5/6-S6-2	97AS-H1-350-360cm-S3-4-1 (BG)	
B	3	Fibre	Fibre	Calcium phosphate Mica Plagioclase feldspar Quartz			LG-2-surface (OG)
B	4	Fibre	Fibre	Amphibole Garnet Ilmenite Quartz		09AS-U/S-1 (BG) 09AS-U/S-2 (BG)	DO-1-surface

Temper group	Temper subgroup	Temper	Temper inclusions always include:	Matrix inclusions may include:	An Sơn Trench 1 C1 samples	Other An Sơn samples	Non-An Sơn samples
B	5	Fibre	Fibre	Alkali feldspar Barite Garnet Quartz Rutile			08/09BNW-N100-9:surface2-feature 1-1
B	6	Fibre	Fibre	Calcium phosphate Illite Iron oxide Quartz Rutile		09AS-TS-240-250cm-4 97AS-H1-A1-350-360cm-S3-4-1	
B/A3	1	Fibre	Fibre Coarse rounded iron-rich phyllosilicates	Ilmenite Iron oxide		09AS-H1-B2-L5/6-S8-2	
B/C	1	Fibre Phosphate	Fibre Calcium phosphate	Alkali feldspar Quartz	09AS-H1-C1-L1-S1-2		
B/C	2	Fibre Phosphate	Fibre Calcium phosphate Iron phosphate	Iron oxide Quartz	09AS-H1-C1-L5-S3-2 09AS-H1-C1-L5/6-S8-2		
B/C	3	Fibre Phosphate	Fibre Calcium phosphate Iron phosphate	Mica Quartz	09AS-H1-C1-L7-S10-2		
B/D	1	Fibre Calcareous	Fibre Calcium carbonate	Pyroxene Quartz	09AS-H1-C1-L5/6-S5-5		
D	1	Calcareous	Calcium carbonate	Quartz	09AS-H1-C1-L5/6-S5-6		
E	1	None	None	Quartz		09AS-H1-C10-L2-S3-Óc Eo-1	
E	2	None	None	Amphibole Calcium phosphate Garnet Plagioclase feldspar Quartz Rutile			MB-1-surface

Source: Compiled by C. Sarjeant.

PART II: CLAY MATRIX ANALYSIS

Introduction: Clay matrix analysis with SEM-EDX

The EDX results from the SEM provided raw data for clay matrix areas, similar to those from non-plastic grain analyses, expressed as a compositional value for each analysed element: Na, Mg, Al, Si, P, S, K, Ca, Ti, V, Mn and Fe. Several representative clay matrix areas, usually five, were analysed from a single sample, as described in Chapter 3. The total value of the clay elemental composition was often lower than the readings from a mineral grain due to the texture and porosity of the clay matrix. To ensure comparability between the readings, they were normalised to 100% and an average was taken for the multiple readings for each sample to result in one compositional data set for each sample. These values were then transformed in log ratio against Al_2O_3 (explained further below).

The analysis of the clay matrix data was undertaken to address questions about the sequence of the ceramic technology at An Sơn, the relationship between rim forms and raw material selections, and to characterise the ceramic technology of An Sơn in comparison with other sites of southern Vietnam and beyond. The identified clay matrix compositional groups are summarised. A combination of log ratio principal components analysis (PCA), average-linkage hierarchical cluster analysis and canonical variate analysis (CVA) was implemented to tackle these questions in each section of Chapter 6, Part II. Each CVA focused on one *a priori* group, rim form and vessel components, layers, tempers or archaeological sites, to deduce clay composition similarities and differences between samples within these groups. These statistical methods were described in Chapter 3. The PCAs and CVAs are presented with plots and the hierarchical cluster analyses with dendrograms. The statistical analyses label the plots with numerical identifications (1–91) for each sample. The corresponding archaeological information for each of these samples is provided in Appendix A.

Which elements to include in the statistical analysis?

The matrix readings were normalised initially and then the numerous readings for each sample were averaged for statistical analysis. Aitchison's (1986, 1983) suggestion that log ratio transformations are required when dealing with compositional data was adopted (previously discussed in Chapter 3). The study presented below, of which element oxides to include in the statistical analysis, revealed that Al_2O_3 reduced the variability in bivariate plots and PCA. While Al_2O_3 should not be excluded from the analysis since it is a common and abundant component of clays used in ceramic manufacture, it was applied against the other included element oxides in the log ratio transformation.

There is also substantial discussion (as presented in Chapter 3) about which elements to include in statistical analyses. Of the analysed element oxides, SO_3 and V_2O_5 were in almost undetectable quantities in many cases. Bivariate plots created prior to statistical analysis revealed that MnO reduced the variability of samples, and there have been suggestions that it is a highly migratory element and should be excluded from statistical analyses (Shepard 1966). The post-depositional effects of phosphorus on archaeological ceramic compositions are well-reported (e.g. Freestone, Meeks and Middleton 1985), and phosphorus was also excluded here.

The complete sample of the An Sơn ceramic sherds for fabric analysis was included in the assessment that follows to determine which element oxides to include in the subsequent statistical analyses.

Bivariate plots

The bivariate plots show each analysed element against another element to understand where the variability in the compositional data lies and which elements may be limiting the observed variability (as recommended by Michelaki and Hancock 2011). Each element was plotted against SiO_2 because of its consistent presence in all of the samples (Figure 6.4). All element oxides and analysed ceramic sherds from An Sơn are included in the bivariate plots. The plotted values were normalised and averaged for each sample, but were not log ratio transformed.

The most noticeable element to have an influence on variability is MnO, and its variation is markedly lower than the other elements in the bivariate plots (Figure 6.4). Reducing the variability in statistical analyses will do little to inform about the ceramic compositions and the relationship between ceramic sherds. Therefore, it is justifiable to remove MnO from the statistical analysis, especially in light of other claims that suggest it is a migratory element (Shepard 1966). Al_2O_3 also diminished the variability of the sample and its consistent presence in the samples is due to the clay matrix containing minerals that are hydrous aluminium phyllosilicates with variable amounts of the other elements (e.g. Fe, Mg). The omnipresence of Al_2O_3 in the ceramic clay matrices and its effect of reduced variability in the sample meant it was a suitable element to divide by in the log ratio transformation.

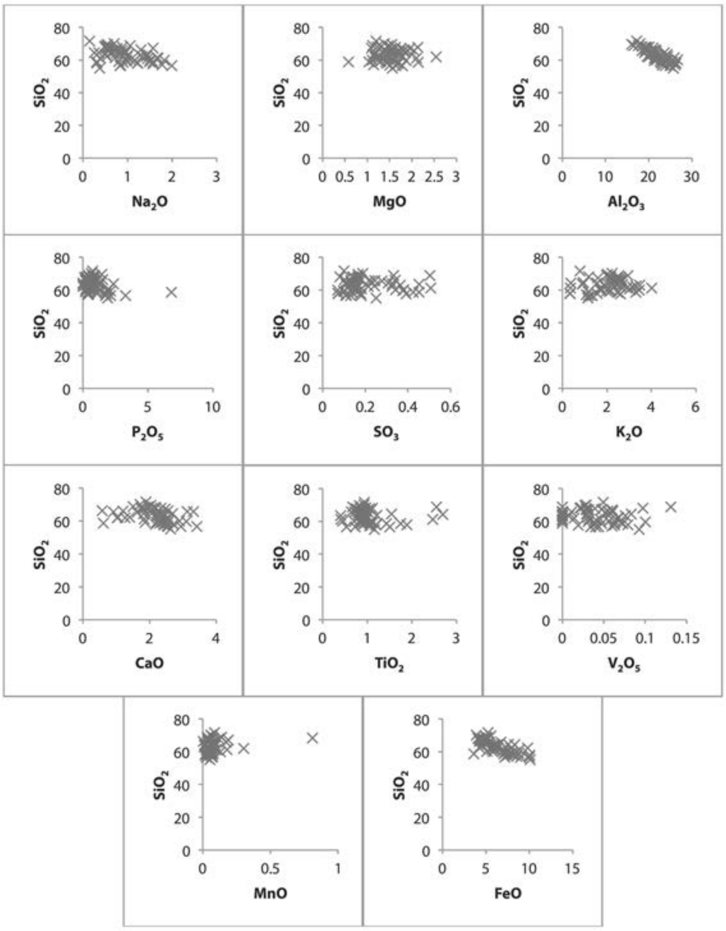


Figure 6.4. Bivariate plots of the concentration of each element oxide against SiO_2 in the analysed sample. The tight distribution of the SiO_3 versus Al_2O_3 plot displays less variability within the An Sơn analysed ceramic sample, and is an appropriate element to divide by in log ratio transformation for subsequent PCAs.

Source: C. Sarjeant.

Principal components analysis

In order to determine which elements should not be included in the PCA of the An Sơn analysed ceramic sample, the bivariate plots of Figure 6.4 were expanded with exploratory PCA, excluding the elements with low compositional values in the fabrics of the ceramic sample. The exclusion of V_2O_5, MnO, P_2O_5 and SO_3 is explored in this section. These PCA plots use log ratio transformed data against Al_2O_3.

PCA excluding vanadium oxide (magnesium, sodium, silicon, phosphorus, sulfur, calcium, potassium, titanium, manganese, iron oxides included)

The negligible quantities of V_2O_5 (Figure 6.4) in the samples meant that the element was to be excluded from all analyses. The following PCA plots (Figure 6.5, Figure 6.6, Table 6.7) should be compared to Figure 6.4 in order to deduce which elements are to be excluded, in addition to V_2O_5, in the PCAs of the An Sơn analysed ceramic sample.

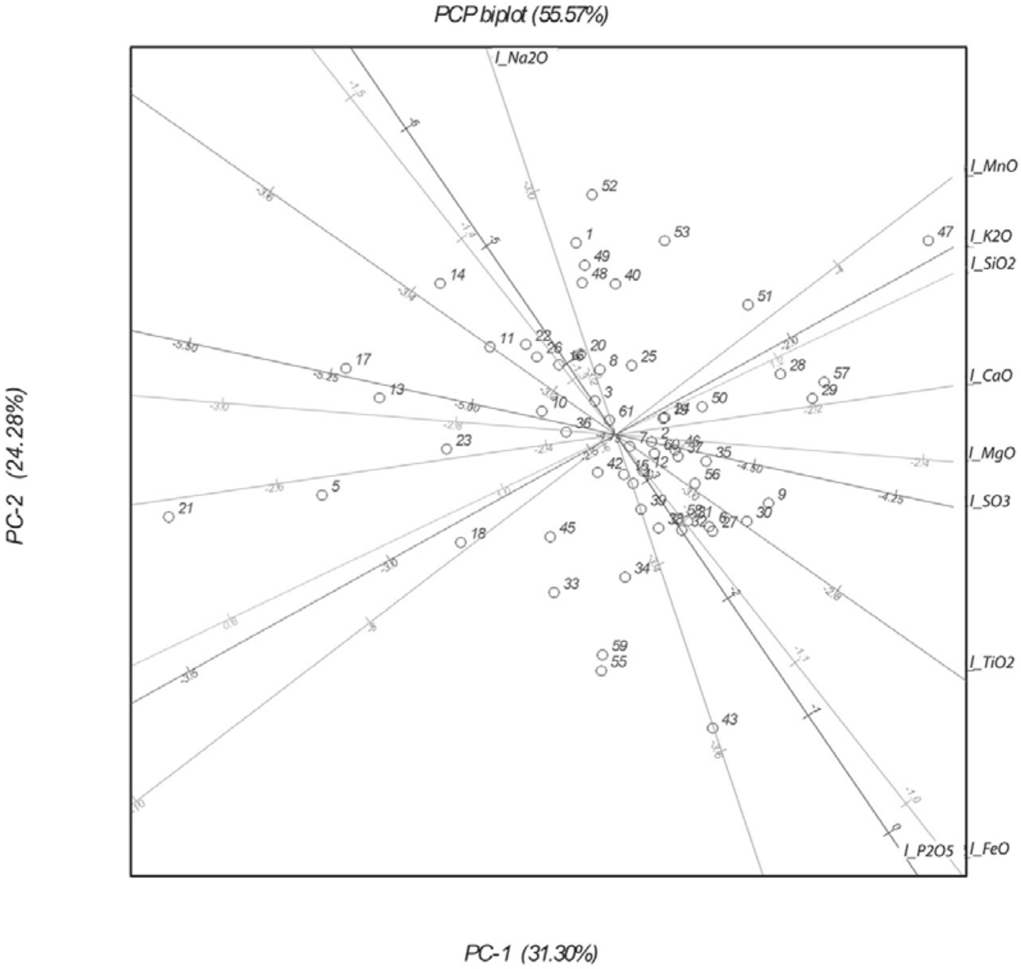


Figure 6.5. PCA biplot, excluding V_2O_5. First two dimensions. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

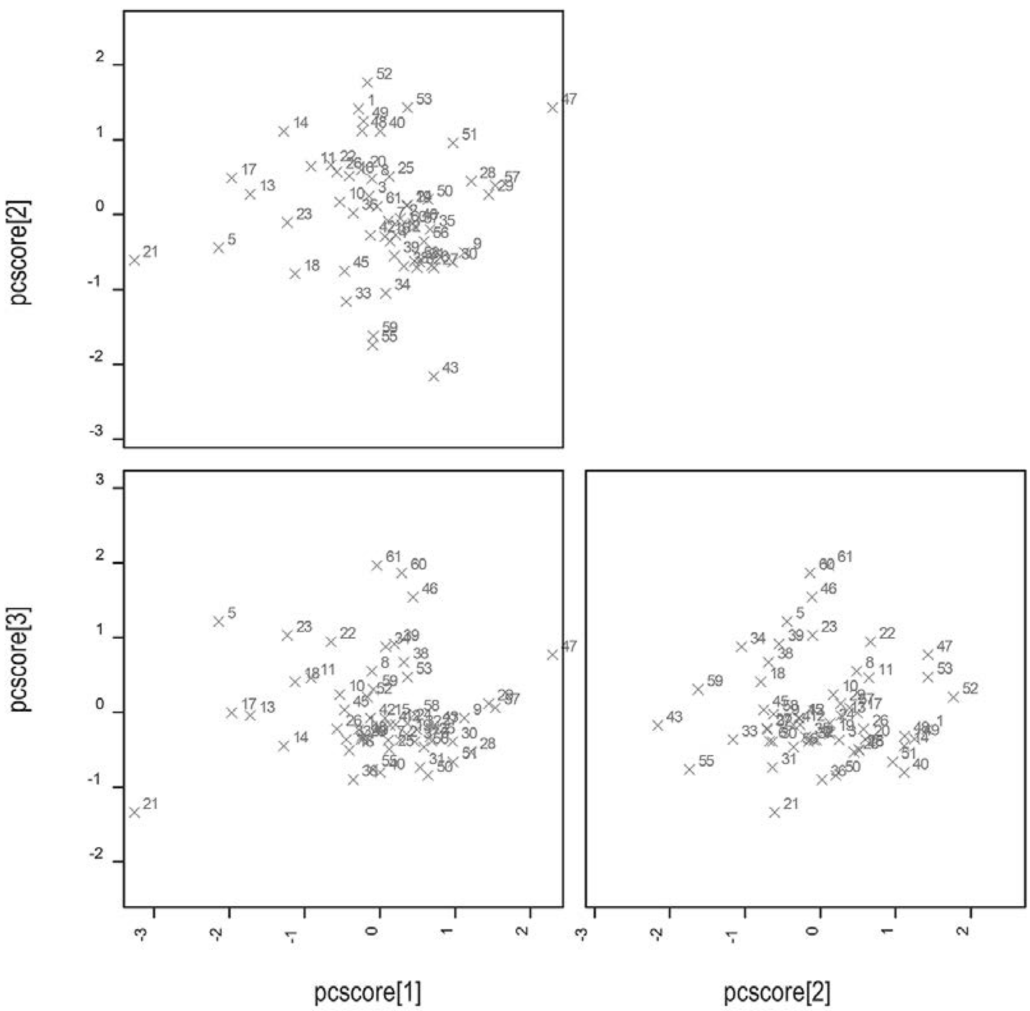


Figure 6.6. PCA plot, excluding V_2O_5. First three dimensions. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

Table 6.7. PCA loadings for Figure 6.5 and Figure 6.6, excluding V_2O_5. First three dimensions. The bold values indicate the element oxides that presented the greatest variability in the PCA.

	PC 1 (31.30%)	PC 2 (24.28%)	PC 3 (16.49%)
CaO	0.09947	0.01454	0.12032
FeO	0.04660	-0.05968	0.14920
K_2O	0.25995	0.14536	**-0.68355**
MgO	0.11637	-0.00944	0.00606
MnO	**0.73450**	**0.56573**	**0.27547**
Na_2O	**-0.04350**	0.13111	-0.53070
P_2O_5	0.53750	**-0.79085**	-0.02715
SO_3	0.23117	-0.05012	-0.32273
SiO_2	0.08127	0.03910	-0.01915
TiO_2	0.12840	-0.09100	0.18223

Source: Compiled by C. Sarjeant.

PCA excluding manganese and vanadium oxides (magnesium, sodium, silicon, phosphorus, sulfur, calcium, potassium, titanium, iron oxides included)

The variability of the PCA increases when MnO is excluded, which warrants the removal of the element in the following statistical analyses (Figure 6.7, Figure 6.8, Table 6.8). The samples appeared homogeneous prior to the exclusion of MnO (Figure 6.6).

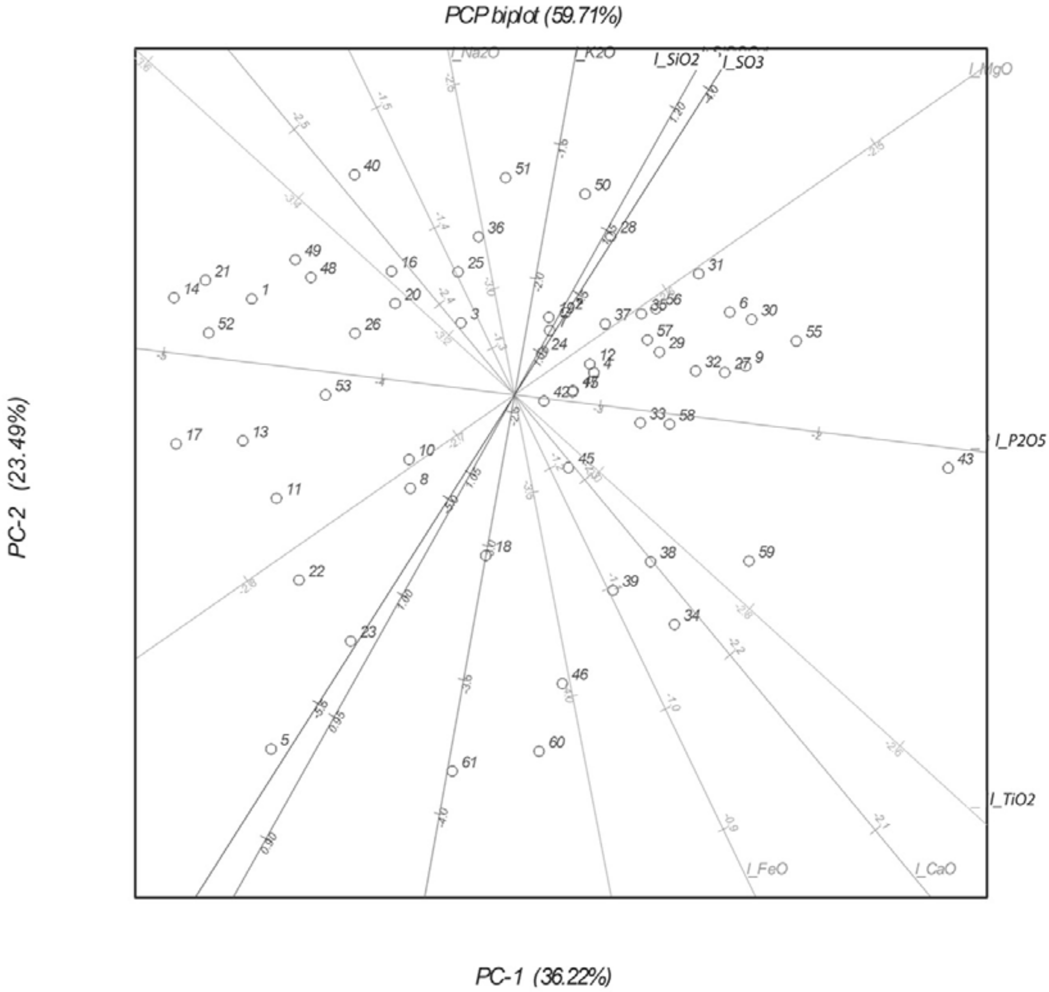


Figure 6.7. PCA biplot, excluding MnO and V_2O_5. First two dimensions. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

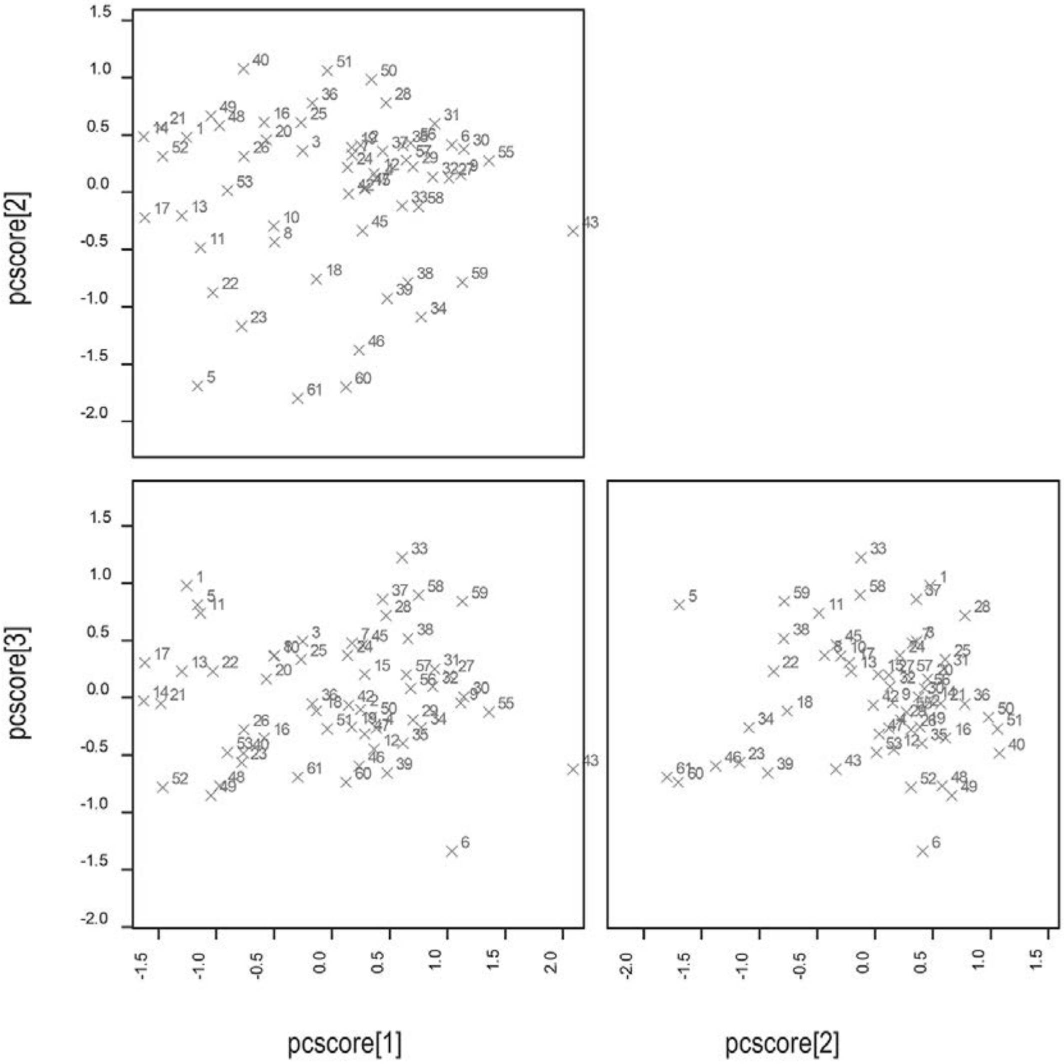


Figure 6.8. PCA plot, excluding MnO and V_2O_5. First three dimensions. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

Table 6.8. PCA loadings for Figure 6.7 and Figure 6.8, excluding MnO and V_2O_5. First three dimensions. The bold values indicate the element oxides that presented the greatest variability in the PCA.

	PC 1 (36.22%)	PC 2 (23.49%)	PC 3 (13.99%)
CaO	0.05815	-0.07041	0.18342
FeO	0.06723	**-0.14038**	0.05444
K_2O	0.13412	**0.75120**	-0.07672
MgO	0.06689	0.04678	-0.18306
Na_2O	**-0.09448**	0.49143	**0.56956**
P_2O_5	**0.94031**	**-0.11511**	0.27788
SO_3	0.22892	0.36170	**-0.57604**
SiO_2	0.03628	0.06503	-0.14666
TiO_2	0.15101	**-0.13798**	-0.41115

Source: Compiled by C. Sarjeant.

PCA excluding phosphorus and vanadium oxides (magnesium, sodium, silicon, sulphur, calcium, potassium, titanium, manganese, iron oxides included)

The variability of the sample diminishes markedly when P_2O_5 is removed (Figure 6.9, Figure 6.10, Table 6.9), compared to Figure 6.6 with P_2O_5. By removing P_2O_5 the variability within some of the other element oxides may be heightened, especially if this variation caused by P_2O_5 was a result of post-depositional leaching (Freestone, Meeks and Middleton 1985).

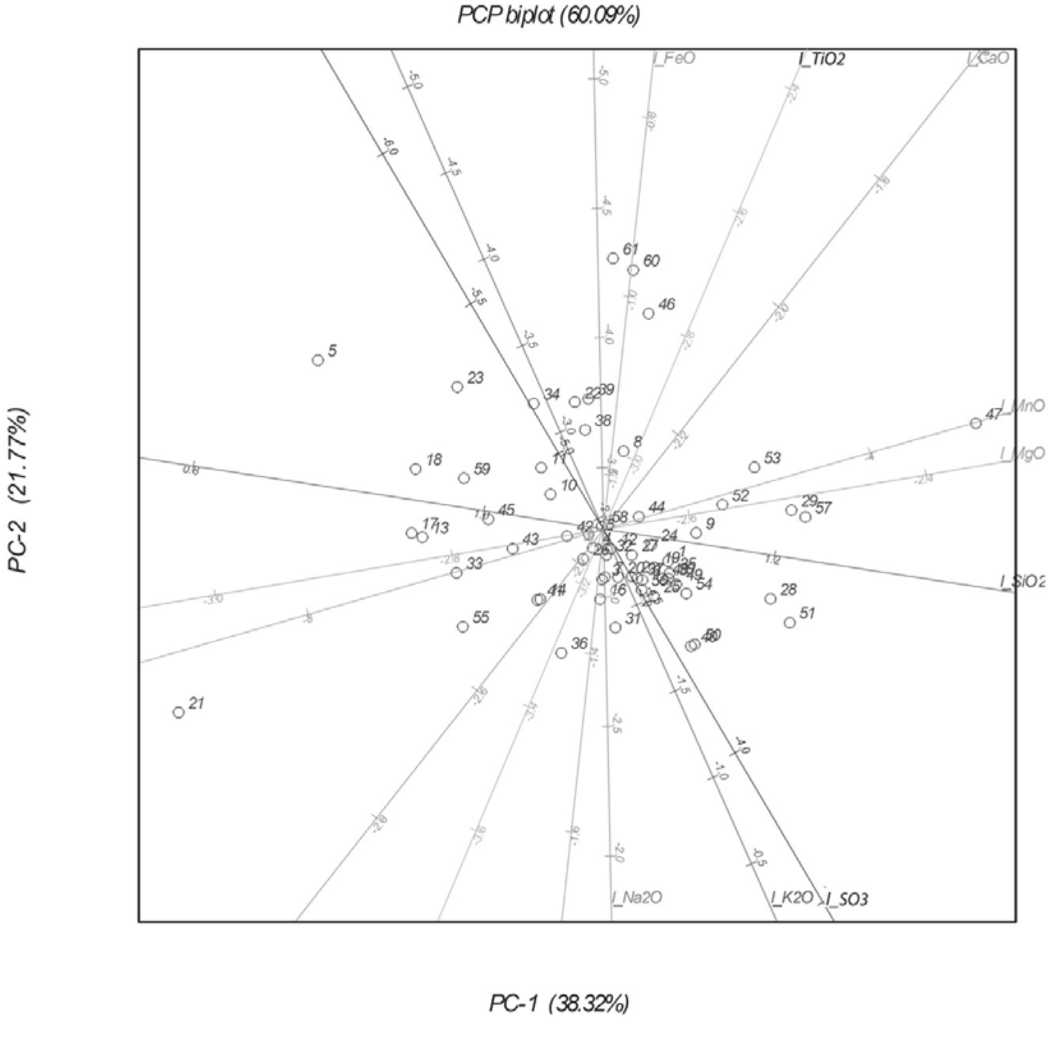


Figure 6.9. PCA biplot, excluding P_2O_5 and V_2O_5. First two dimensions. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

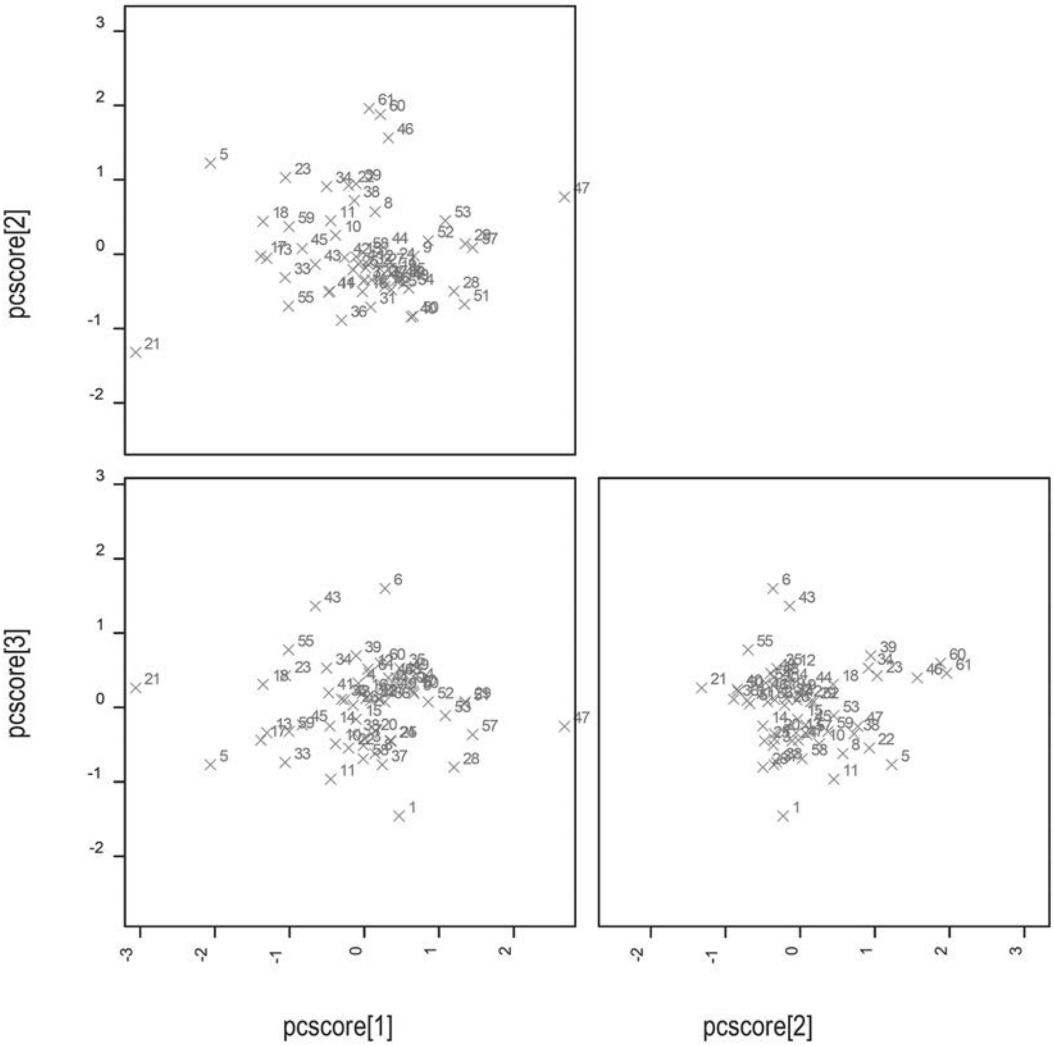


Figure 6.10. PCA plot, excluding P_2O_5 and V_2O_5. First three dimensions. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

Table 6.9. PCA loadings for Figure 6.9 and Figure 6.10, excluding P_2O_5 and V_2O_5. First three dimensions. The bold values indicate the element oxides that presented the greatest variability in the PCA.

	PC 1 (38.32%)	PC 2 (21.77%)	PC 3 (14.41%)
CaO	0.10494	0.13416	-0.19052
FeO	**0.01626**	0.15312	-0.02318
K_2O	0.29547	**-0.67050**	0.05271
MgO	0.11396	0.01934	0.13805
MnO	**0.91251**	**0.26368**	-0.20173
Na_2O	**0.01104**	-0.53344	**-0.51149**
SO_3	0.20131	-0.34389	**0.68031**
SiO_2	0.09331	-0.01444	0.09825
TiO_2	0.08003	0.18990	0.40808

Source: Compiled by C. Sarjeant.

PCA excluding sulphur and vanadium oxides (magnesium, sodium, silicon, phosphorus, calcium, potassium, titanium, manganese, iron oxides included)

The values of SO_3, like V_2O_5, were negligible in most cases and as a result the effect on the PCA plots is minimal (Figure 6.11, Figure 6.12, Table 6.10). SO_3 was removed from the subsequent analyses.

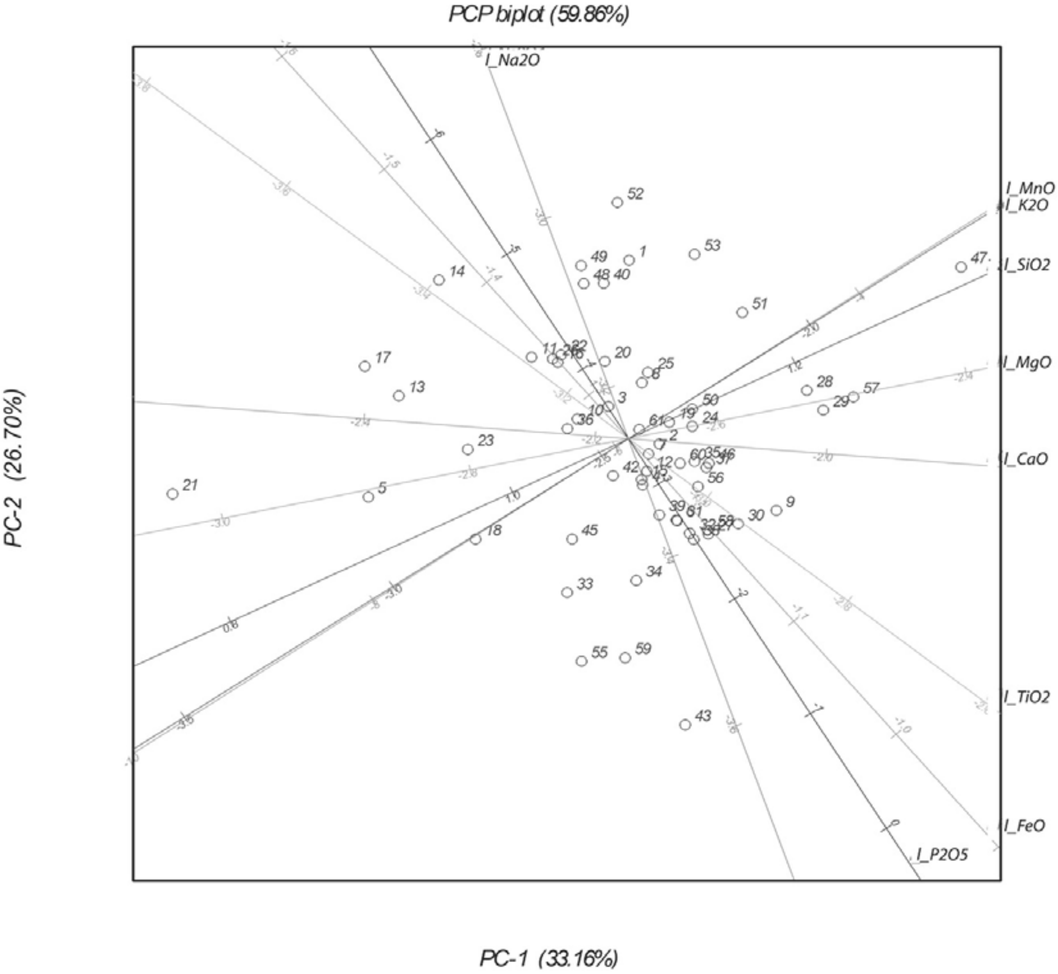


Figure 6.11. PCA biplot, excluding SO_3 and V_2O_5. First two dimensions. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

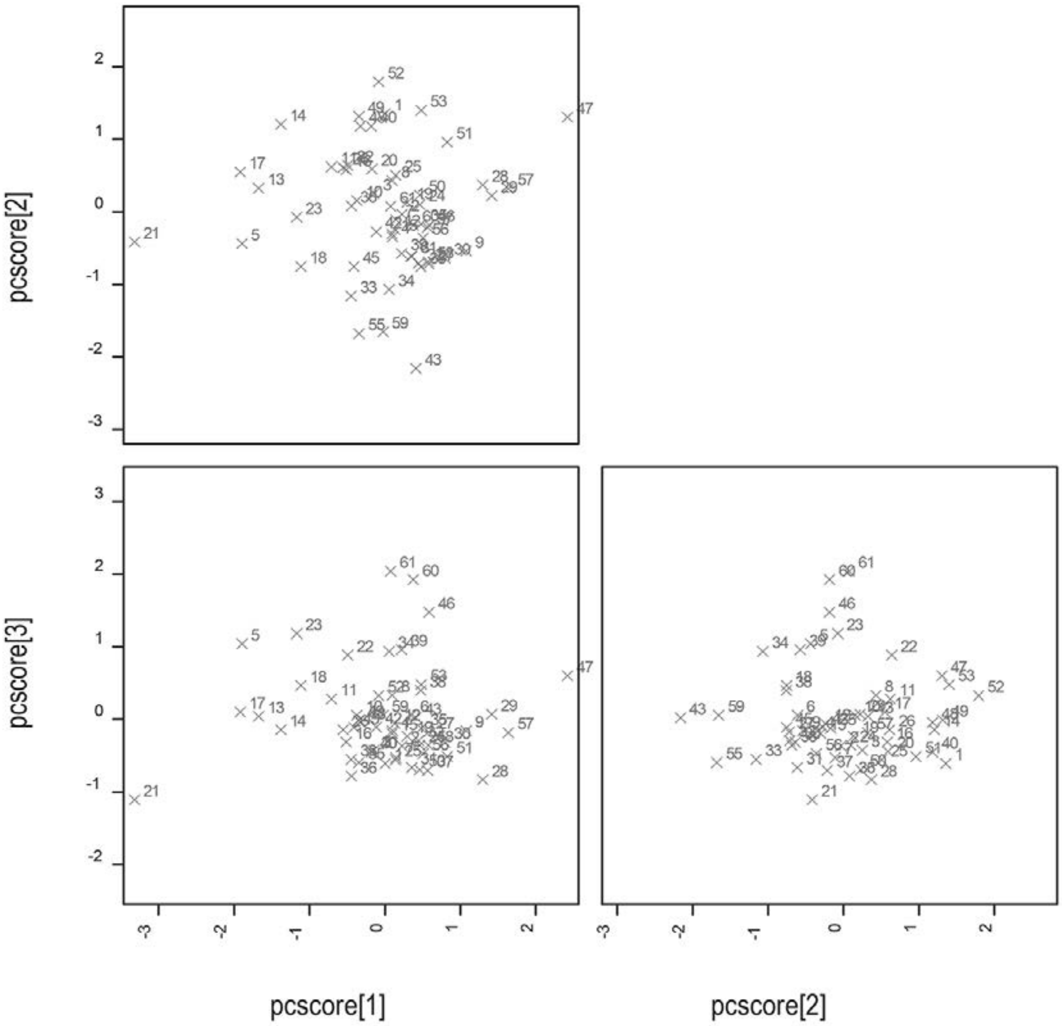


Figure 6.12. PCA plot, excluding SO_3 and V_2O_5. First three dimensions. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

Table 6.10. PCA loadings for Figure 6.11 and Figure 6.12, excluding SO_3 and V_2O_5. First three dimensions. The bold values indicate the element oxides that presented the greatest variability in the PCA.

	PC 1 (33.16%)	PC 2 (26.70%)	PC 3 (17.11%)
CaO	0.11815	-0.00926	0.06640
FeO	0.05795	-0.06651	0.12900
K_2O	0.23118	0.15072	**-0.70428**
MgO	0.10648	0.02174	0.02436
MnO	**0.78888**	**0.52043**	**0.20325**
Na_2O	**-0.04999**	0.13830	-0.60735
P_2O_5	0.52118	**-0.81971**	-0.14038
SiO_2	0.07934	0.03790	-0.01016
TiO_2	0.12310	-0.09465	**0.22882**

Source: Compiled by C. Sarjeant.

The greatest variability (i.e. principal component 1) in the above PCA plots (Figure 6.6, Figure 6.8, Fig, 6.10, Figure 6.12) was a result of the concentrations of FeO, MnO, Na_2O and P_2O_5 in the clay matrix compositions (Table 6.7, Table 6.8, Table 6.9, Table 6.10). V_2O_5 and SO_3 were excluded from the subsequent statistical analyses due to their rare occurrence in the ceramic sample, MnO was excluded since it diminished the variability of the sample, and P_2O_5, in contrast, exaggerated the variability, perhaps due to post-depositional effects. With these element oxides excluded and Al_2O_3 applied to the log ratio transformations, the remaining elements for statistical analyses of the clay matrix data were CaO, FeO, MgO, K_2O, SiO_2, Na_2O, and TiO_2.

Clay matrix characterisation: An Sơn ceramics

Trench 1: Square C1 ceramic samples

This section includes the samples from the representative square C1, Trench 1 from the 2009 excavation at An Sơn. The following clay matrix characterisations correspond to the temper identifications.

Principal components analysis

The greatest variability in the following PCA plots (Figure 6.13, Figure 6.14) is a result of the concentrations of CaO, FeO and K_2O in the clay matrix compositions (Table 6.11). When examining all three PCA dimensions, two main groups cluster, with a large number of outliers and variability evident in the An Sơn Trench 1 square C1 sample (Table 6.12). Refer to Appendix A for sample identification numbers and Figure 5.1 for rim form images.

- **Main group 1**: Samples 2, 4, 9, 12, 15, 16, 19, 24, 26, 29, 32, 35

  This group consists of ceramic sherds from layers 1, 5/6 and 7, with rim forms A1a, B1a, C1b and D1a. The represented tempers were fibre, fibre/phosphate, fibre/calcareous, calcareous, and lateritic sand. The majority of the sherds from this group were A1a fibre tempered and C1b fibre and fibre/calcareous tempered rims.

- **Main group 2**: Samples 1, 7, 20, 21, 25, 28, 31, 36, 37, 40 (merged with main group 1 in PC 2/PC 3)

  This group consists of ceramic sherds from layers 1, 5, 5/6, 7 and 8, with rim forms A1a, A2a, B1a, D1a and D1b. The represented tempers were sand, fibre and sand/fibre. The majority of the sherds were A2a sand tempered rims.

- **Outlier groups**: Samples 3 / 5 / 6 / 8 / 10, 27 / 11, 17 / 13 / 14 / 18, 38 / 22 / 23 / 30 / 33 / 34 / 39

  These included sherds from layers 1, 5, 5/6, 7 and 8. The represented rim forms included A2a, C2b, D1a and D1b, while the majority of the samples were body sherds. The represented tempers were sand, fibre/phosphate, iron-rich sand, lateritic sand (including one sample with orthodox grog), and sand/fibre.

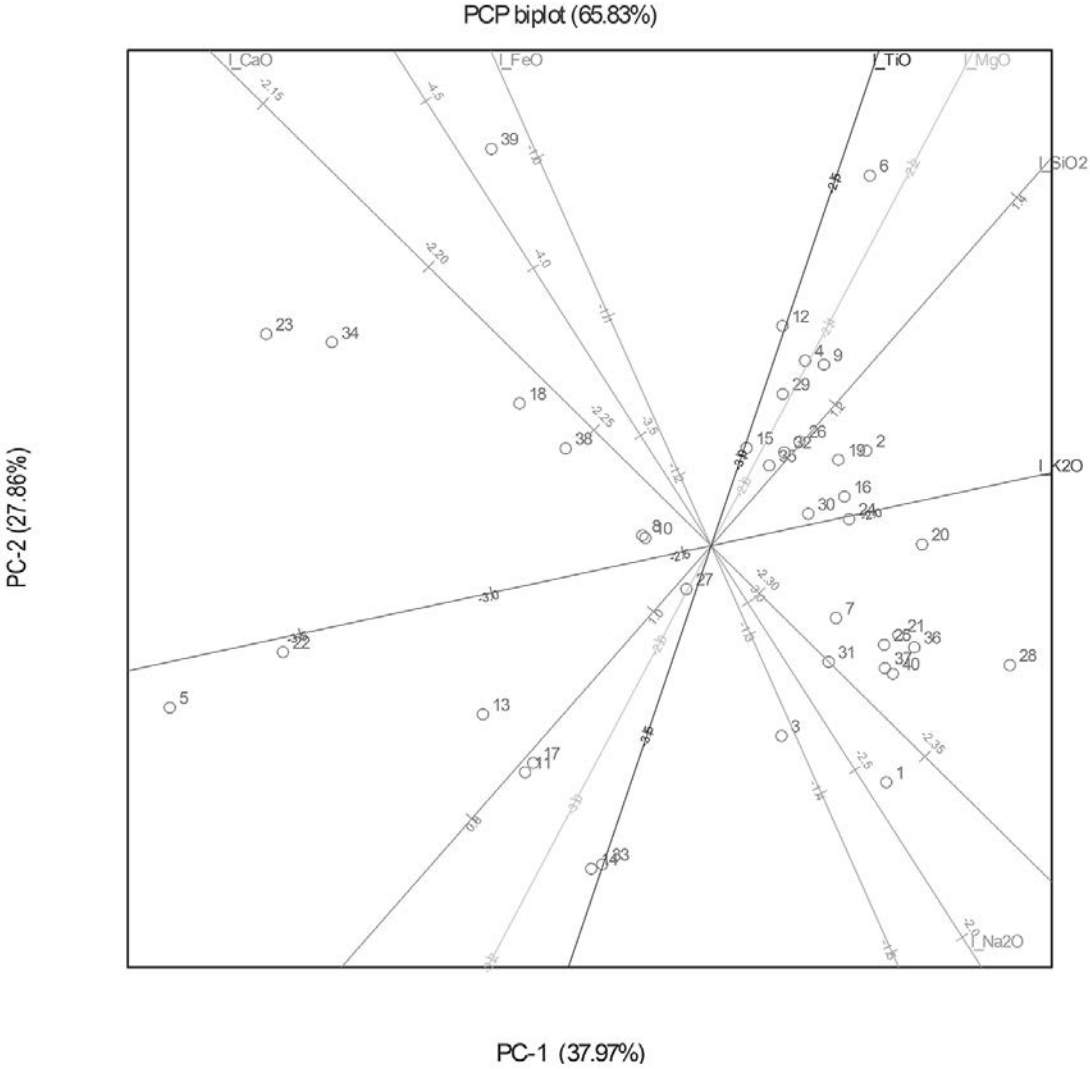


Figure 6.13. PCA biplot of the An Sơn ceramic samples, Trench 1 square C1. First two dimensions. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

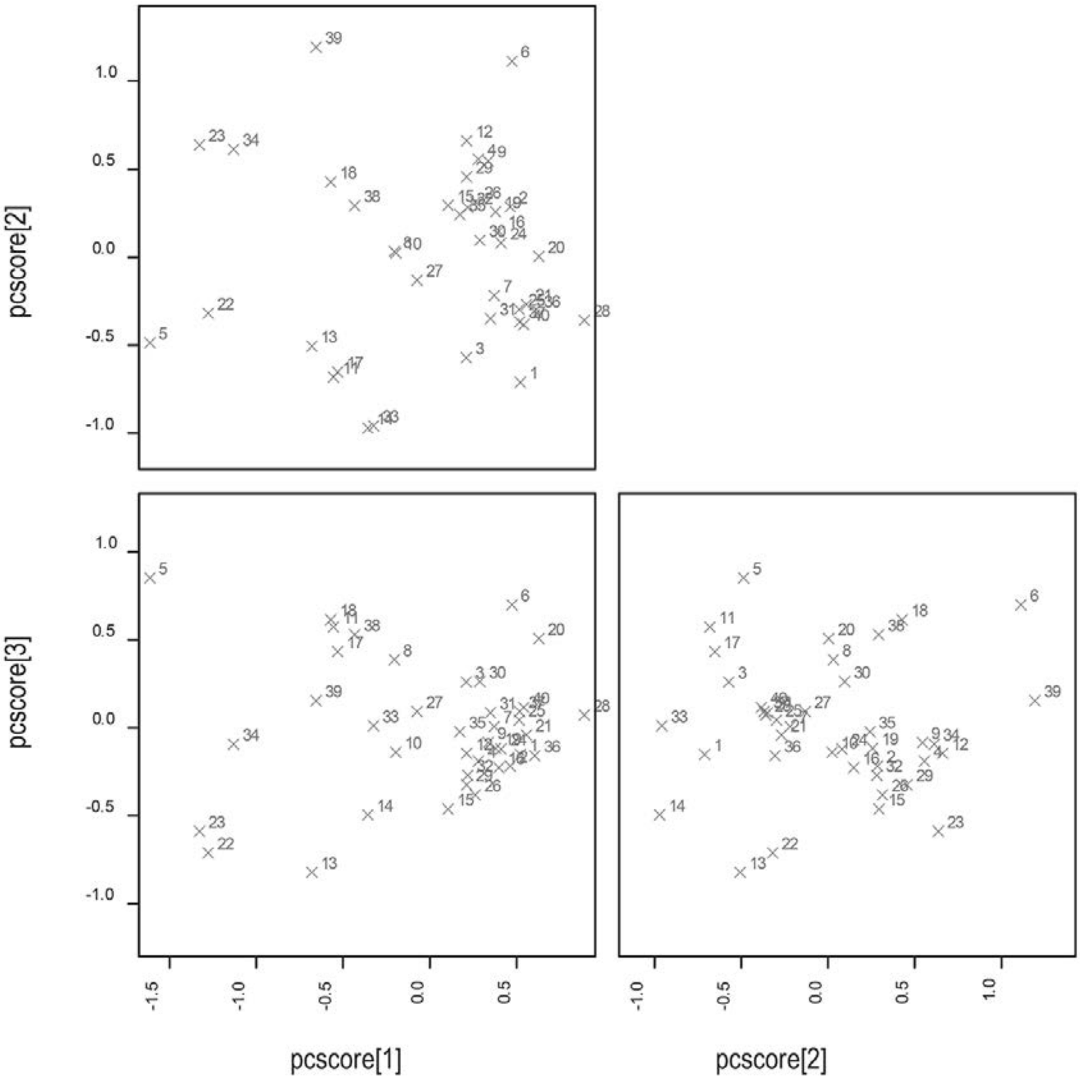


Figure 6.14. PCA plot of the An Sơn ceramic samples, Trench 1 square C1. First three dimensions. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

Table 6.11. PCA loadings for Figure 6.13 and Figure 6.14 of the An Sơn ceramic samples, Trench 1 square C1. First three dimensions. The bold values indicate the element oxides that presented the greatest variability in the PCA.

	PC 1 (37.97%)	PC 2 (27.86%)	PC 3 (14.79%)
CaO	**-0.05094**	0.05068	0.02596
FeO	**-0.07733**	0.17506	0.26074
K_2O	**0.83685**	0.18081	**-0.36087**
MgO	0.17252	0.32777	-0.11623
Na_2O	0.45058	**-0.70797**	0.47797
SiO_2	0.15911	0.18275	-0.04667
TiO_2	0.18169	**0.54040**	**0.74630**

Source: Compiled by C. Sarjeant.

Table 6.12. Samples in the PCA groupings in Figure 6.14 of the An Sơn ceramic samples, Trench 1 square C1. Refer to Appendix A for sample identification numbers.

	PC 1/PC 2	PC 1/PC 3	PC 2/PC 3
Main group 1	2, 4, 9, 12, 15, 16, 19, 24, 26, 29, 30, 32, 35 (20)	1, 2, 4, 7, 9, 12, 15, 16, 19, 21, 24, 25, 26, 29, 31, 32, 35, 36, 37, 40 (28)	2, 4, 9, 10, 12, 15, 16, 19, 24, 26, 29, 32, 34, 35
Main group 2	7, 21, 25, 31, 36, 37, 40 (1, 3, 28)	11, 17, 18, 38	7, 21, 25, 27, 28, 31, 36, 37, 40
Outlier group 1	5, 22	5	3, 5, 11, 17
Outlier group 2	6	6, 20	6
Outlier group 3	8, 10, 27	8	8, 20, 30
Outlier group 4	11, 13, 17	13	13, 22
Outlier group 5	14, 33	14	14
Outlier group 6	18, 38	10, 27, 33	18, 38
Outlier group 7	23, 34	22, 23	23
Outlier group 8	30	3, 30	33
Outlier group 9	39	39	39
Outlier group 10		34	1

Source: Compiled by C. Sarjeant.

Hierarchical cluster analysis

Two major groups are evident for the An Sơn Trench 1 square C1 sample in the cluster analysis dendrogram (when cut at 0.825), each with valid subgroups (cut at 0.950) (Figure 6.15, Table 6.13). Refer to Appendix A for sample identification numbers and Figure 5.1 for rim form images.

- **Main group 1:**
  - **Subgroup 1**: Samples 1, 20, 25, 37, 28, 31, 40

    This subgroup consists of A2a sand tempered rim sherds from layers 1, 5/6 and 8, a sand tempered body sherd from layer 5/6, a D1b sand tempered rim sherd from layer 7, and a D1a sand tempered rim sherd from layer 8.
  - **Subgroup 2**: Samples 3, 7, 8

    This subgroup consists of form A2a roulette decorated body sherds with sand temper from layers 1 and 5, and an A2a sand tempered rim sherd from layer 5/6.
  - **Subgroup 3**: Samples 5, 11, 17

    This subgroup consists of sand tempered sherds from layers 5 and 5/6, and a C2b sand tempered rim sherd from layer 5/6.
  - **Subgroup 4**: Samples 14, 33

    This subgroup consists of lateritic sand tempered sherds from layers 5/6 and 8, one of which also has orthodox grog.
  - **Subgroup 5**: Samples 13, 22

    This subgroup consists of sand tempered and lateritic sand tempered body sherds from layer 5/6.
  - **Subgroup 6**: Sample 23

    This subgroup consists of a form A2a roulette decorated body sherd with sand/fibre temper from layer 5/6.

- **Subgroup 7**: Ssamples 21, 36

  This subgroup consists of an A1a fibre tempered rim sherd from layer 5/6 and a B1a rim sherd with sand/fibre temper from layer 8.

Main group 1 (Table 6.13) of this hierarchical cluster analysis is most consistent with main group 2, and some outliers, of the previous PCA (Figure 6.14, Table 6.12).

- **Main group 2:**
  - **Subgroup 1**: Samples 2, 26, 32, 4, 19, 24, 15, 16, 9, 29

    This subgroup consists of C1b fibre/phosphate and fibre tempered rim sherds from layers 1, 5/6 and 7, a sand/fibre tempered body sherd from layer 7, A1a fibre tempered rim sherds from layers 1 and 5/6, and fibre/calcareous and calcareous tempered body sherds from layer 5/6.

  - **Subgroup 2**: sample 6

    This subgroup consists of a fibre/phosphate tempered body sherd from layer 5.

  - **Subgroup 3**: samples 10, 18, 38, 27, 30, 35

    This subgroup consists of a form A2a sand tempered roulette decorated body sherd from layer 5/6, a sand/fibre tempered body sherd from layer 5/6, a sand tempered body sherd from layer 8, a D1a sand and iron-rich sand tempered rim sherd from layer 5/6, a D1b lateritic sand tempered rim sherd from layer 7, and a D1a lateritic sand tempered rim sherd from layer 7.

  - **Subgroup 4**: sample 12

    This subgroup consists of an A1a fibre tempered rim sherd from layer 5/6.

  - **Subgroup 5**: sample 34, 39

    This subgroup consists of sand tempered body sherds from layers 7 and 8.

Main group 2 (Table 6.13) is most consistent with main group 1 of the previous PCA (Figure 6.14, Table 6.12).

The dendrogram derived from the hierarchical cluster analysis (Figure 6.15, Table 6.13) suggests that the outliers that were plotted in the PCA (Figure 6.14, Table 6.12) are not in fact chemically distinct from the two main groups that were identified in both the PCA and the cluster analysis. The dendrogram plots only two distinct groups, with no outliers.

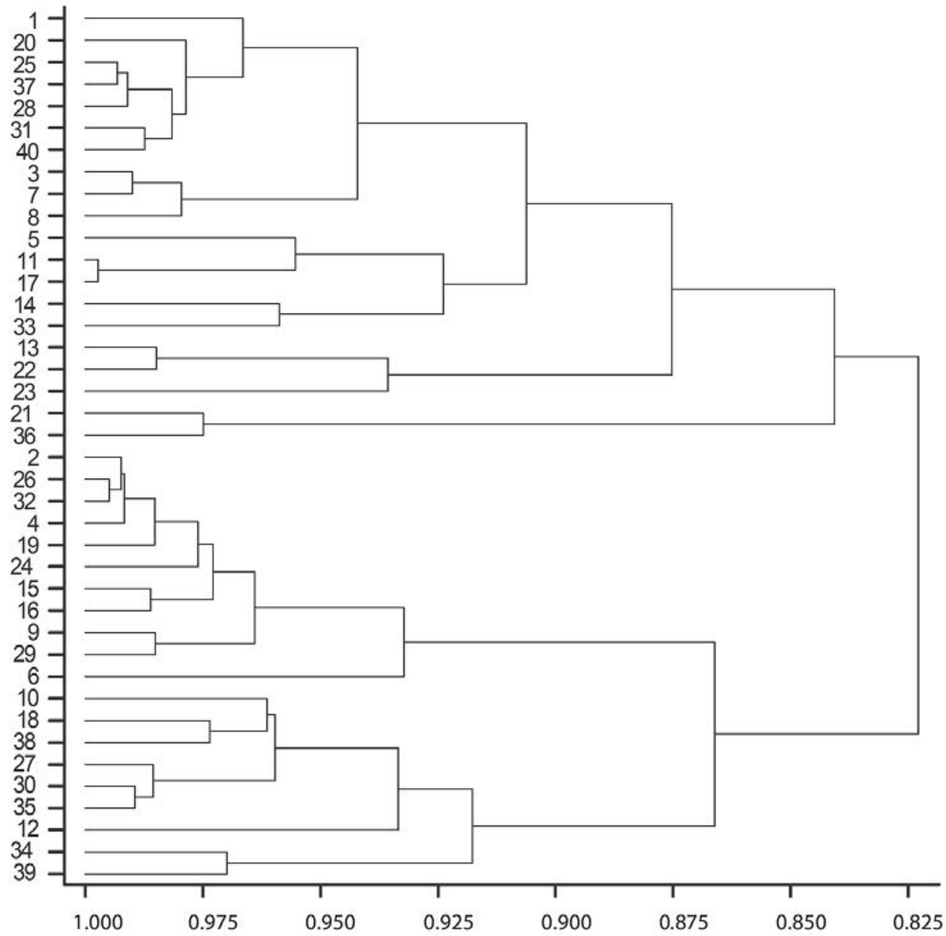


Figure 6.15. Average-linkage hierarchical cluster analysis dendrogram of the An Sơn ceramic samples, Trench 1 square C1. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

Table 6.13. Samples in the hierarchical cluster analysis dendrogram groupings in Figure 6.15 of the An Sơn ceramic samples, Trench 1 square C1 when cut at 0.825 and 0.950. Refer to Appendix A for sample identification numbers.

Main group (cut at 0.825)	Subgroup (cut at 0.950)	Sample identification number
1	1	1, 20, 25, 37, 28, 31, 40
	2	3, 7, 8
	3	5, 11, 17
	4	14, 33
	5	13, 22
	6	23
	7	21, 36
2	1	2, 26, 32, 4, 19, 24, 15, 16, 9, 29
	2	6
	3	10, 18, 38, 27, 30, 35
	4	12
	5	34, 39

Source: Compiled by C. Sarjeant.

Canonical variate analysis

Three CVAs are presented in this section, one for each *a priori* group, rim form and vessel components, layers and tempers.

Rim forms and vessel components

This CVA was carried out to reveal the relationship between rim form and clay matrix composition for the An Sơn Trench 1 square C1 sample (Figure 6.16, Figure 6.17, Table 6.14). Where a rim form according to the categorisation of Figure 5.1 could not be identified, components were identified (e.g. body sherds, pedestal sherds, etc.). The CVA plots show how similar the clay matrix compositions of the samples are within a designated archaeological grouping, the rim form and vessel component group in this case. The CVA biplot shows the relationship between the samples and the element oxide compositional data (Figure 6.16). The circles in the CVA plot represent 95% confidence around the samples of each group. When these circles overlap, the groups are chemically related (Figure 6.17).

The close distribution of A2a rim forms and roulette decorated body sherds in the CVA plot (Figure 6.17) is indicative of a single clay source for the vessel form A2a, and confirms that the roulette decorated body sherds came from concave rimmed A2a vessels. Rim forms A1a, B1a and C1b have a similar clay matrix composition to each other, while rim forms D1a and D1b have a similar clay matrix composition to each other. The C2b rim form sample does not group with the other represented rim forms in the CVA plot (Figure 6.17). Refer to Appendix A for sample identification numbers.

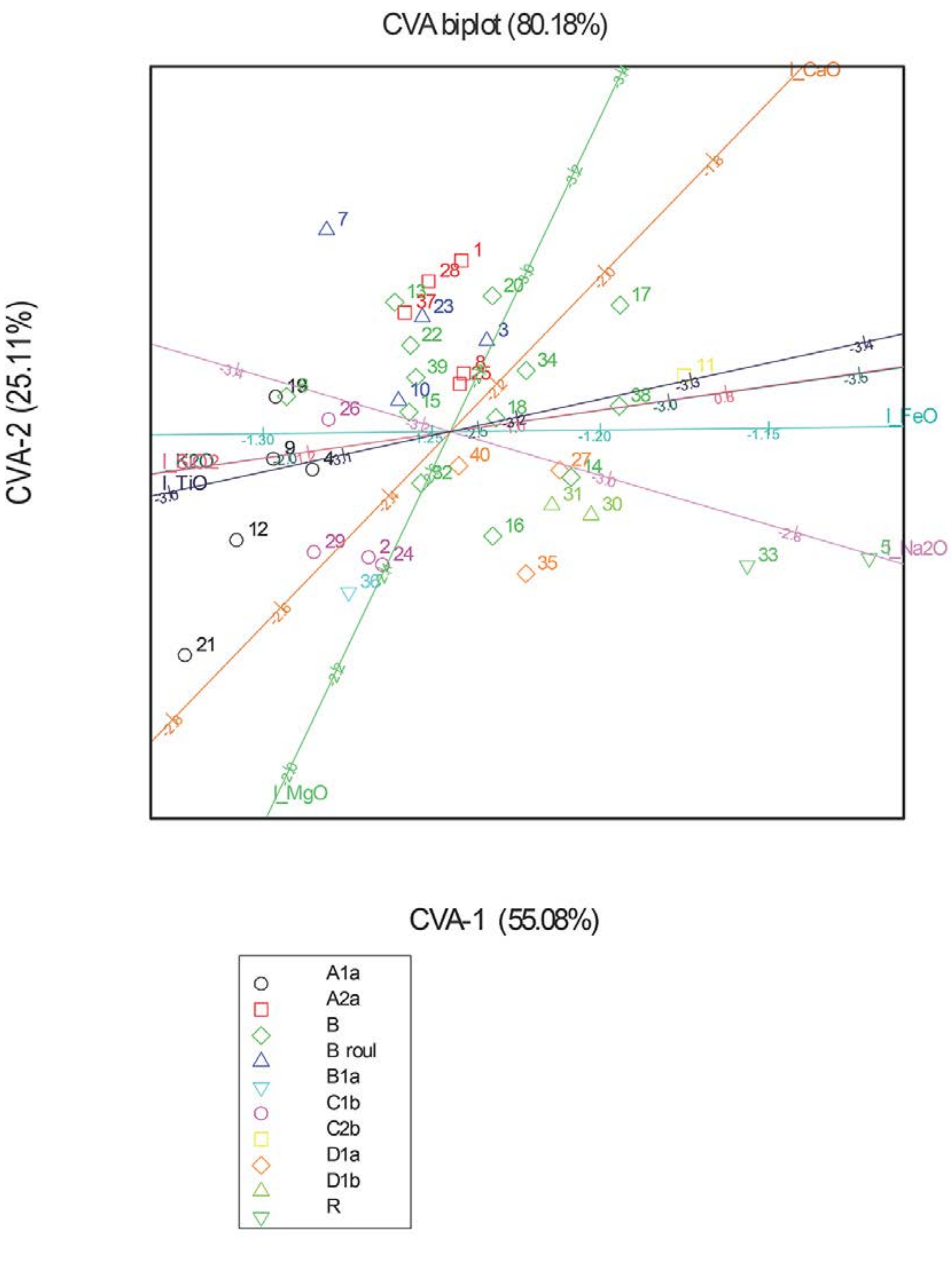


Figure 6.16. CVA biplot of rim forms and vessel components of the An Sơn ceramic samples, Trench 1 square C1. First two dimensions. Refer to Appendix A for sample identification numbers and Figure 5.1 for rim form images. Key: Rim forms: A1a, A2a, B1a, C1b, C2b, D1a, D1b; Unidentified forms: R = rim sherd, B = body sherd, B roul = roulette decoration on body sherd.

Source: C. Sarjeant.

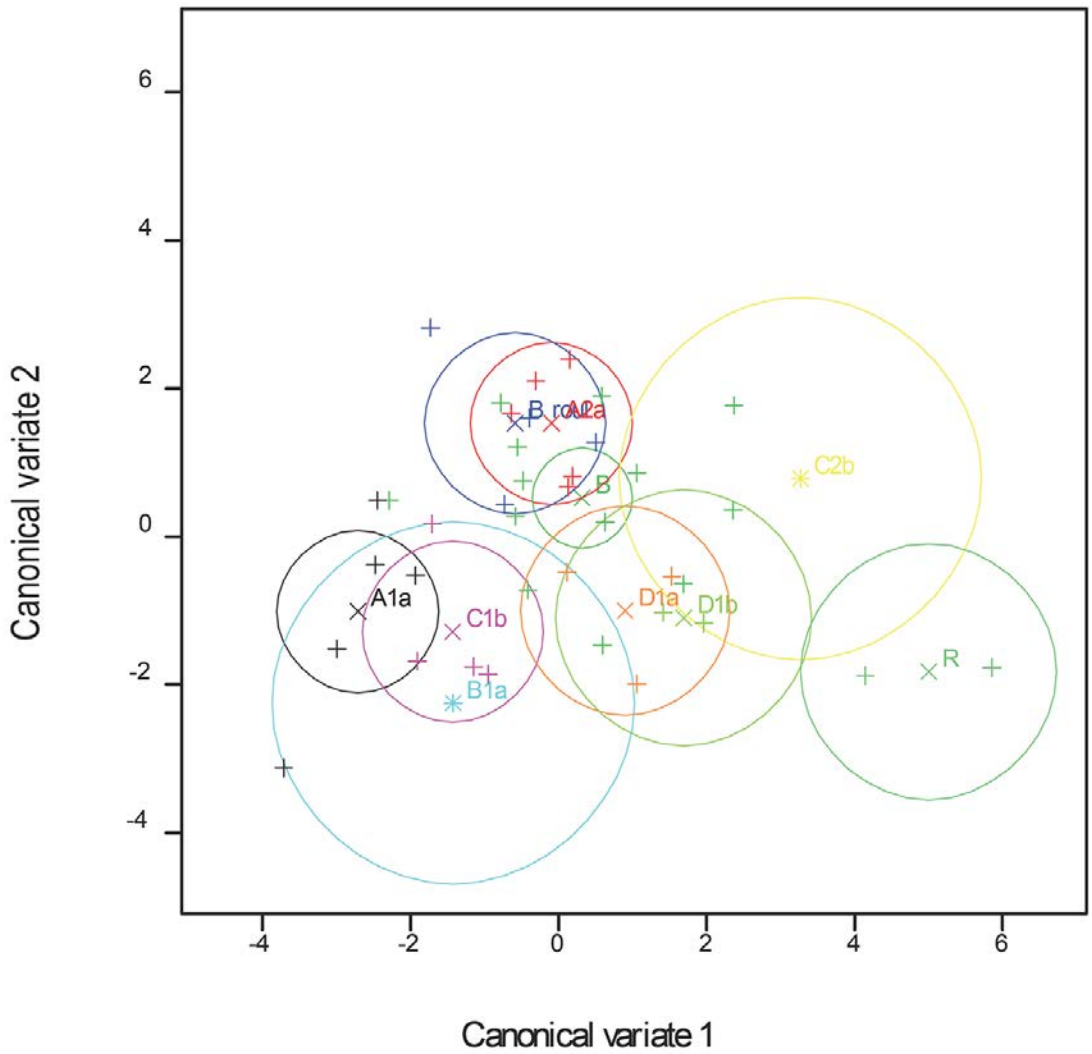


Figure 6.17. CVA plot of rim forms and vessel components with 95% confidence circles of the An Sơn ceramic samples, Trench 1 square C1. First two dimensions. Refer to Figure 5.1 for rim form images. Key: Rim forms: A1a, A2a, B1a, C1b, C2b, D1a, D1b; Unidentified forms: R = rim sherd, B = body sherd, B roul = roulette decoration on body sherd.

Source: C. Sarjeant.

Table 6.14. CVA loadings for Figure 6.16 and Figure 6.17 of rim forms and vessel components of the An Sơn ceramic samples, Trench 1 square C1. First three dimensions.

	1 (55.08%)	2 (25.11%)	3 (7.90%)
1	2.717	2.178	0.667
2	-0.760	-0.312	-0.379
3	-2.267	1.521	1.873
4	2.171	-7.617	0.114
5	1.966	-1.526	0.825
6	-6.587	2.000	-4.226
7	0.877	0.867	0.642

Source: Compiled by C. Sarjeant.

Layers

This CVA was undertaken to assess if there were any differences in the composition of clay matrices over time in Trench 1 square C1 (Figure 6.18, Figure 6.19, Table 6.15). This section is the most critical for understanding the sequence of ceramics at An Sơn. The CVA indicates that there is wide variation in clay matrix compositions of the sampled ceramic sherds from layers 1, 5 and 5/6, while there is less chemical variation in layers 7 and 8. Refer to Appendix A for sample identification numbers.

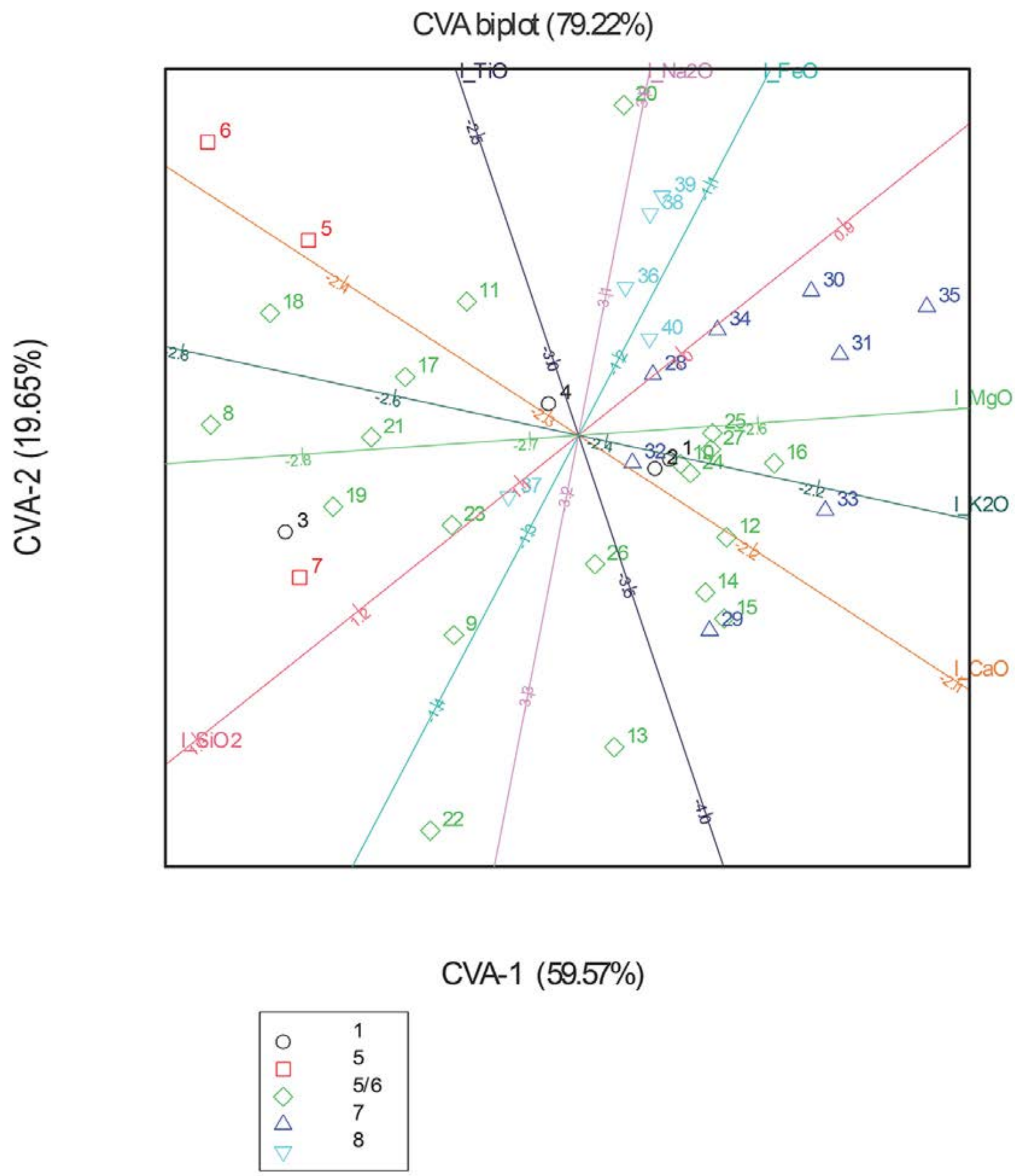


Figure 6.18. CVA biplot of layers of the An Sơn ceramic samples, Trench 1 square C1. First two dimensions. Refer to Appendix A for sample identification numbers. Key: 1, 5, 5/6, 7, 8 = 2009 Trench 1 square C1 layers.

Source: C. Sarjeant.

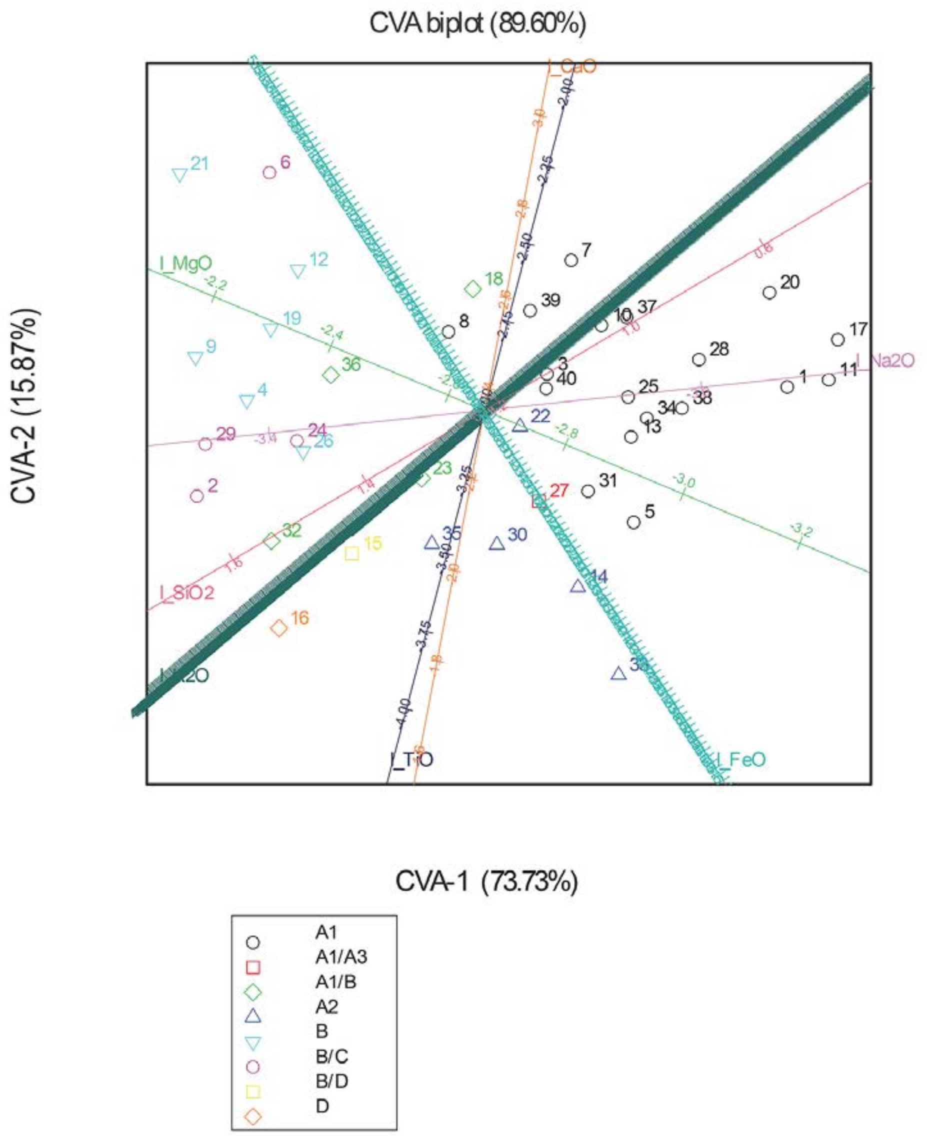


Figure 6.19. CVA plot of layers with 95% confidence circles of the An Sơn ceramic samples, Trench 1 square C1. First two dimensions. Key: 1, 5, 5/6, 7, 8 = 2009 Trench 1 square C1 layers.

Source: C. Sarjeant.

Table 6.15. CVA loadings for Figure 6.18 and Figure 6.19 of layers of the An Sơn ceramic samples, Trench 1 square C1. First three dimensions.

	1 (59.57%)	2 (19.65%)	3 (11.75%)
1	1.072	0.210	2.273
2	0.837	-1.200	-1.526
3	1.549	-0.025	-0.945
4	3.502	0.739	2.040
5	-0.130	0.426	1.171
6	-7.021	-4.718	0.917
7	-1.014	2.898	0.337

Source: Compiled by C. Sarjeant.

Tempers

This CVA was undertaken to assess whether there was any statistical relationships between the tempers (identified according to TG A, B, C, D and E) and clay matrix compositions in the Trench 1 square C1 ceramic samples (Figure 6.20, Figure 6.21, Table 6.16). The clay matrices have been chemically analysed independently from the tempers, therefore the chemistry of the temper minerals does not affect the chemical characterisation of the clay matrix in the statistical analyses. When the temper groups in the CVA plots do not overlap, it is likely specific clays were used with a particular temper. Conversely, when the temper groups overlap in the CVA, it is likely similar clays were used in the manufacture of many vessels, regardless of the applied temper.

The CVA (Figure 6.21) indicates there is some variation in the clay matrix composition between the sand tempered (TG A1 and TG A2) and the fibre (TG B) and fibre/phosphate (TG B/C) tempered sherds, as indicated by the separation in the distribution of the samples within these temper groups. Refer to Appendix A for sample identification numbers.

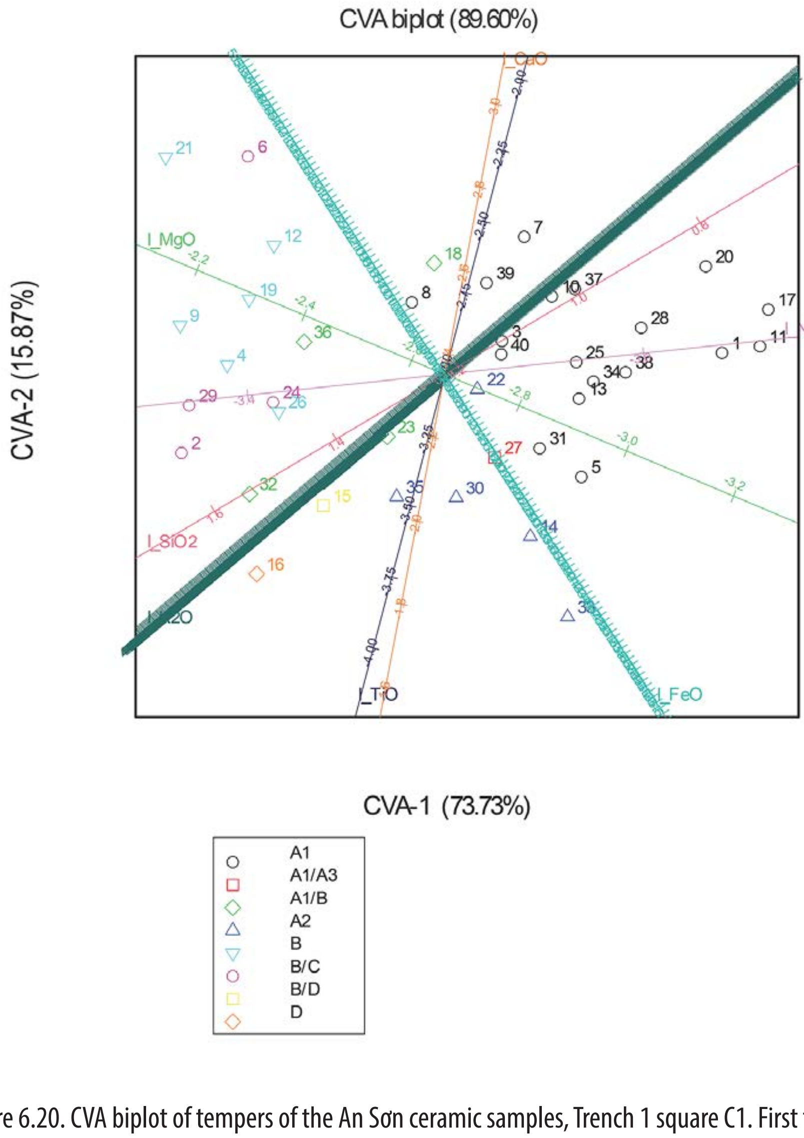


Figure 6.20. CVA biplot of tempers of the An Sơn ceramic samples, Trench 1 square C1. First two dimensions. Refer to Appendix A for sample identification numbers. Key: A1 = mineral sand, A2 = lateritic (micaceous) sand, A3 = impure iron oxide (large grains)/almandine sand, B = fibre, C = phosphate, D = calcareous.

Source: C. Sarjeant.

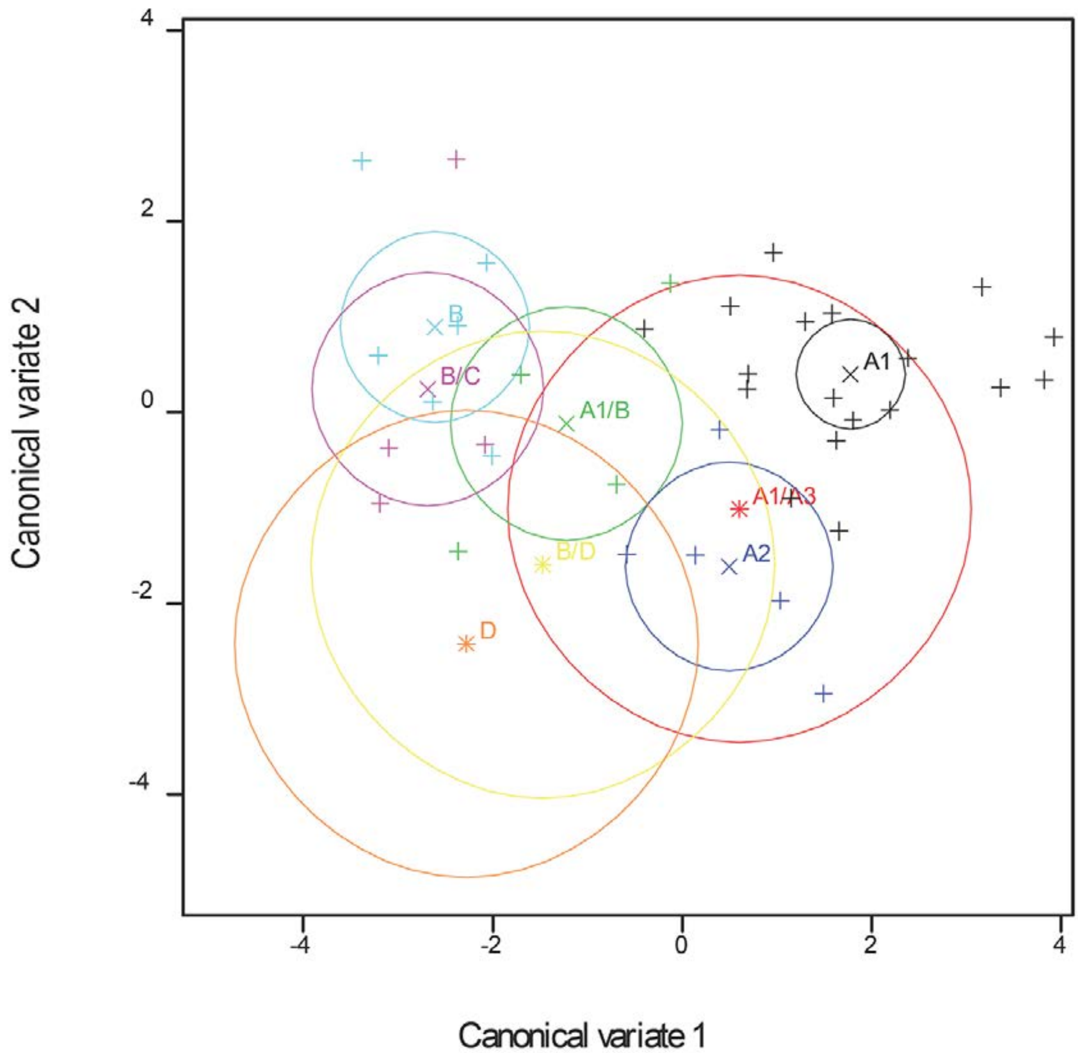


Figure 6.21. CVA biplot of tempers with average value circle perimeters of the An Sơn ceramic samples, Trench 1 square C1. First two dimensions. Key: A1 = mineral sand, A2 = lateritic (micaceous) sand, A3 = impure iron oxide (large grains)/almandine sand, B = fibre, C = phosphate, D = calcareous.

Source: C. Sarjeant.

Table 6.16. CVA loadings for Figure 6.20 and Figure 6.21 of tempers of the An Sơn ceramic samples, Trench 1 square C1. First three dimensions.

	1 (73.73%)	2 (15.87%)	3 (6.32%)
1	2.176	-2.270	-0.150
2	1.137	1.806	5.032
3	0.756	0.642	0.381
4	-5.860	-4.345	0.280
5	0.462	-0.461	1.104
6	-5.550	4.252	3.155
7	0.942	1.169	-1.968

Source: Compiled by C. Sarjeant.

All An Sơn ceramic samples

This section includes the entire ceramic sample for fabric analysis from An Sơn, inclusive of the previously presented Trench 1 square C1. The following clay matrix characterisations correspond to the temper identifications.

Principal components analysis

The greatest variability in the following PCA plots (Figure 6.22, Figure 6.23) is a result of the concentrations of K_2O and TiO_2 in the clay matrix compositions (Table 6.17). The PCA of the fabrics for all of the sampled An Sơn ceramic sherds indicates there were major (and problematic) outliers in the sample. These were sample numbers 43, 60 and 61. These outliers make sense archaeologically as sample 43 is an Óc Eo phase sherd from the upper layers of Trench 1, while samples 60 and 61 were surface collected sherds. They possibly represent markedly different clay collection practices from the neolithic period sherds in the rest of the sample. The presence of these sherds in the PCA diminishes the variability in the remainder of the sample and groups are less clear. Subsequent statistical analyses are presented without the inclusion of these three outlier samples. Refer to Appendix A for sample identification numbers.

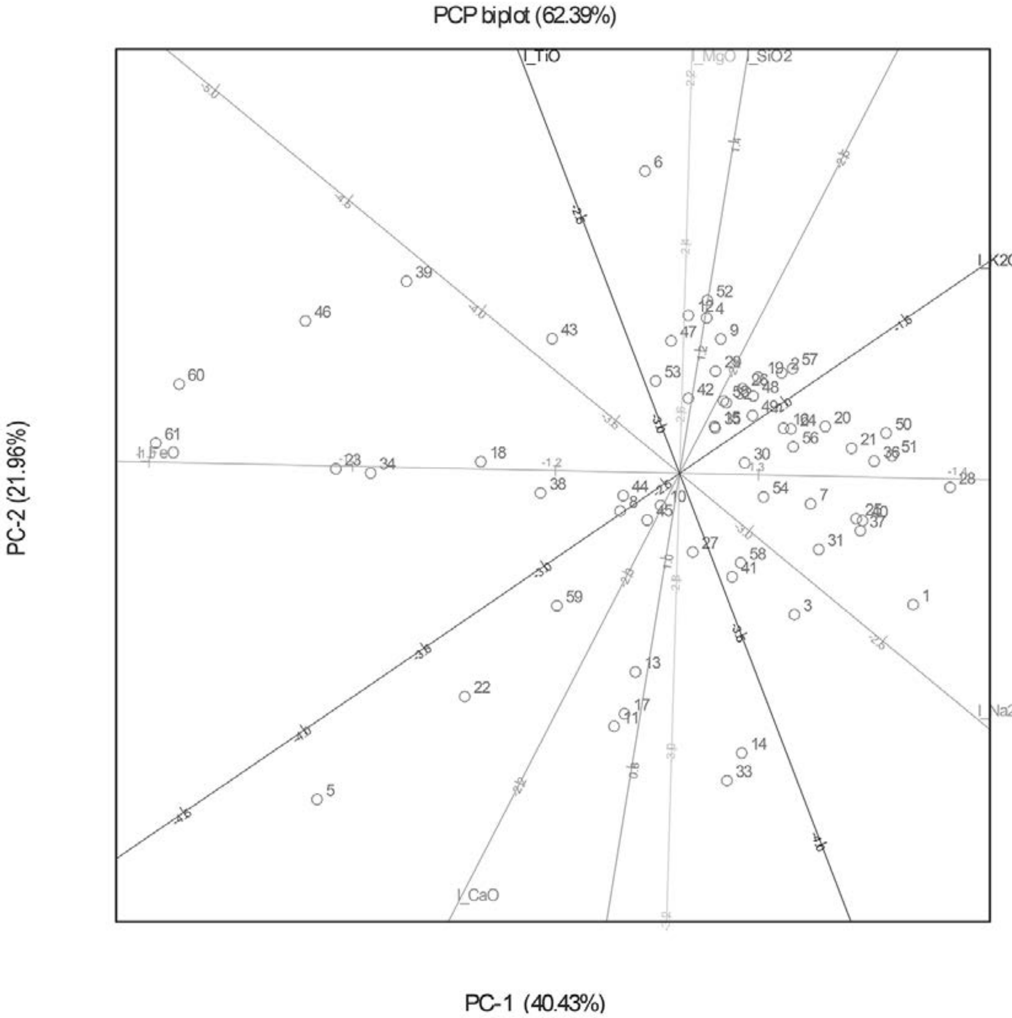


Figure 6.22. PCA biplot of the An Sơn ceramic sample. First two dimensions. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

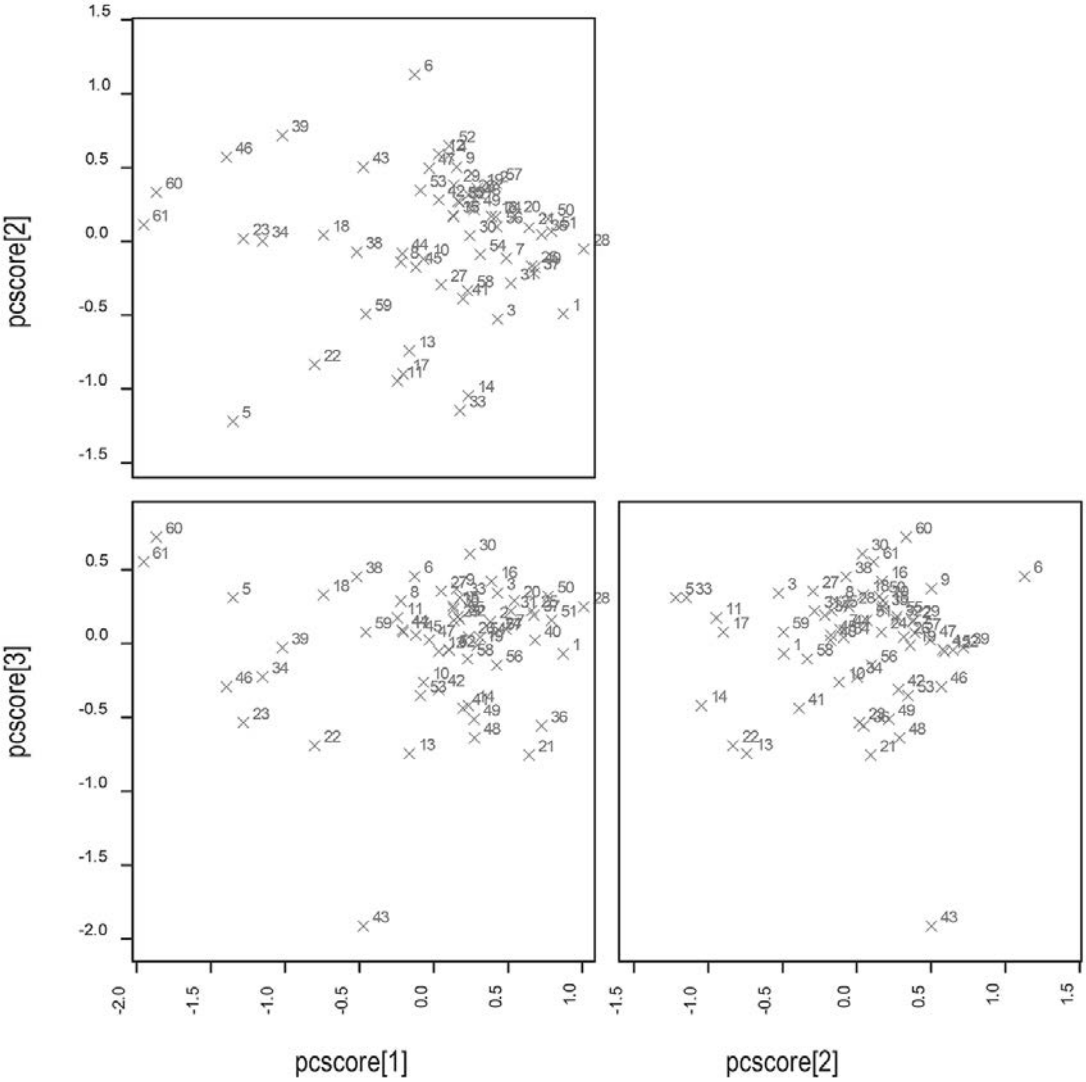


Figure 6.23. PCA plot of the An Sơn ceramic sample. First three dimensions. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

Table 6.17. PCA loadings for Figure 6.22 and Figure 6.23 of the An Sơn ceramic sample. First three dimensions. The bold values indicate the element oxides that presented the greatest variability in the PCA.

	PC 1 (40.43%)	PC 2 (21.96)%	PC 3 (17.11%)
CaO	-0.05207	-0.10115	**0.66076**
FeO	-0.13197	0.00279	0.33246
K_2O	**0.75966**	**0.52011**	**-0.13083**
MgO	0.00926	0.31815	0.35255
Na_2O	0.59630	**-0.49304**	0.41452
SiO_2	0.04079	0.25033	0.09930
TiO_2	**-0.21325**	**0.55881**	0.36024

Source: Compiled by C. Sarjeant.

Hierarchical cluster analysis

The dendrogram indicates a similar positioning of the Óc Eo phase sherd, sample 43, and the surface sherds, samples 60 and 61, as outliers amongst the remaining An Sơn ceramic sherds (Figure 6.24). However, a relationship between samples 60 and 61 and some of the sherds can be observed when the dendrogram is cut at 0.90. The other groups of the dendrogram are described below without the inclusion of these three outlier samples. Refer to Appendix A for sample identification numbers.

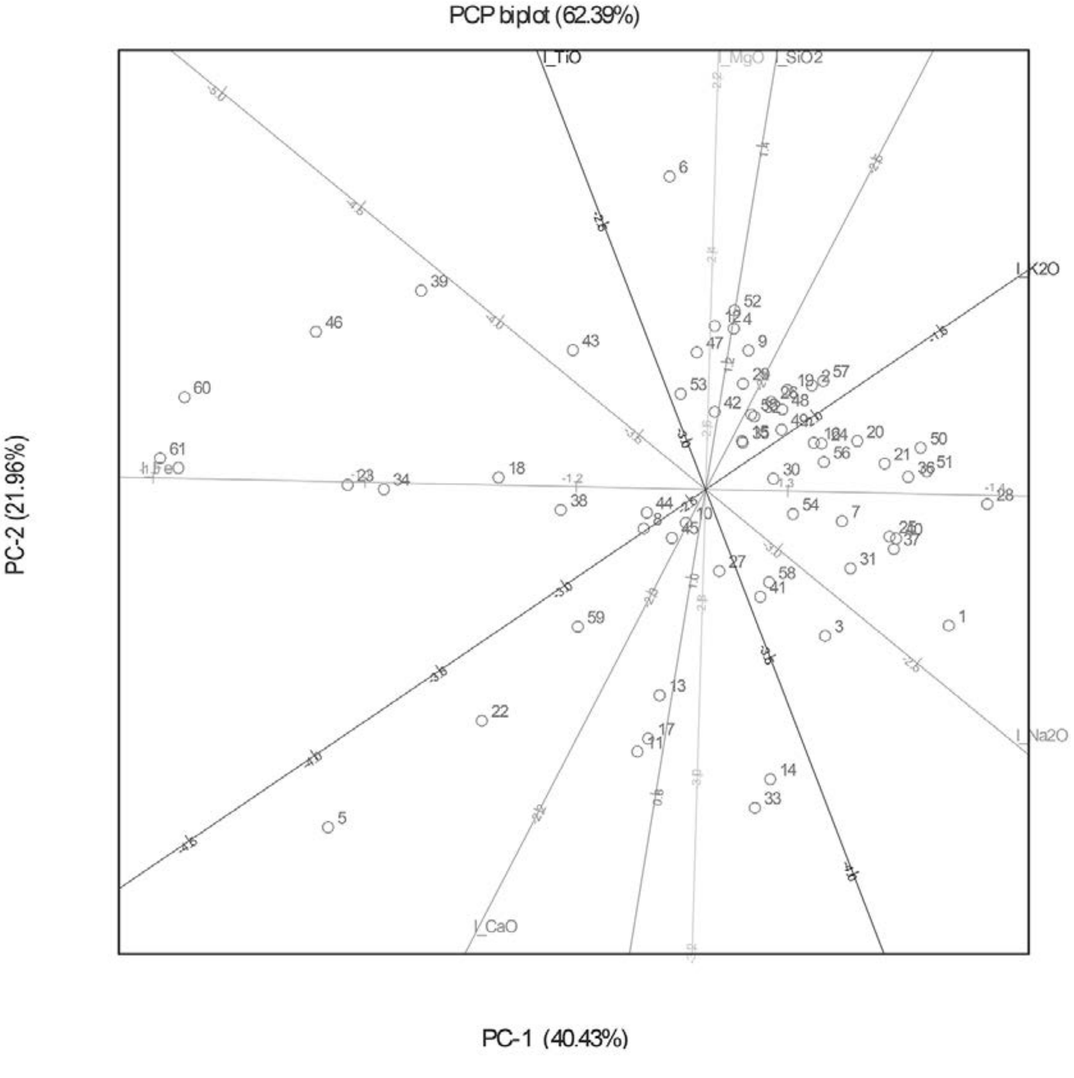


Figure 6.24. Average-linkage hierarchical cluster analysis dendrogram of the An Sơn ceramic sample. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

Principal components analysis, excluding samples 43, 60 and 61

The greatest variability in the following PCA plots (Figure 6.25, Figure 6.26) is a result of the concentrations of CaO, FeO and K_2O in the clay matrix compositions (Table 6.18). When examining all three PCA dimensions, three main groups are evident, with a large number of outliers and variability evident amongst the An Sơn ceramic sherds (Table 6.19). Refer to Appendix A for sample identification numbers and Figure 5.1 for rim form images.

- **Main group 1**: samples 2, 3, 4, 7, 9, 10, 12, 15, 16, 19, 24, 25, 26, 29, 31, 32, 35, 37, 40, 41, 42, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58

  This group consists of ceramic sherds from layers 1, 2, 3, 5/6, 7 and 8; Test Square 200–210 cm, 240–250 cm and 250–260 cm; and 1997 Trench 1 350–360 cm and 360–410 cm. The forms include A1a, A2a, A2b, B1a, C1b, D1a, D1b and D2a. The represented tempers were sand, fibre (including one sample with bleb grog), sand/fibre, fibre/phosphate, fibre/calcareous, calcareous, and lateritic sand.

- **Main group 2**: samples 8, 27, 38, 44, 45

  This group consists of ceramic sherds from layers 5/6 and 8, with forms A2a, C3a, D1a and D2a. The represented tempers were sand and sand/iron-rich sand.

- **Main group 3**: samples 20, 21, 28, 36

  This group consists of ceramic sherds from layers 5/6, 7 and 8, with forms A1a, A2a, and B1a present. The represented tempers were sand/fibre, sand, and fibre.

- **Outlier groups**: samples 1 / 5 / 6 / 11, 17 / 13 / 14, 33 / 22 / 23 / 34 / 39 / 46 / 59

  The range of ceramic sherds represented by these outliers came from layers 1, 5, 5/6, 7 and 8, and 1997 Trench 1 360–410 cm. The represented rim forms include A2a, B1b and C2b, with many body sherds in the sample. The represented tempers were sand, fibre/phosphate, lateritic sand (including one sample with orthodox grog), sand/fibre, and fibre.

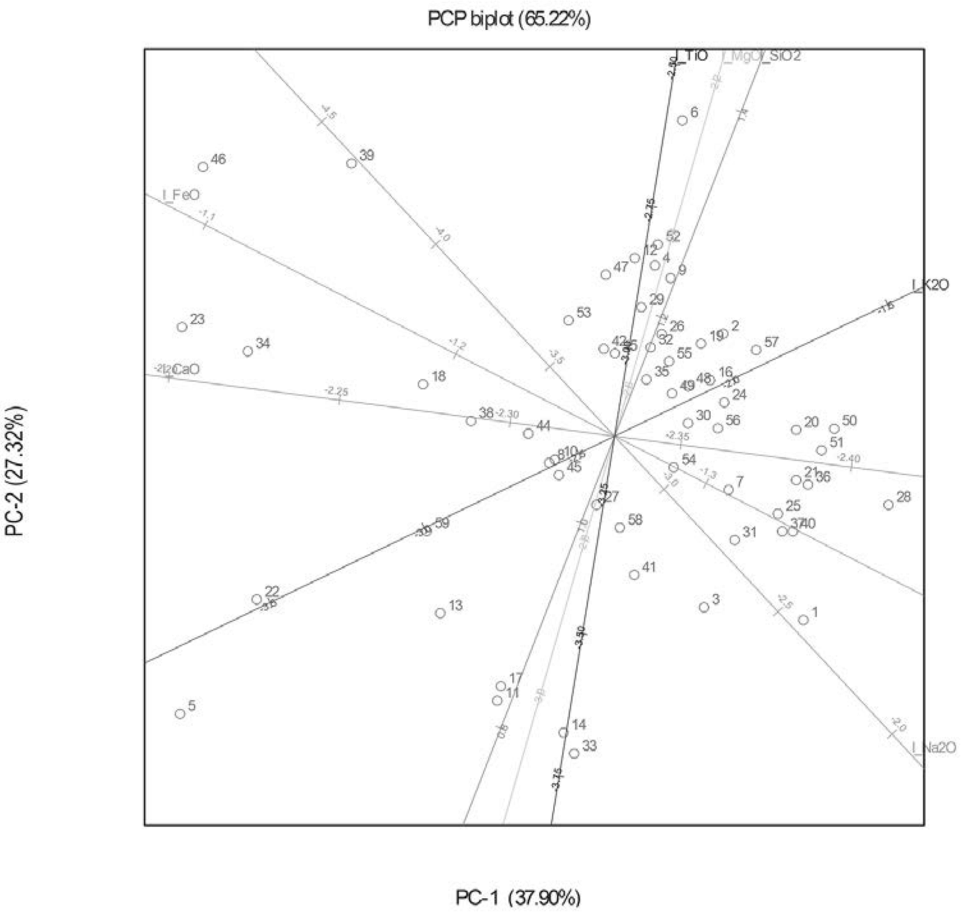


Figure 6.25. PCA biplot of the An Sơn ceramic sample, excluding samples 43, 60 and 61. First two dimensions. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

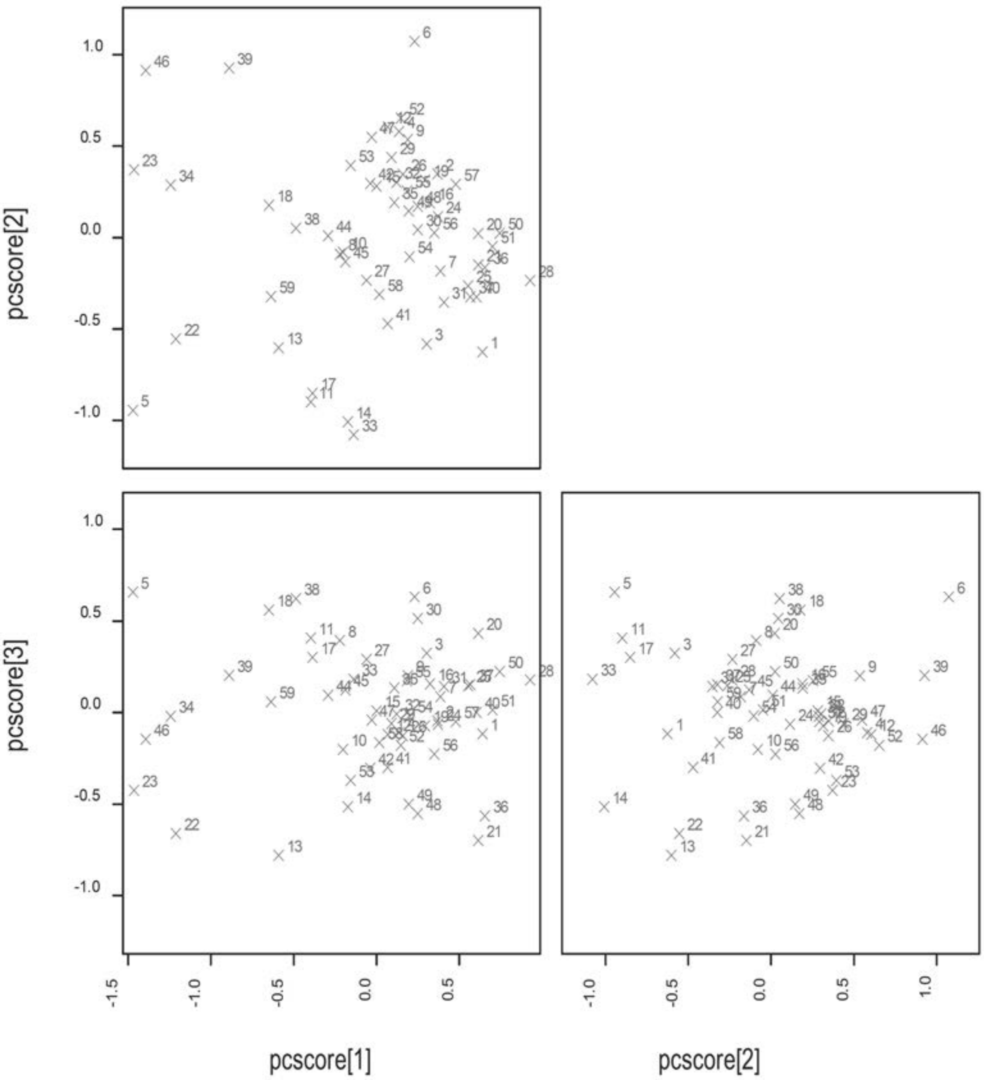


Figure 6.26. PCA plot of the An Sơn ceramic sample, excluding samples 43, 60 and 61. First three dimensions. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

Table 6.18. PCA loadings for Figure 6.25 and Figure 6.26 of the An Sơn ceramic sample, excluding samples 43, 60 and 61. First three dimensions. The bold values indicate the element oxides that presented the greatest variability in the PCA.

	PC 1 (37.90%)	PC 2 (27.32%)	PC 3 (13.30%)
CaO	**-0.08502**	0.01118	0.55347
FeO	**-0.09296**	0.04817	0.33781
K_2O	**0.77438**	0.37517	**-0.25944**
MgO	0.10140	0.35449	0.03811
Na_2O	0.59848	**-0.64519**	0.37769
SiO_2	0.09666	0.24883	-0.00045
TiO_2	0.08159	**0.50295**	**0.60675**

Source: Compiled by C. Sarjeant.

Table 6.19. Samples in the PCA groupings in Figure 6.26 of the An Sơn ceramic sample, excluding samples 43, 60 and 61.

	PC 1/PC 2	PC 1/PC 3	PC 2/PC 3
Main group 1	2, 4, 9, 12, 15, 16, 19, 24, 26, 29, 30, 32, 35, 42, 47, 48, 49, 52, 53, 55, 56, 57 (54)	1, 2, 3, 4, 7, 9, 10, 12, 15, 16, 19, 24, 25, 26, 29, 31, 32, 35, 37, 40, 41, 42, 47, 50, 51, 52, 53, 54, 55, 56, 57, 58 (14, 28)	2, 15, 19, 26, 29, 32, 34, 57 (4, 12, 24, 47, 52)
Main group 2	8, 10, 27, 38, 41, 44, 45, 58 (3, 18)	27, 33, 44, 45	8, 18, 20, 30, 38
Main group 3	20, 21, 25, 31, 36, 37, 40, 50, 51 (7, 28)		7, 26, 27, 28, 31, 37, 40, 45, 50, 59
Main group 4			16, 35, 44, 51, 54, 55
Outlier group 1	1	18, 38	1
Outlier group 2	5	5	5
Outlier group 3	6	6, 30	6
Outlier group 4	11, 17	8, 11, 17	11, 17 (33, 35)
Outlier group 5	13	13	13, 22
Outlier group 6	14, 33	20	14
Outlier group 7	22	22	10, 56
Outlier group 8	23, 34	23	23, 53 (42)
Outlier group 9	39	39	39
Outlier group 10	46	34, 46	46
Outlier group 11	59	59	41
Outlier group 12		21, 36	21, 36
Outlier group 13		48, 49	48, 49
Outlier group 14			9
Outlier group 15			58

Source: Compiled by C. Sarjeant.

Hierarchical cluster analysis, excluding samples 43, 60 and 61

Three major groups are evident in the cluster analysis dendrogram (when cut at 0.875), each with valid subgroups (cut at 0.950) (Figure 6.27, Table 6.20). Refer to Appendix A for sample identification numbers and Figure 5.1 for rim form images.

- **Main group 1:**
  - **Subgroup 1**: samples 1, 20, 25, 37, 28, 50, 40, 31

    This subgroup consists of A2a sand tempered rim sherds from layers 1, 5/6, 7 and 8; sand tempered body sherds from layer 5/6; D1a sand tempered rim sherds from the Test Square 240–250 cm and layer 8; and a D1b sand tempered rim sherd from layer 7.
  - **Subgroup 2**: samples 14, 33

    This subgroup consists of lateritic sand tempered body (also with orthodox grog) and rim sherds from layers 5/6 and 7.
  - **Subgroup 3**: samples 5, 11, 17

    This subgroup consists of a sand tempered rim sherd from layer 5, a C2b sand tempered rim sherd from layer 5/6, and a sand tempered body sherd from layer 5/6.

Main group 1 in this hierarchical cluster analysis (Table 6.20) is most consistent with main group 3 and the outliers identified in the previous PCA (Figure 6.26, Table 6.19).

- **Main group 2:**
    - **Subgroup 1**: samples 2, 26, 32, 16, 15, 52, 4, 47, 19, 42, 53, 24, 56, 55

      This subgroup consists of C1b fibre/phosphate and fibre tempered rim sherds from layers 1 and 5/6, a sand/fibre tempered body sherd from layer 7, a calcareous tempered body sherd from layer 5/6, a fibre/calcareous tempered body sherd from layer 5/6, fibre tempered pedestal sherds from the Test Square 240–250 cm and 250–260 cm, A1a fibre tempered rim sherds from layers 1 and 5/6, an A2b sand/fibre/phosphate tempered rim sherd from Test Square 200–210 cm, a fibre tempered body sherd from layer 2, a B1a sand/fibre tempered rim sherd from the 1997 Trench 1 350–360 cm, and a fibre tempered pedestal sherd from the 1997 Trench 1 350–360 cm.

    - **Subgroup 2**: samples 9, 29

      This subgroup consists of an A1a fibre tempered rim sherd from layer 5/6 and a C1b fibre/phosphate tempered rim sherd from layer 7.

    - **Subgroup 3**: sample 6

      This subgroup consists of a fibre/phosphate body sherd from layer 5.

    - **Subgroup 4**: samples 12, 57

      This subgroup consists of an A1a fibre tempered rim sherd from layer 5/6 and a B1a fibre bleb grog tempered rim sherd from 1997 Trench 1 350–360 cm.

    - **Subgroup 5**: samples 3, 7, 51, 8

      This subgroup consists of form A2a roulette decorated sand tempered body sherds from layers 1 and 5, a D1a sand tempered rim sherd from the Test Square 240–250 cm, and an A2a sand tempered rim sherd from layer 5/6.

    - **Subgroup 6**: samples 10, 58, 38, 59, 45, 27, 54, 44, 35, 30, 18

      This subgroup consists of a form A2a roulette decorated sand tempered body sherd from layer 5/6, a sand tempered body sherd from 1997 Trench 1 360–410 cm, a sand tempered body sherd from layer 8, a B1b sand tempered rim sherd from 1997 Trench 1 360–410 cm, a C3a sand tempered rim sherd from layer 5/6, a D1a sand/iron-rich sand tempered rim sherd from layer 5/6, a D1b lateritic sand tempered rim sherd from the Test Square 250–260 cm, a D2a sand tempered rim sherd from layer 3, a D1a lateritic sand tempered rim sherd from layer 7, a D1b lateritic sand tempered rim sherd from layer 7, and a sand/fibre tempered body sherd from layer 5/6.

    - **Subgroup 7**: samples 21, 36, 48, 49, 41

      This subgroup consists of an A1a fibre tempered rim sherd from layer 5/6, a B1a sand/fibre tempered rim sherd from layer 8, B1a fibre and sand tempered rim sherds from the Test Square 240–250 cm, and a D2a sand tempered rim sherd from layer 3.

Main group 2 in this hierarchical cluster analysis (Table 6.20) is most consistent with main groups 1 and 2 identified in the previous PCA (Figure 6.26, Table 6.19).

- **Main group 3**:
    - **Subgroup 1**: samples 13, 22

      This subgroup consists of sand and lateritic sand tempered body sherds from layer 5/6.

    - **Subgroup 2**: sample 23

      This subgroup consists of a form A2a roulette decorated body sherd with sand/fibre temper layer 5/6.

- **Subgroup 3**: samples 34, 39

  This subgroup consists of sand tempered body sherds from layers 7 and 8.

- **Subgroup 4**: sample 46

  This subgroup consists of a fibre tempered roulette decorated pedestal sherd from layer 5/6.

Main group 3 in this hierarchical cluster analysis (Table 6.20) is most consistent with the outliers identified in the previous PCA (Figure 6.26, Table 6.19).

The dendrogram (Figure 6.27, Table 6.20) clarifies the subgroups within the larger cluster that was evident in the previous PCA (Figure 6.26, Table 6.19), with a definite number of outliers (main group 3 of the dendrogram).

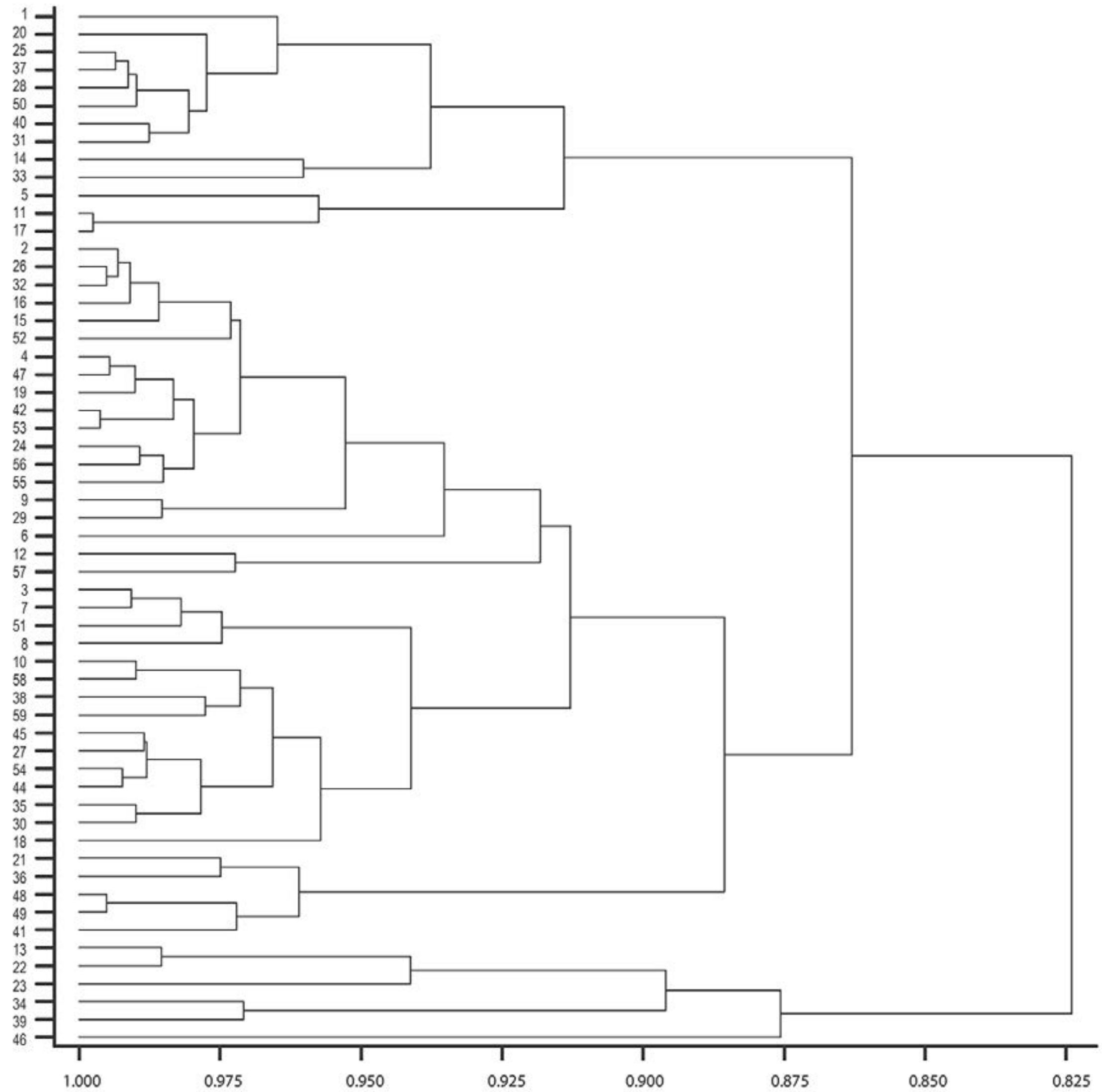


Figure 6.27. Average-linkage hierarchical cluster analysis dendrogram of the An Sơn ceramic sample, excluding samples 43, 60 and 61. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

Table 6.20. Samples in the hierarchical cluster analysis dendrogram groupings in Figure 6.27 of the An Sơn ceramic sample, excluding samples 43, 60 and 61, when cut at 0.875 and 0.950. Refer to Appendix A for sample identification numbers.

Main group (cut at 0.875)	Subgroup (cut at 0.950)	Sample identification number
1	1	1, 20, 25, 37, 28, 50, 40, 31
	2	14, 33
	3	5, 11, 17
2	1	2, 26, 32, 16, 15, 52, 4, 47, 19, 42, 53, 24, 56, 55
	2	9, 29
	3	6
	4	12, 57
	5	3, 7, 51, 8
	6	10, 58, 38, 59, 45, 27, 54, 44, 35, 30, 18
	7	21, 36, 48, 49, 41
3	1	13, 22
	2	23
	3	34, 39
	4	46

Source: Compiled by C. Sarjeant.

Canonical variate analysis

Three CVAs are presented in this section, one for each *a priori* group, rim forms and vessel components, layers and tempers.

Rim forms and vessel components

This CVA was undertaken to understand whether there is a relationship between clay matrix composition and rim form. Where a rim form could not be identified according to the categorisation of Figure 5.1, vessel components were identified, as previously described. The CVA demonstrates that there was substantial overlap in the clay matrix compositional data when sherds are grouped according to rim form. The greatest overlap is observed between the B1a and C1b rim forms, while there is a separate group that includes rim forms A2a, D1a, D1b and D2a (Figure 6.28, Figure 6.29, Table 6.21). Refer to Appendix A for sample identification numbers.

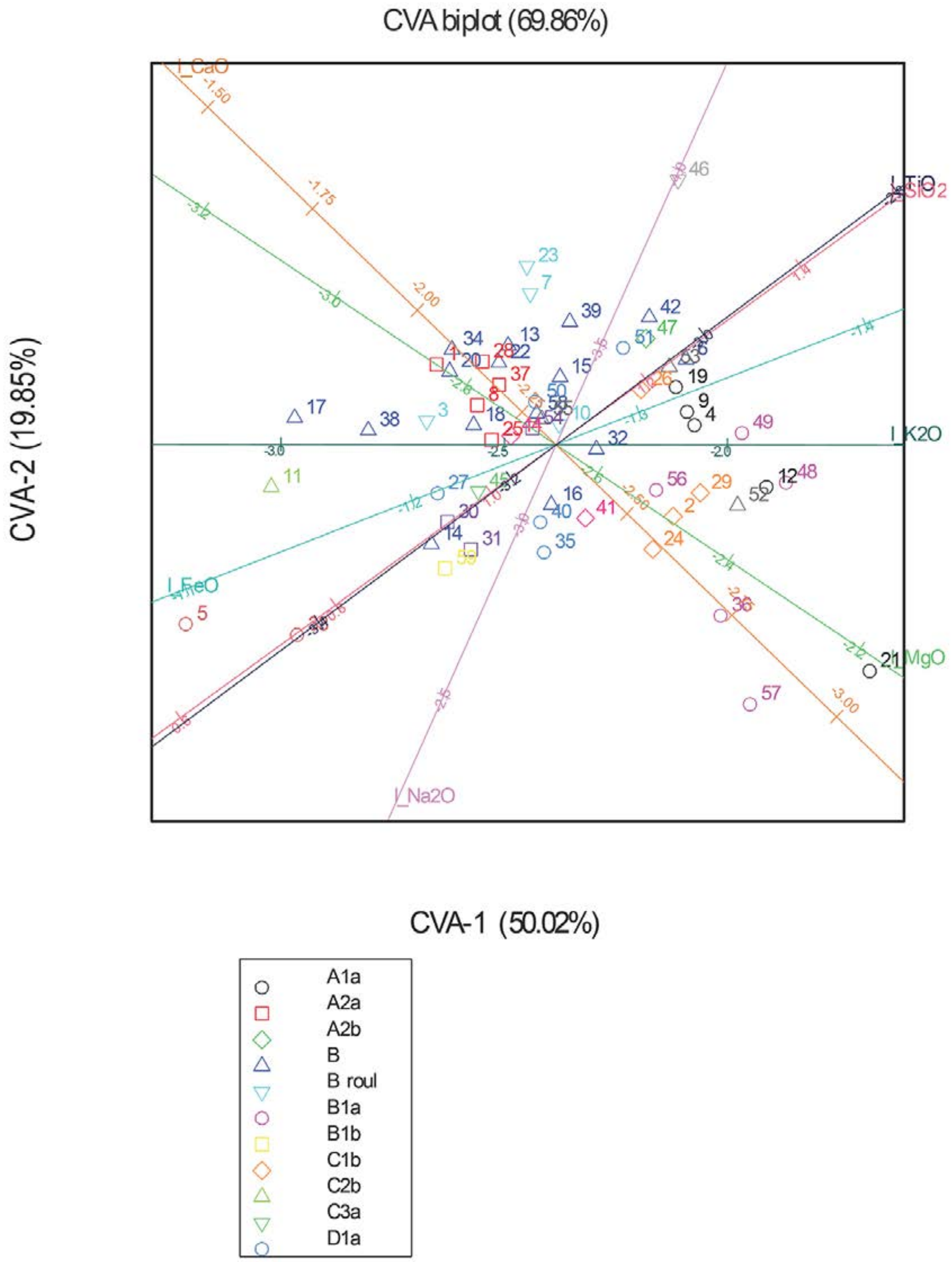


Figure 6.28. CVA biplot of the An Sơn rim forms and vessel components. First two dimensions. Refer to Appendix A for sample identification numbers and Figure 5.1 for rim form images. Key: Rim forms: A1a, A2a, A2b, B1a, B1b, C1b, C2b, C3a, D1a, D1b, D2a; Unidentified forms: R = rim sherd, B = body sherd, ped = pedestal sherd, B roul = roulette decoration on body sherd, ped roul = roulette decoration on pedestal sherd.

Source: C. Sarjeant.

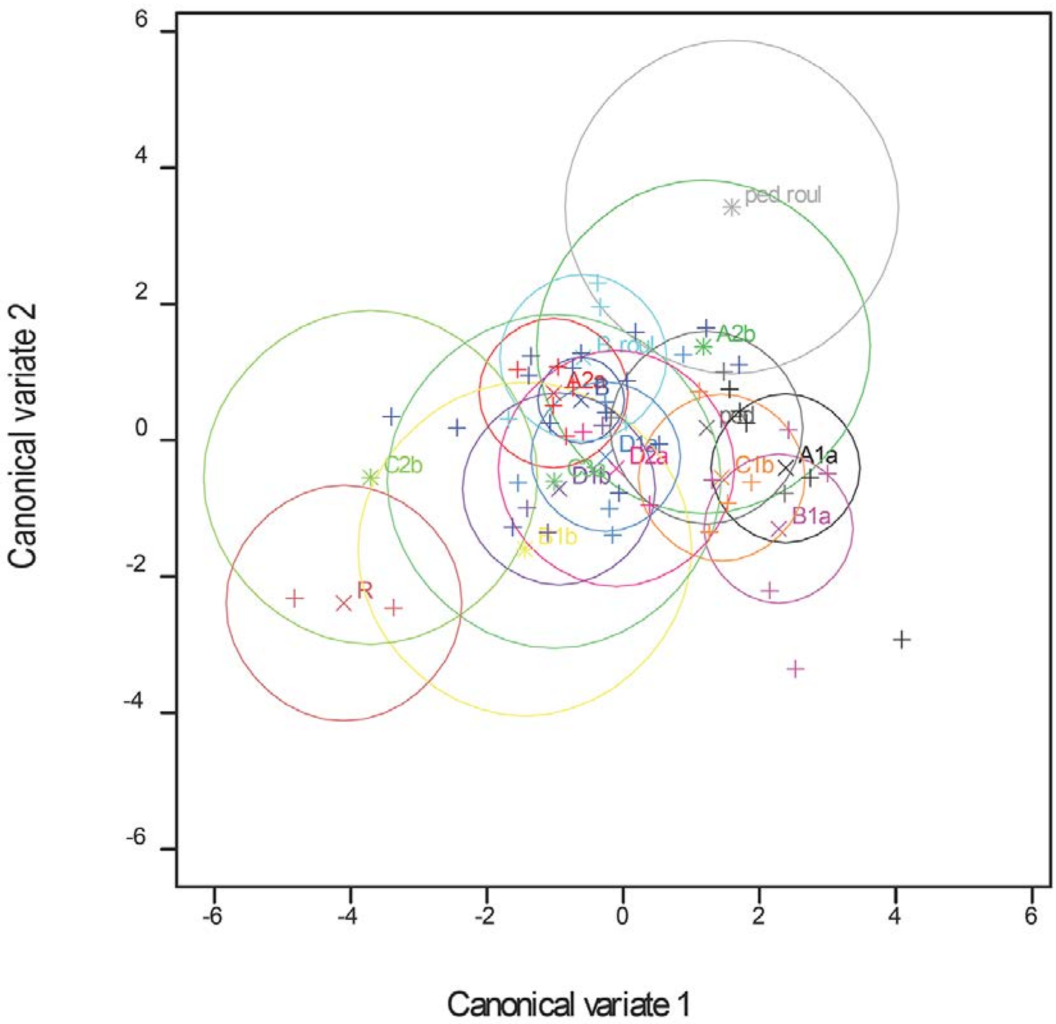


Figure 6.29. CVA plot of the An Sơn rim forms and vessel components with 95% confidence circles. First two dimensions. Refer to Figure 5.1 for rim form images. Key: Rim forms: A1a, A2a, A2b, B1a, B1b, C1b, C2b, C3a, D1a, D1b, D2a; Unidentified forms: R = rim sherd, B = body sherd, ped = pedestal sherd, B roul = roulette decoration on body sherd.

Source: C. Sarjeant.

Table 6.21. CVA loadings for Figures 6.28 and 6.29 of the An Sơn rim forms and vessel components. First three dimensions.

	1 (50.02%)	2 (19.85%)	3 (15.00%)
1	-3.137	1.871	1.062
2	0.180	-0.268	0.190
3	1.504	1.447	2.632
4	1.716	-5.427	-1.875
5	-1.293	-2.194	0.456
6	3.655	2.190	-2.829
7	-0.700	0.735	0.549

Source: Compiled by C. Sarjeant.

Layers

This CVA was undertaken to assess if there were differences in clay matrices over time, within the excavated layers at An Sơn. The CVA includes sherds from the lower deposits of the Test Square and of 1997 Trench 1. The CVA plot reveals a lot of overlap in the clay matrix compositional data of the layer groups (Figure 6.30, Figure 6.31, Table 6.22). There appears to have been some variation between the majority of the sherds and those from the 1997 Trench 1 lower deposit at 360–410 cm. The 2009 Trench 1 layer 8 sherds are variable in their placement in the CVA plot, but the 2009 Trench 1 layer 7 sherds cluster near the 1997 360–410 cm group, while the remaining 2009 layer groups cluster closer together. There appears to be more variation in clay matrix composition in the lower to basal sherds from Trench 1 layers 7 and 8, and also layer 5, and from 360–410 cm of the 1997 excavation. Refer to Appendix A for sample identification numbers.

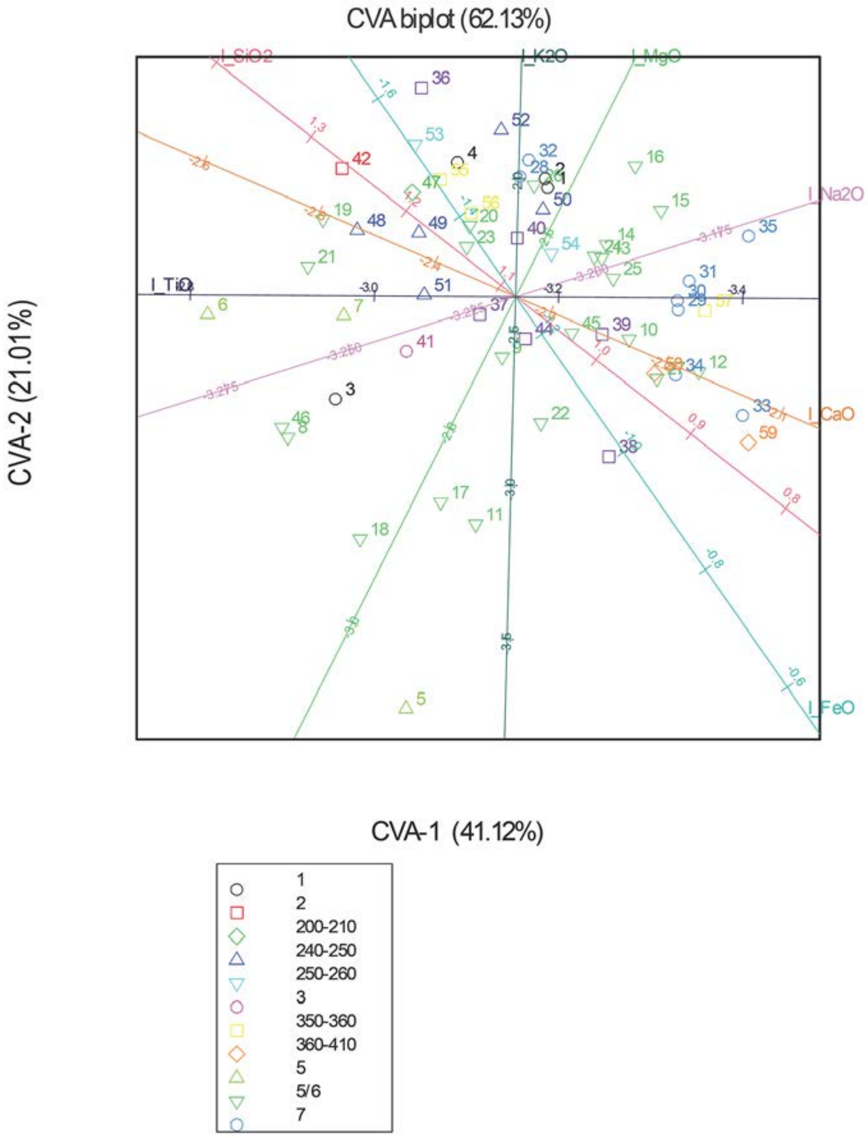


Figure 6.30. CVA biplot of the An Sơn layers. First two dimensions. Refer to Appendix A for sample identification numbers. Key: 1, 2, 3, 5, 5/6, 7, 8 = 2009 Trench 1 layers; 200–210 cm, 240–250 cm, 250–260 cm = Test Square spits; 350–360 cm, 360–410 cm = 1997 excavation spits.

Source: C. Sarjeant.

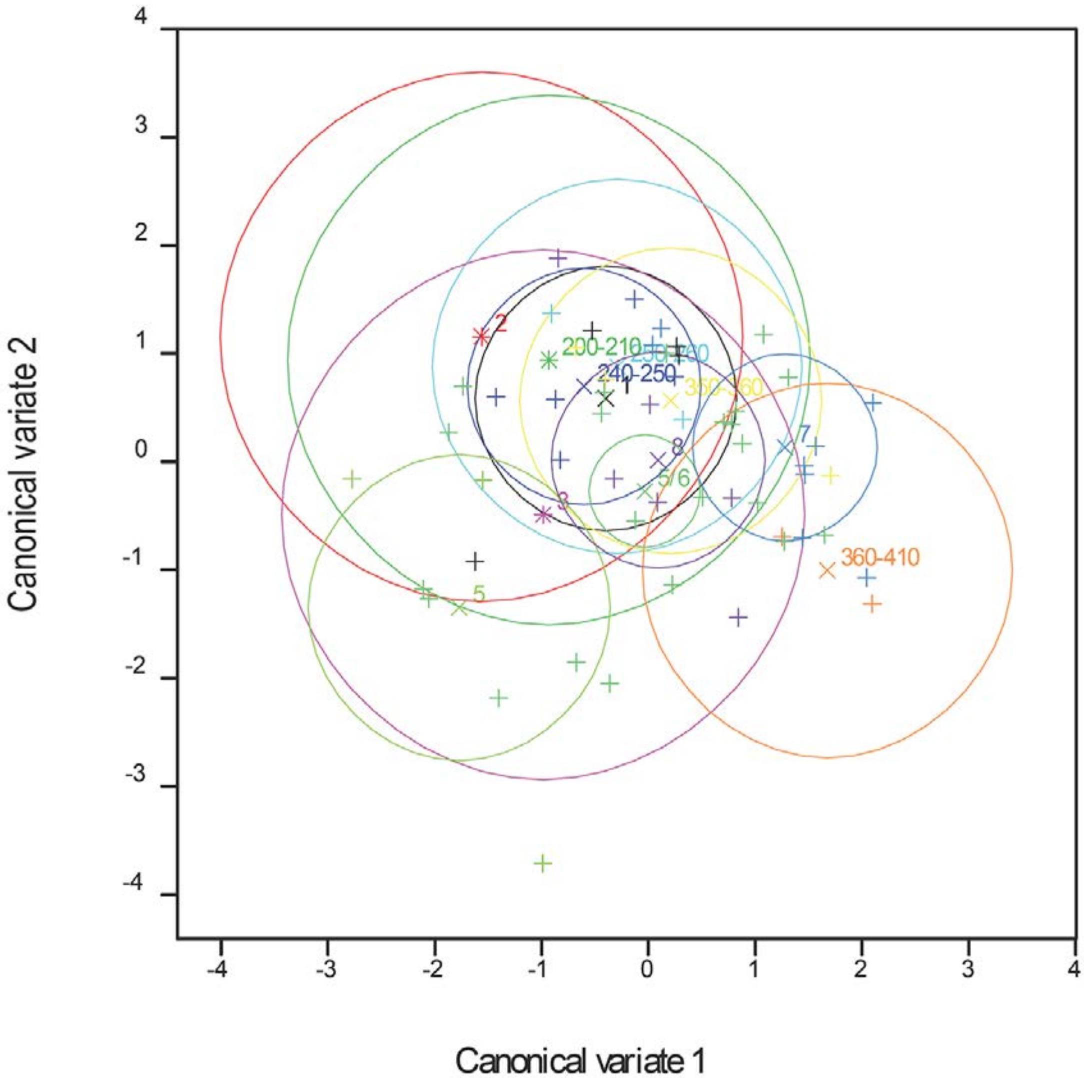


Figure 6.31. CVA plot of the An Sơn layers with 95% confidence circles. First two dimensions. Key: 1, 2, 3, 5, 5/6, 7, 8 = 2009 Trench 1 layers; 200–210 cm, 240–250 cm, 250–260 cm = Test Square spits; 350–360 cm, 360–410 cm = 1997 excavation spits.

Source: C. Sarjeant.

Table 6.22. CVA loadings for Figure 6.30 and Figure 6.31 of the An Sơn layers. First three dimensions.

	1 (41.12%)	2 (21.01%)	3 (15.69%)
1	1.108	0.444	1.716
2	2.307	-2.937	-2.069
3	0.959	2.064	-0.528
4	2.952	0.723	1.963
5	-0.250	-0.903	0.838
6	-4.948	-2.889	-3.497
7	-1.739	0.157	2.586

Source: Compiled by C. Sarjeant.

Tempers

This CVA was undertaken to assess whether there was any statistical relationships between the tempers (identified according to TG A, B, C, D and E) and clay matrix compositions. While the CVA plot presents a close arrangement of the samples, there is separation between the fibre temper (TG B) and sand temper (TG A1, A2, A3) groups, as indicated in the CVA temper plot for the Trench 1 square C1 sherds (Figure 6.32, Figure 6.33, Table 6.23). This suggests there was a distinction, albeit slight, in clay compositions between the sand and fibre groups. This is consistent with the previous hierarchical cluster analysis dendrogram (Figure 6.27, Table 6.20), where the sand tempered sherds were associated with main group 1 and main group 2 (subgroups 5–6), and the fibre (TG B), fibre/phosphate (TG B/C), fibre/calcareous (TG B/D) and calcareous (TG D) tempered sherds were associated with main group 2 (subgroups 1–4). The mixed sand/fibre (TG A1/B) tempered sherds also form a separate group; subgroup 7 of main group 2. Refer to Appendix A for sample identification numbers.

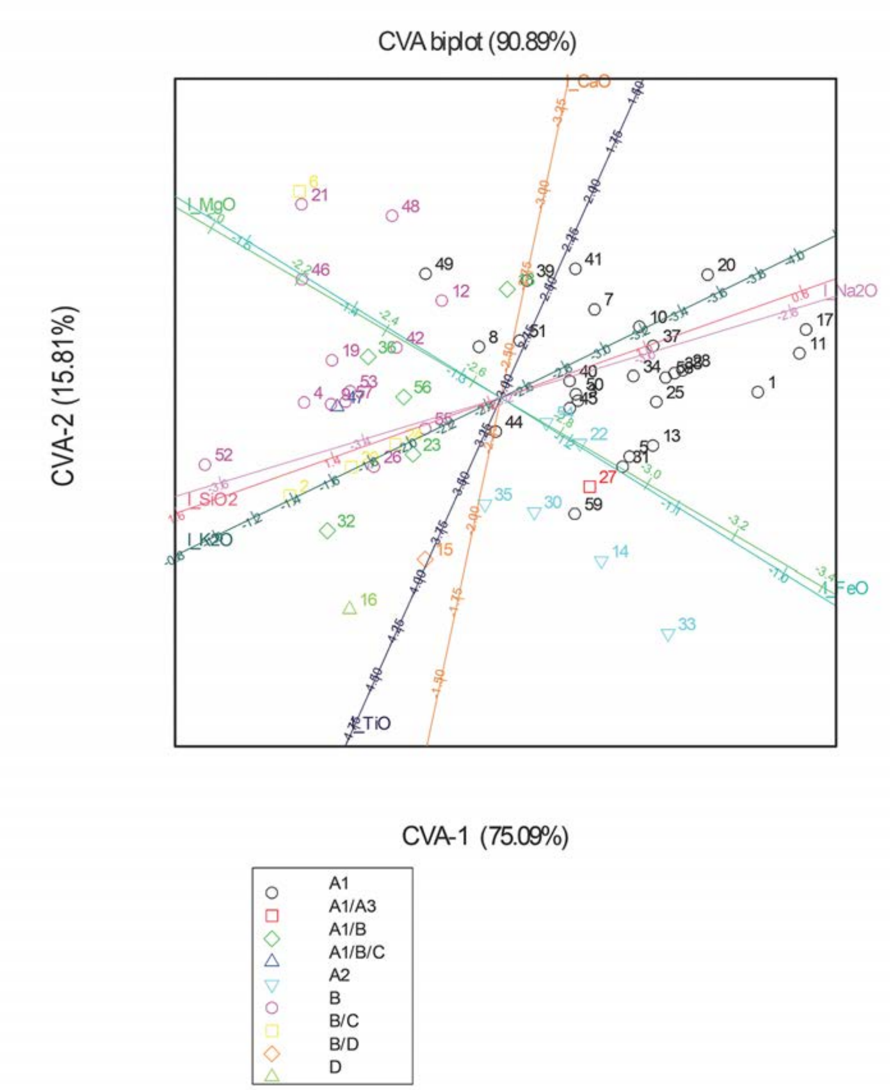


Figure 6.32. CVA biplot of the An Sơn tempers. First two dimensions. Refer to Appendix A for sample identification numbers. Key: A1 = mineral sand, A2 = lateritic (micaceous) sand, A3 = impure iron oxide (large grains)/almandine sand, B = fibre, C = phosphate, D = calcareous.

Source: C. Sarjeant.

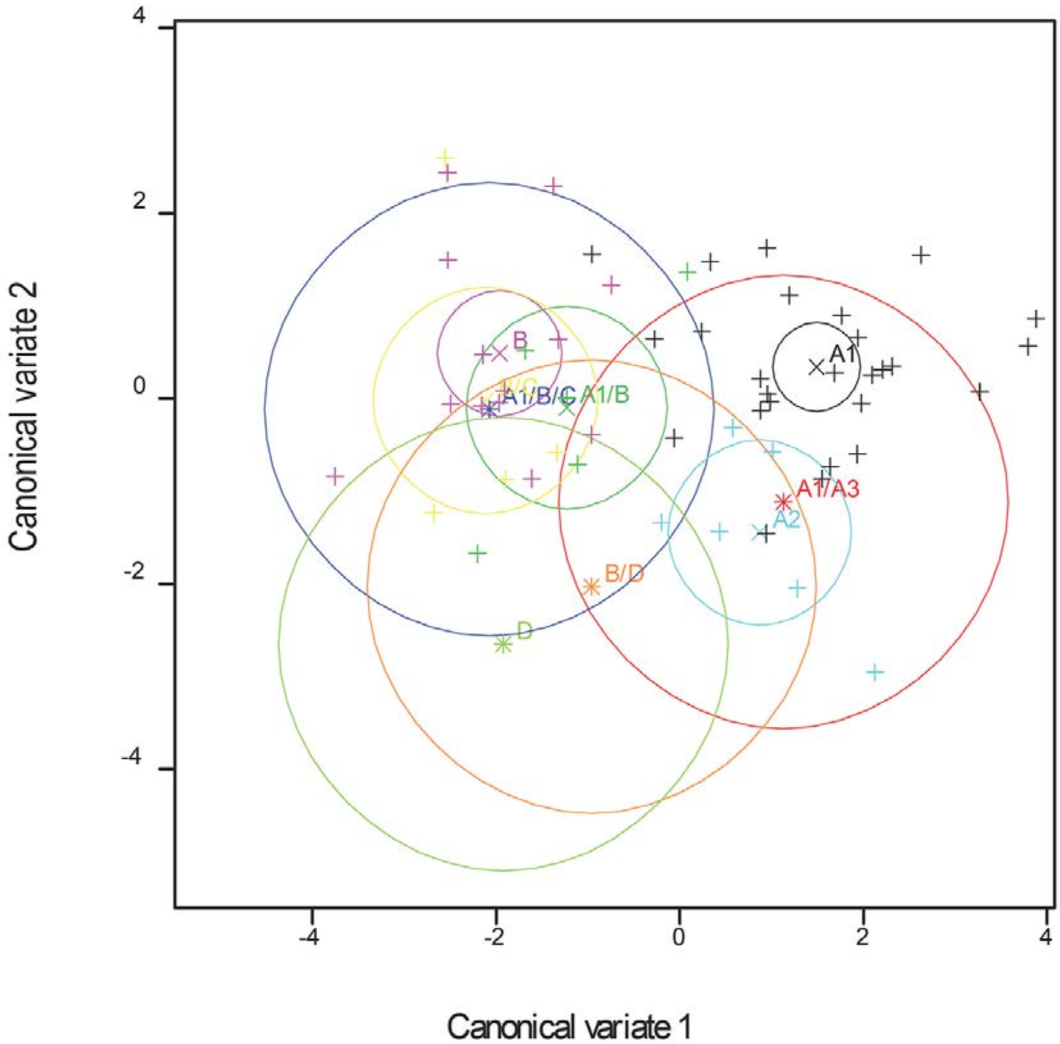


Figure 6.33. CVA biplot of the An Sơn tempers with 95% confidence circles. First two dimensions. Key: A1 = mineral sand, A2 = lateritic (micaceous) sand, A3 = impure iron oxide (large grains)/almandine sand, B = fibre, C = phosphate, D = calcareous.

Source: C. Sarjeant.

Table 6.23. CVA loadings for Figures 6.32 and 6.33 of the An Sơn tempers. First three dimensions.

	1 (75.09%)	2 (15.81%)	3 (5.19%)
1	1.613	-2.239	0.724
2	2.566	1.484	3.906
3	0.624	0.512	0.570
4	-5.033	-4.034	0.031
5	0.745	-0.471	0.680
6	-3.989	2.624	3.264
7	-0.054	1.667	-0.407

Source: Compiled C. Sarjeant.

Rim form and clay selection

A selection of diagnostic An Sơn rim sherds was chosen to investigate the relationship between rim form and clay matrix composition. The selected forms were each represented by numerous samples including: A2a rim sherds and roulette decorated body sherds from these concave rimmed restricted vessels; B1b thickened rims from restricted vessels; C1b rims from shouldered vertical or slightly inverted lipped unrestricted vessels; D1a and D1b wavy rims; and D2a serrated rims (see images of these rim forms in Figure 5.1). These rim forms were identified as characteristic ceramics at An Sơn because they were frequently identified in the assemblage over time and were part of a regional ceramic tradition. These aspects are discussed further in regard to vessel forms in Chapter 10.

Principal components analysis

The greatest variability in the following PCA plots (Figure 6.34, Figure 6.35) is a result of the concentrations of MgO and Na_2O in the clay matrix compositions (Table 6.24). When examining all three dimensions, three main groups are evident, with a number of outliers (Table 6.25). However, the variability is minimal in the three dimensions of the PCA of these specific forms from An Sơn. Refer to Appendix A for sample identification numbers and Figure 5.1 for rim form images.

- **Main group 1**: samples 2, 8, 26, 29, 35

  This group consists of ceramic sherds from layers 1, 5/6 and 7, with rim forms A2a and D1a, but predominantly C1b rim sherds. The represented tempers were sand, fibre and fibre/phosphate.

- **Main group 2**: samples 1, 3, 7, 25, 28, 31, 37, 50, 51

  This group consists of ceramic sherds from layers 1, 5, 5/6, 7 and 8, and from the Test Square 240–250 cm, with form A2a roulette decorated body and rim sherds, and D1a and D1b rim sherds. The represented tempers were predominantly sand, but there was one fibre tempered body sherd.

- **Main group 3**: samples 24, 54, 56

  This group consists of ceramic sherds from layers 5/6, the Test Square 250–260 cm, and 1997 Trench 1 350–360 cm, with the forms B1a, C1b and D1b present. The represented tempers were fibre/phosphate, sand and lateritic sand.

- **Outlier groups**: samples 10 / 23 / 27, 30 / 36 / 40 / 41 / 44 / 48 / 49 / 57

  These outliers included sherds from layers 3, 5/6, 7 and 8, the Test Square 240–250 cm, and 1997 Trench 1 350–360 cm. The forms included A2a roulette decorated body and rim sherds, D1a, D1b and D2a rim sherds, and a majority of B1a rim sherds. The represented tempers were sand, fibre (including one sample with bleb grog), sand/lateritic sand, and sand/fibre.

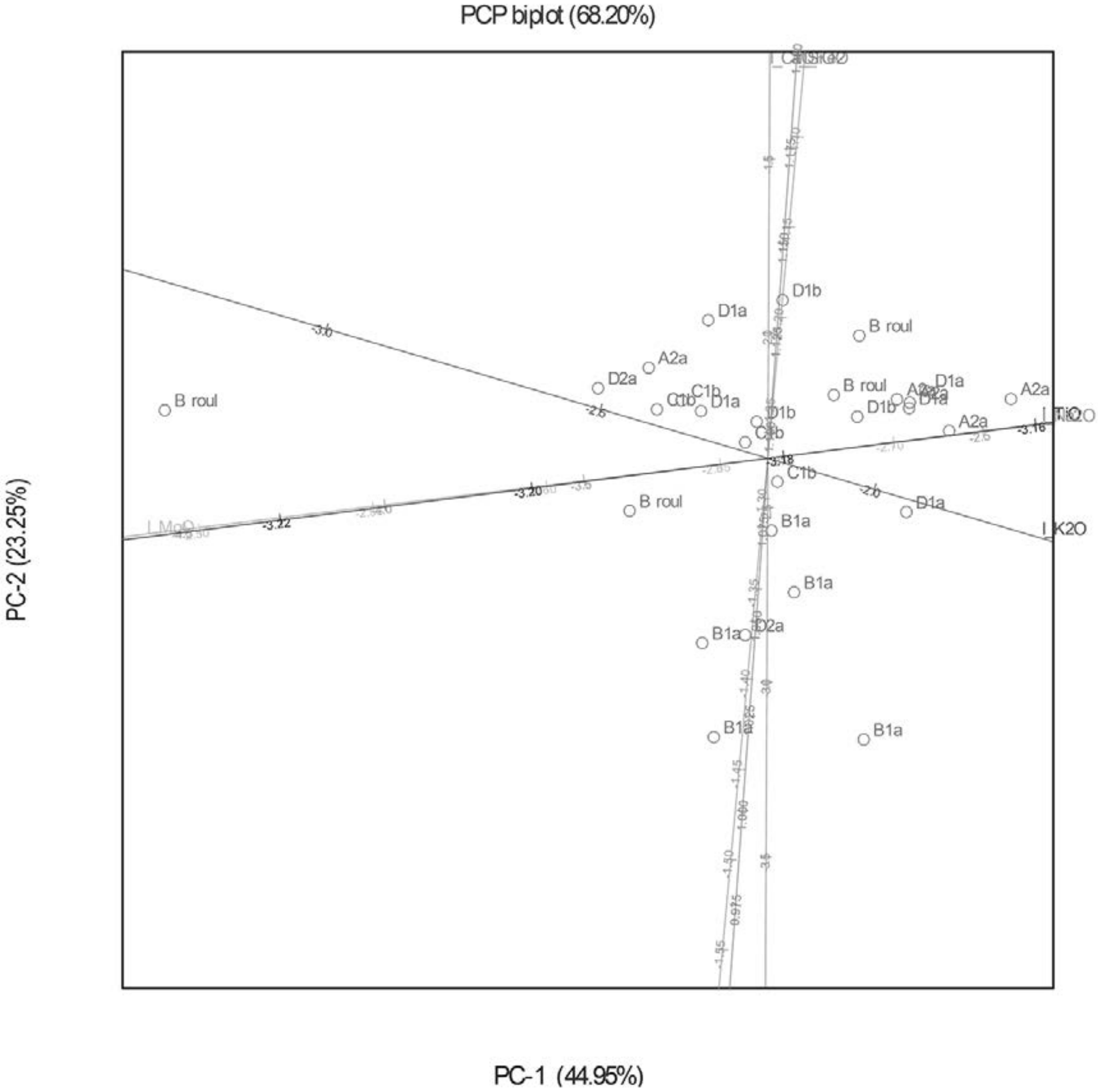


Figure 6.34. PCA biplot of the An Sơn rim forms and vessel components, rim forms A2a, B1b, C1b, D1a, D1b and D2a. First two dimensions. Refer to Figure 5.1 for rim form images. Key: Rim forms: A2a, B1b, C1b, D1a, D1b, D2a; Unidentified forms: B roul = roulette decoration on body sherd.

Source: C. Sarjeant.

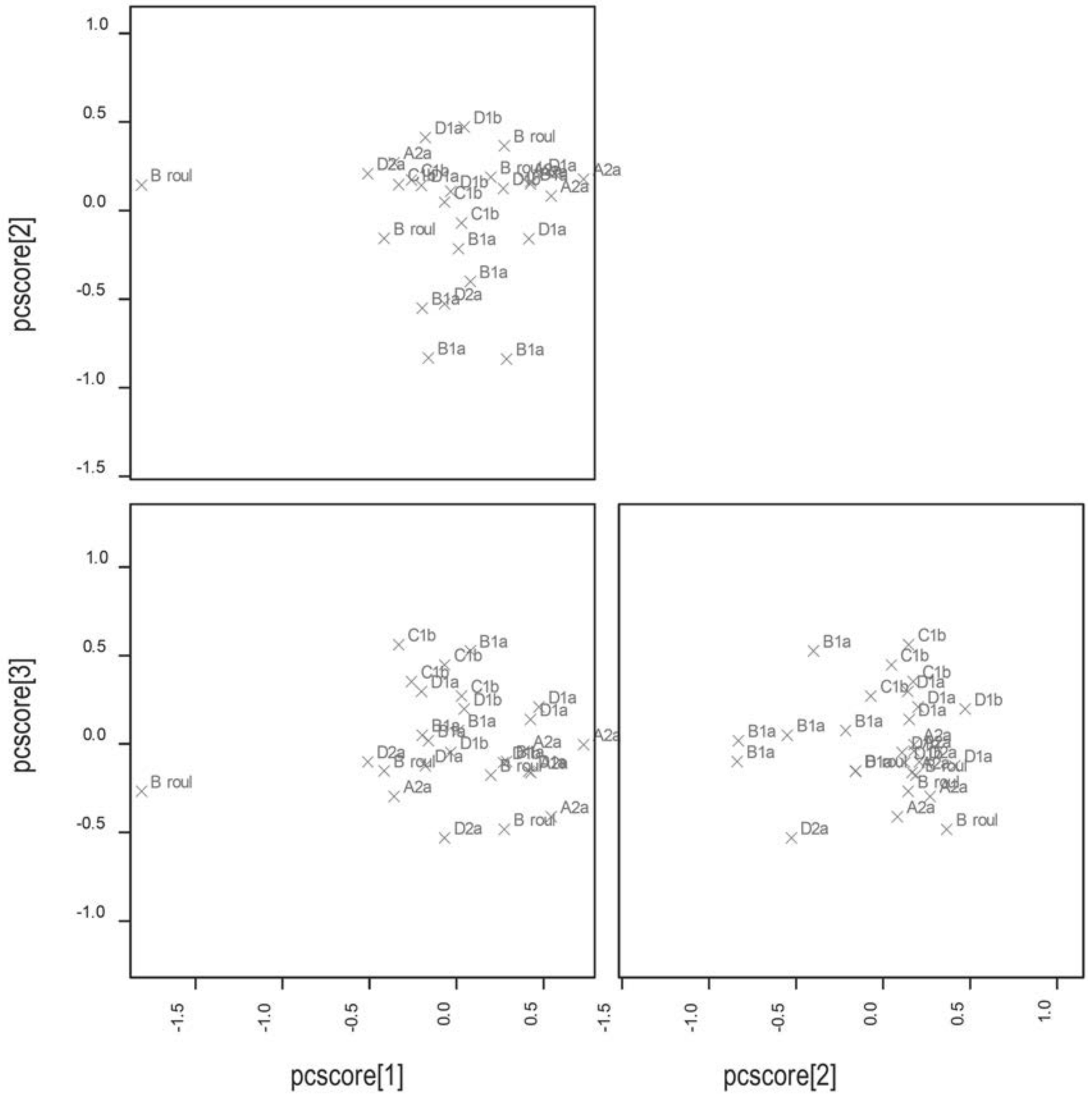


Figure 6.35. PCA plot of the An Sơn rim forms and vessel components, rim forms A2a, B1b, C1b, D1a, D1b and D2a. First three dimensions. Refer to Figure 5.1 for rim form images. Key: Rim forms: A2a, B1b, C1b, D1a, D1b, D2a; Unidentified forms: B roul = roulette decoration on body sherd.

Source: C. Sarjeant.

Table 6.24. PCA loadings for Figures 6.34 and 6.35 of the An Sơn rim forms and vessel components, rim forms A2a, B1b, C1b, D1a, D1b and D2a. First three dimensions. The bold values indicate the element oxides that presented the greatest variability in the PCA.

	PC 1 (44.95%)	**PC 2 (23.25%)**	**PC 3 (15.85%)**
CaO	0.00456	0.96008	0.07069
FeO	0.01706	0.18380	0.24047
K_2O	0.56012	**-0.16304**	0.54442
MgO	**-0.09441**	-0.01182	**0.69410**
Na_2O	**0.82239**	0.09976	**-0.30405**
SiO_2	0.00638	0.08815	0.16545
TiO_2	0.02604	0.00328	0.19796

Source: Compiled by C. Sarjeant.

Table 6.25. Samples in the PCA groupings in Figure 6.35 of the An Sơn rim forms and vessel components, rim forms A2a, B1b, C1b, D1a, D1b and D2a. First three dimensions.

	PC 1/PC 2	PC 1/PC 3	PC 2/PC 3
Main group 1	2, 8, 26, 29, 35, 44, 54	2, 26, 35, 57 (29)	26, 35, 50, 51 (2, 24, 29)
Main group 2	25, 37, 50, 51 (1, 3, 7, 28, 31)	7, 25, 31, 36, 37, 40 (50, 51)	1, 7, 8, 23, 25, 28, 31, 37, 44, 54 (3, 27)
Main group 3	24, 56	24, 27, 30, 48, 49, 54, 56 (8, 10, 44)	
Main group 4	41, 49, 57		
Outlier group 1	10	1	10, 40
Outlier group 2	23	23	41
Outlier group 3	27, 30	3	30
Outlier group 4	36	28	36, 48
Outlier group 5	40	41	49
Outlier group 6	48		56
Outlier group 7			57

Source: Compiled by C. Sarjeant.

Hierarchical cluster analysis

This dendrogram has been presented with An Sơn rim forms instead of the sample numerical codes to clarify the relationships between the rim form groups and clay matrix compositions. Two major groups and one major outlier are evident in the cluster analysis dendrogram (when cut at 0.80), each with valid subgroups (cut at 0.925) (Figure 6.36, Table 6.26). Refer to Appendix A for sample identification numbers and Figure 5.1 for rim form images.

- **Main group 1**:
  - **Subgroup 1**: rim form A2a
  - **Subgroup 2**: form A2a roulette decorated body sherd, rim form D2a
  - **Subgroup 3**: rim form B1a (*n*=3)

Main group 1 of the hierarchical cluster analysis (Table 6.26) is most consistent with the outliers of the previous PCA (Figure 6.35, Table 6.25).

- **Main group 2**:
  - **Subgroup 1**: rim forms C1b (*n*=4), B1a
  - **Subgroup 2**: rim forms A2a (*n*=2), D1b (*n*=3), D1a (*n*=3), D2a
  - **Subgroup 3**: form A2a roulette decorated body sherd (*n*=2), rim forms D1a (*n*=2), A2a
  - **Subgroup 4**: rim form A2a
  - **Subgroup 5**: rim form B1a

Main group 2 (Table 6.26) is most consistent with main group 1, particularly subgroup 1, and main group 2 of the previous PCA (Figure 6.35, Table 6.25).

- **Outlier**: form A2a roulette decorated body sherd

The dendrogram (Figure 6.36, Table 6.26) suggests there are links between rim forms and the clay matrix compositions in the An Sơn ceramics. Notably, the B1a and C1b rim forms are distinct, and the sherds within these form groups are closely related to each other. This is similarly the situation for C1b rim forms. The D1a, D1b and D2a rim forms cluster together, but also cluster with the A2a rim and roulette decorated body sherds.

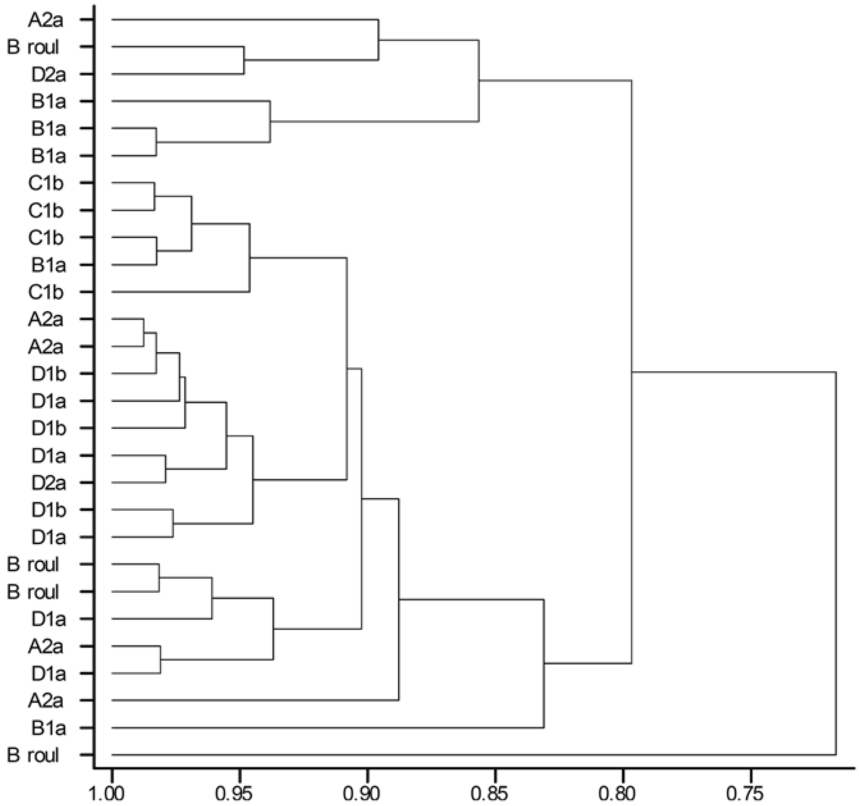


Figure 6.36. Average-linkage hierarchical cluster analysis dendrogram of the An Sơn rim forms and vessel components, rim forms A2a, B1b, C1b, D1a, D1b and D2a. Refer to Figure 5.1 for rim form images. Key: Rim forms: A2a, B1b, C1b, D1a, D1b, D2a; Unidentified forms: B roul = roulette decoration on body sherd.

Source: C. Sarjeant.

Table 6.26. Samples in the hierarchical cluster analysis dendrogram groupings in Figure 6.36 of the An Sơn rim forms and vessel components, rim forms A2a, B1b, C1b, D1a, D1b and D2a when cut at 0.80 and 0.925.

Main group (cut at 0.80)	Subgroup (cut at 0.925)	Forms
	1	A2a
1	2	A2a roulette stamped body, D2a
	3	B1a
	1	B1a, C1b
	2	A2a, D1a, D1b, D2a
2	3	A2a, A2a roulette stamped body, D1a
	4	A2a
	5	B1a
Outlier	1	A2a roulette stamped body

Source: Compiled by C. Sarjeant.

Canonical variate analysis

To follow on from the PCA and cluster analysis, the rim form *a priori* group was applied to this CVA to assess how chemically similar the rim forms at An Sơn were, and which forms were more closely related to each other. The CVA (Figure 6.37, Figure 6.38, Table 6.27) supports the previous PCA (Figure 6.34, Figure 6.35, Table 6.25) and dendrogram (Figure 6.36, Table 6.26), in that it differentiates the B1a and C1b rim forms from the rest. It also shows a close link in the clay matrix composition of rim form A2a sherds and roulette decorated body sherds to confirm that the latter are the shoulder components of the former. While the D1a and D1b rim forms were similarly plotted in the CVA as in the PCA (Figure 6.35) and dendrogram (Figure 6.36), the CVA plotted rim form D2a with more variation, suggesting that the clay matrix composition differs between classes D1 and D2. Refer to Appendix A for sample identification numbers and Figure 5.1 for rim form images.

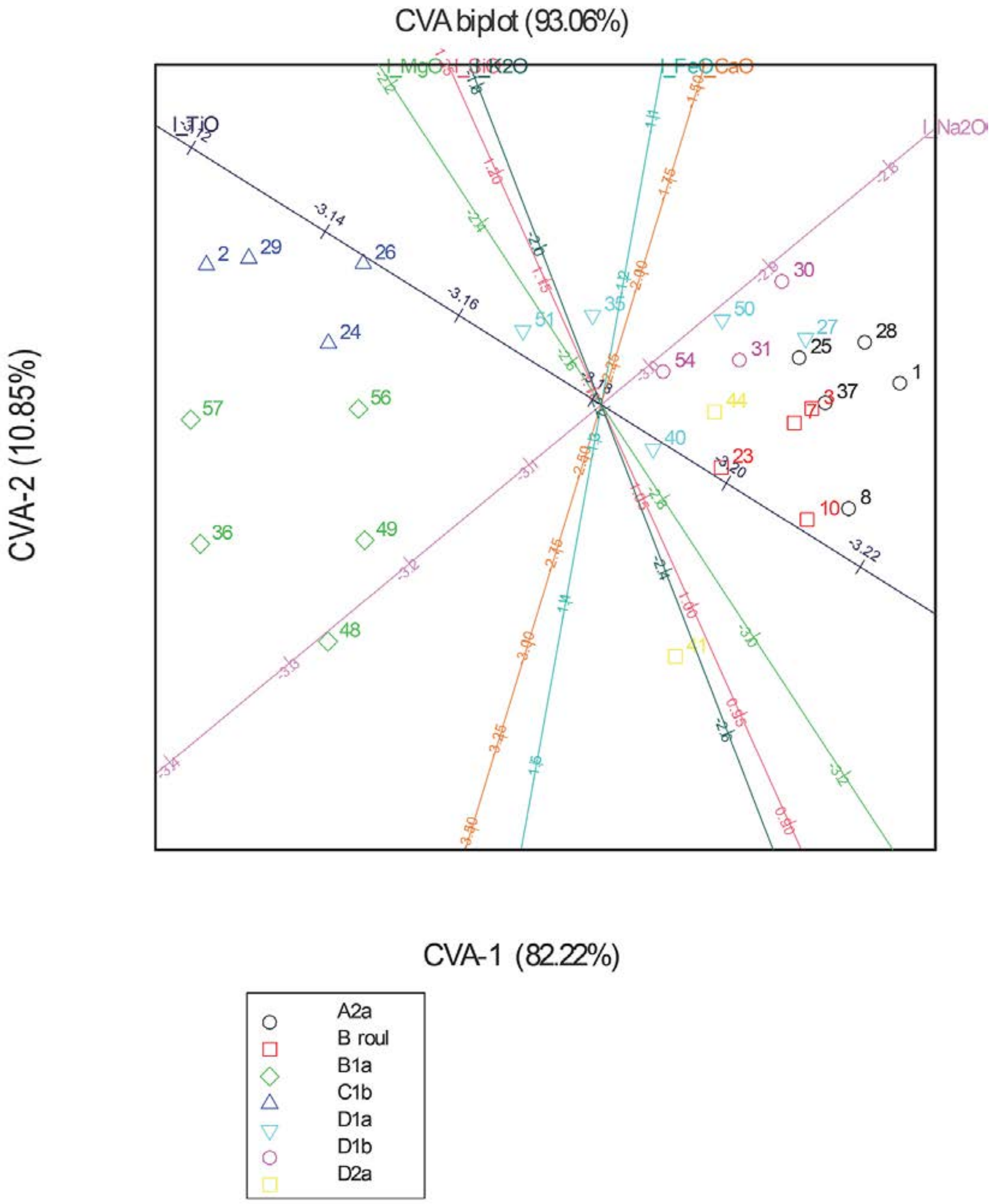


Figure 6.37. CVA biplot of the An Sơn rim forms and vessel components, rim forms A2a, B1b, C1b, D1a, D1b and D2a. First two dimensions. Refer to Appendix A for sample identification numbers and Figure 5.1 for rim form images. Key: Rim forms: A2a, B1b, C1b, D1a, D1b, D2a; Unidentified forms: B roul = roulette decoration on body sherd.

Source: C. Sarjeant.

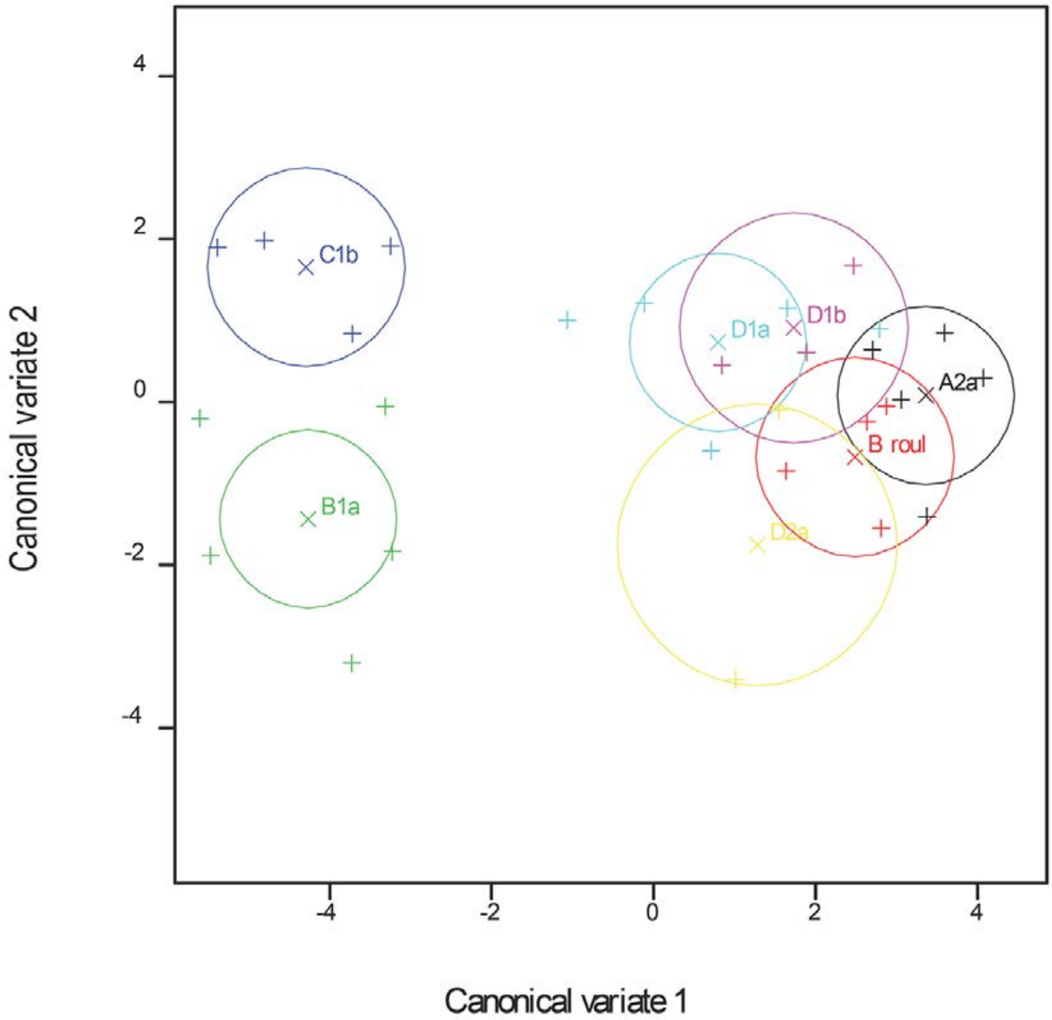


Figure 6.38. CVA plot of the An Sơn rim forms and vessel components with 95% confidence circles, rim forms A2a, B1b, C1b, D1a, D1b and D2a. First two dimensions. Refer to Figure 5.1 for rim form images. Key: Rim forms: A2a, B1b, C1b, D1a, D1b, D2a; Unidentified forms: B roul = roulette decoration on body sherd.

Source: C. Sarjeant.

Table 6.27. CVA loadings for Figure 6.37 and Figure 6.38 of the An Sơn rim forms and vessel components, rim forms A2a, B1b, C1b, D1a, D1b and D2a. First three dimensions.

	1 (82.22%)	2 (10.85%)	3 (5.05%)
1	5.367	3.605	0.040
2	3.520	-0.565	0.548
3	-1.561	1.565	-2.004
4	-11.224	3.550	0.257
5	0.524	0.100	-0.692
6	-7.692	-0.411	5.410
7	5.616	-2.110	-4.893

Source: Compiled C. Sarjeant.

Clay matrix characterisation: An Sơn ceramics compared with clay samples and non-local ceramics

This section compares the previously analysed An Sơn ceramics with unfired and fired clays from the vicinity of the site, sherds from neighbouring sites in the Vàm Cỏ Đông valley, and sites further afield in southern Vietnam and elsewhere. These non-local ceramic and clay samples were described in the temper and non-plastic characterisations. Similar statistical methods were applied as previously with a focus on CVA, applying archaeological sites as *a priori* groups.

Do the An Sơn rim forms and associated clay selections occur in other sites in southern Vietnam?

Continuing from the above section, a CVA was undertaken to reveal any non-local relationships for An Sơn forms A2a, B1a, C1b, D1a, D1b and D2a (see Figure 5.1 for rim form images). Comparative southern Vietnam samples were analysed from neolithic contexts at Đình Ông, Lộc Giang, and Cù Lao Rùa, and metal age contexts at Giồng Cá Vồ (see site locations in Figure 1.3). Background information regarding Cù Lao Rùa, Đình Ông and Lộc Giang are provided in Chapter 2, and Chapters 8, and for Giồng Cá Vồ are in Chapter 2. The CVA plot also includes unfired clay from natural deposits and fired clay lump samples (see Chapter 4) that were identified during excavation in archaeological contexts (see descriptions of the clay samples in this chapter). The clay matrix compositions of the unfired clays were outliers and are not shown in this CVA plot (Figure 6.39, Figure 6.40, Table 6.28).

The CVA plot indicates that there was little relationship, in terms of clay matrix composition, between the An Sơn rim sherds and those from Cù Lao Rùa (Figure 6.39, Figure 6.40, Table 6.28). The An Sơn B1a and C1b rims group closely with the An Sơn fired clay lumps and Giồng Cá Vồ sherds, suggesting that they have similar clay matrix compositions. This is surprising considering the much later date for occupation at Giồng Cá Vồ. In the CVA plot the remaining rim forms, A2a, D1a, D1b and D2a, overlap with each other, and with the Đình Ông sherds, but less so with the Lộc Giang sherds.

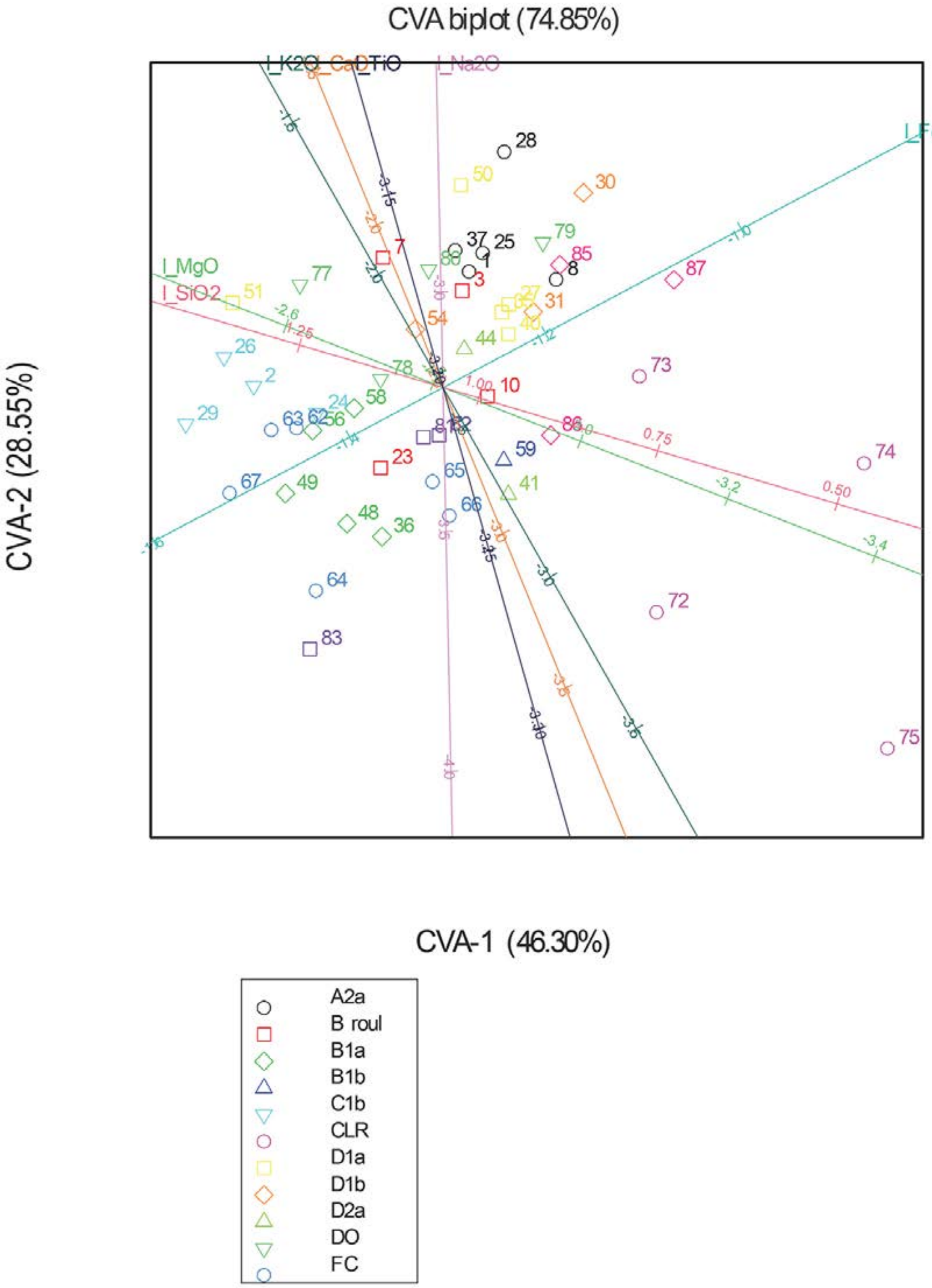


Figure 6.39. CVA biplot of the An Sơn rim forms and vessel components, clays and other site samples. First two dimensions. Refer to Appendix A for sample identification numbers and Figure 5.1 for rim form images. Key: Rim forms: A2a, B1a, C1b, D1a, D1b, D2a; Body sherds: B roul = roulette decoration; Clay: FC = An Sơn fired clay; Other sites: CLR = Cù Lao Rùa, DO = Đình Ông, GCV = Giồng Cá Vồ, LG = Lộc Giang.

Source: C. Sarjeant.

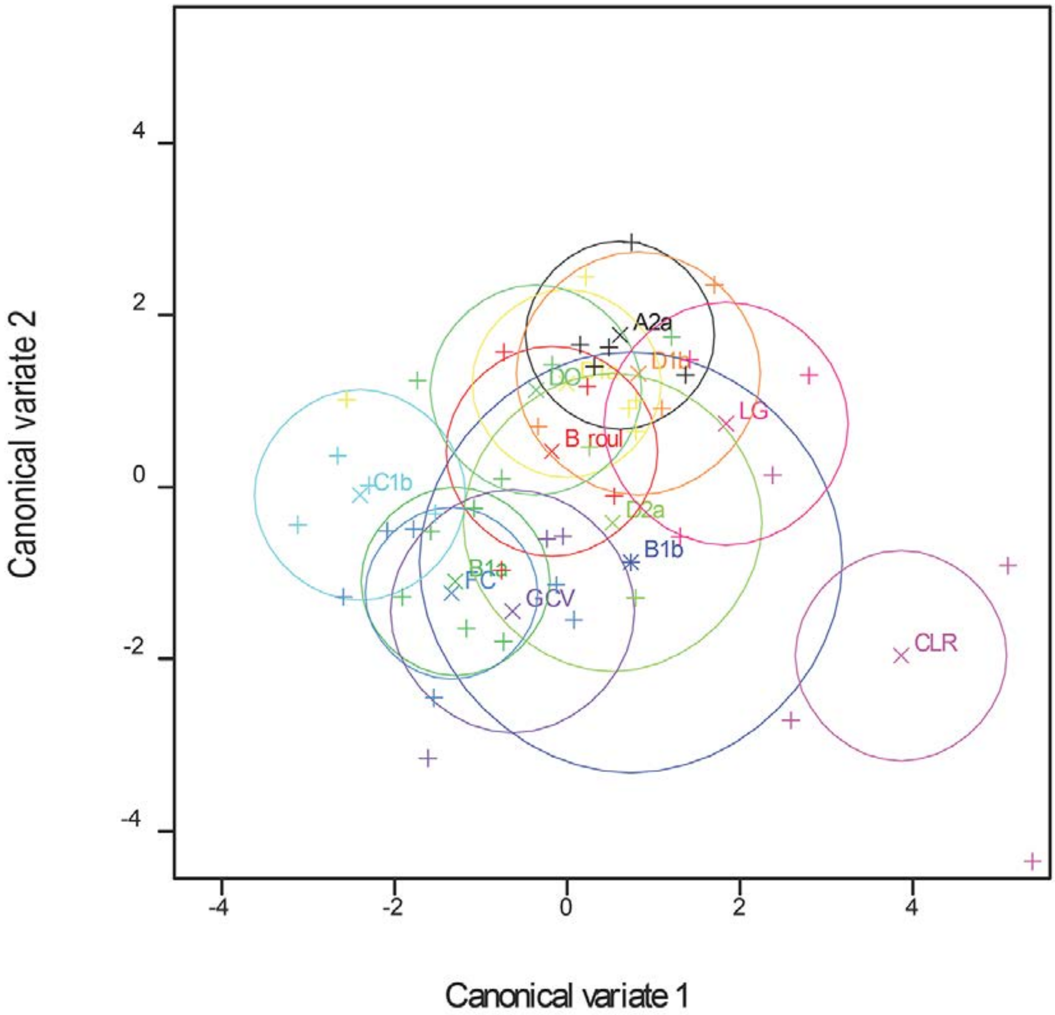


Figure 6.40. CVA plot of the An Sơn rim forms and vessel components, clays and other site samples with 95% confidence circles. First two dimensions. Refer to Figure 5.1 for rim form images. Key: Rim forms: A2a, B1a, C1b, D1a, D1b, D2a; Body sherds: B roul = roulette decoration; Clay: FC = An Sơn fired clay; Other sites: CLR = Cù Lao Rùa, DO = Đình Ông, GCV = Giồng Cá Vồ, LG = Lộc Giang.

Source: C. Sarjeant.

Table 6.28. CVA loadings for Figures 6.39 and 6.40 of the An Sơn rim forms and vessel components, clays and other site samples. First three dimensions.

	1 (46.30%)	2 (28.55%)	3 (12.03%)
1	1.161	3.300	-1.505
2	0.527	0.456	0.833
3	-1.553	1.246	2.098
4	-2.024	-2.470	-1.706
5	1.279	0.270	-0.668
6	-6.890	-1.974	1.030
7	4.883	3.527	1.487

Source: Compiled C. Sarjeant.

What is the relationship between the ceramics and clays of southern Vietnam, and beyond southern Vietnam?

This section includes all of the An Sơn studied ceramic sherds and archaeological fired clay lumps (see Chapter 4), together with unfired clays collected near the site. Included in the analysis were the sherds from Cù Lao Rùa, Đình Ông, Giồng Cá Vồ and Lộc Giang, as well as sites located further afield, Hòa Diêm, Ban Non Wat, Mán Bạc, Cồn Cổ Ngựa and Đa Bút (see site locations in Figures 1.2 and 1.3). Hòa Diêm is a metal age site in coastal central Vietnam (see background information in Chapter 2). Ban Non Wat, northeast Thailand and Mán Bạc, northern Vietnam are neolithic sites (see background information in Chapters 2 and 9). Pre-neolithic or incipient neolithic occupations are represented by Cồn Cổ Ngựa and Đa Bút, northern Vietnam (see background information in Chapter 2).

Principal components analysis

This PCA includes the major outliers in the An Sơn sample (samples 43, 60 and 61) already described. The PCA groupings presented above are obscured here, since the sherds from the more distant sites increased the variability of the sample. Since the clay matrix compositional groups of the An Sơn ceramic sample has already discussed, this section focuses on samples from other sites and their clay compositional relationship with the An Sơn sample as a whole. These relationships are clearer in the following hierarchical cluster analysis dendrogram and CVA plots.

The greatest variability in the following PCA plots (Figure 6.41, Figure 6.42) is a result of the concentrations of CaO and FeO in the clay matrix compositions (Table 6.29). When examining all three PCA dimensions, there is evidence of a main cluster consisting of the majority of An Sơn sherds, and two smaller groups (Table 6.30). Refer to Appendix A for sample identification numbers.

- **Main group 1**: all unlisted An Sơn ceramic sherds, and samples 62, 63, 65, 67, 73, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91

  This group consists of the majority of the An Sơn ceramic sherds, in addition to fired clay lump samples from An Sơn, a sand tempered sherd from Cù Lao Rùa, sand (including one sample with orthodox grog) and fibre tempered sherds from Đình Ông, sand/iron-rich sand and fibre tempered sherds from Giồng Cá Vồ, a sand tempered sherd from Hòa Diêm, sand (including one sample with orthodox grog) and fibre (and orthodox grog) tempered sherds from Lộc Giang, sand/iron-rich sand tempered and untempered sherds from Mán Bạc, and a fibre tempered sherd from Ban Non Wat.

- **Main group 2**: samples 5, 66

  This group consists of a sand tempered rim sherd from layer 5 at An Sơn, and a fired clay sample from the Test Square 240–250 cm.

- **Main group 3**: samples 60, 61

  This group consists of the two surface collected fibre bleb grog tempered sherds from An Sơn.

- **Outliers**: samples 43, 74 / 64 / 68 / 70 / 71 / 72 / 75 / 76

  The outliers include the Óc Eo phase sherd from An Sơn, fired and unfired clay samples from An Sơn, sand and sand/iron-rich sand tempered sherds from Cù Lao Rùa, and sand/iron-rich sand tempered sherds from Cồn Cổ Ngựa and Đa Bút.

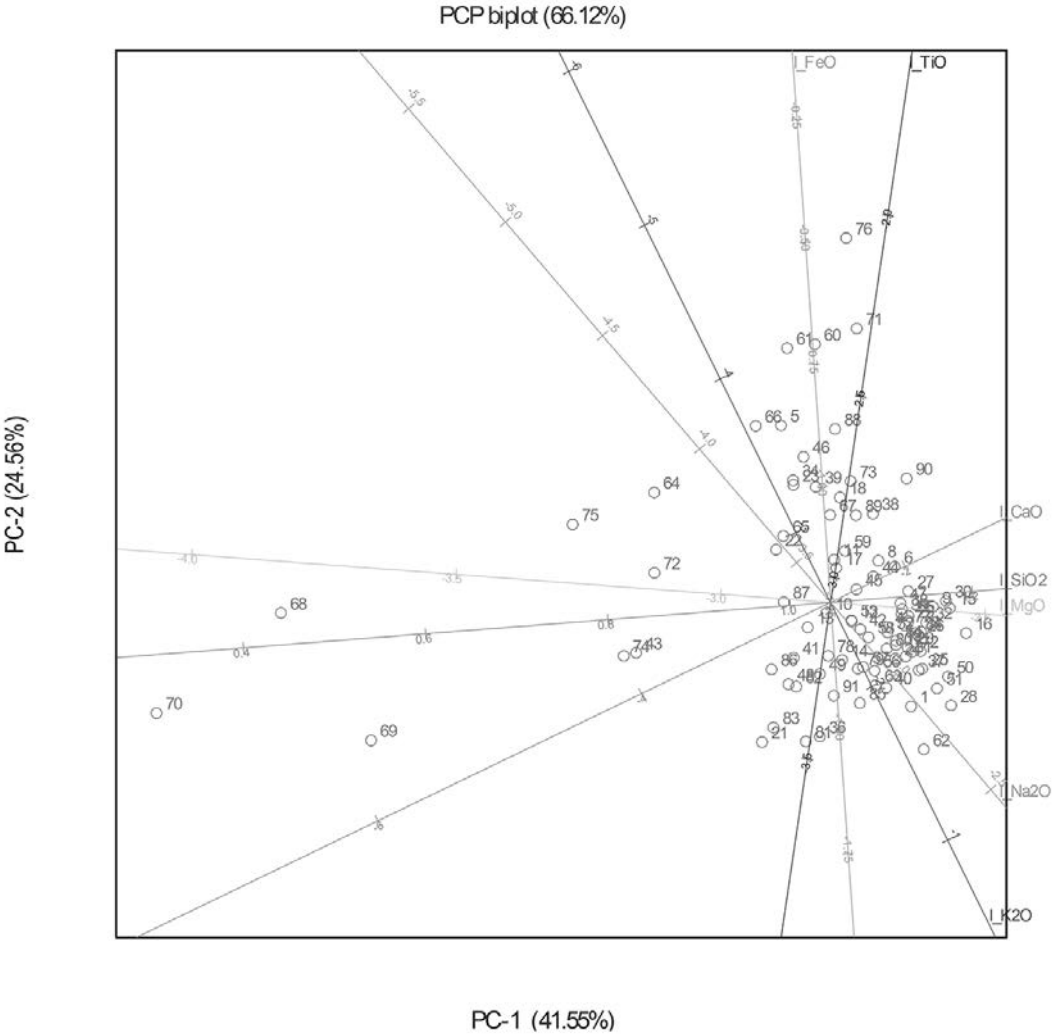


Figure 6.41. PCA biplot of the An Sơn ceramic samples, clays and other site samples. First two dimensions. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

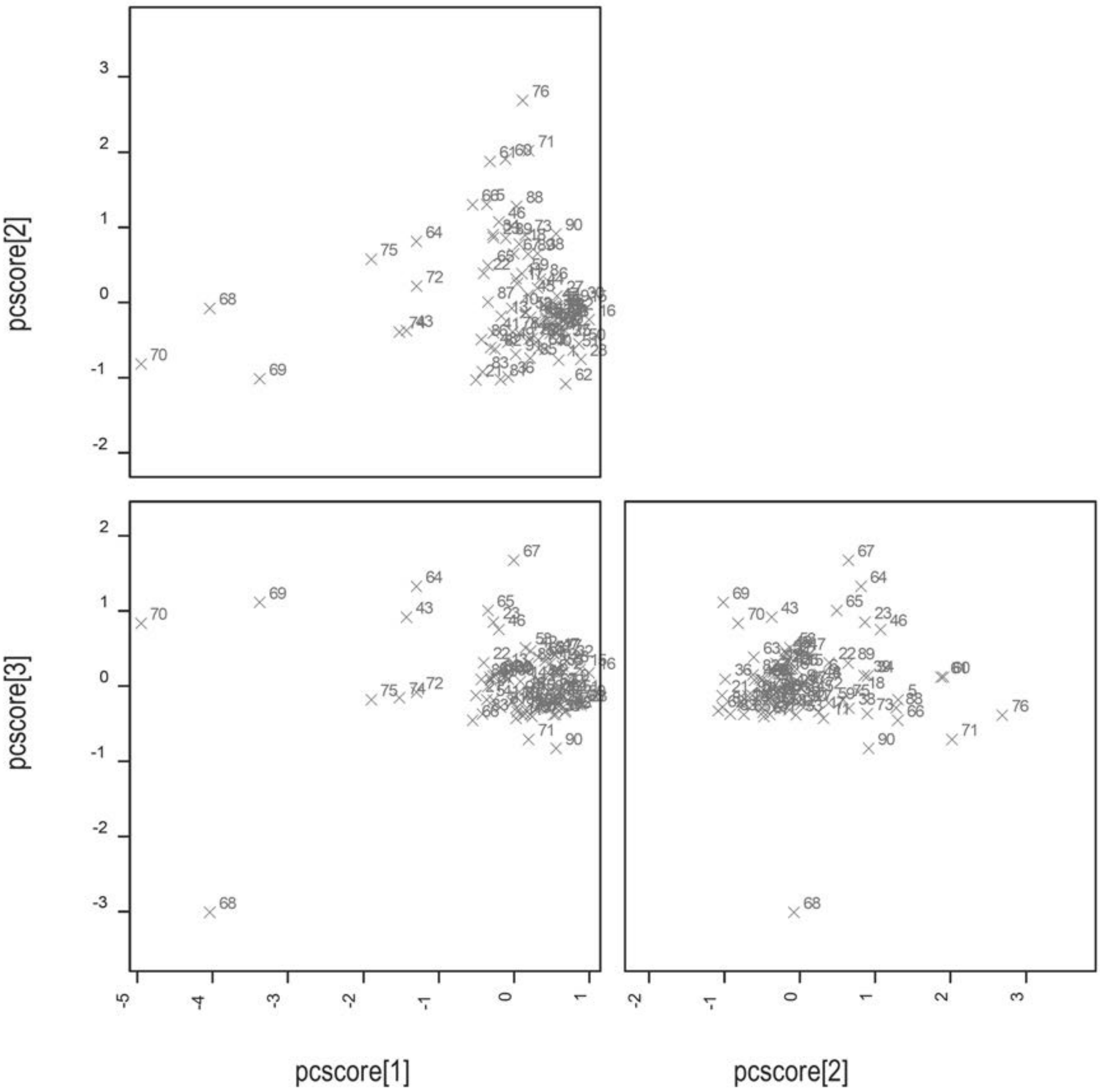


Figure 6.42. PCA plot of the An Sơn ceramic sample, clays and other site samples. First three dimensions. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

Table 6.29. PCA loadings for Figures 6.41 and 6.42 of the An Sơn ceramic sample, clays and other site samples. First three dimensions. The bold values indicate the element oxides that presented the greatest variability in the PCA.

	PC 1 (41.55%)	PC 2 (24.56%)	PC 3 (12.94%)
CaO	**0.83680**	**0.40520**	0.10621
FeO	**-0.01925**	0.27590	**-0.84683**
K_2O	0.34916	**-0.71074**	-0.01478
MgO	0.25605	-0.01923	0.00183
Na_2O	0.29489	-0.34632	-0.46502
SiO_2	0.14853	0.01156	**0.23047**
TiO_2	0.05389	**0.36619**	0.04486

Source: Compiled C. Sarjeant.

Table 6.30. Samples in the PCA groupings in Figure 6.42 of the An Sơn ceramic sample, clays and other site samples. Refer to Appendix A for sample identification numbers.

	PC 1/ PC 2	PC 1/ PC 3	PC 2/ PC 3
Main group 1	all unlisted An Sơn samples, and 62, 63, 65, 67, 73, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91	all unlisted An Sơn samples, and 62, 63, 65, 66, 71, 73, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91	all unlisted An Sơn samples, and 62, 63, 67, 72, 74, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 89, 91
Main group 2	5, 66	23, 46, 65	5, 66, 73, 88 (90)
Main group 3	60, 61, 71		60, 61
Main group 4			18, 34, 38, 39, 75
Outlier group 1	43, 74	43, 64	43, 69, 70
Outlier group 2	64	67	64, 65
Outlier group 3	68	68	68
Outlier group 4	69	69	23, 46
Outlier group 5	70	70	67
Outlier group 6	72	72, 74, 75	71
Outlier group 7	75		
Outlier group 8	76		76

Source: Compiled by C. Sarjeant.

Hierarchical cluster analysis

This dendrogram includes the major outliers (samples 43, 60 and 61) already described. Four main groups are evident in the cluster analysis dendrogram (when cut at 0.950), and a number of samples that are not closely related to the rest of the sample are also present, akin to the outliers in the previous PCA (Table 6.30). A large number of subgroups are evident (when cut at 0.9875) (Figure 6.43, Table 6.31). Refer to Appendix A for sample identification numbers and Figure 5.1 for rim form images.

- **Main group 1**:
    - **Subgroup 1**: sample 91

      This subgroup consists of a Ban Non Wat fibre tempered sherd.
    - **Subgroup 2**: sample 51

      This subgroup consists of a D1a sand tempered rim sherd from the Test Square 240–250 cm.
    - **Subgroup 3**: sample 3

      This subgroup consists of a form A2a roulette decorated sand tempered body sherd from layer 1.
    - **Subgroup 4**: samples 1, 81, 85, 7, 80, 79, 84

      This subgroup consists of A2a sand tempered rim sherds from layers 1 and 5/6, a Giồng Cá Vồ sand/iron-rich sand tempered sherd, a Lộc Giang sand tempered sherd, Đình Ông sand tempered sherds (including one sample with orthodox grog), and a Hòa Diêm sand tempered sherd.
    - **Subgroup 5**: samples 20, 25, 40, 31, 28, 37, 50

      This subgroup consists of a sand tempered body sherd from layer 5/6, A2a sand tempered rim sherds from layer 5/6 and 8, a D1a sand tempered rim sherd from layer 8, a D1b sand tempered rim sherd from layer 7, and a D1a sand tempered rim sherd from the Test Square 240–250 cm.

- **Subgroup 6**: samples 10, 78, 48, 49, 82

  This subgroup consists of a form A2a roulette decorated sand tempered body sherd from layer 5/6, a Đình Ông sand tempered sherd, B1a fibre and sand tempered rim sherds from the Test Square 240–250 cm, and a Giồng Cá Vồ fibre tempered sherd.

- **Subgroup 7**: samples 27, 45, 44, 54, 58, 41

  This subgroup consists of a D1a sand/iron-rich sand tempered rim sherd from layer 5/6, a C3a sand tempered rim sherd from layer 5/6, D2a sand tempered rim sherds from layer 8, a D1b lateritic sand tempered rim sherd from the Test Square 250–260 cm, and a sand tempered body sherd from 1997 Trench 1 360–410 cm.

- **Subgroup 8**: samples 21, 36, 83

  This subgroup consists of an A1a fibre tempered rim sherd from layer 5/6, a B1a sand/fibre tempered rim sherd from layer 8, and a Giồng Cá Vồ fibre tempered sherd.

- **Subgroup 9**: sample 62

  This subgroup consists of a fired clay sample from Trench 2 30–40 cm.

- **Main group 2**:
  - **Subgroup 1**: samples 2, 16, 15, 26, 32, 29

    This subgroup consists of C1b fibre/phosphate tempered rim sherds from layer 1, 5/6 and 7, a calcareous tempered body sherd from layer 5/6, a fibre/calcareous tempered body sherd from layer 5/6, and a sand/fibre tempered body sherd from layer 7.

  - **Subgroup 2**: samples 4, 47, 77, 52, 9

    This subgroup consists of A1a fibre tempered rim sherds from layer 1 and 5/6, an A2b sand/fibre/phosphate tempered rim sherd from the Test Square 200–210 cm, a Đình Ông fibre tempered sherd, and a fibre tempered pedestal sherd from the Test Square 240–250 cm.

  - **Subgroup 3**: samples 19, 24, 56, 63, 55

    This subgroup consists of an A1a fibre tempered rim sherd from layer 5/6, a C1b fibre/phosphate tempered rim sherd from layer 5/6, a B1a sand/fibre tempered rim sherd from layer 1997 Trench 1 350–360 cm, a fired clay sample from Trench 2 40–50 cm, and a fibre tempered pedestal sherd from 1997 Trench 1 350–360 cm.

  - **Subgroup 4**: samples 42, 53, 12

    This subgroup consists of a fibre tempered body sherd from layer 5/6, a fibre tempered pedestal sherd from the Test Square 240–250 cm, and an A1a fibre tempered rim sherd from layer 5/6.

  - **Subgroup 5**: samples 30, 35, 57

    This subgroup consists of a D1b lateritic sand tempered rim sherd from layer 7, a D1a lateritic sand tempered rim sherd from layer 7, and a B1a fibre bleb grog tempered rim sherd from 1997 Trench 1 350–360 cm.

  - **Subgroup 6**: samples 8, 18, 38

    This subgroup consists of an A2a sand tempered rim sherd from layer 5/6, a sand/fibre tempered body sherd from layer 5/6, and a sand tempered body sherd from layer 8.

  - **Subgroup 7**: samples 59, 73

    This subgroup consists of a B1b sand tempered rim sherd from 1997 Trench 1 360–410 cm and a Cù Lao Rùa sand tempered sherd.

- **Subgroup 8**: samples 86, 11, 17

  This subgroup consists of a Lộc Giang fibre and orthodox grog tempered sherd, a C2b sand tempered rim sherd from layer 5/6, and a sand tempered body sherd from layer 5/6.

- **Subgroup 9**: samples 14, 33

  This subgroup consists of a lateritic sand tempered body sherd (also with orthodox grog) from layer 5/6 and a lateritic sand tempered rim sherd from layer 7.

- **Subgroup 10**: samples 13, 22

  This subgroup consists of a sand tempered body sherd from layer 5/6 and a lateritic sand tempered body sherd from layer 5/6.

- **Subgroup 11**: samples 72, 87

  This subgroup consists of a Cù Lao Rùa sand/lateritic sand tempered sherd and a Lộc Giang sand and orthodox grog tempered sherd.

- **Main group 3**: samples 6, 89, 90

This group consists of a fibre/phosphate tempered body sherd from layer 5 and Mán Bạc sand/iron-rich sand tempered sherds.

- **Main group 4**:
  - **Subgroup 1**: samples 23, 34

    This subgroup consists of a form A2a roulette decorated sand/fibre tempered body sherd from layer 5/6 and a sand tempered body sherd from layer 7.

  - **Subgroup 2**: sample 66

    This subgroup consists of a fired clay sample from the Test Square 240–250 cm.

  - **Subgroup 3**: sample 46

    This subgroup consists of a fibre tempered roulette decorated pedestal sherd from layer 5/6.

  - **Subgroup 4**: samples 39, 88

    This subgroup consists of sand tempered body sherd from layer 8 and a Mán Bạc untempered sherd.

  - **Subgroup 5**: samples 60, 61

    This subgroup consists of the surface collected A2a fibre bleb grog tempered rim sherds.

- **Outliers**: samples 64, 65, 67 / 5 / 75 / 71 / 76 / 68 / 69 / 43 / 74 / 70

The outliers included fired clay samples from the Test Square 240–250 cm, a sand tempered rim sherd from layer 5, a Cù Lao Rùa sand/lateritic sand tempered sherd, a Cồn Cổ Ngựa sand/iron-rich sand tempered sherd, a Đa Bút sand/iron-rich sand tempered sherd, unfired geological clay samples from the Vàm Cỏ Đông alluvium, the Óc Eo phase sherd from layer 2, and a Cù Lao Rùa sand tempered sherd.

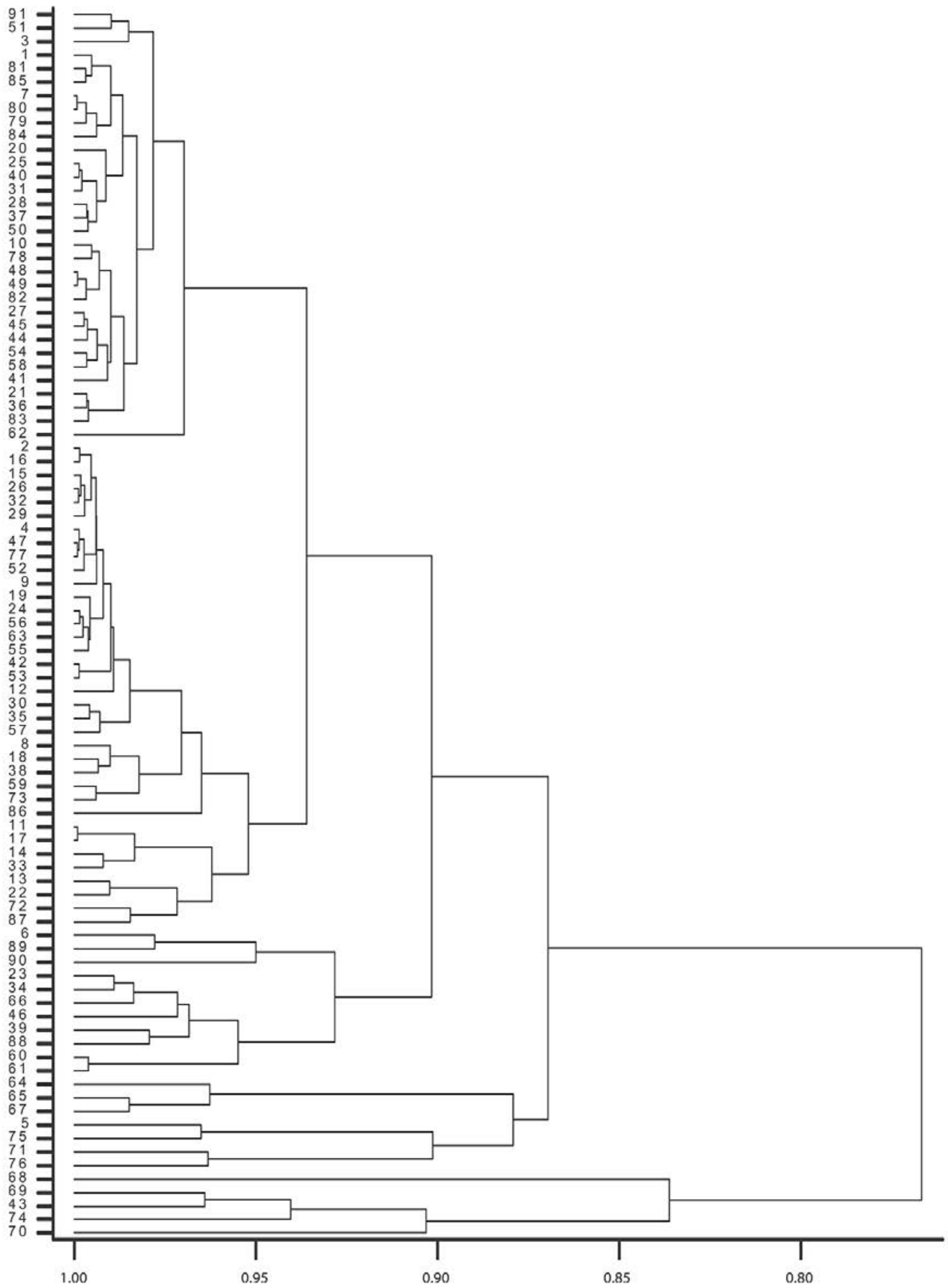


Figure 6.43. Average-linkage hierarchical cluster analysis dendrogram of the An Sơn ceramic sample, clays and other site samples. Refer to Appendix A for sample identification numbers.

Source: C. Sarjeant.

Table 6.31. Samples in the hierarchical cluster analysis dendrogram groupings in Figure 6.43 of the An Sơn ceramic sample, clays and other site samples when cut at 0.950 and 0.9875. Refer to Appendix A for sample identification numbers.

Main group (cut at 0.959)	Subgroup (cut at 0.9875)	Sample identification number
1	1	91
	2	51
	3	3
	4	1, 81, 85, 7, 80, 79, 84
	5	20, 25, 40, 31, 28, 37, 50
	6	10, 78, 48, 49, 82
	7	27, 45, 44, 54, 58, 41
	8	21, 36, 83
	9	62
2	1	2, 16, 15, 26, 32, 29
	2	4, 47, 77, 52, 9
	3	19, 24, 56, 63, 55
	4	42, 53, 12
	5	30, 35, 57
	6	8, 18, 38
	7	59, 73
	8	86, 11, 17
	9	14, 33
	10	13, 22
	11	72, 87
3	1	6, 89, 90
4	1	23, 34
	2	66
	3	46
	4	39, 88
	5	60, 61
Outliers	1	64, 65, 67
	2	5
	3	75
	4	71
	5	76
	6	68
	7	69
	8	43
	9	74
	10	70

Source: Compiled by C. Sarjeant.

Canonical variate analysis

The first CVA biplot (Figure 6.44, Table 6.32) includes all fired and unfired clay and ceramic sherd samples, except for the surface and Óc Eo phase ceramic sherd outliers (samples 43, 60 and 61). This CVA biplot showed that the An Sơn unfired clay samples were outliers (Figure 6.44, Table 6.32). A second CVA that included the fired clay samples, but excluded the unfired clay outliers, was also plotted. This CVA plots the samples according to site groups (Figure 6.45, Figure 6.46, Table 6.33). The outlier composition of the unfired clay samples in Figure 6.44 may be the result of a chemical change during firing. It is also probable that either the sampled alluvial clay deposits were not used in prehistory, have altered since their use, or a combination of these factors.

The second CVA (Figure 6.45, Figure 6.46, Table 6.33) shows the differences between the clay matrix compositions of the Cồn Cổ Ngựa and Đa Bút sherds and those from the other sites. The Mán Bạc and Cù Lao Rùa sherds are also chemically distinct from the other sampled sherds, while the Lộc Giang and Giồng Cá Vồ sherds do not overlap closely with the other site groups. The groups of the An Sơn ceramic samples, the An Sơn fired clay samples, and the sherds from Ban Non Wat, Cù Lao Rùa, Đình Ông and Hòa Diêm overlap each other. Note that only one sherd was sampled from Ban Non Wat and Hòa Diêm and this overlap is not representational of a long-distance link between these sites and An Sơn (in terms of clay matrix composition).

The Đa Bút, Cồn Cổ Ngựa, Mán Bạc, Hòa Diêm and Ban Non Wat sherds were included in the CVAs to show any commonalities in ceramic technology between these sites and An Sơn. The Đa Bút and Cồn Cổ Ngựa sherds with their very coarse non-plastic inclusions display an incipient neolithic or pre-neolithic technology that is quite different to An Sơn. Mán Bạc, also in northern Vietnam, shows a closer link to the ceramic technology at An Sơn, with a preference for mineral sand tempers (TG A1). Similarly to An Sơn, Ban Non Wat exhibits the trend for fibre tempering (TG B) in ceramic manufacture in neolithic mainland Southeast Asia, while Hòa Diêm indicates that neolithic technologies with mineral sand tempers (TG A1) continued to be applied in the metal age.

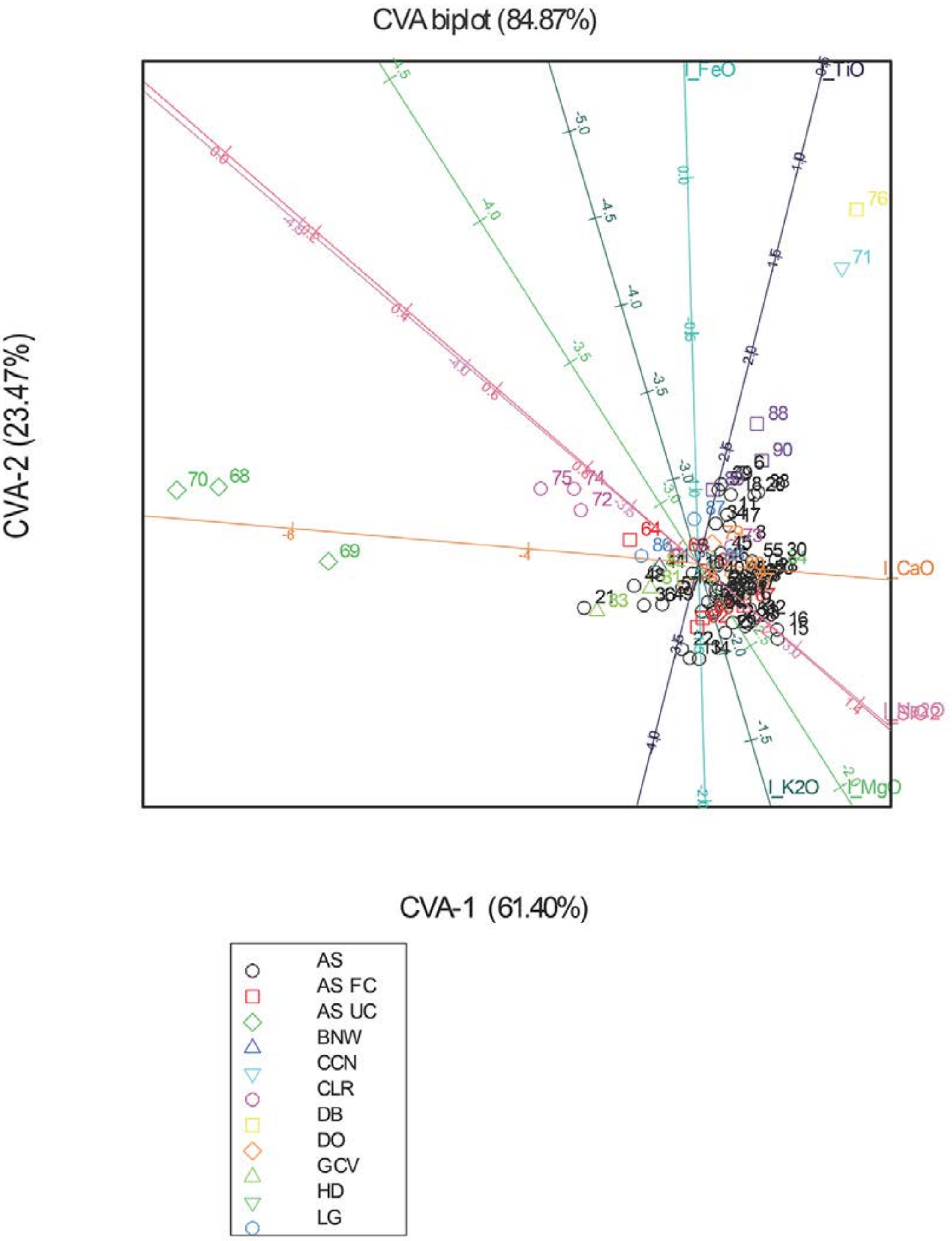


Figure 6.44. CVA biplot of the An Sơn ceramic samples, clays and other site samples. First two dimensions. Refer to Appendix A for sample identification numbers. Key: AS = An Sơn AS, FC = An Sơn fired clay, AS UC = An Sơn unfired clay, BNW = Ban Non Wat, CCN = Cồn Cổ Ngựa, CLR = Cù Lao Rùa, DB = Đa Bút, DO = Đình Ông, GCV = Giồng Cá Vồ, HD = Hòa Diêm, LG = Lộc Giang, MB = Mán Bạc.

Source: C. Sarjeant.

Table 6.32. CVA loadings for Figure 6.44 of the An Sơn ceramic samples, clays and other site samples. First three dimensions.

	1 (61.40%)	2 (23.47%)	3 (6.82%)
1	2.830	0.212	-0.902
2	-0.208	0.538	0.351
3	0.272	-0.576	-1.582
4	-0.389	-1.501	1.294
5	0.235	0.105	0.722
6	-0.263	-1.775	5.375
7	0.662	2.950	0.020

Source: Compiled by C. Sarjeant.

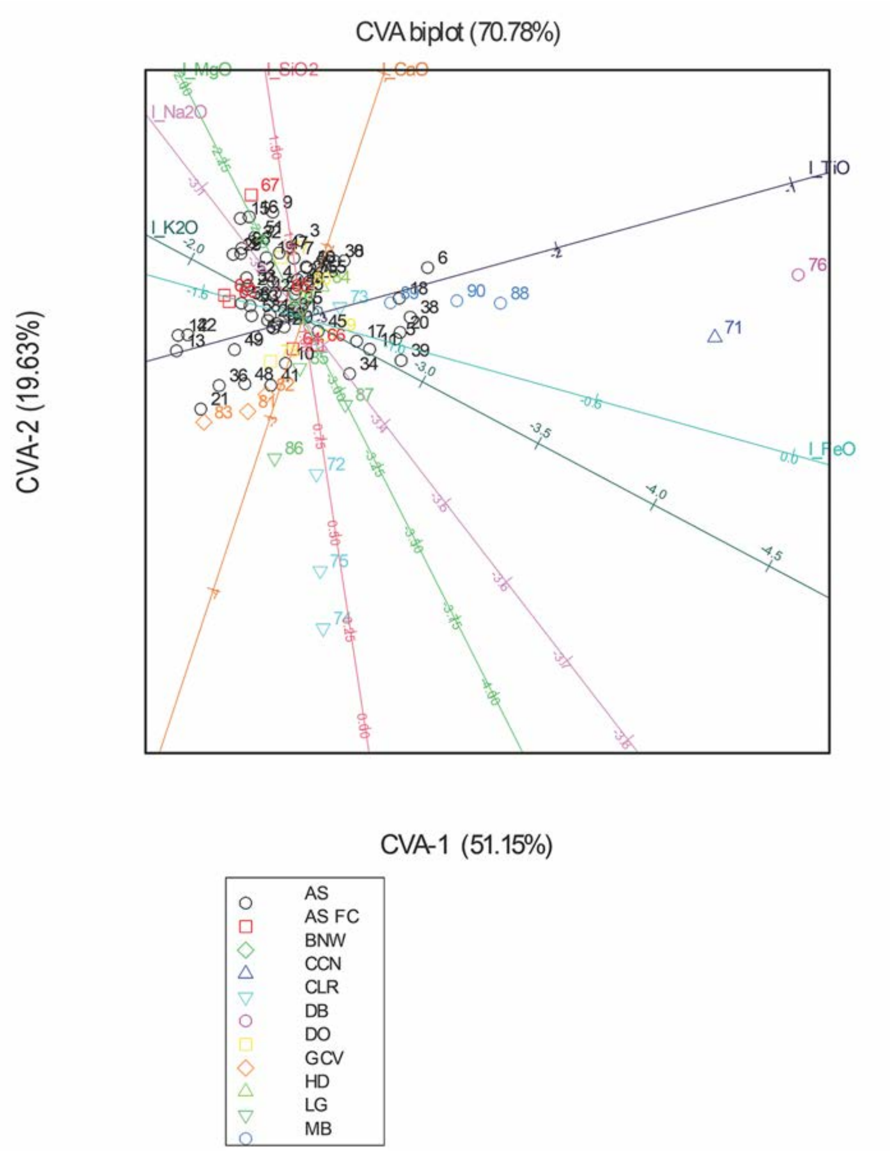


Figure 6.45. CVA biplot of the An Sơn ceramic samples, clays and other site samples. First two dimensions. Refer to Appendix A for sample identification numbers. Key: AS = An Sơn, AS FC = An Sơn fired clay, BNW = Ban Non Wat, CCN = Cồn Cổ Ngựa, CLR = Cù Lao Rùa, DB = Đa Bút, DO = Đình Ông, GCV = Giồng Cá Vồ, HD = Hòa Diêm, LG = Lộc Giang, MB = Mán Bạc.

Source: C. Sarjeant.

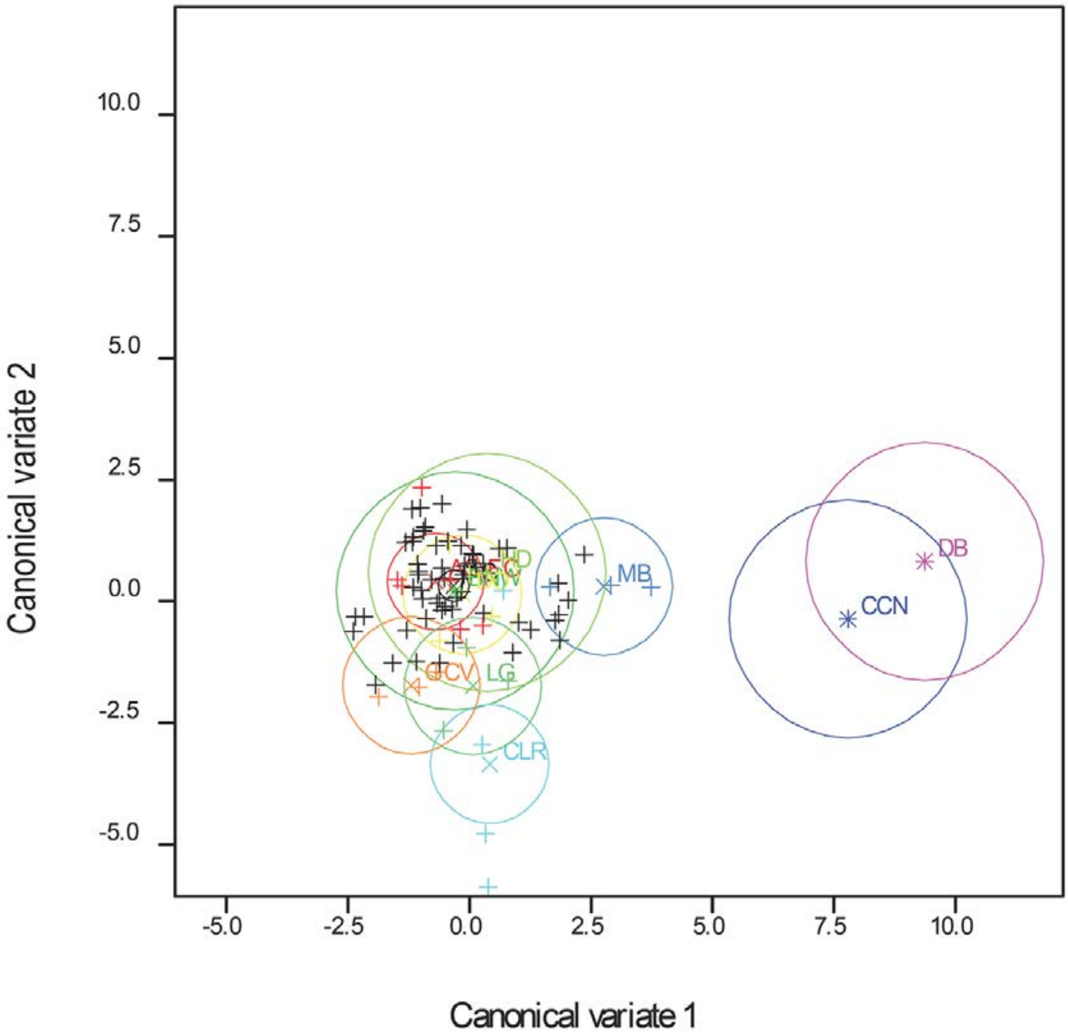


Figure 6.46. CVA biplot of the An Sơn ceramic samples, clays and other site samples with 95% confidence circles. First two dimensions. Key: AS FC = An Sơn fired clay, BNW = Ban Non Wat, CCN = Cồn Cổ Ngựa, CLR = Cù Lao Rùa, DB = Đa Bút, DO = Đình Ông, GCV = Giồng Cá Vồ, HD = Hòa Diêm, LG = Lộc Giang, MB = Mán Bạc.

Source: C. Sarjeant.

Table 6.33. CVA loadings for Figures 6.45 and 6.46 of the An Sơn ceramic samples, clays and other site samples. First three dimensions.

	1 (51.15%)	2 (19.63%)	3 (11.88%)
1	1.022	1.846	-1.967
2	0.760	-0.161	0.138
3	-0.495	-0.090	-2.019
4	-1.493	0.577	1.857
5	0.252	0.404	0.562
6	-1.345	3.059	3.399
7	2.865	-0.234	0.093

Source: Compiled by C. Sarjeant.

What is the relationship between the An Sơn ceramics, the clays collected from An Sơn, and the ceramics from other sites in southern Vietnam?

The PCA and hierarchical cluster analysis have been excluded from this section since the results were similar to those presented in the previous section. The analyses presented in this section exclude the samples from sites outside of southern Vietnam.

Canonical variate analysis

The first CVA includes all fired and unfired clay and ceramic sherd samples, except for the surface and Óc Eo phase ceramic sherd outliers (samples 43, 60 and 61). This CVA plots the samples according to site groups (Figure 6.47, Figure 6.48, Table 6.34). The CVA shows that the unfired clays from An Sơn have little in common with any archaeological sherds from southern Vietnam sites.

The second CVA plot included the fired clay samples, but excluded the unfired clay (and samples 43, 60 and 61) outliers. The CVA examines the samples according to site (Figure 6.49, Figure 6.50, Table 6.35). This CV, reveals that the fired clays are dispersed and do not always group with the clay matrix compositions of the An Sơn sherds. There is a close relationship in clay matrix composition between the An Sơn ceramic and Đình Ông sherds. The other samples, from Cù Lao Rùa, Giồng Cá Vồ and Lộc Giang did not group closely with the An Sơn ceramic sherds.

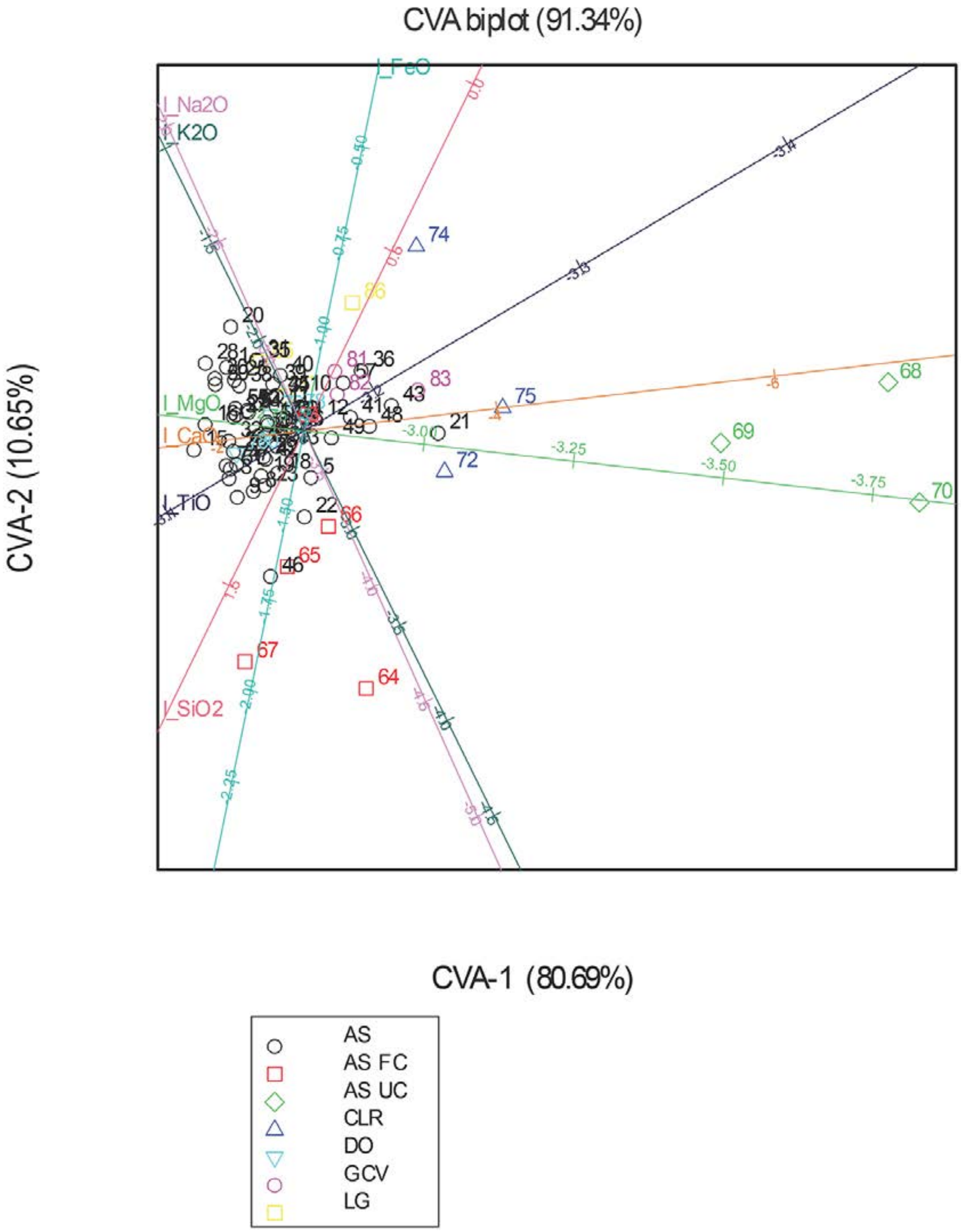


Figure 6.47. CVA biplot of the An Sơn ceramic samples, clays and other site samples. First two dimensions. Refer to Appendix A for sample identification numbers. Key: AS = An Sơn, AS FC = An Sơn fired clay, AS UC = An Sơn unfired clay, CLR = Cù Lao Rùa, DO = Đình Ông, GCV = Giồng Cá Vồ, LG = Lộc Giang.

Source: C. Sarjeant.

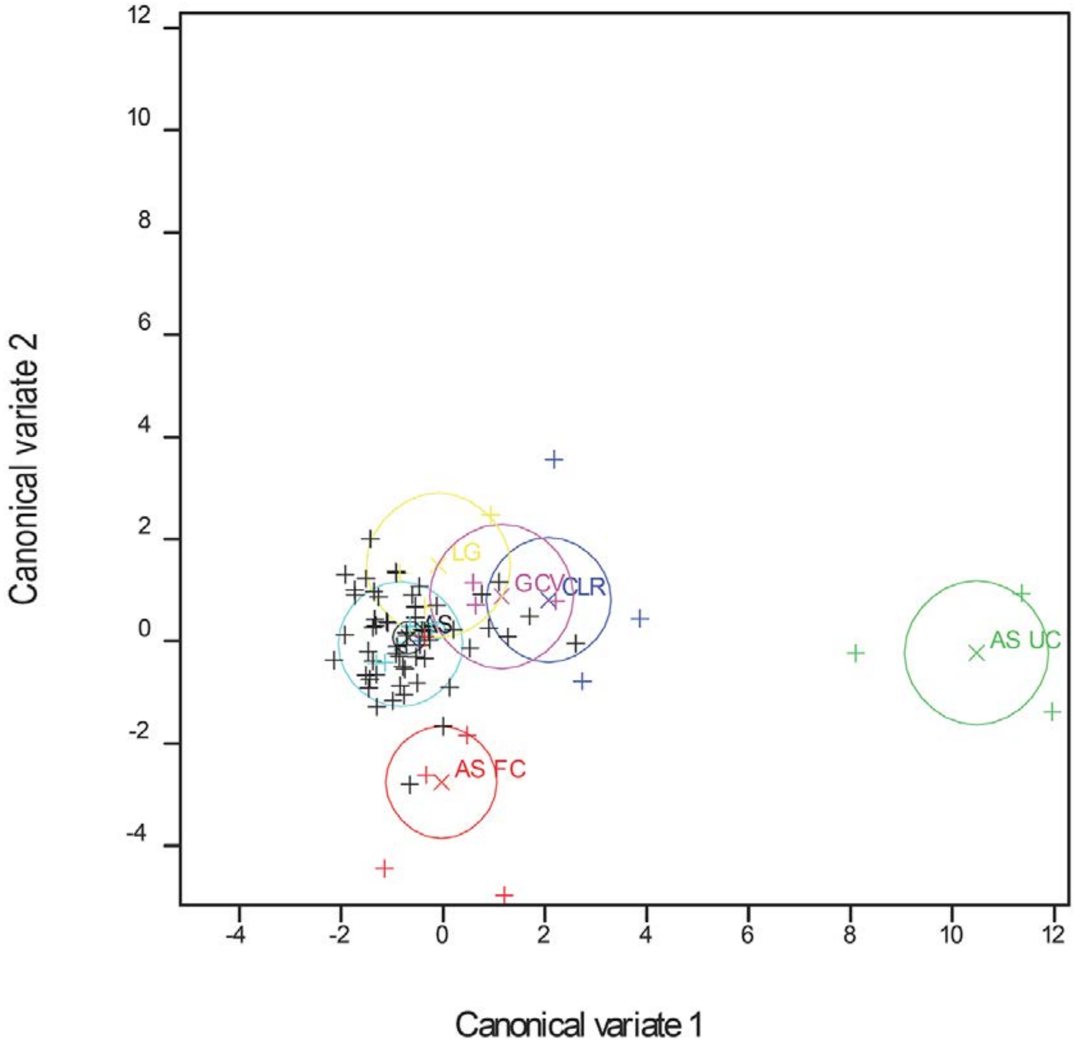


Figure 6.48. CVA plot of the An Sơn ceramic samples, clays and other site samples with 95% confidence circles. First two dimensions. Key: AS = An Sơn, AS FC = An Sơn fired clay, AS UC = An Sơn unfired clay, CLR = Cù Lao Rùa, DO = Đình Ông, GCV = Giồng Cá Vồ, LG = Lộc Giang.

Source: C. Sarjeant.

Table 6.34. CVA loadings for Figure 6.47 and Figure 6.48 of the An Sơn ceramic samples, clays and other site samples. First three dimensions.

	1 (80.69%)	2 (10.65%)	3 (4.74 %)
1	-2.747	0.323	-0.936
2	0.273	-0.080	0.589
3	-0.659	1.330	1.335
4	0.824	0.554	-0.450
5	0.054	0.196	0.368
6	0.249	-5.614	3.891
7	-0.361	0.895	-0.969

Source: Compiled by C. Sarjeant.

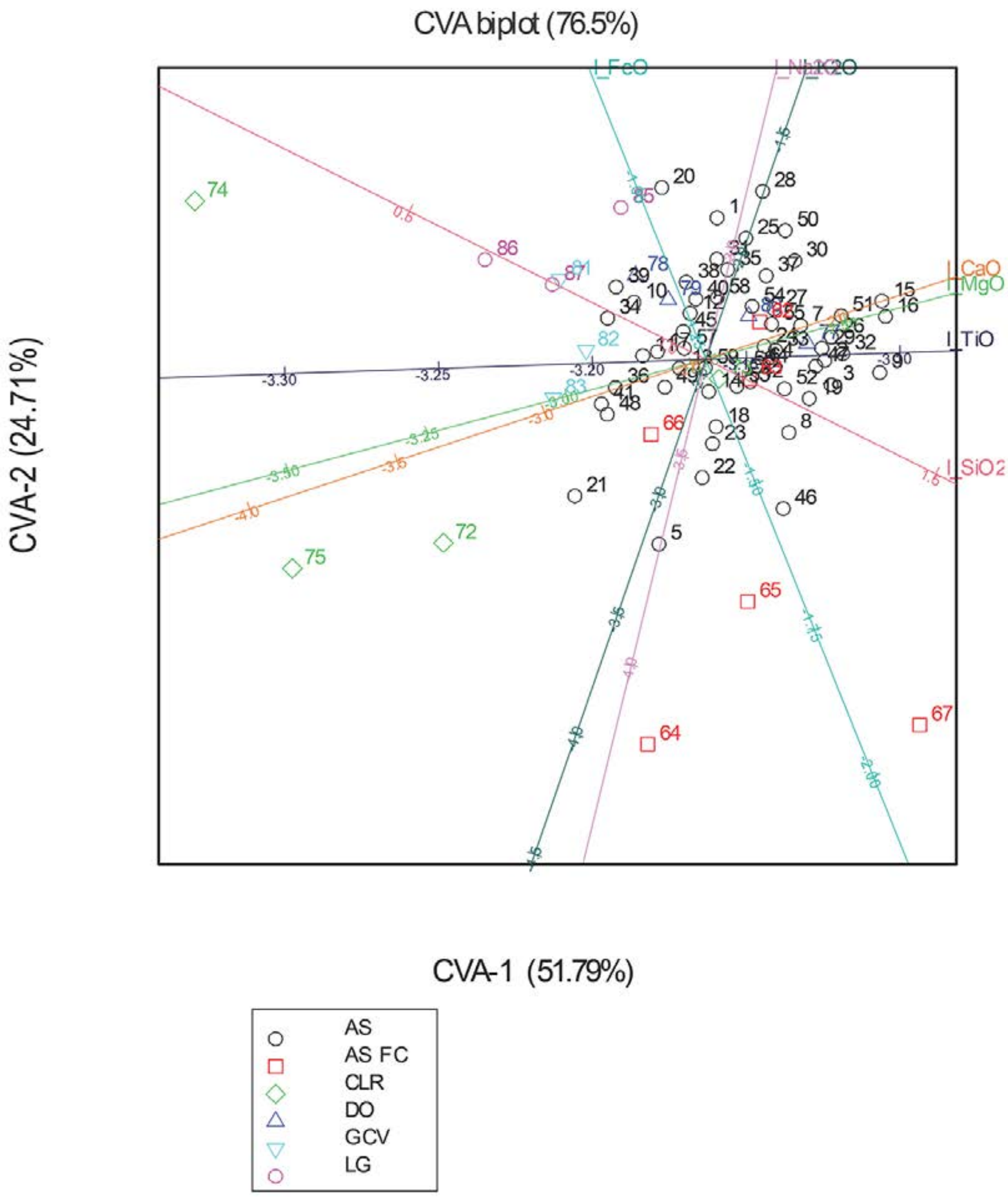


Figure 6.49. CVA biplot of the An Sơn ceramic samples, clays and other site samples. First two dimensions. Refer to Appendix A for sample identification numbers. Key: AS = An Sơn, AS FC = An Sơn fired clay, CLR = Cù Lao Rùa, DO = Đình Ông, GCV = Giồng Cá Vồ, LG = Lộc Giang .

Source: C. Sarjeant.

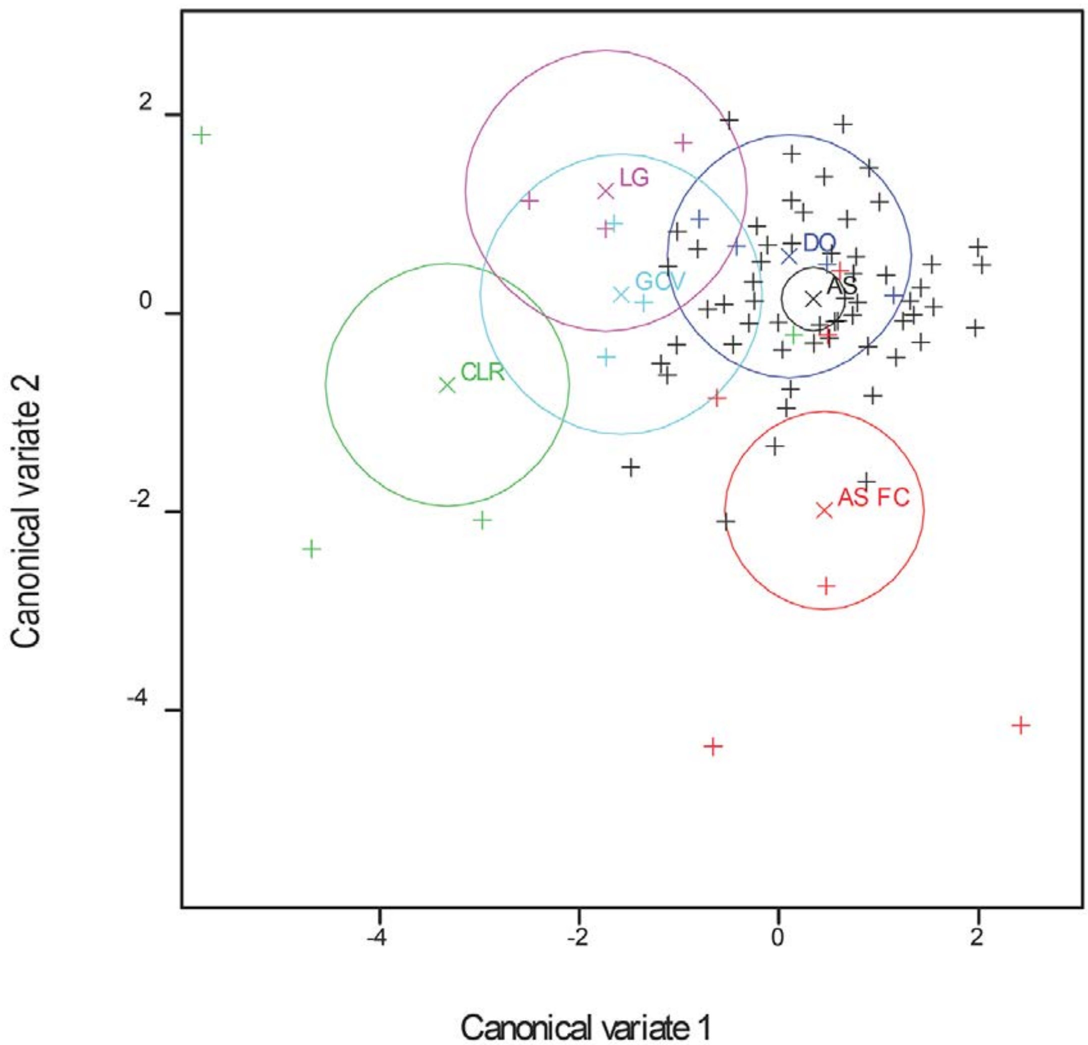


Figure 6.50. CVA plot of the An Sơn ceramic samples, clays and other site samples with 95% confidence circles. First two dimensions. Key: AS = An Sơn, AS FC = An Sơn fired clay, CLR = Cù Lao Rùa, DO = Đình Ông, GCV = Giồng Cá Vồ, LG = Lộc Giang.

Source: C. Sarjeant.

Table 6.35. CVA loadings for Figures 6.49 and 6.50 of the An Sơn ceramic samples, clays and other site samples. First three dimensions.

	1 (51.79%)	2 (24.71%)	3 (16.07%)
1	1.716	1.439	0.325
2	-0.338	0.800	-0.200
3	-0.052	1.851	-1.423
4	0.846	-0.821	3.371
5	0.372	-0.144	0.490
6	2.970	-3.304	-3.495
7	0.477	0.367	-0.577

Source: Compiled by C. Sarjeant.

Summary: Characterisation of clay matrices

To summarise the PCAs, hierarchical cluster analyses and CVAs of Chapter 6, Part II, two Chemical Paste Compositional Reference Units (CPCRUs) were identified based on the clay matrix chemical compositional data. There are also a number of outliers that did not cluster with these main groups. The averaged chemical composition of each CPCRU is presented in Table 6.36.

1. CPCRU 1 is largely represented by fibre-inclusive tempers (TG B) and rim forms A1a and C1b from An Sơn, and also a sherd from Đình Ông. Refer to Appendix A for sample identification numbers and Figure 5.1 for rim form images.
    - Samples: 53, 42, 55, 63, 56, 24, 19, 9, 52, 77, 47, 4, 29, 32, 26, 15, 16, 2
    - Fibre pedestal sherds (*n*=3)
    - Fibre body sherd
    - Sand/fibre body sherd
    - Fibre/calcareous body sherd
    - Calcareous body sherd
    - A1a fibre rim sherds (*n*=3)
    - A2b sand/fibre/phosphate rim sherds
    - B1a sand/fibre rim sherd
    - C1b fibre rim sherd
    - C1b fibre/phosphate rim sherds (*n*=3)
    - Fired clay
    - Đình Ông fibre sherd
2. CPCRU 2 is largely represented by sand-inclusive tempers (TG A1) and the rim form A2a, and includes identifiable subgroups (SG). This group also includes sherds from Đình Ông, Giồng Cá Vồ, Hòa Diêm and Lộc Giang. Refer to Appendix A for sample identification numbers and Figure 5.1 for rim form images.
    - SG1
        - Samples 83, 36, 21
        - A1a fibre rim sherd
        - B1a sand/fibre rim sherd
        - Giồng Cá Vồ fibre sherd
    - SG2

      Samples: 41, 58, 54, 44, 45, 27, 82, 49, 48, 78, 10
        - Roulette decorated sand body sherd
        - Sand body sherd
        - B1a sand rim sherd
        - B1a fibre rim sherd
        - D1a sand/iron-rich rim sherd
        - D1b lateritic sand sherd
        - D2a sand rim sherd (*n*=2)
        - C3a sand sherd
        - Đình Ông sand sherd

    - Giồng Cá Vồ fibre sherd
- SG3
  Samples: 50, 37, 28, 31, 40, 25, 20
    - Sand body sherd
    - A2a sand rim sherd (*n*=3)
    - D1a sand sherd (*n*=2)
    - D1b sand rim sherd
- SG4
  Samples: 84, 79, 80, 7
    - Roulette decorated sand body sherd
    - Đình Ông sand and orthodox grog sherd
    - Giồng Cá Vồ sand sherd
    - Hòa Diêm sand sherd
- SG5
  Samples: 85, 81, 1
    - A2a sand rim sherd
    - Giồng Cá Vồ sand/iron-rich sand sherd
    - Lộc Giang sand sherd
- SG6
  Samples: 91, 51, 3
    - D1a sand rim sherd
    - Roulette decorated sand body sherd
    - Ban Non Wat fibre sherd
- SG7
  Sample: 62
    - Fired clay

3. Outliers were chemically distinct from CPCRU 1 and 2 but some shared chemical relationships with some of the other samples. Refer to Appendix A for sample identification numbers and Figure 5.1 for rim form images.
    - Sample: 70
        - Unfired clay
    - Sample: 74
        - Cù Lao Rùa sand sherd
    - Sample: 43
        - Óc Eo phase untempered sherd
    - Sample: 69
        - Unfired clay
    - Sample: 68
        - Unfired clay
    - Sample: 76
        - Đa Bút sand/iron-rich sand sherd

- Sample: 71
    - Cồn Cổ Ngựa sand/iron-rich sand sherd
- Sample: 75
    - Cù Lao Rùa sand/iron-rich sand sherd
- Sample: 5
    - Sand body sherd
- Samples: 65, 67
    - Fired clays (*n*=2)
- Sample: 64
    - Fired clay
- Samples: 60, 61
    - A2a fibre and bleb grog surface sherds (*n*=2)
- Samples: 88, 39
    - Mán Bạc untempered sherd
    - Sand body sherd
- Sample: 46
    - Fibre pedestal sherd
- Samples: 66, 34, 23
    - Fired clay
    - Sand body sherd
    - Sand/fibre body sherd
- Sample: 90
    - Mán Bạc sand/iron-rich sand sherd
- Samples: 89, 6
    - Mán Bạc sand/iron-rich sand sherd
    - Fibre/phosphate body sherd
- Samples: 87, 72
    - Lộc Giang sand and orthodox grog sherd
    - Cù Lao Rùa sand/iron-rich sand sherd
- Samples: 13, 22
    - Sand body sherd
    - Lateritic sand body sherd
- Samples: 14, 33, 11, 17
    - Lateritic sand and orthodox grog body sherd
    - Lateritic sand rim sherd
    - C2b sand rim sherd
    - Sand body sherd
- Sample: 86
    - Lộc Giang fibre and orthodox grog sherd
- Samples: 73, 59, 38, 18, 8
    - B1b sand rim sherd
    - Sand body sherd

- Sand/fibre body sherd
- A2a sand rim sherd
- Cù Lao Rùa sand sherd
- Samples: 57, 35, 30
  - B1a fibre and bleb grog body sherd
  - D1a lateritic rim sherd
  - D1b lateritic rim sherd
- Sample: 12
  - A1a fibre rim sherd

While there are a number of outliers in the studied sample, there are some clear associations between CPCRUs and temper groups. Since the temper analysis revealed a close link between temper group and rim form, it may be suggested that certain tempers were selected for particular clays with the intention of making a ceramic vessel to a preconceived form. CPCRU 1 was more consistently used for fibre tempered (TG B) ceramics, and CPCRU 2 included a number of subgroups with fibre (TG B), mixed sand (TG A1), and mixed sand/fibre (TG A1/B) tempered sherds. The chemical differences between the CPCRUs are in the concentrations of sodium and iron oxides, which were elevated in CPCRU 2 compared to CPCRU 1. The outliers were characterised by elevated concentrations of iron oxide and decreased concentrations of silicon dioxide (Table 6.36).

The temper and clay combinations that have been identified in this chapter also relate to vessel form selection, suggesting there was a template for the manufacture of certain ceramic forms (described further in Chapter 10). For example, forms A2a, B1a, C1b and D were frequently made with the same temper and CPCRU. The chemistry of the unfired Vàm Cỏ Đông alluvial clay was not consistent with the sherds from An Sơn, however the fired clays from the site were similar in some cases. This suggests that past clay resources were not located during the field season and/or the clay chemistry changes substantially during firing.

The clay matrix compositions of the analysed ceramic sherds from southern Vietnam largely grouped together, particularly the sites along the Vàm Cỏ Đông River, An Sơn, Lộc Giang and Đình Ông. This is likely due to the similar environmental settings of these sites. Giồng Cá Vồ also grouped with these sites, indicating that similar clay resources were utilised later in prehistory. Cù Lao Rùa, however, did not group with the Vàm Cỏ Đông River sites, indicating that the clay resources may have differed along the Đồng Nai River, where Cù Lao Rùa was located.

In the north, very different clay compositions were present at Mán Bạc, which in turn appeared to have little relationship with the earlier ceramics of Đa Bút and Cồn Cổ Ngựa. The technology of ceramic manufacture changed dramatically, in temper, clay and vessel form, between the late Hoabinhian Đa Bút and Cồn Cổ Ngựa sites and neolithic Mán Bạc.

The potters of An Sơn are positioned within a ceramic tradition that shares features with sites beyond southern Vietnam, including aspects of form, decoration and temper. However, the environment influenced clay selection, and the strongest ties with An Sơn were with other sites along the Vàm Cỏ Đông River. An Sơn also exhibited distinctive locally restricted innovations, including the class D wavy rimmed vessels. These local and shared traditions are discussed further in Chapter 10.

Table 6.36. The averaged and normalised chemical composition of each CPCRU group.

Clay group	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	K_2O	CaO	TiO_2	V_2O_5	MnO	FeO	Total
CPCRU 1	0.64	1.62	19.11	67.67	0.81	0.20	2.23	2.06	0.89	0.03	0.10	4.63	100.00
CPCRU 2	1.24	1.33	22.16	62.51	0.67	0.24	2.64	1.89	0.93	0.04	0.08	6.28	100.00
CPCRU 2-SG1	1.36	1.69	22.73	63.21	0.36	0.22	3.04	0.77	0.91	0.04	0.04	5.64	100.00
CPCRU 2-SG2	0.88	1.40	22.78	62.20	0.65	0.25	2.21	1.82	0.91	0.05	0.06	6.78	100.00
CPCRU 2-SG3	1.51	1.36	22.00	60.89	0.90	0.26	3.14	2.32	1.04	0.03	0.09	6.45	100.00
CPCRU 2-SG4	1.17	1.08	22.67	62.59	0.36	0.16	1.97	2.40	0.99	0.03	0.11	6.47	100.00
CPCRU 2-SG5	1.69	0.99	23.95	59.24	1.29	0.18	3.46	1.88	0.80	0.03	0.07	6.42	100.00
CPCRU 2-SG6	1.26	1.05	17.88	69.63	0.39	0.21	2.22	1.74	0.83	0.02	0.13	4.64	100.00
CPCRU 2-SG7	1.78	2.10	19.99	63.44	0.33	0.65	4.08	1.40	0.89	0.03	0.08	5.21	100.00
Outliers	0.72	1.37	22.84	58.61	1.84	0.29	1.32	1.98	1.41	0.05	0.15	9.42	100.00
Outliers-SG1	0.43	0.66	33.53	59.38	0.00	0.34	0.67	0.03	1.59	0.06	0.07	3.23	100.00
Outliers-SG2	0.68	0.73	31.44	37.40	15.29	0.34	2.49	0.76	1.04	0.04	0.07	9.73	100.00
Outliers-SG3	0.31	0.58	24.87	58.79	6.79	0.42	2.51	0.61	1.43	0.04	0.04	3.61	100.00
Outliers-SG4	0.34	1.00	30.21	61.48	0.00	1.16	1.68	0.09	1.26	0.04	0.02	2.72	100.00
Outliers-SG5	0.30	0.40	11.93	14.25	0.02	0.69	0.33	0.02	0.28	0.04	0.19	71.56	100.00
Outliers-SG6	0.40	0.45	17.26	56.15	1.27	0.17	0.30	3.81	6.08	0.09	0.32	13.70	100.00
Outliers-SG7	1.05	0.62	22.94	46.01	1.59	0.27	0.46	4.73	3.99	0.06	2.96	15.33	100.00
Outliers-SG8	0.92	1.22	33.22	51.29	0.22	0.41	0.58	0.72	1.22	0.04	0.05	10.11	100.00
Outliers-SG9	1.23	1.44	26.27	58.01	0.45	0.07	0.35	2.72	1.20	0.06	0.02	8.18	100.00
Outliers-SG10	0.68	1.25	20.57	69.68	0.00	0.43	1.77	1.69	0.86	0.02	0.02	3.03	100.00
Outliers-SG11	0.18	0.46	16.81	77.78	0.14	0.44	0.44	0.77	0.83	0.00	0.00	2.17	100.00
Outliers-SG12	0.38	1.91	20.32	62.75	0.59	0.16	0.37	2.29	2.58	0.00	0.10	8.57	100.00
Outliers-SG13	0.35	1.31	20.76	59.44	1.39	0.24	1.21	2.22	1.95	0.06	0.06	11.00	100.00
Outliers-SG14	0.16	1.20	17.23	71.60	0.73	0.10	0.80	1.89	0.94	0.05	0.09	5.23	100.00
Outliers-SG15	0.29	1.42	22.93	58.41	1.38	0.26	0.89	2.36	0.87	0.08	0.22	10.88	100.00
Outliers-SG16	1.27	2.66	21.97	51.16	2.38	0.43	0.99	2.85	2.16	0.09	0.07	13.96	100.00
Outliers-SG17	0.51	2.22	18.15	66.79	0.59	0.47	1.64	1.55	2.68	0.09	0.04	5.28	100.00
Outliers-SG18	0.75	0.86	24.37	57.54	5.27	0.21	1.37	1.21	1.08	0.04	0.06	7.24	100.00
Outliers-SG19	0.61	1.18	25.04	62.47	0.34	0.15	1.31	2.26	0.41	0.00	0.06	6.18	100.00
Outliers-SG20	1.71	1.32	25.74	58.24	0.73	0.21	1.31	2.72	0.75	0.02	0.04	7.20	100.00
Outliers-SG21	0.66	1.60	25.86	50.77	8.26	0.36	3.32	1.15	1.18	0.01	0.02	6.81	100.00
Outliers-SG22	0.78	1.57	21.78	60.21	2.03	0.15	1.10	2.49	1.17	0.04	0.05	8.63	100.00
Outliers-SG23	1.01	2.18	21.37	60.11	1.36	0.33	2.60	2.21	1.04	0.05	0.15	7.57	100.00
Outliers-SG24	0.53	1.80	19.61	62.18	0.78	0.21	2.61	1.41	0.97	0.07	0.05	9.78	100.00

Source: Compiled by C. Sarjeant.

7

The Degree of Standardisation in the An Sơn Ceramic Assemblage

Introduction: Methodology for the study of standardisation

The level of standardisation within an assemblage of pottery is used as an indirect measure of organisation of production and the skill of potters (Costin 1991). However, the assumption that a higher degree of organisation of craft production and skill may be inferred from a higher level of standardisation in an assemblage is only plausible when the individual pottery forms are intended to be homogeneous. Sometimes uniqueness is required for elite wares, for example, and a measure of group standardisation is not appropriate for such vessels (Costin and Hagstrum 1995). Therefore, while this chapter presents a study of standardisation in the An Sơn assemblage, the actual levels of variability and homogeneity within certain classes of ceramics may be related to a number of different cultural/social and technological factors. This study focuses on complete rim forms that belong to the more frequently observed classes shown in Figure 5.1.

Homogeneity in the thickness of the body wall of a vessel is often attributed to the skill of a potter (see Costin and Hagstrum 1995), but additional variables were measured from the rim forms in this analysis. These variables differ according to each form, as shown in Figure 7.1. The measured dimensional variables were generally diameter at the rim, thickness of the rim, thickness of the body, angle of the rim, and length of the rim for restricted vessels. Not all variables are always present on each measured rim sherd. Additional measurements were taken for the class D vessels to account for variation in the wave or serrated shape of the rims. The most common method of analysis of standardisation is the coefficient of variation (CV) (Roux 2003a; Eerkens and Bettinger 2001; Foias and Bishop 1997; Costin and Hagstrum 1995; Blackman *et al.* 1993; Longacre *et al.* 1988). The method for the CV calculation was presented in Chapter 3, and is applied in this chapter in addition to the previously applied statistical analyses, principal components analysis (PCA), hierarchical cluster analysis and canonical variate analysis (CVA).

A more thorough examination of standardisation for the A2a, B1a, C1b, and D1a forms follows. These forms were frequently observed at An Sơn and characterise the ceramic assemblage of the site. They were included in the fabric analysis (Chapter 6, Part II), and a more comprehensive presentation of the variability and consistency in morphology, decorations (where relevant), and fabrics is provided for these rim forms. This includes variability over time within these form groups. While there has been research into whether ceramic fabrics correlate with standardisation, and it has been suggested that ceramic fabrics cannot inform about production organisation (Arnold 2000), the use of a combination of morphological and fabric variables may support interpretations regarding manufacture and organisation. To guarantee that only those vessels that can be accurately assigned to each vessel form were included in this analysis, sherds that represented at least one third of the profile of the vessel were chosen, i.e. those that show the shape of the rim, shoulder and at least part of the body. While this limited the sample size, it ensured that only comparable vessels were analysed for standardisation. When archaeologists unintentionally combine two or more groups of ceramics and analyse these groups as one category, the variability within the ceramic category increases, and affects the results of standardisation (Eerkens and Bettinger 2001).

The applied statistical methods, PCA, hierarchical cluster analysis and CVA, were previously described in Chapter 3 and used in Chapter 6, Part II. The PCA and hierarchical average-linkage cluster analysis provide two exploratory multivariate statistics of the dimensional and fabric compositional data. The CVA provides similar results as PCA and cluster analysis but with *a priori* groups added, such as the form and provenance of the ceramic samples. The PCA and CVA applied untransformed values for dimensional data and log ratio transformed values for compositional data from the SEM-EDX clay matrix analyses. The PCAs and CVAs are presented with plots and the hierarchical cluster analyses with dendrograms. The addition of CV calculations provides values that indicate the levels of variation with lower values reflecting a more homogeneous sample, and higher values a more variable sample. Together, these methods provide a holistic picture of variation versus homogeneity in the dimensional, decorative and fabric variables within rim form groups at An Sơn.

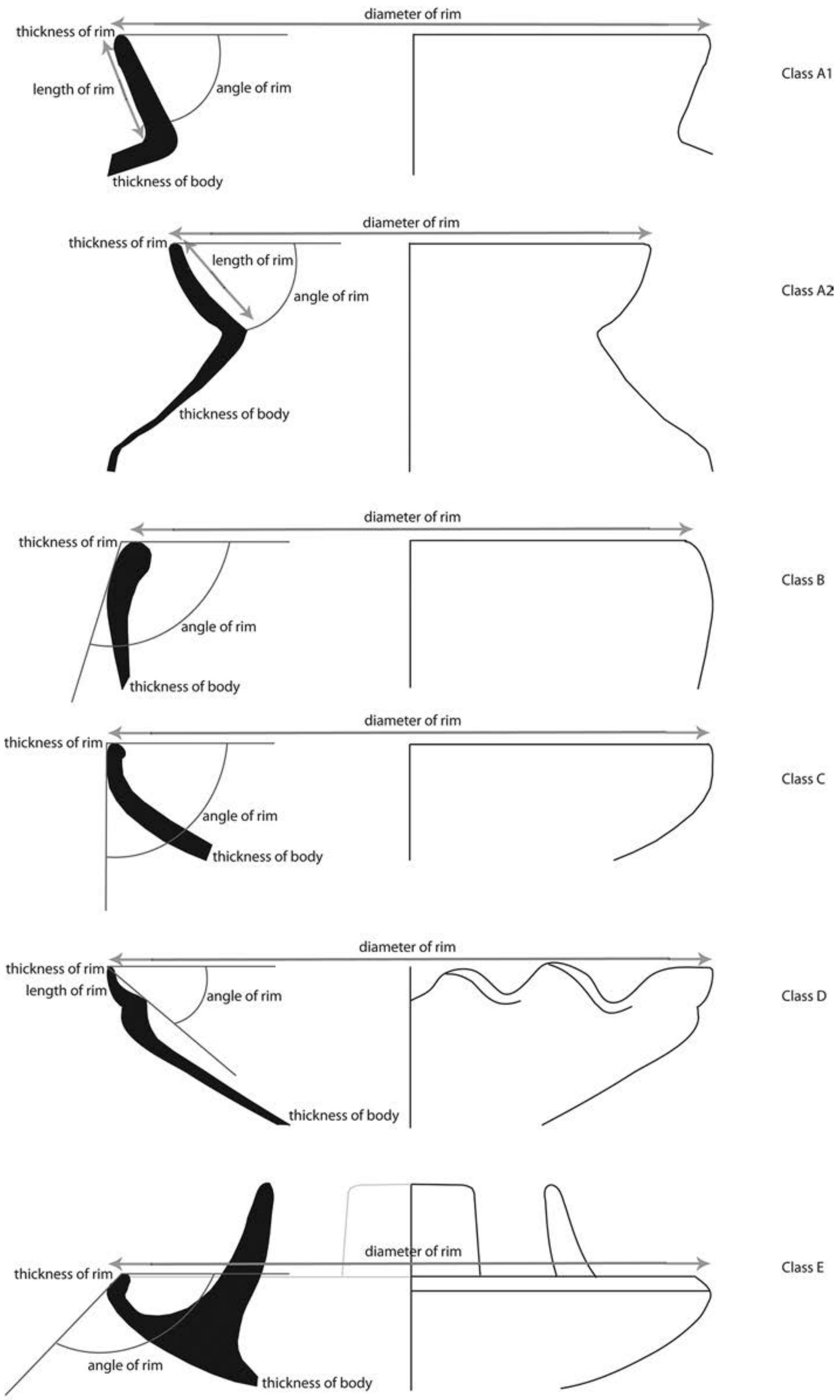


Figure 7.1. The measured dimensional variables used in the study of standardisation for each vessel class. Not to scale.

Source: C. Sarjeant.

Standardisation of morphology

Class A1

Class A1 vessels have straight everted rims (Figure 5.1). The study of dimensional variables in this class concentrated on restricted vessels only. The measured variables were angle of the rim, diameter of the rim, length of the rim, thickness of the body, and thickness of the rim (Figure 7.1). The four statistical methods previously described (PCA, cluster analysis, CVA and CV) were applied to understand the variability and homogeneity in the morphology of the A1 class ceramics (see Chapter 3 and this chapter).

Principal components analysis

The greatest variability in the following PCA plot (Figure 7.2) is a result of the angle of the rim and the diameter (Table 7.1). Generally, the PCA plot shows the majority of the samples form a main cluster, inclusive of all the A1 forms, with some samples from each rim form dispersed from this main cluster (Figure 7.2). The clusters are clarified in the following hierarchical cluster analysis (Figure 7.3, Table 7.2).

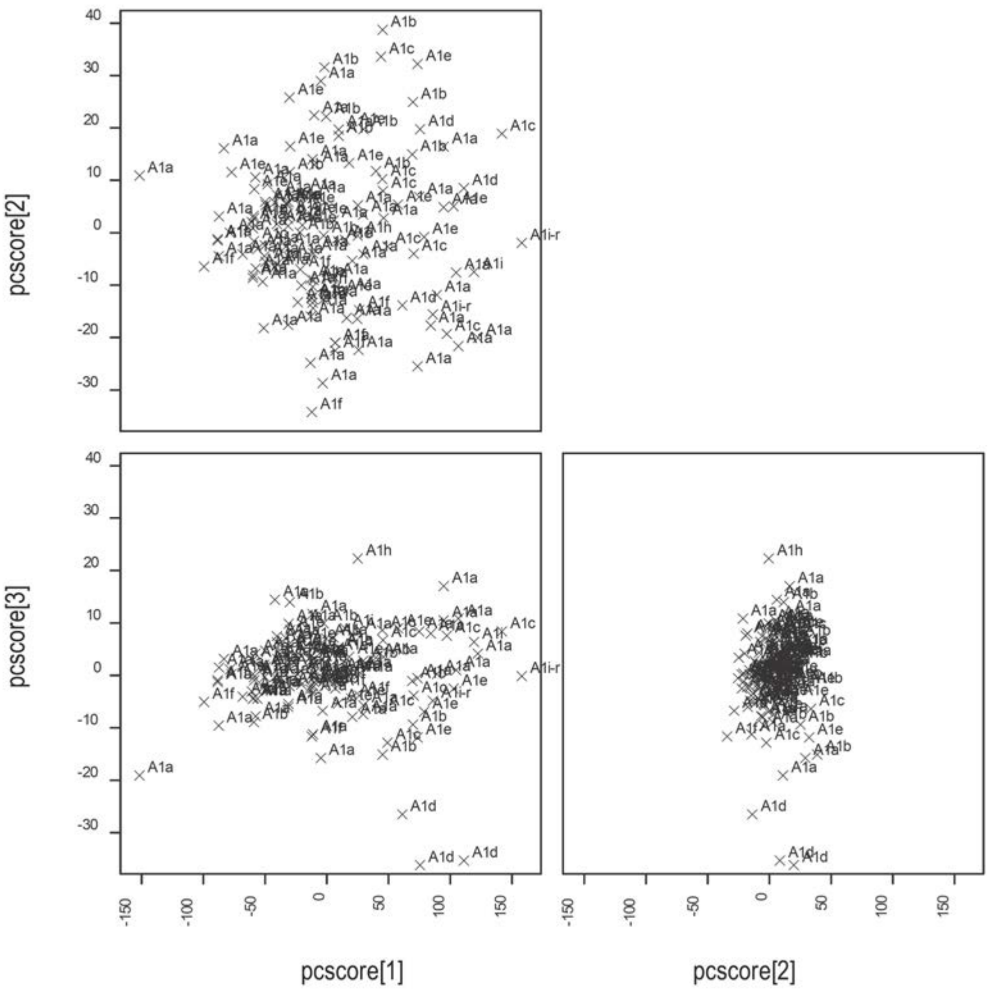


Figure 7.2. PCA plot of class A1 dimensional variables with rim forms labelled. First three dimensions. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Table 7.1. PCA loadings for Figure 7.2 of class A1 dimensional variables. First three dimensions. The bold values indicate the variables that presented the greatest variability in the PCA.

Variables	PC 1 (92.28%)	PC 2 (5.53%)	PC 3 (1.99%)
Angle of rim (degrees)	**-0.04527**	**0.74554**	**0.66462**
Diameter (mm)	**0.97831**	**-0.10100**	0.17995
Length of rim (mm)	0.20096	0.65673	**-0.72469**
Thickness of body (mm)	0.01494	0.05053	-0.02657
Thickness of rim(mm)	**0.01559**	**-0.01139**	**0.00473**

Source: Compiled by C. Sarjeant.

Hierarchical cluster analysis

The dendrogram was cut at 0.925 (Figure 7.3) to divide the class A1 assemblage into clusters or groups. The numbers of samples within each form in these groups are shown in Table 7.2 The dendrogram indicates that specific groups can be identified for A1d (group 4), A1f (group 1), A1g (group 3) and A1i (group 5), suggesting these forms were relatively standardised in dimensional measurements. The other forms were more variable and the samples clustered in multiple groups.

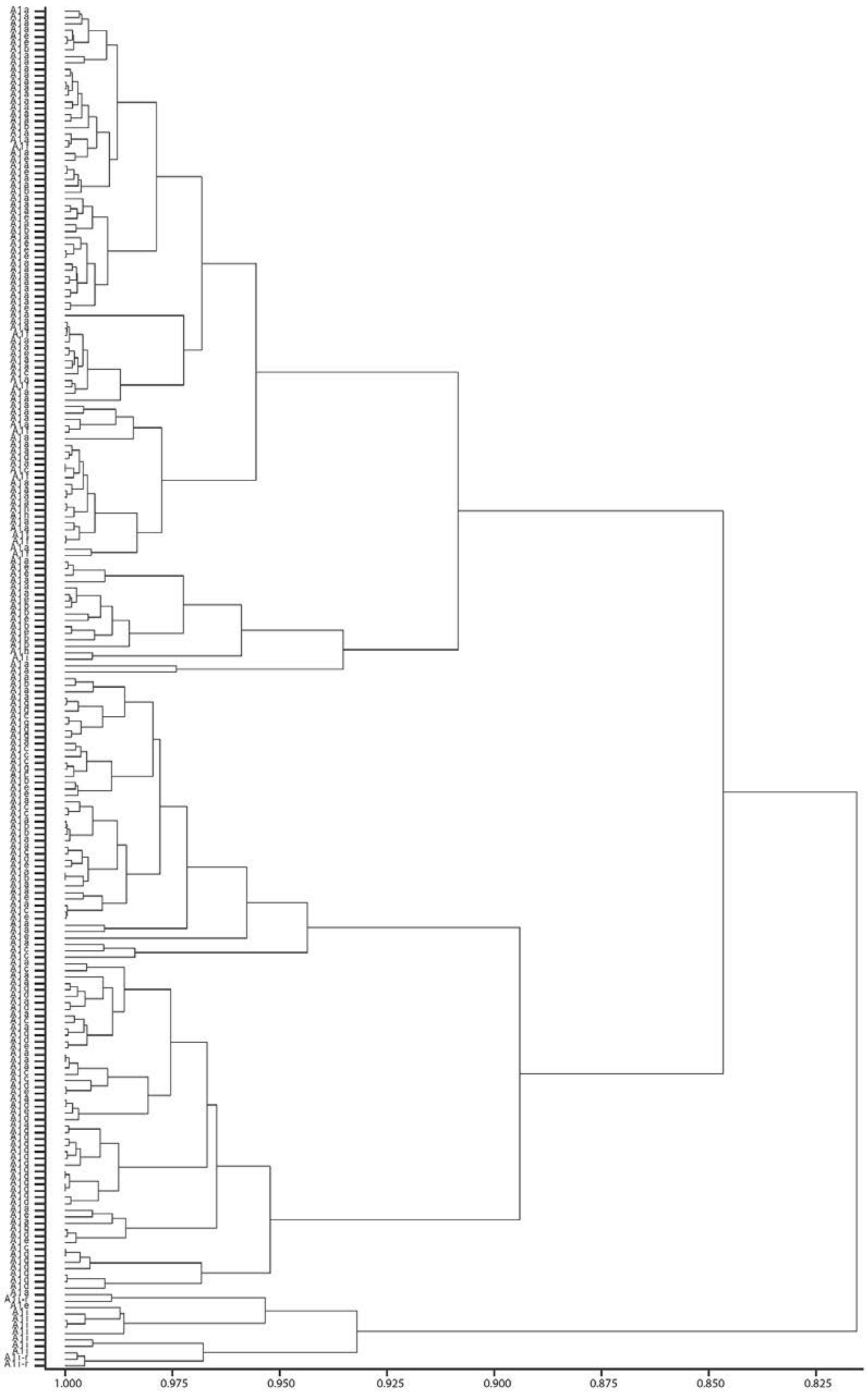


Figure 7.3. Dendrogram of average-linkage hierarchical cluster analysis of class A1 dimensional variables with rim forms labelled. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Table 7.2. Number of samples in the hierarchical cluster analysis dendrogram groupings by rim form in Figure 7.3 of class A1 dimensional variables when cut at 0.925. Refer to Figure 5.1 for rim form images.

Group (cut at 0.925)	A1a	A1b	A1c	A1d	A1e	A1f	A1g	A1h	A1i	A1i-r
1	58	4	2	1	10	8	0	2	0	0
2	6	5	0	0	5	0	0	1	1	0
3	15	5	11	1	6	0	6	0	0	0
4	13	1	5	27	5	0	0	0	0	0
5	1	0	0	0	1	0	0	0	7	3

Source: Compiled by C. Sarjeant.

Canonical variate analysis

The analysed vessel forms group quite close together in the CVA, although there were a few forms that plotted separately from the main cluster, especially A1d, A1i and its variant A1i-r. The variability within the main cluster is most marked within the A1b and A1c rim forms. The most standardised vessel form in this CVA was A1i-r, although very few examples of this form were included in this analysis. The other forms were variable (Figure 7.4, Table 7.3).

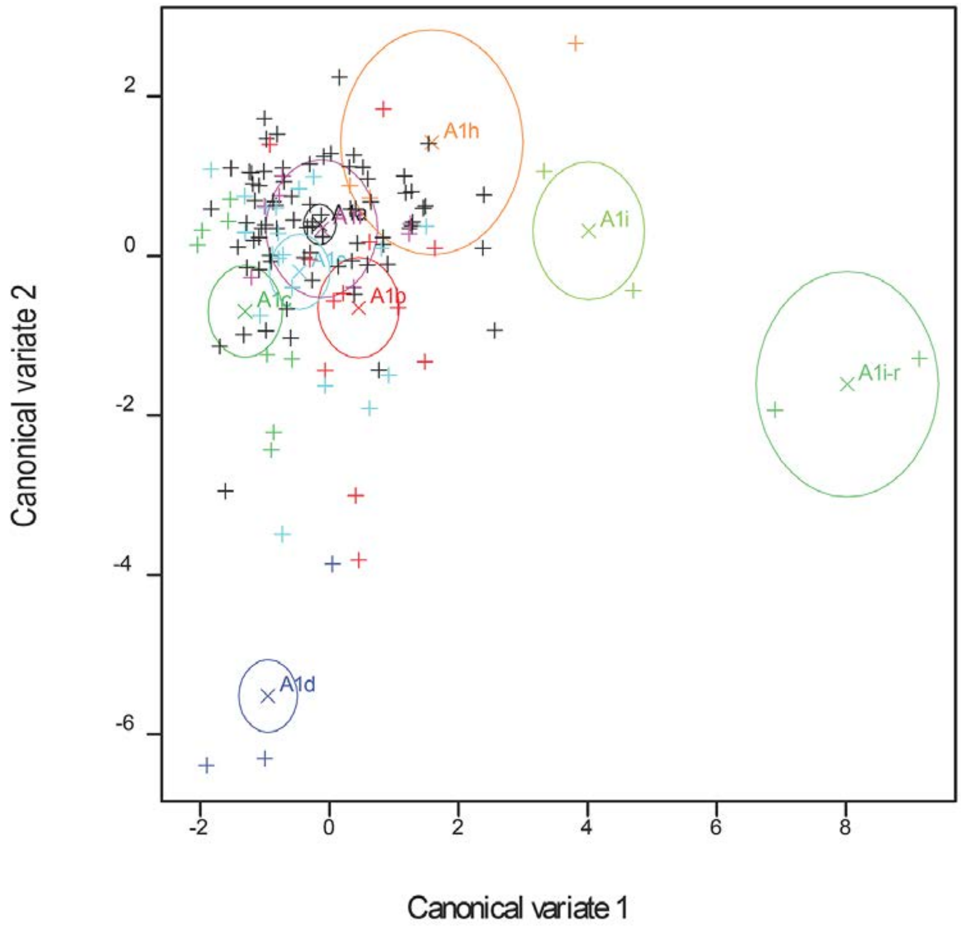


Figure 7.4. CVA plot of class A1 dimensional variables with 95% confidence circles and rim forms labelled. First two dimensions. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Table 7.3. CVA loadings for Figure 7.4 of class A1 dimensional variables. First three dimensions.

Variables	1 (42.27%)	2 (31.86%)	3 (14.21%)
Angle of rim (degrees)	0.77347	-0.01225	0.01082
Diameter (mm)	0.01240	0.06493	0.09896
Length of rim (mm)	-0.05754	0.01652	-0.12303
Thickness of rim (mm)	0.00043	0.01533	0.00995
Thickness of body (mm)	-0.01712	-0.12133	0.00521

Source: Compiled by C. Sarjeant.

Coefficient of variation

Many of the A1 forms had the lowest CV values for the angle of the rim and the highest CV values for the thickness of the body. The coefficient of variation analysis indicated that rim forms A1d, A1g, A1h and A1i-r have low CV values for the majority of the measured variables. The remaining rim forms had mid to high CV values for the majority of the measured variables. This suggests that deliberate standardised manufacturing methods were unlikely to have been practiced in the production of rim forms A1a, A1b, A1c, A1e, A1f and A1i, but standardised practices may have applied to A1d, A1g, A1h and A1i-r for some of the measured variables (Figure 7.5, Figure 7.6).

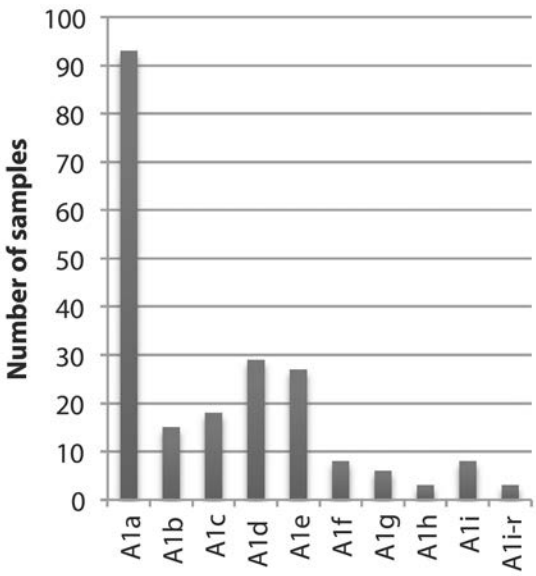


Figure 7.5. Number of class A1 samples of each rim form in the study of standardisation. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

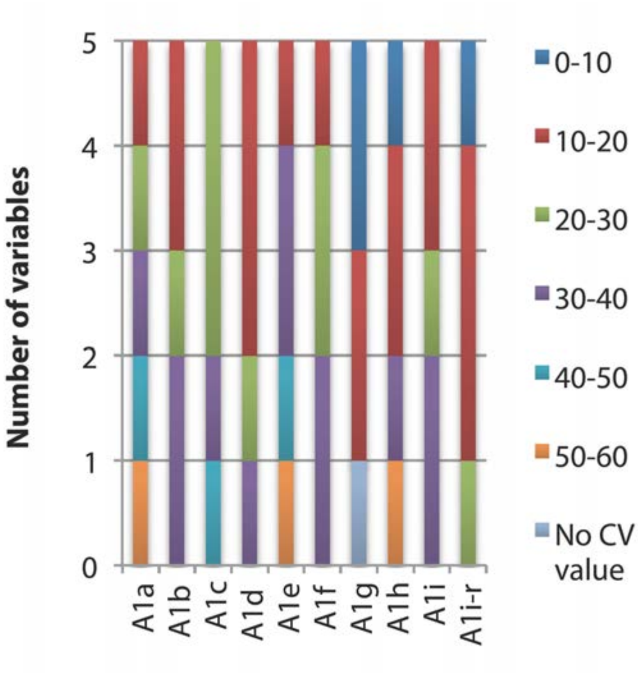


Figure 7.6. Number of variables with CV values 0–60% for each rim form in the class A1 sample. 0–10% CV represents the lowest CV values, i.e. a higher level of standardisation, and 50–60% CV represents the highest CV values, i.e. a lower level of standardisation. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Summary of class A1 standardisation analysis

When the above statistical procedures are considered alongside each other, it is clear that the A1 class encompasses a wide variety of forms, which includes ten rim forms, each with additional variations. It was expected that the standardisation study of the class A1 dimensional variables would show this variability. Some forms, however, displayed more homogeneity than others. More common forms that appear throughout the sequence, such as A1a, were the most variable. In contrast, forms A1d, A1g and A1i (and A1i-r) displayed more homogeneity in all of the statistical results.

Class A2

Class A2 forms are similar to A1 in that they are restricted vessels with everted rims, however the rim is curved and internally concave in shape (Figure 5.1). Decorative panels were frequently identified on the shoulder of these forms, usually a band of roulette stamping within two incised lines. The measured variables were angle of the rim, diameter of the rim, length of the rim, thickness of the body, and thickness of the rim (Figure 7.1). Once again, the four previously described statistical methods (PCA, cluster analysis, CVA and CV) were applied to understand the variability and homogeneity in the morphology of the A2 class ceramics.

Principal components analysis

The greatest variability in the following PCA plot (Figure 7.7) is a result of the diameter and thickness of the body (Table 7.4). Most of the class A2 samples cluster close together in the plot, but some A2a and A2b sherds were major outliers (Figure 7.7). The clusters are clarified in the following hierarchical cluster analysis (Figure 7.8, Table 7.5).

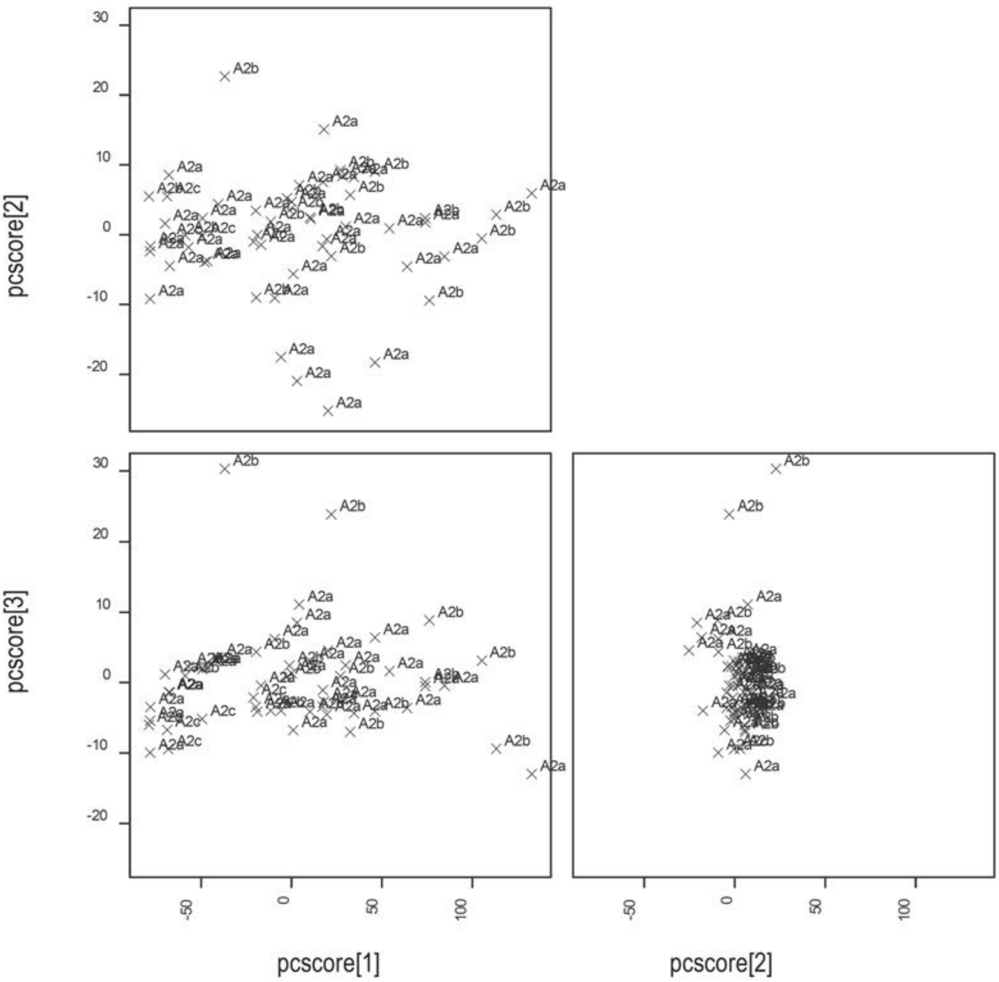


Fig 7.7. PCA plot of class A2 dimensional variables with rim forms labelled. First three dimensions. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Table 7.4. PCA loadings for Figure 7.7 of class A2 dimensional variables. First three dimensions. The bold values indicate the variables that presented the greatest variability in the PCA.

Variables	PC 1 (95.71%)	PC 2 (2.31%)	PC 3 (1.77%)
Angle of rim (degrees)	0.04187	**0.68288**	**0.72720**
Diameter (mm)	**0.98803**	0.07919	**-0.13199**
Length of rim (mm)	0.14727	**-0.72578**	0.66951
Thickness of body (mm)	**0.00169**	-0.02473	0.02322
Thickness of rim (mm)	0.01878	0.00504	0.07056

Source: Compiled by C. Sarjeant.

Hierarchical cluster analysis

The dendrogram was cut at 0.925 (Figure 7.8) to divide the class A2 assemblage into groups. The numbers of samples within each form in these groups are shown in Table 7.5. While there are distinct concentrations of certain rim forms in some of the groups, such as form A2a in groups 4 and 5, there is a high degree of overlap in the measured dimensional variables of the three A2 forms. This suggests that the A2 forms are very similar in morphology except for the shape of the lip, which is their main distinguishing factor.

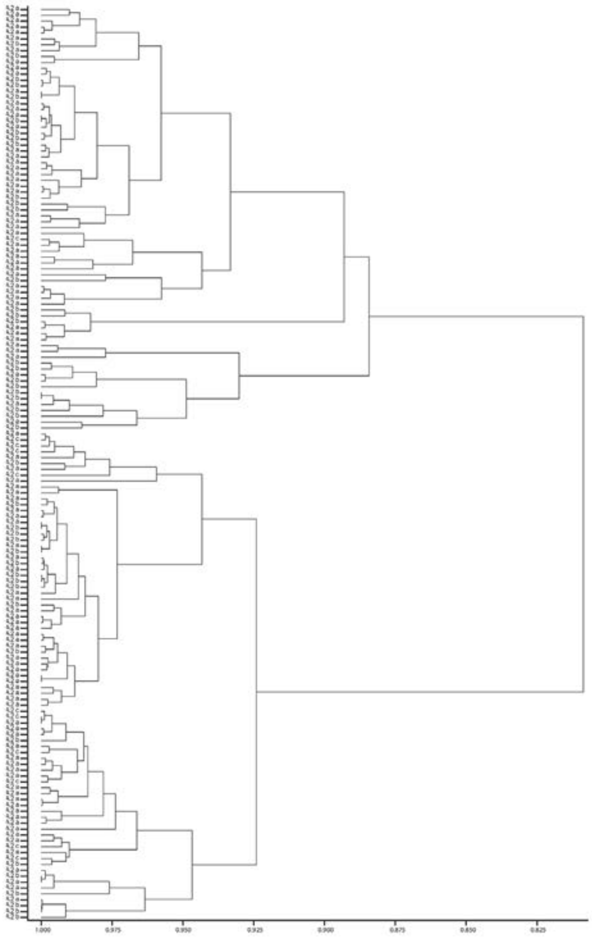


Figure 7.8. Dendrogram of average-linkage hierarchical cluster analysis of class A2 dimensional variables with rim forms labelled. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Table 7.5. Number of samples in the hierarchical cluster analysis dendrogram groupings by rim form in Figure 7.8 of class A2 dimensional variables when cut at 0.925. Refer to Figure 5.1 for rim form images.

Group (cut at 0.925)	A2a	A2b	A2c
1	37	13	1
2	3	3	0
3	6	9	0
4	31	12	4
5	23	7	6

Source: Compiled by C. Sarjeant.

Canonical variate analysis

The CVA displays variability and shows that there is considerable overlap between the three A2 vessel forms. This suggests that different A2 forms have a similar morphology to each other, but also that there is no significant standardisation within each form (Figure 7.9, Table 7.6).

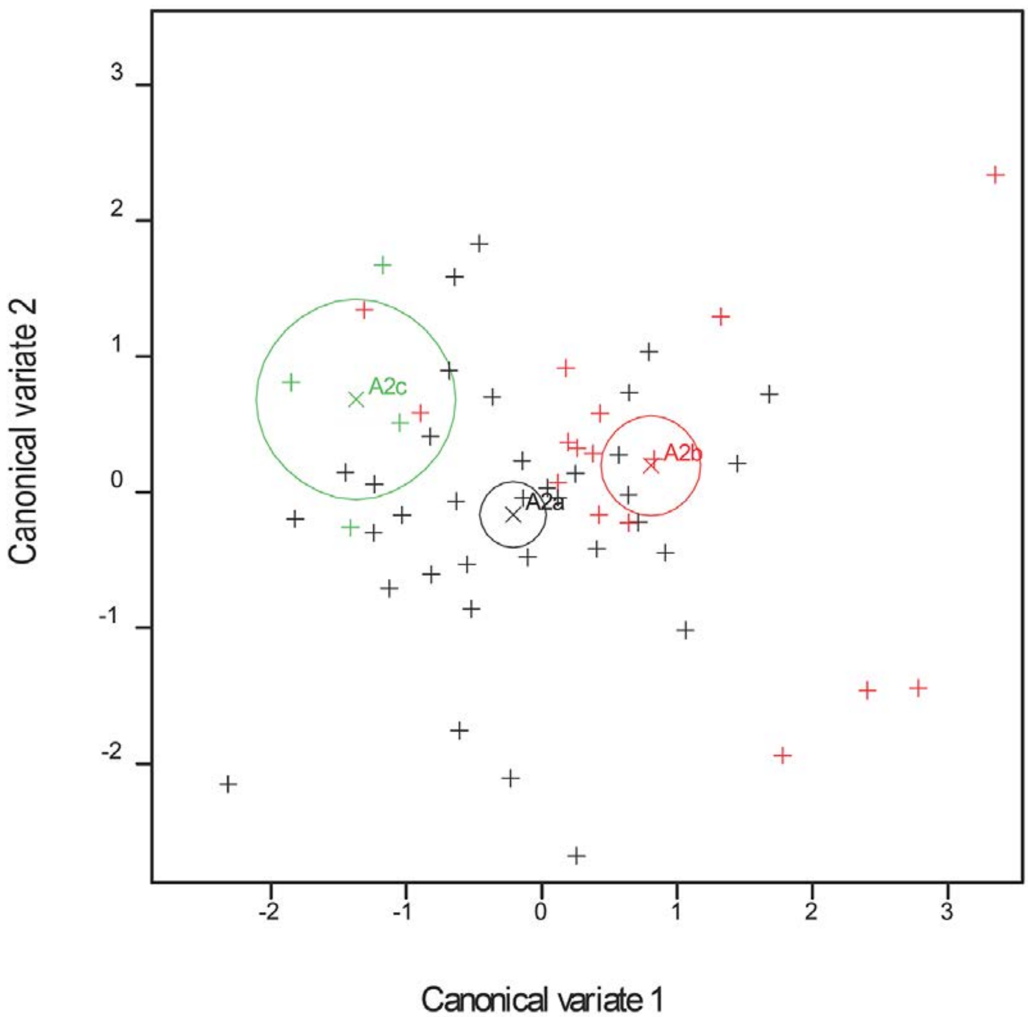


Figure 7.9. CVA plot of class A2 dimensional variables with 95% confidence circles and rim forms labelled. First two dimensions. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Table 7.6. CVA loadings for Figure 7.9 of class A2 dimensional variables. First two dimensions.

Variables	1 (84.99%)	2 (15.01%)
Angle of rim (degrees)	0.2321	-0.0098
Diameter (mm)	0.0834	0.0415
Length of rim (mm)	0.2077	0.3734
Thickness of rim (mm)	0.0031	0.0051
Thickness of body (mm)	0.0123	-0.0984

Source: Compiled by C. Sarjeant.

Coefficient of variation

Within the class A2 assemblage, low CV values were calculated for angle of rim and diameter, while higher CV values were calculated for the length of the rim, thickness of body and thickness of rim. There were very few low CV values overall, except within the A2c rim forms, of which fewer samples were analysed (Figure 7.10, Figure 7.11).

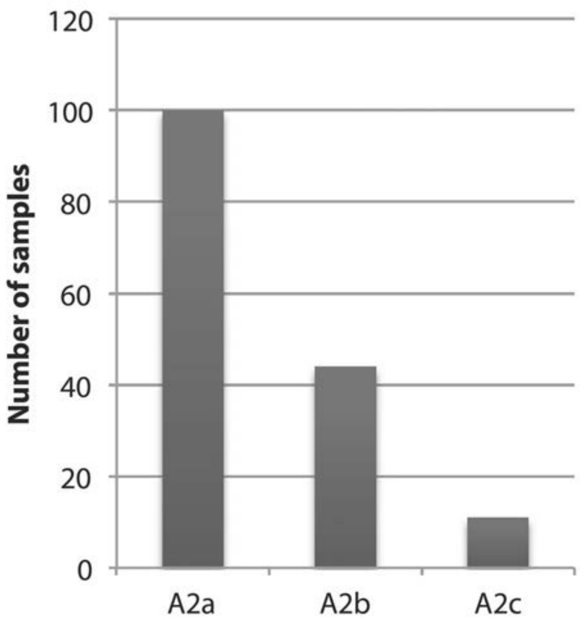


Figure 7.10. Number of class A2 samples of each rim form in the study of standardisation. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

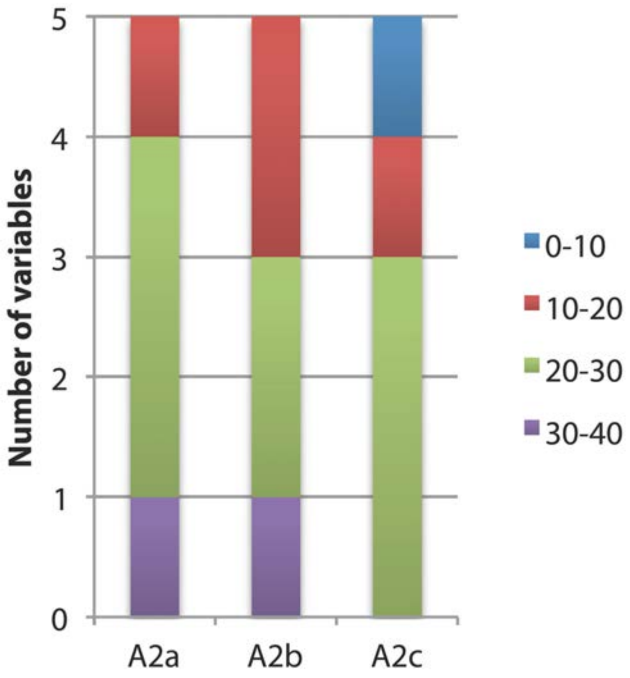


Figure 7.11. Number of variables with CV values 0–40% for each rim form in the class A2 sample. 0–10% CV represents the lowest CV values, i.e. a higher level of standardisation, and 30–40% CV represents the highest CV values, i.e. a lower level of standardisation. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Summary of class A2 standardisation analysis

Generally, the class A2 forms exhibited a great deal of variability in all of the statistical procedures. However, there was greater homogeneity within the A2c rim form group in terms of the dimensional variables. The close study of form A2a may indicate whether this is an accurate assessment, especially when combining morphological, decorative and fabric variables.

Class B

The class B ceramics are simple restricted forms, typically bowl shaped with an inverted rim (Figure 5.1). The measured variables were angle of the rim, diameter of the rim, thickness of the body, and thickness of the rim (Figure 7.1). Once again, four previously described statistical methods (PCA, cluster analysis, CVA and CV) were applied to understand the variability and homogeneity in the morphology of the B class ceramics.

Principal components analysis

The greatest variability in the following PCA plot (Figure 7.12) is a result of the diameter and thickness of the rim (Table 7.7). The PCA plot shows that generally the samples cluster together, with some B2a samples grouping separately, and a few B1a, B1b and B3a outliers (Figure 7.12). These clusters are clarified by the following hierarchical cluster analysis (Figure 7.13, Table 7.8).

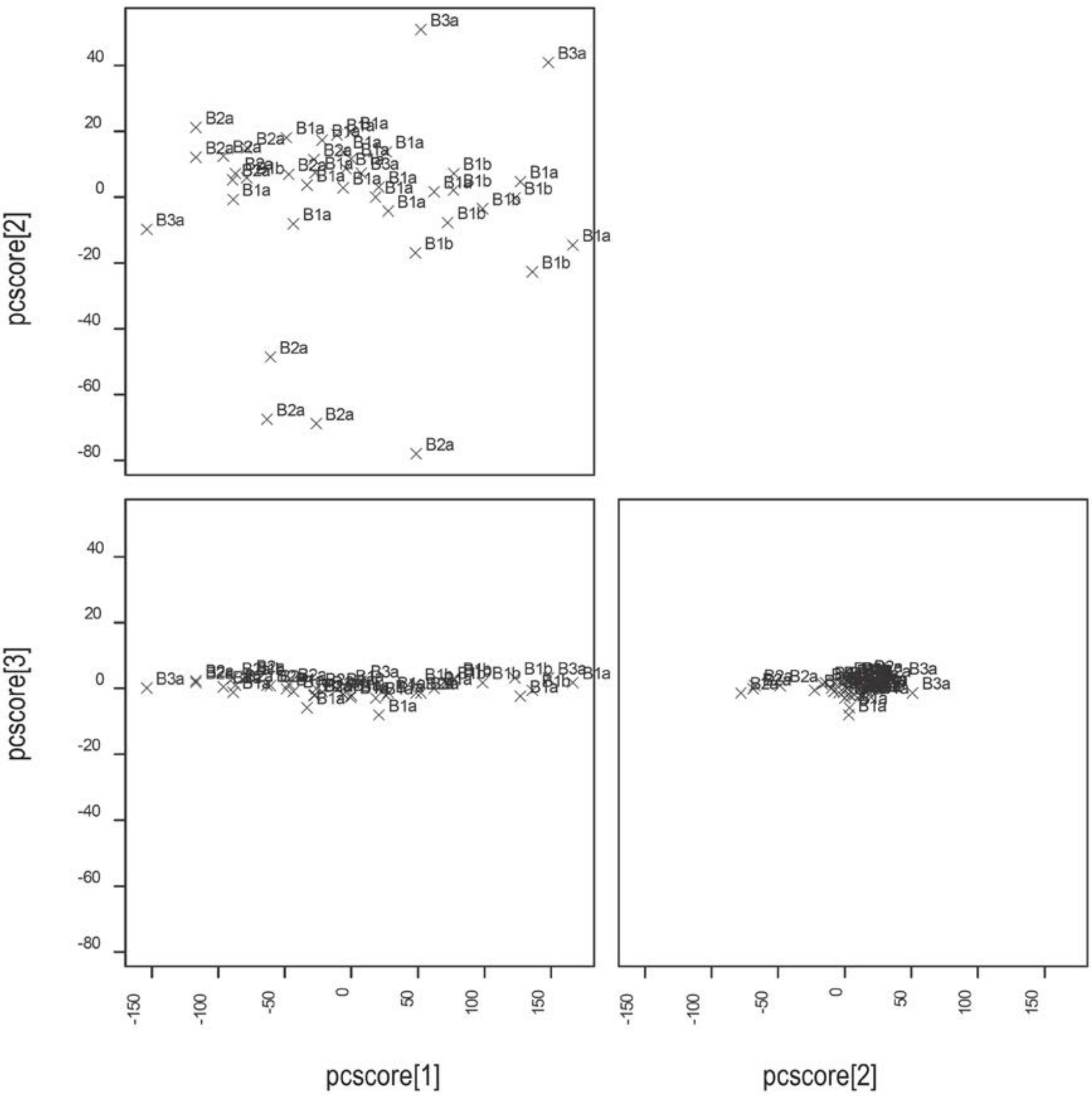


Figure 7.12. PCA plot of class B dimensional variables with rim forms labelled. First three dimensions. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Table 7.7. PCA loadings for Figure 7.12 of class B dimensional variables. First three dimensions. The bold values indicate the variables that presented the greatest variability in the PCA.

Variables	**PC 1 (90.36%)**	**PC 2 (9.52%)**	**PC 3 (0.09%)**
Angle of rim (degrees)	0.03079	**0.99924**	**0.01524**
Diameter (mm)	**0.99951**	**-0.03074**	0.00297
Thickness of body (mm)	0.00608	-0.01145	-0.39022
Thickness of rim (mm)	**0.00116**	0.02129	**-0.92059**

Source: Compiled by C. Sarjeant.

Hierarchical cluster analysis

The dendrogram was cut at 0.90 (Figure 7.13) to divide the class B assemblage into groups. The number of samples within each form in these groups is shown in Table 7.8. The cluster analysis indicated homogeneity within form B1a, with the majority of the samples in group 1, likewise for form B1b in group 3 and form B2a in group 1. Form B3a displayed less homogeneity and the samples were spread over a number of groups in the cluster analysis.

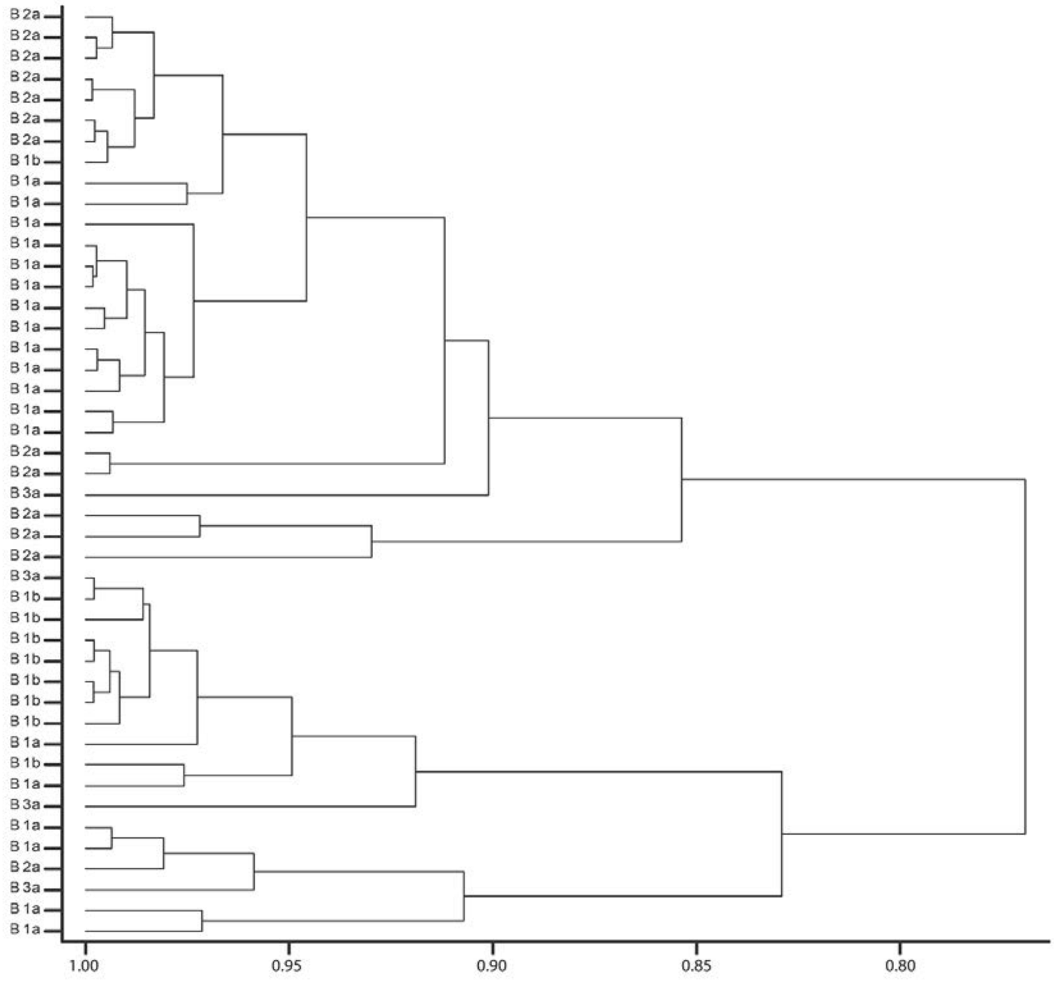


Figure 7.13. Dendrogram of average-linkage hierarchical cluster analysis of class B dimensional variables with rim forms labelled. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Table 7.8. Number of sherds in the hierarchical cluster analysis dendrogram groupings by rim form in Figure 7.13 of class B dimensional variables, when cut at 0.90. Refer to Figure 5.1 for rim form images.

Group (cut at 0.90)	B1a	B1b	B2a	B3a
1	13	1	9	1
2	0	0	3	0
3	2	8	0	2
4	4	0	1	1

Source: Compiled by C. Sarjeant.

Canonical variate analysis

Rim form B1b appears to be the least variable in morphological dimensions, when compared to other class B rim forms in the CVA. The few sampled B3a rim form sherds are particularly variable (Figure 7.14, Table 7.9).

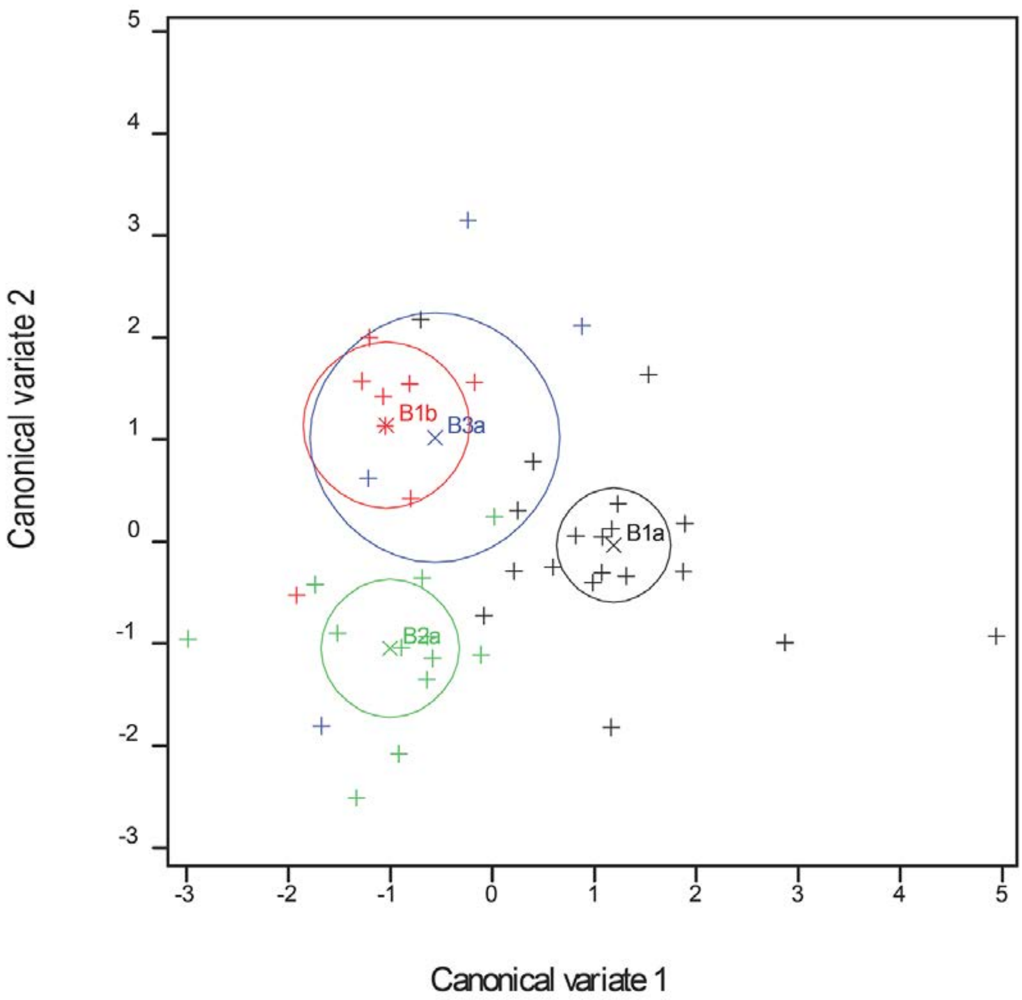


Figure 7.14. CVA plot of class B dimensional variables with 95% confidence circles and rim forms labelled. First two dimensions. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Table 7.9. CVA loadings for Figure 7.14 of class B dimensional variables. First three dimensions.

Variables	1 (55.18%)	2 (34.66%)	3 (8.23%)
Angle of rim (degrees)	-0.0832	-0.6550	-0.2888
Diameter (mm)	0.0864	0.0067	0.0097
Thickness of rim (mm)	-0.0010	-0.0015	0.0034
Thickness of body (mm)	0.4151	0.9116	-0.3910

Source: Compiled by C. Sarjeant.

Coefficient of variation

Low CV values were most frequently calculated for the angle of the rim, while higher CV values were calculated for diameter and thickness of the body. Low CV values were rare for class B, except for two variables in rim form B1b, the angle and thickness of the rim (Figure 7.15, Figure 7.16).

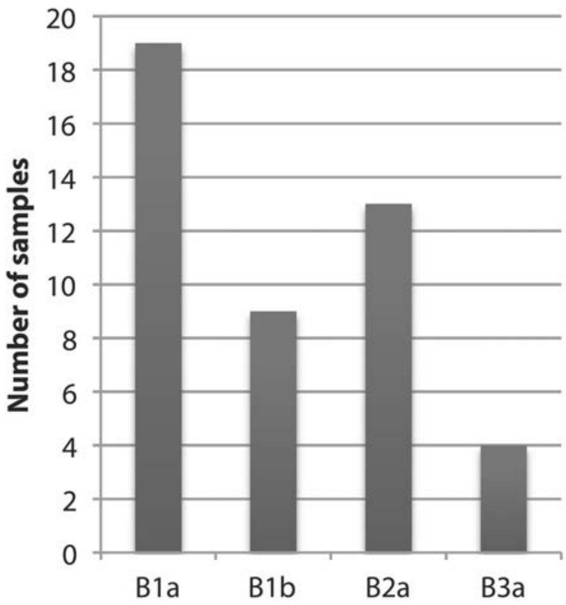


Figure 7.15. Number of class B samples of each rim form in the study of standardisation. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

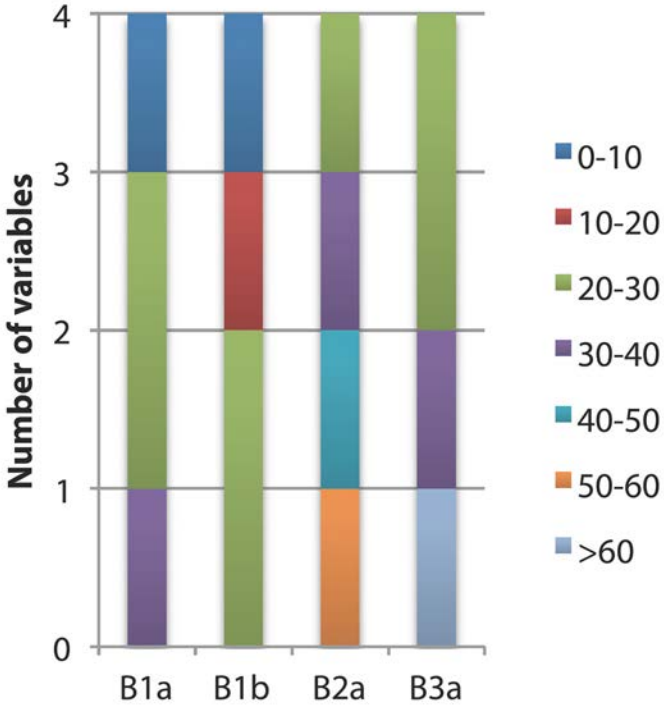


Figure 7.16. Number of variables with CV values 0–>60% for each rim form in the class B sample. 0–10% CV represents the lowest CV values, i.e. a higher level of standardisation, and 50–60% CV represents the highest CV values, i.e. a lower level of standardisation. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Summary of class B standardisation analysis

There was some homogeneity within forms B1a, B1b and B2a in all of the statistical procedures, except for the PCA and CV values, which displayed variability within the form B2a samples. None of the statistical methods indicated homogeneity in the form B3a samples. In terms of the CV values for dimensional variables, only form B1a and B1b exhibited evidence of standardisation.

Class C

Class C consists of simple, unrestricted vessels. These forms differ to class B in that they are commonly dish rather than bowl-shaped (Figure 5.1). Class C vessels incorporate a great deal of morphological variation, particularly in the lip shape of the C1 forms. The measured variables were angle of the rim, diameter of the rim, thickness of the body, and thickness of the rim (Figure 7.1). Once again, the four previously described statistical methods (PCA, cluster analysis, CVA and CV) were applied to understand the variability and homogeneity in the morphology of the C class ceramics.

Principal components analysis

The greatest variability in the following PCA plot (Figure 7.17) is a result of the angle of the rim and diameter (Table 7.10). Generally, the PCA plot shows that the samples cluster together. There is some separation between forms C1a, C2b and C3a, whereby the different forms tend to cluster together, exhibiting some degree of standardisation within each form (Figure 7.17). The clusters are clarified in the following hierarchical cluster analysis (Figure 7.18, Table 7.11).

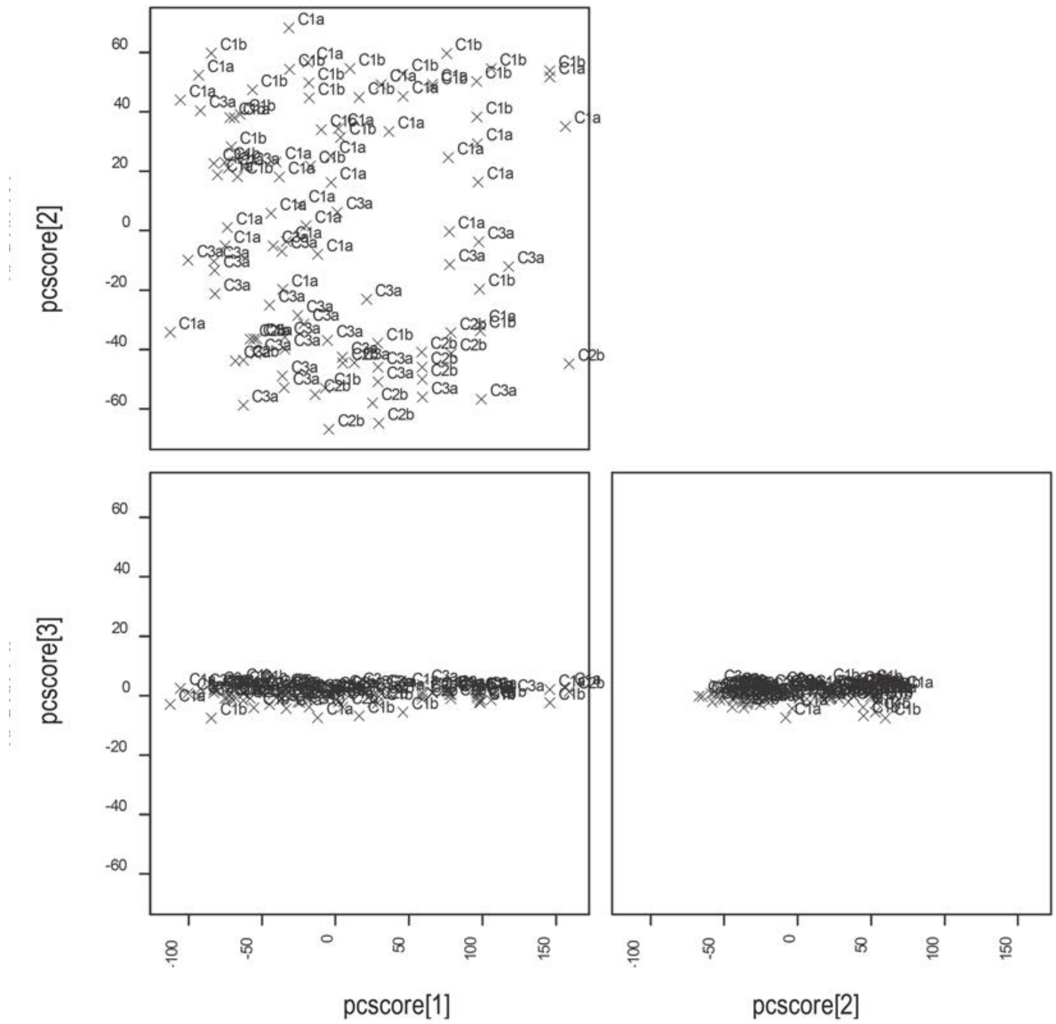


Figure 7.17. PCA plot of class C dimensional variables with rim forms labelled. First three dimensions. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Table 7.10. PCA loadings for Figure 7.17 of class C dimensional variables. First three dimensions. The bold values indicate the variables that presented the greatest variability in the PCA.

Variables	**PC 1 (74.77%)**	**PC 2 (25.10%)**	**PC 3 (0.08%)**
Angle of rim (degrees)	**-0.03096**	**0.99934**	**0.01591**
Diameter (mm)	**0.99946**	0.03075	0.01031
Thickness of body (mm)	0.00670	0.01482	-0.26426
Thickness of rim (mm)	0.00834	**0.01275**	**-0.96427**

Source: Compiled by C. Sarjeant.

Hierarchical cluster analysis

The dendrogram was cut at 0.90 (Figure 7.18) to divide the class C assemblage into groups. The number of samples within each form in these groups is shown in Table 7.11. The cluster analysis indicated there was considerable dimensional overlap between forms C1a and C1b. Form C2a samples cluster together, albeit separately from forms C1a and C1b, in group 7 in the dendrogram. Form C2b is more variable, and the form C3a samples cluster with the majority of the class C samples in groups 1, 2 and 3.

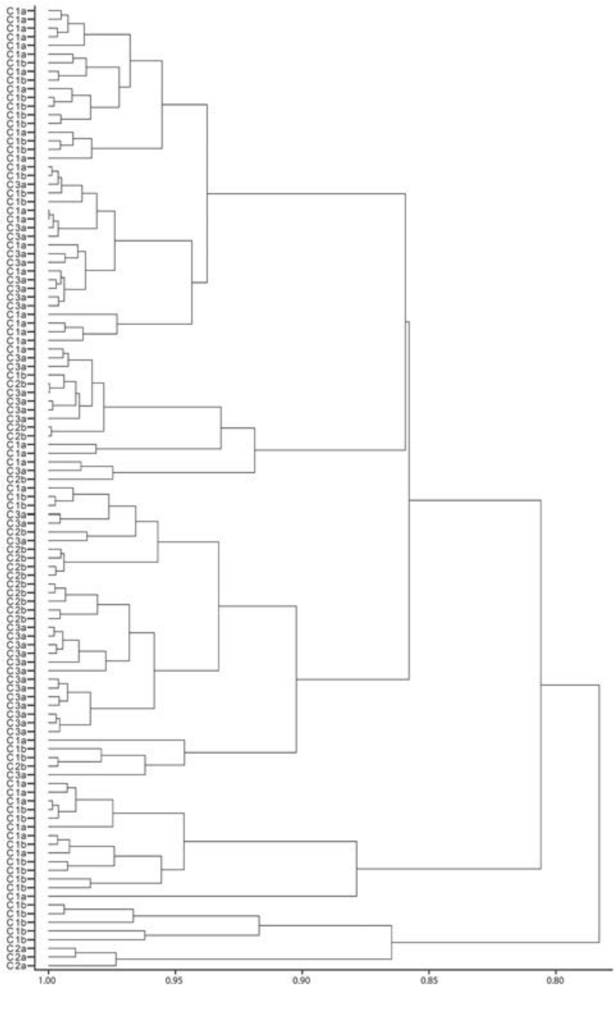


Figure 7.18. Dendrogram of average-linkage hierarchical cluster analysis of class C dimensional variables with rim forms labelled. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Table 7.11. Number of samples in the hierarchical cluster analysis dendrogram groupings by rim form in Figure 7.18 of class C dimensional variables when cut at 0.90. Refer to Figure 5.1 for rim form images.

Group (cut at 0.90)	C1a	C1b	C2a	C2b	C3a
1	19	11	0	0	9
2	4	2	0	3	7
3	2	4	0	11	17
4	6	7	0	0	0
5	1	0	0	0	0
6	0	5	0	0	0
7	0	0	3	0	0

Source: Compiled by C. Sarjeant.

Canonical variate analysis

The number of C2a rim forms was too few to be included in the analysis, and only forms C1a, C1b, C2b and C3a were applied to the CVA. The CVA indicated a high amount of variability within these class C forms in terms of morphological measurements (Figure 7.19, Table 7.12).

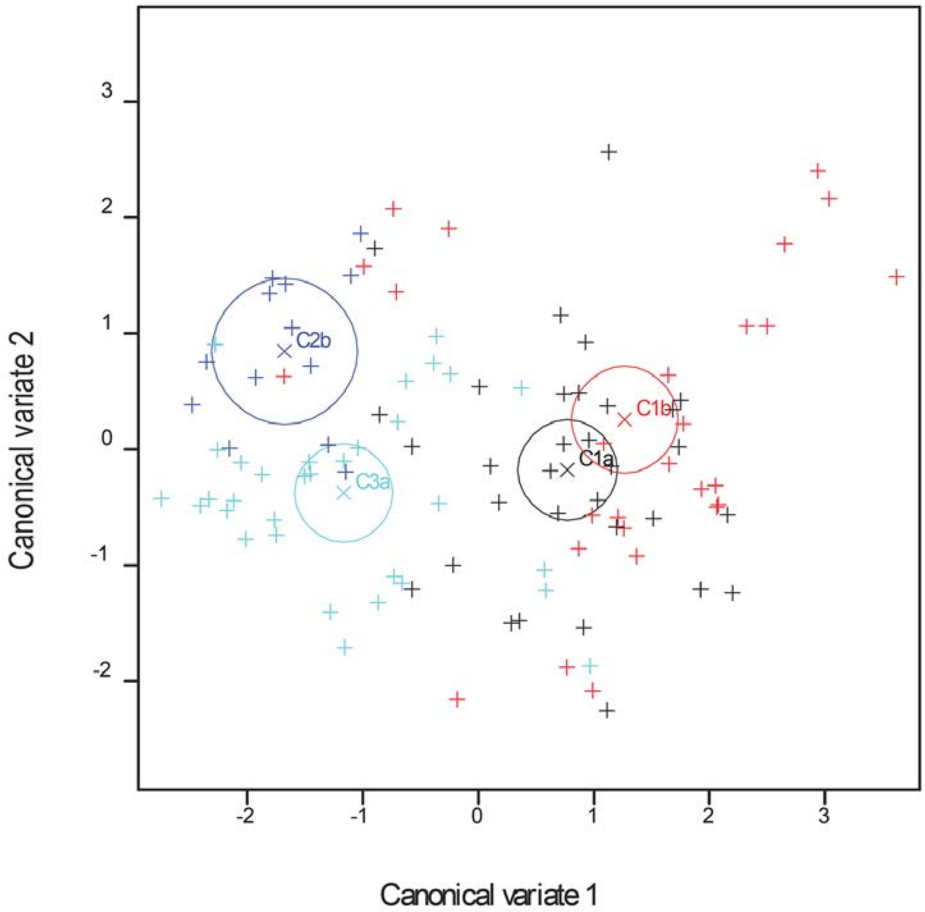


Figure 7.19. CVA plot of class C dimensional variables with 95% confidence circles and rim forms labelled. First two dimensions. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Table 7.12. CVA loadings for Figure 7.19 of class C dimensional variables. First three dimensions.

Variables	1 (89.33%)	2 (10.44%)	3 (0.23%)
Angle of rim (degrees)	0.1788	0.3555	-0.2855
Diameter (mm)	0.0343	-0.0119	0.0028
Thickness of rim (mm)	0.0000	0.0060	0.0116
Thickness of body (mm)	0.0763	0.0396	0.2123

Source: Compiled by C. Sarjeant.

Coefficient of variation

No specific variables contributed to a presence of low or high CV values for the class C samples. This is because many of the variables resulted in relatively mid-range CV values, indicating a low level of control in standardising the production of these forms. The only form to exhibit low variability was C2a, however very few samples of this form were included in the study. The angle of the rim and thickness of the rim variables had low CV values within the form C2a sample (Figure 7.20, Figure 7.21).

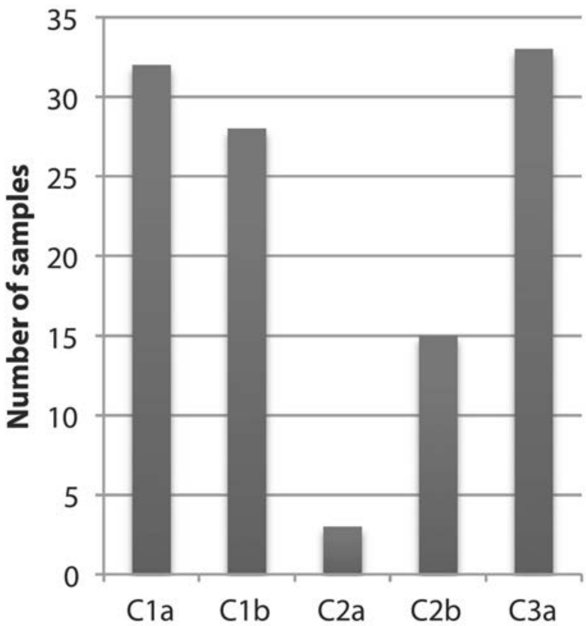


Figure 7.20. Number of class C samples of each rim form in the study of standardisation. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

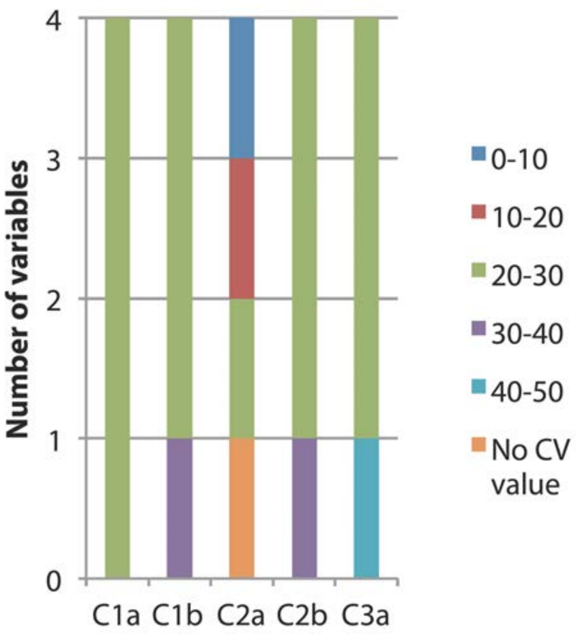


Figure 7.21. Number of variables with CV values 0–50% for each rim form in the class C sample. 0–10% CV represents the lowest CV values, i.e. a higher level of standardisation, and 40–50% CV represents the highest CV values, i.e. a lower level of standardisation. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Summary of class C standardisation analysis

The high degree of variability within all of the class C forms is clear from all of the statistical procedures. The only form that presents less variability is C3a, but this is most likely a result of the small sample size.

Class D

Class D vessels are unique to An Sơn and there are very few known comparative examples elsewhere in Southeast Asia. The class D1 forms are wavy rimmed, unrestricted bowl-shaped vessels and the class D2 forms are serrated rimmed, unrestricted conical-shaped vessels (Figure 5.1). The measured variables include angle of the rim to the internal ridge, diameter of the rim, length of the rim to the internal ridge, height of a single wave, width of a single wave, thickness of the body, and thickness of the rim (Figure 7.1). Once again, PCA, cluster analysis, CVA and CV, statistical methods were applied to understand the variability and homogeneity in the morphology of the D class ceramics, these being.

Principal components analysis

The greatest variability in the following PCA plot (Figure 7.22) is a result of the angle, diameter and length of the rim (Table 7.13). Generally, the PCA plot shows that there is a distinct group of form D1a rims that cluster separately from the other D1a and D1b samples, while the form D2a samples cluster separately (Figure 7.22). The clusters are clarified in the following hierarchical cluster analysis (Figure 7.23, Table 7.14).

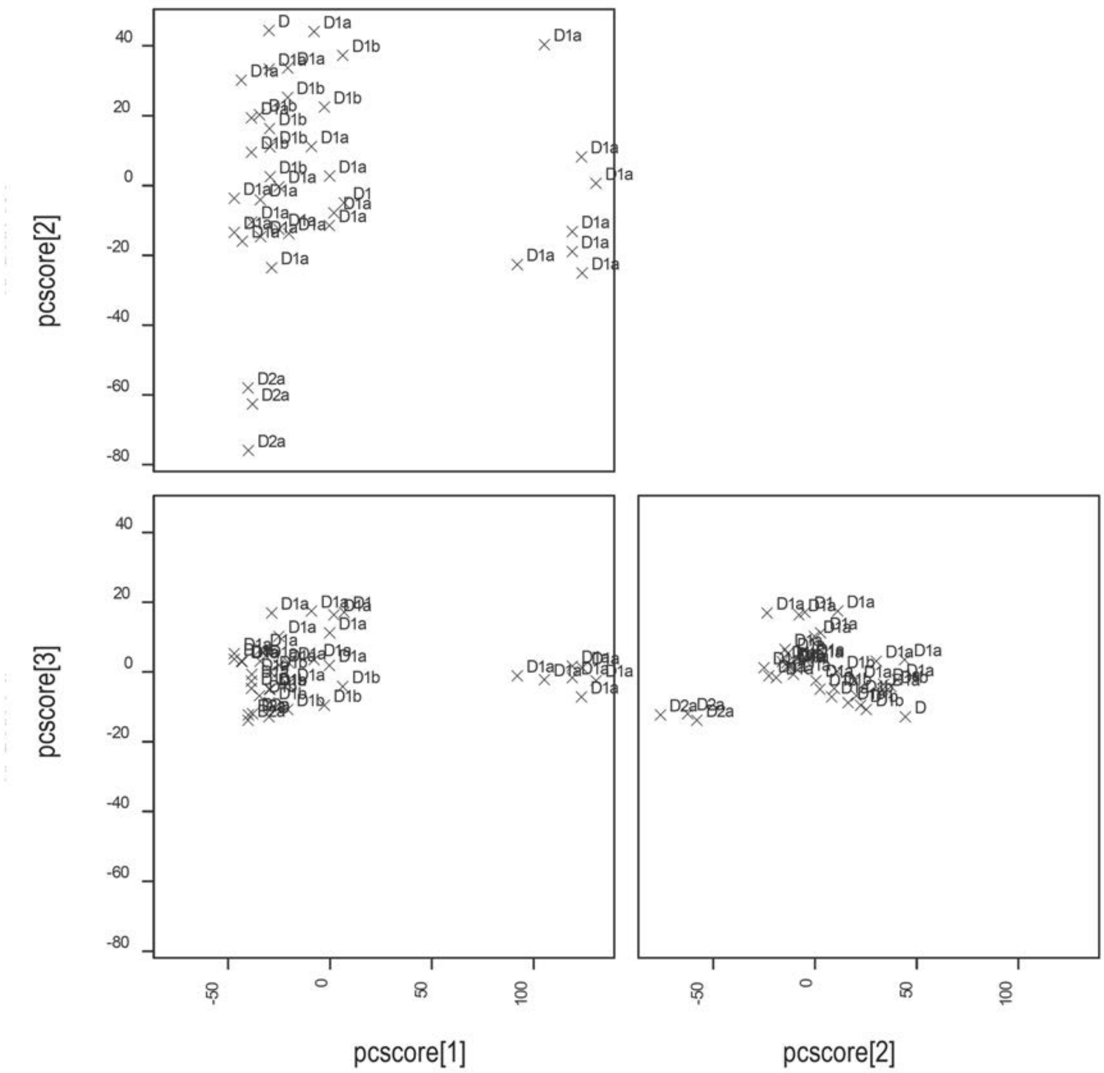


Figure 7.22. PCA plot of class D dimensional variables with rim forms labelled. First three dimensions. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Table 7.13. PCA loadings for Figure 7.22 of class D dimensional variables. First three dimensions. The bold values indicate the variables that presented the greatest variability in the PCA.

Variables	PC 1 (79.14%)	PC 2 (8.67%)	PC 3 (1.71%)
Angle of rim to internal ridge (degrees)	**0.99950**	0.00919	-0.02119
Diameter (mm)	**-0.01197**	**0.99492**	**-0.07478**
Length of rim to internal ridge (mm)	**-0.01100**	**-0.04286**	0.27507
Height of single wave (mm)	-0.00085	0.03239	0.40203
Width of single wave (mm)	0.02707	0.08388	**0.86719**
Thickness of body (mm)	-0.00157	0.00722	0.00364
Thickness of rim (mm)	0.00264	0.00873	0.06812

Source: Compiled by C. Sarjeant.

Hierarchical cluster analysis

The dendrogram was cut at 0.90 (Figure 7.23) to divide the class D assemblage into groups. The number of samples within each form in these groups is shown in Table 7.14. The cluster analysis revealed distinct groups for the class D samples based on the dimensional variables. However, there is substantial overlap between forms D1a and D1b in group 2. The D2a samples were also distinct, with the majority in group 6. The single D2a sample in group 4 and the class D variant in group 5 were outliers.

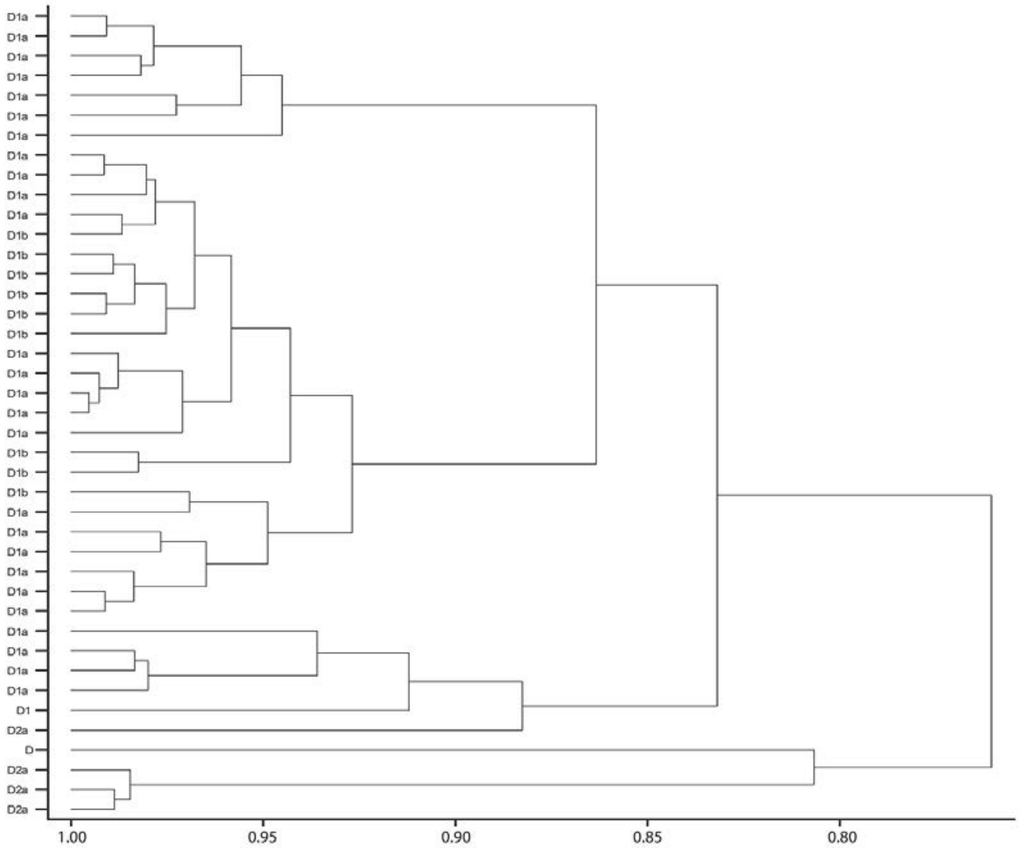


Figure 7.23. Dendrogram of average-linkage hierarchical cluster analysis of class D dimensional variables with rim forms labelled. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Table 7.14. Number of sherds in the hierarchical cluster analysis dendrogram groupings by rim form in Figure 7.23 of class D dimensional variables when cut at 0.90. Refer to Figure 5.1 for rim form images.

Group (cut at 0.90)	D1a	D1b	D2a
1	7	0	0
2	15	9	0
3	5 (D1: n=1)	0	0
4	0	0	1
5	1 (D: n=1)	0	0
6	0	0	3

Source: Compiled by C. Sarjeant.

Canonical variate analysis

The CVA indicates quite a low level of variation, with form D2a separate from the D1 forms. Generally, the D1a and D1b sherds cluster together, suggesting limited morphological variability within these forms (Figure 7.24, Table 7.15).

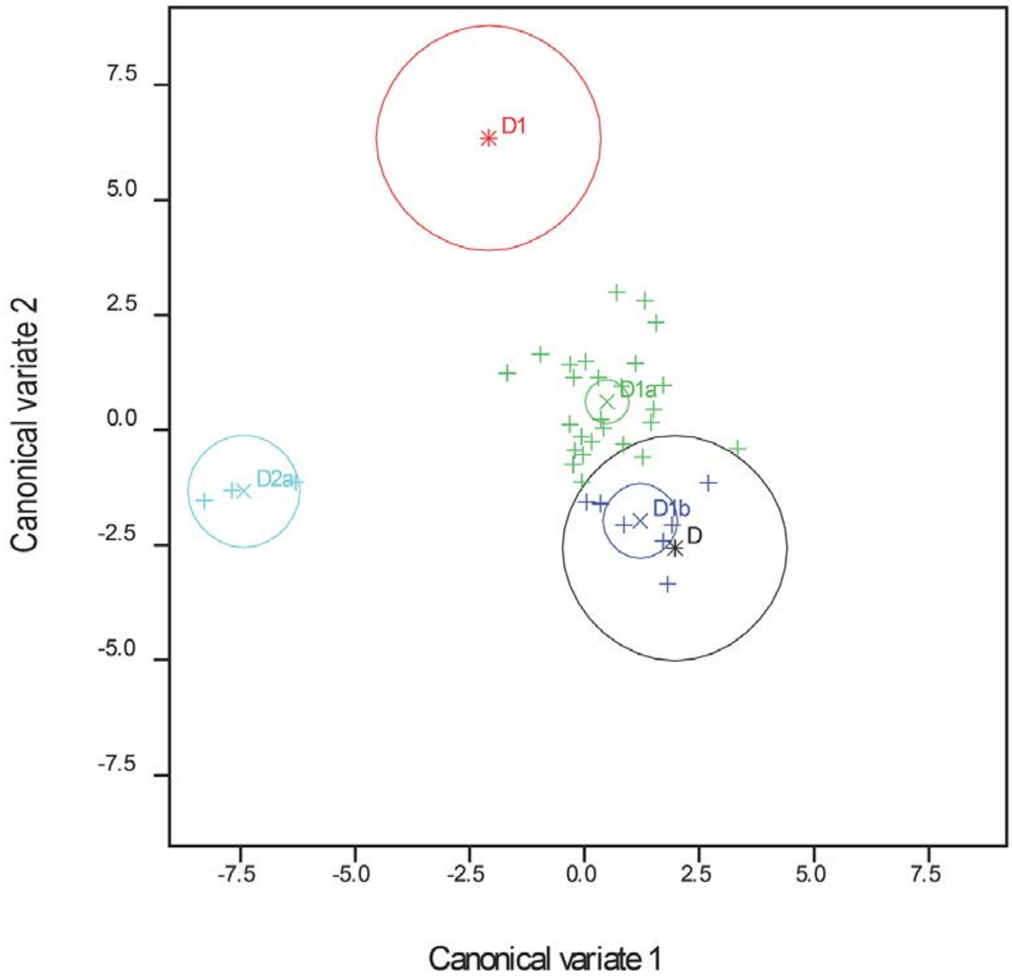


Figure 7.24. CVA plot of class D dimensional variables with 95% confidence circles and rim forms labelled. First two dimensions. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Table 7.15. CVA loadings for Figure 7.24 of class D dimensional variables. First three dimensions.

Variables	1 (61.82%)	2 (30.09%)	3 (6.22%)
Angle of rim to internal ridge (degrees)	0.1043	0.0927	0.0525
Diameter (mm)	0.0011	0.0100	0.0034
Length of rim to internal ridge (mm)	0.0448	-0.0180	-0.0112
Height of single wave (mm)	0.0649	0.2726	-0.2680
Width of single wave (mm)	-0.2188	0.0914	0.1767
Thickness of rim (mm)	0.0625	0.4490	0.2988
Thickness of body (mm)	0.5207	-0.6457	0.6448

Source: Compiled by C. Sarjeant.

Coefficient of variation

CV values were lower for the diameter and the length of the rim to the internal ridge. The D1 vessels had high CV values calculated for the angle of the rim to the internal ridge, and the D2a vessels had high CV values calculated for the variables of height and width of single wave (see Figure 7.1 for measured variables). Rim form D2a had a greater number of variables with low CV values than that of rim form D1 (Figure 7.25, Figure 7.26).

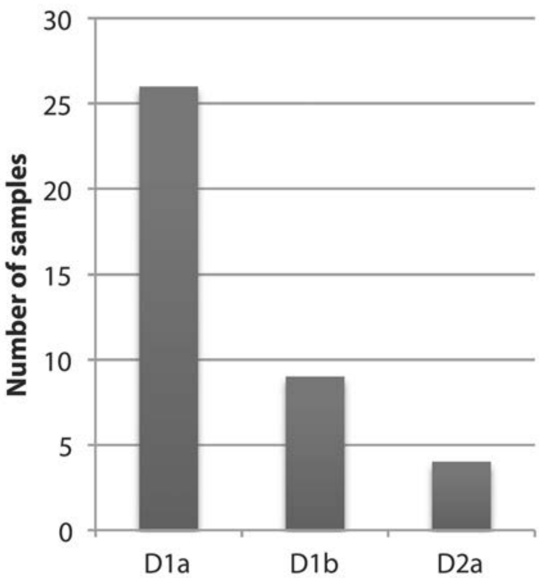


Figure 7.25. Number of class D samples of each rim form in the study of standardisation. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

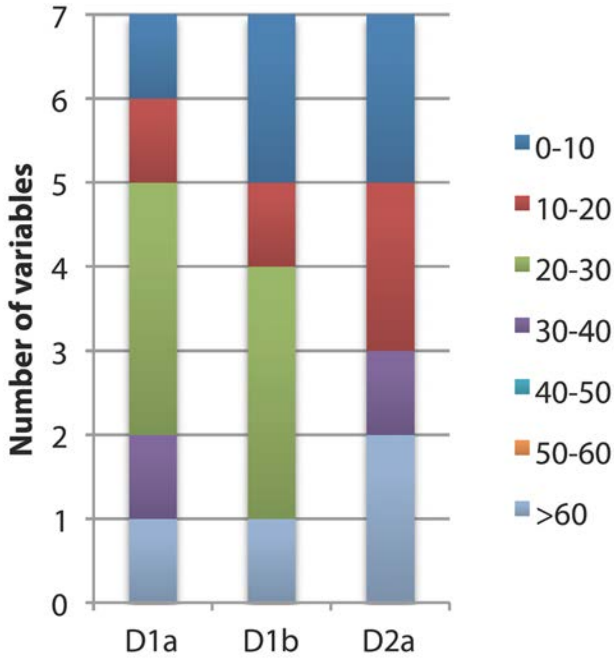


Figure 7.26. Number of variables with CV values 0–>60% for each rim form in the class D sample. 0–10% CV represents the lowest CV values, i.e. a higher level of standardisation, and 50–60% CV represents the highest CV values, i.e. a lower level of standardisation. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

Summary of class D standardisation analysis

The statistical procedures indicated that there was some degree of standardisation in each of the class D forms, particularly form D2a. The D1a and D1b forms were similar in their dimensional variables, but the PCA also displayed two separate groups for D1. This may be clarified further by the following study of standardisation in the D1a form.

Class E

Class E vessels are ceramic stoves, known as *cà ràng* in Vietnamese. They are similar in rim shape to the C1 forms except that the body incorporates three square or rounded-shaped projections, which support another pottery vessel during cooking (Figure 5.1). The measured variables include angle of the rim, diameter of the rim, thickness of the body, and thickness of the rim (Figure 7.1). The number of class E samples included in the standardisation study was minimal and only one analysis was possible, the CV calculation.

Coefficient of variation

There were too few class E sherds in the sample to suggest any kind of standardisation. However, one variable, thickness of the body, had a very low CV value (Table 7.16).

Table 7.16. Number of variables with CV values 0–60% for each rim form in the class E sample. 0–10% CV represents the lowest CV values, i.e. a higher level of standardisation, and 50–60% CV represents the highest CV values, i.e. a lower level of standardisation.

	CV (%)	0–10	10–20	20–30	30–40	40–50	50–60
E1a (n = 5)		1	0	1	0	0	1

Source: Compiled by C. Sarjeant.

Standardisation of morphology, decoration and fabric

Several rim forms were studied more closely in order to combine dimensional variables with decorative and fabric variables. Distinct forms that occurred in high proportions in the An Sơn assemblage were selected for this study. The clay matrix compositional data also presented groups (Chapter 6, Part II) that contribute to the following analyses. The included forms are A2a, B1a, C1b and D1a, and considers the variability and standardisation of these forms within each context, either layer/square or burial.

Form A2a

Form A2a is an everted, restricted vessel, commonly appearing with a decorative panel on the shoulder (Figure 5.1). The dimensional, decorative and fabric variables of this form were assessed statistically. The measured variables include angle of the rim, diameter of the rim, length of the rim, thickness of the body, and, thickness of the rim (Figure 7.1). The four previously described statistical methods (PCA, cluster analysis, CVA and CV) were applied to understand the variability and homogeneity in the morphology of the A2a form ceramics. The decorative data were assessed with CV calculations, and the clay matrix compositional data with PCA.

Standardisation of morphology

Principal components analysis

The greatest variability in the following PCA plot (Figure 7.27) is a result of the form's diameter and thickness of the body (Table 7.17). Generally, the PCA plot shows that there is one main cluster, with some outliers from Trench 1 layers 2 and 8. There are no groups associated with any particular layer, but the samples from Trench 1 layers 7 and 8 tend to group together (Figure 7.27). The clusters are clarified in the following hierarchical cluster analysis (Figure 7.28, Table 7.18a, Table 7.18b).

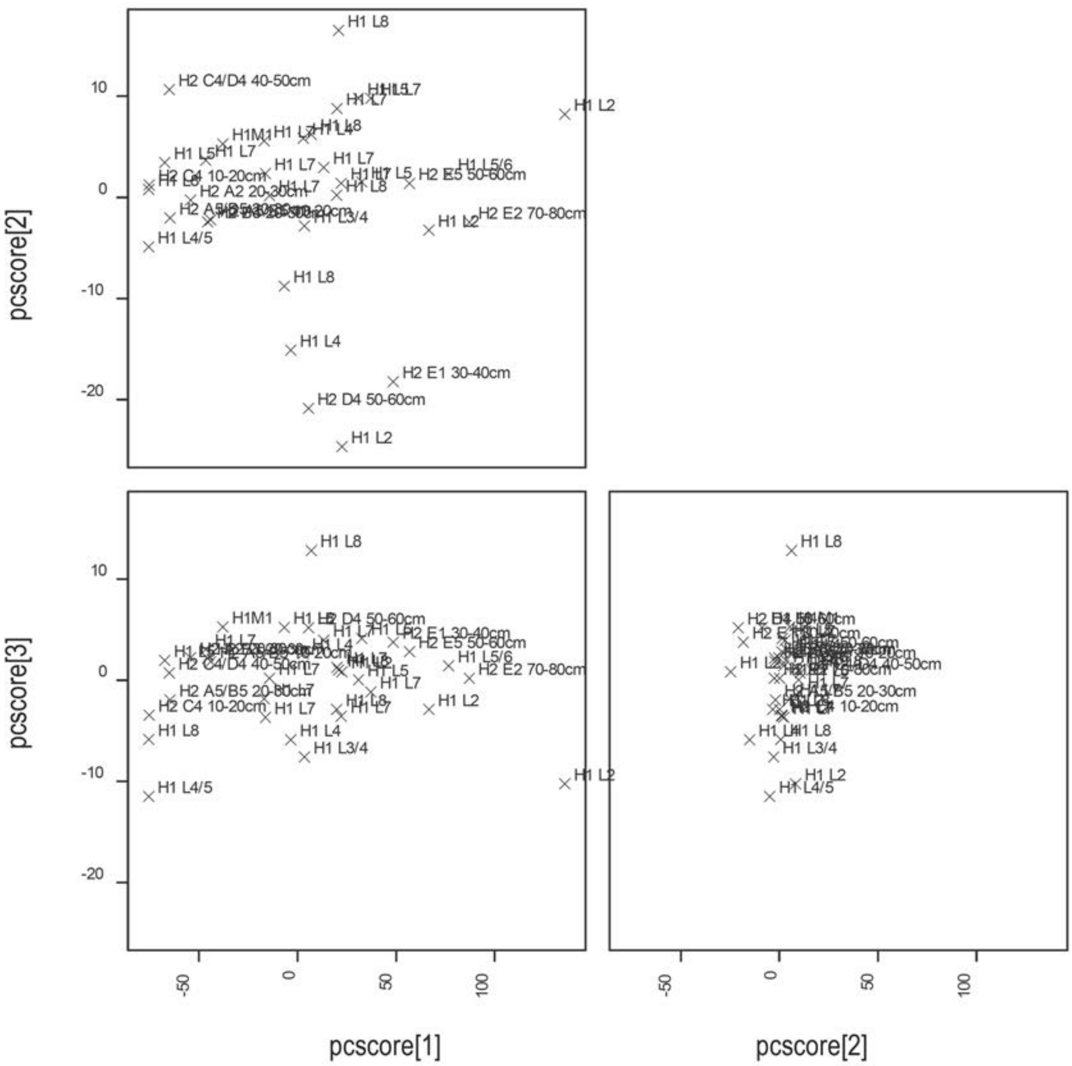


Figure 7.27. PCA plot of form A2a dimensional variables with layers/provenance labelled. First three dimensions. Key: H1 = 2009 Trench 1, H2 = 2009 Trench 2, L = Layer, M = Burial.

Source: C. Sarjeant.

Table 7.17. PCA loadings for Figure 7.27 of form A2a dimensional variables. First three dimensions. The bold values indicate the variables that presented the greatest variability in the PCA.

Variables	PC 1 (96.12%)	PC 2 (2.86%)	PC 3 (0.83%)
Angle of rim (degrees)	0.04199	**0.53170**	**0.84277**
Diameter (mm)	**0.98982**	0.09167	**-0.10562**
Length of rim (mm)	0.13508	**-0.83947**	0.52139
Thickness of body (mm)	**0.00273**	-0.05640	-0.02992
Thickness of rim (mm)	0.01554	0.03152	-0.07641

Source: Compiled by C. Sarjeant.

Hierarchical cluster analysis

The dendrogram was cut at 0.90 (Figure 7.28) to divide the form A2a assemblage into groups. The number of samples within each layer/provenance in these groups is shown in Table 7.18a and Table 7.18b. The cluster analysis illustrates that there is no consistency in the dimensional variables of form A2a within any single layer.

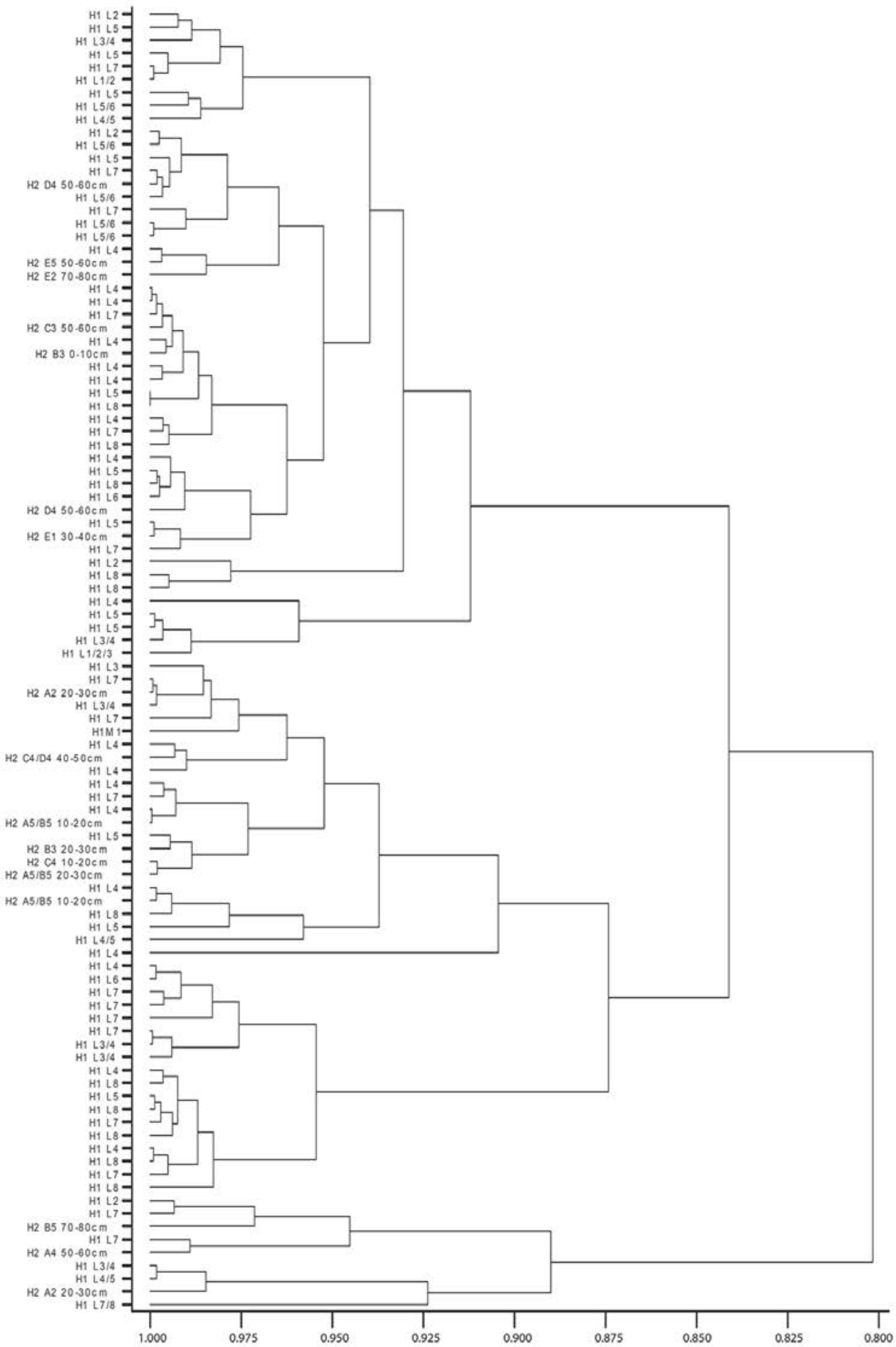


Figure 7.28. Dendrogram of average-linkage hierarchical cluster analysis of form A2a dimensional variables with layers/provenance labelled. Key H1 = 2009 Trench 1, H2 = 2009 Trench 2, L = Layer, M = Burial.

Source: C. Sarjeant.

Table 7.18a. Number of samples in the hierarchical cluster analysis dendrogram groupings by layer/provenance in Figure 7.28 of form A2a dimensional variables when cut at 0.90. Key: H1 = 2009 Trench 1, H2 = 2009 Trench 2, L = Layer, M = Burial: 2009 Trench 1.

Groups (cut at 0.90)	H1 L1/2	H1 L1/2/3	H1 L2	H1 L3	H1 L3/4	H1 L4	H1 L4/5	H1 L5	H1 L5/6	H1 L6	H1 L7	H1 L7/8	H1 L8	H1 M1
1	1	1	3	0	2	9	1	9	5	1	6	0	5	0
2	0	0	0	1	1	6	1	2	0	1	3	0	1	1
3	0	0	0	0	1	3	0	1	0	1	6	0	5	0
4	0	0	1	0	0	0	0	0	0	0	2	0	0	0
5	0	0	0	0	1	0	1	0	0	0	0	1	0	0

Source: Compiled by C. Sarjeant.

Table 7.18b. Number of samples in the hierarchical cluster analysis dendrogram groupings by layer/provenance in Figure 7.28 of form A2a dimensional variables when cut at 0.90. Key: H1 = 2009 Trench 1, H2 = 2009 Trench 2, L = Layer, M = Burial: 2009 Trench 2.

Groups (cut at 0.90)	H2 A2 20–30 cm	H2 A4 50–60 cm	H2 A5/B5 10–20 cm	H2 A5/B5 20–30 cm	H2 B3 0–10 cm	H2 B5 70–80 cm	H2 C3 50–60 cm	H2 C4 10–20 cm	H2 C4/D4 40–50 cm	H2 D4 50-60 cm	H2 E1 30-40 cm	H2 E2 70-80 cm	H2 E5 50-60 cm
1	0	0	0	0	1	0	1	0	0	2	0	1	1
2	1	0	1	2	1	0	0	1	1	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	1	0	0	0	1	0	0	0	0	0	0	0
5	1	0	0	0	0	0	0	0	0	0	0	0	0

Source: Compiled by C. Sarjeant.

Canonical variate analysis

The CVA shows that form A2a samples from Trench 1 layers 7 and 8 cluster together in terms of dimensional variables (Figure 7.29, Table 7.19), as displayed in the previous PCA (Figure 7.27, Table 7.17).

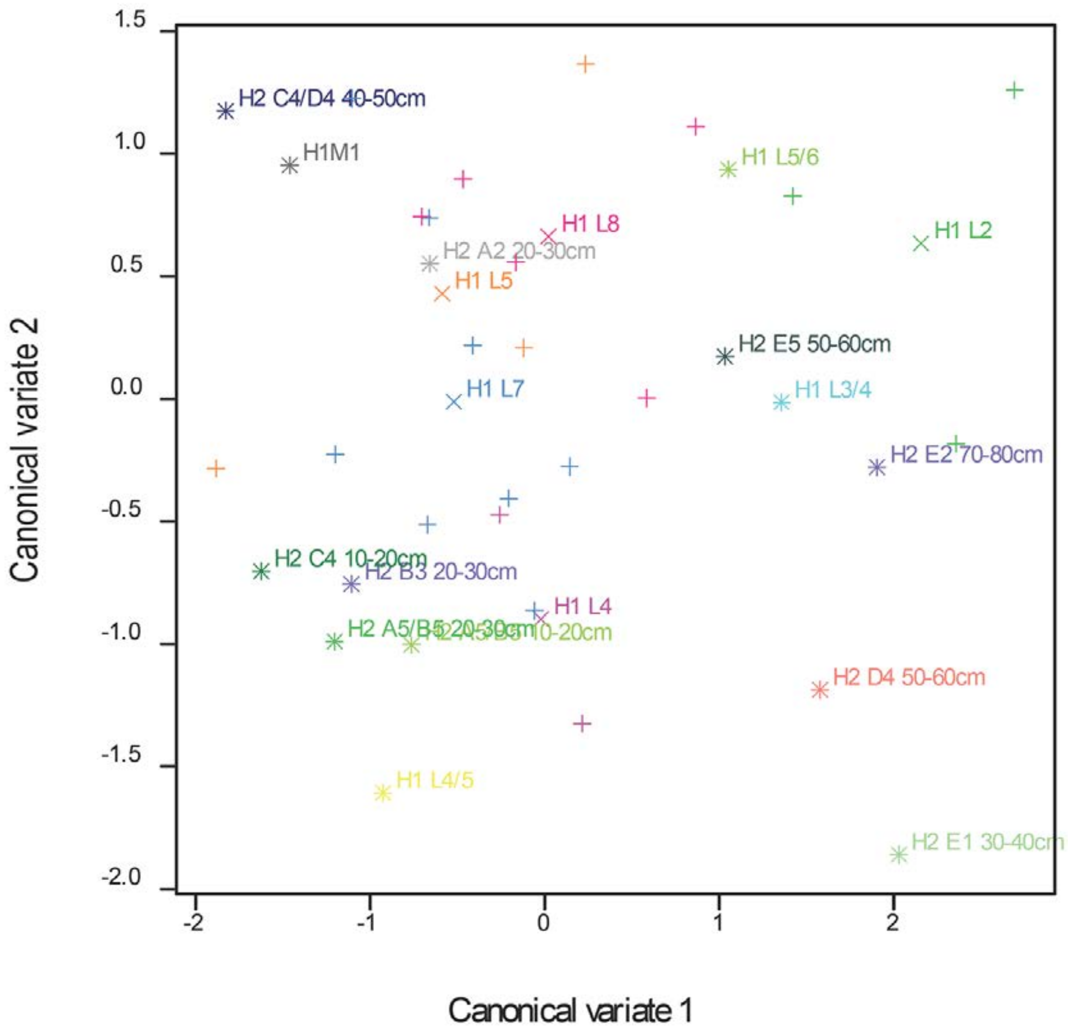


Figure 7.29. CVA plot of form A2a dimensional variables with layers/provenance labelled. First two dimensions. Key: H1 = 2009 Trench 1, H2 = 2009 Trench 2, L = Layer, M = Burial.

Source: C. Sarjeant.

Table 7.19. CVA loadings for Figure 7.29 of form A2a dimensional variables. First three dimensions.

Variables	1 (58.94%)	2 (24.03%)	3 (13.04%)
Angle of rim (degrees)	0.1069	-0.2396	-0.1641
Diameter (mm)	-0.0375	0.0703	0.049
Length of rim (mm)	0.2279	0.4279	-0.2971
Thickness of body (mm)	0.0499	-0.0553	0.0389
Thickness of rim (mm)	0.0118	0.011	0.0016

Source: Compiled by C. Sarjeant.

Coefficient of variation

The CV values were mid-range for all of the dimensional variables. However, the angle of the rim was somewhat lower and thickness of the body somewhat higher, when compared to the other variables. A larger number of form A2a dimensional variables had low CV values in layer 5/6 of

Trench 1, as well as squares A5/B5 and D4 of Trench 2. The CV values of Trench 1 layers 4, 5, 5/6 and 6 were generally lower. These layers represent the mid-sequence when variability within the form A2a assemblage was low (Figure 7.30, Figure 7.31).

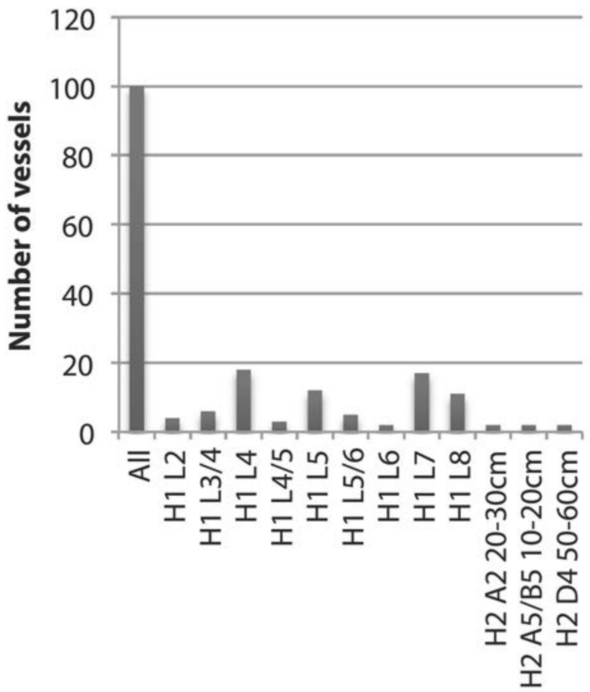


Figure 7.30. Number of form A2a samples of each layer/provenance in the study of standardisation. Key: H1 = 2009 Trench 1, H2 = 2009 Trench 2, L = Layer.

Source: C. Sarjeant.

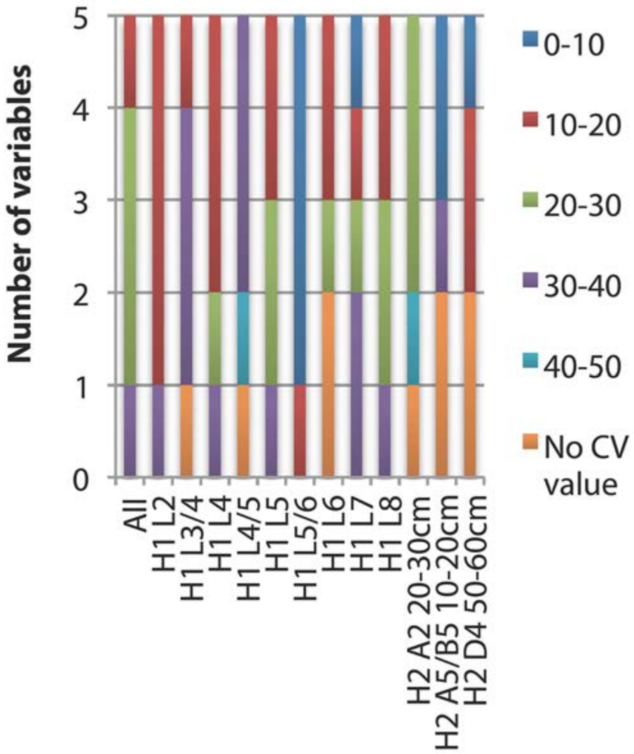


Figure 7.31. Number of variables with CV values 0–50% for each layer/provenance in the form A2a sample. 0–10% CV represents the lowest CV values, i.e. a higher level of standardisation, and 40–50% CV represents the highest CV values, i.e. a lower level of standardisation. Key: H1 = 2009 Trench 1, H2 = 2009 Trench 2, L = Layer.

Source: Compiled by C. Sarjeant.

Standardisation of decoration

The form A2a vessels were predominantly roulette stamped around the shoulder. These band decorations were recorded by measuring the width of the band dimensions of the impressions within the decoration, and the mode and shape of the decoration. The varieties of roulette stamping, some of which are created by knotting cord around a rolling implement, are shown in Figure 7.32. The width of the band on each of the measured samples is shown in Figure 7.33. Most of the decorative bands were 20–30 mm wide, regardless of the mode and shape of the decoration. The decorative variables were analysed using the statistical method, CV.

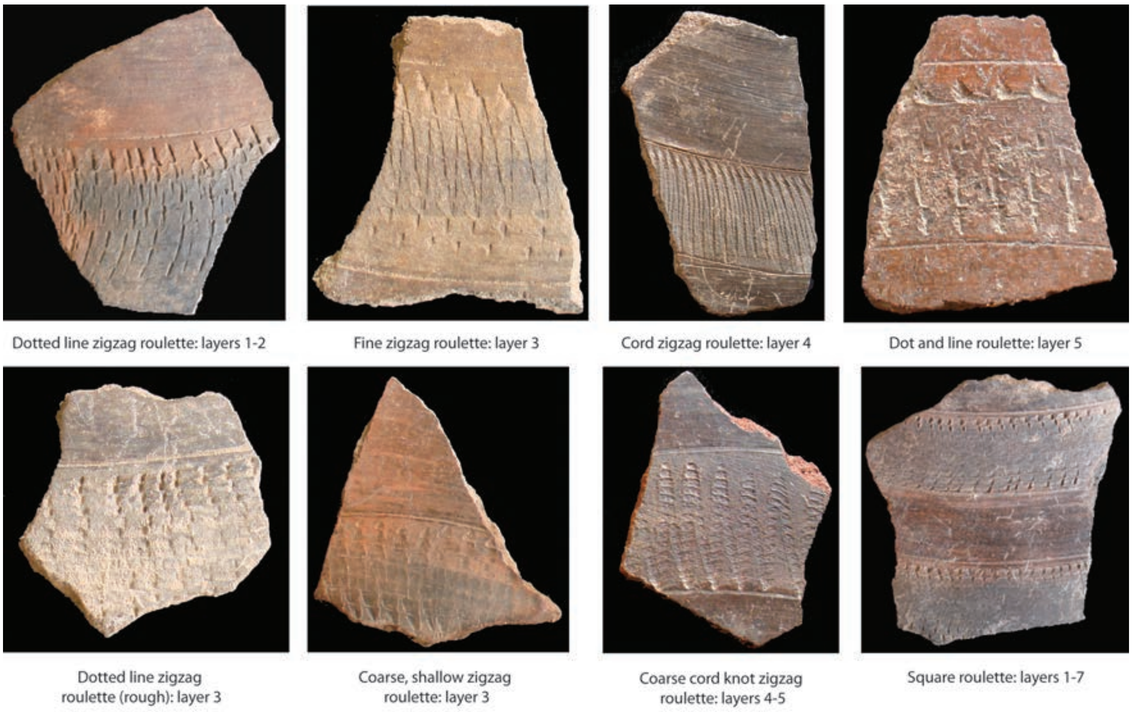


Figure 7.32. Roulette stamped decorations on form A2a vessels. All sherds are from Trench 1. Not to scale.

Source: Photos C. Sarjeant.

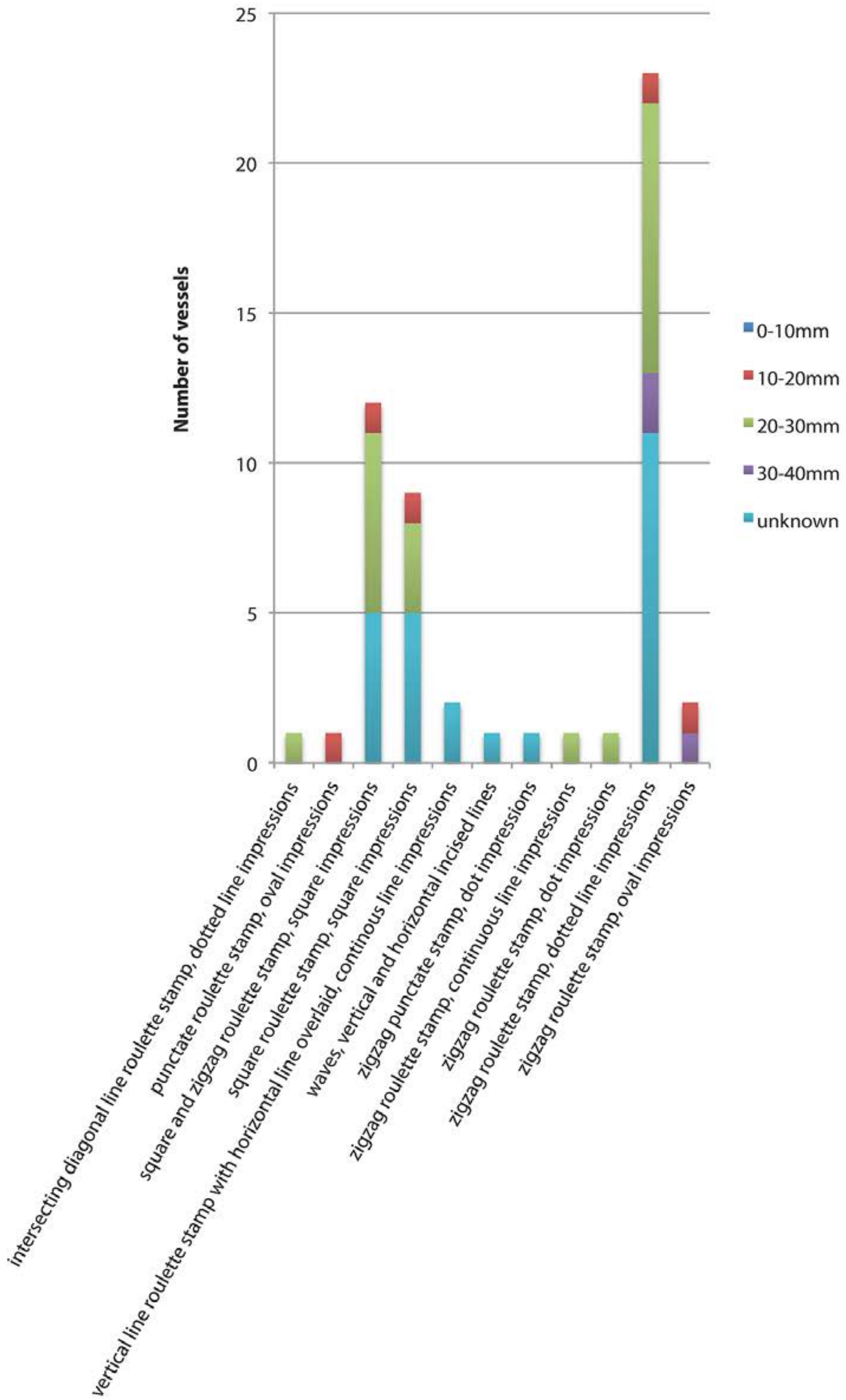


Figure 7.33. Number of form A2a sherds with each mode of decoration and the width (mm) of the decorative band. Total samples=54. Refer to Figure 7.32 for decoration images.

Source: C. Sarjeant.

Coefficient of variation

The CV calculation for the decorative variables on the A2a vessels was conducted in a similar manner as for dimensional variables.

The decorative variables included:

- mode of decoration: continuous line, dot impression, oval impression, square impression, dotted line, incision
- shape of decoration: square roulette stamping, square and zigzag roulette stamping, zigzag roulette stamping, zigzag punctate stamping, intersecting diagonal line roulette stamping, wave and line incision, vertical line roulette stamping with horizontal line overlaid, punctate roulette stamping (some examples are shown in Figure 7.32)
- width of the decorative band
- size of the space between each horizontal decoration point
- size of the space between each vertical decoration point within the band
- number of vertical rows within the band when present.

Generally, decorative variables were calculated to mid to high CV values, although the width of the band variable had a lower CV value. The CV values indicated a high degree of variation within the decorations of A2a vessels. This implies the use of individual implements for applying these decorative bands. That is, each potter had their own implement with a unique pattern. Alternatively, highly perishable throwaway items were only used once or twice to decorate a vessel, before being discarded. The CV values were slightly lower for the square and zigzag roulette stamp decorated samples in comparison to the other modes and shapes of decoration on the form A2a vessels (Figure 7.34, Figure 7.35).

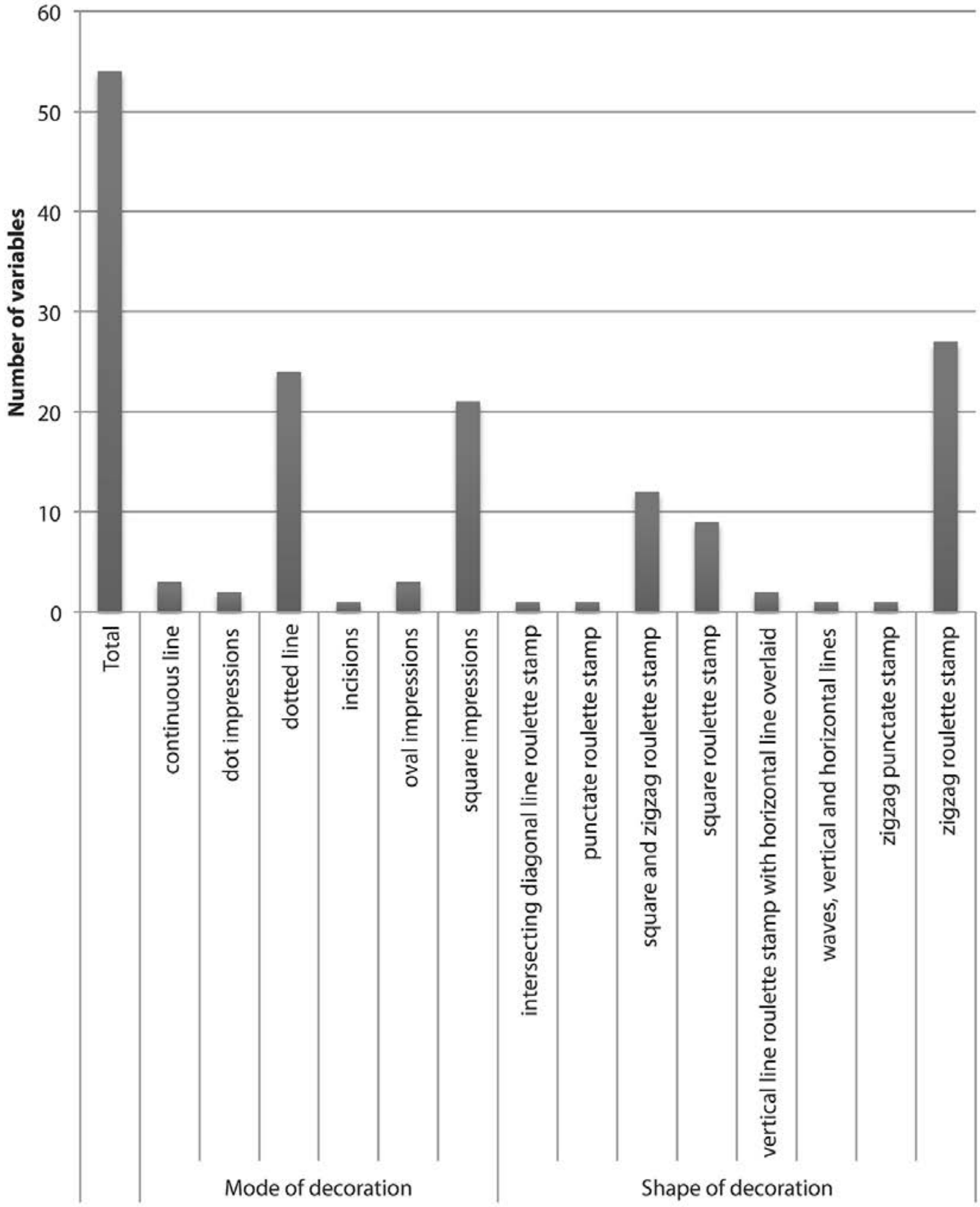


Figure 7.34. Number of form A2a samples with each mode or shape of decoration in the study of standardisation. One mode and one shape of decoration were identified for each sample. Total samples = 54. Refer to Figure 7.32 for decoration images.

Source: C. Sarjeant.

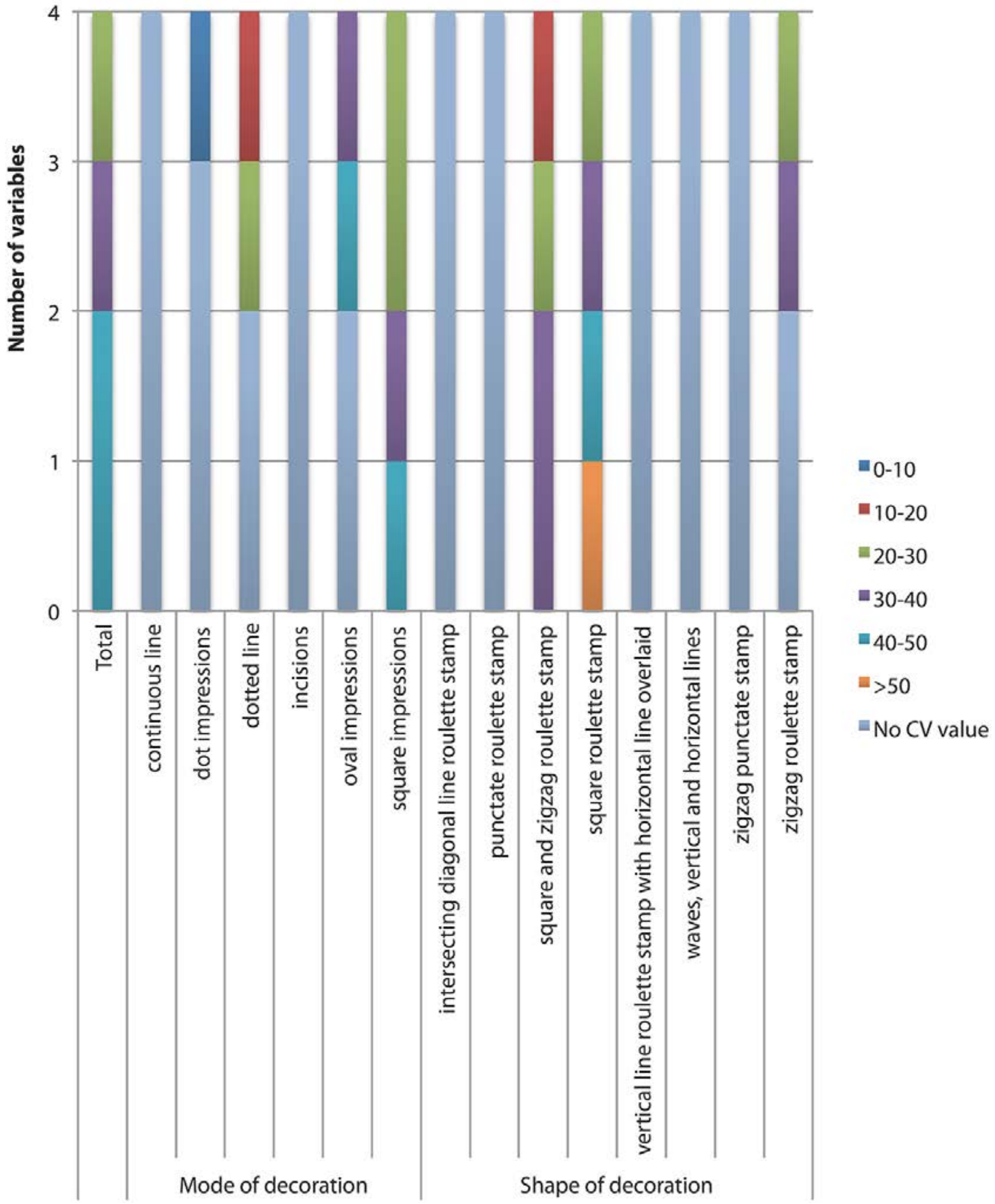


Figure 7.35. Number of variables with CV values 0–>50% for decorative mode or shape in the form A2a sample. 0–10% CV represents the lowest CV values, i.e. a higher level of standardisation, and 40–50% CV represents the highest CV values, i.e. a lower level of standardisation. One mode and one shape of decoration were identified for each sample. Total samples = 54. Refer to Figure 7.32 for decoration images.

Source: C. Sarjeant.

Standardisation of fabrics

The fabric analyses of temper and the clay matrix (Chapter 6) showed that there was consistency in the selection of sand tempers, TG A1-1, TG A1-2 and TG A1-5, for form A2a vessels. These temper groups contained sands of quartz and alkali feldspar; quartz, alkali feldspar and plagioclase feldspar; and quartz, alkali feldspar and amphibole, respectively. The clay matrix compositional data for the sampled form A2a rim and roulette decorated body sherds indicates homogeneity in the PCA plot, with the exception of one sherd from Trench 1 layer 5/6. The greatest variability was evident in the magnesium and sodium oxides variables (Figure 7.36, Table 7.20).

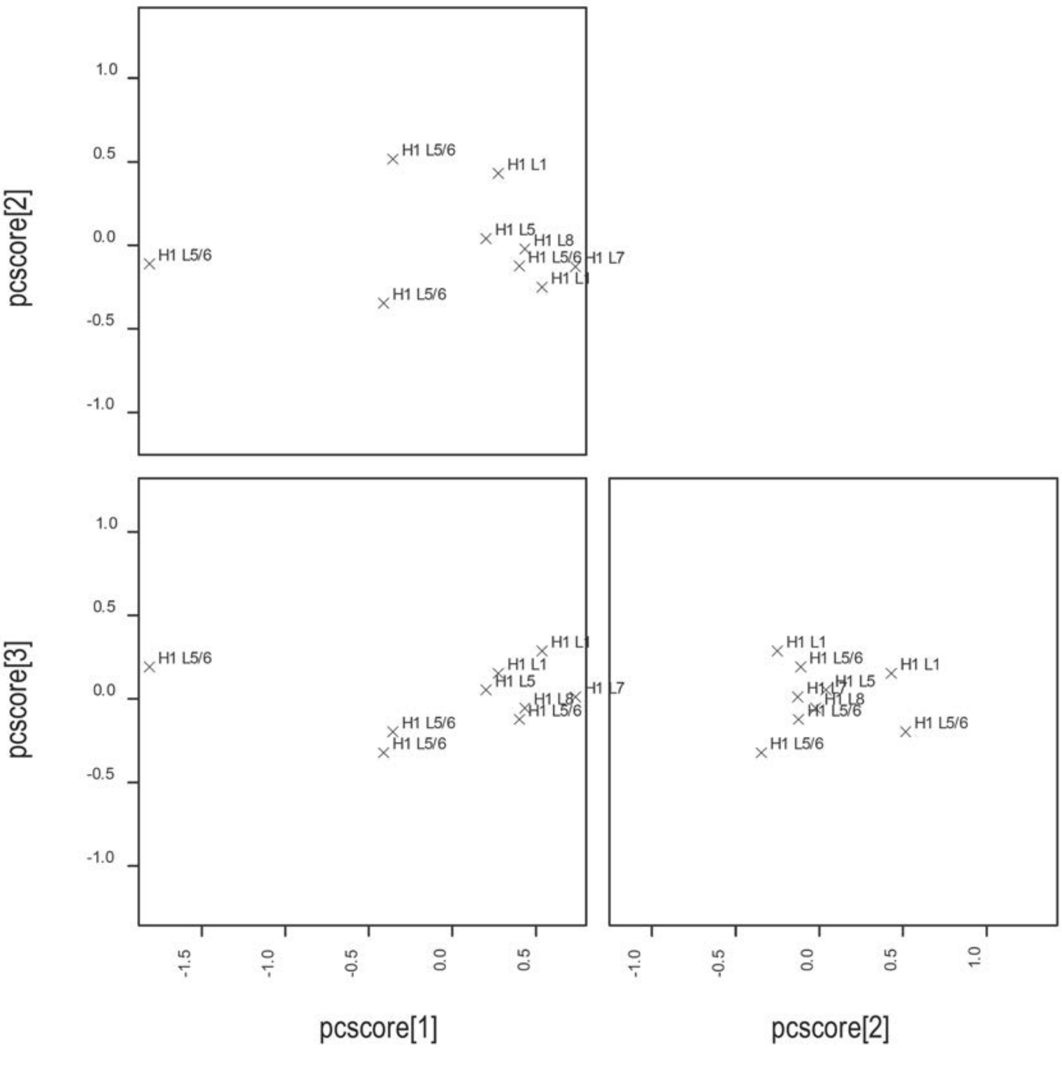


Figure 7.36. PCA plot of form A2a clay matrix composition with layers/provenance labelled. First three dimensions. Key: H1 = 2009 Trench 1, L = Layer.

Source: C. Sarjeant.

Table 7.20. PCA loadings for Figure 7.36 of form A2a clay matrix composition. First three dimensions. The bold values indicate the variables that presented the greatest variability in the PCA.

Variables	**PC 1 (79.42%)**	**PC 2 (11.10%)**	**PC 3 (4.98%)**
CaO	0.03276	0.27122	**0.42444**
FeO	0.05760	-0.18626	**-0.69495**
K2O	0.56883	**-0.59525**	0.01447
MgO	**-0.07147**	0.09223	-0.28644
Na2O	**0.81609**	0.40277	0.00919
SiO2	0.02244	0.42560	0.00956
TiO2	0.02039	**0.43077**	-0.50445

Source: Compiled by C. Sarjeant.

Summary of form A2a standardisation analysis

The statistical analyses of form A2a vessels appear to have mid-range levels of standardisation, indicating there was variation in their manufacture. It is possible that many individuals who had knowledge of this widespread form manufactured this vessel locally at An Sơn (see Chapters 8 and 9). The basic morphology and fabrics were similar across the A2a form, but there was substantial variation in the measured dimensional and decorative variables, implying a variety of functions (inferred from the range in sizes) made by a number of individuals (inferred from the range of decorative modes and shapes).

Form B1a

Form B1a is a simple, restricted bowl-shaped vessel with an inverted, thickened rim. The surface treatment is commonly cord-marked on the body (Figure 5.1). The morphological and fabric variables were assessed statistically. The measured variables include angle of the rim, diameter of the rim, thickness of the body, and thickness of the rim (Figure 7.1). Once again, the four previously described statistical methods (PCA, cluster analysis, CVA and CV) are applied to understand the variability and homogeneity in the morphology of the B1a form ceramics. The clay matrix compositional data were assessed using PCA.

Standardisation of morphology

Principal components analysis

The PCA (Figure 7.37) of form B1a presents variability in the first principal component only, primarily in the angle of the rim and diameter (Table 7.21). There are few major outliers in the PCA plots, except for one sherd from Trench 1 layers 5 and 8 and two sherds from Trench 1 burial 2 (H1M2). The remaining sherds more or less cluster together (Figure 7.37). The clusters are clarified in the following hierarchical cluster analysis (Figure 7.38, Table 7.22).

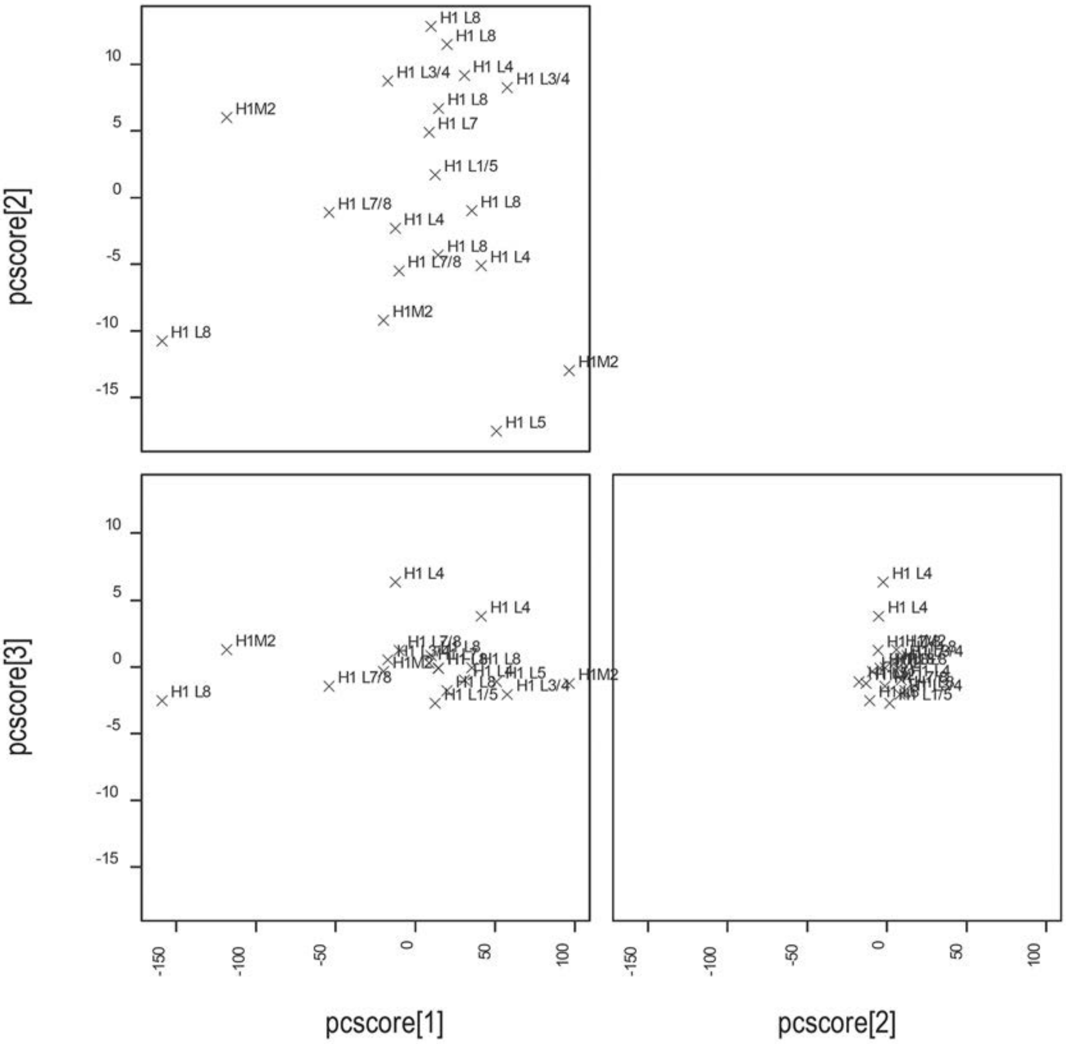


Figure 7.37. PCA plot of form B1a dimensional variables with layers/provenance labelled. First three dimensions. Key: H1 = 2009 Trench 1, L = Layer, M = Burial.

Source: C. Sarjeant.

Table 7.21. PCA loadings for Figure 7.37 of form B1a dimensional variables. First three dimensions. The bold values indicate the variables that presented the greatest variability in the PCA.

Variables	PC 1 (97.69%)	PC 2 (2.14%)	PC 3 (0.13%)
Angle of rim (degrees)	**0.03226**	**0.99931**	**-0.01740**
Diameter (mm)	**-0.99944**	0.03238	0.00346
Thickness of body (mm)	-0.00586	**0.00112**	0.38273
Thickness of rim (mm)	0.00678	0.01823	**0.92369**

Source: Compiled by C. Sarjeant.

Hierarchical cluster analysis

The dendrogram was cut at 0.90 (Figure 7.28) to divide the form B1a assemblage into groups. The number of sherds within each layer/provenance in these groups appear in Table 7.22. There is very little evidence to suggest that B1a vessels from similar contexts had similar dimensions in the cluster analysis, except perhaps for those from Trench 1 layers 7/8 and 8, which cluster together in groups 2 and 3 (Table 7.22).

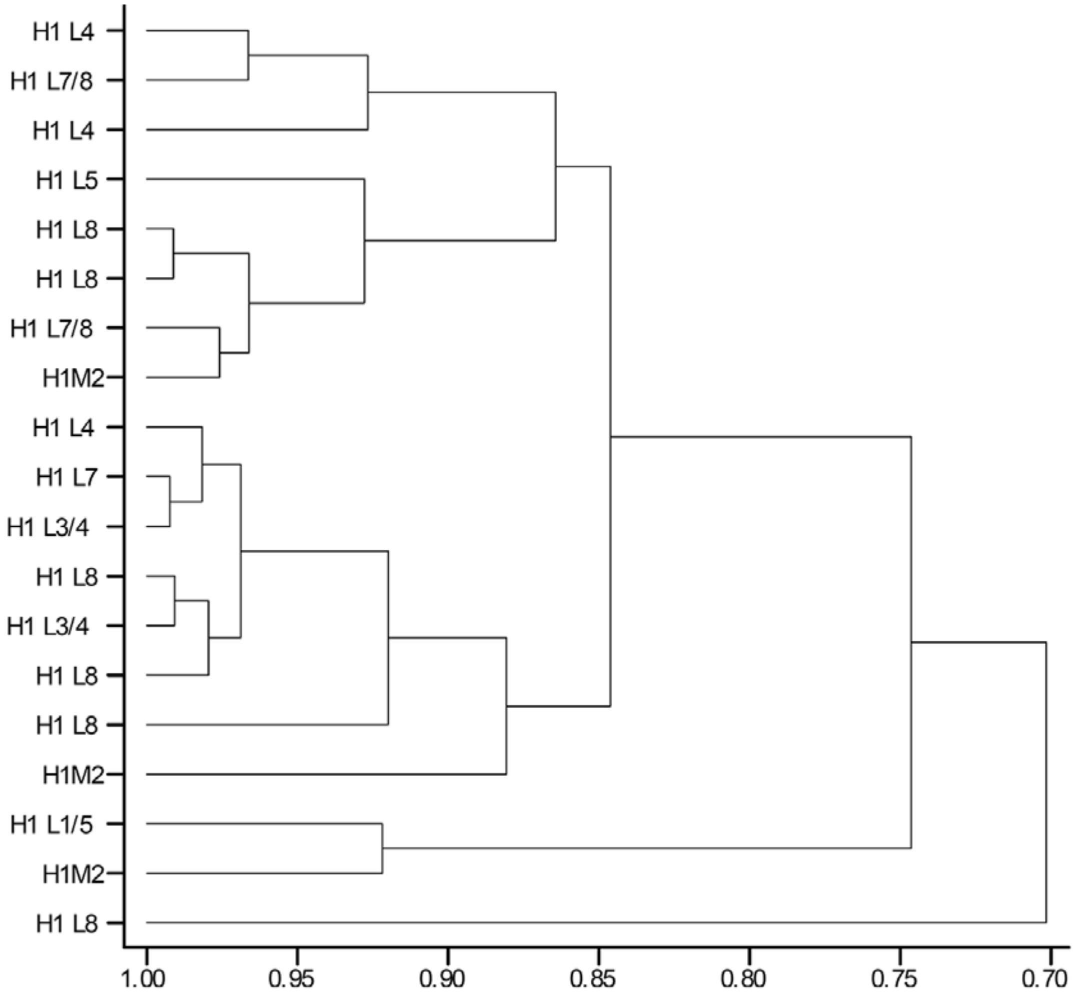


Figure 7.38. Dendrogram of average-linkage hierarchical cluster analysis of form B1a dimensional variables with layers/provenance labelled. Key: H1 = 2009 Trench 1, L = Layer, M = Burial.

Source: C. Sarjeant.

Table 7.22. Number of samples in the hierarchical cluster analysis dendrogram groupings by layer/provenance in Figure 7.38 of form B1a dimensional variables when cut at 0.90. Key: H1 = 2009 Trench 1, L = Layer M = Burial.

Groups (cut at 0.90)	H1 L1/5	H1 L3/4	H1 L4	H1 L5	H1 L7	H1 L7/8	H1 L8	H1M2
1	0	0	2	0	0	1	0	0
2	0	0	0	1	0	1	2	1
3	0	2	1	0	1	0	3	0
4	0	0	0	0	0	0	0	1
5	1	0	0	0	0	0	0	1
6	0	0	0	0	0	0	1	0

Source: Compiled by C. Sarjeant.

Canonical variate analysis

The CVA shows that the form B1a sherds from Trench 1 burial 2 (H1M2) are homogeneous in dimensions, which are plotted alongside the sherds from Trench 1 layers 7/8 and 8. The sherds from the middle to upper layers present greater variation in the CVA (Figure 7.39, Table 7.23).

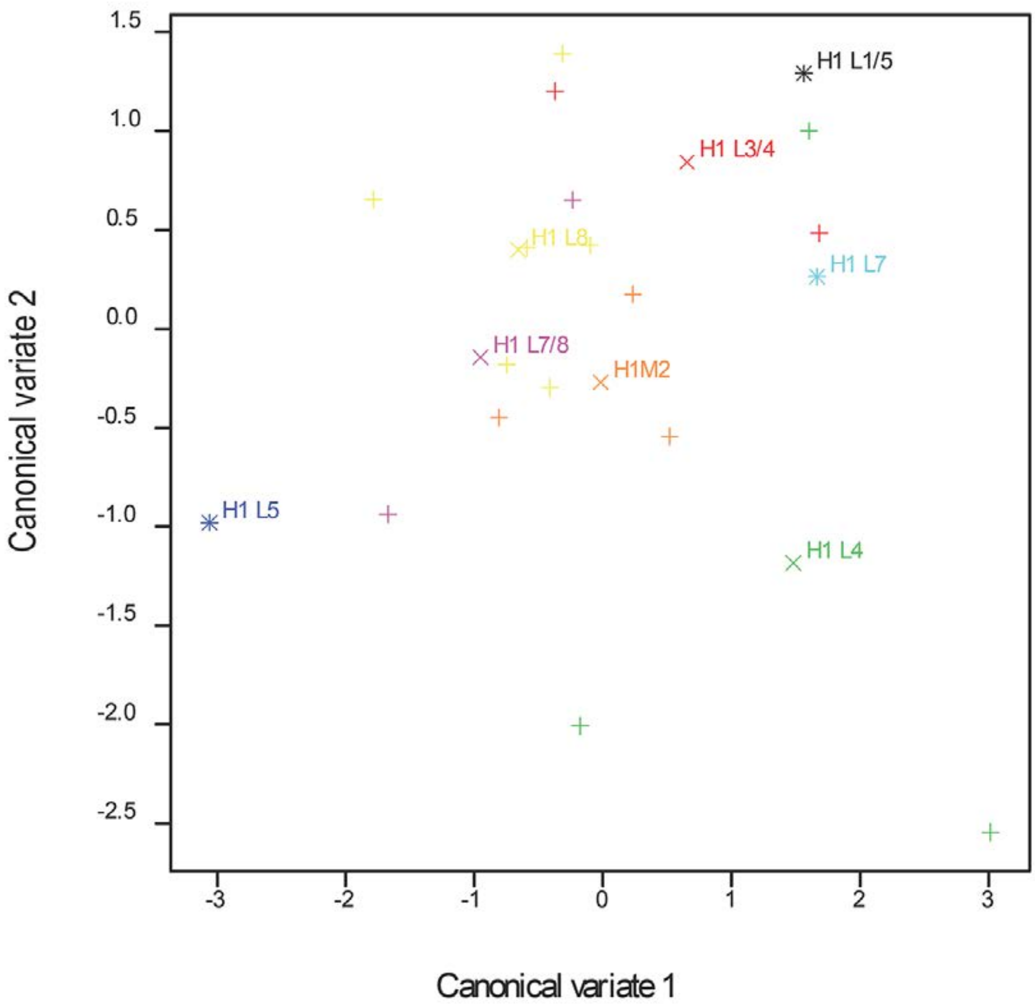


Figure 7.39. CVA plot of form B1a dimensional variables with layers/provenance labelled. First two dimensions. Key: H1 = 2009 Trench 1, L = Layer, M = Burial.

Source: C. Sarjeant.

Table 7.23. CVA loadings for Figure 7.39 of form B1a dimensional variables. First two dimensions.

Variables	1 (61.83%)	2 (22.34%)	3 (12.50%)
Angle of inverted aspect (degrees)	0.6068	-0.3412	-0.0056
Diameter (mm)	0.0658	0.0748	0.0725
Thickness of body (mm)	-0.824	-0.2066	0.516
Thickness of rim (mm)	0.0089	0.0038	0.0011

Source: Compiled by C. Sarjeant.

Coefficient of variation

The angle of the rim was always calculated with a low CV value for form B1a, while the diameter and thickness of the body were often higher. There were a large number of variables with low CV values in the samples from Trench 1 burial 2 (H1M2) and Trench 1 layers 7/8 and 8, indicating less variability in form B1a in these contexts (Figure 7.40, Figure 7.41).

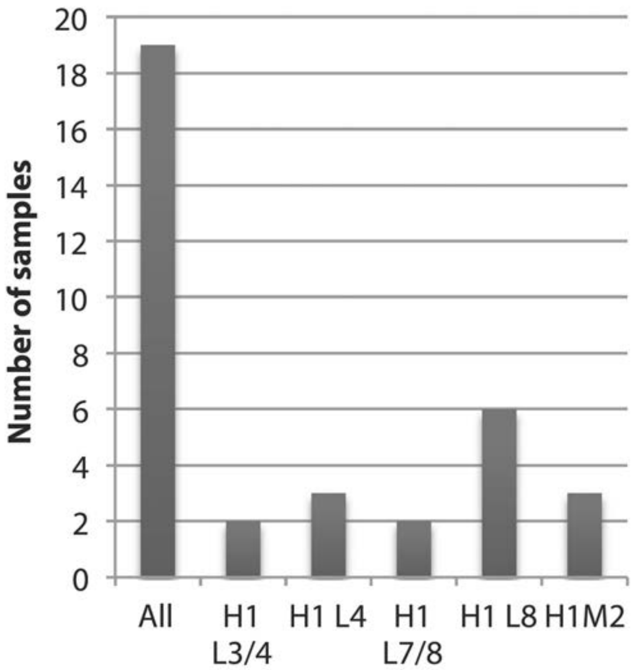


Figure 7.40. Number of form B1a samples of each layer/provenance in the study of standardisation. Key: H1 = 2009 Trench 1, L = Layer, M = Burial.

Source: C. Sarjeant.

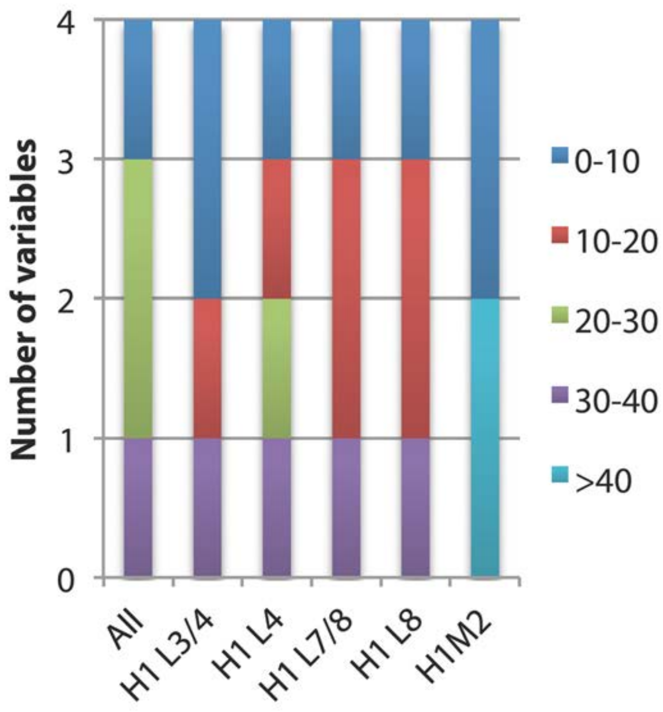


Figure 7.41. Number of variables with CV values 0–>40% for each layer/provenance in the form B1a sample. 0–10% CV represents the lowest CV values, i.e. a higher level of standardisation, and 30–40% CV represents the highest CV values, i.e. a lower level of standardisation. Key: H1 = 2009 Trench 1, L = Layer, M = Burial.

Source: C. Sarjeant.

Standardisation of fabrics

The B1a vessels were either tempered predominantly with fibre (TG B-1), with sand and trace amounts of fibre (TG A1-8), or a mix of quartz mineral sand with fibre (TG A1/B-2) (see Chapter 6, Part I). The PCA plot (Figure 7.42) of the clay matrix compositional data presents greatest variability in the iron and sodium oxide concentrations (Table 7.24). The second and third principal components also contributed to variability in the PCA, as observed in the sodium and silicon, and calcium and iron oxides (Table 7.24). The PCA shows there was no great similarity in the form B1a sherds in terms of the clay matrix composition (Figure 7.42). However, the CVA of all rim sherds (see Chapter 6, Part II) showed that the form B1a sherds cluster together, although they were outliers in comparison to the cluster of A2a, D1a and D1b forms (see Figure 6.38).

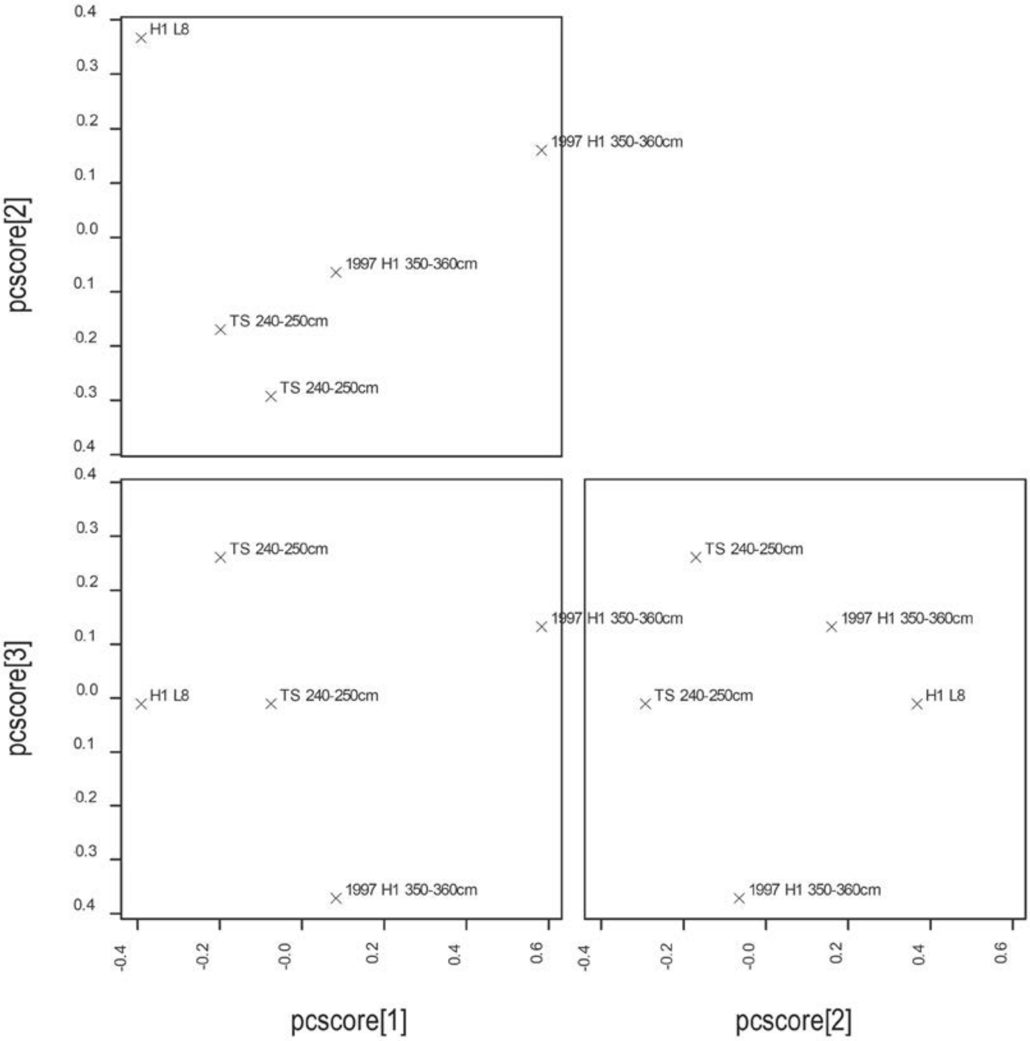


Figure 7.42. PCA plot of form B1a clay matrix composition with layers/provenance labelled. First three dimensions. Key: H1 = 2009 Trench 1, TS = 2009 Test Square, 1997 H1 = 1997 Trench 1, L = Layer.

Source: C. Sarjeant.

Table 7.24. PCA loadings for Figure 7.42 of form B1a clay matrix composition. First three dimensions. The bold values indicate the variables that presented the greatest variability in the PCA.

Variables	**PC 1 (51.63%)**	**PC 2 (26.44%)**	**PC 3 (21.21%)**
CaO	0.41008	-0.18843	**-0.84190**
FeO	**0.71755**	-0.18945	**0.35177**
K2O	0.01773	0.21492	0.03374
MgO	0.52722	0.42910	0.07097
Na2O	**-0.01729**	**0.79166**	-0.22769
SiO2	0.07207	**-0.25420**	-0.09496
TiO2	0.18217	0.08334	0.31690

Source: Compiled by C. Sarjeant.

Summary of form B1a standardisation analysis

The four statistical analyses presented a similar picture for the manufacture of B1a vessels with regard to dimensional variables. The B1a vessels from earlier in the sequence and from the burial context displayed some homogeneity, however these are not high levels of standardisation when considered against absolute CV measures. Variability in the production of form B1a in the middle to later part of the sequence may be attributed to a general decrease in this form over time; the form was made less frequently, therefore there was less structure or regularity in its manufacture. While there was consistency in the dimensions and morphology of B1a vessels, particularly in the lowest layers, there is little evidence of such consistency in temper and clay selection.

Form C1b

Form C1b is a simple, unrestricted dish-shaped vessel with a direct or inverted rim, and a defined angled shoulder. These vessels are commonly plain (Figure 5.1). The morphological and fabric variables were assessed statistically. The measured variables include angle of the rim, diameter of the rim, thickness of the body, and thickness of the rim (Figure 7.1). Four statistical methods (PCA, cluster analysis, CVA and CV) were applied to understand the variability and homogeneity in the morphology of the C1b form ceramics. The clay matrix compositional data were assessed using PCA.

Standardisation of morphology

Principal components analysis

The greatest variability in the following PCA plot (Figure 7.43) is a result of the angle of the rim and diameter (Table 7.25). There is a centralised cluster of most of the form C1b samples, with some outliers, primarily from Trench 1 layers 3, 4, 4/5, 5/6 and 6, i.e. mid-sequence at An Sơn. The samples from higher and lower layers of Trenches 1 and 2, and those from burial contexts, cluster together in the PCA plot (Figure 7.43). The clusters are clarified in the following hierarchical cluster analysis (Figure 7.44, Table 7.26).

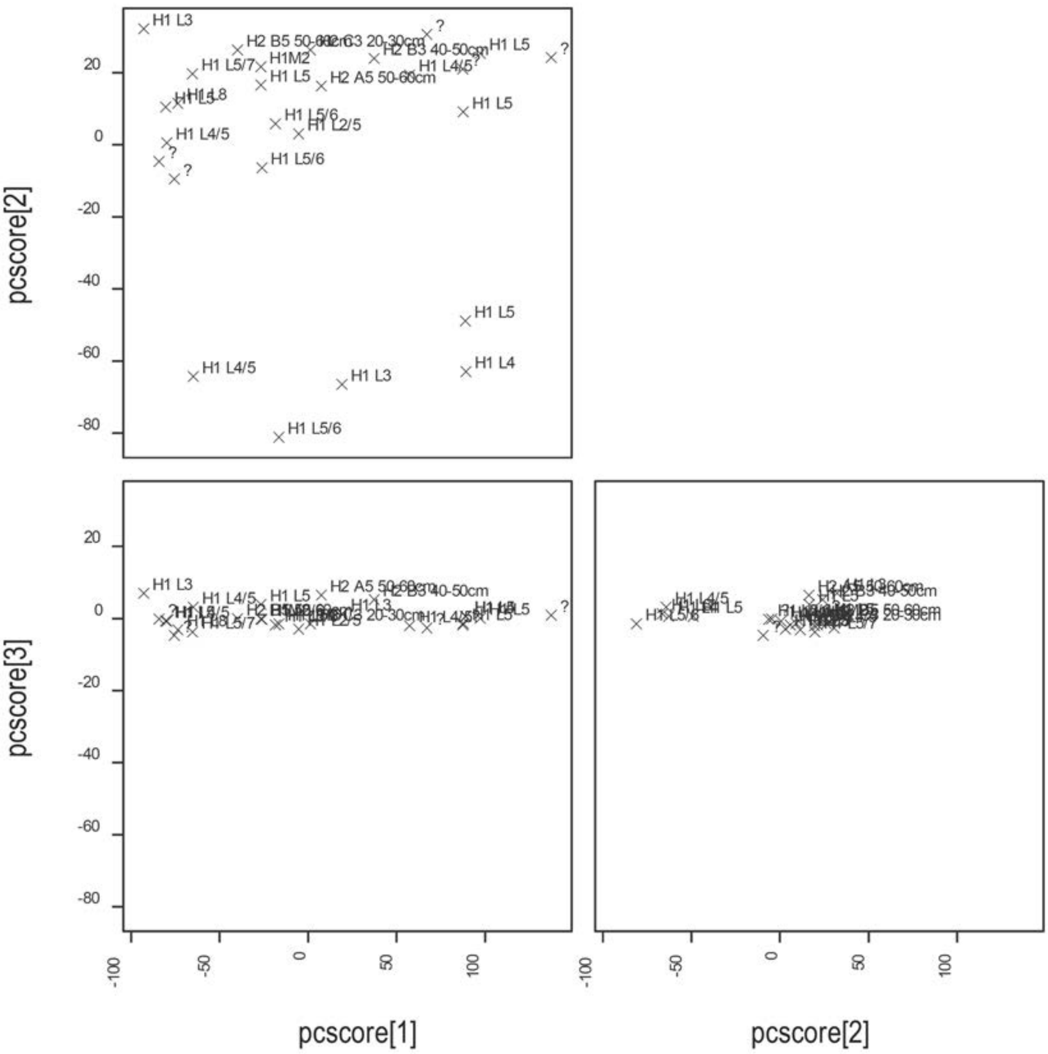


Figure 7.43. PCA plot of form C1b dimensional variables with layers/provenance labelled. First three dimensions. Key: H1 = 2009 Trench 1, H2 = 2009 Trench 2, L = Layer, M = Burial, ? = Unknown context.

Source: C. Sarjeant.

Table 7.25. PCA loadings for Figure 7.43 of form C1b dimensional variables. First three dimensions. The bold values indicate the variables that presented the greatest variability in the PCA.

Variables	PC 1 (80.37%)	PC 2 (19.44%)	PC 3 (0.15%)
Angle of rim (degrees)	**-0.02178**	**0.99952**	0.00169
Diameter (mm)	**0.99962**	0.02149	-0.00989
Thickness of body (mm)	0.01343	0.02232	**-0.02171**
Thickness of rim (mm)	0.01022	**-0.00099**	**0.99971**

Source: Compiled by C. Sarjeant.

Hierarchical cluster analysis

The dendrogram was cut at 0.90 (Figure 7.44) to divide the form C1b assemblage into groups. The number of samples within each layer/provenance in these groups is shown in Table 7.26. The dendrogram displays very little evidence of form C1b samples grouping by context according to dimensional variables. This may be due to the small sample size within each context. However, many of the Trench 1 layer 5 vessels cluster close together in groups 2 to 5 (Table 7.26).

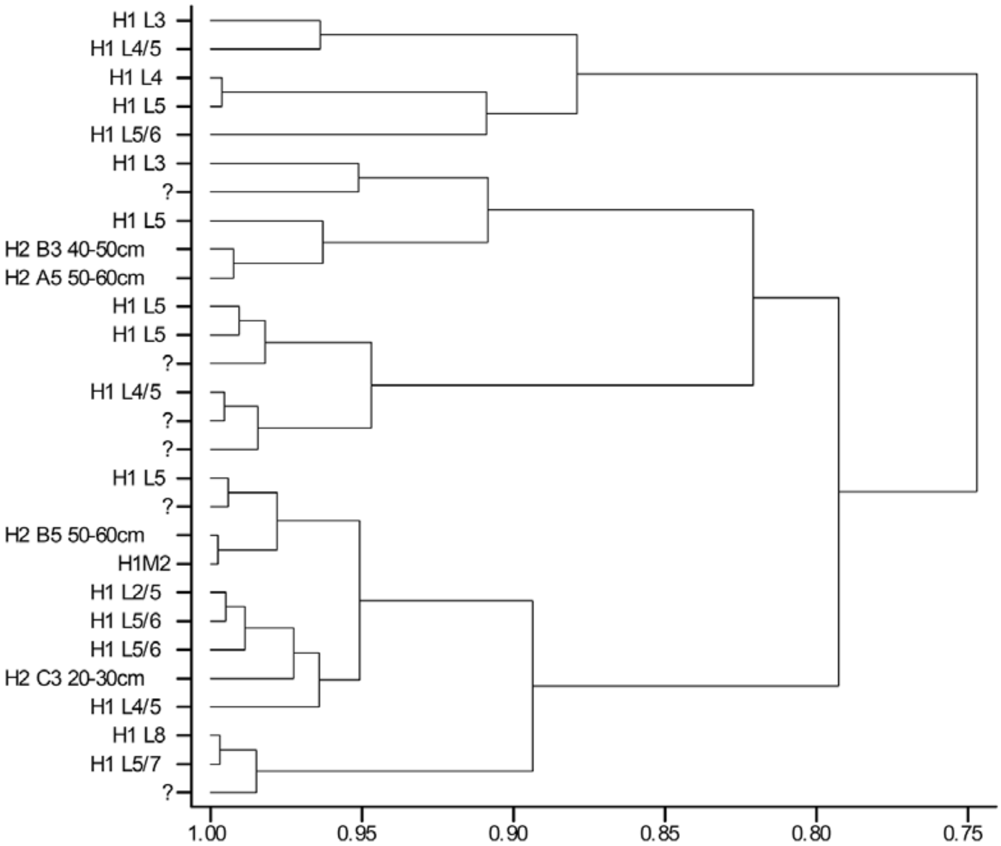


Figure 7.44. Dendrogram of average-linkage hierarchical cluster analysis of form C1b dimensional variables with layers/provenance labelled.Key: H1 = 2009 Trench 1, H2 = 2009 Trench 2, L = Layer, M = Burial, ? = Unknown context.

Source: C. Sarjeant.

Table 7.26. Number of samples in the hierarchical cluster analysis dendrogram groupings by layer/provenance in Figure 7.44 of form C1b dimensional variables when cut at 0.90. Key: H1 = 2009 Trench 1, H2 = 2009 Trench 2, L = Layer, M = Burial.

Groups (cut at 0.90)	H1 L2/5	H1 L3	H1 L4	H1 L4/5	H1 L5	H1 L5/6	H1 L5/7	H1 L8	H1M2	H2 A5 50–60 cm	H2 B3 40–50 cm	H2 B5 50–60 cm	H2 C3 20–30 cm	Unknown context
1	0	1	0	1	0	0	0	0	0	0	0	0	0	0
2	0	0	1	0	1	1	0	0	0	0	0	0	0	0
3	0	1	0	0	1	0	0	0	0	1	1	0	0	1
4	0	0	0	0	3	0	0	0	0	0	0	0	0	3
5	1	0	0	1	1	2	0	0	1	0	0	1	1	1
6	0	0	0	0	0	0	1	1	0	0	0	0	0	1

Source: Compiled by C. Sarjeant.

Canonical variate analysis

The CVA plot shows overlap between the form C1b samples from Trench 1 layers 3, 4, 4/5, 5 and 5/6. The samples from Trench 2 and from Trench 1 layers 5/7 and 8 are outliers. The CVA indicates that there is some homogeneity within the form C1b samples mid-sequence (Fig 7.45, Table 7.27).

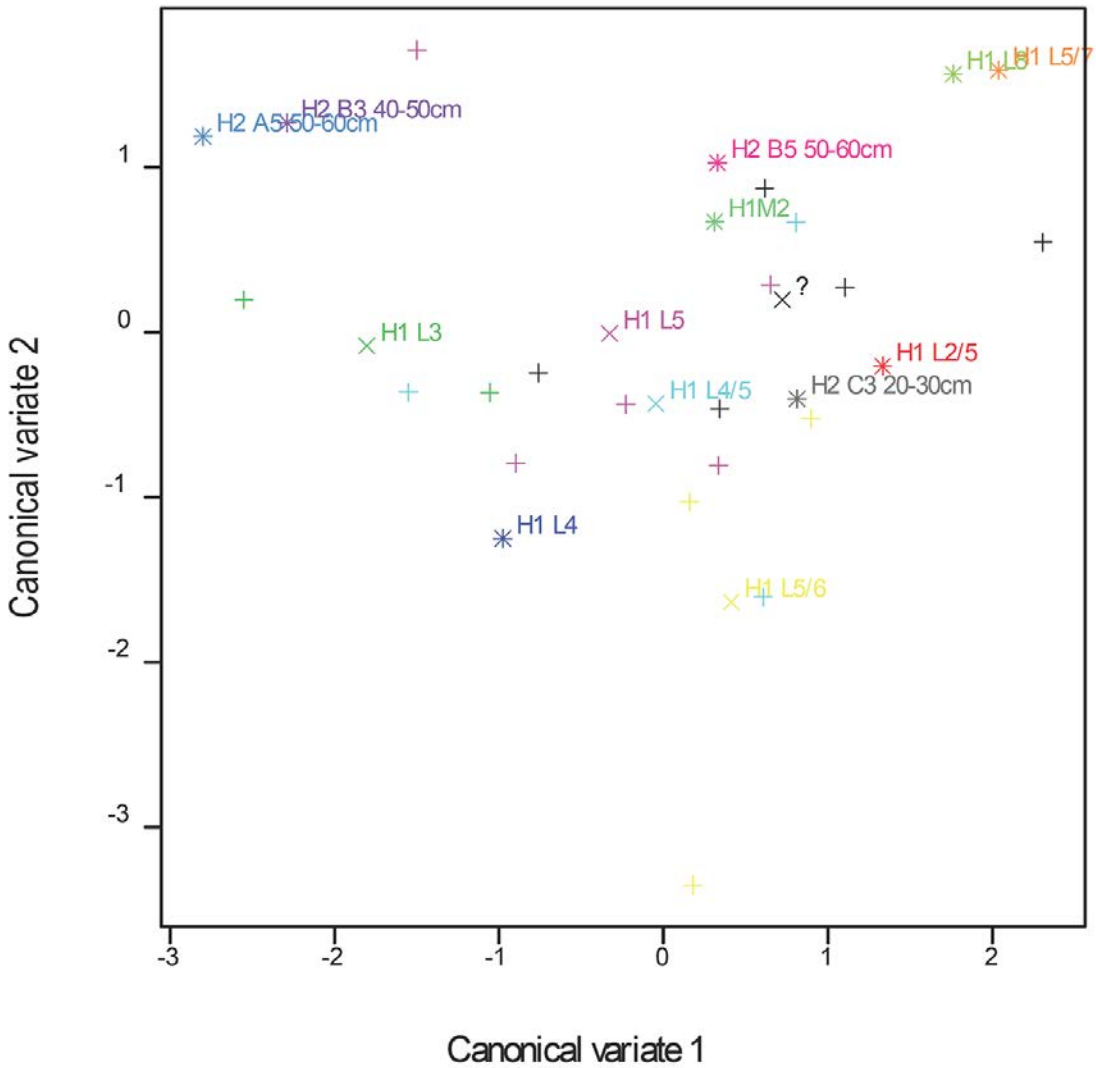


Figure 7.45. CVA plot of form C1b dimensional variables with layers/provenance labelled. First two dimensions. Key: H1 = 2009 Trench 1, H2 = 2009 Trench 2, L = Layer, M = Burial, ? = Unknown context.

Source: C. Sarjeant.

Table 7.27. CVA loadings for Figure 7.45 of form C1b dimensional variables. First two dimensions.

Variables	1 (54.10%)	2 (31.87%)	3 (8.14%)
Angle of rim (degrees)	-0.44349	0.03974	-0.0439
Diameter (mm)	0.0057	0.03271	0.00531
Thickness of body (mm)	0.00394	-0.52347	-0.00723
Thickness of rim (mm)	0.00084	0.00511	0.01243

Source: Compiled by C. Sarjeant.

Coefficient of variation

The CV values of the form C1b dimensional variables were predominantly mid-range, however the angle of the rim and thickness of the body variable had high CV values. The sherds from Trench 1 layer 5/6 had lower CV values for the diameter, thickness of body and thickness of rim variable, suggesting greater homogeneity in the dimensions of C1b vessels from this layer (Figure 7.46, Figure 7.47).

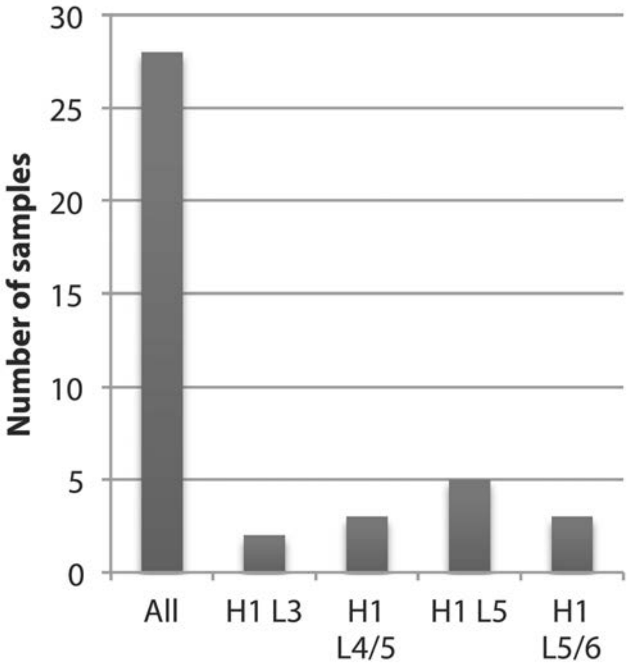


Figure 7.46. Number of form C1b samples of each layer/provenance in the study of standardisation. Key: H1 = 2009 Trench 1, L = Layer.

Source: C. Sarjeant.

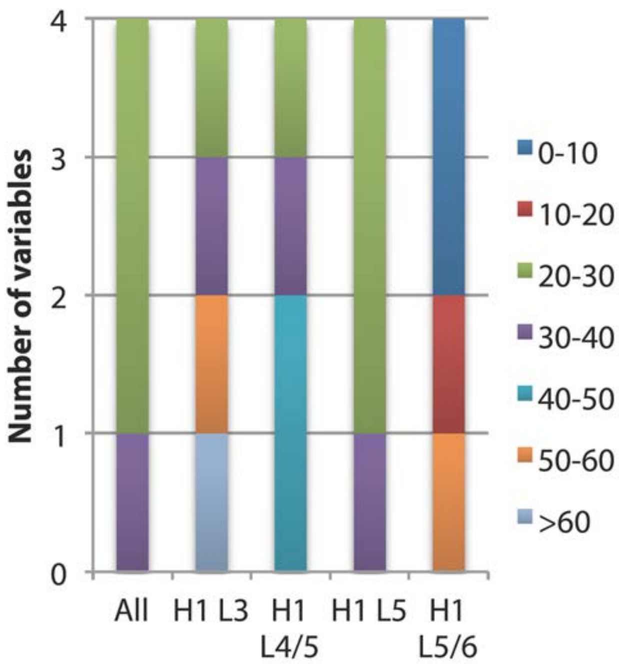


Figure 7.47. Number of variables with CV values 0–>60% for each layer/provenance in the form C1b sample. 0–10% CV represents the lowest CV values, i.e. a higher level of standardisation, and 50–60% CV represents the highest CV values, i.e. a lower level of standardisation. Key: H1 = 2009 Trench 1, L = Layer.

Source: C. Sarjeant.

Standardisation of fabrics

The fabric analyses of temper and the clay matrix (see Chapter 6) showed that there was consistency in the selection of fibre tempers. Many of the fibre tempers also included iron and calcium phosphate sands, (TG B-1, TG B/C-1, TG B/C-2 and TG B/C-3) for C1b vessels. The PCA plot (Figure 7.48) of the clay matrix compositional data displays the greatest variability in calcium, iron and sodium oxides (Table 7.28). There were too few examples to identify any meaningful clustering in the PCA, however the small scale in this PCA plot suggests some compositional homogeneity (Figure 7.48). The PCA and CVA plots in Chapter 6, Part II (Figure 6.35, Figure 6.38) show that C1b vessels tended to cluster together, indicating homogeneity in the clay matrix compositional data.

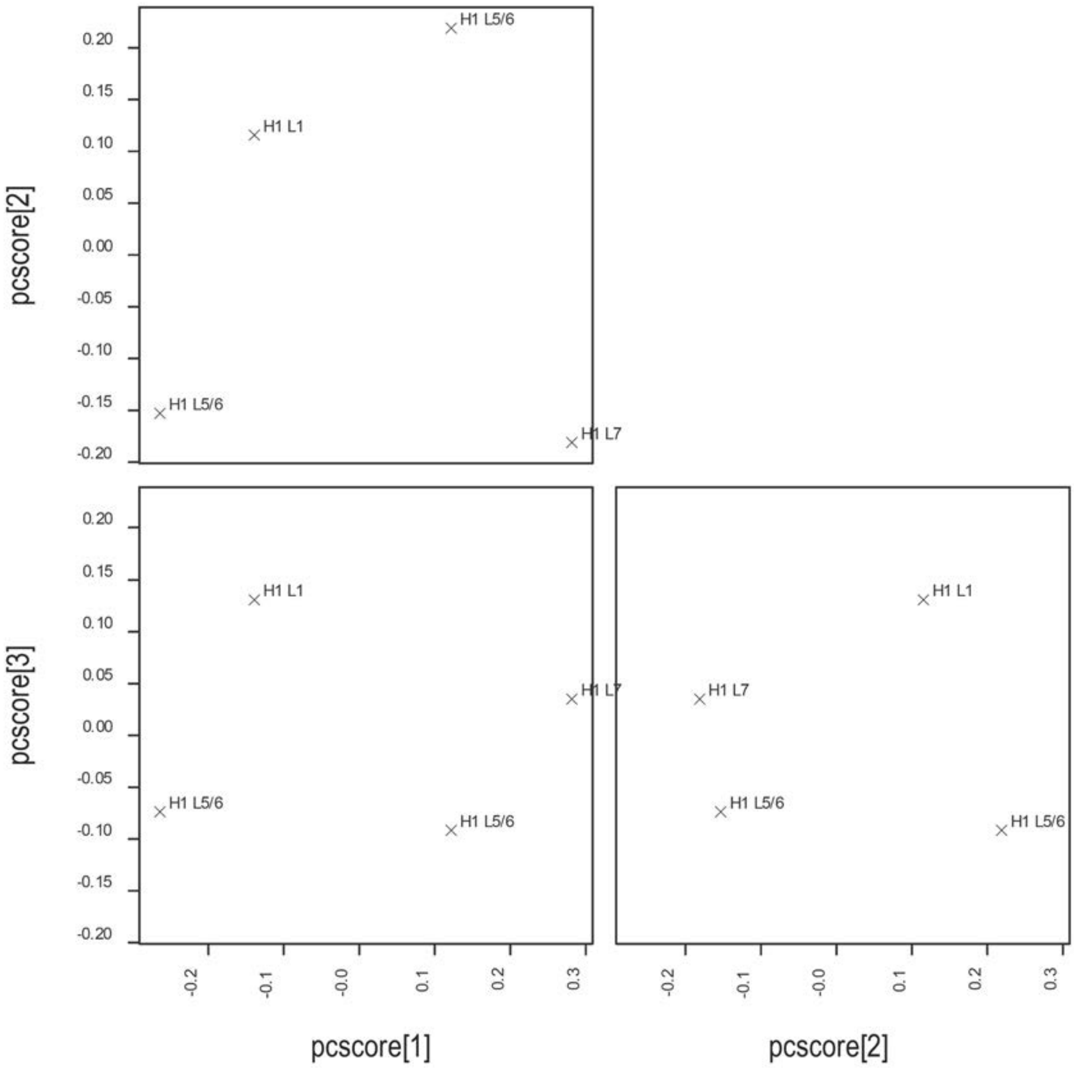


Figure 7.48. PCA plot of form C1b clay matrix composition with layers/provenance labelled. First three dimensions.Key: H1 = 2009 Trench 1, L = Layer.

Source: C. Sarjeant.

Table 7.28. PCA loadings for Figure 7.48 of form C1b clay matrix composition. First three dimensions. The bold values indicate the variables that presented the greatest variability in the PCA.

Variables	PC 1 (55.04%)	PC 2 (35.29%)	PC 3 (9.68%)
CaO	**0.40465**	**0.43414**	0.04846
FeO	**0.38303**	**-0.82541**	**-0.06191**
K_2O	-0.05200	0.15216	0.17504
MgO	0.06815	-0.20169	**0.84590**
Na_2O	**-0.78042**	-0.20388	0.00560
SiO_2	0.18018	0.12462	0.25551
TiO_2	-0.20169	0.09634	0.42698

Source: Compiled by C. Sarjeant.

Summary of form C1b standardisation analysis

The statistical analyses of dimensional variables indicates that C1b vessels were variable, but that homogeneity increased in this form during the middle of the sequence at An Sơn. This was perhaps a result of an increase in production of C1b vessels at this time. The PCA of An Sơn rims (see Chapter 6, Part II) show that C1b vessels tend to cluster together in terms of clay matrix composition, with both the selection of clay and temper homogeneous in the C1b samples analysed.

Form D1a

Form D1a is a simple, unrestricted bowl-shaped vessel with an everted, wavy rim and a defined internal ridge between the rim and body. These vessels are commonly paddle linear impressed or comb incised on the body, and impressions are also usually observed on the waves of the rim (Figure 5.1). The dimensional and fabric variables were assessed statistically. Measured variables include angle of the rim to the internal ridge, diameter of the rim, length of the rim to the internal ridge, height of a single wave, width of a single wave, thickness of the body, and thickness of the rim (Figure 7.1). Once again, the four previously described statistical methods (PCA, cluster analysis, CVA and CV) were applied to understand the variability and homogeneity in the morphology of the D1a form ceramics. The clay matrix compositional data were assessed using PCA.

Standardisation of morphology

Principal components analysis

The greatest variability in the following PCA plot (Figure 7.49) is a result of angle of the rim to the internal ridge and diameter variables (Table 7.29). According to these two variables, two main clusters are evident in the plots. The D1a vessels from burial contexts cluster together in one of these groups (Figure 7.49). The clusters are clarified in the following hierarchical cluster analysis (Figure 7.50, Table 7.30).

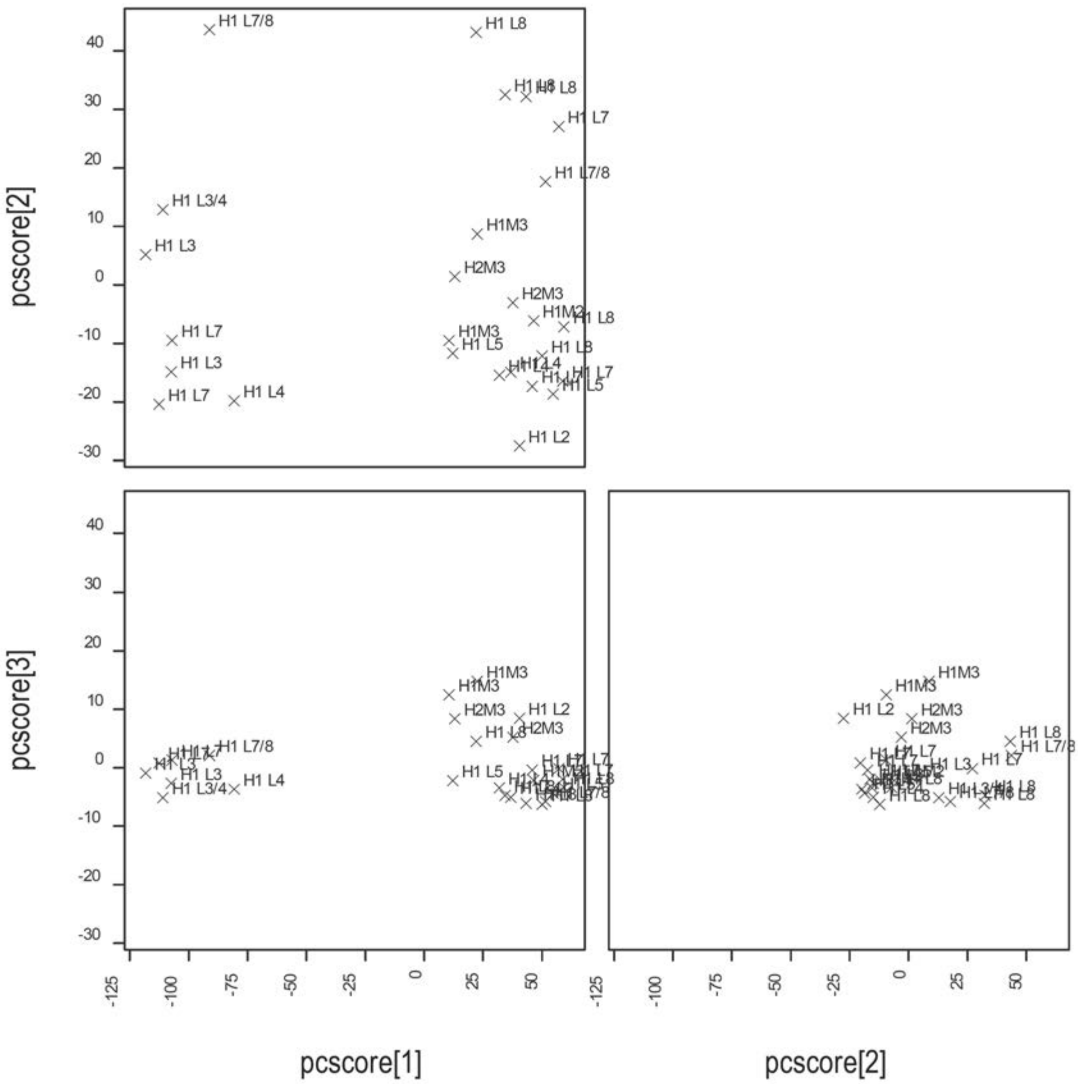


Figure 7.49. PCA plot of form D1a dimensional variables with layers/provenance labelled. First three dimensions. Key: H1 = 2009 Trench 1, H2 = 2009 Trench 2, L = Layer, M = Burial.

Source: C. Sarjeant.

Table 7.29. PCA loadings for Figure 7.49 of form D1a dimensional variables. First three dimensions. The bold values indicate the variables that presented the greatest variability in the PCA.

	PC 1 (90.03%)	**PC 2 (9.00%)**	**PC 3 (0.68%)**
Angle of rim to internal ridge (degrees)	**-0.99832**	0.05160	0.02321
Diameter (mm)	**0.05144**	**0.99693**	0.02078
Length of rim to internal ridge (mm)	0.01849	0.03178	0.42786
Height of single wave (mm)	0.01631	0.00576	0.40207
Width of single wave (mm)	0.00962	**-0.04530**	**0.80394**
Thickness of body (mm)	0.00322	-0.00485	**-0.03109**
Thickness of rim (mm)	-0.00005	-0.01865	0.08377

Source: Compiled by C. Sarjeant.

Hierarchical cluster analysis

The dendrogram was cut at 0.90 (Figure 7.50) to divide the form D1a assemblage into groups. The number of samples within each layer/provenance in these groups is shown in Table 7.30. The dendrogram does not clarify any differences in the dimensional variables according to context, however most of the D1a vessels from burials contexts cluster together in groups 5 and 6 (Table 7.30).

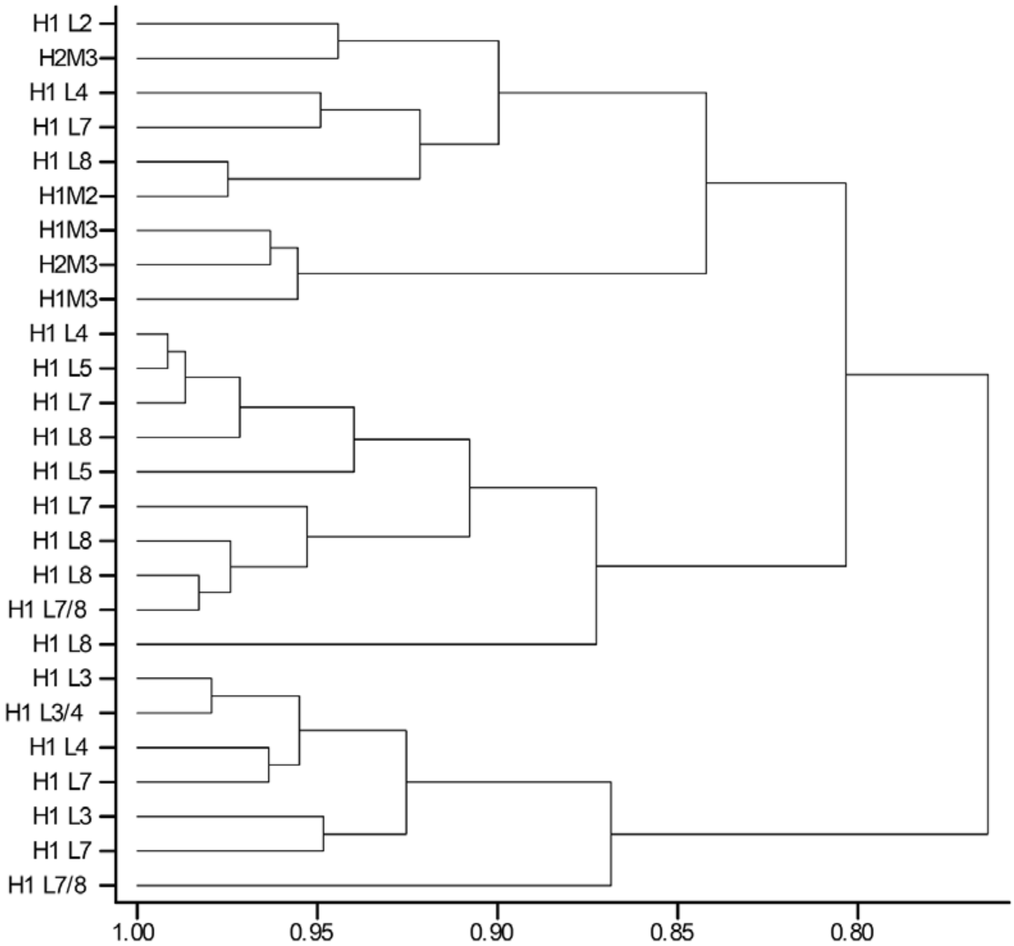


Figure 7.50. Dendrogram of average-linkage hierarchical cluster analysis of form D1a dimensional variables with layers/provenance labelled. Key: H1 = 2009 Trench 1, H2 = 2009 Trench 2, L = Layer, M = Burial.

Source: C. Sarjeant.

Table 7.30. Number of samples in the hierarchical cluster analysis dendrogram groupings by layer/provenance in Figure 7.50 of form D1a dimensional variables when cut at 0.90. Key: H1 = 2009 Trench 1, H2 = 2009 Trench 2, L = Layer, M = Burial.

Groups (cut at 0.90)	**H1 L2**	**H1 L3**	**H1 L3/4**	**H1 L4**	**H1 L5**	**H1 L7**	**H1 L7/8**	**H1 L8**	**H1M2**	**H1M3**	**H2M3**
1	1	0	0	1	0	1	0	1	1	0	1
2	0	0	0	0	0	0	0	0	0	2	1
3	0	0	0	1	2	2	1	3	0	0	0
4	0	0	0	0	0	0	0	1	0	0	0
5	0	2	1	1	0	2	0	0	0	0	0
6	0	0	0	0	0	0	1	0	0	0	0

Source: Compiled by C. Sarjeant.

Canonical variate analysis

The CVA plot indicates that there is a difference in the dimensional variables between those D1a vessels from the mid to upper layers of Trench 1 layers 3, 4, 5 and 7; those from the lower layers, Trench 1 layers 7/8 and 8; and those from burial contexts. These groupings suggest some standardisation in the manufacture of contemporary D1a vessels (Figure 7.51, Table 7.31).

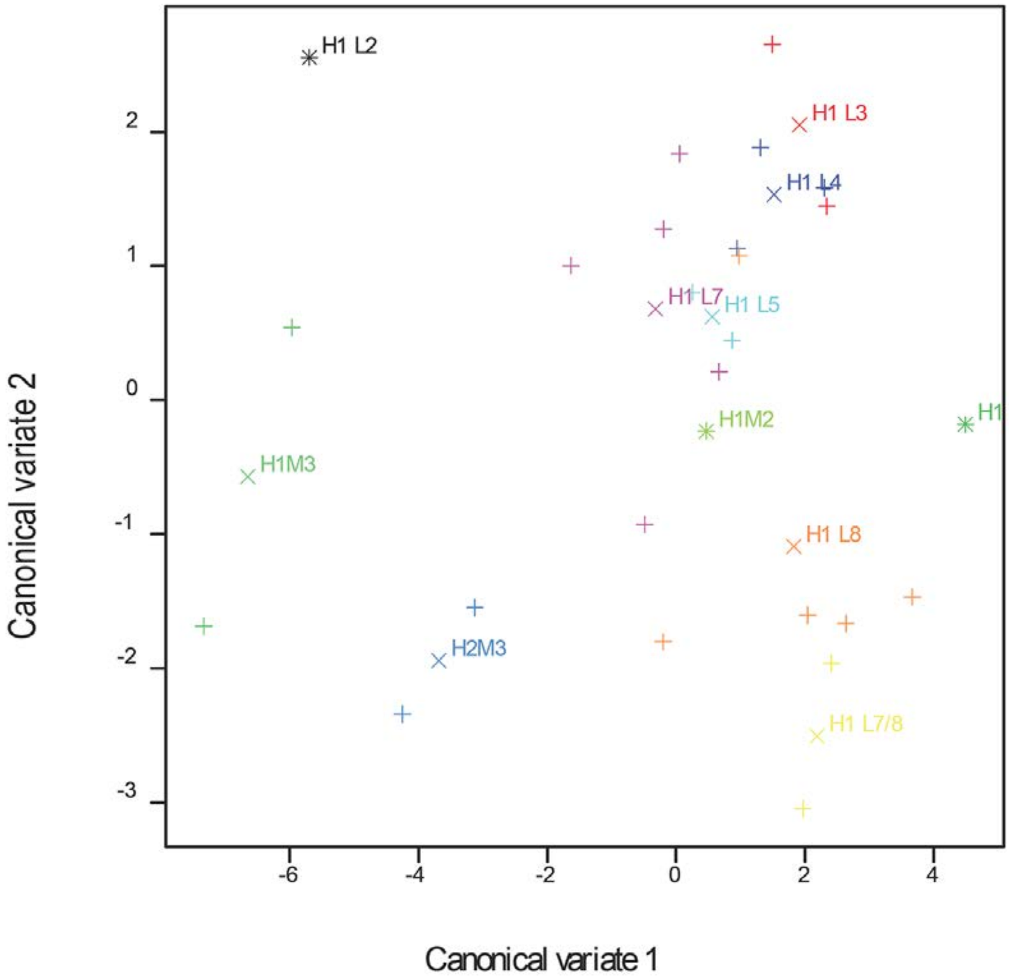


Figure 7.51. CVA plot of form D1a dimensional variables with layers/provenance labelled. First two dimensions.Key: H1 = 2009 Trench 1, H2 = 2009 Trench 2, L = Layer, M = Burial.

Source: C. Sarjeant.

Table 7.31. CVA loadings for Figure 7.51 of form D1a dimensional variables. First three dimensions.

Variables	1 (69.52)	2 (17.15)	3 (6.98)
Angle of rim to internal ridge (degrees)	-0.4212	-0.0167	0.1747
Diameter (mm)	0.0020	0.0072	0.0125
Length of lip to internal ridge (mm)	0.0330	-0.0647	0.0262
Height of single wave (mm)	-0.0901	0.4027	-0.2270
Width of single wave (mm)	-0.2851	-0.2317	-0.0383
Thickness of body (mm)	0.1382	-0.8569	0.2748
Thickness of rim (mm)	-0.2498	0.3615	0.2986

Source: Compiled by C. Sarjeant.

Coefficient of variation

The CV values for form D1a were high for the angle of the rim to the internal ridge variable, while the values were lower for the variables of diameter and width of single wave at the rim. When separated into context groups the CV values decreased dramatically. This supports the previous claim for more homogeneity and the possibility of standardisation in methods for the manufacture of contemporaneous D1a vessels, yet this homogeneity was not constant over time. CV values were generally lowest in burial contexts (Figure 7.52, Figure 7.53), and it is possible that one person made these vessels for the specific purpose of mortuary offering.

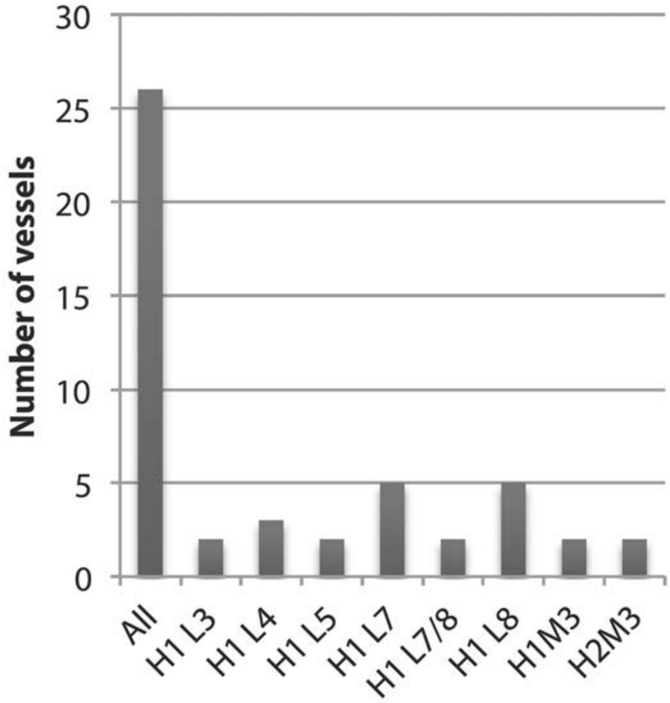


Figure 7.52. Number of form D1a samples of each layer/provenance in the study of standardisation. Key: H1 = 2009 Trench 1, H2 = 2009 Trench 2, L = Layer, M = Burial.

Source: C. Sarjeant.

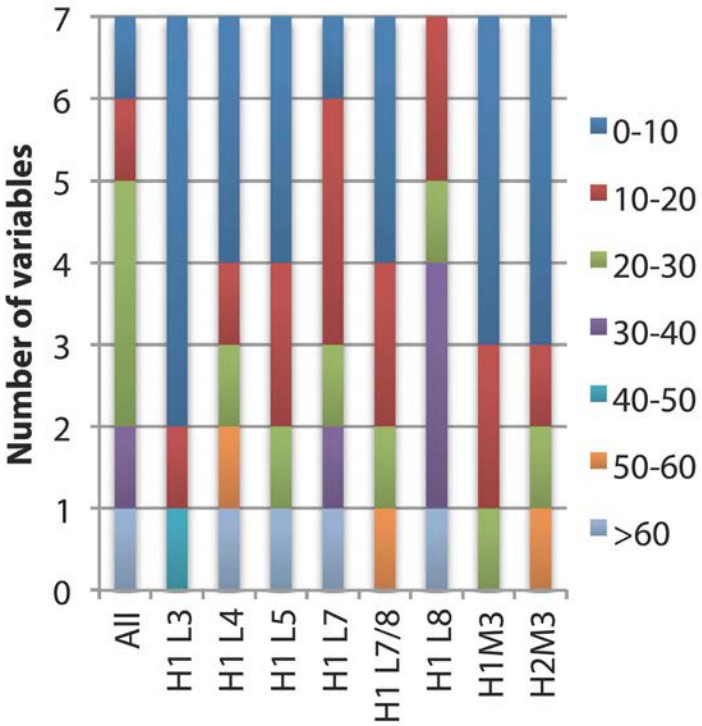


Figure 7.53. Number of variables with CV values 0–>60% for each layer/provenance in the form D1a sample. 0–10% CV represents the lowest CV values, i.e. a higher level of standardisation, and 50–60% CV represents the highest CV values, i.e. a lower level of standardisation.Key: H1 = 2009 Trench 1, H2 = 2009 Trench 2, L = Layer, M = Burial.

Source: C. Sarjeant.

Standardisation of fabrics

The fabric analyses of temper and the clay matrix (see Chapter 6, Part II) shows that there was consistency in the selection of sand temper, TG A1-1, TG A1-5, TG A1/A3-2 and TG A2-1, for D1a vessels. The sand inclusions were quartz and alkali feldspar, quartz, alkali feldspar and amphibole, quartz and impure iron oxide, and quartz, alkali feldspar, biotite and muscovite, respectively. The PCA plot (Figure 7.54) of the clay matrix compositional data displays the greatest variability in iron, potassium and magnesium oxides (Table 7.32). There were too few examples to identify any meaningful clustering, however the small scale in this PCA plot suggests some compositional homogeneity (Figure 7.54). The PCA, cluster analysis and CVA plots in Chapter 6, Part II (Figure 6.35, Figure 6.36, Figure 6.38) show that the D1a vessels tended to cluster together, indicating homogeneity in the clay matrix compositional data.

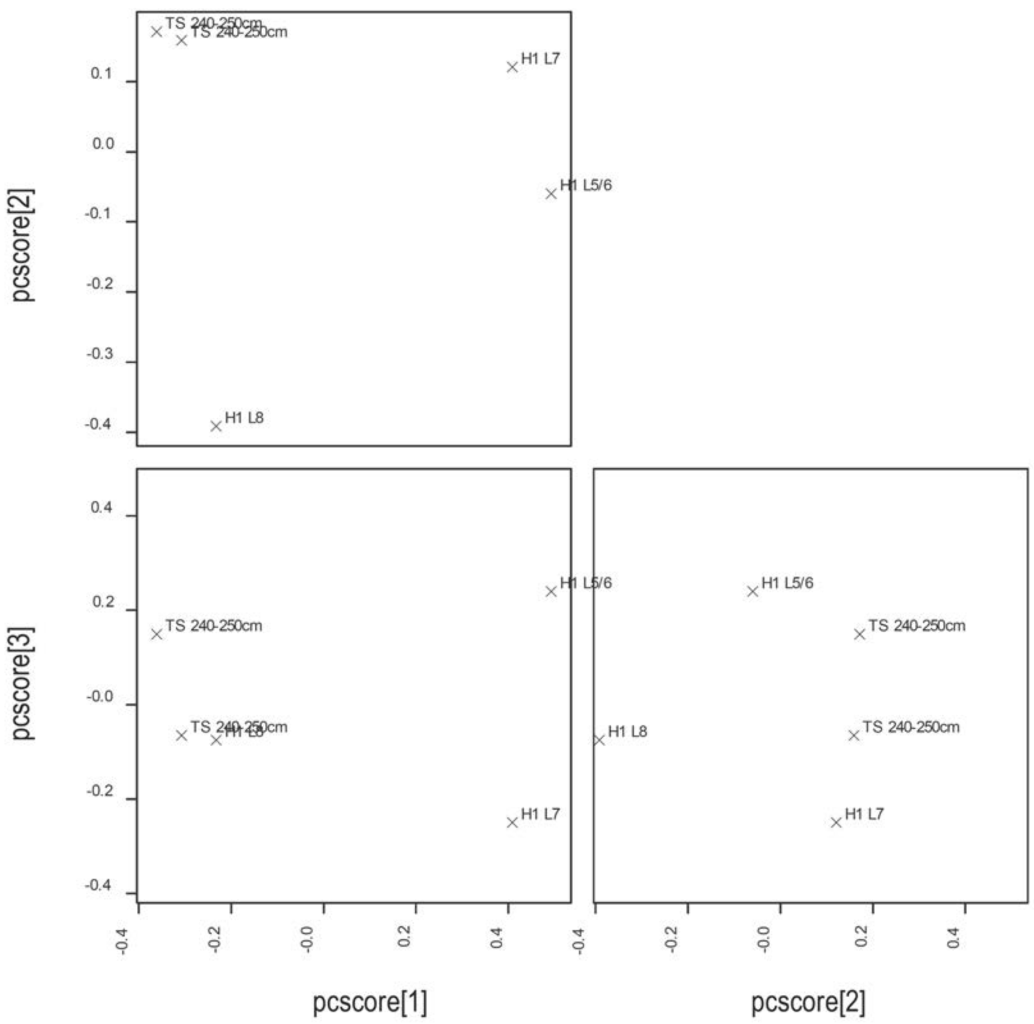


Figure 7.54. PCA plot of form D1a clay matrix composition with layers/provenance labelled. First three dimensions. Key: H1 = 2009 Trench 1, TS = 2009 Test Square, L = Layer.

Source: C. Sarjeant.

Table 7.32. PCA loadings for Figure 7.54 of form D1a clay matrix composition. First three dimensions. The bold values indicate the variables that presented the greatest variability in the PCA.

Variables	**PC 1 (61.77%)**	**PC 2 (20.31%)**	**PC 3 (13.64%)**
CaO	0.18272	**0.57642**	**0.43708**
FeO	**0.26039**	0.21028	0.08393
K_2O	**-0.71545**	0.47208	-0.34902
MgO	**0.27919**	0.20306	**-0.45455**
Na_2O	-0.48319	**-0.46425**	0.26081
SiO_2	-0.27224	0.36574	**0.42689**
TiO_2	-0.03751	0.10068	**-0.47246**

Source: Compiled by C. Sarjeant.

Summary of form D1a standardisation analysis

The standardisation study of the dimensional data indicates that there were two major groups within the D1a assemblage and that there was consistency in the dimensions of D1a vessels produced at the same time, i.e. those found in the same layer or context. This consistency extended to the selection of clay and temper.

Summary of standardisation within A2a, B1a, C1b and D1a forms: Temporal trends

The basic morphologies (Figure 5.1, Figure 7.1) of the forms A2a, B1a, C1b and D1a are homogeneous in appearance within each form group, at a superficial level. Through an examination of dimensional and fabric variables (and decorative variables in the case of A2a), this apparent homogeneity has been scrutinised. Variability within the form A2a and B1a rims increased later in the sequence, while there was homogeneity within the B1a rims earlier in the sequence. There was also homogeneity within the C1b and D1a rims. There were two distinct dimensional groups within the D1a form.

To summarise the level of variability and standardisation in forms A2a, B1a, C1b and D1a, each variable must be considered independently. The presented analysis showed that none of the forms were completely variable or standardised, although some forms exhibited some standardised variables at certain times during the sequence (Figure 7.55). All of the form A2a variables were more standardised in Trench 1 layers 5/6 and 7, mid to early sequence, than in the later layers. Similar form B1a variables were variable and standardised throughout the sequence, and the angle of the rim was consistently the least variable measured dimension. Form C1b was more standardised mid-sequence, in Trench 1 layer 5/6, compared to the earlier and later layers. The angle of the rim on form D1a was variable throughout the sequence, but less variation was evident in the upper layers (Trench 1 layers 5 to 3), as production of this form declined. When the temporal contexts are removed, it is evident that specific variables were more standardised in each form. The possible ritual/ceremonial sand tempered vessels, forms A2a and D1a (discussed in Chapter 5), were less variable in diameter, while the utilitarian fibre tempered vessels, forms B1a and C1b, were less variable in thickness of the body (Figure 7.56).

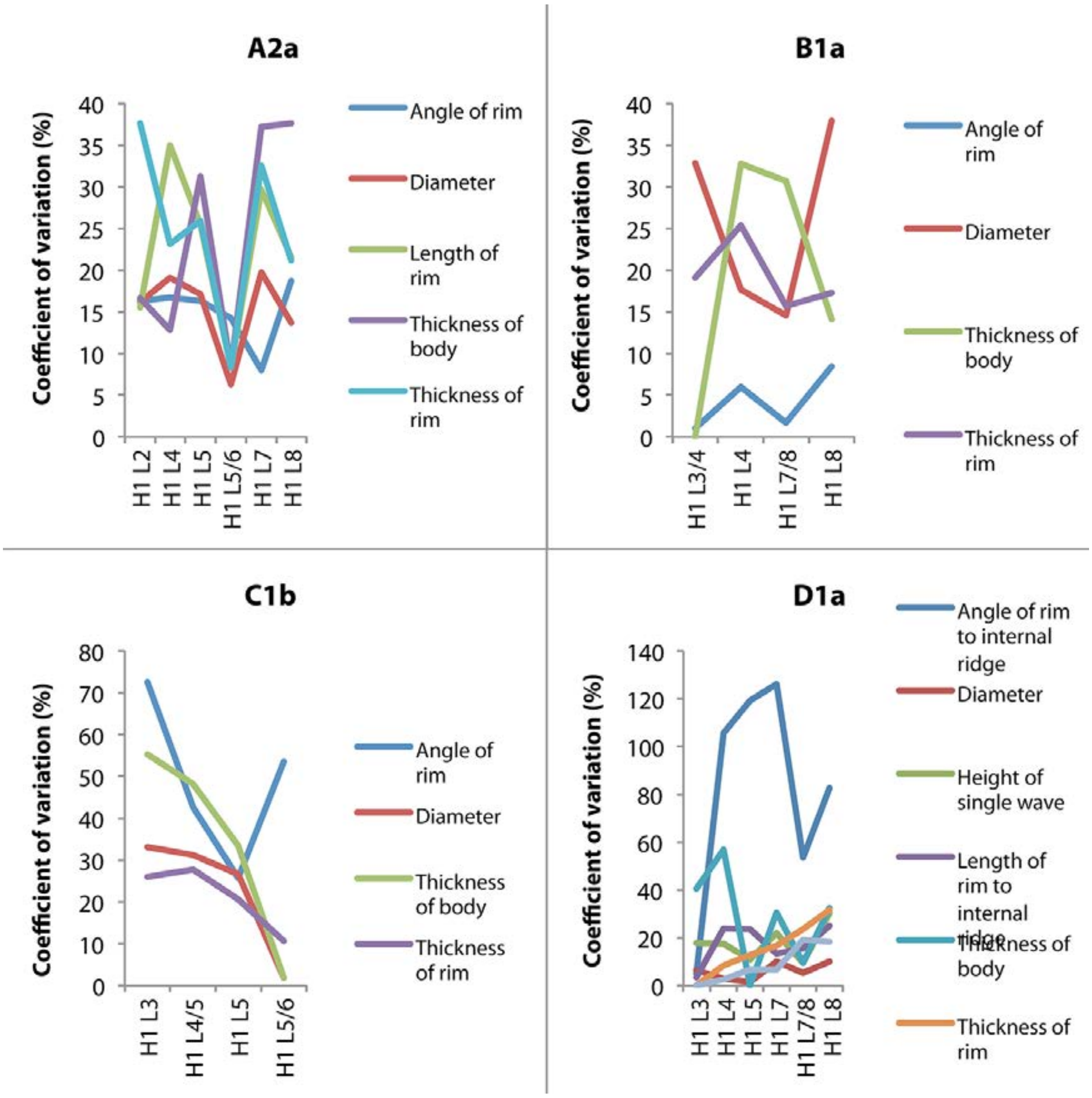


Figure 7.55. CV values (%) of each dimensional variable from represented layers of Trench 1 for each rim form. Refer to Figure 5.1 and Figure 7.1 for rim form images and measured variables. Key: H1 = Trench 1, L = Layer.

Source: C. Sarjeant.

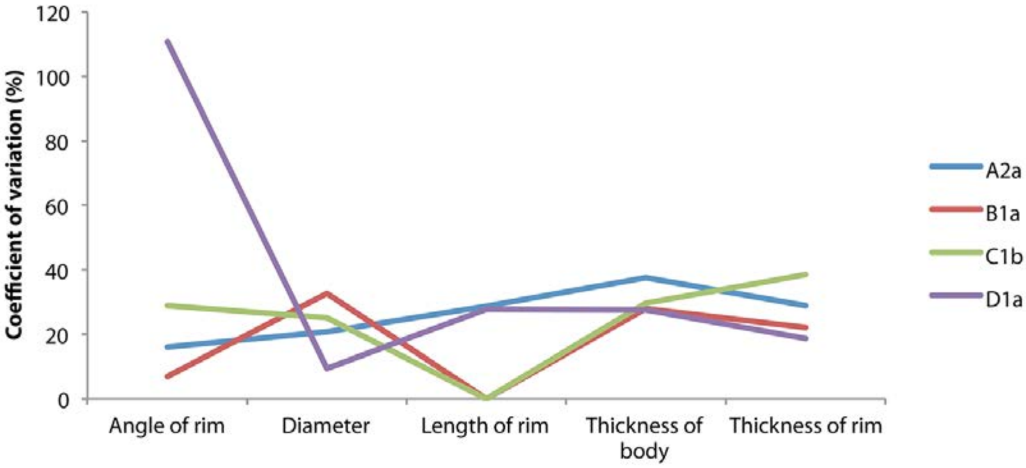


Figure 7.56. CV values (%) of each dimensional variable for each rim form. Note that forms B1a and C1b do not have length of rim variables, and are presented as '0' in the plot. Refer to Figure 5.1 and Figure 7.1 for rim form images and measured variables.

Source: C. Sarjeant.

Summary: The degree of standardisation in the An Sơn ceramic assemblage

The analysis of the degree of standardisation allows for a greater understanding of the life history, or chaîne opératoire (Roux 2003b; Lemonnier 1983; Leroi-Gourhan 1964), of particular vessel forms, the structures in place to manufacture them, and the technical choices of the potters (Roux 2003b; Schiffer and Skibo 1997). With the exception for the coefficient of variation, the degree of standardisation was considered comparatively across the sample, between the different forms in this chapter. Other studies have determined CV values that represent standardised and variable assemblages. Eerkens and Bettinger (2001) identified a CV of 1.7% as the highest degree of standardisation and 57.7% the lowest degree. Research has shown that full-time specialists manufacture ceramic products with a CV between 5–10%, while products made by part-time artisans in small, household-level organisation have a CV of 15% (Foias and Bishop 1997; Blackman *et al*. 1993; Longacre *et al*. 1988). From this research, the An Sơn assemblage may be discussed as either standardised or variable in both relative and absolute ways.

The relative comparison between the rim forms was determined from the PCA, hierarchical cluster analysis and CVA. General trends have been identified within each vessel form group, where homogeneity was noted more often (standardised) or not (variable). The small sample size of some rim forms meant it was not always possible to come to a conclusion about the relative level of standardisation, and some forms displayed variable and homogeneous results in different statistical analyses. The analysis of the dimensional variables indicated that many of the A1 forms were rather standardised in comparison to each other, notably forms A1b, A1c, A1d, A1g, A1i and A1i-r, whereas A1a and A1e were not. The A2 forms were variable, while class B forms were comparatively standardised, as were the C2, D1b and D2a forms (Table 7.33). Refer to Figure 5.1 for rim form images.

The levels of standardisation for each rim form, as determined from the CV values, are presented here both as an average of the CV values (Figure 7.57) and the proportion of each dimensional variable within the total CV value (Figure 7.58). The averaged values show that only form A1g had a 5–10% CV, suggesting specialisation of this vessel form. Forms A1i-r and C2a had slightly higher averaged CV values than the other forms, suggesting some kind of household-based organisation. The remaining forms had higher CV values in comparison to the forms mentioned above, indicating variability in the dimensional variables, with the highest CV value for form D2a. This is surprising since a great deal of homogeneity was observed in the D2a form in terms of dimensional and fabric variables (see Chapter 6, Part II). However, the averaged CV value for the D2a form has been affected by the small sample size, and the high CV values for the height and width of the serrated portions of the rim (Figure 7.57).

The proportion plot of CV values (Figure 7.58) showed that the angle of the rim was low for the majority of the A1 and A2 forms, B1b, B3a and D2a, and was very high for C2a, C2b, C3a, D1a, D1b and E1a. The proportion of CV values for the diameter was low for forms A1h, A2a, A2b, A2c, D1a, D1b and D2a, and very high for A1g and class B forms. The proportion of CV values for the length of the rim was low for forms A1d, A1g, A1h, D1a, D1b and D2a, and high for A1i-r. The proportion of CV values for the thickness of the body was low for forms A1f, A1i, D1a, D2a and E1a, and high for A1h and C2a. The proportion of CV values for the thickness of the rim was low for forms A1a, A1b, A1c, A1d, A1e, A1f, A1i-r, B2a, B3a, C2a, D1a, D1b and D2a, and high for A1g, C1b and E1a. The proportion of CV values for the height and width of a single wave were low for forms D1a and D1b, and very high for D2a.

The CV values of the stacked bar plot (Figure 7.59 and summarised in Table 7.34) clarify which variables for each form were within the range of potentially standardised (under 10%), manufactured under household production (around 15%), and non-standardised (over 57.7%). Based on the two plots of dimensional variables (Figure 7.58, Figure 7.59), it may be suggested that when those variables with very high CV values are excluded from the final interpretation, the forms that display a standardised level of production in more than one dimensional variable are forms A1g, A1i-r, D1b and D2a. One variable is standardised in forms A1h, A2c, B1a, B1b, C2a, D1a and E1a. A household level of production may be inferred for forms A1b, A1f, A1g, A1h, A1i, A1i-r, A2a, A2c, B1b, C2a, D1b and D2a (Table 7.34). Highly variable forms that do not present any kind of organisation in production are not included in the standardisation and household level columns of Table 7.34. These are forms A1a, A1c, A1d, A1e, A2b, B2a, B3a, C1a, C1b, C2b and C3a. Most of these forms had CV values between household level and the lowest level of standardisation (over 15 and less than 57.7%), i.e. they were not standardised.

It is commonly perceived that there was very little standardisation in pottery production during the neolithic occupation of mainland Southeast Asia (e.g. White and Pigott 1996) (see Chapter 10). While this may be true, very few studies have investigated the degree of standardisation in neolithic Southeast Asian ceramic assemblages. This chapter has discussed variability and standardisation between different forms and between different ceramic variables. While there were few definitive examples of standardised production for a specific form at An Sơn, developments in craft production were evident in the homogeneity of particular variables for some vessel forms. This homogeneity has arisen out of taught behaviours that are passed on for these particular variables of specific vessel forms, as a template for manufacture (see Chapter 10). This homogeneity extends beyond the dimensional variables to temper and clay selections of some forms, as shown when the study combined dimensional and fabric variables for the analysis of the B1a, C1b and D1a forms. Form A2a presented variable decorations, dimensions and fabrics. The longevity of many of the forms with standardised variables indicates a strong tradition in the teaching and manufacturing of particular vessels with specific methods, while the analysis of form B1a also suggests that there were modifications in these methods over time. These findings indicate that a common mental template was used by the An Sơn potters for certain vessel forms (discussed further in Chapter 10). The level of standardisation cannot be determined for the An Sơn assemblage as a single entity, since fluctuations in the homogeneity of a vessel form were evident in different variables and in different contexts over time.

Table 7.33. Relative level of standardisation for each rim form, based on all statistical methods presented in Chapter 7. Refer to Figure 5.1 and Figure 7.1 for rim form images and measured variables.

Standardised	Variable	Both variable/standardised dimensional variables	Unknown level
A1b	A1a	A1f	A1h
A1c	A1e	C1a	B3a
A1d	A2a	C1b	
A1g	A2b	C3a	
A1i	A2c	D1a	
A1i-r		E1a	
B1a			
B1b			
B2a			
C2a			
C2b			
D1b			
D2a			

Source: Compiled by C. Sarjeant.

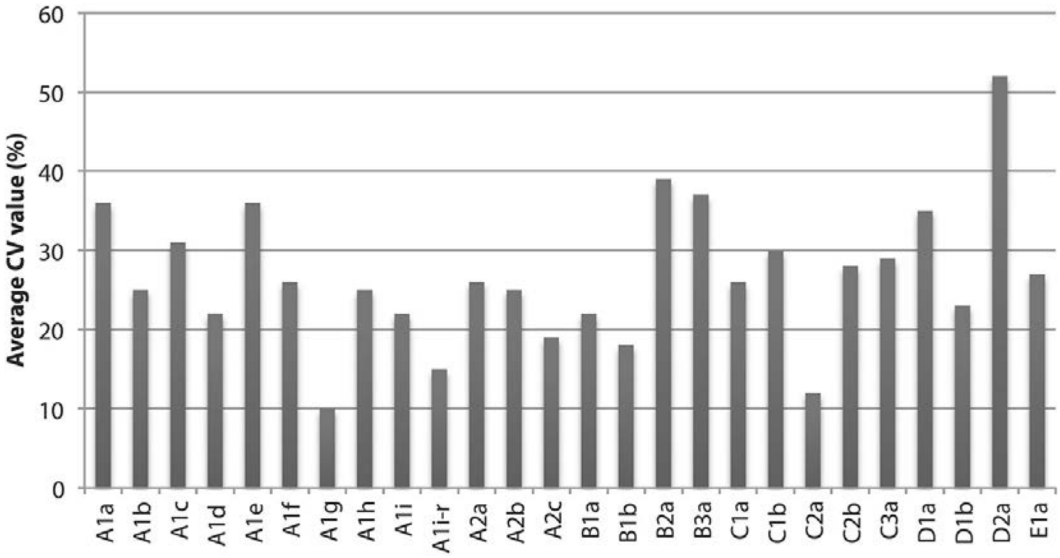


Figure 7.57. Average of CV values (%) for each rim form. Refer to Figure 5.1 for rim form images.

Source: C. Sarjeant.

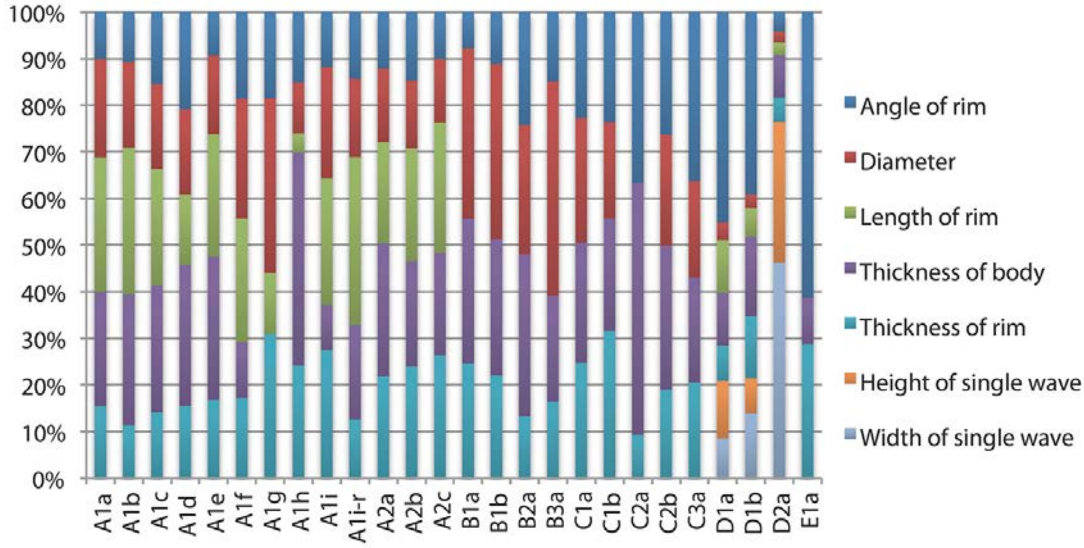


Figure 7.58. Proportion of CV values (%) for each variable within each rim form. Note that the length of the rim was not calculated for class B, C and E vessels and the height and width of single wave variables were only measured for class D. There was no thickness of body CV value calculated for A1g, no diameter CV value for C2a and E1a and no length of rim CV value for E1a. Refer to Figure 5.1 and Figure 7.1 for rim form images and measured variables.

Source: C. Sarjeant.

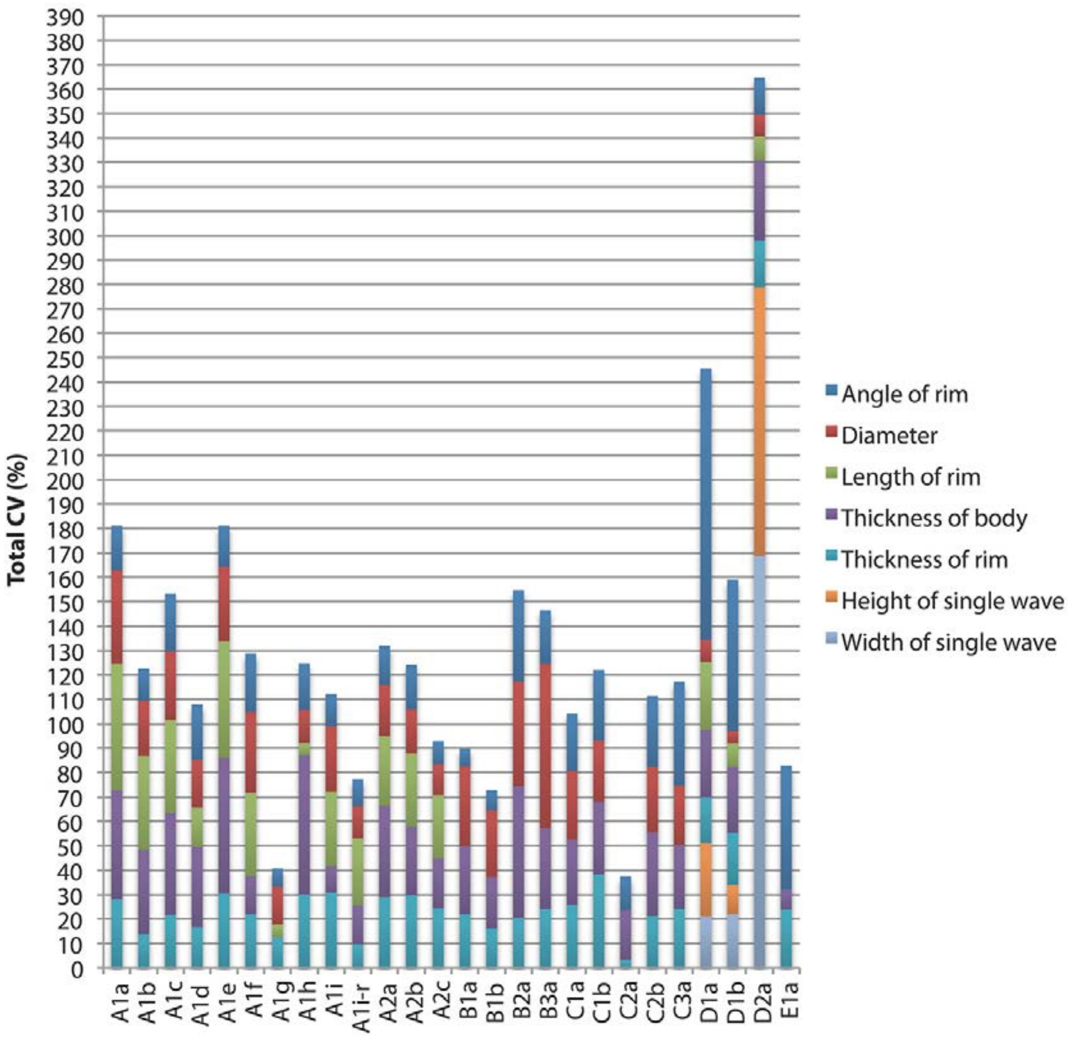


Figure 7.59. Total CV values (%) for each variable for each form. Note that the length of the rim was not calculated for class B, C and E vessels and the height and width of single wave variables were only measured for class D. There was no thickness of body CV value calculated for A1g, no diameter CV value for C2a and E1a and no length of rim CV value for E1a. Refer to Figure 5.1 and 7.1 for rim form images and measured variables.

Source: C. Sarjeant.

Table 7.34. The presence of dimensional variables with standardised level, household level and lowest level of standardisation in each rim form. Forms with values between ~15% and 57.7% not included in this table. Refer to Figure 5.1 and 7.1 for rim form images and measured variables.

Variables	Standardised level (<10%)	Household level (~15%)	Lowest level of standardisation (variable) (>57.7%)
Angle of rim	A1g A1i-r A2c B1a B1b	A1b A1i A2a C2a D2a	D1a D1b
Diameter	D1a D1b D2a	A1g A1h A1i-r A2c	B3a
Length of rim	A1g A1h D1b D2a	A1d	
Thickness of body	E1a	A1f A1i A1i-r	
Thickness of rim	A1i-r C2a	A1b A1g B1b	
Height of single wave		D1b	D2a
Width of single wave			D2a

Source: Compiled by C. Sarjeant.

8

Comparison of Neolithic Sites in Southern Vietnam

Introduction: Methodology for comparative research of southern Vietnam neolithic ceramics

Early research in southern Vietnam includes investigations by Henri Fontaine, who referred to the area inclusive of the sites Cù Lao Rùa, Ngãi Thắng, Phước Tân, Hội Sơn and Bến Đò in Đồng Nai Province as the 'Phước Tân Culture' (Fontaine 1972, 1971). Since then, more sites with neolithic and metal age remains have been identified and excavated in southern Vietnam, such as Cầu Sắt and Cái Vạn in Đồng Nai Province, and An Sơn and Rạch Núi in Long An Province. These sites are characterised by a shared tradition of shouldered and unshouldered lithic adzes and stone bangles. Differences have been observed in the sites that share this material culture, in terms of changes in sizes and proportions of the shouldered adzes, most of which were made from basalt. Stone bangles also varied in type between the sites. The pottery in southern Vietnam has been described as 'simple' in comparison to that of the northern and central sites of Vietnam (Hoàng and Bùi 1983: 62).

Hoàng and Bùi (1983) organised the sites of southern Vietnam into four phases from the neolithic to the metal age. The first phase, with some of the earliest occupation in the region, was represented by the site Cầu Sắt; comparable in culture to Phùng Nguyên in northern Vietnam and Long Thành in central Vietnam (Hoàng and Bùi 1983). Shouldered stone adzes and stone 'harvesting knives' were present at Cầu Sắt, while stone bangles were rare. Decoration of the ceramic vessels was described as 'simple' with incision and cordmarking in this phase (Hoàng and Bùi 1983).

The second phase was represented by the sites of Bến Đò, Phước Tân, Hội Sơn and Ngãi Thắng. The lithic tool assemblage included triangular-shaped and shouldered adzes, 'harvest knives', and an increase in large, shouldered 'hoe' adzes compared to the earlier phase. The ceramics from this phase were reported as simple once again, and included *cà ràng* vessels (Hoàng and Bùi 1983).

The third phase was represented by Cù Lao Rùa, Cái Vạn, Gò Đá, and the lower layer of Đốc Chưa, and Hoàng and Bùi (1983) suggested An Sơn and Rạch Núi were part of this phase. Shouldered adzes diminished in this period and were replaced by unshouldered rectangular-sectioned adzes. Stone 'harvest knives' with a notch at each end, pottery similar to that of the previous phases, and moulds for metal axes were identified at Cù Lao Rùa and Đốc Chưa.

The fourth and final phase was represented by Đốc Chưa with the presence of bronze and early iron metallurgical items. While stone adzes were still present, the technology for stone bangles and ceramic vessels changed. It has been suggested that the development in southern Vietnam from Cầu Sắt to Đốc Chưa was continuous (Hoàng and Bùi 1983).

While this sequence has been revised by Nishimura Masanari (2002) (as described in Chapter 2), it is important to review the material culture from these sites in greater detail. Due to the increase in archaeological investigations in recent years by The Australian National University, Nishimura and others at An Sơn and Đa Kai (Bellwood *et al.* 2011; Nishimura *et al.* 2009; Nishimura and Nguyễn 2002), and by the Centre for Archaeological Studies of the Southern Institute of Social Sciences, Ho Chi Minh City at Cù Lao Rùa (Nguyễn 2008), clearer information about the occupational sequences and material culture of southern Vietnam is now available.

The comparative analysis of neolithic sites in southern Vietnam in this chapter includes the sites of Bến Đò, Bình Đa, Cù Lao Rùa, Cái Vạn, Cầu Sắt, Đa Kai, Đình Ông, Lộc Giang, Rạch Lá, Rạch Núi and Suối Linh, alongside An Sơn. Refer to the map in Figure 1.3 and the summary in Table 3.2 of these sites. An Sơn is divided into early, middle and late phases of occupation for this analysis. Data for a correspondence analysis (CA) (described in Chapter 3) were collected and plotted in terms of the presence or absence of certain variables. Absence was assigned when no information for that variable was available; this does not always mean that the variable concerned was not present, but that there was no evidence for its presence. This chapter firstly outlines earlier published comparisons between sites in southern Vietnam sites, followed by a synthesis for each site to be included in the comparative analysis. A CA between An Sơn and these sites is presented, followed by further discussion in terms of regional developments and material culture relationships during the neolithic phase of southern Vietnam. The methods for data collection from these sites and the CA were described in Chapter 3. The material culture variables, presence and absence data, and the numerical codes for the variables used in the CA are presented in Appendix B.

Previous comparative research in southern Vietnam

Past comparisons of ceramics within southern Vietnam have adopted a traditional approach to analysis by examining vessel form and decoration. The following statistical analysis aims to expand on these previously observed parallels, and to extend them into a comprehensive systematic and intensive comparison with further afield neolithic sites in Southeast Asia (Chapter 9). A summary of the previous comparative research by Nishimura and Vương (1997; see also Nishimura 2002) is first provided, from which subsequent comparisons can develop.

Previous studies once considered Cầu Sắt to be the oldest neolithic site in the Đồng Nai River Basin based on the lithic tool assemblages, but the ceramic sequence displayed similarities with Bình Đa, so these two sites were interpreted as contemporary. In fact, it is incredibly difficult to establish the earliest site amongst An Sơn, Lộc Giang, Bình Đa, Rạch Núi and Cầu Sắt because of the 'scant studies on pottery chronology', and some researchers have estimated the earliest occupation in southern Vietnam began around the early second millennium BC (Nishimura and Vương 1997: 81).

At Bình Đa, the pottery is characterised by multiple incised lines and simple paddle impressed surfaces, either with cord or fibre impressions, particularly on the shoulder of the body. It has been termed the 'Bình Đa type' (Nishimura and Vương 1997: 78), and this characteristic decoration on the pottery was recorded throughout the Bình Đa layers. In basal layer 15 the decorations were multiple wavy lines between two bands of multiple horizontal lines. In layers 9 to 6 they were double bands of multiple horizontal lines. In layers 6 and 5, quarter concentric circles were incised by rocking a comb-like tool, and bands of horizontal lines were transformed into a smoothed wide band. In layers 4 to 2, a single wavy line or diagonal impressions replaced the wavy lines (Nishimura and Vương 1997).

The lowest spit of the 1977 excavation at Rạch Núi contained ceramic sherds with the 'Bình Đa type' decoration with wavy lines between two bands of horizontal lines. There was also a variant of this motif with looser wavy lines in the upper layers at Rạch Núi. An Sơn also had some 'Bình Đa type' sherds, including quarter concentric circular lines formed by rocking rotation, loose wavy lines in lower layers, and combined with horizontal lines, like in the lower layers of Bình Đa. The styles of these incised waves at An Sơn were not completely identical to those at Bình Đa (Nishimura and Vương 1997).

The nearby site of Lộc Giang had very similar pottery to An Sơn. Among the 'Bình Đa type' sherds at Lộc Giang were some with wavy lines combined with horizontal lines at the lowest layers, and looser wavy line decorations in the middle layers. According to Nishimura and Vương (1997: 80), 'An Sơn type' sherds also appeared in the lower layers at Lộc Giang. In the upper layers, looser rocking impressions were observed. There was another variant with hatching bounded by horizontal lines. The typical decoration in the lowest layers, at both An Sơn and Lộc Giang, had multiple wavy lines combined with horizontal lines. It has been suggested that the lowest levels of Bình Đa, An Sơn and Lộc Giang were contemporary (Nishimura and Vương 1997: 80). However, there was perhaps an earlier neolithic phase of occupation at An Sơn and Đa Kai (Nishimura 2002).

Due to the presence of such parallels in the southern Vietnamese ceramic assemblages, the possibility of inter-site interaction is likely. At Bình Đa a few 'An Sơn type' sherds suggest importation of vessels. Similarly at An Sơn and Lộc Giang the 'Bình Đa type' was rare in the assemblage and the 'An Sơn type' was dominant. However, greater geographical distance is likely to have exacerbated differences in ceramic assemblages, i.e. sites closer together display similarities in material culture. With less evidence of 'An Sơn type' sherds, Rạch Núi may have had more contact with the Đồng Nai sites and related maritime and riverine systems, rather than with sites along the upper Vàm Cỏ Đông River (Nishimura and Vương 1997: 80). The An Sơn and Lộc Giang ceramics are paralleled with burnished wares, rocker/roulette stamping, and impression between incised lines that occur at Samrong Sen, Ban Chiang, Ban Kao, Tha Kae and Khok Phanom Di in Cambodia and Thailand (Nishimura and Vương 1997: 81).

This chapter exposes the intricacies and unsolved questions in terms of relating neolithic sites to one another within southern Vietnam. The nature of interaction between these sites would have been a contributing factor to the way in which material culture and technology were shared between sites. Similarities in material culture may be related to spatial proximity, however material cultural differences can also occur with increased cultural contact, for instance when competition for resources increased between groups (see Rowlands 2007: 57). The comparison between An Sơn and southern Vietnam sites begins by examining the original data from each site in the following section.

Southern Vietnam

This section provides a literature review of the sites included in the comparison with a correspondence analysis (CA). The radiocarbon dates from many of these sites can be deemed inaccurate and from insecure contexts, but they have nevertheless been included to display the past research at each of the sites. More reliable dates have been obtained from the recent excavations at Đa Kai (Nishimura *et al.* 2009) and An Sơn (Bellwood *et al.* 2011) (see Chapter 4). In general, the radiocarbon dates alone are insufficient for studying the neolithic sequence of southern Vietnam, and parallels in material culture must also be considered (Thomas and McLauchlan 2006; Nishimura 2002; Nishimura and Vương 1997). All published uncalibrated dates have been calibrated with OxCal 4.1.7 IntCal09 (Bronk Ramsey 2010; Reimer *et al.* 2009), as presented in Table 3.2 and in this chapter. Refer to site locations in Figure 1.3.

Bến Đò

Bến Đò is located within the city limits of Ho Chi Minh City, along the Đồng Nai River. The site is thought to date to *c*. 3000 BP (Fontaine and Delibrias 1974). Like Cù Lao Rùa, Bến Đò is located on basaltic terrain. This site yielded an assemblage that was similar to An Sơn, including shouldered stone adzes, and incised, cord-marked or paddle linear impressed ceramics. The decorative motifs included incised horizontal lines, diagonal incision in a band between horizontal incision, wavy and horizontal line incision over paddle linear impression or comb incision, and roulette stamped zigzag impression. Bến Đò also contained *cà ràng* and pedestal dishes (Phạm 1977; Fontaine 1975, 1971). Stamped decoration was identified on the shoulders and lips of ceramic vessels, but was more common on the body. External ridges were identified on dishes. Some of these vessel forms are shown in Figure 8.1. The adzes at Bến Đò included unshouldered broad and long, narrow varieties, as well as small, shouldered types. There was substantial reuse and reworking of some lithic tools. Bến Đò also presented clay pellets, stone bangle fragments, pestles, grinders and red ochre (Fontaine 1975, 1972). A summary of the material culture at Bến Đò is listed in Table 8.1.

The data in Appendix B and the CA for Bến Đò were adapted from reported information (Phạm 1977; Fontaine 1975, 1971).

Table 8.1. The material culture contents of the neolithic layers at Bến Đò.

Ceramic vessels	Other material culture
everted rim restricted independent vessel	unshouldered stone adze
concave rim restricted independent vessel	shouldered stone adze
concave rim restricted independent vessel with pedestal	stone bangle
simple restricted vessel	stone tools well-worn/reworked
simple unrestricted vessel	clay pellet
cà ràng	
linear incision	
cordmarking	
paddle impression	
roulette stamping	

Source: Data from Phạm 1977; Fontaine 1975, 1971.

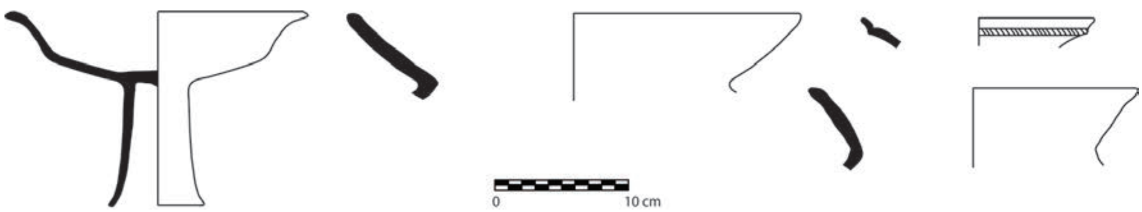


Figure 8.1. Bến Đò vessel forms, 1977 excavation.

Source: Illustrations, C. Sarjeant (After: Phạm 1977: 21).

Bình Đa

Bình Đa is located in An Bình ward, Biên Hòa city, Đồng Nai Province, along the Đồng Nai River. Excavations were conducted at Bình Đa in 1979 and 1993. There is one reported date for Bình Đa, 3180±50 BP uncalibrated (Nishimura et al. 2009), which is 1606–1318 cal. BC (95.4% probability) when calibrated with OxCal 4.1.7 (Figure 8.2).

The 1993 report has the most comprehensive information about the archaeological remains at Bình Đa (Phạm and Nguyễn 1993). The pottery fabrics were dominated by sand tempered wares in all spits, with fibre tempered wares diminishing in the lower layers. Some of the Bình Đa vessel forms are presented in Figure 8.2. Triangular and rectangular-sectioned adzes were identified in the assemblage. Although unshouldered adzes were identified throughout the sequence, shouldered adzes occur in higher quantities than unshouldered in the upper layers. Hammerstones were more frequently observed in the upper layers, and whetstones were present throughout the sequence. Lithophones were only present in the upper layers. Additional material culture included clay figurines, *cà ràng* vessels, ceramic roundels, and clay pellets (Phạm and Nguyễn 1993). A summary of the material culture at Bình Đa is listed in Table 8.2.

The data in Appendix B and the CA for Bình Đa were adapted from reported information (Nishimura et al. 2009; Phạm and Nguyễn 1993; also in Nishimura 2002; Nishimura and Vương 1997), and from personal observations in the Đồng Nai Provincial Museum in 2010.

Table 8.2. The material culture contents of the neolithic layers at Bình Đa.

Ceramic vessels	Other material culture
everted rim restricted independent vessel	unshouldered stone adze
concave rim restricted independent vessel	shouldered stone adze
simple restricted vessel	whetstone
simple unrestricted vessel	hammerstone
simple unrestricted vessel with pedestal	lithophone
cà ràng	stone preform
linear incision	ceramic roundel
geometric incision	clay pellet
red paint	
burnishing	
cordmarking	
paddle impression	
roulette stamping	
white lime infill	
ridge/appliqué	
fibre temper	
sand temper	
laterite sand temper	

Source: Data from Nishimura *et al.* 2009; Phạm and Nguyễn 1993; also in Nishimura and Vương 1997, Nishimura 2002, and personal observations.

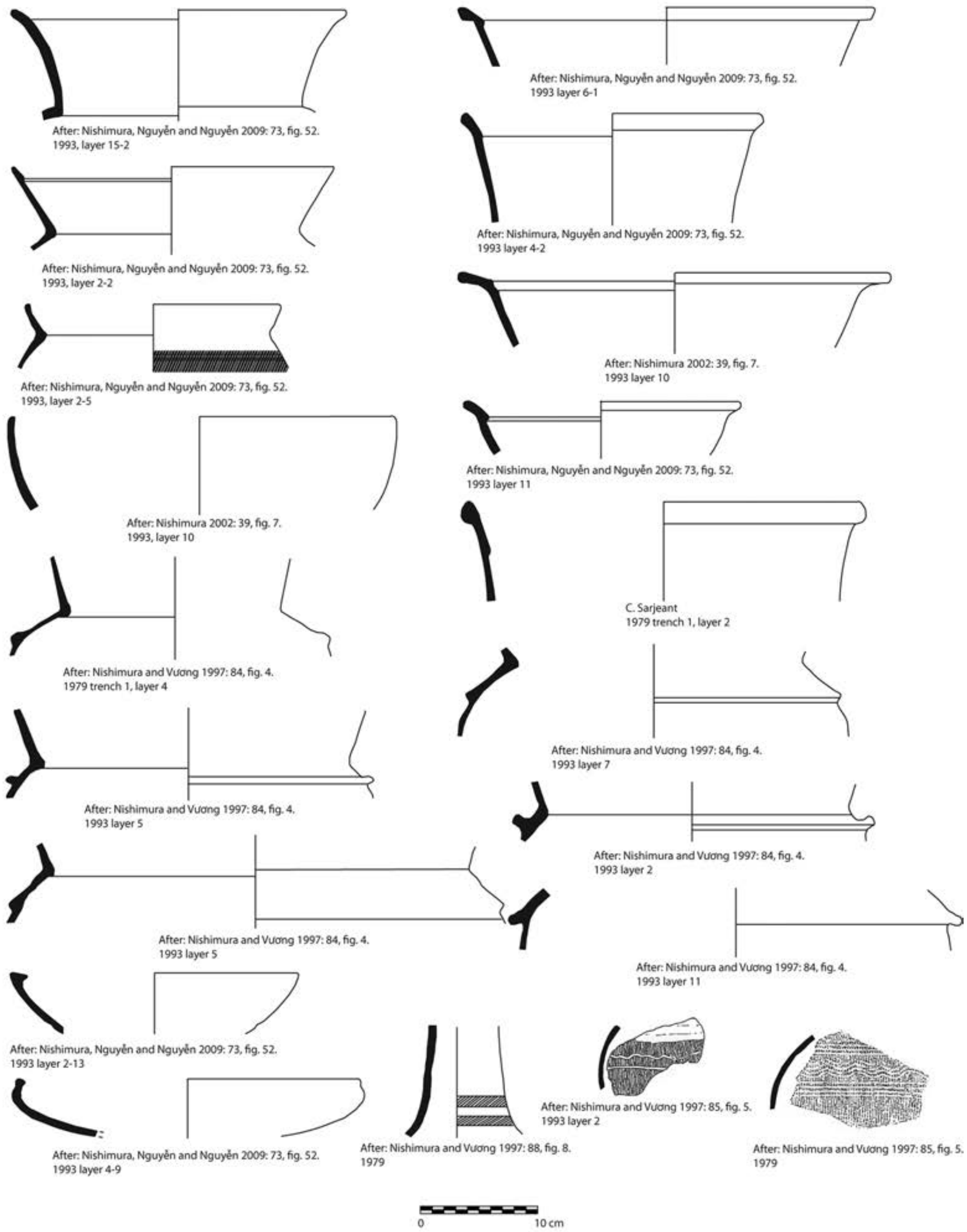


Figure 8.2. Bình Đa vessel forms, 1979 and 1993 excavations.

Source: Illustrations, C. Sarjeant (After: Nishimura *et al.* 2009, Nishimura 2002, Nishimura and Vương 1997, as credited).

Cái Vạn

Located in Long Thành district at the southeastern margin of Đồng Nai Province, Cái Vạn was excavated in 1978 and 1996. Nishimura (2002) considers Cái Vạn to be mostly neolithic, with a bronze age phase at the end of occupation, as evidenced by a few bronze artefacts. The stone adzes and pottery were similar to those at An Sơn and Bình Đa. Very little reported information is available for Cái Vạn. A summary of the material culture at Cái Vạn is listed in Table 8.3 and some of the ceramic forms are shown in Figure 8.3.

The data in Appendix B and the CA for Cái Vạn were adapted from personal observations at the Đồng Nai Provincial Museum in 2010.

Table 8.3. The material culture contents of the neolithic layers at Cái Vạn.

Ceramic vessels	Other material culture
everted rim restricted independent vessel	stone adze
concave rim restricted independent vessel	ceramic roundel
simple restricted vessel	clay pellet
simple unrestricted vessel	
simple unrestricted vessel with pedestal	
cà rang	
linear incision	
geometric incision	
burnishing	
coarse cordmarking	
cordmarking	
paddle impression	
roulette stamping	
coarse punctate stamping	
punctate stamping	
ridge/appliqué	
fibre temper	
sand temper	
laterite sand temper	
calcareous sand temper	

Source: Data from personal observations.

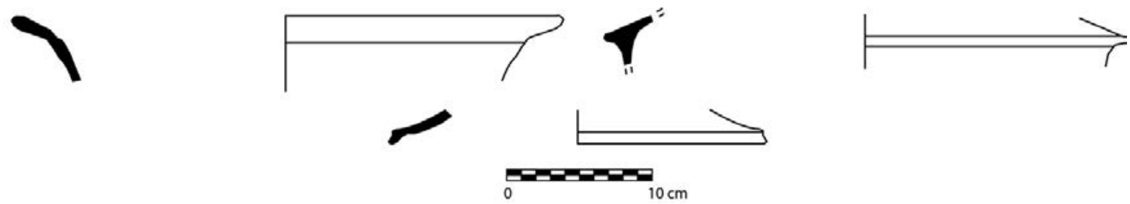


Figure 8.3. Cái Vạn vessel forms.

Source: Illustrations, C. Sarjeant (After: Nishimura 2002: 48, Figure 12).

Cầu Sắt

Cầu Sắt is located in Bình Lộc village, Xuân Lộc district, Đồng Nai Province. There are no reported dates for Cầu Sắt despite claims that it is an early neolithic site. The lithic assemblage included shouldered and unshouldered adzes, drill points, knives, chisels, hammerstones, whetstones, and bangles or rings. Like the early An Sơn adzes, they were small, triangular-shaped and rectangular-sectioned shouldered types. The ceramic assemblage included unrestricted and restricted vessels (Hoàng and Nguyễn 1977; Hoàng *et al.* 1976). One example is an unrestricted vessel with a ridge at the shoulder and a pedestal (Figure 8.4). A summary of the material culture at Cầu Sắt is listed in Table 8.4. The data in Appendix B and the CA for Cầu Sắt were adapted from reported information (Hoàng and Nguyễn 1977; Hoàng *et al.* 1976).

Table 8.4. The material culture contents of the neolithic layers at Cầu Sắt.

Ceramic vessels	Other material culture
everted rim restricted independent vessel	unshouldered stone adze
unrestricted independent vessel	shouldered stone adze
simple unrestricted vessel	hammerstone
simple unrestricted vessel with pedestal	
ridge/appliqué	

Source: Data from Hoàng and Nguyễn 1977; Hoàng *et al.* 1976.

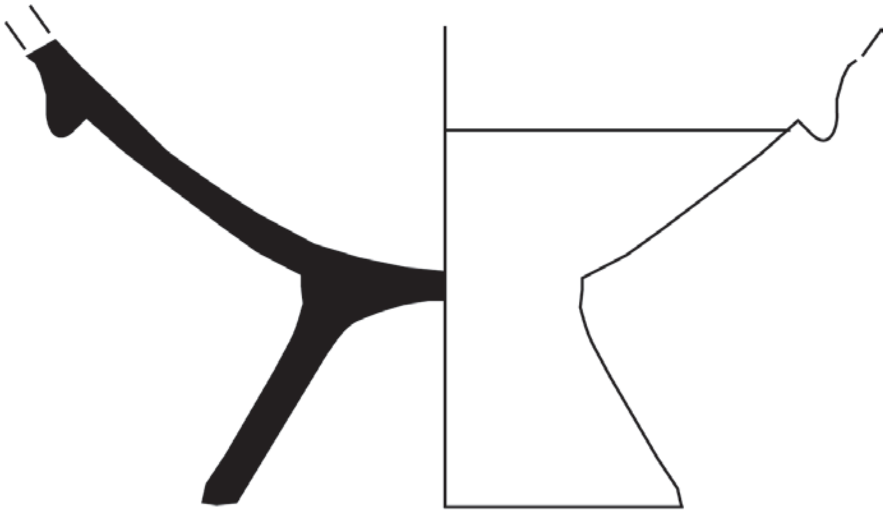


Figure 8.4. Cầu Sắt vessel form. Not to scale.

Source: Illustrations, C. Sarjeant (After: Hoàng and Nguyễn 1977).

Cù Lao Rùa

Cù Lao Rùa is a site in Thạnh Phước village, Tân Uyên district, Bình Dương Province. Cù Lao Rùa is located on the old alluvium, adjacent to the Đồng Nai River. Shallow laterite deposits are present in this area and sites are located on basaltic terrain with red soil on top (Fontaine 1975). Cù Lao Rùa has been a known archaeological site since 1888, when it was reported by Émile Cartailhac. It was later investigated in 1975 and then in 2003 (Nguyễn 2008). Cù Lao Rùa has evidence of metal technology and spindle whorls that are associated with the later occupation. Early reports also indicated that Cù Lao Rùa had ceramics with punctate dots between two incised lines, incised zigzag lines, and incised concentric circle motifs. Pestles and grinders were also identified (Fontaine 1975, 1971).

Cù Lao Rùa was most recently excavated in 2003, during which mortuary remains were recovered, and detailed information about the ceramic vessel forms, decorations and lithic assemblages was revealed (Nguyễn 2008) (see Table 8.5). One uncalibrated date has been reported for Cù Lao Rùa of 2230±40 BP (Nguyễn 2008), which was calibrated to 389–202 cal. BC (95.4% probability) with OxCal 4.1.7 (Figure 8.6), representing the later metal phase occupation (see Chapter 2). Only the material associated with the earlier neolithic occupation is included in the comparison presented in this chapter and in the CA (see also Appendix B).

The Cù Lao Rùa ceramic assemblage excavated in 2003 included forms with incised decoration on the interior of the rim, and decorations that were paralleled at An Sơn including the zigzag roulette design in a band on the shoulder. The ceramic assemblage also included rounded cà ràng projections. Some of these forms are shown in Figure 8.5. The lithic assemblage Cù Lao Rùa included ground stone tools, such as small, shouldered adzes in both broad and narrow varieties, and some large adzes were also identified. Unshouldered rectangular-sectioned and triangular-shaped adzes were less common. Hammerstones, whetstones and stone bangles were also present (Nguyễn 2008).

The data in Appendix B and the CA for Cù Lao Rùa were adapted from reported information (Nguyễn 2008; Fontaine 1975, 1971), and from personal observations at the Centre for Archaeological Studies of the Southern Institute of Social Sciences, Ho Chi Minh City in 2010.

Table 8.5. The material culture contents of the neolithic layers at Cù Lao Rùa.

Ceramic vessels	Other material culture
everted rim restricted independent vessel	unshouldered stone adze
everted rim restricted independent vessel with pedestal	shouldered stone adze
concave rim restricted independent vessel	whetstone
unrestricted independent vessel with pedestal	hammerstone
simple restricted vessel	stone bangle
simple unrestricted vessel	stone preform
simple unrestricted vessel with pedestal	stone tools well-worn/reworked
linear incision	ceramic roundel
geometric incision	clay pellet
red paint	clay anvil
burnishing	
cordmarking	
paddle impression	
roulette stamping	
coarse punctate stamping	
fibre temper	
sand temper	
laterite sand temper	

Source: Data from Nguyễn 2008; Fontaine 1971, 1975, and personal observations.

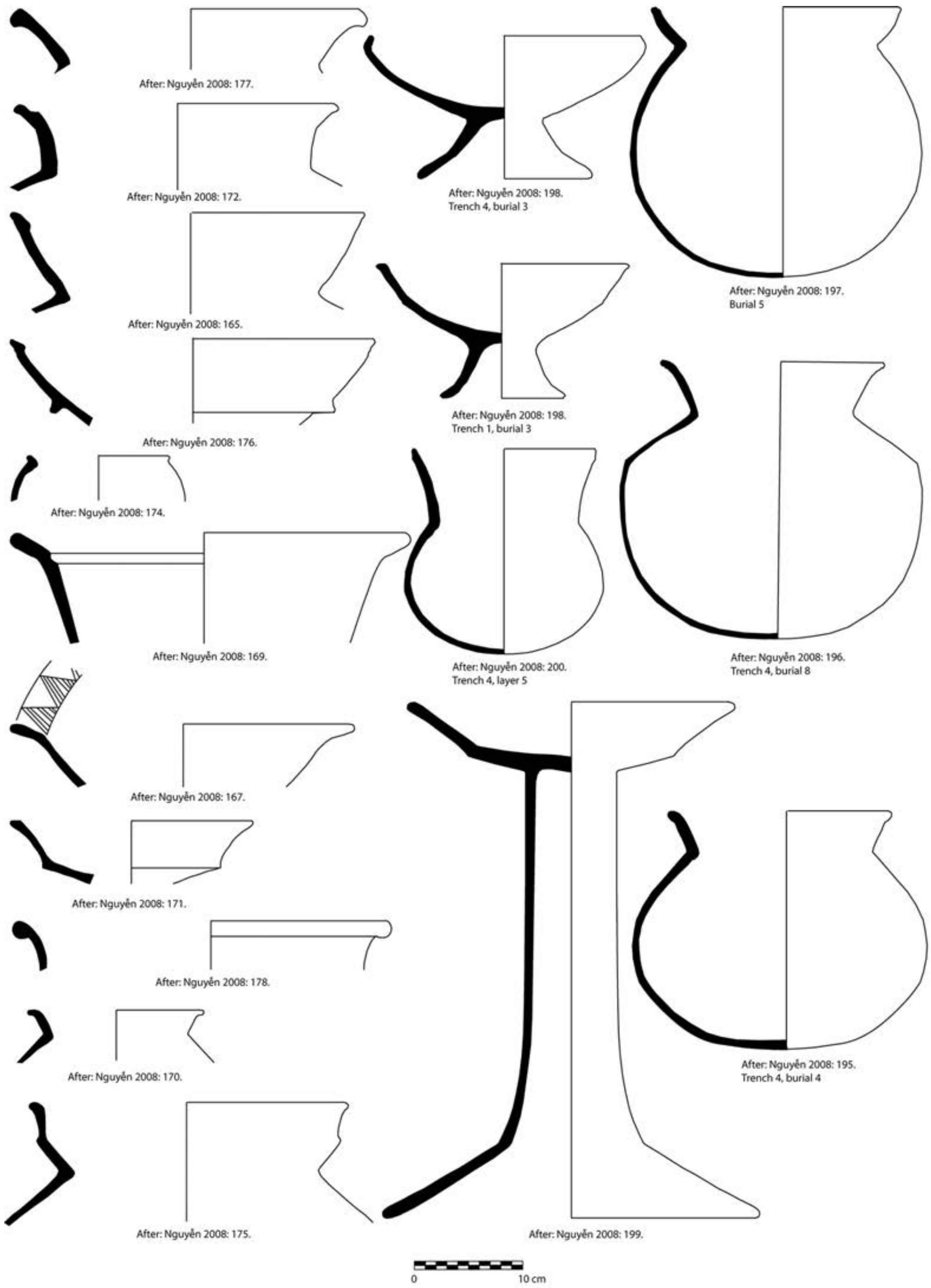


Figure 8.5. Cù Lao Rùa vessel forms, 2003 excavation.

Source: Illustrations, C. Sarjeant (After: Nguyễn 2008, as credited).

Đa Kai

Đa Kai is located in the upper reach of the Đồng Nai River in Đa Kai village, Đức Linh district, Bình Thuận Province. Đa Kai was first identified in 1981 when lithophones were discovered there, and test excavations followed in 1997. Subsequent excavations took place in 1998 and 2005 (Nishimura et al. 2009). Đa Kai is a circular earthwork site (as described in Chapter 2) with a different topography to mounds like An Sơn, and has a largely neolithic occupation, with one iron age jar burial. Two dates from Đa Kai have been reported, both of which are from charcoal samples, 3215–3376 cal. BP and 3299–3455 cal. BP, however neither of these dates relate to a specific archaeological context (Nishimura et al. 2009). Only the material associated with the neolithic occupation is included in the comparison presented in this chapter and in the CA (see also Appendix B).

While it was assumed that Đa Kai was used for burials, bone and shell remains were absent due to the soil chemistry. Parallels between the ceramics, stone tools and site construction of Đa Kai have been discussed in comparison with the circular earthwork sites of Memot, eastern Cambodia (e.g. Krek), and other neolithic sites of southern Vietnam (e.g. An Sơn, Bình Đa) (Nishimura et al. 2009) (see Chapter 2). Some of the ceramic vessel forms are shown in Figure 8.6. A summary of the material culture at Đa Kai is listed in Table 8.6.

The data in Appendix B and the CA for Đa Kai were adapted from reported information (Nishimura et al. 2009).

Table 8.6. The material culture contents of the neolithic layers at Đa Kai.

Ceramic vessels	Other material culture
everted rim restricted independent vessel	unshouldered stone adze
concave rim restricted independent vessel	shouldered stone adze
simple restricted vessel	whetstone
simple unrestricted vessel	sandstone
simple unrestricted vessel with pedestal	hammerstone
linear incision	stone bangle
geometric incision	lithophone
red paint	stone preform
burnishing	stone tools well-worn/reworked
cordmarking	ceramic roundel
paddle impression	clay pellet
roulette stamping	
white lime infill	
ridge/appliqué	
fibre temper	
sand temper	
calcareous sand temper	

Source: Data from Nishimura *et al.* 2009.

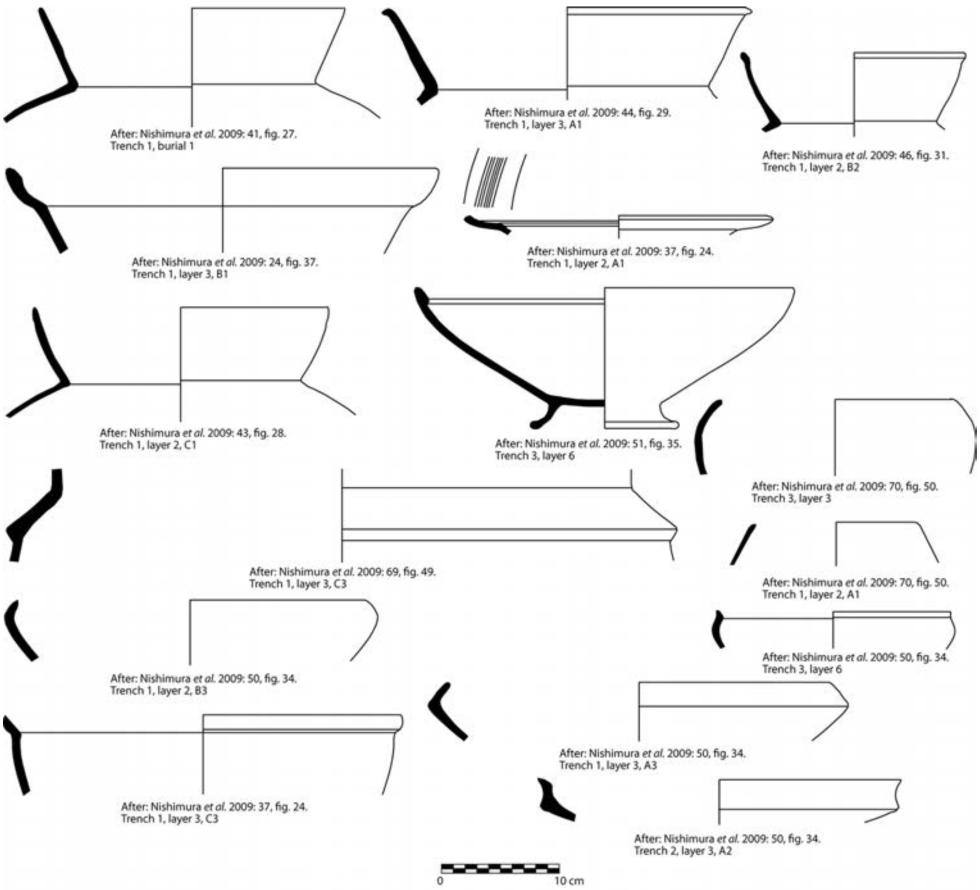


Figure 8.6. Đa Kai vessel forms, 1997 excavation.

Source: Illustrations, C. Sarjeant (After: Nishimura *et al.* 2009, as credited).

Đình Ông

Located in Gò Dầu district, Tây Ninh Province, along the Vàm Cỏ Đông River and north of An Sơn, Đình Ông was excavated by the Centre for Archaeological Studies of the Southern Institute of Social Sciences, Ho Chi Minh City. There is limited reported information about this research, particularly about the non-ceramic assemblages. A summary of the material culture at Đình Ông is listed in Table 8.7.

The data in Appendix B and the CA for Đình Ông were adapted from personal observations at the Centre for Archaeological Studies of the Southern Institute of Social Sciences, Ho Chi Minh City in 2010.

Table 8.7. The material culture contents of the neolithic layers at Đình Ông.

Ceramic vessels
concave rim restricted independent vessel
simple unrestricted vessel
simple unrestricted vessel with pedestal
linear incision
burnishing
cordmarking
paddle impression
roulette stamping
fibre temper
sand temper

Source: Data from personal observations.

Gỗ Cao Su

Gỗ Cao Su is located near An Sơn and Lộc Giang in Đức Hòa district, Long An Province. The site was excavated by the Institute of Archaeology in Hanoi and the Long An Provincial Museum in 1994. It is slightly elevated, and about 2 m of cultural deposit were revealed in the excavation. The ceramics were mostly fibre tempered, and reportedly have parallels with later prehistoric sites of the region. Some later deposits were associated with bronze, iron and stone beads (Nguyễn 2001). Two charcoal dates have been reported, 3370±80 BP uncalibrated from Pit 1, layer 10, and 2650±70 BP uncalibrated from layer 3 (Bùi *et al.* 1997). The dates are 1884–1496 cal. BC and 979–550 cal. BC (95.4% probability), when calibrated with OxCal 4.1.7 (Figure 8.9). There was insufficient information to include this site in the CA.

Lộc Giang

Lộc Giang is a neighbouring site to An Sơn, and is also located near the Vàm Cỏ Đông River in Lộc An hamlet, Lộc Giang village, Đức Hòa district, Long An Province. It was first identified by Louis Malleret in 1963, and surveys took place in 1978, followed by excavations in 1988 and 1993 (Quang and Ngô 1994). One charcoal date has been reported for Lộc Giang, 3950±75 BP uncalibrated from the lowest layer (Nishimura and Nguyễn 2002). This date has been calibrated to 2834–2203 cal. BC (95.4% probability) with OxCal 4.1.7, and is comparable to the earliest dates at An Sơn (Figure 8.10; compare Figure 4.6).

The ceramic assemblage Lộc Giang was generally similar to that at An Sơn in terms of rim form and decoration (Figure 8.7, Figure 8.8). This included square *cà ràng* projections, foot rims, and high pedestals/stems with roulette stamped and incised decoration. Some forms had motifs on the interior of the rim. The paddle linear impressed surface treatment with horizontal and wave incisions overtop was a common decoration at neolithic sites in southern Vietnam, and also occurred at Lộc Giang. The presence of shoulder sherds with a ridge or appliqué and concentric circle, wave or spiral incisions is paralleled at sites in the Đồng Nai region. The 1994 report also states that Óc Eo ceramics were identified in the upper layer at Lộc Giang (Quang and Ngô 1994).

The lithic assemblage at Lộc Giang included broad, rectangular-sectioned shouldered adzes, ground unshouldered rectangular-sectioned and triangular-shaped adzes, points, flake scrapers, chopper-type tools, quadrangular and triangular-shaped axes, and whetstones. The adzes varied in size and the larger were typically unshouldered and rectangular-sectioned (Quang and Ngô 1994). A summary of present material culture at Lộc Giang is listed in Table 8.8.

The data in Appendix B and the CA for Lộc Giang were adapted from reported information (Quang and Ngô 1994), and from personal observations Long An Provincial Museum in 2009 and 2010.

Table 8.8. The material culture contents of the neolithic layers at Lộc Giang.

Ceramic vessels	Other material culture
everted rim restricted independent vessel	unshouldered stone adze
concave rim restricted independent vessel	shouldered stone adze
simple unrestricted vessel	whetstone
simple unrestricted vessel with pedestal	lithophone
wavy rim simple unrestricted vessel	stone tools well-worn/reworked
cà ràng	ceramic roundel
linear incision	clay pellet
geometric incision	
red paint	
burnishing	
coarse cordmarking	
cordmarking	
paddle impression	
roulette stamping	
ridge/appliqué	
fibre temper	
sand temper	
phosphate sand temper	

Source: Data from Nishimura and Vương 1997; Quang and Ngô 1994, and personal observations.

Figure 8.7. Lộc Giang incised and roulette stamped sherds. Not to scale.

Source: Photo C. Sarjeant.

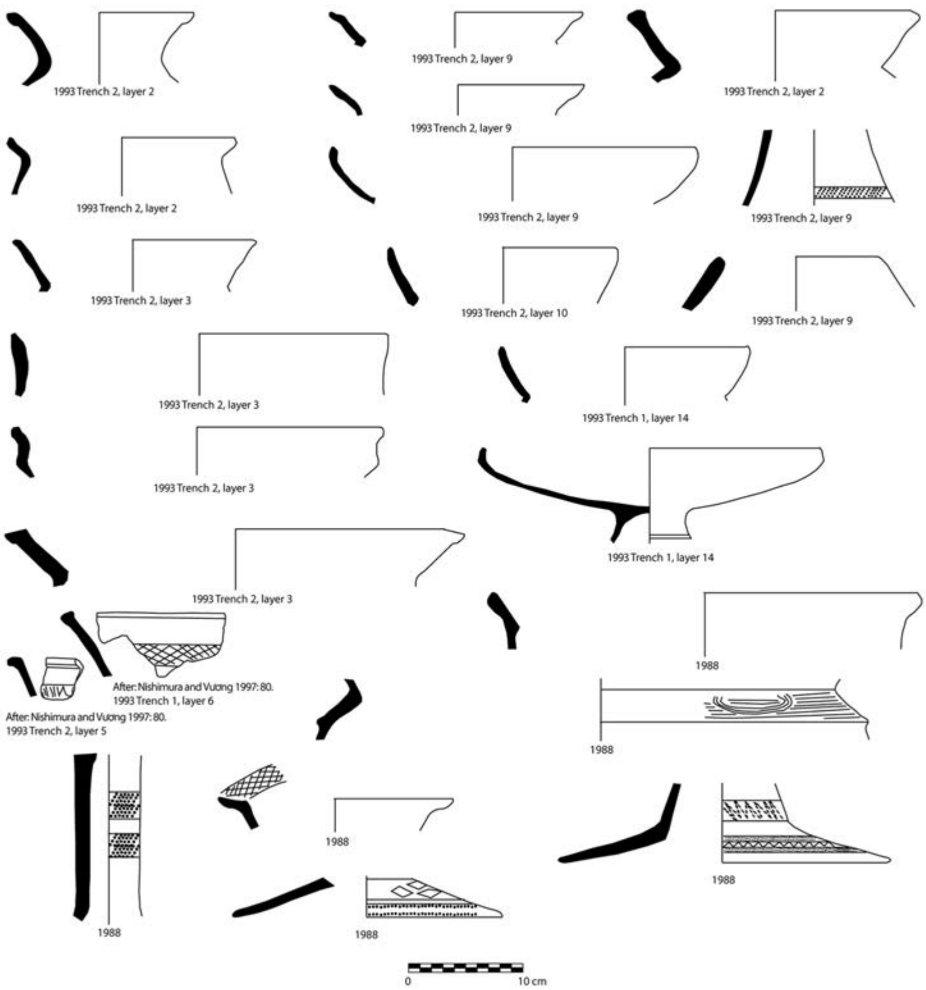


Figure 8.8. Lộc Giang vessel forms, 1988 and 1993 excavations.

Source: Illustrations, C. Sarjeant (After: Quang and Ngô 1994; except those labelled as Nishimura and Vương 1997).

Rạch Lá

Rạch Lá is located in Quới Thạnh hamlet, Phước An village, Nhơn Trạch district, Đồng Nai Province. There is little reported information available for Rạch Lá, even though the site was excavated in 2002. The reported uncalibrated dates for Rạch Lá are 3790±60 BP, 3900±60 BP, 3960±85 BP, and 4080±90 BP (Unknown author, *The excavation of Rạch Lá* 2002). These dates are 2469–2038 cal. BC, 2566–2203 cal. BC, 2852–2203 cal. BC and 2894–2356 cal. BC (95.4% probability), when calibrated with OxCal 4.1.7 (Figure 8.13).

Rạch Lá is known for its mangrove environment and the preservation of wood remains suggest the use of raised stilt housing. The manufacture of stone tools was thought to have taken place inside houses. This is supported by the 2002 excavations, as knapping debris was often found near the evidence of housing. Similarities have been noted between the ceramics of Rạch Lá, Cái Vạn and Cái Lăng in the Đồng Nai region, but Rạch Lá is considered to have had an earlier occupation because there is no evidence of metal (Unknown author, *The excavation of Rạch Lá* 2002). A summary of the material culture at Rạch Lá is listed in Table 8.9.

The data in Appendix B and the CA for Rạch Lá were adapted from personal observations at the Đồng Nai Provincial Museum in 2009 and 2010.

Table 8.9. The material culture contents of the neolithic layers at Rạch Lá.

Ceramic vessels	Other material culture
everted rim restricted independent vessel	clay pellet
concave rim restricted independent vessel	
simple restricted vessel	
simple unrestricted vessel	
cà ràng	
linear incision	
cordmarking	
paddle impression	
ridge/appliqué	
fibre temper	
sand temper	

Source: Data from personal observations.

Rạch Núi

Rạch Núi is a mound located in Đông Thạnh village, Cần Giuộc district, Long An Province, on salt marshland near the Rạch Cát River. The mouths of the Đồng Nai and Vàm Cỏ Đông Rivers are approximately 20–30 km from the site. Rạch Núi is 100–120 m in diameter and about 7 m high. The site was first surveyed and excavated in 1975, but little was published from this expedition (Bùi *et al*. 1997). Fontaine reported a date of 2400±100 BP uncalibrated from an unknown context (Bùi *et al*. 1997). This has been calibrated to 794–231 cal. BC (95.4% probability) with OxCal 4.1.7 (Figure 8.14).

Phạm Quang Sơn excavated into the top of the mound at Rạch Núi in 1977, and the cultural deposits were about 5 m deep. Material recovered included mollusc shells and the remains of domesticated pigs. The lithic assemblage primarily included untanged rectangular-sectioned adzes, particularly in the upper layers, with very few shouldered types. It has been suggested that less reworking of lithics took place at Rạch Núi in comparison to the stone assemblage at An Sơn (Bùi, Vương and Nishimura 1997). The presence of shouldered turtle bone adzes at Rạch Núi indicates that they may have been used in place of shouldered stone adzes. It has also been hypothesised that exchange goods may have been more accessible to the inhabitants of Rạch Núi than to those at An Sơn (Bùi *et al*. 1997). However, more recent evidence suggests the contrary. If we accept the shouldered to unshouldered transition in adzes over time (as at An Sơn, see Chapter 4), then the absence of shouldered stone adzes at Rạch Núi may indicate a later occupation of the site. Alternatively it may indicate limited access to exchange networks that provided the necessary stone resources at initial occupation and a need to utilise local turtle bone instead. Suitable stone resources are known to exist further north in Đồng Nai Province. Other bone artefacts identified at Rạch Núi included awls, a knife-shaped tool, and ornaments. A summary of the material culture at Rạch Núi is listed in Table 8.10. The ceramic assemblage included *cà ràng* vessels, deep cord-marked round bowl vessels that contributed more than 90% of the assemblage, miniature vessels, and limestone ceramic tempers (Nishimura and Nguyễn 2002; Bùi *et al*. 1997). Examples of these vessel forms are shown in Figure 8.9.

The most recent excavations at Rạch Núi in March–April 2012, revealed extensive evidence of living floors and platforms. These were constructed from local clay, probably imported sand, and burnt shell to create hard lime-rich surfaces. The material culture associated with these floors was minimal, with ceramic sherds the major component, specifically the deep cord-marked round bowl vessels. These vessels had irregular rim shapes, presumably due to en masse and rapid hand construction of these utilitarian vessels. They were presumably used for cooking, due to their shell and fibre tempers that would have been ideal for heating and cooling. A secondary role of these sherds was to create the living floors, which were flattened as a hard layer between deposits of clay and lime. There were very few sand tempered ceramic sherds, specifically rims, compared to the shell tempered utilitarian bowls, and with further research it may become possible to determine whether these sand tempered vessels were non-local imports. Other Rạch Núi material culture excavated in 2012 included shell beads, unshouldered stone adzes and evidence of reworking these adzes (there was only one shouldered stone adze), turtle shell shouldered adzes and bangles, clay pellets and ceramic roundels.

The data in Appendix B and the CA for Rạch Núi were adapted from reported information (Nishimura and Nguyễn 2002; Bùi *et al.* 1997) and personal observations during the 2012 field season.

Table 8.10. The material culture contents of the neolithic layers at Rạch Núi.

Ceramic vessels	Other material culture
everted rim restricted independent vessel	unshouldered stone adze
concave rim restricted independent vessel	shouldered stone adze
simple restricted vessel	ceramic roundel
simple unrestricted vessel	clay pellet
cà ràng	clay anvil
linear incision	shell bead
burnishing	bone/ivory bangle
cordmarking	worked bone
paddle impression	
roulette stamping	
punctate stamping	
ridge/appliqué	
fibre temper	
sand temper	
laterite sand temper	
calcareous sand temper	

Source: Data from Nishimura and Nguyễn 2002; Bùi *et al.* 1997, and personal observations.

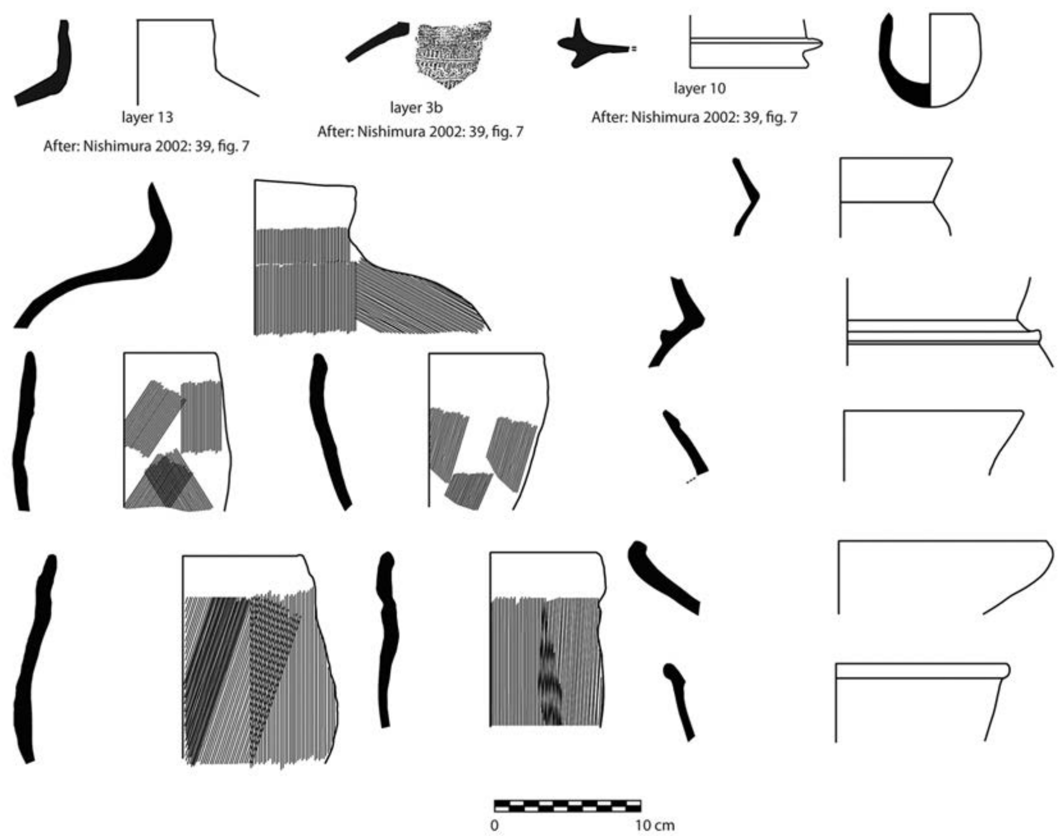


Figure 8.9. Rạch Núi vessel forms, 1977 and 2012 excavations.

Source: Illustrations, C. Sarjeant (except those labelled After: Nishimura 2002: 39, fig. 7).

Rạch Rừng

Rạch Rừng is located in Tân Lập village, Mộc Hoá district, Long An Province, along the Vàm Cỏ Tây River. The site was surveyed by the Long An Provincial Museum in 1990. It is a small mound, but the site has been disturbed by road construction. Stone rings and bangles, ceramic sherds, stone adzes, and animal bones were collected during the survey. Both unshouldered and shouldered adzes were recovered. Excavations at Rạch Rừng revealed human burials and wooden piles that were identified as house remains. Radiocarbon dates of a wood fragment from a burial provided the dates 2780±40 BP and 2800±45 BP uncalibrated (Bùi *et al.* 1997). The dates have been calibrated to 1019–829 cal. BC and 1110–833 cal. BC (95.4% probability) with OxCal 4.1.7 (Figure 8.16). There was insufficient information to include this site in the CA.

Suối *Linh*

Suối Linh is located in Trị An village, Vĩnh Cửu district, Đồng Nai Province, in the upper reach of the Đồng Nai River. Excavations were conducted at Suối Linh in 1985 and 2002, and it is thought to date to *c.* 3500–2500 BP. Suối Linh is considered to have been a stone workshop site, after the discovery of a comprehensive lithic assemblage with triangular and rectangular-sectioned unshouldered and shouldered adzes, chisels, scrapers, arrowheads, drill points, awls, hammerstones, whetstones, and pestles, as well as stone pellets and bangles. Ceramic pellets, rings, pendants and anvils were also identified in the 2002 excavation. A summary of the material culture at Suối Linh is listed in Table 8.11. The decoration on the Suối Linh ceramics included geometric incision, wave incision over paddle linear impression, and punctate or roulette stamping, as seen at other neolithic sites of southern Vietnam (Trịnh 2005; Trịnh *et al.* 2003). Some of the Suối Linh vessel forms are presented in Figure 8.10.

The data in Appendix B and the CA for Suối Linh were adapted from reported information (Trịnh 2005; Trịnh *et al.* 2003), and from personal observations at the Đồng Nai Provincial Museum in 2010.

Table 8.11. The material culture contents of the neolithic layers at Suối Linh.

Ceramic vessels	Other material culture
everted rim restricted independent vessel	unshouldered stone adze
concave rim restricted independent vessel	shouldered stone adze
unrestricted independent vessel	whetstone
simple unrestricted vessel	hammerstone
simple unrestricted vessel with pedestal	stone bangle
linear incision	stone arrowhead
geometric incision	stone preform
burnishing	ceramic roundel
cordmarking	clay pellet
paddle impression	clay anvil
roulette stamping	clay bangle
punctate stamping	
ridge/appliqué	
sand temper	
laterite sand temper	
calcareous sand temper	

Source: Data from Trịnh 2005; Trịnh *et al.* 2003, and personal observations.

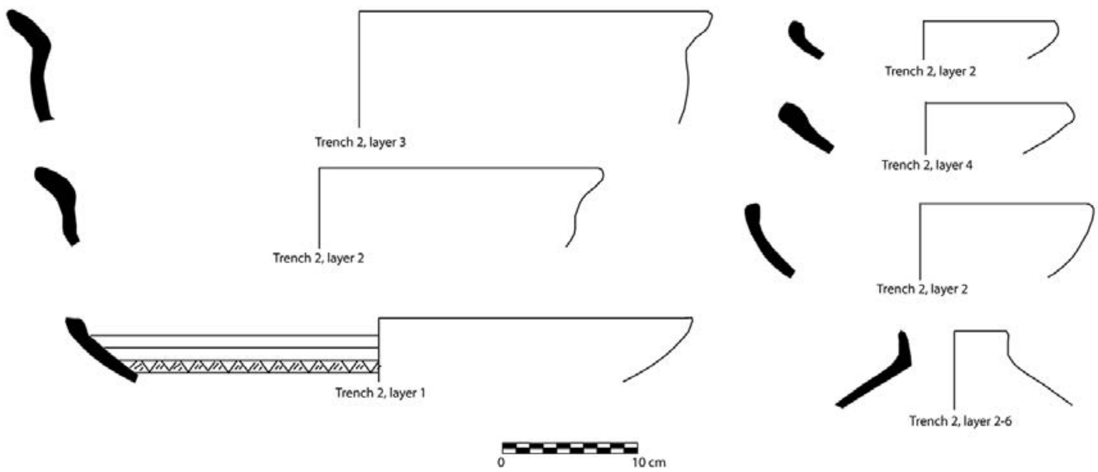


Figure 8.10. Suối Linh vessel forms, 2002 excavation.

Source: Illustrations C. Sarjeant (After: Trịnh 2005: 51; Trịnh *et al.* 2003).

Comparison with An Sơn: Correspondence analysis

The identified variables for the CA included ceramic rim forms from the An Sơn categorisation (Figure 5.1), variants of the categorised rim forms (e.g. Figure 5.2), complete An Sơn ceramic vessel forms (Figure 5.14), any anomalous rim forms at An Sơn and the other eleven assessed sites. Variables considered included ceramic modes of decoration and surface treatment, the location of these decorations on vessels, ceramic tempers when possible, the presence (or absence) of stone tools, other stone ornaments, bone/ivory tools and ornaments, and ceramic/clay items like roundels and pellets. The presence and absence data for these variables applied in the CA are in Appendix B. A total of 135 variables were included in the CA, of which 112 were ceramic vessel variables and the remaining 23 were other material culture variables. Two CAs are presented here, one of all material culture variables (Figure 8.11), and one of only the ceramic variables (Figure 8.12). Each CA is separated into two plots, the first plotting the sites and the second the variables. The variables are coded with a number, and this section should be read in conjunction with these codes in Appendix B. To relate the chronology of the analysed sites to the sequence at An Sơn, the material culture at An Sơn is divided into early, middle and late phases of occupation.

The CA plot (Figure 8.11) indicates that many sites cluster together, based on the majority of the included material culture variables. The main cluster of the CA plot includes most of the compared variables and sites, and there are two subgroups. The first subgroup includes the middle occupation at An Sơn, Lộc Giang, Đa Kai and Bến Đò, which correspond with the majority of the variables applied in the analysis, as seen in the central cluster of the variables in Figure 8.12. Lộc Giang corresponds with the variables of roulette stamping in a zigzag shape, fine fibre temper, and rim forms A1e and A1f. The second subgroup includes Bình Đa, Cái Vạn and Suối Linh, which correspond due to the presence of form A1g variants and shoulder sherds with a ridge or appliqué that are decorated with incised swirls/concentric circles. Rạch Lá and Đình Ông somewhat correspond with this subgroup, although not as closely as the aforementioned sites.

Early and late An Sơn, Cù Lao Rùa, Rạch Núi, and Cầu Sắt are all outliers in Figure 8.11. Đình Ông, Cầu Sắt and Rạch Lá are affected by lack of information in the statistical analysis. Cầu Sắt and Suối Linh cluster together when considering the limited available variables, and correspond with the presence of punctate stamped bands on ceramics and triangular-shaped unshouldered adzes. Cù Lao Rùa appears to be distinct from the main cluster, due to its unique vessel forms. Late An Sơn is an outlier in the CA plot (Figure 8.11), due to the presence of ceramic with incised and impressed decoration on high stem and foot rims, phosphate sand temper, rim forms A1i-r, B3a and D2a, and sandstone and shell beads. This suggests that changes occurred towards the end of the neolithic at An Sơn, leading to cultural differentiation between sites within southern Vietnam.

When only considering the ceramic vessel variables similar patterns emerged and some relationships become clearer (Figure 8.12). Two main groups are distinguished once again: one inclusive of the early and middle occupations at An Sơn and Lộc Giang; and the second including Bình Đa, Cái Vạn, Suối Linh, Đình Ông and Rạch Núi. The outliers of this plot were the late occupation at An Sơn, Cù Lao Rùa, Cầu Sắt, Đa Kai, Rạch Lá and Bến Đò. These results suggest a geographic model for the distribution of material culture in southern Vietnam: one group based on the Vàm Cỏ Đông River region that includes An Sơn and Lộc Giang, and a second that includes sites near the Đồng Nai River such as Bình Đa and Rạch Núi. Clarification of the apparent relationship between Đình Ông and the Đồng Nai River sites, rather than with the geographically closer sites of the Vàm Cỏ Đông River region, requires further research. The Vàm Cỏ Đông sites are characterised by class A2 and class D wavy rimmed ceramic vessels (refer to rim form images in Figure 5.1), roulette and punctate stamped decoration, both sand and fibre tempered ceramics, and shouldered stone adzes. The Đồng Nai River sites are characterised by ceramic vessel variants of form A1g, class B and form C2b, as well as ridge/appliqué on the shoulder of vessels, calcareous tempers, and clay anvils. There was some correspondence between these Đồng Nai River sites and Đa Kai, which is distinguished from the main cluster due to an absence of form C2b variants and coarse punctate stamping, and a presence of zigzag incision and decoration on high-stemmed pedestal vessels (Figure 8.11, Figure 8.12).

Rạch Lá, Cầu Sắt, Suối Linh and Đình Ông are affected by a lack of reported information, and their relationships to the other sites in the CA are not completely clear (Figure 8.12). Bến Đò does not correspond with An Sơn and the main cluster due to a presence of a form C3a variant and A1h vessels. The neolithic occupation of Cù Lao Rùa is also an outlier in the plot, despite its proximity to the Đồng Nai River and sites like Bình Đa. Its distinctiveness is heightened by the presence of form A1 variants, incised and impressed stems of form C1 vessels, and square/rectangular geometric incised decoration. The known bronze age occupation of Cù Lao Rùa may be reflected in the studied neolithic assemblage. The diversity in the material culture assemblage discussed in this chapter, and its divergence from other assemblages in neolithic southern Vietnam, may be indicative of sites with a later neolithic date or transitional occupation into the bronze age, such as Cù Lao Rùa. This divergence is also observed in the late occupation at An Sơn, with different ceramic material culture to the earlier phases and other analysed sites, evidenced by a presence of form A1a variants with incised rims, A1i-r rims, A2 vessels with pedestals, B3a rims, C1b restricted vessels with a pedestal, D2a rims, and phosphate sand tempers (Figure 8.12).

The An Sơn ceramic forms and identified variants and the other included variables in this comparison are shown in Appendix B, alongside the presence and absence data and variable codes. Seven groups have been identified in the CA, and the corresponding variables shared by the sites within each group are summarised in Table 8.12 and presented in the map of Figure 8.13.

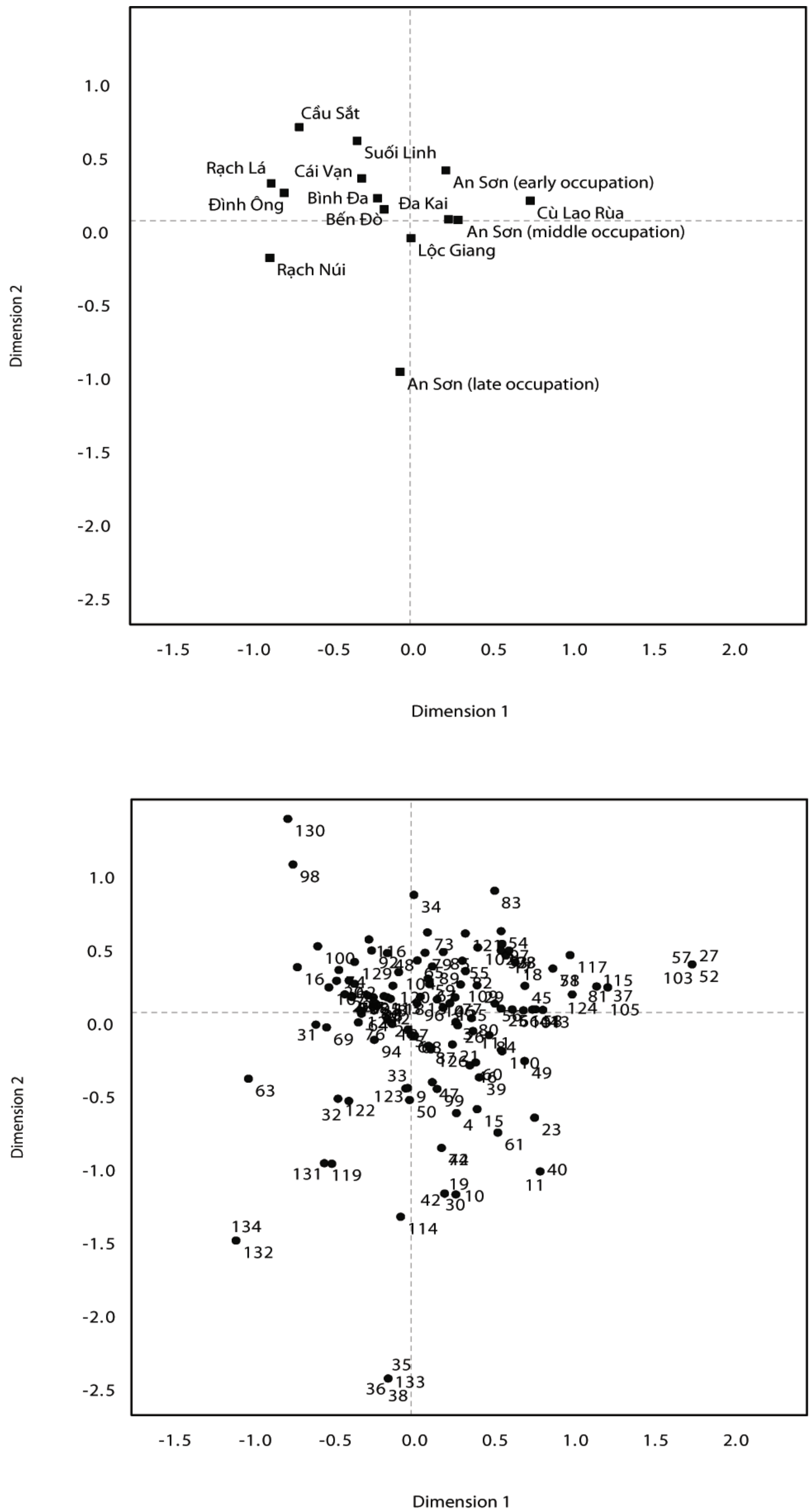


Figure 8.11. CA plots for all southern Vietnam neolithic material culture variables. Top: sites, bottom: variables. Refer to Appendix B for variable codes.

Source: C. Sarjeant.

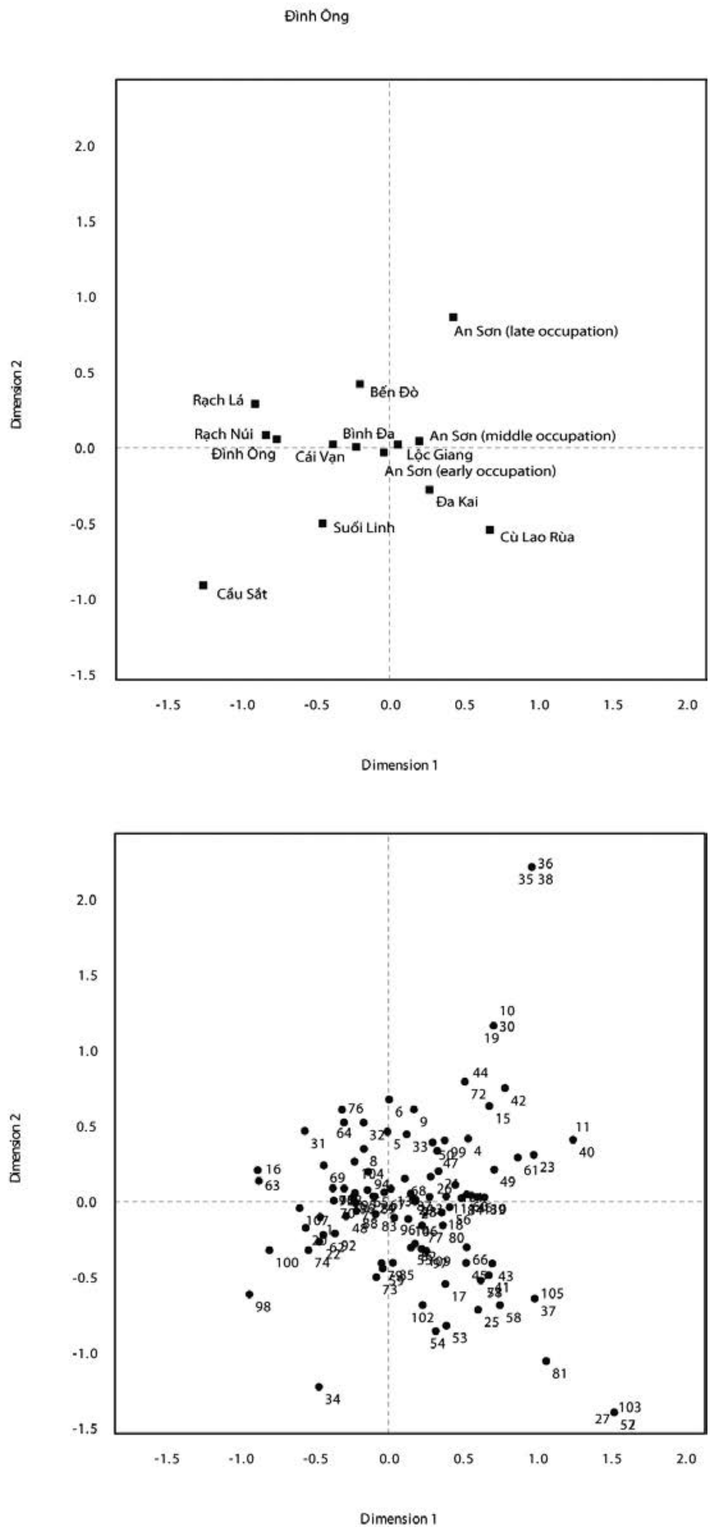


Figure 8.12. CA plots for the southern Vietnam neolithic ceramic vessel variables. Top: sites, bottom: variables. Refer to Appendix B for variable codes.

Source: C. Sarjeant.

Table 8.12. Groups in Figure 8.11 and Figure 8.12 CA plots and the contributing variables. Not all variables are applicable for all sites of each group. Note: the information from Đình Ông, Rạch Lá, Cầu Sắt and Bến Đò is limited in comparison to the other sites. Bình Đa shares variables with both groups 1 and 2. Refer to Appendix B for ceramic form images and presence or absence of the variables at each site.

Group number	Corresponding sites	Corresponding variables
1	An Sơn (early occupation) An Sơn (middle occupation) Lộc Giang	A1 class ceramic vessels A2 class ceramic vessels B1b ceramic vessels C2 class ceramic vessels C3 class ceramic vessels D1 class ceramic vessels E1a cà rang ceramic vessels Incised pedestals A class ridged shoulder sherds Coarse cordmarking Concentric curvilinear incisions Roulette stamping Punctate stamping Fibre temper Sand temper Coarse sand temper Shouldered adzes Lithophones Stone bangles
1/2	Bình Đa	
2	Cái Vạn Đình Ông Rạch Lá Rạch Núi Suối Linh	A1g ceramic vessels and variants B class ceramic vessels and variants C1 class ceramic vessels with pedestal C2b ceramic vessels and variants A class ridged shoulder sherds Ridge/appliqué Lateritic sand temper Calcareous temper Unshouldered adzes Clay anvils Clay bangles Shell beads Bone/ivory bangles Worked bone

Group number	Corresponding sites	Corresponding variables
3	An Sơn (late occupation)	A1i-r ceramic vessels B3a ceramic vessels C1a ceramic vessels with high-stemmed pedestals C1b ceramic vessels with pedestal D2a ceramic vessels Mortuary ceramic vessels Phosphate sand temper Unshouldered adzes Polishing stones Lithophones Shell beads Bone/ivory bangles Worked bone
4	Cầu Sắt	Unrestricted independent vessel with pedestal
5	Bến Đò	A1e ceramic vessels A1f ceramic vessels A1i ceramic vessels C3a ceramic vessel variants E2 cà rang ceramic vessels projections Vertical linear incisions
6	Đa Kai	C class ceramic vessels with pedestals C2b ceramic vessel variants
7	Cù Lao Rùa	A1 class ceramic vessel variants B1b ceramic vessels C1a ceramic vessel variants C1b ceramic vessels with pedestal Incised pedestals Square/rectangular geometric incisions Triangular geometric incisions with diagonal line incision fill Shouldered adzes

Source: Compiled by C. Sarjeant.

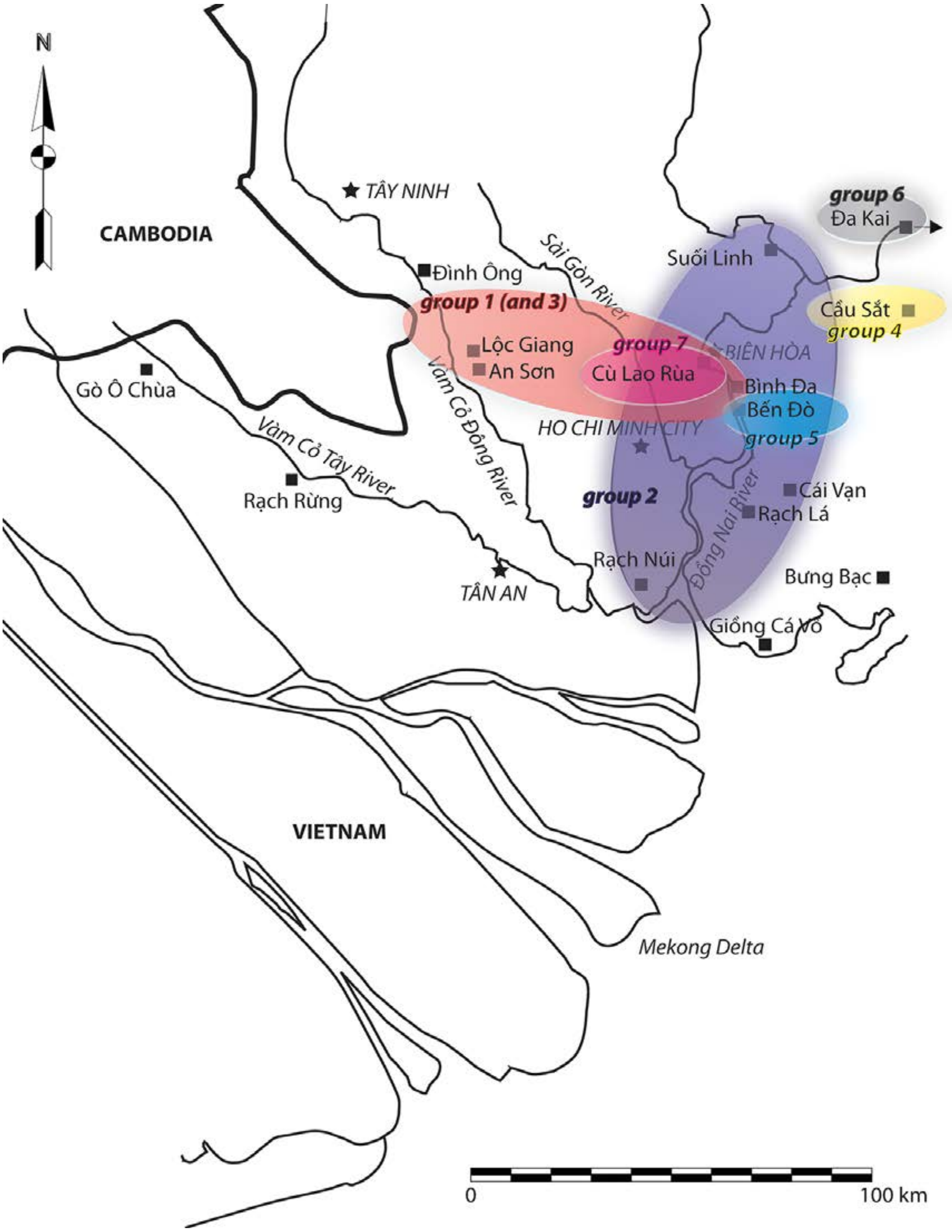


Figure 8.13. Distribution of CA groups in Table 8.12 according to material culture variables in southern Vietnam. Đình Ông corresponds with group 2 in the CA but further evidence is required to confirm this.

Source: C. Sarjeant.

Summary: The material culture comparison of southern Vietnam

In general, relationships are evident between the sites of southern Vietnam, especially due to geographical proximity. Many of the differences in material culture also relate to chronology, whereby most of the sites correspond with the early to middle occupation at An Sơn. These include Bình Đa, Cái Vạn, Đình Ông, and primarily Lộc Giang. At this stage, some of the material culture at Rạch Núi exhibited parallels with early An Sơn. However, since Rạch Núi presents such contrasting evidence overall to An Sơn, it appears to represent different cultural developments closer to the coastline. These contrasts are further discussed in relation to cultural isolation at Rạch Núi in Chapter 10.

Two separate but connected ceramic manufacturing complexes can be identified within southern Vietnam, one in the Vàm Cỏ Đông River region and one in the Đồng Nai River region. These regions share some ceramic traditions, as evidenced by the parallels between Bình Đa and An Sơn, but the commonalities between Lộc Giang and An Sơn within the Vàm Cỏ Đông River region, and between Bình Đa, Cái Vạn, Rạch Núi, and Suối Linh within the Đồng Nai River region, are much clearer.

The large geographical distances between Cù Lao Rùa, Đa Kai, Bến Đò and Cầu Sắt and the other sites may explain why these sites were outliers in the CA plots (Figure 8.11, Figure 8.12). These sites also share some material culture links with the majority of the other sites in southern Vietnam. Given its proximity to Rạch Lá, Cái Vạn would be expected to have had a greater correspondence with this site in the CA, unless they represent different phases within the neolithic sequence. A similar situation also applies to Bến Đò and Bình Đa, but there is currently little information about Bến Đò to expand on such comparisons.

Since Cù Lao Rùa is located within the geographical area of sites in CA group 3 (Figure 8.13), but is an outlier in the plots, Cù Lao Rùa was perhaps occupied at a different, presumably later, time to the other sites of group 3. The limited radiocarbon dating of Cù Lao Rùa is insufficient to confirm this. Marked diversification was presented in the material culture of Cù Lao Rùa during the neolithic occupation, and it is clear that regionalisation increased over time within southern Vietnam, as also observed at An Sơn in the later occupation, when new ceramic forms (e.g. the serrated rimmed D2a) and unshouldered stone adzes appeared.

9

Comparison of Neolithic Sites in Southeast Asia

Introduction: Methodology for comparative research of Southeast Asian neolithic ceramics

There are few well-documented neolithic sites in Southeast Asia. This has had consequences for understanding the inception of agriculture and related events in the region. At present, there are two main explanations for the origins of the neolithic in Southeast Asia. The first is the 'Two Layer' model for demographic transition (Bellwood and Oxenham 2008), which links archaeological and linguistic evidence. It posits that the growth of the population and expansion in the Southeast Asia region can be attributed to the adoption of food production, whereby farmers spread and assimilated indigenous hunter-gatherers. This hypothesis explains the widespread presence of Austroasiatic languages across areas with similar neolithic mortuary traditions, ceramic vessels, weaving evidence, and domestic rice and pigs (Bellwood and Oxenham 2008). The second model, which is purely archaeological, places more importance on the role of the indigenous hunter-gatherers, and suggests that the intrusive neolithic farmers had a reduced impact when compared to the adaptation within the hunter-gatherer groups (Gorman 1977, 1972, 1971; Solheim 1972).

There is increasing evidence that rice farming only entered the prehistoric Southeast Asian economy around 2000 BC (Higham 2011b). There is a noticeable distinction between Hoabinhian hunter-gatherers and neolithic populations of mainland Southeast Asia who arrived with knowledge of rice cultivation, ground and polished stone adzes, and incised and impressed pottery. In accordance with the first hypothesis described above, their origin has been suggested to be in southern China, with most research supporting the Yangtze Valley (Higham 2009d, 2002a; Rispoli 2007; Wiriyaromp 2007; Bellwood 2005; Blust 1996).

This chapter builds upon past ceramic comparative research in the region (e.g. Wiriyaromp 2011, 2007; Rispoli 2007) to investigate the relationship between neolithic sites. It draws upon specific comparisons with An Sơn in order to place southern Vietnam in the wider context of neolithic events in Southeast Asia. As in Chapter 8, a correspondence analysis (CA) is employed (described in Chapter 3) to compare a broad range of sites in mainland Southeast Asia, chosen for their neolithic occupational evidence and accessible excavation reports. Some sites have dubious chronologies and efforts have been made to include only evidence from pre-metal contexts. Both early and late neolithic contexts are represented in this study. The comparison included the sites of Ban Non Wat, Khok Phanom Di, Nong Nor, Khok Charoen, Tha Kae, and Mán Bạc since they exhibited neolithic evidence from secure contexts, even if the radiocarbon dates have not been confirmed from some sites. The additional sites of Samrong Sen, Laang Spean, early Ban Lum Khao, early Ban Chiang, early Non Nok Tha, Krek and Xóm Rền were also included but contextual information and chronology for these sites is less secure. Collectively, these sites cover a wide geographic area and span some 1000 years of time, so a relative lack of precision is unavoidable. For this analysis, An Sơn is divided into a burial phase and early, middle and late phases of occupation. Refer to the map in Figure 1.2 and the summary of Table 3.3 for these sites.

Unlike the previous CA of the southern Vietnam sites (Chapter 8), there is less focus on the combinations of material culture traits, for example each variable represented a number of traits identified together on a ceramic vessel. Each trait is treated separately as one variable in the current analysis. This is to account for and manage the increasing variability of material culture as a wider area is examined. Data for the CA were collected and plotted in terms of the presence or absence of certain variables. As in the previous CA analyses for southern Vietnam, absence was assigned when no information for that variable was available. This does not always mean that the variable concerned was not present, but that there was no evidence for its presence. The results of these analyses should be revisited and revised as more information becomes available for the studied sites, and as more sites are added as research expands in Southeast Asia. This chapter first introduces each site and summarises the material culture data. This is followed by the results of the CA and a discussion of the material culture relationships within the neolithic of landscape Southeast Asia. The methods for data collection from these sites and the CA were described in Chapter 3. The material culture variables, presence and absence data, and the codes for the variables used in the CA are presented in Appendix C.

Northeast Thailand

Ban Non Wat

The site of Ban Non Wat is situated on the Khorat Plateau in northeast Thailand, in the Huai Yai valley. Ban Non Wat has been extensively excavated and comprehensive radiocarbon determinations have indicated that it represents a sequence in which late neolithic occupation developed onwards into bronze age and iron age occupation. Ban Non Wat was a moated site during the iron age, one of many in northeast Thailand visible in aerial photographs. The majority of the radiocarbon dates were determined from bivalve shell offerings in burials and charcoal from burials and features. The inception of neolithic occupation at Ban Non Wat occurred *c.* 1750–1500 cal. BC, with the Neolithic phase 1 burials dated to *c.* 1450–1350 cal. BC, and Neolithic 2 burials to *c.* 1350–1150 cal. BC. The earliest date for the bronze age burials is 1100–900 cal. BC, and this period extends to the beginning of the iron age, *c.* 700–400 cal. BC, after which Iron Age phase 1 ceased *c.* 175 cal. BC–AD 200 cal. (Higham and Higham 2009a).

The earliest evidence for occupation at Ban Non Wat may represent late Pleistocene hunter-gatherers. This evidence is scarce and includes clusters of bivalve shell, a deer skeleton, an infant human skeleton, and crouched burials with mortuary offerings. The dates are less secure from these burials than for the rest of the Ban Non Wat sequence, and three of these crouched burials dated to 1741–1537, 1521–1423 and 1262–1055 cal. BC (95% probability). Some of these dates are the earliest for the site and others overlap with the neolithic occupation (Higham 2009d; Higham and Higham 2009a).

The first neolithic people at Ban Non Wat grew rice, had domestic animals, fished and collected shellfish, and hunted wild animals. This first phase of neolithic occupation is consistent with the wider patterns of habitation in mainland Southeast Asia at this time. There is evidence for trade and exchange during this phase with a presence of marine cowrie shells in burial contexts. This is similar, perhaps, to Shang state traditions in the Yellow River Valley of China and to the more recent Dian culture in Yunnan. Stone resources were also imported (Higham 2009d). An evident decrease in decorated pottery and other mortuary offering in the second neolithic burial phase is paralleled at Ban Lum Khao (Higham 2009d).

The neolithic occupation of Ban Non Wat was associated with the basal layer 5 and the lowest spits of layer 4. Artefacts were rare in layer 5 and mostly included stone adzes, ceramic anvils, clay pellets and worked bone. The lowest spits of layer 4 predominantly included clay pellets, stone adzes and shell bangles (Higham 2009a, 2009b) (Table 9.1). Middens identified as representative of neolithic occupation contained gastropod and bivalve shells, and fish bones. The main species of shellfish were *Filopaludina* and *Pila*, which are found in freshwater ponds and lakes. The most common fish species were *Hemibagrus/Mystus*, a bagrid catfish that is widespread in the Mekong and Chao Phraya River basins; *Channa striata*, snakehead, and *Clarias* and *Anabas testudineus*, walking catfishes (Thosarat and Kijngam 2011).

The inhabitants at Ban Non Wat are believed to have kept domestic cattle and also hunted the local wild bovid species during the neolithic. Greater quantities of pig remains, *Sus scrofa*, were identified in the lowest layers 5 and 4. Domestic dog, *Canis familiaris*, was also an important presence at the site, since dogs were introduced to Southeast Asia and there were no native wolves south of China (see Chapter 4). The presence of domestic dog is closely linked to the appearance of rice cultivation. Other fauna represented on site included deer, the Javan rhinoceros, tiger, hare, lizard, the elongated tortoise, the Malayan snail-eating turtle, the Asiatic soft-shell turtle, Indian bullfrog, and bird bones, including a few chicken bones, possibly domestic (Thosarat and Kijngam 2011).

There was a predominance of stone adzes in the neolithic occupation of Ban Non Wat, with a drop-off in the number of such items in the subsequent bronze age. Unshouldered adzes were three times more common than shouldered adzes. The adzes were small with ovoid cross-sections, in general, and an average length of 53 mm (Boer-Mah 2008a, 2008b; and in Higham 2009c). Compared to the later layers, ceramic anvils and burnishing stones were relatively rare, and there was a noticeable increase in these items at the transition point from neolithic to bronze age occupation. Similar observations were reported for spindle whorls, although the major increase in these items occurred at the terminus of the bronze age and the inception of the iron age (Higham 2009c).

No clay bangles were found complete at Ban Non Wat, but the majority of the fragments were variable in cross-section and originated from neolithic and bronze age occupation layers. It has been suggested that these items were for everyday wear rather than mortuary offering. While clay pellets and ceramic counters were identified throughout the Ban Non Wat sequence, pellets increased in number after the initial occupation (first two spits) and the counters were rare in the neolithic layers (a reported total of 85 in all layers) (Higham 2009c). The quantity of counters was minimal given the extensive excavation area and length of the sequence at Ban Non Wat, when compared to the relatively small excavation of only neolithic occupation at An Sơn, which yielded a total of 48 roundels/counters (see Chapter 4).

The neolithic burials at Ban Non Wat have been grouped into two phases. Phase 1 included burials interred with incised and painted ceramic vessels. The phase 2 burial vessels had minimal decoration, except for cordmarking, and fewer grave goods. The vessels of phase 2 were similar to those found in the subsequent earliest bronze age phase (Higham 2011a; Higham and Wiriyaromp 2011c). The Neolithic phase 1 burials also contained pig and fish bones, stone adzes, some shell beads and bangles, bivalve and cowrie shells (Higham and Wiriyaromp 2011c). The burials of phase 2 also contained the occasional pig and fish bones, bivalve shells and shell beads (Higham 2011a). Increasingly exotic and prized items, such as marble, shell and bronze ornaments, appeared subsequently in bronze age burials (Higham 2009c).

A summary of the material culture identified in neolithic occupational (Table 9.1) and burial (Table 9.2) contexts, and a sample of vessel forms and modes of decoration (Figures 9.1, 9.2 and 9.3) at Ban Non Wat are provided. The data in Appendix C and the CA for Ban Non Wat were adapted from reported information (Higham and Wiriyaromp 2011c; Higham 2011a, 2009a, 2009b, 2009c; Wiriyaromp 2007), and from personal observations of neolithic occupation ceramics excavated during 2008–2009.

Table 9.1. The material culture contents of the neolithic occupation layers and spits (4:7 to 5:3; 5:3 is the base) at Ban Non Wat. Note that the unexpected items for neolithic contexts (e.g. bronze, iron, and perhaps spindle whorls) may represent the disturbance of artefacts from higher layers, and not original deposition. Ceramic vessels are not included in this table but sherds were present in all layers.

Layer: Spit Quantity of material culture present						Layer: Spit List of material culture present				
	4:7	4:8	5:1	5:2	5:3	4:7	4:8	5:1	5:2	5:3
burnishing stone	2	3	1	2	0	burnishing stone	burnishing stone	burnishing stone	burnishing stone	clay anvil
bronze artefact	22	33	2	2	0	bronze artefact	bronze artefact	bronze artefact	bronze artefact	clay pellet
clay anvil	11	16	9	6	2	clay anvil	clay anvil	clay anvil	clay anvil	stone adze
clay conical roller	4	10	1	0	0	clay conical roller	clay conical roller	clay conical roller	clay pellet	whetstone
clay counter	2	1	2	0	0	clay counter	clay counter	clay counter	mould	
clay pellet	37	94	25	2	6	clay pellet	clay pellet	clay pellet	shell bangle	
cowrie shell	0	7	2	0	0	crucible	cowrie shell	cowrie shell	stone adze	
crucible	9	18	1	0	0	iron artefact	crucible	crucible	whetstone	
iron artefact	1	1	1	0	0	iron slag	iron artefact	iron artefact	worked bone	
iron slag	1	3	0	0	0	marble bangle	iron slag	ivory bangle		
ivory bangle	0	2	1	0	0	mould	ivory bangle	marble bangle		
marble bangle	15	30	6	0	0	shell bangle	marble bangle	shell bangle		
mould	4	9	0	1	0	spindle whorl	mould	spindle whorl		
shell bangle	30	50	4	2	0	stone adze	shell bangle	stone adze		
spindle whorl	14	10	3	0	0	whetstone	spindle whorl	whetstone		
stone adze	33	101	32	19	14	worked bone	stone adze	worked bone		
whetstone	10	13	5	4	2		whetstone			
worked bone	6	24	10	4	0		worked bone			

Source: Data from Higham 2009a: 22, table 3:1, 2009b: 33, table 4:1.

Table 9.2. The material culture contents of the neolithic burials at Ban Non Wat.

Neolithic burial phase 1	Neolithic burial phase 2
bivalve shell	bivalve shell
ceramic vessel	ceramic vessel
cowrie shell	shell rectangular bead
fish remains	pig remains
ivory bead	
pig remains	
shell bangle	
shell disc bead	
shell rectangular bead	
stone adze (most unshouldered, small)	

Source: Data from Higham and Wiriyaromp 2011c; Higham 2011a, 2009a, 2009b, 2009c; Wiriyaromp 2007.

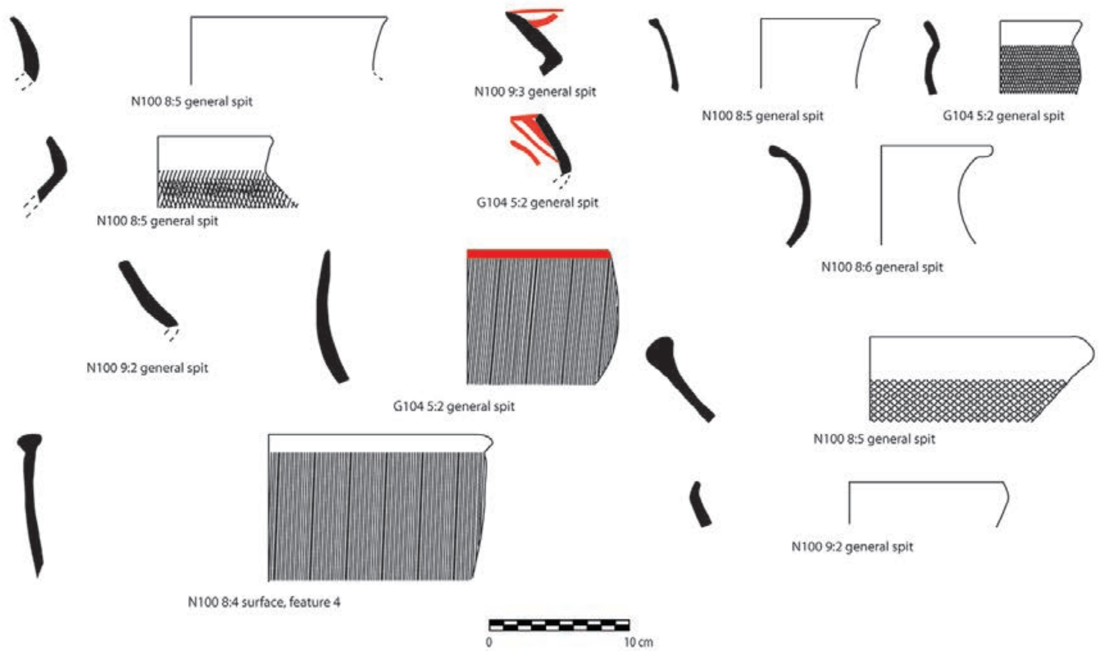


Figure 9.1. Ban Non Wat ceramic vessel forms, neolithic occupation layers, 2008–2009 excavation.

Source: Illustrations, C. Sarjeant.

Figure 9.2. Ban Non Wat ceramic modes of decoration, neolithic occupation layers, 2008–2009 excavation.

Source: Photos C. Sarjeant.

Figure 9.3. Ban Non Wat ceramic vessel forms and modes of decoration, Neolithic burial phases 1 and 2.

Source: Higham and Wiriyaromp 2011a, 2011b, 2011c, 2011d, as credited.

Ban Lum Khao

Ban Lum Khao had a mainly bronze age sequence, although some of the earliest evidence from the site was indicative of neolithic occupation. Situated downstream from Ban Non Wat in the upper Mun Valley, Ban Lum Khao differs from many of the other sites in the area due to its lack of iron age occupation and moat construction. The calibrated radiocarbon dates indicate the site was initially occupied *c.* 1450–1000 BC (T.F.G. Higham in Higham and Thosarat 2004d: 5). Parallel evidence to the neolithic occupation of Ban Non Wat (Neolithic 2) occurred within the earliest mortuary phase 1 at Ban Lum Khao, with simply decorated ceramic vessels. These vessels were commonly small, everted rimmed independent restricted forms with cord-marked surfaces, however two everted rimmed simple unrestricted vessels with pedestals were also recovered (see Figure 9.3 for similar vessels from Neolithic 2 burials at Ban Non Wat). Other material culture in these burials included 786 shell beads in one interment, and some pig bones, bivalve shells, *Cervus unicolor* antlers, marble bangles and turtle bones. It is unclear if these burials were terminal neolithic or bronze age, however there is very little evidence of metal in the lower occupation layers in the site (Higham and Thosarat 2004a).

The possible neolithic occupation at Ban Lum Khao was represented by pits filled with potsherds, shellfish, animal bones, and shell midden. The lowest occupation layer 3 at Ban Lum Khao had evidence of deer species (*Cervus eldi, Cervus unicolor, Muntiacus muntjak*), water buffalo (*Bubalus bubalis*), *Bibos* sp., domestic dog (*Canis familiaris*) and wild boar/pig (*Sus scrofa*). Pig was the most common fauna throughout the sequence. There appeared to be greater wild mammal diversity in the assemblage of the lowest layer compared to the upper layers (Higham 2004b). The fish bones of layer 3 included the climbing perch (*Anabus testineus*), catfish (*Mystus nemurus*, *Clarius* sp., *Wallagonia* sp.), swamp eel (*Monopterus albus*), bronze featherback (*Notopterus notopterus*), and snakehead (*Channa striatus*) (Thosarat 2004).

There were a larger number of adzes in the potentially neolithic layers (3:3 to 2:8), after which the number decreased substantially. Although a couple of the adzes were shouldered, the majority were small and unshouldered with an ovoid or elliptical cross-section. Clay anvils were rare in the lowest layer. The number of clay bow pellets was low in the basal spit but was high in the other spits of layer 3, and spindle whorls only appeared in significant quantities from layer 2:7 and into the upper layers, after the neolithic occupation (Higham 2004a). Shell beads were uncommon at Ban Lum Khao, and most were disc-shaped and mainly from layer 3. Some *Tridacna* and *Trochus* shell bangles were identified in layer 3 occupational contexts (Chang 2004). The Ban Lum Khao ceramics have been likened to the Tamyae phase pottery identified by Welch and McNeill (1991) at Phimai.

A summary of the material culture identified in neolithic occupational and burial contexts at Ban Lum Khao is provided in Table 9.3. The data in Appendix C and the CA for Ban Lum Khao were adapted from reported information (Chang 2004; Higham 2004a; Higham and Thosarat 2004a). Only the earliest and possibly neolithic data was utilised in the CA and presented in the Appendix C.

Table 9.3. The material culture contents of the possible neolithic occupation layers and burials at Ban Lum Khao.

Occupation (layer 3)	Burial (mortuary phase 1)
ceramic vessel	bivalve shell
clay anvil	ceramic vessel
clay pellet	deer antler
shell bangle	marble bangle
shell disc bead	pig remains
stone adze (most unshouldered, small)	shell disc bead
	turtle bone

Source: Data from Chang 2004; Higham 2004a; Higham and Thosarat 2004a.

Northeast Thailand and the bronze age

Like Ban Non Wat, Non Nok Tha and Ban Chiang in northeast Thailand have revealed deposits that may show a transition from neolithic technology to a knowledge of metallurgy. Ban Chiang has a legendary status within the history of archaeology in Southeast Asia owing to the dispute over the dating of the initial bronze production there. Bronze was originally placed at 3600 BC by Gorman and Charoenwongsa (1976) as a result of poorly-contexed radiocarbon dates from an early phase of burials with incised pottery and a bronze spearhead (Higham, Higham, Ciarla*, et al.* 2011; Higham, Higham and Kijngam 2011; Higham 2011a, 1996b: 7–12, 1996c; Higham and Higham 2009b; White and Hamilton 2009; White 2006, 1997, 1986; White *et al.* 2004; Bayard 1996).

Non Nok Tha is located about 80 km from Khon Kaen. The site was shallow, but revealed 205 burials and about 800 complete or reconstructable ceramic vessels. The earliest period at Non Nok Tha had evidence of rice, domestic cattle and pigs, stone tools and a single copper tool. Bronze tools, crucibles and moulds, and new ceramic forms appeared in the middle occupation. Earlier pottery vessels were predominantly sand tempered, although a few were grog or fine rice chaff and sand tempered. The rim forms of the early period were mostly straight everted rims, with some curved inverted rims, curved everted rims, simple vertical or slightly inverted rims, and tall vertical rims. After the early period, the variety in forms increased substantially. The surface decoration in the early period included cordmarking, cross-hatched cordmarking, diagonal unidirectional cordmarking, smoothed cordmarking, red slipping, and burnishing (Bayard and Solheim 2009; Rispoli 1997; Bayard 1977: 61–83). Parallels with other neolithic sites included incised and impressed decorations, such as the 'scale pattern impressed decoration' (SPID) within curvilinear incised motifs (Rispoli 1997: 68) (see Figure 9.5 for similar motifs from Khok Charoen). Rispoli (1997: 68) identified SPID as 'small, contiguous scales' that resemble fish or reptile scales. SPID was usually applied between two incised lines. Some SPID examples are similar to the identified roulette stamping at An Sơn (see Figure 5.17).

Non Nok Tha ceramics were not as ornately decorated as those from Ban Chiang (Bayard and Solheim 2009: 234). The Ban Chiang vessels incorporated the scale pattern impressed decoration (SPID), and an incised zigzag motif between two incised lines, either as a band or in curvilinear motifs (Rispoli 1997). Other incised curvilinear motifs were identified at Ban Chiang during the period tentatively dated to 2000 BC, similar to those in the basal layers of Non Nok Tha. Ban Chiang is also known for its red painted spiral designs on pottery vessels, but these appear in the mid to late sequence, contemporary with bronze and possibly iron metallurgy (Gorman and Charoenwongsa 1976). Ban Chiang has become synonymous with a 'culture' of pottery vessels that are observed at other sites in eastern Udon and western Sakon Nakhon provinces in northeast Thailand (Bayard 1977: 90).

The pottery sequence at Ban Chiang began with cord-marked or incised scroll motifs with impressed fill on black surfaces. This was followed by a layer including cord-marked vessels with curvilinear incised designs and followed again by the appearance of incised and painted curvilinear and geometric motifs, then red-on-buff freehand painted pottery. The most recent upper layers included red slipped and burnished pottery, followed by historic Thai celadon and earthenware and Chinese porcelain (Bayard 1977: 91; Gorman and Charoenwongsa 1976). Quartz sand and grog tempers were identified throughout the sequence in preliminary analyses, while plant material tempers were observed primarily in the Early and Middle Periods, and not the Late Period (McGovern *et al.* 1985: 110, figure 3; see also Bubpha 2003).

A summary of the material culture identified in neolithic contexts at Non Nok Tha and Ban Chiang is provided (Table 9.4). The Non Nok Tha data in Appendix C and the CA were adapted from reported information (Bayard and Solheim 2009; Rispoli 1997; Higham 1996b: 189–194; Bayard 1977, 1971). The Ban Chiang data in Appendix C and the CA were adapted from reported information (Bubpha 2003; Rispoli 1997; Higham 1996b: 196–198; McGovern *et al.* 1985; Bayard 1977; Gorman and Charoenwongsa 1976). Only Early Period data from Non Nok Tha (Bayard and Solheim 2009: 93) and Initial Period and Early Period I and II data from Ban Chiang (White 2006: 93, 97, table 1, figure 3) were utilised for the CA presented in Appendix C.

Table 9.4. The material culture contents of the possible neolithic burials and occupation layers at Non Nok Tha and Ban Chiang.

Non Nok Tha (Early Period)	Ban Chiang (Initial–Early Period I–II)
bone tool	ceramic vessel
cattle remains	clay roller
ceramic vessel	ivory bangle
clam shell	
dog remains	
hammerstone	
pig remains	
red ochre	
sandstone	
shell disc bead	
stone bangle	
stone unshouldered adze (small)	
whetstone	

Source: Data for Non Nok Tha: Bayard and Solheim 2009; Rispoli 1997; Higham 1996b: 189–194; Bayard 1977, 1971. Data for Ban Chiang: Bubpha 2003; Rispoli 1997; Higham 1996b: 196–198; McGovern *et al*. 1985; Bayard 1977; Gorman and Charoenwongsa 1976.

Central Thailand

Tha Kae

In the Khao Wong Prachan Valley of central Thailand, south of Khok Charoen (described below), the Lopburi Archaeological Project investigated the sites of Tha Kae and Non Pha Wai. Tha Kae was excavated in 1988, 1989, 1990, 1991 and 1993 (Ciarla 1992, n.d.). The site revealed evidence of both stone and shell bangle manufacture. Rispoli (1992) has assessed the similarities between the bronze age ceramics of layers 4 and 3 at Tha Kae and those of central Thailand and the Khorat Plateau of northeast Thailand. Layer 5 at Tha Kae, the basal layer, most likely corresponds with the neolithic since layer 4 above it exhibited parallels with the Early Period (late neolithic/early bronze age) at Ban Chiang (Rispoli 1992: 59; White 1982). Layer 5 dates to around the end of the third millennium BC and the beginning of the second millennium BC, and according to ceramic typologies represents the late neolithic or a transition to the bronze age. The ceramics included light grey pedestal bowls, and black ovoid jars with incised and impressed decoration (dentate stamping or SPID). The burials of this layer contained small disc-shaped shell beads, H-shaped shell beads and freshwater bivalve shells. Some of the later burials in this layer included Thick Red Burnished Slip (TRBS) bowls with red painted motifs on the pedestal (Rispoli 1997, 1992; Ciarla n.d.). Other decorative modes recovered from this layer included zigzag incision (Rispoli 1992; Ciarla n.d.).

A summary of the material culture identified in neolithic occupational contexts (Table 9.5), and a sample of vessel forms and modes of decoration (Figure 9.4) at Tha Kae are provided. The data in Appendix C and the CA for Tha Kae were adapted from reported information (Rispoli 1997, 1992; Ciarla 1992, n.d.).

Table 9.5. The material culture contents of the neolithic occupation layer at Tha Kae.

Occupation (layer 5)
bivalve shell
ceramic vessel
shell disc bead
shell H-shaped bead

Source: Data from Rispoli 1997, 1992; Ciarla 1992, n.d.

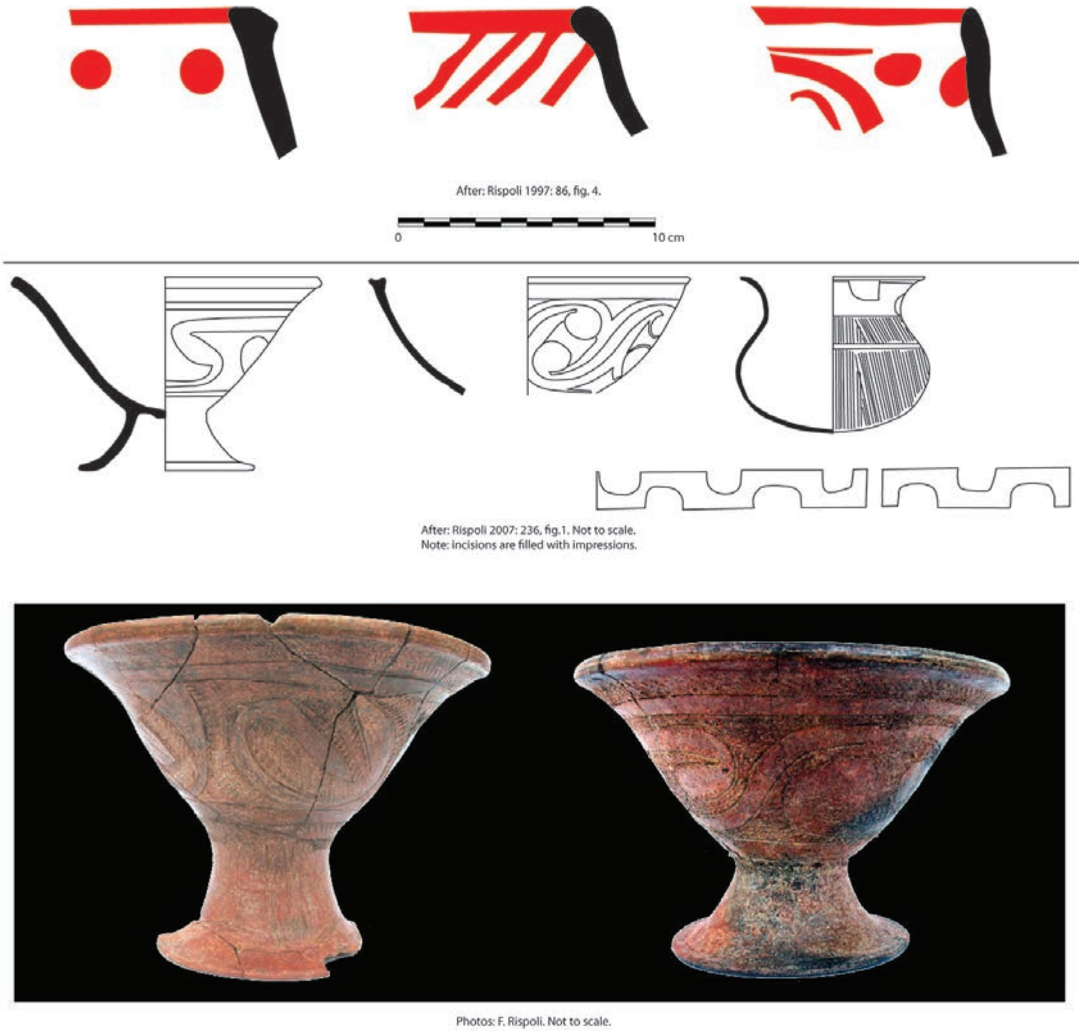


Figure 9.4. Tha Kae red painted and incised and impressed ceramic vessels.

Source: Photos, F. Rispoli (Not to scale). Illustrations, C. Sarjeant (After: Rispoli 2007; 1997; as credited).

Khok Charoen

Khok Charoen, a neolithic cemetery site located in the Pa Sak Valley of central Thailand, was excavated by William Watson and Helmut Loofs-Wissowa in 1966. Thermoluminescence dates of 980±450 BC and 1180/1080±300 BC were acquired for two burial groups, which are tentatively considered in comparison to the more reliable material culture evidence that suggests a neolithic occupation (Ho 1984; Watson 1979).

Forty-four burials were revealed in an extended position, and revealed apparent differential wealth with regard to the associated grave goods. One burial incorporated 19 pottery vessels, stone beads, ten shell and nine stone bangles and many small shell disc beads, while other burials had fewer items. Shell disc beads were found in the pelvic areas of some skeletons and small, trapezoid-sectioned polished stone adzes were common and comparable to those from Ban Kao and Ban Non Wat in Thailand. Shouldered adzes were present at Khok Charoen but were absent in the burials. Khok Charoen was originally interpreted to date between 1000 and 500 BC, due in part to the fact that shouldered adzes were dated to after 1000 BC in southern China (Ho 1984; Watson 1979). However, more recent research in the lower reaches of the Yangtze River and southeastern China has dated shouldered and stepped adzes to at least 3000 BP (Jiao 2007: 123–124). Most of the shell ornaments were marine in origin, including *Trochus* for bangles, ear ornaments and finger rings, and *Conus* for small finger rings. The pottery vessels included incised and impressed decoration, as observed at Tha Kae, Ban Chiang and Non Pa Wai, together with cordmarking and red slipping (Ho 1984; Watson 1979).

Ho Chui Mei Wendy (1984) has reported that at least two ceramic vessels were imported to Khok Charoen, since these vessels were manufactured with a non-local epidotised granitic temper. The forms of these imported wares were also imitated in local fabrics with either simplified or no decoration. The majority of the studied ceramic sherds from Khok Charoen were sand tempered with feldspar, quartz and fine-grained volcanic rock fragments, and this was considered be a local fabric. Some sherds were tempered with grog fragments that had similar inclusions to the sand temper, and the temper was presumably manufactured by crushing these local sherds. Other rare fabrics included rice husk, grog and sand, and those inclusive of the non-local granitic inclusions (Ho 1984). Parallels have been noted between the Thai sites of Tha Kae, Sab Champa II, Ban Krong Bamrung, Non Nok Tha, Ban Kao and Khok Charoen, in an attempt to outline a Southeast Asian tradition of not only ceramics, but also metal, shell and stone artefacts. Roulette decoration has also been identified at Khok Charoen, Tha Kae and Ban Krong Bamrung (Ho 1984).

The shell ornaments at Khok Charoen were similar to those at the coastal site of Khok Phanom Di, and trade links between coastal and inland sites have been suggested (Higham 2011c). In an effort to explain the shift from non-local to local strontium isotope signatures in female burials, Bentley *et al*. (2007) hypothesised that women may initially have moved from this central inland region to coastal sites like Khok Phanom Di. If Khok Charoen is a later site, as the very early attempt at thermoluminescence dating might suggest, and contemporary with some metal age sites of central Thailand, then the absence of metal must indicate that the movement of metal technology overlooked Khok Charoen in terms of consumption and smelting (Pryce *et al.* 2011; White and Hamilton 2009). In general, the lack of metal at Khok Charoen and the above parallels with Khok Phanom Di indicate a neolithic occupation.

A summary of the material culture identified in neolithic occupational and burial contexts (Table 9.6), and a sample of vessel forms and modes of decoration (Figure 9.5) at Khok Charoen are provided. The data in Appendix C and the CA for Khok Charoen were adapted from reported information (Higham 2011c; Ho 1984; Watson 1979) with illustrations courtesy of Helmut Loofs-Wissowa.

Table 9.6. The material culture contents of the neolithic occupation layers and burials at Khok Charoen.

Occupation	Burial
burnt clay lump	animal teeth
ceramic vessel	ceramic vessel
chicken remains	conus shell
clay bangle	shell bangle
clay barrel bead	shell disc bead
clay cones	shell ear ornament
clay phallus item fragment	shell finger ring
hammerstone	stone adze (small)
marble ear ornament	stone bangle
pestle stone	stone bead
stone adze (small)	trochus shell
stone bead	
stone blank	
tortoise shell	
wild boar teeth	

Source: Data from Higham 2011c; Ho 1984; Watson 1979.

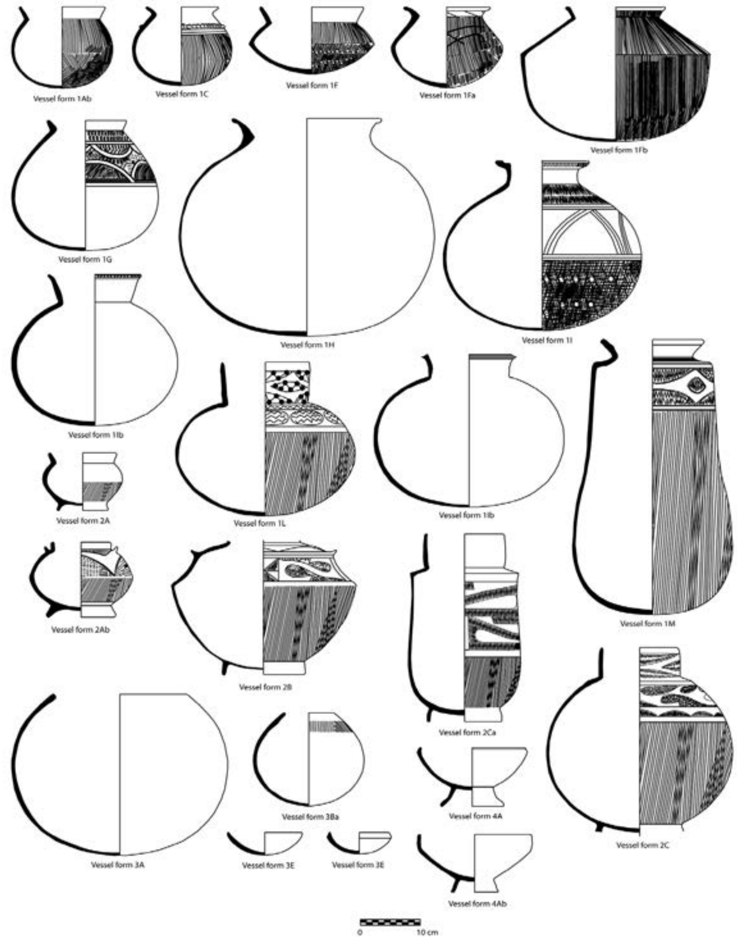


Figure 9.5. Khok Charoen vessel forms and modes of decoration.

Source: Illustrations, C. Sarjeant (After: Illustrations courtesy of H. Loofs-Wissowa).

Coastal central Thailand

Khok Phanom Di

Khok Phanom Di is situated in the Bang Pakong Valley of coastal central Thailand. The site is a mound and the main excavation of 1985 was conducted at its highest, central point. While Charles and Thomas Higham's revisions of the Khok Phanom Di radiocarbon dates continue, the published dates of the 1990 volume must be applied here, which Charles Higham now considers to be a *terminus post quem* (pers. comm. 2011; see also Higham, Higham and Kijngam 2011). The dates indicate rapid deposition of cultural remains between 2000 and 1500 B. Although no dates were determined for the upper layers (5 to 1), it is thought that these layers represent a short period of occupation, after 1500 BC, of perhaps 100 years or less. The dates were determined from discrete ashy/charcoal or hearth deposits (Higham and Bannanurag 1990: 19). The excavation revealed 154 burials that represented seven mortuary phases (Higham and Bannanurag 1990: 19–21). The offerings in each mortuary phase are listed in Table 9.7.

The lower occupation layers (11 to 8) included ceramic anvils, clay pellets, bone tools including large one-piece fishhooks, burnishing stones, whetstones, stone adzes and 'hoes', ceramic net weights, shell bangles and knives, and stone and turtle-shell bangles. The middle occupation layers (7 to 6) contained a similar assemblage, with the addition of ivory bangles, clay ladles, and a shark tooth pendant. The upper layers (5 to 2) added bone bangles, worked antlers, awls and micro-awls (Higham and Bannanurag 1990: 31–48). The occupational material culture is listed in Table 9.8.

The adzes were typically small in size, ground and polished. Many observed throughout the sequence were unshouldered and elliptical to oval in cross-section, rounded or flattened. Some adzes were shouldered, particularly those in the lower layers. Other stone items included chisels, sandstone grinding stones, fine-grained sandstone whetstones, pounders and red ochre. The majority of the adzes were broken and then sharpened or modified, suggesting long-term use of each item and that stone was scarce. Adzes were very rarely found in mortuary contexts. It has been suggested the adzes or raw materials were acquired via exchange along the Bang Pakong River (Pisnupong 1993).

The shell ornaments included disc beads 2–7 mm in diameter, funnel-shaped beads 2–4 cm long, I-shaped beads 2–6 cm long, H-shaped beads 1–2 cm long, cylindrical beads about 1 cm in diameter, and barrel-shaped beads about 1 cm long. These beads were identified in mortuary contexts. The shell bangles were made from *Tridacna* and *Conus* shells. The larger bangles had an L-shaped cross-section and the smaller ones had a quadrangular cross-section. Many of the bangles were found in burials. All of the small fishbone bangles were in mortuary contexts. With the exception of fine quadrangular cross-sectioned bangles, few stone ornaments occurred in mortuary contexts. Some fragments of ivory bangle were also recovered in the occupation layers. Modified animal teeth were found in both burial and non-burial contexts, and large turtle carapace plaques appeared with burials from mortuary phase 3 (Pilditch 1993).

Four ceramic periods have been defined for Khok Phanom Di, based on stratigraphic relationships and ceramic characterisations. The first period included pottery made from a local fabric with sand temper, and occupational and pottery working contexts. The forms were frequently inverted rimmed restricted vessels with coarse cordmarking up to the rim. Ceramic period 1 also included everted rimmed independent restricted vessels with cordmarking up to the rim. Finer wares from ceramic period 1 included inverted rimmed simple restricted vessels, both plain and incised and impressed, and everted rimmed independent restricted vessels, some with a carination, both plain and incised and impressed (Vincent 2004: 107–163) (Figure 9.6).

Ceramic period 2 was associated with mortuary contexts. The typical local period 2 ceramics were dark brown to black highly burnished wares with incision, and were tempered with sandy grog. A smaller number of sherds were paddle impressed, painted or slipped, punctate stamped, appliqué, and shell impressed. Also present in this period were inverted rimmed restricted vessels with coarse cordmarking up to the rim, some with incision, and everted rimmed independent restricted vessels with cordmarking up to the rim. Finer wares from ceramic period 2 included inverted rimmed simple restricted vessels, both plain and incised and impressed, and everted rimmed independent restricted vessels, both plain and incised and impressed. The decorated everted rimmed vessels (rim form 5) exhibited a great deal of variation and after characterisations of the fabrics some sherds were identified as exotic (Vincent 2004: 110, 165–301).

Some of the ceramic period 2 non-mortuary wares were crudely made direct rimmed simple unrestricted vessels, everted rimmed independent restricted vessels, direct rimmed independent restricted vessels, and inverted rimmed simple restricted vessels. The mortuary vessels of ceramic period 2 were from mortuary phases 2 and 3; mortuary phase 1 interments did not include ceramic vessels. These mortuary vessels included everted rimmed independent restricted vessels with a carination; everted rimmed independent restricted vessels with a low carination and pedestal; direct, inverted and everted rimmed simple unrestricted vessels; direct and everted rimmed independent restricted vessels; inverted rimmed simple restricted vessels with a pedestal; everted rimmed simple unrestricted vessels with a pedestal; and highly burnished and incised everted rimmed independent restricted vessels with a convex neck and carination. Many of the vessels from ceramic period 2 mortuary contexts were burnished and incised and impressed (Vincent 2004: 110, 165–301) (Figure 9.6).

Ceramic period 3 was also associated with mortuary contexts. This period is characterised by orthodox grog tempered wares, with incised and impressed motifs, appliqué, highly burnished surfaces, paddle impressed, painted and slipped, and a few were punctate stamped. The vessel forms were oval-shaped inverted rim simple restricted vessels, and inverted rimmed simple restricted vessels with coarse cordmarking or incision. Roulette stamping appears at this period, while the curvilinear and geometric incised motifs continue; both decorations were identified on inverted rimmed simple restricted vessels. Everted rimmed vessels, some of which have a concave profile, were also present with roulette stamping and geometric, zigzag and curvilinear incisions. Coarse cordmarking was present on inverted rimmed simple restricted vessels (Vincent 2004: 110, 303–461).

The ceramic period 3 non-mortuary vessels were typically tempered with orthodox grog and included everted rimmed independent restricted vessels with cordmarking up to the rim; highly burnished everted rimmed independent restricted carinated vessels with a convex neck; inverted rimmed simple restricted vessels with a pedestal; and everted rimmed simple unrestricted vessels with a carination and geometric incised and impressed motifs. The mortuary vessels came from mortuary phases 5, 6 and 7. The vessels were typically tempered with orthodox grog, while a few were tempered with bleb grog/rice husk. The highly burnished everted rimmed independent restricted vessels with a carination and convex neck continued in this period, usually with incised decoration. Large unrestricted vases with a pedestal and curvilinear incised and impressed motifs were present. Simple unrestricted vessels also appeared, as well as slightly burnished everted rimmed independent restricted vessels (Vincent 2004: 110, 303–461).

Ceramic period 4 is represented by the upper layers of the site, layers 4 to 1, and is marked by evidence of a pottery workshop. The ceramics were predominantly tempered with rice and bleb grog. The fine burnished and incised wares of the previous periods diminished and were only present in layer 4, although fine incised wares and paddle impressed wares increased in period 4. Few painted or slipped and punctate sherds were present, while there were a number of appliqué sherds. The forms included simple unrestricted and restricted vessels, including an inverted rimmed simple vessel with an angled shoulder and triangular incisions at the rim infilled with punctate and/or zigzag-line roulette stamping or other geometric incised motifs. The inverted rimmed simple restricted vessels were also decorated with geometric incision. Everted rimmed independent restricted vessels were also present, with cordmarking, paddle impression and incision. This period saw the introduction of historic wheel-turned vessels, stoneware and porcelain sherds. Non-mortuary complete vessels included burnished everted rimmed independent restricted vessels with a carination and convex neck, inverted rimmed simple unrestricted vessels, some with an angled shoulder and/or a pedestal, and everted rimmed independent restricted vessels (Vincent 2004: 479–608).

The most common decorative modes at Khok Phanom Di were horizontal incision, impressed dots in vertical and horizontal rows, impressed diagonal dotted lines, cordmarking with incised lines overtop, and paddle impressed lines. Horizontal incision was present throughout the sequence, and rows of short vertical incision with horizontal incised lines between each row were more common in the earliest layers. The impressed dot and dotted line motifs were not so prevalent in the upper layers. Cordmarking with smoothed incision over the top was less apparent in the upper layers, while cordmarking with fine incised lines increased in the middle and upper layers. Paddle impressed designs also increased in the upper layers (Hall 1993). Burnishing stones, ceramic anvils, bone stylus points, ceramic firing stands and prepared clay occurred in ceramic periods 1, 2, 3 and 4, and support local manufacture of pottery throughout the sequence (Vincent 2004: 109–128, 168–185, 306–320, 486–527).

The evidence of subsistence at Khok Phanom Di indicated a wide spectrum of exploited resources. Marine resources dominated the faunal assemblage, and while some domesticated land animals, such as pig and dog were present, wild fauna continued to be exploited. The marine, estuarine and riverine resources included the carapaces of turtle and tortoise in higher proportions in the upper layers; mud crab (*Scylla serrata*) was most common in the middle and lower layers; blue crab (*Portunus pelagicus*) in the lower layers; freshwater crab (Potamidae) in the middle layers; catfish (Tachysuridae, Bagridae, *Plotosus canius*, *Clarius* sp.) and barramundi (*Lates calcarifer*) throughout the sequence; snakehead (*Channa* sp.) that was present in low quantities throughout the sequence except the upper layers; stingrays (Dasyatidae) were present throughout the sequence but increased in the upper layers; minimal sharks remains (Carcharinidae) and climbing perch (*Anabas testudineus*) (Higham and Bannanurag 1991).

The land mammals included water buffalo (*Bubalus bubalis*) which was minimal throughout the sequence but increased somewhat in the upper layers; Bovidae and Canidae were minimal throughout the sequence; Sambar deer (*Cervus unicolour*), marsh deer (*Cervus schomburgki, Cervus eldi*), other deer species (*Muntiacus muntjak, Axis porcinus*) and surili (*Presbytis* sp.) all increased in the upper layers; and macaque (*Macaca* sp.), wild boar/pig (*Sus scrofa*), and rat (*Rattus rattus*, *Rattus* sp.), which were present throughout the sequence. Other fauna present in small numbers thoughout the sequence were crocodile (*Crocodylus porosus/siamensis*), rhinoceros (*Rhinoceros sondaicus*), tiger (*Panthera tigris*), various wild cat species (*Felis viverrina, Felis temmincki, Felis marmorata, Felis bengalensis*), civet species (*Viverra zibetha*, *Paradoxurus hermaphroditus, Paguma larvata, Viverra megaspila, Cynogale bennetti, Civet* sp.), loris (*Nycticebus coucang*), porcupine (*Hystrix brachyura/hodgsoni*), otter species (*Aonyx cinerea*, *Lutra sumatrana, Lutra* sp.), and bandicoot rat (*Bandicota indica*) (Higham and Bannanurag 1991).

The bird species included crane (*Grus antigone*), stork (*Ciconia* sp., *Mycteria leucocephala*, Stork sp.), heron (*Ardea sumatrana),* pelican *(Pelecanus* sp.)*,* ibises and spoonbills (Threskiornithidae), cormorant species *(Phalacrorax pygmaeus, Phalacrocorax carbo),* crow *(Corvus* sp.), godwit *(Limosa limosa/lapponica),* broadbill *(Corydon sumatranus)*, anhinga *(Anhinga* sp.), fowl *(Gallus gallus),* duck species *(Anas crecca,* Duck sp.). Frog species were also recovered in minimal quantities throughout the sequence (Higham and Bannanurag 1991).

With the exception of rice, the plant remains recovered from Khok Phanom Di comprised few species that were likely to have contributed to the diet, except for rice. The former mangrove environment of Khok Phanom Di was best suited to non-food plants, such as those for house and boat construction, and most of the biodiversity came from animals. The evidence indicates a strong reliance on shellfish, crustacean and fish for subsistence. The lack of edible wild plants available in the area meant that a balanced diet was not available without rice cultivation. Evidence of rice was observed in the temper of ceramics and in human and/or dog coprolites. Even though experimentation of rice production was not likely to have occurred in an unsuitable environment like this coastal area, once rice was introduced, the site could be settled for some time. It has not been determined whether a transition from wild to domestic rice occurred during the occupation of Khok Phanom Di. While the site offered great marine and estuarine resources, nutrients from plants and necessary water may have been difficult to access at times (Thompson 1996: 215–225).

There were commonalities in the material culture of early Khok Phanom Di and Nong Nor phase 1, and increasing similarities from mortuary phase 3 onwards at Khok Phanom Di with inland agricultural settlements like Khok Charoen and Ban Non Wat. Higham and Thosarat (2004c: 157–158) suggest that this was due to the inception of a relationship between inland rice farmers and coastal groups which involved the exchange of goods, ideas and people, namely: dogs, knowledge of rice cultivation, and a coastal migration of inland women (as previously discussed for Khok Charoen, see Bentley *et al.* 2007; Bentley *et al.* 2005; also in Higham, Guangmao*, et al.* 2011).

A summary of the material culture identified in neolithic burial (Table 9.7) and occupational (Table 9.8) contexts, and a sample of vessel forms and modes of decoration (Figure 9.6) at Khok Phanom Di are provided. The data in Appendix C and the CA for Khok Phanom Di were adapted from reported information (Vincent 2004; Higham and Bannanurag 1990).

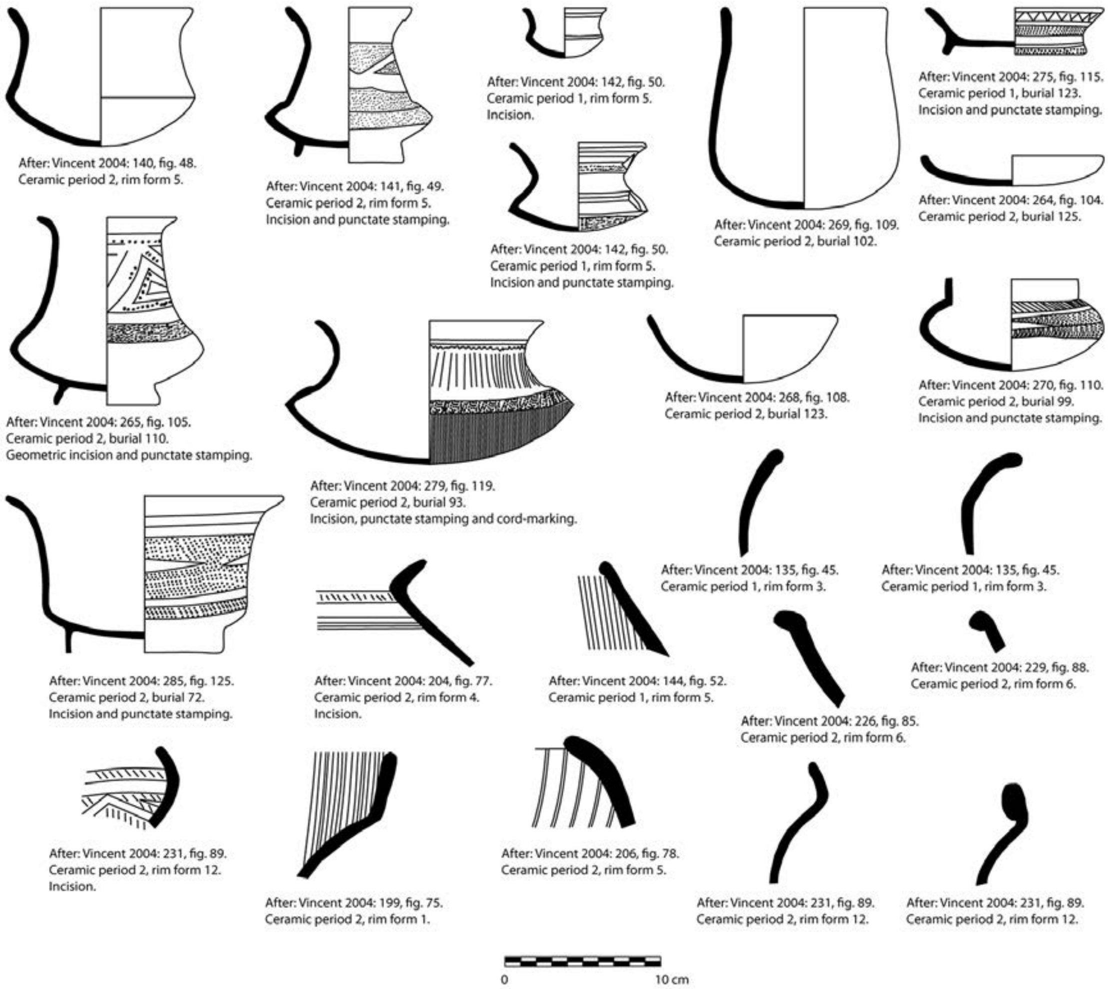


Figure 9.6. Khok Phanom Di vessel forms and modes of decoration.

Source: Illustrations, C. Sarjeant (After: Vincent 2004, as credited).

Table 9.7. The material culture contents of the burials at Khok Phanom Di. MP = mortuary phase.

MP1	MP2	MP3	MP4	MP5	MP6	MP6–7
red ochre	animal bone	bored shell object	bone fishhook	bivalve container	bone object	burnishing stone
shell disc bead	bone cylinder-shaped bead	burnishing stone	burnishing stone	burnishing stone	burnishing stone	ceramic vessel
shell funnel bead	bone fishhook	ceramic vessel	ceramic vessel	ceramic vessel	ceramic vessel	clay anvil
Tapa fabric	bored canine tooth	fish skeleton	clay anvil	clay anvil	clay anvil	red ochre
	burnishing stone	fish vertebra disc/bangle	clay counter	clay cylinder	fish vertebra disc/bangle	shell disc bead
	ceramic vessel	Nautilus shell	red ochre	clay pellet	red ochre	shell disc/bangle
	clay cylinder	perforated fish vertebra	shell disc bead	horned shell disc	shell bead disc/bangle	shell H-shaped bead
	clay net weight	polished stone chisel	shell L-shape bead	pierced mammal canines	shell disc	stone adze
	clay pellet	red ochre	Tapa fabric	red ochre	shell disc bead	stone disc/ bangle
	cowrie shell	shaped animal tusk	turtle bone object	shell barrel beads	shell H-shaped bead	worked shell
	fish vertebra disc/bangle	shark dorsal spine pendant	turtle bone pendant	shell cylindrical beads	shell small cylindrical bead	
	pierced snail shell	shell barrel bead	turtle carapace ornament	shell disc	Tapa fabric	
	pig scapula	shell disc bead	worked gastropod shell	shell disc beads	turtle carapace ornament	
	red ochre	Tapa fabric		shell disc/bangle	turtle plastron ornament	
	rhinoceros tooth	turtle bone ornament		shell headdress		
	shell disc beads			shell L-shape bead		
	shell funnel beads			turtle carapace ornament		
	shell implement					
	Shell-perforated disc					
	stone adze					
	Tapa fabric					
	wooden bier					
	worked fish vertebrae					
	worked shell					

Source: Data from Higham and Bannanurag 1990: 143–363.

Table 9.8. The material culture contents of the occupation layers at Khok Phanom Di.

Layer 11	**Layer 10**	**Layer 9**	**Layer 8**	**Layer 7**	**Layer 6**	**Layer 5**	**Layer 4**	**Layer 3**	**Layer 2**
bone bobbin	bone awl	bone fishhook	bone fishhook	bone bobbin	bone disc/bangle	bone awl	bone awl	bone awl	bone awl
bone fishhook	bone bobbin	burnishing stone	burnishing stone	ceramic vessel	burnishing stone	bone bobbin	bone bobbin	bone bobbin	bone disc/bangle
burnishing stone	bone fishhook	ceramic vessel	ceramic vessel	clay anvil	ceramic vessel	burnishing stone	bone disc/bangle	bone disc/bangle	bone micro-awl
ceramic vessel	bone harpoon	clay anvil	clay anvil	clay ladle	clay anvil	ceramic vessel	bone micro-awl	bone micro-awl	burnishing stone
clay anvil	burnishing stone	clay net weight	clay pellet	clay net weight	clay pellet	clay anvil	ceramic vessel	burnishing stone	ceramic vessel
clay pellet	ceramic vessel	clay pellet	net weight	fishhook	ivory disc/bangle	clay pellet	clay anvil	ceramic vessel	clay anvil
stone adze	clay anvil	shell disc/bangle	shell disc/bangle	ivory disc/bangle	shark tooth pendant	shell disc/bangle	clay pellet	clay anvil	clay ladle
whetstone	clay net weight	shell knife, point	shell knife	shell knife	shell disc/bangle	stone 'hoe'	shell disc/bangle	clay pellet	clay net weight
	clay pellet	stone adze	stone 'hoe'	stone adze	stone adze	stone adze	stone 'hoe'	ivory disc/bangle	clay pellet
	crocodile tooth pendant	stone disc/bangle	stone disc/bangle	stone disc/bangle	stone disc/bangle	stone disc/bangle	stone adze	shark tooth pendant	clay pellet
	shell knife	whetstone	turtle shell disc/ bangle	turtle shell disc/bangle			stone disc/bangle	stone 'hoe'	ivory disc/bangle
	stone 'hoe'		whetstone				worked antler	stone adze	shark tooth pendant
	stone adze							stone disc/bangle	stone adze
	stone disc/bangle							worked antler	stone disc/bangle
	whetstone								turtle shell disc/bangle
	worked shell								whetstone
									worked antler

Source: Data from Higham and Bannanurag 1990: 31–48.

Nong Nor

Neighbouring Khok Phanom Di, Nong Nor, located in Tambon Rai Lak Thong, Amphoe Phanat Nikhom, Changwat Chonburi, was excavated under the direction of Charles Higham and Rachanie Thosarat from 1991 to 1993. The three distinct layers in the site consisted of an upper rice field layer, a second layer of compact midden that was 20cm thick, and a basal third layer of natural substrate (Higham and Thosarat 1998c: 12-13). The radiocarbon dates for Nong Nor commenced from approximately 2500-2100 cal. BC, but most of the burials dated to around 1200-1100 cal. BC (Higham and Hogg 1998).

Nong Nor had two occupation phases, of which the first dated to about the mid-third millennium BC, according to the radiocarbon dates obtained at the time. The first phase was associated with concentrations of shellfish, lenses of ash and burnt material, and pottery scatter deposits. No evidence for rice was observed. The material culture included bone fishhooks, awls, weaving shuttles, and evidence of local pottery manufacture with anvils and burnishing stones. This phase exhibited cultural connections with Khok Phanom Di, *c.* 2500-1500 BC, particularly in the pottery, stone adze and bone fishhook assemblages (Higham and Thosarat 1998e; see also O'Reilly 1998c).

The most common ceramic rim forms were everted with a flattened or rounded lip, everted with a tapered lip, but the most frequent were everted with an inward-folding lip (O'Reilly 1998b: 100-103). The reconstructed ceramic vessels of phase 1 included: simple unrestricted bowls with horizontal incisions over the whole vessel and two zigzag incisions without fill over top; carinated vessels that were incised and impressed with dentate stamping; vessels with a pronounced shoulder and combed incised designs that are similar to the An Sơn decorated form A2a; and simple unrestricted vessels with a flat base and horizontal incision and stamping. The decorations on the ceramics included: one or more incised lines; combed concentric rings; punctate and dentate stamping; painted and slipped designs, stamped with rollers; matte finish; paddle impression; and various incised, cross-hatched and zigzag motifs. Curvilinear incised decoration was most common, while an undulating incised line between two parallel lines and three or more horizontal parallel lines with juxtaposed vertical lines also appeared frequently. Other incised and impressed decorative variations appeared less frequently (see examples in Figure 9.7). Other clay artefacts included wasters and a clay pellet (O'Reilly 1998b: 104-113).

The lithic artefacts included grindstones, whetstones, hammerstones, pounders, stone flakes and burnishing stones, but only four adzes were recovered. The adzes were small, 5-6 cm long, with an elliptical cross-section and unshouldered with a flattened poll (O'Reilly 1998d). The faunal remains included large deer, bovid, turtle/tortoise, cetacean and crocodile. Nong Nor phase 1 exhibited no evidence of domesticated plants or animals, and the earliest occupation contained no dog remains. Large mammal bones were exploited for artefact manufacture. Worked bone was generally rare in phase 1, and it is likely that mammals were an addition to the shellfish and fish diet for the Nong Nor inhabitants from time to time. There was a lack of butchery evidence at the site and the bones for artefacts were most likely brought from the kill site where the animals were originally butchered. All of the bone fishhooks had a U-shaped shank, while awls and a shuttle/bobbin made from bone were also recovered (Higham *et al.* 1998).

It has been hypothesised that the Nong Nor shell midden reflects a single occupation, probably during a dry season. There is evidence for pottery production in the site, which ethnographically, is a dry season occupation in Southeast Asia from October to May. In rare cases, pottery production occurs year-round in tropical rainy environments (O'Reilly 1998a: 141-143; see also Rice 1987:

156). The stone and bone resources were valued, as the adzes were well-worn and the mangrove environment of Nong Nor would not have been a preferred environment for large terrestrial mammals (O'Reilly 1998a: 141-142).

There were parallels between Nong Nor phase 1 and Khok Phanom Di layers 11 and 10, *c.* 2130-1700 BC, prior to the change in Khok Phanom Di material culture in layers 10 and 9 (c.f. Table 9.8, Table 9.9). Comparisons between the ceramic motifs at Khok Phanom Di and Nong Nor were difficult to ascertain since complete motifs are known only from Khok Phanom Di (Hall 1993), whereas only partial motifs were identified at Nong Nor (O'Reilly 1998c). The ceramic designs that were paralleled included, plain burnished zigzag bands within a panel of stamped impression, curvilinear incision with stamped impression, cross-hatching between incised lines, a single-incised line with stamped impression, and combed rings and stamping. There were very few pigmented sherds at Khok Phanom Di, while no highly burnished sherds were identified at Nong Nor. The adzes were classified as Duff type 2G, with a lenticular cross-section, at Nong Nor and in layers 10 and 11 at Khok Phanom Di. The fishhooks at both sites were identical, and after 2000 BC, in layers 11 and 10 at Khok Phanom Di, they appeared less frequently (O'Reilly 1998c). It is thought that Khok Phanom Di may have evolved from the tradition represented at Nong Nor, particularly in terms of the ceramics (O'Reilly 1998c: 172).

Phase 2 at Nong Nor represents a bronze age cemetery. The pottery vessels from mortuary contexts at phase 2 are illustrated in Figure 9.8. Many personal ornaments, made from glass, shell, bone, stone and bronze, were also recovered from this phase (Chang 1998; Debreceny 1998).

The sites of Nong Nor and Khok Phanom Di have been considered in light of a potential transition from hunter-gatherer to agricultural communities in central Thailand, given that there was no evidence for rice cultivation in Nong Nor phase 1, but it was present at a slightly later date at Khok Phanom Di. In spite of the commonalities in material culture between the earliest occupations at both sites, domesticated plants and animals may have appeared in a later, separate transmission. In comparison to rice cultivation, material culture (items or ideas) appear to have been part of an earlier exchange between sites of the third millennium BC in coastal Thailand. This situation highlights a potentially slow, staggered and multi-layered trajectory for the introduction of 'neolithic' attributes, particularly the incised and impressed ceramics, ground and polished stone adzes, domestic dogs and pigs, and cultivated rice (O'Reilly 1998e).

Earlier arguments for continuity from the terminal palaeolithic Hoabinhian to neolithic occupation in Southeast Asia (e.g. Gorman 1977; Meacham 1977; Solheim 1972) have been supplanted by archaeological and linguistic claims that immigrant populations played a role in the development of the neolithic (e.g. Blust 1996; Higham 1996a; Bellwood 1994). Higham and Thosarat (1998a) believe there is limited evidence to support a continuous transition since the information to support this hypothesis has often been scant and from dubious contexts. Now, archaeological evidence supports immigration with a potential origin in the Yangtze River region (Bellwood 2011; Castillo 2011; Lu 2011; Nakamura 2010; Zhang and Hung 2010; Rispoli 2007; Higham 2002a). This does not rule out any role for indigenous groups, and interaction between immigrants and indigenous people would have been important in generating the subsequent regional diversification of material culture, as observed at Khok Phanom Di and Nong Nor.

A summary of the material culture identified in phase 1 occupational contexts (Table 9.9), and a sample of vessel forms and modes of decoration for both phases 1 and 2 (Figure 9.7, Figure 9.8) at Nong Nor are provided. The data in Appendix C and the CA for Nong Nor were adapted from reported information (Higham and Thosarat 1998e; O'Reilly 1998b: 104–113). Only phase 1 at Nong Nor was utilised in the CA and presented in Appendix C.

Table 9.9. The material culture contents of occupation phase 1 at Nong Nor.

Occupation phase 1
bone awl
bone fishhook
bone weaving shuttles
burnishing stone
ceramic vessel
clay anvil
clay pellet
clay waster
hammerstone
sandstone
stone adze (few, small, most unshouldered)
stone flake
stone pounder
whetstone

Source: Data from Higham and Thosarat 1998e; O'Reilly 1998b: 104–113.

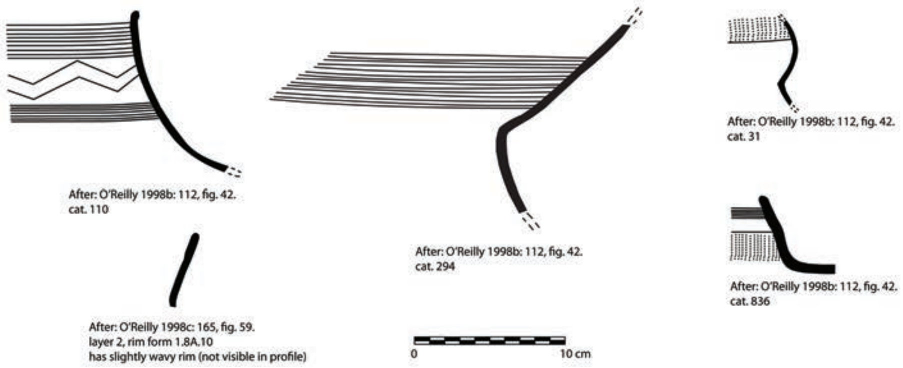


Figure 9.7. Nong Nor phase 1 ceramic vessel forms and modes of decoration.

Source: Illustrations, C. Sarjeant (After: O'Reilly 1998b; 1998c, as credited).

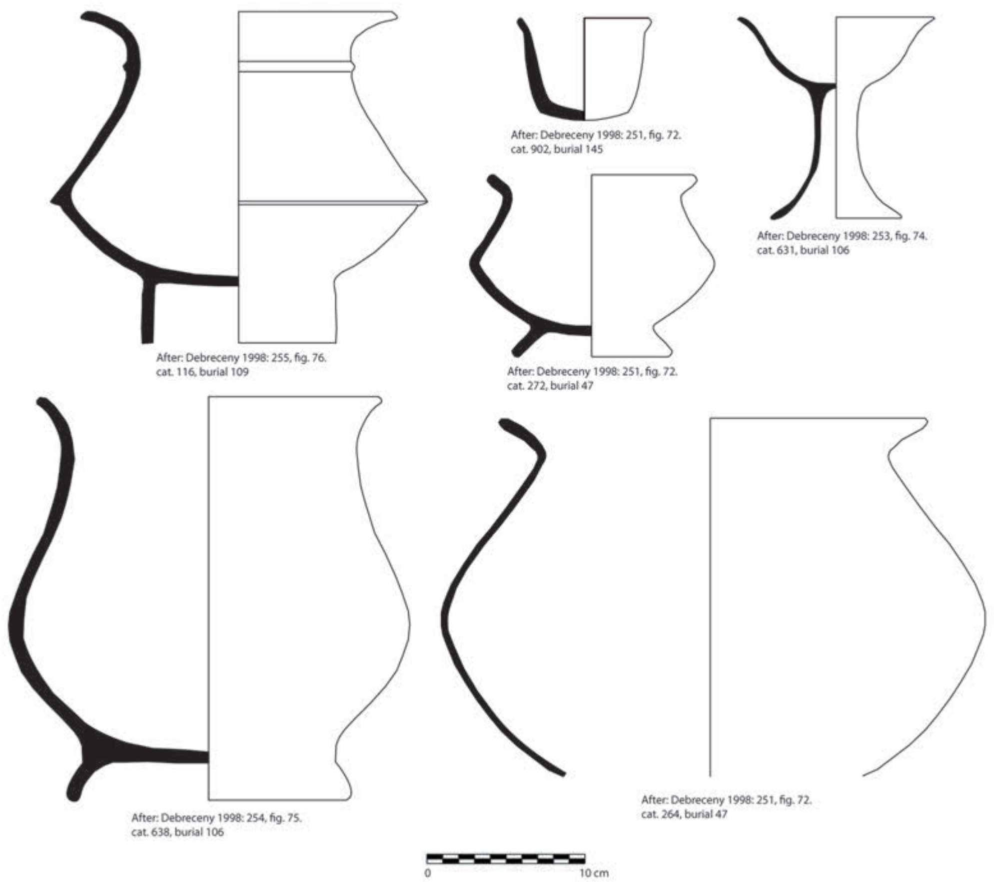


Figure 9.8. Nong Nor phase 2 ceramic vessel forms and modes of decoration.

Source: Illustrations, C. Sarjeant (After: Debreceny 1998, as credited).

Cambodia

Laang Spean

The large cave of Laang Spean is situated on the top of a limestone hill, Phnom Teak Trang, at 150 m altitude in a landscape of hills and caves in Battambang Province, Cambodia. The cave was inhabited periodically throughout antiquity, and has presumably undergone a great deal of disturbance, leading to uncertainty over the dating and stratigraphic relationship of the layers (Hubert Forestier, pers. comm.). One of the original dates, probably for the earliest occupation, is 6240±70 BP (Gorman 1971). Cécile Mourer and Roland Mourer (1970) suggested there were five cultural levels in the site, from 6800 BC to AD 750–830.

Mourer and Mourer undertook excavations in the 1960s, while more recent excavations have been run by Hubert Forestier and Heng Sophady. The earliest cultural level had no pottery and minimal chert flakes. Cord-marked or paddle-marked ceramics appeared in cultural level II, particularly in the middle and upper part of the layer (dated to *c.* 4290 BC) in association with core stone tools like short axes, side-scrapers, scrapers, disc-shaped items, and flakes. Some of these Hoabinhian-type tools had been retouched. Incised and impressed decoration like that found elsewhere in neolithic mainland Southeast Asia appeared in cultural layer III, *c.* 2050 BC (Mourer and Mourer 1970).

In addition to stone tools and pottery, burnt bones, shells and lateritic concretions were recovered at the site, although no bone industry was identified. The stone tool assemblage included scrapers and flake tools, but there was a notable absence of polished and ground stone tools or their debitage. Very little is known about the vessel forms of the ceramics since only small sherds were recovered, and many of these sherds were cord-marked. Both mineral sand and organic tempers are thought to be present, and decoration included impression, incised bands in association with other motifs or short parallel incisions within the band, comb-like 'stippling' and punctate stamping, and appliqué (Mourer and Mourer 1970). The 'stippling' decoration was also noted by Edmond Saurin and Madeliene Colani (in Mourer and Mourer 1970) at neolithic sites in Quảng Bình Province in northern Vietnam, and may be similar to the An Sơn examples.

Many of the animal bones were burnt, and others were gnawed. The majority of the faunal remains were from small bovids and freshwater turtle, but also included rhinoceros, chevrotain, deer, small carnivores, porcupine, primates, and reptiles. The molluscs included local gastropods in addition to large aquatic gastropods and bivalves that were imported for subsistence and ornament manufacture (Mourer and Mourer 1970).

A summary of the material culture identified in potentially neolithic occupational contexts, (Table 9.10), and a sample of vessel forms and modes of decoration (Figure 9.9) at Laang Spean are provided. The data in Appendix C and the CA for Laang Spean were adapted from reported information (Mourer and Mourer 1970).

Table 9.10. The material culture contents of the possible neolithic occupation layers at Laang Spean.

Occupation
ceramic vessel
flake tool
no bone industry
no polished stone industry
pebble tool

Source: Data from Mourer and Mourer 1970.

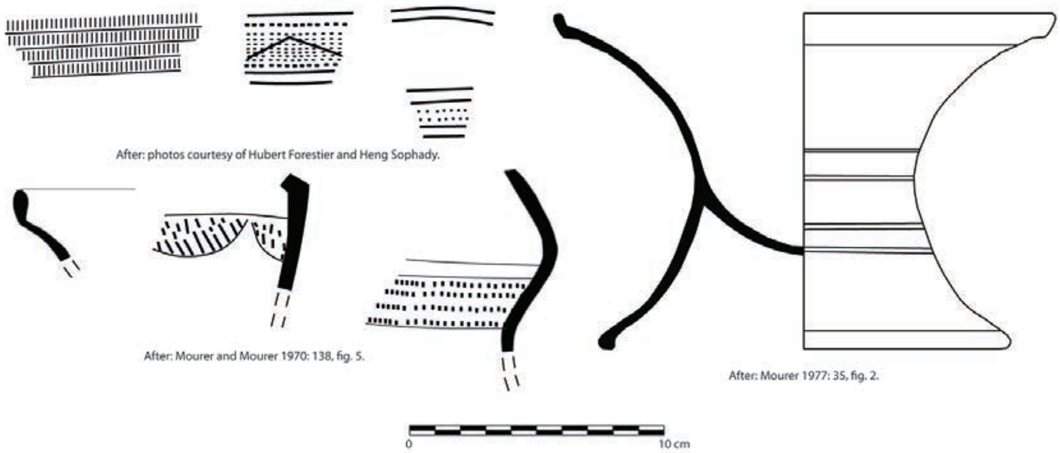


Figure 9.9. Laang Spean vessel forms and modes of decoration.

Source: Illustrations, C. Sarjeant (After: photos courtesy of H. Forestier and S. Heng; Forestier and Heng 2010; Mourer 1977; Mourer and Mourer 1970, as credited.

Samrong Sen

Samrong Sen is a well-known shell midden site located on alluvial terrain in Kampong Chnang Province on the Tonlé Sap floodplain of central Cambodia. Its importance has been noted since the late nineteenth century, but the site was not excavated until 1902 and 1923 (Mansuy 1923, 1902). The stratigraphy is reported to have an upper historic layer, a second dense shell midden layer, a third cultural layer with shells, animal bones, hearths, and prehistoric artefacts, and a base layer of clayey loam. Mansuy claimed the site was late neolithic, in spite of the bronze evidence, and the only radiocarbon date, obtained from shells, was 3230±120 BP (Carbonnel and Delebrias 1968). The metallurgical evidence perhaps represents the introduction of such technology to the site later than the dated shells (Mourer 1977: 46–47).

The stone artefacts of Samrong Sen were predominantly adzes and chisels, including both trapezoidal-sectioned unshouldered adzes, some of which were a curved gouging type, and sharply shouldered adzes. Some symmetrical-sectioned axes were present. While a polished stone industry was present, there was a lack of evidence of polishers, waste flakes and cores, suggesting the tools were brought to the site. The bone industry included arrow points, spear points, fishhooks, smoothing tools for pottery production, and personal ornaments. Complete pottery vessels were few at Samrong Sen but the assemblage included unrestricted vessels with pedestals, inverted rimmed independent restricted vessels with a shoulder carination and either a flat or a rounded base, and oval-shaped restricted vessels. Since bronze items, albeit minimal, were identified at Samrong Sen, some of these ceramic vessel forms are likely to represent occupation later than the neolithic period. The decoration included geometric with incision, either in curves or triangles, found in association with cordmarking, wavy lines, and punctate stamping. Like Laang Spean, there was a lack of painting and a preference for incised and impressed decoration (Mourer 1977: 42–45).

The Samrong Sen faunal remains included cervids, bovids, rhinoceros and elephant, and riverine resources such as Corbicula or Paludina shells, tortoise, crocodiles and otter. Pig and dog bones were also recovered, and these animals which may have been domesticated. The faunal descriptions from Mansuy's excavations are incomplete, lacking bone morphology and measurements to support the claim of mammalian domestication, and the absence of reported fish remains indicates that no sieving took place on site (Mourer 1977: 46).

More recent research took place at Samrong Sen in 1999 and 2001 (Vanna 2002). The 1999 excavations revealed sixteen ceramic rim types, as classified by Ly Vanna (2002: 287–288, figures 6 and 7) (Figure 9.10). Rim forms B, D, E, F, G, I, K, L, M, N and O were present in the lowest layer, and most likely represented the neolithic assemblage (Vanna 2002: 289, figure 8). Many of these rim forms were everted rims from independent restricted vessels, others were from inverted simple restricted vessels. Some rim form D vessels were decorated with punctate dots separated by geometric incisions. Incised decoration was identified on form E vessels with an applied ridge, in addition to wavy incisions, appliqué and punctate dots at the lip in some cases. Rim form G was regularly identified with punctate dot and circular stamping and incisions. Rim form K was decorated with simple incisions (Vanna 2002: 81–86). Please note that Vanna's rim form categorisation does not correspond to the An Sơn rim forms of Figure 5.1.

The 2001 excavation revealed twenty-eight rim forms. Bronze was not found in layers 3 and 4. Rim forms 1, 2, 3, 4, 5, 6, 7, 8, 9 and 11 were associated with layers without evidence of bronze. The forms included inverted simple restricted vessels (one of which had triangular handles at the shoulder), everted rim independent restricted vessels, and everted rims with protruding lateral lips (Figure 9.10). Rim form 2 was sometimes associated with parallel and wavy incisions and herringbone designs, and rim form 11 was decorated with parallel cord lines on the body of the vessels (Vanna 2002: 140–152, 298–306, figures 17, 18, 19, 20, 21, 22, 23, 24, 25). While various decorative modes have been reported for the ceramics from Samrong Sen, no particular sequence was identified. The decorations included cord impression, finger imprint and fingernail impression, paddle striation, punctate and dot stamping, and a variety of incised designs such as wavy, dotted, lattice, parallel straight, herringbone and curvilinear, fluting (narrow grooves cut out of surface), appliqué, comb marks, roller stamping, and slipping. Incised and impressed decoration was most common. Other clay items included net sinkers, balls, a slotted earring, bangles and pottery-making anvils (Vanna 2002: 153–158).

The Samrong Sen adzes were polished and divided into five different types by Vanna (2002: 88–89, 290–291, figures 9 and 10). Types 1 and 2 were both unshouldered and rectangular-sectioned, but type 2 was retouched at the edges so the cross-section was more rounded. The type 3 adzes were smaller, unshouldered, and rectangular or ovoid in cross-section. Type 4 appears to have been worked to create a shoulder, while type 5 adzes were very small and highly polished. One flake tool and sandstone whetstones were also recovered (Vanna 2002: 90–91). An animal bone and antler industry was also present for fishing and hunting activities, and preparing fabric or skin with 'bobbins', or awls (Vanna 2002: 91–92; Higham and Thosarat 1994). Clay, stone and bronze bangles were recovered, faunal remains, shellfish and rice remains as husk and carbonised grain in pottery tempers were also identified (Vanna 2002: 92–94). The relationship between the appearance of bronze and the early occupation at Samrong Sen remains unanswered (Vanna 2002: 121), so it is possible that the site contains mixed neolithic and metal age assemblages.

A summary of the material culture identified in potentially neolithic occupational contexts (Table 9.11), and a sample of vessel forms and modes of decoration (Figure 9.10) at Samrong Sen are provided. The data in Appendix C and the CA for Samrong Sen were adapted from reported information (Heng 2007; Vanna 2002; Mourer 1977).

Table 9.11. The material culture contents of the possible neolithic occupation layers at Samrong Sen.

Occupation
bone arrow point
bone fishhook
bone ornament
bone smoothing tool
bone spear point
ceramic vessel
clay anvil
clay bangle
clay net sinker
stone adze (most unshouldered)
stone bangle
stone chisel

Source: Data from Heng 2007; Vanna 2002; Mourer 1977.

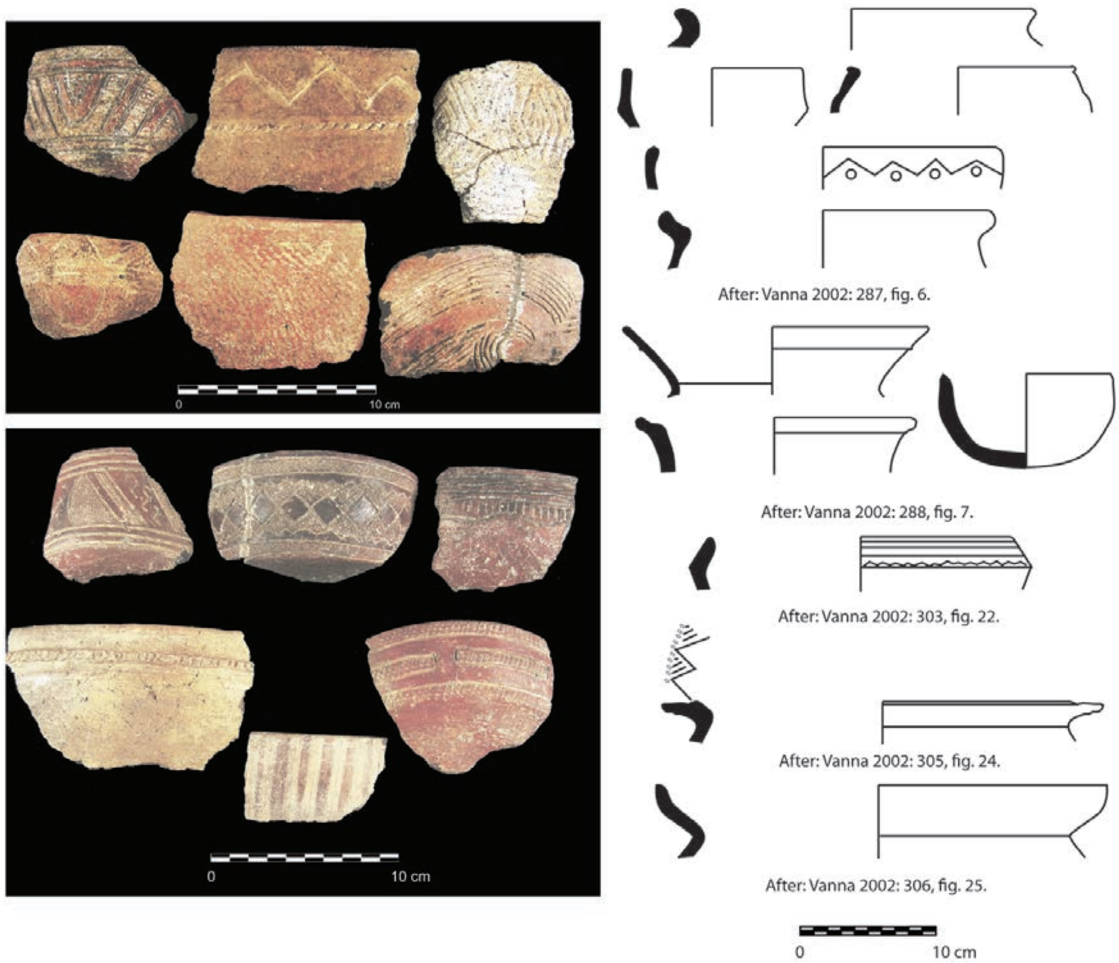


Figure 9.10. Samrong Sen ceramic vessel forms and modes of decoration.

Source: Photos, P. Bellwood; Illustrations, C. Sarjeant (After: Vanna 2002, as credited).

Krek and Memot circular earthwork sites

The numerous circular earthwork sites within eastern Cambodia and southwestern Vietnam contain similar material cultures (Dega 2002: 1). While the site of Krek 52/62 is the focus of the comparative study, other Memot sites such as Chi Peang and Phuom Trameng, are included for additional information. The contentious dating for the region, and the absences of shell, bone and metal and presence of glass have resulted in varying chronologies for the Memot earthwork sites, ranging from neolithic to metal age, and even to historic contexts (see Chapter 2).

The material culture from these sites included a varied lithic toolkit: basalt and sandstone cores, whetstones, rectangular-sectioned and shouldered adzes, chisels, scrapers, and flakes and debitage. This is indicative of local stone tool manufacture. The ceramic assemblage consisted of low-fired earthenwares with variable surface decorations and vessel forms. This included plain, red-slipped, cord-marked, stamped, punctate, dentate and incised decorations, and the use of more than one technique on a vessel was not uncommon. The tempering agents were identified as quartz and sand or rice and rice chaff. The vessel forms included small, thin bowls and large, thick-walled and shallow vessels (Dega 1999). The Memot sites are located on highly acidic soil that may have inhibited the survival of faunal, botanical and human remains, and evidence of metallurgy. However, any stone or ceramic items indicative of metalworking (such as moulds and crucibles) would have survived if they were present (Dega 1999).

A summary of the material culture identified in potentially neolithic occupational contexts (Table 9.12), and a sample of vessel forms and modes of decoration (Figure 9.11) at Krek are provided. The data in Appendix C and the CA for Krek were adapted from reported information (Dega 2002; Albrecht *et al.* 2000).

Table 9.12. The material culture contents of the possible neolithic occupation layers at Krek.

Occupation
ceramic vessel
clay anvil
clay spindle whorl
sandstone
stone adze
stone bangle
stone chisel
stone core
stone flake
whetstone

Source: Data from Dega 2002; Albrecht *et al.* 2000.

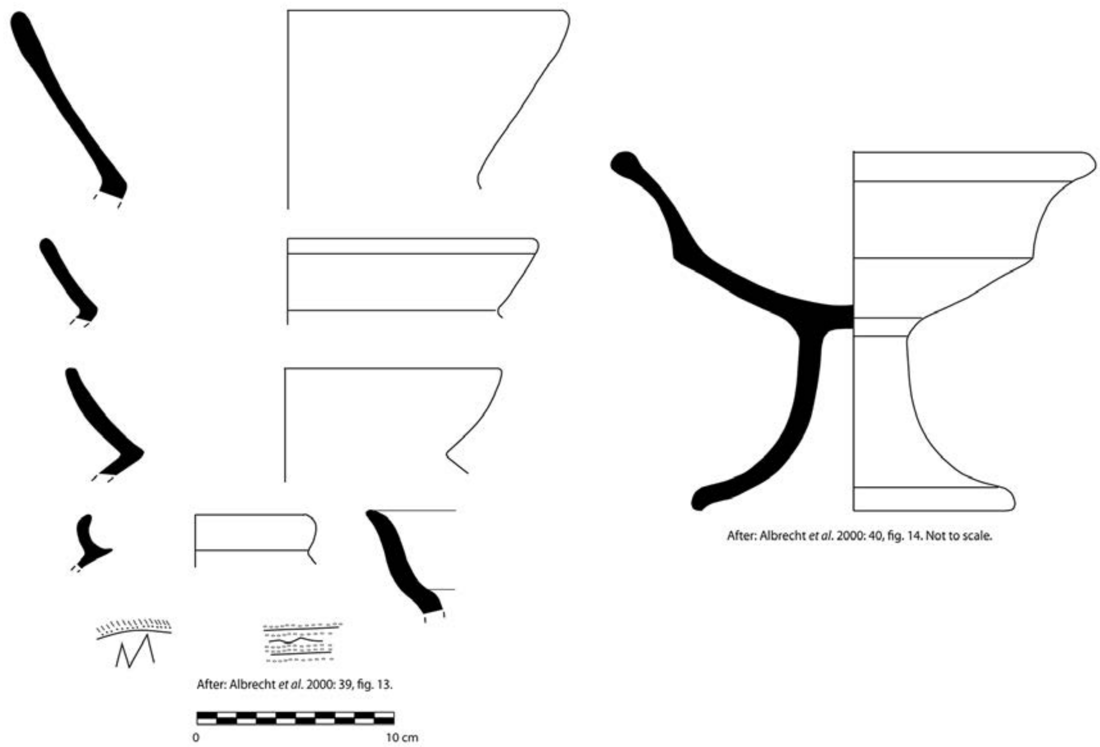


Figure 9.11. Krek ceramic vessel forms and modes of decoration.

Source: Illustrations, C. Sarjeant (After: Albrecht *et al.* 2000, as credited).

Central Vietnam

Bàu Tró

Located near Đồng Hới in Quảng Bình Province of central Vietnam, Bàu Tró is associated with stone adzes, hammerstones, flakes, quartz, whetstones, polishing stones and ochre. The ceramic fabrics were coarse with angular rock fragments, and incised and painted decoration was observed on the pottery. The stone adzes were small, either polished, trapezoidal-sectioned unshouldered or rectangular-sectioned shouldered (sometimes with heavily retouched and rounded edges). The ceramics were commonly incised in vertical and horizontal combinations, criss-cross patterns or in triangular motifs, and coarse cordmarking was present. The vessel forms included everted rimmed, independent restricted vessels with an oval body shape and cordmarking, and plain simple unrestricted vessels. The inhabitants of Bàu Tró exploited both marine and inland resources for subsistence: deer, *Sus scrofa*, small carnivores, freshwater fish, dugong, marine snails, marine bivalves, shark, stingray, parrot fish, sea bass, and coastal dwelling fish species (Gorman 1971; Patte 1924). The sequence of Bàu Tró is roughly consistent with neolithic occupation, as indicated by the material culture evidence and approximate dates of 4000–3500 BP (Phạm 1997).

A number of sites have been associated with the Bàu Tró culture, named after the aforementioned site, that have late neolithic to early metal age sequences in the Nghệ An, Hà Tĩnh and Quảng Bình provinces. Bàu Tró itself was a shell midden site, but other Bàu Tró assemblages occurred in sand dunes, mound sites or cave sites. Animal bone and shell artefacts were recovered from Bàu Tró culture sites, and included chisels, points, scrapers, and pierced shell beads. The major vessel forms included pointed bottomed pots, round bottomed pots with cordmarking, and round bottomed pots or pedestals with incision, cordmarking and red paint. Most of the ceramics were tempered with sand or lime particles (Phạm 1997).

A summary of the material culture identified in neolithic occupational contexts (Table 9.13), and a sample of vessel forms and modes of decoration (Figure 9.12) at Bàu Tró and related sites are provided below. The data in Appendix C and the CA for Bàu Tró were adapted from reported information (Phạm 1997; Patte 1924).

Table 9.13. The material culture contents of the neolithic occupation layers at Bàu Tró.

Occupation
ceramic vessel
hammerstone
red ochre
sandstone
stone adze (small)
stone blade
stone flake
whetstone

Source: Data from Phạm 1997; Patte 1924.

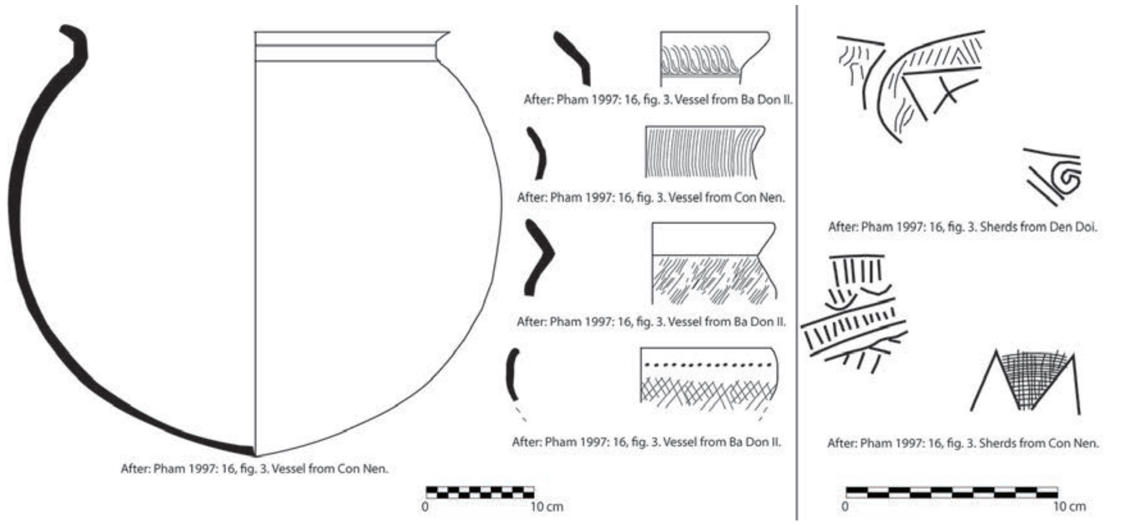


Figure 9.12. Bàu Tró culture ceramic vessel forms and modes of decoration.

Source: Illustrations, C. Sarjeant (After: Phạm 1997, as credited).

Northern Vietnam

Mán Bạc

Mán Bạc is located within the Tam Điệp limestone outcrop in Ninh Bình Province in northern Vietnam. The 2004–2005 excavations revealed three cultural layers, the upper with faunal remains, charcoal, and ceramic and stone artefacts, the middle with shell midden remains and ceramic and stone artefacts; the lower contained only human burials (Nguyễn 2006). The radiocarbon dates of 2000 to 1500 cal. BC suggest the site was early neolithic, although there have been suggestions of contemporaneity with the Phùng Nguyên period, which dates from *c.* 1800 to 1400 BC

(Oxenham *et al.* 2008; Nguyễn *et al.* 2004). Phytolith analysis by Tetsuro Udatsu indicated there were high densities of rice husk in the middle and upper cultural layers, suggesting that cultivation probably took place nearby.

The 35 burials contained pottery vessels, stone adzes/axes, a stone chisel, whetstones, nephrite beads, T-sectioned bangles, shells, shell beads, and animal bone tools as mortuary offerings. In the occupation layers above the burials, the stone artefacts included adzes and axes, chisels, blades, whetstones, net sinkers, hammerstones, nephrite beads and rings/bangles, red ochre, and flakes. Most of the adzes were unshouldered, although a few small shouldered adzes were recovered (Nguyễn 2006).

Complete pottery vessels were found mainly with the burials, including simple unrestricted and restricted vessels, everted rimmed independent restricted vessels that were plain, cord-marked or carved paddle impressed on the body, concave everted rimmed independent restricted vessels, rare oval-shaped vessels with everted rims and pedestals, and rectangular-bodied restricted vessels with everted rims, pedestals and incised and impressed decorations. Most of the rim forms were everted, and the globular vessels with a flat or rounded lip have been identified as cooking pots. These cooking pots were not decorated with incised designs, but were cord-marked or impressed with geometric or cross-ribbed patterns, presumably applied with a carved paddle. Other vessels were incised with an S-shape motif, like the Phùng Nguyên ceramics, although these were rare in the Mán Bạc assemblage (Figure 9.13). The vessels were predominantly tempered with laterite particles and pulverised mollusc shells. Other ceramic artefacts included pediform items that may have served as vessel supports, anvils (see Figure 9.13), and clay pellets. The bone items included points, harpoons, earrings and fish-vertebrae beads, and the shell artefacts included beads with evidence of perforation (Nguyễn 2006).

Many vessels at Mán Bạc had incision, impressed zigzag lines or punctate dots at the rim. Another decoration, impressed or punctate hollow circles, at the site was observed at Phùng Nguyên sites like Xóm Rền (Hán 2009) and more frequently in northern Philippines sites (Bellwood and Dizon 2005). Incised curvilinear motifs filled with roulette stamping, linear dentate or comb stamping, or small incised lines were a rare but important addition to the assemblage, linking Mán Bạc to Phùng Nguyên culture sites. These incised and impressed wares were commonly everted rimmed simple unrestricted dishes on pedestals, or everted rimmed independent unrestricted vases with low foot rims. One dish was decorated with continuous semi-circular incisions around the base, which were infilled with incisions. This was similar to the An Sơn vessel with similar infill incisions and triangular incisions on the foot. The ceramic anvils that were probably for making pottery were also decorated with rolled cord/knotted impressions (Figure 9.13).

A summary of the material culture identified in neolithic occupational and burial contexts (Table 9.14), and a sample of vessel forms and modes of decoration (Figure 9.13) at Mán Bạc are provided below. The data in Appendix C and the CA for Mán Bạc were adapted from reported information (Nguyễn 2006), and from personal observations at the Institute of Archaeology, Hanoi in 2009.

Table 9.14. The material culture contents of the neolithic occupation layers and burials at Mán Bạc.

Occupation	Burial
bone earring	animal bone tool
bone harpoon	ceramic vessel
bone point	nephrite bangle
ceramic pediforms	nephrite bead
ceramic vessel	shell disc bead
clay anvil	whetstone
clay pellet	
fish vertebrae bead	
nephrite bangle	
nephrite bead	
ceramic vessel	
red ochre	
shell disc bead	
stone adze (most unshouldered)	
stone axe	
stone bangle	
stone chisel	
whetstone	

Source: Data from Nguyễn 2006.

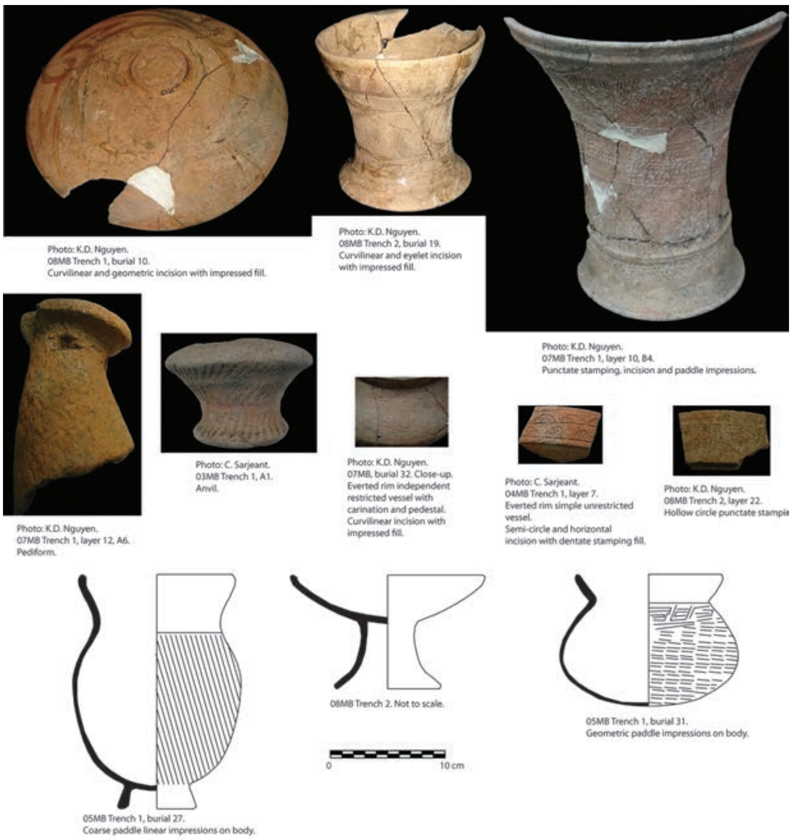


Figure 9.13. Mán Bạc vessel forms and modes of decoration, 2003, 2004, 2005, 2007 and 2008 excavations.

Source: Photos, K.D. Nguyễn and C. Sarjeant, as credited. Illustrations, C. Sarjeant (After: Images courtesy of K.D. Nguyễn).

Xóm Rền and Phùng Nguyên

The Phùng Nguyên culture of northern Vietnam shares similarities with some of the ceramics from Mán Bạc. These sites contained stone rectangular-sectioned unshouldered adzes, whetstones, chisels and gouges, drill points, blades, and arrowheads. Some of the stone materials have been linked to the successive bronze technology at Dong Sơn sites. Stone bangles, with varied cross-sections and shapes, and stone beads between 6 and 8 mm in diameter and 4 to 20 mm long were also recovered. The ceramic materials included spindle whorls, which were not observed in neolithic contexts at Mán Bạc, An Sơn or any other neolithic sites in mainland Southeast Asia, unlike clay pellets that were present at all sites. There was evidence of local manufacture of clay pellets at the site of Phùng Nguyên, since many were found in a firing pit. Many of the cooking pot forms at Phùng Nguyên were similar to those at Mán Bạc, and the assemblage also included curvilinear incised motifs and pediform supports, as shown in Figure 9.13 (Nguyễn 1980).

While there is evidence for both indigenous and introduced elements at Mán Bạc, Vietnamese scholars tend to posit continuity between the neolithic groups of northern Vietnam and the Phùng Nguyên and then Dong Sơn cultures. The two layer hypothesis suggests that there was influence and immigration of individuals from the north at the time of introduced rice cultivation at Mán Bạc (Matsumura *et al.* 2008), which would have had the effect of continuing interaction into the later metal age periods in northern Vietnam.

Xóm Rền is used as an example of a Phùng Nguyên site for comparative analysis with An Sơn. Xóm Rền is located on the left bank of the Lô River in Phú Thọ Province, northern Vietnam, and was most recently excavated in 2006. The site contained a wide variety of stone artefacts including nephrite items, and revealed material culture affinities with the nearby Phùng Nguyên site. Xóm Rền revealed evidence of habitation and burial remains (Hán 2009).

A summary of the material culture identified at Xóm Rền (Table 9.15) is provided. The data in Appendix C and the CA is adapted from reported information (Hán 2009).

Table 9.15. The material culture contents of the occupation layers at Xóm Rền.

Occupation
ceramic pediforms
ceramic vessel
clay bangle
clay counter
clay figurine
clay pellet
clay spindle whorl
nephrite bangle
nephrite bead
nephrite yazhang
stone adze
stone arrow point
stone axe
stone bangle
stone flake

Source: Data from Hán 2009.

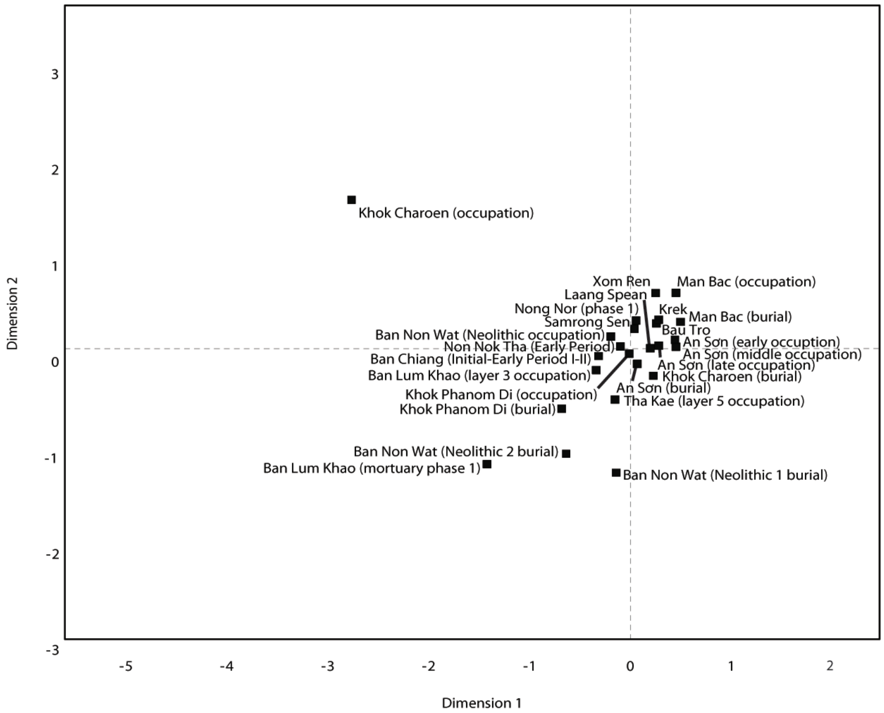
Comparison with An Sơn: Correspondence analysis

The identified variables for the CA included the major ceramic vessel forms, modes of decoration and surface treatment, location of decoration on ceramic vessels, ceramic temper when possible, and the presence (or absence) of animal bones, specific stone tools, other stone and bone/ivory tools and ornaments, and ceramic/clay items like roundels and pellets at An Sơn and the other fourteen assessed sites. The presence and absence data for these variables applied in the CA are in Appendix C. A total of 131 cultural variables were included in the CA, of which 73 were ceramic vessel variables and the remaining 58 were other variables. Two CAs are presented here, one that separates the occupational and burial phases for each site when possible (Figure 9.14), and one that combines this data for each site except An Sơn (Figure 9.15). Each CA is separated into two plots, the first plotting the sites and the second the variables. The variables are coded with an abbreviation, and this section should be read in conjunction with these codes in Appendix C. To relate the chronology of the analysed sites to the sequence at An Sơn, the material culture at An Sơn is divided into a burial phase and early, middle and late phases of occupation.

When the sites are separated into occupational and burial phases, the CA plot (Figure 9.14) shows a clustering of sites from the various regions, regardless of the different chronologies. There was a concentration of the sites from northern and central Vietnam, Cambodia, together with An Sơn, Nong Nor, and the occupational phases from the northeast Thailand sites (Ban Non Wat, Ban Lum Khao, Non Nok Tha, and Ban Chiang) and Khok Phanom Di. Mán Bạc (occupation) and Xóm Rền were closely related to each other because of the presence of nephrite artefacts, shell temper in the ceramics, and geometric impression, scroll incision and eye-shaped incision. The majority of the variables were associated with the main cluster of sites, which included Nong Nor, Samrong Sen, Krek, Bàu Tró, Mán Bạc (burial), An Sơn (early occupation), An Sơn (middle occupation), An Sơn (late occupation), Laang Spean, Ban Non Wat (occupation), Non Not Tha, Ban Chiang, Khok Phanom Di (occupation), An Sơn (burial), Khok Charoen (burial), and Ban Lum Khao (occupation).

There is closer correspondence between the late occupation and burials at An Sơn in terms of material culture, which is concordant with the dates for the burials (see Chapter 4). The majority of the occupation assemblages from Ban Non Wat and Khok Phanom Di may also have predated the burials, as at An Sơn. This may explain why these occupation phases cluster with the An Sơn occupation rather than with the burial phases for these sites. Outliers of the CA plot included Khok Charoen (occupation), because of the presence of clay beads and marble items; Ban Lum Khao (burial), because of an absence of artefact variability; Ban Non Wat neolithic burial phases 1 and 2, because of the presence of a range of shell, ivory and marble ornaments and curvilinear incision and painting on the ceramic vessels; Tha Kae, because of the presence of painted curvilinear designs, and Khok Phanom Di because of the presence of a wide range of shell items. No further commentary for the CA plot of Figure 9.14 is provided as a different CA plot (Figure 9.15) revealed clearer relationships between the sites.

When the occupational and burial phases were combined to increase the number of variables that were present for each site, the CA plot in Figure 9.15 was clearer. The differences were emphasised between sites that previously clustered together, in spite of known marked differences in material culture at the sites. Seven approximate groups can be identified in this second CA plot (Figure 9.15), and the corresponding variables shared by the sites within each group are summarised in Table 9.16. The previously discussed corresponding variables for Figure 9.14 remain relevant to Figure 9.15. Some of the groups corresponded tightly, such as group 4, while others corresponded loosely, such as group 5. Ban Lum Khao and An Sơn (burial) were the main outliers, but the An Sơn (burial) somewhat corresponds to group 1, particularly the late occupation at An Sơn.



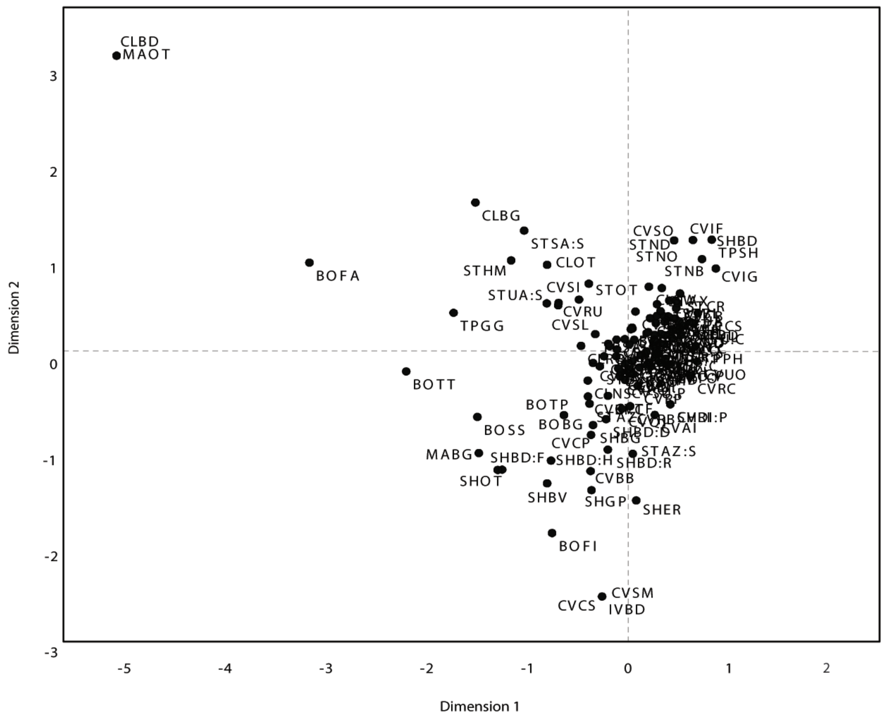


Figure 9.14. CA plots for the Southeast Asian neolithic cultural variables. Occupational and burial data separated. Top: sites, bottom: variables. Refer to Appendix C for variable codes.

Source: C. Sarjeant.

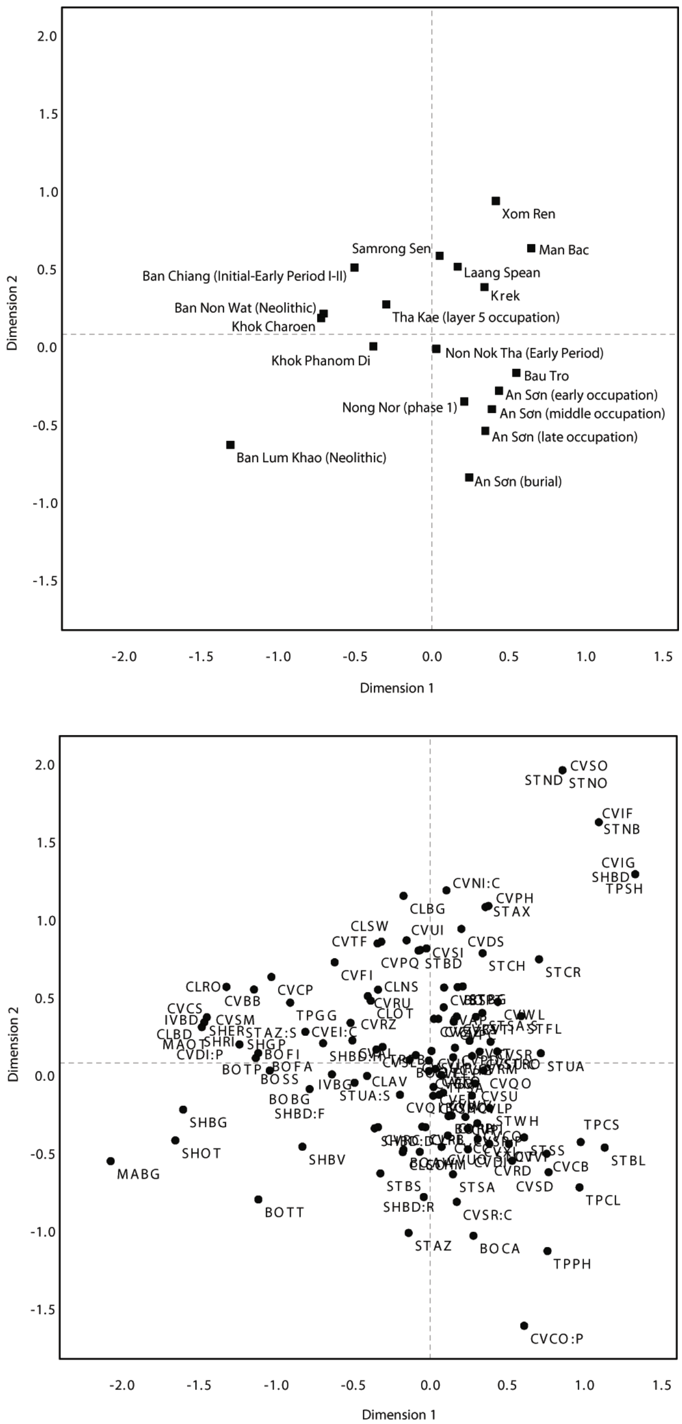


Figure 9.15. CA plots for the Southeast Asian neolithic cultural variables. Occupational and burial data combined, except for An Sơn. Top: sites, bottom: variables. Refer to Appendix C for variable codes.

Source: C. Sarjeant.

Table 9.16. Groups in Figure 9.14 and Figure 9.15 CA plots and the contributing variables. Not all variables are applicable for all sites of each group. Refer to Appendix C for presence or absence of the variables at each site.

Group number	Corresponding sites	Corresponding variables
1	Bàu Tró An Sơn (early occupation) Nong Nor (phase 1) An Sơn (middle occupation) An Sơn (late occupation)	Shell rectangular beads Circular and semi-circular incisions on ceramic vessels Shouldered and unshouldered adzes, varying sizes Concave rim ceramic vessels
2	An Sơn (burial)	Concave rim ceramic vessels with pedestal
3	Ban Lum Khao (neolithic)	Absence of artefact variability
4	Ban Non Wat (neolithic) Khok Charoen	Shell artefacts Marble artefacts Ivory artefacts Small adzes Curvilinear incision and painting on ceramic vessels
5	Ban Chiang (Initial–Early Period I–II) Tha Kae (layer 5 neolithic) Non Nok Tha (Early Period) Khok Phanom Di	Shell artefacts Ivory artefacts Unshouldered adzes Zigzag incision on ceramic vessels Black surface treatment on ceramic vessels Curvilinear incision and painting on ceramic vessels S-shaped incision with impressed fill on ceramic vessels
6	Xóm Rền Mán Bạc	Nephrite artefacts Geometric impression on ceramic vessels Shell temper in ceramic fabrics Scroll incisions on ceramic vessels Eye-shaped incisions on ceramic vessels
7	Laang Spean Samrong Sen Krek	Flake and core stone tool artefacts Hollow circle punctate stamping on ceramic vessels

Source: Compiled by C. Sarjeant.

The CA analyses (Figure 9.14, Figure 9.15, Table 9.16) and previous research on parallels between the ceramics of mainland Southeast Asian sites (Wiriyaromp 2011, 2007; Rispoli 2007, 1997; Vincent 2004, 2003) permit the following observations about cross-cultural connections within material culture:

1. **Sequence of fibre temper**: Fibre or rice-chaff temper was widespread during the neolithic. The ceramics of Khok Phanom Di were only tempered with rice in the latest phase of occupation, and the earlier ceramics were tempered with sand, then grog (Vincent 2003). This differs from An Sơn, where the temper sequence began with a short early phase of only sand-tempered ceramics, followed by two major temper groups, one of sand and one of rice chaff. These two groups continued until the end of the prehistoric occupation at An Sơn. Even though the inhabitants of Khok Phanom Di may have grown rice during the second millennium BC, the potters did not utilise it for temper until later (Vincent 2003). Other sites are less clear about this sequence, and there is as yet no published information about the presence of rice-chaff temper during neolithic Ban Non Wat, however analysis of the bronze

age ceramics suggests that fibre temper was introduced during the bronze age, after sand temper (Sarjeant 2010). While many sites are known to have ceramics with rice chaff and other organic tempers, further studies are necessary.

2. **Sand temper is ubiquitous in the region**: Sand temper commonly comprised of quartz, although feldspar and laterite sands were also common, and can be coarse or fine.
3. **Shell and calcareous temper**: This temper was limited at An Sơn and Khok Phanom Di, but appeared more frequently at other sites that lacked fibre tempers, such as Mán Bạc and Bàu Tró. Related phosphatic tempers (fossilised shell or bone) were also identified at An Sơn.
4. **Grog temper**: Grog temper was absent at An Sơn but was present at Khok Phanom Di, Ban Chiang and Khok Charoen.
5. **Roulette/rocker stamping**: This decorative mode was observed at most sites, but the range in stamping shapes and the detail of the stamp at An Sơn was unparalleled at other sites. Ban Non Wat had similar roulette stamping to An Sơn, but many examples were rough. Other sites with roulette stamping included Khok Charoen, Khok Phanom Di, Nong Nor, Samrong Sen, Laang Spean, Krek, Xóm Rền, Mán Bạc, Non Nok Tha and Ban Chiang.
6. **Punctate stamping**: Punctate stamping was widespread and was generally coarser than roulette stamping, sometimes using large circular stamps. This mode was present at Ban Non Wat, Laang Spean, Mán Bạc, Xóm Rền and Krek. Punctate stamping in general was rare, and was coarse when present at An Sơn.
7. **Triangular incisions with diagonal or zigzag line fill**: Since this motif appeared at Xóm Rền and continued into Sa Huỳnh times, later in prehistory, it was originally thought this decorative mode dated to the late neolithic/early metal age. However, it was present at Khok Phanom Di, Ban Non Wat, Samrong Sen and Xóm Rền.
8. **Geometric infilled incision**: This motif was more common at An Sơn than the painted, slipped or more ornate 'S'-shaped incised designs identified in northeast and central Thailand and northern Vietnam. The An Sơn incisions were commonly triangular or diamond-shaped, but rectangular incised meanders were also present. Other sites with this mode included Ban Non Wat, Khok Phanom Di, Samrong Sen, Krek, Khok Charoen, Mán Bạc, Xóm Rền and Bàu Tró. These motifs were infilled with roulette or punctate stamping, combed impression, or short stroke incisions.
9. **Curvilinear incision**: This appeared at An Sơn in spiral or multiple combed waves or concentric circle motifs. Curvilinear incision was widespread in neolithic Southeast Asia and generally associated with impressed fill. These incised motifs were highly variable compared to the following scroll/'S'-shaped incisions, which were more restricted geographically.
10. **Scroll/'S'-shaped incision**: Scroll incision was identified in northern Vietnam at Xóm Rền and Mán Bạc, and has been linked to 'Phùng Nguyên culture' sites. The similar-themed 'S'-shaped incisions appeared as curvilinear motifs that can resemble snakes, waves or human figures, depending on how the motif has been interpreted. Rispoli (1997) has noted that many of these 'S'-shaped incised motifs are filled with scale pattern-impressed decoration (SPID), or other forms of impressed decoration. 'S'-shaped incision was identified in the occupation layers at Mán Bạc, and also at Xóm Rền, Tha Kae, Non Nok Tha, Ban Chiang, Krek and Khok Charoen. Only one example has been identified from Ban Non Wat in Neolithic phase 1 (Higham and Wiriyaromp 2011b; Wiriyaromp 2011: 110).
11. **Band design**: This was an incised and impressed motif within a band across the shoulder of ceramic vessels. It was the most frequent mode of decoration at An Sơn, rather than the incised and impressed motifs that covered the entire body of the vessel at Tha Kae, Mán Bạc, Ban Non Wat and Khok Phanom Di. Complete vessel coverage with incised and impressed motifs was typically only seen on a few complete vessels from burial contexts at An Sơn.

12. **Geometric impression***:* This carved paddle impression was observed in place of cordmarking on the body of ceramic vessels and was only identified at Mán Bạc in this study. It recalls decorative modes in southeastern China and Hong Kong (Jiao 2007; Ng *et al*. 2005; Meacham 1978; Chang 1977).
13. **Curvilinear red painted designs***:* These were present at Ban Chiang, perhaps later than the neolithic occupation studied here, and were observed during the neolithic of Ban Non Wat and Tha Kae (Rispoli 1997). No painted or slipped motifs were identified at An Sơn.
14. **Concave rim independent restricted vessels***:* This is one vessel form that is singled out in this analysis because of its apparent importance throughout the sequence at An Sơn (form A2a). This form also appeared at Khok Phanom Di in occupation layers, Mán Bạc in burial contexts, and at Krek in Cambodia.
15. **Nephrite artefacts were only present during the neolithic in northern Vietnam (Hung et al. 2007).**
16. **Shell artefacts were the main prestige or exotic item during the neolithic:** Additional exotic or prized items included marble and ivory, both of which were at Ban Non Wat during the neolithic, marble at Khok Charoen and Ban Lum Khao, and ivory at Khok Phanom Di, Ban Chiang and late An Sơn.
17. **Restricted ornamentation of buried individuals at An Sơn:** Only shell beads were present as jewellery, although there was variability in the bead shapes in the middle and later phases of An Sơn. There was a greater range of beads at Tha Kae, Khok Phanom Di and Ban Non Wat, while Ban Lum Khao, Khok Charoen, Khok Phanom Di and Ban Non Wat had both shell beads and bangles, and sometimes earrings.
18. **Stone ornament artefacts***:* Stone ornaments were present in many neolithic sites in addition to stone tools, including at the sites of An Sơn, Khok Charoen, Khok Phanom Di, Mán Bạc, Samrong Sen, Xóm Rền, and Krek. The range of stone tools was greater at Krek, Samrong Sen, Mán Bạc and Khok Phanom Di than at An Sơn.
19. **Stone adze size and shape differed regionally***:* The adzes were generally small with an ovoid cross-section in northeast Thailand, while the adzes of southern Vietnam and Cambodia were more varied in size and rectangular-sectioned. However, Samrong Sen had both ovoid and rectangular-sectioned adzes.
20. **Shouldered adzes were rarer in northern regions***:* This includes Samrong Sen, Mán Bạc and Ban Non Wat, and may be indicative of an early neolithic sequence at these sites, since An Sơn displayed a transition from early to late neolithic occupation with shouldered to unshouldered adzes.

While ceramic vessel forms were highly variable and difficult to compare in such an analysis and ceramic temper sequences for most sites in the region are incomplete, the disentangling of incised and impressed designs (as previously analysed by Rispoli 2007, 1997) that predominate the decorative modes of the assemblages has added to understanding their movements during the neolithic. This extends to the relationship between these motifs and other material cultural variables within Southeast Asia. The distributions of selected analysed variables in the CA are presented in Figure 9.16, Figure 9.17 and Figure 9.18. These spheres of variable presences are intended to be open-ended areas rather than rigid outer limits. The absence of central Vietnamese sites in this study is notable, and limits interpretations for the region. Future research in all regions is needed to add to these observations.

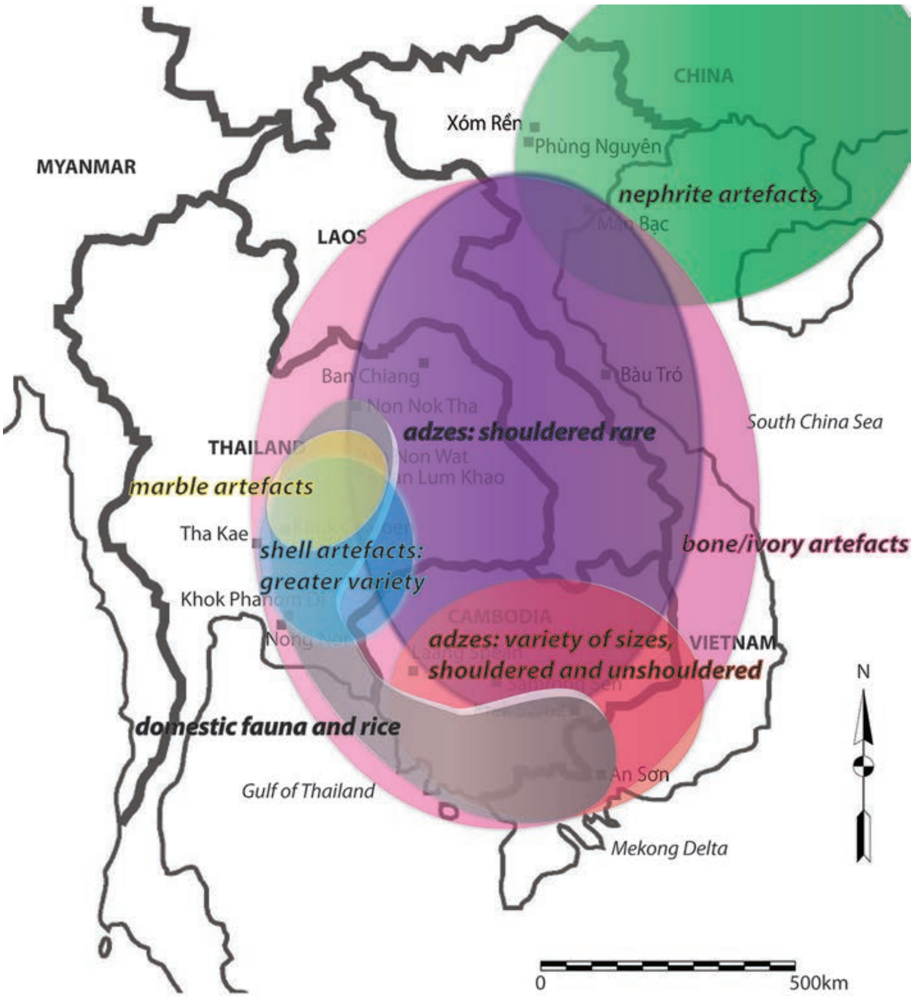


Figure 9.16. Distribution of notable non-ceramic material culture in mainland Southeast Asia.

Source: C. Sarjeant.

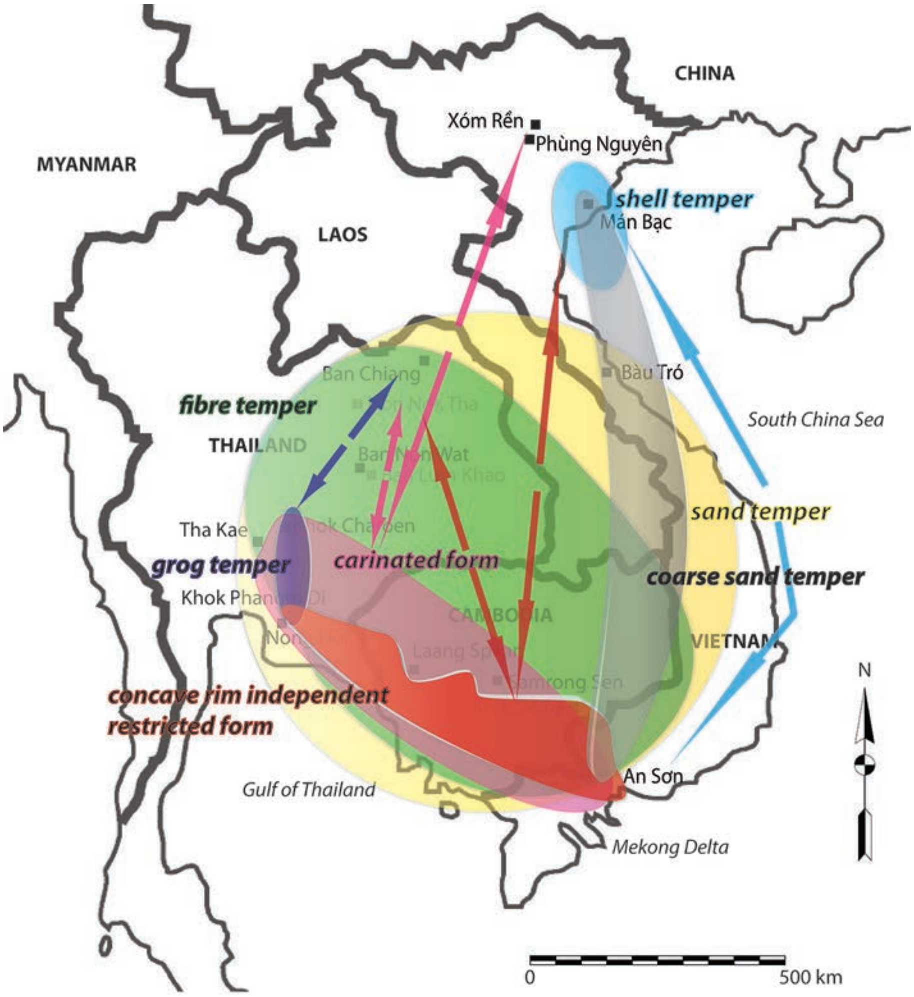


Figure 9.17. Distribution of notable An Sơn ceramic vessel forms and dominant tempers in mainland Southeast Asia. The arrows point to sites beyond the coloured sphere with the specified variable.

Source: C. Sarjeant.

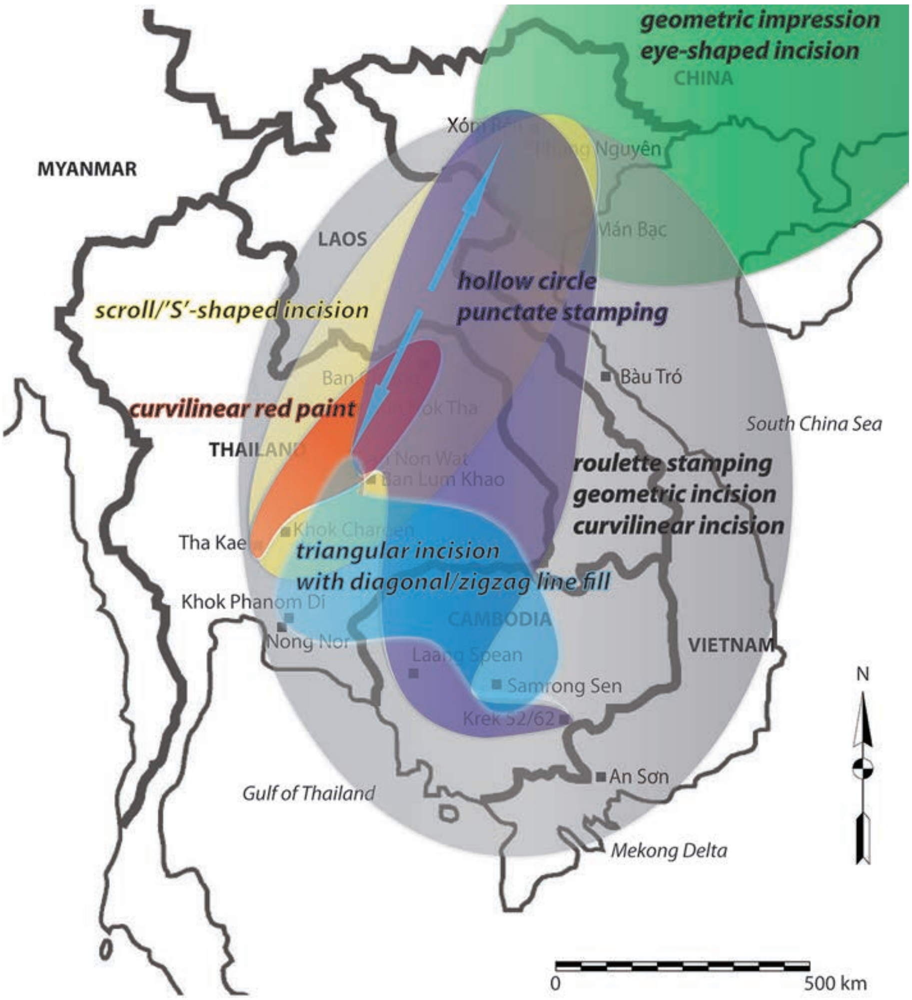


Figure 9.18. Distribution of notable modes of decoration on ceramic vessels in mainland Southeast Asia. The arrows point to sites beyond the coloured sphere with the specified variable.

Source: C. Sarjeant.

Summary: The material culture comparison of Southeast Asia

Many of the material culture variables studied in the CA indicate relationships of time and geographical proximity. The variables are highly susceptible to differences in chronology, which cannot be avoided in such comparative studies. While An Sơn displayed the greatest correspondence with Nong Nor (phase 1) and Bàu Tró in the CA (Figure 9.15), certain variables also signified the proximity between southeastern Cambodia and southern Vietnam, especially between Krek and An Sơn. A visual representation of the paralleled vessel forms and modes of decoration is shown in Table 9.17. The variability of material culture at Krek was limited, due to the lack of survival of bone and shell artefacts in the local soil conditions, while An Sơn had good preservation of such items. However, they were generally quite rare and not as varied as some other sites in the region, namely Ban Non Wat and Khok Phanom Di. In many ways, An Sơn shared closer affinities with Nong Nor (phase 1) rather than with any other neolithic sites beyond southern Vietnam, particularly in the band designs on the shoulder of ceramic vessels. This correspondence may be indicative of an earlier neolithic occupation at An Sơn. Another possibility is that the An Sơn region was not exposed to the exchanges and movements that may have introduced a wider range of shell and marble artefacts, which would have linked An Sơn to Khok Phanom Di and other sites in central and northeast Thailand.

The environment of Long An Province was alluvial, much like southeastern Cambodia. However, unlike Đồng Nai Province and southeastern Cambodia, the sites along the Vàm Cỏ Đông River were not near significant basalt resources. Thus, An Sơn was restricted in its stone resources. The range in sizes and the shape of the adzes was probably related to the technology based in the Đồng Nai region, and the tools were reduced and reworked at An Sơn to result in the observed variation in size. The sites of the Khorat Plateau in northeast Thailand were also situated on quaternary alluvium and basaltic landscapes. The small, ovoid-sectioned adze technology of northeast Thailand was connected to a localised stone technology unrelated to that for rectangular-sectioned adzes of the Đồng Nai region. Khok Phanom Di and Nong Nor were also situated in quaternary alluvium and mangrove environments with nearby granitic resources for stone working (Vimuktanandana 1999; Fromaget *et al.* 1971).

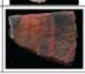
The absence of marble artefacts at An Sơn may be attributed to its distance from limestone and marble deposits, which are located in the Lopburi region, near Mán Bạc, Bàu Tró, Samrong Sen and Laang Spean (Vimuktanandana 1999; Fromaget *et al.* 1971). The lack of shell artefacts may be due to restricted access to a marine environment with suitable shells, unlike Khok Phanom Di and Nong Nor. In the case of Ban Non Wat and northeast Thailand, exchanges from the coast for shell and Lopburi for marble to the Khorat Plateau may have been established in a way that never transpired for An Sơn during the neolithic.

Strong parallels were established in Chapter 8 between the ceramic vessel forms of An Sơn and those at other neolithic sites in southern Vietnam. Although such parallels were limited in this study, and the dominant vessel form with a concave rim (form A2a) at An Sơn was only noted in the southern region of this study, at Khok Phanom Di and Krek, while some variations of this form were observed at Mán Bạc. The concave rim forms were associated with band designs on the shoulder, typically roulette stamping between two horizontal incised lines. Many decorated vessels in mainland Southeast Asia had incised and impressed motifs that covered a greater area of the body than just the shoulder. This was not the case at An Sơn. Additionally, the roulette/rocker stamping impression, while highly sophisticated, detailed and varied at An Sơn, was in fact a widespread mode of decoration in mainland Southeast Asia. Roulette stamping appeared alongside many other modes associated with incised and impressed motifs, such as SPID, during the neolithic at other sites (see Rispoli 1997).

The limited variation in decorative mode, but focus on variation within a single mode of decoration on one vessel form frequently produced at An Sơn, indicates an intensity in the ceramic manufacture of form A2a at An Sơn. An Sơn was part of the incised and impressed tradition in neolithic Southeast Asia, but it was not exposed to the traditions of painted motifs or 'S'-shaped incised motifs, which were part of a tradition restricted to northeast and central Thailand and northern Vietnam. These more northern traditions never manifested in the material assemblages of southern Vietnam. Roulette stamping spread to this region and developed further, but painting and other incised and impressed modes were never transferred. Sites like Ban Non Wat were centrally located to obtain goods and technological ideas from both the south and north, visible in shell and marble artefacts and ceramics, respectively, but the directions and area of contact appear to have been more limited in southern Vietnam.

While the occurrence of roulette stamping is not unique to mainland Southeast Asia, and does not necessarily stipulate contact between sites from its presence alone, the overall combination of neolithic features at An Sơn (domestic rice, dog and pig, polished stone technology, and incised and impressed ceramic vessels) implies an associated transference of this mode of decoration with neolithic settlement. At the point of transference to southern Vietnam, certain material cultural variables were adopted and others were omitted. Those variables that were initially adopted developed locally over time, but contacts inclusive of ornate shell and marble ornaments, painted ceramics and increasingly variable incised ceramics, did not extend into the wider neolithic environment. An Sơn was one of the sites at the 'end of the line' in terms of these neolithic traditions in mainland Southeast Asia. The CA indicates that certain traits in material culture at An Sơn were descended from those in northeast and central Thailand, while there were more specific parallels between An Sơn, Nong Nor (phase 1) and Krek. There is evidence of long-lasting and widespread neolithic traditions extending to southern Vietnam, but little direct contact between An Sơn and sites further north was apparent over the 1000 years of occupation. Contact via material culture was limited to the more immediate vicinity of southern Vietnam and southeastern Cambodia.

Table 9.17a. Table of comparative ceramic traits from the studied Southeast Asian sites in Chapter 9. Not to scale.

	An Sơn	References	Ban Non Wat	References	Khok Charoen	References	Tha Kae	References	Khok Phanom Di	References
Roulette stamped band		C. Sarjeant		C. Sarjeant						
Roulette stamped band		C. Sarjeant		C. Sarjeant						
Roulette stamped band		C. Sarjeant		C. Sarjeant						
Roulette stamped band		C. Sarjeant								
Curvilinear incision		C. Sarjeant								
Zigzag incision		C. Sarjeant		C. Sarjeant		C. Sarjeant (After: Illustration courtesy of H. Loofs-Wissowa)				
Wavy incision		C. Sarjeant		C. Sarjeant						
Red paint fill		C. Sarjeant								
Lime infill		C. Sarjeant								
Geometric incision		C. Sarjeant								C. Sarjeant (After: Vincent 2004: 265, fig. 105)
'S'-shaped incision and impression		C. Sarjeant		C. Sarjeant		C. Sarjeant (After: Illustration courtesy of H. Loofs-Wissowa)		C. Sarjeant (After: Rispoli 2007: 236, fig.1)		
Curvilinear incision and impression		C. Sarjeant		Higham and Wiriyaromp 2011b: 99, fig. 5.7						After: Hall 1993: 248, fig. 102
Hollow circle punctate stamp				C. Sarjeant						
Curvilinear red paint				C. Sarjeant				C. Sarjeant (After: Rispoli 1992: 86, fig. 4)		

Source: Compiled by C. Sarjeant.

Table 9.17b. Table of comparative ceramic traits from the studied Southeast Asian sites in Chapter 9. Not to scale.

	Nong Nor	References	Krek	References	Laang Spean	References	Samrong Sen	References	Mán Bạc	References	Bàu Tró	References
Roulette stamped band												
Roulette stamped band												
Roulette stamped band		C. Sarjeant (After: O'Reilly 1998b: 112, fig. 42)				C. Sarjeant (After: Mourer and Mourer 1970: 138, fig. 5)						
Roulette stamped band												
Curvilinear incision												
Zigzag incision												
Wavy incision												
Red paint fill												
Lime infill												
Geometric incision						C. Sarjeant (After: Mourer and Mourer 1970: 138, fig. 5)				C. Sarjeant		
'S'-shaped incision and impression										C. Sarjeant		
Curvilinear incision and impression										K.D. Nguyễn		
Hollow circle punctate stamp										K.D. Nguyễn		
Curvilinear red paint												

Source: Compiled by C. Sarjeant.

Table 9.17c. Table of comparative ceramic traits from the studied Southeast Asian sites in Chapter 9. Not to scale.

	An Sơn	References	Ban Non Wat	References	Khok Charoen	References	Tha Kae	References	Khok Phanom Di	References
Independent restricted vessel with everted rim		C. Sarjeant		C. Sarjeant		C. Sarjeant (After: Illustration courtesy of Helmut Loofs-Wissowa)		C. Sarjeant (After: Rispoli 2007: 236, fig. 1)		C. Sarjeant (After: Vincent 2004: 231, fig. 89)
Independent restricted vessel with concave everted rim		C. Sarjeant								
Simple restricted vessel		C. Sarjeant		C. Sarjeant		C. Sarjeant (After: Illustration courtesy of Helmut Loofs-Wissowa)				C. Sarjeant (After: Vincent 2004: 135, fig. 45)
Simple unrestricted vessel		C. Sarjeant		C. Sarjeant						
Simple unrestricted vessel		C. Sarjeant		After: Higham and Wiriyaromp 2011c: 18, fig. 3.3		C. Sarjeant (After: Illustration courtesy of Helmut Loofs-Wissowa)				C. Sarjeant (After: Vincent 2004: 268, fig. 108)
Simple unrestricted vessel with pedestal		C. Sarjeant		After: Higham and Wiriyaromp 2011c: 17, fig. 3.2		C. Sarjeant (After: Illustration courtesy of Helmut Loofs-Wissowa)				
Simple unrestricted vessel with everted rim and pedestal		C. Sarjeant						C. Sarjeant (After: Rispoli 2007: 236, fig.1)		
Simple restricted vessel with inverted lip and pedestal		C. Sarjeant		After: Higham and Wiriyaromp 2011c: 17, fig. 3.2						
Carinated independent restricted vessel		C. Sarjeant				C. Sarjeant (After: Illustration courtesy of Helmut Loofs-Wissowa)				C. Sarjeant (After: Vincent 2004: 279, fig. 119)
Independent unrestricted vessel with pedestal		C. Sarjeant								C. Sarjeant (After: Vincent 2004: 265, fig. 105)
Independent restricted vessel with pedestal		C. Sarjeant								
Simple unrestricted vessel with everted lip		C. Sarjeant								C. Sarjeant (After: Vincent 2004: 285, fig. 125)
Independent restricted vessel with direct rim		C. Sarjeant				C. Sarjeant (After: Illustration courtesy of Helmut Loofs-Wissowa)				
Ridge with incision at shoulder of vessel		C. Sarjeant. Vessel from Loc Giang. (Form also at Binh Da.)				C. Sarjeant (After: Illustration courtesy of Helmut Loofs-Wissowa)				

Source: Compiled by C. Sarjeant.

Table 9.17d. Table of comparative ceramic traits from the studied Southeast Asian sites in Chapter 9. Not to scale.

	Nong Nor	References	Krek	References	Laang Spean	References	Samrong Sen	References	Mán Bạc	References	Bàu Trò	References
Independent restricted vessel with everted rim						C. Sarjeant (After: Mourer and Mourer 1970: 138, fig. 5)		C. Sarjeant (After: Vanna 2002: 287, fig. 6)		C. Sarjeant (After: Illustration courtesy of K.D. Nguyễn)		C. Sarjeant (After: Pham 1997: 16, fig. 3. Vessel from Ba Don II)
Independent restricted vessel with concave everted rim		C. Sarjeant (After: O'Reilly 1998b: 112, fig. 42)		C. Sarjeant (After: Albrecht *et al.* 2000: 39, fig. 13)				C. Sarjeant (After: Vanna 2002: 306, fig. 25)		C. Sarjeant (After: Illustration courtesy of K.D. Nguyễn)		
Simple restricted vessel								C. Sarjeant (After: Vanna 2002: 287, fig. 6)				C. Sarjeant (After: Pham 1997: 16, fig. 3. Vessel from Ba Don II)
Simple unrestricted vessel								C. Sarjeant (After: Vanna 2002: 305, fig. 24)				
Simple unrestricted vessel		C. Sarjeant (After: O'Reilly 1998b: 112, fig. 42)						C. Sarjeant (After: Vanna 2002: 288, fig. 7)				
Simple unrestricted vessel with pedestal										C. Sarjeant (After: Illustration courtesy of K.D. Nguyễn)		
Simple unrestricted vessel with everted rim and pedestal						C. Sarjeant (After: Mourer 1977: 35, fig. 2)						
Simple restricted vessel with inverted lip and pedestal								C. Sarjeant (After: Vanna 2002: 303, fig. 22)				
Carinated independent restricted vessel		C. Sarjeant (After: O'Reilly 1998b: 112, fig. 42)										
Independent unrestricted vessel with pedestal												
Independent restricted vessel with pedestal												
Simple unrestricted vessel with everted lip				C. Sarjeant (After: Albrecht *et al.* 2000: 40, fig. 14)				C. Sarjeant (After: Vanna 2002: 287, fig. 6)				
Independent restricted vessel with direct rim												
Ridge with incision at shoulder of vessel												

Source: Compiled by C. Sarjeant.

10

The Role of Potters in Establishing Identity at An Sơn

Introduction: Theoretical approaches to the use of ceramics in the expression of identity

This chapter returns to the original aims of the monograph (Chapter 1) and interprets the results of Chapters 5 to 9 with respect to relevant concepts of identity and craft production. In order to extrapolate social meaning from a ceramic artefact, the ceramic assemblage of An Sơn must be considered with respect to the potters, their identity and role in An Sơn society and with other communities. The behaviours and choices of potters play an integral part in identity. Conservative and innovative behaviours in ceramic manufacture at An Sơn are indicative of factors that contributed to the position of potters within the An Sơn community. The ceramic assemblage is also assessed for its contribution to the identity of the community, and how others may have perceived An Sơn through its ceramics and other material culture.

The relationship between artefacts and identity has always been important in archaeological inquiries. Objects are the most reliable and resilient forms of evidence that characterise prehistoric cultural groups and can be 'read' for their meaning to a culture (Hides 1996: 25; Hodder 1982: 185; Mauss 1931: 6–7). It is the intention here to understand 'the social life of things', the history of the objects and those who created and used them, especially in the daily interactions between objects and people, known as *habitus* (Appadurai 1986; Bourdieu 1977). Identity is an elusive term, from which 'contradictory and heterogeneous definitions' arise out of multidimensional studies (Meskell and Preucel 2007: 122). There are psychological associations with familiar objects, which become part of a sense of identity. Objects do not offer identity to individuals, but the interactions via material culture that connect people and groups solidify relationships and associated identities of sameness or difference (Hodder 2012: 38, 89, 210; Meskell and Preucel 2007).

In order to assess the cultural identity for the An Sơn group(s) and their associated material culture, for the potters, individuals and the community as a whole, Sian Jones' theoretical approach is applied. This approach considers the variable nature of cultural identity with respect to context, and the fluidity inherent in its definition (Jones 1996: 63, 67). The overlapping and blurring of different facets of social life are observable when considering the domestic, ritual and sexual spheres, and studies of identity and social life approach these various domains in a multidimensional analysis (Meskell 2007, 2001). The practice of identity involves repeated production and consumption of distinctive material culture, and material culture analysis can provide information about this identity (Jones 1996: 72).

Material culture can be distributed in various social and historical contexts that may result in different modes of production and use, and may be seen to exhibit 'a variety of expressions' (Jones

1996: 72). In order to reveal variations in the deposition and use of material culture in different social spaces, artefact assemblages must be considered with an understanding of their context and stratigraphy. This is aided by the application of classificatory methods in material culture analysis. It is these distributions of specific material culture in different contexts that can help archaeologists to infer expressions of identity (Jones 1996: 73). This approach has been applied in this monograph, with a priority placed upon ceramic forms, modes of decoration and fabrics in stratigraphic and spatial contexts.

It extends to understanding the ceramic material culture together with potter behaviours and cultural identity. By applying learning theory and multiple lines of evidence, archaeologists can address the complexity of identity from analyses. Cultural transmission can be studied by identifying patterns of repeated co-occurring attributes while also analysing the variability that occurs as a result of this transmission in learning (Eerkens and Lipo 2008: 66). Archaeological evidence of identity can be retrieved from analysing learning frameworks, the daily practices of a past group and patterns in material culture, because they are part of specific set of social circumstances for a particular group (Wills 2009: 287; see also Minar and Crown 2001).

It is within the daily routine of domestic activities that individuals enact their identity, and it is within the household where signatures of identity may be archaeologically visible (Wills 2009; see also Lightfoot, Martinez and Schiff 1998; Stark, Elson and Clark 1998). This includes learned technological behaviours, since they are tied to tradition and effectiveness. These behaviours withstand time and along with other forms of evidence encompass different levels of identity. Evidence of identity may be found in the built environment, ceramic manufacture, food preparation and cuisine, refuse disposal, and ritual. Ritual is one of the most conservative markers of identity and cross-cultural comparisons of identity are most convincing when comparing ritual alongside other evidence (Wills 2009: 287–289).

Cross-cultural comparisons often involve distribution maps of material culture to reveal the mobility of objects between static human groups. Such maps indicate processes of exchange and a single endpoint where the object comes to rest archaeologically. When considering the processes of distribution, variations in these patterns may be interpreted as involving people in simultaneous events of interaction. The transactions of objects between people involve meetings and material transfers, with artefacts tied to the identities of individuals or groups of people. A series of transactions is what differentiates each group depending on the context, place, groups or individuals involved, and several narratives of identity are then constructed. Transactions also form connections between people and groups, including the people involved in the exchanges and the absent manufacturers. Concepts of social meaning associated with the object may also be transferred with it (Thomas 1996: 159–162).

With the application of specific theoretical frameworks, the results of the analysis (Chapters 5 to 9) provide the basis for the following interpretations. In Chapter 5, the ceramic sequence and contexts of the ceramic deposits at An Sơn addressed the use of ceramics as temporal markers and in domestic and ritual life. The categorisation of the An Sơn ceramic vessels in Chapter 5, and the fabric analyses in Chapter 6, were applied to identify ceramic vessel manufacturing templates, that were part of a transmission for learning the craft. Variability and conservatism in following these templates is discussed in relation to standardisation in the most common vessel forms (Chapter 7). Regional understandings of the organisation of ceramic production and labour divisions in Southeast Asia are also discussed. The overall identity and role of potters in An Sơn society are interpreted in light of the findings reported in Chapters 5, 6 and 7. The nature of interaction via material culture between sites in southern Vietnam (Chapter 8), is then employed to discuss identity for the An Sơn community in relation to material culture shared with other sites in southern Vietnam. The final section of this chapter contextualises An Sơn in terms of wider traditions and developments during the neolithic occupation of Southeast Asia, with reference to the results of the comparison presented in Chapter 9.

The temporal sequence and spatial distribution of ceramics at An Sơn

An Sơn was a site with dense concentrations of ceramic sherds in layers 1 to 6, clay pellets in layers 1, 4 and 5, ceramic roundels in layers 3 to 5, unshouldered adzes in the upper layers and shouldered adzes in the lower layers of Trench 1. The distribution of material culture over the site indicates dense deposition of ceramic sherds in the C squares of Trench 1, and minimal deposition of ceramics in the northeast corner of Trench 2. *Cà ràng* stove cooking vessels and midden, as well as low-fired clay lumps, especially in Trench 2 squares C1 and E4 layers 1 to 5, support evidence for cooking. The distribution of clay pellets in Trench 2 is somewhat consistent with this cooking area, with most pellets distributed in the southernmost squares of the trench. There was a more even distribution of ceramic roundels on site. There were no indicators of reworking stone tools in Trench 2, with Trenches 1 and 3 exhibiting evidence of finishing and retouching with polished flakes, whetstones and sandstones. The distribution of shell, namely shell beads, was limited to the burials and the selected midden samples in Trench 2 that were wet sieved through a 2 mm screen. Shell beads may have been more evenly distributed if this excavation strategy was applied for the entire excavated site.

The burials revealed the highest number of mortuary ceramic vessels offered to adult male and female individuals. However, some adults were not associated with any ceramic vessels, or only one. Sub-adults were usually interred with only one or no vessels and very few infants were buried with ceramic vessels. Individuals who were interred with a greater number of ceramic vessels were more likely to also have other grave goods, such as bivalve shells, shell beads and lithic adzes.

The sequence of rim forms shows that the initial settlement of An Sơn was marked by utilitarian bowls (form B1b) and concave rimmed independent vessels (form A2a), which may have had symbolic and utilitarian functions. After this initial settlement, the range of apparently utilitarian vessels increased with, A1 forms, a modification of form B1b into form B1a, and specific ritual vessels for An Sơn burials: especially class D1 vessels. By mid-sequence at An Sơn, the range of vessel forms increased in classes A1, A2 and C (see rim form images in Figure 5.1). The later sequence was characterised by D2a vessel forms for ritualistic burial goods, and a continuation of these forms from mid-sequence. The decoration of ceramic vessels at An Sơn transitioned from initial coarse cordmarking and coarse punctate stamping to more elaborate and varied roulette stamped and incised motifs.

Characteristic forms often exhibited high frequency and longevity in the sequence. This is suggestive of a mental template for the overall ceramic assemblage, or for each specific vessel form. There was some resistance by potters to deviate from these traditions or templates for the more common and long-lasting forms at An Sơn. This is not to imply that variations do not appear in the assemblage, nor is the assemblage devoid of change. These modifications of tradition are discussed below in terms of the mental templates for specific ceramic forms, and the occurrences of intentional innovation, accidental modification and error in ceramic manufacture.

The initial settlement at An Sơn had evidence of a ceramic assemblage that may have been brought from another locale within southern Vietnam, or further afield, as part of neolithic developments in the region. Initial settlement incorporated vessel forms, some of which were modified, that ceased or continued to be produced in the subsequent occupation. This presented three possible scenarios for the incipient potters at An Sơn: (1) the earliest potters left An Sơn after an initial visitation and returned a short time later with a larger repertoire of ceramic forms and settled permanently; (2) the earliest potters at An Sơn were later joined by other potters with different ceramic traditions, and these traditions combined to become the more varied assemblage evident in mid-sequence An Sơn; and (3) new ceramic forms developed out of the earliest forms at An Sơn in an evolutionary manner after initial settlement. The assemblage that appeared after the earliest occupation of An Sơn was largely continuous with expected developments within the tradition.

The spatial distribution of ceramics and other material culture shows how An Sơn can be divided into three activity areas: general refuse, cooking and food preparation, and burial. These areas do not overlap directly. While burials occur in the same squares as cooking and refuse localities, they were never interred directly with such cooking and refuse traces, but at different times during the occupation of the site. Trench 1 was associated with the waste disposal of ceramics, stone and faunal remains. The multiple layers of Trench 2 were associated with cooking, food deposition and food preparation. The number of actual cooking events in Trench 2 may have been few, but the area was nevertheless used multiple times for cooking. It may signify communal rather than household cooking, since the associated midden was dense and possibly deposited over a short period.

Temporal markers in the ceramic assemblage

While a sequence for the ceramic vessel forms was outlined in Chapter 5, the clearest temporal markers in the ceramic assemblage were the class D vessels associated with mortuary contexts. The striking transition from wavy to serrated rim forms, where one form replaces another at a certain point in the occupation of An Sơn, is one example that may connect the ceramic sequence to the absolute chronology of the site (see Chapter 4).

The low quantity of D2a rim sherds and the very high quantity of D1a in Trench 1 has complicated the issue of applying the wavy and serrated rim forms to the chronology. However, the class D sequence in the 1997 excavation showed the relationship between D1a and D2a (Nishimura and Nguyễn 2002). The initial occupation at An Sơn did not include class D forms, but the first D1 forms were introduced soon after. Some had the D1a wavy rim but more had the D1b narrow wavy rim (Figure 5.1), as observed in layer 3–4 of the 1997 excavation. The appearance of D1 forms has been dated to before 1750 cal. BC, according to the dated occupational deposits (see Chapter 4). The D1a form became a very narrow wavy/wide serrated form from layer 2–13 in the 1997 excavation, and by layer 2–9 only the serrated D2a was present. This transitional rim form differs from the narrow wavy rim form D1b (see Chapter 5 and Figure 5.1, c.f. middle image of Figure 10.1). The transition from D1 to D2 was gradual and occurred around the middle of the sequence, at around 1500 cal. BC, according to the dated layers of the 1997 excavation (see Chapter 4, Figure 10.1).

Two burials from the 2009 Trench 1 excavation also assist in applying an absolute chronology to the sequence of class D vessels. Burial 4 was interred with a D2a vessel that intersected burial 3 which had two D1a vessels. The earlier burial 3 was dated from tooth enamel by AMS to 1431–1314 cal. BC, and so burial 4 and the appearance of the D2a rim form must post-date this. Serrated D2a vessels were identified in two burials (10 and 14) from the 2004 Trench 3, of which the teeth were AMS dated to 1534–1431 and 1518–1429 cal. BC, respectively (Anna Willis, pers. comm.) (see Chapter 4). The serrated D2a vessel of burial 14 was in fact a wide serrated form (Figure 10.1), and possibly an intermediate form between D1 and D2. Given the error margin of the dating method, it is possible the point of transition from wavy to serrated pottery forms was *c.* 1430 BC.

If the dates are correct, it is possible that continued use or reuse of D1a vessels occurred after their production diminished or ceased, because the burials after the transition to D2a vessels continue to have D1a vessels interred within them. The transition is difficult to interpret as being clear-cut from one form to another, although it is plausible if the margin of error in the dating is considered alongside a period of crossover between D1a and D2a forms, and there was of experimentation in class D vessel manufacture within a short timeframe.

Relative temporal relationships were identified in the other ceramic vessel classes (see rim form images in Figure 5.1). The initial settlement of An Sơn was marked by A2a vessels that were fine sand tempered and sometimes decorated. These forms were made with respect to continuing ceramic traditions that were observed in the southern Vietnam and Cambodia region. Unlike the A1a fibre tempered vessels, that may have been used for cooking or storage and were in greater numbers after the initial settlement, the A2a form was not an obviously utilitarian vessel. The initial settlement assemblage consisted of B1 vessel forms, which were, most likely, utilitarian bowls. While utilitarian vessels, especially class A1, increased in proportion in the assemblage after initial settlement, a new ritual ceramic tradition appeared at the same time, in the form of the class D1 vessels. These vessels appear to have been innovated for mortuary offering. The class E *cà ràng* vessels peaked in Trench 1 layer 5, which may reflect the greater density of sherds mid-sequence. However, there does seem to be a preference for this stove vessel during mid-sequence, perhaps indicating an increase in cooking activities at this time.

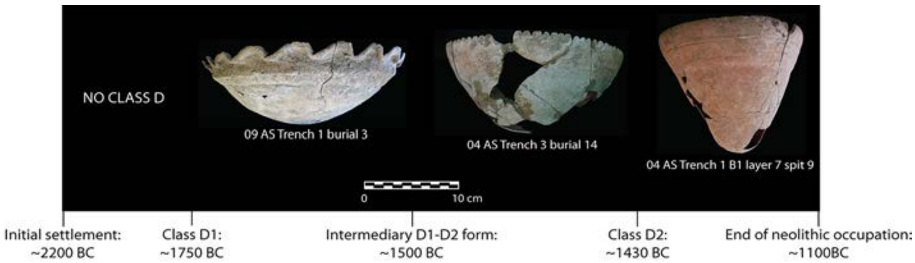


Figure 10.1. The sequence of class D vessels at An Sơn.

Source: C. Sarjeant.

The function of the An Sơn ceramics

In very basic terms, some of the ceramic forms at An Sơn can be distinguished as either utilitarian or ritualistic in their functions. The areas of cooking in Trench 2 were associated with form A1a, possibly undecorated A2a and C1a vessel forms, as well as class E *cà ràng* sherds. A2a vessels were widespread at An Sơn and dispersed throughout the sequence. They were identified in a variety of contexts and were possibly multifunctional. It is also likely that some were decorated with a shoulder band and others were not, perhaps signifying the function of the vessel in ceremonial or ritualistic scenarios. The A2a vessels were frequently burnished at the interior and exterior of the rim and down to the shoulder of the exterior surface. Burnishing reduces the porosity of a ceramic vessel (Dales, Kenoyer and Alcock 1986: 42), but these vessels were only partially burnished in the upper portion, suggesting they may have not been used for liquids but for serving food. Alternatively, in Mississippian archaeology, burnishing is commonly interpreted as a feature of serving vessels (Wilson 2008: 96), which was observed on the interior of a large decorated dish with a pedestal (09AS Trench 1 A6 layer 5 spit 6–7 in Figure 5.16).

The A2a vessels exhibit a great deal of care in manufacture, with detailed surface treatment and decoration, selected sand temper, and a high temperature for firing. Unlike the utilitarian cooking vessels and *cà ràng* that were porous with fibre temper and discarded after only a few uses, the A2a vessels were probably re-used many times, perhaps for serving at particular occasions rather than for every meal. Some other unique vessel forms were burnished with ornate decoration, and were unique forms probably used in feasts associated with ritual and ceremony (see Figure 5.16). Most of the class A1, B, C and E vessels were unburnished and fibre tempered, signifying a utilitarian function for storage and/or cooking.

Apart from class D vessels, there was little consistency between the mortuary offerings, although some included stone adzes and shell beads. The most common mortuary offerings were ceramic vessels, at least when mortuary goods were present in the burials. While class D ceramics were the most frequent vessel form in mortuary contexts, Trench 1 burial 2 in the 2009 excavation revealed a greater variety of ceramic forms. These included a highly decorated incised and impressed vessel that was unique in its form, as well as forms that were identified in the occupational layers and were presumably utilitarian vessels, such as forms C1a and C1b (see Figure 5.1 and Figure 5.14). The main difference between these vessels and those in occupational contexts was apparently greater care in manufacture, as evidenced by the shape, surface treatment and fabric, and the addition of a pedestal. This attention towards the ceramic vessels in burial contexts indicates that their primary function was for mortuary offering.

Organisation of ceramic production at An Sơn

Understanding the organisation of craft production in the past can be difficult to ascertain, largely due to a lack of direct evidence for production areas. While there was a large supply of ceramics at An Sơn, the site offered no production areas or even tools for pottery manufacture such as baked clay anvils. It is presumed that the vessels were manufactured with wooden paddles and anvils using cord and other plant materials for decorative motifs. One burnishing stone was recovered in the 2009 Trench 1 burial 2, and this may have been used in ceramic production.

From the assemblage of ceramic vessels and sherds, it is possible to infer the behaviours of potters at An Sơn. The main focus of this section is to outline the ceramic templates that were followed; to assess the deviational and conformist behaviour associated with these mental templates; and to understand how these templates might have been taught and learned in order to pass on traditions to the next generation of potters. By understanding the behaviours and choices of potters, it is possible to interpret the structure of ceramic production and the identity and agency of the potters.

The potter, choices and the ceramic template

The analysis of the morphology, decoration and fabrics of the An Sơn ceramics (Chapters 5 and 6) indicated that there was a basic structure for how certain vessel forms were manufactured by potters. Certain common forms were prescribed with a particular decoration, if present, and clay and temper selection. In order to create the desired vessel, a recipe was followed. The preciseness of this recipe was investigated in the study of standardisation in Chapter 7. There is a limited level of standardisation that is achievable in an early sedentary settlement setting, at which time it was likely there were a number of potters producing vessels without measurement or mechanised implements, thus increasing ceramic variability. This kind of manual production means that an intended 'ideal' form may vary by 5% when standardisation was intended (Eerkens 2000). This 5% is the effect of unavoidable copying errors, and the impact of these errors cannot be easily determined by researchers (Eerkens and Lipo 2008: 71). I interpret the standardised manufacture of certain forms as following a mental template rather than industrialisation and craft specialisation, which is more commonly linked to later iron age developments in mainland Southeast Asia.

The mental template for a ceramic vessel is the psychological mechanism that involves the ideal vessel that a potter has in mind prior to manufacturing the pot. This 'ideal' may be in the imagination of the potter, in the memory of the potter in an attempt to replicate other vessels, or in the copying of other vessels visible. The ideal or template may be taught by verbal instruction or demonstration. The variation that is evidenced in ceramic vessels in the teaching and learning process is discussed further in this chapter. The ideal product may have been formulated by the potter, other potters, and/or other individuals who control the standard of ceramic products. The ideal of a proper form for an object exists in the mind of the maker. Once the mental template has been translated by the craftsperson into a physical object, there has been a communication between the person's brain and motor skills. As a result, knowledge has been attained, and the detail of the object is no longer an abstract concept (Olausson 2008; Connerton 1989: 11).

Each technical operation is linked to others in a chain, a *chaîne opératoire*, involving materials, energy and gestures (Leroi-Gourhan 1964), which is then described with reference to techniques, methods and tools (Roux 2003b). These include production, exchange and consumption with material, economic, social and conceptual meanings (Hodder 2003: 162–163). The belief, idea or intention of a material item adheres to the object, and both utilitarian and conceptual meanings can be interpreted from material culture (Hodder 2003: 167). The mental template for manufacture dictates potter behaviours in the *chaîne opératoire.* Deetz (1967: 46) suggested that tradition is associated with how this ideal or mental template is perceived, due to the transfer of templates from generation to generation, although other factors are important. This includes whether the template exists for technology, function, innovation, or tradition (Deetz 1967: 46–47). These ideas or mental images can be compared within and between cultures (Gifford 1960: 346). The ceramic 'type', and thus the mental template of the form, is composed of features according to a set of attributes. These attributes are characteristic of the ceramic types that are constructed and analysed by archaeologists. The contrasting view is that pots take on a particular form due to motor habits rather than mental templates, and mental templates are visual categories that are consistent with produced vessel forms (Arnold 1985: 7–8).

The process from the template in mind to its physical manifestation encounters an exponential number of points where variability might be introduced (Figure 10.2). Some of these are within the control of an individual potter as a result of their choices, and some may be unavoidable. These variables centre around the potter, and the aptitude of the potter to navigate the mental template and manufacturing choices in order to produce the finished product. Even when controlled by experienced potters, certain variables may deviate from the template more than others. For example, vessel wall thickness may vary substantially in response to other choices and conditions, to specifically ensure a successful final product. Environmental and situational conditions, such as access to raw material resources, may also result in the need for modification in manufacturing methods, while wet weather can influence working, drying and firing times.

Potters follow the mental template and make decisions for the manufacture of a particular vessel in order to comply with a personal intention or invention, a social demand or tradition, an economic demand, or a combination of these factors. Intentional deviation from tradition or demand is an active innovative act. Complying with tradition may also be marked by variation in the features of the finished product, since the template is in the memory of many different potters, who are each equipped with differing adaptive skills and learnt procedures for constructing the template. Therefore, a number of individuals constructing the same vessel form from a mental template, at the same time, may manufacture different vessels that have the same fundamental features that define the form (archaeologists define these forms according to these features; see Figure 5.1). Whilst it might be assumed that potters manufacture vessels from a shared mental template, the reinterpretation of the template within the minds and actions of potters will result in slight differences between vessels.

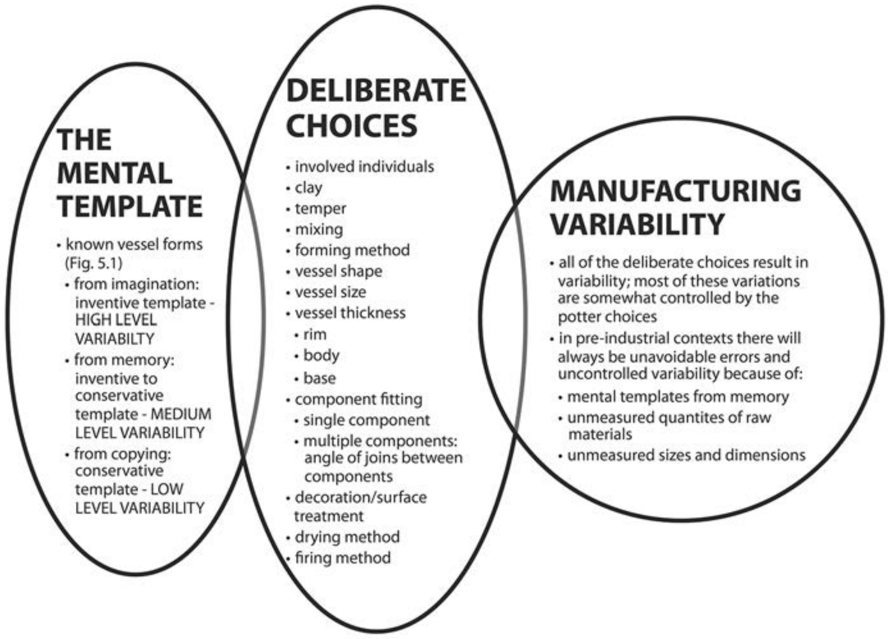


Figure 10.2. An overview of the variables involved in ceramic vessel manufacture from the mental template to the choices made by the potter and the incidences where variability occurs.

Source: C. Sarjeant.

Mental templates of An Sơn ceramic forms

Based on the statistical analyses of morphology, decoration and fabrics in Chapter 7 and the summary of fabric groups in Chapter 6, the four components (morphology, surface treatment/decoration [for class A2 only], temper and clay) of the mental template are outlined for each of the forms considered. One vessel form from each major class is considered here: A1a, A2a, B1a, C1b and D1a (see Figure 5.1). While class E is omitted here, the rim form and temper similarities between forms E1a and C1b suggest similar templates were in place, except for the body shape. The consistency or variability of each component is presented in Figure 10.3. Forms A2a, B1a, C1b and D1a displayed relative morphological standardisation in the coefficient of variation analysis of dimensional measurements, while A1a was more variable. Therefore the structure of the mental template was followed more closely for the manufacture of forms A2a, B1a, C1b and D1a than for form A1a.

- **Form A1a**: A1a was not closely analysed in the study of standardisation of forms in Chapter 7, since the preliminary results for class A1 indicated that morphology was variable, and a mental template for the form was also variable. The dimensional variables with the lowest levels of standardisation were the diameter of the rim, the length of the rim and the thickness of the body wall. This variability was evident throughout the sequence. The analysis of the A1a fabrics presented in Chapter 6 indicated there was consistency in the selection of fibre temper and the clay compositional group CPCRU 1.
- **Form A2a**: When all of the A2a samples were considered together in a standardisation study of morphology a great deal of variation was also observed, but this form had lower coefficient of variation values than form A1a. The least standardised dimensional variable was the thickness of the body wall and the most standardised was the angle between the rim and neck of the vessel. The angle is a distinguishing feature of this restricted vessel form and it would be expected that this variable would be an accurately executed component of the

mental template. Morphologies were more similar in dimensional measurements when vessels were produced at a similar time in the sequence, especially those within layers 4, 5/6, 7 and 8 of Trench 1. Additionally, while the fundamental principal for the shoulder band design was similar in all of the form A2a decorated sherds, whereby roulette stamped impressions were commonly applied, the dimensions and details of these designs were highly variable, except for the band width of the square and zigzag roulette stamped. Conversely, the fabrics were standardised with the prevailing selection for sand temper and clay matrix compositional group CPCRU 2.

- **Form B1a**: The B1a vessels were morphologically similar to each other in terms of the dimensional variables, but were statistically standardised in the lower layers (7 and 8) of Trench 1. The tempers ranged from fibre to mixed sand with fibre but the clay selection was homogeneous for form B1a and most samples had the clay matrix composition of group CPCRU 2.
- **Form C1b**: The morphology of C1b vessels was similar throughout the sequence with standardisation increasing for two dimensional variables, the diameter and thickness of the body, in Trench 1 layer 5/6. The temper consistently included fibre and many vessels also incorporated phosphate sand grains (as discussed in Chapter 6, Part I). The clays were homogeneous with clay matrix compositional group CPCRU 1.
- **Form D1a**: The statistical analysis of the morphological dimensions of D1a vessels divided the D1a sample into two major groups, one represented the earliest layers and the other represented the mid-sequence layers. This was based on the rim diameter and angle of the rim to the internal ridge dimensional variables. Within the two groups, the morphology was similar, especially the diameter dimensional variable. When compared with the other vessel forms, morphologically, the D1a vessels produced some of the more standardised practices at An Sơn with low coefficient of variation values for many variables than for the other vessel forms. This was especially relevant for the vessels from contemporaneous and similar contexts, such as burials. The fabrics were consistently tempered with sand with clay matrix compositional group CPCRU 2.

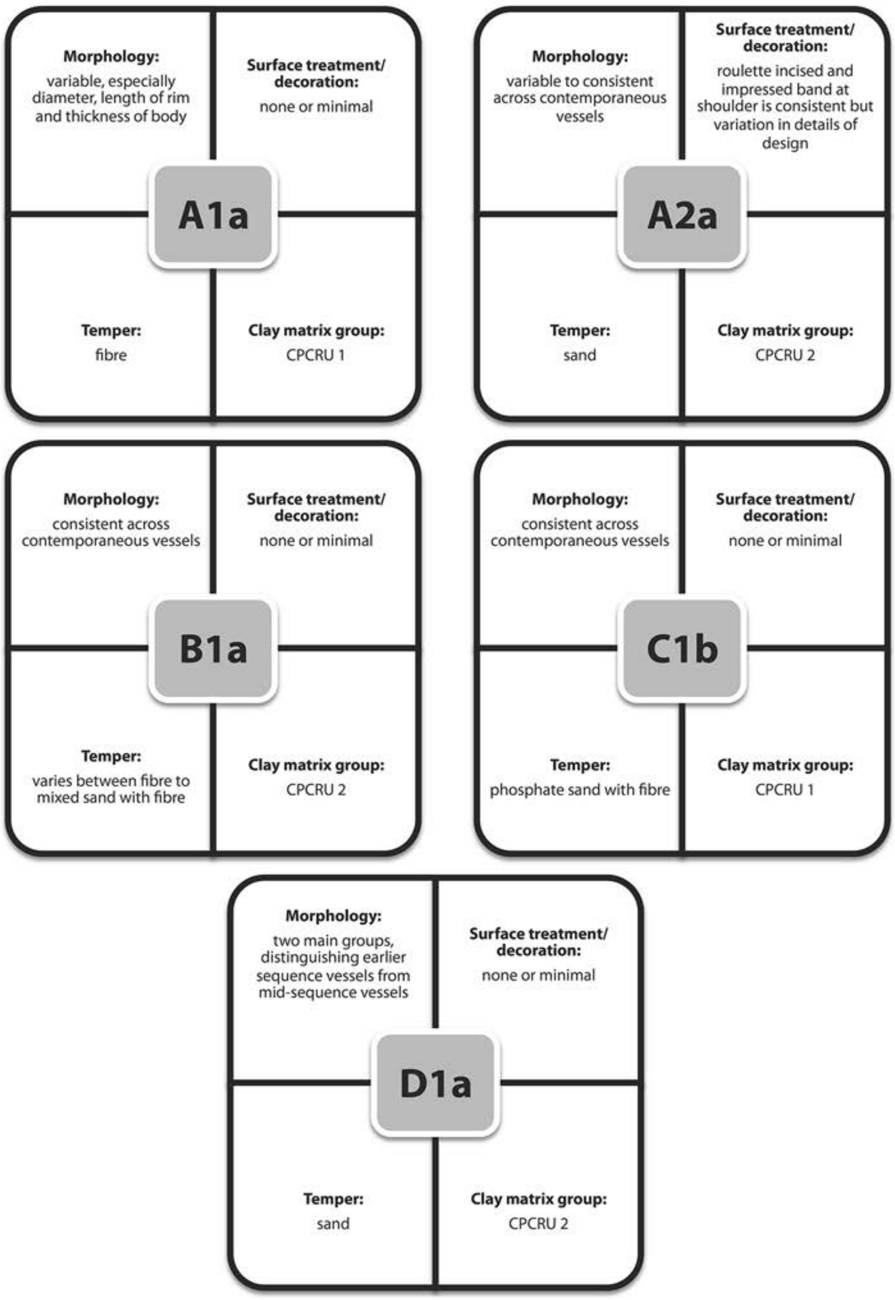


Figure 10.3. The reconstructed mental templates of An Sơn vessel forms A1a, A2a, B1a, C1b and D1a.

Source: C. Sarjeant.

Variations of the mental template and innovative behaviours

Each of the forms included in the mental template descriptions exhibited at least some variation in morphology, temper and clay selection, and decoration (Figure 10.3). However, form B1a was more standardised in form than the others, and form A1a was more variable than the others. The reasons for deviating from the mental template are likely to have been numerous. The first, as already mentioned, was possibly the result of errors that were incurred when translating the mental template from memory to a physical pottery vessel (Figure 10.2). The second could be the result of deliberate deviation, either slight or radical, such as invention or innovation. *Invention* occurs on an individual level, within the actions of the potter, and *innovation* occurs when there is widespread acceptance of this invention to cause change in the technology (Roux 2003b; van der Leeuw and Torrence 1989a). The third reason for deviating from the mental template could be the result of unavoidable but deliberate deviations, in turn as a result of external, uncontrollable factors. These may be environmental (for example wet weather and resource depletion or access limitations) and/or cultural (for example social controls for access to raw materials and time allocation for craft production). The fourth reason could be the result of personal influences, which may also relate to the social controls of craft organisation. These include such as part-time versus full-time craft production, specialised or diversified manufacture, illness or injury, or the potter as an amateur or experienced producer.

The transmission of complex craft traditions relying upon human memory to pass on a mental template to many generations would be expected to be vulnerable to failings of memory, copying error, and differences in potter ability. Tehrani and Riede (2008: 318) state that social learning theory must be applied in order to understand how these variables are accounted for in the transmission of skills. Social learning theory encompasses the range of ways in which people copy one another, and the level of 'accuracy and fidelity' that occurs when either following actions or observing the result of these actions in creating a product. Active teaching is an important deterrent to introducing variability, which may be employed since there is often an attitude in societies to preserve objects and traditions from the past (Tehrani and Riede 2008: 318; Miller 1994). Experimentation may be avoided in complex technologies, since the production and economic risks and attribute covariation will be high (Eerkens and Lipo 2007; Bettinger and Eerkens 1999, 1997). Behavioural chain activities also affect design variability, and even the design may be compromised when an artisan makes choices that are dependent upon individual invention and/or external factors (Schiffer and Skibo 1997).

There are likely to be more complex social devices at work in terms of how variation and deviation from tradition and the mental template operate beyond that which may be read from archaeological material alone. A potter may be 'within' or 'outside' inventive behaviours, or innovations may be either within the scope of the traditional production system or outside the system (Senior 2000: 78–79). The aforementioned causes of variation have been elaborated on by Senior (2000: 80–81), who states that a change in 'style' can be linked to availability of natural resources, variation in work efficiency, dietary changes, ritual behaviour, transformations in value systems, migration, contact with other groups, shifts in potter status, organisation of production, alterations in market demand, and gender roles.

Transmission of a mental template for a vessel form is dependent on the system of learning and teaching for ceramic manufacture. Knowledge may be passed on to or withheld from certain individuals deliberately in order to maintain exclusivity and/or tradition (Hurcombe 2000: 101). Eerkens and Lipo (2008: 66–67) focus on the variation that transpires during instruction and learning the skills of craft production. This variation occurs as a result of the accumulation of errors in the transmission of information or actual execution of the instructions (when the potter has the correct information but has not executed it correctly), or flaws in raw materials. Archaeologists might perceive these circumstances as invention, interpretation (using an item for a different function than it was originally intended) or translation (making an item from a different raw material than usual), rather than as errors in learning, execution and materials respectively (Eerkens and Lipo 2008: 66, table 4.1).

Boyd and Richerson (1985) have stated that there are two groups of artisans in a system of craft production: those that produce variability, usually with experimentation, and those that reduce it by copying others. The manufacturer may not always be aware of the errors they are introducing to the product and some copying errors are unavoidable, but how much change do copying errors cause? When less variation occurs than would be expected from copying errors, i.e. more than 5% variation, the change must be the result of other factors (Eerkens and Lipo 2008: 67–69, 73).

In coefficient of variation analyses or other modelling techniques, some material culture variables may reflect copying errors, while others may utilise variation-reducing mechanisms (less variability than for copying error) or variation-increasing factors (greater variability than for copying error), i.e. standardisation and specialised workshops, or experimentation and invention (Eerkens and Lipo 2005). As mentioned previously, not only do variation and change occur as a result of behavioural choices and errors, but also as a result of the ways in which potters learn technique. Ferguson (2008) states that when scaffolding is practiced, that is the integration of novices into craft production in which experts can teach, assist and intervene as much as necessary in order to ensure a successful outcome, then variability in the archaeological assemblage is limited.

The lack of manufacturing mistakes in the An Sơn assemblage, or evidence of vessels produced by novices may suggest that scaffolding was one of the learning structures present at the site. While certain ceramic forms exhibited both standardisation and variability in some of the analysed variables, none of the vessel forms in Chapter 7 were determined to have a standardised production overall. However, the standardised variables may have involved careful demonstration during scaffolding instruction to ensure that the complexities of manufacture for the particular form were learnt accurately. These more standardised variables included temper and clay selection and angle of the rim for most forms, with the exception of class D forms which exhibited greater standardisation in diameter. In contrast, body thickness was variable, and consequently less likely to have been taught by scaffolding.

While technological change may be considered in evolutionary terms, i.e. as technological development, the process is not always linear (Roux 2008: 82). Technological change may be considered a dynamic and complex process ‘emerging from interactions among properties of the task-environment-subject nexus, and is self-organising over time’ (Roux 2008: 83–84). It can result from many factors, including political, social, economic and religious reasons, and is characterised as either continuous or discontinuous. There is a limit to the evolution of technical aspects, up to the point at which technical change is introduced. Technical development is continuous and evolutionary, while technical change is discontinuous (Roux 2008: 84–87).

The ceramic assemblage at An Sơn exhibited continuous technological change, when change occurred, in all ceramic vessel forms. The most striking morphological change in vessel form class was from D1 wavy rimmed vessels to D2 serrated rimmed vessels, and suggests a slightly different mode of technological change. This included some evolutionary technical developments, after a period of experimentation, to develop the serrated rim form: the original large serrated portions decreased in size as the method for D2a vessels was refined. More dramatic discontinuous technical changes occurred in thinness of the body wall and in the conical shape of the body of the D2 form. The function of these vessels was continuous, in that they were made for mortuary practices.

Overall, there is a continuous evolutionary development of a somewhat conservative ceramic sequence at An Sơn. However, evidence of behaviour that could represent deliberate deviation from the mental template appears primarily in decorative motifs. This specifically occurs on the A2a vessel form, and the study of standardisation for decoration on this form (Chapter 7) indicates a high degree of variability within these motifs. The tools required for the roulette stamped motifs were probably applied with knotted cord or other perishable woven plant material that did not survive beyond application to more than a few vessels. While the form of the vessel tended to follow the template closely, possibly because of social and functional requirements for that vessel, the stamp motifs did not. With the opportunity to develop new tools constantly for decoration, potters had the opportunity to experiment and innovate in order to individualise vessels either according to potter or function.

The role of innovation in establishing and re-establishing the identity of the An Sơn community via material culture, in response to ongoing interactions with other groups, is discussed below.

Continuity in the ceramic assemblage and conservative behaviours

Continuity in material culture is not just an unconscious transmission of ideas from one generation to the next involving inherent conservatism. There are decisions to copy or vary previously adopted choices at different 'levels of consciousness' that may reference aspects of social identity (Bowser and Patton 2008: 106). Those who practice a shared tradition have a shared identity in connection with the craft. This identity may be shared between teacher and student. Studies have shown that women who manufacture ceramic vessels of a similar style share that style with their close matrilineal kinswomen (Bowser and Patton 2008: 108, 119).

There is a common perception that past societies were inherently 'conservative' because they retain traditions in craft technologies. Incidences of innovation are viewed as radical and rare, as *revolutions* (e.g. the chronological phases that are labelled after technological innovations, Stone Age, Bronze Age and Iron Age) (van der Leeuw 1990: 92). Arnold (1985: 220) declared that there is no economic value for innovation. Producing ceramic vessels that do not fit with tradition and market demand is an economic risk, recalling the work of Silver (1981), who investigated innovation amongst West African woodcarvers. Four inhibitors to innovation and cultural change have been proposed (Arnold 1985: 221–223):

1. The motor habits required for innovation may be incompatible with existing motor habits, which can also be resistant to change. This has been most commonly related to the resistance to utilising the wheel in pottery production (see Spier 1967; Foster 1965).
2. The organisation of ceramic manufacture may be inconsistent with innovation, owing to traditional methods and organisations, such as gendered divisions of labour, which in turn are tied to traditional economic values.
3. The economic status of potters limited innovation, since potters were often poor and may have had limited resources, while innovation required capital investment that may not have been available.
4. Rituals, beliefs and traditions required that potters practice traditional occupations and not innovate or deviate from tradition. This is related to symbolic or social values, rather than to the economic values identified in point 2.

Conservatism amongst potters has been linked to occupational isolation. Since ceramic manufacture is not always highly profitable, potters may be under-educated, and experimentation within ceramic technology can include a great deal of risk. The gender of potters has even been offered as an explanation for this conservatism, since most potters in pre-industrial societies were women, who were often isolated due to lack of education compared to males (Arnold 1985: 102). Creativity and artistic innovation are relatively modern, Western notions and the value of innovation may have been low in traditional societies, while conservatism and the retention of past techniques for ceramic production were of greater importance (Vincentelli 2000: 52–53; see also Rice 1984; Nicklin 1971; Foster 1965).

While variability was most certainly a feature of the ceramic vessel forms at An Sơn, there was a structure in place within production that enabled the identification of mental templates for forms A1a, A2a, B1a, C1b and D1a (Figure 10.3). The conservative behaviours and consistencies in the production of these vessel forms illustrate singular intent. In order for social or functional demands to be fulfilled, the shapes and fabrics remained largely consistent within a particular form. There were strong social attachments to these vessels for perhaps two reasons. One was functional as these vessels performed roles in domestic, occupational and/or ritualistic life and there would be no need to change functional items that work well. The second was ideational, to uphold ceramic traditions as reminders of the past, ancestry and origin.

Conservative attitudes in ceramic manufacture may be explained further by economic and social systems that require specialised production of ceramic vessels. While Chapter 7 outlined how specialisation would have been an unlikely feature in neolithic communities, elements of standardisation appeared within some vessel form groups when dimensional, decorative and fabric variables were statistically analysed. However, standardisation is not a direct indicator of specialisation. More reliable evidence is derived from context, concentration, scale and intensity (Costin 1991). Unfortunately, no detailed analysis of specialisation at An Sơn was conducted, due to the lack of direct evidence for these features. The results of the analysis of the ceramic assemblage and the study of standardisation were applied in order to infer aspects of the organisation of ceramic manufacture at An Sơn in terms of context, concentration, scale and intensity (see the following section).

Craft specialisation at An Sơn

When fewer people involved in craft production work in close proximity to each other, they are more likely to produce standardised vessels, which may indirectly suggest specialisation. Standardisation can be the result of many factors, such as consumer demand or efficient production. Variability may be measured in a relative way, as conducted in Chapter 7, in which analytical units (sites, regions, phases, or types) are compared. Variability may be attributed to reasons other than beyond the degree of standardisation, for example raw material compositions, environmental conditions, and cultural acceptance for non-conforming behaviours. Numerous variants in a region indicate a low level of specialisation, because many production groups would have provided vessels to the same region. In constrast, when a region contains a homogeneous product, production is likely to have been more concentrated (Costin 1991: 18–21, 32–36, 41–42).

Context is the link between the producers and the demand for their products, according to socio-political organisation. One way to assess demand is to analyse each vessel type, since each will have addressed different demands. Specialists will produce one type of vessel, and pre-industrial groups often include both attached (under the control of an authority) and independent specialists, primarily for the production of utilitarian vessels (Costin 1991: 11–13).

The study of spatial distribution of ceramic forms at An Sơn (Chapter 5) can provide further insight into the context of An Sơn ceramic production. This was most striking between Trenches 1 and 2. The majority of the layers of Trench 1 were composed of form A1 ceramic sherds, many of which were fibre tempered utilitarian wares. A significant portion of the assemblage also included form A2a vessels, and also C1a and D1a vessels. The class D vessels were the only form certain to be directly related to mortuary ritual. The majority of the other sherds probably came from utilitarian vessels. In comparison to the other 2009 excavated areas, Trench 1 also contained the most decorated sherds. Burial 2 in Trench 1 included one partially reconstructed incised and impressed vessel and sherds, as did the dumped layers of ceramics in Trench 1. Trench 1 has evidence of successive disposal of utilitarian and possibly broken ritualistic or feasting vessels.

Trench 2, on the contrary, contained quite a different assemblage, inclusive of a higher proportion of form A2a compared to A1a vessels. These A2a vessels often had a band of decoration at the shoulder and may have had a role in ritualistic or feasting events at An Sơn. Form B1a and C1a vessels were also a significant component in Trench 2. The main difference to Trench 1 was the presence of forms D2a and E1a. The higher proportion of form D2 compared to D1 vessels in Trench 2 was not only a marker of the chronology of the Trench 2 layers, but also indicated a locus of disposal for these vessels. The quantity of form D2 sherds was minimal in Trench 1, but one D2a vessel was identified in burial 4. Only form D1 vessels were identified in one burial of Trench 2. The presence of class E *cà ràng* and other indicators of cooking in Trench 2 (burnt midden concretions and clay lumps) suggests that form D2 sherds broken in manufacture may have been disposed of in Trench 2. It is also possibly they were used for other non-mortuary tasks, such as in preparing, cooking or serving food. The thin vessels may have suited this function.

There was little evidence available on *concentration, scale* and *intensity* of ceramic production at An Sơn. *Concentration* is the geographic organisation of production and distribution. The cost of transportation of goods is diminished when craftspeople live in direct association with consumers (Costin 1991: 13–15). *Scale* is the size of the enterprise and the number of producers in a single production unit. This relates to how producers are recruited and integrated into production organisation, including teaching individuals the skills to manufacture ceramic vessels. Quality control is easily monitored when a large number of producers are working in the same locality, as opposed to smaller groups working in separate localities (Costin 1991: 15–16). *Intensity* is the time spent on craft production, whether it be part-time or full-time. Potters in pre-industrial societies might have divided their time between many tasks, such as agricultural work. Concentrated debris indicative of pottery manufacture may suggest full-time production (Costin 1991: 16–18, 30–32).

It has been postulated that community-based production dates to 2000–300 BC in Southeast Asia, with specialised production commencing by the early first millennium BC, and prior to any evidence of political centralisation (White and Pigott 1996). Associations have been made between the adoption of rice harvesting and the transition to increasing social complexity in Southeast Asian prehistory (Dega 2002: 13–14; Higham and Maloney 1988). The results of the ceramic analyses from An Sơn indicate a dominant local-level ceramic production during the neolithic. The export of ceramic vessels from An Sơn appears limited, since unique items, such as the wavy and serrated rimmed class D vessels, have been found only at An Sơn and nearby Lộc Giang. At this stage, there is no evidence to suggest any other occupational organisation beyond household-based, part-time production, in co-existence with agricultural and hunting-gathering subsistence.

Division of labour in ceramic production

Pottery production is not always viewed in the highest economic esteem in subsistence agricultural communities, however, individuals involved in subsistence may shift into craft production if subsistence fails or is inefficient. In the case of pottery production, this may see the introduction of men into a predominantly female-oriented occupation (Arnold 1985: 220). In agricultural communities, there is flexibility in household-based ceramic production, and this occupation can be combined with other domestic and seasonal agricultural work (Vincentelli 2000: 45).

Links between certain individuals in society and specific occupations have been interpreted for past groups: women at Khok Phanom Di have been interpreted as potters, at Noen U-Loke high status individuals were identified with iron sickles, and at Shizhaishan in Yunnan women were linked to weaving crafts (Higham 2002b). It is common for women to be at the centre of ceramic production in pre-industrial societies or at the very least women spent much of their time potting. Women were often involved in many tasks in addition to ceramic manufacture, such as gathering plant foods, dairy production, spinning, laundering, water fetching, and cooking and preparation of vegetal food (Arnold 1985: 102).

If women were the most likely producers of pottery in the past, this study of ceramics not only informs about the identity and role of potters but also of women at An Sơn. Ceramic manufacture was often household-based in pre-industrial communities and women were able to conduct the occupation alongside other duties, such as caring for children. They could also combine potting with other domestic and seasonal agricultural tasks. However, there are counterarguments to this suggestion since there may be many arrangements for child caring in order for individuals to fulfil occupational tasks, and gender roles in labour and society may not have been well-defined. Many small ethnographic groups organise society according to kinship, whereas state-level organisations alter kinship relationships in modes of labour organisation and may include gendered divisions of labour amongst other organisational efforts (Vincentelli 2000: 34–46; Wright 1991: 200–203; Arnold 1985).

Gendered division of labour is intrinsic to most crafts and affects the way in which production is organised and practiced. There is a long-standing tradition of women manufacturing earthenware vessels. This has been noted in ethnographic research by Lefferts and Cort (2003, 1999) in Southeast Asia, in which women were identified as being at the centre of earthenware production, while also assisted by men and children in certain tasks. Men, however, were more closely associated with the manufacture of stoneware and wheel throwing. In rare cases, men who produced stoneware may have also made earthenware (Lefferts and Cort 2003: 308; 1999). The organisation of craft production according to gender roles is reinforced by the ways in which it is acted out, and the identity of the potter within the organisation (Vincentelli 2000: 34).

Past analyses of gender in relation to mortuary offerings in prehistoric Southeast Asia have revealed that there were few gender differentiations in terms of material culture offerings at Non Nok Tha. By comparison Khok Phanom Di indicated that mortuary offerings were differentiated according to occupation and gender. The female potters were revered in life and death as valuable contributors to the economy (Bacus 2006; Higham 2002b). Wu (2004) interpreted the social status of males in the late neolithic society at Dadianzi, Inner Mongolia, as being based on inherited status and wealth or individual achievements during life. The status of females was more complex and based on both inherited status and status acquired through marriage. Gender-specific burial goods were only identified with males at Dadianzi. At Mán Bạc, children the age of two years old were interred with goods, like those of adult male and female burials. It has been suggested that the mortuary goods may not have had any meaning in terms of age and gender, but perhaps reflected some other economic value or symbolism that was appropriate for both children and adults of all genders (Oxenham *et al.* 2008).

There is little evidence to suggest that potters at An Sơn were a single age, gender or other social group. There is some evidence to suggest that males were interred with a greater number of ceramic vessels compared to females, although one female was interred with just as many ceramic vessels and possibly a burnishing stone, which may signify her role as a potter (2009 Trench 1 burial 2) (see Table 4.5). It is a reasonably safe assumption that the women of An Sơn were at the centre of ceramic manufacture, given the evidence from ethnographic studies and from contemporary sites like Khok Phanom Di. However, it is likely that the female potters relied on assistance from males and children for various tasks related to potting at some points in the ceramic manufacturing process.

The identity of potters at An Sơn

The discussion has revealed several behavioural, occupational and contextual factors that contribute to understanding the identity of the potters at An Sơn:

1. Potters existed in an economic sphere that co-existed with agricultural activities, as well as hunting and gathering practices. The time spent on ceramic production had to be managed in accordance with these other occupations. Many potters may have been simultaneously involved in these subsistence tasks, as well as child caring and other crafts.
2. Potters followed mental templates for the most frequently produced ceramic vessels at An Sơn. Both utilitarian and ritualistic vessels followed these templates.
3. Conservative attitudes towards these templates were critical for the temper and clay choices needed to create functional and successful vessels.
4. Known templates were passed on from one generation of potters to the next with little variation in the most conservative variables, these being choices in vessel shape, temper and clay. This transmission included passing on knowledge of where to acquire the raw materials, the proportions of those materials, and methods of forming, shaping and finishing, decoration and surface treatment, and drying and firing. The longevity and conservatism of the vessel forms at An Sơn indicates instruction, demonstration and interactive learning from an expert to an amateur, probably within the occupation zone, such as from mother to daughter within the household.
5. The conservative attitudes in ceramic manufacture upheld traditions of the past, recalling ancestry and origin of the An Sơn community, and ensured a supply of known and reliable utilitarian vessels.
6. Innovation and experimentation co-existed with conservative behaviours in surface decoration. Potters could individualise their vessels according to ownership, artistry or function with varied roulette stamped motifs, some of which were more complex than others.

The following section discusses the ancestral ceramic traditions that connected An Sơn to other neolithic sites in southern Vietnam and Southeast Asia, particularly in relation to the use of innovation in order to differentiate An Sơn from other groups.

The identity of the An Sơn community

The concept of identity, or the self-identification of an individual or group, is more than a simple reflection of the spatial distribution and variation of material culture in a region (Lucy 2005: 109; Shennan 1989: 5–14; Mann 1986). Whilst it might be convenient to analyse the distributions of material culture and define cultures according to these groupings, the intricacies of material culture and social group relationships require consideration beyond geographical boundaries, since diverse identities and groups may have simply shared a relatively homogeneous material culture. Spatial boundaries can change even when social boundaries, such as age and gender groupings, remain stable. When material culture appears opposed, it may represent a physical portrayal of differentiation in identities. This kind of social interaction can be interpreted from material culture, but only when the context of use and production of the artefact is considered (Lucy 2005).

The spatial distinctions presented in Chapters 8 and 9 offer a starting point for discussion regarding interaction spheres in which identity may be constructed in response to communication. Groups are differentiated from each other based on the inclusion or exclusion of certain material culture. In a functionalist perspective, utilitarian items spread from one group to another rapidly, while burial, ritualistic and decorative ornaments and household pottery tend to be localised, and less likely to change over time (Hodos 2010). These local features are more likely to represent identity according to this view. The concept of a local tradition implies a boundary once again, and such distinctions may not be clear for the past. Shared habitual practices have been shown to be part of a sense of identity within a group (Hodos 2010).

The patterns by which material culture is dispersed in the landscape have been commonly discussed in terms of diffusion and evolutionary developments that create variation in artefacts as they are passed on. Culture transmission is a term used 'to *explain* variability, similarity and relatedness' (Eerkens and Lipo 2007: 240). Evolutionary perspectives and the concept of common descent in cultural transmission, such as those by Franz Boas, have been used to explain that the number of similarities between groups is proportional to the distance between them. This patterning has been described as diffusion of cultural traits from a point of common descent. This refers only to cultural descent, not genetic descent, which may evolve and diffuse in different and independent ways (Eerkens and Lipo 2007).

Modern cultural transmission theory is not dependent upon early concepts of diffusion, whereby bounded entities and 'cultures' were finite labels. Recent theories have employed a more Darwinian approach in order to explore changes that occurred, including the rate of change, rates of error in transmission, and modes of transmission. Cultural transmission theory allows for evolutionary processes that include individual learning, in which acts of experimentation and innovation occur alongside social learning and copying behaviours. Additionally, not all similarities can be perceived as indicative of cultural transmission between groups, since convergence of cultural traits can occur between groups with no spatial or temporal relationship (Eerkens and Lipo 2007).

In some situations, change in material culture can be the result of the diffusion of stylistic ideas through interaction between groups. Diffusion is never the sole explanation in the choice to adopt or not adopt a cultural trait. Theories of social interaction or information exchange need not be considered in isolation and various forms of contact can result in variation and change in culture, while evolutionary perspectives in a natural progression of cultural development may also contribute to cultural change. The process of selecting the features for change and variation is an important consideration since there must be a reason for making these choices (Hill 1985: 382–383).

Those cultural traits that illustrate cultural transmission must consider the social and physical setting in which the cultural trait is transmitted. Determinants include the individuals who transmit and acquire the information, the number of individuals involved, the direction the information is transferred, and how the information is packaged in order to understand whether all elements are acquired in a single event or in pieces, or if the information has been transmitted by 'hitchhiking' with other information (Eerkens and Lipo 2007: 249–252). These aspects offer further variables in the assessment of cultural transmission that also affect the way in which cultural elements are transferred, adopted and executed. Neiman (1995) concluded that measures of diversity within and between ceramic assemblages were affected by rates of innovation, horizontal transmission and population size. The expected rate of novelty proposed by Neiman (1995) has been applied in many studies to determine whether cultures were pro-novelty (innovative) or anti-novelty (conservative) (Eerkens and Lipo 2007: 256).

There is a prevailing opinion throughout Southeast Asian archaeology that neolithic developments spread throughout the mainland rapidly, and were associated with ground stone tools, cultivation of rice and millet, sometimes husbandry of pig and dog, a higher quality of ceramic production often associated with incised and impressed decoration, shell technologies, partial or completely sedentary lifestyles, and an increasing presence in landscapes that were most likely previously uninhabited (Rispoli 2007: 238; Bellwood 2005: 131–134; Higham and Thosarat 1998d: 74–

75). While there is no lack of an appreciation for the complex nature of this dispersal (see Chapter 1), detailed study of the actual mechanisms and modes of transmission for these diffusions is still in its infancy.

The analyses presented in Chapters 8 and 9 have synthesised some noted commonalities and differences between sites and regions exhibiting neolithic occupation, and integrated new research to contextualise An Sơn in this landscape of multi-lineal diffusion and local developments. The correspondence analysis in Chapter 8 revealed a close link in material culture between An Sơn and Lộc Giang of the Vàm Cỏ Đông River region. This was expected since they are very close geographically. The late occupation at An Sơn exhibited different material culture to the other sites of southern Vietnam. The parallels between the Vàm Cỏ Đông River region and the more eastern Đồng Nai River region were demonstrated within the material culture of Bình Đa. From Bình Đa, a greater network of sites along the Đồng Nai River appeared to be connected with sand tempered rim forms with ridge/appliqué and incised motifs at the vessel shoulder. The Đồng Nai rim forms differed from those at An Sơn, which were characterised by concave and wavy rimmed vessels, and roulette and punctate stamping.

The multiple and fragmentary paths of neolithic culture arriving at An Sơn were demonstrated in Chapter 9. Shouldered rectangular-sectioned adzes were primarily a feature of Cambodian sites and An Sơn, and may have been a local development. Shouldered adzes were present at other sites in mainland Southeast Asia, but were generally rare. Carinated and concave rimmed form vessels were restricted to southern Vietnam, Cambodia and central Thailand, within the studied area. While shell artefacts, namely beads, were present in southern Vietnam, shell artefacts were significantly more varied in central and northeast Thailand, where marble artefacts were also identified. The restricted distribution of these shell and marble ornaments may indicate their prestige status, which is signified by their scarcity (Thomas 1996: 150). Shell temper in pottery was rare at An Sơn, but common at Rạch Núi and Mán Bạc. Shell temper was probably a local innovation based on resource availability, such as a lack of organic or sand materials and a ready supply of shells. Certain features of the neolithic repertoire developed out of local resource availability, and others were independently developed such as variations in vessel forms.

Variables that apparently dispersed to An Sơn via diffusion include the use of rice chaff and sand tempers for ceramic production, and roulette stamping, geometric incision and curvilinear incision decorations on ceramic vessels. Decorations such as red painting in curvilinear motifs and scroll or 'S'-shaped incisions were more common in central and northeast Thailand and northern Vietnam, but never reached coastal central Thailand, Cambodia and An Sơn. In terms of ceramics, the most striking distinctions between the sites of southern Vietnam, Cambodia and coastal central Thailand and the sites of inland central and northeast Thailand and northern Vietnam were the predominance of stamped and incised motifs and concave rimmed vessels in the south and red painted motifs and scroll or 'S'-shaped incisions in the north.

It is clear that An Sơn and southern Vietnam fit with the overall neolithic dispersal in mainland Southeast Asia, but there were developments within southern Vietnam that could be attributed to interactions with coastal central Thailand and Cambodia. The local development and refinement of ceramic forms and stamped motifs was evident at both An Sơn and Khok Phanom Di, where the ceramic assemblages were, in turn, distinct from each other. Despite cultural changes and local developments at An Sơn, there is often reference to the past in order to retain a connection with earlier traditions and identities, as frequently observed in prehistoric societies (Wills 2009: 287).

Material markers of identity for the An Sơn community

Social divisions and boundaries are represented by both material and behavioural markers. Style in material culture is often a marker of social identity, but both style and identity have multiple meanings (Bowser and Patton 2008: 105–106). Recordings of material cultural traditions are often arbitrary with little consideration for the inherent material or psychological constraints during material culture manufacture. Neolithic ceramic artefacts sometimes incorporated a 'revolution of symbols', in that there was a relationship between symbols in material culture and social codes and ideologies (Cauvin 2000: 237; Orrelle and Gopher 2000: 303; see also Miller 1985).

It is commonplace in archaeology to characterise cultural groups according to pottery styles, which often displays some of the greatest variation. However similarities and differences in other material culture may also reveal different cultural group associations. For example, in British archaeology, Stuart Piggott (1954: 277) identified a primary Neolithic culture according to lithic types and secondary Neolithic cultures according to pottery types, in which distinct ceramic traditions overlaid a fundamental cultural unity that was observed in lithic homogeneity (Thomas 1996: 142–144). Therefore, while it may be possible to identify groups according to ceramics alone, other material culture should also be considered to clarify these groups, and the complexities that exist within them.

This monograph has explored material culture evidence, closely examining the ceramics, but has also included other technological evidence, as well as aspects of environmental, landscape, mortuary, economic and subsistence evidence to investigate the ways in which cultural features developed and diffused within neolithic Southeast Asia. The analysed variables discussed in Chapters 8 and 9 revealed complex relationships between sites via the distribution of certain material culture (see Figure 8.20, 9.16, 9.17 and 9.18).

There is a wide repertoire of features that link An Sơn to the rest of the neolithic landscape in mainland Southeast Asia. This includes cultivated rice and domestic dog and pig, ground stone adzes, the use of fibre and sand tempers in ceramic manufacture, and certain incised and impressed modes of decoration. The shape of vessels appears to have diversified significantly at a local level, apart from basic dish or bowl and restricted everted rim forms. While there was a preference for geometric impressed and eyelet-shaped incised motifs in northern Vietnam and into the southeastern provinces of China, the sites of the Khorat Plateau and Lopburi regions in northeast and central Thailand were concerned with curvilinear motifs that were incised or painted. This includes those that may have represented humans, whales or sickles (see Wiriyaromp 2007). These traditions appear to be regionally restricted and do not extend to the coastal areas of central Thailand, Cambodia and southern Vietnam.

The similarities between An Sơn and the sites of Cambodia and coastal central Thailand may represent the rapid dispersal of neolithic attributes within the zone along the Gulf of Thailand and Mekong Delta, some of which was suitable for cultivation activities. Once settled, local developments were quickly in place, resulting in a distinctive variant of neolithic culture within southern Vietnam. This is characterised by shouldered and unshouldered stone adzes, concave rimmed vessels, pedestalled vessels, and a preference for roulette and punctate stamped motifs, typically as a band at the shoulder of globular vessels.

Local innovations evident at An Sơn distinguished its ceramics from other sites in southern Vietnam, including the precise application of roulette stamping on the shoulder concave rimmed vessels. Stamped motifs were present at the other sites in the region, but were rare because there was a preference for impressed or combed surfaces with incised lines overtop (either horizontal or wavy) at sites like Bình Đa. Other examples of roulette stamping in a band at the shoulder were observed at Ban Non Wat, however the motifs were rough and less ornate in comparison to those at An Sơn. I have proposed that these motifs were a mechanism for potters to exercise artistry, innovation and individualism on certain vessels and therefore the detail was presented carefully.

The innovation of wavy rimmed vessels was also part of establishing a locally restrictive tradition, primarily for ritual as a mortuary offering. This vessel may have been applied to distinguish the An Sơn community. With the evolution of the wavy to serrated rimmed form there was a continuing re-evaluation of the tradition, technology and any associated identities in place at An Sơn. Other ceremonial vessels at An Sơn included ornate incised and roulette stamped decorations that are largely unparalleled in southern Vietnam, but recall the local innovations for mortuary ceramics at Khok Phanom Di. There is little in common between the vessel forms of An Sơn and Khok Phanom Di, but the incised and stamped decorative tradition at both sites was adopted in opposition to the use of curvilinear incised, especially scrolls or 'S'-shaped, and curvilinear red painted motifs that were common at inland sites in central and northeast Thailand and northern Vietnam.

The early occupation at An Sơn is marked by a limited range of ceramic vessels, which expanded soon after settlement in terms of the range of forms, decorations and fabric technologies, including those that represent local and widespread traditions. Most of the southern Vietnam sites studied in this monograph correspond with this early to middle occupation at An Sơn. The later occupation at An Sơn was marked by increased diversification in the range of ceramic forms, which was also evident at Cù Lao Rùa, and it is likely there was a trend for increased localisation of ceramic traditions in southern Vietnam in the late neolithic occupation.

The geographical distance of An Sơn from the other studied sites of Southeast Asia suggests there was likely a trickle-down effect, whereby a repertoire of neolithic ceramic traditions were brought initially to southern Vietnam, but then developed locally and independently from the other traditions exhibited further afield. The result was a unique material culture identity at An Sơn, where potters manufactured particular vessels with local, regional and inter-regional affinities in mind. Local innovations increased and less regard for those neolithic traditions occurred in the late neolithic occupation at An Sơn. This trickle-down effect was most likely in place for most of the sites in southern Vietnam, with varying impacts from inter-site communications.

Other indicators of identity at An Sơn

It has been proposed that daily practices reveal evidence of identity in the past (Lightfoot, Martinez and Schiff 1998). This includes understanding the maintenance of residential space, organisation of trash disposal, menu and food preparation, material culture from domestic contexts, and the settlement layout. There is no direct evidence of residential spaces at An Sơn, such as of housing structures, but there is evidence of domestic life with areas of refuse, cooking, and craft occupations. The separation of the refuse of ceramics and cooking activities with related discarded food and ceramic items indicates spatial organisation at An Sơn. The multiple layers of discarded ceramics intermixed with stone reworking debitage and faunal remains in Trench 1 suggests that it was an ongoing practice to dump refuse to the side of the mound at this locale.

Lightfoot, Martinez and Schiff (1998) identified native Alaskan groups with households that combined the living room, kitchen and workshop in a large central space. These spaces were not cleaned but were covered with fresh grass from time to time. The archaeological evidence of this were 20–30 cm deposits of dense vegetable matter, bones, shellfish, matted grasses, hair, artefacts, wood, ash, charcoal, fire-altered rocks, and fur. Other communities revealed clear segregation of residential and midden spaces. The households were clean except for some lithic artefacts, while the midden was deposited downslope where dense layers of bone and shellfish were revealed (Lightfoot, Martinez and Schiff 1998).

At An Sơn, three different disposal methods are evident. The first, located at the top of the mound and excavated in 1997, indicates cultural deposits were covered by alluvial soil, on which a cultural layer was then deposited. This process was repeated many times and is similar to the aforementioned household arrangement of waste in the first example of native Alaskan groups (see Figure 4.1). The second involved disposing of ceramics, lithics and faunal remains off the side of the mound, away from potential household localities (as observed in Trench 1). The third method was evident in Trench 2, whereby a few cooking events occurred and the midden of food remains were deposited adjacent to the cooking and eating site. This may have been a house site, but unlike in the 1997 excavation, was not covered up and the cooking activities may have been moved to another location on site. It is also possible that Trench 2 was the site of a one-off event, such as ceremonial feasting, although the midden would be expected to be larger if this was the case. I propose the midden of Trench 2 is representative of a household or a communal cooking event, while the deposits of Trench 1 represent waste for the majority of the community. The 1997 excavation represents the repeated use of one site as either a kin house or communal site.

The diet of the individuals who ate in the area of Trench 2 primarily subsisted on fish remains and shellfish, with some mammal and possibly reptile bones (Piper *et al.* 2012). The deposition of *cà rang*, cooking and serving vessels in association with the midden is also apparent in Trench 2. This may have been an anomaly, but *cà ràng* left at the site of cooking suggests that there was a high frequency of breakage during cooking or that there was no need to reuse the vessels. The pressure to reuse these vessels, even broken ones, occurs when ceramics are limited or prestigious. The disposable attitude towards ceramics at An Sơn is indicative of a society with continuous ceramic production and a community of local potters.

Material culture, identity and social contact in southern Vietnam: The contrast between An Sơn and Rạch Núi

Considering that identity is represented by multiple factors, including language, ancestry and ethnicity, appearance and costume, environment and landscapes, and material culture, an approach that aptly applies all variables for past groups is unlikely to be possible. If we accept that expressions of identity almost always incorporate material culture as a tangible medium for social meaning, the data for analysing identity were most extensively found in the current archaeological record at An Sơn. Compared to the other aforementioned variables for the representation of identity, the premise that identities develop in response to increased contact with other groups, rather than as a result of isolation, requires validation by considering variability and innovation in the material culture and ways in which artefacts were used to display the social life of individuals and groups. Spatial distributions of material culture differ from concepts of self-identification, which may be explained by modes of transference of material culture, different applications of material culture in various cultures, and innovation and conservatism in material culture production. Overlapping of some material culture items in space, and at the same time not of others, calls for the use of spatial distribution data, and an interpretation that regards the nature of cultural interaction in response to identity. This accounts for the fluidity and re-evaluation of social boundaries, and the identity, use and symbolism of material culture (Jones 2008, 1996; Rowlands 2007; Lucy 2005; Shennan 1989).

The premise that cultural boundaries are established through interaction between groups rather than social or geographic isolation has been outlined by Jones (2008) and Rowlands (2007). Cultural boundaries cannot always be identified on the basis of language, culture, polity and territory (Jones 2008: 326). Rowlands' (2007) research has shown that in the transition from the early to the middle Bronze Age in the northern German plain, the similarities in regional traditions, dress and appearance found in the earlier period were replaced by local differentiations in the middle period. There is evidence of contact, trade, movement and influence between groups in the middle Bronze Age when these local divergences occurred, perhaps as a result of a decreasing socio-economic space and increasing competition between groups. Visible differences appear in material culture and traditions and 'ethnic identities are always a product of contact rather than isolation' (Rowlands 2007: 57).

With this concept in mind, broader concepts of cultural identity expressed in material culture relative to spatial distribution data, regional diffusion of neolithic cultural elements and cultural transmission theory, the social role of material culture at An Sơn have been discussed in relation to the interaction with other groups in southern Vietnam and Southeast Asia. Further discussion based on the preliminary observations reveal the contrasting material culture and the identities between the seemingly interactive An Sơn and the relatively isolated Rạch Núi (see Chapter 8) in southern Vietnam.

Rạch Núi was one of the sites deemed roughly contemporaneous for at least part of the sequence at An Sơn, although the Rạch Núi sequence was probably not as long. At times of contact with other groups, markers of interaction apparently appeared at the same time as markers of local innovations at An Sơn, such as in decorated ceramics and common vessel forms. This interaction could have occured via spheres of shared technologies in an initial diffusion and/or ongoing trade communications. While class D ritual ceramics and some decorations were locally distinctive at An Sơn, Rạch Núi exhibited an overwhelmingly high proportion of apparently utilitarian vessels with a local technology of shell tempered bowls (96%). Sand tempered sherds were minimal at Rạch Núi (4%). There was a lack of evidence for ritualistic or symbolic ceramics, especially due to the lack of burials exposed thus far in the excavations. There was evidence of possible repair of some sherds; those that were only decorated or rim sherds from sand tempered wares with perforated holes that could be used to string sherds together. Many of the sand tempered sherds were also small, and some were modified into roundels as 'special' items with a secondary function, perhaps as a token from the past, an heirloom.

At An Sơn, almost equal proportions of sand and fibre tempered wares were found within the assemblage of utilitarian and ritualistic wares. The Rạch Núi community may have been exposed to these ceramics via infrequent communication and trading with other groups throughout the occupation. Alternatively, the original inhabitants of Rạch Núi may have arrived with some ceramics from another locality and did not reproduce them once established on site, but retained the original ceramics as heirlooms and special items. The absence of trading with Rạch Núi is also supported by a shortage of stone materials and the need to develop a local turtle-shell adze technology. These shell adzes were likely to have been used for a very different function to stone adzes since the relative hardness between the two materials was so marked.

The analyses presented in Chapter 8 indicates there was a relationship between the ceramic material culture of Rạch Núi and sites along the Đồng Nai River (group 2 in the CA, see Fig 8.20). This is based upon the presence of some possibly exotic ceramic sherds from this region, although the minimal presence of these sherds is suggestive of infrequent contact. This interaction sphere does not extend to An Sơn or other sites along the Vàm Cỏ Đông River. The arrival of neolithic occupation in southern Vietnam resulted in diversification after the initial settlement in response to ongoing interactions and resource availability. Sites, such as An Sơn, that were exposed to continued contact with other groups appeared to have retained the wider neolithic tradition whilst also establishing new local ceramics. The ceramic variety at isolated sites like Rạch Núi diminished in response to decreased contact, and there was a loss of investment in manufacturing those ceramics that represented the wider neolithic expression or local material markers. The level and nature of contact between Rạch Núi and other sites of southern Vietnam will be investigated further. Future research on the ceramic assemblage will examine local production and the origins of the possibly exotic sand-tempered sherds.

Conclusion: Neolithic developments in southern Vietnam

The connection between the neolithic sites of Southeast Asia may be evaluated by interpreting the relationship of either distinct or cohesive cultures within the region. Nevertheless, the identification of archaeological 'Cultures', as practiced in past Vietnamese archaeology, comes into question when considering the interactions between groups during the neolithic (see Jones and Graves-Brown 1996: 4). While material culture that could be interpreted as associated with a cultural group suggests group identity, this research showed that a single identity of a group could not be isolated because group identity is multi-dimensional. This expression of identity affects the archaeological evidence, since identity is transient, repeated and varies in different contexts and in different scales and manifests in 'multiple, overlapping distributions of material culture assemblages,' involving complex interactions (Jones and Graves-Brown 1996: 7).

The boundaries that material culture analysis can reveal are likely to be discontinuous in space and time since fluctuating concepts of identity can disrupt such groupings (Jones 1996: 73). Material culture traditions are rarely spatially bounded by separate language and gene pools. A coherent unit of a culture with corresponding language, material culture and identity is a simplistic view and has no real basis according to ethnographic and historic observations (Zvelebil 1996: 159–160). The transition to neolithic occupation as it has been described in the Southeast Asian context includes social and subsistence changes that are not separate, but interconnected, involving complex interactions (Orrelle and Gopher 2000: 295–296; Whittle 1988: 108, figure 4.1). When considering the range of variation shown in Chapter 9, an inability to assign groups to maps according to material culture suggests there are issues in establishing 'Cultures' for the past. This monograph has considered the 'composite distributions of the many different kinds of polythetic cultural assemblages' (Clarke 1968: 248).

While there is general acceptance for a neolithic transference from southern China to mainland Southeast Asia, with an ultimate origin potentially along the Yangtze River, the timing of these events and the routes via river courses or coastal lowlands continue to be discussed (Bellwood 2011; Castillo 2011; Higham, Guangmao and Qiang 2011; Lu 2011; Fuller *et al.* 2010; Nakamura 2010; Zhang and Hung 2010; Zhao 2010; Rispoli 2007; Higham 2002a). There are increasing interpretations that posit multiple movements over a period of time that suggest selective traits were adopted in a transition to agriculture (Zhang and Hung 2010). Rispoli (2007) indicates that single traits were selected or rejected as material culture moved from the Yangtze into southern and southeastern China, and then into mainland Southeast Asia. Fuller (2011) hypothesises that distinct waves with taro and rice-millet cultigens occurred at different times and may have overlaid former routes.

By the time cultivation and the domestic animal reached southern Vietnam, however, there is evidence of a collective package that was associated with neolithic occupation. This rapid adoption of a developed neolithic culture was probably well established in mainland Southeast Asia (Zhang and Hung 2010). An Sơn was previously unoccupied before the neolithic and the initial occupation was marked by ceramics and polished, ground stone tools. Evidence for rice and domestic pig and dog appears soon after. The onset of this widespread neolithic culture in southern Vietnam led to regionalisation and innovation at a local level almost immediately after settlement. In addition, previous links evidenced by ceramic forms and decoration were retained. Long-lasting traditions for ceramic manufacture, observed all over mainland Southeast Asia, were maintained as new ones were established at a local and regional level.

The research of neolithic Southeast Asia presented in this monograph illustrates incidences of consistency and discontinuity in human interaction across the neolithic landscape:

1. Local innovations at An Sơn separate the identity of the community from other groups within southern Vietnam.
2. The sites in southern Vietnam exhibit a lineage that connects them to the sites of coastal central Thailand and Cambodia.
3. A more distant, perhaps ancestral, relationship is evident between southern Vietnam and the sites of northeast Thailand. However, there are also a number of traditions that never reached southern Vietnam.
4. There is no clear relationship between the sites of southern Vietnam and northern Vietnam, whereby each region displays distinct ceramic traditions.
5. Components of both of these northern and southern traditions were only evident in northeast and inland central Thailand and northern Cambodia.

The distributions of material culture and elements of ceramic traditions indicate events of diffusion and lineages based on geographical proximity. Within each geographic area, material culture was utilised as a tool for displaying differentiations between social groups and identities, as shown in the comparisons between An Sơn and other sites in southern Vietnam. The potters at An Sơn actively maintained ceramic traditions that connected southern Vietnam with the wider neolithic expression, whilst also investing in new traditions that exhibited a local material identity. The diversification that followed in the later occupation indicates that increased regionalisation occurred within southern Vietnam. At that time there were developments in local ceramic manufacture as potters expanded their repertoire, incurring differentiation from other groups in the region.

11

Conclusions

This chapter concludes the monograph with a summary of the results and discussion concerning ceramic production at An Sơn, the identity of potters at An Sơn, and the use of ceramics in establishing identity as a result of the introduction and development of neolithic occupation in southern Vietnam.

Summary of monograph

This monograph has introduced the site of An Sơn in light of recent excavations and within the context of neolithic Southeast Asia. The analytical components of this monograph involved a categorisation and characterisation of the ceramic assemblage. This was extended in Chapter 5 to a study of form and decoration, in order to uncover the temporal sequence and spatial distribution of the ceramics at An Sơn.

The initial settlement at An Sơn was marked by a dominance of class A2 and B ceramic forms. After this initial occupation, class A1 forms became more common than the A2 forms, and the B1b forms were replaced by B1a forms. The wavy rimmed class D1 forms were not present at initial occupation but appeared soon after, and a transition from D1a to the serrated rimmed D2a form occurred during the mid to late part of the sequence. Diversification in rim and vessel forms in all classes increased during in the middle of the occupation, as did the range of decorations on the A2a vessels. The earliest modes of decoration and surface treatment included coarse cordmarking and coarse punctate stamping. Red paint, roulette stamping and a greater variety of incised motifs appeared after the initial occupation at An Sơn.

The 2009 excavation exposed two distinct areas where ceramics were discarded. Trench 1 consisted of layers of deposits with both utilitarian and ritualistic vessels, as well as evidence of reworking stone tools. Trench 2 revealed ceramic forms that were associated with cooking activities, specifically class E *cà ràng* stove vessels. Vessels for mortuary ritual were identified within burials in both trenches.

The subsequent analysis in Chapter 6 involved characterising the An Sơn ceramic fabrics, both tempers and clays, over time and in relation to other sites in Southeast Asia. The fabric analysis revealed a close correlation between temper, clay and vessel form. The fibre-tempered sherds were frequently made with clay matrix compositional group CPCRU 1. The predominantly sand or mixed sand and fibre-tempered sherds were made with clay group CPCRU 2. Forms A2a, B1a, C1b and D were frequently manufactured with the same temper and clay for each form. The ceramics from An Sơn had a similar clay composition to many other sites in southern Vietnam, particularly Lộc Giang and Đình Ông along the Vàm Cỏ Đông River, suggesting that the potters of these sites selected clays from similar environmental settings.

Closer examination of the manufacture of ceramic forms was investigated with the analysis of standardisation undertaken in Chapter 7. While this study did not produce unequivocal results, some dimensional variables exhibited standardised results for forms A2a, B1a, C1b and D1a. There were no definitive examples of overall standardised production of any particular vessel form, but certain variables, specifically the angle of the rim, and temper and clay choice, exhibited some degree of standardisation in order to comply with required shapes and functions.

The results of the analytical procedures discussed in Chapters 5 to 7 were utilised for the comparative analyses in Chapters 8 and 9 between neolithic sites in southern Vietnam, and then between other neolithic sites in mainland Southeast Asia. Within southern Vietnam, two distinct ceramic manufacturing cultures were identified. An Sơn corresponded more closely with the other sites along the Vàm Cỏ Đông River, while the sites along the Đồng Nai River correlated more with each other than with the Vàm Cỏ Đông sites. Nevertheless, some communication was evident between the two regions during certain periods of the neolithic occupation. The comparative research indicated that An Sơn exhibited evidence of a long-lasting and widespread neolithic tradition, and that this extended to other sites in southern Vietnam. Further similarities were identified between An Sơn and neolithic sites of Cambodia, central and coastal Thailand and northeast Thailand. However, actual interaction across the whole region was clearly limited, and southern Vietnam was more likely exposed to the greatest degree of direct contact only to as far as southeastern Cambodia.

As discussed in Chapter 10, the ceramic assemblage at An Sơn exhibited both a continuity in the temporal sequence of forms and also an existence of temporal markers. The latter included the major changes in class D vessels, from wavy to serrated rimmed vessels, and minor modifications in the A2a and E forms. The multifunctional roles of some vessel forms, in particular form A2a, were in contrast to vessels that appear to have had singular roles, for instance class D vessels as mortuary offerings and the class E *cà ràng* for cooking. The high level of standardisation in class D vessels is suggestive of control in the teaching and manufacture of these vessels for mortuary ritual. All such vessels for contemporaneous burials may have been made at one time by a single potter. In keeping with past traditions and formulating a mode of transmission for learning, mental templates were in place for the manufacture of certain vessel forms. Recipes and steps, or a *chaîne opératoire*, were followed, either in instruction or from memory, to ensure consistency in manufacture, but not total organised standardisation, in order to retain traditions and to produce items that fulfilled the required functions.

The major themes of this monograph, the organisation of ceramic manufacture and the role of potters at An Sơn, and the comparison of An Sơn with other sites in the region and indicators of cultural identity, were also addressed in Chapter 10. These concepts are reviewed in the conclusions of the following sections of this chapter.

Potters at An Sơn: The relationship between craft and food production

The initial settlement of An Sơn *c.* 2500–2000 cal. BC, was marked by an arrival potters with a repertoire of ceramic vessel shapes and methods for manufacture that was closely related to contemporary traditions in Cambodia and central and northeast Thailand. The connections were fewer with regions to the north, such as northern Vietnam and southeastern China. This repertoire included sand-tempered ceramics, with the forms A2a and B1b. The initial assemblage was expanded soon after settlement with the introduction of fibre-tempered wares and an increase in the variety of forms. The appearance of rice chaff temper after the initial settlement can probably be attributed to a delay between initial settlement in a resource-rich riverine environment and an eventual focus on rice as the major subsistence cereal. It is likely that the inhabitants of An Sơn arrived with a knowledge of rice cultivation and rice chaff tempering, and fibre tempering was employed as soon as the chaff resource was locally available, certainly according to the phytolith record obtained from the site by Tetsuro Udatsu. The wavy rimmed class D1 vessels also appeared soon after the initial settlement at the same time as fibre tempering appeared, and were invented as a ritualistic mortuary offering that was unique to the An Sơn settlement. The ceramic templates for the most frequently manufactured forms at An Sơn were established in order to recall widespread traditions for manufacture prior to settlement, and also to develop local innovations.

Environmental studies in Southeast Asia have indicated that the neolithic inhabitants were involved in a varied subsistence economy, not just one that relied upon rice agriculture. Rice cultivation is now acknowledged to have been just one activity in a shifting agricultural economy, accompanied by horticulture, hunting, arboriculture and animal husbandry (Dega 2002: 37). The economy at An Sơn prioritised the production of plants, inclusive of rice (and possibly millet, which has been preliminarily been identified at Rạch Núi but not at An Sơn) for subsistence. The by-products of the cultivation activities were utilised as temper in ceramic production, and were probably also used as a catalyst in the firing of ceramics and in heating ceramics during cooking.

An Sơn individuals were most likely involved in multiple occupations, inclusive of subsistence procurement, which included cultivation, keeping animals, and hunting and gathering, and ceramic manufacture. Like ceramic production itself, subsistence tasks also would have required additional assistance from those who were not occupied full-time in other activities, such as children and spouses, and even household-based potters.

Initial interactions at An Sơn: The neolithic spread in mainland Southeast Asia

Discussions about the timing and mechanisms of the introduction of cultivation and neolithic events in Southeast Asian research have been referred to many times in this monograph. Regardless of the actual date and route for the initial neolithic occupation of southern Vietnam, there is evidence that the sites of this region belonged to a major tradition that appears to have followed the Mekong River and its major tributaries. This is suggestive of interactions and movements of neolithic peoples from Cambodia and northeast Thailand into southern Vietnam, and also across land and/or coastlines from central Thailand, through Cambodia, to southern Vietnam. Conversely, distinct traditions were exhibited by the sites of northern Vietnam and southern Vietnam. However, remnants of the ceramic traditions in northern Vietnam were evident in central and northeast Thailand, and it appears that some of these never reached southern Vietnam.

This ceramic evidence is consistent with hypotheses that propose riverine as opposed to coastal origins for Austroasiatic speakers, who travelled up and down the Mekong (Sidwell and Blench 2011). This led to the appearance of a similar neolithic expression, inclusive of the incised and impressed decoration on ceramics, alongside rivers in mainland Southeast Asia (Rispoli 2007; Bellwood 2005: 131–134; Higham 2004c). While there is archaeobotanical evidence for the dispersal of rice cultivation along coastal lowlands and coastlines in Southeast Asia (Fuller *et al.* 2011; Fuller *et al.* 2010), there is currently a lack of ceramic evidence to support this. However, the multiple waves of cultigens that have been hypothesised to have come into Southeast Asia (Fuller 2011) may affect an interpretation of any direct correspondence between rice and ceramic origins.

The complexity of the neolithic landscape in mainland Southeast Asia, as seen from the analysis of material culture, highlights the likelihood of multiple pathways that enabled the transfer of cultural attributes, with only some leading to southern Vietnam. At the conclusion of this monograph, it is only possible to summarise the major ones that incorporated An Sơn:

- rice (and possibly other plant cultigens), and domesticated pig and dog;
- unshouldered and shouldered ground and polished stone adze production;

- bone and ivory artefact production;
- sand and fibre tempering for ceramic production;
- a few specific ceramic forms like carinated and concave rimmed vessels, but vessel forms in general varied significantly between sites and regions;
- roulette stamping, geometric and curvilinear incision as modes of ceramic decoration.

At An Sơn, the introductions of cultigens, domestic animals and neolithic assemblages of lithics and ceramics occurred together at the initiation of the settlement.

Ongoing interactions at An Sơn: Establishing identity within southern Vietnam

The level of contact with regions further afield in Southeast Asia lessened after the initial neolithic settlement at An Sơn. However, there is evidence of continuing communication between An Sơn and other sites in southeastern Cambodia and southern Vietnam, both in terms of shared material culture and items that could be used to distinguish groups from each other for identity purposes. For instance, southern Vietnam and southeastern Cambodia (e.g. Krek) shared a presence of both shouldered and unshouldered rectangular-sectioned lithic adzes and concave rimmed independent restricted vessels, in contrast to other regions of Southeast Asia, where shouldered adzes and concave rimmed vessels were rare. An Sơn also revealed a lack of the curvilinear red painting and 'S'-shaped incision more typical of sites in northeast and central Thailand, and conversely a preference for roulette stamping in a band, or curvilinear and geometric incision, as decorative modes on ceramic vessels.

Within southern Vietnam, the sites examined in this monograph exhibited two major ceramic cultures during the neolithic occupation. Each consisted of characteristic vessel forms, decorative modes and technological elements, while also sharing other ceramic and material cultural variables. The two areas were distributed around the Vàm Cỏ Đông River and the Đồng Nai River. The sites associated with An Sơn along the Vàm Cỏ Đông River shared numerous vessel forms, parallels in ceramic decorations and manufacturing technologies. The sites along the Đồng Nai River shared other ceramic vessels forms that have been treated as variants of specific forms at An Sơn, as well as a regional tendency to add a ridge/appliqué at the shoulder of vessels, and to use calcareous tempers and clay anvils in ceramic manufacture.

Exchange of ceramic vessels appears to have occurred during the neolithic, but was not constant, and some sites may have been culturally isolated due to a lack of geographic proximity or other social and cultural inhibitors. Rạch Núi is one site with some fairly rare and perhaps imported sand-tempered ceramics from the Đồng Nai River region, but little evidence for any actual production of these vessels on site. Local production at Rạch Núi primarily focused on shell tempered utilitarian vessels. This can be seen as indicative of intermittent cultural isolation. The lack of a ceramic local signature at Rạch Núi, as expressed for instance in the class D vessels at An Sơn, also suggests a relative isolation. There was no need to establish identity at Rạch Núi through ceramic material culture since frequent contact with other groups probably did not occur. The turtle shell adzes at Rạch Núi probably reflected isolation and limited access to stone resources and/or lithic tools. While not a functional replacement for stone, the turtle shell adzes were alternative tools that were probably used in a different way to stone adzes such as for scraping.

The evidence for sharing of cultural material and interaction at An Sơn was primarily along the Vàm Cỏ Đông River. However, interaction certainly existed at times beyond this region, especially to the Đồng Nai River for hard stone resources. Local innovations appeared soon after the initial occupation at An Sơn, suggesting that there was a growing need to distinguish cultural identity there, as groups emerged within the landscape of southern Vietnam. The An Sơn inhabitants invented the unique vessel form, class D, which persisted as a material marker of identity throughout the occupation. The transition from a wavy to serrated rim on these vessels is just one of the factors that indicate increasing regional diversification in the later period of the neolithic within southern Vietnam.

Future directions and concluding remarks

The methods introduced in this monograph have illustrated one way in which to approach comparative studies in Southeast Asia. Future research at sites in this region that employ comprehensive analysis of ceramics, inclusive of form, decoration and fabrics, and provide illustrations of the data, will offer usable information with which to expand on the comparative research presented here. This applies to all of Southeast Asia, but it is vital within southern Vietnam that excavations continue with thorough post-excavation analysis and reporting. The results from An Sơn and Rạch Núi offer examples of the differences that can develop between sites in terms of cultural interaction and isolation, highlighting the complex nature of neolithic occupation within southern Vietnam.

This monograph has expanded research on the neolithic occupation of Southeast Asia by analysing the ceramic assemblage excavated in 2009 from An Sơn. The excavated ceramics were analysed according to form, decoration and fabric over time and space to reveal evidence of the sequence and function of vessel forms. A separate analysis of standardisation of specific rim forms revealed the existence of mental templates, which were most likely evidence of a mode of cultural transmission for teaching ceramic manufacture, rather than of any specialised or standardised organisation of production.

The ceramic assemblage demonstrated ancestral links to the neolithic ceramic expression in Southeast Asia that spread along major river tributaries. After the initial occupation at An Sơn, evidence of an expanded ceramic vessel repertoire suggests that the development of local ceramic traditions and inter-site communication within wider southern Vietnam both influenced innovation. Within each geographical area of Southeast Asia, the excavated material culture displayed differentiations between interacting social groups and identities. Local innovations at An Sơn separated the identity of this community from other groups within southern Vietnam. Analyses from the ceramic assemblage of the final occupation at An Sơn suggest that emerging identities associated with ceramic material culture during the neolithic occupation appeared to diversify as potters reworked vessel forms in order to accommodate regionalisation. The potters were active participants in the settlement of An Sơn. By retaining certain associations with neolithic groups elsewhere in mainland Southeast Asia, the potters had a continuing role in the development of ceramic material culture that distinguished An Sơn from other groups within southern Vietnam.

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Appendix A

Summary of Ceramic Samples in Fabric Analysis

Table A.1. An Sơn 2009 Trench 1: C1 ceramic samples.

Identification number in statistical analyses	Sample	Portion/rim form	Surface treatment	Munsell:exterior surface	Munsell: interior fabric	Temper group: descriptions in Table 6.6
1	09AS-H1-C1-L1-S1-1	A2a	brown burnish	5YR 1/2	2.5YR 7/4	A1-5
2	09AS-H1-C1-L1-S1-2	C1b	none	7.5YR 7/8	10BG 1/2	B/C-1
3	09AS-H1-C1-L1-S2-1	body	roulette, burnish	7.5Y 2/2	10BG 1/2	A1-1
4	09AS-H1-C1-L1-S2-2	A1a	none	5YR 7/8	5B 1/2	B-1
5	09AS-H1-C1-L5-S3-1	rim	burnish	5YR 4/6	7.5Y 2/2	A1-1
6	09AS-H1-C1-L5-S3-2	body	none	2.5YR 7/10	10BG 1/2	B/C-2
7	09AS-H1-C1-L5-S3-3	body	roulette, burnish	10YR 2/2	5GY 1/2	A1-1
8	09AS-H1-C1-L5/6-S4-1	A2a	brown burnish	5YR 2/4	10BG 1/2	A1-5
9	09AS-H1-C1-L5/6-S4-2	A1a	none	2.5YR 6/12	10BG 1/2	B-1
10	09AS-H1-C1-L5/6-S4-3	body	roulette, burnish	2.5YR 3/6	10YR 7/4	A1-1
11	09AS-H1-C1-L5/6-S5-1	C2b	none	5GY 1/2	2.5YR 7/6	A1-1
12	09AS-H1-C1-L5/6-S5-2	A1a	none	10YR 7/6	10BG 1/2	B-1
13	09AS-H1-C1-L5/6-S5-3	body	impressions	2.5YR 5/8	2.5YR 7/10	A1-6
14	09AS-H1-C1-L5/6-S5-4	body	impressions	10YR 2/2	2.5YR 7/10	A2-1 (OG)
15	09AS-H1-C1-L5/6-S5-5	body	cord-marking	2.5YR 6/10	5B 1/2	B/D-1
16	09AS-H1-C1-L5/6-S5-6	body	cord-marking	2.5Y 1/2	2.5Y 1/2	D-1
17	09AS-H1-C1-L5/6-S5-7	body	cord-marking	7.5GY 1/2	2.5YR 7/6	A1-5
18	09AS-H1-C1-L5/6-S6-1	body	paddle linear impressions, horizontal lines over top	2.5YR 7/8	2.5YR 8/4	A1/B-3
19	09AS-H1-C1-L5/6-S6-2	A1a	none	10R 6/14	10BG 1/2	B-2
20	09AS-H1-C1-L5/6-S7-1	body	burnish	2.5YR 3/8	5YR 8/4	A1-1
21	09AS-H1-C1-L5/6-S7-2	A1a	none	2.5YR 5/10	10BG 1/2	B-1

Identification number in statistical analyses	Sample	Portion/rim form	Surface treatment	Munsell:exterior surface	Munsell: interior fabric	Temper group: descriptions in Table 6.6
22	09AS-H1-C1-L5/6-S7-3	body	none	2.5YR 2/6	5YR 7/6	A2-3
23	09AS-H1-C1-L5/6-S8-1	body	roulette, burnish	10B 1/2	7.5GY 1/2	A1/B-1
24	09AS-H1-C1-L5/6-S8-2	C1b	none	7.5YR 7/6	10BG 1/2	B/C-2
25	09AS-H1-C1-L5/6-S9-1	A2a	burnish	2.5YR 5/8	5YR 8/4	A1-1
26	09AS-H1-C1-L5/6-S9-2	C1b	none	10BG 1/2	10BG 1/2	B-1
27	09AS-H1-C1-L5/6-S9-3	D1a	paddle linear impressions	2.5YR 7/10	2.5YR 2/2	A1/A3-2
28	09AS-H1-C1-L7-S10-1	A2a	burnish	2.5YR 4/8	10YR 2/2	A1-1
29	09AS-H1-C1-L7-S10-2	C1b	none	5YR 8/6	10BG 1/2	B/C-3
30	09AS-H1-C1-L7-S10-3	D1b	paddle linear impressions	10BG 1/2	5GY 1/2	A2-2
31	09AS-H1-C1-L7-S10-4	D1b	paddle linear impressions	10BG 1/2	2.5YR 7/8	A1-5
32	09AS-H1-C1-L7-S11-1	body	none	5YR 7/8	5B 2/2	A1/B-2
33	09AS-H1-C1-L7-S11-2	foot rim?/A1b	coarse cord-marking	5YR 2/4	7.5YR 7/4	A2-2
34	09AS-H1-C1-L7-S11-3	body	paddle linear impressions	7.5YR 5/6	7.5YR 5/6	A1-1
35	09AS-H1-C1-L7-S11-4	D1a	paddle linear impressions	5GY 1/2	5GY 1/2	A2-1
36	09AS-H1-C1-L8-S12-1	B1a	paddle linear impressions	7.5YR 7/4	2.5B 1/2	A1/B-2
37	09AS-H1-C1-L8-S12-2	A2a	none	5YR 7/8	10B 8/2	A1-2
38	09AS-H1-C1-L8-S12-3	body	paddle linear impressions	2.5YR 7/10	10BG 1/2	A1-1
39	09AS-H1-C1-L8-S12-4	body	paddle linear impressions	7.5YR 7/6	7.5YR 7/4	A1-1
40	09AS-H1-C1-L8-S12-5	D1a	paddle linear impressions	2.5YR 7/6	5YR 8/6	A1-1

Source: Compiled by C. Sarjeant.

Table A.2. Other An Sơn ceramic samples

Identification number in statistical analyses	Sample	Portion/rim form	Surface treatment	Munsell:exterior surface	Munsell: interior fabric	Temper group: descriptions in Table 6.6
41	09AS-H1-C4-L3-S10-1	D2a	none	5YR 7/8	2.5YR 7/6	A1-5
42	09AS-H1-C5-L2-S3-1	body	impressions	7.5YR 7/8	10BG 1/2	B-1
43	09AS-H1-C10-L2-S3-Oc Eo type-1	body	none	2.5YR 8/2	10BG 1/2	E-1
44	09AS-H1-C10-L8-S10-1	D2a	none	5YR 5/8	5YR 7/6	A1-4
45	09AS-H1-B2-L5/6-S8-1	C3a	burnish, rim impression	SGY 1/2	10YR 4/2	A1-1
46	09AS-H1-B2-L5/6-S8-2	pedestal stem	burnish, roulette fine, horizontal incisions	2.5YR 2/8	2.5Y 5/2	B/A3-1
47	09AS-TS-200-210cm-1	A2b	none	2.5Y 7/6	2.5Y 1/2	A1/B/C-1
48	09AS-TS-240-250cm-1	B1a	cord-marking	5YR 7/6	10BG 1/2	B-1
49	09AS-TS-240-250cm-2	B1a	cord-marking	5YR 8/4	10BG 1/2	A1-8
50	09AS-TS-240-250cm-3	D1a	paddle linear impressions	10BG 1/2	10BG 1/2	A1-1
51	09AS-TS-240-250cm-3b	D1a	paddle linear impressions	10BG 1/2	10BG 1/2	A1-5
52	09AS-TS-240-250cm-4	robust foot rim	none	10BG 1/2	10BG 1/2	B-6
53	09AS-TS-250-260cm-1	robust foot rim	none	2.5Y 7/4	10YR 2/2	B-1
54	09AS-TS-250-260cm-2	D1b	paddle linear impressions	10BG 1/2	10BG 6/2	A2-2
55	97AS-H1-A1-350-360cm-S3-4-1	foot rim	none	5YR 5/8	7.5Y 2/2	B-6
56	97AS-H1-B2-350-360cm-S3-4-1	B1a	cord-marking	2.5YR 6/4	7.5Y 2/2	A1/B-2
57	97AS-H1-350-360cm-S3-4-1	B1a	cord-marking	10R 6/14	2.5B 1/2	B-2 (BG)
58	97AS-H1-360-410cm-S3-5-1	neck	none	10R 4/10	SYR 1/2	A1-1
59	97AS-H1-360-410cm-S3-5-2	B1b	paddle linear impressions	7.5YR 6/6	7.5YR 6/6	A1-1
60	09AS-U/S-1	A2a	burnish	5YR 2/4	SGY 1/2	B-4 (BG)
61	09AS-U/S-2	A2a	burnish	5YR 2/4	SGY 1/2	B-4 (BG)

Source: Compiled by C. Sarjeant.

Table A.3. Clay samples

Identification number in statistical analyses	Sample	Munsell
62	09AS-H2-B2-L3-3(30-40 cm)-fired clay-1	7.5YR 8/4
63	09AS-H2-D4-L3-4-fired clay-1	5YR 7/4
64	09AS-fired clay lump-1	5YR 6/6
65	09AS-TS-240-250 cm-fired clay-1	10YR 8/3
66	09AS-TS-240-250 cm-fired clay-2	10YR 8/6
67	09AS-TS-240-250 cm-fired clay-3	10YR 8/1
68	09-Vam Co Dong side channel-unfired clay-1	10YR 7/6
69	09-Vam Co Dong side channel-unfired clay-2	10YR 5/8
70	09AS-1.5m in borrow pit-unfired clay-1	10YR 8/3

Source: Compiled by C. Sarjeant.

Table A.4. Non-local ceramic samples. Key: BNW = Ban Non Wat, CCN = Cồn Cổ Ngựa, CLR = Cù Lao Rùa, DB = Đa Bút, DO = Đình Ông, GCV = Giồng Cá Vồ, HD = Hòa Diêm, LG = Lộc Giang, MB = Mán Bạc.

Identification number in statistical analyses	Sample	Portion/rim form	Surface treatment	Munsell:exterior surface	Munsell: interior fabric	Temper group: descriptions in Table 6.6
71	CCN-1-surface	body	coarse cord-marking	10R 5/12	10R 5/12	A1/A3-1
72	CLR-1-surface	C2b	none	2.5YR 7/8	5GY 1/2	A1/A3-2
73	CLR-2-surface	foot rim	horizontal incisions	7.5YR 7/8	5Y 2/2	A1-6
74	CLR-3-surface	foot rim	none	10R 5/12	10BG 1/2	A1-4
75	CLR-4-surface	ridged body	none	5YR 7/8	10BG 1/2	A1/A3-3
76	DB-1-surface	body	coarse cord-marking	7.5YR 1/2	10R 4/12	A1/A3-1
77	DO-1-surface	neck	corded paddle impression	7.5YR 8/6	10BG 1/2	B-4
78	DO-2-surface	body	paddle linear impressions	5YR 1/2	2.5YR 3/8	A1-6
79	DO-3-surface	body	roulette, brown burnish	5GY 1/2	5GY 1/2	A1-3
80	DO-4-surface	A2a	brown burnish	5YR 1/2	5GY 1/2	A1-5 (OG)
81	GCV-1-surface	body	paddle linear impressions	2.5YR 5/10	10R 7/10	A1/A3-2
82	GCV-2-surface	body	coarse vertical and horizontal incisions	5YR 8/6	10B 1/2	B-1
83	GCV-3-surface	body	none	10R 6/14	10B 1/2	B-1
84	HD-1-surface	concave/vessel unknown	none	5Y 2/2	5Y 1/2	A1-6
85	LG-1-surface	body	paddle linear impressions	10YR 7/6	10YR 8/4	A1-1
86	LG-2-surface	robust foot rim?	none	2.5YR 5/10	5YR 8/6	B-3 (OG)
87	LG-3-surface	A1i	none	2.5YR 6/10	2.5YR 7/4	A1-7 (OG)
88	MB-1-surface	foot rim	none	10R 6/14	10BG 1/2	E-2
89	MB-2-surface	impressed anvil	impressed with knot/ roulette?	2.5YR 5/10	2.5YR 5/10	A1/A3-1

Identification number in statistical analyses	Sample	Portion/rim form	Surface treatment	Munsell:exterior surface	Munsell: interior fabric	Temper group: descriptions in Table 6.6
90	MB-3-surface	A2c variant	none	2.5YR 3/6	2.5Y 2/2	A1/A3-4
91	08/09BNW-N100-9:surface2-feature1 -1	body	cord-marking	10YR 8/4	SGY 1/2	B-5

Source: Compiled by C. Sarjeant.

Appendix B

Presence and Absence of Variables for Correspondence Analysis: Southern Vietnam Sites

Table B.1. Key: BD = Bình Đa, CLR = Cù Lao Rùa, DK = Đa Kai, LG = Lộc Giang, Variable present = 1, Variable absent = 0.

Variables	CA Code	An Sơn early occupation	An Sơn middle occupation	An Sơn late occupation	Bến Đò	Bình Đa	Cái Vạn	Cầu Sắt	Cù Lao Rùa	Đa Kai	Đình Ông	Lộc Giang	Rạch Lá	Rạch Núi	Suối Linh
An Sơn rim forms															
A1a	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
A1b	2	1	1	1	1	1	0	0	1	1	0	1	0	0	1
A1c	3	1	1	1	0	1	1	0	1	1	0	1	0	0	0
A1d	4	0	1	1	0	0	0	0	0	1	0	1	0	1	0
A1e	5	1	1	1	0	1	1	0	0	0	0	0	0	0	0
A1f	6	1	1	1	1	0	1	0	0	0	0	0	0	0	0
A1g	7	1	1	1	1	1	1	0	1	1	0	0	1	1	1
A1h	8	1	1	1	1	0	1	0	0	0	0	0	0	0	1
A1i	9	0	1	1	0	0	1	0	0	0	0	1	0	0	0
A1i-r	10	0	1	1	0	0	0	0	0	0	0	0	0	0	0
A1 with pedestal/foot rim	11	0	0	1	0	0	0	0	1	0	0	0	0	0	0
A2a	12	1	1	1	1	1	1	0	1	1	1	1	1	0	1
A2b	13	1	1	1	1	1	1	0	1	0	0	1	0	1	1
A2c	14	1	1	1	0	1	1	0	1	1	0	1	0	0	1
A2 with pedestal/foot rim	15	0	0	1	1	0	0	0	1	0	0	0	0	0	0
B1a	16	1	1	0	0	0	1	0	0	0	0	0	1	1	0
B1b	17	1	0	0	0	1	0	0	1	1	0	0	0	0	0
B2a	18	1	1	0	1	0	0	0	1	0	0	0	0	0	0
B3a	19	0	1	1	0	0	0	0	0	0	0	0	0	0	0
C1a	20	1	1	1	0	1	1	1	1	1	1	1	1	1	1
C1b	21	0	1	1	1	0	1	0	1	1	0	1	0	0	0
C1 with pedestal/foot rim	22	0	1	1	0	1	1	1	1	1	1	1	0	1	1
C2a	23	0	1	1	0	0	0	0	1	0	0	0	0	0	0
C2b	24	0	1	1	1	1	1	0	1	1	0	1	0	1	1
C2 with pedestal/foot rim	25	0	0	0	0	0	0	0	0	1	0	0	0	0	0
C3a	26	1	1	1	1	0	1	0	1	1	0	1	0	0	0
C3 with pedestal/foot rim	27	0	0	0	0	0	0	0	1	0	0	0	0	0	0
D1a	28	1	1	0	0	0	0	0	0	0	0	0	0	0	0
D1b	29	1	1	0	0	0	0	0	0	0	0	1	0	0	0
D2a	30	0	1	1	0	0	0	0	0	0	0	0		0	0
E1a	31	1	1	1	0	1	1	0	0	0	0	0	1	1	0
E2a square	32	0	1	1	0	1	0	0	0	0	0	1	0	1	0
E2b rounded	33	0	1	1	1	0	0	0	1	0	0	0	0	1	0

Table B.2. Key: BD = Bình Đa, CLR = Cù Lao Rùa, DK = Đa Kai, LG = Lộc Giang, Variable present = 1,Variable absent = 0.

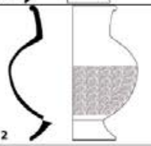
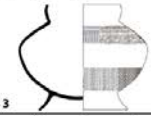
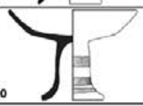
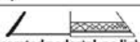
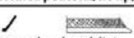
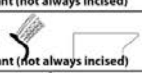
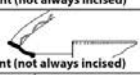
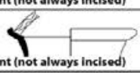
Variables	CA Code	An Sơn early occupation	An Sơn middle occupation	An Sơn late occupation	Bến Đò	Bình Đa	Cái Vạn	Cầu Sắt	Cù Lao Rùa	Đa Kai	Đình Ông	Lộc Giang	Rạch Lá	Rạch Núi	Suối Linh
Complete vessels															
 AS 1	34	0	1	0	0	0	0	1	1	0	0	0	0	0	1
 AS 2	35	0	0	1	0	0	0	0	0	0	0	0	0	0	0
 AS 3	36	0	0	1	0	0	0	0	0	0	0	0	0	0	0
 AS 4	37	0	1	0	0	0	0	0	1	0	0	0	0	0	0
 AS 5	38	0	0	1	0	0	0	0	0	0	0	0	0	0	0
 AS 6	39	0	0	1	0	1	0	0	1	1	0	0	0	0	0
 AS 7	40	0	0	1	0	0	0	0	1	0	0	0	0	0	0
 AS 8	41	0	1	0	0	0	0	0	1	1	0	1	0	0	0
 AS 9	42	0	0	1	0	0	0	0	0	1	0	0	0	0	0
 AS 10	43	0	1	0	0	0	0	0	1	0	0	1	0	0	0
 AS 11 (stem and foot ring with incision and impression)	44	0	1	1	0	0	0	0	0	0	0	1	0	0	0
 AS 12 (decorated pedestal, no lip)	45	1	1	0	0	1	0	0	1	1	0	1	0	1	0
 AS 13 (decorated pedestal, lip)	46	0	0	1	0	0	1	0	1	1	0	0	0	0	0
Other An Sơn rim forms (1997)															
 A1a variant (not always incised)	47	0	1	1	0	1	0	0	0	1	0	1	0	0	0
 A1g variant (not always incised)	48	0	1	0	0	1	1	0	1	0	0	0	1	0	0
 A2a variant (not always incised)	49	1	1	1	0	0	0	0	1	0	0	0	0	0	0
 C2b variant (not always incised)	50	0	0	1	0	1	0	0	0	1	0	1	0	0	0

Table B.3. Key: BD = Bình Đa, CLR = Cù Lao Rùa, DK = Đa Kai, LG = Lộc Giang, Variable present = 1,Variable absent = 0.

Variables	CA Code	An Sơn early occupation	An Sơn middle occupation	An Sơn late occupation	Bến Đò	Bình Đa	Cái Vạn	Cầu Sắt	Cù Lao Rùa	Đa Kai	Đình Ông	Lộc Giang	Rạch Lá	Rạch Núi	Suối Linh
Other rim forms															
CLR A1c variant (not always incised)	51	1	1	0	0	0	0	0	1	1	0	0	0	0	0
CLR A1d variant	52	0	0	0	0	0	0	0	1	0	0	0	0	0	0
CLR A2b variant	53	0	1	0	0	0	0	0	1	1	0	0	0	1	1
CLR B2a variant	54	0	1	0	0	0	0	0	1	0	0	0	0	0	1
CLR C2b variant	55	0	1	0	0	1	1	0	1	0	0	0	0	0	0
CLR C3a variant	56	0	1	0	1	0	0	0	1	0	0	1	0	0	0
CLR 1	57	0	0	0	0	0	0	0	1	0	0	0	0	0	0
CLR 2	58	0	0	0	0	0	0	0	1	1	0	1	0	0	0
LG A1a variant	59	1	1	0	0	0	0	0	1	1	0	1	0	1	1
LG A1a variant	60	0	1	1	0	1	0	0	1	1	0	1	0	0	0
LG A1c variant	61	0	0	1	0	0	0	0	1	0	0	1	0	0	0
LG A body (commonly in association with incision but not at An Sơn)	62	0	1	0	0	1	1	0	0	1	0	1	0	1	1
LG B variant	63	0	0	0	0	0	0	0	0	0	0	1	0	1	0
LG C3a variant	64	1	1	1	1	1	1	0	0	0	0	1	1	0	0
DK A2a variant	65	1	1	0	1	1	1	0	0	1	0	0	0	0	0
DK C1a variant	66	0	1	0	0	0	0	0	0	1	0	0	0	0	0
BD A1g variant	67	0	0	0	0	1	0	0	0	0	0	0	0	1	0
BD C3a variant	68	0	1	0	0	1	0	0	0	0	0	0	0	0	0
Fabrics															
Fine fibre temper	69	0	1	1	0	0	1	0	1	1	0	1	1	1	0
Coarse fibre temper	70	0	1	1	0	1	1	0	1	0	1	1	1	1	0
Fine sand temper	71	1	1	1	0	1	1	0	1	1	1	1	1	1	1
Coarse sand temper	72	1	1	1	0	0	1	0	1	1	0	1	1	1	1
Phosphate sand	73	0	1	1	0	0	0	0	0	0	0	1	0	0	0
Lateritic sand temper	74	0	1	0	0	1	1	0	1	0	0	0	0	1	1
Calcareous temper	75	0	1	0	0	0	1	0	0	1	0	0	0	1	1
Surface treatments/decorations															
linear incision - horizontal	76	1	1	1	1	1	1	0	1	1	1	1	1	1	1
linear incision - vertical	77	1	1	1	0	0	1	0	0	0	0	0	1	0	0
linear incision - combination	78	1	1	1	0	0	1	0	1	1	0	0	0	1	1
geometric incision - square/rectangular	79	1	1	0	0	0	0	0	1	1	0	0	0	0	0
geometric incision - curvilinear	80	0	1	0	0	1	1	0	1	0	0	1	0	0	1
geometric incision - triangular/diamond	81	1	1	1	0	0	0	0	1	1	0	1	0	1	1
geometric incision - triangular with diagonal line fill	82	0	0	0	0	0	0	0	1	1	0	0	0	0	0
zigzag incision	83	1	1	0	0	1	1	0	1	1	0	1	0	0	0
zigzag incision over linear paddle impressions	84	1	0	0	0	0	0	0	0	0	0	0	0	0	0
criss-cross incision	85	1	1	1	0	1	0	0	1	1	0	0	0	1	0
wavy incision	86	1	1	0	0	1	1	0	1	1	0	1	0	0	1
wavy incision over linear paddle impressions	87	1	1	1	1	1	1	0	1	1	1	1	0	1	1
red paint	88	1	1	1	0	1	0	0	1	1	0	1	0	1	0
burnishing	89	1	1	1	0	1	1	0	1	1	1	1	0	1	1
coarse cordmarking	90	1	1	0	0	0	1	0	0	0	0	1	0	1	0
cordmarking	91	1	1	1	1	1	1	0	1	1	1	1	1	1	1
linear paddle impressions	92	1	1	1	1	1	1	0	1	1	1	1	1	1	1
concentric circle incision	93	0	1	0	0	1	1	0	0	0	0	1	0	0	1
concentric circle incision over linear paddle impressions	94	1	1	0	0	0	0	0	0	0	0	0	0	0	0
roulette stamp in band with horizontal incision outline - zigzag pattern	95	0	1	1	1	0	1	0	1	1	1	1	0	0	0
roulette stamp in band with horizontal incision outline - general fill	96	1	1	1	0	1	1	0	0	1	1	1	0	1	1
roulette stamp in geometric section divided with linear incisions - general fill	97	1	1	1	0	1	0	0	1	1	1	1	0	0	1
coarse punctate stamp in geometric section divided with linear incisions	98	1	1	0	0	0	1	0	1	0	0	0	0	0	0
punctate stamp in band with horizontal incision outline	99	0	0	0	0	0	1	0	0	0	0	0	0	1	1
white lime infill	100	0	1	1	0	1	0	0	0	1	0	0	0	1	0
appliqué or ridge	101	1	1	0	0	1	1	1	0	1	0	1	1	1	1
appliqué or ridge with vertical incisions over top	102	0	1	0	0	0	0	0	0	0	0	0	0	0	0
spiral wave incision	103	1	0	0	0	0	0	0	1	1	0	1	0	0	1
spiral wave incision over linear paddle impressions	104	0	0	0	0	0	0	0	1	0	0	0	0	1	0

Table B.4. Key: BD = Bình Đa, CLR = Cù Lao Rùa, DK = Đa Kai, LG = Lộc Giang, Variable present = 1,Variable absent = 0.

Variables	CA Code	An Sơn early occupation	An Sơn middle occupation	An Sơn late occupation	Bến Đò	Bình Đa	Cái Vạn	Cầu Sắt	Cù Lao Rùa	Đa Kai	Đình Ông	Lộc Giang	Rạch Lá	Rạch Núi	Suối Linh
Placement of decorations															
at lip	105	1	0	0	1	1	0	0	0	0	0	1	0	0	0
external rim	106	0	1	0	0	0	0	0	1	0	0	0	0	0	0
internal rim	107	1	1	1	0	1	1	0	1	1	0	1	0	0	1
shoulder	108	1	1	1	1	1	1	1	0	1	1	1	0	1	1
body	109	1	1	1	1	1	1	0	1	1	1	1	1	1	1
stem/high pedestal	110	0	1	0	0	1	1	0	1	1	0	1	0	0	0
wide foot	111	1	1	1	0	0	0	0	1	1	0	1	0	0	0
pedestal/foot ring	112	1	1	1	0	0	1	0	1	1	0	1	0	1	0
Other neolithic pre-metal artefacts															
stone unshouldered adze - rectangular or trapezoidal shape/rectangular section	113	0	1	1	1	1	0	1	1	1	0	1	0	1	1
stone shouldered adze - rectangular or trapezoidal shape/rectangular section	114	1	1	1	1	1	0	1	1	1	0	1	0	1	1
stone unshouldered adze - ovoid shape/rectangular section	115	0	0	1	0	0	0	0	0	0	0	1	0	0	0
stone shouldered adze - ovoid shape/rectangular section	116	0	1	0	0	0	0	0	1	0	0	0	0	0	0
stone unshouldered adze - triangular shape/rectangular section	117	0	1	0	0	1	0	1	0	1	0	1	0	0	1
stone shouldered adze - triangular shape/rectangular section	118	1	1	0	0	0	0	0	1	0	0	0	0	0	0
whetstone	119	1	1	1	0	1	0	1	1	1	0	1	0	1	1
polishing stone	120	0	0	1	0	0	0	0	0	1	0	0	0	1	0
hammerstones	121	0	0	1	0	1	0	1	1	1	0	0	0	0	1
stone bangle	122	1	0	0	1	0	0	0	1	1	0	0	0	0	1
stone arrowhead	123	0	0	1	0	0	0	0	0	0	0	0	0	0	1
lithophone	124	0	0	1	0	1	0	0	0	1	0	1	0	0	0
bifacial flaked stone tool	125	0	1	0	0	0	0	0	1	1	0	0	0	0	0
preform	126	1	0	1	0	1	0	0	1	1	0	0	0	0	1
stone tools are well-worn/reworked	127	1	1	1	1	0	0	0	1	1	0	1	0	1	0
ceramic roundel	128	0	1	1	0	1	1	0	1	1	0	1	0	1	1
clay pellet	129	0	1	1	1	1	1	0	1	1	0	1	1	1	1
clay anvil	130	0	0	0	0	0	0	0	1	0	0	0	0	1	1
clay bangle	131	0	0	0	0	0	0	0	0	0	0	0	0	0	1
shell beads	132	0	1	1	0	0	0	0	0	0	0	0	0	1	0
bone/ivory bangle	133	0	0	1	0	0	0	0	0	0	0	0	0	1	0
bone fishhook	134	0	0	1	0	0	0	0	0	0	0	0	0	0	0
worked bone, e.g. awls	135	0	0	1	0	0	0	0	0	0	0	0	0	1	0

Source: Compiled by C. Sarjeant.

Appendix C

Presence and Absence of Variables for Correspondence Analysis: Southeast Asia Sites

Table C.1. Variable present = CA code, Variable absent = 0.

Note: only dominant temper groups for neolithic occupation recorded as present since most of the listed sites are present at all sites.

Variables	CA Code	An Son early occupation	An Son middle occupation	An Son late occupation	An Son burial	Ban Non Wat occupation	Ban Non Wat Neolithic burial phase 1	Ban Non Wat Neolithic burial phase 2	Ban Lum Khao Neolithic burial	Ban Lum Khao Neolithic occupation	Non Nok Tha (early phase)	Ban Chiang (early phase)	Tha Kae (layer 5 occupation)
bone awl	BOAW	0	0	0	0	0	0	0	0	0	0	0	0
bone bangle	BOBG	0	0	0	0	0	0	0	0	0	0	0	0
cattle remains	BOBO	0	0	0	0	0	0	0	0	0	BOBO	0	0
dog remains	BOCA	0	0	0	BOCA	0	0	0	0	0	BOCA	0	0
other faunal remains	BOFA	0	0	0	0	0	0	0	0	0	0	0	0
bone fishhook	BOFH	0	0	BOFH	0	0	0	0	0	0	0	0	0
fish remains	BOFI	0	0	0	0	0	BOFI	0	0	0	0	0	0
bone worked	BOOT	0	0	BOOT	0	BOOT	0	0	0	0	BOOT	0	0
bone tool/weapon point	BOPT	0	0	0	0	0	0	0	0	0	0	0	0
pig remains	BOSS	0	0	0	0	0	BOSS	BOSS	BOSS	0	BOSS	0	0
tooth pendant	BOTP	0	0	0	0	0	0	0	0	0	0	0	0
turtle/tortoise remains	BOTT	0	0	0	BOTT	0	0	0	BOTT	0	0	0	0
clay anvil	CLAV	0	0	0	0	CLAV	0	0	0	CLAV	0	0	0
clay bead	CLBD	0	0	0	0	0	0	0	0	0	0	0	0
clay bangle	CLBG	0	0	0	0	0	0	0	0	0	0	0	0
clay counter/roundel	CLCO	0	CLCO	CLCO	0	CLCO	0	0	0	0	0	0	0
clay net sinker/weight	CLNS	0	0	0	0	0	0	0	0	0	0	0	0
clay artefact	CLOT	0	0	0	0	CLOT	0	0	0	0	0	0	0
clay pellet	CLPL	0	CLPL	CLPL	CLPL	CLPL	0	0	0	CLPL	0	0	0
clay roller	CLRO	0	0	0	0	CLRO	0	0	0	0	0	CLRO	0
clay spindle whorl	CLSW	0	0	0	0	CLSW	0	0	0	0	0	0	0
appliqué and incision on top	CVAI	0	CVAI	0	0	0	CVAI	0	0	0	0	0	0
appliqué	CVAP	CVAP	CVAP	0	0	CVAP	CVAP	0	0	0	CVAP	CVAP	0
black burnished/surface	CVBB	0	0	0	0	0	CVBB	0	0	0	0	CVBB	CVBB
decoration on body	CVBO	CVBO	CVBO	CVBO	CVBO	0	CVBO	0	CVBO	0	CVBO	CVBO	CVBO
decoration on base	CVBS	0	0	0	0	0	0	0	0	0	0	0	0
combed	CVCB	0	0	0	CVCB	0	0	0	0	0	0	0	0
coarse cord-marking	CVCC	CVCC	CVCC	0	0	0	0	0	0	0	0	0	0
curvilinear incision with impressed fill	CVCI	0	CVCI	0	0	CVCI	CVCI	0	0	0	CVCI	CVCI	CVCI
cord-marking	CVCM	CVCM	CVCM	CVCM	CVCM	CVCM	CVCM	CVCM	CVCM	0	CVCM	CVCM	CVCM
ceramic vessel concave rim independent restricted	CVCO	CVCO	CVCO	CVCO	CVCO	0	0	0	0	0	0	0	0
ceramic vessel concave rim independent restricted:pedestal	CVCO:P	0	0	CVCO:P	CVCO:P	0	0	0	0	0	0	0	0
curvilinear painted	CVCP	0	0	0	0	CVCP	CVCP	0	0	0	0	0	0
curvilinear incision with painted/slipped/burnished fill	CVCS	0	0	0	0	0	CVCS	0	0	0	0	0	0
ceramic vessel direct independent restricted	CVDI	CVDI	CVDI	0	0	0	0	0	0	0	CVDI	0	0
ceramic vessel direct independent restricted:pedestal	CVDI:P	0	0	0	0	0	0	0	0	0	0	0	0
dentate stamped	CVDS	0	0	0	0	0	0	0	0	0	CVDS	CVDS	CVDS
ceramic vessel everted independent restricted	CVEI	CVEI	CVEI	CVEI	CVEI	0	CVEI	CVEI	CVEI	0	CVEI	CVEI	0
ceramic vessel everted independent restricted:carinated	CVEI:C	0	0	0	0	0	0	0	0	0	0	CVEI:C	0
ceramic vessel everted independent restricted:pedestal	CVEI:P	0	0	CVEI:P	0	0	0	0	0	0	CVEI:P	CVEI:P	0
fingernail impression	CVFI	0	0	0	0	CVFI	0	0	0	0	0	0	0
horizontal incision	CVHI	CVHI	CVHI	CVHI	CVHI	0	CVHI	0	0	0	0	CVHI	0
incision	CVIC	CVIC	CVIC	CVIC	CVIC	CVIC	CVIC	0	0	0	0	0	0
geometric eye-shaped incision with impressed or incised fill	CVIF	0	0	0	0	0	0	0	0	0	0	0	0
geometric impressed	CVIG	0	0	0	0	0	0	0	0	0	0	0	0
incised and impressed	CVII	0	0	0	0	0	CVII	0	0	0	CVII	CVII	CVII
impressed	CVIP	CVIP	CVIP	CVIP	CVIP	CVIP	CVIP	0	0	0	CVIP	CVIP	CVIP
decoration at lip	CVLP	CVLP	CVLP	CVLP	CVLP	0	0	0	0	0	0	0	0
ceramic vessel inverted independent restricted:carinated	CVNI:C	0	0	0	0	0	0	0	0	0	0	0	0
punctate stamped:circular	CVPC	CVPC	CVPC	0	0	CVPC	0	0	0	0	0	0	0
decoration on pedestal	CVPD	CVPD	CVPD	CVPD	0	0	CVPD	0	0	0	0	0	CVPD
punctate stamped:hollow circular/large circular	CVPH	0	0	0	0	CVPH	CVPH	0	0	0	0	0	0
paddle impression	CVPI	CVPI	CVPI	CVPI	CVPI	0	0	0	0	0	0	0	0
punctate stamped:quadrangular/triangular	CVPQ	0	0	0	0	CVPQ	CVPQ	0	0	0	0	0	0
geometric quadrangular incision with impressed fill	CVQI	0	0	0	CVQI	0	CVQI	0	0	0	0	0	0
geometric quadrangular incision	CVQO	CVQO	CVQO	0	0	0	0	0	0	0	0	0	0
red burnished	CVRB	CVRB	CVRB	CVRB	0	0	CVRB	0	0	0	CVRB	0	CVRB
roulette stamped:zigzag line continuous	CVRC	0	CVRC	0	0	0	0	0	0	0	0	0	0
roulette stamped:dotted linear	CVRD	CVRD	CVRD	0	CVRD	0	0	0	0	0	0	0	0
decoration on rim	CVRM	CVRM	CVRM	CVRM	0	0	CVRM	0	0	0	CVRM	0	CVRM
red painted	CVRP	CVRP	CVRP	CVRP	0	CVRP	CVRP	CVRP	0	0	0	0	CVRP
roulette stamped:square	CVRS	CVRS	CVRS	0	0	CVRS	0	0	0	0	CVRS	0	0
roulette stamped:dotted zigzag line continuous	CVRT	0	CVRT	CVRT	0	CVRT	0	0	0	0	0	0	0
roulette stamped:unspecified	CVRU	0	0	0	0	0	0	0	0	0	0	CVRU	0
roulette stamped:zigzag lines	CVRZ	0	0	0	0	CVRZ	0	0	0	0	0	0	0
decoration on pronounced shoulder	CVSD	0	CVSD	0	CVSD	0	0	0	0	0	0	0	0
decoration on shoulder	CVSH	CVSH	CVSH	CVSH	CVSH	0	CVSH	0	0	0	CVSH	CVSH	0
S'/scroll-shaped incision with impressed fill	CVSI	0	0	0	0	0	0	0	0	0	CVSI	CVSI	CVSI
red slipped	CVSL	0	0	0	0	0	0	0	0	0	CVSL	0	0
shell impressed	CVSM	0	0	0	0	0	CVSM	0	0	0	0	0	0
S'/scroll-shaped incision	CVSO	0	0	0	0	0	0	0	0	0	0	0	0
ceramic vessel simple restricted	CVSR	CVSR	CVSR	0	0	0	0	0	0	0	CVSR	0	0
ceramic vessel simple restricted:carinated	CVSR:C	0	CVSR:C	CVSR:C	CVSR:C	0	0	0	0	0	0	0	0
ceramic vessel simple restricted:pedestal	CVSR:P	0	CVSR:P	CVSR:P	CVSR:P	0	0	0	0	0	0	0	0
ceramic vessel simple unrestricted	CVSU	CVSU	CVSU	CVSU	CVSU	0	CVSU	CVSU	0	0	CVSU	0	0
ceramic vessel simple unrestricted:carinated	CVSU:C	0	CVSU:C	CVSU:C	0	0	0	0	0	0	0	0	0
ceramic vessel simple unrestricted:pedestal	CVSU:P	0	CVSU:P	CVSU:P	CVSU:P	0	CVSU:P	0	CVSU:P	0	CVSU:P	CVSU:P	CVSU:P

Source: Compiled by C. Sarjeant.

Table C.2. Variable present = CA code, Variable absent = 0.

Variables	CA Code	An Son early occupation	An Son middle occupation	An Son late occupation	An Son burial	Ban Non Wat occupation	Ban Non Wat Neolithic burial phase 1	Ban Non Wat Neolithic burial phase 2	Ban Lum Khao Neolithic burial	Ban Lum Khao Neolithic occupation	Non Nok Tha (early phase)	Ban Chiang (early phase)	Tha Kae (layer 5 occupation)
geometric triangular/diamond incision with diagonal incision fill	CVTF	0	0	0	0	0	CVTF	0	0	0	0	0	0
geometric triangular/diamond incision with impressed fill	CVTI	0	0	0	CVTI	0	0	0	0	0	0	0	0
geometric/diamond triangular incision	CVTO	CVTO	CVTO	CVTO	0	0	CVTO	0	0	0	0	0	0
geometric circular/semi-circular incision with impressed fill	CVUI	0	0	0	0	0	CVUI	0	0	0	0	0	0
geometric circular/semi-circular incision	CVUO	CVUO	CVUO	0	0	0	0	0	0	0	0	0	0
vertical incision	CVVI	CVVI	CVVI	CVVI	CVVI	0	0	0	0	0	0	0	0
white lime	CVWL	0	CVWL	CVWL	0	CVWL	0	0	0	0	0	0	0
wavy incision	CVWV	CVWV	CVWV	CVWV	0	CVWV	0	0	0	0	0	0	0
criss-cross incision	CVXI	CVXI	CVXI	CVXI	0	0	CVXI	0	0	0	0	0	0
zigzag incision	CVZZ	CVZZ	CVZZ	0	0	0	0	0	0	0	0	CVZZ	CVZZ
ivory bead	IVBD	0	0	0	0	0	IVBD	0	0	0	0	0	0
ivory bangle	IVBG	0	0	IVBG	0	IVBG	0	0	0	0	0	IVBG	0
marble bangle	MABG	0	0	0	0	MABG	0	0	MABG	0	0	0	0
marble other	MAOT	0	0	0	0	0	0	0	0	0	0	0	0
shell bead	SHBD	0	0	0	0	0	0	0	0	0	0	0	0
shell bead:disc shape	SHBD:D	0	SHBD:D	SHBD:D	SHBD:D	0	SHBD:D	0	SHBD:D	SHBD:D	SHBD:D	0	SHBD:D
shell bead:funnel shape	SHBD:F	0	0	0	0	0	0	0	0	0	0	0	0
shell bead:H-shape	SHBD:H	0	0	0	0	0	0	0	0	0	0	0	SHBD:H
shell bead:rectangular/ barrel/ cylindrical-shape	SHBD:R	0	SHBD:R	SHBD:R	SHBD:R	0	SHBD:R	SHBD:R	0	0	0	0	0
shell bangle	SHBG	0	0	0	0	SHBG	SHBG	0	0	SHBG	0	0	0
shell bivalve	SHBV	0	0	0	SHBV	0	SHBV	SHBV	SHBV	0	SHBV	0	SHBV
shell earring	SHER	0	0	0	0	0	SHER	0	0	0	0	0	0
shell gastropod	SHGP	0	0	0	0	0	SHGP	0	0	0	0	0	0
shell worked	SHOT	0	0	0	0	0	0	0	SHOT	0	0	0	0
shell ring	SHRI	0	0	0	0	0	0	0	0	0	0	0	0
stone axe	STAX	0	0	0	0	0	0	0	0	0	0	0	0
stone adze	STAZ	0	0	0	STAZ	0	0	0	0	0	0	0	0
stone adze:small	STAZ:S	0	0	0	0	0	STAZ:S	0	0	0	0	0	0
stone bead	STBD	0	0	0	0	0	0	0	0	0	0	0	0
stone bangle	STBG	STBG	0	0	0	0	0	0	0	0	0	0	0
stone blade	STBL	0	0	0	0	0	0	0	0	0	0	0	0
stone burnishing	STBS	0	0	0	STBS	STBS	0	0	0	0	0	0	0
stone chisel	STCH	0	0	0	0	0	0	0	0	0	0	0	0
stone core	STCR	0	0	0	0	0	0	0	0	0	0	0	0
stone flake	STFL	0	0	0	0	0	0	0	0	0	0	0	0
stone hammerstone	STHM	0	0	STHM	0	0	0	0	0	0	0	0	0
stone nephrite bangle	STNB	0	0	0	0	0	0	0	0	0	0	0	0
stone nephrite bead	STND	0	0	0	0	0	0	0	0	0	0	0	0
stone nephrite other	STNO	0	0	0	0	0	0	0	0	0	0	0	0
stone other	STOT	STOT	STOT	STOT	STOT	0	0	0	0	0	0	0	0
stone red ochre	STRO	0	0	0	0	0	0	0	0	0	STRO	0	0
stone shouldered adze	STSA	STSA	STSA	STSA	STSA	0	0	0	0	STSA	0	0	0
stone shouldered adze:small	STSA:S	0	0	0	0	STSA:S	0	0	0	0	0	0	0
stone polishing/ sandstone/ coarse grained	STSS	0	0	STSS	0	0	0	0	0	0	0	0	0
stone unshouldered adze	STUA	0	STUA	STUA	STUA	0	0	0	0	0	0	0	0
stone unshouldered adze:small	STUA:S	0	0	0	0	STUA:S	0	0	0	STUA:S	STUA:S	0	0
stone whetstone/grinding stone/fine grained	STWH	STWH	STWH	STWH	0	STWH	0	0	0	0	STWH	0	0
other calcareous temper	TPCL	0	TPCL	0	0	0	0	0	0	0	0	0	0
coarse sand temper	TPCS	TPCS	TPCS	TPCS	0	0	0	0	0	0	0	0	0
fibre/rice chaff temper	TPFB	0	TPFB	TPFB	0	TPFB	0	0	0	0	TPFB	TPFB	TPFB
grog temper	TPGG	0	0	0	0	0	0	0	0	0	0	TPGG	0
phosphate temper	TPPH	0	TPPH	TPPH	0	0	0	0	0	0	0	0	0
sand temper	TPSA	TPSA	TPSA	TPSA	0	TPSA	0	0	0	0	TPSA	TPSA	TPSA
shell temper	TPSH	0	0	0	0	0	0	0	0	0	0	0	0

Source: Compiled by C. Sarjeant.

Table C.3. Variable present = CA code, Variable absent = 0.

Variables	CA Code	Khok Charoen occupation	Khok Charoen burial	Khok Phanom Di occupation	Khok Phanom Di burial	Nong Nor occupation phase one	Laang Spean	Samrong Sen	Krek	Bàu Tró	Mán Bạc occupation	Mán Bạc burial	Xóm Rền
bone awl	BOAW	0	0	BOAW	0	BOAW	0	0	0	0	0	0	0
bone bangle	BOBG	0	0	BOBG	BOBG	0	0	0	0	0	0	0	0
cattle remains	BOBO	0	0	0	0	0	0	0	0	0	0	0	0
dog remains	BOCA	0	0	0	0	0	0	0	0	0	0	0	0
other faunal remains	BOFA	BOFA	0	0	BOFA	0	0	0	0	0	0	0	0
bone fishhook	BOFH	0	0	BOFH	BOFH	BOFH	0	BOFH	0	0	0	0	0
fish remains	BOFI	0	0	0	BOFI	0	0	0	0	0	0	0	0
bone worked	BOOT	0	BOOT	BOOT	BOOT	BOOT	0	BOOT	0	0	BOOT	0	0
bone tool/weapon point	BOPT	0	0	BOPT	0	0	0	BOPT	0	0	BOPT	BOPT	0
pig remains	BOSS	BOSS	0	0	BOSS	0	0	CLAV	0	0	0	0	0
tooth pendant	BOTP	0	0	BOTP	BOTP	0	0	0	0	0	0	0	0
turtle/tortoise remains	BOTT	BOTT	0	0	BOTT	0	0	0	0	0	0	0	0
clay anvil	CLAV	0	0	CLAV	CLAV	CLAV	0	0	CLAV	0	CLAV	0	0
clay bead	CLBD	CLBD	0	0	0	0	0	0	0	0	0	0	0
clay bangle	CLBG	CLBG	0	0	0	0	0	CLBG	0	0	0	0	CLBG
clay counter/roundel	CLCO	0	0	0	CLCO	0	0	0	0	0	0	0	0
clay net sinker/weight	CLNS	0	0	CLNS	CLNS	0	0	CLNS	0	0	0	0	0
clay artefact	CLOT	CLOT	0	CLOT	0	CLOT	0	CLOT	0	0	0	0	CLOT
clay pellet	CLPL	0	0	CLPL	CLPL	CLPL	0	0	0	0	CLPL	0	CLPL
clay roller	CLRO	0	0	0	0	0	0	0	0	0	0	0	0
clay spindle whorl	CLSW	0	0	0	0	0	0	0	CLSW	0	0	0	CLSW
appliqué and incision on top	CVAI	0	CVAI	0	0	0	0	CVAI	0	0	0	0	0
appliqué	CVAP	0	CVAP	CVAP	0	0	0	CVAP	0	0	CVAP	0	CVAP
black burnished/surface	CVBB	0	0	0	0	0	0	0	0	0	0	0	0
decoration on body	CVBO	0	CVBO	CVBO	CVBO	CVBO	CVBO	CVBO	CVBO	CVBO	CVBO	0	CVBO
decoration on base	CVBS	0	0	CVBS	CVBS	0	CVBS	0	CVBS	0	0	0	0
combed	CVCB	0	0	0	0	CVCB	0	0	0	0	CVCB	CVCB	0
coarse cord-marking	CVCC	0	0	CVCC	0	0	0	0	0	CVCC	0	0	0
curvilinear incision with impressed fill	CVCI	0	CVCI	CVCI	CVCI	CVCI	CVCI	0	CVCI	CVCI	CVCI	CVCI	CVCI
cord-marking	CVCM	CVCM	CVCM	CVCM	0	CVCM	CVCM	CVCM	CVCM	CVCM	CVCM	0	CVCM
ceramic vessel concave rim independent restricted	CVCO	0	0	CVCO	0	0	0	0	CVCO	0	0	CVCO	0
ceramic vessel concave rim independent restricted:pedestal	CVCO:P	0	0	0	0	0	0	0	0	0	0	0	0
curvilinear painted	CVCP	0	0	0	0	0	0	0	0	0	0	0	0
curvilinear incision with painted/slipped/burnished fill	CVCS	0	0	0	0	0	0	0	0	0	0	0	0
ceramic vessel direct independent restricted	CVDI	0	0	0	CVDI	0	0	0	0	0	0	0	0
ceramic vessel direct independent restricted:pedestal	CVDI:P	0	CVDI:P	0	0	0	0	0	0	0	0	0	0
dentate stamped	CVDS	0	0	0	0	0	0	CVDS	CVDS	0	CVDS	CVDS	CVDS
ceramic vessel everted independent restricted	CVEI	0	CVEI	CVEI	CVEI	CVEI	CVEI	0	CVEI	CVEI	CVEI	CVEI	CVEI
ceramic vessel everted independent restricted:carinated	CVEI:C	0	CVEI:C	0	CVEI:C	0	0	0	0	0	0	0	0
ceramic vessel everted independent restricted:pedestal	CVEI:P	0	CVEI:P	0	CVEI:P	0	0	0	0	CVEI:P	0	CVEI:P	0
fingernail impression	CVFI	0	0	0	0	0	CVFI	CVFI	0	0	0	0	0
horizontal incision	CVHI	0	CVHI	CVHI	0	CVHI	CVHI	CVHI	CVHI	CVHI	CVHI	0	CVHI
incision	CVIC	0	0	CVIC	CVIC	CVIC	CVIC	CVIC	CVIC	CVIC	CVIC	0	0
geometric eye-shaped incision with impressed or incised fill	CVIF	0	0	0	0	0	0	0	0	0	CVIF	0	CVIF
geometric impressed	CVIG	0	0	0	0	0	0	0	0	0	CVIG	CVIG	0
incised and impressed	CVII	CVII	CVII	CVII	CVII	CVII	CVII	0	0	CVII	0	CVII	CVII
impressed	CVIP	0	CVIP	CVIP	0	0	0	CVIP	CVIP	0	CVIP	0	CVIP
decoration at lip	CVLP	0	CVLP	CVLP	CVLP	0	CVLP	CVLP	0	0	CVLP	0	0
ceramic vessel inverted independent restricted:carinated	CVNI:C	0	0	0	0	0	0	CVNI:C	0	0	0	0	0
punctate stamped:circular	CVPC	0	CVPC	CVPC	CVPC	CVPC	CVPC	CVPC	CVPC	0	CVPC	0	CVPC
decoration on pedestal	CVPD	0	0	CVPD	CVPD	0	CVPD	0	0	CVPD	CVPD	0	CVPD
punctate stamped:hollow circular/large circular	CVPH	0	0	CVPH	0	0	CVPH	0	CVPH	0	CVPH	0	CVPH
paddle impression	CVPI	0	CVPI	CVPI	0	CVPI	0	CVPI	0	0	0	0	CVPI
punctate stamped:quadrangular/triangular	CVPQ	0	0	CVPQ	CVPQ	0	CVPQ	0	CVPQ	0	0	0	CVPQ
geometric quadrangular incision with impressed fill	CVQI	0	0	0	0	0	0	CVQI	0	0	0	0	0
geometric quadrangular incision	CVQO	0	0	CVQO	0	0	0	CVQO	CVQO	0	0	0	0
red burnished	CVRB	0	0	CVRB	CVRB	0	0	0	0	0	0	0	0
roulette stamped:zigzag line continuous	CVRC	0	CVRC	0	0	0	0	0	0	0	0	0	0
roulette stamped:dotted linear	CVRD	0	0	CVRD	0	CVRD	0	0	0	0	CVRD	CVRD	0
decoration on rim	CVRM	0	0	CVRM	CVRM	0	CVRM	CVRM	CVRM	CVRM	CVRM	0	0
red painted	CVRP	0	CVRP	CVRP	0	CVRP	0	CVRP	0	CVRP	0	0	0
roulette stamped:square	CVRS	0	0	CVRS	0	0	CVRS	CVRS	CVRS	0	0	0	CVRS
roulette stamped:dotted zigzag line continuous	CVRT	0	0	0	0	0	CVRT	0	0	0	0	0	CVRT
roulette stamped:unspecified	CVRU	CVRU	CVRU	CVRU	0	0	0	CVRU	CVRU	0	0	0	0
roulette stamped:zigzag lines	CVRZ	0	0	0	0	0	0	CVRZ	0	0	0	0	0
decoration on pronounced shoulder	CVSD	0	0	0	0	CVSD	0	0	0	0	0	CVSD	0
decoration on shoulder	CVSH	0	CVSH	CVSH	CVSH	CVSH	0	0	CVSH	0	0	0	CVSH
S'/scroll-shaped incision with impressed fill	CVSI	CVSI	0	0	0	0	0	0	CVSI	0	CVSI	0	CVSI
red slipped	CVSL	CVSL	CVSL	CVSL	0	CVSL	0	0	CVSL	0	0	0	0
shell impressed	CVSM	0	0	0	0	0	0	0	0	0	0	0	0
S'/scroll-shaped incision	CVSO	0	0	0	0	0	0	0	0	0	0	0	CVSO
ceramic vessel simple restricted	CVSR	0	CVSR	CVSR	0	0	0	0	CVSR	CVSR	CVSR	0	CVSR
ceramic vessel simple restricted:carinated	CVSR:C	0	CVSR:C	0	0	CVSR:C	0	0	0	0	0	0	0
ceramic vessel simple restricted:pedestal	CVSR:P	0	CVSR:P	0	0	0	0	0	0	0	0	0	CVSR:P
ceramic vessel simple unrestricted	CVSU	0	CVSU	CVSU	CVSU	CVSU	CVSU	0	CVSU	CVSU	CVSU	CVSU	CVSU
ceramic vessel simple unrestricted:carinated	CVSU:C	0	CVSU:C	0	0	0	0	0	CVSU:C	0	0	0	CVSU:C
ceramic vessel simple unrestricted:pedestal	CVSU:P	0	CVSU:P	0	CVSU:P	0	CVSU:P	CVSU:P	CVSU:P	CVSU:P	0	CVSU:P	CVSU:P

Source: Compiled by C. Sarjeant.

Table C.4. Variable present = CA code, Variable absent = 0.

Variables	CA Code	Khok Charoen occupation	Khok Charoen burial	Khok Phanom Di occupation	Khok Phanom Di burial	Nong Nor occupation phase one	Laang Spean	Samrong Sen	Krek	Bàu Tró	Mán Bạc occupation	Mán Bạc burial	Xóm Rến
geometric triangular/diamond incision with diagonal incision fill	CVTF	0	0	0	0	0	0	CVTF	0	0	0	0	CVTF
geometric triangular/diamond incision with impressed fill	CVTI	0	CVTI	CVTI	0	0	0	CVTI	CVTI	CVTI	CVTI	0	CVTI
geometric/diamond triangular incision	CVTO	0	CVTO	CVTO	0	0	0	0	CVTO	0	0	0	CVTO
geometric circular/semi-circular incision with impressed fill	CVUI	0	CVUI	CVUI	0	0	CVUI	CVUI	0	0	CVUI	0	CVUI
geometric circular/semi-circular incision	CVUO	0	CVUO	0	0	0	0	0	0	0	0	0	0
vertical incision	CVVI	0	0	CVVI	0	0	0	CVVI	CVVI	CVVI	0	0	0
white lime	CVWL	0	0	0	0	0	0	CVWV	CVWV	0	CVWV	0	CVWL
wavy incision	CVWV	0	CVWV	CVWV	0	0	0	0	0	CVWV	0	0	CVWV
criss-cross incision	CVXI	0	0	CVXI	0	CVXI	0	0	CVXI	CVXI	0	0	0
zigzag incision	CVZZ	0	CVZZ	CVZZ	0	CVZZ	0	CVZZ	0	0	CVZZ	0	CVZZ
ivory bead	IVBD	0	0	0	0	0	0	0	0	0	0	0	0
ivory bangle	IVBG	0	0	IVBG	0	0	0	0	0	0	0	0	0
marble bangle	MABG	0	0	0	0	0	0	0	0	0	0	0	0
marble other	MAOT	MAOT	0	0	0	0	0	0	0	0	0	0	0
shell bead	SHBD	0	0	0	0	0	0	0	0	0	SHBD	0	0
shell bead:disc shape	SHBD:D	0	SHBD:D	0	SHBD:D	0	0	0	0	0	0	SHBD:D	0
shell bead:funnel shape	SHBD:F	0	0	0	SHBD:F	0	0	0	0	0	0	0	0
shell bead:H-shape	SHBD:H	0	0	0	SHBD:H	0	0	0	0	0	0	0	0
shell bead :rectangular/ barrel/ cylindrical-shape	SHBD:R	0	0	0	SHBD:R	0	0	0	0	0	0	0	0
shell bangle	SHBG	0	SHBG	SHBG	SHBG	0	0	0	0	0	0	0	0
shell bivalve	SHBV	0	0	0	SHBV	0	0	0	0	0	0	0	0
shell earring	SHER	0	SHER	0	0	0	0	0	0	0	0	0	0
shell gastropod	SHGP	0	SHGP	0	SHGP	0	0	0	0	0	0	0	0
shell worked	SHOT	0	0	SHOT	SHOT	0	0	0	0	0	0	0	0
shell ring	SHRI	0	SHRI	0	0	0	0	0	0	0	0	0	0
stone axe	STAX	0	0	STAX	0	0	0	STAX	0	0	STAX	0	STAX
stone adze	STAZ	0	0	STAZ	STAZ	0	0	0	0	0	0	0	0
stone adze:small	STAZ:S	0	STAZ:S	STAZ:S	0	0	0	0	0	0	0	0	0
stone bead	STBD	0	STBD	0	0	0	0	0	0	0	STBD	0	0
stone bangle	STBG	0	STBG	STBG	STBG	0	0	STBG	STBG	0	STBG	0	STBG
stone blade	STBL	0	0	0	0	0	0	0	0	STBL	0	0	0
stone burnishing	STBS	0	0	STBS	STBS	STBS	0	0	0	0	0	0	0
stone chisel	STCH	0	0	0	STCH	0	0	STCH	STCH	0	STCH	0	0
stone core	STCR	0	0	0	0	0	0	0	STCR	0	0	0	0
stone flake	STFL	0	0	0	0	STFL	STFL	0	STFL	STFL	0	0	STFL
stone hammerstone	STHM	STHM	0	0	0	STHM	0	0	0	0	0	0	0
stone nephrite bangle	STNB	0	0	0	0	0	0	0	0	0	STNB	STNB	STNB
stone nephrite bead	STND	0	0	0	0	0	0	0	0	0	0	0	STND
stone nephrite other	STNO	0	0	0	0	0	0	0	0	0	0	0	STNO
stone other	STOT	STOT	0	0	0	0	0	0	0	0	0	0	STOT
stone red ochre	STRO	0	0	0	STRO	0	0	0	0	STRO	STRO	0	0
stone shouldered adze	STSA	0	0	0	0	0	0	STSA	STSA	0	0	0	0
stone shouldered adze:small	STSA:S	STSA:S	0	0	0	0	0	0	0	STSA:S	STSA:S	0	0
stone polishing/ sandstone/ coarse grained	STSS	0	0	0	0	STSS	0	0	STSS	STSS	0	0	0
stone unshouldered adze	STUA	0	0	0	0	0	0	STUA	STUA	0	STUA	0	STUA
stone unshouldered adze:small	STUA:S	STUA:S	0	0	STUA:S	STUA:S	0	0	0	STUA:S	0	0	STUA:S
stone whetstone/grinding stone/fine grained	STWH	0	0	STWH	0	STWH	0	0	STWH	STWH	STWH	STWH	0
other calcareous temper	TPCL	0	0	0	0	0	0	0	0	TPCL	0	0	0
coarse sand temper	TPCS	0	0	0	0	0	0	0	0	TPCS	TPCS	0	0
fibre/rice chaff temper	TPFB	TPFB	0	TPFB	0	0	TPFB	0	TPFB	0	0	0	0
grog temper	TPGG	TPGG	0	TPGG	TPGG	0	0	0	0	0	0	0	0
phosphate temper	TPPH	0	0	0	0	0	0	0	0	0	0	0	0
sand temper	TPSA	TPSA	0	TPSA	TPSA	0	TPSA	0	TPSA	TPSA	0	0	0
shell temper	TPSH	0	0	0	0	0	0	0	0	0	TPSH	0	0

Source: Compiled by C. Sarjeant.