THE UNIVERSITY OF CHICAGO

COMMUNITY, POTTERY, AND POLITICAL CULTURE:

CRAFTING THE STATE IN THE LUOYANG BASIN, NORTH CHINA, 3000–1500 BCE

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In order to properly understand the big picture, we should fear becoming mentally clouded and obsessed with one small section of truth.

Chapter 21 “Dispelling Obsession”
The *Xunzi*

荀子
解蔽篇第二十一

凡人之患，蔽于一曲，而闇于大理。

To Jennifer and Charles for encouraging me and
Estela for believing in me.

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Abstract

The Late Neolithic (3000-2000 BCE) is characterized by the spread of the Longshan Culture Complex throughout the Huanghuai floodplain, covering all regions occupied by the earlier Yangshao and Dawenkou cultures. Definition of local Longshan phases is based primarily on minor stylistic differences in the pottery inventories of these regions, though such stylistic criteria are limited to external, decorative features of the pottery. At the heart of this inquiry is a concern to detail the development of a Longshan political culture within contemporary ceramic repertoires that reflected, and to some extent drove, the formation of an increasingly homogeneous sense of community. In order to shed light on the development of a political culture during the Late Neolithic, this research will investigate how ceramic aesthetic styles changed over time in relation to technical styles of manufacture by tracing changes in pottery assemblages across the basin. The beginning hypothesis of the work is that aesthetic styles became increasingly homogeneous during the Late Neolithic, even as technical styles remained relatively heterogeneous. As such, these data will indicate an increasingly regional and standardized understanding of how pottery should look, trending toward homogeneity, but continuity in local understandings of how pottery should be made, remaining heterogeneous in their production.

1

INTRODUCTION

"The past is a foreign country; they do things differently there."
– L.P. Hartley, *The Go-Between* (1953)

The discussion by Baines and Yoffee (1998) of "high culture" in complex polities is intended to deal with the fully developed expression of political culture within a society, but as the name suggests, such "high" political culture is restricted to the elite (read: political leaders) of that society. In other words, by this "late" stage of development in a complex society, the elite dictate many of the forms and modes of expression used in the current political culture, and it is restricted to the highest levels of society. However, all such political cultures have their origins in earlier, more accessible, forms and modes for the expression of political culture, and these forms and modes do not disappear. The "high culture" of the elite in the political realm does not replace these formative expressions of political culture, it simply builds on top of them. The influence of the citizenry of a society on its political culture is ongoing, and provides the symbolic basis for the subsequent legitimization of political authority.

1.1 A Critique of "High Culture"

The conventional emphasis on high culture presents the problem, first, for the culture of a society as a whole, while secondly and perhaps more importantly, removes non-elites from the political sphere, from participating in its own political culture. In short, high culture suggests that non-elites have no culture of their own, or at the very least that their culture is of little consequence in the construction of society and the use of power within it. Non-elites become non-agents in their own community.

I suggest that this presents a systemic problem for two reasons: first, as scholars we have not broken away from the traditional view that the "formation" of complex polities is a purely top-down enterprise, and second, that there is no meaning to the daily lives of non-elites because they have no agency in how

their own society develops. I will address each of these problems in more detail in Chapter 3, but for this introduction it is important to define some terms and how they are used in this dissertation.

1.1.1 Why Political Culture?

The concept "political culture" may at first seem an unusual concept to be used in archaeological research, but this stems primarily because of its ubiquitous use in sociology and political science where the inclusion of "culture" has its roots in anthropological research of the 60s and 70s in which "culture" seemed to provide powerful explanatory power for scholars, both anthropologists and archaeologists alike—even if they didn't always agree on what "culture" was. Combine this with political scientists' desire to find a concept on which to hang political behavior, especially with regard to the formation of nation-states, and the term "political culture" was given life (Beer et al. 1973; Chilton 1988). Fast forward several decades, and I believe that the ways political culture have been defined allows the concept to return to its roots.

So what is political culture? As I use the concept here, taken from exceptional work by Chilton (1988) in particular, political culture is defined as "all publicly common ways of relating within the collectivity." This definition understands culture as the "ways of relating within the collectivity" and adds "publicly common" to this definition as the referent for the political sphere. Perhaps most importantly, though, is that this definition indicates action, the work of agents within society (i.e. "the collectivity"). This defining characteristic of political culture as a concept is what allows us to draw its use back into anthropology and archaeology because, if nothing else, as anthropologists we are interested in agentive behavior in the construction and maintenance of the societies we seek to better understand.

"Publicly Common" Practice

How then do we connect political culture to non-elites? Through practice theory, and in particular the "communities of practice" concept. Practice theory introduced to the anthropological literature from French sociology has come to be a key component in how we, as anthropologists, define culture: culture is made up of sets of practices, and practice writ large doesn't discriminate between elite and non-elite. Indeed, that is

one of the reasons practice theory is so useful, and why it has so much explanatory power. All members of a society engage in practices that help define them and their identity, as well as providing behaviors which give their life meaning. I will discuss practice theory and the "communities of practice" concept later (see Chapter 3), but a few general points can be laid out here.

Chief among these points is how understanding communities of practice links productive activities to material culture, the primary source of data for archaeologists. Things, well *man-made* things, are the result of work done by craftspeople, especially in antiquity (i.e. pre-Industrial Revolution), and these craftspeople draw on shared pools of knowledge to make these things, even if the actual persons themselves are not literally working in the same space. Even within societies where a particular thing is produced by craftspeople that physically live hours apart, these artisans are thought of as part of the same community of practice because these artisans occupy a socieconomic role that is defined by shared sets of knowledge and practice. To distinguish between geo-spatial or physical communities and the "communities" part of the communities of practice concept, I will try and use an analogous term like settlement, town, or village. Indeed, especially in the anthropological literature, just the concept of "community" is understood to be applicable to communities of people that are not physically near one another (the "online community" or "knitting community").

And this idea of "practice as culture" gets to the heart of why the "high culture" concept is so problematic when discussing so-called "state-formation" or the development and maintenance of complex polities. It represents or is the work of ideology, compromised of sets of values and beliefs created and imposed on non-elites by the elite themselves. In material terms, "high culture" is for the elite to be consumed by other elites. Do such objects and beliefs of "high culture" impact non-elites? Without a doubt. But because of for whom such cultural constructs are made, it becomes clear that this is a false consciousness, a mask to drape over the structure of inequality and oppression by the elite upon the rest of society.

The primary critique of ideology as *merely* false consciousness is that it ignores the fact that all such beliefs have some element of truth to them; they must if these beliefs are to endure (Eagleton 1991). In other words, these beliefs are not purely "false" in the sense of untruths, they are built upon systems of belief or constellations of practice that came before, and these systems of belief and constellations of practice have

practical value to the society in its entirety. This is why I used the term "masks" earlier when describing these beliefs and practices: their basis has truth or reality within the society, but these beliefs are now masking the social and economic inequality that has been built behind them. Indeed, for whatever we may now think about the structured "stages" of societal evolution from the late nineteenth and early twentieth century, there is a reason why all societies seem to progress through these stages (or whatever we choose to call them), because it is not until the society has built a solid cultural foundation of beliefs and practices which govern people's everyday lives that an ideological mask can even be constructed. As its name suggests, "high culture" first requires a society to have "culture" in the first place.

The False Consciousness of Ideology

This is the practical aspect of ideology, that it must make some degree of sense in people's everyday experiences and practical interactions with the world. This ideology must conform in recognizable ways to their lived reality (e.g. Eagleton 1991). And it is this idea of practical interaction that we get to the realm of material culture, which so often mediates such interactions. Material culture participates, actively and passively, in the practical life of members of society and it is through these objects that members make meaning in their everyday lives. What this means, then, is that ideology must be part of the material process in which beliefs and practices are produced in everyday life. For material culture in particular, this is the "humility of things" in which Miller argues that:

> . . . objects are important, not because they are evident and physically constrain or enable, but quite the opposite. . . . The less we are aware of them, the more powerfully they can determine our expectations, by setting the scene, and ensuring appropriate behavior, without being open to challenge. They determine what takes place to the extent that we are unconscious of their capacity to do so. (2010:50)

To conceptualize ideology as false consciousness, then, fails because it does not connect in any way to the material processes in which ideas and beliefs, the ways in which societies make meaning, are produced in social life. By understanding this relationship between "things" and beliefs, the making of meaning, and how production of objects creates the conditions on which ideologies are built, we can better understand how things facilitate social interactions in everyday life. Objects, or "things" as I have described them, open

up "ways of relating" between members of the society, and the ability for objects to do this is what places these often times mundane objects into the field of political culture.

This connection is particularly relevant for archaeology because we cannot study beliefs except through its reification in objects. And study of the practice of a society provides the linkage[1] from an ideology founded on a society's beliefs and everyday lived experience to its political culture, which is a subset of its culture taken as a whole. As discussed above, those "publicly common" *ways of relating* apply equally to all members of a society, and yet while political culture builds consensus, builds solidarity, it also contains within its make-up the seeds of subjugation as well. All aspects of political culture, be they oratory, ritual, feasting, or gifting all frame the "publicly common ways of relating" and objects are no different in this regard. Just as a public feast or speech frame these behaviors as political in nature (aside from other social or economic benefit they may be part of), so too do objects frame the behavior which include them. Indeed, one of the unique aspects of objects is that they often help frame the behavioral forms of political culture described above. To return to Miller (2010), this is the "humility of things" because objects often are not explicit indicators of political culture, but they do help frame political cultural behaviors.

Before the complex polity, all members are more or less of equal status, but through the construction of an ideology of subjugation, couched in culturally appropriate and meaningful language and symbols, some members rise in social and political status above most others. When objects cease to be "humble" in the framing of political culture, and instead are part of the political cultural behavior is when, I would argue, objects become part of the society's "high culture" as described by Baines and Yoffee (1998) because such objects become ritual objects in and of themselves, being symbols of office, pottery vessels that have no purpose outside ritual behavior, or garments that signify positions of power. That generic "political culture" has developed into a "high culture" that legitimizes authority. Things in the sphere of "high culture" become less involved with the practical, everyday interactions of life and take on more symbolic functions.

Nevertheless, objects or things, whether the goods produced are part of society's everyday life, or the specialized ("high") forms of political culture, all begin as the products of a craftsman's imagination, and as

1. A "middle-range" theory if you will.

such are produced within a community of practice in which techniques, tools, and the passing of knowledge are integral to the maintenance of society and its material culture.

1.1.2 Craft Production as Political Production

The communities of practice model of production has its origins in understanding modes of learning (Lave et al. 1991) with its emphasis on "legitimate peripheral participation" in the learning process. Such research is of particular interest for archaeologists who have turned to ethnoarchaeology to understand how a society learns to produce the objects of everyday life. Likewise, practice theory sought to understand how objects came to be made the way they were, what accounted for heterogeneity within an artifact class of its archaeological assemblage. Merging these two concepts gives us the communities of practice model which seeks to explain learning and the making of meaning through the practices employed in societal production. Looking at craft production (i.e. the production of objects within a society), through the lens of a community of practice model helps us to understand how practices come into being and how they are perpetuated or changed, and how these practices are the means by which societal beliefs and the making of meaning becomes reified within the society by means of its objects. The strength of this process exemplifies "the humility of things" because this production is not explicit in the making of meaning, or the reification of societal beliefs, but it allows us to consider how objects help align people's actions, and facilitate participate in social activities. That is very much the point of a community of practice, that such production is done unconsciously. Obviously, setting out to make pottery may be the explicit intent, but the making of meaning and reification of beliefs that happens as part of that production occurs without us being aware that they are "produced" at the same time.

In the communities of practice model, one component of the community is Identification which articulates how members create their own self-identity through the community of practice, and thereby create meaning in their lives. Imagination is what enables producers that do not live in the perceived "center" of the society (the Erlitou settlement in our case), nor that are considered "movers and shakers" within the society to nevertheless see themselves as part of this society, as having a role and being active participants within

it. To take this a step further, it is by means of aligning themselves to the broader society that members of a community engage in their practice as a means to belong to something outside of the community itself. They do, say, or *make* things that clearly indicate with whom they, as persons, align themselves. Most concretely, this alignment is a "publicly common way of relating" to others that imagine themselves as part of this larger society and make this identification known through their speech, actions, and products. It is the *imagination* and *alignment* aspects of the community of practice model that provides the linkage between craft production and political culture.[2]

1.2 Research Questions

This research poses the question: did the formation of complex polities in north-central China depend upon a "political culture" formed, in part, in changing practices of craft production during the Longshan period?

The beginning hypothesis of the research is that how things look (aesthetic style) became increasingly homogeneous during the Late Neolithic, while how things are made (technical style) remained relatively heterogeneous. As such, I suggest that these data indicate an increasingly regional and "standardized" understanding of how pottery should look, trending toward homogeneity, but continuity in local understandings of how pottery should be made, remaining heterogeneous in their production. The ceramic analysis that constitutes the primary source of data for this project will be combined with an analysis of mortuary remains using published reports for the sites included in this project in order to provide an additional link to social differentiation through time, while data on clay sourcing (Gorton 2003), and recent settlement data (Qiao 2003) in order to provide an additional link to social differentiation across space. In short, this research intends to produce a complementary, yet more complex, picture of the emergence of inequality and regional solidarity in the Luoyang Basin.

2. All of this is discussed in much more detail in Chapter 3, but I believe it is important to touch on alignment here so as to highlight its important role in the discussion that follows.

1.2.1 The Luoyang Basin

The developments that took place in the settlements of the Luoyang Basin between 3000 and 1500 BCE provide an excellent opportunity for studying the emergence of the state through material culture. In this research, I focus on the concept of political culture, which I define as those aspects of materiality that are employed in the creation of political authority through means other than coercion. That is, these are not the tools of violence or the threat of violence, but in the broader sense include "political speech" or public ritual, and in the archaeological sense include the organization of public or ritual space, material symbols of power, and markers of a "civic" identity.

As I use the term in this research, political culture involves the shifting of stylistic markers toward a standardized set that actively signals participation in a wider network (see Chapman 2002). The dichotomy proposed by Wiessner (1990) regarding passive and active style proves useful here, though in a modified form, and it is in this arena of style that the community of practice concept provides much-needed support (but see Sackett 1990). I will employ the communities of practice concept as a means to distinguish discrete communities based on the five phases of pottery production outlined below. It is presumed that the primary locus for active stylistic communication is to be found on the exterior of the pots, those aesthetic qualities most strongly determined during the completion phase, and secondarily during the firing phase (see below). The primary locus for passive style, however, is found in the structural characteristics of the pot, those technical qualities most strongly determined during the formation phase, and secondarily during the processing phase (see below). Establishing these characteristics for each sherd will provide the necessary data to trace the changes in pottery style, both active and passive, throughout the Longshan and into the Erlitou periods.

This research primarily draws its data from the Huizui site in the Luoyang Basin[3] which is located about 10 km south of the Erlitou site. Though not a major center, Huizui is important because it seems to have been a major producer of lithic tools during the Longshan Period (Ford 2004; Liu, Chen, Lee, et al. 2002-2004; Webb et al. 2007). As a result, the settlement can clearly be shown to have had a close relationship with the elite at Erlitou, but at the same time was not a major center for pottery production (if there is such a thing

3. See Chapter 2 for a more detailed description of this site and its relationship to other sites in the Luoyang Basin.

in the Longshan Period). Huizui was both geographically and socially close to the major Erlitou settlement, but its pottery would have been produced by craftsmen and women that do not participate directly in this close social relationship.

1.2.2 Longshan Political Culture

At the heart of the inquiry is a concern to detail the development of a Longshan political culture within contemporary ceramic repertoires that reflected, and to some extent drove, the formation of an increasingly homogeneous sense of community. In order to shed light on the development of a political culture during the Late Neolithic, this research will investigate how ceramic aesthetic styles changed over time in relation to technical styles of manufacture by tracing changes in pottery assemblages across the basin.

With these data, then, two questions motivate the present research: 1) Is there a trend toward aesthetic homogeneity through the periods covered, though the communities of practice remain relatively stable? Following from this: 2) Combined with settlement data, are we able to infer that this trend can be explained by the increasing influence of the settlement at Erlitou, and thereby suggest that such a trend allowed for a concomitant sense of solidarity to develop that tied the disparate settlements of the Luoyang Basin to the Erlitou elite? And finally: Could the material manifestation of this group solidarity not best be understood as the emergence of a societal political culture that is focused on the display of acceptance of these asymmetrical relations to an external entity?

1.2.3 Contribution to the Field

Engaging with new theoretical approaches to craft production and new methods of instrumental analysis, this research examines the emergence of a regional repertoire of material culture during the Late Neolithic period in China's Luoyang Basin. This project seeks to develop a better understanding of the role that pottery plays in the development of early political culture and the formation of group solidarity prior to the formation of complex societies. The research focuses on the transitional Late Neolithic, or Longshan, period (3000-2000 BCE) in north-central China. In contrast to the somewhat undifferentiated social world of the

earlier Yangshao period (5000-3000 BCE), recent research has demonstrated the emergence of significant social inequality during the Longshan period (Liu 2004, 2006; Liu and Chen 2003; Liu, Chen, Lee, et al. 2002-2004). Processes of social differentiation initiated in the Longshan period established the foundations for the subsequent formation of China's earliest centralized polity, at the Erlitou settlement in the Luoyang Basin during the Early Bronze (2000-1500 BCE). The emergence of a complex polity during the Erlitou period was accompanied by the coalescence of a geographically extensive shared material repertoire during the preceding Late Neolithic Period (Chang 1983, 1986; DeMatté 1999; Fitzgerald-Huber 1988, 1995; Fried 1983; Liu 2004, 2006; Liu, Chen, Lee, et al. 2002-2004; Shao 2000). The primary goal of this research is to elaborate archaeological observations of Longshan period stratification into a more detailed account of the sociological processes that navigated the considerable distance between Yangshao egalitarian communities and Early Bronze Age state emergence.

Part One

Cultures and Styles

2

RESEARCH IN CHINA'S CENTRAL PLAIN

"A regional culture's sustained interaction with other regions is linked to its internal development. Thus, the formation of the Chinese sphere of interaction . . . and the transition to civilization in each of several constituent regions are two facets of the same development."
– K.C. Chang, *The Archaeology of Ancient China*, 4th ed. (1986)

In this chapter I first orient the research geographically within China, describing the location and significance of the Central Plain (or *Zhongyuan* [中原], its literal place in the history of Chinese Civilization, and its importance for a native understanding of the origin of the Chinese people. I then orient the research temporally, discussing the cultural complexes covered in this research, their geographic coverage, and the shifting of cultural complexes across the Central Plain through time.

2.1 The Huanghuai Plain

The Huanghuai Plain [黄淮平原] is a loess plain approximately 200,000 km^2 in size located between several small mountain ranges at its edges, crisscrossed by numerous rivers, large and small, and bordered by the Yellow (*Huang*) River to the north and the Huai River to the south, a major tributary of the Yangzi River (Figure 2.1). The plain is characterized by small mountain ranges concentrated in the western part of the plain and gradually lowers in elevation and overall flatness of terrain as one moves east.

One important factor in the development of cultures in the Huanghuai macro-region is the changing course of the Yellow River through time (Figure 2.2). While it might be a bit premature to speculate too deeply, the apparent course changes of the Yellow River do seem to coincide very well with cultural developments in the Huanghuai Plain as discussed below.

Interestingly, the purported founder of the Xia Dynasty, Da Yu [大禹] or "Yu the Great," was said to have gained the throne because of his numerous great deeds helping the people of ancient China. Chief among these deeds was the stabilization of the Yellow River into a steady course where it was said to have

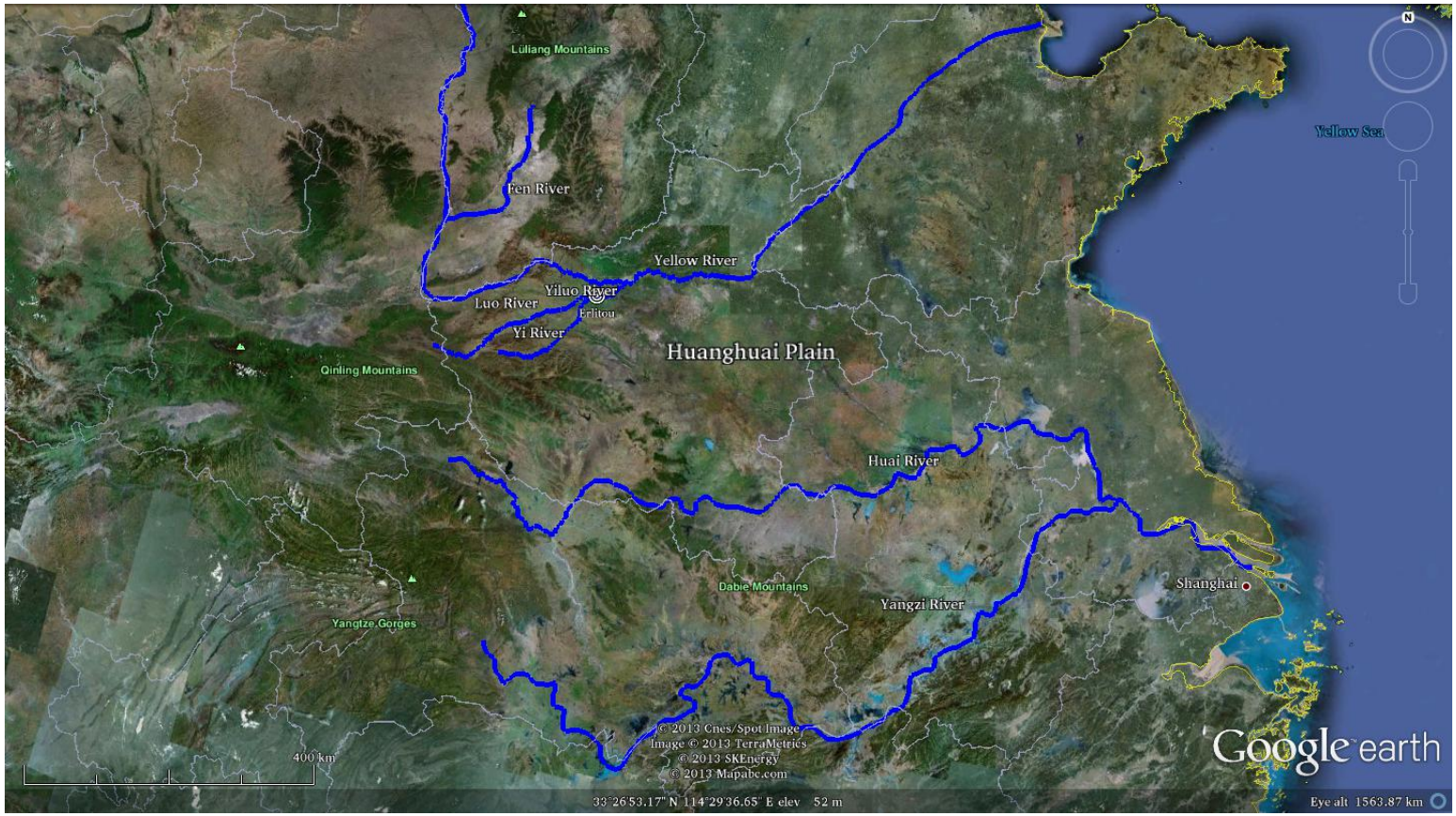


Figure 2.1: The Huanghuai Plain

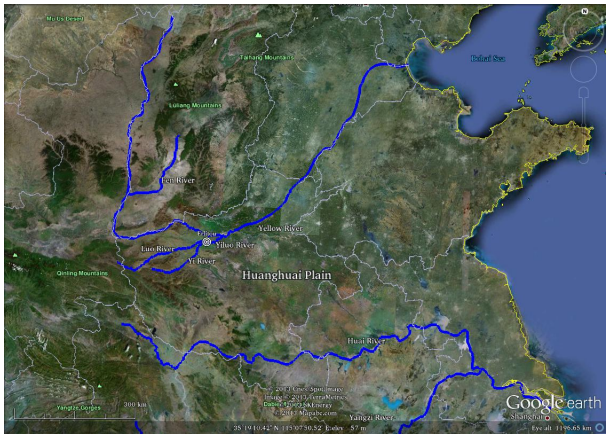
previously caused untold havoc in the people's lives as the river was constantly flooding their fields and changing its course unchecked (see next subsection).

2.1.1 The Luoyang Basin

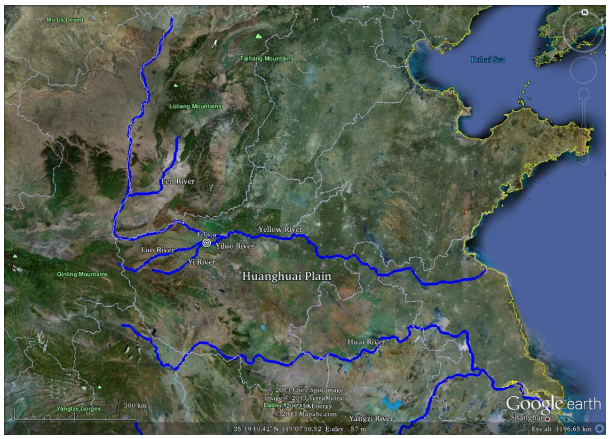
The Luoyang Basin is approximately 1150 km^2 in size, located in the northwestern portion of the Huanghuai Plain, with the plain extending to the east, southeast, and south of the basin. The terrain in the basin is rather unique in that it is the only part of the plain which is semi-circumscribed (see Liu 2004:176-78), being surrounded by smaller mountain ranges directly to the east, southeast, south, southwest, and west, the Yellow River and the Mang Hills to the northwest, and north, with the Yiluo River running toward the Yellow River to the northeast (Figure 2.3). The courses of the Yi and Luo Rivers (which join further into the basin to form the Yiluo River) have smaller river valleys of their own, but the course of the Yi River is constrained by the Song (Longmen) Mountains on the east side of the river and the Xionger (Xiang) Mountains on the west side at a juncture called the *Yique* ("Gate of the Yi [River]").[1] The Luo River valley, however, continues to the southwest, heading further into the mountains and does not intersect the plain at all. This situation makes travel from the Luoyang Basin to the rest of the Huanghuai Plain by this southern route somewhat difficult, and leaves the relatively flat terrain along the course of the Yiluo River as the primary route out of the basin and into the rest of the plain. However, the Song Mountains are bisected by a highland pass between the Junshi (eastern) and Taoshi (western) peaks, a course which leads from the basin to the modern city of Dengfeng, and in prehistory to the walled settlements of Wangchenggang, Guchengzhai, and Xinzhai (see §2.4.1 on page 31) of the late Longshan period.

Climate and vegetation has changed somewhat over time, in particular during the early Longshan Period in which conditions appear to have been wetter than they were previously and have been since (Liu 2004; Liu and Chen 2012). It is also important to note that the Yiluo River, not unlike the Yellow River itself, has

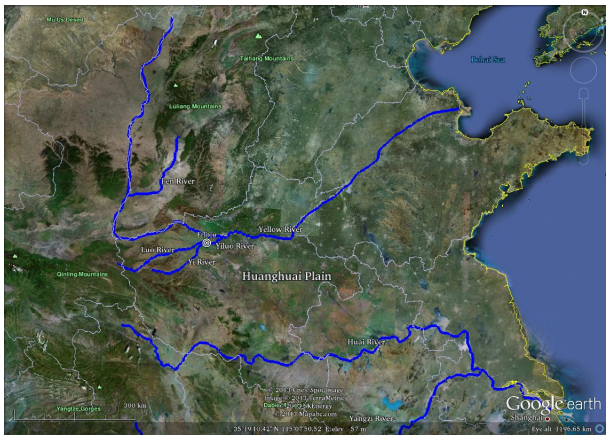
1. The tight passage through which the Yi River travels is the location of the Longmen Grottoes, a series of caves cut into the rock on the western side of the river that contain various depictions of the Buddha. The carvings were started in the Northern Wei Dynasty and completed in the Northern Song Dynasty, spanning from 493 to 1127 CE, though the majority of the work was accomplished during the Tang Dynasty (618-907 CE).



(a) The Yellow River before 2600 BCE



(b) The Yellow River from 2600 to 2000 BCE



(c) The Yellow River after 2000 BCE

Figure 2.2: Changing courses of the Yellow River

shifted its course through time. Based on geoarchaeological analyses by the Erlitou Excavation Team of the Institute of Archaeology (CASS-IA-EET 2005), the junction of the Luo and Yi Rivers was located about 14 kilomenters to the west in Chinese prehistory, but the river junction has since moved eastward to its present location (Figure 2.3). Interestingly, during its period of ascendance in the region the Erlitou settlement itself was located "outside" (or east of) the juncture of the Luo and Yi Rivers, though still alongside the Yiluo River. As a result, though the Erlitou site is currently "inside" the juncture, and therefore slightly less accessible, the community was previously more easily accessible during its rise and at the height of its power (Liu, Chen, Lee, et al. 2002-2004).

2.1.2 The "Middle Kingdom"

The modern name of the People's Republic of China in Chinese remains *Zhongguo* [中国] which translates most directly as "central state" or in literary usage "middle kingdom." This identification of the nation is based on the reckoning of directions in the Chinese worldview that there are five "directions," though five "places" might be more precise, these being the four cardinal directions familiar in the West (i.e. north, south, east, and west), and the "center" or the place in which one currently stands. This system of reckoning derives from the earliest conceptions of time and space in Chinese civilization (Allan 1991; Keightley 2000).

In some of the earliest Chinese texts, such as the *Shanhaijing* [山海经] or 'Classic of Mountains and Seas' (Birrell 1999; for dating of this text see Fracasso 1993), the "known" world was made up of nine provinces with the central province being the location of the earliest Chinese polity (see Section 2.4 on page 29). The nine provinces are mentioned in regard to governance by Da Yu (see previous subsection) because bronze (lit. "metal") sent from the nine provinces was used to cast nine *ding* tripod cauldrons (Figure 2.4) that indicated rightful rulership to whomever possessed them (Chang 1983; Ching 1997:46-48).

In primary documents from the subsequent Shang Dynasty (see §2.4.2 on page 34), the system was somewhat simplified to the "five places" system where the Shang polity occupied the central place and was surrounded by the *sifang* [四方], literally "four places," which were the border areas from which all barbarians came. The implication was clear: those living in the center were civilized while those living in

(a) The Yi and Luo River courses in prehistory

(b) The Yi and Luo River courses in the present

Figure 2.3: The Luoyang Basin

(a) The "Nine Provinces"

(b) The Da Ke ding (The Shanghai Museum collection)

Figure 2.4: In the time of Yu

the *sifang* were not. It was from the *sifang* that the many tribal groups raided the Shang polity, at times sending armies, and at other times sending tribute. Perhaps of equal importance to the Shang rulers, the nature powers and gods of those living in the border areas sent "misfortune" to the Shang polity from the *sifang*, suggesting not only a geographical understanding of the *sifang*, but a natural and spiritual one as well (Ching 1997; Wang 2000). It comes as no real surprise, then, that the Zhou are said to originate in the west, and hence from one of the *sifang*, suggesting perhaps that the Shang preoccupation with the *sifang* was not entirely misplaced after all.

After the Zhou conquest of Shang, the Zhou leaders retained the geographical significance of the *sifang*, but passed on the other meanings attributed to these regions from Shang thought. As with many of the borrowings by Zhou of Shang cosmology, the *sifang* came to have a meaning similar to the term "all under Heaven" (*Tianxia* [天下]) with regard to Zhou rulership, now firmly following the Mandate of Heaven or *Tianming* [天命] doctrine proffered by the Zhou leaders as justification for the overthrow of the Shang. Within Zhou thought, then, the *sifang* came to have both a social and political understanding. Thus, the Zhou kings were to rule (benevolently, of course) and maintain the *sifang*, which included not only those groups living there but their leaders and political institutions as well (Allan 2007; Keightley 1978; Wang 2000).

Figure 2.5: The Five Regions
(showing the course of the Yellow River before 2600 BCE in blue and after 2600 BCE in orange)

In the discussions of archaeological cultures and geo-spatial analysis of ceramic productionthat follows, I employ a modified "five places" schema as a means to "regionalize" the topography of central China (Figure 2.5). This is done for two reasons: first, I want to avoid using modern provincial borders and simply let the distributions of archaeological cultures speak for themselves (as it were); and second, the "five region" model has a degree of simplicity and utility while also using somewhat emic understandings and renderings of the landscape (for a thorough discussion see Wang 2000:26-28).

2.2 Cultures of the Huanghuai Plain

In this section I review the cultures and transitions that occurred in the Eastern, Western, and Song Mountain regions of the Huanghuai Plain, with particular emphasis placed on the Western and Song Mountain regions. Below I discuss each region in turn, starting with social and cultural developments in the middle neolithic period, followed by a synthesis of the cultural movements and developments that occurred in the late neolithic (Figure 2.6).

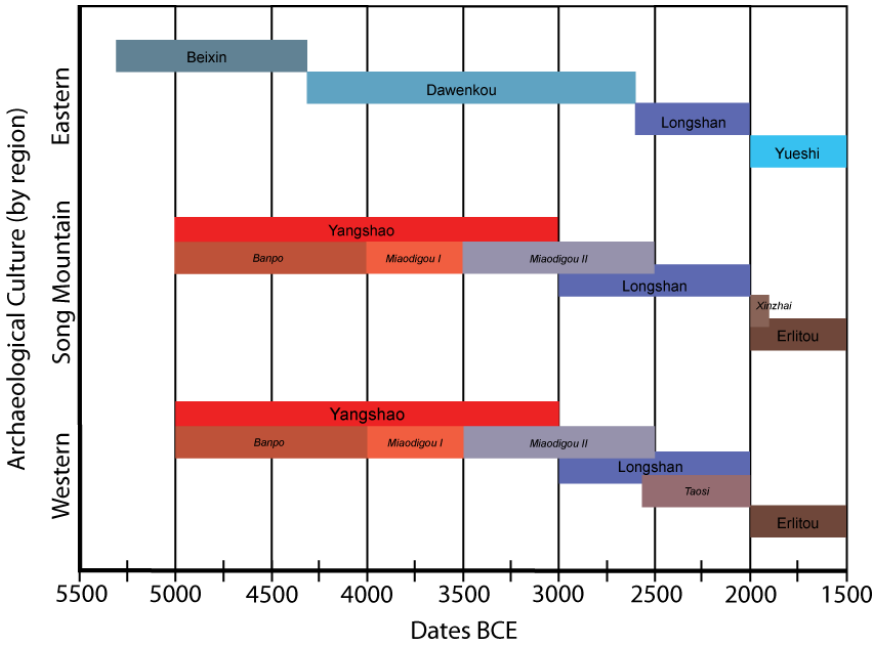


Figure 2.6: Archaeological Cultures of the Three Regions

The area described here as the Song Mountain Region (hereafter abbreviated as "SMR") circumscribes a circle with a radius of 80 km, which is approximately the maximum distance at which the highest peaks of the Song Mountains are visible on the plain. The Song Mountains (or *Songshan* [嵩山]) are among the earliest "sacred peaks" of ancient China.[2] In modern parlance it is known as the "Central Peak" and the peak from which the other four sacred peaks of China are reckoned. Because the Luoyang Basin is found in the SMR, this region is covered in more detail below.

2.2.1 Eastern Region

In the Eastern Region the earliest culture is the Beixin [北辛] Culture (5300-4100 BCE) where approximately 50 sites have been found (Liu 2004).

The Dawenkou [大汶口] Culture (4100-2600 BCE) follows the Beixin Culture and is divided into three periods: early (4100-3500 BCE), middle (3500-3000 BCE), and late (3000-2600 BCE). The late period

2. Indeed, according to the *Shanhaijing* (see §2.1.2 on page 16), Mount Song is said to be the home of several spirits that must be appeased regularly.

overlaps with the early Longshan Culture in the Song Mountain Region (Liu 2004; Liu and Chen 2012). There are no Yangshao sites in the Eastern Region during the middle neolithic, but Dawenkou Culture sites have been found primarily along the coast in the early and middle Dawenkou periods, and by the late Dawenkou period in the late neolithic, Dawenkou Culture sites have moved west into the highland sub-region (Table 2.1 on page 23). Likewise, there are no early Longshan Culture sites in the Eastern Region, but the Dawenkou Culture gives way to the Longshan Culture by the late Longshan period (2600-2000 BCE) of the Song Mountain Region.

Finally, while the Erlitou Culture comes to dominate the material record in the Song Mountain and Western Regions after the late Longshan period, the Yueshi Culture (2000-1500 BCE) proliferates in the Eastern Region during this period (Liu 2004; Liu and Chen 2012).

2.2.2 Western Region

The Western Region is primarily described as following along the north-south course of the middle Yellow River valley, but is for the most part made up of communities located in river valleys that are tributaries of the Yellow River. Because of the divergence in development between different parts of the Western Region, for this discussion it has been stratified into two distinct socio-topographic sub-regions; the first is the Linfen Basin in southern Shanxi Province which includes the Fen River Valley and adjacent Yuncheng Basin, and the second is the Xi'an Basin which includes the Wen River Valley (Table 2.1 on page 23). In general, the Western Region follows a similar progression to that of the SMR, however, as is suggested by the sub-division of the region, there are socio-cultural developments in the two basins that require some additional discussion.

For both sub-regions, the middle neolithic begins with the Yangshao [仰韶] Culture (5000-3000 BCE) which is sub-divided into early, middle, and late periods: early Yangshao (5000-4000 BCE), middle Yangshao (4000-3500 BCE), and late Yangshao (3500-3000 BCE). The Yangshao Culture is the earliest culture in the Huanghuai area where social stratification appears within its communities (Liu 2004; Liu and Chen 2012). In terms of cultural assemblages, the Yangshao Culture is defined primarily through its oxidized

pottery, with bodies ranging in color from pale yellow to deep orange, and decorated in black or white slip using geometric patterns, zoomorphic forms, and tool pictographs.

The Linfen Basin

In the Linfen Basin, the Yangshao Culture is followed by the Longshan [龙山] Culture (3000-2000 BCE), which is also sub-divided into early and late periods: early Longshan (3000-2600 BCE) and late Longshan (2600-2000 BCE). The Longshan Culture continues the trend started in the Yangshao Culture of social stratification, particularly evident through burial practices (Liu 2004; Liu and Chen 2012). However, around 2600 BCE in the Linfen Basin we find the rise of the Taosi settlement (Xiangfen County, Linfen) and the Taosi [陶寺] Culture. The Taosi Culture is subdivided into early Taosi (2600-2300 BCE) and late Taosi (2300-2000 BCE) periods, though the site itself is divided into early, middle, and late phases (He 2013; Liu 2004).[3] The Taosi site was one of the largest settlements in the late Longshan period at approximately 300 ha in size. The site is situated just to the northwest of the Taer Mountains, overlooking the Fen River to the west.

Following the late Longshan/Taosi periods, there is a lull in occupation during the Xinzhai phase and Erlitou period of the SMR.

The Yuncheng Basin In the adjacent Yuncheng Basin, just south of the Linfen Basin, a community of nearly similar size (more than 200 ha) developed at Zhoujiazhuang (Jiang County, Yuncheng) in the late Taosi period, further suggesting the declining influence of the Taosi community (Liu and Chen 2012:227). There does not appear to be as much activity in the Yuncheng Basin (compared to the Linfen Basin) during the Longshan period, and after the decline of Taosi this trend continues until phase 2 of the Erlitou period, primarily at the Dongxiafeng site (Liu 2004:228). Interestingly, this new cultural horizon appears to be made up of some local elements, but Erlitou cultural elements predominate, suggesting that this renewed activity is the result of Erlitou socio-political expansion into the basin (Ji 1995; Li 1997).

3. Following Liu (2004:172), I identify the early and middle phases of the Taosi site with the early Taosi period, and the late phase of the Taosi site with the late Taosi period.

Start Date BCE	Regions			
	Xi'an Basin	Linfen Basin	Song Mountain	Eastern
5000	(E)Yangshao	EYangshao	EYangshao	Beixin
4000	Miaodigou I	MYangshao	MYangshao	EDawenkou
3500		LYangshao	LYangshao	MDawenkou
3000	Miaodigou II	(E)Longshan	ELongshan	LDawenkou
2600	(L)Longshan	ETaosi	LLongshan	(L)Longshan
2300		LTaosi		
2000	Qijia	Erlitou	Erlitou	Yueshi
(dates approximate)		E = Early	M = Middle	L = Late

Table 2.1: Archaeological Cultures through time by region

The Xi'an Basin

In the Xi'an Basin, during the middle and late Yangshao periods archaeologists have identified a distinct branch of the Yangshao Culture known as the Miaodigou [描地沟] (I) Culture (4000-3000 BCE). Likewise, while the late Yangshao gives rise to the early Longshan period in the Linfen Basin, in the Xi'an Basin the Miaodigou (I) Culture gives rise to a new variant identified as the Miaodigou (II) Culture (3000-2600 BCE). However, a definite Longshan Culture follows Miaodigou (II) in the Xi'an Basin, equivalent to the late Longshan period (2600-2000 BCE) in the SMR.

2.2.3 Song Mountain Region (SMR)

The Song Mountain Region is situated in the heart of Henan Province where the Song Mountains stand alone in the northwestern Huanghuai Plain, visible nearly 80 km distant. The Luoyang Basin is located along the northern slopes of the Song Mountains.

From the middle neolithic the progression of cultural groups in the SMR is somewhat more straightforward. The progression begins with the Yangshao Culture which is essentially identical to the Yangshao Culture of the Western Region (Table 2.1 on the preceding page).

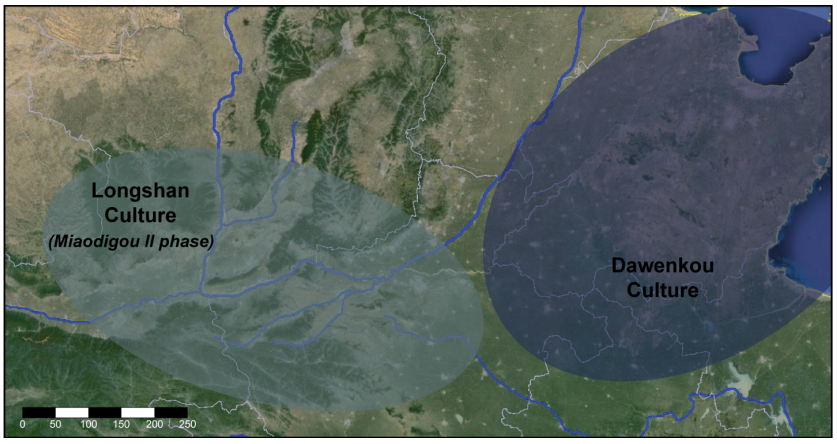
The Yangshao Culture is followed by the Longshan Culture, also nearly identical to the Longshan Culture of the Western Region. However, as discussed below (see §2.3.1 on page 26), there are notable differences between the Longshan Culture components in Shaanxi, Shanxi, Henan, and Shandong Provinces.

The Longshan Culture is followed by the Erlitou Culture (1900-1500 BCE), and is the first early Bronze Age cultural group in the Huanghuai. The Erlitou [二里头] Culture itself is essentially a manifestation of the increasing influence exercised by the settlement at the present-day Erlitou site. As Liu (2004) has suggested, the Erlitou Culture sees the development of a three-tier settlement hierarchy within the Song Mountain Region of the Huanghuai Plain centered on the Erlitou settlement. The social and political structures of the Longshan and Erlitou Cultures are each discussed in more detail below in §2.3.2 on page 26 and §2.4.2 on page 33 respectively.

2.3 Longshan Culture in the SMR

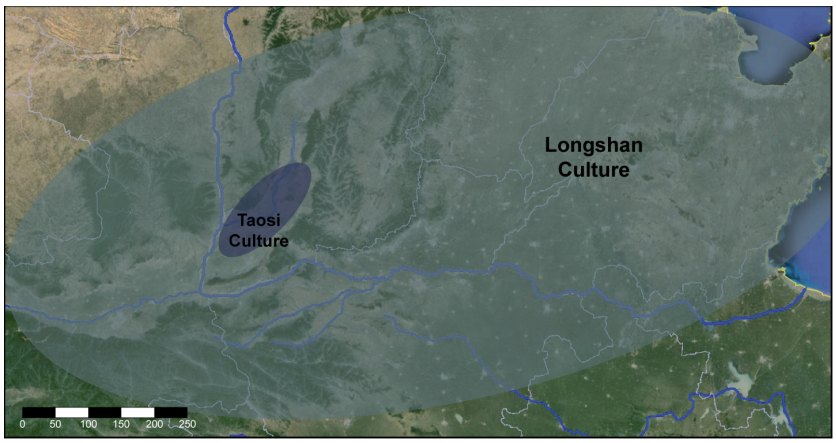
The present research is focused on the Longshan period in the SMR because of its position in time just before the Erlitou Period and the rise of the Erlitou polity itself. The Longshan Culture is important to investigate because it occurs in the "formation" phase of the earliest complex polity in the central plain, especially if one is looking for social and political developments that created the "conditions of possibility" for the Erlitou polity.

The Longshan Culture is perhaps more properly considered a horizon (see Chang 1986:33 for "Longshanoid Horizon"), especially since it is primarily defined by pottery assemblages that are quite distinctive from pottery of the previous Yangshao Culture. In any case, because the Longshan Culture is so widespread it is generally divided into regional cultures based on provincial boundaries: Henan Longshan, Shandong Longshan, and Shaanxi Longshan. These provincial boundaries are surprisingly rather coherent in unifying the typological traits of their respective pottery assemblages. Using the five-region model mentioned above,



(a) 3000 BCE

(b) 2600 BCE



(c) 2300 BCE

Figure 2.7: Cultures of the Eastern, Western, and Song Mountain Regions during the late Neolithic period

the Henan Longshan Culture is found primarily in the Song Mountain region, and partially in the Eastern and Western regions (see Figure 2.5 on page 19).

2.3.1 Types and Variants of Longshan Culture

The Longshan Culture is generally divided into an early period and a late period. The early Longshan period is made up of the Miaodigou II Culture, named after a later phase found at the Miaodigou site in Shan County, Sanmenxia Prefecture (see §2.2.3 on page 23 for information on the Miaodigou I phase). The late Longshan period is represented by different cultural types based on sets of characteristics shared by sites within a local vicinity. Following Zhao (2013), these culture types are: Wangwan III[4] in the Song Mountain region; Hougang II[5] in northern Henan; Zaolutai or Wangyoufang in eastern Henan; Sanyunqiao in western Henan; Xiawanggang in southwestern Henan.

In the SMR, the Wangwan III Culture, based on the third phase of occupation at the Wangwan site in Luoyang Municipality, Luoyang Prefecture, is itself subdivided into two variants: the Wangwan variant found north of the Song Mountains and the Meishan variant found south of the Song Mountains (Zhao 2013:241).

2.3.2 Late Longshan Society

The late Longshan sees a marked increase in terms of population, demonstrated through an increase in small sites throughout the SMR. This increase in density also sees the increase in size of several settlements, supporting the notion that such sites have become nodes of traffic in an increasingly complex tapestry of settlements, with growth in economic activity as well as the flow of information across the SMR. Whether such nodal settlements are part of a nascent polity is difficult to determine from settlement data alone, but the increase in economic activity, in particular the volume of goods, as well as increasing status differentiation evident in late Longshan burials, all point to a more complex political environment.

4. Wangwan III specifies the third (III) phase at the Wangwan site which dates to the Longshan period.

5. Hougang II specifies the second (II) phase at the Hougang site which dates to the Longshan period.

Households and Settlements

There are a wide range of settlement sizes during the late Longshan period (see Section 2.5 on page 35 for more detailed information on settlement sizes), as well as new forms of settlement organization in the SMR. Moreover, there are three features which characterize the late Longshan from previous periods: the appearance of compound-like house clusters, very large settlements (>200 ha in size), and systems of walled settlements (Liu 2004:95).

Across the region there are several prominent household types found: semi-subterranean, ground-level, and raised-platform. Semi-subterranean houses are either square or round in shape, and all have lime-covered floors, though many of these structures are not well-preserved in the archaeological record. Ground-level structures are much more common in this period, and are often multi-room structures. For example, numerous recti-linear, double-room houses were found at the Meishan site, each with its own hearth and lime-plastered floor; at the Zhanmatun site (in Zhengzhou Municipality), excavators found a similar recti-linear structure, also divided into two sub-chambers, each with its own hearth and doorway (Zhao 2013:248). Raised-platform structures are often only identified by the rammed-earth platform on which a wooden structure was built; the wooden structure itself, needless to say, does not survive in the record except as organically-rich postholes sunk into the platform that supported the wooden structure itself. The late Longshan also sees the first appearance of new construction materials in the form of sun-dried bricks (Liu 2004:95).

Another form of household structure which deserves mention is a form somewhat unique to the SMR and northern Henan: earthen cave dwellings (Liu 2004). These household structures were created in one of two ways; one, when the plain is cut by floodwaters, leaving large arroyos through the loess, the caves can be cut into the loess soil; or two, when no arroyos are present, residents cut large trenches into the flat terrain, then cut the caves from the vertical loess walls of the trench (Fu 1989; Liu 2004).

The remains of late Longshan period settlements suggest a level of increased organization over the previous early Longshan (Miaodigou II) period. The placement of storage pits, kilns, and ditches within the settlement, in relation to the household structures, indicates a more orderly aesthetic for community life, and

the fusion of small Yangshao period pithouses into household compounds suggests that these late Longshan period settlements were organized around functional or perhaps even occupational units in addition to kin-units. In addition, whereas Yangshao settlements probably consisted of a single kin group, by the late Longshan period, the household compounds suggest that many kin-groups lived in the settlement, with the kin-groups coming together to form multi-generational or multi-branch family compounds.

Burials and Cemetaries

As briefly mentioned above, the Longshan Culture continues the trend started in the middle neolithic of increasing social stratification, evidenced primarily through patterning in cemeteries and the distribution of grave goods in burials (Liu 1996a, 2004).

Production and Consumption

In terms of tools and production, late Longshan period society became both increasingly specialized, in terms of tool function and location of use, and engendered, in terms of what tools are used where, over previous periods (Liu 2004). These trends suggest not only increasing complexity in methods of production as new types of tools are used to do either new activities, or old activities but in a different way, but also demonstrate the increasingly complex ways different parts of society are interacting, perhaps even the development of new types of relationships. Such relationships extend beyond the expected social relationships between people in a community, but new types of relationships with material goods as tools for the production of goods, and as objects of consumption themselves (e.g. Appadurai 1988).

There is also a noted increase in the volume of material goods found at late Longshan sites. Based on an analysis of types and quantity of remains found on household floors, Liu (2004:40) suggests that, though household and family sizes may have increased, such does not explain the increase in quantity of consumed goods. Rather, increasing specialization of knowledge and craft production can account for some increase in the overall number of goods within each household. According to her research, though, the greatest contributor to an increasing number of material goods comes from increased feasting activities

(Liu 2004:40). She goes on to suggest that feasting, a ritualized form of communal consumption of food and drink (see Dietler and Hayden 2001:3), best explains the increase of material goods in the household because the largest increase is in cooking, serving, and drinking vessels (Hayden 2001). "As a strategy for power, many feasts were held by the elite in order to attract followers, form alliances, and obtain prestige in local and regional social settings" (Liu 2004:40-41). As she notes, China has a long history of incorporating the consumption of food into social events and religious activities,[6] and Cooper (1982) even notes similarities between the *potlatch* of the local Native American tribes of the NW coast and feasting behaviours in China; likewise, both Fung (2000) and Underhill (2002) note feasting activities related to funerary contexts in the Dawenkou Culture of the Eastern Region.

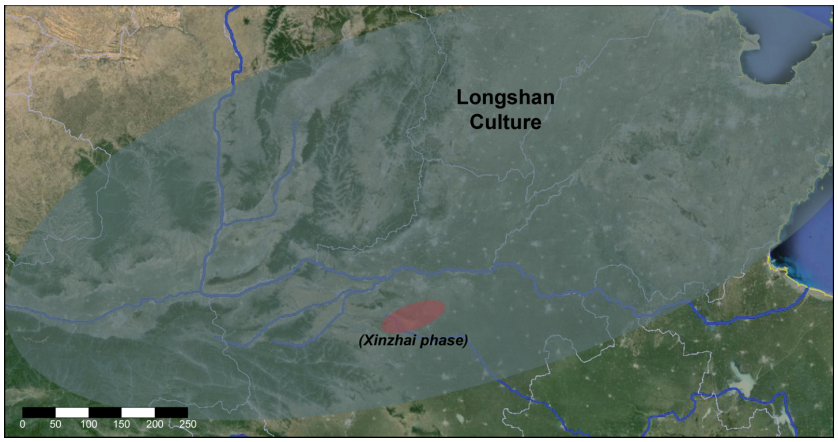
In any case, even if increased feasting activity is not the explanation for the growth of consumption in the late Longshan, there is certainly an increase in the number of material goods found in households during this period.

2.4 Erlitou Culture in the SMR

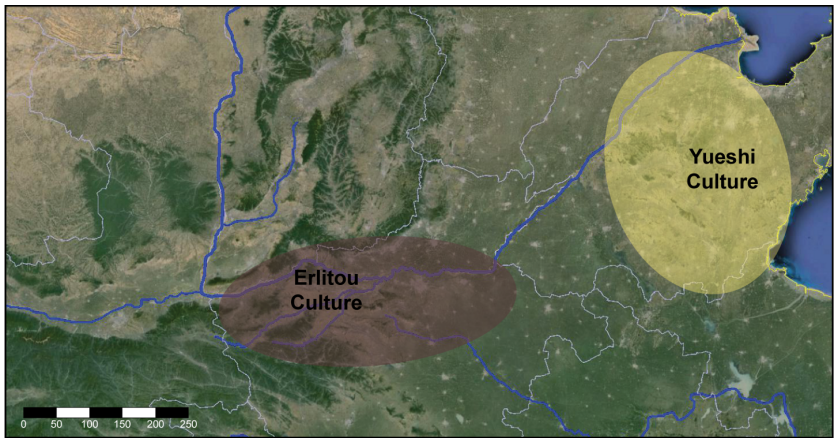
The Erlitou Culture is linked to the cultural traits (often stemming from ceramic style) that originate from the settlement located at the present-day Erlitou site in Yanshi County, Luoyang Prefecture. Following developments of increasing social and political complexity during the late Longshan Period, the Erlitou Culture represents the next step in the chain of progression from individual settlements, to a basin-wide political entity in the Linfen Basin centered on the Taosi settlement (and later, perhaps, Fangcheng), to a regional political entity centered (relatively speaking) on the settlement at Erlitou in the Luoyang Basin.

The rise and subsequent decline of the presumed power and influence of the Erlitou settlement in many ways may mirror that of the rise and decline of the Taosi community as well. While it is certainly unclear what led to the decline at Taosi, if the interpretation put forth by Liu (2004) that the rather circumscribed topography of the Linfen Basin was a catalyst in both the rise and decline of Taosi, concentrating resources

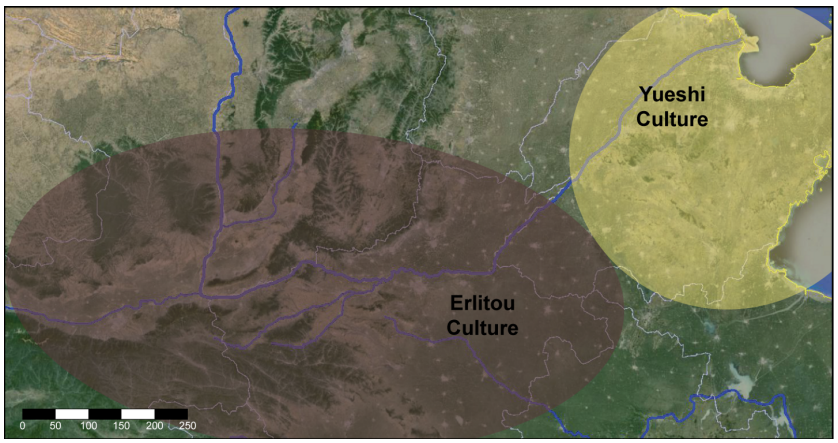
6. For a general introduction to food in China, see E. N. Anderson (1990); for the incorporation of food into religious activities, see Paper (1995) and Poo (1998).



(a) 2000 BCE



(b) 1900 BCE



(c) 1500 BCE

Figure 2.8: Cultures of the Eastern, Western, and Song Mountain Regions during the early Bronze period

within the basin but also restricting trade outside the basin, then the rise and decline of Erlitou no doubt has a similar, but not identical, answer. As Liu (2004) and Liu and Chen (2012) suggest, the semi-circumscribed nature of the Luoyang Basin not only concentrated resources, but also fostered trade outside the basin with the rest of the SMR and beyond.

2.4.1 Types and Phases of the Erlitou Culture

The Erlitou Culture, not unlike the Longshan Culture, is also divided into variants, but in the case of the Erlitou Culture there are only two variants. In Henan generally, and the SMR in particular, this variant is identified as the Erlitou variant, while Erlitou Culture sites in southern Shanxi are identified as the Dongxiafeng variant (Liu 2004; Liu and Chen 2012).[7]

Because Erlitou is not simply the type-site for the Erlitou Culture, but the "source" from which all Erlitou Culture traits derive (directly or indirectly), the Erlitou Culture is divided into phases that match those established at the Erlitou site itself. These are: Erlitou phase I (1900-1800 BCE), Erlitou phase II (1800-1700 BCE), Erlitou phase III (1700–1600 BCE),and Erlitou phase IV (1600-1500 BCE).[8]

Xinzhai phase The Xinzhai phase (2000–1900 BCE) is relatively new in the chronological schema of late Neolithic and early Bronze Age China. This phase was first employed in the 1980s for a ceramic assemblage that falls after the Longshan period, but before the Erlitou period. The phase is named for the walled Xinzhai site located just to the west of Xinzhai Village in Xinmi County, but around fifteen sites have been determined to have Xinzhai materials as part of their multicomponent assemblages. All of these sites are in the SMR; Pang and Gao (2008) have broken these sites into two clusters, one in the north and one in the south, divided by the Song Mountains themselves, each with a medium-sized site as its regional center: Xinzhai itself in the south, and Huadizui, Gongyi Municipality, in the north. Many authors (e.g. Fang 2005; Gu 2002; Zhang 2013; Zhao 2004) have since argued that the Xinzhai phase represents the early

7. See "The Linfen Basin" on page 22 for more information on the Dongxiafeng site.

8. See Appendix C, "Erlitou Site" on page 409 for more information on the phases at the Erlitou site itself.

Xia Dynasty, and that the Xinzhai site was Yu's capital named Yangcheng in historical texts (see §2.4.2 on page 34).

Erlitou phase I The earliest phase of the Erlitou Culture, the Erlitou settlement is increasing in influence, but it has not yet reached its high point. The disappearance of the variability in pottery shape and decoration continues, a trend started in the Xinzhai phase. During this early phase, the Erlitou community is slowly extending its reach outward in a quest for new sources of raw material, new trading partners, and new resources to exploit. In particular, during phase I at Erlitou the beginnings of bronze casting have been recovered, but the production of bronze objects is limited during this phase (Liu and Chen 2012). Another important specialized (and prestigious) commodity that first appears in this phase is white pottery, made from rare kaolinitic clays (Liu and Chen 2012; Liu, Chen, and B. Li 2007).

Erlitou phases II and III The Erlitou settlement reaches its maximal power and influence during phases II and III. The reach of the polity extends far beyond the Luoyang Basin, the Song Mountain Region, and out to far-flung settlements or outposts, probably established to facilitate trade. A much larger bronze-casting work space was created during this phase, complete with a rammed-earth enclosure, no doubt leading the community to expand its influence in order to acquire ore for smelting, and prodigious amounts of wood and other fuels to smelt and cast this new material. Other common or domestic tools continue to be made at the site, and it is likely that such tools and wares are also being made locally at other Erlitou period sites throughout the SMR. However, the production of other prestigious commodities such as turquoise stones appears to have been centralized within the same enclosure as the bronze foundry, suggesting the creation of a class of attached specialists, producing prestige goods for the elite and their patrons (Liu and Chen 2012; Liu and Xu Hong 2007).

Erlitou phase IV and Lower Erligang Erlitou phase IV maintains much of the activity and power expressed during phases II and III. The bronze foundry remains in operation, and most of the site continues to be occupied, with most other craft production continuing as in previous phases. Of note, arrowhead produc-

tion at the site increases, likely indicating warfare being waged by the Erlitou polity on rivals in the region (Liu 2006).

However, by the latter years of phase IV a shift in power seems to have occurred despite possible attempts to subjugate regional opposition. A new cultural horizon, the Erligang, appears at the Yanshi site not 6 km to the northeast of the Erlitou settlement. The early, or Lower, Erligang (ca. 1600–1415 BCE) overlaps with Erlitou phase IV slightly, but there are few remains of the Lower Erligang at the Erlitou site. As Liu and Chen suggest, "it is possible that the Erlitou residents continued to produce and use pottery of Erlitou phase IV style, whereas its close neighbors at Yanshi were making Erligang style pottery" (2012:269).

Erlitou Upper Erligang phase By the subsequent Upper Erligang phase (ca. 1450–1300 BCE) of the Erlitou site, the settlement has decreased dramatically from an urban center of 300 ha to a large village of no more than 30 ha in size. Moreover, the production of all prestige goods, in particular bronzes, has also ceased within the community, and only typical features for a village, small houses and ash pits, have been uncovered (Liu and Chen 2012; Xu Hong 2013).

2.4.2 Erlitou Society

Erlitou society seems for the most part not much different than in the late neolithic: even though we "officially" enter the early Bronze Age in China, this metal has little impact on most residents in the Erlitou Culture, except for those involved in the bronze industry, who themselves are only found at the Erlitou settlement (Liu and Chen 2012:271). Otherwise, though the population increases, living conditions also become more dense with more people living within a given settlement, thereby creating more major and minor centers in the Erlitou polity system (Liu, Chen, Lee, et al. 2002-2004:96).

Households and Communities Not many residential structures have been found dating to the Erlitou period at the Erlitou site itself, though this may simply be due to the fact that much of the excavation work at the site is concentrated in the palace areas.

Burials and Cemetaries Social stratification also increases based on differentiation between elite and non-elite burials, heavily furnished and unfurnished graves, and even human sacrifice as is the case with palace construction at Erlitou (Liu and Chen 2003, 2012; Xu Hong 2013:314).

Production and Consumption Production at the Erlitou site itself steadily increases from phase I to early phase IV, but with the possible rival settlement at Yanshi, production of all kinds dwindles by the latter part of phase IV at the site itself—with the exception of arrowheads (see above).

The "Xia Dynasty" question

Most archaeologists in China equate the Erlitou Culture (and the prior Xinzhai phase) with the historical Xia Dynasty (e.g. Gao et al. 1998). The culture's position in space and time are consistent with the territory said to have been claimed by the Xia Dynasty in historical records, and the period of occupation for Erlitou Culture components found at SMR (and beyond) sites is also consistent with the position in history of the Xia Dynasty, falling as it does just prior to the "historically secure" Shang Dynasty (see below).

However, I share the view deftly laid out by Liu and Xu Hong (2007) that while the Erlitou Culture seems particularly positioned to be the Xia Dynasty, the lack of any textual data thus far makes all such claims of historical affinity essentially conjecture, well-argued though they may be. Unlike the late Shang Dyansty, where we have textual records in the form of oracle bone inscriptions (see Keightley 1985), no such records exist for the Xia Dynasty. Indeed, as they argue, the earliest mention of the Xia does not occur until several hundred years later when the Zhou conquer the Shang.[9].

What comes After: The Shang Dynasty

The Shang conquest of the Erlitou polity brings the "prehistoric" stage of Chinese civilization to a close; the Shang Dynasty, in particular the late Shang Dynasty, is the first historically verified dynasty (Keightley 1999). The oracle bone inscriptions from the late Shang period, a period after the capital of the polity was

9. While outside the scope of this research, for works dealing with the Xia in textual records Chang (see e.g. 1983), Ching (1997), Keightley (1999), and Shaughnessy (1997a,b)

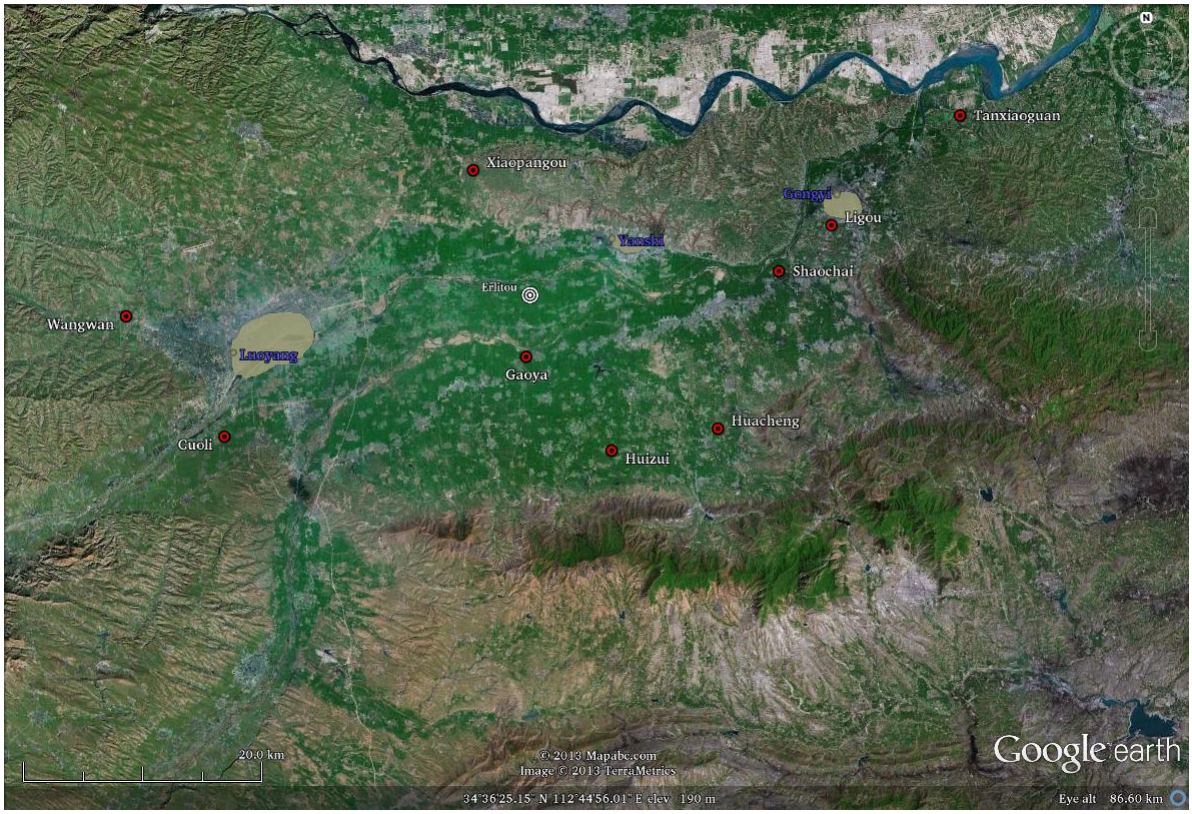


Figure 2.9: Map of the Luoyang Basin showing sites included in the study

moved to modern-day Anyang (referred to as "Yinxu" in these texts; see Chang 1986; Keightley 1999). It is at this point that dynastic king lists may be reconstructed, extending back to the beginning of the dynasty and the first king. More importantly, a great deal of information can be gleaned about Shang society, religion, and the political landscape from the oracle bone inscriptions (Keightley 1985, 1999, 2000).

2.5 The Luoyang Basin During the Longshan Period

Looking specifically at this project, the sites used in this research are all located within the Luoyang Basin, or lie along the Yiluo River drainage (the Tanxiaoguan site) of the Song Mountain Region. With the exception of the Erlitou site itself, emphasis is placed on imagined communities (see Anderson 1983) that existed within the basin during the Longshan and Erlitou periods (Figure 2.9).

Travel Distances

The distance criteria are based on several factors, but primarily include travel distances per day for a person traveling on foot, and correspond to one day of travel moving at an average of 5 km/h (*Walking* n.d.), for a maximum of approximately 40 km per day. Though this is a generalization, the distance criteria are intended to have some real-world basis in terms of ease of communication for members of Luoyang Basin society in which periods of contact, both frequency and duration, are the prime variables in determining transfer of design criteria and aesthetics or, with regard to the potters themselves, transfer of skill sets. The distance (in kilometers) between settlements and the approximate number of days travel required is shown in Table 2.2 on the next page.

In most cases, these settlements would have been within a single day's travel from each other, and in many cases a potter could return to their home community the same day.

Settlement Hierarchy

In terms of site sizes, there is a degree of variability from the Longshan to the Erlitou period. In general, not only do the sites increase in size, sites such as Shaocai seemingly appear "out of nowhere" within the archaeological record, having no detectable presence in the Longshan Period, but grow into a major center during the Erlitou Period (Table 2.3 on page 38).

An analysis of settlement data for the Luoyang Basin comes from a survey conducted between 2001 and 2004 as part of the Yiluo River Valley Project (Liu, Chen, Lee, et al. 2002-2004). Using a settlement size as hierarchy model to determine when "state formation" occurred, the authors assert that the small-scale two-tier settlement hierarchy first seen in the late Yangshao period appears to drop as the number and sizes of sites falls in the early Longshan Period. However, by the late Longshan, this hierarchy is re-established and culminates with the massive increase in size of the Erlitou settlement in the late Longshan Period. Of course, this also heralds the beginning of the Erlitou Period, during which time the Erlitou settlement nearly doubles in size, and the first three-tiered settlement hierarchy is found (Figure 2.10 on page 39). It is suggested that this three-tiered hierarchy is indicative of the creation of "The State" and an early complex polity.

	Erlitou	**Cuoli**	**Gaoya**	**Huizui**	**Ligou**	**Shaocai**	**Tanxiaoguan**	**Wangwan**	**Xiaopangou**
Erlitou	—	28k ($\frac{3}{4}$d)	5k (0d)	15k ($\frac{1}{2}$d)	26k ($\frac{3}{4}$d)	20k ($\frac{1}{2}$d)	40k (1d)	34k ($\frac{3}{4}$d)	12k ($\frac{1}{4}$d)
Cuoli	28k ($\frac{3}{4}$d)	—	26k ($\frac{3}{4}$d)	32k ($\frac{3}{4}$d)	54k ($1\frac{1}{4}$d)	50k ($1\frac{1}{4}$d)	67k ($1\frac{3}{4}$d)	13k ($\frac{1}{4}$d)	30k ($\frac{3}{4}$d)
Gaoya	5k (0d)	26k ($\frac{3}{4}$d)	—	10k ($\frac{1}{4}$d)	28k ($\frac{3}{4}$d)	22k ($\frac{1}{2}$d)	41k (1d)	34k ($\frac{3}{4}$d)	16k ($\frac{1}{2}$d)
Huizui	15k ($\frac{1}{2}$d)	32k ($\frac{3}{4}$d)	10k ($\frac{1}{4}$d)	—	26k ($\frac{3}{4}$d)	20k ($\frac{1}{2}$d)	40k (1d)	42k (1d)	26k ($\frac{3}{4}$d)
Ligou	26k ($\frac{3}{4}$d)	54k ($1\frac{1}{4}$d)	28k ($\frac{3}{4}$d)	26k ($\frac{3}{4}$d)	—	6k (0d)	14k ($\frac{1}{4}$d)	60k ($1\frac{1}{2}$d)	30k ($\frac{3}{4}$d)
Shaocai	20k ($\frac{1}{2}$d)	50k ($1\frac{1}{4}$d)	22k ($\frac{1}{2}$d)	20k ($\frac{1}{2}$d)	6k (0d)	—	20k ($\frac{1}{2}$d)	55k ($1\frac{1}{4}$d)	27k ($\frac{3}{4}$d)
Tanxiaoguan	40k (1d)	67k ($1\frac{3}{4}$d)	41k (1d)	40k (1d)	14k ($\frac{1}{4}$d)	20k ($\frac{1}{2}$d)	—	72k ($1\frac{3}{4}$d)	41k (1d)
Wangwan	34k ($\frac{3}{4}$d)	13k ($\frac{1}{4}$d)	34k ($\frac{3}{4}$d)	42k (1d)	60k ($1\frac{1}{2}$d)	55k ($1\frac{1}{4}$d)	72k ($1\frac{3}{4}$d)	—	32k ($\frac{3}{4}$d)
Xiaopangou	12k ($\frac{1}{4}$d)	30k ($\frac{3}{4}$d)	16k ($\frac{1}{2}$d)	26k ($\frac{3}{4}$d)	30k ($\frac{3}{4}$d)	27k ($\frac{3}{4}$d)	41k (1d)	32k ($\frac{3}{4}$d)	—

Table 2.2: Straight-line distance (in km) and approximate number of travel days between settlements

Site	Size
Cuoli	3.5 ha
Erlitou	~5 ha [i]
Gaoya	57 ha
Huizui	10 ha
Ligou	10 ha
Shaocai	n/a [ii]
Tanxiaoguan	10 ha
Wangwan	2 ha
Xiaopangou	10 ha

(a) Longshan Period

Site	Size
Cuoli	3.5 ha
Erlitou	300 ha
Gaoya	80 ha
Huizui	25 ha
Ligou	10 ha
Shaocai	100 ha
Tanxiaoguan	20 ha
Wangwan	n/a [iii]
Xiaopangou	20 ha

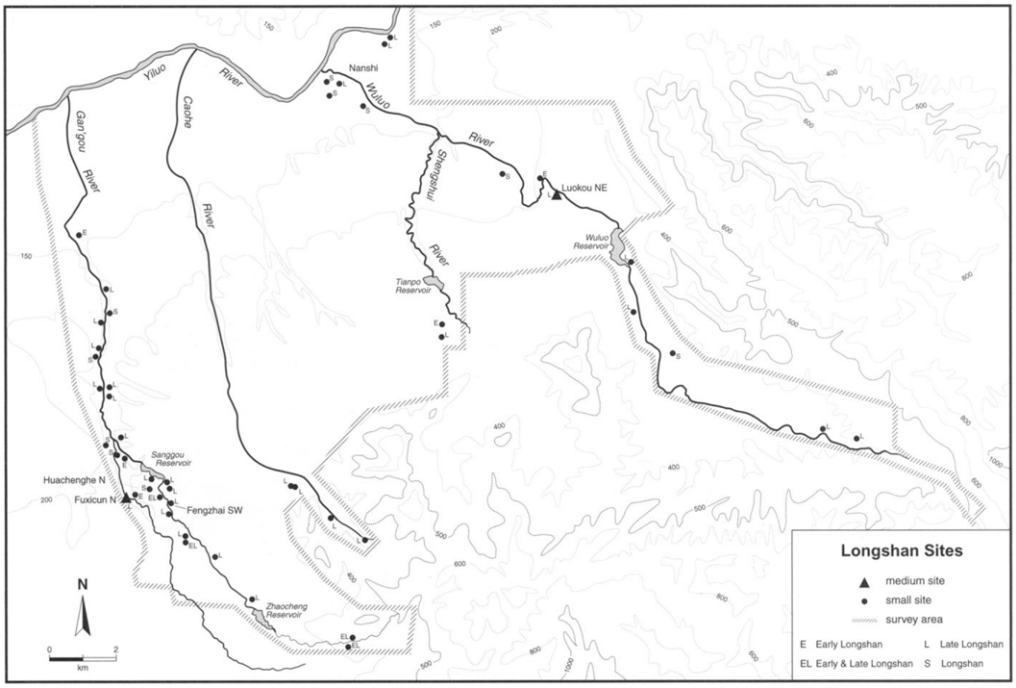
(b) Erlitou Period

[i] The Erlitou site is occupied during the early Longshan period (see “Erlitou Site” description, on page 409), but the earlier occupation has been completely subsumed by the massive growth of the subsequent Erlitou period; the size given here is only an estimate. However, we do know that the site is abandoned during the late Longshan period, and is re-occupied by phase I of the Erlitou period.

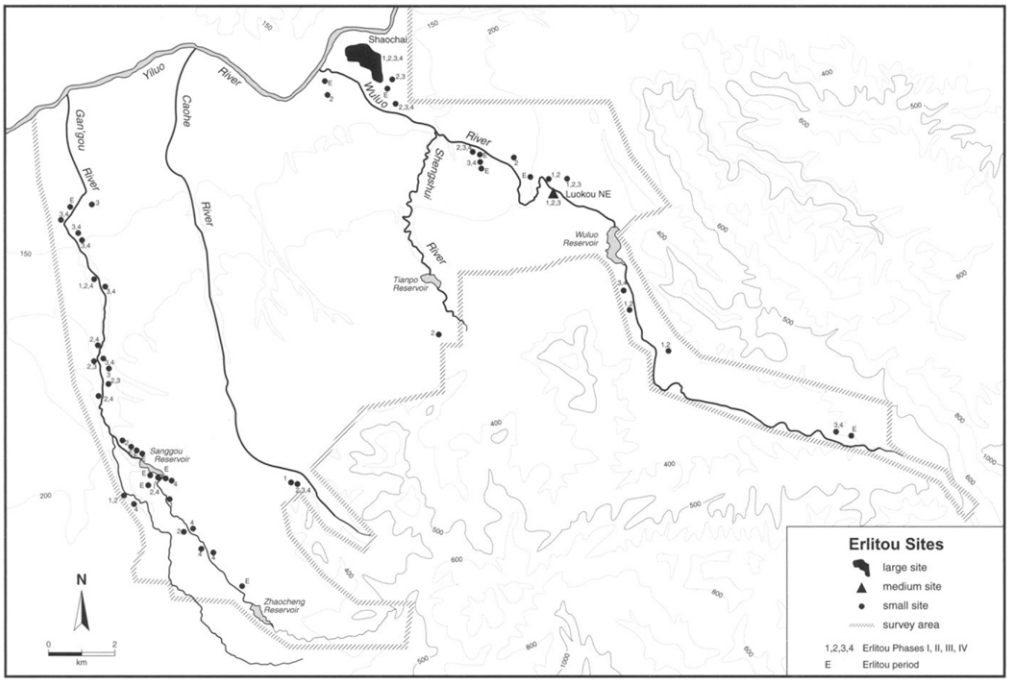
[ii] The Shaocai site is not present during the Longshan period, not appearing until phase I of the Erlitou period.

[iii] The Wangwan site appears not to have much of a presence by the Erlitou period, though the Wangwan excavators do mention some Erlitou traits evident in pottery forms during the site’s final occupation in the late Longshan (see "Wangwan Site" description, on page 428).

Table 2.3: Site sizes, by period



(a) Distribution of the 48 Longshan sites.



(b) Distribution of the 53 Erlitou sites.

Figure 2.10: Results of the Yiluo Rivery Valley site survey
(from Liu, Chen, Lee, et al. 2002-2004:15-16)

While these data are interesting, and in many respects formed the kernel of this project's thesis, the site size data used above are drawn from the site reports themselves (Table 2.3 on page 38).

3

PRACTICE AND POLITICAL CULTURE

> *"I have analyzed the peculiarity of cultural capital, which we should in fact call* informational capital *to give the notion its full generality, and which itself exists in three forms, embodied, objectified, or institutionalized."*
>
> – Pierre Bourdieu, *An Invitation to Reflexive Sociology* (1992)

In this research I focus on four related issues in the emergence of political culture and the state: 1) the relationship between practice, style, and identity; 2) social interactions between local identity groups; 3) the role of social influence on stylistic change through time, and; 4) stylistic change as an index for the role of a political (material) culture in the emergence of the state (see also Anderson 1983; Baumann 1987; Formisano 2001; Grosby 1997; Somers 1995). These four aspects build upon each other, establishing the foundation for an analysis of stylistic change that points to the influence of a dominant settlement on pottery styles in the region. Below, I describe each of these aspects in detail, elucidating the links between these discrete bodies of theory.

This research embraces the pre-processual approaches and understandings of ceramics and society pioneered by (Taylor 1948). However, this project incorporates new approaches to the investigation of ceramics using instrumental analysis, while the communities of practice concept is utilized to set the terms upon which style is understood, and how social factors affect the creation of style. Because of this relationship between society and style, style must also be understood to signal group identity, and contribute to group solidarity. As it is used here, "solidarity" does not mean the "equality" of social relationships or between social actors, but must be understood as simply the incorporation of hierarchies of status—even when one of the tenets of solidarity is the perception of equality. This being the case, those entities with higher status within the group, be they individuals or communities, provide certain degrees of leadership in many aspects of social life, both material and immaterial. Included in these aspects is the group's aesthetic sense of proper and improper style, dictating styles that strongly indicate "belonging" versus those that do not. Finally, when

looked at as part of political culture, the development of this aesthetic may be used as an index of the increasing solidarity within the group, and in particular, points to the growing influence (and concomitantly, the status) of one member community over the rest. This development, I suggest, is the essence of the emergence of the state.

Complex Polities and Political Culture

Understanding the dynamics of state formation has a rather long and varied history within archaeology, but in many respects this area of research encompasses several of the fundamental questions that study of political culture in historical and modern society also seeks to address. Perhaps most importantly is the question of what forms does political culture take? As discussed below, many of the definitions of political culture revolve around attitudes or dispositions, but few of the definitions directly include material culture. However, aspects of those definitions that deal with symbols and identity (e.g. Beer and Ulam: "set of expressive symbols" (1973) or Verba: "sense of national identity" (1965)) lend themselves to manifestation in material culture, and these can most readily be studied from a stylistic perspective (e.g. Miriam T. Stark 1998). The task becomes more difficult, though, when we are also interested in behavior, and this brings us to Chilton's (1988) conception of political culture which is focused less on attitudes and dispositions, but the behaviors that result from them.

3.1 A Primer on Political Culture

The concept of political culture has its roots in Western Sociology and has been little used in archaeology. In some ways this may be the result of difficulties social and political scientists have had in defining political culture, though similar difficulties in defining "the state" have not slowed its use in archaeological discourse. Nevertheless, a concept of political culture, one particularly focused on its material manifestations seems to be an area of numerous possibilities. In this section, I briefly review usage of political culture in sociology and political science, and then turn to a definition of political culture that seems well-suited to usage in a practice-based approach to archaeological research.

Usage in the Social Sciences

First utilized by Almond (1956) and subsequently refined by Almond and Verba (1963) in their analysis of "civic culture" throughout American history, political culture came as a result of the introduction into political science of the "culture" concept as it was being used in anthropology. In sociology and political science, with their emphases on Western society, the notion of an all-pervasive system that tied people within a society together appeared to solve several problems that were being encountered by social scientists.

Samuel Beer, drawing on Talcott Parsons, approached the concept of political culture by suggesting that political culture orients a society toward a polity and its processes, provides it with a system of beliefs, a way of evaluating its operations, and a set of expressive symbols (see also Beer et al. 1958, 1973). Around the same time, Verba (1965) defined four key dimensions of political culture in his analysis of modern German politics: 1) a sense of national identity; 2) attitudes toward oneself and one's fellow citizens as participants; 3) attitudes toward the political processes of decision-making, and; 4) attitudes and expectations regarding governmental output and performance (see also Pye et al. 1965).

3.1.1 Political Culture Redefined

In an article appropriately titled "Defining Political Culture," Chilton (1988) distilled current usages of political culture down into what he believed were its most basic elements, while also addressing the problems each of these previous definitions encountered in their application. Chilton defined nine criteria that need to be met for a good definition of the political culture concept:

Supramembership "The conceptualization of [political] culture must distinguish culture from mere aggregates of individuals considered in isolation. As Lehman (1972) insists, culture is a supramembership (emergent) property."

Sharedness "The conception of [political] culture must refer specifically to something shared among people. The importance and uniqueness of culture lie in its role as a common framework of mutual orientation."

Inequality "The conception of [political] culture must allow for the *possibility* that different people have different degrees of influence over the culture" (emphasis in original).

Behavioral "The concept of [political] culture must be such that culture's effects can be observed in public behavior—actions performed when taking other people into account."

Post-Behavioral "The conception must distinguish culture from mere regularities of behavior. . . . Geertz (1973:3-30) terms badly factual reports of behavior 'thin description' in contrast to 'thick description,' which situates behavior in its web of cultural meaning."

Unrestricted Applicability "The conception must apply to the entire range of human social organization, so that social scientists may use the concept without restriction."

Non-Reductionism "... the conception must also permit full attention to the unique aspects of any culture's approach to politics."

Comparability "The conception must permit meaningful comparisons of cultures, and within a single society, meaningful comparisons of different facets of its culture."

Objective Testability "The conception must be capable of producing hypotheses that are testable by objective standards against empirical data" (Chilton 1988:422-4).

Chilton examines two definitions of political culture against these criteria, then when both are found lacking in meeting all of these criteria, he modifies one of the definitions (Dittmer 1977) as the foundation for his own definition of the political culture concept. In brief, Chilton defines political culture as "all publicly common ways of relating within the collectivity," a definition that satisfies all nine of his criteria (Chilton 1988:431). The phrase "way of relating" is key to this definition in that each "cultural symbol stands for, justifies, describes, or otherwise contemplates a culture's 'way of relating'—the organized system of mutual expectations by which social behavior is informed and made meaningful" (Chilton 1988:427)[1]. Also key to

1. "By social behavior I mean all action undertaken in coordination with other actors, whether or not those actors are present [see subsection §3.2.1, pg. 54 below on "participation" in communities of practice]. . . . A way of relating is a standard for engaging in interaction: a method of defining situations, selecting alternatives, and acting. . . . [Thus] a way of relating is not any specific set of actions but is rather a way of understanding and coordinating action. Ways of relating involve not simply isolated actions but rather many actual and potential actions integrated in a web of meaning as Geertz (1973:3-30) argues" Chilton 1988:427, n.14.

this definition is the insistence on the ways of relating being *publicly common* within the collectivity. This insistence is necessary, Chilton explains, for four reasons:

1. Public commonness "eliminates ad hoc specifications of which social aggregates are cultures."
2. Public commonness "allows cultures to be studied and characterized as wholes, because by definition all actors in the culture work within shared, and acted upon, ways of relating."
3. Public commonness "distinguishes acquiescence from approval, acknowledging that cultural expectations can differ from individuals' preferred ways of relating."
4. Public commonness is understood to provide the foundation for two important social phenomena: socialization and cultural change. Thus, it "is difficult to maintain, and so is responsible for society's immense investment of labor in schooling and other socialization [and it] is also difficult to establish and alter" (Chilton 1988:429-30).

Considerations of social and political power stem from item three (3) above because political culture "is established and maintained not just from people's preferences but also from their relative ability to make those preferences publicly common" (Chilton 1988:430).

Another important aspect of this definition is the idea that "ways of relating" is not indicative of structured behavior in a structural-functional sense; these ways of relating are not part of a social "script" that people follow in their day to day lives as they interact with each other when, in the present scenario, dealing with political situations. "Social behavior comes not out of fixed behavior patterns but rather as people engage social situations by interpreting them. People identify, interconnect, and consequently make meaningful their own and others' actions" (Chilton 1988:432-3).

Finally, Chilton acknowledges that there may be costs associated with the insistence on the ways of relating being "publicly common," the most important of which is that political culture "can be determined only *ex post facto* and provisionally. Cultures can shift rapidly as people adopt (or fall away from) an existing publicly common way of relating" (1988:430).

3.1.2 Collectivity and Solidarity

Bound up within the "ways of relating" and being "publicly common" is the notion of solidarity. Chilton acknowledges that much of his theorizing on political culture owes a debt to social scientists, among these Émile Durkheim. In many ways, Durkheim's interest in and investigations of solidarity are a subset of the larger question of political culture, and Chilton's definition provides a mechanism and rationale for the concept of solidarity. In other words, "ways of relating" and the ability to negotiate meaning within a society in "publicly common" ways gets to the very heart of solidarity itself.

Durkheim was interested in what holds a society together and sought to distinguish between two types of society: mechanical solidarity and organic solidarity. In practical terms, these are also societal stages of development. The traditional society was held together through *mechanical solidarity*, a solidarity based on shared kinship and familial networks. This is the solidarity of small-scale societies with little division of labor. The implication, of course, was that simple societies were less-evolved or "primitive" in many respects compared to modern Western societies. The industrialized, complex societies of the West in the 19th century were, by contrast, held together through *organic solidarity*, a solidarity based not on any specific demographic characteristic, but on the inter-related nature of society and the reliance one individual had on others to provide the material means of life that they themselves did not provide due to the division of labor. This model, while clearly bi-polar and perhaps simplistic in nature, nevertheless provided a basis upon which much of the social sciences relied in the following century of research. As subsequent research has shown, it may very well be that the two poles of Durkheim's model do not exist in the real world, but they delineate the spectrum along which societies, "real" societies, are characterized. The challenge for social scientists is that, if mechanical and organic solidarity (as defined by Durkheim) are more akin to Weberian "ideal-types" (Weber 1997), what does one look for to define societies that fall between these two poles?

What we are often interested in when we discuss "state formation" is the transition from mechanical to organic solidarity; the move from kin-based society to one in which bonds between individuals extend beyond their families and kin, and instead tie one to the other through a reliance on work and economic interdependence of craft. Society moves from the "everyman" and jack-of-all-trades to those that gain

expertise through the dedication of one's time to improving skills in a limited range of tasks. The problem with the bi-polar view of solidarity is that there is little understanding of how a society gets from one to the other. In many ways, this is what makes research on state formation so wide-ranging and intense: scholars seek to find the in-between spaces that indicate a shift from mechanical to organic solidarity.

Symbols of Solidarity

One of the tools for creating organic solidarity are the symbols that identify an individual as a member of a particular group, as discussed above with regard to style and identity. Consider Wiessner's articulation of styles as emblemic and assertive (Wiessner 1983, 1990): objects that have emblemic style elements are those that signal social identity within a cultural network, while those objects that have assertive style are those that "assert" the cultural (ethnic) identity of the individual possessing the object. In Wiessner's formulation, assertive style is understood to be directed outward, toward individuals that are *not* members of the same culture/ethnic group. However, the same markers of assertive style may also be employed to build a collective conscience, in a political push to assert a sense of solidarity among disparate settlements, formerly not bound by any ties except perhaps informal kin and economic ties.

As nascent political leaders expand their control through economic ties, at least according to traditional models of state formation, they are also expanding control through social ties as well. Whether these efforts are overt and intentional on the part of the political elite, or these leaders are simply taking advantage of an "organically" developing sense of solidarity needs to be determined on a case by case basis. Nevertheless, the role of assertive style in building this solidarity is crucial in as much as such forms of passive style can be. However, it may even be the case that such assertive style is employed in an active fashion, as a "living" symbol and declaration of one's alignment with a particular political leader. Indeed, the communities of practice model provides a mechanism for this use of assertive style through the dimensions of *imagination* and *alignment* under identification.[2] And while Anderson (1983) discusses the creation of much later European nations in *Imagined Communities*, he nonetheless provides a set of examples of this process, even if he

2. See *Identification* on p. 56 for a discussion of alignment in the communities of practice model.

is not specifically using the terminology of the communities of practice model. These are also nations that have social and economic ties that develop into political ties and the extension of political power.

Asymmetries of Solidarity

The solidarity of a settlement is predicated upon shared sets of criteria, aspects of the individual members of the society that they all share and that have their basis in locality (e.g. community), in kinship (e.g. family, clan), or in culture (e.g. ethnicity). This *collective conscience* (Durkheim 1984 [1893]), however, also provides the perfect tool for the creation of an elite class within the community because it can be manipulated to convert social power into political power, or power that is itself "public" and not limited to the socially constructed units which all members of the community are born into. In other words, the collective conscience provides the social legitimacy for political authority when the shared sets of criteria that form the basis for solidarity are manipulated in order to legitimate the rule of one individual or group of individuals over others. The collective conscience becomes the foundation for an ideology in which having these nascent political leaders is considered not unusual, and indeed necessary for the community's continued success. When we consider these intra-community relationships, of leaders to citizens, they are no longer symmetrical because not all members share the same degree of influence in acting for the furtherance of community goals. These asymmetrical relationships are manifest through differential uses of power (Baumann 1987; Chase et al. 1996; Eisenstadt et al. 1984).

Networks of Solidarity

Material culture certainly plays a role in building organic solidarity within a settlement, or even several nearby settlements that have long histories of social and economic ties. Indeed, these settlements often result from economic specialization that Durkheim sees as the key distinction between mechanical and organic solidarity. But material culture also provides the vehicle for expanding solidarity outside these localized settlements into the region at large. The political power that comes from solidarity, a coalescence of the collective conscience around a shared sense of identity and culture, creates a powerful motivational

point from which political leaders can rally members of society. Such attitudes are infectious, especially when being considered a member of this successful society confers social and economic advantages.[3] If such solidarity comes about "organically," the seeds of solidarity may already be present in settlements that engage in trade with the original settlement, and if there are economic ties, there are almost certainly social ties as well. As the success of the original settlement grows, these outlying trade partners also seek to become part of a network of solidarity, a network of shared identity, a network which confers a certain social and economic status with surrounding settlements.

When we treat settlements, such as those of the Luoyang Basin, as members of an expanding, regional group and consider instead *inter*-settlement relationships, similar principles of asymmetry within this regional group also apply. Just as solidarity creates a bond within a settlement, the development of solidarity that expands beyond the settlement also creates bonds between the settlements across the region. However, this solidarity is based not merely on kin-ties alone, but on the reliance of one community on the others for different needs as the communities themselves specialize in certain production activities—the classic definition of settlement hierarchies.

Reconsidering collectivity in this way actually takes us back to the concept of political culture, and we can modify, for our purposes, the definition of political culture as the "publicly common ways of relating within the collective" which generates a sense of solidarity between settlements. Again, such solidarity in the early stages does not have any asymmetric relationships, which is to say any hierarchies, but these develop as time goes on and political entrepreneurs build an ideological mask on top of this foundation of solidarity. All of this solidarity, of course, is part of the political culture, and it within this framework of solidarity that meaning and identity is negotiated on a daily basis within the constellations of practice that make up the society (aka, the collectivity), as a whole.

3. Membership in the European Union is a prime example of this, especially for smaller member states (and former Soviet states) in which participation in the EU economic system enhances trade relationships and the social status of its citizens.

3.2 Understanding Practice

What came to be called "practice theory" has its origins in Mauss' "technique du corps" (1973 [1936]) when he observed that certain ways of walking or moving appeared to be culturally circumscribed. That is, members of a particular ethnic group (in Mauss' case, ethnic groups in sub-Saharan Africa) moved in similar ways; they did not walk or perform certain actions identically, but their movements did share certain stylistic features. For Mauss, this suggested that these ways of moving, these "techniques of the body," were learned in the process of enculturation from older community members, and proscribed the range of acceptable movements for the group.

This look into "techniques" is taken up by Pierre Bourdieu in his work *Esquisse d'une théorie de la pratique* published in 1972 and "Outline of a Theory of Practice" for the Anglophone world (1977). Bourdieu's practice theory is intensely interested in understanding social and political behavior and he provides a sketch of the role played by techniques in human society. Four concepts are key: practice, *habitus*, symbolic capital, and the frame.

Bourdieu sought to understand these practices and how they might impact or influence behavior. As Mauss suggested, certain groups engage in activities similarly as individuals, but as a group what and how they do these activities varies from other groups doing the same activities. Practice entails essentially any action an individual engages in, no matter the situation. The French *la practique* translates as "ways of doing" in English; this includes the entire breadth of human activity, from making baskets, to formal and informal speech patterns, to choices of dress for work versus family functions. In each case, an individual's understanding of what is or is not appropriate in any particular setting (the office, the family picnic, or the political rally) is governed by their knowledge of the "frame" in which they are operating. The frame is comprised of sets of embedded practice.

Within any given frame, for example attending an office party or giving a political speech, we behave in certain ways, and these are "structured" by our societal *habitus* which proscribes "ways of doing things" that are acceptable within that frame. Within a different frame, practices that are acceptable in one frame may not be acceptable in another, and our knowledge of these stems from the *habitus* for that frame. The situation

provides, essentially, a "frame of reference" for our actions, and each frame has a different *habitus* associated with it, even if the individual has never been in the particular situation before. When this is the case, when someone finds themselves in a new frame, they draw on the *habitus* of similar frames, often with the most conservative range of behaviors, and begin the process of intense learning as they put together what is and is not acceptable practice within the new frame. Again, behind these practices lie a more pervasive *habitus* that guides everyone else, and the individual discovers the acceptable practices based on this *habitus*; in essence, the individual constructs their *habitus* for this frame through participant learning. This also means, though, that some frames, while they might appear the same, actually differ because they are structured by a *habitus* foreign to the individual, in which other participants are of different social, religious, cultural, or political backgrounds.

In modern sociological theory an individual can engage in a wide array of practices and the individual is understood to have free will. According to Bourdieu, though, in reality the *habitus* structures and limits what an individual can do, what practices they can engage in. Only by "spending" symbolic capital can an individual change the habitus for that frame. Symbolic capital is derived from aspects of an individual's status and position is society; thus, in most cases a judge, politician, or pop star will have accumulated more symbolic capital than a teacher, government administrator, or small-business owner. In Bourdieu's theory of practice, only those with symbolic capital can change the *habitus* structuring practice within a given frame. Moreover, with enough symbolic capital, such an individual may be able to effect change within a frame they have only a basic familiarity with, such as a pop star working to change treatment of the poor. However, one caveat to this basic equation comes when a group of individuals rally together to affect change in *habitus*, their symbolic capital pools together, generating a reservoir of symbolic capital far greater than that possessed by them as individuals.

Anthropological Archaeology

The foundations of practice theory made their move to archaeology through André Leroi-Gourhan. Leroi-Gourhan focused on techniques which are a subset of practice involving not the pervasive "ways of doing"

but the more circumscribed "ways of making" because his emphasis was on the creation of material culture. He also introduces the notion of the *tendance* or the technical tendencies that are shared by a culture group, and argues that, though these tendencies are independent of any specific culture or ethnic group, they nevertheless are expressed through the production activities of the culture or group.

Through Leroi-Gourhan's study of prehistoric technology, he develops the concept of the *chaîne opératoire* in which the techniques used in the production of objects can be analyzed and understood as being part of a sequence (or chain) of operations.

Lemmonier, who developed Leroi-Gourhan's concepts into an archaeological approach, concedes that techniques are independent of cultures, but nevertheless argues that the use of specific techniques, or more precisely, specific sequences of techniques, as evidenced on artifacts, can be used as a means to identify and differentiate culture groups from one another (Lemonnier 1986). In essence, Lemmonier identifies and clarifies the "mechanics" that lie behind the old, and perhaps believed antiquated, methods used only intuitively by culture history and its concept of the "archaeological culture" which identified "style" as its sole criterion. In other words, there is a mechanism or process that creates "style" and it can be found in the use of specific sequences of techniques by individual cultures.

From Bourdieu and the subsequent generations of French scholars, practice theory has made a significant impact on social science research, as seen by the proliferation of studies which make use of, and even extend, the understanding and role practices play in everyday lives. Though research on learning has a much longer history in the social sciences, its relatively recent introduction into archaeological discourse suggests that the effect of learning patterns on artifact variability, especially stylistically, are only now becoming realized. Most recently, the interaction between learning and distinct sets of practices has been most powerfully articulated through research on "communities of practice" that considers the way in which groups of people do things differently based on where and how they learn to do these activities, or "situated learning" (Lave et al. 1991).

3.2.1 Communities of Practice

The "community of practice" concept was first suggested by Jean Lave and Etienne Wenger (1991) in their analysis of apprenticeship as a form of learning. In this early iteration of the communities of practice model, what defines a community is left broad in order to include many types of organizations, from apprentice tailors to apprentice midwives. In general, though, a community is understood in the sense of individuals engaged in certain tasks (i.e. practice) in which learning occurs as a matter of course in such contexts. As they suggest: "In our view, learning is not merely situated in practice—as if it were some independently reifiable process that just happened to be located somewhere; [instead] learning is an integral part of generative social practice in the lived-in world" (1991:35). In some cases these interactions take place within the family (e.g. midwifery), within a newly constituted family (e.g. tailor apprenticeship), or even a work unit within an imagined family (e.g. US Naval quartermaster training). Lave and Wenger argue that by renewing an investigation of apprenticeships as a learning context, they seek to cast off the generally pejorative views of apprenticeship that had been based on Feudal and Enlightenment periods of European apprenticeship in which apprenticeship is considered an institutionalized form of free labor, and even a relationship between master and apprentice that bordered on master and slave (Lave et al. 1991:62-3). Because their research was focused on learning-in-working contexts, they needed to describe these contexts in terms that incorporated the two fundamental aspects of these contexts—that the learning occurred in a community (social context) of people engaged in a practice (work context)—hence, community of practice. However, in these contexts the community of practice itself is not an object of study, but is considered a discrete level of analysis and the best level at which to understand the social process of learning.

One of the key concepts that Lave and Wenger use to describe how they understand this learning-in-working is *legitimate peripheral participation*, in which each of the terms that make up the phrase are important and not reducible to each other.[4] Perhaps most importantly, however, they suggest that legitimate peripheral participation is not a generalization of the mode of learning that occurs within an apprenticeship,

4. Nor are they in an antonymic relationship with their opposites; there is no illegitimate central observation, for example, although this sounds almost like the ethnographer's "participant–observation" method, one hopes their work is at least "legitimate" in the eyes of their consultants.

it is not an abstraction, but a concept that can be used to analyze specific historical and cultural instances of learning: "It may convey better what we mean by a historically, culturally concrete 'concept' to describe legitimate peripheral participation as an 'analytical perspective' "(Lave et al. 1991:39).

Communities of Practice *Redux*

In a subsequent volume, Wenger (1998) explored more fully the communities of practice concept developed previously by Lave and Wenger, expanding it into a more fully formed model for social life, one particularly focused on doing, especially producing things both material and immaterial. According to Wenger, one of the key precepts that undergirds the community of practice model is the notion that there are two aspects: first, there is the practice itself, the doing of a group of individuals, and the primary reason the group exists in the first place (i.e. people come together as a group to engage in a certain set of activities for a given purpose—see below). Second, however, is the identification of individual group members with the group's practice. These two aspects of the concept are the social of doing (to practice) and the members of becoming (to identify).[5] This dual nature is what makes the "work" of a community of practice a generative social process, because the group is continuously engaged in doing and becoming, both of which create a sense of belonging. The reason that being part of a community of practice creates the sense of community and identity is that, in addition to the material "output" the community is engaged in, the community (and its members) are constantly engaged in a negotiation of meaning for themselves as individuals and as a group. This negotiation of meaning lies at the center of the community of practice concept, forming the nucleus for the two aspects of practice and identification.

Participation and Reification. Wenger also describes the two complementary processes that are involved in order to engage in practice (and identification): participation and reification. The first process, participation, is important in the sense that if an individual is a member of a community of practice, then they are always *participating* in the community, even when they are not literally engaged in the work of the

5. Wenger discusses these two aspects in separate "parts" of the volume which makes the importance of the dual nature of the community of practice difficult to reconcile.

community of practice (see below on "engagement"). Thus, once a community of practice forms, its members are always involved in the negotiation of meaning for their community and their identity. The second process, reification, is where the community creates reified "bits" of its practice in order to more easily (one hopes) facilitate the work of the community. For example, forms and worksheets created to more accurately record data, rules and regulations to systematize the practice, or shorthand phrases that represent larger operations of practice are each types of reification; they make the work of the community easier and faster. Both of these processes are important when considering pottery production, but reification in particular is something we will return to later.

In what follows, I have distilled the core components of the community of practice model along two lines. First, what I have termed "Relational Aspects" include the core concepts of Practice and Identification. Second, are the "Contextual Aspects" of Learning and Locality/Boundary that are temporal and spatial in nature.

Relational Aspects: Practice and Identification The core concepts of the community of practice model, practice and identification, are the primary loci in which the negotiations of meaning take place within the group and between its members.

Practice. The practice of a group has three dimensions: its members have mutual engagement; in a joint enterprise; with a shared repertoire. Through practice, members interact with one another on a regular basis and engage in tasks which they each acknowledge must be completed, and which results in a shared pool of knowledge about how to accomplish these tasks as a group. In other words, practice is "the source of coherence of a community" (Wenger 1998:72).

The first of these, mutual engagement, simply means that the members must engage in the practice of the group in order for the community to be created. This may seem somewhat obvious, but this dimension is essential as a means to distinguish members of a given community of practice from others that may be engaged in the same kind of work—they cannot be members of this community of practice because they are

not engaged in the work with the members of this group, but with their own.[6] This distinction is especially important if the community of practice is to be considered a "level of analysis" as Wenger (1998) argues. Moreover, unlike participation that was mentioned earlier, mutual engagement specifically refers to the actual act of engaging in a group's practice.

The second, a joint enterprise, comes from the members acknowledging that they are engaged in the same practice, that they are "in this together." In other words, this engagement creates an indigenous enterprise—through the negotiation of meaning, the members make the practice their own, even if they have been tasked with the work by an external authority. This engagement also creates a regime of mutual accountability; the members become accountable to each other for doing their part in the practice of the group, regardless of any accountability to an external authority.

The third, a shared repertoire, is the sum of the "routines, words, tools, *ways of doing things*, stories, gestures, symbols, genres, actions, or concepts that the [group] has produced or adopted in the course of its existence [and] the discourse by which members create meaningful statements about the world, as well as the styles by which they express their forms of membership and their identities as members" (Wenger 1998:83, emphasis added). The shared repertoire has two characteristics: 1) it reflects a history of mutual engagement; and 2) it remains inherently ambiguous. These characteristics reflect the malleability of a shared repertoire in which "words, artifacts, gestures, and routines are useful not only because they are recognizable in their relation to a history of mutual engagement, but also because they can be re-engaged in new situations" (Wenger 1998:83). The repertoire is thus a collective resource for the negotiation of meaning; it is built up in order to make different parts of practice faster or more efficient. So, while some components of the shared repertoire may become reified in the form of tools, written procedures, or short hand phrases and gestures, the repertoire itself is always being created and renewed.

Identification. The identification of a group also has three dimensions: engagement, imagination, and alignment. The three dimensions of identification develop through time as well, and the sense of belong-

6. see *Locality/Boundary* below on pg. 58 for a related discussion on practices moving between communities of practice.

ing becomes incorporated into the individual's identity. These dimensions are also predominantly internal states, though clearly there is a healthy "doing" component to engagement. Nevertheless, unlike the three dimensions of practice, these states allow for individual members of the group to imagine or align themselves without this being a shared, collective, state of being. Wenger reiterates throughout the volume that these three dimensions are a source of heterogeneity, and may create discontinuity within the group—in other words, a community of practice is not synonymous with harmony or complete agreement.

Not unlike its twin in practice "mutual engagement," the first dimension of the aspect of identification, engagement, means the members engage in the practice along with the other members of the group. This "engagement" in identification and mutual engagement in practice provide a link between these two aspects and make clear the active and collective nature of a community of practice. Because of the bounded nature of engagement, it is distinct from the other two dimensions of identification. Most importantly, there are physical limits to engagement: first, "we can only be in one place at a time;" and second "there are physiological limits ...to the scope of activities we can be directly involved in, and to the number of people and artifacts with which we can sustain substantial relationships of engagement" (Wenger 1998:175).

The second dimension, imagination, is what allows the member to see themselves as part of a group greater than or outside their local community of practice, and imagine others that are just like them, engaged in the same activities under similar conditions. In this sense, imagination entails the ability to transcend ourselves in the here and now, in order to create an image of ourselves and others like us elsewhere and elsewhen. Wenger also makes clear that his use of imagination is not meant to suggest fantasies or withdrawal from reality, but instead it "emphasizes the creative process of producing new 'images' and of generating new relations through time and space that become constitutive of the self" (1998:177).

The last dimension of identification, alignment, is how members of a community of practice engage in their practice as a means to belong to something outside of the community itself. Is their practice part of a greater social and physical community? Or perhaps they are working for a certain company or organization with whom they (want to) feel connected. As Wenger suggests

> ...alignment is an important aspect of belonging. For instance, governmental institutions, ...religious faiths, ...political and social movements, ...all propose broad systems of styles

> and discourses through which we can belong by aligning, for certain purposes, our ability to direct our energy and affect the world. (1998:180)

Wenger further explains alignment also concerns power, in the sense of "power over one's own energy to exercise alignment and the power to inspire or demand alignment" from others (1998:180). Lastly, Wenger (1998:182-3, ns. 2, 3) describes imagination and alignment as more broadly applicable versions of Benedict Anderson's (1983) *Imagined Communities*.

Contextual Aspects: Learning and Locality/Boundary In addition to the core aspects of the communities of practice model, practice and identification, there are three other key aspects of the communities of practice model that require discussion. These key aspects are essentially temporal (learning) or spatial (locality/boundary) in nature.

Learning. The first is learning which, according to Wenger (1998), occurs as part of practice, and in many senses represents a "time" axis within the model. The accumulated experience a member of a community of practice gains should be considered learning; this includes all types of practice, not just in an apprenticeship, because members learn how to do their jobs with increasing accuracy and speed. Clearly this learning is restricted to those areas of knowledge relevant to a particular community of practice, but since all members participate in multiple communities of practice throughout their lifetime, the community members' learning is not so restricted.

In addition, by means of learning the practice of a community leads to "emergent structure" (Wenger 1998:96-98). This emergent structure is Bourdieu's *habitus*, except that for Wenger, the directionality is reversed; for Bourdieu practice is structured by the *habitus*, but for Wenger the *habitus* (to use the same terminology) is the result of learned patterns of practice.[7] It is also the case that communities of practice themselves learn. At any particular moment this knowledge may be confined to certain community members, but through the reification process in which this community knowledge is written down and recorded, the

7. See Wenger 1998:96 n.3 for his explanation of why the CoP model reverses the original *habitus* and structure process.

community can be said to have learned. This collective learning adds to the history of the community, and allows future members to acquire this knowledge more quickly. Likewise, as members leave the community through time, if this community knowledge is not retained in some reified form, then the knowledge is also lost.

Locality/Boundary. The aspects locality and boundary are really two states of a single concept, but it is useful to separate these states and discuss them individually. In many ways, these define "space" for the community of practice, but are not merely locational concepts. Locality refers to the particular (physical) place that the community engages in its practice; for the researcher, this helps to narrow the "scope of engagement" for the community of practice because one cannot be engaged in a community of practice if one is not in the same place as other members of the community (see *mutual engagement* and *engagement* above). To reiterate, engagement requires locality, but members always participate in the community even when they are not engaged in active practice. As with learning, an individual likely participates in several communities of practice at a time, but they are only engaged with and located within one of those communities at a time. Furthermore, other individuals are engaged in other communities of practice at the same time, and may even be located within close proximity to other members in the same settlement.

This leads to consideration of a related concept that deals with locality: constellations of practice. We cannot consider a given community of practice in isolation because other communities are always being engaged in at the same time, and these communities "run into" each other as members engage in practice in the same locality, all of these communities create constellations of practice, each connected to the other through proximity of space and time. As mentioned previously, as communities of practice develop (and learn) they develop a shared repertoire of particular practices, styles, and discourses that assist them in their activities, and that are unique to that particular community. Through a constellation of practices, these styles and discourses may become adopted by other communities of practice within the constellation, and in this way communities of practice may influence each other.

Nevertheless because the communities of practice are distinct collectives in their own right, there are boundaries between the communities within a constellation of practices. The boundaries, in most senses a metaphorical term, of a community of practice are those figurative spaces where communities of practice within a constellation of practices come into contact, and explain in general terms how practices, styles, and discourses (the *shared repertoire*) can be transferred from one community to another. Wenger (1998) describes two complementary processes, one participatory and one reificatory, by which the shared repertoire of one community of practice may be transferred to another.[8] The participatory process is called brokering based on the concept introduced by Eckert (1989, 2000) to describe how high school students that have membership in different cliques are able to act as "brokers" to introduce new styles and discourses from one clique into another. For Wenger, brokering requires the broker to strike a delicate balance of participation within both communities, risking becoming drawn into the adopting community and perhaps rejected as an outsider by the original community.[9] As a result of needing to maintain this "in-between" status on the boundaries of communities of practices, brokers often find themselves somewhat isolated from either community, and "[b]ecause communities of practice focus on their own enterprise, boundaries can lack the kind of negotiated understanding found at the core of practices about what constitutes competence" (Wenger 1998:110). In other words, the broker ends up having no expertise in either community.

The reificatory process located at the boundaries of communities of practice comes from *boundary objects*, a term first used by Star et al. (1989) to discuss the means by which objects can be agents in changing perspectives among different groups within the sciences, not unlike what you find today in the tech field with co-working spaces or for creatives in maker spaces. Boundary objects are often what allow different communities of practice to work together, and despite the term itself, boundary objects are not only objects that are used by different communities, they can also be buildings or forests where communities of practice (and different interests) engage in their practice—in this way, physical spaces can themselves be boundary objects, and each community has its own negotiated meaning attached to the space.

8. see pg.54 above on the dual processes of participation and reification.

9. i.e. the community of practice from which the new style or discourse originates, as opposed to the community which the broker is introducing the style or discourse into, i.e. the adopting community.

To reiterate, through both of these participatory and reificatory processes, the shared repertoire of a community of practice can move from one community of practice to another within the constellation of practice. As mentioned above, the constellation of practices is not strictly speaking a single society or culture, although one can imagine that there may be more "boundaries" between communities of practice that operate within different constellations of practice. In some regard, such constellations of practice may be thought of as discrete, bounded entities akin to a society, except that we know that is not how societies work. The *network of practices* (Latour 1993) that make up a constellation of practice share boundaries with other such constellations of practice and its own network of practices. In any case, trying to define a constellation of practice misses the point—it is also a level of analysis above a single community of practice. When thinking about how localities and boundaries work in the model, the ability of styles and discourses to move from one community of practice to another is rather simple, and yet with regard to the spread and adoption of new styles and discourses from one community to another, the notion that a constellation of practices is not fixed, but fluid, that it grows to encompass new communities of practice, signified by the adoption of these shared repertoires, it hopefully becomes more clear how the model accounts for change, and how such adoptions tie back to the aspects of imagination and alignment. Through learning (i.e. the time axis), signaling a shared alignment with others in the imagined constellation of practice through the replication of these styles and discourses provides a valuable tool toward understanding how meaning is negotiated within a community of practice and its relationship to other communities of practice within a constellation of practices. We will return to this process in the section on style.

3.2.2 Communities of Practice and Pottery Production

With the framework laid out for the communities of practice model, we need to articulate how this model can be applied to an archaeological case study. In contemporary archaeological research we are able to make well-reasoned inferences regarding behavior from the materials we do have, but there is generally a discon-

nect between model and data where inferences must act as a bridge.[10] When we apply the communities of practice model to archaeological data, we are in a more tenable position because the model incorporates and accounts for the objects within the social processes in which we are interested (e.g. the production of, the assimilation of, the mutability of, etc.).

There are few difficulties using communities of practice to understand skill acquisition because the concept has its origins in the study of learning and apprenticeship (see §3.2.1 above on pg. 53). The definition of apprenticeship used by Lave et al. (1991) is open-ended in the sense that essentially in any situation where one person has less skill than another, learning is occurring. This is not an apprenticeship in the traditional sense, but this definition does work well for archaeological studies of skill acquisition (e.g. learning to make pottery) because in many cases it is very difficult to determine the particular organization of production and learning. If, however, we assume that an individual is "always learning" in a community of practice, the broad definition of apprenticeship wholly applies.

Nevertheless, there is one aspect of an assumed apprenticeship that need to be dealt with: what is the community of practice for an apprenticeship? The obvious answer is between master and apprentice, but when we are dealing with small-scale (likely household) production, this definition is too narrow. Though this relationship is perhaps the most intensive in terms of frequency and duration of interaction, the master already participates in the settlement-wide potter's community of practice; because of this, once someone becomes an apprentice, they too become part of the potter's community of practice through legitimate peripheral participation. Later, once an apprentice transitions to become a master in their own right, they transition from "peripheral" to "full" participation within the community of practice (see Lave et al. 1991).[11]

10. Binford called for middle-range theory (Binford 1962) in order to generate theory which addresses this gap between anthropological theory (of behavior) and archaeological data (of material).

11. I would like to add an addendum to the community of practice model that takes into account conditions in the past, and suggest that the "engagement" aspect of practice not be confined to modern workplace standards (whence the model derives; see Wenger 1998) in which engagement is sustained for hours at a time, and members are all working in the same physical space at the same time. It seems reasonable when discussing communities of practice in the past that engagement has a somewhat more disjunctive character in which engagement still occurs when, for example, potter A stops by to talk with potter B while potter B is engaged in pottery production even though potter A is not engaged in producing pottery at that moment. Thus, engagement is neither sustained for hours at a time (i.e. during the "40-hour" work week), nor do all members have to be engaged in practice at the same time. Conceived in this way,

Because the model is so general, and accounts for so much social behavior, when it comes to pottery production we need to work through the model to see where there are equivalences between what the model accounts for and the data that is available. The process of reification is the means by which social and cultural meanings become invested in codes, patterns, documents, and, for our purposes, physical objects. More importantly, when considering communities of practice and political culture, through the imagination and alignment aspects, members of the community create the physical expression of these alignments through their reification in the style of the pottery vessel itself.

3.3 Approaches to Style

The use of style within archaeological discourse has a long history, beginning with culture-historical approaches to the past through material culture. Despite the shift away from the predominantly descriptive method of culture-history toward current anthropological approaches to past cultures and societies, as an analytical concept, style has continued to be deployed in a fashion not unlike its use in culture-history. Attempts to organize the growing wealth of material being unearthed in a region, in particular ceramic materials, relied heavily upon the use of stylistic criteria to establish boundaries for "archaeological cultures" and within these boundaries to seriate their archaeological assemblages. This, in turn, provided a framework for the creation of relative dating schema. The principles at the core of culture historical work are still used today in contemporary archaeology; the organization of assemblages within a region still relies (to a great extent) upon stylistic criteria to provide basic geographical order to the material excavated, and seriation is still used to provide basic chronological order. As a result, the concept of "style" in archaeology is perhaps one of the most widely used, yet often times least clearly defined.

The difference, however, between traditional culture history and the use of style in contemporary archaeological projects lies in the myriad of ways archaeologists define style, in terms of criteria used and how the values of these criteria are determined. Starting in the late 1970s and continuing to the early 1990s,

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the locality aspect is maintained, though perhaps somewhat more spread out across the settlement, as is the boundary of the community of practice.

archaeologists began to theorize more complex understandings for the stylistic features of material culture. Much of this development came as a result of many years of ethnoarchaeological research and experimental archaeology, and because of these shifts in theorizing this relationship, the concept of style itself has also evolved. Nevertheless, style continues to be the signature index for the definition of "cultures" within archaeology.

Considering style and its role in archaeological analysis, I will first review recent perspectives on style, and attempt to synthesize these to explore my own contribution to theorizing the concept of style, followed by a review of my approach to ceramic style and the possible contributions to this discourse.

3.3.1 A new approach to Style

This new theorizing has prompted the discussants to think more critically on the style concept and its role in societies. Following the re-invigoration of archaeology by Binford and the shift toward understanding the function material culture plays within a society, decoration (as a cipher for style) was given a communicative function within and between societies (Wobst 1977). In this framing of the "function" of style, style expressed through material media represented attempts to communicate social aspects such as identity[12] through stylistic elaboration in objects. Moreover, social distance between the producer (individual, group, or society) and the intended audience could be determined through analysis of the energy expended in the processes of elaboration. Thus, the more complex the message that was to be communicated, or the further the social distance between those involved in this material "dialogue," the greater the effort required to create the desired message (Wobst 1977).

With this new formulation for stylistic elaboration as a communicative tool by Wobst as a jumping off point, and a related interest in ethnoarchaeological research, Wiessner (1983, 1990) further developed the agentive aspects for communication through style in her concepts of "emblemic" and "assertive" styles. Wiessner's emblemic and assertive style elaborated the differential valences between those involved in these

12. As discussed by Goodenough (1965) in his clarification of Linton's "status" and calling it instead "social identity."

acts of stylistic communication. Emblemic style was used to communicate status between members of a single cultural group, while assertive style was used to communicate difference, signaling cultural boundaries between two or more groups (Wiessner 1983).

In the latter part of new theorizing on style, Sackett (1977, 1982, 1985, 1986b) developed what he termed a model for where style "resides" in material culture (summarized in Sackett 1986a, 1990). Stemming from his research with Paleolithic stone tools, Sackett (1977, 1982) proposed what he called an isochrestic model for where style is made manifest in cultural objects. According to the model, style may be perceived in either the instrumental or the adjunct form of an object; instrumental form includes those aspects of form that have decidedly functional explanations for being present, while adjunct form includes those aspects of form that have essentially non-functional explanations (Sackett 1990). Such aspects of a ceramic vessel, for example, that would be instrumental are its globular form for carrying and storing liquids, the presence of handles for carrying, and perhaps a flared rim for improved pouring. The adjunct form would be the specific curvature of the handle, the scalloping along the rim, and the incised line/hatch mark motif found along the neck of the vessel. As to where style exists within artifacts, prior to the isochrestic model, confining style to decoration suggested that form was not considered stylistic, but appeared, by implication, to have been a non-indexical feature.

In an unassuming chapter discussing style in technology, Lechtman (1977) introduced the notion that style could be found in technology, which is to say, technological processes. She argued that the way something is produced also contains stylistic information that can also be used to identify different social groups. In her discussion, she leaves the assignment of social groups vague with regard to the concept itself, allowing the concept to be applicable in many different archaeological contexts. It is up to the researcher to assign culture, faction, or ethnic group affiliation in their own research. Indeed, this is one of the things that makes her contribution so important is that the concept of technical style could be applied in many different research contexts where technology was involved.

Each of the previous conceptions of style made positive contributions to the current debate concerning style, but they each nonetheless possess problematic aspects. On the one hand, the recognition of commu-

nicative aspects of style, in particular, was an important development in style theory. However, the intentionality of this communication implies (either implicitly or explicitly) degrees of agency which, in many cases, are difficult to support. On the other hand, the attempt to create a scalar understanding of style (as decoration) by Wobst (1977), and taken up by Wiessner (1990), were also important contributions regarding the operation of objects at multiple scales of a social network.

Style through Communities of Practice

Style within objects, I argue, is the sum of relative similarities and differences between two comparative sets (see Latour 1993). That is, style: 1) is a comparative (relational) concept; 2) made between sets of things (pots, clothing, pieces of writing, meals, etc.); 3) in which a listing of attributes for every thing in each set would demonstrate more intra-set coherence than inter-set coherence. When articulating style (that is, "this has style x" or "this is in the style of..."), a relational comparison between a particular set of things and any other set is always being made regardless of whether this comparison is being made explicit or not.

Coherence Aspects of Style in Objects As the above formulation of style applies to archaeology, these sorts of stylistic criteria are used in the creation of typologies. In this regard, isochretism (Sackett 1990) remains an important contribution, because it attempts to explicitly define what attributes of things should be considered when organizing stylistically. However, the isochrestic model falls short, first, by restricting itself to essentially formal variability; and second, by labeling "decorative" features as adjunctive in nature. By restricting style to formal attributes and separating perceived functional attributes from decorative attributes, isochrestism does not move far enough from traditional means for assessing style in archaeology.

In order to move toward more holistic methods for assessing degrees of stylistic coherence, I break the broad concept "style" into three components: functional, technical, and imaginal for archaeological analysis. The two aspects argued for in Sackett's isochrestic model (i.e. instrumental and adjunctive style; 1990) should be broken apart, and the concept of "technological style" proposed by Lechtman (1977, 1988) should be introduced. By integrating aspects of style that encompass practices, aesthetics and features for the analysis of style in artifact assemblages, the investigator approaches these objects as the products of

socially and culturally situated material relations. This new approach to style includes three axes of object attributes: 1) functional features; 2) technical practices, and; 3) imaginal forms. Analyzed in isolation, or even in small numbers, attributes of these three aspects may create the appearance of a single style within what may otherwise be a heterogeneous assemblage. Hence, I stress the need to assess these attributes for coherence as a whole. I briefly discuss these three aspects of coherence below.

Functional Style. The aspect termed "functional style," is a variation of "instrumental form" outlined in the isochrestic model (Sackett 1990), and applies to what might be termed the "functional" attributes of objects. In the case of pottery this would include the traditional attributes found on water jars, cooking pots, storage vats, and serving basins, such as the presence of everted rims, angled shoulders, ring-footed base, or lug handles.

Technical Style. This aspect draws upon the technological style concept by Lechtman (1977), rendered here as "technical style," to account for the duplicitous ways of making a single class of objects (Leeuw 1993; Lemonnier 1986; Mahias 1993). Unlike the other two axes of coherence, this aspect is a processual one in that it requires investigation of the technical pathways used in the production of the object (Sigaut 1994).

Imaginal Style. The aspect termed "imaginal style," is a variation of "adjunct form" described in the isochrestic model. This aspect comes closest to representing aesthetic choices in the production and consumption of classes of objects. For studies of pottery, imaginal style might include the particular shape of strap handles, the directionality of cord-marking, angularity of shoulders, or placement of particular motifs.

I argue that these "types" of style are all present in any given object, but each "locates" style in different parts of an object, and any particular "part" of the object, for example, in a piece of pottery, the handle or body has each type of style; some may be non-indexical (i.e. they may not be useful for analysis), but that is the researchers task, to determine how or if each type of style seems to hold social significance. Style is

also present in the CoP model as an aspect of a community of practice, as part of its repertoire (see *Practice* on page 55). A style in a community of practice represents the differences in gestures and other ways of doing things that accumulate as part of a history of mutual engagement. In other words, as members of a community of practice continue to work together, they come up with ways of accomplishing their work that are unique to the group, that can in some ways be used to identify them.

3.3.2 Style as Identity

The linking of style and identity has a rather long genealogy in archaeological discourse, though the origins of this debate may have proved heated (e.g. David et al. 1988; Sackett 1990; Wiessner 1984, 1985; Wobst 1977). Recently, emphasis has been placed on the role of style as a marker of social boundaries (e.g. Barth 1969), an observation first made by Keightley (1987) for the Neolithic period in China. An edited volume by Miriam T. Stark (1998) titled *The Archaeology of Social Boundaries* collected together new thinking on the relationship between style and identity.

Gosselain (1998) argues that strong links can be found between pottery styles and historically discrete ethnic groups. From his fieldwork in Cameroon, there are a number of different ethnic (tribal) groups that each have distinct differences in their pottery styles, though there are some aspects that overlap as well.[13] Likewise, for Chilton (1998), there are stylistic characteristics in all aspects of production, including paste recipes in pottery production. She argues that of the various places identity can be found in pottery production, the recipes used to make local pottery are some of the strongest measures of correlation. This is because recipes are often highly specific to local clay sources, and that clay sources, as sacred spaces of a sort, are passed down from one generation to the next of potters, and not socially circumscribed. This argument is born out by compositional studies which allow archaeologists to determine the source of pottery based on the unique geo-chemical signatures of the paste constituents.

13. He cautions, however, that we must be careful in our use of this stylistic information, especially in post-colonial contexts where once ambiguous tribal distinctions may have become pronounced, even exaggerated, during a colonial period either as a response to colonial rule, or because such distinctions were part of the colonial project.

In their chapter, Dietler and Herbich (1998) link style to identity as other contributors to the volume did, but caution against over-simplification. They argue that by doing so, archaeologists run the risk of falling into the "pots are people" trap which resulted from analysis gone awry in the "ceramic sociology" paradigm. Proof of this, they argue, comes from contexts where such stylistic criteria can be used to identify ethnic differences, but that there are also situations where style fails to discern ethnic differences. As a case in point, the Luo make pots for themselves, and the stylistic differences can gainfully discriminate the Luo from neighboring ethnic groups that also make pots. However, this argument falls apart because a neighboring ethnic group, which does not make pots, also buys pots from the Luo. In an archaeological context, looking only at stylistic criteria in pottery it would appear that the Luo were more widespread than they actually are. Thus, it is important to look at multiple lines of evidence when using stylistic criteria as a tool for differentiating identity groups.

Markers of Identity

Though I do not suggest that we can reach the level of detail articulated by Dietler and Herbich (1989) in the definition of "microstyles" using excavated pottery from the late neolithic, I do suggest that we can break apart these monolithic cultural blocks through careful analyses of ceramic style, concentrating on what I have termed "markers" of identity, or those indices of identity based primarily on habitual practice. Needless to say, such research must be conducted at the regional level, if for no other reason than as a consideration of the work required to gain the degrees of precision necessary to make meaningful inferences regarding identity. However, I wish to emphasize that the active use of style cannot be inferred using archaeological evidence alone, and in the ethnoarchaeological cases mentioned, assertions regarding the intentional signaling of identity are the result of ethnographic work and not based exclusively on "archaeological" (i.e. material) data. Moreover, inferences concerning identity cannot reliably be specific enough to signal actual ethnic groups for the reasons just mentioned, despite ethnic affiliations that are suggested in the historical records of later periods in China (e.g. Cohen 2001).

As discussed above, it is possible to make inferences concerning identity based on patterns of learning. This goal may be achieved through detailed analyses of style through space and time, paying particular attention to all aspects of stylistic coherence as a means for inferring patterns of learning. That is, while technical (i.e. processual) style is elsewhere emphasized, attributes of functional and imaginal style must be accounted as equally determinative in style coherence. However, all that I suggest here is that we may determine the "identity" of a community of practice, not a culture or ethnic group. Determinations of ethnic/cultural identity cannot be made using stylistic analyses alone, especially not from practice-oriented analyses of pottery, but in conjunction with other lines of evidence, such as domestic structures, community layout, and investigation of other types production.

Thus, I would argue that we need to break apart those monolithic "archaeological culture" groupings and instead use the communities of practice model to identify the smaller, inter-connected, communities of practice that make up these monolithic (and seemingly undifferentiated) conglomerations of material culture as people (i.e. the "pots as people" problem; see Dietler and Herbich 1998). Sets of similar practices, those belonging to a particular community of practice, and their relationship with other communities of practice in the constellation of practices, can help us identify the extent and degree of interaction between settlements within a region.

Networks of Identity

Chapman (2002) suggested the concept of "network" as a conceptual alternative to the archaeological culture because it invokes a sense of connectedness between archaeological sites without making the potentially reifying leap of thought that this evidence is indicative of a distinct identity group—typically, of a distinct ethnicity. Latour (1993) suggested a similar conceptualization of practices when he discussed understanding societies by studying their "network of practices" (cf. Carr and Neitzel 1995). Although one is discussed as an analytical tool and the other a re-conceptualization of the archaeological culture, by thinking about a culture in terms of its component social parts, as communities of practice, we are better placed to understand "the whole" (whatever that may be) in more distinct terms. Lechtman (1988) did essentially this, looked at

the "network of practices" by studying the technical and aesthetic style of metal and textile objects in order to suggest that the producers held certain beliefs or understandings of the natural world. Keightley (1987) did something similar for two early neolithic cultures in eastern and central China, Dawenkou and Yangshao. He framed it as attempting to understand the "mentality" of these two cultures, but by using aesthetic, and to a lesser degree technical, styles of their pottery, Keightley made some interesting insights into the social structures[14] guiding the conceptualization and production of these two distinct material culture assemblages. In many ways, Keightley's analysis, however much conjecture one takes his conclusions to be, followed the directionality discussed by Bourdieu; namely, that social structures determined the society's *habitus* and thus its practices. In the communities of practice model, however, Wenger (1998) understands practice and the directionality of these two differently; that practices create the *habitus* which determines social structure.[15]

The term "network" also returns us to the discussion of solidarity above, but we move from the mechanical solidarity of small-scale societies, societies which rely on familial networks, to the organic solidarity of complex societies, societies in which the networks are not kin-based, but are networks of practices. Such networks are, in the language of the communities of practice model, constellations of practice in which the multiple communities of practice (i.e. specialists) interact and rely on one another in order to survive. Moreover, identity is no longer tied to a certain kin-group, but a collection of individuals and communities of practice that see each other as part of the same, macro-scale, social entity. Such identity, when it is shared by many different individuals is the collective conscience of the society, while the practices and "ways of relating" that enable this society to function as a whole become "publicly common" and part of the *political* (as opposed to *social*) culture.

By strengthening the link between style, communities of practice, and identity in material culture, we have made the step toward practices utilized in the production of objects as a means for understanding intentional uses of stylistic features in everyday objects such as pottery. One of the keys aspects of Chilton's theory discussed below is that pottery provides a perfect vehicle from which to "...make those preferences

14. Taking "mentality" to suggest widespread mental structures, and thus, social structures.

15. See *Locality/Boundary* and note 7 above on pg. 58 for a discussion of this reversal.

publicly common" (Chilton 1988:430) because pottery is such a ubiquitous type of material culture in early complex polities. I now turn to political culture and demonstrate the link between political culture and those aspects of material culture (cf. Duff 1996; Golde et al. 1973; Kiriatzi et al. 1997).

Style as Political Culture

When we are discussing identity, we enter the realm of the political as well. As suggested above, we can see the material manifestations of practices, and the forms these material manifestations take, as a whole, have style. This style can be broken down into three axes (functional, technical, imaginal) which allows us to identify the communities of practice which made them because each community of practice shares a repertoire of "routines, gestures, tools, and ways of doing things" (Wenger 1998) which make them distinctive from other, perhaps similar, communities of practice.

I have also discussed how, in anthropological discourse, style is understood to carry information, or signal to those both within the group and those without. As mentioned above, this style is signaling the identity and other aspects of alignment held by the community of practice. Style, therefore, constitutes a "way of relating" as discussed by Chilton (1988), and when it is found in a "publicly common" type of material culture such as pottery, this material culture becomes part of the political culture as well. Indeed, practice theory's "ways of doing" can be seen as a lens for interpreting "ways of relating" and how one is a reflection of the other. This is the case because techniques and *habitus* specifically focus on the daily lives of the society's members through which we can imagine the production of expectations and the daily negotiations of meaning and identity. Put another way, the *habitus* of everyday life and the solidarity it generates within the society through these negotiations of meaning and identity form the structure on which an ideological mask is built up over time.

To return to the "high culture" concept for a moment, this ideological mask which we call "high culture" itself is not built overnight (e.g. "Rome…") because just as group solidarity is generated over time in order to create the society and its cultural foundation, so too must the ideological mask also be built, slowly over time. It is important to keep in mind that the "high culture" we see and discuss, that which makes it into

museum cases, is the result of this slow build-up of ideas which normalize subjugation *by using the cultural elements already present* in the society. This is what gives this ideological mask of "high culture" its air of legitimacy, and why it is only in long-lived "civilizations" where we traditionally utilize the "high culture" concept. That said, since such masks are products of ideology or ideology itself, it stands to reason that any society which demonstrates social stratification and the subjugation of one group over others, an early complex polity, undoubtedly also bears early forms of "high culture" though such does not rise to the level it is found in later complex polities.

Differentiating communities of practice, as will be done in this research, is only part of the story, because while different communities of practice may utilize different technical pathways in the early stages of production (based on patterns of learning), it is important that these different communities of practice also end up using the same techniques in the finishing and firing stages of production that produce vessels which are aesthetically similar. In other words, even though these different communities of practice learned to make vessels differently, when it comes to the aesthetic characteristics, the members of these communities share an aesthetic sense which comes to be more and more similar through time. The boundaries between these local communities of practice breakdown as they share or emulate the aesthetic characteristics which reflect the identity and alignment each community (settlement and community of practice) shares. Moreover, the ubiquity of a material artifact class such as pottery makes it the perfect vehicle to signal alignment through stylistic attributes because it is shared and valued.

Intersection of Practice and the Political

This section began with a discussion of theories of political culture, and settled on the characteristics defined by Chilton (1988). I then turned to the question of practice theory as the best means to interpret the phrase "ways of relating" utilized in the definition of political culture: "all publicly common ways of relating within the collectivity," (Chilton 1988:431). That is, a "way of relating" is a practice, and being "publicly common" tells us that the practice is part of the repertoire used within a community of practice. Indeed, the political community of practice is quite large, though it may be made up of smaller units (communities) defined by,

say, political party affiliation, group advocacy, etc. that make up the constellations of political communities of practice.

I lastly turned to style as a tool for identifying communities of practice. Based on practice theory, a style represents the aggregation of the practices used. For the production of pottery, a resultant style is the accumulation of the technical choices used; in Sigaut's (1994) terminology, the accumulation of the choices made along the technical pathway.

Practice theory intertwines well with Chilton's definition of political culture as "ways of relating" (1988). Just as material cultures are constituted of practices for "ways of making" and the more circumscribed sphere of techniques, political cultures are constituted of practices for "ways of relating" through dispositions for or against some social act or agent, and the use of symbols and speech in accordance with those dispositions.

Part Two

Pottery Analysis, Pottery Production

4

POTTERY, PRODUCTION, AND PRACTICE

"As long as ceramic research is divided between archaeologist and ceramic technologist, it is highly desirable—I am tempted to say imperative—that both understand the fundamentals of ceramics, the principles and limitations of analytical methods, and the objectives of archaeological research."

– Anna O. Shepard, *Ceramics for the Archaeologist* (1956 [1985, 12th printing])

The analysis of pottery production has a very long history in archaeology. One reason for this is that pottery is extremely durable and survives in the archaeological record rather well, and as a result, has been one of the primary sources of information on societies of the past. Granted that for much of the latter 19th and early 20th centuries it has been used for the "fixing" of cultural groups in the culture-history mode, but this long history also means that there are a plethora of ways in which to analyze pottery and pottery production.

When using pottery as a means for understanding social processes, we need to look first to the so-called "ceramic sociology" perspective as the first robust body of theory linking pottery and society. The early work in ceramic sociology[1] was heralded, according to Longacre (2008), by Cronin (1962) in which she saw more intra-site similarities among decorative attributes of different pottery types than there were among a single pottery type found at multiple sites; in short, the similarities in these decorative attributes were most likely the result of intra-community learning patterns.

Following the call by Binford (1962) for archaeological research to contribute to anthropological theory and knowledge of human society, Longacre (1963) heeded this call with his dissertation and the subsequent flood of articles and books that would come to be labeled part of the "New Archaeology" (and later "processual archaeology") as part of this push for archaeological research to say something about human societies rather than simply identify and date them. Longacre in particular demonstrated that an understanding of

1. For the origin of this label see Sackett (1977:377)

the production of material culture, in his case ceramics, could be used to make more reaching inferences regarding the society that produced them. Other early work, first by Deetz (1965) and later by Longacre (1970) and Hill (1970) furthered this programme of using ceramic attributes (primarily decorative) to make inferences about social interaction within and between communities.

This push for better understandings of production activities came with the advent of techniques of instrumental analysis in which excavating production loci no longer became strictly necessary to study production; instead, the objects of production could be studied directly for clues to their manufacture, and from this base, inferences could be made regarding the social organization of which such production was embedded. For ceramics in particular, this meant that pottery could be used for more than the identification of an archaeological culture and the creation of relative chronologies based on the stylistic attributes of the ceramics.

4.1 Research on Pottery Production in China

Research into pottery making has nearly a hundred-year history in China, starting in the 1920s and 1930s with research by Liang Siyong (1932) on pottery making at an excavated village site where he found pottery wheels and other tools. Though Liang talks about pottery being made using either hand-building or wheel-throwing, he never discusses how he came to these conclusions (see also Liang 1959). One of the earliest actual studies of pottery making was in the 1930s by Wu Jinding (1934) while working at the Chengziya site in Licheng County, Shandong. Wu recognized that inferences of production technologies could be determined through examination of the surface traces left on pottery vessels. However, one of Wu's colleagues and co-authors, Li Ji, was a little more reserved in his estimation of how reliable such methods were. To be sure Li was in the majority at the time because in this early stage of archaeological research in China there was still a reliance or preference on the written record. Therefore, if there were no records, then such methods based on an analysis of the materials themselves would have to suffice, though the results would be considered a rough determinations at best. Nevertheless, based on Wu's analysis, he concluded that there

were four primary methods of pottery manufacture: hand-build method, model method, wheel method, and the molded method.

A few years later, Wu Jinding (1936) studied pottery from phase three at the Gaojingtaizi site, focusing on the red wares at the site. For this type of pottery, Wu determined there were three methods used: molded, hand-built, and model, though the majority of the red wares unearthed were produced by the mold method. The methods used to make gray wares were a little more advanced, using the wheel method, clay coil and half-model method, and the clay coil method. Later still, for Wu's doctoral dissertation, he conducted research by observing modern potters at work, especially in the northern region, and compared the results to those found in the archaeological record. Based on these experiments, he refined his method typology to four primary methods: hand-building, the model method (molding), the tamping method (paddle and anvil), and wheel throwing.

The Second World War engulfed China in the 1940s, but research on pottery production resumed in the 1950s, this time drawing on the use of ethnographic research and analogues as a way to interpret ancient pottery making methods, though this method had been used previously by Liang and Wu, if on a smaller scale. In the mid 1950s, Rong Guanxiong (1956) studied pottery making by the Yi people of Hainan Province and suggested that the pinching method and round coil method should each be added. A few years later, Li Yangsong (1958, 1959) studied pottery made by the Wa people of Yunnan Province. In his analysis, Li suggested that for hand-built pottery, in addition to the molding method, a round clay plate method should be added.

In the 1960s, the study of pottery became a specialized field of study. The best example comes from a seminal study by Zhou, Zhang, and Zheng (1964) on pottery production from the neolithic through the Zhou Dynasty that used scientific analyses in order to understand the pottery making process. The article takes a multi-scalar approach, discussing four areas that should be used to improve the study of ancient pottery: first, the benefits of using scientific methods of analysis; second, use of ethnographic research to aid in the interpretation of pottery; third, experimental archaeology; and four, the comparative study of pottery across cultures.

Events in the People's Republic caused a 15-year pause in archaeological research of this type, but by the 1980s Li Wenjie became a pioneer in the field of pottery technology research. These studies were focused on determining "technology" in much the same way I discuss later, namely techniques of manufacture. The earliest is a study looking at the Daxi Culture of southern Ningxia (Li 1988), followed by a more complete study with Huang Suyin (Li and Huang 1989), a further look at the southern mountainous region of Ningxia (Li 1993b); Chengbeixi Culture, Hubei (Li 1993a), followed by a later study with Huang Suyin (Li and Huang 2001); the Qujialing site in Jingshan, Hubei (Li 1994); phase I of the Dadiwan culture (Li, Lang, and Zhao 1996); Erlitou Culture at Zengyao site in Mianchi, Henan (Li and Zhang 1998); Tianmen Xiaojiawu and Dengjiawan sites in Hubei (Li 1999); Wuyang Jiahu site in Henan (Li and Zhang 1999); Guanmiaoshan and Honghuatao sites in Hubei (Li 2000); Dongguan site in Yuanqu, Shanxi (Li 2001); Zengpiyan site in Guilin, Guangxi (Li 2005).

However, while these late twentieth-century Chinese archaeologists and those within contemporary archaeology are each concerned with techniques, for these early Chinese practitioners, the intent was to catalog techniques used by different cultures, to create a history of technological skill and diversity. In other words, this was a more detailed form of culture-history. The goal was not to utilize our understanding of these techniques and what they can tell us about those individuals living as members of these culture groups, but as an additional criterion for parsing out different culture groups; again, a more detailed means of using "decoration" to determine cultural affiliation. Nevertheless, it is important to bear in mind that while these early researchers were not interested in the questions we are asking now in studies of socially structured techniques and technology, that work provides a strong foundation from which to do so. While limited in research scope, at least compared to modern understandings of what one can learn from a critical study of techniques, the work of these twentieth-century archaeologists still has great relevance to contemporary research into techniques of pottery manufacture in late Neolithic and early Bronze Age China.

One of the more recent sources of information on pottery-making in neolithic China is the seminal study by Li (1996) "A Study of the Pottery-Making Technology in Ancient China" [中国古代制陶工艺研究] using pottery in the National History Museum collection. The first chapter of Li's treatise draws

heavily from an earlier study with Huang Suyin (Li and Huang 1989) focusing on Daxi Culture pottery. An additional source is the smaller, though more targeted, study Li Wenjie conducted with Zhang Juzhong (1998) using Erlitou period pottery excavated at the Zengyao site in Sanmenxia Prefecture, Henan.

4.1.1 Style in the Archaeology of Early China

Based on the theory and methods outlined in the previous sections, I turn to ways in which style may be used in the archaeology of early China. In particular, I restrict myself to possible deployment of these methods to the ceramics of Late Neolithic North China. The ceramic horizon of the Longshan (*ca.* 2500-2000 BCE) and Erlitou (*ca.* 2000-1500 BCE) Periods as it is understood at present is spread widely across North China in the Late Neolithic. Current typologies used in the archaeology of early China have been generated for establishing temporal (i.e. chronological) control within and between sites (e.g. Lee 2002). However, this expansive ceramic horizon has been little problematized in terms of the identities to which these traditions belong—hence, the Longshan Period is marked by the Longshan Culture, and the Erlitou Period is marked by the Erlitou Culture (for an exception see Cohen 2001). As a result, in practice, sites that possess Longshan cultural components become essentially the same as other Longshan Culture sites across time and space, leading to expansive, relatively undifferentiated cultural complexes. Recent trends toward regionalization within archaeological practice in China (Falkenhausen 1995) have begun to change this situation, though questions arise concerning the degree to which such regionalist "projects" are attempts to essentialize the archaeological subjects of each region (cf. Smith 2004).

The importance of these efforts to add complexity to Late Neolithic North China lies in the potential for inferring identity and social structure across the social landscape through space and time. More to the point, it is argued that through an inverse application of indices of identity, detailed stylistic analyses may allow us to break the ties inherent in the "material-culture equals culture" paradigm, and instead follow stylistic attributes as they are socially reproduced in material objects across the landscape. Because these stylistic attributes "travel" spatially or temporally through social networks, either as choices passed along or producers relocating, it may also be possible to trace the connections within the social network itself. This

approach would prove particularly interesting with regard to the development of complex polities within and across regions.

Typology as a Theory of Style

Although there has not been as much research on style, per se, in the Chinese archaeological community, we can nevertheless consider the extensive typological schema used as a de facto theory of style in and of itself. To be sure, the Chinese use of style very much mirrors that of Western "culture-history" which was the dominant (if not only) scheme for making sense of the archaeological record in the 19th and early 20th centuries. However, Chinese scholars have taken it to another level, and the complex system (and sometimes uneven application) of type, sub-type, and variants can be understood as the codification of style and lays out which aspects of vessel style are considered indexical compared to other aspects. At its core, the system is based around vessel types, and while for the most part these are fairly well-defined, there is some variability between characteristics of a vessel form that are given precedence over others; this varies by researcher, and is likely related to the teacher the researcher learned from (see *Potters and Learning* in subsection §4.3.1 on page 101). In general, though, precedence is given according to a similar set of criteria to determine vessel type, and these are analogous to Sackett's "instrumental" style (1990). A vessel sub-type is related to the type, of course, in which macro-features that greatly change the overall appearance of the vessel are nevertheless considered less-relevant than the perceived "function" of the vessel. Hence, you have a container and cooking vessel type *guan* that has the "round-bodied" and "deep-bodied" subtypes, as well as the less-often seen "large-mouth" subtype. These are the primary organization characteristics used, with each type and subtype having its own entry or subsection within the pottery section of a report. Within a report, under a given type, the sub-types are often organized in an ordinal system using roman numerals, giving subtype Ⅰ "round-bodied" and sub-type Ⅱ "deep-bodied" *guan* vessels.

When we get to variants, the field becomes far less defined, though there are some common variant characteristics. Variants usually cover aspects such as base type (flat-bottom, round-bottom, etc.), rim type

(curved rim, squared rim, flared rim, etc.), or neck type (tall-neck, short neck, etc.). These variants are often labeled using capital English letters, for example giving subtype ⅠA round-bodied, curved rim *guan*.

4.1.2 Archaeological Studies

Railey (1999) conducted an early study of pottery production in north-central China centered on the Yuanqu Basin region, about 50 kilometers to the north west of the Luoyang Basin. Railey's research utilized three main lines of evidence to trace increasing socio-political complexity (i.e. "the state"): changes in shape, size, and numbers of pottery vessel form classes; the elaboration and number of ashpits, burials, and fortification works; site settlement patterns in the basin. Though his work was not exclusively focused on pottery manufacture, Railey was able to draw some interesting conclusions. Most importantly, using these three lines of evidence, Railey was able to test several theories on the increase and elaboration of these various artifact and feature types (Railey 1999:394-400; and Railey 1999:457-468), as well as an increase in the number of settlements and their settlement hierarchy (Railey 1999:581-607). Looking specifically at his analysis of pottery, Railey is interested in testing models put forth by Rice (1981, 1984, 1989) regarding changes in pottery production that would be expected with increasing social complexity. Rice predicted that as society and polity became more complex, there would be a concomitant increase in numbers and form classes in local pottery, and many of these changes would lead to specialist potters for whom the manufacture of pottery is their sole occupation (in addition to other types of occupational specialists). The result of such specialization would be increasing standardization as more potters attempt to simplify and unify their own production.

While Railey mentions several potential biases and challenges in data collection for his pottery sample (Railey 1999:242-247), he nevertheless is able to provide an interesting view of society in the basin as glimpsed through changes in pottery production.[2] He found that there was indeed a trend toward the creation of new form-classes through the periods studied, a trend which supports one part of Rice's model (Railey

2. Railey's sample included almost 6,500 years worth of pottery, spanning the Peiligang through Erligang [Early Shang] cultures.

1999:395-6). However, he did not find support for the second trend expected from Rice's model in which there would be increasing specialization in the production of pottery, which would lead to more within form-class standardization. It seems unclear from his discussion whether Rice would use "standardization" as an indicator of specialization, or whether there are other causes to explain standardization, and you would have to use other lines of evidence to infer specialized production such as the presence of specialized workshops, etc. and the standardization observed could then be understood as the result of specialized production. This potential tautology is a problem because, as was discussed in Chapter 3, so-called "standardization" may be explained more easily from a practice-based approach to production. And in this, Railey almost reaches this same conclusion when he suggests, "standardization may also be expected simply from the extreme routinization of motor habits resulting from frequent repetition of pottery-making tasks *under conditions of specialized production*" (1999:220). Here, were it not for the last qualifier (in italics) in his statement, Railey would have identified one of the major problems with using standardization to infer specialized production, when there are better ways to explain this facet of production (Longacre 1999).

Railey's study in the Yuanqu basin was followed by Dai (2005) who also sought to describe the organization of pottery production through, primarily, pottery production data, both direct and indirect. He includes a chapter on settlement data as Railey (1999) had done, but these data do not seem terribly relevant to his study except as a brief attempt to support the societal levels of complexity used in the analysis of pottery production, and which makes up the majority of the research. Specifically, Dai uses excavation data and artifacts from two sites in the Yuanqu Basin: Dongguan for the Late Yangshao, Miaodigou I, and Longshan periods (see Section 2.1); and Nanguan for the Erlitou and Erligang periods. These data are definitely more contextually secure than that used previously by Railey, and this allows Dai to talk generally about these periods in the Yuanqu Basin using data drawn from two specific examples. Dai concurs that there is an increase in diversity of pottery form-classes from the Early Neolithic through Early Bronze, but perhaps as a result of the different datasets, Dai also demonstrates that there is a change in the organization of pottery production from the Neolithic to the Bronze (2005:221-226). These results are primarily due to the more comprehensive nominal and metric analyses Dai uses that are focused on determining degrees of special-

ization based on the "standardization" of products. In this, Dai provides support for Rice's model (1981, 1984, 1989) for the link between socio-political complexity and the organization of pottery production. Dai also points out that his study does not attempt to demonstrate any causal link between changes in the organization of pottery production and increasing socio-political complexity (e.g. Dietler and Herbich 1989). Overall, while Dai's research in many ways resembles that undertaken by Railey, due to improvements in data access, collection, and analysis, Dai provides more concrete inferences regarding pottery production in the Yuanqu Basin.

Underhill (2002) took a more systematic anthropological approach toward discerning socio-political development in the Shandong region through ceramic materials by looking at the production of vessel classes that are tied to ritual behavior. She suggested that we can infer the development of the state as seen through production of ritual pottery vessels. Underhill argued that for the Longshan period there would not be a single pattern of access to mortuary ceramics (contra Shao 2000), and elites would have better access to more labor-intensive wares, but lower-status individuals could still make use of these vessels in their mortuary rituals. She goes on to argue that, unlike the Dawenkou period where competition was high for access to and the display of labor-intensive wares, by the Longshan period, the competitive field had stabilized into these two pathways of access based on social status. Such increasing sophistication of ritual behavior and the concomitant sophistication in production of ritual pottery vessels is associated with the development of political culture (see also Underhill, Fang, et al. 2000; Underhill, Feinman, et al. 1998). Her research marks an early and important step in the integration of anthropological theories regarding social behavior and material culture.

Houle (2002) looked at markers of "standardization" in domestic pottery production to infer that pottery was produced by specialists in several Luoyang Basin communities, and suggests that this likewise indicates social complexity. Unfortunately, this conclusion is somewhat complicated by ethnoarchaeological research on specialists, skill, and organization of pottery production (e.g. Arnold 2000; Costin 1991, 2001; Longacre 1999; Underhill 2003) that each demonstrate the difficulty of defining categories of production based on any of these three variables (potters, skill, and organization) alone, because each variable is independent of

the other two, and as a result, characterizing one variable does not determine the characteristics of the other variables.

An interesting study by Haapanen (2005) has integrated the communities of practice concept into an analysis of ceramics from the Late Shang period sites of Miaopu Locus North and Dasikongcun. In her diachronic study, she includes an array of cooking, serving, and storage vessels in terms of their size attributes and analysis of their use-wear patterns; this is done for the Early and Late phases of the Late Shang period where she is interested in how foodways changed from the early to late phases within and between these communities. Based on her analysis of ceramic data, with an emphasis on communal eating practices, Haapanen argues that the community underwent changes during the Late Shang Period, resulting in the fragmentation of the community and its members into several smaller communities. She traces the changes in the manufacture of pottery used in commensal eating to suggest that the once communal environment transitions to a network of workshop communities.

Most recently, Qin (2009) provides an analysis of ceramic production at the Early Shang Dynasty site of Fucheng in which she looks at rates of change in ceramic style, and markers of standardization in certain pottery form-classes. Most importantly, she utilizes quantitative style analysis to delineate potting communities (i.e. communities of practice).

4.1.3 Archaeometric Studies

There are several early archaeometric studies undertaken by the Chinese. One of the earliest is a compositional study by Pan Xianjia, Jin Guoqiao, and Sun Zhongtian (1983) of ancient pottery using Mössbauer spectroscopy, in some sense ushering in the era of archaeometric analysis in Chinese archaeology.

Some of the earliest research was conducted by Zhou Ren, Zhang Fukang, and Zheng Yongzhen (1964) where they performed a series of visual and compositional analyses on sixty-nine potsherds from Neolithic,

Shang, and Zhou sites.[3] The researchers also conducted "microstructural" analyses on the formation and firing of the vessels, as well as determining their elemental compositions.[4]

Around the same time, Li Jiazhi (1978) discussed the results of compositional analyses of pottery and porcelain using samples from numerous sites in China ranging from the Neolithic to the Western Zhou periods. Based on his compositional research and the test firing experiments he conducted looking for firing temperatures, he sought to determine the transition from pottery (stoneware) to porcelain in early Chinese ceramics.

Somewhat later, Lu Wei (1996) conducted a compositional study of pottery from the Beixin and Shandong Longshan Cultures from the Beixin site and Sanlihe sites. In the study they conclude that even though the sites are not close, their compositional profiles are similar.

Wei Suide (1999) conducted a similar study of white pottery *gui* vessels from the Dawenkou period. In addition to the traditional methods of typological analyses done by Chinese archaeologists, Wei also conducted compositional analyses to determine if different "recipes" of kaolinitc clays correlated with the different form varieties.

Somewhat recently, Liu Li, Chen Xingcan, and Li Baoping (2007) used ICP-MS to study the composition of white pottery from three Erlitou period sites: Erlitou, Huizui, and Nanzhai. These elemental profiles were compared to the profiles from two soil samples taken from the vicinity of the Nanwa site, and based on the similarities in the profiles of some of pottery from the three sites they conclude that Nanwa may have been a production site for whiteware pottery during the Erlitou period. However, other potsherds from the three sites did not fit the profile, indicating another production center for whiteware as well.

In the rest of this section, I discuss the history and use of radiographic methods in archaeological investigations. I then briefly describe older radiographic methods, and contrast these with the benefits provided by newer digital radiographic methods.

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3. Of note, as it relates to the discussion below, the authors contend that "The bulk of Neolithic and Yin [Shang] and Chou [Zhou] pottery was ring-built but their shapes were often improved on a turn-table" (1964:17).

4. This follows a slightly earlier study by Zhou and Li (1960) on the elemental signatures produced by different kilns across many regions of China.

4.2 Pottery-Making Techniques

Unlike other types of research on pottery, organization of production being the most prolific, the study of pottery making techniques enables us to look for the subtle differences in pottery manufacture that point more closely to cultural choices. To be sure, there are cultural traits to the organization of pottery production, but the study of pottery making techniques takes us to the level of individual actors (at least in the aggregate sense), those individuals that are "doing" culture each time they produce a pot in accordance with the cultural dictates they know, even if at a subconscious level.

What's important about this approach to techniques is that it allows us to look at choices potters make as agents of culture (see Leeuw 1993). When viewed through the communities of practice lens, techniques become much more than rote behaviors undertaken by potters at some site as part of their cultural group. They become active participants and creators, even if in small ways, of culture itself–materially and ideologically–by the choices they make when decorating pots. Of course pottery being both plentiful and conventional in terms of its uses means that even these little "small ways" quickly add up to a material type that has tremendous potential for possibly signaling alignments of the potters, but almost certainly the consumers. In other words, across social groups, techniques can be used to signal membership in a specific cultural group, and collectively this set of styles become what we might think of as a pottery tradition; within a culture group, techniques can be used to indicate membership in a specific lineage or school of learning found within the group.

To be sure, specific techniques themselves may be picked up by another "school" within a culture group, or may even migrate to another culture group altogether (see §3.2.1 on page 58 regarding this process in the communities of practice model). This is why specific techniques, in and of themselves, cannot be used to signal group or school membership, but the collection of techniques used together in the process of making pottery is what counts. As Sigaut (1994) suggests, the "technical pathway" is key to delineating these different schools (communities) of practice within a culture group.

4.2.1 Research on Techniques of Pottery Manufacture

Even though explicit research on pottery making techniques is relatively recent, scholars have sought to understand at least the basic manufacturing techniques any time the production of pottery is discussed. As a result, the field is quite diverse and varied in terms of classifying different techniques; of course, the broad categories used in earlier research that was not focused on studying pottery making techniques have been refined over the years as new research has turned to focus on the study of pottery making techniques. Below I review the variety of techniques described by scholars in the West, followed by similar research from scholars in China.

Research in the Western Tradition

Because there are so many researchers engaged in techniques research in the West, there are a number of sources that attempt to understand and categorize the range of variability of pottery making techniques. Much of this research has been conducted using an ethnoarchaeological method of studying living groups of potters to better understand different pottery making processes. In this section I discuss these various techniques as described by the researcher.

In an early ethnoarchaeological study of pottery production that paid careful attention to techniques, Longacre (1991b) discusses ceramic variability and the diagnostic aspects of tracing techniques used to make pottery among the Kalinga in Kenya. There, he argued that it is possible to use lineages of techniques passed from teacher to student as a way to trace marriage patterns. In Kalinga society, young women do not learn from their own mothers, but instead from their mothers-in-law in a patrilocal pattern of residence. This has the effect of localizing pottery traditions since techniques used are learned in a woman's final residence rather than learning them from a parent in their natal home, and then taking these techniques with them when they marry.

Gosselain (1992) conducted a different series of analyses among the Bafia of Cameroon in order to determine the fluidity of the production process, and find stages of production in which techniques are not guided by environmental criteria alone. Indeed, he concludes that the stages of paste preparation and vessel

formation are particularly resistant to change over time because these techniques form the "foundation" of the production process, learned over many years from their teacher. As such, techniques for finishing, decoration, and to a lesser degree firing are more susceptible to change based on local conditions of time and place.

Moving from the use of ethnoarchaeological methods to study techniques of pottery manufacture, Underhill (2003) looked at the organization of production among potters in Guizhou, China. Though there are fewer potters than in the past, most potters nevertheless engage in production on a part-time basis, their primary work focused on agricultural production. She looks at the workshops of these part-time specialists and the environment in which they engage in their craft. Underhill considers the impact of workshop organization and vessel uniformity as markers of ceramic variability. She suggests that aside from these factors, another key aspect in determining variability is the experience level of the potter.

Research in the Chinese Tradition

Based on the work by Wu (1938) and Li (1996), the following techniques have been recorded for Longshan period pottery. However, Wu and Li primarily discuss the initial formation of a vessel, and do not cover any of the later stages of production. I also extrapolated from excavation reports a list of "finishing" techniques and decorating techniques.[5] This set of techniques will guide subsequent stages of the research discussed later in Chapter 5.

1. Formation techniques "shape the base form" [坯体的成型工艺]
    (a) hand modeling [手慢制]:
        - includes coil build method [泥条盘]
    (b) mold method [范制法]
    (c) beating method [拍打法]
    (d) wheel method [轮制法]

5. Note that these are really "patterns" or types of decoration and not techniques themselves.

2. Finishing techniques “trim the base form” [坯体修整工艺]

    (a) pat/slap [拍打]

    (b) scrape [刮削]

    (c) (wethand) smoothing [湿手抹平]

    (d) slow wheel [慢轮修整]

3. Decoration techniques “decorate the base form” [坯体的装饰工艺]

    (a) Painted designs:[6]

        i. cloud pattern [云线]

        ii. thunder pattern [雷纹]

        iii. concentric circle pattern [同心圆线]

    (b) applique pattern [附加对文]

        i. method 1 (cord)

        ii. method 2 (raised line)

        iii. method 3 (ring shaped)

    (c) dentation border [齿状花边]

    (d) incised line pattern [凹线纹]

    (e) raised line pattern [凸线纹]

    (f) strike pattern [划线]

    (g) cord pattern [绳纹]

    (h) basket pattern [蓝纹]

    (i) square stamp (cross-hatch) pattern [方格纹]

This list, while perhaps not exhaustive, is nevertheless the result of years of research and is as complete as possible. More importantly, however, this list represents the consensus among those that considered

6. These are tenative at best since there is not much evidence for painted pottery in the Longshan period.

themselves part of this early complex polity, a consensus driven by consumer choice and the choices potters made during the early and late Longshan, suggested at least an implicit, if not explicit, understanding of how pottery should look. Put another way, what we find in the archaeological record is an *ex post facto* tradition that represents the choices made by potters and consumers. I mentioned that the list is not exhaustive; what I mean by this is that there may very well be other techniques or decorative schemes that existed during the Longshan period, but that such techniques or schemes were not as pervasive as those listed above, and were not chosen by consumers nor were they used again by the potters for whom such techniques or schemes were a bit of artistic expression.

The techniques outlined in the list above lay out the range of techniques used in the formation and decoration of pottery. When the list was created following years of analysis, it was simply intended as a catalog of Chinese pottery technology during the late Neolithic period. Now, however, the list serves as a jumping off point for analyzing the techniques themselves and assembling a picture of what social and political role the intentional use of some of these techniques, compared to others, can tell us about the social milieu these potters and the consumers of their craft lived in. As discussed in Chapter 3 on page 41, I argue that by understanding what the use of these techniques can say about the society, we gain a window, however small, into that world. Preference for pots that look one way versus another informs us as to what was happening at the time because we can infer choices being made based on what the consumer wanted to signal to others. Just as today, people make conscious decisions about many types of material culture because they want to signal to others something about who they are as individuals. Likewise, sometimes these choices are made unconsciously, too, but that also tells others something about you. This is not to claim that by understanding the use of one technique over another is going to allow us to infer individual decisions; rather, we can see societal trends and the consensus of members of society about what is important to them. These are individual decisions in aggregate, and the interpretation of these decisions has its foundation in frequency seriation, among the oldest techniques of analysis in archaeology.

In the next section I discuss methods that have been used in the analysis of pottery production, and in particular analyses that focus on the study of techniques of manufacture. I also briefly review the pottery

production cycle as it is used in this study, and compare this with the list that has been drawn from Chinese sources.

4.2.2 Characterizing Techniques of Pottery Manufacture

The characterization of communities of practice will be focused on five phases of ceramic production: conceptualization, processing, formation, completion, and firing. The second and final phases of work (processing and firing) are considered "procedures" in that I can only indirectly infer the general technical process that would have resulted in the final vessel characteristics evident. These procedures also operate at the assemblage level of structure in that they act upon an assemblage of pots in the production process. In other words, the processing of clay is undertaken for a "batch" of pots to be made at the same time, and the firing of pots is conducted for a "batch" of pots to be fired at the same time; it is unlikely that clay would be processed for single pots, nor are pots fired one at a time. The two intermediary phases of work (formation and completion) are considered "applications" in that I can directly infer whether certain techniques have been applied that would result in the final characteristics of a pot. In contrast to the procedures, applications are to an extent specific to each pot, and operate at the vessel (or macro-scale) level of structure. The first phase, conceptualization, is not work in the strict sense, but represents the mental "work" the potter undertakes before beginning the production process itself, before any materials are prepared. This phase, though wholly mental in nature, can nevertheless be considered an application because the conceptualization has been made material in the form of the final pottery vessel. That is, we can infer that the potter intended to make, for example, a *pen* basin when we are analyzing *pen* basins. This may seem trivial, but a pottery vessel cannot be made without this preparatory phase. For a more experienced potter this phase may take a trivial amount of time and in this way be invisible, but for less experienced potters the conceptualization phase may be more visible externally, perhaps even resulting in some "concept art" as the potter determines

what the final vessel will look like. This "visibility" would also be true for experienced potters if they are using some creative license to change a recognized vessel form.[7]

Below, I briefly discuss these five phases and what the choices employed in the production of pottery suggest regarding bases of knowledge and patterns of learning. These four phases of manufacture represent discernible practices utilized by potters to make their wares during the Longshan and Erlitou Periods; connected, such phases constitute a recurring technical pathway (Sigaut 1994). Combining a series of synchronic analyses that employ technical pathways allows us to investigate pottery made by potting communities from a diachronic perspective, and thereby frame the discussion in terms of social production through continuities and discontinuities in learning that can be inferred by overlapping patterns of knowledge, practice, and material (Boileau 2005; Herbich 1987; Kalentzidou 2000; Wallaert-Pêtre 2001).

Conceptualization The "mental" work that determines what form the vessel will take, what the final vessel will (likely) be used for, and hence what temper or clay must be used, what size will be required, and perhaps even what surface treatment will be used. This last, however, may have more to do with the recognizable form the vessel will take if a certain surface treatment is considered a necessary aspect of the final vessel and is contingent on the vessel form.

Processing Features of processing such as use of specific tempering materials, sorting, and use of specific clay components will allow for the definition of clay body formulae within an assemblage. The description of clay body formulae is a likely focus of spatial and temporal variability (Livingstone Smith 2000; Miriram T. Stark et al. 2000).

Formation Techniques used to form pottery vessels represent what are likely the most stable sets of practice within the five-phase model proposed. As a result, determining techniques used during the formation stage is of particular importance in terms of establishing communities of practice representative of learning patterns across space and through time (Gosselain 2000).

Completion Techniques used to finish pottery vessels represent the most fluid sets of practice within the five-phase model proposed. As a result, determining techniques used during the completion phase is of particular importance in terms of establishing the extent and degree of social interaction between potting communities across space and through time.

Firing Investigation of firing procedures represents a complex series of steps that begins with the drying of the completed vessels prior to the actual firing (Kingery 1982; Rice 1987, 1994). Factors involved in the firing of pottery, such as aesthetic concerns to fire ce-

7. See (Dietler and Herbich 1998) for their useful discussion on "microstyles" and how these end up part of the repertoire of vessel forms.

ramics that look "correct" in terms of color are indicative of dispositions toward certain practices.

Despite the apparent similarity of the ceramic assemblages of the Longshan and Erlitou Periods across North China, the creation of a comprehensive ware typology for materials from a particular region represents a first step toward utilizing additional methods of analysis that are part of a specific research program (Adams et al. 1991; Duff 1996; Sinopoli 1991). As stated previously, current typologies exist for these periods, but such typologies are directed toward the creation of a systematic chronological typology. Hence, these typologies are loosely stylistic in nature. By generating a typological system that is focused on a specific region and based on technical criteria, we will begin to find a greater degree of differentiation between seemingly analogous assemblages (Deboer et al. 1996; Dietler and Herbich 1989; Gilboa et al. 2004; Miller 1985). These typologies would undergo continuous transformation as classifications are refined, new insights are gained, and new assemblages incorporated into the typological system.

In order to investigate the techniques used to make pottery at the Huizui site, it is necessary to find methods other than visual examination of the pottery sherds. In order to accomplish this, I turned to radiographic methods of analysis. This decision was twofold: first, this method allows me to look "through" the vessel wall and in a way quantify the pressure gradients indicative of formation techniques; second, this method is non-destructive, an issue of particular importance when dealing with objects of cultural heritage.

4.2.3 Radiographic Analysis in Archaeology

Many archaeologists are not aware that the use of radiographic methods has a rather long history in the analysis of archaeological materials. Some of the first uses of radiography in archaeological analyses were used on whole vessels to determine how the vessels were made (formation techniques) and look at the pastes used in the construction of the vessels (Digby 1948; Titterington 1935). Subsequently, the method went on to be used in the analysis of a variety of archaeological objects: faunal remains (Ambers 2005), human remains (Davis 2005), metals (Lechtman et al. 1975), and textiles (Yoder 2008). One of the key aspects as to why x-ray radiography has such wide appeal and may be used in such a wide range of object classes is the

fact that image acquisition using x-rays is completely non-destructive. This is clearly important for fragile materials like textiles or bone, but when dealing with objects of cultural significance, this capacity becomes paramount.

Radiography of Ceramics

The use of radiography in ceramic analysis has, as indicated above, the longest tradition. Indeed, the ability for looking "inside" a ceramic vessel, or even into a vessel wall, has been demonstrated to be a very powerful tool. Radiographic imagery shows density differences within an object, and this unique trait allows a researcher to examine the size, shape, and orientation of non-plastic inclusions (i.e. temper) and voids present in the vessel wall. Voids are created when organic matter such as chaff or grasses is added to the potting clay and burns out during firing. Non-plastic inclusions themselves include sand, stone, or even old pottery (as grog) that can also be added to the potting clay; both of these types of materials create additional positive (inclusions) and negative (organics) space within the vessel wall when fired. For the potter, adding these materials enhances the properties of strength, thermal and shock resistance, and insulation in a pottery vessel (Orton et al. 1993; Rice 1987). For the researcher, the "positive" and "negative" space created by inclusions and voids are perceived in the radiograph because of their density differences: inclusions show up as darker (more dense) spaces and voids show up as lighter (less dense) spaces.[8]

For the archaeologist this unique trait also enables the researcher to infer techniques of vessel formation. No matter what techniques are used to form a vessel, from coiled, paddled, or molded, to slow and fast wheel, these processes also leave variable thicknesses throughout the vessel. In some cases, this variability may be discernible through visual inspection, though the variability may be very minute. However, even when the method is covered over through smoothing by the potter, variability in the vessel wall shows up in radiographic imagery as lighter and darker areas because of the relative density differences due to these minute patterns of variability in thickness (see Vandiver 1987).

8. This pairing of "more dense=dark" and "less dense=light" is how most radiographs represent density; however, some methods such as medical radiography use an inverse pairing such that "more dense=light" and "less dense=dark" as the imagery norm.

Titterington (1935) was the first to use radiographic methods to analyze archaeological ceramics, using the method to categorize pastes among North American Woodland period pottery. In 1939, Digby (1948) used the method to image whole stirrup vessels of Moche, Chimu, and Tiwanaku manufacture in order to demonstrate how these complex vessel forms were made. His results highlighted the utility of using radiographic methods, and he argued for the technique as it allowed them to see the different techniques used in making these vessels. As he suggests in the brief report, World War 2 brought momentum in further development for using the radiograpic method to a halt, a delay from which it took a long time to recover.

Indeed, radiography and its cousin xeroradiography have made significant contributions to the analysis of ceramics in the recent past. Early applications focused on understanding largely macro-scale aspects of ceramic structure which were rendered inaccessible by the size and structure of the vessels themselves. These applications had much in common with the earliest archaeological radiography of mummies and other ethno-historical bundled objects, and were most useful in the process of evaluating museum holdings and enigmatic objects produced during excavation. It was only in the early 1980s, with the debut and popularization of the Xerox Company's xeroradiograph machine, that several scholars began to explore the potential for a more systematic ceramic radiography. These research programs had two main themes in common. First, they examined more seriously the potential meso- and micro-scale usefulness of radiography in pottery analysis. While macro-structural analysis was useful, it was hardly applicable over an entire and mostly fragmented archaeological assemblage. Secondly, they pursued a more quantifiable radiography that could identify both meso-structural formation aspects as well as micro-structural patterning in inclusions and voids. While meso-scale investigations of formational technique proved worthwhile, micro-scale approaches to vessel tempering strategies, inclusion distribution and orientation, and porosity measurement were not yet possible with the resolving power of the xeroradiograph. This was, perhaps ironically, due to some of the benefits that the xeroradiography device brought to pottery analysis in the 1980s. While the technique was admired for its ability to perform "edge enhancement" and to exaggerate the image contrast between structures and voids, these same benefits made it very difficult to distinguish between inclusionary material and the surrounding aluminum-silicate paste. As Xerox closed out service contracts for its xeroradiography

equipment in 1996, scholarly access to older analog techniques has now become severely limited by the scarcity of functional machines, which are now incredibly expensive and difficult to maintain and repair.

Analog and Digital Radiography

Until now, all uses of radiography in archaeological analyses have used analog equipment. Needless to say, this is primarily due to the rather recent introduction of digital radiographic technologies in the last fifteen to twenty years. Still, it has been nearly twenty years, and digital radiography has seen little use in archaeology since the early adoption of radiographic analysis for archaeological materials.

Radiography: Basic Principles The principles of how radiographic imaging works are the same between analog and digital methods–it is primarily the media used that distinguishes the two, at least at the image acquisition stage. In a conventional photograph, light reflected off an object is transmitted to a medium. In the case of analog photography, this medium is photographic film, while in digital photography the medium is a digital detector which translates each pixel into a color value that ranges from 0 to 255 (or 8-bit) for red, green, and blue colors (RGB), called 24-bit "true color" imagery (i.e. 8-bits times the three RGB colors) which possesses a range of up to 16,777,216 colors. However, when considering radiography, the media are only recording grayscales and not color scales, so for a conventional 8-bit radiograph, there are 256 shades of gray that are possible.

In radiography, and not unlike taking a reflected-light photograph, the "light" from an x-ray source is captured by the analog or digital medium. However, because of its higher frequency the light is not reflected, but passes through the object and is captured by the medium. This capturing results in different values ("shades") based on how much energy makes it through the object—more energy for low density objects or parts and less energy for high density objects or parts. In a medical radiograph, for example, denser matter in the body such as bone stops more of the x-ray energy while lower density parts such as tissue and organs stop much less energy. The amount of energy stopped is called "attenuation" and this principle forms the basis of x-ray radiography.

In analog radiography, x-ray beam attentuation is captured on the medium which is a photo plate much like a conventional film camera, and the image must be developed using chemicals. The xeroradiograph devices use a photostatic plate that does something similar without chemicals (and similar to the original xerox process of photocopying). In both cases, however, for very dense materials such as ceramics, low energies must be used to preserve the medium which dictates long exposure times, in which the medium needs to "soak" in the x-ray energies, sometimes for up to several minutes at a time. Once the medium has been developed and an image is present, the film is viewed like any other picture and is considered to have near-infinite resolution and near-infinite levels of grayscale. As mentioned above, the human eye can only perceive so many of the these levels, and even using a magnifying glass or similar device, there are limits to what the human eye can detect. In a sense, the infinite resolution and shades of gray in an analog radiograph are wasted when viewed using the human eye alone. This limitation can be overcome somewhat by doing high-resolution scans into a computer to make use of digital image processing tools, but this is a half-measure for using computing power to analyze analog radiographs.

Needless to say, the long exposure times and development of images for analog radiography or xeroradiography mean that one image takes a while to produce before any analysis can begin. Add to that the difficulty of storing fragile radiographs for future analysis and the cost of acquiring and developing an image, and it seems pretty clear why radiography did not catch on with the majority of archaeologists. Enter the "Digital Age" of radiography.

Digital (Radiography) Revolution The process just described for image acquisition in analog radiography is essentially the same for digital radiography. However, gone is the continuous restocking of film media and development chemicals, and with those consumables the long acquisition times necessary in analog radiography. By using a digital detector analogous to a digital visible light camera, the analyst cuts out the "middle-man" so to speak and goes straight from acquisition to image to analysis using digital image processing tools.

Once we move past the image acquisition stage, the differences between analog and digital radiography become much more more apparent. There are several benefits and improvements that come with transi-

tioning to digital equipment. One of the most important is the ability to store images digitally in the same fashion as digital photography. Likewise, images can be more easily shared and prepared for publication. In short, image integrity is maintained and can be viewed in its "native" resolution and sharpness without loss of detail as is the case when analog radiographs are digitally scanned for wider distribution. Another benefit is the ability to magnify an image using a digital image viewing program available on almost any computer. In addition, digital radiographs may also be analyzed digitally for patterning in the internal structure of an object (see below). Finally, to return to the acquisition stage discussed previously, the speed with which a digital radiograph can be acquired cuts the acquisition time by a factor of at least 20 and perhaps more. This means that digital radiography may be used to acquire imagery data at an assemblage scale rather than being limited to a few select artifacts.

The "Making of Ancient Eurasia" Project

The radiographs used in this research were acquired as part of a University of Chicago, Department of Anthropology and Argonne National Laboratory joint project. Initially started in 2005 with a seed funding grant from the Argonne National Laboratory Board of Governors to explore opportunities for collaborative research using x-ray analysis of cultural materials, the project went on to focus on two primary areas: SAXS (Small Angle X-ray Scattering) and digital radiography. The data gained from the SAXS research is still a work in progress, but the digital radiographic data is used in this research to investigate and distinguish between different pottery-making techniques, primarily the formation stage.

These data will be discussed in Chapter 5 in much greater detail, but it seems important to touch on a few aspects of the project itself.[9] First, as described above, we were already aware of the potential for using radiography to analyze pottery making techniques, so this project provided an opportunity to utilize a then state of the art x-ray set-up that could be used to analyze artifacts as dense as ceramics. The x-ray tube had the power to easily penetrate the denser materials of which pottery is made as opposed to cloth and bone where radiography had been used in the past, in which lower energy values were sufficient. Second,

9. The digital radiography side of the project's goals and protocols are explained further in Appendix B.

the project opened up the use of digital data collection which, at the time, had been little explored. We felt that with the diminishing access to xeroradiography equipment and the techniques utilized in that research, digital radiography held promise in its ability to mimic, and perhaps even surpass, what had been done with xeroradiography of ceramics.

"Not just for Interior Spaces anymore"

We are all familiar with the "x-ray" images taken by the dentist to look at our teeth, or by the doctor to look at our broken leg; these show what is "inside" a person's body and allows us to view their skeletal structure, and any anomalous structural features such as the broken tibia. Using radiography on human or faunal remains from an archaeological site is an obvious analogue. But when we come to pottery or other "manufactured" artifact, the utility of radiography goes beyond simply structure; it can help us understand processes. By being able to distinguish the parts that make up an artifact, or the structures of those parts, we are able to glimpse the process that was used to manufacture the object. It is sometimes possible to do this to some degree by careful visual inspection of a potsherd, but so much gets "smoothed over" (sometimes literally) in the process of making an object that visual inspection of the exterior is not sufficient. This is where radiography comes in because it allows us to glimpse these internal structural features in order to better understand the manufacturing process. Understanding these processes allows the archaeologist to "see" actual behavior as it is encoded into the production of an object, and behaviors lead to an array of possible limitations, consideration of choices, and ultimately social factors that constrain or enable the manufacturing to take place.

In ceramic analysis, the ability to document techniques used provides an *entré* into the manufacturing process. More importantly, aside from knowing individual techniques, we can understand nearly the entire manufacturing process as a series of production events, each that leaves some trace "encoded" within its structural characteristics. To quote Sigaut, a "technical pathway" (1994) of the manufacturing process focused on the techniques used in the production of the pot. This is the power of using radiography on ceramic artifacts over and above conventional visual inspection, and suggests why using radiography on manufac-

tured objects is so critically important when compared to using it on natural materials such as human or animal remains. Pots are not grown, they are made by human hands.

4.3 Techniques, Style, and Communities of Practice

Research into the production of pottery was initially focused on understanding the organization of production, though this often was used as a tangential means to determine the complexity of the society that produced it. From one standpoint, the research was less about the pottery and more invested in understanding the level of complexity of production held by the society, mirroring in a more detailed degree settlement research that sought to determine the "tiers" of settlement hierarchy in order to infer administrative and thus political complexity, which was in turn used as a surrogate for social complexity. In all of this research, the actual production of pottery became lost, perhaps in part because there appeared no further research we could do on the pottery itself. This situation began to change as new scientific ("archaeometric") techniques such as compositional analysis came to be utilized in research on the pottery itself as a means to understand what source materials were use in the production of pottery. Research had returned to the pots themselves.

Fast forward a decade or two and the field of pottery analysis had changed with the advent of ethnoarchaeological research as a means for better understanding "how" pottery was made and a new emphasis on patterns of learning. This became coupled with the introduction of practice theory, and a renewed sense that technology, too, plays a role in how and why a society develops the way it does, and the agentive role of producers of the material goods of a society. Even while such research may still hold to the formula "social complexity" equals or gives "political complexity" at its core, we nevertheless have turned the directionality of causal agency from a top-down approach to one that is, if not bottom-up, at least not uni-directional.

4.3.1 Potters and Learning

While practice theory was still little known in the Anglophone archaeological community, there was a growing field of ethnoarchaeology in which archaeologists (many students of Binford) turned to studying contemporary societies that were still engaged in pottery production. They sought to fill the "middle-range"

theory gap Binford discussed by trying to understand the learning patterns of potters in these contemporary, "traditional" societies. There has been a good deal of literature on the acquisition of potting skills, and each researcher stressed a certain aspect of the learning process.

Arnold (1988) looked at potting traditions among traditional potters of Highland Mexico. While his main focus was on the production of ceramic pastes, in his study he nevertheless grappled with the role learning plays in the production of those pastes (see also Arnold 1972, 2000).

Herbich (1987) studied the Luo potters of Kenya, paying particular attention to how interactions among the potters affected the pottery styles. The project among the Luo potters (conducted with Dietler) was also intended to test theories of matrilocal residence as an explanation the continuity of pottery styles put forth by Longacre (see below). According to Herbich, because female potters were trained by their mothers-in-law, there was a spatial component to the stylistic cohesion, not one through time because the styles differed by where the potter learned how to make pots which was more or less fixed by patriline. At best, there were small-scale differences between the pots produced within a potting community[10] which resulted in what Dietler and Herbich (1989) describe as "micro-styles" because they are only identifiable as such by a very small set of individuals and at best indicate who the potter was and little else.

The collection of papers in Longacre's *Ceramic Ethnoarchaeology* (1991a), and followed a few years later by *Kalinga Ethnoarchaeology: Expanding Archaeological Method and Theory* (Longacre and Skibo 1994), represented the results of a multi-year research project carried out by Longacre's students among Kalinga potters of northern Luzon in the Philippines. In his introduction, Longacre (1991b) addressed the role of learning in the transmission of pottery-making skills. A decade later, Skibo et al. (2001) tie artifact variability and change to skills taught in the learning process, and subsequently to techniques picked up by a potter throughout his or her lifetime.

Kramer (1997) conducted research among potters of two cities in Rajasthan, India (for a summarized version see Kramer 1994). Kramer looks at how the different social structures in potters of two sub-castes (*jati*) affect the production and ultimately different forms of the pottery produced in two regional cities.

10. A potting community is defined by Herbich as those homesteads located near clay sources, which is the primary determinate for a family being potters.

She notes that despite the caste system of India, there are many examples of similar, if not so structured, relationships between different artisans, that themselves are also separated into endogamous, or limited exogamous, kin groups. Such groups also share extensive trade relationships that extend back generations in a structured relationship that mirrors that of India's caste system. Kramer notes that the larger city of Jodhpur has fewer potters for its population, that their potters use clays from a larger catchment area, but because of its small potter community, the city imports pots from a greater number of outlying settlements. On the other hand, Udaipur potters appear more specialized in terms of their output, but the city still imports pots from outlying settlements even though the ratio of potters to residents is better. In terms of ceramic assemblages, she notes that despite their relatively close proximity, the assemblages are slightly different in terms of vessel type and numbers (e.g. some types are found in greater number in one city versus the other, etc.). Kramer suggests that these differences may indicate different consumer preferences based on food preparation or local ecological variations (e.g. vessel types intended to carry water) as well as the "stylistic and technological differences in the repertoires of settlements supplying the cities" with pots (1997:175). For the present study, she also notes that

> [s]ince there are numerous ethnographically documented cases of contemporaneous production techniques ... even within a given settlement, as well as within individual regions, archaeologists would do well to utilize more than one approach to linking a particular pot, or even "ware," to a particular source. A consideration of the combined features of paste, surface treatment, and form should permit a provisional discrimination among a group of similar pots. (Kramer 1997:175)

However, despite the recognition of the role learning plays in the production of material culture, in particular pottery, these efforts were ultimately undermined by rather vague notions of what constituted learning and how the culturally-specific techniques and aesthetics of making pottery were transmitted from experienced to inexperienced potters (Herbich and Dietler 2008:223-224).

The importance of "situated learning" (Lave et al. 1991) already has a solid foundation in archaeological discourse thanks to important ethnoarchaeological research in recent years (Crown 2001; Herbich 1987; Kamp 2001; Minar 2001; Wallaert-Pêtre 1999, 2001), and has now become a powerful tool in the delineation of identity groups through these communities of practice, rendered here as potting communities, which

represent one axis along which the identities of these distinct communities may be defined (Huntley 2006; Sassaman et al. 2001; Miriam T. Stark 2006). This delineation of identities is only possible because of the relationship between these locally-situated communities to each other through the network that is itself the sum of the stylistic features embodied in their pottery through these sets of practices (Lesure 2005; Voss et al. 1995).

4.3.2 Engagements with Style

One of the key concepts in this research is what I have called "technical" style, which is to say, style that contains all of the possible choices (i.e. techniques) a potter uses when producing a pottery vessel. Specifically, technical style is primarily centered on the formation stage of production because it is here that the impacts of learning maintain their strongest hold on the potter, and such techniques are most resistant to change. To be clear, this resistance comes not from any intentional or conscious decision on the part of the potter, but simply because no matter what paste is used[11] to make a given vessel form, and no matter what surface treatment and decoration applied to the vessel, the vessel is formed with the highest degree of skill using the techniques learned and used from the time when the potter first learned to produce pots. The firing process, not unlike the paste preparation process[12] is generally equally contingent on learning as they are with local conditions of available raw materials and facilities. A potter can make do with paste preparation and firing conditions that may differ from what they are used to, though they certainly have preferences based on what they learned through years of hard work, but a work area that has none of the familiar setup will almost certainly need to be "improved" to bring it closer to what the potter is familiar with.

And why not. In order for the potter to create the vessel envisioned in the conceptualization stage into a material form, the work area must be as close as possible to how the potter learned to make such forms in the first place, based on years of practice. Hence, Gosselain suggests that

11. With some possible exceptions, such as when the paste characteristics vary widely from that normally used.

12. See note note 11 above.

> [t]hrough the repeated practice of the activity, these gestures [in vessel formation] gradually become incorporated as an unconscious psycho-motor schemata. At this moment, innovation or the adoption of another technique is virtually impossible because it would require an unlearning compensated by a [new learning][13] process, and it is hard to imagine any factor strong enough to provide adequate motivation for such drastic measures. (1992:582)

In contrast, that style I have termed "imaginal" style is style that is much more amenable to change. Surface treatments and decoration, be it incising, application of slips, or even the use of paints and glazes, are all far less structured by "psycho-motor schemata" as Gosselain puts it. Indeed, in an open society, it is precisely such styles that offer the greatest room for personal expression by the potter, and this can be seen in contemporary society through the work of modern artists working with ceramics. Needless to say, in a somewhat less open society, there are societal understandings of how a vessel should be decorated, and much of this, then falls to the vacillating whims of the consumer. And here we enter the realm of "fashion" because the consumer in a more restrictive society expresses interest less in personal tastes and more toward those that signal participation in or identify the consumer with a social construct of society, be it ethnic, class, vocation, faith, or nation. In other words, "imagined communities" (Anderson 1983).

These connections from "technical" and "imaginal" style and the degree to which each is influenced by forces (social or otherwise) on the potter brings us back to the concept of communities of practice. As outlined in the communities of practice model discussed in Chapter 3, on page 54 (titled "Communities of Practice *Redux*"), there are already components within the model to explain the mechanism for these social and political forces to influence practice, and thus production. In its simplest form, each member of a community of practice can have an 'alignment' toward something within broader society, be it their family, a social movement, or a political entity. This alignment can influence the creation of practice; in other words, if a member wants to "signal" their identity (as part of the 'identification' aspect) through their behaviors, and have it reified in some material form (say, pottery), the potter would create practices that signal this alignment. Above, I have discussed the propensity for this type of 'signaling' to happen and be integrated within material culture, and it is through the communities of practice model that it becomes clear

13. I have replaced Gosselain's original term 'relearning' here with 'new learning' to make clear the potter is not relearning the original process but learning a new process. A revision of the phrasing for clarity only.

how the disposition to signal becomes integrated within everyday practices, and in the present case, how a community of potters change their practice. With the exception of the individual that initiates this change in practice in order to signal alignment[14] some, if not most, will make such changes without intending to do so, they are just following the changes in practice without knowing *why* such changes are becoming integrated into their practice of making pottery. As discussed in the communities of practice model, such changes may be subtle (or they may not), and they likely originate with one of the more experienced members, or a member that is described as a 'boundary agent' in the model, an individual that has one foot in the community of potters and the other in a community of practice which has more overt social or political goals. Thus, and in particular for archaeology, the 'who' is not as important as the 'how' and the 'why' of changes to practice and the chain reaction of practice that becomes reified in material culture.

4.3.3 Style in Political Culture

As mentioned in the previous section, assertions of style are made based on attributes compared during particular instances in time. Even in objects, style should still be thought of as behavior, or, more precisely, the result of behavior. What we are comparing when we think stylistically about objects are the instances of its creation that result in the object we perceive. As a result, just as with behavior, some techniques in the creation of the object may be used by the producer intentionally to evoke referents in a particular audience, while most techniques are used by the producer habitually, habits representative of learned practices. Sackett (1990) developed two concepts regarding style (labeled "Sackettism" to distinguish it from isochrestism) in an effort to address these two valences of intentionality in the creative acts of material style.

The first, active style, describes attributes used by the producer to evoke specific referents from the consumer, even if the "consumer" is a person that simply sees the object. Fashion trends should be understood as predominantly active styles in that they are making explicit reference to designers ("trendsetters") and

14. Of course, this intention to 'signal' could be more widespread and include multiple members of the community, but it doesn't necessarily have to be.

the respect they are accorded within the high-status ("high society") networks of society.[15] Moreover, the uses of style generated by Wiessner (1983, 1990) based on San spear points, emblemic and assertive, would both be regarded as forms of active style (intentional referents) that target audiences at different relational scales. For emblemic style, the relation between the wearer (who may or may not be the producer) and the consumer (person seeing the object that "contains" style) exists at the intra-tribe scale wherein the referent of the stylistic attributes are to symbols of rank or status (i.e. social identity) known within the tribe. In contrast, for assertive style, the relation between the wearer and the consumer exists at the inter-tribe level, and the referent of the stylistic attributes are to symbols of ethnic or cultural identity know to be used by each tribe. The same stylistic attributes that are significant at one scale (intra- or inter-tribe) would likely prove meaningless (or without referent) at the other relational scale. Finally, frequency seriation also assumes this process of an active valence, providing the "battleship curves" of fashion so prominent in the archaeology of the early 20th century.

The second concept, passive style, describes attributes that are not referential, but which nonetheless mark certain attributes of an object that may be regarded as stylistic. Minute details of artifice described by Dietler and Herbich (1989) in the creation of Luo pots almost certainly describe passive style. However, within the potter communities even these minute details are distinctive enough to mark specific pots as the work of specific potters when inspected (i.e. consumed) by other potters; hence, their use of "microstyles" is particularly apt because these stylistic features operate at a "microscale" (i.e. small potter community) within a larger settlement.

The aspects of style outlined above suggest axes along which attributes can be assessed for coherence in the articulation of particular styles in objects, conceptualizing style must also acknowledge that style is perceived differently by consumers at relational scales that are different from the producer. That is, the set of attributes of a particular style that are judged to cohere will be different at different relational scales.

It is also important to note that none of these represent circumscribed aspects, nor should they. They should be thought to overlap with each other because, when we think or categorize stylistically, we create

15. I would argue that the active valence accounts for the so-called "high culture" phenomenon suggested by Baines and Yoffee (1998).

fluid sets in which these three axes overlap. In this sense, to set out seemingly distinct axes of coherence may seem counter intuitive, but these are suggested merely as general guidelines which can account for many aspects of style in objects.

THE POLITICS OF POTTERY

In principle, use of style criteria is not problematic in defining the archaeological culture as long as we do not mistake the archaeological culture as necessarily representing actual or specific cultures in the past. Moreover, the difficulty with the practice of defining cultures based on stylistic criteria is that archaeological cultures are often defined using extremely limited sets of stylistic criteria–decorative styles remain particularly popular.

Typologies currently used for the creation of site chronologies by archaeologists rely almost entirely upon stylistic attributes. In this regard, seriation of sites is based on differences in stylistic behavior and an assumption of changes in preference in stylistic attributes of objects (see below). However, because seriation has been focused on perceived changes in style through aesthetic style (or what Sackett (1990) labels "adjunctism"), such seriation is inherently biased toward what might be termed aesthetic judgments. In general, this is certainly an expedient, sound practice. Nevertheless, in principle, seriation should also take into consideration other aspects of style—namely technical and functional styles. The inclusion of these additional aspects may demonstrate that in addition to imaginal criteria, patterns of learning (and hence technical, habitual forms of practice) are likewise influential in the distribution of styles in particular site components.

In the next chapter I turn to looking at the data from Huizui, first parsing out several technical styles in the formation of pottery and then delineate functional and imaginal styles. Using these three types of style, I use these data to assess the significance of areas of overlap between these three types of style and how imaginal styles change through time, functional styles change somewhat, and the technical styles change very little.

5

COMMUNITIES OF PRACTICE AT HUIZUI

"... one still must acknowledge that the richest aspects of any large and complicated system arise in factors that cannot be measured easily, if at all. For these, the artist's approach, uncertain although it inevitably is, seems to find and convey more meaning."

– Cyril Stanley Smith, *A Search for Structure* (1981)

In this chapter I analyze and discuss the primary data collected from the Huizui site and the archaeometric analysis that was undertaken using samples from the primary dataset. I begin with a brief introduction to the Huizui site, with an emphasis on production activities at the site, including any evidence for pottery production. I then discuss the pottery assemblage collected from the site, including the Huizui Pottery Technique Database. This is followed by a radiographic analysis of a subsample of the pottery collection. This archaeometric analysis is intended to facilitate the subsequent statistical analysis.

The Huizui Community

In order to study techniques of pottery production at Huizui, first an understanding of the Huizui community, its environs, and its inhabitants is necessary to put the production of pottery of the Huizui community into perspective.

Huizui is a small to medium-sized site located in the southern part of the Luoyang Basin, just north of the Song Mountains. The site is situated between two outcrops of sandstone and within 5 km of numerous limestone and oolitic dolomite deposits along the base of the Song Mountains (Gorton 2003; Webb et al. 2007).

Excavations by Chinese archaeologists at the site were small, first conducted in the late 1950s (HPBCCRET 1961; HPICRA 1990),[1] but the most intensive excavation and research was conducted in the early 2000s by the Yi-Luo River Valley Project in conjunction with the Institute of Archaeology, Chinese

1. see Appendix C, "Huizui Site" on page 418 for more information on excavations at the site.

Academy of Social Sciences.[2] In addition to excavation, the Yi-Luo River Valley (YRV) Project enlisted specialists in several fields to analyze different artifact and ecofact types (Figure 5.1).

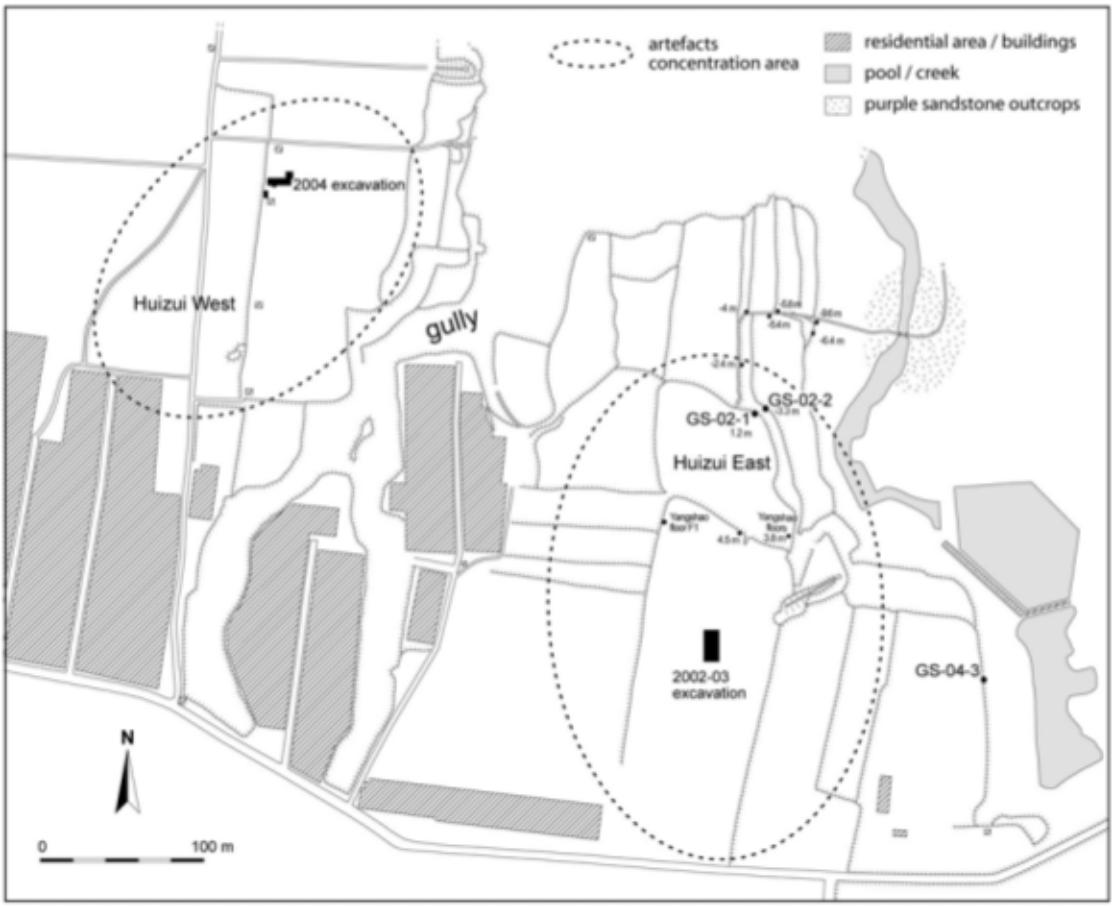


Figure 5.1: The Huizui site (showing 2002/3 and 2004 excavations)
from Liu, Chen, Lee, et al. (2002-2004)

Production at Huizui

Huizui became a ground stone tool production center by the Erlitou period (Ford 2004; Gorton 2003; Liu, Chen, and B. Li 2007; Webb et al. 2007), so that despite its size the site seems to hold a particularly

2. Here is a near complete listing of research done by the Yi-Luo River Valley Project involving the Huizui site: CASS-IA-H1T 2004, 2010a,b,c; Ford 2004; Gorton 2003; Liu, Chen, Lee, et al. 2002-2004; Liu, Chen, and B. Li 2007; Macphail et al. 2007; Owen 2007; Qiao 2007; Rosen 2007; Webb et al. 2007.

important position within the economy of the basin. This importance is further indicated because the Huizui community provided stone tools to the Erlitou settlement (Ford 2004; Liu, Chen, and B. Li 2007).

Pottery excavated from the Huizui site was most likely made within the community throughout its occupation. However, compositional analysis such as instrumental neutron activation needs to be done in order to confirm this by comparing the elemental signatures of the ceramic materials to that of the local source materials.[3]

5.1 Pottery Assemblage from Huizui

The primary data used in this research consists of 333 pottery sherds[4] set aside from the 2002-2003 excavation season at the Huizui site. The sherds that make up the database collection were selected by me in 2004 from among the sherd assemblage located at the field station in Huizui Village. The collection was then stored for several years until I arrived to conduct my database coding in 2009.

These pottery sherds were entered into a Microsoft® Access database I created in the field, though the basic outline of the database had been constructed at university.[5] Statistical analysis of the Huizui Pottery Technique Database was undertaken using SOFA (Statistics Open For All)[6] to generate frequency tables, and generate the technical pathway tables (which are layered frequency tables). In both cases the database tables were exported as CSV files and then imported into Microsoft® Excel 2003 (or the open-source alternative, Libre-Office Calc) for analysis.

3. Soil samples were collected, but due to budgetary constraints I was unable to conduct any compositional analysis using soil samples and pottery from Huizui. This will be undertaken in a future study.

4. While most "sherds" are single sherds in the traditional archaeological sense, I have also included some "multi-part" sherds in the database. Multi-part sherds are sherds that can be fitted together to form a unified section of the original ceramic vessel, though they presently exist as individual pieces.

5. See Appendix A on page 219 for details of the database's structure and coding used in this research.

6. A free python-based program available here: http://www.sofastatistics.com/home.php

5.1.1 Assemblage Characteristics

In this section I discuss the characteristics of the Huizui assemblage, describing the "demographic" characteristics that are traditionally used to describe a pottery assemblage such as ware types, vessel forms, and decoration types.

Form and Ware Classes The pottery assemblage at Huizui consists of a typical array of pottery forms found at almost all Longshan Period sites, and were most likely produced at Huizui since there is noindication of centralized pottery workshops. These include: *guan* jars, *pen* and *yu* basins, *weng* urns, *zun* jars, *dou* stands, and *pan* dishes. This series of vessel frequencies includes data from the Huizui Technique Database and data drawn from reports on the Huizui site (CASS-IA-H1T 2010a,c; HPICRA 1990).

Major Vessel Forms The majority of vessel forms at the Huizui site include five main types, and three sub-types. In general, the major forms are found in high numbers in both the early and late Longshan periods (Figure 5.2 on the following page and Table 5.1a on page 114).

Minor Vessel Forms Those vessel forms here identified as "minor forms" in no way suggest that these forms are less important, they are simply less frequent in the assemblage (Figure 5.3 on page 115 and Table 5.1b on page 114). Indeed, from a socio-political standpoint, some of these forms may be some of the most important for their role as ritual vessels.

Ware Types Aside from vessel forms, one of the other primary attributes of neolithic Chinese pottery is the ware type. In most reports there are two basic ware types: fine ware (*nizhi* [泥质]) and coarse (*jiasha* [夹砂]). These ware types provide a bulk characterization of the paste preparation used in a given piece of pottery, as well as providing a clue as to what type of formation methods were used in so far as coarse wares are most often hand-built, whereas fine wares are more likely to have been made on a wheel of some kind (see Paste Preparing and Vessel Formation below). Cross-referencing these data with the functional groups by vessel type indicated above (Figures 5.1a and 5.1b on page 114) we see that most coarse wares belong to

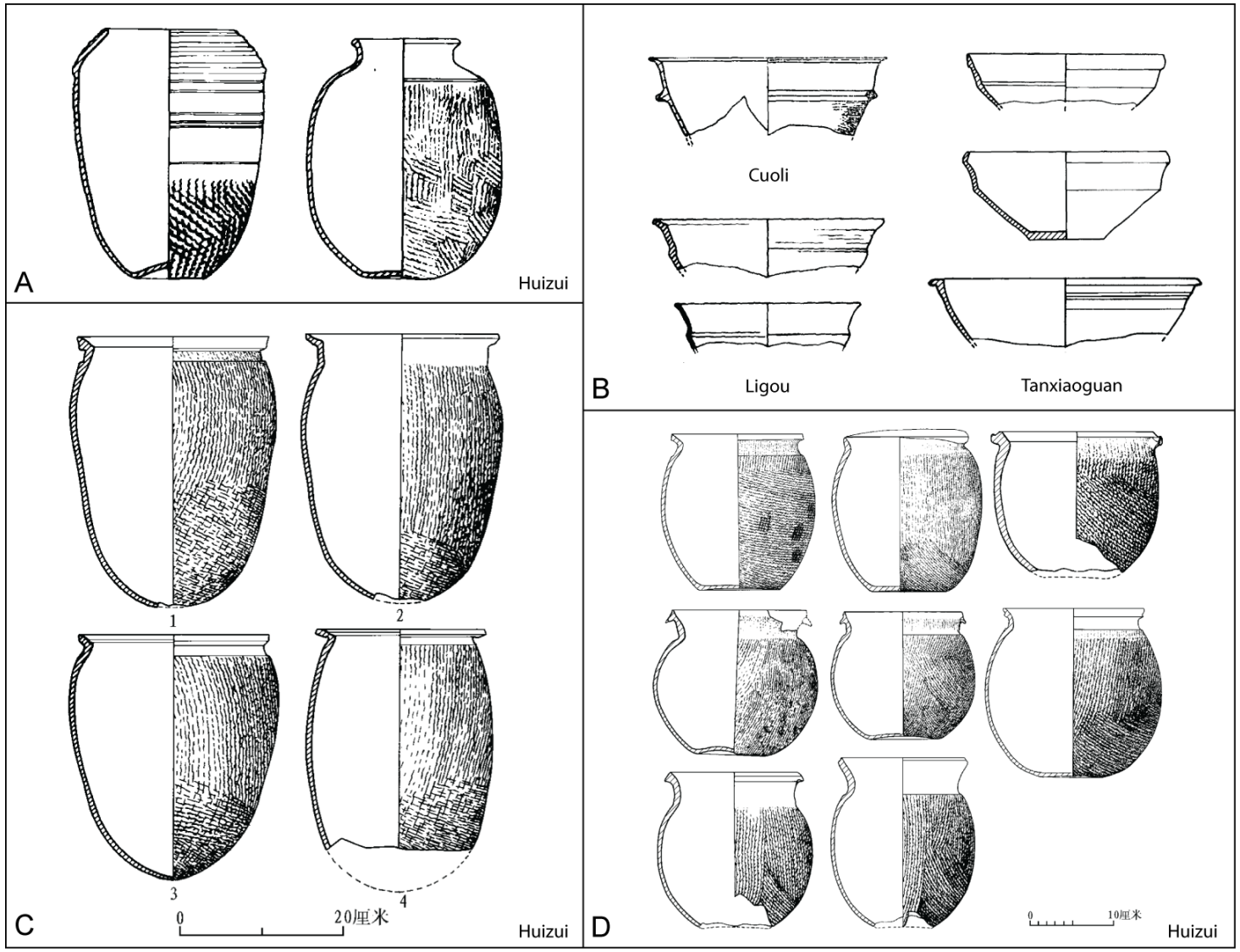


Figure 5.2: Major Vessel Forms: **A)** *weng* urns; **B)** *pen* basins; **C)** deep-bodied *guan* vats; **D)** round-bodied *guan* jar (Including source sites)

Form Name (pinyin)	Form Name [characters]	Form Subtype	Category	Functional Type
guan	罐	guan-deep	vat	storage
		guan-round	pot	cooking/serving
pen	盆		basin	cooking/serving
weng	瓮		urn	storage

(a) Major Forms

Form Name (pinyin)	Form Name [characters]	Form Subtype	Category	Functional Type
dou	豆		stand	serving
pan	盘		dish	serving
wan	碗		bowl	serving
yu	盂		basin	serving
zun	尊		jar	cooking/serving

(b) Minor Forms

Table 5.1: Vessel Forms at Huizui

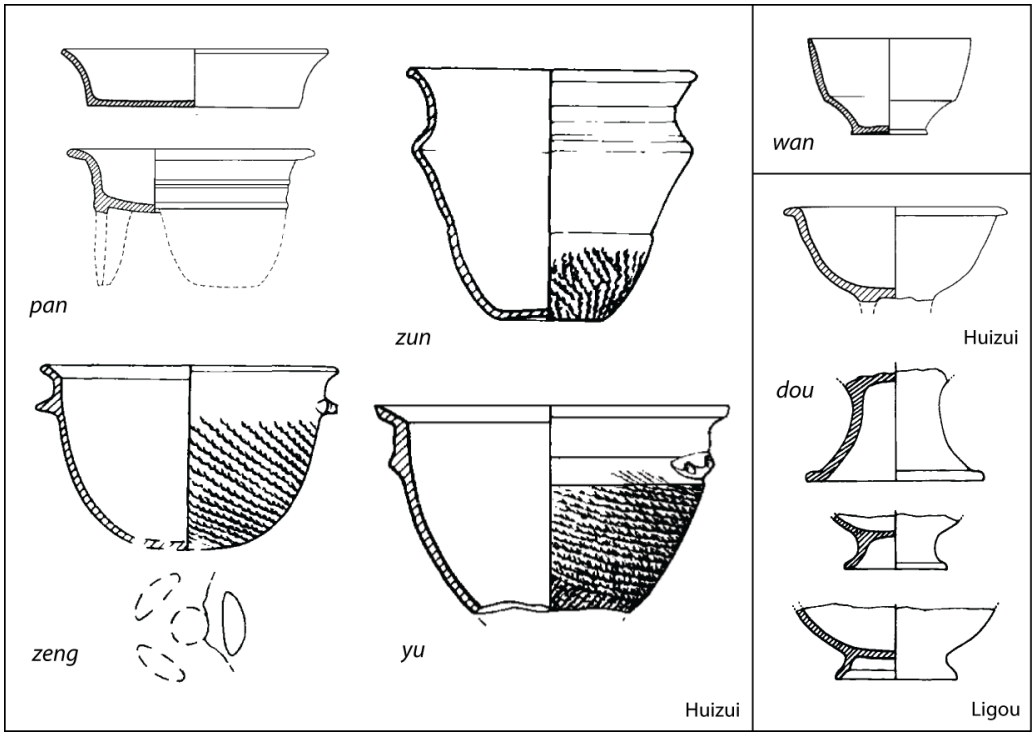


Figure 5.3: Minor Vessel Forms (Including sites listed)

the cooking and storage groups, while most of the fine wares belong to the serving group, or in the case of fine *guan* and *zun* jars, a dual role in storage and serving groups.

We also see that the majority of the coarse wares belong to two of the *guan* sub-types, deep and round, with a few *pen* basins, *wan* bowls, and *weng* urns mixed in (Table 5.2 on the next page). However, there are no *pan* dishes, *yu* basins, or *zun* jars (and fine *guan*, of course). In looking at the fine wares, all vessel types except deep and round *guan* have some or all of their numbers falling into the fine ware type.

5.1.2 Ceramic Technology

The analysis of pottery technology focuses on the four main stages of the production process: paste preparing, vessel forming, vessel finishing, and vessel firing.

	Ware Type	
Form	*coarse*	*fine*
dou	–	1
deep guan	30	–
fine guan	–	19
round guan	25	–
pan	–	3
pen	1	7
wan	–	3
weng	3	7
yu	–	8
zun	–	4
Total	**59**	**52**

(a) Early Longshan

	Ware Type	
Form	*coarse*	*fine*
dou	–	5
deep guan	11	1
fine guan	–	61
round guan	19	–
pan	–	17
pen	1	32
wan	–	8
weng	2	61
yu	1	10
zun	–	17
Total	**34**	**212**

(b) Late Longshan

Table 5.2: Ware Types by Vessel Form

Paste Preparing The first stage of pottery manufacture involves the acquisition of constituent clays or clay-bearing soils, as well as any material used to add additional characteristics to the final pottery vessel. In particular, this includes different types of non-plastic or organic inclusions, generally referred to as temper. The two basic ware types used in almost all Chinese reports provide an indication of the general inclusionary characteristics of pottery. However, here I seek to look at the ware types with a greater degree of detail in order to determine if there are any "paste recipes" particular to given vessel forms, forming techniques, etc.

As can be seen in Table 5.3, during the early Longshan period most vessels have either grit or sand inclusions, indicating generally coarse ware vessels. However, even some supposedly "fine" *guan* have these larger inclusion types; in such cases, it is a matter of percentage of these materials. There are many examples of otherwise fine ware vessels that have one or two larger inclusions in an otherwise fine paste which suggests either naturally-occurring materials, or imprecisely prepared pastes. In any case, the overall "coarse" nature of vessels in the early Longshan may be indicative of a reliance on inclusionary material to strengthen pottery vessels.

This trend shifts toward the lessening of inclusions by the late Longshan. Even while our numbers of late Longshan vessels increase, there is a trend toward smaller material like sand, and even to simply using organic material or no temper at all. This may in part be the result of a shift from cooking and serving vessels (see Functional style discussion below in §5.2.1 on page 133), and the near disappearance of deep *guan* which made up almost half of the *guan* vessels. This shift from these large, coarse ware vessels is countered by a dramatic increase in fine guan, in particular those that are definitely fine-pasted with a small number even having sand temper.

Vessel Formation Because of the number of vessel forms, I will primarily focus my discussion on the four major forms: deep *guan*, round *guan*, *pen*, and *weng* vessels. Looking first at the early Longshan (Figure 5.4a on page 120), among the major vessel forms there appears to be a preference for paddle and anvil forming, comprising 90% of the deep *guan* vessels, while the round *guan* are formed primarily using paddle and anvil (65%), there is also an even split between mold formed and wheel formed vessels (17% and 18% respectively). On the other end of the scale, *pen* are also primarily paddle and anvil formed (50%),

Recipe		Vessel Form									
		dou	deep *guan*	fine *guan*	round *guan*	*pan*	*pen*	*wan*	*weng*	*yu*	*zun*
Grit (RT)		–	10	8	5	–	–	–	1	–	–
Limestone (LM)		–	4	3	–	–	2	–	3	–	2
Sand (SD)		–	16	4	18	–	1	1	2	–	–
Organics		–	–	1	–	1	1	–	–	2	–
no temper		1	–	3	2	2	4	2	4	6	2
Total	**112**	1	30	20	25	3	8	3	10	8	4

(a) Early Longshan

Recipe		Vessel Form									
		dou	deep *guan*	fine *guan*	round *guan*	*pan*	*pen*	*wan*	*weng*	*yu*	*zun*
Grit (RT)		–	2	3	3	2	–	1	1	–	–
Limestone (LM)		–	2	7	2	2	7	2	13	3	4
Sand (SD)		–	8	15	14	–	1	–	12	1	2
Organics		1	–	6	–	6	5	–	2	2	1
no temper		4	–	30	–	7	20	5	35	5	10
Total	**246**	5	12	61	19	17	33	8	63	11	17

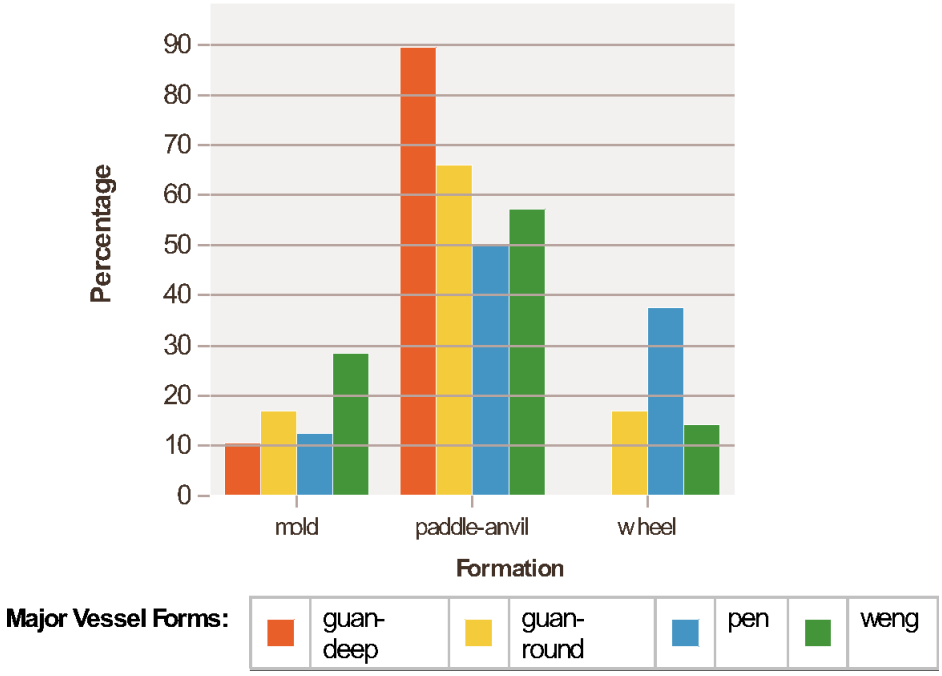
(b) Late Longshan

Table 5.3: Paste Recipes by Vessel Form

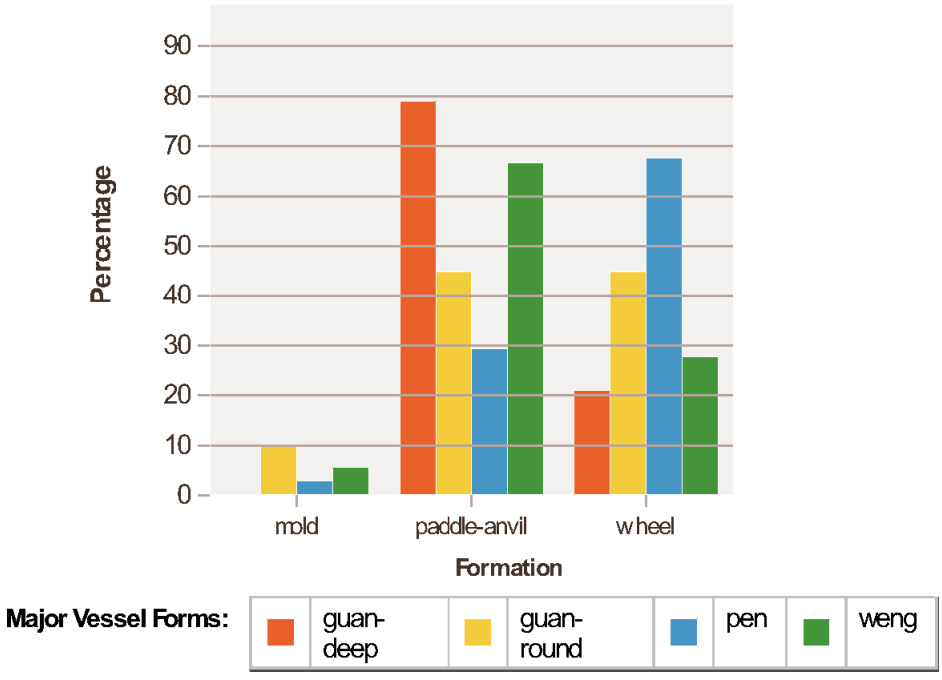
the balance is followed closely by wheel-formed *pen* (38%), with a marginal number of *pen* formed using mold techniques (12%). Lastly, *weng* are similar but inverse of the *pen* vessels being 67% paddle and anvil formed, followed by a strong showing for mold formed *weng* (29%), while wheel formed *weng* only amount to half the number of mold formed vessels (14%).

However, there is a distinct shift in formation techniques from the early Longshan to the late Longshan (Figure 5.4b on the following page). Whereas in the early Longshan paddle and anvil formed a majority of all major vessel forms, by the late Longshan while some vessels are still predominantly made using paddle and anvil techniques, with deep *guan* at 79% and *weng* at 67%, there is a noticeable reversal for *pen* to wheel formed vessels accounting for 68% and paddle and anvil formed vessels dropping to 29%; mold formed *pen* are reduced to a paltry 3% of their number. Also of note, round *guan* are now made equally using paddle and anvil (50%) and wheel (50%), with a small holdout of these vessels formed using the mold (10%). Returning to the majority paddle and anvil deep *guan* and *weng* vessels, while the majority of *weng* are made using the wheel (28%), a small minority (5%) are still made using the mold as well. As for the deep *guan*, mold formed vessels disappear completely, and I suspect that the 21% of these vessels that seem to be wheel made are in fact paddle and anvil formed vessels with wheel-turned rims (see §5.2.3 on page 146).

There is some interesting information to be gleaned by looking at formation techniques for the minor forms as well. Since many of the minor forms are categorized as "serving" vessels, it should not be surprising that the majority of these vessels are made on the wheel in both the early and late Longshan (Figure 5.5 on page 121). Looking specifically at the early Longshan, there are a few things to note. First, the *zheng* steamer, which is essentially a *yu* or *pen* basin with holes cut out of its base, shares a nearly identical production pattern as the *pen* basin described above, except that for the *yu*, often being a slightly smaller vessel, has its numbers of wheel versus paddle and anvil formation reversed: 50% wheel and 38% paddle and anvil, compared to the pen 38% wheel and 50% paddle and anvil. Moreover, both of these vessels demonstrate identical mold formed vessels at 12% of their total. Likewise, the *zun* jar has somewhat comparable numbers to the round *guan* jar in being predominantly made using paddle and anvil (68% and 65% respectively). The difference comes from the fact that there are no mold formed *zun*, the balance of their numbers (32%) being

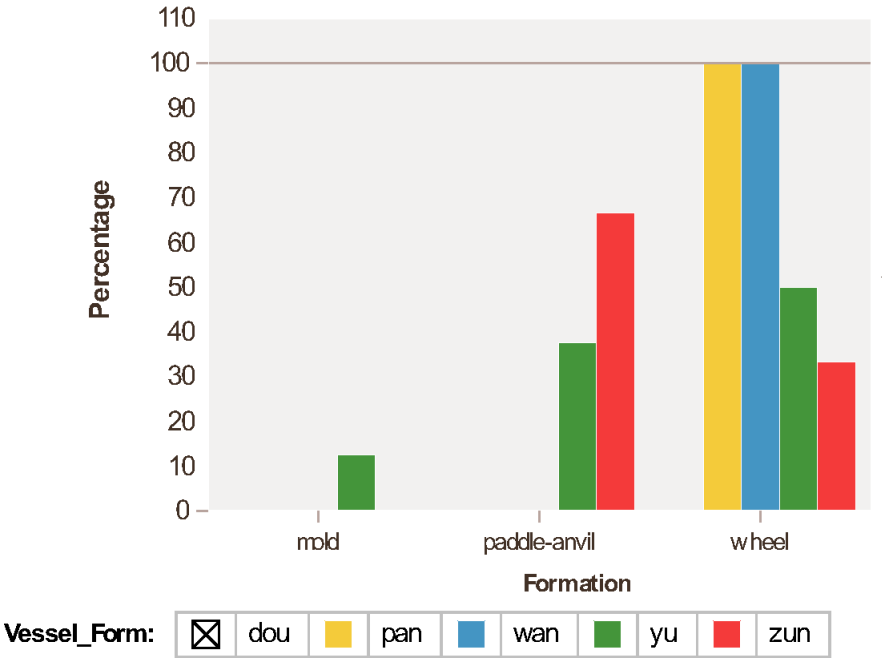


(a) Early Longshan

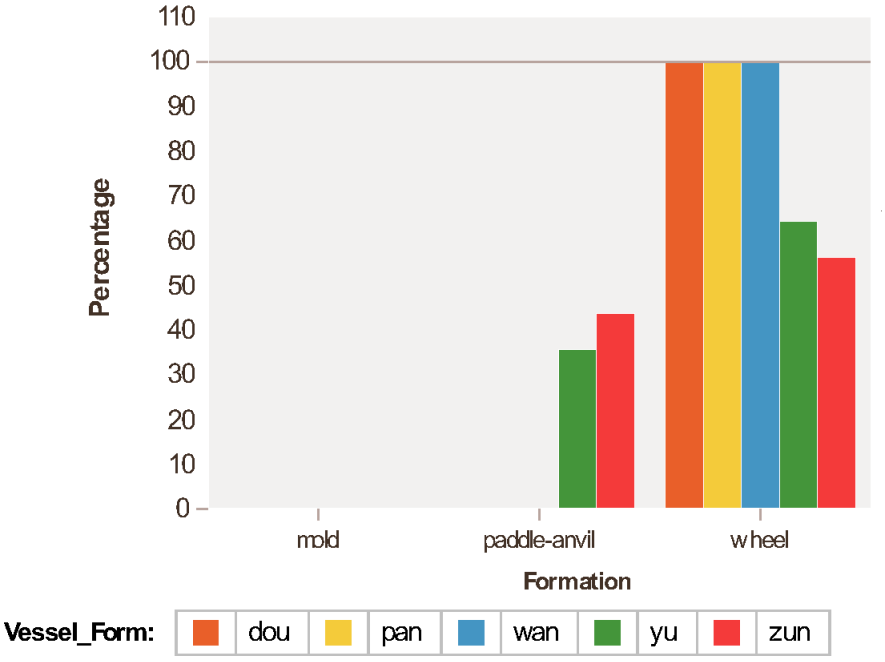


(b) Late Longshan

Figure 5.4: Forming Techniques by Major Vessel Forms



(a) Early Longshan



(b) Late Longshan

Figure 5.5: Forming Techniques by Minor Vessel Forms

wheel formed vessels. Lastly, it is not surprising to see that in the early Longshan the small serving vessel types, *wan* bowls and *pan* dishes, are both made on the wheel.

By the late Longshan (Figure 5.5b on the previous page), we have the introduction of *dou* stands as another small serving vessel, and as with the *wan* and *pan*, it, too, is also exclusively wheel formed. The *yu* continues the trend and in fact more closely matches that of its sibling the *pen* basin, with the majority made on the wheel (65%) followed by those made using paddle and anvil (35%), while mold formed *yu* have disappeared from the record. Lastly, *zun* jars also more closely match round *guan* in their numbers, with a slight majority being wheel made (55%) and the rest made using paddle and anvil (45%).

Vessel Finishing As with the discussion of formation techniques, I will focus this discussion on the major vessel forms. However, unlike the forming techniques being consolidated around a few methods of formation, techniques used to finish these vessels are fairly well distributed throughout the early and late Longshan (Figure 5.6 on page 124). Nevertheless, in the early Longshan, there is a preference for combed vessels, followed by the preference for "minimal" surfaces as represented by plain or burnished vessels (Figure 5.6a on page 124).[7] Compare this to nearly non-existent impressed vessels, a few stamped vessels, and a consistent number of marked vessels across all of the major forms.

By the late Longshan, there are a few noticeable shifts, especially among deep *guan* and *pen* vessels forms (Figure 5.6b on page 124). First, deep *guan* go from predominantly plain in the early Longshan (42%) to 16% in the late Longshan and become increasingly marked, with marked vessels increasing from 10% in the early Longshan to 32% in the late Longshan. And while the use of comb remains the same, there is an increase in burnished vessels; however, as I argued above, I believe this represents deep *guan* that have wheel-formed rims. For *pen* vessels, burnishing becomes less favorable and there is a switch between burnished vessels in the early Longshan (38%) to plain vessels in the late Longshan (39%). The number of combed *pen* remains almost identical at 24% in the early Longshan to 26% in the late Longshan, with the change coming from the lower 25% plain *pen* in the early Longshan to a now lower 30% burnished *pen* in

7. Hopefully it is clear that burnished surfaces are first plain surfaces that have been "glamoured" by burnishing them with a smooth stone to produce a shine.

Vessel Form	Period	No. of Cores			
		1	2	3	4
guan	Early Longshan	32	19	2	1
	Late Longshan	53	21	4	–
pen	Early Longshan	1	5	–	–
	Late Longshan	10	15	2	–
weng	Early Longshan	4	4	–	–
	Late Longshan	23	22	5	–

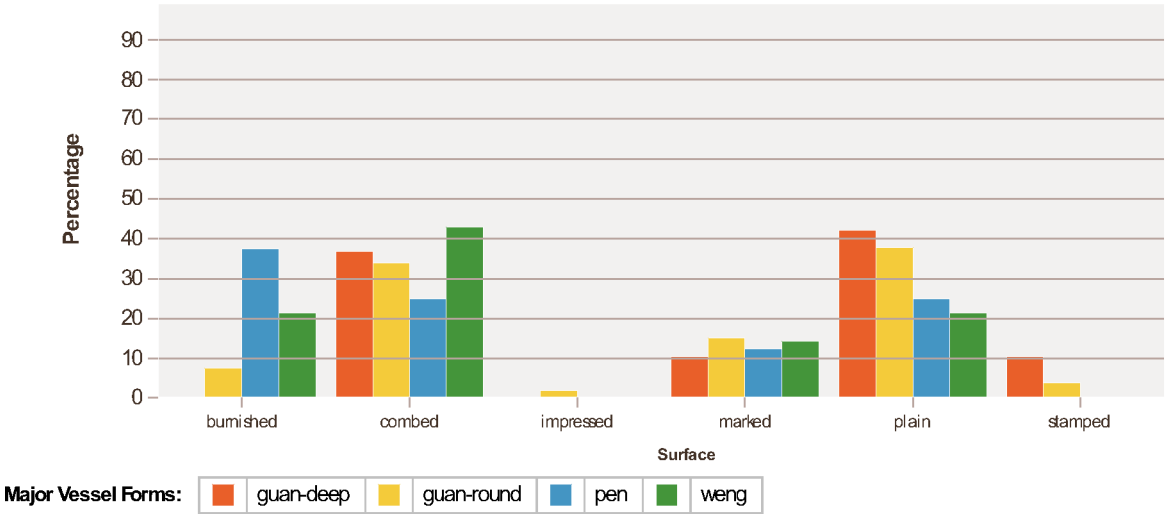
Table 5.4: Number of Cores by Major Vessel Form (count) for Early and Late Longshan periods.

the late Longshan. Some of these transitions also come from the near complete reduction of marked *pen* to a minimal showing of both marked and impressed *pen* to around 2% each by the late Longshan. Even among *weng* vessels, there is a loss of marked vessels from 14% in the early Longshan to a small 6% showing of stamped vessels and a slight boost in burnished vessels from 21% in the early Longshan to 28% in the late Longshan.

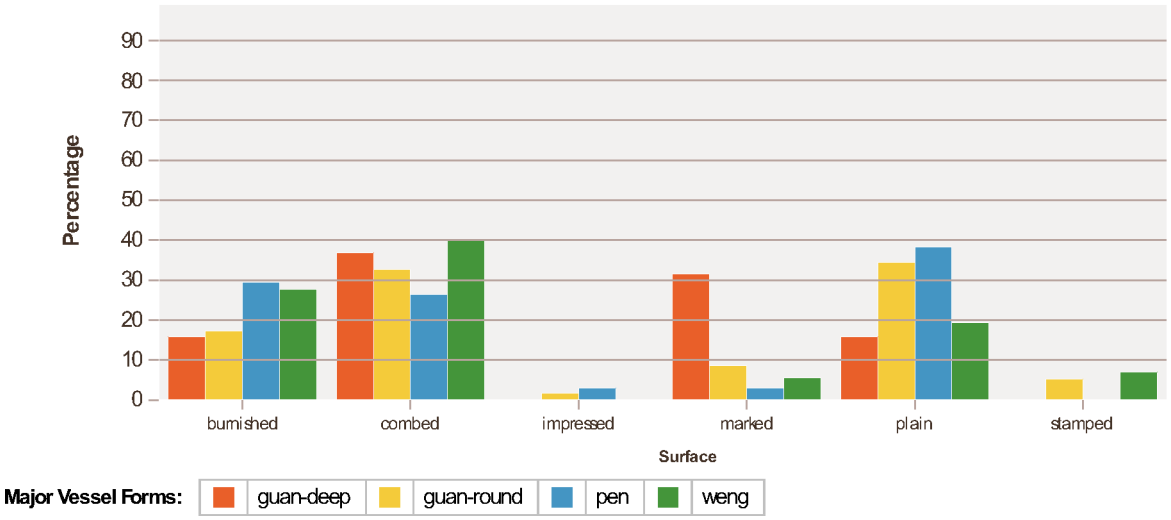
Vessel Firing Firing is assessed via the cores or interior characteristics of a vessel's wall. Here I first look at the sharpness of the boundary between cores for vessels that have more than a single core as a gauge of firing precision. This sharpness is designated by a simple binomial of "blurred" boundary between cores, or "distinct" boundary between cores.[8] This is followed by an analysis of the relationship of core color for vessels that had more than a single core.

Simply based on the number of cores present for the early and late Longshan periods (Table 5.4), it seems likely that a vessel with three cores is somewhat anomalous, while four cores may simply suggest poor firing skills. In any case, where two or more cores are present, it seems useful to interpret data regarding

8. In the database, there are actually four categories: blurred, very blurred and distinct, very distinct. However, as with much of this analysis, I deemed these designations overly, or unnecessarily, precise, and ultimately rather subjective. As a result, for the purposes of analysis, the "very -" designations were merged with their less emphatic versions.



(a) Early Longshan



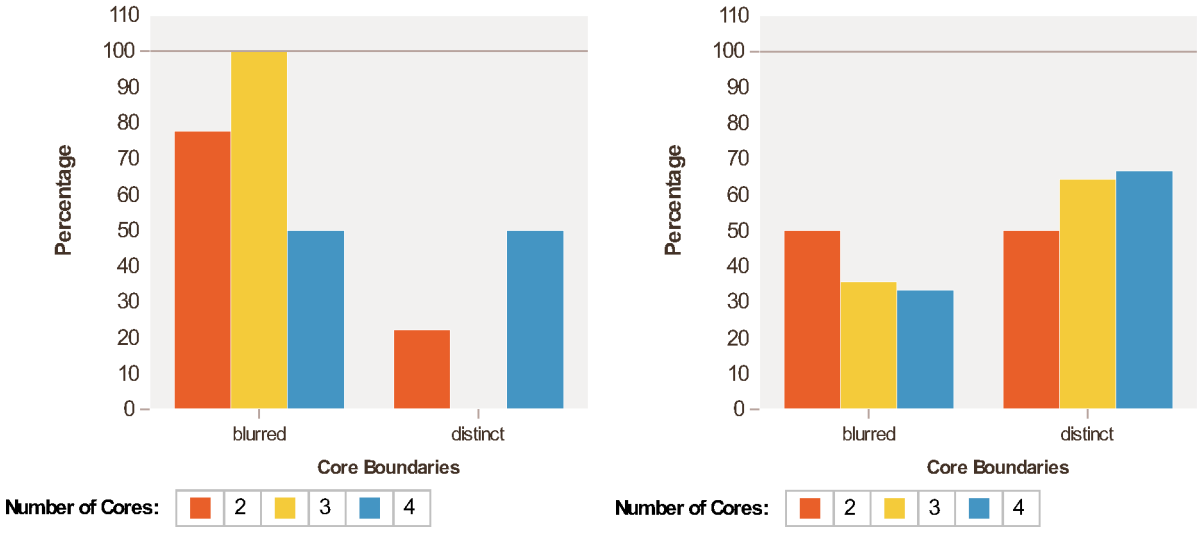
(b) Late Longshan

Figure 5.6: Finishing Techniques by Major Vessel Forms

the boundaries as one way to examine either: 1) level of firing skill (e.g. timing of reduction and oxidation processes or control of kiln temperature); or 2) technical aspects of kiln technology (Figure 5.7).

The majority of vessels fired during the early Longshan period demonstrate blurred boundaries between their cores (Figure 5.7a). Since there are so few sherds with four cores, and considering the dubious analytical usefulness of these sherds, concentrating on two- and three-core sherds, either all (three-core at 100%) or most (two-core at 80%) vessels had blurred core boundaries. Again, whether this speaks to skill or technology is unclear, but covered under the scope of "firing techniques and technology," these data strongly suggest less developed skill and kiln technology.

By the late Longshan period, the picture is less clear as to what we can say regarding these data, although it does appear that either firing skills improved, firing technology improved, or most likely a combination of both (Figure 5.7b). In fact, the distribution between blurred and distinct boundaries, one slightly skewed toward distinct with regard to three-core vessels, looks like what one would expect from improvements in both techniques and technology. I would argue that the continued presence of blurred boundaries simply indicates generations of new potters learning their trade.



(a) Early Longshan

(b) Late Longshan

Figure 5.7: Number of Cores by Core Boundary (percentage)

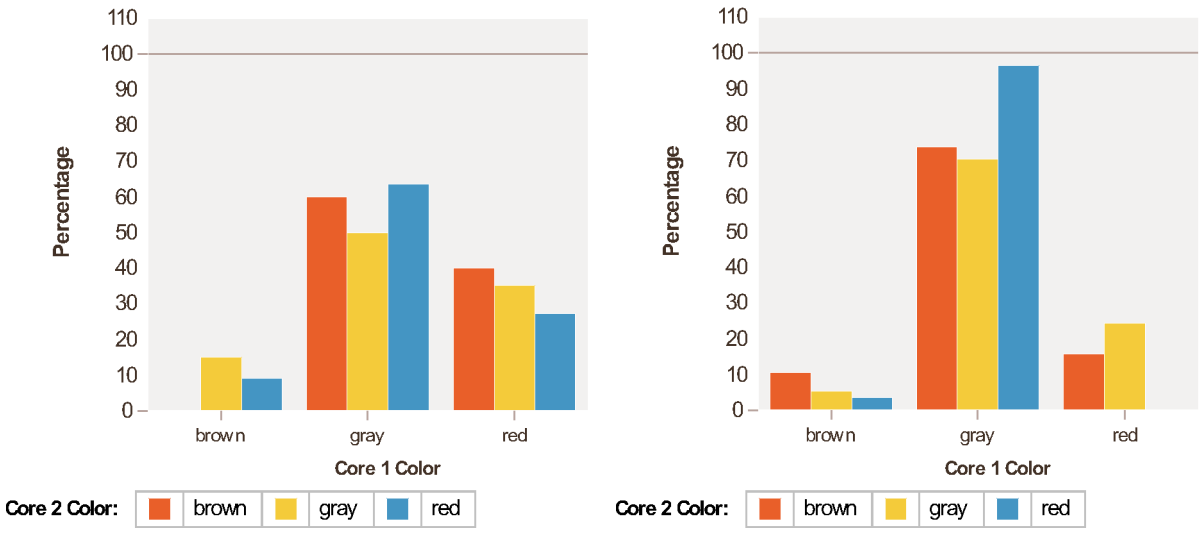
It is also interesting to note that the distribution of core 1 color compared to the color of a second core (core 2 color) is quite even across all three core 1 colors; a brown core 1 color is only slightly more likely to have a gray core 2 color, a gray core 1 color is slightly more likely to have a core 2 color of either brown or red, and so on (Figure 5.8 on the following page). This is certainly true for the early Longshan (Figure 5.8a), and not surprisingly, a core 1 color is less likely to have a second core of the same color.[9] What is also clear is that in the early Longshan, core 1 colors are somewhat more evenly distributed between all three, though gray and red predominate. However, in this regard by the late Longshan the situation has changed, and we find that the majority of core 1 colors are gray, and almost all of the red core 2 colors are matched with gray core 1 colors (Figure 5.8b).

Based on these data, I suggest that from the early Longshan to the late Longshan, firing techniques became much more precise, resulting in gray cores with secondary cores that are predominantly red or brown. To be clear, as will be discussed in the next subsection, by the late Longshan, most vessels are fired to have gray or black exterior and interior colors, surface colors produced in an reducing atmosphere. Combined with these core data, we see that most vessels had a gray or black exterior, maintained a reduce-fired core 1, and was surrounded by an oxidize-fired secondary core. This again suggests a much greater degree of control over firing from the early to late Longshan.

5.1.3 Appearance Characteristics

Finally, an analysis of appearance is intended to show how technical choices in the appearance of pottery through the Longshan period shows the evolution of aesthetics. Appearance is analyzed using data on surface treatments (based heavily on the finishing techniques used), and the decorative features added to the pottery. This series of appearance characteristics includes data from the Huizui Technique Database and data drawn from reports on the Huizui site (CASS-IA-H1T 2010a,c; HPICRA 1990).

9. As mentioned in the section titled *Characteristics Tables* of Appendix A (p.221), the core colors are all listed using the Munsell color system, but these have been simplified into single color designations to allow for this kind of statistical analysis. Therefore, while the cores are listed as being different (core 1, core 2, etc.), because of this simplification, they may appear to be the same when the cores are in fact different shades (Munsell codes) of the broad color designation of “gray” or “red” in the database.



(a) Early Longshan

(b) Late Longshan

Figure 5.8: Core 2 Color by Core 1 Color (percentage)

Surface Color Shades of surface color can be quite varied,[10] and to a great extent are contingent on firing practices (see above). Nevertheless, some interesting information can be obtained by looking at this variable more closely.

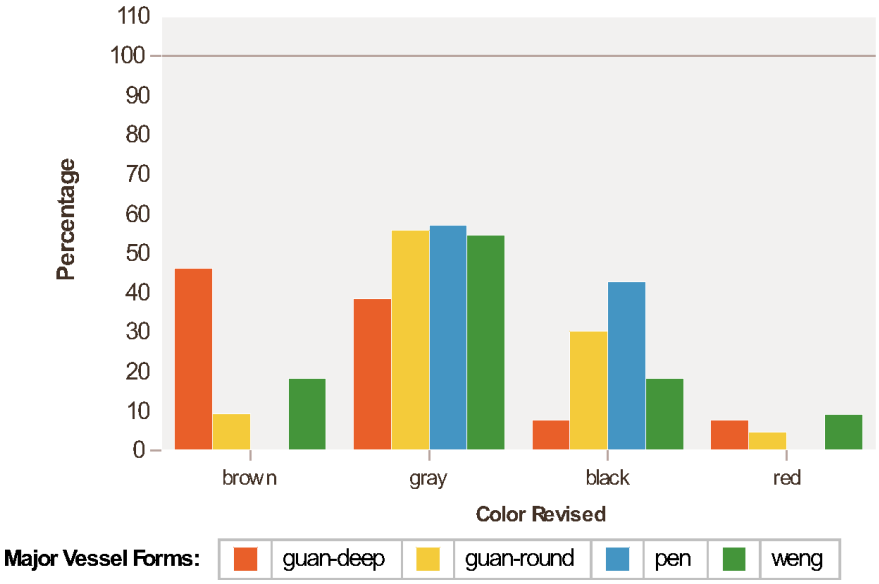
In the early Longshan most of the major vessel forms are gray wares (Figure 5.9a on page 129), although for deep *guan* there is a slight majority of brown vessels (46%) compared to gray vessels (38%), with the remaining numbers equally distributed between black and red surface colors (each 8%). Likewise, *pen* basins stand out for their distribution as well, though gray vessels still make up the majority (57%), there are a significant number of black vessels as well (43%). It is interesting to note that with regard to *pen*, there are no red or brown vessels in the early Longshan. This is in contrast to *weng* which are represented in every color, gray being the majority by a substantial margin (55%), an equal distribution of brown and black vessels (18% each), and a small minority of red vessels (9%). The most ubiquitous vessel, round *guan*, have

10. I should note here that as for some of these analyses, as was done elsewhere, I consolidated some of values when determining surface color: the color "yellow" was consolidated with "brown" as they are essentially different shades of the same color (as far as pottery goes); the value "black on red" which is of value in other types of analyses was consolidated with the color "black" since its "black surface and red core" dynamic is immaterial here.

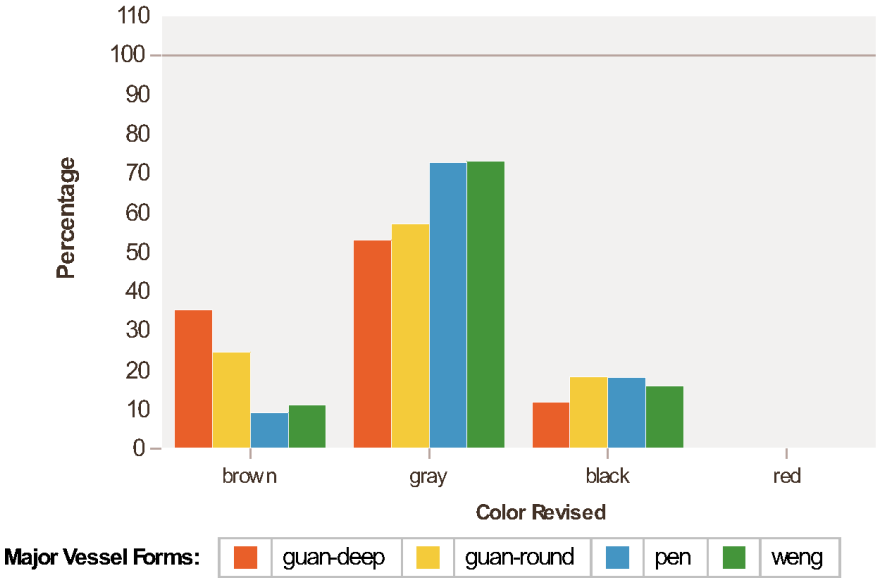
nearly twice the number of gray vessels (56%) to black vessels (30%), followed by a minimal showing of brown (9%) and red (5%) vessels.

By the late Longshan, while gray wares remain dominant, what stands out is the degree to which gray vessels predominate across all major vessel forms (Figure 5.9b on the following page). This trend is best exemplified by *pen* and *weng* vessels where 73% of both forms are gray in color. For *weng*, these means decreases in all other colors, and the complete absence red vessels. Black *weng* drop slightly to 16% (from 19%), while brown *weng* drop to 11% from 18% in the early Longshan. Likewise, *pen* vessels see the largest drop in black vessels, from 43% in the early Longshan to 18% in the late Longshan. Interestingly, whereas there are no brown *pen* in the early Longshan, a small number (9%) show up in the late Longshan. For the deep *guan*, the situation has followed the trend toward gray vessels, reversing the earlier predominance (though slight) of brown deep *guan*, to a slight increase in gray vessels (53%) over brown (35%). Much of this shift, however, comes from the complete absence of red deep *guan*, while there is a slight increase of black vessels from 8% in the early Longshan to 12% in the late Longshan. Finally, looking at round *guan*, gray vessels remain almost identical (from 56% to 57%), much of the shift comes again from the complete absence of red vessels, and the shift from black vessels to brown vessels. Black deep *guan* move from 30% in the early Longshan to 18% in the late Longshan, while brown vessels move from 9% to 25% by the late Longshan.

Surface Decoration In general, a wide range of decorative choices can be found on pottery at the Huizui site, and just as with the change in finishing techniques, we clearly see shifts in decoration schema for the major vessel forms from early to late Longshan (Figure 5.10 on page 131). In the early Longshan, there are some interesting groupings, with the exception of *pen* basins which only utilize the <raised-line> motif (Figure 5.10a on page 131). Of note, the three other major vessel forms, deep *guan*, round *guan*, and *weng* all utilize the <cord-applique> motif. The deep *guan* also use the <raised-line> motif in about equal numbers (each at 50%), while *weng* also use the <incised-line> motif, though in slightly fewer numbers compared to the aforementioned <cord-applique> motif (40% to 60% respectively). Bridging these two vessels are the round *guan*, which are the only vessel form to have the combination <incised-line> and



(a) Early Longshan



(b) Late Longshan

Figure 5.9: Surface Color by Major Vessel Forms

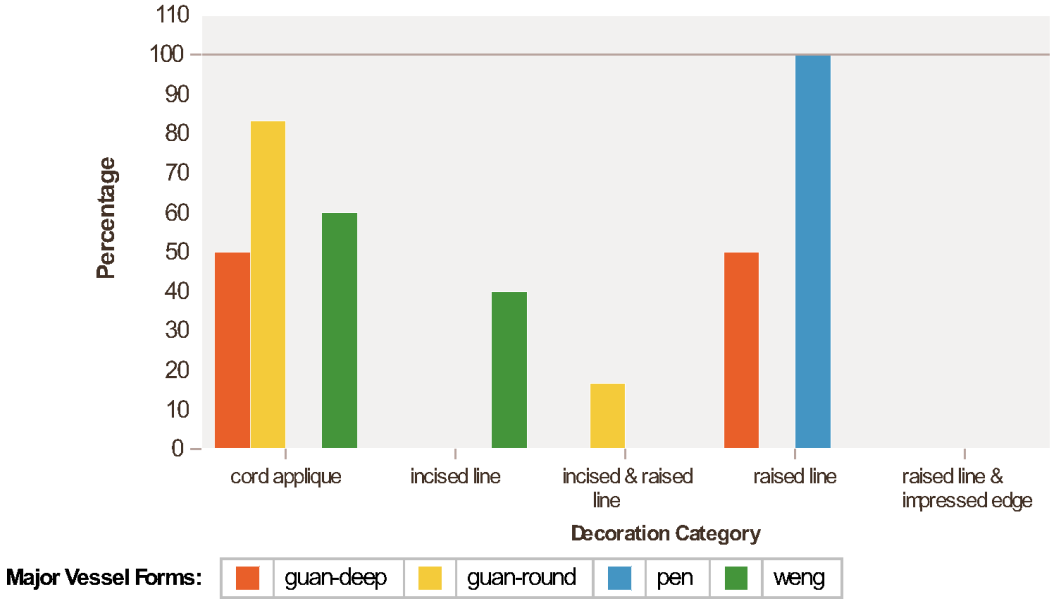
<raised-line> motif, though in far fewer numbers than the cord applique (83% compared to 17%). In the early Longshan, none of the major vessel forms utilizes the <raised-line> and <impressed-edge> motif (See examples in Figure 5.11 on page 132).

However, by the late Longshan, the situation has changed rather dramatically (Figure 5.10b on the following page). Interestingly, no deep *guan* have any type of decoration motif, bearing only some type of surface treatment. In addition, round *guan* and *pen* have identical numbers in the same decoration categories: each have 65% for the <incised-line> motif and 35% for the <raised-line> motif; neither vessel form has any other type of decorative motif. That trend is almost at complete odds with the decorative motifs used in *weng* vessels: *weng* have all of the decoration types except for the <incised-line> and <raised-line> combination. The *weng* vessels are the only major vessel form to still have the <cord-applique> motif (36%), though at nearly half its usage in the early Longshan. Both the <incised-line> and <raised-line> motifs are still used, not in combination, at 39% for the <incised-line> motif (comparable to its use during the early Longshan), and 18% for the <raised-line> motif, which it did not have in the early Longshan. Lastly, *weng* have a small number (3%) of vessels with the <raised-line> and <impressed-edge> motif, a decorative style not found in the early Longshan.

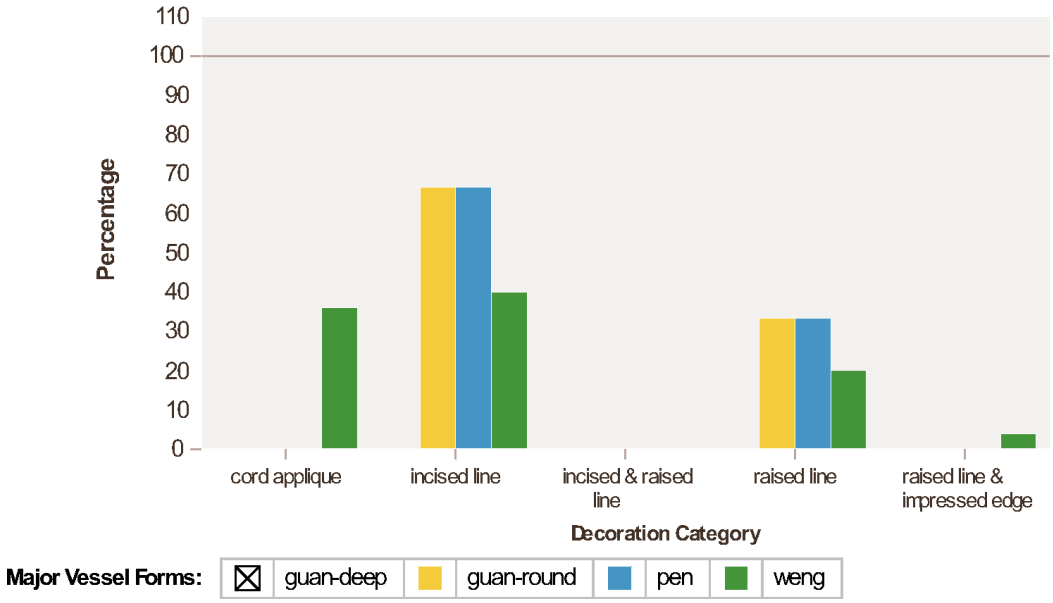
5.2 Style Groups at Huizui

Having provided an overview of the Huizui Collection, I turn to the primary heuristic tool that will help us better understand the significance of the variety of characteristics described in the previous section. In this section I return to the discussion of style started in Chapter 3 (§3.3.1 on page 64). There I outlined the three types of style I will use in this research: functional, imaginal, and technical. The functional and imaginal styles each combine several of the characteristics described above, while the technical styles are investigated using radiography to verify, and if necessary, change the formation techniques already assigned to sherds in the assemblage.

In this sense, the functional and imaginal styles can fairly easily be taken from data as it exists in the HPTDb; in general, formation techniques were assigned as part of the database creation, but those



(a) Early Longshan



(b) Late Longshan

Figure 5.10: Decoration Category by Major Vessel Forms

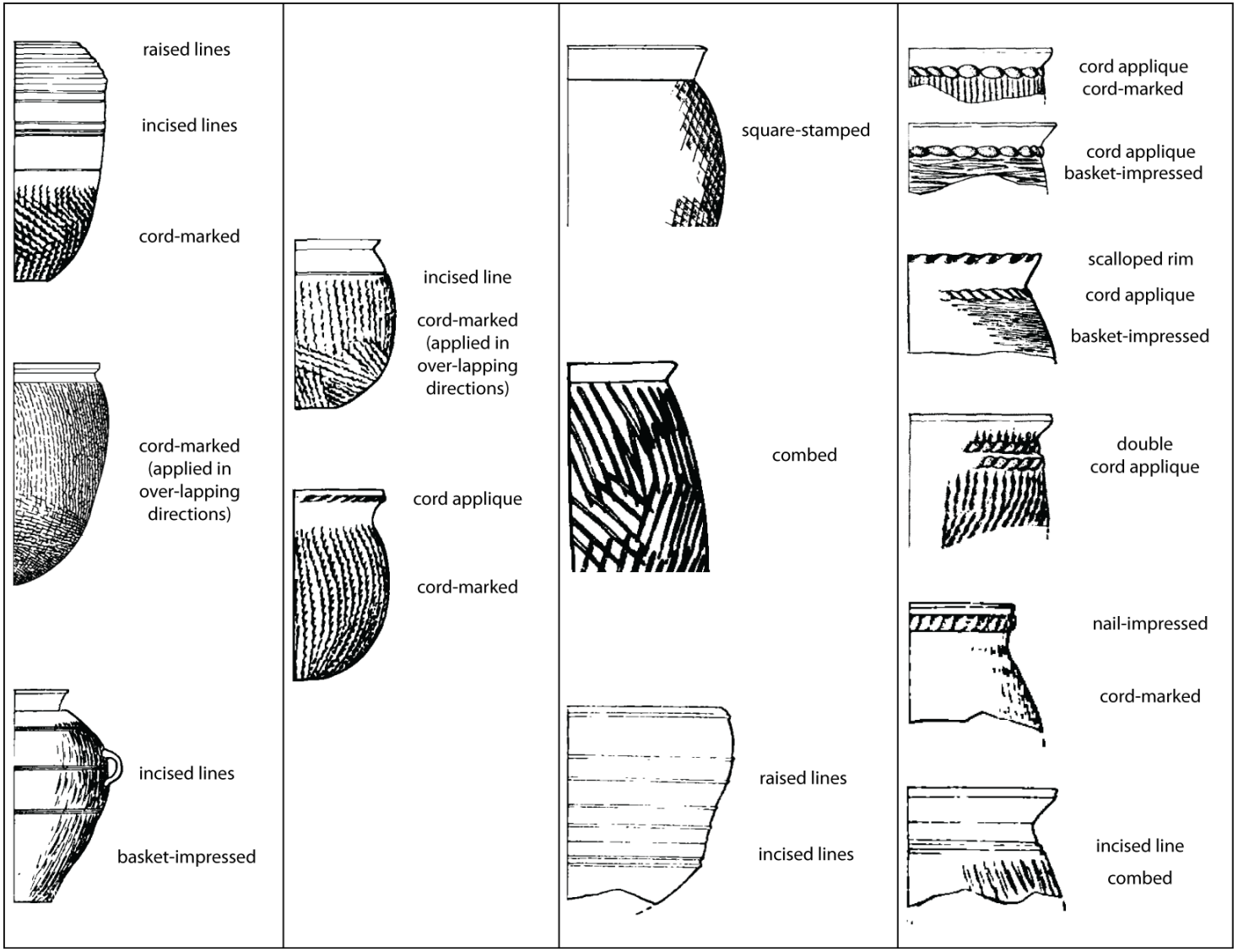


Figure 5.11: Decorative motifs found a variety of vessel forms and how they were combined.

assignments were done based off of visual inspection and assessment of inclusions (frequency, type, size of particulates, etc.; i.e. essentially ware type). Of all of the attributes, the formation technique assignments are the most subjective—no doubt the reason such information is almost never recorded in site reports. For this reason, assignment of the formation technique, and by extension a sherd's technical style, is based off of visual analysis of a sherd's internal structure using x-ray radiography. One-third of the collection was analyzed using this technique, and changes were made to the assignment of formation techniques based off of these results for those sherds imaged, and based on the information gained in the course of that analysis, reassignments were made to the rest of the collection where deemed necessary.

5.2.1 Defining Style Groups: Functional and Imaginal

In this section I will discuss the creation of the Functional and Imaginal style groups; the creation of the Technical style groups, which makes use of radiographic analysis, is covered in the next section.

Functional Style groups

Groups for Functional styles ("F-style groups") were created based on the pottery vessel's <vessel_form> and <vessel_ware> attributes in the HPTDb. Originally, the form itself was used, but this lead to a proliferation of possible F-style groups, about thirteen in total, to account for all combinations of <vessel_form> (9) and <vessel_ware> (2) where several vessel forms had both coarse and fine values. The fairly high number of possible F-style groups meant that cross-referencing with Imaginal or Technical styles would produce an even greater number of Functional/Imaginal or Functional/Technical style combinations, thereby reducing the utility of the style groups in the first place. Therefore, vessel forms were used to categorize the vessels into one of three functional types (see Table 5.1 on page 114). This results in a much more manageable six F-style groups in which each of the three functional types has either a coarse ware type or a fine ware type (Table 5.5 on the next page).

F-style	Functional Type	Ware Type
ST0	Storage	Fine
ST1	Storage	Coarse
CS0	Cooking/Serving	Fine
CS1	Cooking/Serving	Coarse
SR0	Serving	Fine
SR1	Serving	Coarse

Table 5.5: Functional (F-style) groups

Treatments	Colors					
	Brown (B)	**Gray (G)**	**Black (H)**	**Red (R)**	**Yellow (Y)**	
burnished	Bb	Gb	Hb	–	Yb	**I-style group**
combed	Bc	Gc	Hc	Rc	Yc	
impressed	–	Gi	Hi	–	–	
marked	Bm	Gm	Hm	Rm	Ym	
plain	Bp	Gp	Hp	Rp	Yp	
stamped	Bs	Gs	–	–	–	

Table 5.6: Imaginal (I-style) groups

Imaginal Style Groups

As with the Functional style groups, the Imaginal style groups ("I-style groups") were created by combining values from the <exterior_color> and <sur_treatment> variables in the HPTDb. With five colors possible (brown gray, black, red, and yellow) and six treatments possible (burnished, combed, impressed, marked, plain, and stamped), the number of possible Imaginal styles is quite large (Table 5.6). However, unlike the F-style groups, there are a few missing combinations (i.e. where the colors and treatments are not found together): brown impressed (Bi); black stamped (Hi); red burnished (Rb), red impressed (Ri), and red stamped (Rs); yellow impressed (Yi) and yellow stamped (Ys).

Type	F-style group	Period					
		ELS		LLS		ELT	
Cooking	**CS0**	21	(0.58)	81	(1.0)	2	(1.0)
	CS1	36	(1.0)	28	(0.32)	1	(0.5)
Serving	**SR0**	7	(0.19)	26	(0.29)	1	(0.5)
	SR1	0	(0)	3	(0)	0	(0)
Storage	**ST0**	5	(0.14)	60	(0.73)	0	(0)
	ST1	16	(0.44)	18	(0.19)	0	(0)

Table 5.7: F-style group membership from HPTDb: count (normalized)

5.2.2 Functional and Imaginal styles at Huizui

Having laid out what criteria were used to create the Functional and Imaginal style groups, in this section I will analyze and discuss the F- and I-styles from Huizui using data drawn from the HPTDb as well as pottery included in site reports that are not part of the Huizui Collection. These data are included here in order to supplement that provided by the Huizui Collection materials, in particular for the Erlitou period. These data are taken from an **All_Sites** database and are used to supplement numbers form the Huizui Collection. Unfortunately, the reports do not make distinctions between early and late Longshan materials; therefore in some parts of the discussion below I discuss the early and late Longshan periods separately when using data drawn from the HPTDb, and in others I use aggregated data for Longshan period (both early and late) and Erlitou period (phases 1-4) materials that has been extracted from the Huizui reports.

F-style group Membership

Of the total Huizui Collection, the membership breakdown for each F-style group can be found below (Table 5.7). For the total Huizui assemblage (HPTDb and reports), however, because data drawn from the reports does not distinguish between early and late Longshan materials, in order to better compare the two datasets, values for the Longshan period from the HPTDb have been aggregated (see Table 5.8 on page 138).

As can be seen from the distribution of raw values as well as the normalized values in the F-style groups between the Huizui Collection (HPTDb) and the Huizui reports, there are clearly some F-styles which are in accord between the two datasets, but some that seem over or underrepresented in the Huizui Collection data.

Longshan Period Interestingly, the normalized values for group SR1 are identical testifying to the scarcity of coarse ware serving vessels (SR1). Likewise, the normalized values for groups CS1 and ST0 from the reports are nearly half of that from the Huizui Collection, though this is possibly due to selection bias in the Huizui Collection. The normalized values for group CS0 suggest that the two datasets are more or less on par with each other; this parsimony is disturbed, however, when looking at the normalized values for groups SR0 and ST1. In the case of SR0, the value from the HPTDb is less than one-third that of the report value, and in the case of group ST1, the gap between the HPTDb value is a little more than 10 times that of the report value. While the aforementioned selection bias may be at play here, it is also likely that the excavation contexts from which these data were drawn are quite different. Indeed, from the Huizui Collection, the normalized values for groups SR0 and ST1 are almost identical, suggesting a private domestic space, while the values for these same groups from the reports are almost complete opposites (compare SR0 normalized 1.0 and ST1 normalized 0.02) which suggests a public feasting space.

Erlitou Period The values for the Erlitou period are not really comparable simply due to the paucity of data from the Huizui Collection. Nevertheless, concentrating on data from the reports and based on the preceding inferences regarding public vs. private spaces, it seems that a change in space usage/function occurred at the site.[11] Whereas in the Longshan period, the CS- and SR-types are most prevalent, by the Erlitou period the CS-types are still strongly represented, but the SR-types have declined significantly; this is contrasted with the marked increase of the ST-types. Compare aggregate scores (and normalized values) for the Longshan period: CS 51 (0.96), SR 52 (1.0), ST 23 (0.0); and the Erlitou period: CS 73 (1.0), SR 14

11. Assuming, of course, that the materials from the Longshan and Erlitou periods come from the same excavation units which is most likely.

(0.0), ST 41 (0.45). This suggests that the same loci shifted usage from cooking and feasting spaces (private and public) to primarily domestic (private) spaces.

I-style group Membership

Of the total Huizui Collection, the membership breakdown for each I-style group can be found in Table 5.9 on page 139. As with the F-styles just discussed, data drawn from the reports does not distinguish between early and late Longshan period materials. Therefore, in order to compare the two datasets I have combined the early and late Longshan counts and their normalized values together as can be seen in Table 5.10 on page 141. One important item to note regarding the table is that only those I-styles that had at least one member from either dataset across both periods are included in the table. As a result, though the HPTDb has both yellow and red surface colors, because these are not found in the assemblage discussed in the reports, these colors are not included in the table.

As with the combined HPTDb and report data for the F-styles, comparing the two datasets makes clear that there are some surprising differences. I will address how each period differs below.

Longshan Period In the Longshan period, the period for which we have the best comparable data, it seems clear that the predominate color for Longshan period pottery is gray. Interestingly, however, in the Huizui Collection the majority of all vessels are gray being seventy-seven percent of the collection, followed by black at nineteen percent, while the Huizui report data indicate that black is the primary surface color at fifty-three percent of the assemblage, though gray comes in at thirty-eight percent; in both datasets brown makes up the remainder at four percent in the HPTDb and nine percent in the reports. Within the Gray(G)-series, in the Huizui Collection the impressed, plain, and stamped surface treatments are nearly identical, but for burnished, combed, and marked treatments, the differences are quite stark, with the greatest difference coming from combed which is nearly ten times that of the counts in the reports. Within the Black(H)-series, the situation is somewhat reversed, though not to the same degree. The greatest difference comes from the plain surface treatment in the reports which is approximately five-times that of the Huizui Collection, and the burnished treatment which is just over twice that of the Huizui Collection. Interestingly, however, is the

F-style group	Period			
	LSH		ELT	
CS0	102	(1.0)	2	(1.0)
CS1	64	(0.61)	1	(0.5)
SR0	33	(0.30)	1	(0.5)
SR1	3	(0)	0	(0)
ST0	65	(0.62)	0	(0)
ST1	34	(0.31)	0	(0)

(a) Aggregated F-style membership from HPTDb

F-style group	Period			
	LSH		ELT	
CS0	33	(0.71)	31	(0.74)
CS1	18	(0.32)	42	(1.0)
SR0	49	(1.0)	14	(0.33)
SR1	3	(0)	0	(0)
ST0	19	(0.34)	9	(0.21)
ST1	4	(0.02)	32	(0.76)

(b) F-style membership from reports

Table 5.8: F-style membership from Huizui: count (normalized)

I-style	Period		
	eLSH	lLSH	ELT
Bb	2	4	0
Bc	2	3	0
Bi	0	0	0
Bm	1	0	0
Bp	5	3	0
Bs	1	0	0
Gb	5	31	0
Gc	20	46	0
Gi	0	3	1
Gm	7	15	1
Gp	23	54	2
Gs	3	8	0

(a) B- and G-series

I-style	Period		
	eLSH	lLSH	ELT
Hb	6	15	0
Hc	7	12	0
Hi	1	0	0
Hm	3	2	0
Hp	7	7	0
Hs	0	0	0
Rb	0	1	0
Rc	3	0	0
Ri	0	0	0
Rm	0	0	0
Rp	4	0	0
Rs	0	0	0

(b) H- and R-series

I-style	Period		
	eLSH	lLSH	ELT
Yb	0	9	0
Yc	1	9	0
Yi	0	0	0
Ym	2	5	0
Yp	4	5	0
Ys	0	0	0

(c) Y-series

Table 5.9: I-style membership from HPTDb: count

combed treatment in which the Huizui Collection is just over twice that of the report counts. Finally, the Brown(B)-series is nearly identical between the the HPTDb and the report data, though stamped is more than ten times greater in the reports–bearing in mind that the actual count goes from one in the Huizui Collection to five in the reports. Despite these seemingly large differences, however, it is important to point out that some of these perceived discrepancies may be explained as subjective interpretation of color in which there is likely some disagreement as to what constitutes a "dark gray" and what constitutes a "light black" color.

Erlitou Period Turning to the Erlitou period, though the two datasets are not comparable due to the dearth of data from the Huizui Collection, based on the report data we see a distinct shift in terms of surface color from a nearly equal split between black (53%) and gray (38%) to a near dominance of gray over the assemblage at eighty-one percent and black coming in at around twelve percent; brown remains nearly identical, dropping from nine percent to seven percent. Indeed, the little data available for the Erlitou period from the Huizui Collection supports this as all examples are gray-series. In terms of surface treatment, in the G-series we see a strong shift from plain, combed, burnished, and marked (in descending order) in the Longshan period to the predominance of marked vessels which makes up just over seventy percent of the G-series assemblage by itself. In the H-series, even though the overall number declines from a normalized value of 0.92 in the Longshan to 0.14 in the Erlitou period, the plain treatment remains the primary treatment.

F- and I-styles at Huizui

In terms of the Functional and Imaginal styles at Huizui, some definite shifts seem to have occurred in the Imaginal styles from the Longshan to Erlitou periods, while the Functional styles have remained more consistent. Overall, the F-style group counts indicate that the majority of vessels were CS0, CS1, and SR0 groups as demonstrated by the parsimony between the normalized values for the HPTDb (CS0 1.0 / CS1 0.61 / SR0 0.30) and the Huizui reports (CS0 0.71 / CS1 0.32 / SR0 1.0) in the Longshan period. This trend continues into the Erlitou period, though there is an interesting trend apparent in the normalized values for the CS0/CS1/SR0 set. Based on the report data, in the Longshan period the values are skewed toward fine wares (CS0 0.71 / CS1 0.32 / SR0 1.0), but by the Erlitou period, the values have shifted (CS0 0.74 / CS1

Color	I-style	Period							
		LSH				ELT			
		HPTDb [a]		Reports		HPTDb		Reports	
Brown	**Bi**	0	0.0	1	0.03	0	0.0	0	0.0
	Bm	1	0.01	0	0.0	0	0.0	8	0.09
	Bp	8	0.10	5	0.14	0	0.0	1	0.01
	Bs	1	0.01	5	0.14	0	0.0	0	0.0
Gray	**Gb**	36	0.47	0	0.0	0	0.0	7	0.08
	Gc	66	0.86	4	0.11	0	0.0	0	0.0
	G1	3	0.04	0	0.0	1	0.5	3	0.03
	Gm	22	0.29	3	0.08	1	0.5	91	1.0
	Gp	77	1.0	36	1.0	2	1.0	3	0.03
	Gs	11	0.14	5	0.14	0	0.0	0	0.0
Black	**Hb**	21	0.27	25	0.69	0	0.0	2	0.02
	Hc	19	0.25	3	0.08	0	0.0	0	0.0
	Hp	14	0.18	33	0.92	0	0.0	13	0.14
	Hs	0	0.0	6	0.17	0	0.0	0	0.0

Table 5.10: I-style Membership at Huizui: count (normalized)
[a] Using aggregated counts for the Longshan period

1.0 / SR0 0.33); though the CS0 values remain nearly identical, the values for CS1 and SR0 have essentially switched places indicating a shift from pure serving vessels to multi-role cooking/serving vessels. The SR1 group is a rarity in the Longshan period, virtually disappearing in the Erlitou period.

The trend in Functional style becomes more interesting when we look at the ST-groups. Though there appears to be a rather large discrepancy between the normalized values in Longshan period data from the HPTDb (ST0 0.62 / ST1 0.31) and the report data (ST0 0.34 / ST1 0.02), we can at least say that there is a preference for fine ware storage vessels. However, by the Erlitou period, based on the report data the preference has shifted from fine wares to coarse ware storage vessels (ST0 0.21 / ST1 0.76); this is nearly an exact switch comparing the Erlitou report data to the HPTDb Longshan period data (ST0 0.62 / ST1 0.31). Similar to the case with the CS1/SR0 set discussed above, the preference has shifted to coarse ware vessels in the Erlitou period.

Looking at the Imaginal styles may depend on what dataset is being discussed. Utilizing the report data, a distinct shift is noticeable from nearly balanced distribution of gray (38%) and black (53%) wares in the Longshan period to the predominance of gray wares (81%) in the Erlitou period, with black wares (12%) reduced by three-quarters. With the Huizui Collection the data are more ambiguous due to the paucity of Erlitou materials. However, if we compare the Longshan data from the Huizui Collection to the Erlitou data from the report data, the story is rather different. Indeed, according to these two datasets the predominance for gray wares remains constant from the Longshan to Erlitou periods, increasing from seventy-seven to eighty-one percent, followed by a decrease in black wares from nineteen percent to twelve percent. Brown wares also drop by almost half from four percent in the Longshan period to seven percent in the Erlitou period.

Looking to the surface treatments, the trends again depend on which dataset is being discussed. That said, there are some definite trends observable no matter which data is being considered–what varies by dataset is the degree of change. Brown wares have, in general, low counts among all surface treatments in the Longshan and Erlitou periods, so I will focus the following discussion on black and gray wares. The occurrence of impressed wares is low in the Longshan and Erlitou periods, and is not found on any black

wares. Stamped wares, occurring in all three colors (brown, gray, and black) at least in some measure in the Longshan period, with maximum normalized values of 0.14 for gray wares and 0.17 for black wares (Table 5.10 on page 141). However, by the Erlitou period, stamped wares have disappeared from the record. The situation is somewhat different for burnished wares, found only on black and gray wares. In the Longshan period, burnished black wares have fairly high normalized values (0.27/0.69),[12] but decline to near nonexistence (—/0.02)[13] in the Erlitou period, a situation paralleled by burnished gray wares with fairly high normalized values (0.47/0.0) in the Longshan period, declining to near obscurity (—/0.08) in the Erlitou period. Combed wares share a fate similar to that of burnished wares, also only found on black and gray wares: for black wares normalized values of 0.25/0.0 in the Longshan, and –/0.0 in the Erlitou period, while gray wares start at a fairly high value of 0.86/0.11 in the Longshan period but also decline to —/0.0 in the Erlitou period.

The situation becomes more complicated when it comes to marked and plain wares. Gray plain wares have the highest normalized values in the Longshan period (1.0/1.0), but decline to near non-existence in the Erlitou period (—/0.03). The situation is somewhat similar for black plain wares, having fairly high normalized values (0.18/0.92) in the Longshan period, declining to much lower values (—/0.14) in the Erlitou period. These trends are in stark contrast to marked wares; though there are no marked black wares, there is a decent showing of cord-marked gray wares (0.29/0.08) in the Longshan period which then shoots up to the highest level (—/1.0) with a count of ninety-one in the Erlitou period based on the reports, a count seven-times that of the next highest count of thirteen.

Communities of Practice: Functional and Imaginal Styles

The preceding discussion of the Functional and Imaginal styles found at Huizui allows us to render these trends in terms of changing communities of practice. According to the F-styles, there is first a move from

12. In the following examples, this parenthetical pairing is used to indicate values from the Huizui Collection and the reports: (HPTDb/Reports).

13. Values for the Erlitou period are in the same format, but because of the paucity of Erlitou data from the Huizui Collection, in the parenthetical pairing the HPTDb values will be removed: (—/#.#).

pure serving vessels to multi-role cooking/serving vessels, and second a small shift from fine wares to coarse wares in the CS-series, but an even greater shift from fine wares to coarse wares in the ST-series. Both of these shifts suggest changes in food consumption practices in the first case, which necessitates changes in production practice, and a more direct shift in production practice in the second case from fine wares to coarse wares.[14] In other words, the shared repertoire of the potters changed from producing pure serving vessels to cooking/serving vessels on the one hand, and a shift (a choice?) in the shared repertoire employed in producing storage vessels with a new preference for coarse wares over the fine wares on the other. Indeed, the shift from fine to coarse wares in both the CS- and ST-series is interesting: do these changes represent changes reflective of new consumer needs, or are there technical issues that lie at the heart of these changes in production practice? We will look more closely at this issue in the next section with the analysis of technical styles.

At this point it is unclear why there were changes in the F-styles at Huizui, both in preference for multi-role cooking/serving vessels over pure serving vessels and in the move from fine ware storage vessels to coarse ware storage vessels. As mentioned above, the change in vessel forms, as a subset of the functional type, may be indicative of changes in eating or feasting patterns; why this would require a change in the ware type, however, is less clear. Perhaps the cooking-end of the cooking/serving vessels use-life took precedence and the vessels needed to be able to handle a greater "workload" in terms of cooking tasks. Thinking in terms of society and practice, however, it could also be the case that we see an increase in membership of a community of practice that makes CS vessels using coarse paste. It is also important to understand that along with the increase in CS1 vessels there is not a decrease in the normalized value (and numbers) of CS0 vessels, again suggesting an increase in membership of the coarse-paste of potting community. A possible explanation for this perceived change in production comes from Underhill (2002) where she argues that there is a transition from more equitable feasting and access to food surpluses in the Early Longshan, but through entrepreneurial feasts held by nascent elites, there is a change in fortunes (as it were) for the majority of societal members with decreased access to prestige items for display during feasts

14. This assumes, of course, that there were no major changes in storage needs from lighter duty, fine ware vessels to more heavy duty, coarse ware vessels.

and concomitant decreased access to foodstuffs. With this in mind, our data may indicate that the majority of society had to use these multi-role vessels for their own feasting activities, being unable to acquire a set of cooking vessels *and* another set of serving vessels. This trajectory may also explain the aforementioned changes in ware type as vessels had to do more work during their use-lives, necessitating a sturdier ware.

Turning to the changes in I-style from the Longshan to Erlitou periods, potters had a fairly wide field to draw upon in terms of aesthetic choices with fourteen combinations (in the terminology used here, fourteen I-styles) of surface color and treatment to choose from. By the Erlitou period, however, the range of possibilities has decreased by almost half to only eight combinations. Moreover, of those eight choices, only one seems to have the widest acceptance at Huizui, cord-marked gray wares. In terms of practices, there is little difference between creating gray and black pottery as both are accomplished using a reducing firing atmosphere, though the amount of organics used may be a factor. In addition to the severe decline in surface color variety, there is also a decline in the variety of surface treatments considered viable. Aside from cord-marked pottery, the next type, plain, is less a technique and more a choice *not* to use a surface treatment. This leaves three surface treatments, the majority being marked vessels followed by a few burnished vessels and a rare impressed vessel in the production repertoire at Huizui.

Returning to Chapter 3, §3.3.2 on page 72, there are two possible explanations for these perceived changes in Imaginal styles, and neither is mutually exclusive. Indeed, in all likelihood, both processes were at play throughout the Longshan from Early to Late within the Song Mountain Region. The changes in Imaginal style:

1. reflect changes in the social and political identity of those using the object, a change that necessitates changes in practice for those making the object as well. That is to say, consumer demand was pushed in a certain direction in terms of aesthetic choices, a set of choices that reflected the aesthetic tastes of an influential group, nascent elites, and/or;
2. an alternative explanation, one which relies less on active influence and more on a collective aesthetic is to suggest that, from among the choices available in the late Longshan period, the marked gray ware was the one set of aesthetic choices that had the widest appeal; and wide appeal was reflective

of the growing sense of social and cultural solidarity among the communities of the Luoyang Basin, and those living in the Song Mountain Region overall.

Moreover, both explanations are reflected in settlement pattern changes from the Early to Late Longshan where we see a consolidation of settlements from the widely dispersed nature in the Early Longshan (itself indicative of population growth compared to the earlier Yangshao Period) to a pattern with more nucleated settlements where aesthetic tastes of both consumers and elites could be more widely shared in these early regional centers (Liu, Chen, Lee, et al. 2002-2004).

I will leave further discussion of the changes in Functional and Imaginal styles until later, and turn to the definition of Technical styles and the use of radiography in defining these styles.

5.2.3 Defining Style Groups: Technical

Unlike the database-derived method used to define the Functional and Imaginal styles from the HPTDb, defining Technical styles (T-styles) utilized radiography to determine the formation techniques used to produce the pottery in the Huizui Collection.[15] Because of the resolution and ability to view the internal structures of the pottery in the collection, which was then used to construct a set of types based on the formation technique. The first phase of analysis was a digital radiography study using a subsample (n=111) of the larger Huizui Collection in order to find patterning in pottery production at Huizui.[16] The second phase, discussed in the next section, will incorporate the other two styles previously discussed and statistically test these data for patterning.

15. See Appendix B on page 243 for information on the MAE radiography project.

16. While it would have been ideal to have used the entire Huizui Collection, I was unable to acquire permission to transport the entire Collection; as a result, a smaller subsample of approximately one-third of the total Collection was used.

Label	Forming
WL	Wheel (from lumps)
WL-R	Paddle & Anvil (from coils)
PA	Paddle & Anvil (from coils)
MD	Molded (from slabs)

Table 5.11: Technical Style Groups

Procedure

The method employed in this study is based on the protocol development programme described in Appendix B on page 243 as part of the MAE Project. The 111 sherd subsample from the Huizui Collection was a judgmental sample selected based on providing a representative sample of forming and tempering techniques. These sherds were transported to the United States in July 2010 for radiographic analysis at Argonne National Laboratory. The analysis was carried out using the set of "best quality" settings described in Appendix B over the course of a week in October 2011.

The resultant sherd images were analyzed using visual inspection in order to determine the techniques used in the formation stage of production. A preliminary perusal of the images was used to get a sense of the assemblage and no pre-determined categories or types were used; instead visual patterns were recorded for comparison to other radiographic images (primarily xeroradiographs) of more or less known formation technique.[17] Based on the results of this initial assessment, a rough set of types was created for the second round of analysis. In the second round, each of the 111 sherds in the subsample were placed into one of three types based on formation technique. A final assessment round was then conducted to check the assignments and make any final adjustments in the assignment of types to the sherds.

17. For a list of sources for comparative imagery, see Chapter 4, §4.2.3 on page 94.

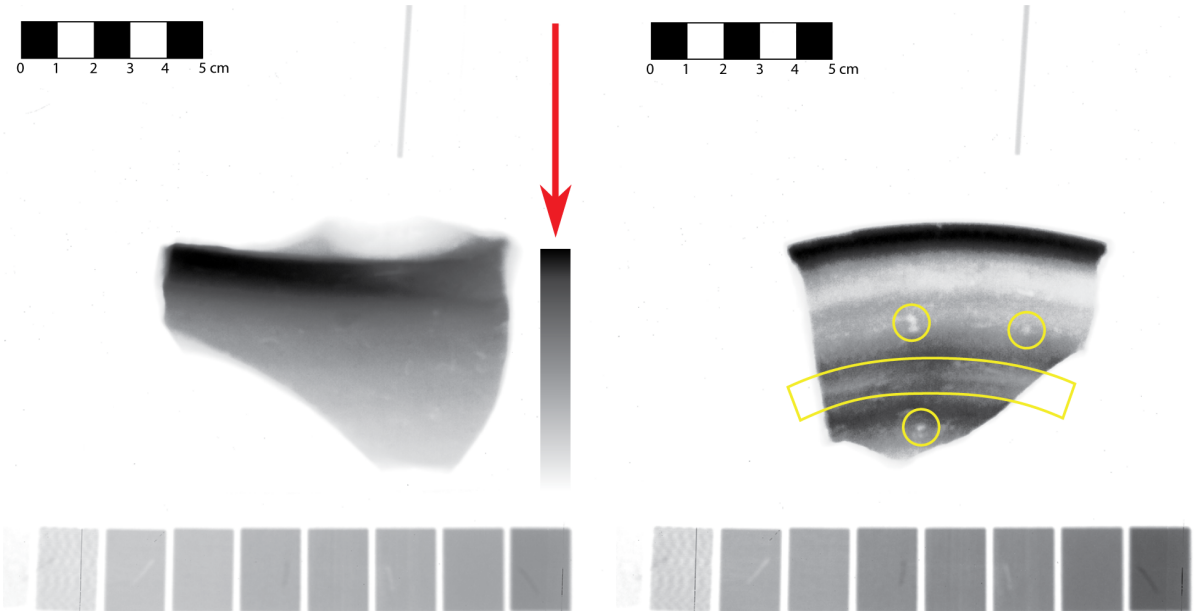
Technical Style Groups

As was done in §5.2.1 on page 133 for Functional and Imaginal style, here I will discuss the creation of the Technical style groups used in this research. However, unlike the previous two style groups, groups for Technical styles ("T-style groups") were created based on a single criteria: formation technique. At an earlier stage of analysis, the T-style groups were also formed using two criteria: formation technique and paste type. However, through the course of the statistical analysis of phase two, it became clear that including paste type overlapped to a great extent with the "ware type" attribute used in defining Functional styles.[18] Statistically, this meant that ware type was part of two styles and thus they would always correlate, thereby negating the whole point of using three different styles in the first place. Therefore, paste type was dropped in defining T-style groups and the resultant groups relied solely on formation technique. Three formation techniques were identified in the subsample: wheel formed, paddle and anvil formed, and mold formed. However, due to the segmentary nature of the HPTDb, there were a number of sherds (many multi-part sherds; see note 4 on page 111) that had a formation technique that differed from the rest of the sherd. These "sherds" were identified as wheel-turned rims that were attached to paddle and anvil or mold formed vessels. Therefore, a fourth group, WL-R, was created to distinguish these from vessels that had been wholly formed on a wheel. The resultant T-style groups are described in (Table 5.11 on the previous page. It should be noted that these three methods match the methods described by Wu (1938) and Li (1996) in Chapter 4, "Research in the Chinese Tradition" (on page 89), and in the radiographic analysis of the Huizui pottery no additional methods were discovered.

The WL group This group comprises all vessels that have been made entirely on the wheel. Of note, almost half of the minimally-tempered ($\leq$ 15% frequency) vessels are also in this group. Wheel made vessels have a characteristic gradient of very consistent thicknesses or gradient bands from overzealous attempts to thin the vessel walls (Figure 5.12a on the next page) Another key feature of this group is the

18. Technically speaking, these two attributes are not the same thing. In "paste type" I was looking at the densities of the inclusions, their sorting, and their frequency or percent of the clay body as revealed in the radiographs. However, it soon became clear that paste type led to too many variables on its own and was simplified to the point of being analogous to ware type.

minimal or near absence of temper. Tempering materials include very fine sand or silt which shows up as very small dark spots in the radiographs. However, the temper used may also include organic materials that were burned out during firing, leaving voids in the vessel wall (Figure 5.12b).



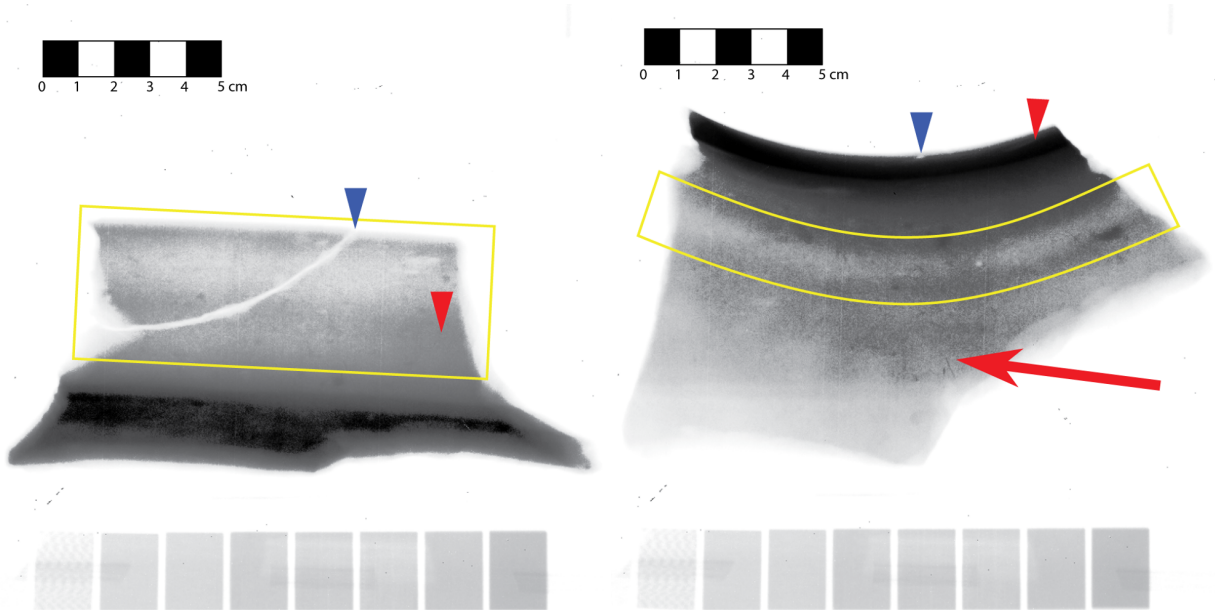
(a) MAE 2445 (b) MAE 2459

Figure 5.12: Radiographs from the WL group

The red arrow (a) shows a consistently thinning gradient as a comparison to an actual sherd. A single gradient band is boxed in yellow with voids circled in yellow in (b).

The WL-R group This group is the only group that consists of a single vessel portion: the rim, and sometimes its attendant neck. The characteristic attribute of these rims (and necks) is that they were all formed on the wheel, a technique that differs from that of the rest of the vessel. In most cases, this group is comprised of multi-part sherds in which the rim (neck) and torso are all present. As with the WL group, wheel made rims (and necks) also have a characteristic gradient of very consistent thicknesses with minor gradient bands (Figure 5.13a on the next page). Unlike the WL group, however, this group may include a wide range of temper types and sizes which will generally match that of the parent vessel. There is often

a space where the join is visible in the radiograph, and where the formation technique of the torso can be clearly identified as different than the rim (Figure 5.13b).



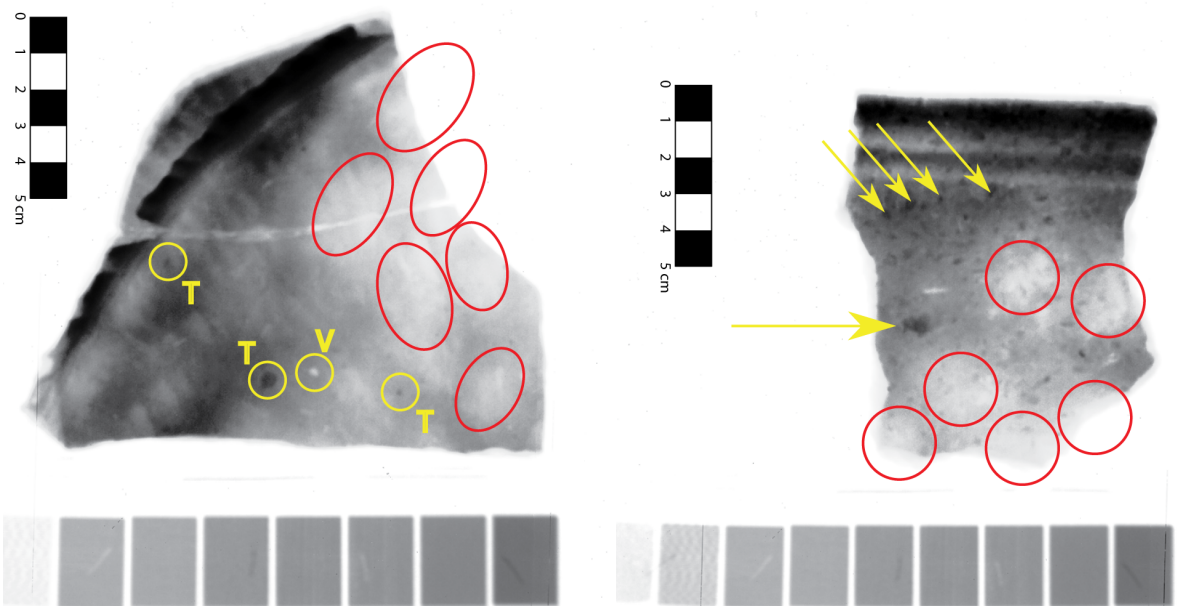
(a) MAE 2467b (b) MAE 2467c

Figure 5.13: Radiographs from the WL-R group

Gradient bands similar to those of the WL group are boxed in yellow in (a) while the join between the wheel-formed rim/neck and the mold-formed body (red arrow) is indicated in yellow in (b). The red pointer in (a) shows what appears to be a disruption in the gradient, but this is caused by the curvature of the rim as indicated in (b). The blue pointer in (a) and (b) indicates a post-excavation crack in the rim.

The PA group The PA group is defined by the use of a paddle and anvil in forming the vessel. This technique of vessel formation leaves tell-tale impressions which are easily visible in the radiograph (Figure 5.14 on the next page). In general, these vessels are built up using coils and the walls are then thinned using the paddle and anvil. The PA group is composed of more than half of the minimally-tempered ($\leq$ 15% frequency) vessels, the rest making up the WL group. Many vessels, however, are comprised of medium (30-45%) to high (45-60%) frequency tempered vessels and the PA group is the first group in which tempering materials make up a much higher percentage of the overall vessel paste. These tempering materials

include aplastics like fine sand or silt as well as organic materials which appear as voids in the radiograph (Figure 5.14a). This can be seen in the radiographs as dark spots, and the temper is often highly concentrated as well (Figure 5.14b). In some sherds, the impressions are somewhat elliptical in shape, suggestive of using the heel of the hand as an *ad hoc* anvil (Figure 5.14a), while other traces of the paddle and anvil technique suggest that the potters used a more "reified" anvil, probably a mushroom-shaped tool created specifically for this purpose (Figure 5.14b).



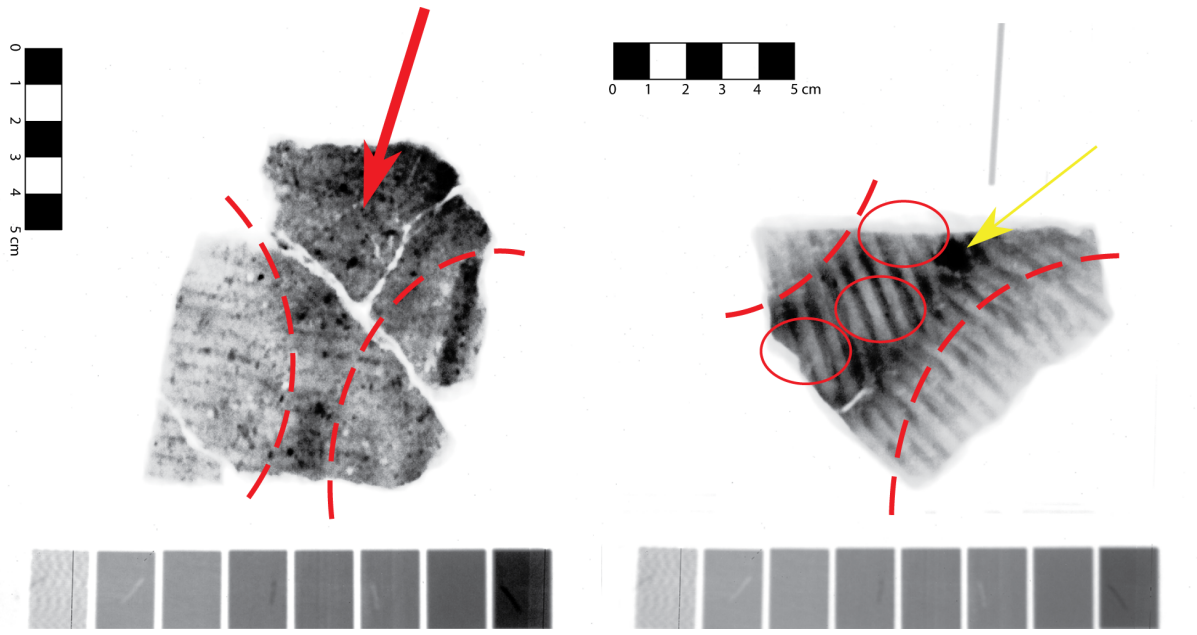
(a) MAE 2511 (b) MAE 2453

Figure 5.14: Radiographs from the PA group

These radiograpghs show typical anvil marks in red ellipses (a) and circles (b); concentrations of temper "T" or voids "V" are circled in yellow (a) or indicated by yellow arrows (b).

The MD group The last style group is comprised of medium (30-50%) frequency tempered vessels, formed using the molding technique. These vessels are generally built using slabs which are hand-blended into place over a vessel mold. The MD group stands out from the others primarily because of its use of a molding technique in the formation of the vessels. As with the PA group, the MD group includes vessels with a somewhat high frequency of tempering materials, but the majority are those that stand between the

first two groups by being uniformly balanced in terms of a clay to temper ratio. Because of the formation technique used, the temper is often found clustered in thicker areas of the vessel wall between thinner areas where the paste has been pressed onto the mold (Figure 5.15a). These areas of uniformly differential thicknesses stand in contrast to the traces of paddle and anvil work seen in the PA group above, and the uniform gradients or gradient bands seen in the WL group (Figure 5.15).



(a) MAE 2469 (b) MAE 2508

Figure 5.15: Radiographs from the MD Group

The red arrow in (a) and yellow arrow in (b) indicates a temper cluster; the dashed lines in (a) and (b) indicate the broad density differences between concentrated and compacted clay body left from the mold forming technique.

5.2.4 Technical Style at Huizui

Now that the criteria for assigning technical styles to sherds in the Huizui Collection has been described using radiography, I then continued to assign styles to sherds that were not imaged using radiography. This might seem fairly straight forward, but was in fact a rather complex process of comparison between the MAE sherds and the rest of the Collection by looking for exterior indicators of formation technique from

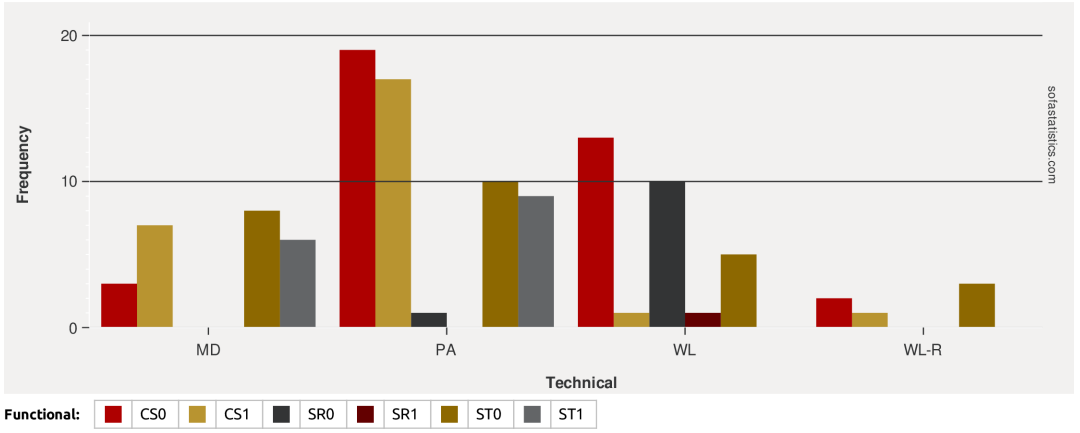
the "known" group (i.e. the MAE sherds) and comparing them to the "unknown" group (the rest of the Huizui Collection). This process was repeated several times as my familiarity with the exterior indicators increased, and many sherds were re-coded in the process. I discuss this process in more detail below.

One issue remains with regard to the Huizui Collection data: the low count for Erlitou period sherds. In the previous discussions on Functional and Imaginal style, I was able to supplement the HPTDb data using pottery data extracted from excavation reports for Huizui. Determination of Technical style, however, relies on the ability to visually inspect the sherds in order to assign them to the correct T-style group. Needless to say, this is not possible from excavation reports. There is a secondary, smaller, dataset that was collected at the same time as the HPTDb but from the Shaocai site, all of which is from the Erlitou period. These data are in fact part of the HPTDb and were in fact the first entries into the database. Of course, the Shaocai data have been filtered out of all previous discussions which are intended to rely solely on data from Huizui. However, the near complete lack of Erlitou period sherds in the HPTDb makes the use of data from Shaocai rather important. In what follows, I hope you will excuse the slight-of-hand deemed necessary in order to bolster conclusions made.

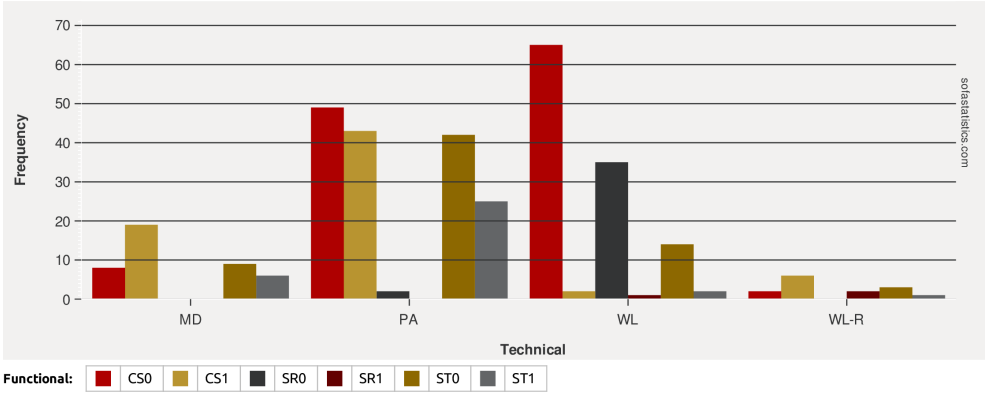
Assigning T-style Groups One of the main functions of the database is the ability to query these data and determine, at an assemblage scale, the techniques and technical pathways of pottery production at Huizui. In order to determine the number of communities of practice, it is necessary to arrange the rest of the pottery in this collection and place those sherds not part of the MAE radiographic analysis (n=222) into one of the four style groups that resulted from that analysis.

Not unlike the process for creating the style groups based on the radiographic imagery discussed above, a similar painstaking process was used to assign the rest of the pottery from the Huizui collection into one of the four style groups outlined there. The criteria for these assignments was discussed in the previous section; here we compare the results of this process to the groupings first determined based on the radiographic imagery of the MAE subsample (for a bulk comparison see Figure 5.16 on the following page).

As discussed in the previous section, the HPTDb includes detailed notes on paste preparation and formation techniques for all sherds in the database. Determinations of paste preparation, which plays a role



(a) MAE subsample

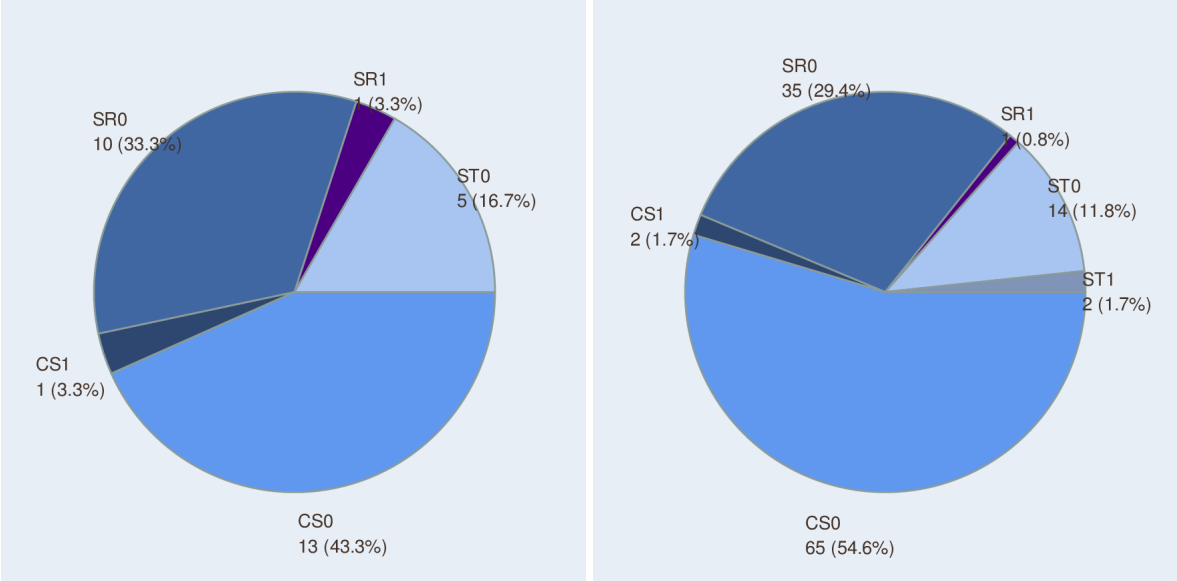


(b) Huizui Collection

Figure 5.16: Comparison of MAE subsample to Huizui collection

in formation techniques, can be gotten from several possible attributes: "ware type" provides a general, bi-modal, gauge of the paste preparation; however, this could also be determined and/or checked against the "inclusions" attribute also recorded for all sherds that have inclusions of any kind.[19] Using the data from these attributes in the database, I assigned all remaining sherds in the collection to one of the four style groups using the following criteria. Because the criteria used in the radiographic analysis has correlates with attributes recorded in the HPTDb as mentioned above, a style group affiliation was determined for all remaining sherds. The correlated attributes are shown in Table 5.12 on the next page.

The WL group For the WL group, the best indicator is either an extremely smooth surface (Figure 5.12a on page 149) or a surface with a consistent thickness around the circumference of the vessel, as best as can be seen around the distance present on a sherd, but that has an undulating surface indicating uneven pressure applied while the vessel was turned (Figure 5.12b on page 149).



(a) MAE Subsample (b) Huizui Collection

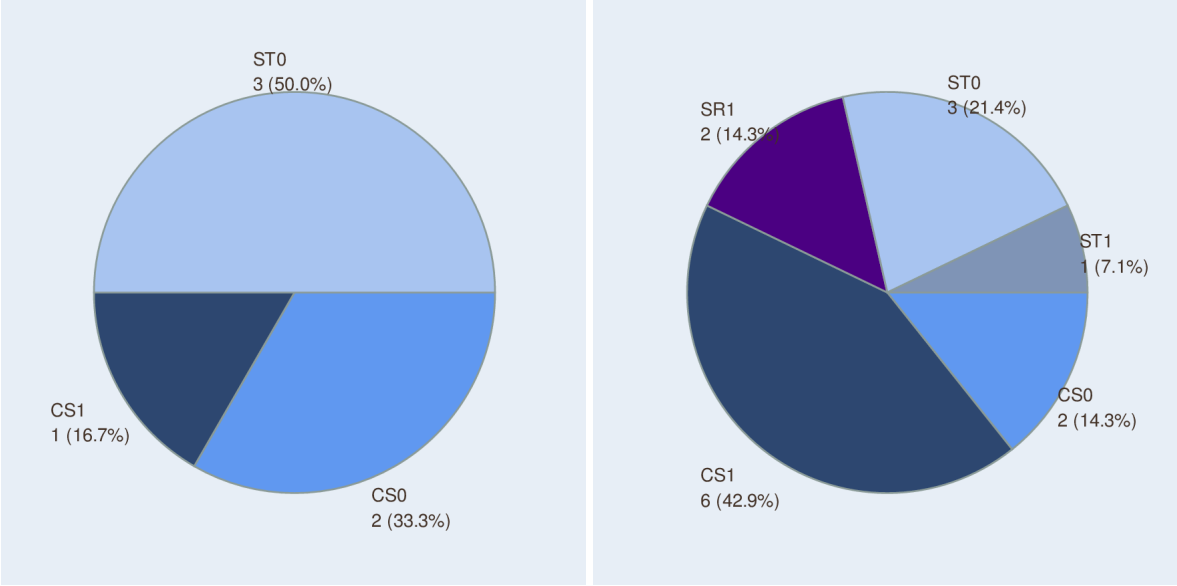
Figure 5.17: The WL Group–Samples Compared

19. With the exception of sherds that only had organic temper added since this burns out and results in voids. In any case, all sherds of this type have the "fine" ware type.

T-style Groups	Db Correlates	
	attributes	**values**
WL Group	vessel_ware	fine
	formation	wheel
	inclusion_type	limestone ($\leq$ 10%) silt ($\leq$ 10%)
WL-R Group	vessel_ware	fine
	formation	wheel
	inclusion_type	limestone ($\leq$ 10%) sand ($\leq$ 10%)
PA Group	vessel_ware	coarse
	formation	paddle and anvil
	inclusion_type	limestone ($\leq$ 20%) gravel ($\leq$ 30%) grit ($\leq$ 50%) sand ($\leq$ 50%)
MD Group	vessel_ware	coarse (medium)
	formation	mold
	inclusion_type	limestone ($\leq$ 20%) gravel ($\leq$ 20%) grit ($\leq$ 30%) sand ($\leq$ 30%)

Table 5.12: Style Groups and HPTDb Correlates

The WL-R group Identification of vessels with wheel-turned rims relies in great measure on first identifying if the vessel was formed using one of the hand-build techniques (paddle/anvil or mold); if so, the rim needs to be inspected for markers similar to those mentioned above for the WL group (Figure 5.13a on page 150). In particular, a graduated thickness or an undulating surface around the rim circumference. Needless to say, this is easier to determine for rims that are wide (often flared rims) where more surface are is present. Still, a rim that appears all-too-even, especially compared to the rest of the vessel (i.e. slight irregularities in shape, uneven vessel wall thickness, etc.) strongly suggests a wheel-formed rim. In addition, there is often a join between the two parts visible in which the even rim is attached to the less-than-even vessel neck or torso (Figure 5.13b on page 150). This interpretation is borne out by the number of vessels that have multiple entries in the database because they have both rim and torso portions (Appendix A on page 221). This mainly includes the following form classes: *weng* urns, deep *guan* jars, and round *guan* jars (Table 5.13 on the next page and Table 5.14 on page 159).



(a) MAE Subsample (b) Huizui Collection

Figure 5.18: The WL-R Group–Samples Compared

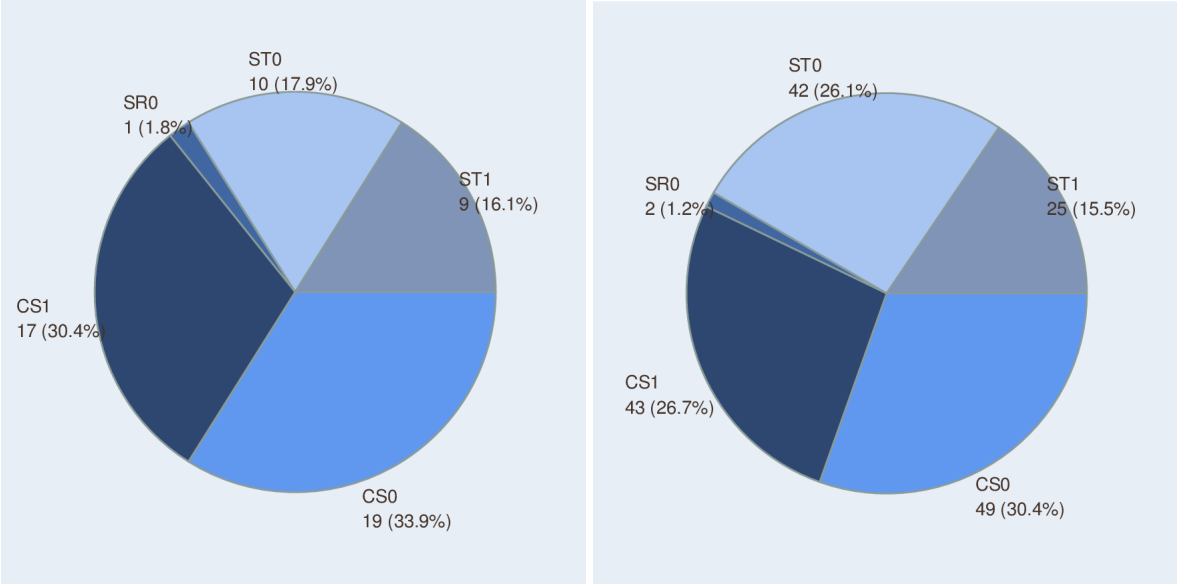
ID	Period	Form Class	Portion	Ware Type	Formed	T-style Group
0026	LL	guan (round)	torso	fine	mold	MD
			shoulder	fine	wheel	WL-R
0034	LL	guan (deep)	torso	coarse	paddle-anvil	PA
			neck	coarse	wheel	WL-R
			rim	coarse	wheel	WL-R
0044	EL	guan (deep)	torso	coarse	paddle-anvil	PA
			rim	coarse	wheel	WL-R
0090	LL	guan (round)	torso	fine	paddle-anvil	PA
			rim	fine	wheel	WL-R
0098	LL	weng	shoulder	fine	mold	MD
			neck	fine	wheel	WL-R
0117	EL	guan (round)	torso	coarse	paddle-anvil	PA
			rim	coarse	wheel	WL-R
0121	EL	pen	neck	fine	paddle-anvil	PA
			rim	fine	wheel	WL-R
0125	LL	weng	shoulder	fine	paddle-anvil	PA
			neck	fine	wheel	WL-R

Table 5.13: (1) Multi-part sherds with different techniques used

ID	Period	Form Class	Portion	Ware Type	Formed	T-style Group
0149	EL	guan (deep)	torso	coarse	paddle-anvil	PA
			rim	coarse	wheel	WL-R
0195	LL	weng	neck	fine	mold	MD
			rim	fine	wheel	WL-R
0227	LL	guan (round)	torso	fine	paddle-anvil	PA
			rim	fine	wheel	WL-R
0259	LL	guan (deep)	neck	coarse	paddle-anvil	PA
			rim	coarse	wheel	WL-R
0298	LL	weng	neck	fine	mold	MD
			rim	fine	wheel	WL-R
0328	LL	guan (round)	torso	coarse	mold	MD
			rim	coarse	wheel	WL-R
0331	LL	guan (deep)	torso	fine	paddle-anvil	PA
			rim	fine	wheel	WL-R
0332	LL	guan (round)	torso	fine	paddle-anvil	PA
			rim	fine	wheel	WL-R

Table 5.14: (2) Multi-part sherds with different techniques used

The PA group The paddle and anvil group is most easily identifiable from the series of circular/ovoid depressions left on the interior surface (Figure 5.14 on page 151). These are sometimes slight to be sure, and identifying these markers is especially difficult on smaller sherds. Nevertheless, the depressions are often accompanied by sections where the temper has accumulated and is visible on the surface, and is are distinctive compared to the markers from mold forming (see below). Unlike the wheel-formed groups, another factor is that the PA group has both coarse and fine ware vessels within it membership; coarse ware sherds generally show the concentrations of temper near the surface, while fine ware vessels more clearly show the depressions due to the even consistency and texture of the paste.

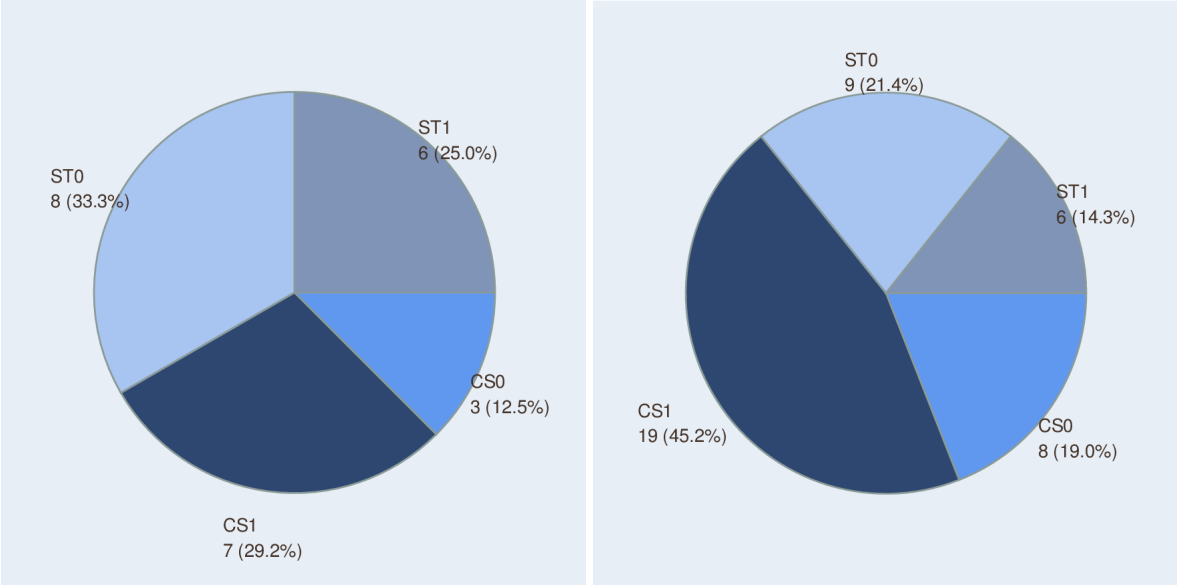


(a) MAE Subsample (b) Huizui Collection

Figure 5.19: The PA Group–Samples Compared

The MD group Lastly, the MD group is in some ways most easily identified by not having any characteristics of the wheel- or paddle/anvil-formed groups. That said, there are definite markers for identifying mold formed vessels, in particular the "smeared" texture of the interior surface from adding paste to the interior of a mold. By this I am clearly suggesting that the molds are "exterior" molds in that the paste is applied to the interior of the mold, thus being on the exterior of the vessel. This technique is in contrast to

an “interior” mold where paste is applied to the exterior of the vessel. In addition, there is often a faint trace of fabric being used to separate the added paste from the surface (interior or exterior) of the mold.



(a) MAE Subsample (b) Huizui Collection

Figure 5.20: The MD Group–Samples Compared

As mentioned above, the assignment process was a great deal of back and forth between the sherds, sherd pictures, and the database itself. In the end, however, I feel very confident that the assignment of T-style groups is the best as could be done under the circumstances, especially where these sherds were not readily accessible, unlike the MAE sherds.

DATA FROM SHAOCAI

The data from Shaocai was coded at the earliest part of the data collection trip over the course of one week at the end of August 2009 in Zhengzhou.[20] The Shaocai data was recorded using the same method as the Huizui material, though all of the sherds were “multi-part” sherds consisting of two, three, or sometimes even four

20. To reiterate this from the Acknowledgments, I would like to thank Ma Xiaolin 马小林 at the Henan Provincial Institute of Cultural Relics and Archaeology (HPICRA) for granting me access to the Shaocai materials, especially with rather short notice.

entries in the HPTDb; this meant that the 25 sherds recorded actually had 69 entries in the database between the portions and portions-minor tables. To be clear, though, as with the Huizui materials, aside from wheel-formed rims that differ from their torso, each sherd only has one entry in the database as far as numbers are concerned for all three styles. In the analyses that follow in this chapter, the Shaocai materials have already been aggregated with the Huizui materials.

T-style group Membership

The counts (and their normalized values) for the four T-style groups can be found in Table 5.15 on the following page. Because there are only four T-style groups, the variability contained within each of the technical styles in terms of vessel forms and wares is quite large. This also makes many of the groups rather large in their counts as well. As was mentioned previously (§5.2.3 on page 148), this "lumping" of vessel forms was intentional since the opposite method of defining each group with a narrow set of criteria resulted in several smaller groups, with lower counts, that generally factored in criteria from one of the other styles (Functional or Imaginal) which resulted in false correlations during the statistical analysis. As a result, the T-styles became single-criterion groups. I will discuss the breakdown of the T-style membership by period below.

Longshan Period In the early Longshan period there is clearly an almost mono-modal distribution among the four style groups in which the modal technique, paddle-anvil forming, is nearly three times larger than the next two techniques, wheel-forming (0.26) and mold-forming (0.22). Even adding the WL-R counts to the WL group results in a shift from three-times larger to two-times larger (from 0.26 to 0.48). In the next section, we will look at the relationship between formation technique and vessel form through the T- and F-styles to determine whether there is a correlation between form and forming.

By the late Longshan, the paddle-anvil technique remains the primary formation technique, but there is more than a three-fold jump in the value for wheel forming; while paddle-anvil remains dominate, the "lead" is significantly smaller than it had been in the early Longshan. Interestingly, the value for wheel-formed rims remains the same, so it does not appear to be the case that use of the wheel-forming technique

T-style group	Period					
	eLSH		lLSH		ELT [a]	
WL group	18	(0.26)	87	(0.84)	14	(1 .0)
WL-R group	6	(0.0)	16	(0.0)	0	(0.0)
PA group	52	(1.0)	101	(1.0)	8	(0.57)
MD group	16	(0.22)	19	(0.04)	7	(0.5)

Table 5.15: T-style group membership from the HPTDb: count (normalized)
[a] Using aggregated counts (Huizui and Shaocai) for the Erlitou period

increases overall. Rather, the number of individuals using the wheel to form vessels (rather than just rims) increases. This increase in wheel-forming is contrasted by the apparent reduction in the use of the mold-forming technique (from 0.22 to 0.04); indeed, even the actual counts are not much different.

Erlitou Period Despite low counts overall for Erlitou period data, based on these data it seems that there is a shift in terms of production away from "hand-forming" to wheel-formed pottery. The values for both paddle-anvil and mold-formed vessels drop to half their previous level (for PA), or for mold-formed vessels, the value actually bypasses the previous value (which was already low to begin with), and doubles the value from the early Longshan (from 0.22 to 0.5). In relation to the overall decline of hand-formed vessels, though the MD group increases it is still significantly lower than the WL group and now on par with the PA group. Interestingly, the WL-R group is non-existent, and even accounting for overall low counts in the Erlitou data, this absence is telling. The low value for vessels with wheel-formed rims is likely tied to the reduction in hand-formed vessels such that a reduction in one (paddle-anvil and mold-formed vessels collectively) also means a reduction in hand-formed vessels with wheel-formed rims.

Communities of Practice: Technical Styles

As with the previous two styles, there are trends evident in the Technical style numbers and normalized values. Though it seemed important to make the distinction between a fully wheel-formed vessel and a

wheel-formed rim attached to a vessel, it appears that for the WL-R group the numbers for this technique remain low through the early and late Longshan and may in fact disappear all together in the Erlitou period. However, this may be the result of the major trend in the data, a steady increase of wheel-formed vessels from early (0.26) to late (0.84) Longshan and into the Erlitou (1.0) period. This trend correlates with a similar though opposite decrease in the values for the PA group, which is the dominant formation technique in the early and late Longshan period (1.0), but which drops by nearly half (to 0.57) in the Erlitou period. The MD group presents a somewhat confusing picture in which the values from early (0.22) to late (0.04) Longshan decrease, but there is a relative resurgence (to 0.5) of mold-formed vessels in the Erlitou period. This could be a result of sampling error considering the low overall numbers in the Erlitou period even with data from Shaocai, but this may also represent an actual preferential shift in "hand-formed" vessels from paddle and anvil-formed vessels to mold-formed vessels. In other words, the decline in the PA group may have less to do with the increase in wheel-formed vessels, and more to do with a shift in hand-forming techniques in which those using the mold-forming technique achieve numbers equal to that of the paddle and anvil-forming communities of practice.

During the Longshan period, there appears to be at least three distinct technical styles present, based primarily on the different ways in which key vessel forms are tempered and formed. To begin, the unrestricted serving vessel forms, *dou* stands, *pan* dishes, and *wan* bowls appear to only have little or no temper and be made on the wheel, so styles are difficult to distinguish among those vessel forms. However, storage and multi-purpose vessel forms appear to be represented among the three style groups, in particular the *pen* basin, *guan* round jar, and *weng* urn forms.

The *guan* deep jars, with a high frequency of temper, are only formed using one of two methods, a paddle and anvil or a mold. This is also the case for *zun* jars and *yu* and *pen* basins that are strictly low-tempered vessels, and also formed using two methods, the wheel or a paddle and anvil. This already suggests two distinct styles found at Huizui. For the first style, *zun* jars and *yu* and *pen* basins are formed using a wheel from a low temper paste; this group may also produce the *dou* stands, *pan* dishes, and *wan* bowls. A second

Diagnostic Vessel Form	Paste	Formation	Style Group
***guan* deep jar**	coarse	paddle-anvil	CP1
	coarse	mold	CP2
***pen* basin**	fine	wheel	Any
	fine	paddle-anvil	CP3
	coarse	paddle-anvil	CP1

Table 5.16: Style Groups based on *guan* deep jars and *pen* basins

style also produces *zun* jars and *yu* and *pen* basins using a low temper paste, but form these vessels using paddle and anvil.

The last key vessel form, *guan* round jars, can be either low or high tempered and are represented in all four of the style groups. Rather than suggest, though, that there are four styles present, I would argue that with these two vessel forms, because of their size, we have *guan* round jars and *weng* urns that are formed using low temper and a paddle and anvil, a high temper and a paddle and anvil, or a medium to high temper and a mold with neck-rims formed on the wheel and attached to the vessel bodies. Having wheel-formed neck-rims could also account for the presence of *zun* jars in the WL group since these vessels have a complex body form, not unlike the *guan* round jars and *weng* urns.

Based on the results of the radiographic analysis, it seems likely that there were at least three different communities of practice producing pottery at Huizui (Table 5.16). Clearly some vessels are produced on the wheel no matter what style one uses and hence, regardless of what community of practice one participates in, so wheel thrown vessels could be part of any style group. The fact that *guan* deep jars are found in two technical style groups, one paddle and anvil (PA) produced and the other mold (MD) produced indicates two communities of practice. Likewise, *pen* basins are found in three style groups, two of which use minimally tempered pastes, and the third which uses a higher temper paste. However, two of the style groups are

produced using a paddle and anvil which suggests two different communities of practice, one that uses a fine paste on the wheel to form the vessel and the other that uses a fine paste but the paddle and anvil to form the vessel. Vessels from the third style group would then indicate a third community of practice that uses a coarse paste and the paddle and anvil.

5.3 Analysis of Style Groups

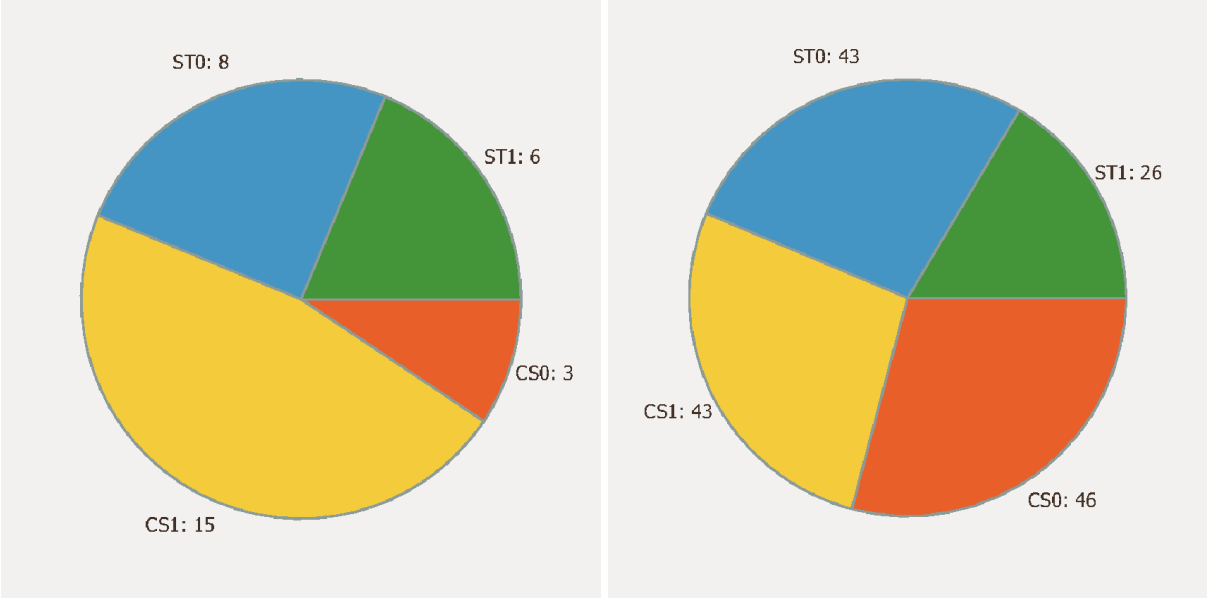
In this section I will utilize the data generated in the previous sections and the creation and assignment of style groups to determine whether there are specific communities of practice that can be identified. As mentioned previously, the style groups enable the many factors used to characterize the pottery from Huizui to be distilled down to just three variables. This means that statistical analyses are more likely to reveal patterns and associations between the variables (i.e. style groups). As defined in this research, these style groups represent three aspects of style that make up the style of a community of practice as described in the Chapter 3 section titled "Communities of Practice *Redux*" (on p.54).

Two types of analyses were undertaken in order to explore the Huizui data. The first, ceramic technology, investigates the relationship between the Functional, Technical, and Imaginal styles. In general, the style groups themselves are used in charts or graphs since the intention in creating them in the first place was done to cut down on the large numbers of variables that needed to be used. However, once relationships were determined involving Functional or Imaginal styles, it became necessary to determine whether one or both of the variables that are used to create those style groups was responsible for the demonstrated relationship (see §5.2.1 on page 133).

The second, technical pathways, is used to examine pathways that potters would have followed in the production of pottery. This information can be used, on the one hand, to determine and describe the communities of practice present at Huizui, and on the other, to describe learning frameworks. These analyses involve the use of nested frequency tables in order to trace the technical pathways used by the potters in making a given pottery vessel.

5.3.1 Ceramic Technology and Style Groups

Here I will explore the relationships between the different style groups, if any, and look for trends in the data that suggest changes in the nature of pottery production at Huizui. The analysis is conducted using charts or graphs between the different style groups, and their constituents where necessary.[21] In the following discussion, I will first discuss the early Longshan period, then the late Longshan period, and lastly any changes that are discernible from one period to the next.



(a) T-style: MD (b) T-style: PA

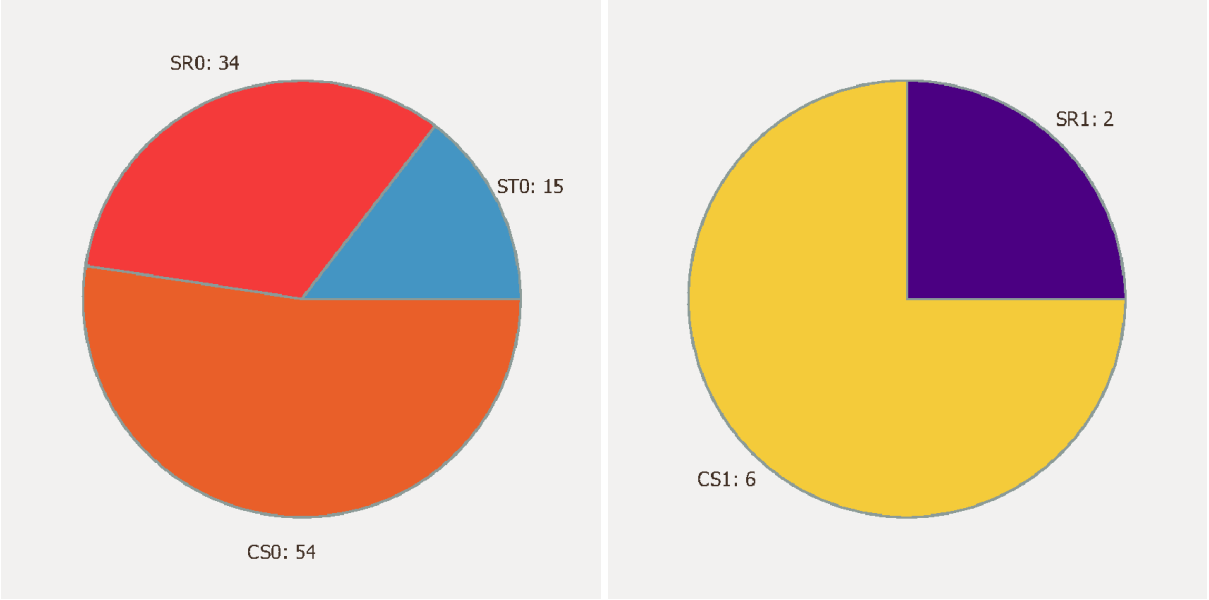
Figure 5.21: The MD and PA T-styles, Longshan period

However, in order to help make sense of any discernible changes, it seems prudent to review the Longshan period overall before breaking the analysis down by period. Looking first at the two hand-building techniques, mold and paddle/anvil formation (i.e. the MD and PA T-styles), we can see that the majority of vessels made using these techniques are the multi-purpose cooking-serving (CS0 and CS1) types (Fig-

21. I originally used the chi-square χ^2 method for this analysis, but it quickly became apparent that this was not a viable option because so many of the categories (styles) had low cell counts (>5), thus leading to "statistically significant" results that were difficult to justify with such skewed numbers. The situation was only made worse when trying to analyze data from individual periods.

ure 5.21 on the preceding page). The rest belong to the storage types (ST0 and ST1); for both mold and paddle/anvil formed vessels this accounts for 100% of the assemblage, and there are no serving style vessels (SR0 and SR1).

Turning to the wheel T-styles (WL and WL-R), we see (Figure 5.22) the situation is reversed where all of those in the WL T-style are fine wares of each type: CS0, SR0, and ST0. The majority of these are the cooking-serving (CS0) style, followed by the serving style (SR0), and less than half of that number of storage vessels (ST0). Likewise, only coarse ware vessels are present for the wheel-formed rim style (WL-R). It is also interesting to note that there are only cooking-serving (CS1) and serving (SR1) vessels in this style; there are no coarse ware storage vessels (ST1) that have wheel formed rims.



(a) T-style: WL (b) T-style: WL-R

Figure 5.22: The WL and WL-R T-styles, Longshan period

Without telegraphing my conclusions too much, based on these aggregate results, at minimum there are two communities of practice, one that favors mold forming and the other that favors paddle/anvil forming. Moreover, because of the distribution of F-styles between the two hand-forming styles and the one wheel-formed style, I believe that each community of practice was able to make the full suite of vessels (F-styles)

using one of the hand-forming techniques and the wheel. In other words, each community of practice used the wheel for some vessels types (CS0, SR0, and ST0) and either mold or paddle/anvil for the rest.

Early Longshan Period

Looking at the early Longshan, in general, the trends discussed above hold, but there are some important aspects I would like to discuss (Figure 5.23 on the following page). It comes as no surprise that all of the WL-R formed vessels are from the CS1 F-style; this means that any coarse serving vessels (SR1) with the WL-R T-style come from the late Longshan. Also, as expected based on the bulk analysis above for the Longshan period, any wheel-made vessels come from the fine cooking-serving and serving F-styles, in nearly even numbers: 56% for CS0 vessels and 44% for SR0 vessels.

However, these data become far more interesting looking at the hand-forming techniques of mold (MD) and paddle/anvil (PA). In particular, of the coarse ware cooking-serving vessels (CS1), which includes round *guan* and *pen* in particular, exactly half are made using PA and half using MD. The situation is identical for the small number ST0 F-style vessels in which the numbers for such vessels are also identical, each making up 7% of the PA and MD T-style totals. The balance of MD and PA vessels are most skewed in opposite directions for fine cooking-serving (CS0) vessels and coarse storage (ST1) vessels. The balance of the CS0 F-style are made using MD (7%) and PA (21%), while the balance of ST1 F-style are made using MD (36%) and PA (22%).

Turning to look at the relationship between F-style and I-style necessitates breaking the data into three groups, based on color, in order to make graphing more manageable. Looking first at gray vessels there is some noticeable clustering, in particular for gray-burnished and gray-stamped vessels (Figure 5.24 on the next page): the gray-burnished (Gb) imaginal style is only found in fine cooking-serving vessels (CS0, most likely *pen* basins), while the gray-stamped (Gs) imaginal style is only found on coarse cooking-serving (CS1) and coarse storage (ST1). These data stand in contrast to the gray-combed (Gc) style which is found on both fine and coarse cooking-serving (CS0 and CS1) vessels and fine and coarse storage (ST0 and ST1) vessels—no serving vessels (SR0 and SR1) are gray-combed. The same is essentially true for gray-marked

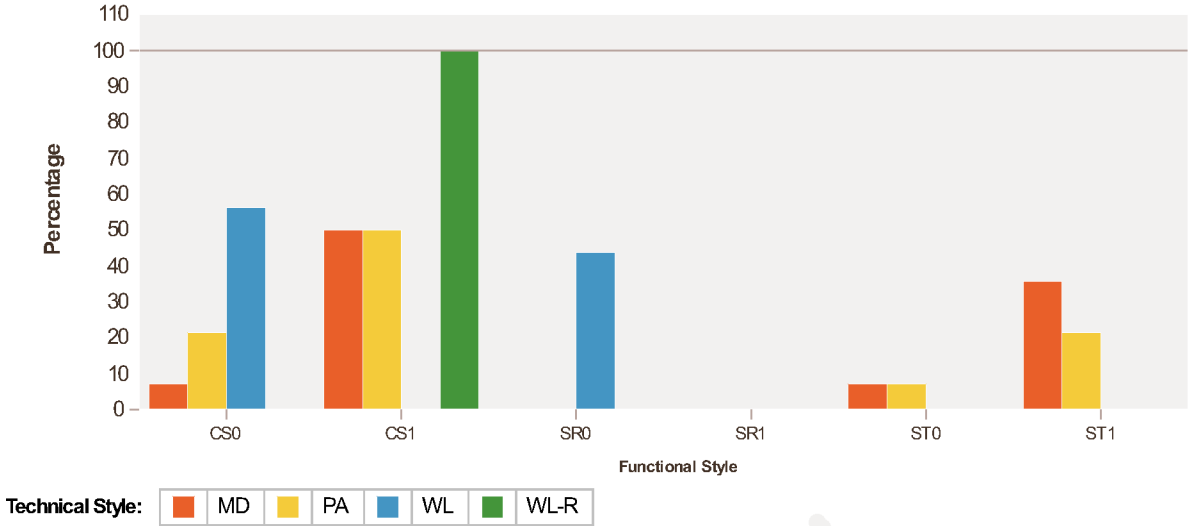


Figure 5.23: T-style by F-style in the early Longshan

(Gm) style vessels as well: both cooking-serving vessels (CS0 and CS1) and only coarse storage (ST1) vessels. Lastly, perhaps not surprisingly, gray-plain (Gp) vessels are found in all three functional types (CS, SR, and ST), although among the serving and storage vessels, gray-plain is only found on the fine ware vessels (SR0 and ST0).

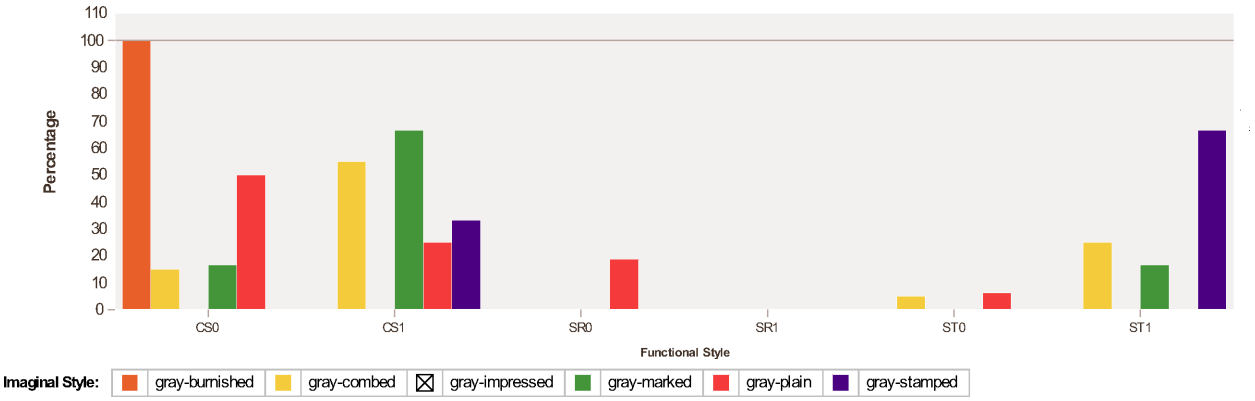


Figure 5.24: I-style (gray) by F-style in the early Longshan

The situation is rather different for black I-styles in terms of the types of vessels and their distribution, but a similar pattern of preferences in style are clear (Figure 5.25 on the following page). Although the numbers are low, the black-impressed (Hi) and black-plain (Hp) styles are only found on the coarse cooking-

serving (CS1) vessels or the fine serving (SR0) vessels respectively. This is in stark contrast to their gray counterparts in which there are no gray-impressed vessels and gray-plain is found in all three functional types (CS, SR, and ST). Another interesting pairing are black-marked (Hm) and black-combed (Hc) styles; black-marked is only found on cooking-serving vessels (CS0 and CS1), while black-combed is only found on coarse wares of the cooking-serving (CS1) and storage (ST1) vessels. The numbers for black-marked and gray-marked are similar, but confined to the cooking-serving vessels in the black-marked style, where gray-marked was found there as well as coarse storage (ST1) vessels. Black-combed, on the other hand, is restricted to the CS1 and ST1 vessels, a noticeable difference from their gray-combed counterparts which are found in four of the six F-styles. Lastly, the black-burnished (Hb) style is found in all four of the cooking-serving (CS0 and CS1) and serving (SR0 and SR1) style vessels. Compare this to the gray-burnished (Gb) style which is only found in fine ware cooking-serving (SR0) vessels.

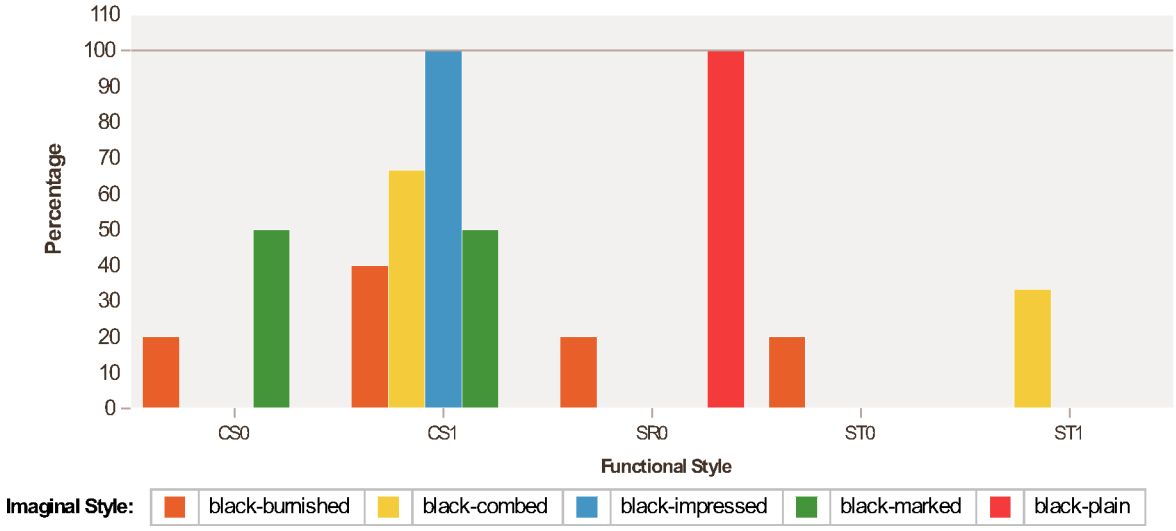


Figure 5.25: I-style (black) by F-style in the early Longshan

The last of the primary I-styles are drawn from the brown-series vessels (Figure 5.26 on the next page). Their numbers are not as high as those for the gray- and black-series vessels, but the set of I-styles is also more restricted as well; only burnished (Bb), combed (Bc), marked (Bm), and plain (Bp) styles are present. Absent are impressed and stamped styles, although stamped is actually only found in gray-series vessels

anyway. Here, brown-combed is only found in coarse storage (ST1) vessels, while brown-marked is only found in coarse cooking-serving (CS1) vessels; interestingly the same pattern as that for black-combed (Hc) vessels. The brown-burnished (Bb) style is only found in fine serving (SR0) and fine storage (ST0) F-styles. Lastly, the plain style for the brown-series is found in multiple F-styles, but even there only in three of the five F-styles present (there are no brown-series SR1 vessels). Brown-plain is found in both cooking serving (CS0 and CS1) vessels and coarse storage (ST1) vessels, and in all cases, low numbers.

In general, that sums up the challenge of comparing brown-series vessels to those of other I-styles, especially in the early Longshan: their low numbers. In total, only eight brown-series vessels are present, making any kind of strong comparison impossible aside from the general idiosyncrasies noted above. The data for the late Longshan should be a little more revealing, as should comparison between the early and late periods.

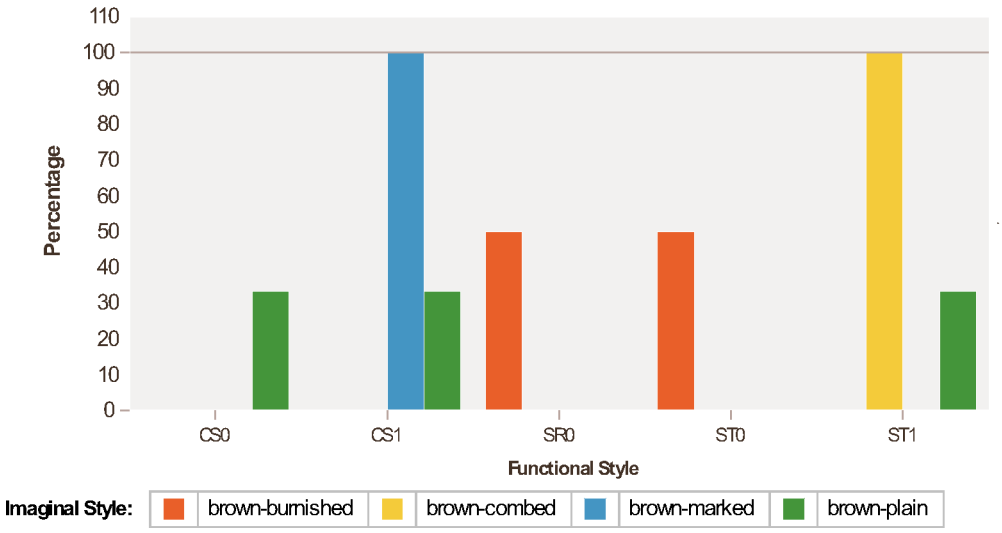


Figure 5.26: I-style (brown) by F-style in the early Longshan

Late Longshan Period

The situation changes for the late Longshan period with regard to relationships between styles. Functional style continues to be related to Technical style as was the case in the early Longshan, but in the late Longshan

we now find a partial relationship between both Functional and Technical styles and Imaginal style. I will discuss each of these developments in detail below.

There are noticeable changes in the distribution of technical styles, in particular within the cooking-serving (CS) series vessels (Figure 5.27 on the following page). The percentage of CS fine wares made using the mold technique increases slightly (from 8% to 10%), as does the percentage of CS0 wares produced using the paddle/anvil technique (from 20% to 33%, though a slight decrease in vessels produced on the wheel (from 55% to 50%). For the cooking-serving vessels, the most noticeable difference is in the percentage of vessels of coarse wares (CS1) where there is an almost equal percentage produced using the mold technique (50% to 45% early to late), but the percentage produced using the paddle/anvil technique drops from 50% to 12% of the assemblage. Some of this is made up by the 10% increase in CS0 vessels, though this is mostly balanced with the lower percentage of coarse storage (ST1) vessels (from 22% to 12% early to late). The biggest change comes from increased production of fine storage wares (ST0) using the paddle/anvil technique which jumps from 5% to 40% of the assemblage. A similar, though not as dramatic, redistribution in percentages comes from wheel formed vessels. As noted above, the fine cooking-serving percentage changes slightly (from 55% to 50%), this is accompanied by a lower percentage of fine serving (SR0) vessels as well (from 45% to 30%), so that by the late Longshan, 20% of wheel-formed vessels come from the fine storage (ST0) vessels. In short, many more fine ware storage vessels are being produced by the late Longshan. Also of note, the complete absence of coarse serving (SR1) vessels in the early Longshan also takes a dramatic turn, such that a full 35% of wheel-formed rims are found on SR1 vessels, dropping the percentage of such specialty rims on coarse cooking-serving (CS1) vessels from 100% to 65% of the assemblage.

Turning to the relationship between Functional style and Imaginal styles, we will again break the analysis by color for easier comparison (Figure 5.28 on page 175). One of the most notable changes comes from the gray burnished style (Gb) which, in the early Longshan, is only found on fine cooking-serving vessels (CS0). By the late Longshan, however, this style is completely broken down between three main functional styles: fine cooking-serving (CS0) at 35%, fine storage (SR0) also at 35%, and fine serving (SR0) at 25%,

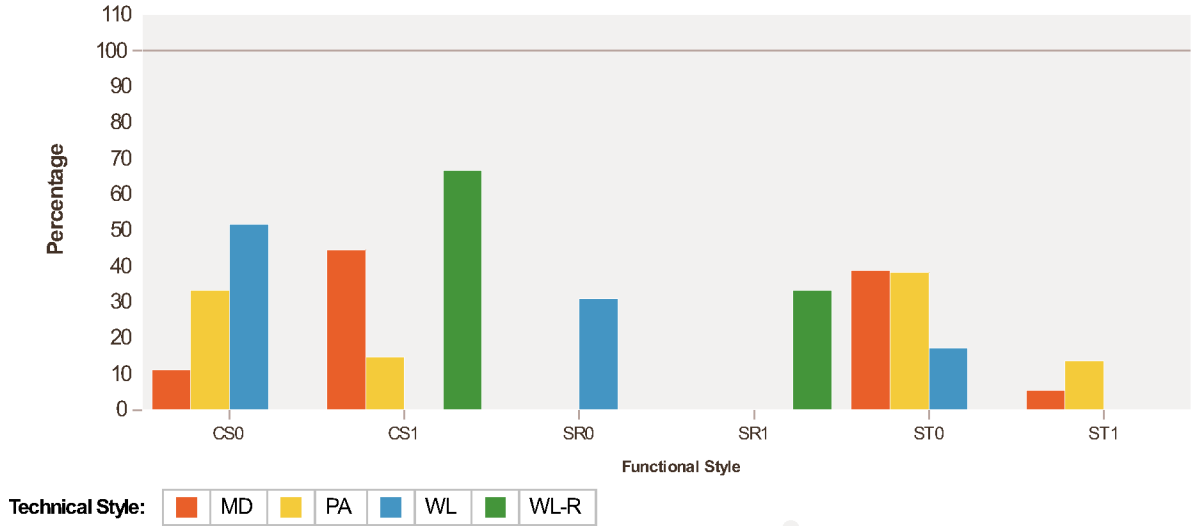


Figure 5.27: T-style by F-style in the early Longshan

with the final 5% coming from coarse serving (SR1) vessels.[22] In reverse fashion, whereas the gray-stamped (Gs) style is found in coarse cooking-serving (CS1) and coarse storage (ST1) vessels, in the late Longshan all gray-stamped vessels are fine storage (ST0) vessels.

For other I-styles, there is mostly a shifting of percentages between the different F-styles. In the early Longshan, the gray-marked (Gm) style is found in both cooking-serving styles, with the majority in the CS1 vessels (68% and 16% respectively), and some coarse storage vessels (also 16%), by the late Longshan, the numbers shift to majority fine cooking-serving vessels (60%), followed by both storage vessel styles; coarse at 27% and fine at 13% of the assemblage. The gray-combed style (Gc) is represented in the same F-styles, cooking-serving and storage, but the percentages shift a fair bit: CS0, 15% to 30% early to late; CS1 55% to 15%; ST0, 5% to 48%; and ST1, 25% to 7%. The most stable I-style comes from the gray-plain (Gp) vessels, which stay in the four F-styles where they are present in the early Longshan, but also make a minor showing in the other two styles, coarse serving and coarse storage vessels (approx. 2% each). Otherwise, the percentages remain not dissimilar from early to late Longshan: CS0, 50% to 48%; CS1, 25% to 13%; SR0 19% to 20%; and ST0 goes from 6% to 15% of the assemblage.

22. It also bears mentioning that there are no coarse serving vessels in the early Longshan. Even then, in the late Longshan these vessels are still barely found with a few gray-burnished and gray-plain styled vessels.

The most notable change, however, comes from the introduction of the gray-impressed (Gi) style in the late Longshan. It is not found on any vessels in the early Longshan, but by the late Longshan this style is found on both cooking-serving F-styles: CS0 (67%) and CS1 (33%). This change is particularly interesting since the gray-impressed style supplants the gray-burnished (Gb) style as the primary imaginal style for CS0 vessels (which, as mentioned above, becomes ubiquitous across the range of F-styles). For coarse cooking-serving (CS1) vessels, the gray-impressed style has completely replaced gray-marked (Gm) all together by the late Longshan.

By the late Longshan, gray fine cooking-serving (CS0) vessels bear five of the six I-styles, followed by fine storage (ST0) vessels which also have five of the six styles. Most importantly, though, is the fact that the only style missing from either of these F-styles is the style found in the other F-style. There are no gray-stamped (Gs) vessels of the CS0 style, while all of the Gs style vessels are found in the fine storage (ST0) F-style; in contrast, there are no gray-impressed (Gi) styles vessels in the ST0 F-style because, as mentioned above, they are all found in the cooking-serving style vessels, with the majority being fine cooking-serving (CS0) vessels. I will discuss the possible significance of these trends later.

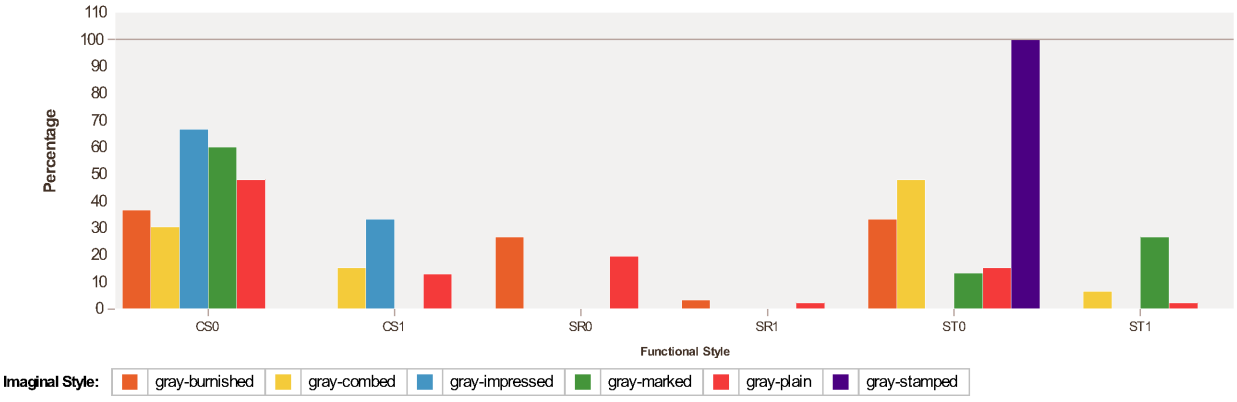


Figure 5.28: I-style (gray) by F-style in the late Longshan

Turning again to black vessels, here too we find some stability as well as some drastic shifts from early to late Longshan (Figure 5.29 on the following page). First, as was the case in the early Longshan, there are

no coarse serving (SR1) vessels to be found in the black I-styles. As I will discuss later, the coarse serving F-style is only found in the gray I-style (and even then, not in very great numbers).[23]

There is a great deal of stability for the black-burnished (Hb) vessels because it is found in almost all of the same F-styles as was the case in the early Longshan with the exception of coarse cooking-serving (CS1) vessels for which that I-style has vanished. Those numbers have been redistributed between fine cooking-serving (CS0) at 46% and fine storage (ST0) vessels at 31% with fine serving (SR0) rounding the numbers out with 23% of the assemblage. The black-combed (Hc) style remains on coarse cooking-serving (CS1) vessels at 50% (from 67% in the early Longshan), but this I-style moves from coarse storage (ST1) vessels to fine storage (ST0) vessels, and now makes up the balance in numbers of this I-style, from 33% in the ST1 style to 50% in the ST0 style.

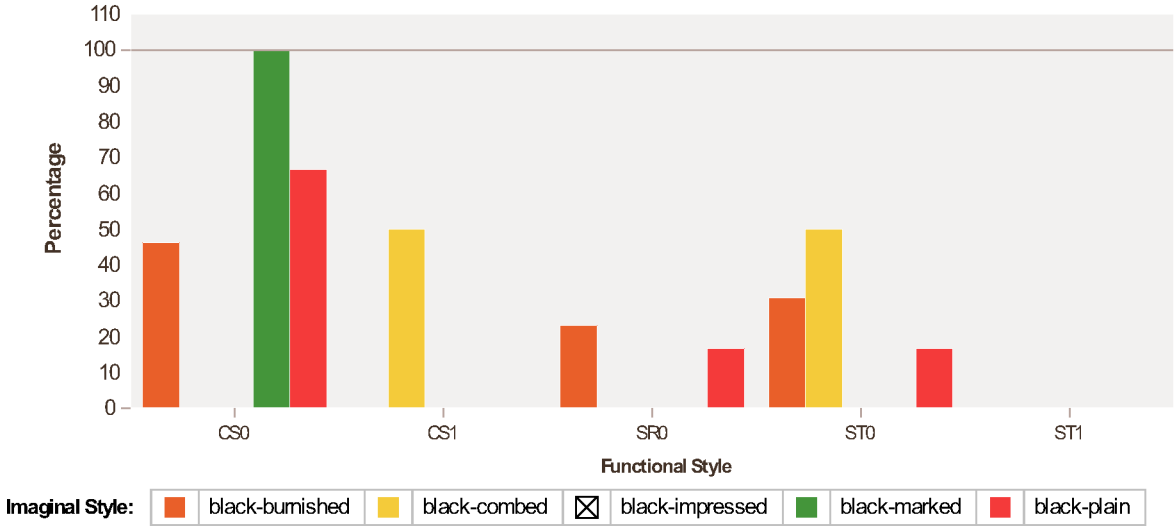


Figure 5.29: I-style (black) by F-style in the early Longshan

Looking at the other I-styles, where gray-impressed is absent in the early Longshan, making its appearance in late Longshan vessels, for the black-impressed (Hi) I-style, it is present during the early Longshan solely in coarse cooking-serving (CS1) vessels, the I-style disappears by the late Longshan, which is a com-

23. In fact, this situation raises the question as to whether the coarse serving F-style is even a viable style since on closer inspection, it is likely that any vessels of the SR1 F-style could be classified as either coarse cooking-serving or storage vessels instead.

plete reversal of the trend found for gray-impressed (Gi) I-style vessels. By contrast, the black-marked (Hm) I-style is found evenly distributed between the two cooking-serving F-styles in the early Longshan (each at 50%), by the late Longshan all of the vessels with the black-marked style are found in the fine cooking-serving (CS0) vessels.

It is with the black-plain (Hp) I-style that we see the most drastic changes. Being solely found on fine serving (SR0) F-style vessels in the early Longshan, the late Longshan sees that number drop from 100% of the assemblage to 16% with some transference to fine storage (ST0) vessels (at 17%), the majority of the black-plain (Hp) I-style is now found among fine cooking-serving (CS0) vessels at 67% of the assemblage; this represents a major change for this I-style. Lastly, it bears mentioning that the black-stamped (Hs) I-style is completely absent from all vessel F-styles. The possible significance of this will be explored later in this chapter.

As was the case for the early Longshan, for brown I-style vessels, the relative low numbers make any strong conclusions untenable, but a few points bear mentioning (Figure 5.30 on the next page). First, brown-marked (Bm) vessels disappear from the record, and second, the late Longshan has become a study of balance for the other three I-styles still found among the assemblage. In addition to the absence of brown-marked (Bm) vessels, brown-combed (Bc) vessels are now split between coarse storage (ST1) vessels (formerly 100% of the assemblage) and coarse cooking-serving (CS1) vessels. The brown-burnished (Bb) I-style was previously evenly split between fine serving (SR0) and fine storage (ST0) vessels, is now split between the previous F-styles and fine cooking-serving (CS0) vessels with SR0 maintaining 50%, followed by ST0 and CS0 each with 25% of the assemblage. In reverse fashion, in the early Longshan the brown-plain (Bp) I-style was found in both cooking-serving (CS0 and CS1) F-styles and coarse storage (ST1) vessels, by the late Longshan, the Bp style has stayed with the coarse cooking-serving (CS1) vessels and consolidated from fine cooking-serving (CS0) and coarse storage (ST1) to fine serving (SR0) vessels, with CS1 and SR0 each at 50% of the assemblage.

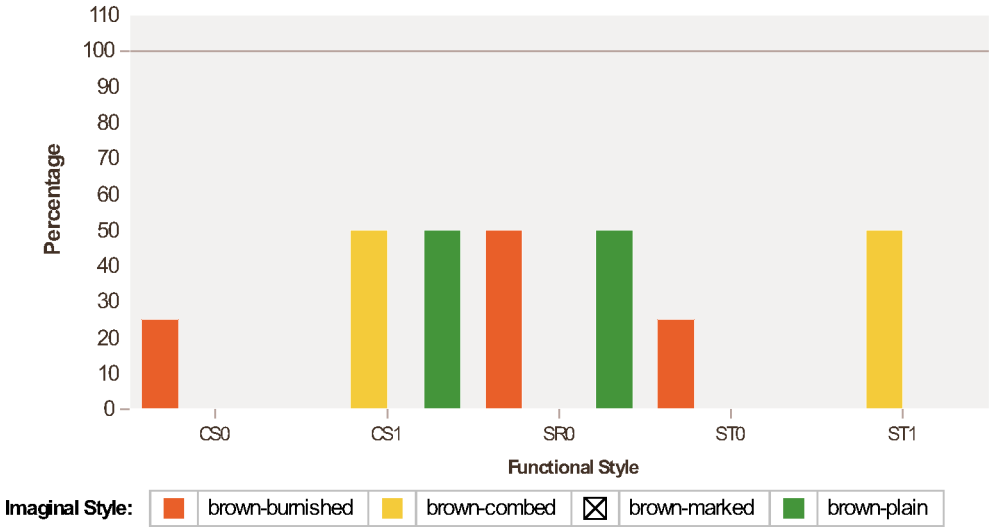


Figure 5.30: I-style (brown) by F-style in the early Longshan

Erlitou Period

Unfortunately, results for the Erlitou period are difficult to interpret, due primarily to the relatively small number of Erlitou period members in the Huizui Collection (even with including the Shaocai materials). If we were to go by the chi-square tests for any of the styles, no style or attribute is related to any other; there is no relationship between Functional and Technical styles, nor any relationship between Technical and Imaginal styles. In short, the numbers are too small to run viable chi-square tests. This is one of the major objectives for future research.

Style Groups at Huizui

Based on the results of the statistical analysis, a few features of the Huizui Collection become more clear. First, the relationship between Functional and Technical Styles remains strong from the early to late Longshan. Indeed, one of the strongest links between these two styles is that between 'vessel form' and the Technical style. In other words, there is a definite link between the vessel form envisioned in the Conceptualization phase (§4.2.2 on page 92) and the technique used to produce the vessel. This is interesting because, as will be discussed in more detail below, many of the major vessel forms are produced using all three differ-

ent techniques, so there is no one-to-one correlation between a vessel form and a single technique; instead this appears to be determined by the community of practice the potter belongs to.

Second, while there is a strong relationship between the Functional and Technical styles, this is not the case for either Functional or Technical styles and Imaginal style, at least during the early Longshan period. That is to say that there is no given Imaginal style (i.e. color or surface treatment) style for specific vessel forms and/or techniques used to produce the vessel in the early Longshan. However, the situation changes in the late Longshan and both Functional and Technical styles do appear to have a bearing on the Imaginal style used at the completion phase. Specifically, vessel form and indirectly formation technique, do appear to determine what type of surface treatment will be used on the vessel. The same does not hold true for color, however, and color continues to be unrelated to any other variable.

As mentioned above, these correlations suggest that in the early Longshan period, potters would produce certain vessel forms in accordance with the techniques used within their community of practice (i.e. how they learned to make pots), and would then apply surface treatments based on personal taste, then fire the vessels, again, in accordance with their community of practice. However, by the late Longshan period, the application of surface treatment seems to be dictated according to an external party, whether it be customers or clients, and that there was an understood surface treatment for specific vessel forms. In other words, no longer could the potter apply surface treatments according to personal taste, but was adhering to external tastes for surface treatment. Nevertheless, at least in the late Longshan period, the potter continues to be able to decorate the vessels according to personal taste, but it would be interesting to see if this changes by the Erlitou period.

Unlike the early Longshan period, by the late Longshan there is a discernible relationship between Functional or Technical styles and Imaginal style. As was discussed above, the Functional style and the Technical style were relevant in determining what color or surface treatment was used in the final vessel. The situation is complicated though, because despite this relationship between Functional and Imaginal style which has “Vessel Form” and “Surface” at its core (see above), the relationship does not go in reverse. In other words, Imaginal style cannot be used to determine either the “Vessel Form” nor the “Ware” of a vessel.

From this we might infer that the choice of surface treatment was not up to the individual potter and that by this period appropriate surface treatment (though not color) was not determined by his/her community of practice, but whether some outside factors or influence are at work is difficult to discern, be it from the consumer most directly, or a general "sense of belonging" created by the pairing of vessel form and surface treatment.

5.3.2 Technical Pathways and Style Groups

Tracing technical pathways is most easily accomplished using nested frequency tables, and in the present case, determining what variables or styles play the biggest role in evaluating changes in the production of pottery vessels at Huizui utilized basic statistics to learn that the Functional and Technical styles maintain a relationship throughout the Longshan period, from early to late, and that it is only in the late Longshan that Imaginal style becomes a factor. Specifically, that Imaginal styles are not related to Functional or Technical style in the early Longshan period, and therefore that potters appear to be free to use any type of surface treatment for the vessels they produce and produce pots in a range, though narrow, of colors. However, by the late Longshan period both Functional and Technical style are factors in determining surface treatment used, though color still seems open to the potter's taste or ability.

The majority of the work on styles used in this research has concentrated on the earlier stages of pottery production, namely conceptualization, paste preparation, formation, and finishing (surface treatment and decoration). Little has been discussed using firing except for color which is only a proxy for firing, but not firing itself. However, the firing process will be used as a final characteristic of the Huizui Collection pottery to delineate communities of practice below.

Vessel Form and Formation

The conceptualization process is encapsulated by the Functional style (§4.2.2 on page 92) in which the final vessel form and its general performance are summarized by the attributes "vessel form" and "ware" in the HPTDb. Moreover, as was demonstrated above, vessel form plays a more significant role in the

determination of subsequent style groups for Technical style and possibly Imaginal style as well. Because of this, tracing technical pathways begins with vessel form.

Deep and round *guan* Both deep and round *guan* are only produced using the hand-building techniques, and maintain fairly similar numbers from the early to late Longshan. Unlike the round *guan*, the deep *guan* do not have any wheel-formed rims in the early Longshan, but both forms have wheel-formed rims in the late Longshan, and the numbers increase a good bit from early to late for the round *guan*, from 0.10 to 0.40 (normalized). Mold forming drops for deep *guan* and stays more or less the same for round *guan*, while paddle/anvil stays identical for deep *guan* and decreases by almost half for round *guan*.

***Weng* urns** Unlike the *guan* vessels, both of which see either stable numbers (round *guan*) or decreasing numbers (deep *guan*) of mold-formed vessels into the late Longshan, the numbers increase two-fold from 0.08 to 0.17 (normalized) for *weng* urns. In contrast, the numbers increase dramatically by almost five-fold for paddle/anvil formed *weng* urns from 0.21 to 1.0 (normalized) between the early and late Longshan. Also of note, since there are no wheel-formed *weng* in the early Longshan, the appearance of wheel-formed vessels in the late Longshan is surprising, increasing from 0.0 to 0.36 (normalized).

***Pen* and *yu* basins** Overall, there is an increase in the number of *pen* and *yu* basins, though the more numerous *pen* basin sees the largest increase in wheel-formed vessels from 0.08 to 0.52 (normalized) between the early and late Longshan periods. Interestingly, however, is the fact that from early to late Longshan, the mold-forming technique is not longer used for either basin forms. The numbers are already fairly low in the early Longshan, but the technique ceases to be used in the late Longshan. This contrasts with the slight increases seen in mold-formed vessels for both round *guan* and *weng* urns in the late Longshan.

Minor Forms: *dou*, *pan*, *wan*, and *zun* Aside from the *yu* basins, the rest of the minor forms show almost equal growth of approximately two to three fold from early to late Longshan. The one exception is the *pan* dish which increases four-fold from 0.08 to 0.38 (normalized).

Vessel Form	Technical	Period			
		ELSH		LLSH	
dou	WL	1	(0.03)	5	(0.12)
***guan*, deep**	MD	6	(0.15)	2	(0.05)
	PA	12	(0.31)	13	(0.31)
	WL-R	0	(0.0)	4	(0.10)
***guan*, round**	MD	8	(0.21)	12	(0.29)
	PA	39	(1.0)	26	(0.62)
	WL-R	4	(0.10)	17	(0.40)
pan	WL	3	(0.08)	16	(0.38)
pen	MD	2	(0.05)	0	(0.0)
	PA	3	(0.08)	12	(0.29)
	WL	3	(0.08)	22	(0.52)
wan	WL	3	(0.08)	8	(0.19)
weng	MD	3	(0.08)	7	(0.17)
	PA	8	(0.21)	42	(1.0)
	WL	0	(0.0)	15	(0.36)
	WL-R	2	(0.05)	4	(0.10)
yu	MD	1	(0.03)	0	(0.0)
	PA	2	(0.05)	6	(0.14)
	WL	5	(0.13)	6	(0.14)
zun	PA	2	(0.05)	8	(0.19)
	WL	1	(0.03)	8	(0.19)

Table 5.17: Vessel Forms and Technical Styles: count (normalized) [a]

[a] All counts are normalized for each period.

One of the most stable relationships throughout the Longshan period is that between vessel form (and Functional style) and Technical style. Based on the numbers (Table 5.17 on the preceding page) one detail that stands out is that two of the four major vessel forms (deep *guan* vats and round *guan* jars) are each produced by both of the hand-build techniques, paddle/anvil and mold forming. By contrast, the other two major forms (*pen* basins and *weng* urns) are produced by both hand-build techniques as well as the wheel-building technique, though the *weng* is wheel-built only in the late Longshan, not in the early Longshan. Nevertheless, like the *guan* vessels, *weng* also are consistently produced using the two hand-build techniques from early to late Longshan. In addition, though not considered a major form due to overall low numbers, the *yu* basin follows the same trajectory as its *pen* basin counterpart in no longer being made using the mold-forming technique after the early Longshan period.

This trend of these four vessel forms produced using both hand-building techniques suggests the existence of two communities of practice, one that uses the mold-forming technique to produce these vessel forms, and the other that uses the paddle/anvil technique to produce these same vessel forms.

However, though there is strong consistent use of the wheel for forming vessels, I would argue that this does not represent a third community of practice. This argument stems from the presence of wheel-formed rims for deep and round *guan* and *weng* which suggests that both communities of practice use the wheel to form rims for these vessels. Besides, it seems unlikely that there was a special community of practice making rims for these vessels while also being the only producers of the various serving-type vessels (*dou* stands, *pan* dishes, and *wan* bowls). Instead, both communities of practice utilize the wheel to form these serving-type vessels and to produce nice wheel-formed rims for their *guan* and *weng* vessels.

Firing and Formation

If the Technical style (essentially formation) provides the first key to determining communities of practice, the next stems from looking at firing and formation. Here, the vessel firing is looked at through the "color" attribute; an imperfect proxy to be sure, but I am thinking of one color code in particular: black on red. The 'black on red' value in color is really a combination between the exterior color and the core color of

the vessel, and whereas the majority of the vessels in the Huizui Collection have cores of black to gray to brown, the 'black on red' vessels are fairly unique. In general, the 'black on red' vessels have cleanly and completely oxidized cores, producing a consistent red core color, though there are a few exceptions for thick-walled vessels that have black or dark gray cores. In any case, the 'black on red' type combines this consistent red (oxidized) core color with a consistent black (reduced) exterior color (Figure 5.31). In most cases this exterior black is on both the inside and outside of the vessel, but in some cases the black is only present on the outside of the vessel.

Figure 5.31: Example of the 'black on red' type from the HPTDb (HuZu.C.0039)

This rather distinct firing procedure suggests a third community of practice. The difficulty with the 'black on red' type, though, is that it calls into question the proposed two communities of practice mentioned above that are based on two different formation techniques for a discrete set of vessel forms. This problem stems from the fact that the 'black on red' type is found across all three formation techniques, wheel,

paddle/anvil, and mold (Table 5.18 on the following page). If the 'black on red' type was to represent a different community of practice, one in which the two hand-building techniques are used together as well as the wheel, then this calls into question the original criteria for the first two communities of practice. In other words, if the 'black on red' group is using both hand-building techniques, then why cannot any other group.

One possibility is that rather than the 'black on red' type representing its own community of practice, perhaps the fact that it ranges across the two hand-building techniques suggests that there are in fact four communities of practice; one that uses the mold and wheel, another that uses the paddle/anvil and wheel, a third like the first that uses the mold and wheel, but that also fires its pottery using a very distinct firing procedure, and a fourth group that also uses the distinct firing procedure, but that uses the paddle/anvil and wheel. From a learning standpoint we would have a series of generations of potters that learned the distinctive firing procedure and one hand-building technique, that subsequently used the other hand-building technique but kept the distinctive firing procedure. Likewise, an individual taught to use the second hand-building technique, but decides to try/use a different firing procedure (which ultimately seems to predominate the collection), perhaps learned from a fourth group that continued to use the original hand-building technique, but developed a different firing procedure (again, which comes to predominate the collection).

5.3.3 Return to Political Culture

Returning to the communities of practice model, the previous sections have discussed in detail the different style types from the functional, technical, and imaginal categories I outlined in Chapter 4. As explained there, it is only by breaking apart the different types of style that we can utilize the conventional notion of style as used in archaeology to its fullest potential as articulated by Lemmonier and Sigaut. When we conceptualize style as made up of different types, and that these types do not necessarily change together, in the same ways or at the same rates, we can make use of the study of style types for particular anthropological purposes. Some of these uses were articulated by the Ceramic Sociology school in the U.S. but were not fully realized; indeed, some of these conclusions drawn as part of that paradigm were causally simplifications,

Technical	Color	Period	
		eLSH	lLSH
MD	brown	2	1
	gray	10	14
	black	2	1
	black on red	3	2
	red	3	0
	yellow	0	3
PA	brown	5	3
	gray	36	76
	black	9	6
	black on red	3	10
	red	3	0
	yellow	0	13
WL	brown	1	3
	gray	9	46
	black	3	15
	black on red	1	4
	red	0	1
	yellow	0	8
WL-R	brown	1	0
	gray	4	19
	black	0	1
	black on red	0	2
	yellow	1	4

Table 5.18: Technical Styles and Colors: count (normalized) [a]

[a] All counts are normalized for each Technical style.

leading to the "pots are people" trap. However, by breaking style into styles of different types, we can more fully make use of style as a diagnostic attribute in ceramic studies.

This research has demonstrated that the Technical styles have remained quite consistent throughout the Longshan period, but not static, and that is an important point. Indeed, were the technical styles to remain static, it would more likely support some sort of centralized production (see Costin 2001), where as the slight shift we see away from mold-formed vessels and a shift toward paddle-anvil formed vessels speaks to the community of practice for pottery during the Longshan consisting of household production which was consumed within the settlements in which the pottery was made. This transposition of formation techniques also demonstrates that there was a degree of contact between potters living in disparate settlements, with the result that, over the course of many generations, the paddle-anvil technique was adopted over the mold-formed technique.

The supposition that potters had sustained contact throughout the Longshan period is further reinforced by the changes in Functional styles as well, with a shift toward multi-use cooking-serving vessels over less utilitarian forms, as well as the increase of pure serving vessels, especially those that we might classify as "ritual" serving vessels such as *dou* stands and *pan* plates. As the everyday lives of Longshan peoples changed from an "every settlement for itself" way of life (DeMatté 1999; Liu 2004) to an increasingly homogeneous group identity, the domestic pottery used would undoubtedly reflect this as we see at Huizui. But again, we do not see so-called "standardized" vessel forms (if such a thing exists), but perhaps standardized sets of vessel forms used by every household as demonstrated by the ubiquity of round-bodied *guan* jars, deep-bodied *guan* vats, and *pen* basins, with the addition of *zun* jars possibly replacing some of the round-bodied *guan* by the very late Longshan (a trend that seems to continue into the Erlitou period), and an increased use of large *weng* urns to replace deep-bodied *guan* or *gang* vats, and smaller *weng* urns replacing some round-bodied *guan* as well. It is also worth noting the uniformity of *pen* basins throughout the Longshan period and into the Erlitou period, as well as the variants of the *pen* basin in the form of *zeng* steamers or *yu* basins. Indeed, *pen* basins are found in assemblages from the late Yangshao at least, and possibly even the early Yangshao as well, suggesting that this basin plays an integral role in everyday

and ritual life in the Luoyang Basin. In any case, this narrowing of vessel forms, while at the same time a preference for variants of these same forms speaks to the independence of potters within their community of practice. Of the three styles used in this research, functional style best emphasizes this independence yet inter-connectedness of the potters throughout the Longshan period because the influence from the social, religious, and economic leaders at the Erlitou settlement are most lightly felt, and yet this refinement of a households' pottery assemblage speaks to the subtle nature of changes in the preferences for these new styles and forms.

It is in the arena of Imaginal style that the picture of this community of practice becomes most clear: imaginal styles and decorations include a wide array of different types in the early Longshan period, but by the late Longshan, certain imaginal styles are nearly absent. In particular, the disappearance of the square-stamped surface treatment and cord-applique decorative element demonstrates most strongly preferences in the way pots look, and by understanding the identification and alignment aspects of the community of practice model, how choosing pots that look a certain way (i.e. have a similar imaginal style), pottery enters the realm of political culture, even if its in a subtle way. Through settlement-wide commensal feasts in public spaces or inter-personal feasts (the "having neighbors over for dinner") in private spaces, the imaginal styles of pots provide a "way of relating" that signals alignment or identification with a specific organization or group, as well as the imagined group it represents. And it is through these "ways of relating" that individuals make meaning in their lives. By recognizing a shared set of beliefs, solidarity with others is built and maintained. More importantly, because this solidarity is understood to include unseen or imagined agents in other households and other settlements, the "imagined community" they see themselves as part of creates the foundation of shared culture when these others follow the same practices, the same rituals, and the same daily lives. It is in this way that pottery becomes part of the political culture of this society, even if it is unrecognized by those that share in it.

By focusing on the techniques used in pottery production, and the broader set of practice of which such techniques are a part, the communities of practice model provides the connection between these practices and the human agents which use them. In essence, practice connects people and style. The communities of

practice model outlines how human agents as members of a community of practice (in our case, the community of potters in the Luoyang Basin) can be influenced by broader social and political forces of which they are a part because at its broadest level, these members are also part of many other communities of practice whose scale reaches beyond the community of potters. The members of the potting community are also part of their familial community, their settlement community, their ethnic community, their religious community, and so on. At the broadest scale, I argue that these members become part of the "imagined community" described by Anderson (1983), a community that includes all of the smaller scale communities into a "political" community, one which almost certainly includes multiple settlements, and may even include, at least in its earliest incarnation, multiple ethnic or religious communities of practice as well. When looking at the "imagined community" which is the constellation of practices for a society, and specifically the political entity of which it is coterminous, any aspect of cultural practice, and in particular the material culture which are reified forms of such practice, become part of its political culture as well. In other words, if style can be understood as signaling political alignment, whether intentional or not, it makes such practice and its reified forms of material culture a part of its political culture as well.

6

"THROUGH POTTERS' HANDS…"

THE DEVELOPMENT OF POLITICAL CULTURE IN THE LUOYANG BASIN

"Do you know, I said, that governments vary as the dispositions of men vary, and that there must be as many of the one as there are of the other?"

– Plato, *The Republic*, Bk. VII (trans. Jowett 1894)

There is always a danger in trying to determine intent based on materials from the past, when the producers and consumers cannot be asked why they made an object this way, or why they selected the object when procuring it at market. And while this creates a degree of uncertainty with regard to our interpretations, it does not prevent us from asking, at the very least, what the evidence seems to be telling us. Moreover, unlike trying to determine what the effects of a certain social or material phenomenon might be on future society, when studying the past, even if it seems remote, we at least know what happens next—we know how the story "ends," even if we don't exactly know the reasons why it ends that way. In that sense, we know where, sociopolitically-speaking, a society "started" based on numerous lines of evidence, and we know where a society "ended" as well because of different lines of evidence. The task before us is to query the data in order to find the best fit in terms of a "how," if not a "why," that explains those developments.

One of the questions that plagued me as an undergraduate was the notion of "state formation" and how this transformative process happened. The literature always seemed vague on this point. Authors described a more simple sociopolitical structure, or, broadly-speaking, a society, that went from having this aspect, and this other aspect to a more complex sociopolitical structure that had all of these other aspects. To be sure, these indexical aspects were often related in some way (i.e. simple kin-based society to a complex kin and fictive-kin based society that has transformed into an aristocratic structure, etc.), but the actual processes that got them there always seemed to be missing. Moreover, the mechanisms of this transformation were

not discussed, or a set of ambiguous mechanisms were pointed to, but referred to in generalities without having specific data-sets to support those mechanisms. It seemed to require us to look at the before and after images and say, "yeah, I see how they could have gotten from there to there" and use our imagination to fill in all of the social and political struggles that had occurred in between. In essence, the connections were clear, but the processes were not, and to me, the processes were the thing, and understanding those processes were what social science research was all about. Otherwise, it just seemed to be "history" in the conventional sense of that field.[1] This project is an attempt to understand the process, or at least one aspect of it, of how a society goes from a ranked society based around individual, often kin-based, settlements to an interconnected series of settlements that participates in a region-wide network of economic, social, and political ties.

This project has had numerous starts and stops throughout the years, but in addition to the contributions to the fields of politics and practice, and our understanding of the Neolithic in China, there has always been a desire to contribute to expanding the scope of pottery analysis, especially in Chinese archaeology. I do not deny the power of compositional analysis in the study of pottery, but it can only take you so far; knowing what components, clays, temper, etc, were used to produce a pottery vessel only allows the researcher to get the briefest glimpse into the production of the vessel. So much of the manufacturing process is in how those materials are put together: so much more understanding is to be found in the process, not the starting point or end result. This understanding can only come from studying the techniques of manufacture and, through practice theory, how that information tells us about the people producing the pottery.

Despite these challenges, there were two primary goals: first, to demonstrate the utility of a properly applied communities of practice model and how this model can be used under the umbrella of a theory of political culture; second, to elucidate the origins of the first "state" level society in the Luoyang Basin and a portion of the inner workings of so-called "state formation" in Neolithic China.

1. Which is to say, at most universities, history is lumped in with the "humanities" as a prosaic reading of the past and discussing what happened without necessarily getting into the "why" of those historical events which is generally considered the wheelhouse of the Social Sciences such as anthropology, sociology, and political science; to my mind, that is where the study of history should be.

6.1 Practice and Politics

Practice theory provides a point of entry into why societies do what they do by understanding how they actually do those things, how they engage in those practices. The community of practice model takes the foundations of practice theory a step further by showing how those practices come to determine behavior as we negotiate meaning from the work that we do as humans. And while the impetus in developing the community of practice model was not driven by concerns of political behavior as was the case with practice theory, the model does provide a means to develop the model toward those ends. The model does, in a sense, provide the means for looking at political action through the relational aspect "identification." In this way, we come to understand that political action is about identity; that of ourselves and what we stand for, and how we would like others to act: the same as we do.

The merging of the community of practice model with political culture theory is an attempt to understand the "why" of political action, rooted in Chilton's "ways of relating" (1988) and the relational aspect of identification in the community of practice model. In particular, the last two dimensions of identification, imagination and alignment, bear on the "...relating" part of political culture described by Chilton. These two determine with whom an individual or group interacts with, while practice covers the field of "ways of ..." in Chilton's definition. In other words, imagination and alignment determine the nature of the "relating" and practice determines the "ways" in which those relations occur.

To return to political action and identity, the nature of those relations between individuals or groups depend on the identity of those involved, such that if identities are in alignment, then the relations should be favorable; if the identities are not in alignment, those relations will not be favorable. Those that feel strongly about their identity, or at least certain aspects of it, will be more strongly political, and will seek solidarity with others like them. In contrast, others that feel strongly about aspects of their identity that are not in alignment with that individual will find themselves in opposition; either way, both are strongly political.

As humans, we like to identify ourselves through body art (tattoos, body modification, scarification, etc.), adornments (piercings, bracelets, earrings, etc.), and finally clothing. These have the strongest association with us as persons because they are closest to our physical selves. When we identify ourselves in this

way, we are signaling alignment with certain values and beliefs; these are Wiessner's assertive and emblemic styles, though I would argue that *modes of style* might be more accurate (see Wiessner 1990). Also in Wiessner's terminology, we can consider both of these active forms of style: the individual is intentionally and actively indicating their alignment with a particular set of beliefs and values. The modes differ depending on the receiver, so that for groups that "know" what certain symbols mean, those individuals are *asserting* that identity using those known symbols. However, for those that do not know what certain symbols might mean, what alignment with a particular identity "stands for" within that group, the individual must use *emblems* to indicate alignment, though perhaps the identity being signaled is of a more general order, one that merely says "I want you to know that I am of this group" because the receiver is not of that group.

For most material culture, however, we are looking at passive forms of style: the individual is not actively signaling anything, but for those that know, the alignment is clear based on the symbols used. This is, I argue, where pottery "decoration" comes in, as a passive form of identification that indicates our alignment with a certain set of values and beliefs, no matter how vague or generic that understanding of those values and beliefs may be. Moreover, while not as overt as active forms of style, passive forms of style are much more pervasive and subtle, and indeed many individuals may not really be aware that the unconscious choices they make when producing or purchasing a particular product may be influenced by a subtle desire to align themselves with a particular set of values and beliefs.

The use of style in "signaling" our identity, whether passive or active, forms the most basic and fundamental "way of relating" because they identify us as of a certain group, or at least in alignment with a certain set of values and beliefs. It is impossible to relate to another individual without knowing something about them, who they are and what they "stand for" even in the most general sense. For example, at a cocktail party, someone might be able to identify the alignment of another attendee based on the passive or active signals used, and that provides a basis for future interaction and trying to relate, or not, to the other person. However, when such forms of signaling are not present, we must engage in conversation with that person in order to find out who they are, and thus how we relate to them. When we learn that alignment, we have found the "ways of relating" to the other person; sharing of the mutual values and beliefs ensues, or the

challenging of values and beliefs ensues depending on those alignments. If only one of the individuals has a strong alignment, that is, it is an important and even defining part of their own identity, then the relation may be short-lived as the other individual disengages to talk with someone else that shares their alignment, or at least someone whose identity is not so strongly aligned, and they find "neutral" alignments to talk about.

In this project, I hoped to illustrate how we can understand "style" as part of a passive campaign to identify those producing and/or consuming the pottery, for them to indicate their alignment to a particular economic, and perhaps administrative, power that had arisen in the Luoyang Basin. The majority of those consuming the pottery that was part of this shared repertoire, this increasingly coherent set of design features, probably did not have much of a strong feeling for that rising power at Erlitou. However, they were certainly aware that there were advantages to being part of something, an imagined group of other individuals that extended far beyond the boundaries of their own settlement; and there is power in that.

6.2 Political Culture and Practice

One aim of this project is to come to a better understanding of what the "State" is. Perhaps a better way of stating the problem is trying to suggest what the state is not. Following Abrams (1988), I suggest that the state is not a concrete object as it has generally been treated in the literature. Instead, the "State" is a mask for the political process of domination; "that the state was a practice not an apparatus" (Abrams 1988:64). Therefore, when we seek to study the state we must look to the governmental or administrative institutions through which these practices are carried out.

> In other words the state emerges from these studies as an *ideological* thing. It can be understood as the device in terms of which subjection is legitimated; and as an ideological thing it can actually be shown to work like that. ...It gives an account of political institutions in terms of cohesion, purpose, common interest and morality without necessarily telling us about the actual nature, meaning or functions of political institutions. We are in the world of myth. (Abrams 1988:68; emphasis in original)

It is in this sense that we can see "state formation" not as a process (i.e. not evolutionary), but as a project, "the organized project of those with the social power to define, as is entailed in explaining enduring

patterns of subordination by the 'false consciousness' of the subordinated" (Corrigan et al. 1985:9). It is also with this in mind that we must distinguish the "state-idea" from the "state-system" (Abrams 1988:82) in which the "state-idea" can be seen with the creation of the earliest ideologies, while the "state-system" (or form) is described through the particular social and political institutions through which domination is carried out. In other words, it is generally the state-system we are looking at in the material record; the state-idea can only present itself through a sophisticated analysis of this record.

Moreover, I think it is instructive to suggest that the use of the term "civilization" is also bound up with the state-idea vs. state-system distinction. What we generally think of as civilization is often equated with the "State" (i.e. the state-system), but what it actually represents is the state-idea. Therefore, the "high culture" complex Baines and Yoffee associate with civilization is the playing field for this ever-changing state-idea (see also Richards and van Buren 2000:9-10). Civilization is part of the project of the creation and maintenance of order in which peoples that are "civilized" act according to sets of rules which should guide their conduct properly in relation to the state-system. Not surprisingly, then, those without civilization or outside the "civilized world" (i.e. "barbarians") are also those that defy the state-system and its attempts to control and harness daily lives by rejecting the state-idea. That civilization is real cannot be denied, as it is made manifest through thousands of years of material (high) culture. However, as with the "State" it must also be understood in terms of its relationship to those to whom the civilization belongs.

6.2.1 Understanding Choice and Practice

As discussed in Chapter 3, I argue that indices of political culture can be most closely ascribed to the Imaginal style of material culture. While a comprehensive analysis of pottery making in the Luoyang Basin was limited due to data availability, we can make some inferences concerning changes in political culture.

It is obvious that there were changes in the Imaginal styles of different pottery forms from the early to late Longshan period; this is born out by simple frequency seriation diagrams. What I hoped to show with this analysis is "how" the Imaginal styles changed, and by comparison to the vessels Functional and Technical styles, suggest a "why" the Imaginal styles changed. My working thesis was that by showing,

first, the stability of manufacturing methods for pottery assemblages from early to late Longshan and into the Erlitou period—its *Technical* style—and through this lay to rest the notion that any changes in the pottery assemblages were the result of "outsiders" bringing new forms of pottery into the Luoyang Basin (and broadly speaking, the Song Mountain Region). This analysis of Technical styles would prove most interesting for the early Neolithic with the obvious changes in pottery assemblages from the early to late Yangshao period and into the early Longshan period. This thesis is based on the premise that formation techniques within a single society are the most stable and least affected by other changes in the society, especially sociopolitical changes (e.g. Gosselain 2000), and as a result can help us determine if such changes, such as massive immigration or conquest, occurred within the society.[2]

Turning to the Functional styles, it is here that we see societal changes being reflected. As discussed in Chapters 4 and 5, the Functional style also has imaginal elements in the sense that there are aesthetic choices made for what any jar, bowl, pot looks like, what *specific* form it takes. For this assemblage, both round-bodied *guan* and *zun* are classed as jars, but each type has aesthetic (i.e. imaginal) features that distinguish one from the other. Because of this, Functional styles occupy a middle ground between Technical and Imaginal styles in the sense that while the vessel forms are generally stable (e.g. *guan* jars and *pen* basins are found throughout the Yangshao, Longshan, and Erlitou periods), new vessel forms may also make an appearance, such as *weng* urns or *dou* stands. The addition of these new vessel forms indicates that sociopolitical factors do play a more significant role in Functional styles. Such vessel forms as *dou* stands, *pan* plates, or *ding* tripods (though not included in this study) appear to reflect changes in feasting and veneration practices and, I would argue, speak to influence from religious or political elites on how such rituals are to be practiced, and as a result, this influence manifests as a need for new vessel forms. Nevertheless, these new forms are added to the repertoire of vessel forms already prevalent in the society because the "old" forms still play a significant role in the everyday lives of Longshan society. Indeed, we could even suggest that through the addition of these new "ritual" vessel forms, we see early examples of what will become "high culture" with an expansion of vessel forms used for very specific roles that may not

2. For more on this, see Chapter 4, §4.3.2 on page 104

play a role in the everyday lives of members of these settlements, but the new forms build on the material and cultural practices at the core of the society.

Lastly, it is in the area of Imaginal style that we see the most change, and as was argued above, this is because Imaginal style is most strongly affected by sociopolitical factors within a society. Broadly speaking, changes in Imaginal style may reflect preferential choices of certain stylistic attributes over others as we find in basic fashion trends today. But even in contemporary society, such trends are strongly influenced by social and political factors: designs by certain artists, designs that mark the wearer as of a certain identity group, alignment with particular organizations (such as sports teams), and so on. Prehistory is no different, and to an extent, this assertion is nothing new. However, in this research I sought to determine *how* these social and political factors led to changes in Imaginal style, and the communities of practice model does this very well. The model links how artisans producing goods, especially everyday goods like pots, can make changes to Imaginal styles through Identification, imagination, and alignment. In short, when a member of a community of practice imagines themselves as part of a larger network, be that along ethnic, religious, or kinship (fictive or otherwise) lines, their identification with this network may be encoded into the artisans wares through design elements (my "decorations" in particular). In aggregate, if this is a nascent sense of shared ethnicity then small design choices that indicate alignment with this network will, over time, coalesce around a shared repertoire of shared symbols, and from the perspective of practice, shared techniques to achieve these design choices, and an accepted sense of the correct way pots should look comes into the collective conscious or unconscious comes into being.

6.2.2 Emergent Political Culture

I haven't stressed this much previously, but when looking at the stretches of time this research covers, over a thousand years, the importance of small choices made that result in an accepted aesthetic for manufactured goods, especially something as mundane as pottery, is crucial. In the Longshan period, what eventually becomes Erlitou "culture" is being created, and as I argue from a "state formation" standpoint, there are no state agents directly influencing these aesthetic choices. But in the course of the growing social and

economic power by political entrepreneurs at the Erlitou settlement, the foundation of this emergent cross-basin, and eventually regional (i.e. the Song Mountain Region), culture with its unique set of aesthetic characteristics provides the tools for those political actors to begin to influence these choices by selecting certain design features they prefer. For anyone wishing to align themselves with these social and economic leaders, the choices they make in their practices and designs will invariably begin to align with those from the Erlitou settlement. And to be clear, I do not mean to suggest that, at least in the Late Longshan period, these "pre-political" actors were influencing design choices on purpose; they have not gathered together in secret to intentionally manipulate the populace of the Luoyang Basin like some league of super villains. Instead, by the very fact that they too, like everyone else, have aesthetic preferences and they consume in accordance with those preferences, those consumption patterns (i.e. which pottery or aesthetic set they prefer) indirectly influence the consumption patterns of others. The difference is in the growing asymmetry of influence those actors have within the society because of the "important" status they hold as social, religious, or economic leaders of the society.

Understanding this slow process of development for emergent Erlitou culture and the early complex polity we label the Erlitou period (or if you prefer, the "Xia Dynasty")[3] enables us to characterize "state formation" as the creation of a political culture within the society because the very act of consuming goods that tacitly align the consumer with an imagined collective is one of the "ways of relating" that Chilton (1988) uses in his definition of political culture as discussed in Chapter 3. Which is to say, one way that we "relate" to other members of the society is to assert our social, political, and economic dispositions. Whether such assertion is done "actively" or "passively" (i.e. Wiessner 1983) depends on the cultural object being discussed; viz. a personal garment or adornment (seen in public) may assert a political alignment or social/religious identity quite actively, while the designs on pottery (seen in private) may likewise assert the same identity or alignment, but in a passive way.

3. See §2.4.2 on page 34 in Chapter 2 for a brief discussion of this issue.

Complexity in the Luoyang Basin

In addition to contributing to our understanding of practice and its role in political culture, this project also intended to show not "what happened" in the Luoyang Basin and the rise of the first, lasting, complex polity in the Huanghuai Plain, but to provide a "how" of this accomplishment by Erlitou leaders and the role that everyday citizens had in the process. In other words, the process of "state formation" is not simply a matter of an elite taking advantage of a populace by duping them, nor necessarily through strength of arms. Instead, through their everyday lives, a people contributed to their own subjugation. How long they stay subjugated, of course, is a different matter.[4]

It seems clear that in the Huanghuai Plain, as discussed in Chapter 2, there was an earlier complex polity in the Linfen Basin prior to the rise of the Erlitou settlement in the Luoyang Basin. The Taosi polity grew over the course of a few hundred years into a sizable settlement, reaching the size of the Erlitou settlement itself, but the polity eventually collapsed and never extended outside the Linfen Basin. As Liu (1996b, 2004, 2006) has argued, while being circumscribed may have pushed the elite at Taosi to work toward more complex social and political structures, the settlement was ultimately too constrained with limited access to trade and exchange outside the Linfen Basin. What was an initial impetus toward complexity, also led to the decline of the Taosi polity in the end as the leaders and citizens were unable to gain access to trading partners further afield. The basin's relative isolation on the middle Yellow River valley meant that there was one point of entry to the basin: along the often turbulent Yellow River itself.

However, the settlement at Erlitou did not suffer from this problem. The Luoyang Basin is what Liu (1996b, 2004, 2006) has called "semi-circumscribed" in that the basin itself does have limited access points, but there are more than one. So while the partially circumscribed nature of the basin may have pushed the elite toward social and political complexity, the basin also afforded opportunities to access trading partners outside the basin as well. The polity was not socially and economically strangled as it extended its reach

4. This gets to the heart of why the "Mandate of Heaven" is such an interesting political device because such devices, which bear the rules for defining legitimate rulership, do not normally include a means for losing that rulership as well. The nature of the "Mandate of Heaven" approaches rulership from the perspective of those governed as reflected by "Heaven" so that the ruler is legitimate until he or she no longer has the Mandate, at which point the right of rulership is passed to another.

beyond its original boundaries. One of the arguments in this project, though, is to suggest that the rise of the Erlitou polity is not solely an economic process. As settlements in the basin formed increasingly interconnected relationships, the elite at Erlitou saw an opportunity to expand their reach and encouraged trade with additional communities, first within the basin, and as Erlitou's status grew, outside the basin as well. The successes of these relationships and the "foreign" goods it brought to the basin increased the prestige of the Erlitou settlement.

In terms of the seemingly mundane world of domestic goods, the aesthetic style of pottery became a factor for the common citizen of the Erlitou network in which styles favored by those at the "center" were selected over other styles as a means to signal to others that they were part of this network, that they in some sense "supported" the leaders of that settlement "so far away." From a social, and perhaps economic, standpoint there were presumably benefits to being part of the Erlitou network, but for those on the fringes, it may have simply been a matter of feeling part of something bigger than themselves and their families, something outside the community they grew up in. By "fringes," I simply mean those that are spatially distant from the Erlitou settlement itself, but also those that are socially or economically on the outside, either because the goods that they produce are not as desired and do not participate as actively in network trade, or that they and their families do not produce goods *per se*, and could be socially marginalized within their own community. However, whether you make pottery or not, everyone uses pottery, from the marginalized to the active participant in the network. Pottery, then, becomes a material "way of relating" for all members of the network; indeed, the emblemic properties of pottery become a way of identifying one as a member of the network, as one that supports the leadership of those at the Erlitou settlement. Undoubtedly there were those that either did not support those far-away leaders, or did not want to follow the stylistic trends, and for those individuals there were other stylistic features for them to consume as well. They could, in a sense, demonstrate their resistance to the influence of the elite at Erlitou by using pottery that does not bear the "approved" styles. This, too, allows pottery to act as a "way of relating" in that it sends the opposite message: "I am not…" (or do not want to be) "…part of that group." Finally, we may ask: is this emergent

sense of solidarity not a prerequisite for “the state” or is the emergence of the state really just the emergence of increasing levels of such asymmetrical relationships of power and authority (e.g. Abrams 1988)?

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Appendices

APPENDIX A

HUIZUI POTTERY TECHNIQUE DATABASE

This appendix describes the construction and organization of the pottery technique database. My intention was to create a database designe that could be "ported" to or used for pottery assemblages at other sites in China, and perhaps even for other types of artifacts. This accounts for its rather open structure and the somewhat "generic" terminology used.

In designing the database, I wanted to come up with a structure that would be flexible in that new tables could be added in the future for new types of data. For example, if compositional data be collected in the future, the resultant table (e.g. of elemental percentages from neutron activation analysis) can easily be incorporated into the database by linking it to the master table. Likewise, if a new "feature" or "characteristic" need to be incorporated, a new table can be created and populated with columns to record the additional information. Lastly, I wanted the design of the basic database and table structure to allow expansion and include other object types: stone, bone, and horn tools, bronze vessels or tools, jade or turquoise objects, etc. Only time will tell if I have been successful in this regard.

One of the primary uses for the Huizui Pottery Technique Database (HPTDb) was to enable an investigation of potting practices at the Huizui site. Envisioned as the first step in a basin-wide project to study pottery-making techniques, this pottery from Huizui will be the test case for future research.

Organization of the Database

The database was constructed using Microsoft® Access 2003,[1] and is made up of 7 primary tables and 9 secondary tables (Table A.1 on the following page). The database was designed to be expandable and modular, able to handle almost any kind of pottery object including individual pottery sherds, "multi-part" sherds (see note 4 on page 111), partially reconstructed vessels, and whole vessels (reconstructed or otherwise).[2]

1. However, I have begun the process of porting the database tables into PostgreSQL, and the data is being used in the creation of the ReArch database as part of the MAE Project which is discussed in Appendix B (§B.2.1 on page 245).

2. A complete breakdown of the database tables and possible values can be found in Appendix A.

Table Name	Table Description
0_master_pottery	Primary table that has basic descriptors for each sherd; all other tables reference this table.
1_base_pottery	Portions table for describing the base present on the vessel/sherd.
2_torso_pottery	Portions table for describing the torso (i.e. body) present on the vessel/sherd.
3_rim_pottery	Portions table for describing the rim present on the vessel/sherd.
4_colors_pottery	Characteristics table for describing up to two colors on the exterior and interior of the sherd; also for description of up to five cores within the sherd.
5_inclusions_pottery	Characteristics table for describing up to four inclusion types in the sherd.
6_decorations_pottery	Characteristics table for describing up to five decoration types on the sherd.

(a) Primary Tables

Table Name	Table Description
7_foot_pottery	Portions-minor table for describing a foot or any feet present on the vessel/sherd.
8_shoulder_pottery	Portions-minor table for describing any shoulder present on the vessel/sherd.
9_neck_pottery	Portions-minor table for describing any neck present on the vessel/sherd.
10_handles_pottery	Features table for describing any handles present on the vessel/sherd.
11_spouts_pottery	Features table for describing any spouts present on the vessel/sherd.
12_perforations_pottery	Features table for describing any perforations found on the vessel/sherd.
13_photo_pottery	Concordance table of sherd numbers and photo numbers.
14_draw_pottery	Concordance table of sherd numbers and drawing numbers
15_mae_pottery	Concordance table of sherd numbers and MAE numbers.

(b) Secondary Tables

Table A.1: Tables of the Huizui Technique database

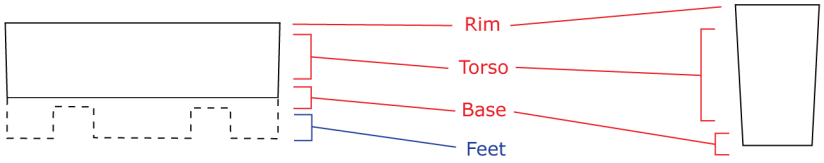
Primary Tables These are the seven primary tables in the database. These tables are considered "primary" because each pottery object will have at least one entry in each of the three table categories (the Master table being its own category): all objects have a record on the master table; at least one entry on the portions tables, though more entries are possible; and at least one entry on the characteristics tables (color), though more entries are possible (Table A.1a on the previous page).

Master Table The "master" table is used to record basic "demographic" information about the pottery object. The table has four sections of information: Recording Information; Periodization, Condition, Thickness; Form Information; and Vessel Information. Combined, these four sections include the object's period, site phase, excavation unit, feature, level (if any), original number (given by the excavating institution), etc. as well as the object IDs given by the project. This table also includes the series of form descriptors: form_class, form_type, form_variety. Finally, the series of vessel descriptors: vessel_label, vessel_aspect, vessel_grade, vessel_ware, vessel_fracture, and vessel_hardness (see Appendix A on page 219).

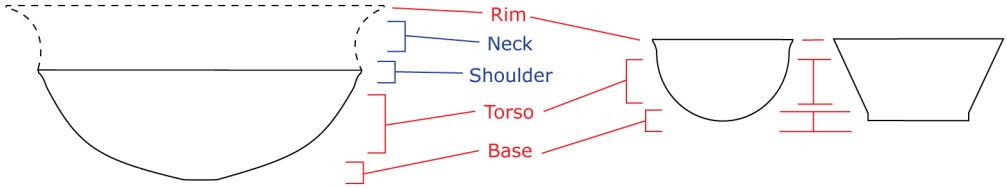
Portions Tables After the master pottery table, the three "portions" tables form the heart of the database. Rather than label each pottery object (sherd) as a "rim," "body," or "base" in a single row[3] in a single table, each object has an entry on at least one of the three "portions" tables: base, torso, and rim (Figure A.1 on the next page). Such a breakdown was deemed necessary because of the likelihood that partially reconstructed or whole vessels would be added to the database in the future. For example, if an object only "has" a rim (normally a "rim sherd"), it would be entered into the "3_rim_pottery" table; however, if that object was a larger (or multi-part) sherd and had both a rim and part of the body (or torso), it would be entered into both the "3_rim_pottery" and "2_torso_pottery" tables. Whole vessels would be entered into all three of the portions tables (Table A.1 on the preceding page).

Characteristics Tables The three "characteristics" tables are used to record the presence of and describe any colors, inclusions (temper), or decorations in or on the pottery object. The first is a bit of a ruse,

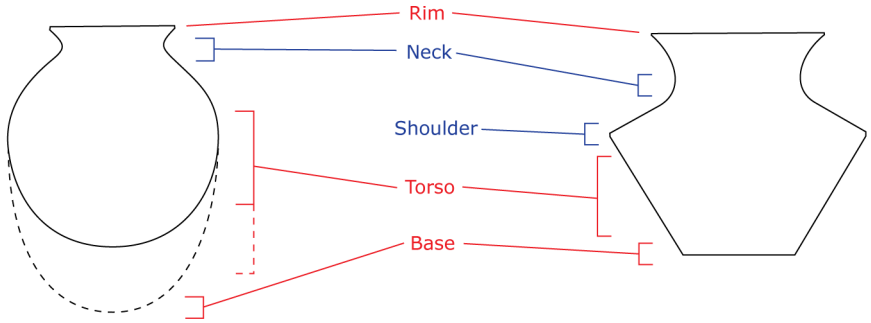
3. This is often the case for databases that record only pottery sherds.



(a) Consistent Vessels



(b) Everted Vessels



(c) Inverted Vessels

Figure A.1: Vessel portions, by form-class
("portions" in red and "portions-minor" in blue)

however, since all pottery objects have at least one color no matter what other characteristics they may have. As for the inclusions and decorations present, the database is set up to allow up to four different types of inclusions to be recorded, and up to five different types of decorations to be recorded.

With regard to colors, not only are the exterior and interior colors recorded, the colors table also has space to record up to four core colors. In many cases, a sherd has a single core (location indicated in the database as "center-1"), but there are many sherds which demonstrate a more complex firing process; as a result, a system for recording these cores was used (Figure A.2). After nearly thirty sherds were recorded, it was recognized that when "three" cores were present, the second and third cores were often the same color with one being exterior-facing and the other interior-facing. This lead to the system indicated in the figure where if the core was the same color on both sides of the central core, its location was listed as "ext/int-2" in the database, a "symmetrical" two-core sherd. However, in some cases, the first core was not in the center of the sherd wall, so starting from exterior to interior, the first core was located as "ext-1" and the second core was located as "int-2" (what I describe as an "asymmetrical" two-core sherd).

Secondary Tables These are the nine secondary tables used in the database. These tables are considered "secondary" because unlike the primary tables, each pottery object may or may not have a record in any of these table categories (Table A.1b on page 220).

Portions-Minor Tables In a manner similar to the portions tables, the three portions-minor tables are used to record the presence of smaller and less-frequent portions of pottery objects: neck, shoulder, and foot (Figure A.1 on the preceding page). The neck is defined as the point in the contour of a sherd/vessel where the line of the torso changes as it heads toward the rim; if the contour changes between the torso and rim, then there is a neck portion. Likewise, the shoulder is defined as the point in the contour of a sherd/vessel where the line of the torso changes; if the contour of the torso "breaks" in a different direction, then there

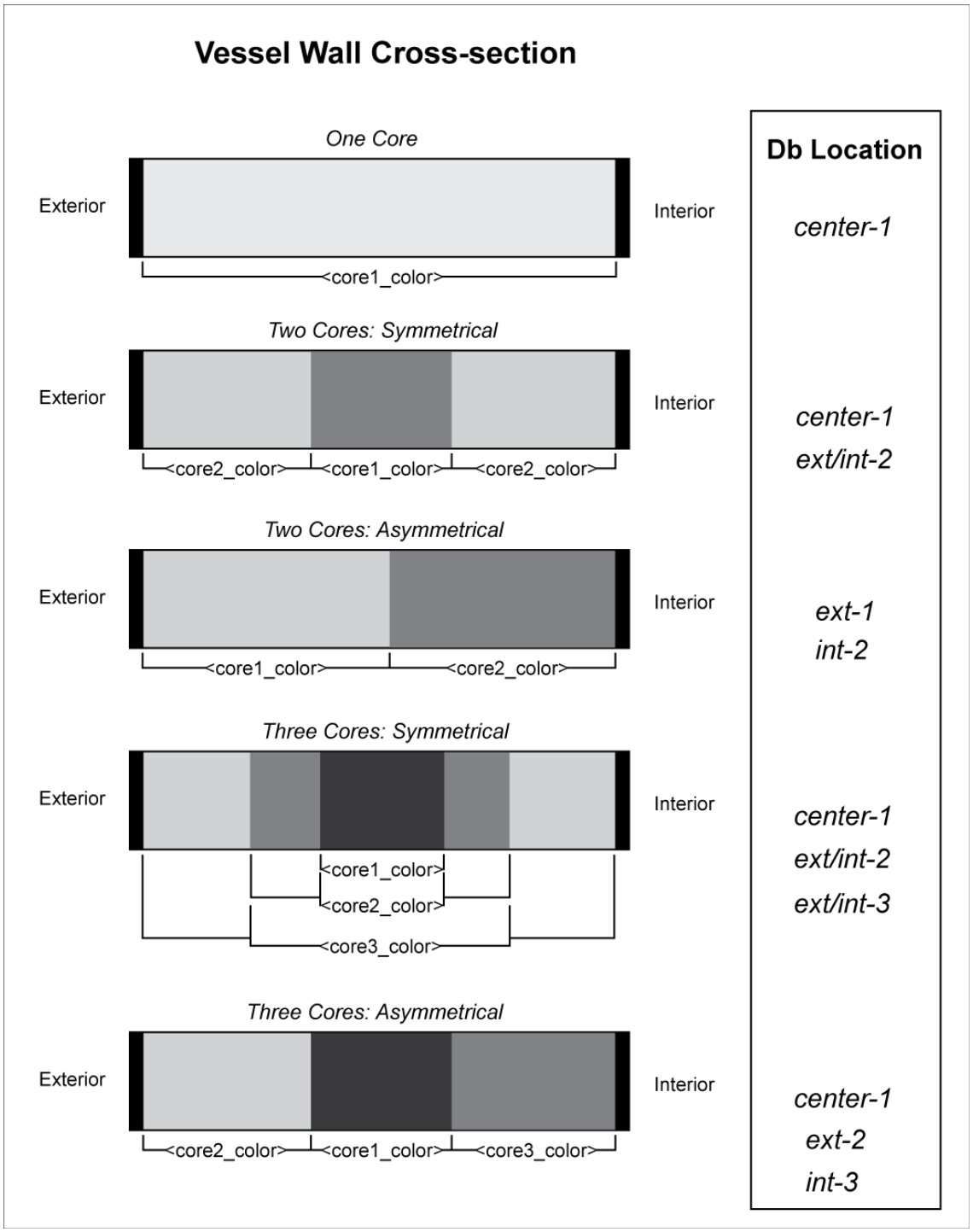


Figure A.2: System for recording sherd cores
(and how their locations are indicated in the database)

is a shoulder portion. Finally, a foot (or multiple feet) is defined as any structure permanently affixed to the vessel that would raise the base off of the surface it was sitting on.[4]

Features Tables The three "features" tables are used to record the presence of and describe any handles, spouts, or perforations found on the pottery object. While recording such features is most likely only necessary when describing reconstructed or whole vessels, because of the possibility that at least some remnants of any of these features is evident on a sherd, the database includes these three tables; indeed a small number of spouts and handles have been recorded for the collection.

Concordance Tables Finally, the three "concordance" tables are used to tie each pottery object to any photographs taken of the object, any drawings made of the object, and any MAE numbers if they were assigned as part of the MAE Project (see Appendix A, §B.2.1 on page 245).

Assessing the HPTDb

For the initial "demographic" analysis of the collection that appears in §5.1.1 on page 112, some vessel forms were combined, where appropriate, to create fewer categories. For example, a "basin-forms" aggregated category called "*pen* basins" was used that combined *pen* basins with *zeng* steamers.[5] Similar logics were applied to vessel forms such as "*guan*-shaped *ding*" or "*pen*-shaped *ding*" which had their vessel form changed to *guan* jar and *pen* basin, respectively.[6] Below, I briefly describe a few other important adjustments to the data that were more complex and time-consuming in nature.

4. In a somewhat awkward example of this principle, as is the case with many of the terms used in this database the human body is used as a metaphor for labeling parts/portions of pottery vessels. So, when a person is sitting, they are sitting on their base (i.e. buttocks); and when a person stands, raising their base off of the surface it was sitting on, they are standing on their feet (standing on a single foot is possible, of course, but not the norm).

5. The *zeng* steamer is essentially a *pen* basin with holes punched through the base of the vessel for steaming (see Figure).

6. In each of these cases, the *ding* is first formed as either a small round *guan* jar or a small *pen* basin to which three or four slab legs are attached to create the final *ding* vessel form.

Inclusions The fairly complex series of variables used to record inclusions in the database was reduced to a string of letters of one to four letters separated by a dash; for example, a vessel with sand, stone grit, and limestone was abbreviated as "s-g-l" in a new <paste_recipe> variable, while a vessel with only sand was abbreviated as "s" in the new variable. Initially, in an attempt to be very specific with regard to frequency or "percent of volume" for each of the paste recipes, a reduced though still fairly complex system was used which listed the recipe constituents in order from highest to lowest frequency using a binomial designation for each type of inclusion listed in the database (see Table). However, it was subsequently determined that this amounted to "misplaced concreteness" by attempting to be very specific in what were essentially estimated percent of volume values on the one hand, and unnecessarily segmenting of paste recipes by insisting on an ordinal progression on the other which made recipes such as "sand, grit, limestone" (by percent of volume) or "s-g-l" different than recipes of "limestone, sand, grit" (by percent of volume), or "l-s-g" in the database. To remove these essentially subjective divisions, all recipes were abbreviated using the same codes depending on what their constituents were. As a result, in the previous example, both vessels would have an "s-g-l" recipe since they both have the same constituents regardless of perceived volumes.[7]

Decorations In a similar vein, the multiple variables used to record decoration attributes in the database were rendered into a standardized code, one that was originally developed for transcribing decorations from site reports into the <all_sites> database (see below). In the HPTDb, each decoration had its own "section" in the <6_decorations_pottery> table which allowed for up to five decorations per vessel; in most cases, though, three appeared to be the maximum number of decorations identified.[8] Each decoration had a number, a motiff, a frequency, a placement, etc. and these variables were "translated" into a unified decoration code (Table A.2 on page 228). This unified code summarizes the decorative variability fairly well; however,

7. In addition, the "gravel" inclusion type was removed and subsumed within the stone grit type, thereby also removing the need for two "G" types such that gravel (GV) and stone grit (RT) were combined into the stone grit (g) type.

8. Note that "decorations" are imaginal aspects that are in addition to the surface treatment which was its own variable in the database. All vessels had both a color and a surface treatment, even if that treatment was "plain" which might seem to be the absence of a surface treatment, but was considered a treatment or aesthetic choice all its own. However, not all vessels had decorations, and hence the distinction between these two attributes.

statistically having more than one decoration code makes frequency tables and chi-square tests challenging because the shear number of tests required looking for relationships doubles or triples (though, few vessels had more than two decorations, and most only one if they had any).

The following sections provide a complete breakdown of the tables and possible values used in the Huizui Pottery Technique Database.

A.0 0_master_pottery

The <0_master_pottery> table is the keystone of the database, used to record the basic "demographic" information on the pottery object. This table also includes the "key" value which is used to create relationships with each of the other tables in the database.

Number		Decoration					Frequency		Location		Decoration Code
num.	mkr	depth	–	type	–	form	mkr	freq.	mkr	loc.	
2	#	incised	-	line	-	band	%	1	@	neck	2#incised-line-band%1@neck
2	#	raised	-	line	-	thick	%	2	@	neck	2#raised-line-thick%2@neck
1	#	incised	-	line	-	thin	%	2	@	torso	1#incised-line-thin%2@torso
2	#	raised	-	line	-	thin	%	2	@	torso	2#raised-line-thin%2@torso
1	#			cord	-	applique	%	2	@	shoulder	1#cord-applique%2@shoulder
1	#	incised	-	line	-	fingernail	%	1	@	rim	1#incised-line-fingernail%1@rim

Table A.2: Decoration Codes

A.0.1 Recording Information

Variable	Description	Possible Values
site	Site name acronym consisting of four capital letters.[9]	SHCH HUZU
context	Excavation unit object was excavated from.	
location	Feature or level within unit that object was excavated from.	
object_id	Primary key for this table (used to relate to all other tables in the database).	
institution	Excavating institution acronym.[10]	HPICRA IA, CASS
institution_id	Identification string for the object given by the excavating institution.	
id_longform	The complete ("longform") id string for the object.	
id_shortform	The abbreviated ("shortform") id string for the object.	
coder_id	Identification of individual that coded the object into the database.	Hartley
code_date	Date the object was coded into the database.	

Table A.3: Recording Information Variables

9. SHCH: Shaochai; HUZU: Huizui

10. HPICRA: Henan Provincial Institute of Cultural Relics and Archaeology; IA, CASS: Institute of Archaeology, Chinese Academy of Social Sciences

A.0.2 Period, Condition, Thickness

Variable	Description	Possible Values
period	Period assigned to the object.	Early Yangshao, Late Yangshao, Early Longshan, Late Longshan, Erlitou
phase	Phase (if any) assigned to object.	
subphase	Subphase (if any) assigned to object.	
condition	Type of object.	sherd, single; sherd, multi-part; vessel, partial; vessel, restored; vessel, whole
thickness_min	Minimum object thickness.	measurement
thickness_max	Maximum object thickness.	measurement

Table A.4: Periodization, Condition, Thickness Variables

A.0.3 Form Information

Variable	Description	Possible Values
form_class	Descriptor of the vessel's rim/opening axis.	constricted, dilated, consistent, undetermined
form_type	Descriptor of the vessel's body/torso shape characteristics.	shallow cone-bodied, shallow round-bodied, shallow cylinder-bodied, deep cone-bodied, deep round-bodied, deep cylinder-bodied, undetermined
form_variety	Descriptor of the vessel's base and foot characteristics.	flat-bottomed, round-bottomed, footed, pedastaled, undetermined, other (see notes)

Table A.5: Form and Vessel Variables

A.0.4 Vessel Information

Variable	Description	Possible Values
vessel_label	English vessel label.	jar, vat, basin, basin, steamer, jar, cauldron, cauldron, stand, plate, vat, urn, bowl
vessel_label_cn	Chinese vessel label.	*guan*, *pen*, *yu*, *zheng*, *zun*, *ding*, *li*, *dou*, *pan*, *gang*, *weng*, *wan*
vessel_aspect	Secondary vessel label.	round-bodied, deep-bodied, large-mouthed, small-mouthed, three-footed, ring-footed
vessel_grade	Durability or functional category of vessel.	ornamental, light-duty, heavy-duty, industrial
vessel_ware_temper	Paste and temper characteristics of vessel.	coarse-low_tempered, coarse-high_tempered, fine-untempered, fine-low_tempered
vessel_fracture	Friability of vessel wall.	brittle, very brittle, resistant, very resistant
vessel_hardness	Hardness of vessel wall.	hard, very hard, soft, very soft

Table A.6: Vessel Information

A.1 1_base_pottery

The <1_base_pottery> table is used to record characteristics of the vessel's base, or of a base sherd, and then connect to the master pottery table (Table A.7).

Variable	Description	Possible Values
pottery_base_id	Used to connect to the <0_master_pottery> table.	sequential number
shortform_id	Abbreviated ("shortform") id string for the object.	
base_plan	Shape of the base.	circle, ovoid, triangular, square, rhomboid, quadrangular, pentangular, other (see notes)
base_axis	Shape along the vertical axis of the vessel.	perpendicular, cylindrical, spherical, conical, conical-inverted, conical-near_perpendicular, conical-near_cylindrical, cone_2_cylinder, inverse_cone_2_cylinder, conical-tip_2_tip, conical-base_2_base, other (see notes)
base_profile	Vertical shape of the base.	straight, concave, convex, other (see notes)
base_treatment	Surface treatment of the base.	smoothed, stippled, punctated, stamped, impressed, marked, scored, burnished-low, burnished-high, self-slipped, slipped-monochrome, slipped-polychrome, painted-monochrome, painted-polychrome, glazed
base_diameter	Number value determined from vessel size curve tool.	numerical value
base_tech_initial	Technique used to initiate vessel formation.	hand-lump, hand-coil, hand-slab, tool-tournette, tool-wheel, other (see notes)
base_tech_formation	Technique used to form the vessel base.	hand-blended, tool-mold, tool-paddle/anvil, tool-tournette, tool-wheel, other (see notes)
base_tech_finished	Technique for finishing the base.	hand-fingertips, hand-fingernails, tool-mat/fabric, tool-stamp/roulette, tool-pick/comb, tool-punch/incisor, tool-string/cord, tool-scraper/shaper, tool-stone, other (see notes)
notes	Column for recording detailed notes about the sherd.	

Table A.7: Base Characteristics

A.2 2_torso_pottery

The <2_torso_pottery> table is used to record characteristics of the vessel's trunk, or of a trunk sherd (Table A.8).

Variable	Description	Possible Values
pottery_torso_id	Used to connect to the <0_master_pottery> table.	sequential number
shortform_id	Abbreviated ("shortform") id string for the object.	
torso_plan	Shape of the torso.	circle, ovoid, triangular, square, rhomboid, quadrangular, pentangular, other (see notes)
torso_axis	Shape along the vertical axis of the vessel.	perpendicular, cylindrical, spherical, conical, conical-inverted, conical-near_perpendicular, conical-near_cylindrical, cone_2_cylinder, inverse_cone_2_cylinder, conical-tip_2_tip, conical-base_2_base, other (see notes)
torso_treatment	Surface treatment of the torso.	smoothed, stippled, punctated, stamped, impressed, marked, scored, burnished-low, burnished-high, self-slipped, slipped-monochrome, slipped-polychrome, painted-monochrome, painted-polychrome, glazed
torso_tech_initial	Technique used to initiate vessel formation.	hand-lump, hand-coil, hand-slab, tool-tournette, tool-wheel, other (see notes)
torso_tech_formation	Technique used to form the vessel torso.	hand-blended, tool-mold, tool-paddle/anvil, tool-tournette, tool-wheel, other (see notes)
torso_tech_finished	Technique for finishing the torso.	hand-fingertips, hand-fingernails, tool-mat/fabric, tool-stamp/roulette, tool-pick/comb, tool-punch/incisor, tool-string/cord, tool-scraper/shaper, tool-stone, other (see notes)
notes	Column for recording detailed notes about the sherd.	

Table A.8: Torso Characteristics

A.3 3_rim_pottery

The <3_rim_pottery> table is used to record characteristics of the vessel's rim, or of a rim sherd (Table A.9).

Variable	Description	Possible Values
pottery_rim_id	Used to connect to the <0_master_pottery> table.	sequential number
shortform_id	Abbreviated ("shortform") id string for the object.	
rim_type	Directionality of the rim.	applied, bent, continuous, flared, folded, 2-part, other (see notes)
rim_plan	Shape of the rim.	circle, ovoid, triangular, square, rhomboid, quadrangular, pentangular, other (see notes)
rim_axis	Shape along the vertical axis of the vessel.	perpendicular, cylindrical, spherical, conical, conical-inverted, conical-near_perpendicular, conical-near_cylindrical, cone_2_cylinder, inverse_cone_2_cylinder, conical-tip_2_tip, conical-base_2_base, other (see notes)
rim_form	Treatment of the rim.	figurative, flat/smooth, morphic, pulled/scalloped, scored/indented, twisted/braided, other (see notes)
rim_section	Shape of the rim.	crescent-shaped, gibbous-shaped, L-shaped, ovoid, ovoid-beveled, ovoid-flanged, pointed, rhomboid, rhomboid-beveled, rhomboid-flanged, triangular, other (see notes)
rim_treatment	Surface treatment of the rim.	smoothed, stippled, punctated, stamped, impressed, marked, scored, burnished-low, burnished-high, self-slipped, slipped-monochrome, slipped-polychrome, painted-monochrome, painted-polychrome, glazed
rim_diameter	Number value determined from vessel size curve tool.	numerical value
rim_tech_initial	Technique used to initiate vessel formation.	hand-lump, hand-coil, hand-slab, tool-tournette, tool-wheel, other (see notes)
rim_tech_formation	Technique used to form the vessel rim.	hand-blended, tool-mold, tool-paddle/anvil, tool-tournette, tool-wheel, other (see notes)
rim_tech_finished	Technique for finishing the rim.	hand-fingertips, hand-fingernails, tool-mat/fabric, tool-stamp/roulette, tool-pick/comb, tool-punch/incisor, tool-string/cord, tool-scraper/shaper, tool-stone, other (see notes)
notes	Column for recording detailed notes about the sherd.	

Table A.9: Rim Characteristics

A.4 4_handles_pottery

The <4_handles_pottery> table is used to record characteristics of any handles the vessel has, or evidence of handles on a sherd (Table A.10).

Variable	Description	Possible Values
pottery_handles_id	Used to connect to the <0_master_pottery> table.	sequential number
shortform_id	Abbreviated ("shortform") id string for the object.	
handle1_number	If more than one handle, this is for the first handle.	handle number
handle1_type	Basic shape of the handle.	ear-handle, flange-handle, grip-handle, lug-handle, pinch-handle, other (see notes)
handle1_plan	Distribution of handles.	singular (single-handled), linear (2-handled), trilinear (3-handled), quadrilinear (4-handled), pentilinear (5-handled), hexilinear (6-handled), polilinear (7- or more handled), other (see notes)
handle1_axis	Directionality of the handle.	horizontal, vertical, other (see notes)
handle1_profile	Curve of the handle.	bowed, elbow, straight, rhomboid, other (see notes)
handle1_form	Texture on the handle.	scored/indented, flat/smooth, ridge/ribbed, pulled/scalloped, twisted/braided, morphic, figurative, other (see notes)
handle1_section	Cross-section of handle.	square, half-square, circle, half-circle, oval, half-oval, trapezoid, rhombus, triangle, kidney, v-shaped, braided, other (see notes)
handle1_placement	Location of the handle on the vessel.	foot, base-foot, base, base-trunk, trunk, trunk-shoulder, trunk-neck, shoulder, neck-shoulder, neck, rim-neck, rim-shoulder, rim-trunk, rim, unknown, other (see notes)
handle1_treatment_1	Primary surface treatment of the handle.	smoothed, stippled, punctated, stamped, impressed, marked, scored, burnished-low, burnished-high, self-slipped, slipped-monochrome, slipped-polychrome, painted-monochrome, painted-polychrome, glazed
handle1_treatment_2	Secondary surface treatment of the handle.	smoothed, stippled, punctated, stamped, impressed, marked, scored, burnished-low, burnished-high, self-slipped, slipped-monochrome, slipped-polychrome, painted-monochrome, painted-polychrome, glazed
handle1_tech_initiated	Technique used to initiate handle formation.	hand-lump, hand-coil, hand-slab, tool-tournette, tool-wheel, other (see notes)
handle1_tech_formed	Technique used to form the handle.	hand-blended, tool-mold, tool-paddle/anvil, tool-tournette, tool-wheel, other (see notes)
handle1_tech_finished	Technique for finishing the handle.	hand-fingertips, hand-fingernails, tool-mat/fabric, tool-stamp/roulette, tool-pick/comb, tool-punch/incisor, tool-string/cord, tool-scraper/shaper, tool-stone, other (see notes)
notes	Column for recording detailed on about the sherd.	
handle2_number	If more than one handle, this is for the second handle.	handle number

Table A.10: Handle Characteristics

A.5 5_spouts_pottery

The <5_spouts_pottery> table is used to record characteristics of any spouts the vessel has, or evidence of spouts on a sherd. (Table A.11).

Variable	Description	Possible Values
pottery_spouts_id	Used to connect to the <0_master_pottery> table.	sequential number
shortform_id	Abbreviated ("shortform") id string for the object.	
spout1_number	If more than one spout, this is for the first spout.	spout number
spout1_type	Basic shape of the spout.	indented, extended_rim, short-channel, long-channel, short-tube, long-tube, tapered_short-channel, tapered_long-channel, tapered_short-tube, tapered_long-tube, other (see notes)
spout1_axis	Directionality of the spout.	perpendicular, cylindrical, spherical, conical, conical-inverted, conical-near_perpendicular, conical-near_cylindrical, cone_2_cylinder, inverse_cone_2_cylinder, conical-tip_2_tip, conical-base_2_base, other (see notes)
spout1_form	Texture on the spout.	scored/indented, flat/smooth, ridge/ribbed, pulled/scalloped, twisted/braided, morphic, figurative, other (see notes)
spout1_section	Cross-section of spout.	square, half-square, circle, half-circle, oval, half-oval, trapezoid, rhombus, triangle, kidney, v-shaped, braided, other (see notes)
spout1_placement	Location of the spout on the vessel.	foot, base-foot, base, base-trunk, trunk, trunk-shoulder, trunk-neck, shoulder, neck-shoulder, neck, rim-neck, rim-shoulder, rim-trunk, rim, unknown, other (see notes)
spout1_treatment_1	Primary surface treatment of the spout.	smoothed, stippled, punctated, stamped, impressed, marked, scored, burnished-low, burnished-high, self-slipped, slipped-monochrome, slipped-polychrome, painted-monochrome, painted-polychrome, glazed
spout1_treatment_2	Secondary surface treatment of the spout.	smoothed, stippled, punctated, stamped, impressed, marked, scored, burnished-low, burnished-high, self-slipped, slipped-monochrome, slipped-polychrome, painted-monochrome, painted-polychrome, glazed
spout1_tech_initiated	Technique used to initiate spout formation.	hand-lump, hand-coil, hand-slab, tool-tournette, tool-wheel, other (see notes)
spout1_tech_formed	Technique used to form the spout.	hand-blended, tool-mold, tool-paddle/anvil, tool-tournette, tool-wheel, other (see notes)
spout1_tech_finished	Technique for finishing the spout.	hand-fingertips, hand-fingernails, tool-mat/fabric, tool-stamp/roulette, tool-pick/comb, tool-punch/incisor, tool-string/cord, tool-scraper/shaper, tool-stone, other (see notes)
notes	Column for recording detailed notes on the sherd.	
spout2_number	If more than one spout, this is for the second spout.	spout number

Table A.11: Spout Characteristics

A.6 6_perforations_pottery

The <6_perforations_pottery> table is used to record characteristics of any perforations the vessel has, or evidence of perforations on a sherd (Table A.12).

Variable	Description	Possible Values
pottery_perforations_id	Used to connect to the <0_master_pottery> table.	sequential number
shortform_id	Abbreviated ("shortform") id string for the object.	
perforation1_number	If more than one type of perforation, this is for the first perforation type.	perforation number
perforation1_type	Purpose of the perforation.	drainage, random, sieve, other (see notes)
perforation1_section	Shape of the perforation.	square, half-square, circle, half-circle, oval, half-oval, trapezoid, rhombus, triangle, kidney, v-shaped, braided, other (see notes)
perforation1_placement	Location of the perforation(s) on the vessel.	foot, base-foot, base, base-trunk, trunk, trunk-shoulder, trunk-neck, shoulder, neck-shoulder, neck, rim-neck, rim-shoulder, rim-trunk, rim, unknown, other (see notes)
perforation1_tool	Tool used to create the perforation.	finger. fingernail, knife/edged_tool, wood/bone-narrow_width, wood/bone-medium_width, wood/bone-wide_width
perforation1_time	Point in the production process the perforation was created.	finish, post-finish/pre-fire, post-fire, post-fire/pre-deposition, post-deposition
perforation2_number	If more than one type of perforation is present, this is for the second perforation type.	perforation number

Table A.12: Perforation Characteristics

A.7 7_colors_pottery

The <7_colors_pottery> table is used to record characteristics of the vessel or sherd's colors (Table A.13).

Variable	Description	Possible Values
pottery_colors_id	Used to connect to the <0_master_pottery> table.	sequential number
shortform_id	Abbreviated ("shortform") id string for the object.	
exterior_hue1	Munsell hue group.	hue group
exterior_value1	Munsell value number.	value number
exterior_chroma1	Munsell chroma number.	chroma number
exterior_hue2	Munsell hue group.	hue group
exterior_value2	Munsell value number.	value number
exterior_chroma2	Munsell chroma number.	chroma number
interior_hue1	Munsell hue group.	hue group
interior_value1	Munsell value number.	value number
interior_chroma1	Munsell chroma number.	chroma number
interior_hue2	Munsell hue group.	hue group
interior_value2	Munsell value number.	value number
interior_chroma2	Munsell chroma number.	chroma number
core_number	Number of core colors present.	number of cores
core_boundaries	Boundary type between cores if more than one.	none, distinct, very_distinct, blurred, very_blurred, other (see notes)
core1_location	Location value (see Figure A.2)	center-1, exterior-2, interior-2, ext/int-2, exterior-3, interior-3, ext/int-3, exterior-4, interior-4, ext/int-4, other (see notes)
core1_pecentage	Percentage of the total core.	number (percent)
core1_hue	Munsell hue group.	hue group
core1_value	Munsell value number.	value number
core1_chroma	Munsell chroma number.	chroma number
core2_location	Location value (see Figure A.2)	center-1, exterior-2, interior-2, ext/int-2, exterior-3, interior-3, ext/int-3, exterior-4, interior-4, ext/int-4, other (see notes)
core2_pecentage	Percentage of the total core.	number (percent)
core2_hue	Munsell hue group.	hue group
core2_value	Munsell value number.	value number
core2_chroma	Munsell chroma number.	chroma number

Table A.13: Color Characteristics

A.8 8_inclusions_pottery

The <8_inclusions_pottery> table is used to record characteristics of the vessel or sherd's inclusions, if any (Table A.14).

Variable	Description	Possible Values
pottery_inclusions_id	Used to connect to the <0_master_pottery> table.	sequential number
shortform_id	Abbreviated ("shortform") id string for the object.	
inclusion1_type	Composition of the inclusion.	silt, sand, gravel, grog, organic, limestone, stone grit
inclusion1_size1	Relative size of the inclusion type.	very fine, fine, medium, coarse, very coarse
inclusion1_size2	Relative size of the inclusion type if imprecise sorting.	very fine, fine, medium, coarse, very coarse
inclusion1_size3	Relative size of the inclusion type if imprecise sorting.	very fine, fine, medium, coarse, very coarse
inclusion1_sorting	Level of sorting of the inclusion type.	unsorted, poorly sorted, balanced sorting, precisely sorted
inclusion1_location	Approximate location of the inclusion within the clay matrix.	all_cores, core_1, core_2, core_3, core_4, core_5
inclusion1_pecentage	Percentage of the inclusion type	number (percent)
inclusion2_type	Composition of the inclusion.	silt, sand, gravel, grog, organic, limestone, stone grit
inclusion2_size1	Relative size of the inclusion type.	very fine, fine, medium, coarse, very coarse
inclusion2_size2	Relative size of the inclusion type if imprecise sorting.	very fine, fine, medium, coarse, very coarse
inclusion2_size3	Relative size of the inclusion type if imprecise sorting.	very fine, fine, medium, coarse, very coarse
inclusion2_sorting	Level of sorting of the inclusion type.	unsorted, poorly sorted, balanced sorting, precisely sorted
inclusion2_location	Approximate location of the inclusion within the clay matrix.	all_cores, core_1, core_2, core_3, core_4, core_5
inclusion2_pecentage	Percentage of the inclusion type	number (percent)
inclusion3_type	Additional variables for a 3rd type.	
inclusion4_type	Additional variables for a 4th type.	

Table A.14: Inclusion Characteristics

A.9 9_decorations_pottery

The <9_decorations_pottery> table is used to record characteristics of the vessel or sherd's decorations, if any (Table A.15).

Variable	Description	Possible Values
pottery_decorations_id	Used to connect to the <0_master_pottery> table.	sequential number
shortform_id	Abbreviated ("shortform") id string for the object.	
decoration1_label	Description of the decorative element.	cord-pattern, basket-pattern, comb-pattern, square-stamp-pattern, incised-line, incised-line-pattern, raised-ridge, raised-ridge-pattern, dotted-line-pattern, cord-applique
element1_type	Specifics of the decorative element.	incised_line-thin, incised_line-thick, incised_line-band, raised_line-thin, raised_line-thick, raised_line-band, raised_line-cord
element1_placement	Location of the decoration on the vessel.	foot, base-foot, base, base-trunk, trunk, trunk-shoulder, trunk-neck, shoulder, neck-shoulder, neck, rim-neck, rim-shoulder, rim-trunk, rim, unknown, other (see notes)
element1_motif	Structure of the decorative element.	single-line, double-line, triple-line, bent-line, circular, ovoid, triangle, square, rhomboid, rectangle, paralleloid, pentangle, spiral/whorl, stamp/roulette-repeating, mat/fabric-weaving, comb/pick-scoring, cord/string-twisting
element1_mode	Decoration frequency of use.	solitary, spaced2, spaced_3, spaced_4, solitary-nested, spaced_2-nested, spaced_3-nested, spaced_4-nested, repetitive-lo_freq, repetitive-hi_freq, repetitive-lo_freq-overlapped, repetitive-hi_freq-overlapped
element1_tool_1	Tool used to create the decorative element (inferred).	cord-light_weight, cord-heavy_weight, comb/pick-small_tooth, comb/pick-large_tooth, mat/fabric-tight_weave, mat/fabric-loose_weave, punch-narrow_gauge, pinch-broad_gauge, scraper/shaper-smooth, scraper/shaper-beveled_edge, scraper/shaper-ovoid_notch, scraprer/shaper-arrow_notch, scraper/shaper-rhomboid_nothc, stamp/roulette-cord/fabric, stamp/roulette-geometric, stamp/roulette-punctate, stamp/roulette-morphic
element1_tool_2	Tool used to create the decorative element (inferred).	cord-light_weight, cord-heavy_weight, comb/pick-small_tooth, comb/pick-large_tooth, mat/fabric-tight_weave, mat/fabric-loose_weave, punch-narrow_gauge, pinch-broad_gauge, scraper/shaper-smooth, scraper/shaper-beveled_edge, scraper/shaper-ovoid_notch, scraprer/shaper-arrow_notch, scraper/shaper-rhomboid_nothc, stamp/roulette-cord/fabric, stamp/roulette-geometric, stamp/roulette-punctate, stamp/roulette-morphic
element1_time	Point in the production process the decoration was created.	finish, post-finish/pre-fire, post-fire, post-fire/pre-deposition, post-deposition
element1_notes	Notes about this decorative element.	
decoration2_label	Description of the decorative element.	Additional variables for a 2nd type.
decoration3_label	Description of the decorative element.	Additional variables for a 3rd type.

Table A.15: Decorations Characteristics

A.10 10_photo_pottery

The <10_photo_pottery> table is used to record the photograph filenames of the vessel or sherd (Table A.16).

Variable	Description	Possible Values
pottery_photo_id	Used to connect to the <0_master_pottery> table.	sequential number
shortform_id	Abbreviated ("shortform") id string for the object.	
photo-exterior_id	Exterior photo filename.	filename1, filename2
photo-interior_id	Interior photo filename.	filename1, filename2
photo-profile_id	Profile photo filename.	filename1, filename2
photo-detail_id	Detail photo filename.	filename1, filename2

Table A.16: Photo Cross-Reference

A.11 11_draw_pottery

The <11_draw_pottery> table is used to record the drawing filenames of the vessel or sherd (Table A.17).

Variable	Description	Possible Values
pottery_draw_id	Used to connect to the <0_master_pottery> table.	sequential number
shortform_id	Abbreviated ("shortform") id string for the object.	
draw-exterior_id	Exterior drawing filename.	filename
draw-profile_id	Profile drawing filename.	filename
draw-detail_id	Detail drawing filename.	filename

Table A.17: Drawing Cross-Reference

A.12 12_mae_pottery

The <12_mae_pottery> table is used to record a vessel's MAE (Making of Ancient Eurasia) Project number if it was used in the project (Table A.18).

Variable	Description	Possible Values
pottery_draw_id	Used to connect to the <0_master_pottery> table.	sequential number
shortform_id	Abbreviated ("shortform") id string for the object.	
mae_id	Corresponding number from the MAE Project.	MAE number

Table A.18: MAE Cross-Reference

APPENDIX B

CERAMIC IMAGERY

Appendix B includes images and radiographs of all ceramics used in this study.

B.1 Color Photography

Photography for the majority of the project was conducted at the Institute of Archaeology's field station in Luoyang from August 2009 to June 2010. No images were taken of the first 25 sherds that were coded from the Shaocai site at the Henan Provincial Institute of Cultural Relics and Archaeology (HPICRA) storage facility in Zhengzhou. I was there for about one week in late July 2009 before my stay was cut short due to a scheduling conflict that arose with my collaborator Ma Xiaolin [马小林] due to my negligence in consulting him as to when I would be there and his visiting professorship at LaTrobe University in Melbourne, Australia.

Photographic Protocols At the field station in Luoyang I was given a room to use for my coding and analysis. Photographs were taken using a Canon DS800 digital SLR 12 megapixel camera (almost the highest resolution available for non-professional SLR cameras at the time) mounted on a small tripod that was pointed down at a blue felt background where the sherds were positioned. In most cases I relied on natural sunlight coming through the window for lighting.

The sherds were photographed on the exterior surface first, followed by the interior surface. In a few cases, for multi-part sherds, more than one image was required to capture the entire sherd. These external images were followed by an image of the internal part of the sherd, its cross-section, which required the use of a stand of some kind—generally a binder clip was used, although I had to use my hand to obtain the proper angle.

My intention was to use the exterior and interior images as a basis for generating drawings of all sherds used in the study (with the exception of those from Shaocai, obviously). My hope was that I could pay an undergraduate student to create these drawings, but unfortunately my budget was too limited by the time I

returned to the U.S., and my own time and/or talents were not up to the task, though I did make an attempt which led to this realization. In any case, color imagery will have to suffice in place of black and white line drawings, though this breaks with archaeological tradition.

B.2 Radiographic Techniques of Analysis

The acquisition and analysis of pottery from Huizui was undertaken as part of the MAE Project and I provide details of the collaborative project of which these materials from Huizui took part. One of the project goals was the development of procedures and protocols for conducting digital radiographic analyses. Finally, I discuss the results of this analysis, and show how radiographic analysis provided further support for the formation categories produced previously.

Digital Radiography

One of the secondary goals is demonstrating the usefulness of using digital radiography in the study of ceramics; to be sure, this core technology is not new, and yet, aside from the key seminal articles discussed in those chapters, it is clear that use of the technology has never become widespread. No doubt much of this has to do with the difficulty in using the analog equipment and the preparation of images from the film substrate. The relative difficulty of finding equipment to use is another factor, especially where xeroradiography is concerned. Nevertheless, even with some of the seminal articles by Pamela Vandiver (1988) showing the usefulness of the technique for analyzing pottery production techniques, there has nor been much attention given to the use of radiography. At the heart of this quandry, I believe, has little to do with the technique or technology itself, but the general lack of interest in studying pottery structure: the "what, where, and how" of making pottery. In the early years of renewed research into pottery, there was an emphasis on the organization of production, an area in which archaeologists could utilize already existing skill sets, founded in excavation techniques, to uncover and make sense of the record and work to understand how what was found could be matched to different organizational schema. These were the "what, where, and how" of those producing pottery, but not of the pottery itself. The use of radiography

actually reappears after a hiatus of close to fifty years, and several scholars demonstrate its usefulness to a new generation of archaeologists. Again, the difficulty of using the equipment and the steep learning curve seems to have stifled its widespread use, but contrast this with the relative ease of doing compositional analysis, and it becomes clear why radiography was relegated to the fringe of the field. In compositional analysis, in particular neutron activation analysis and inductively-coupled plasma mass spectrometry, the chain was relatively straight forward and the researcher received quantitative data at the end of the procedure. This result was an additional counter-point to radiography because radiographic analysis was a qualitative effort; it did not result in numbers, but in descriptions and postulates of what the parts were as seen in the radiographs and how those parts were put together.

The work my colleagues and I undertook to develop digital radiograohic techniques at Argonne National Laboratory represent some of the first of renewed attempts to return pottery analysis to its roots as laid out by Anna Shepard (1936): the study of the pottery, its design, and how it is made. That project at Argonne Labs was long in development, but allowed us to experiment with the different equipment and its capabilities in order to, first, duplicate the results achieved through xeroradiography, and second, to push beyond qualitative radiography and make full use of the new capabilities afforded by the digital process to generate quantitative data as well (see Greene, Hartley, et al. 2017).

B.2.1 The Making of Ancient Eurasia Project

The Making of Ancient Eurasia (or MAE) Project was created in 2005 as the result of a seed grant provided by the Argonne National Laboratory Board of Governors designed to encourage scientific collaboration between scholars at the University of Chicago and those at Argonne National Laboratory. The co-PIs of the grant, Adam Smith (then University of Chicago) and William Ellingson (Non-Destructive Evaluation [NDE] section) proposed a project that would investigate the feasibility of using digital radiography (as well as other techniques) to analyze various types of archaeological materials, in particular bronze and pottery objects. I was a graduate student research assistant on the project.

The project had three main goals that it sought to fulfill. First, we were attempting to chart the technical pathways of large samples collected from select regions across Eurasia using an assemblage-based approach. This meant the delineation of data sets that could adequately contain the variability of production practices found in a given region. Secondly, as a "multi-modal" project, we targeted multi-scalar descriptions of a statistically significant quantity of objects within a single material class that could simultaneously 1) examine sociocultural practices at multiple scales, and 2) provide complementary analytic regimes that cross-cut traditional material classes organized by form and decoration. Lastly, as archaeology has long been a passive recipient of new technologies developed for other applications, this project offered opportunities for new techniques and applications to be developed directly out of archaeological questions in concert with Argonne National Laboratory's material scientists.

After the first year of the two-year grant, it became clear that digital radiography could make a great contribution to the analysis of pottery production, especially questions surrounding techniques of pottery manufacture. This application was in keeping with research done previously by Carr (1990, 1993) and Vandiver (1988) using the older analog xeroradiography method which allowed for exaggerated image contrast that enabled the researcher to see, most importantly, formation joins and tempering. Indeed, after the two year run of the project, several of the graduate researchers continued the development of protocols for acquiring good, reproducible, digital imagery of pottery sherds (see Greene and Hartley 2009).

Instrumentation

The primary instrument for the acquisition of radiographic data at Argonne National Laboratory consists, first, of a Phillips 420 kVp x-ray tube used to generate x-rays of the needed energies in order to penetrate the more dense materials that make up archaeological assemblages. The Phillips tube has a 1500μm spot-size, has both small and large filament imaging modes, and can be finely tuned from the control station, which means that the kilovolt and milliamp settings can be adjusted as needed for different materials. The x-ray signal is recorded by the second instrument, a Perkin-Elmer x-ray detector with a 200μm resolution that measures 2048 pixels square. As a digital device recording 16-bit grayscale imagery, the detector can

capture up to 65,536-pixel value shades of gray; however, the human eye can only discriminate 60. Thus, though an analog image essentially has an infinite grayscale range, the human eye can only discriminate a very small fraction of them, which means much of this rich data is lost if analysis is done visually using analog radiographs. This limitation can be circumvented in order to take advantage of a computer's capacity to evaluate high-value imagery by scanning analog imagery with a digital scanner, but this means that the analog technique was only quantifiable based on the dot-per-inch level of the scanned film. However, data produced by the digital detector are immediately available for visual analysis as well as computer assisted post-processing techniques using image manipulation software (such as Adobe Photoshop®) and statistical analysis.

B.2.2 Protocol Development

In order to make the best use of the digital x-ray setup the MAE Project team implemented a program of protocol development for instrumental ceramic analysis using digital radiography and computed tomography. Our first step in this process was to develop a set of standardized parameters for the acquisition of DR and CT images of ancient ceramics. Archaeological ceramic materials are significantly more heterogeneous than the modern industrial ceramic materials commonly analyzed radiographically at Argonne National Laboratory, so significant protocol adjustments were necessary.

David Middleton (2005) published a recommended set of parameters for the analog radiography of material culture, but these parameters quickly revealed themselves to be inappropriate for the newer digital device. For example, analog film radiography and xeroradiography utilized a long integration period, where the object would sit in a relatively low kVp environment soaking up radiation for minutes on end. This kind of exposure would quickly saturate a digital x-ray detector, but the kVp an experimental digital x-ray tube's power and tunability, more than compensates. In total, the settings which we included in out protocol study were: x-ray tube kilovolts; x-ray tube milliamperes; the integration or "exposure" time of the beam; Source-to-Object Distance (SOD); and Object-to-Detector Distance (SDD). We also experimented with the use of variable density metal screens over the detector and filters over the x-ray source. Different metals affect the

quality of the beam in different ways, but it was eventually determined that the best way to maximize image contrast was to operate without these enhancements.

Our set of standardized parameters for digital ceramic radiography was determined by acquiring numerous images of a set of typical objects–of the same ancient sherd with a sliced edge–then quantifying the quality of each experimental image by measuring its Modulation Transfer Function, or MTF value. A random sample of 50 permutations of x-ray tube settings and object/source positions was used. The resultant data were run through a software module written by the project in Interactive Data Language (IDL) which samples the pixel values across the sherd edge and calculates the MTF value for each successive image. It also outputs the function in graphical form. When plotted together, these fifty images suggested that the following parameters will be ideal for the radiography of ancient ceramics: a kVp between 250 and 275, a milliamp setting around 0.15, about 8 seconds of integration time, and the positioning of the source and object as close together as possible. At present, this is the best combination of parameters to acquire ancient ceramic imagery, yielding a maximal 0.6 MTF value.

There are benefits and drawbacks to each technique of analysis. The acquisition of digital radiographs is relatively straight-forward, taking a minute or two, not much different than taking any other kind of digital photo. However, because the resultant image compresses all of the object's internal features into a two-dimensional image, there may be difficulties in the interpretation of features visible in the radiograph.

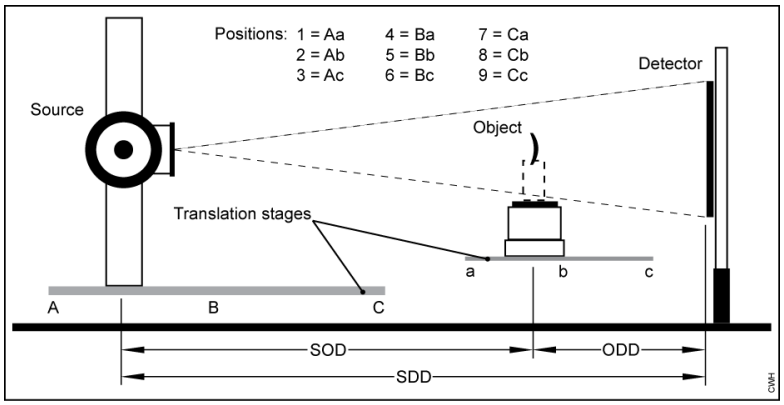


Figure B.1: X-ray setup for protocol development at Argonne National Laboratory

Stage Position	SDD (cm) [a]	SOD (cm) [b]	Magnification Factor
1	349	225	1.55
2	349	256	1.36
3	349	294	1.19
4	284	160	1.78
5	284	191	1.49
6	284	229	1.24
7	219	95	2.31
8	219	126	1.74
9	219	164	1.34

[a] Source-to-Detector Distance
[b] Source-to-Object Distance

Table B.1: Distances and magnification achieved by stage position

Image Analysis The second phase of the digital radiography programme involved creating tools that take advantage of these digital forms of data. We initially used image manipulation programs such as Adobe Photoshop® to view the resultant radiographs, but quickly realized how limited we were. That is, standard image manipulation software is designed to change images, and, not surprisingly, manipulate the pixels that make up the image. What we wanted was a program that would allow us to adjust basic image quality aspects of the radiograph as can be done with standard software, but we also wanted a program that would allow us to record features or characteristics seen in the radiographic image; in short, we wanted to be able to code the images for analysis.

After consulting with staff at Argonne National Laboratory, we decided that we would build our own software using Interactive Data Language® developed by Research Solutions, Inc. (RSI) which was a programming language specifically designed for software to perform image analysis.[1] With a programmer to write the code, we developed a program called "ShIVA" (Sherd Imagery and Visual Analysis) that would

1. RSI became a wholly owned subsidiary of ITT Industries in March 2004. As of May 15, 2006, RSI began doing business as ITT Visual Information Solutions. Effective 31 October 2011, as a result of restructuring, that company become Exelis Visual Information Solutions.

allow us to do the image manipulation required, and allow us to markup the images and export the coded notes into a spreadsheet format (as *.csv).

In addition to the ability to markup the radiographs, ShIVA also allows the researcher to run several algorithmic filters that colorize the grayscale radiograph based on the internal structures visible in the image. This capacity takes advantage of the digital format to its fullest by allowing the computer to digitally analyze the images in ways that are impossible with traditional analog radiography.

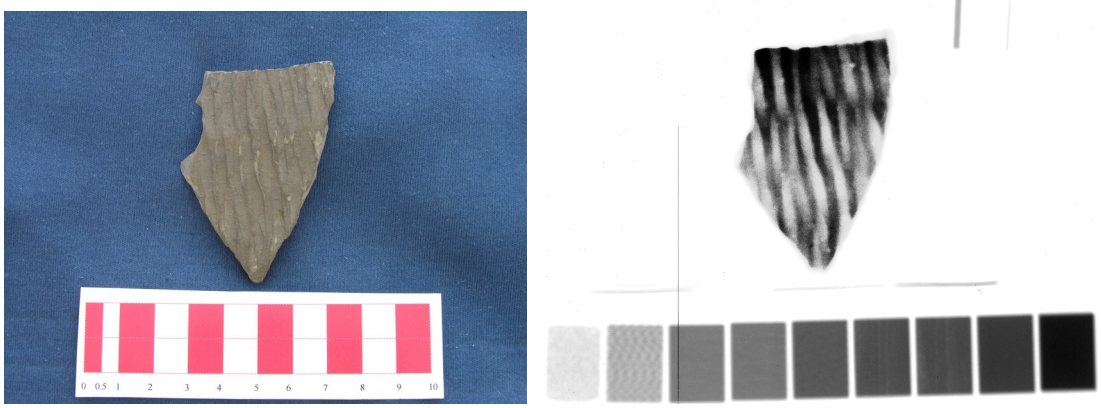
B.3 Ceramic Imagery

This section includes imagery of the sherds used in this study. For those sherds not included in the radiographic analysis, the images are color photographs of the exterior and interior surfaces of the sherd. For the 111 sherds used in the radiographic study, the images are color photographs of the exterior surface alongside the radiograph of the sherd.

Note that there are a few instances where sherds from Huizui were given MAE numbers to be included in the radiographic analysis, but if radiographs were acquired, I cannot find the images in my files. These instances are indicated in the descriptive text to the images. And in one case, Huizui ceramic 0181, the exterior, interior, and profile photographs of this sherd are also missing from my files. Because of the amount of time that has passed, I was bound to lose track of a few pictures.

(a) Exterior (b) Interior

Figure B.2: Huizui Ceramic 0026



(a) Exterior (b) Radiograph

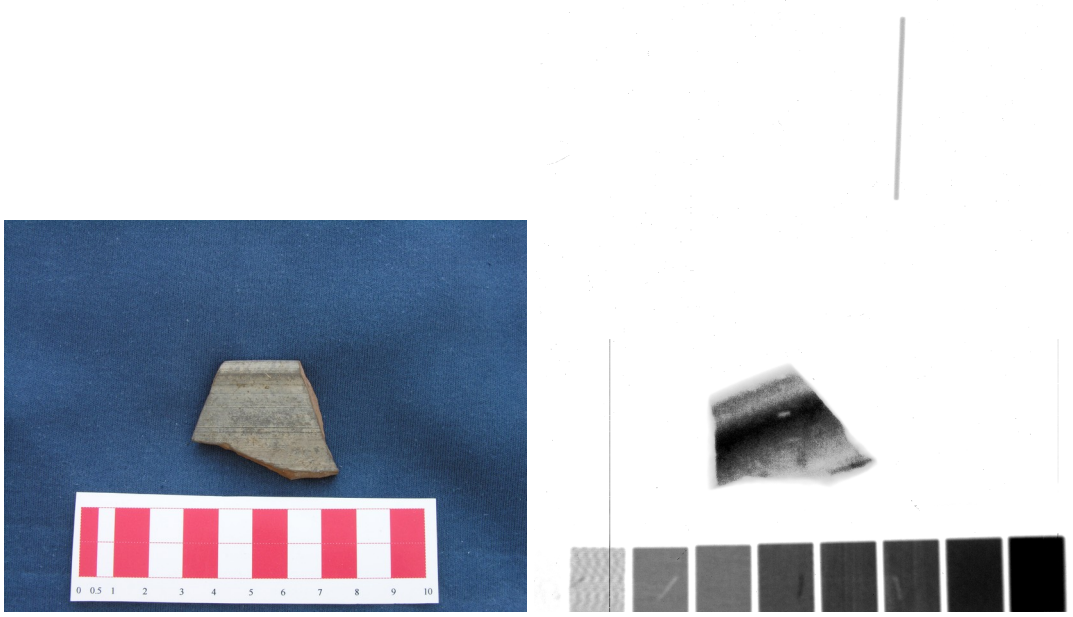
Figure B.3: Huizui Ceramic 0027 [MAE 2401]

(a) Exterior (b) Interior

Figure B.4: Huizui Ceramic 0028

(a) Exterior (b) Interior

Figure B.5: Huizui Ceramic 0029

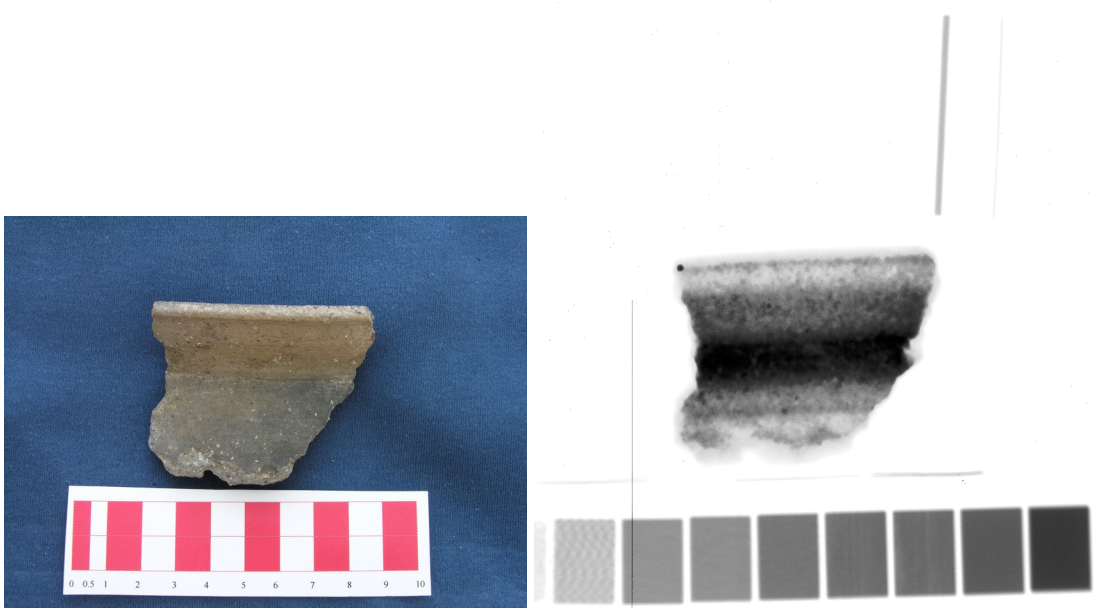


(a) Exterior (b) Radiograph

Figure B.6: Huizui Ceramic 0030 [MAE 2402]

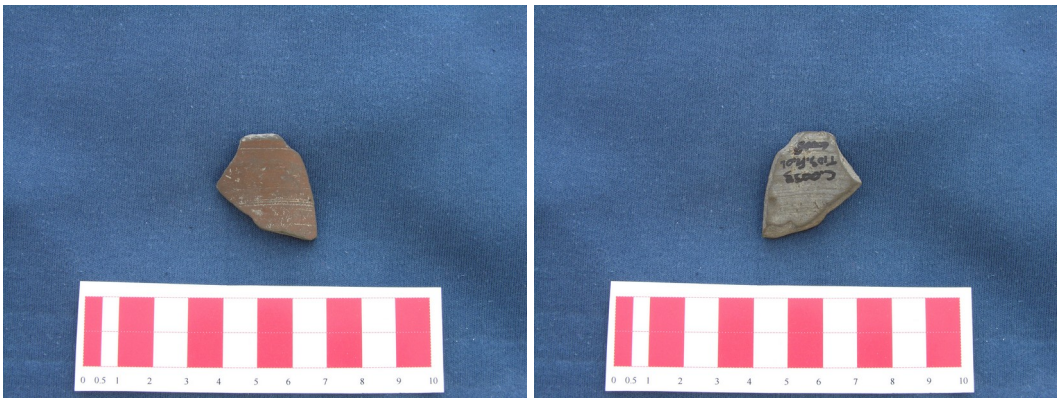
(a) Exterior (b) Interior

Figure B.7: Huizui Ceramic 0031



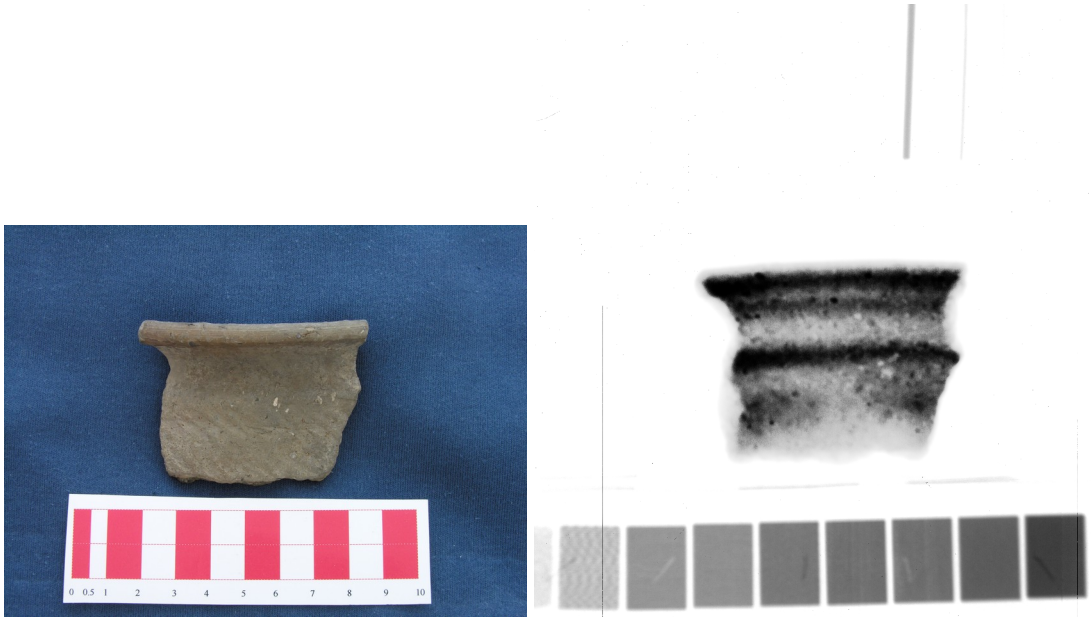
(a) Exterior (b) Radiograph

Figure B.8: Huizui Ceramic 0032 [MAE 2403]



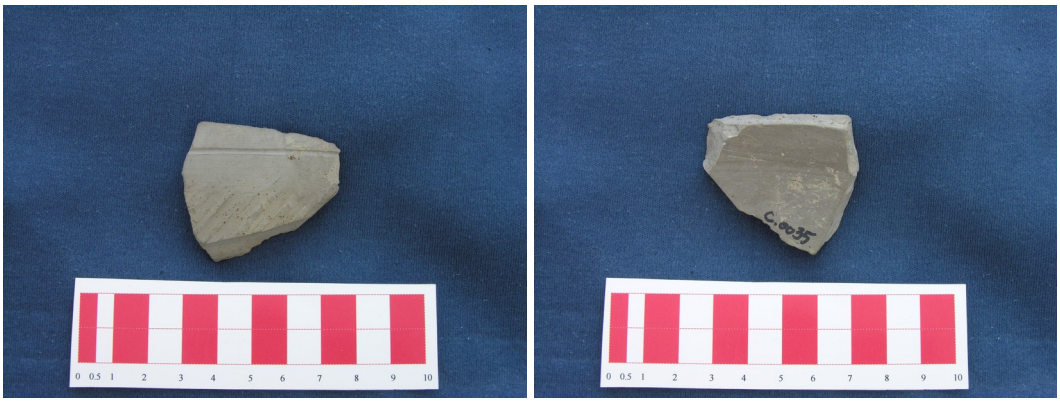
(a) Exterior (b) Interior

Figure B.9: Huizui Ceramic 0033



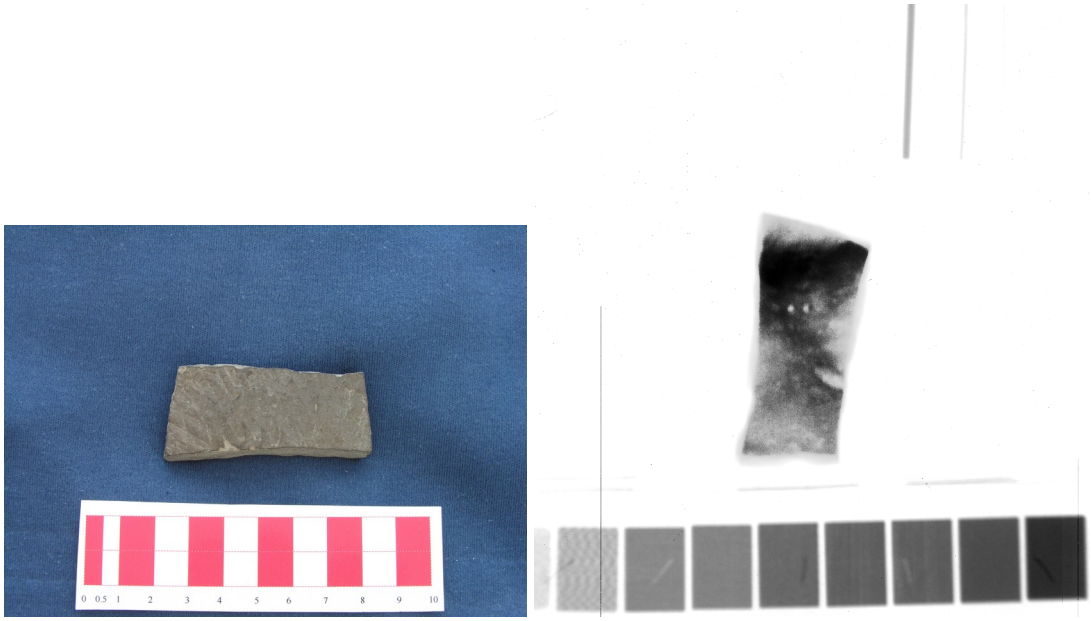
(a) Exterior (b) Interior

Figure B.10: Huizui Ceramic 0034 [MAE 2404]



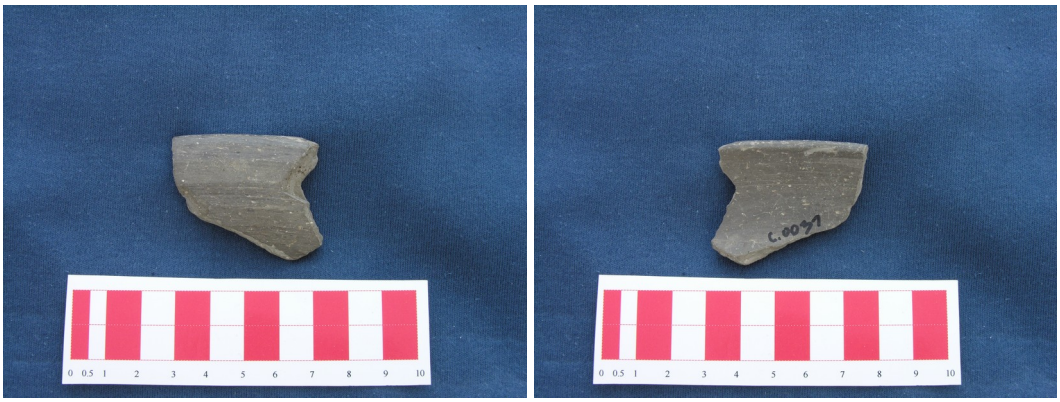
(a) Exterior (b) Interior

Figure B.11: Huizui Ceramic 0035



(a) Exterior (b) Interior

Figure B.12: Huizui Ceramic 0036 [MAE 2405]

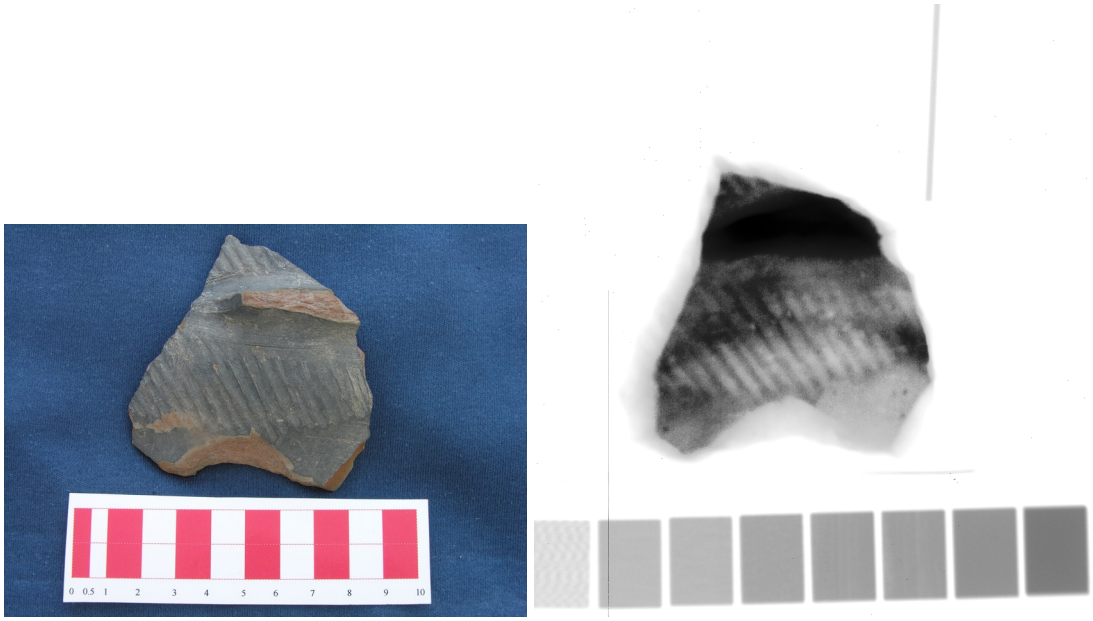


(a) Exterior (b) Interior

Figure B.13: Huizui Ceramic 0037

(a) Exterior (b) Interior

Figure B.14: Huizui Ceramic 0038

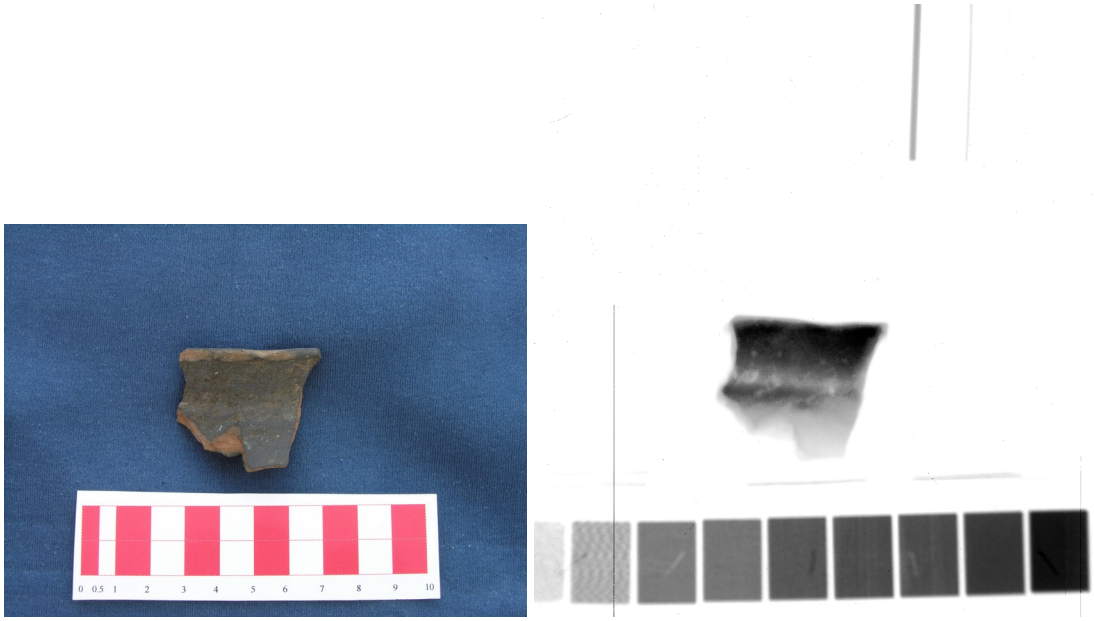


(a) Exterior (b) Radiograph

Figure B.15: Huizui Ceramic 0039 [MAE 2406]

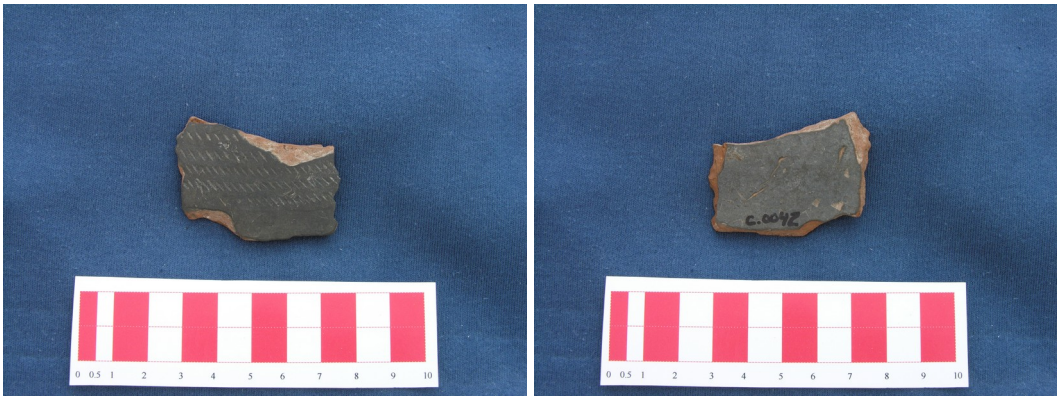
(a) Exterior (b) Interior

Figure B.16: Huizui Ceramic 0040



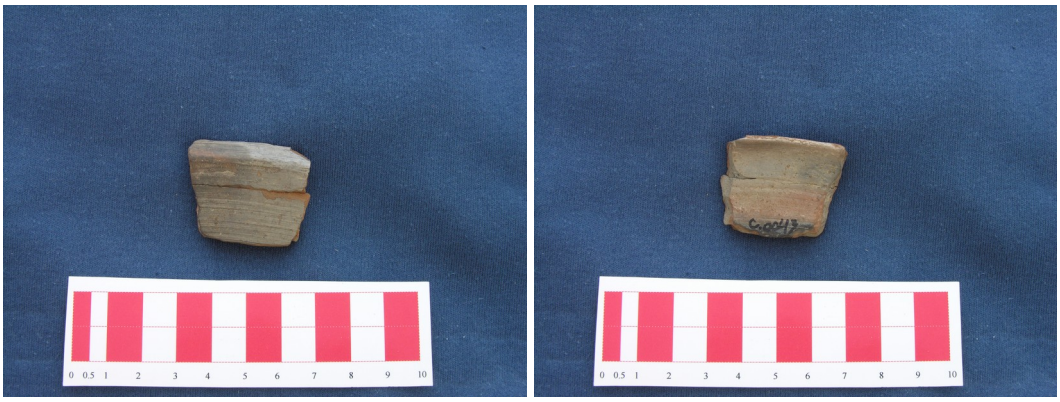
(a) Exterior (b) Radiograph

Figure B.17: Huizui Ceramic 0041 [MAE 2407]



(a) Exterior (b) Interior

Figure B.18: Huizui Ceramic 0042

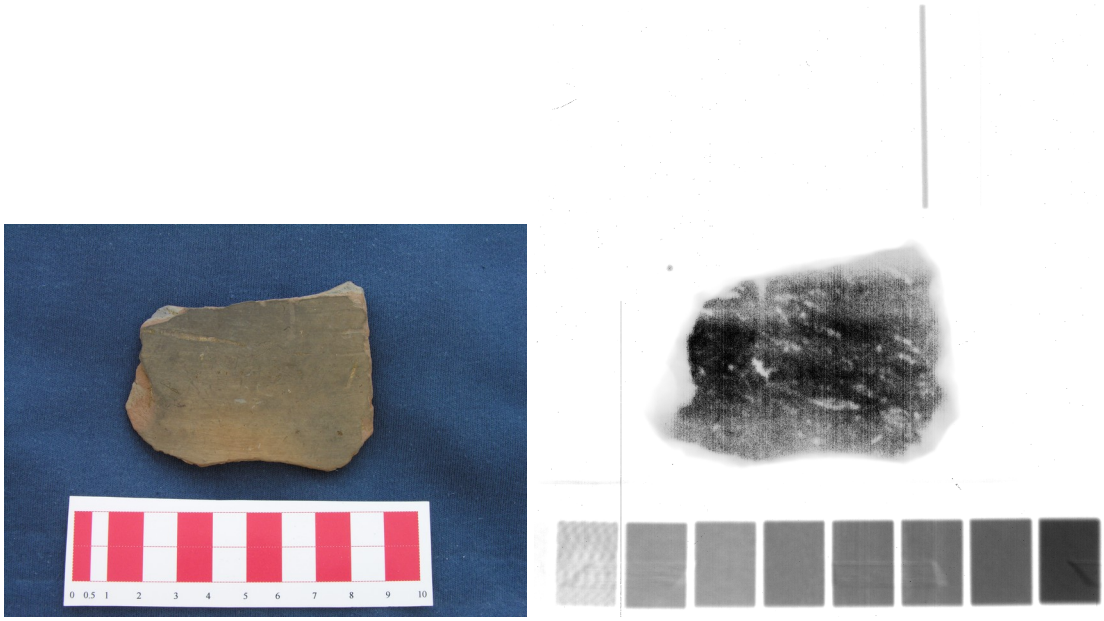


(a) Exterior (b) Interior

Figure B.19: Huizui Ceramic 0043

(a) Exterior (b) Interior

Figure B.20: Huizui Ceramic 0044

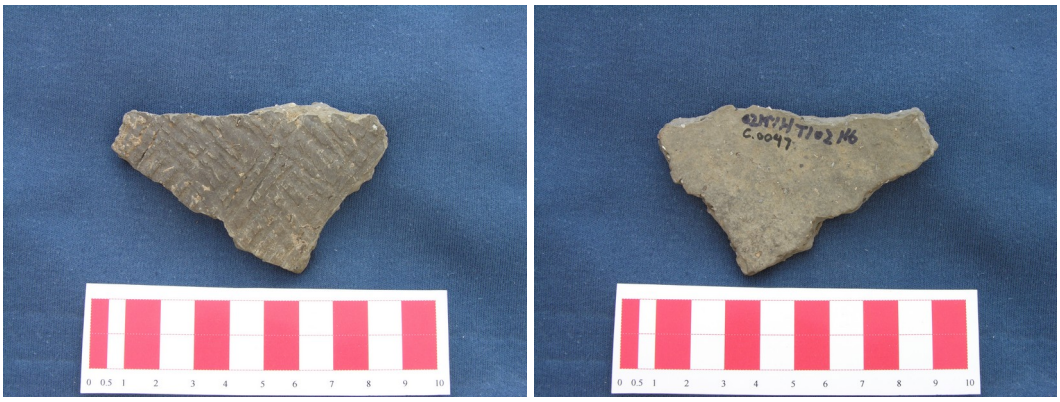


(a) Exterior (b) Radiograph

Figure B.21: Huizui Ceramic 0045 [MAE 2408]

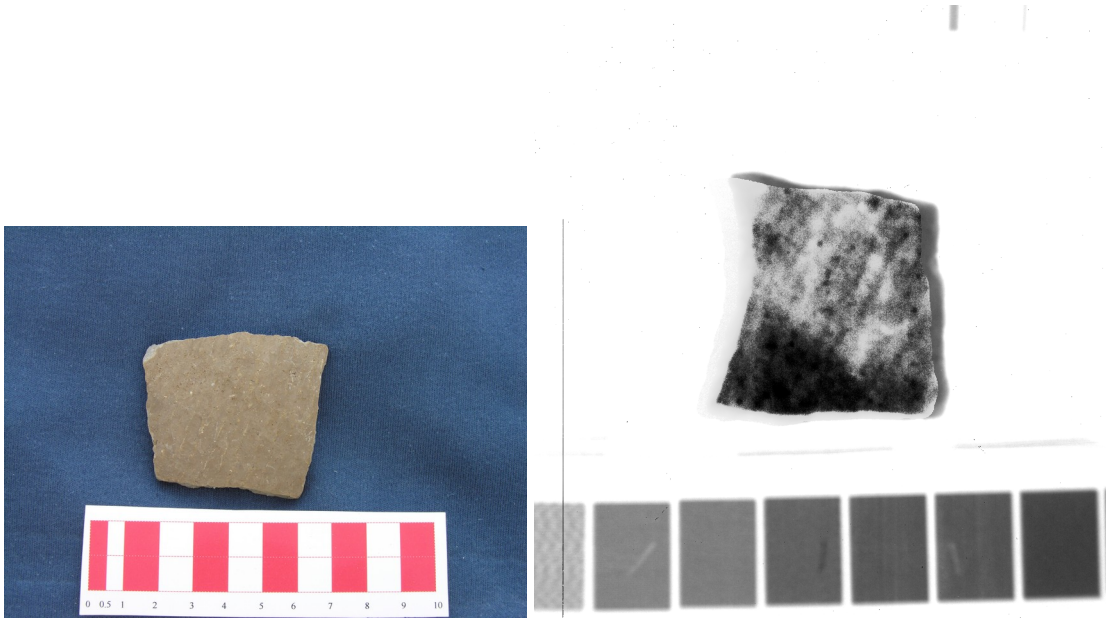
(a) Exterior (b) Interior

Figure B.22: Huizui Ceramic 0046



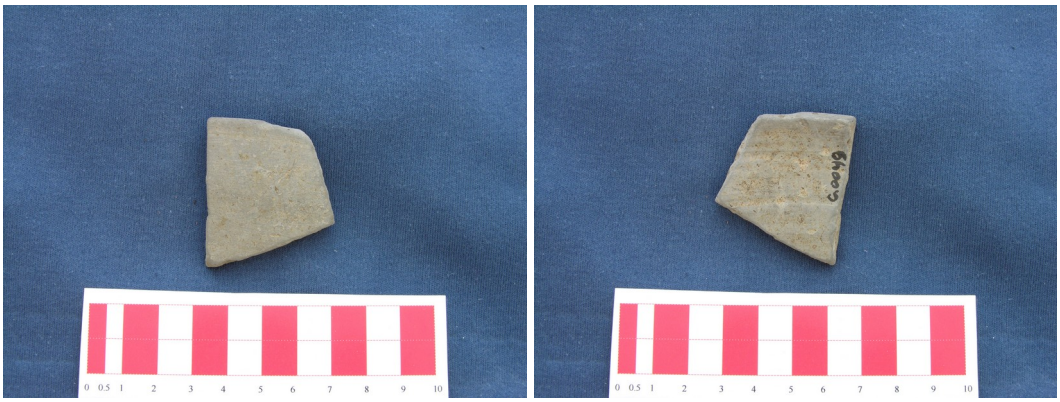
(a) Exterior (b) Interior

Figure B.23: Huizui Ceramic 0047



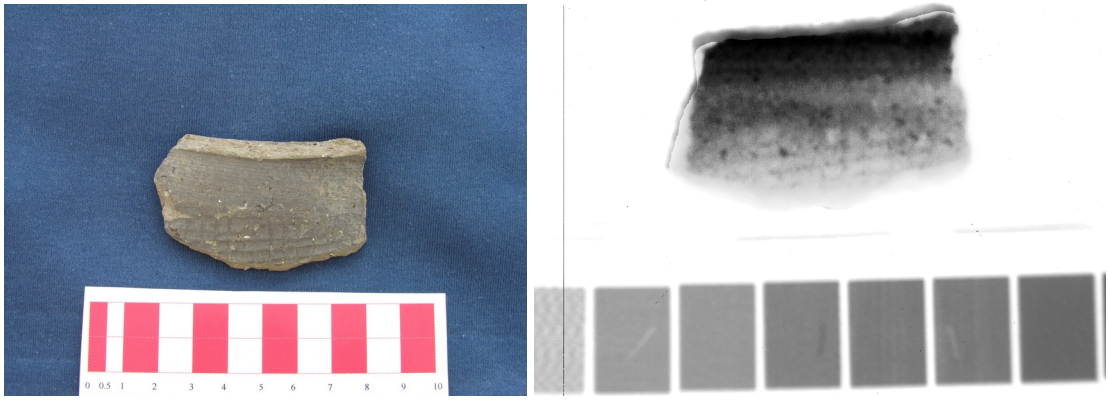
(a) Exterior (b) Radiograph

Figure B.24: Huizui Ceramic 0048 [MAE 2409]



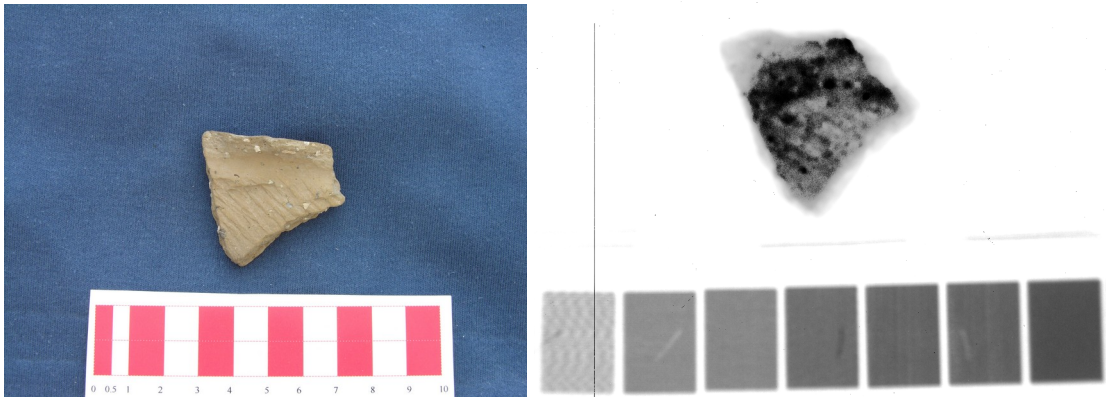
(a) Exterior (b) Interior

Figure B.25: Huizui Ceramic 0049



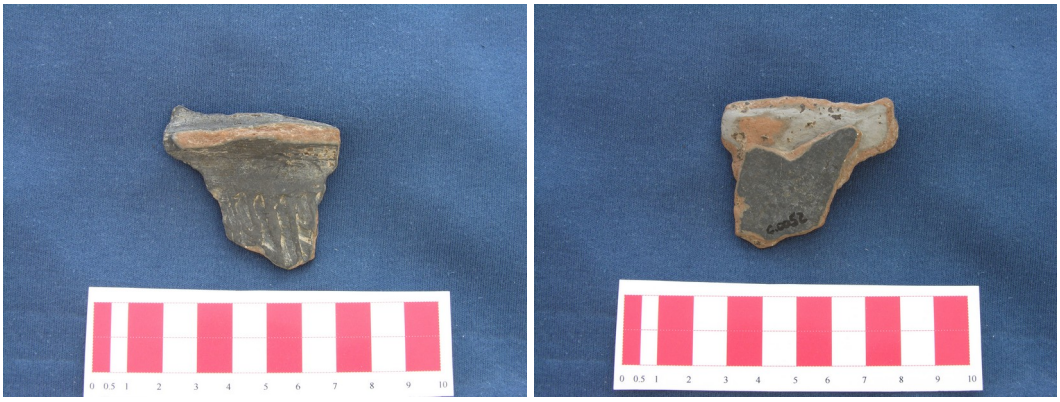
(a) Exterior (b) Radiograph

Figure B.26: Huizui Ceramic 0050 [MAE 2410]



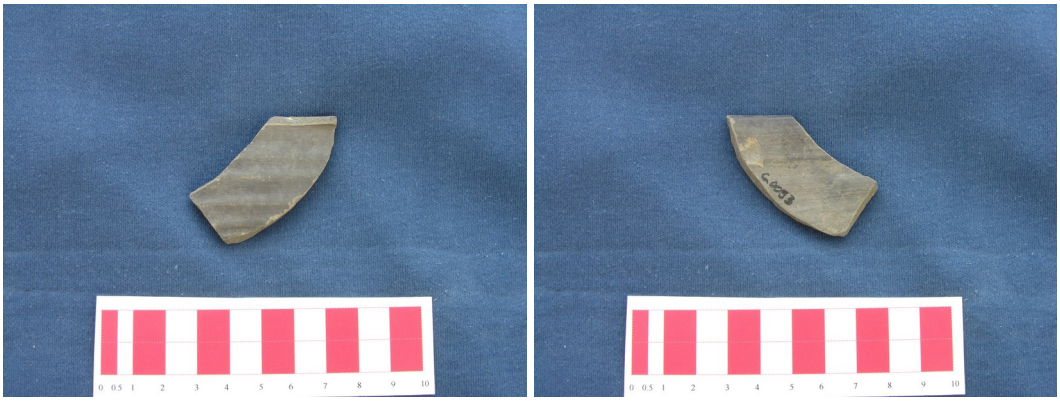
(a) Exterior (b) Radiograph

Figure B.27: Huizui Ceramic 0051 [MAE 2411]



(a) Exterior (b) Interior

Figure B.28: Huizui Ceramic 0052

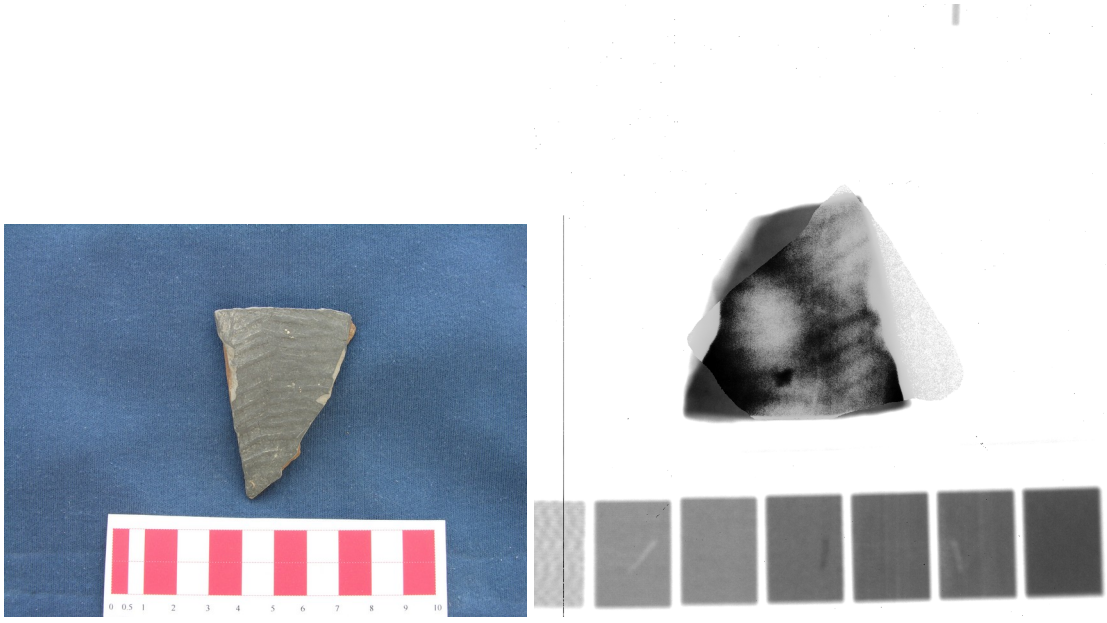


(a) Exterior (b) Interior

Figure B.29: Huizui Ceramic 0053

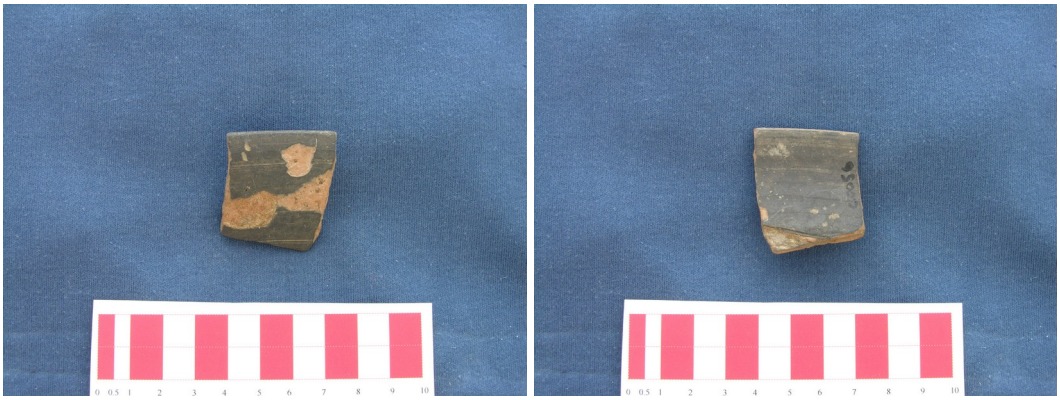
(a) Exterior (b) Interior

Figure B.30: Huizui Ceramic 0054



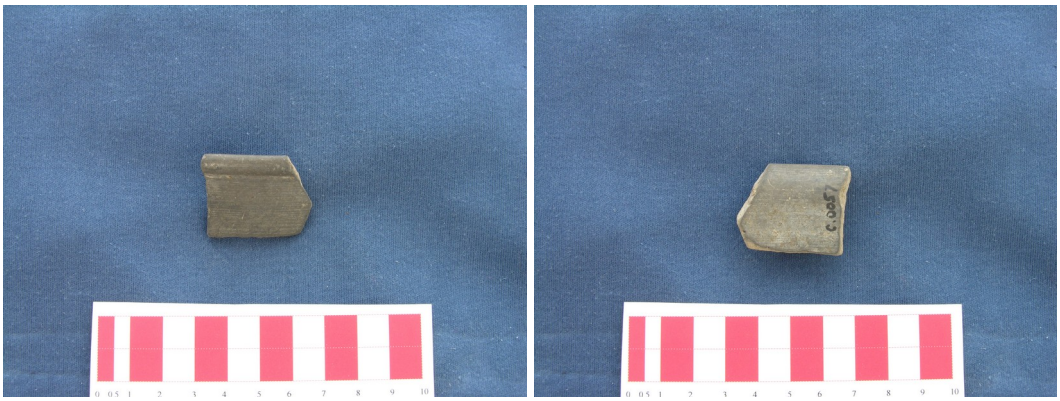
(a) Exterior (b) Radiograph

Figure B.31: Huizui Ceramic 0055 [MAE 2412]



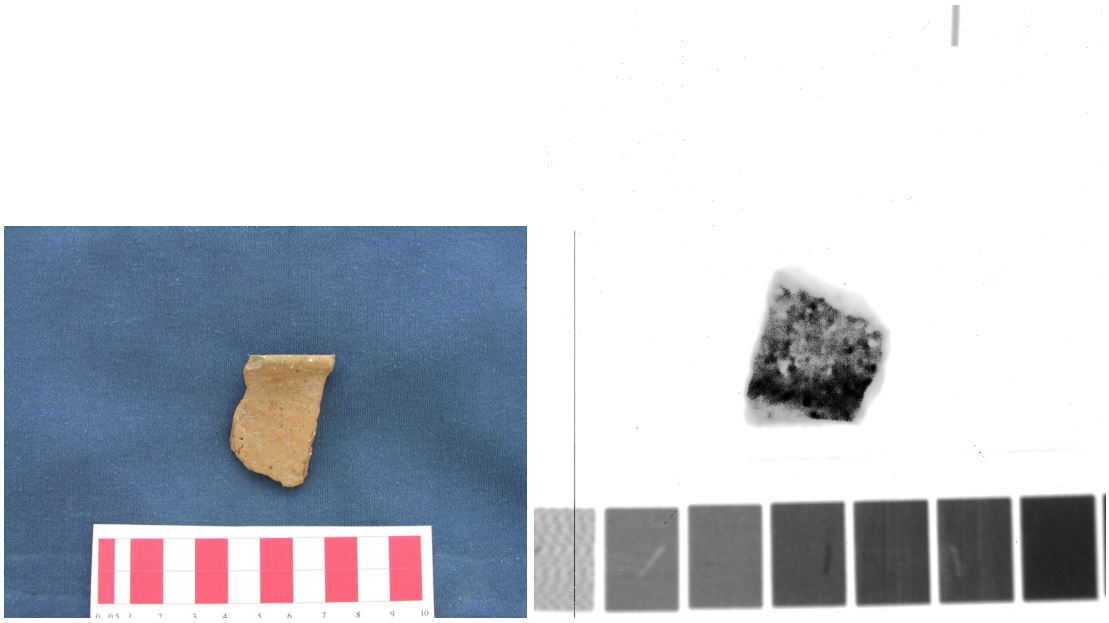
(a) Exterior (b) Interior

Figure B.32: Huizui Ceramic 0056



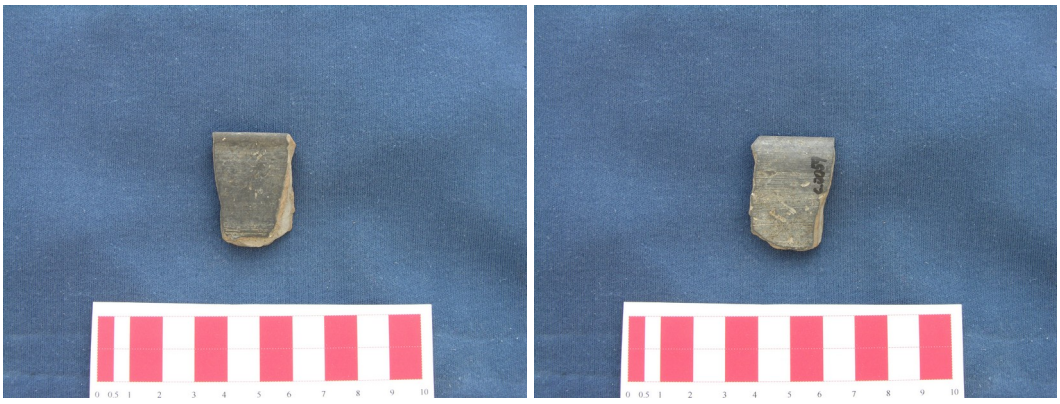
(a) Exterior (b) Interior

Figure B.33: Huizui Ceramic 0057



(a) Exterior (b) Radiograph

Figure B.34: Huizui Ceramic 0058 [MAE 2413]



(a) Exterior (b) Interior

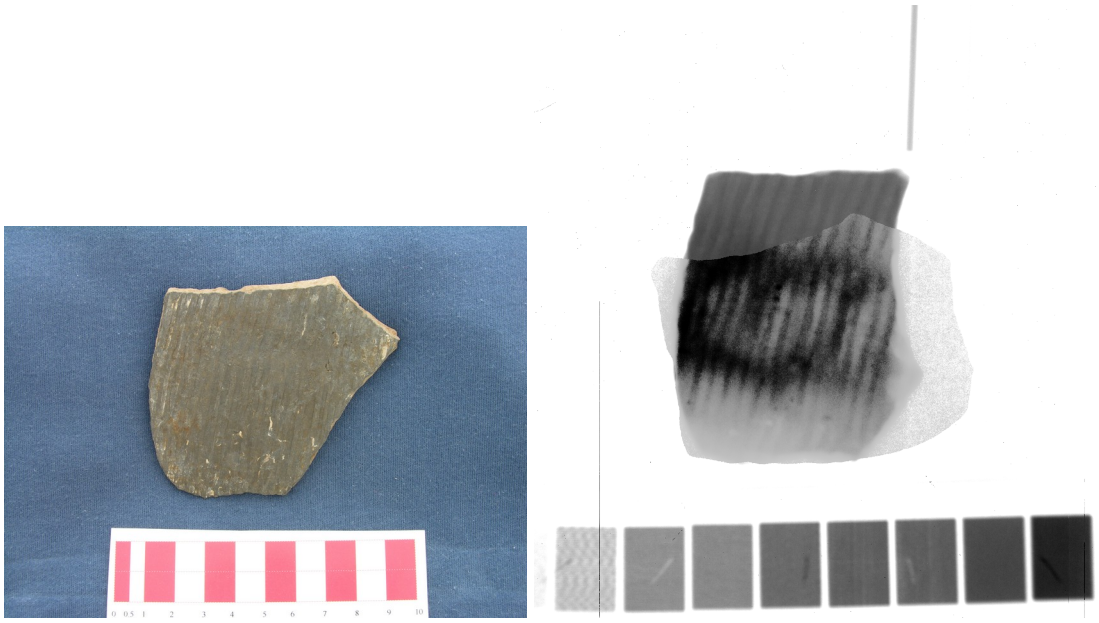
Figure B.35: Huizui Ceramic 0059

(a) Exterior (b) Interior

Figure B.36: Huizui Ceramic 0060

(a) Exterior (b) Interior

Figure B.37: Huizui Ceramic 0061



(a) Exterior (b) Radiograph

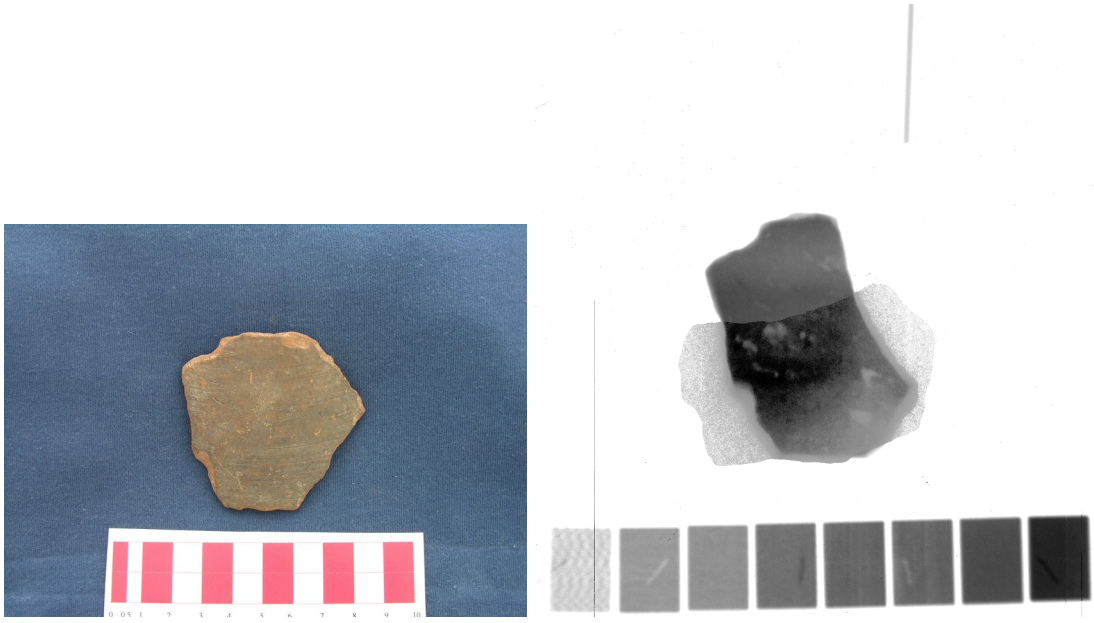
Figure B.38: Huizui Ceramic 0062 [MAE 2414]

(a) Exterior (b) Interior

Figure B.39: Huizui Ceramic 0063

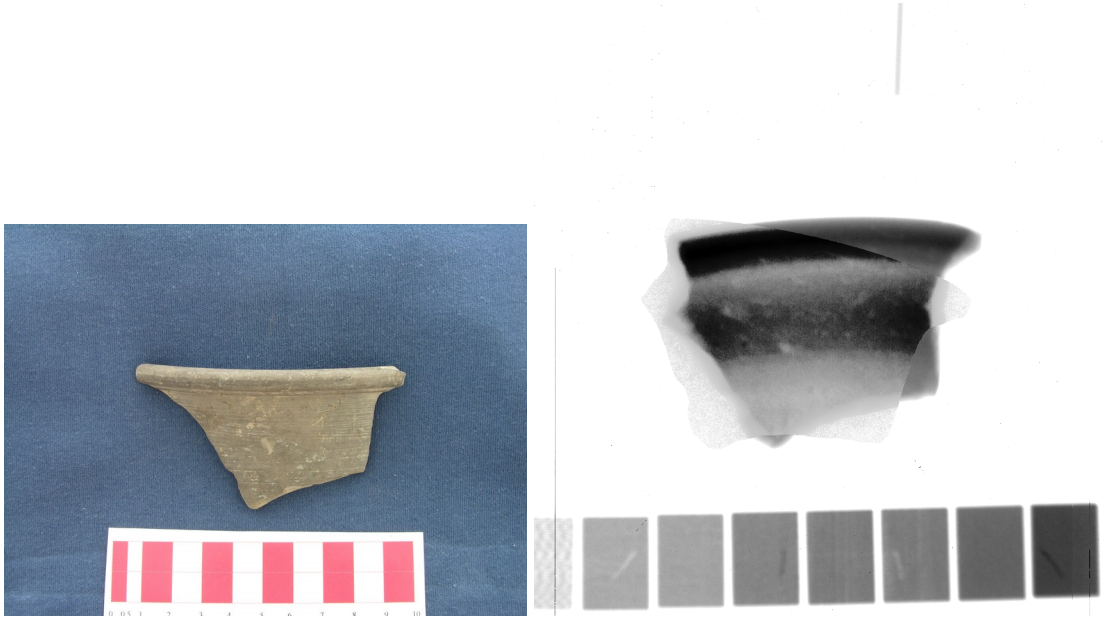
(a) Exterior (b) Interior

Figure B.40: Huizui Ceramic 0064



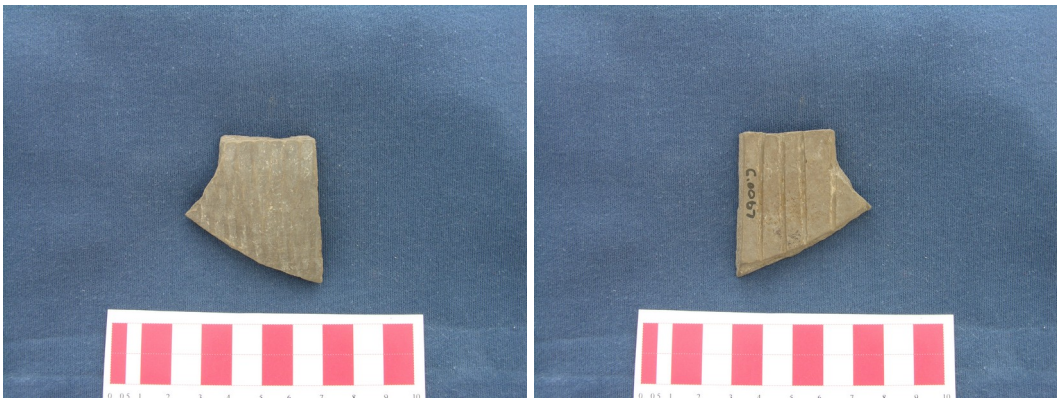
(a) Exterior (b) Radiograph

Figure B.41: Huizui Ceramic 0065 [MAE 2415]



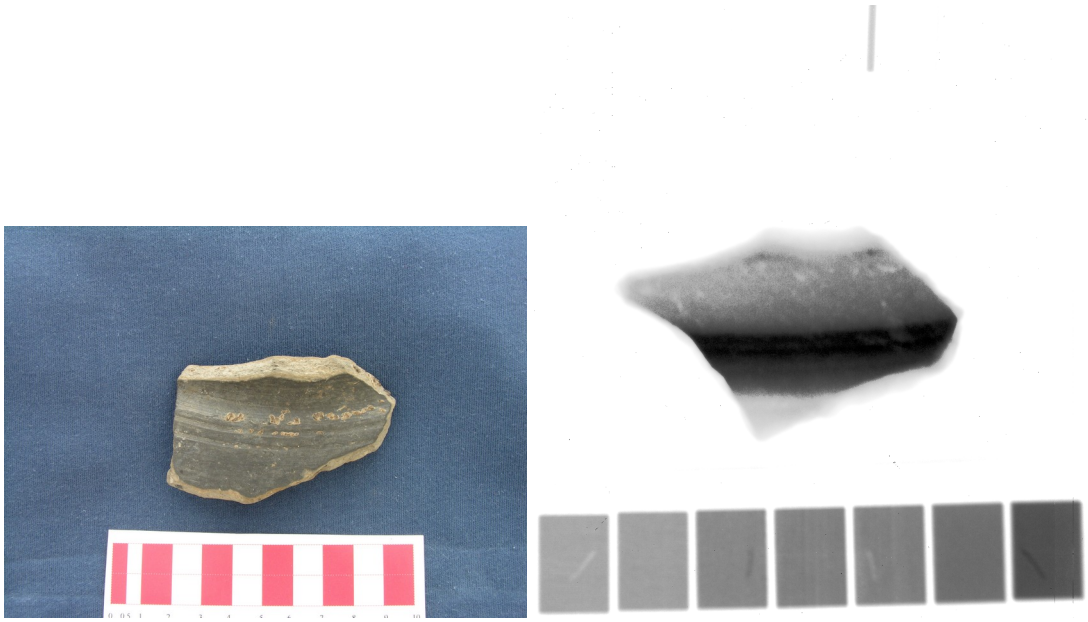
(a) Exterior (b) Radiograph

Figure B.42: Huizui Ceramic 0066 [MAE 2416]



(a) Exterior (b) Interior

Figure B.43: Huizui Ceramic 0067



(a) Exterior (b) Radiograph

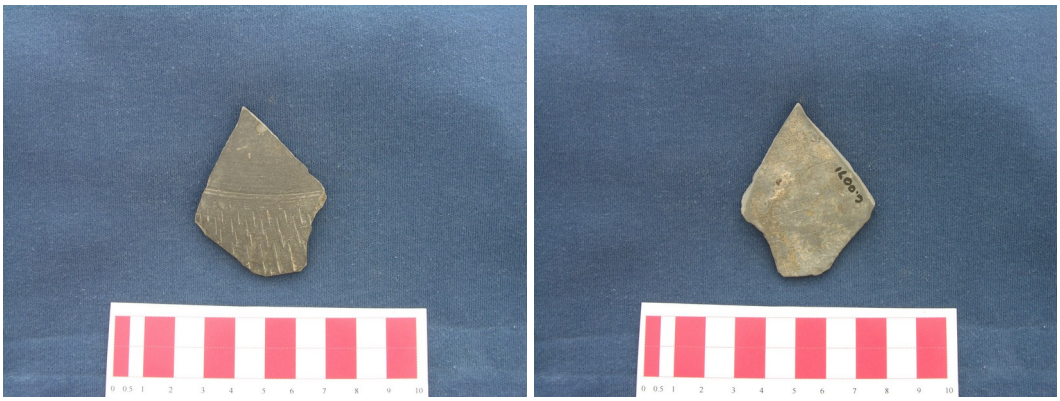
Figure B.44: Huizui Ceramic 0068 [MAE 2417]

(a) Exterior (b) Interior

Figure B.45: Huizui Ceramic 0069

(a) Exterior (b) Interior

Figure B.46: Huizui Ceramic 0070

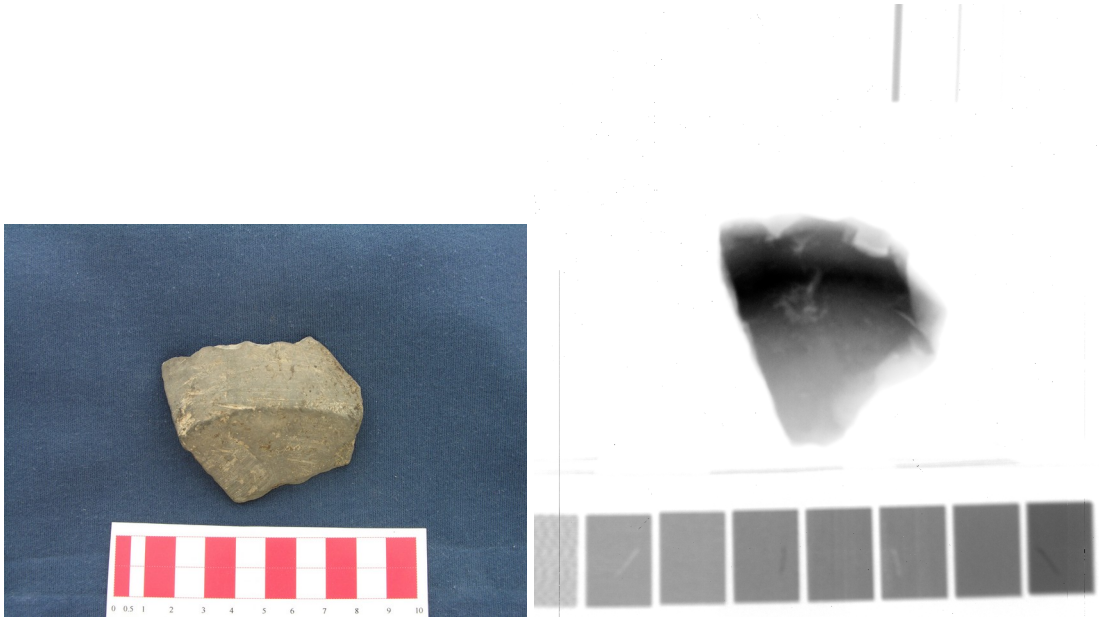


(a) Exterior (b) Interior

Figure B.47: Huizui Ceramic 0071

(a) Exterior (b) Interior

Figure B.48: Huizui Ceramic 0072

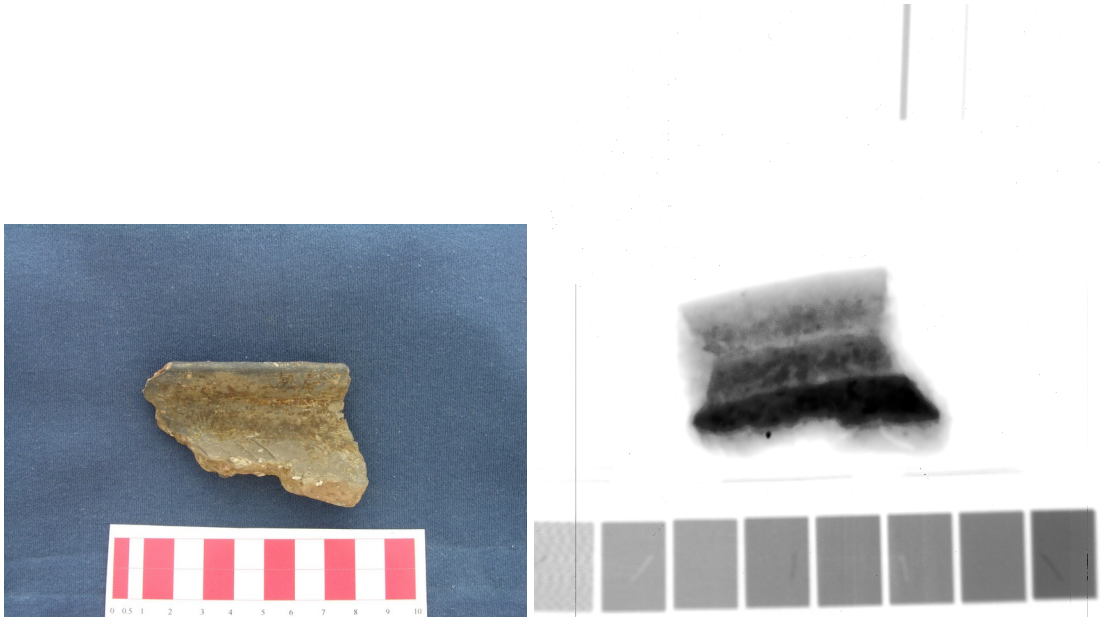


(a) Exterior (b) Radiograph

Figure B.49: Huizui Ceramic 0073 [MAE 2418]

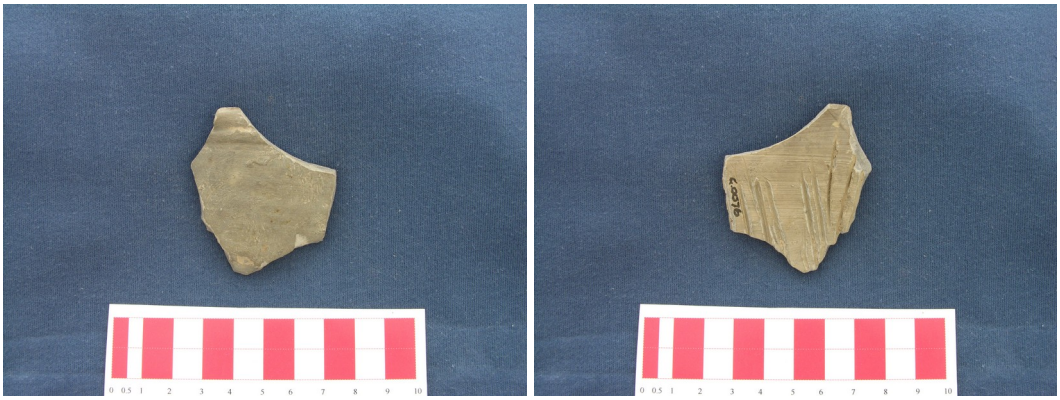
(a) Exterior (b) Interior

Figure B.50: Huizui Ceramic 0074



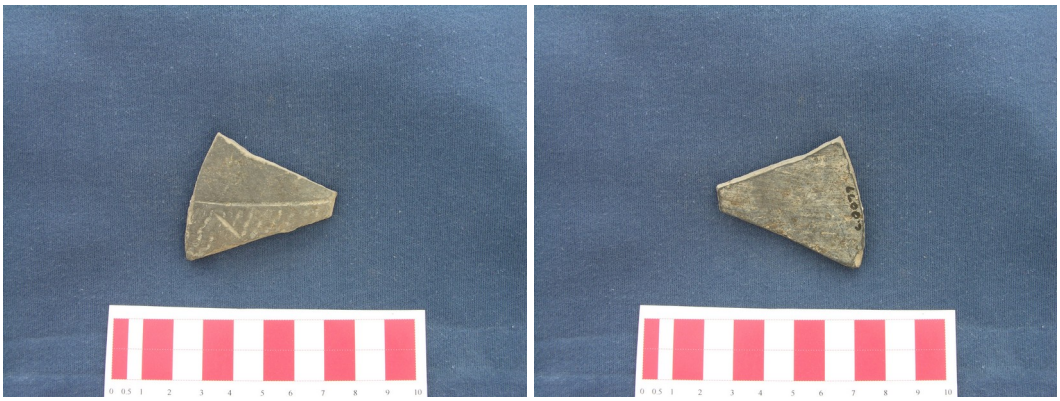
(a) Exterior (b) Radiograph

Figure B.51: Huizui Ceramic 0075 [MAE 2419]



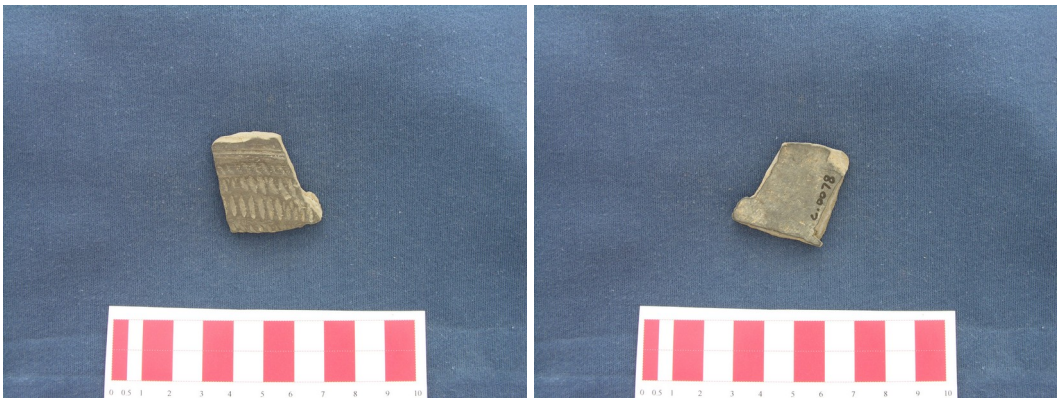
(a) Exterior (b) Interior

Figure B.52: Huizui Ceramic 0076



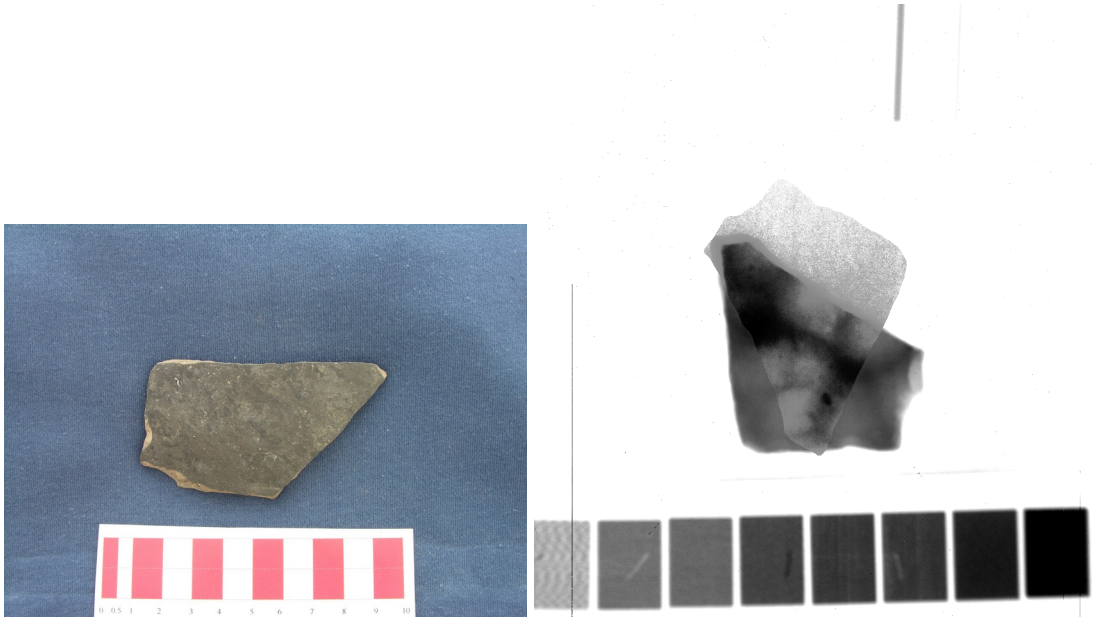
(a) Exterior (b) Interior

Figure B.53: Huizui Ceramic 0077



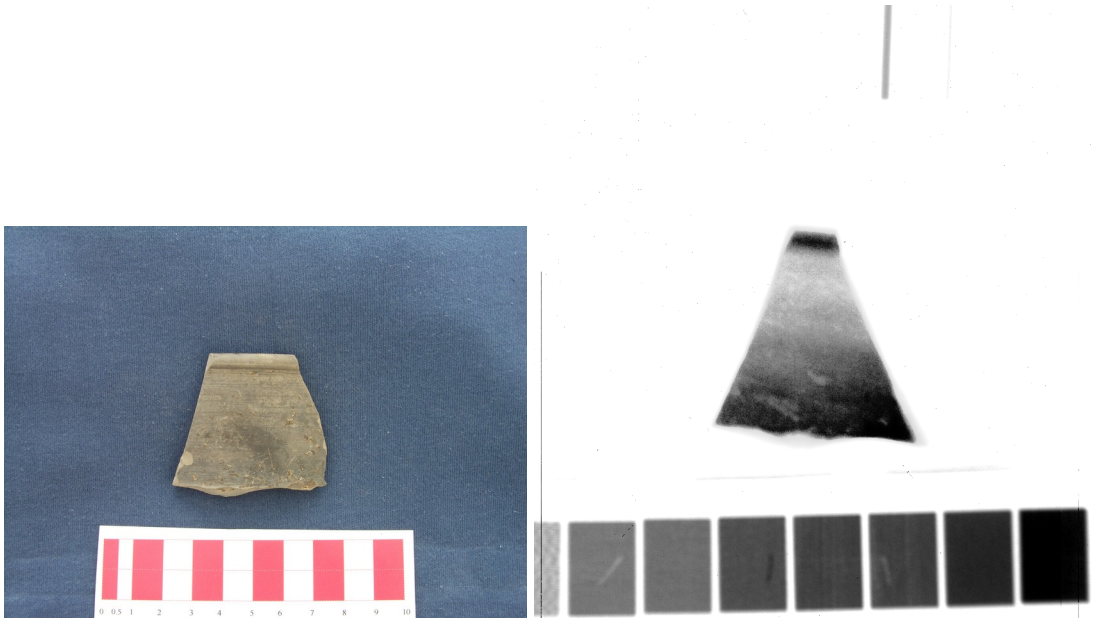
(a) Exterior (b) Interior

Figure B.54: Huizui Ceramic 0078



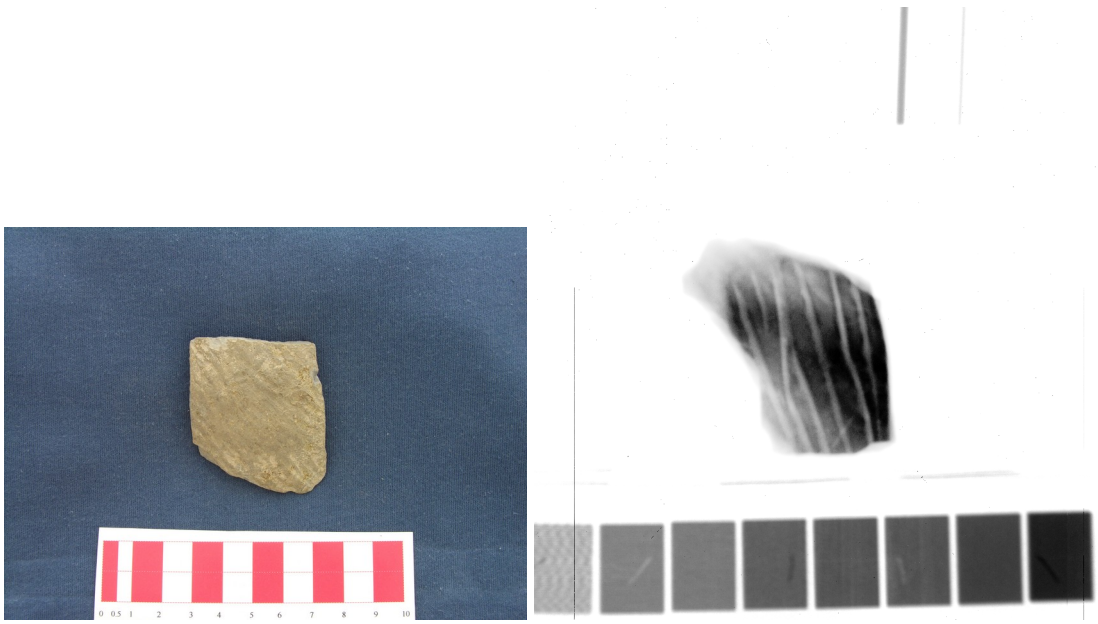
(a) Exterior (b) Radiograph

Figure B.55: Huizui Ceramic 0079 [MAE 2420]



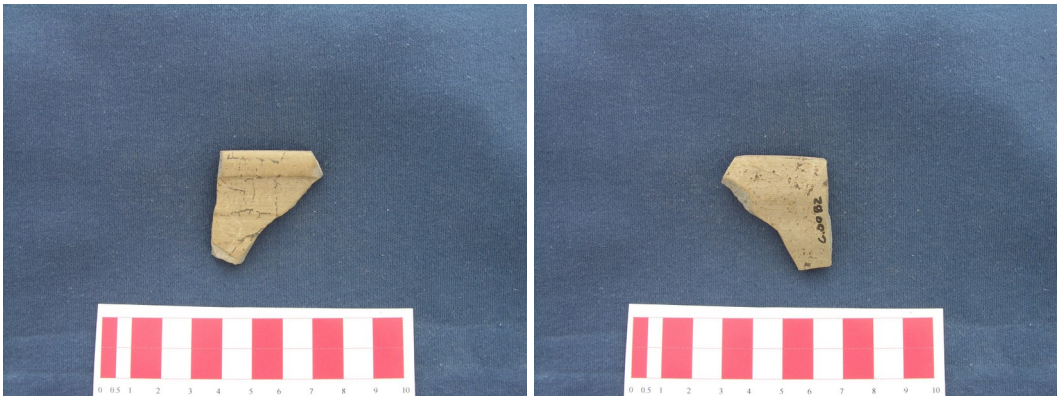
(a) Exterior (b) Radiograph

Figure B.56: Huizui Ceramic 0080 [MAE 2421]



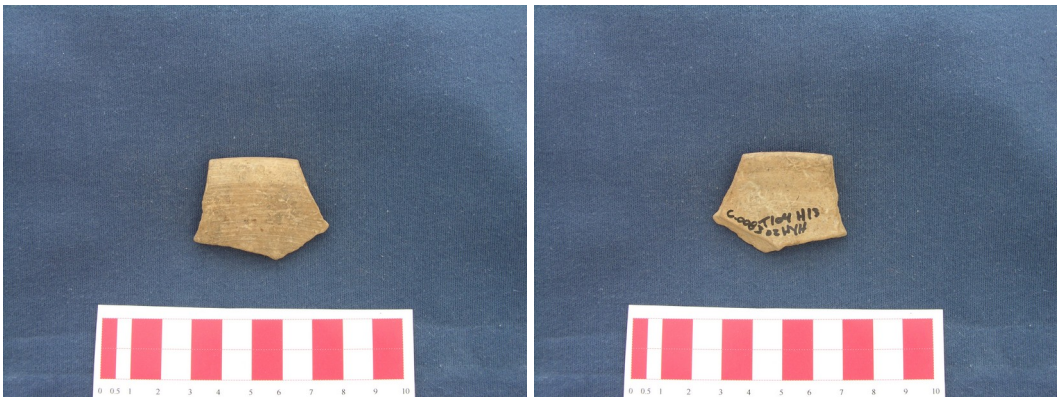
(a) Exterior (b) Radiograph

Figure B.57: Huizui Ceramic 0081 [MAE 2422]



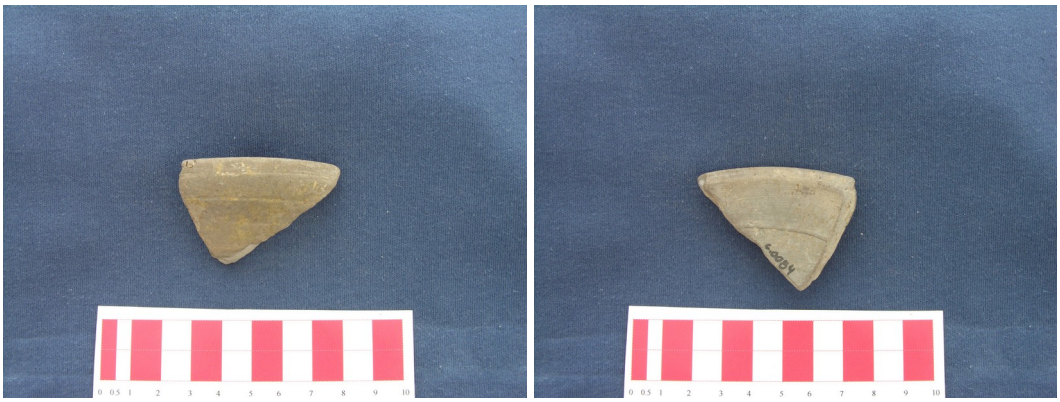
(a) Exterior (b) Interior

Figure B.58: Huizui Ceramic 0082



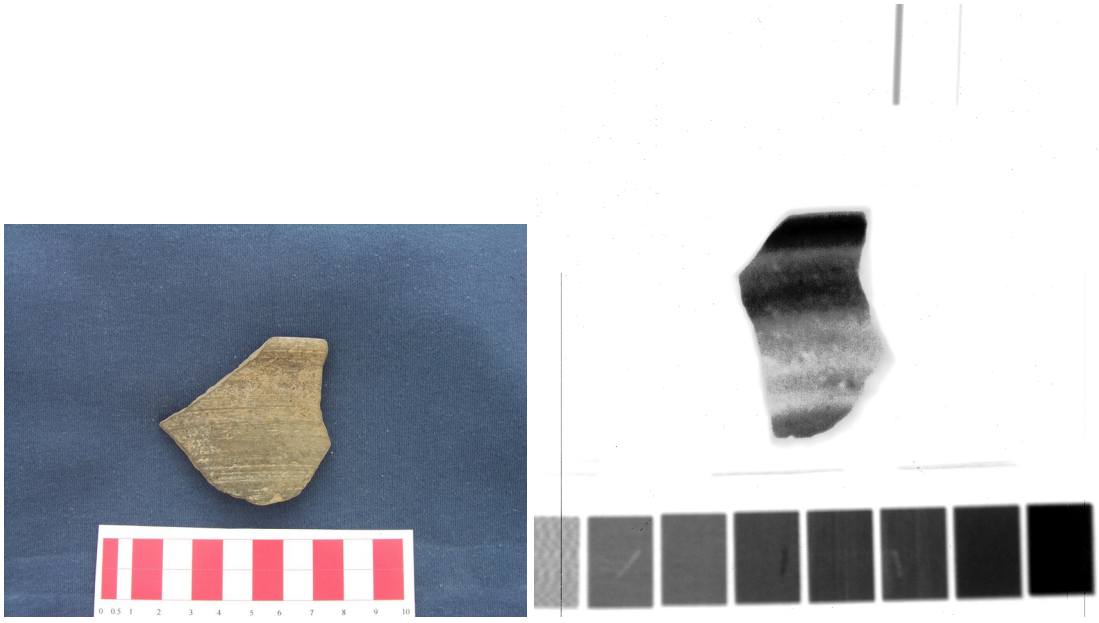
(a) Exterior (b) Interior

Figure B.59: Huizui Ceramic 0083



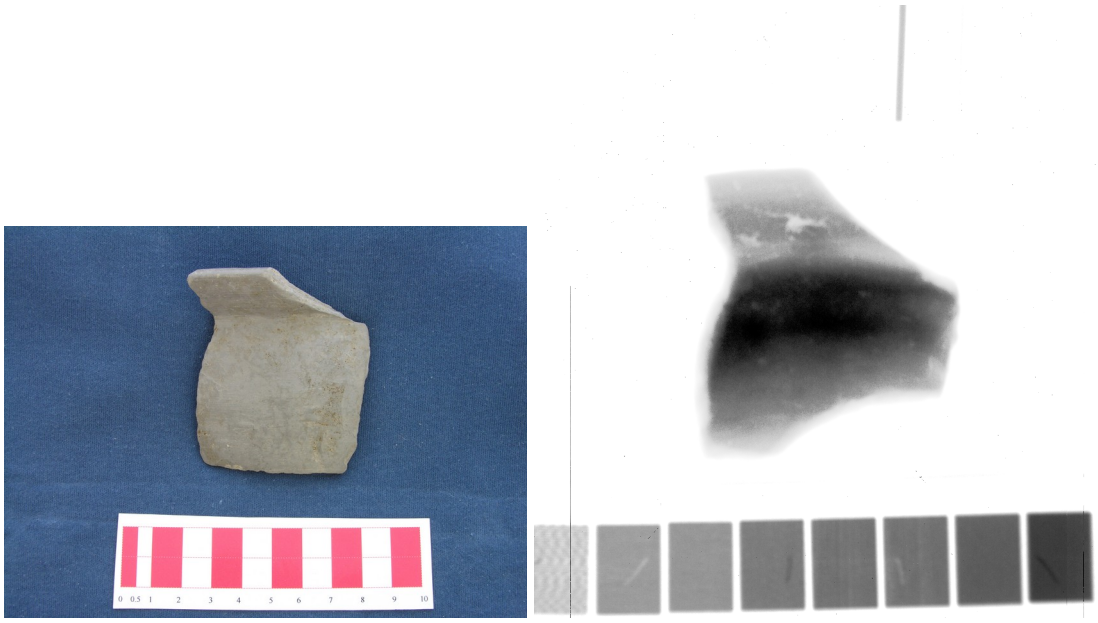
(a) Exterior (b) Interior

Figure B.60: Huizui Ceramic 0084



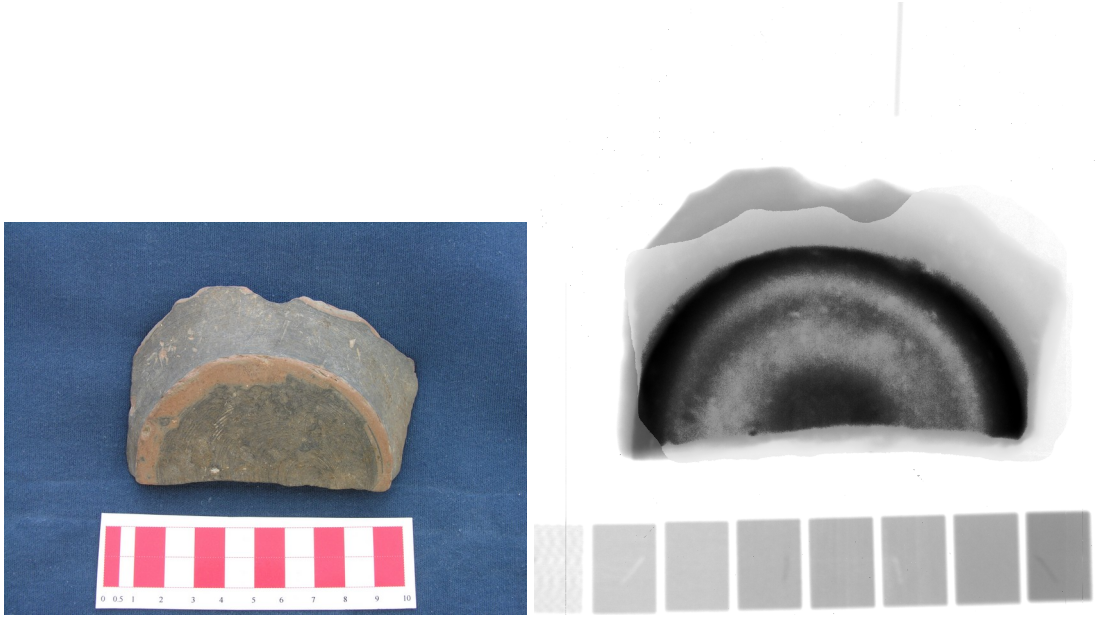
(a) Exterior (b) Radiograph

Figure B.61: Huizui Ceramic 0085 [MAE 2423]



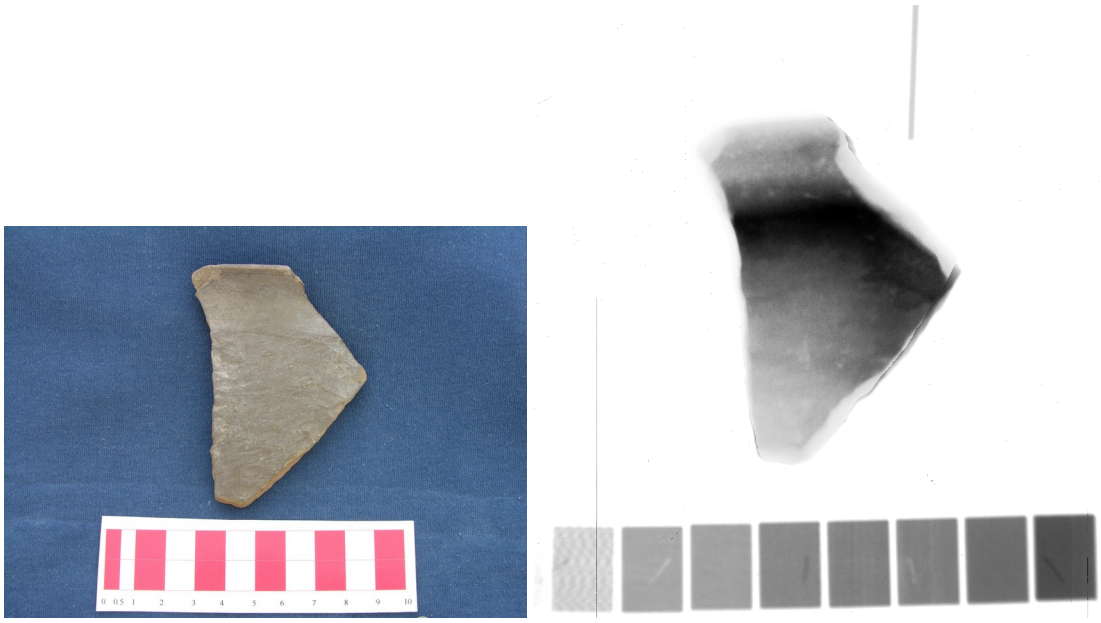
(a) Exterior (b) Radiograph

Figure B.62: Huizui Ceramic 0086 [MAE 2424]



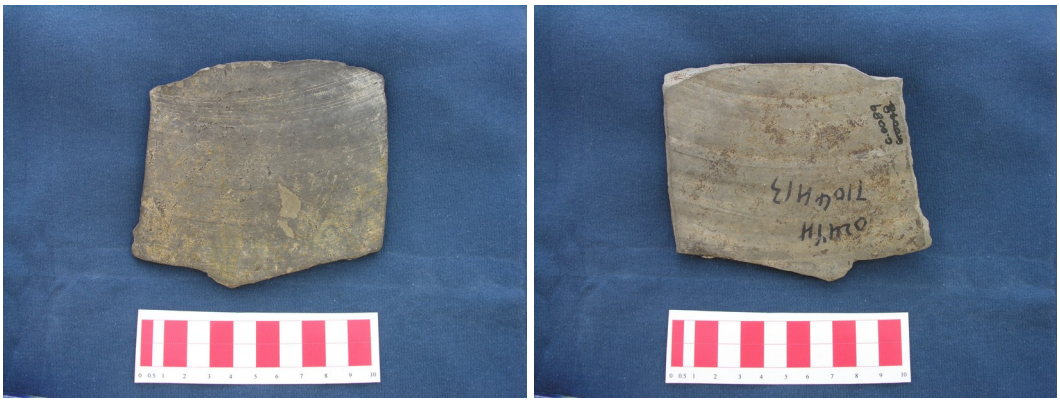
(a) Exterior (b) Radiograph

Figure B.63: Huizui Ceramic 0087 [MAE 2425]



(a) Exterior (b) Radiograph

Figure B.64: Huizui Ceramic 0088 [MAE 2426]



(a) Exterior (b) Interior

Figure B.65: Huizui Ceramic 0089

(a) Exterior (b) Interior

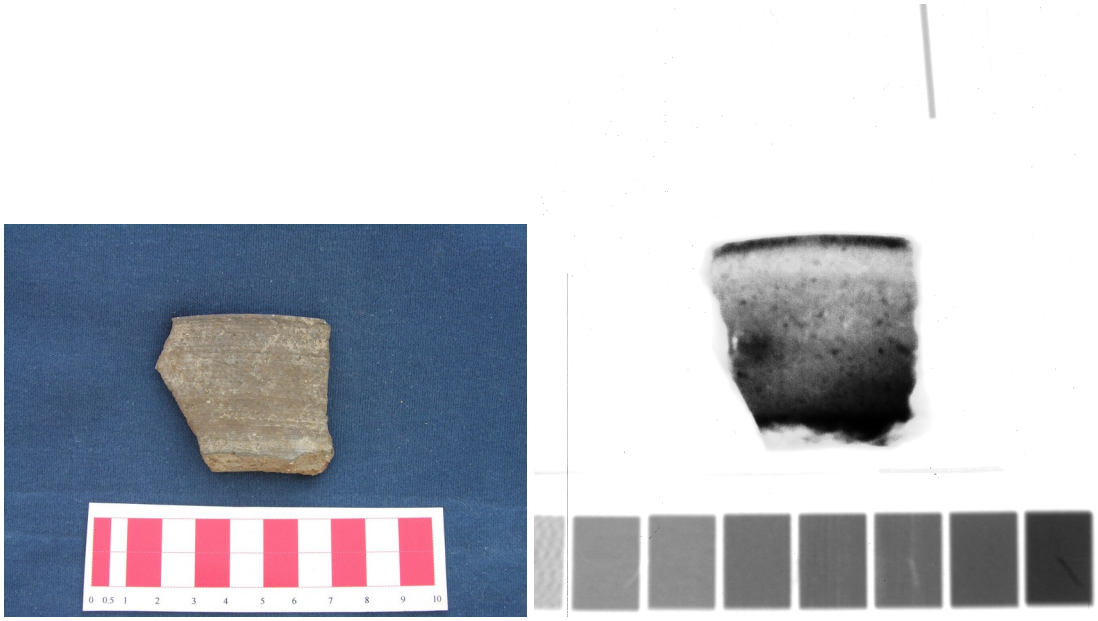
Figure B.66: Huizui Ceramic 0090

(a) Exterior (b) Interior

Figure B.67: Huizui Ceramic 0091

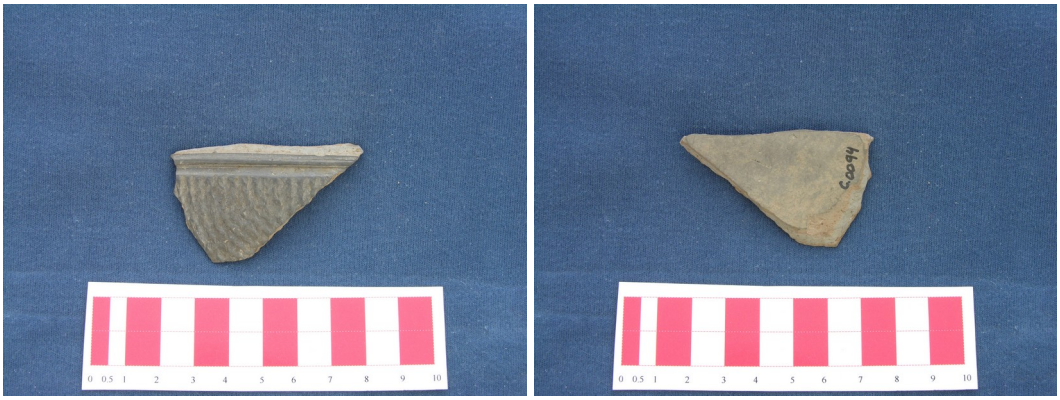
(a) Exterior (b) Interior

Figure B.68: Huizui Ceramic 0092



(a) Exterior (b) Radiograph

Figure B.69: Huizui Ceramic 0093 [MAE 2427]

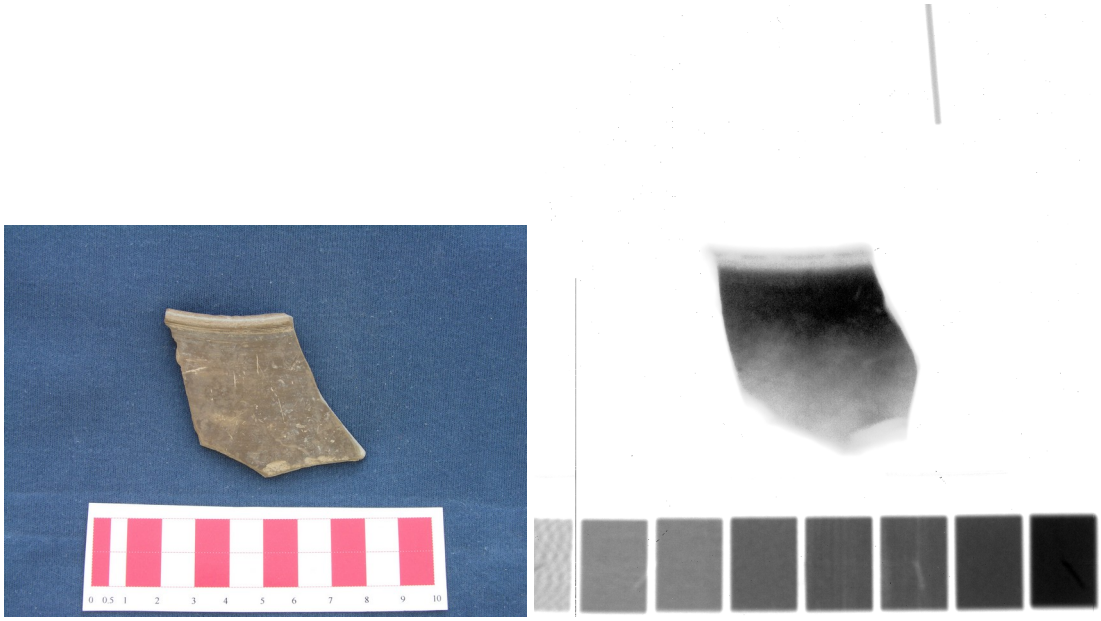


(a) Exterior (b) Interior

Figure B.70: Huizui Ceramic 0094

(a) Exterior (b) Interior

Figure B.71: Huizui Ceramic 0095

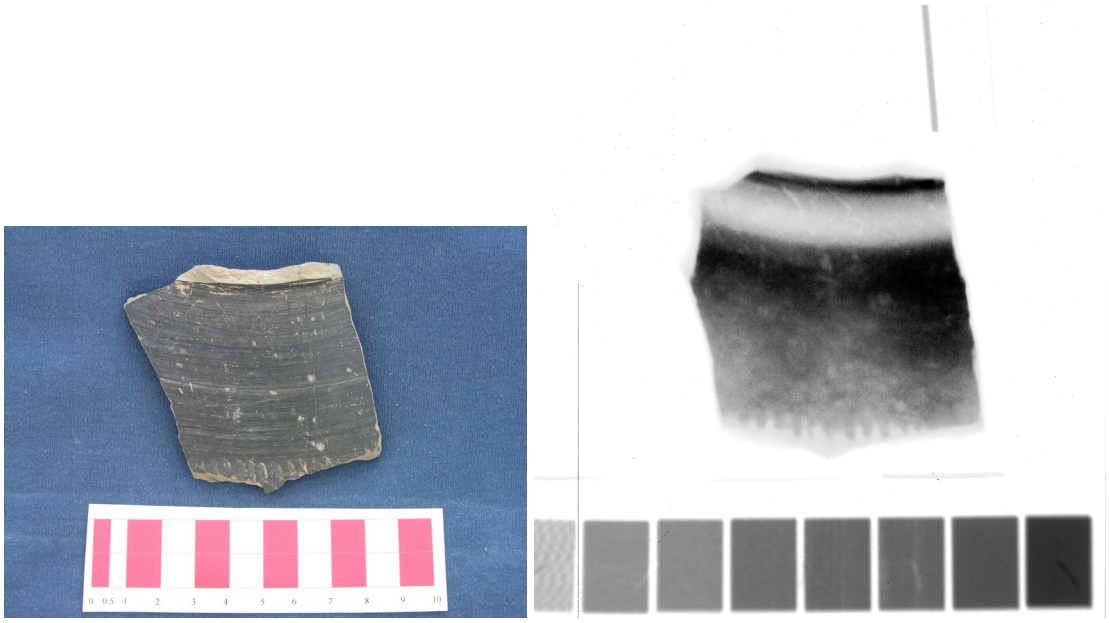


(a) Exterior (b) Radiograph

Figure B.72: Huizui Ceramic 0096 [MAE 2428]

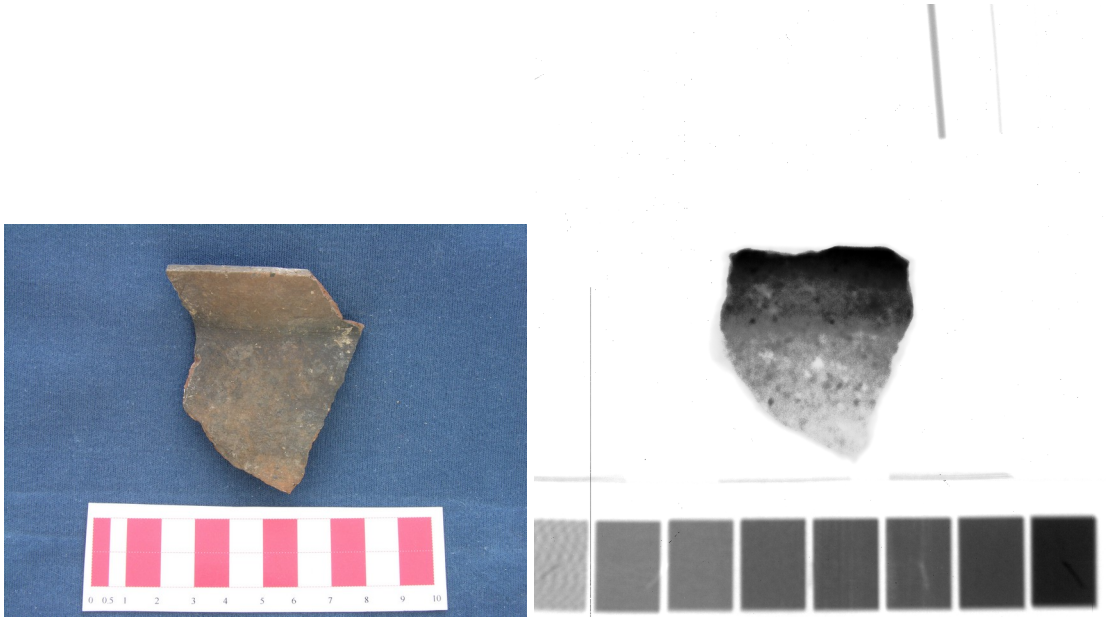
(a) Exterior (b) Interior

Figure B.73: Huizui Ceramic 0097



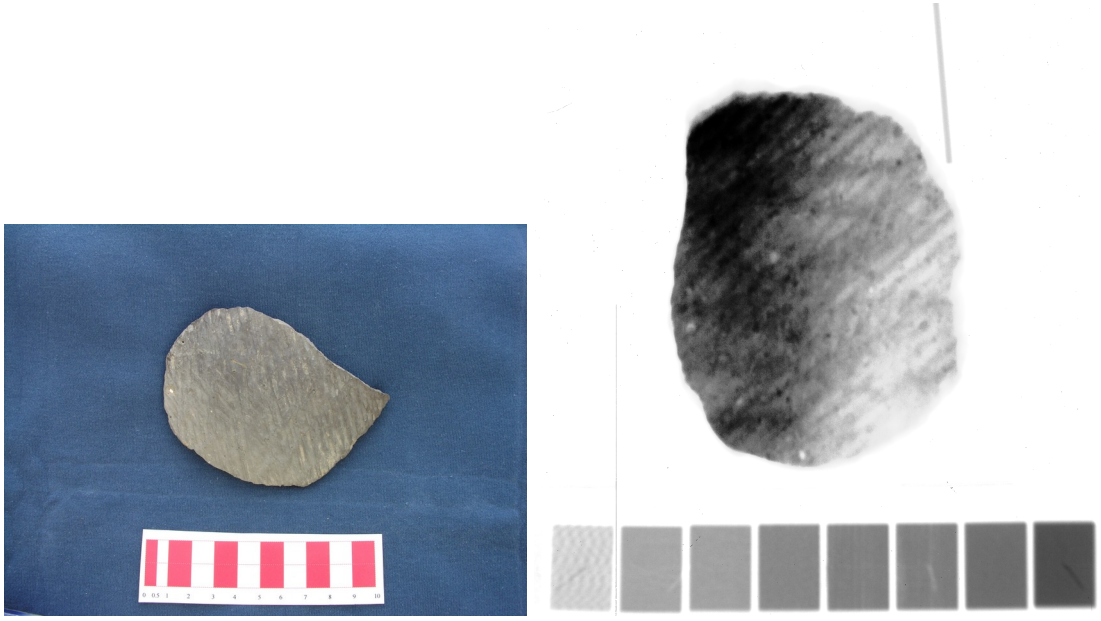
(a) Exterior (b) Radiograph

Figure B.74: Huizui Ceramic 0098 [MAE 2429]



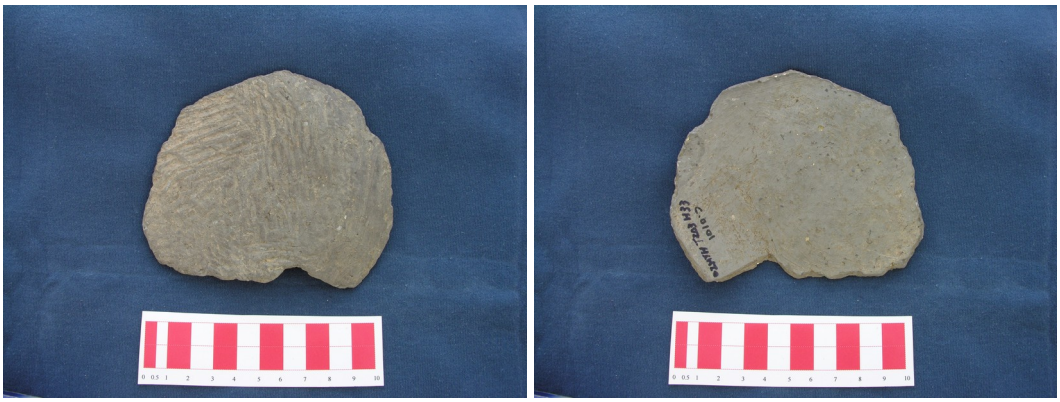
(a) Exterior (b) Radiograph

Figure B.75: Huizui Ceramic 0099 [MAE 2430]



(a) Exterior (b) Radiograph

Figure B.76: Huizui Ceramic 0100 [MAE 2431]

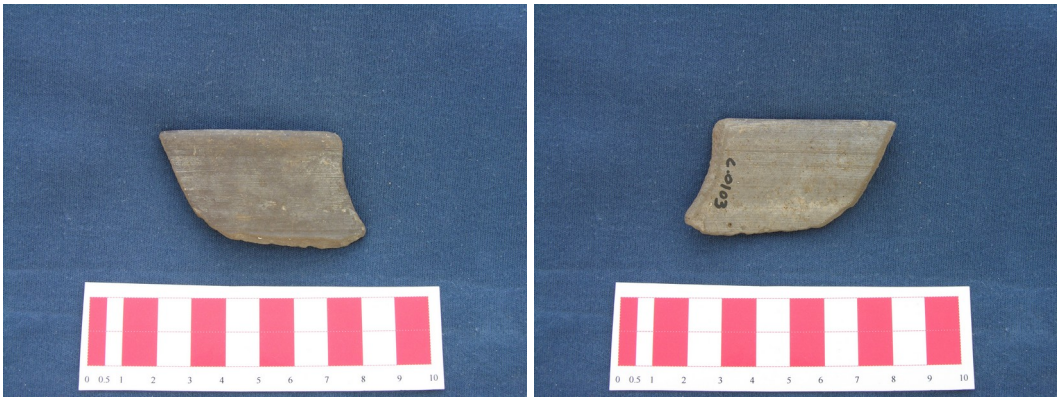


(a) Exterior (b) Interior

Figure B.77: Huizui Ceramic 0101

(a) Exterior (b) Interior

Figure B.78: Huizui Ceramic 0102



(a) Exterior (b) Interior

Figure B.79: Huizui Ceramic 0103

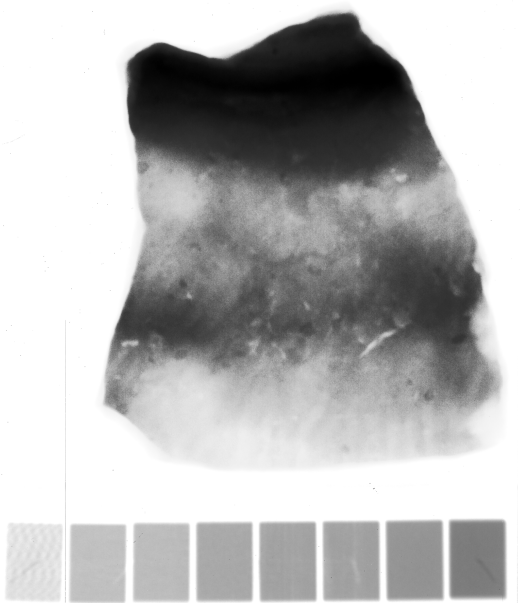
(a) Exterior (b) Radiograph

Figure B.80: Huizui Ceramic 0104 [MAE 2432]

(a) Exterior (b) Interior

Figure B.81: Huizui Ceramic 0105

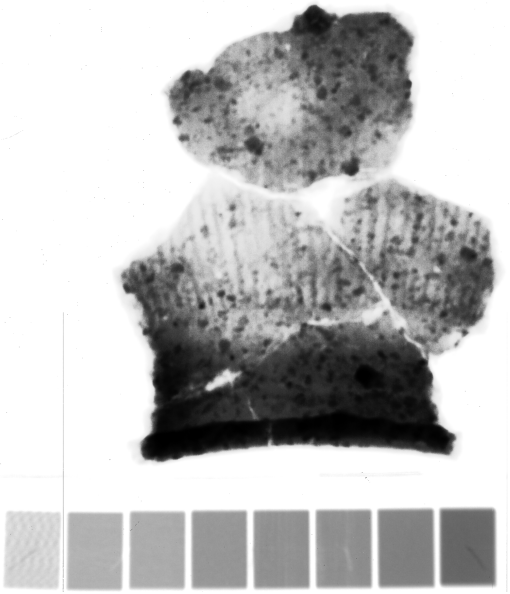
(a) Exterior



(b) Radiograph

Figure B.82: Huizui Ceramic 0106 [MAE 2433]

(a) Exterior



(b) Radiograph

Figure B.83: Huizui Ceramic 0107 [MAE 2434]

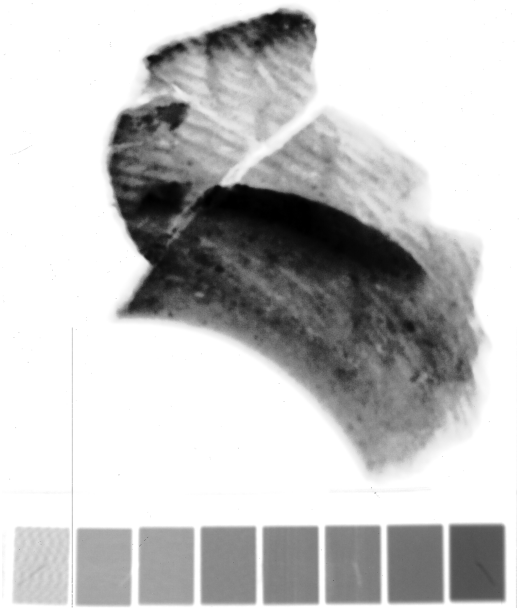
(a) Exterior (b) Interior

Figure B.84: Huizui Ceramic 0108

(a) Exterior (b) Radiograph

Figure B.85: Huizui Ceramic 0109 [MAE 2435a]

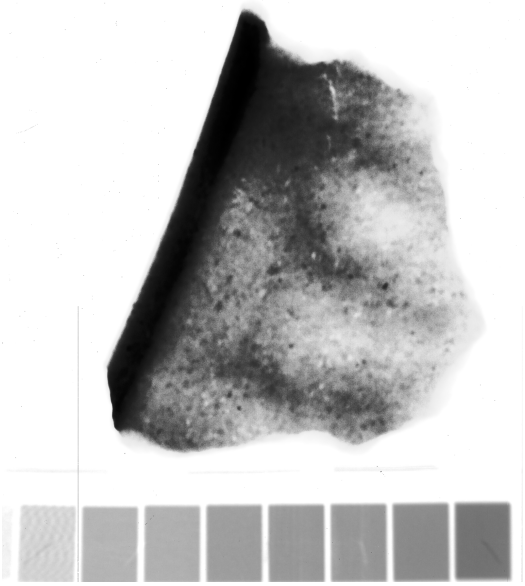
(a) Exterior



(b) Radiograph

Figure B.86: Huizui Ceramic 0109 [MAE 2435b]

(a) Exterior

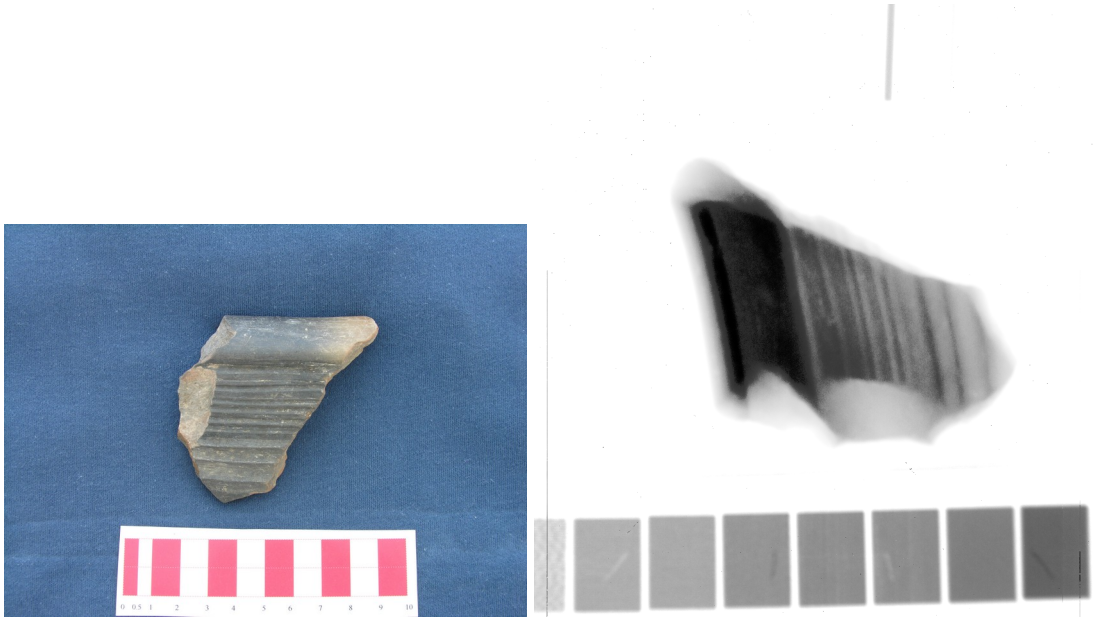


(b) Radiograph

Figure B.87: Huizui Ceramic 0110 [MAE 2436]

(a) Exterior (b) Interior

Figure B.88: Huizui Ceramic 0111

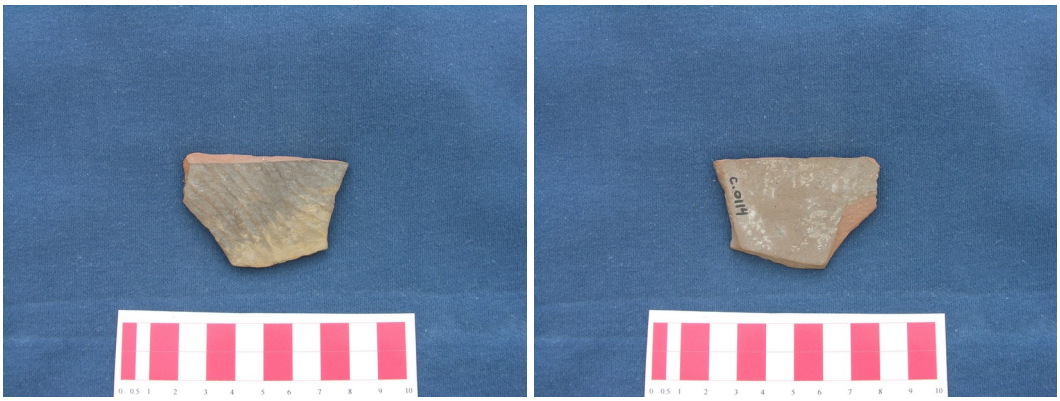


(a) Exterior (b) Radiograph

Figure B.89: Huizui Ceramic 0112 [MAE 2437]

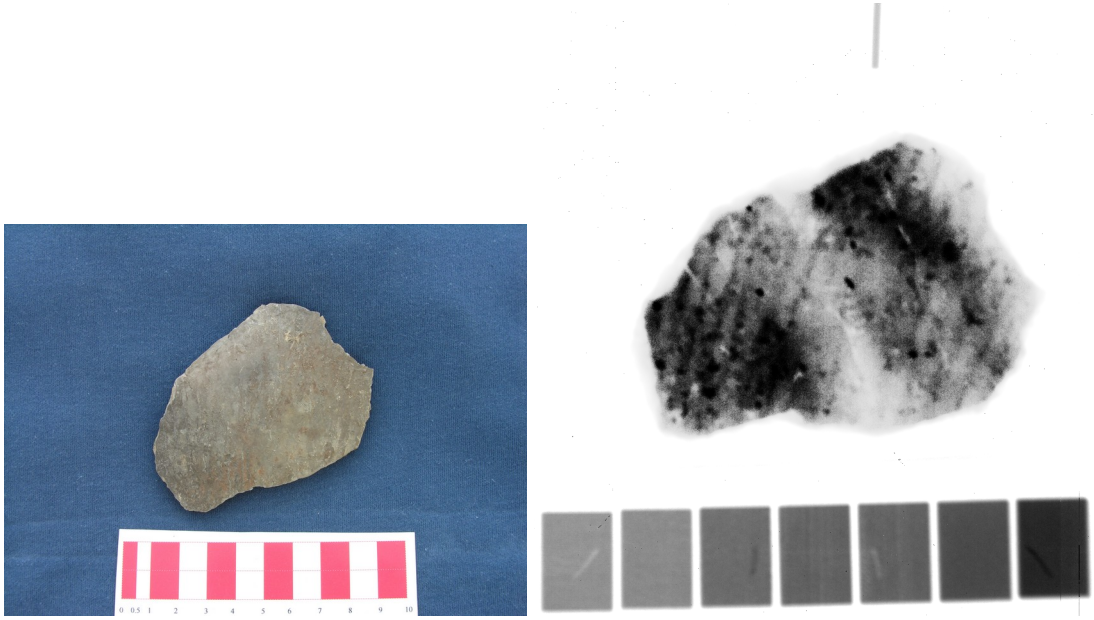
(a) Exterior (b) Interior

Figure B.90: Huizui Ceramic 0113



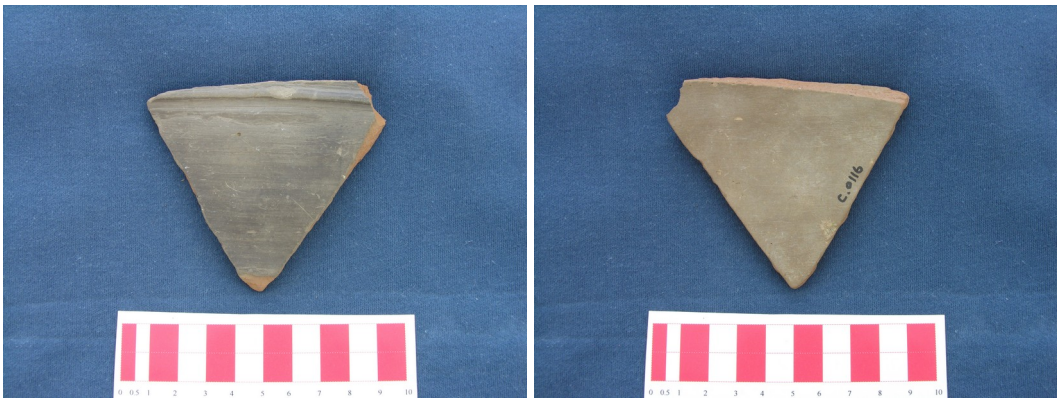
(a) Exterior (b) Interior

Figure B.91: Huizui Ceramic 0114



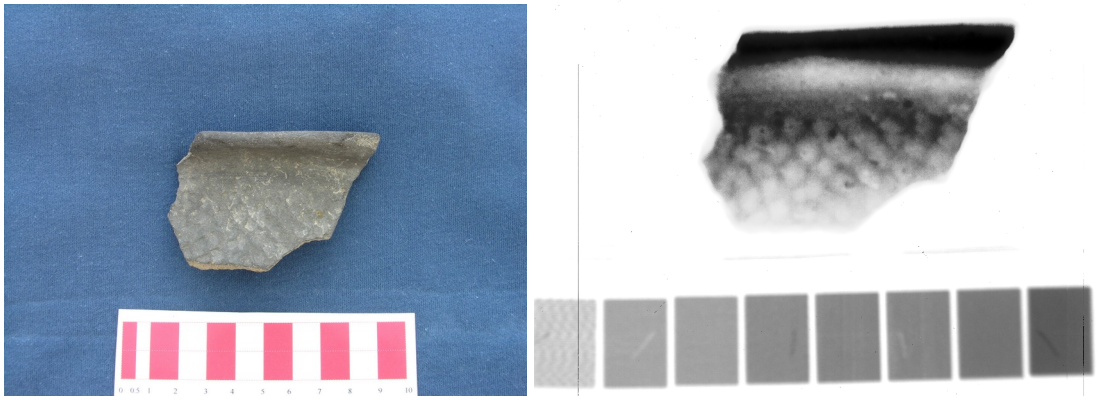
(a) Exterior (b) Radiograph

Figure B.92: Huizui Ceramic 0115 [MAE 2438]



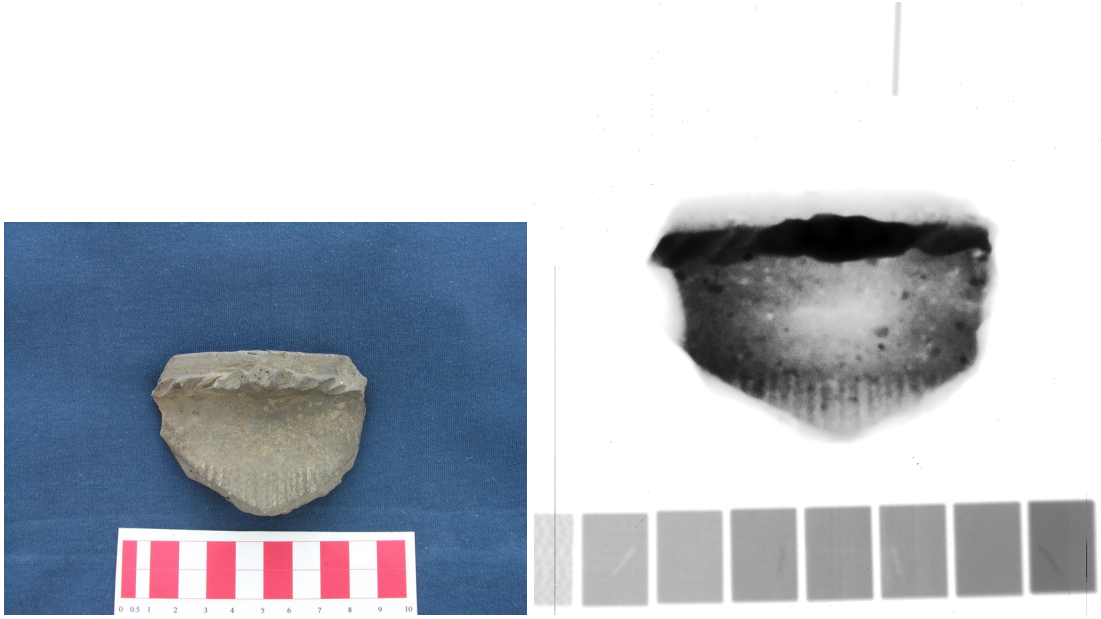
(a) Exterior (b) Interior

Figure B.93: Huizui Ceramic 0116



(a) Exterior (b) Radiograph

Figure B.94: Huizui Ceramic 0117 [MAE 2439]

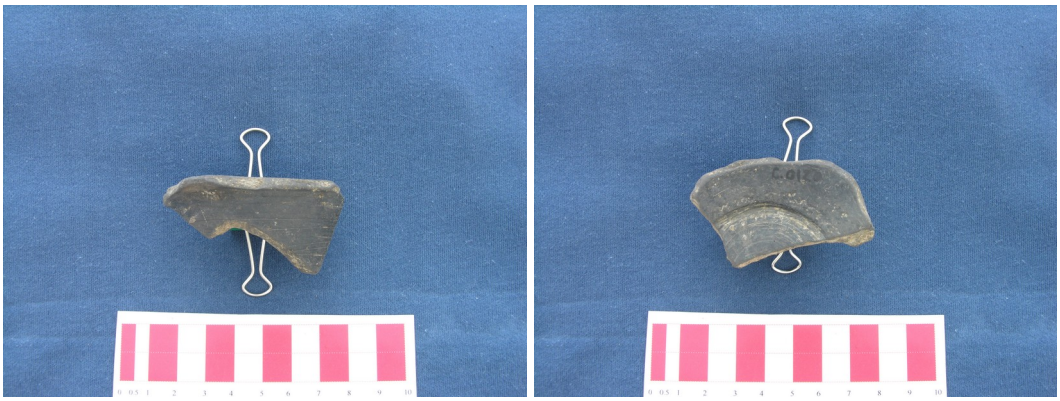


(a) Exterior (b) Radiograph

Figure B.95: Huizui Ceramic 0118 [MAE 2440]

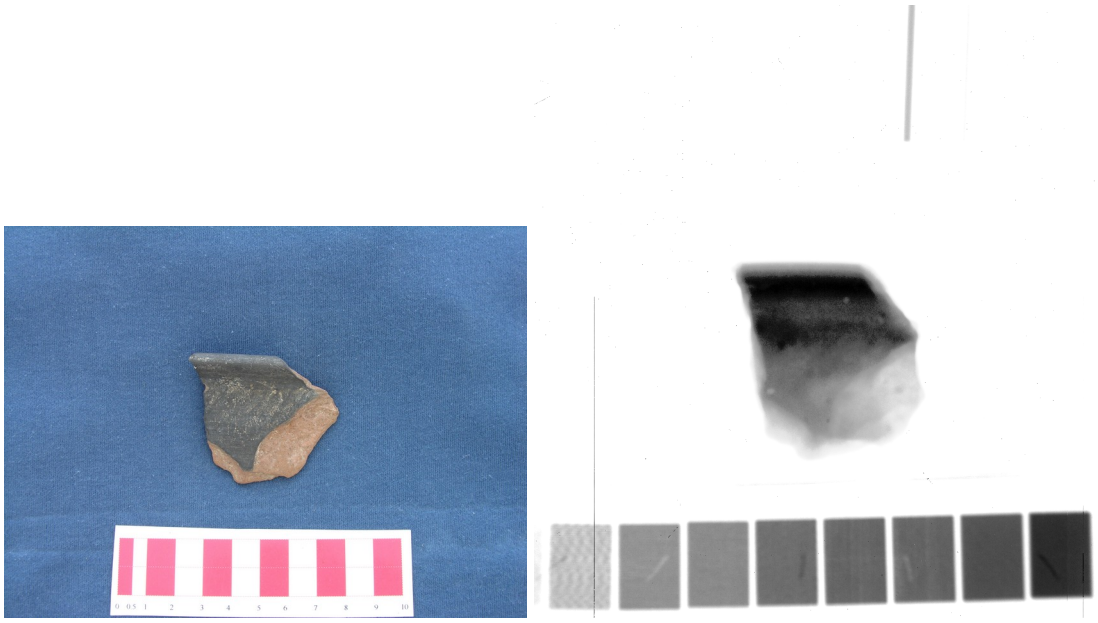
(a) Exterior (b) Interior

Figure B.96: Huizui Ceramic 0119



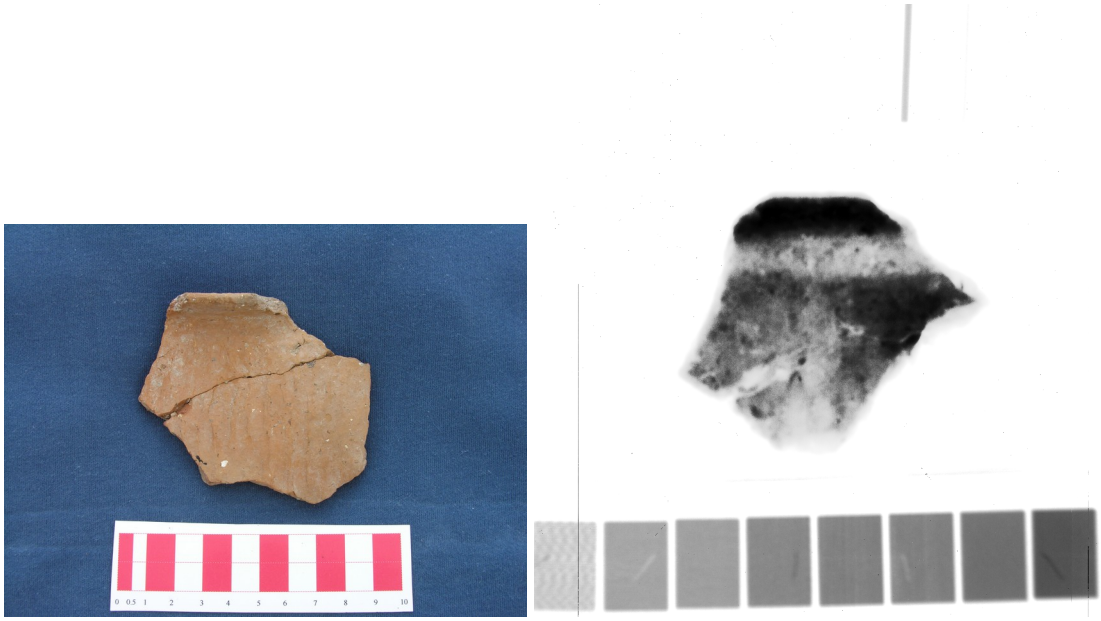
(a) Exterior (b) Interior

Figure B.97: Huizui Ceramic 0120



(a) Exterior (b) Radiograph

Figure B.98: Huizui Ceramic 0121 [MAE 2441]

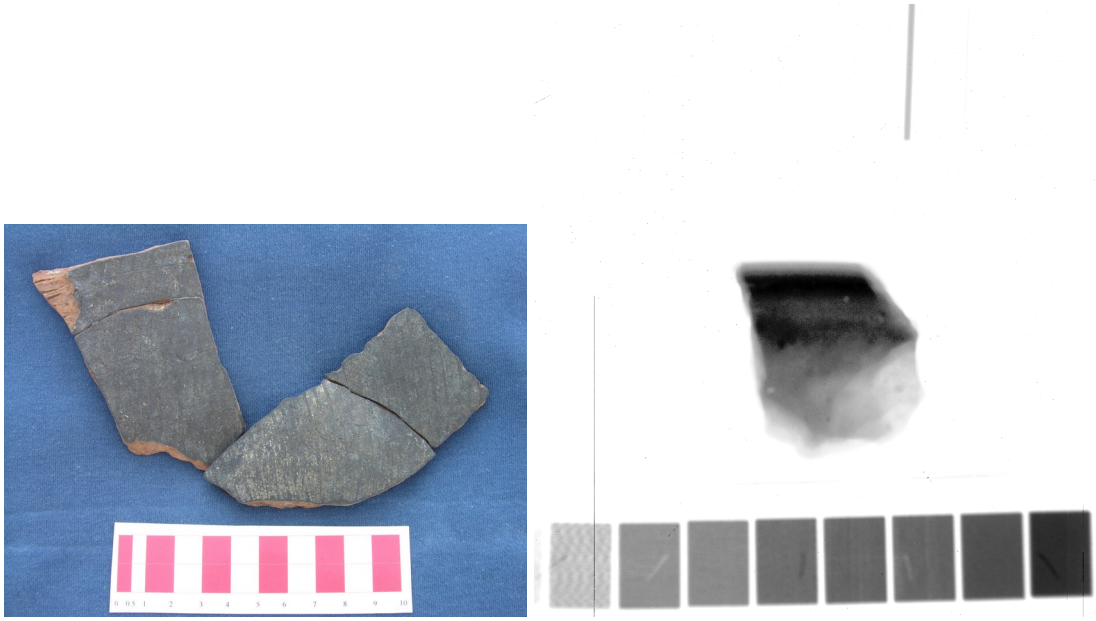


(a) Exterior (b) Radiograph

Figure B.99: Huizui Ceramic 0122 [MAE 2442]

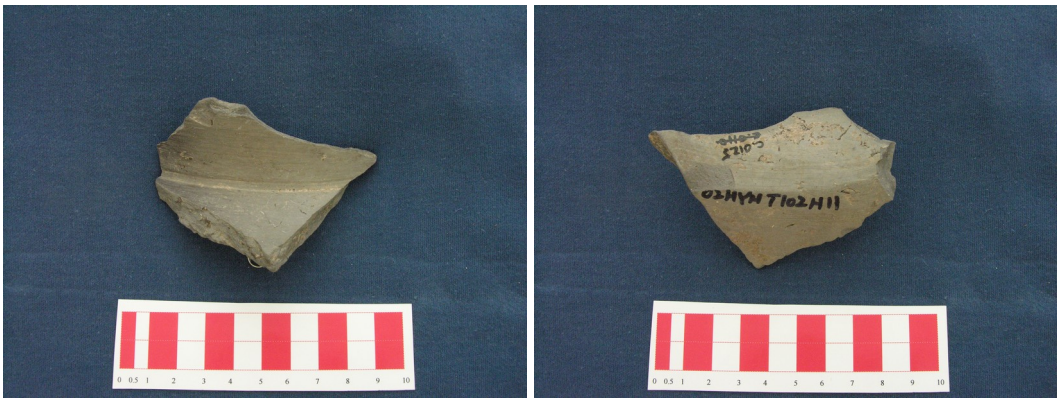
(a) Exterior (b) Interior

Figure B.100: Huizui Ceramic 0123



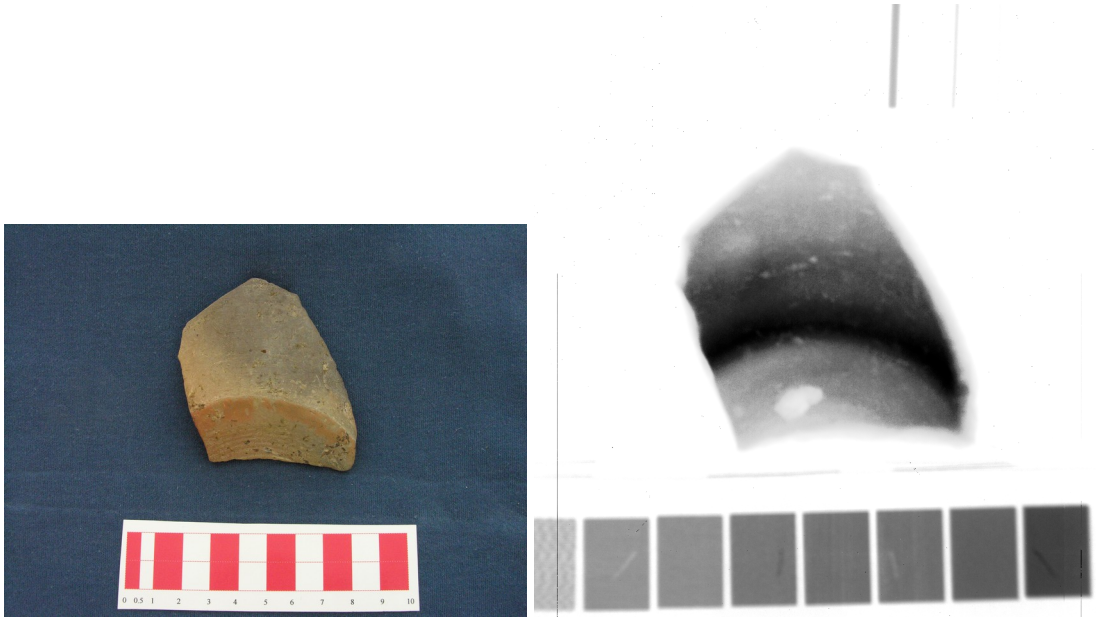
(a) Exterior (b) Radiograph

Figure B.101: Huizui Ceramic 0124 [MAE 2443]



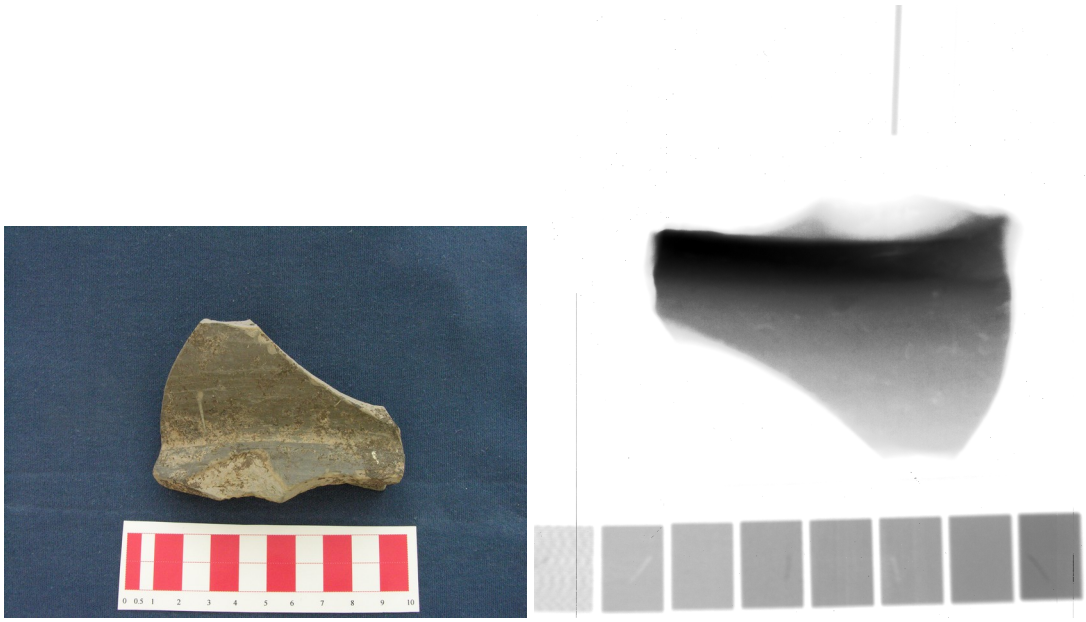
(a) Exterior (b) Interior

Figure B.102: Huizui Ceramic 0125



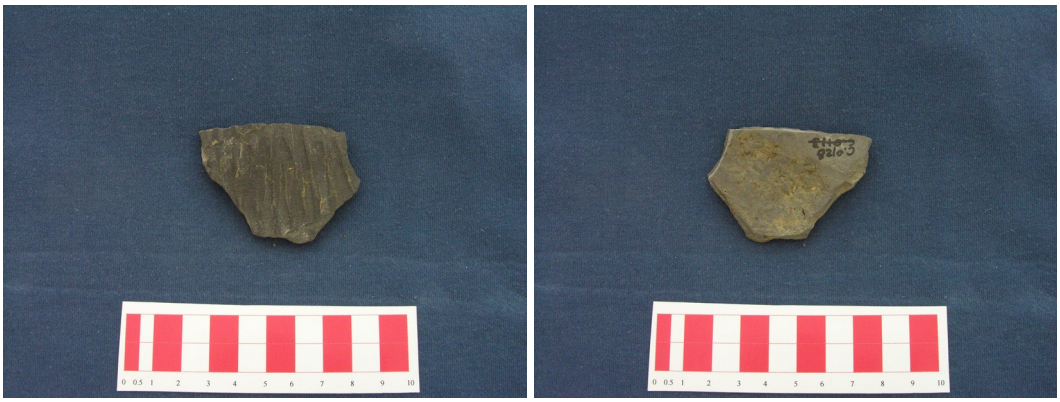
(a) Exterior (b) Radiograph

Figure B.103: Huizui Ceramic 0126 [MAE 2444]



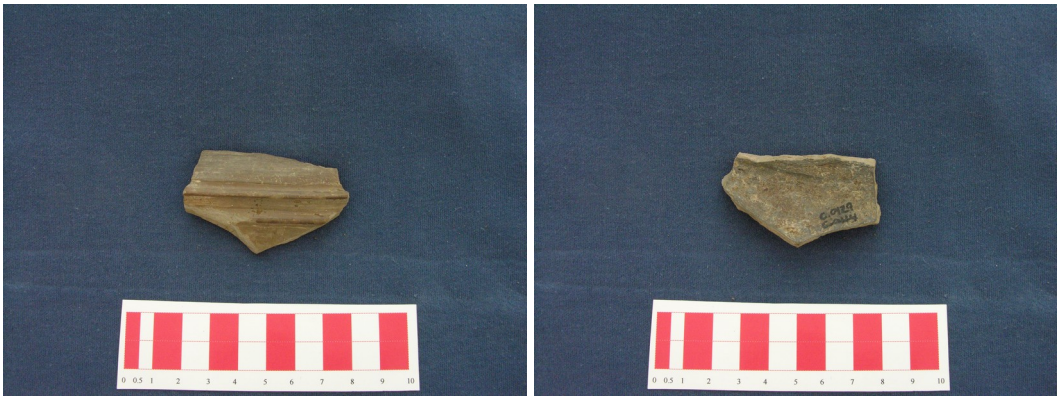
(a) Exterior (b) Radiograph

Figure B.104: Huizui Ceramic 0127 [MAE 2445]



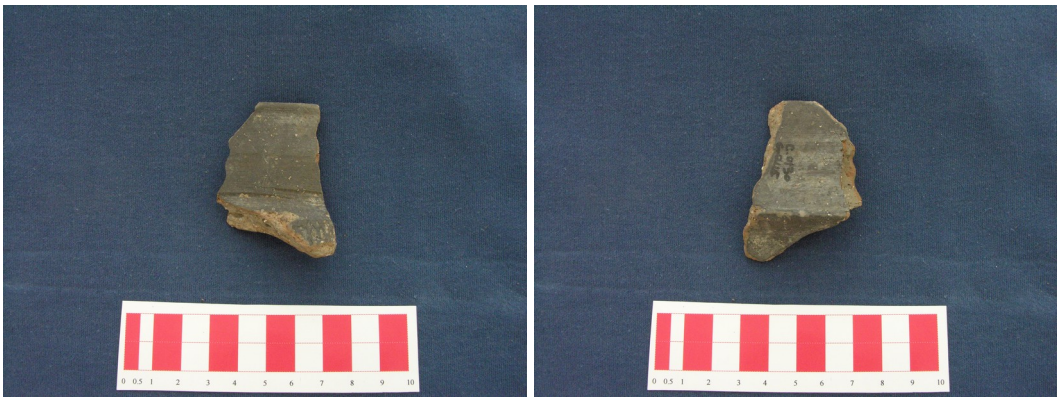
(a) Exterior (b) Interior

Figure B.105: Huizui Ceramic 0128



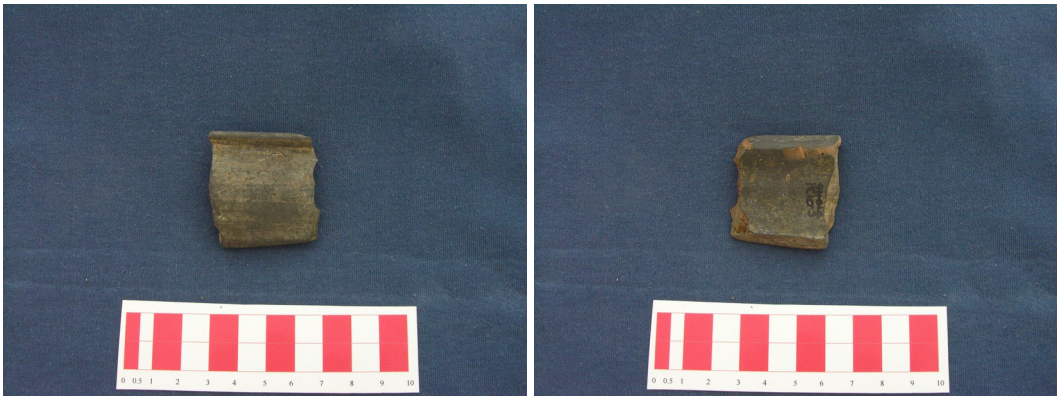
(a) Exterior (b) Interior

Figure B.106: Huizui Ceramic 0129



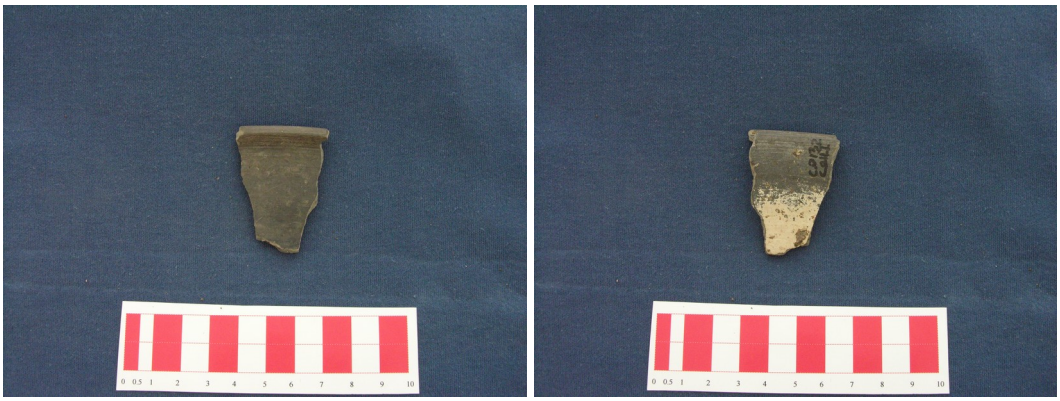
(a) Exterior (b) Interior

Figure B.107: Huizui Ceramic 0130



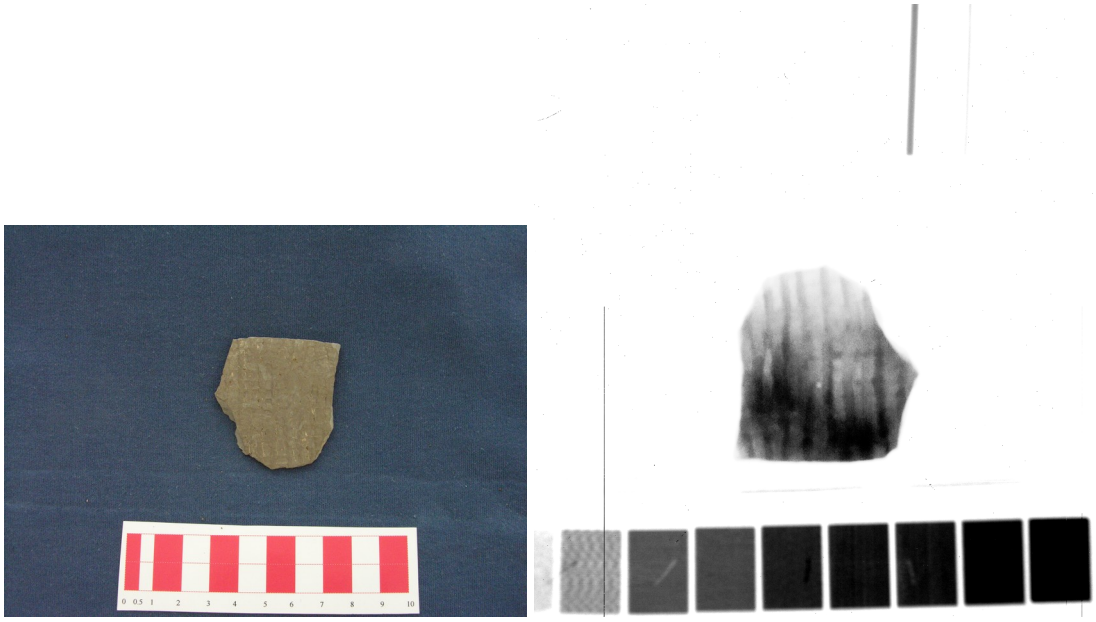
(a) Exterior (b) Interior

Figure B.108: Huizui Ceramic 0131



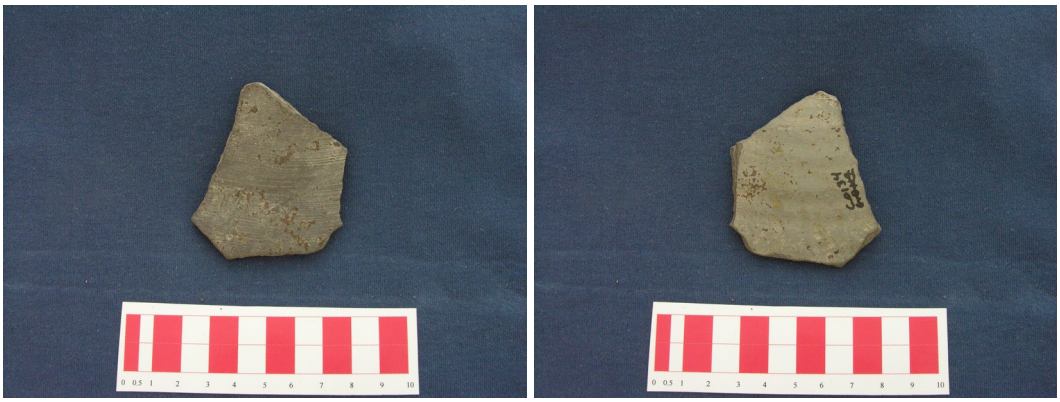
(a) Exterior (b) Interior

Figure B.109: Huizui Ceramic 0132



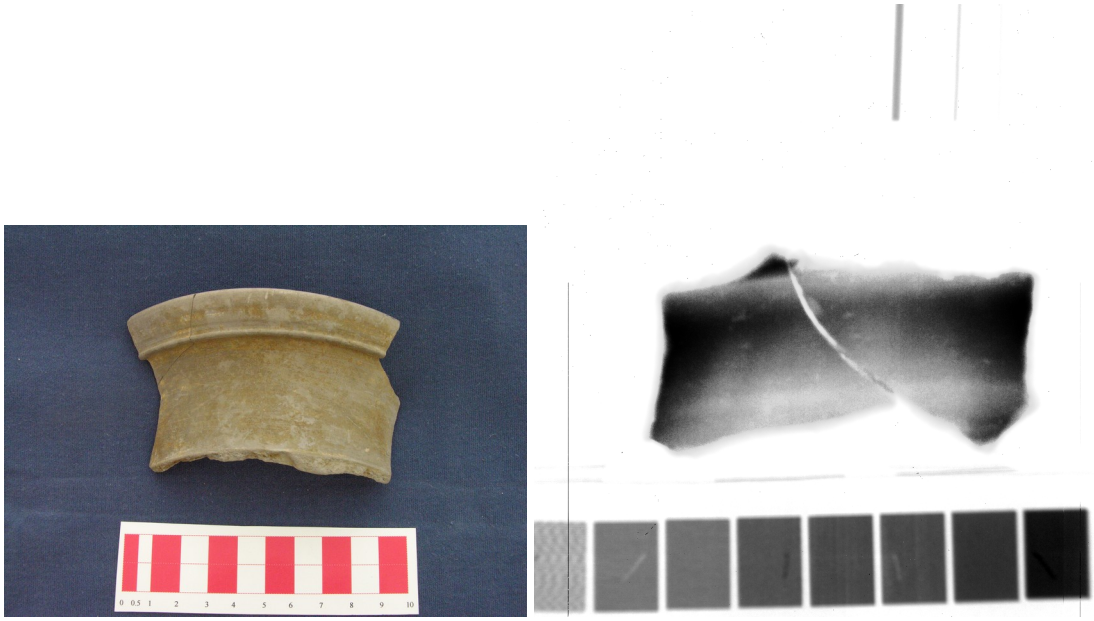
(a) Exterior (b) Radiograph

Figure B.110: Huizui Ceramic 0133 [MAE 2446]



(a) Exterior (b) Interior

Figure B.111: Huizui Ceramic 0134

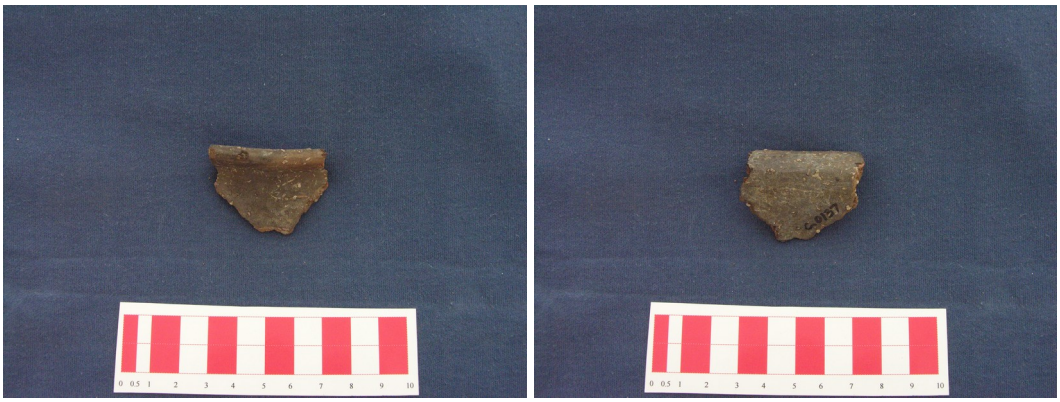


(a) Exterior (b) Radiograph

Figure B.112: Huizui Ceramic 0135 [MAE 2447]

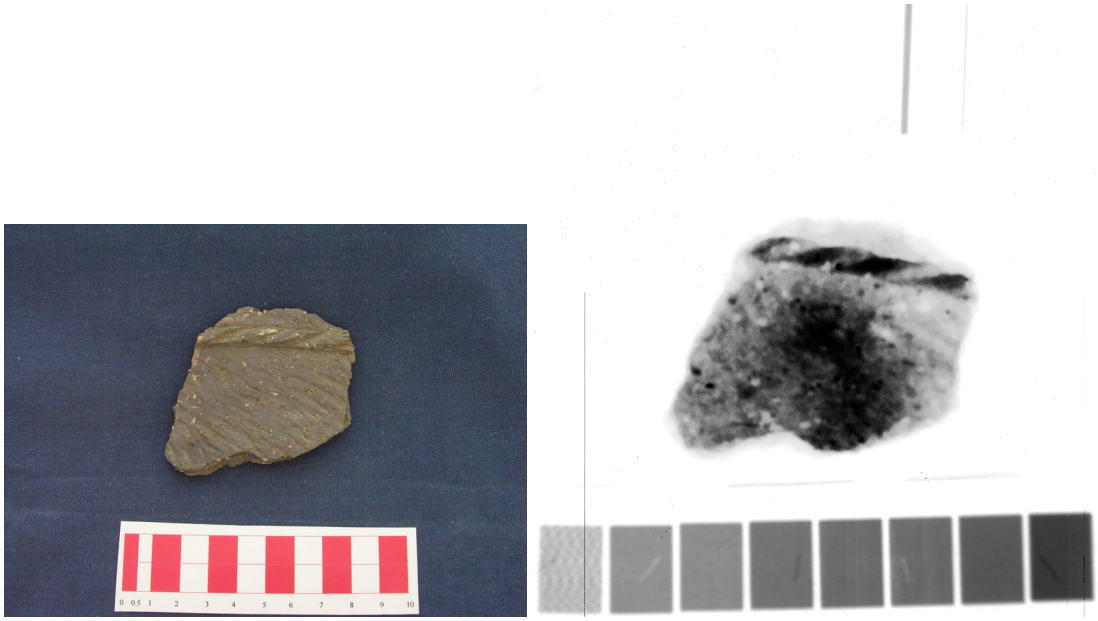
(a) Exterior (b) Interior

Figure B.113: Huizui Ceramic 0136



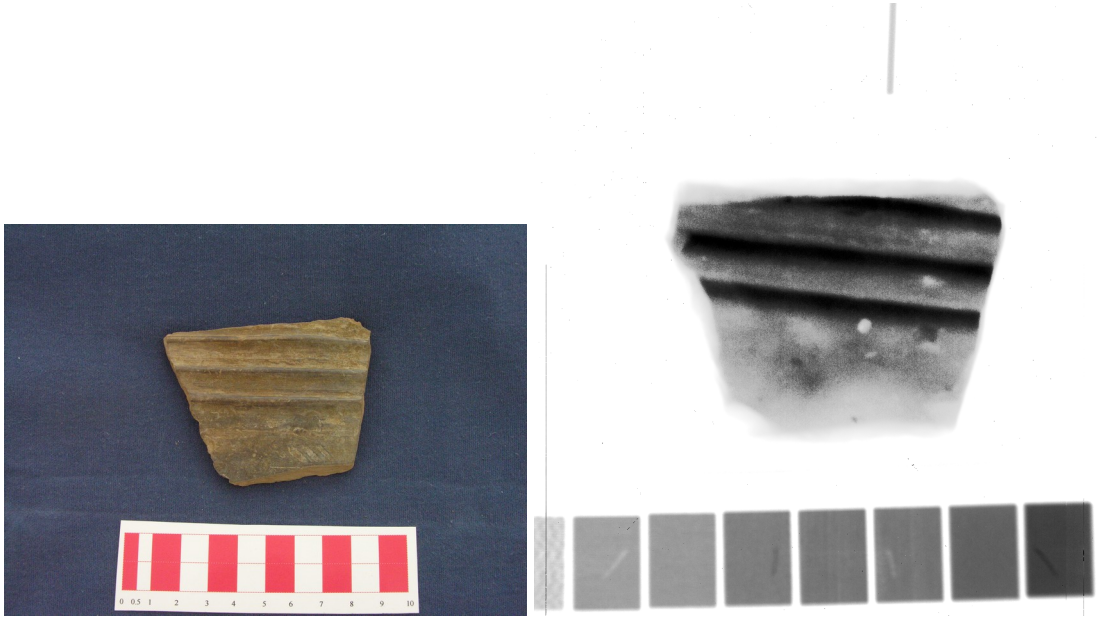
(a) Exterior (b) Interior

Figure B.114: Huizui Ceramic 0137



(a) Exterior (b) Radiograph

Figure B.115: Huizui Ceramic 0138 [MAE 2448]

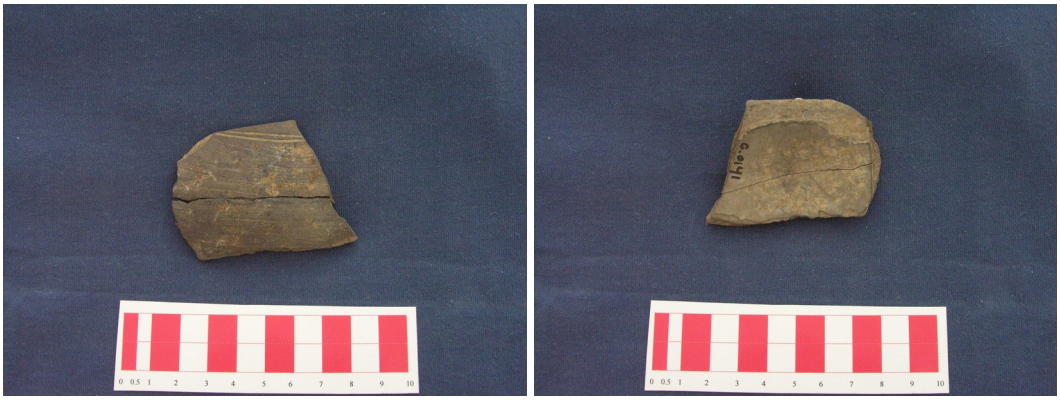


(a) Exterior (b) Radiograph

Figure B.116: Huizui Ceramic 0139 [MAE 2449]

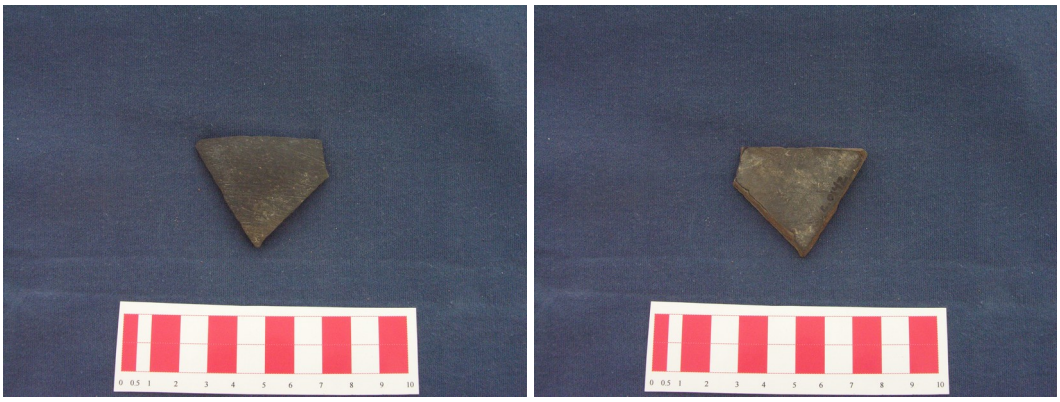
(a) Exterior (b) Interior

Figure B.117: Huizui Ceramic 0140



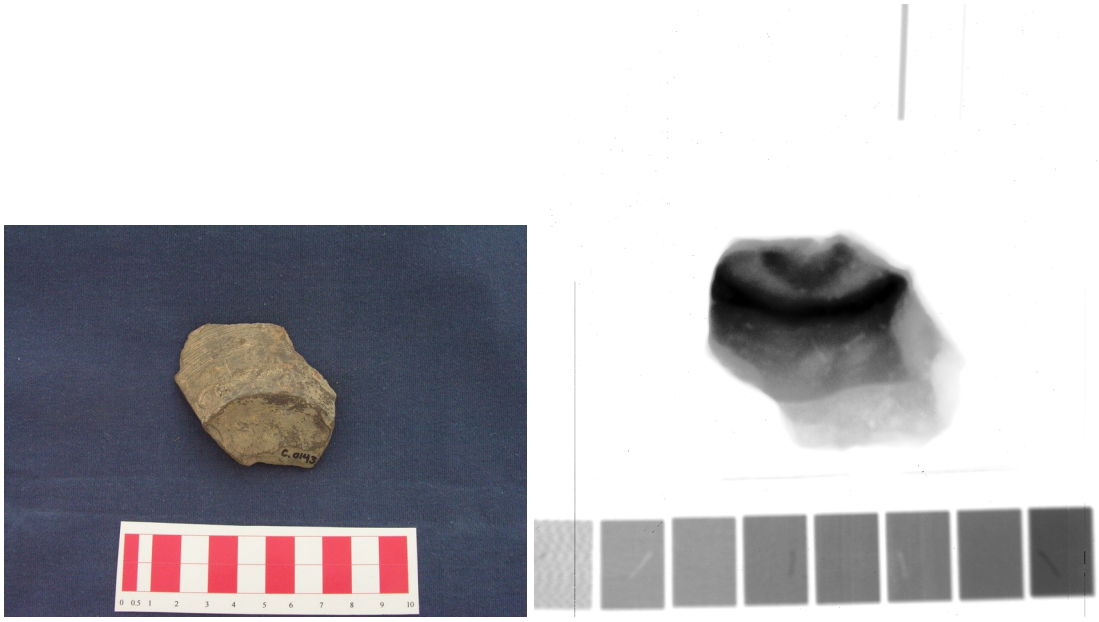
(a) Exterior (b) Interior

Figure B.118: Huizui Ceramic 0141



(a) Exterior (b) Interior

Figure B.119: Huizui Ceramic 0142

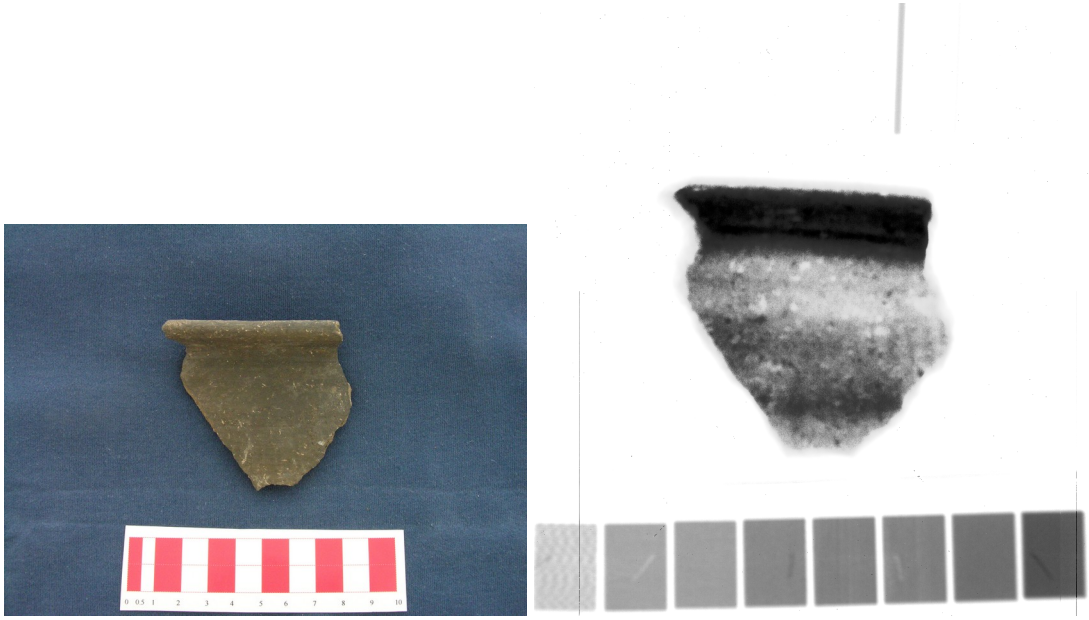


(a) Exterior (b) Radiograph

Figure B.120: Huizui Ceramic 0143 [MAE 2450]

(a) Exterior (b) Interior

Figure B.121: Huizui Ceramic 0144



(a) Exterior (b) Radiograph

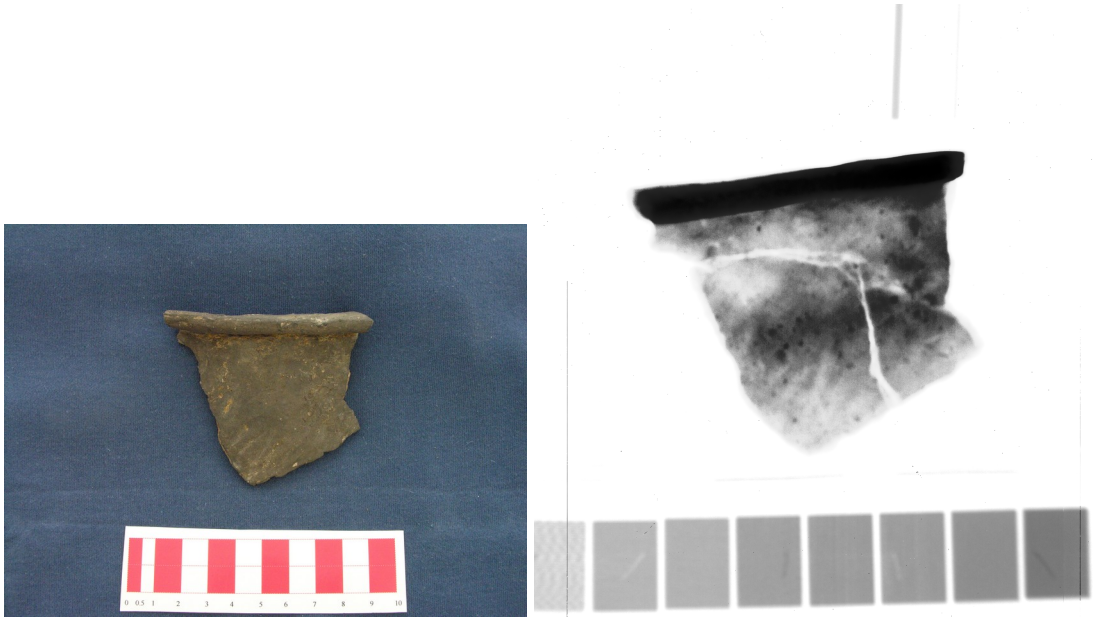
Figure B.122: Huizui Ceramic 0145 [MAE 2451]

(a) Exterior (b) Interior

Figure B.123: Huizui Ceramic 0146

(a) Exterior (b) Interior

Figure B.124: Huizui Ceramic 0147

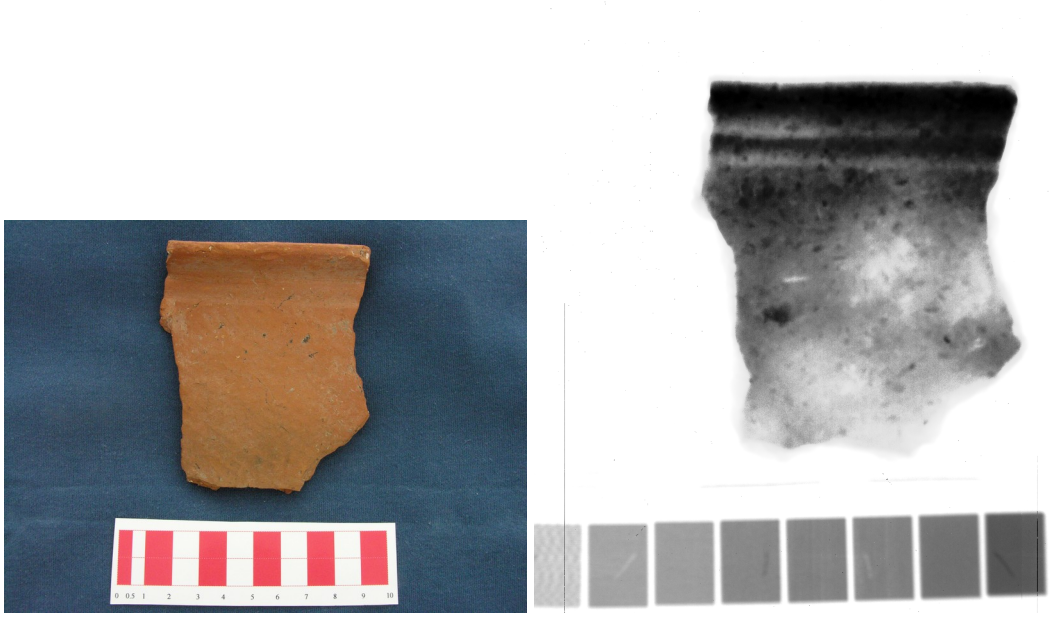


(a) Exterior (b) Radiograph

Figure B.125: Huizui Ceramic 0148 [MAE 2452]

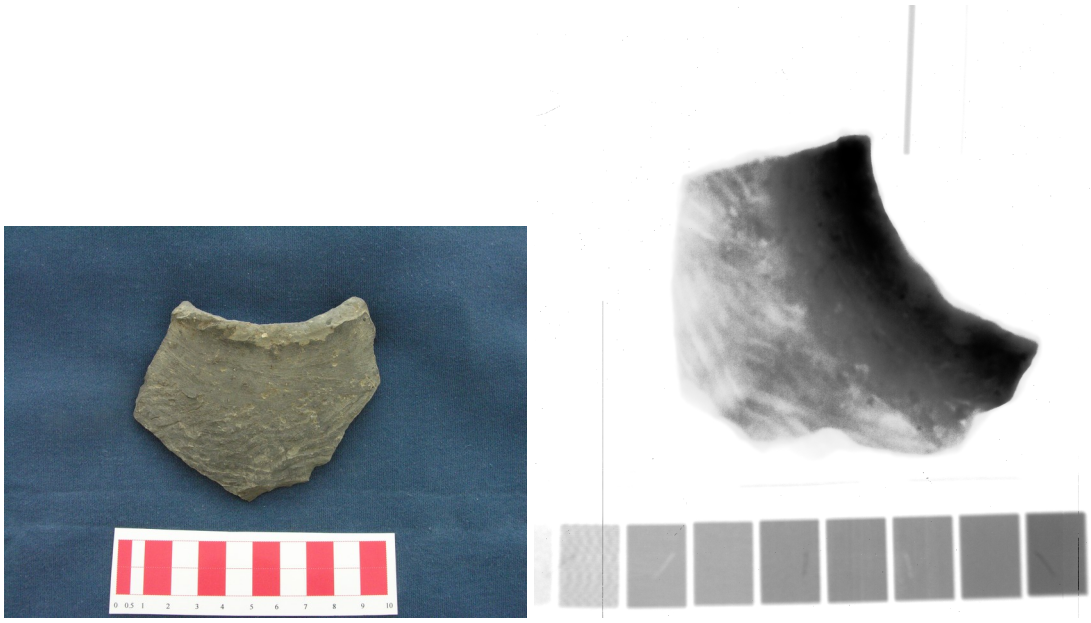
(a) Exterior (b) Interior

Figure B.126: Huizui Ceramic 0149



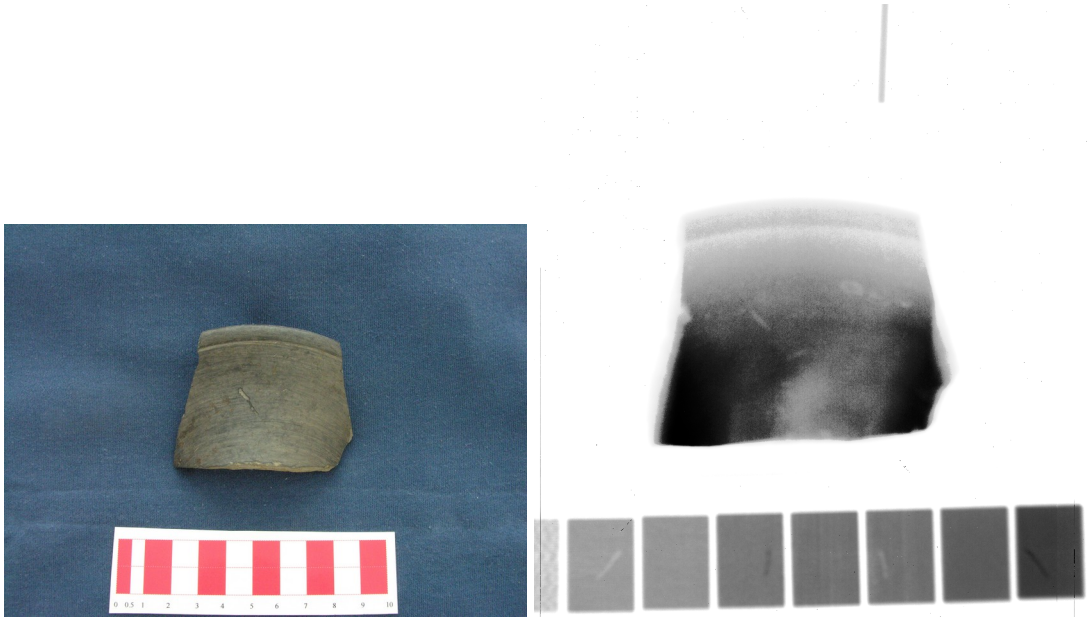
(a) Exterior (b) Radiograph

Figure B.127: Huizui Ceramic 0150 [MAE 2453]



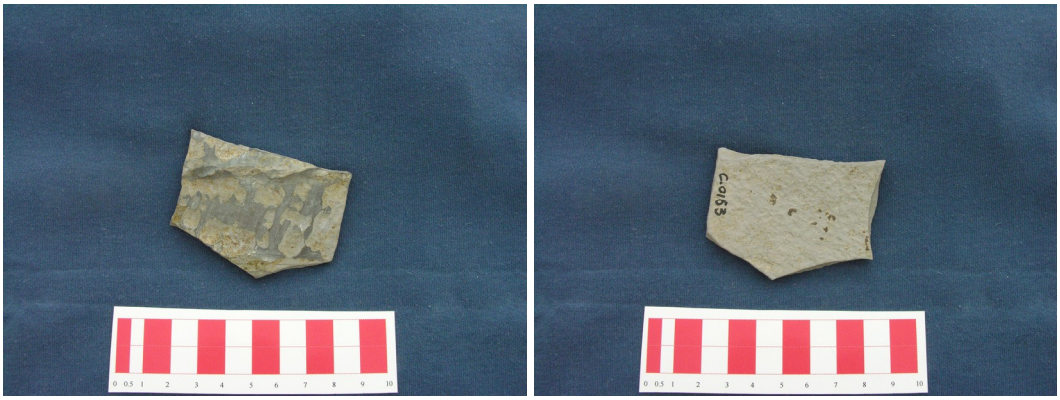
(a) Exterior (b) Radiograph

Figure B.128: Huizui Ceramic 0151 [MAE 2454]



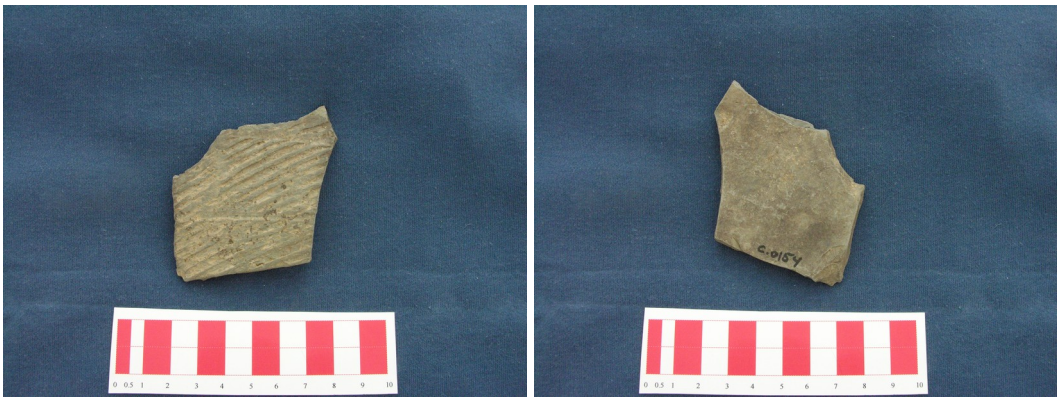
(a) Exterior (b) Radiograph

Figure B.129: Huizui Ceramic 0152 [MAE 2455]



(a) Exterior (b) Interior

Figure B.130: Huizui Ceramic 0153



(a) Exterior (b) Interior

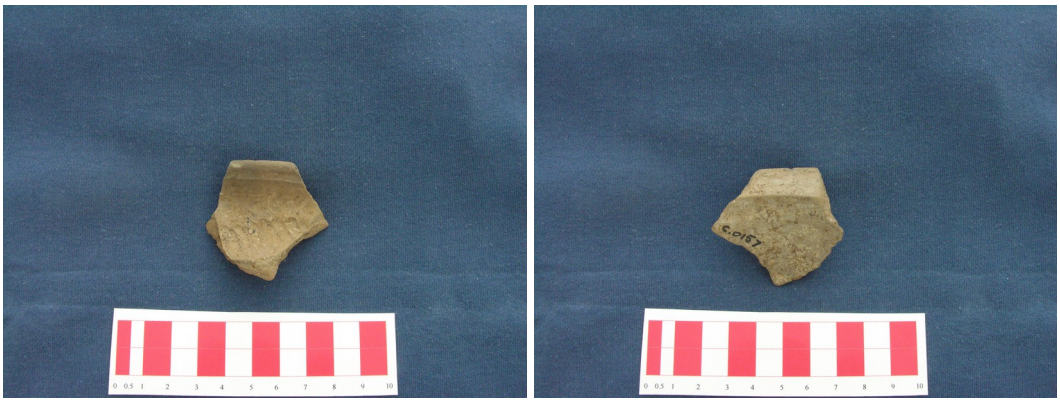
Figure B.131: Huizui Ceramic 0154

(a) Exterior (b) Interior

Figure B.132: Huizui Ceramic 0155

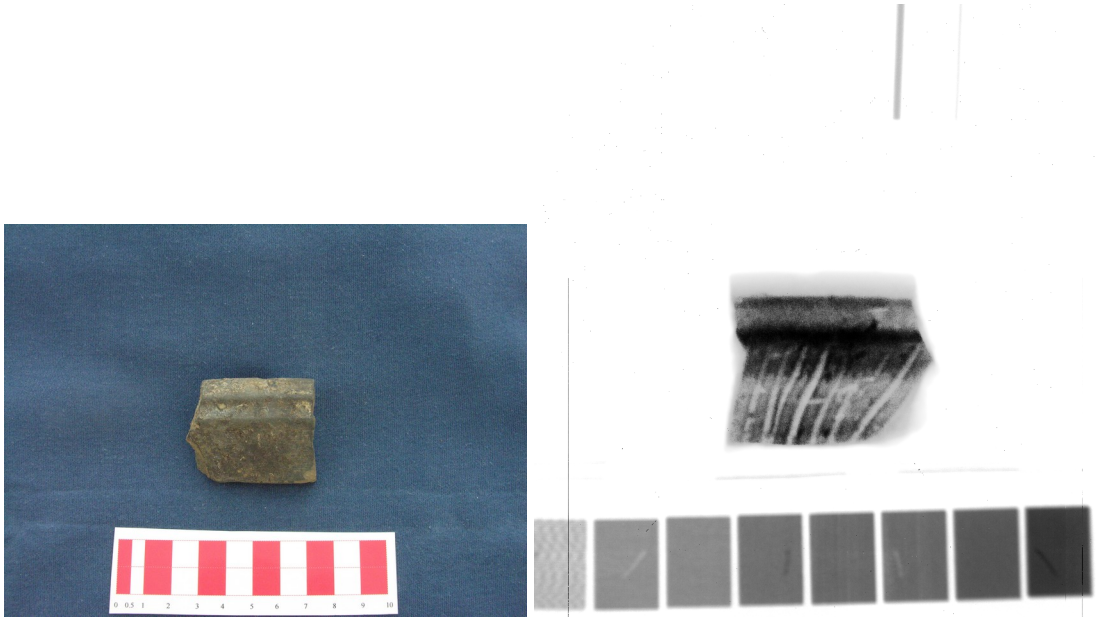
(a) Exterior (b) Interior

Figure B.133: Huizui Ceramic 0156



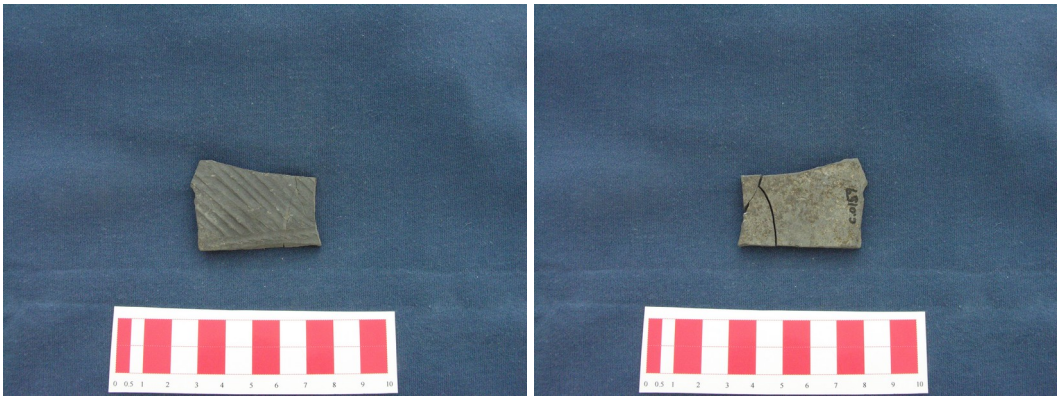
(a) Exterior (b) Interior

Figure B.134: Huizui Ceramic 0157



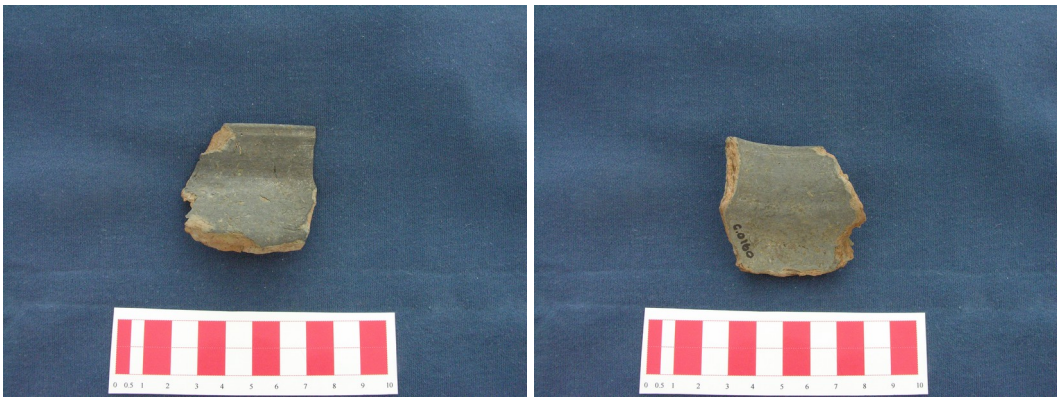
(a) Exterior (b) Radiograph

Figure B.135: Huizui Ceramic 0158 [MAE 2456]



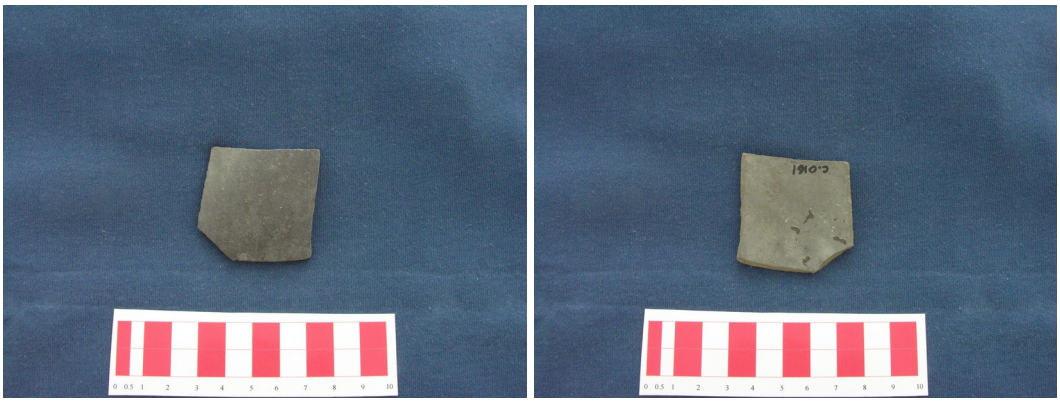
(a) Exterior (b) Interior

Figure B.136: Huizui Ceramic 0159



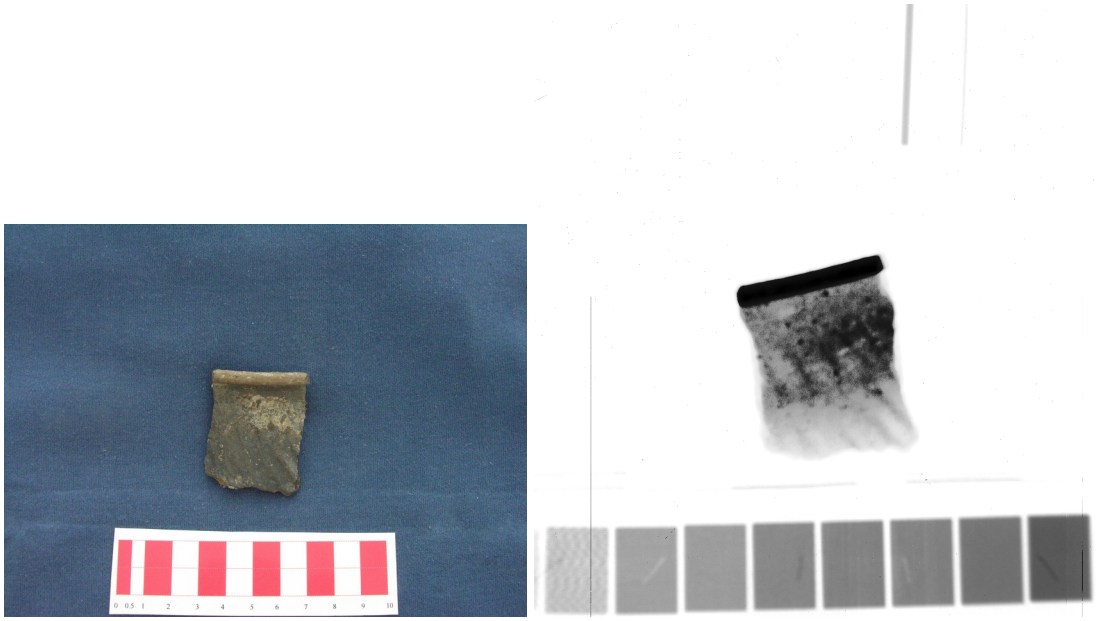
(a) Exterior (b) Interior

Figure B.137: Huizui Ceramic 0160



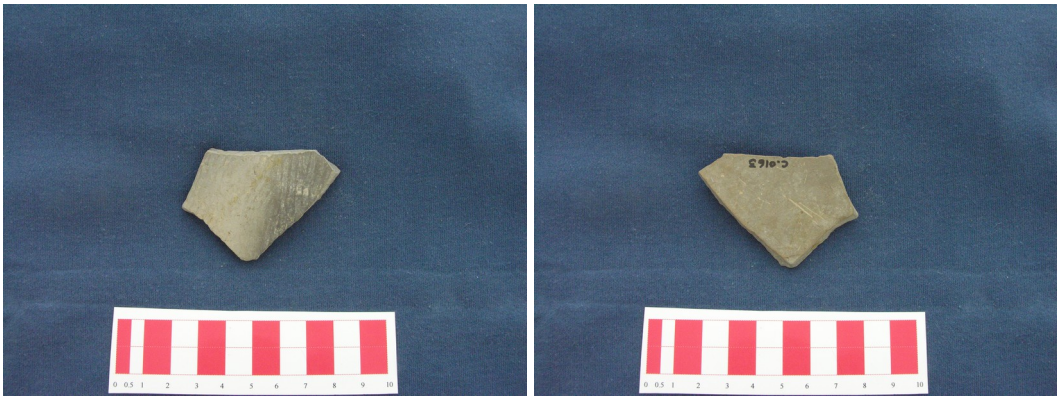
(a) Exterior (b) Interior

Figure B.138: Huizui Ceramic 0161



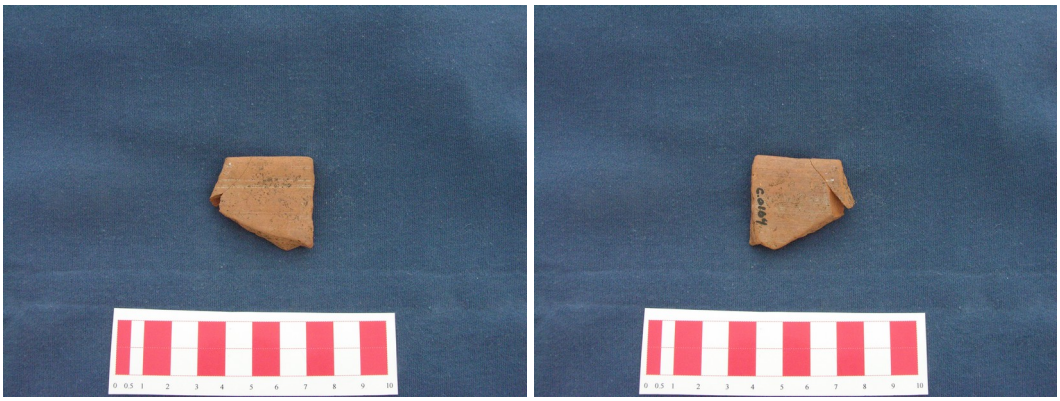
(a) Exterior (b) Radiograph

Figure B.139: Huizui Ceramic 0162 [MAE 2457]



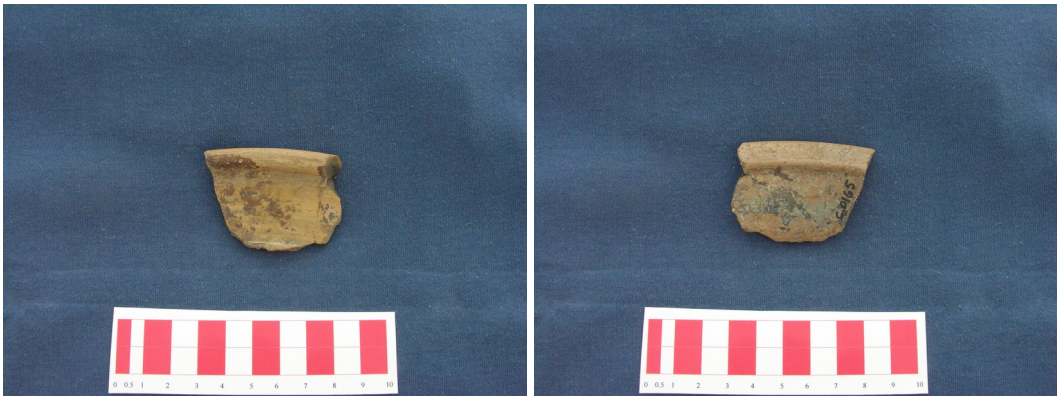
(a) Exterior (b) Interior

Figure B.140: Huizui Ceramic 0163



(a) Exterior (b) Interior

Figure B.141: Huizui Ceramic 0164

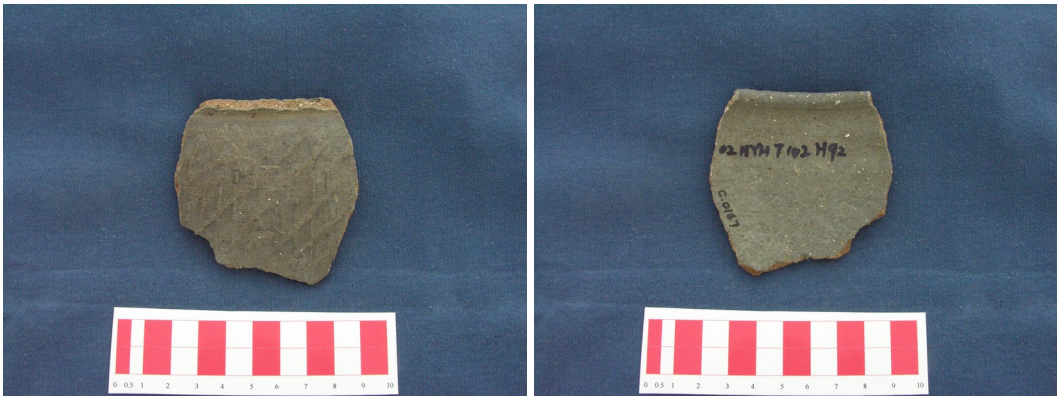


(a) Exterior (b) Interior

Figure B.142: Huizui Ceramic 0165

(a) Exterior (b) Interior

Figure B.143: Huizui Ceramic 0166

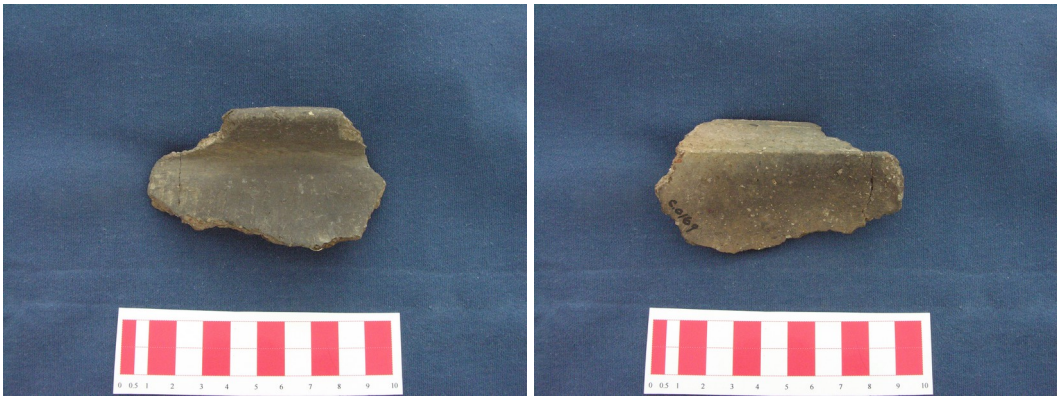


(a) Exterior (b) Interior

Figure B.144: Huizui Ceramic 0167

(a) Exterior (b) Interior

Figure B.145: Huizui Ceramic 0168



(a) Exterior (b) Interior

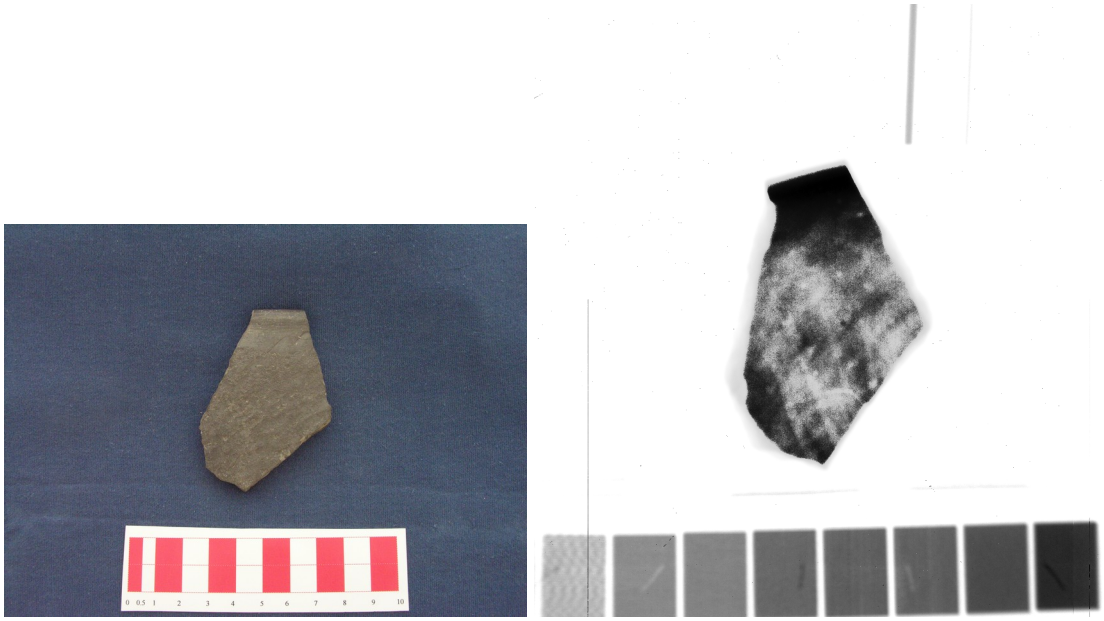
Figure B.146: Huizui Ceramic 0169

(a) Exterior (b) Interior

Figure B.147: Huizui Ceramic 0170

(a) Exterior (b) Interior

Figure B.148: Huizui Ceramic 0171

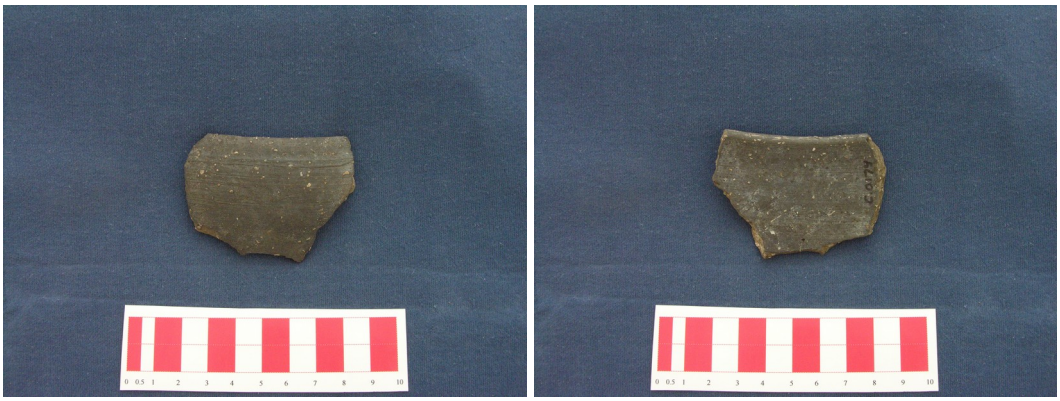


(a) Exterior (b) Radiograph

Figure B.149: Huizui Ceramic 0172 [MAE 2458]

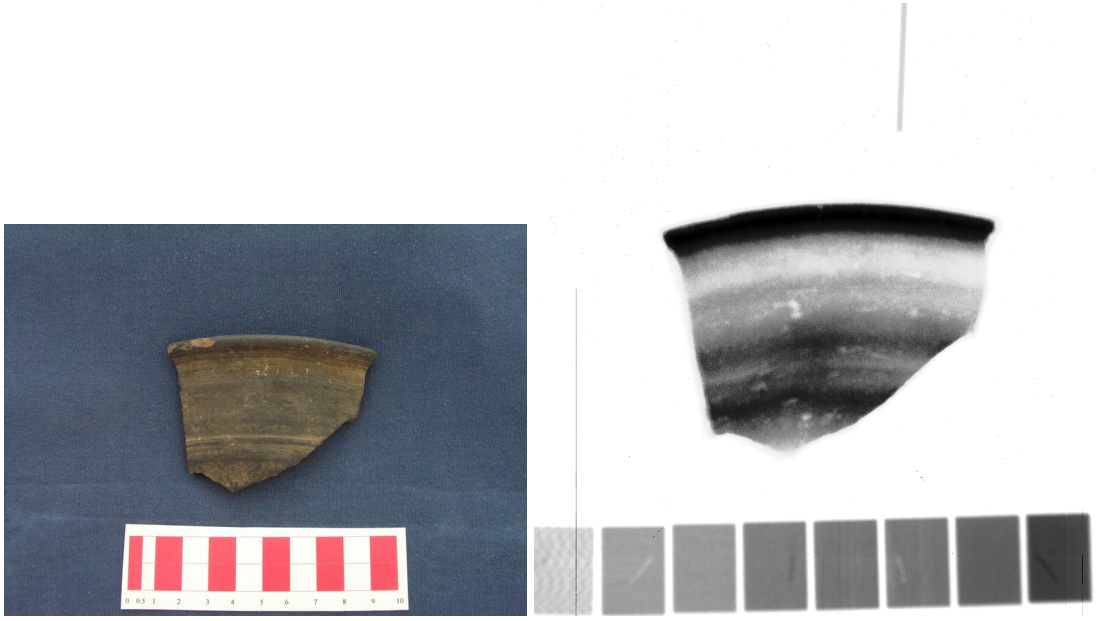
(a) Exterior (b) Interior

Figure B.150: Huizui Ceramic 0173



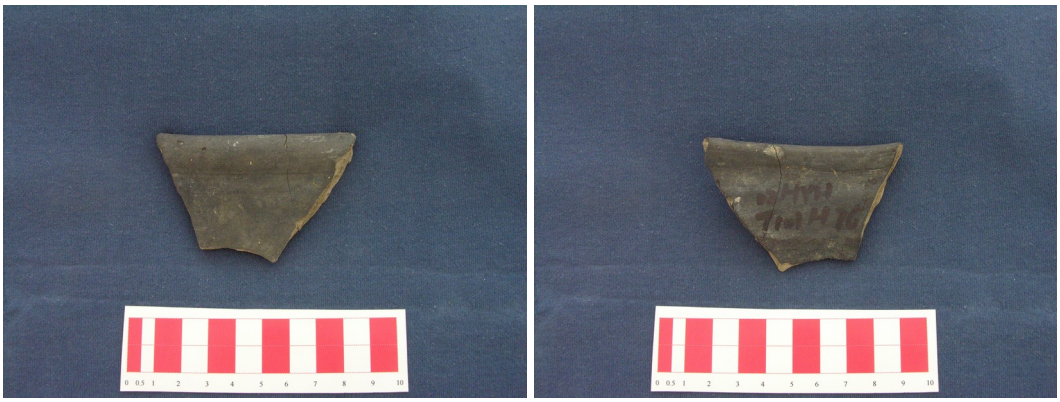
(a) Exterior (b) Interior

Figure B.151: Huizui Ceramic 0174



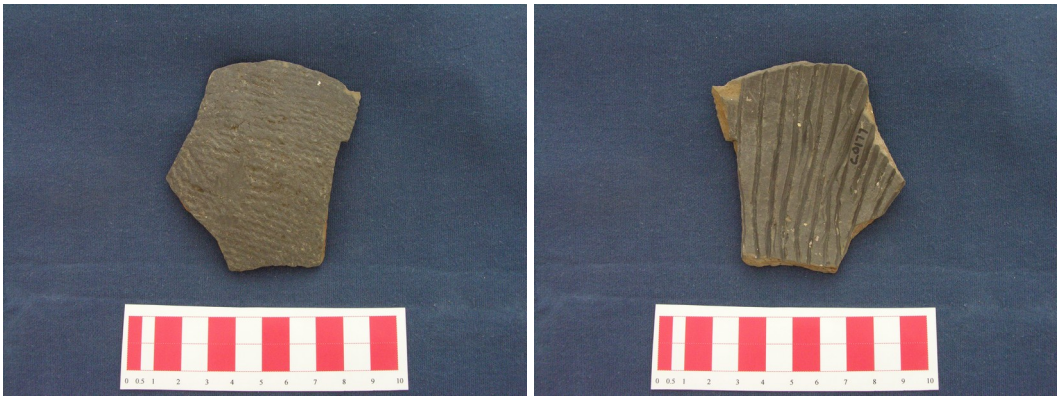
(a) Exterior (b) Radiograph

Figure B.152: Huizui Ceramic 0175 [MAE 2459]



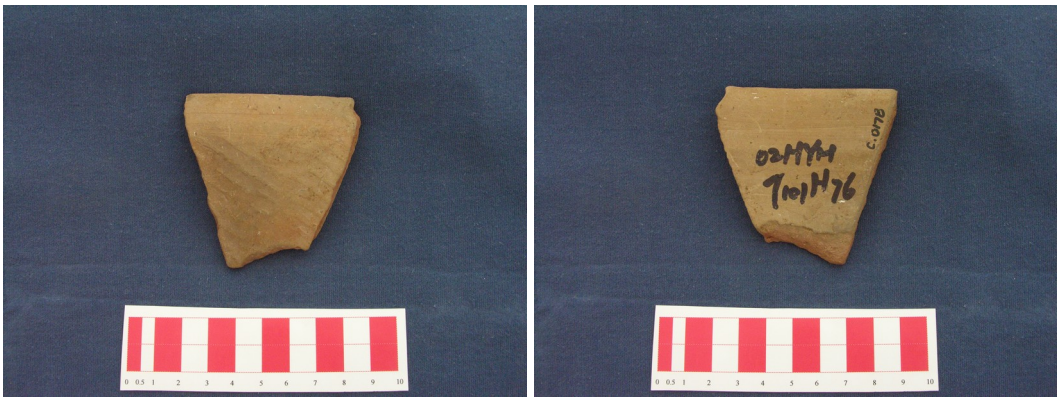
(a) Exterior (b) Interior

Figure B.153: Huizui Ceramic 0176



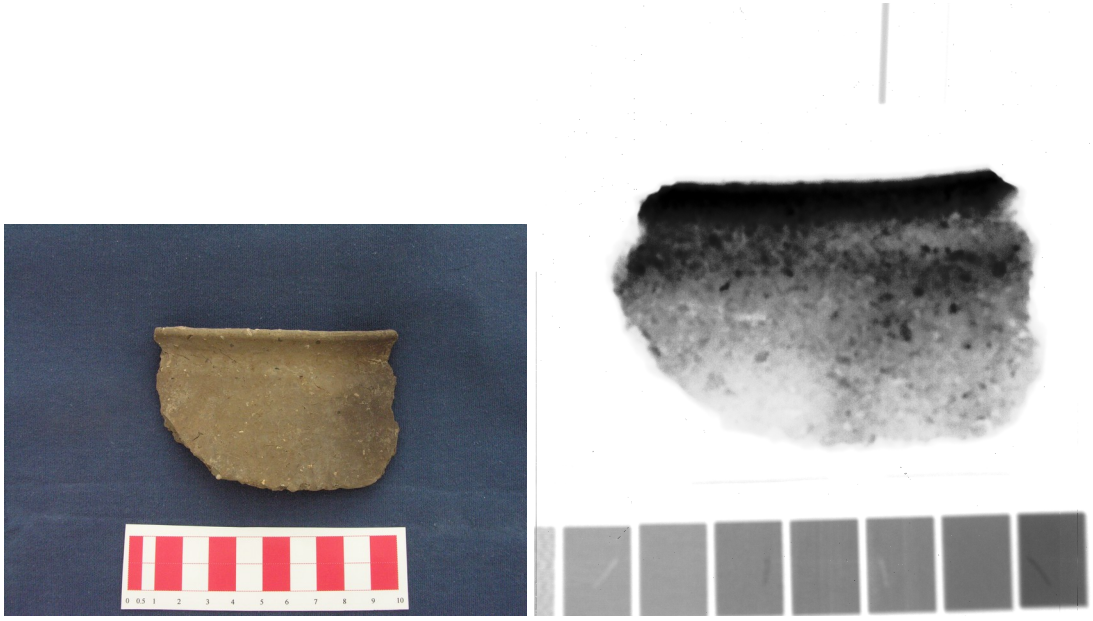
(a) Exterior (b) Interior

Figure B.154: Huizui Ceramic 0177



(a) Exterior (b) Interior

Figure B.155: Huizui Ceramic 0178

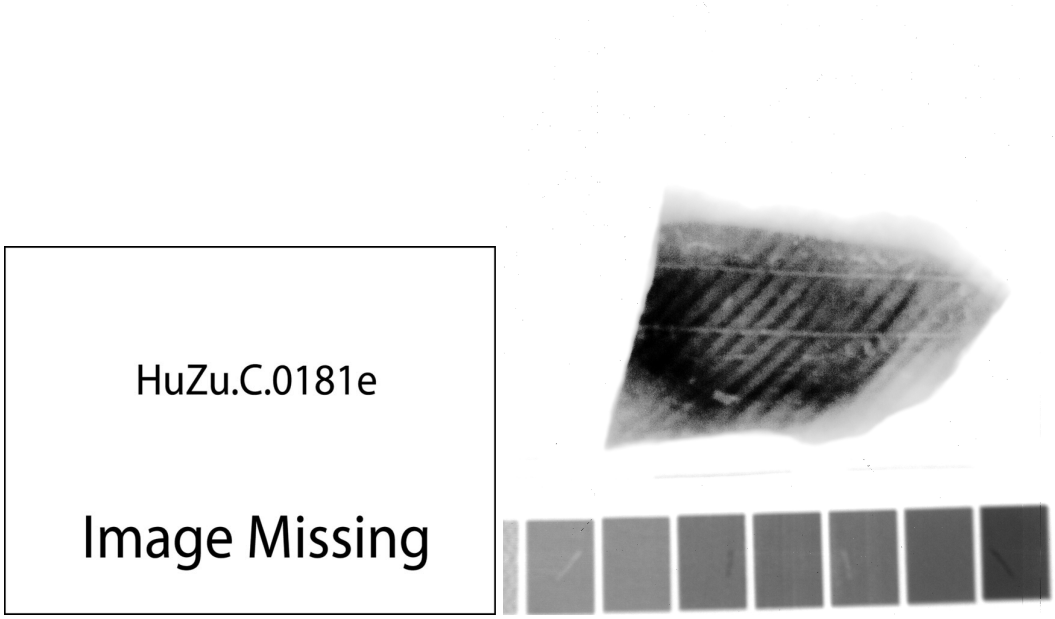


(a) Exterior (b) Radiograph

Figure B.156: Huizui Ceramic 0179 [MAE 2460]

(a) Exterior (b) Interior

Figure B.157: Huizui Ceramic 0180



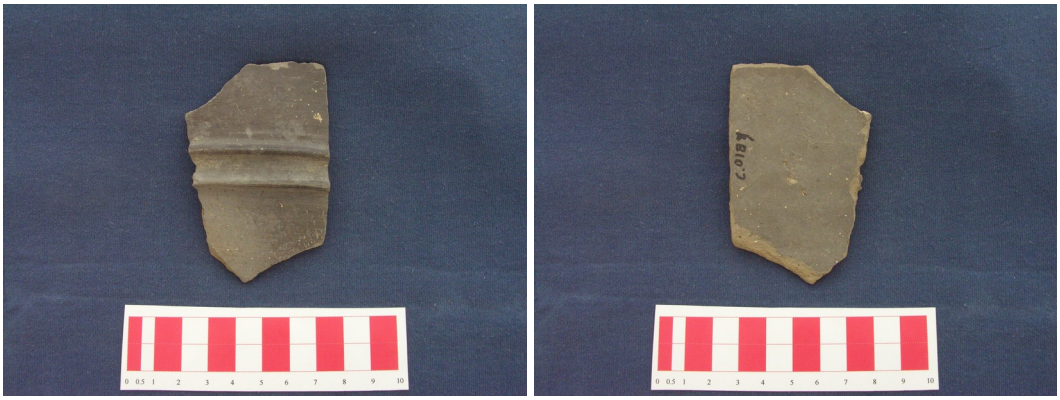
(a) Exterior (b) Radiograph

Figure B.158: Huizui Ceramic 0181 [MAE 2461]

Note: The exterior and interior photos for this sherd are missing from my files.

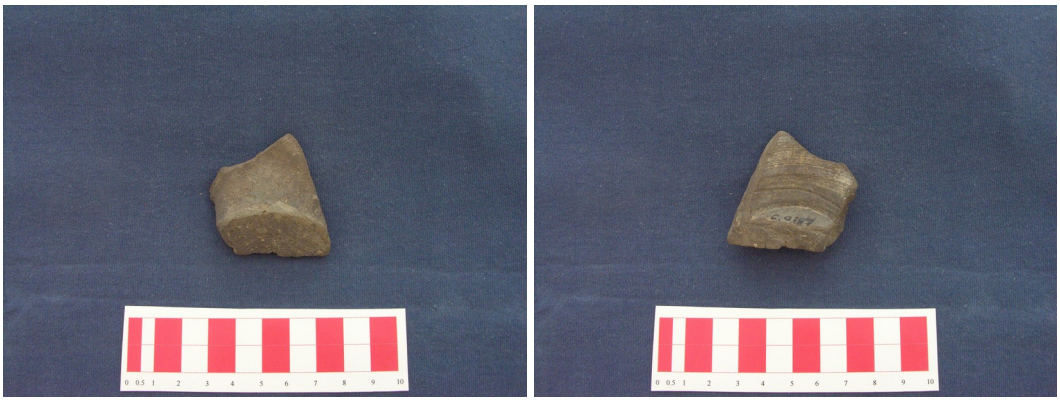
(a) Exterior (b) Interior

Figure B.159: Huizui Ceramic 0182



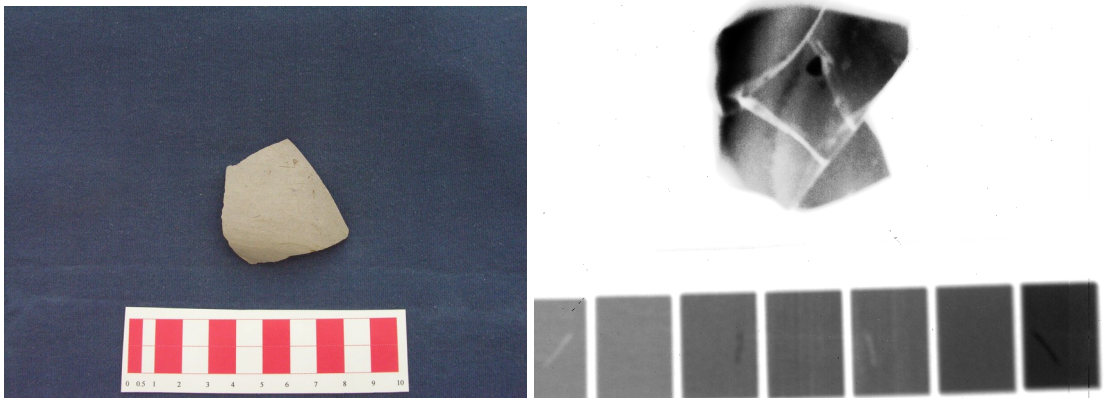
(a) Exterior (b) Interior

Figure B.160: Huizui Ceramic 0183



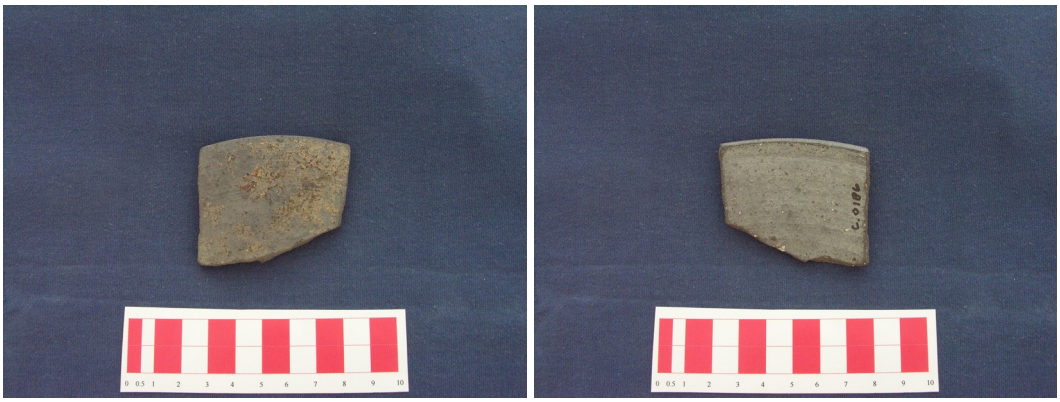
(a) Exterior (b) Interior

Figure B.161: Huizui Ceramic 0184



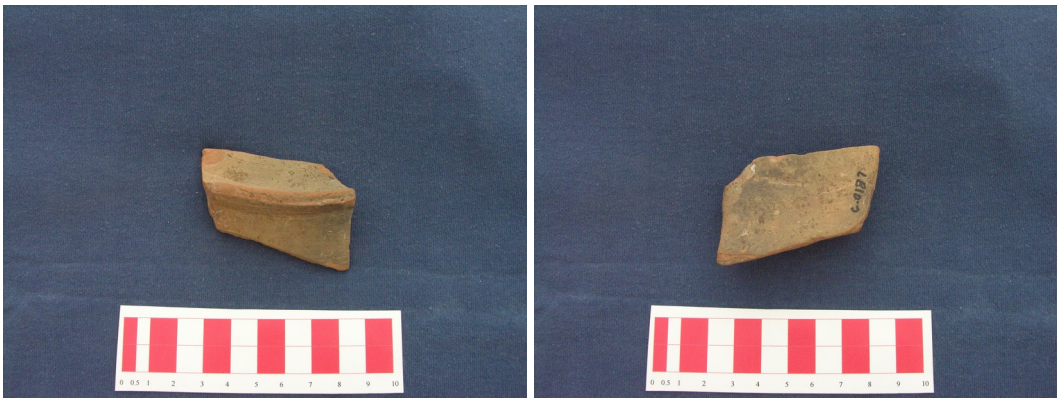
(a) Exterior (b) Radiograph

Figure B.162: Huizui Ceramic 0185 [MAE 2462]



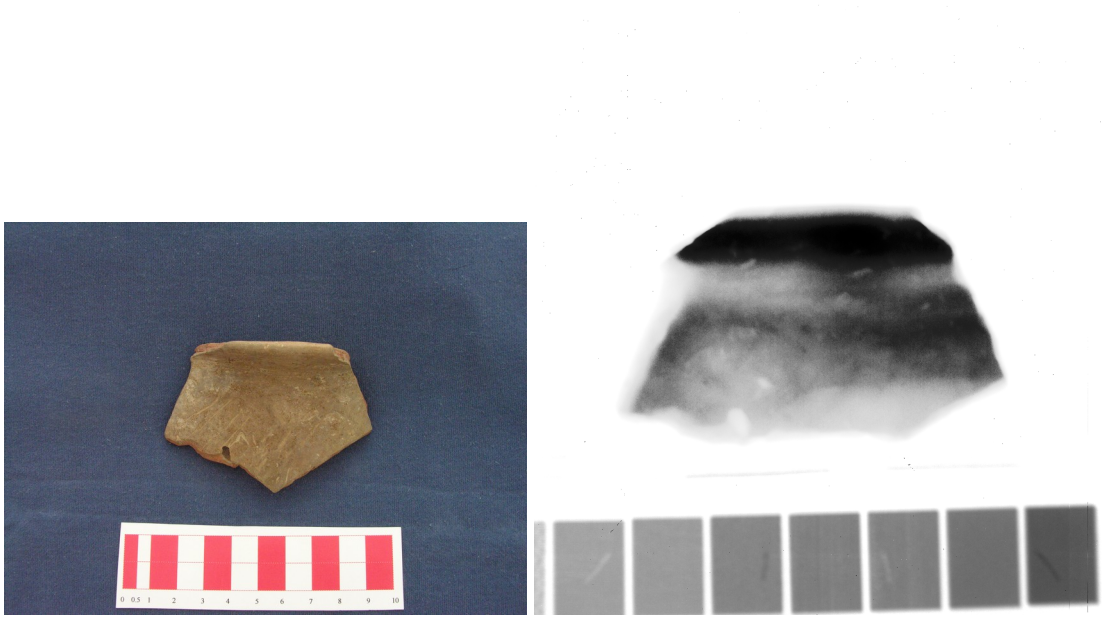
(a) Exterior (b) Interior

Figure B.163: Huizui Ceramic 0186



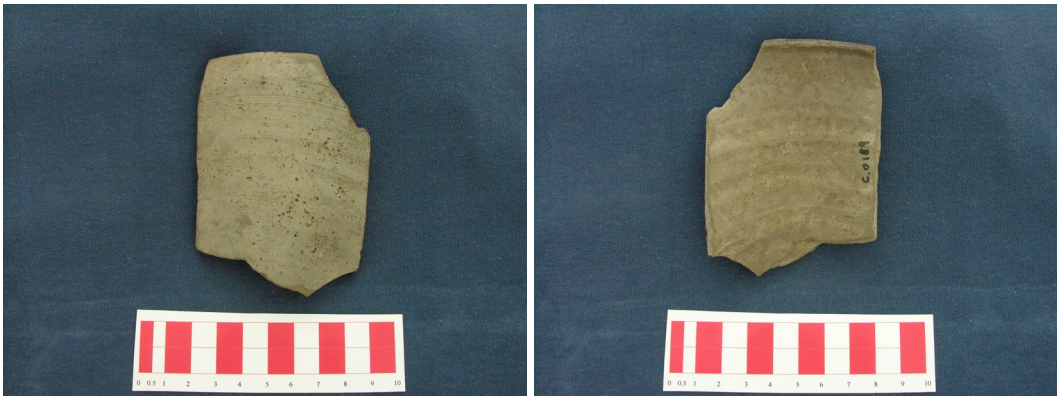
(a) Exterior (b) Interior

Figure B.164: Huizui Ceramic 0187



(a) Exterior (b) Radiograph

Figure B.165: Huizui Ceramic 0188 [MAE 2463]

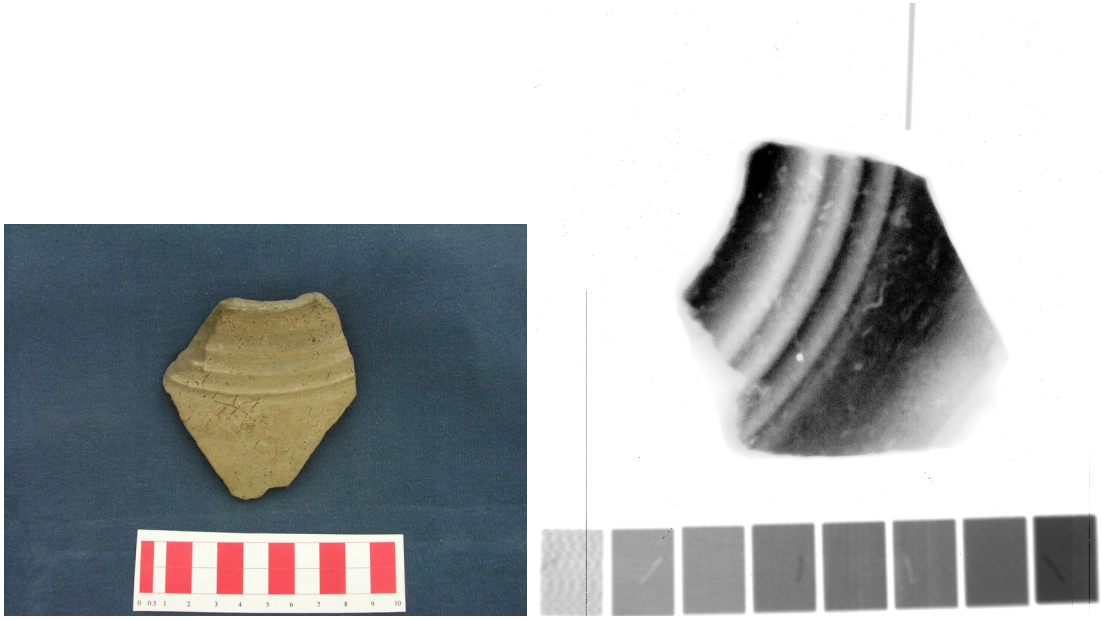


(a) Exterior (b) Interior

Figure B.166: Huizui Ceramic 0189

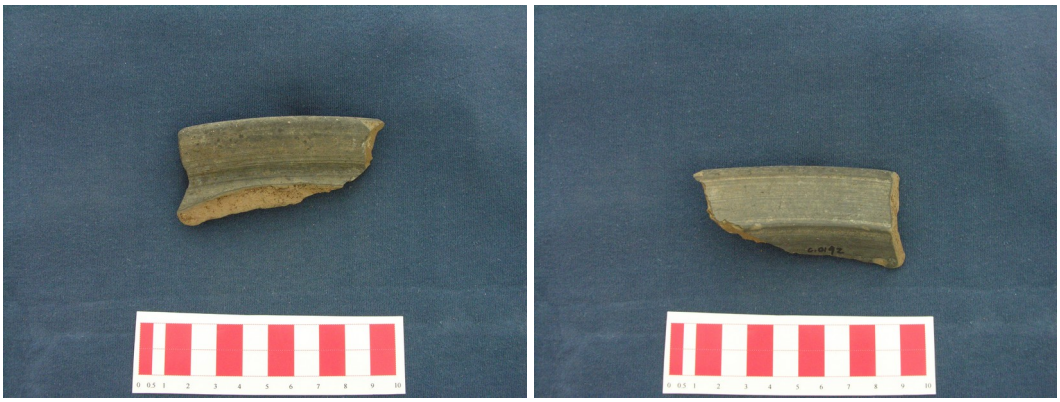
(a) Exterior (b) Interior

Figure B.167: Huizui Ceramic 0190



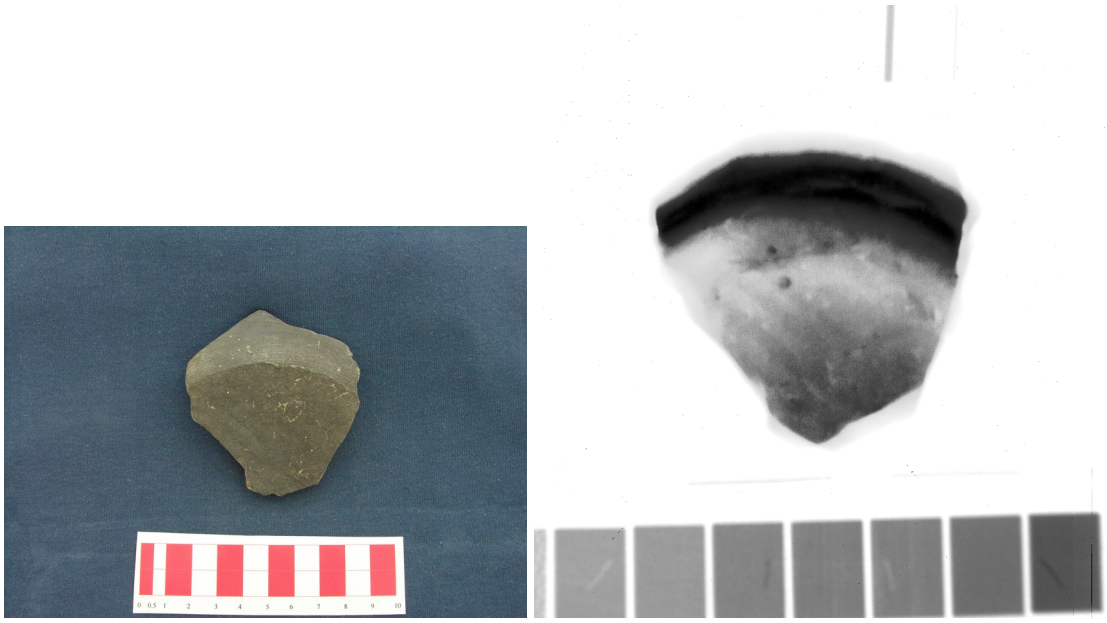
(a) Exterior (b) Radiograph

Figure B.168: Huizui Ceramic 0191 [MAE 2464]



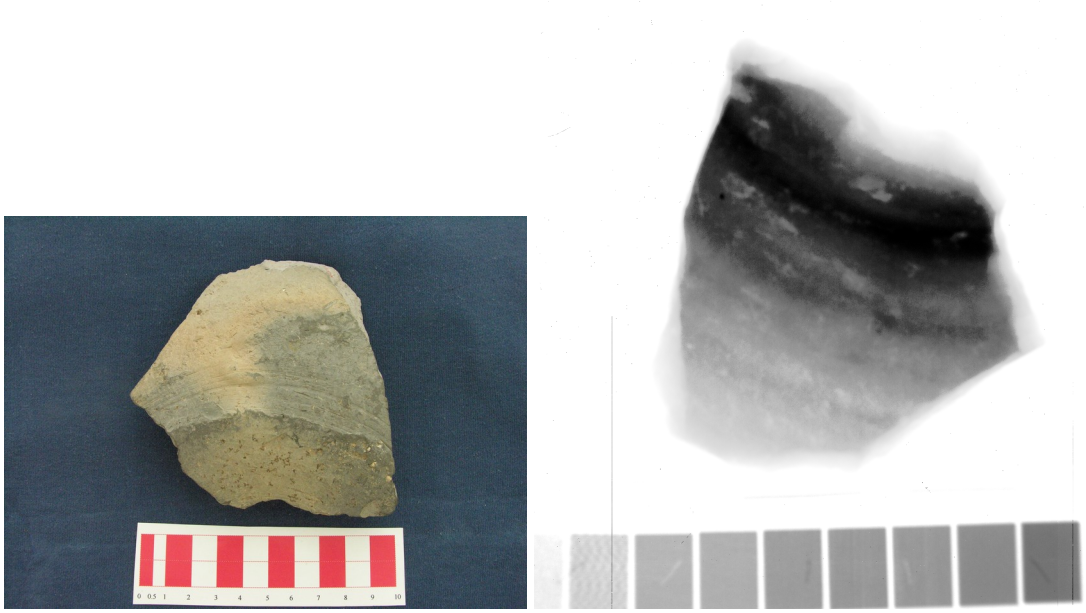
(a) Exterior (b) Interior

Figure B.169: Huizui Ceramic 0192



(a) Exterior (b) Radiograph

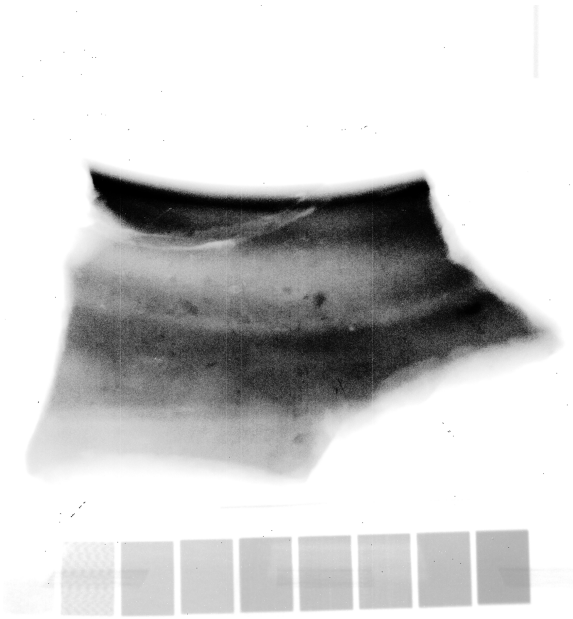
Figure B.170: Huizui Ceramic 0193 [MAE 2465]



(a) Exterior (b) Radiograph

Figure B.171: Huizui Ceramic 0194 [MAE 2466]

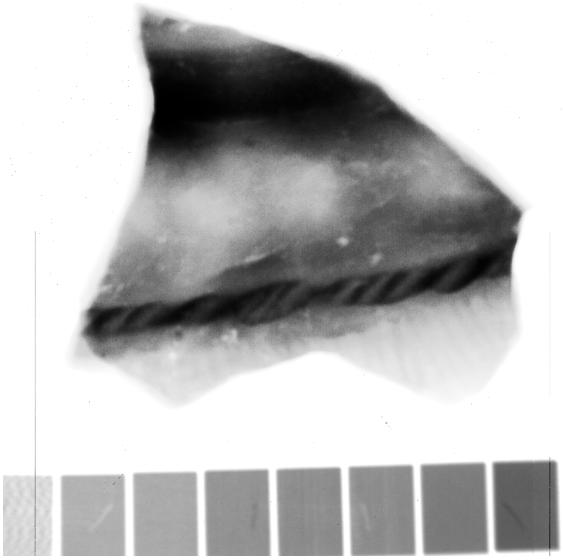
(a) Exterior



(b) Radiograph

Figure B.172: Huizui Ceramic 0195 [MAE 2467]

(a) Exterior

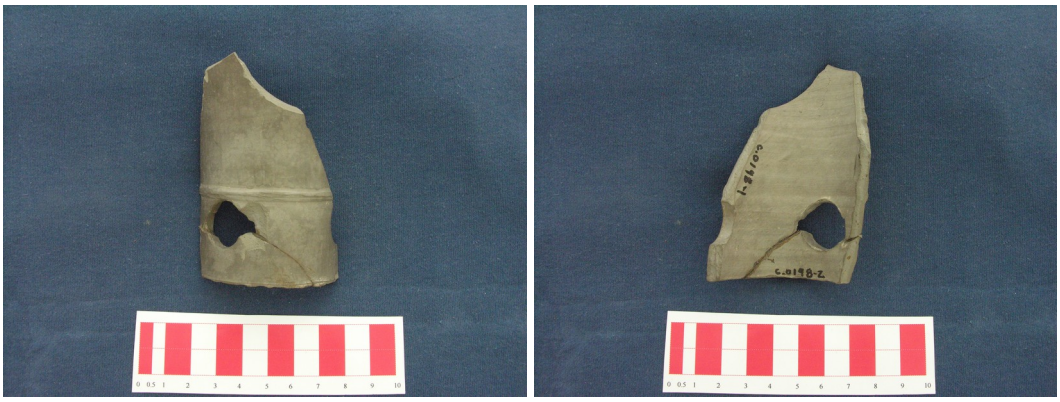


(b) Radiograph

Figure B.173: Huizui Ceramic 0196 [MAE 2468]

(a) Exterior (b) Interior

Figure B.174: Huizui Ceramic 0197

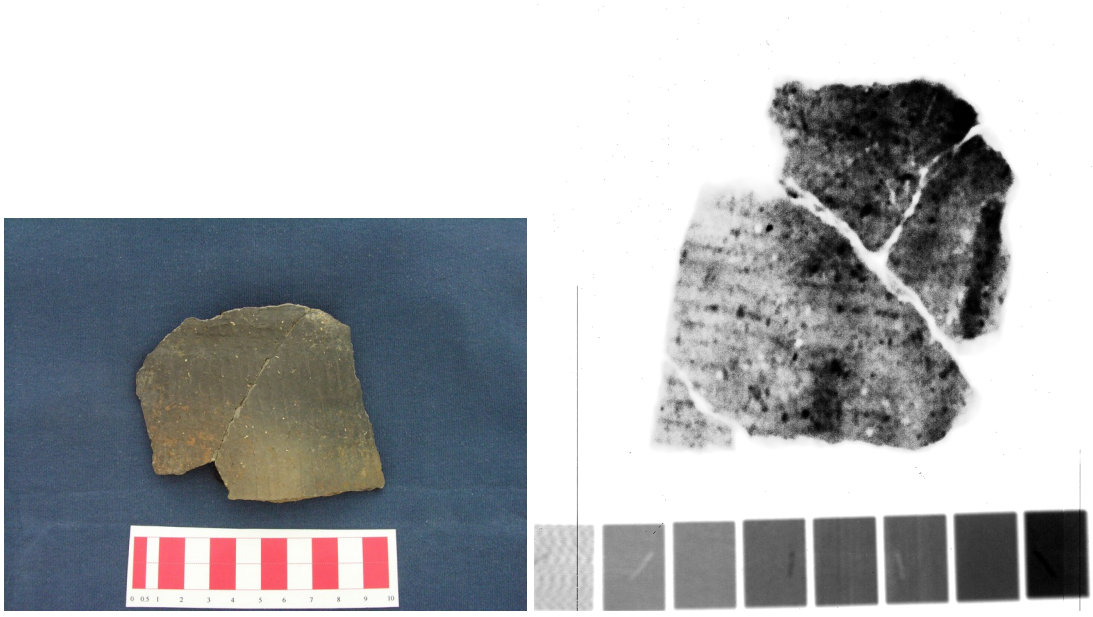


(a) Exterior (b) Interior

Figure B.175: Huizui Ceramic 0198

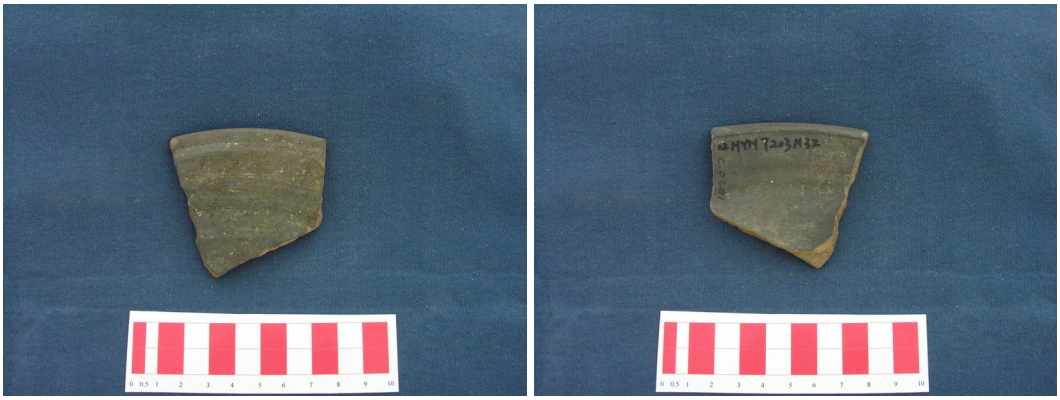
(a) Exterior (b) Interior

Figure B.176: Huizui Ceramic 0199



(a) Exterior (b) Radiograph

Figure B.177: Huizui Ceramic 0200 [MAE 2469]



(a) Exterior (b) Interior

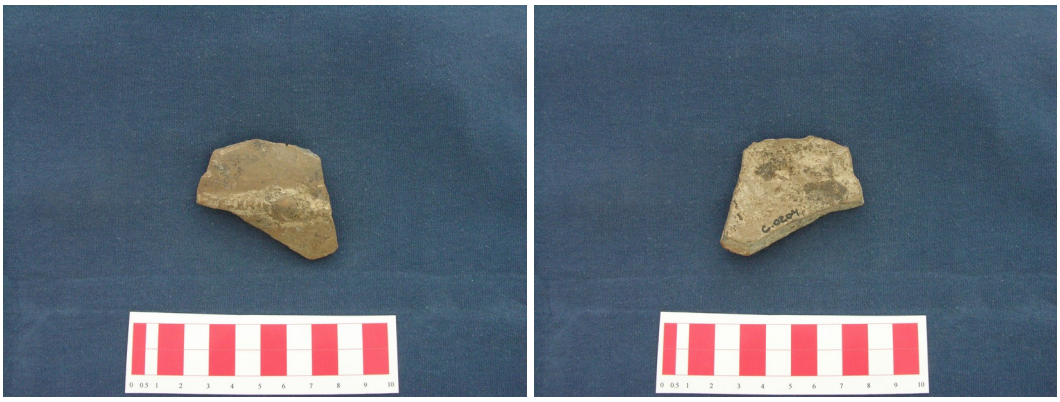
Figure B.178: Huizui Ceramic 0201

(a) Exterior (b) Interior

Figure B.179: Huizui Ceramic 0202

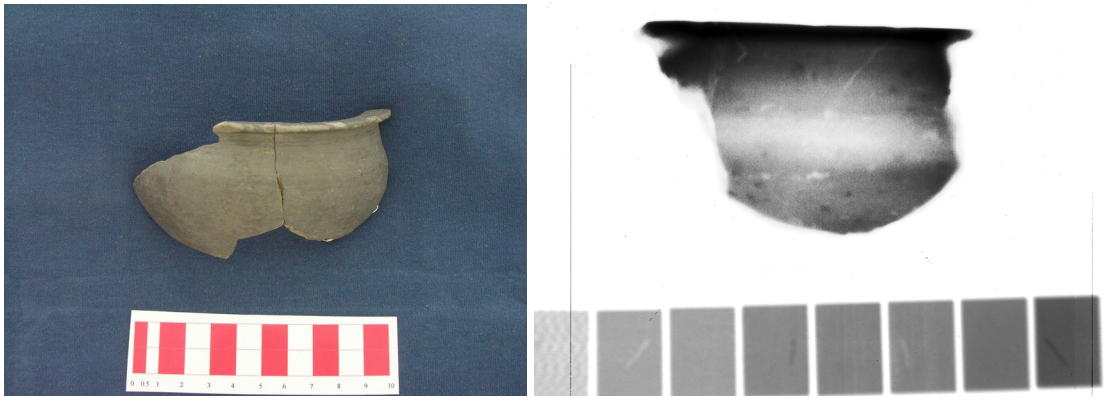
(a) Exterior (b) Interior

Figure B.180: Huizui Ceramic 0203



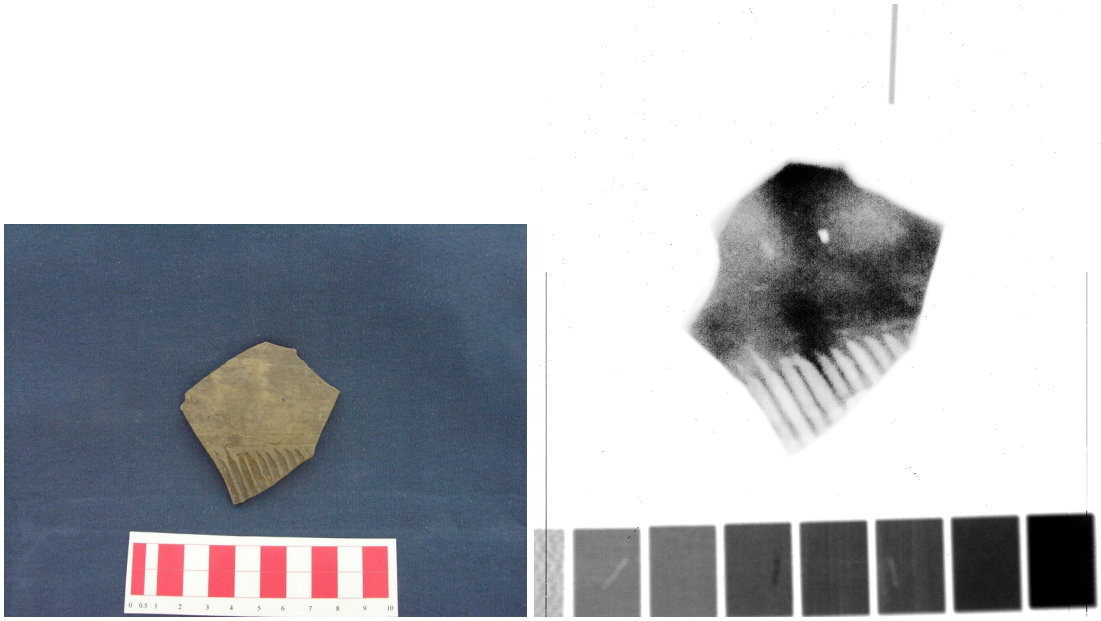
(a) Exterior (b) Interior

Figure B.181: Huizui Ceramic 0204



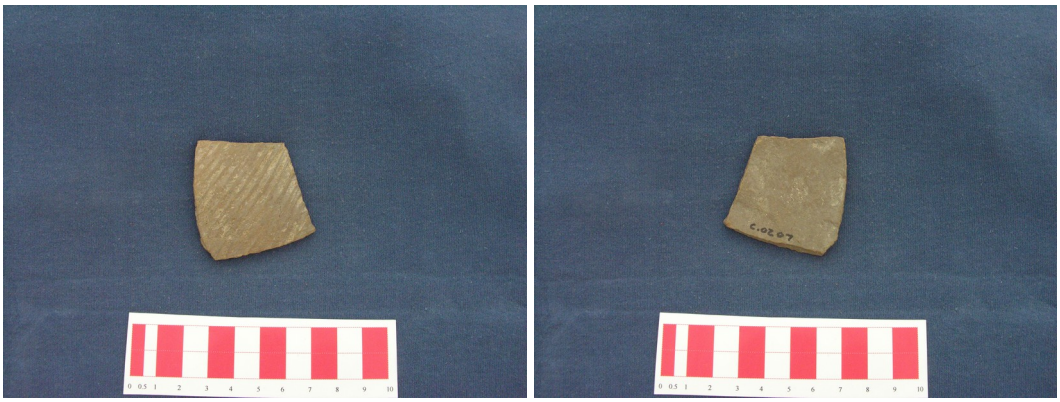
(a) Exterior (b) Radiograph

Figure B.182: Huizui Ceramic 0205 [MAE 2470]



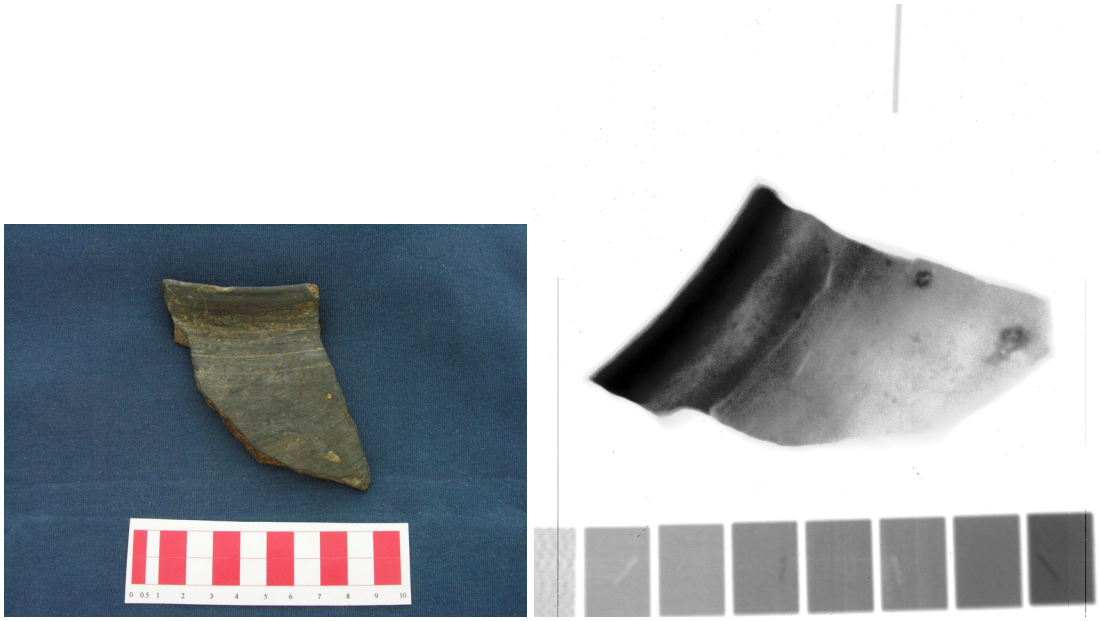
(a) Exterior (b) Radiograph

Figure B.183: Huizui Ceramic 0206 [MAE 2471]



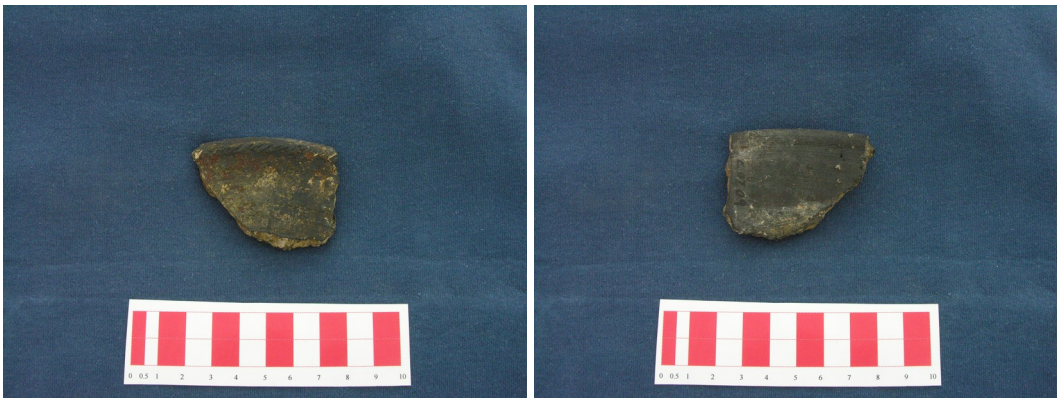
(a) Exterior (b) Interior

Figure B.184: Huizui Ceramic 0207



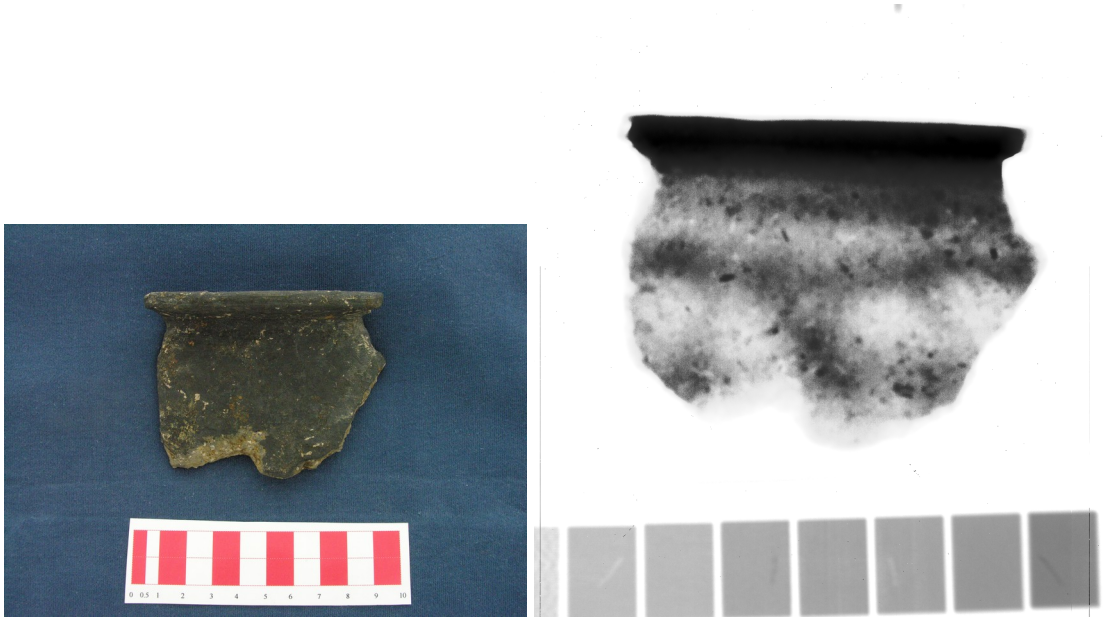
(a) Exterior (b) Radiograph

Figure B.185: Huizui Ceramic 0208 [MAE 2472]



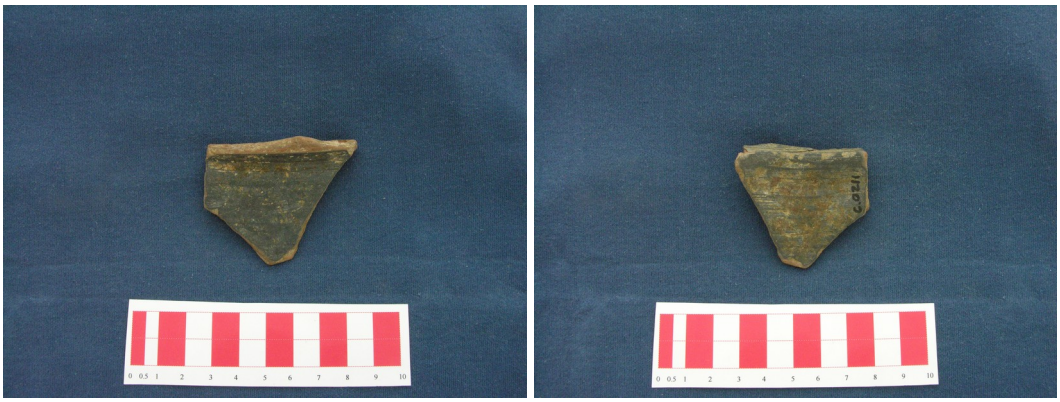
(a) Exterior (b) Interior

Figure B.186: Huizui Ceramic 0209



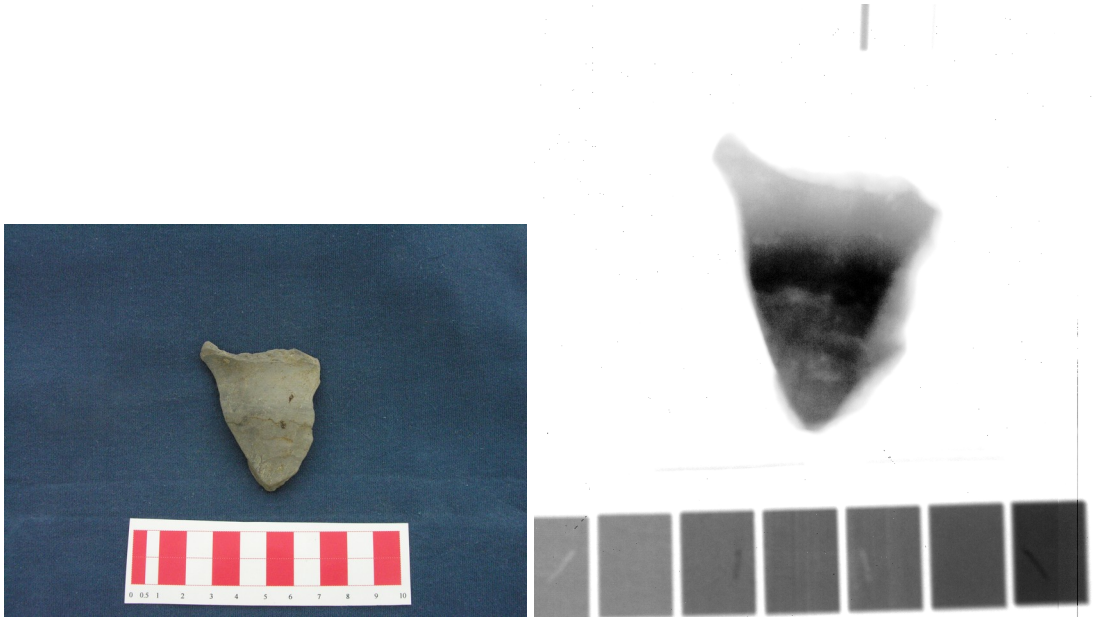
(a) Exterior (b) Radiograph

Figure B.187: Huizui Ceramic 0210 [MAE 2473]



(a) Exterior (b) Interior

Figure B.188: Huizui Ceramic 0211



(a) Exterior (b) Radiograph

Figure B.189: Huizui Ceramic 0212 [MAE 2474]

(a) Exterior (b) Interior

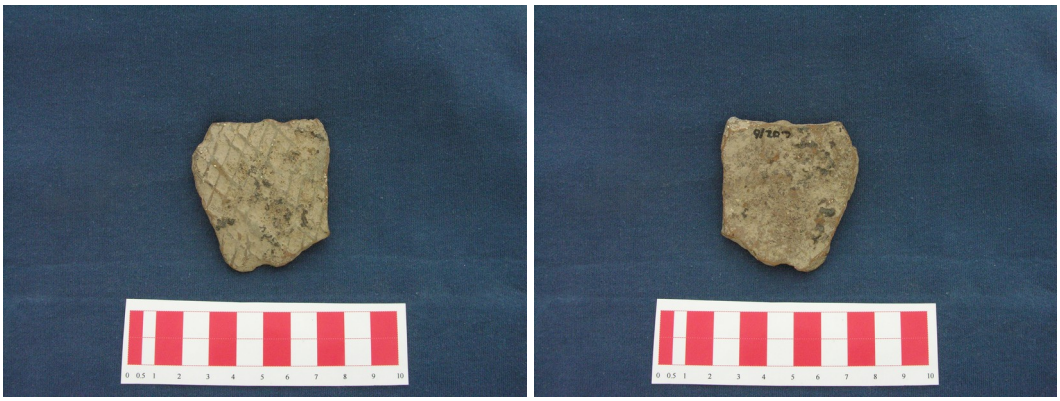
Figure B.190: Huizui Ceramic 0213

(a) Exterior (b) Interior

Figure B.191: Huizui Ceramic 0214

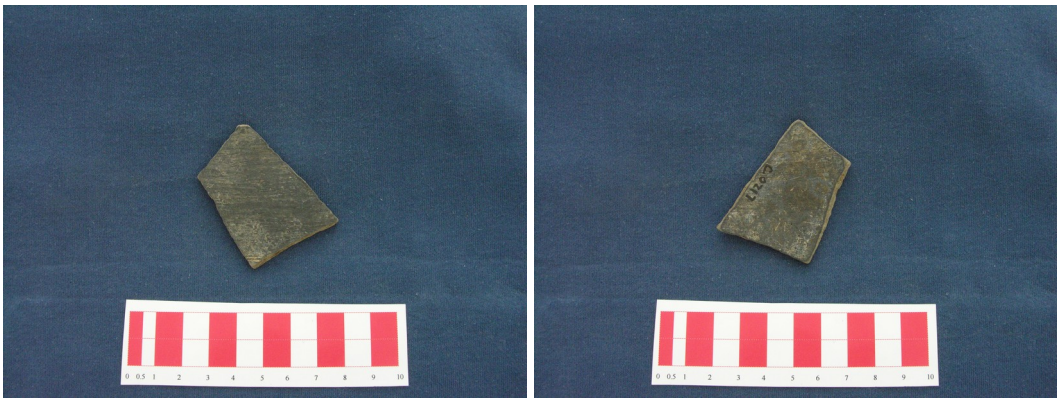
(a) Exterior (b) Interior

Figure B.192: Huizui Ceramic 0215



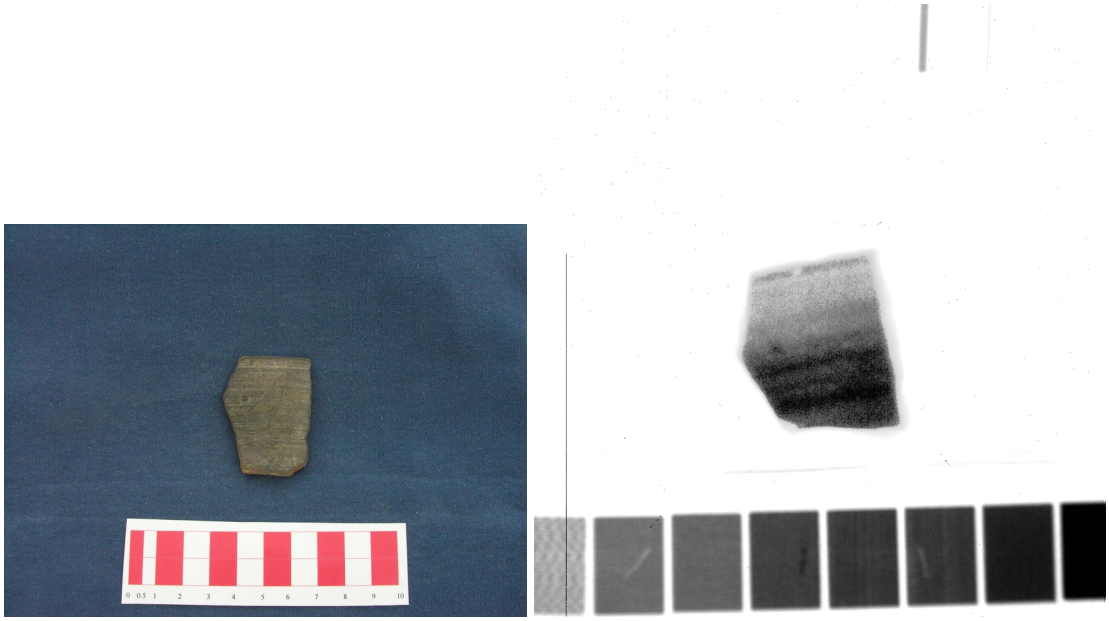
(a) Exterior (b) Interior

Figure B.193: Huizui Ceramic 0216



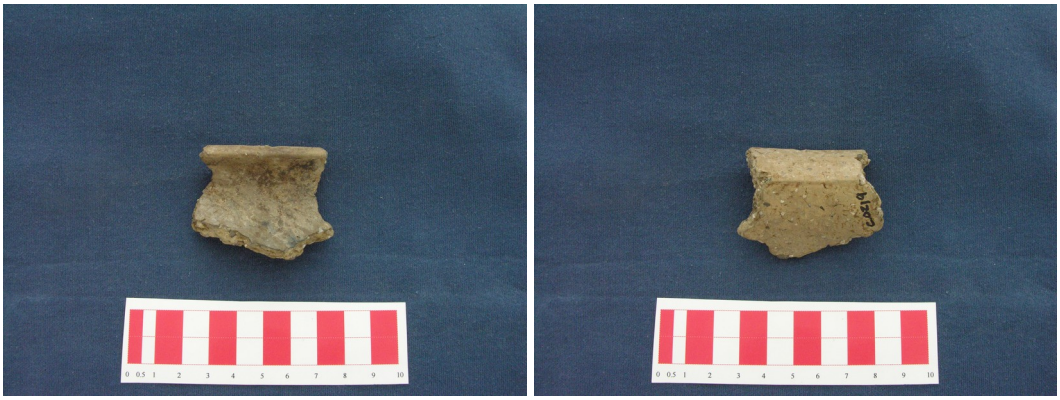
(a) Exterior (b) Interior

Figure B.194: Huizui Ceramic 0217



(a) Exterior (b) Radiograph

Figure B.195: Huizui Ceramic 0218 [MAE 2475]

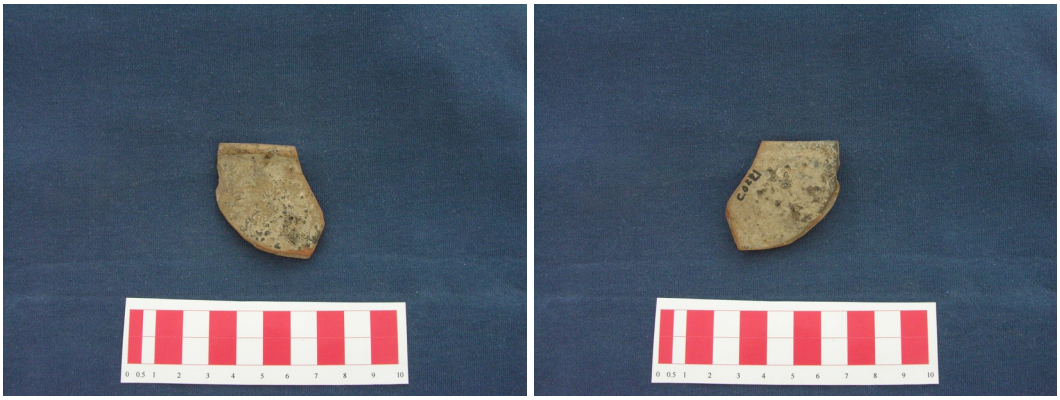


(a) Exterior (b) Interior

Figure B.196: Huizui Ceramic 0219

(a) Exterior (b) Interior

Figure B.197: Huizui Ceramic 0220

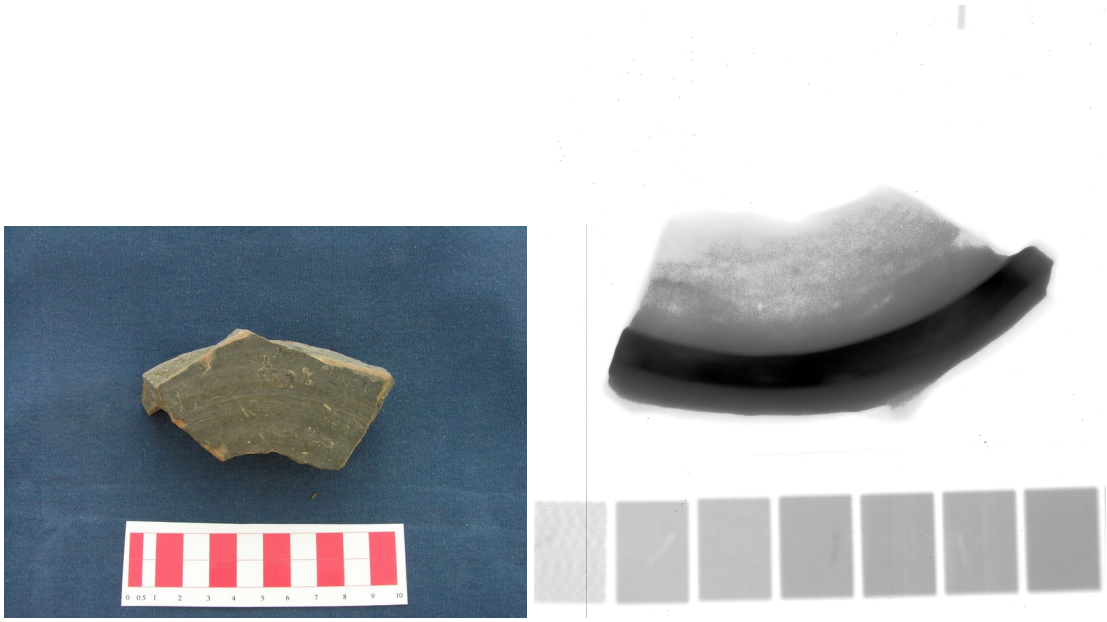


(a) Exterior (b) Interior

Figure B.198: Huizui Ceramic 0221

(a) Exterior (b) Interior

Figure B.199: Huizui Ceramic 0222



(a) Exterior (b) Radiograph

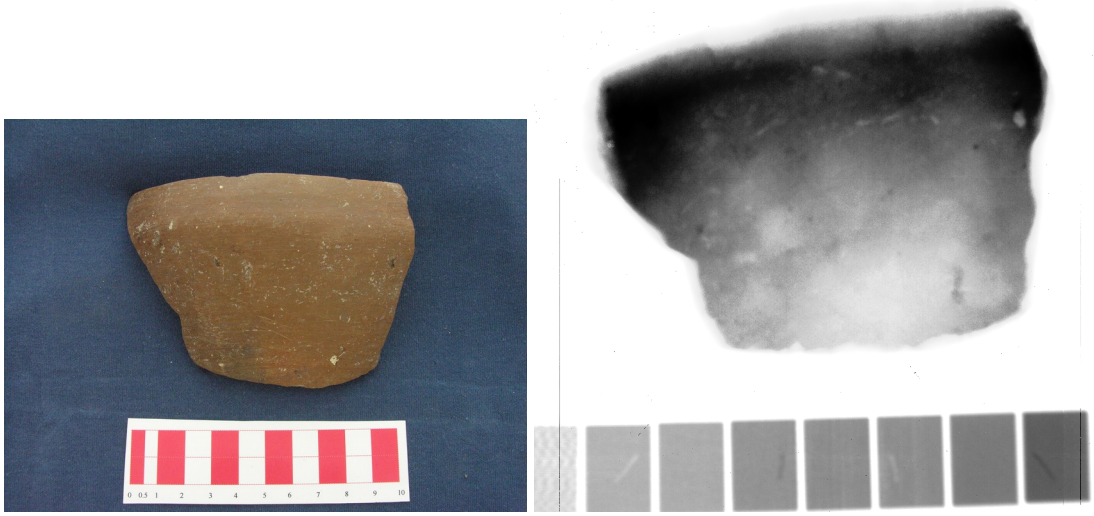
Figure B.200: Huizui Ceramic 0223 [MAE 2476]

(a) Exterior, part 1 (b) Exterior, parts 2 and 3

Figure B.201: Huizui Ceramic 0224

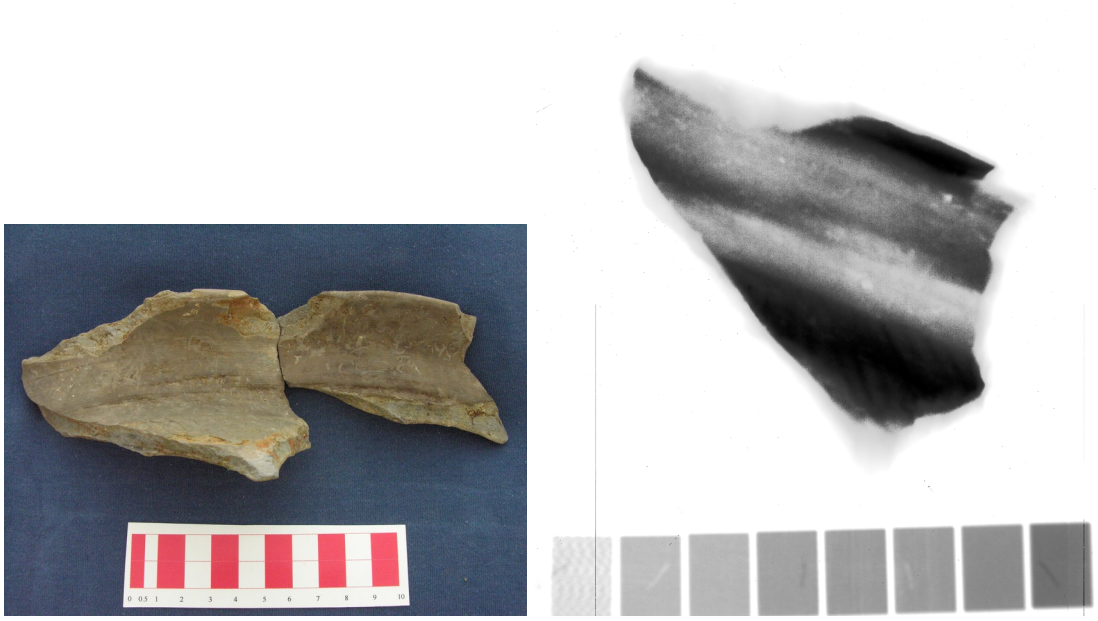
(a) Exterior (b) Interior

Figure B.202: Huizui Ceramic 0225



(a) Exterior (b) Radiograph

Figure B.203: Huizui Ceramic 0226 [MAE 2477]

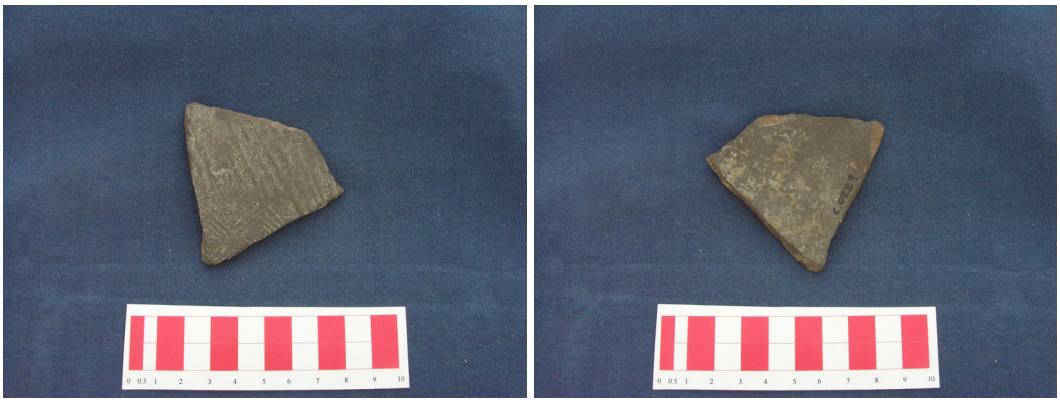


(a) Exterior (b) Radiograph

Figure B.204: Huizui Ceramic 0227 [MAE 2478]

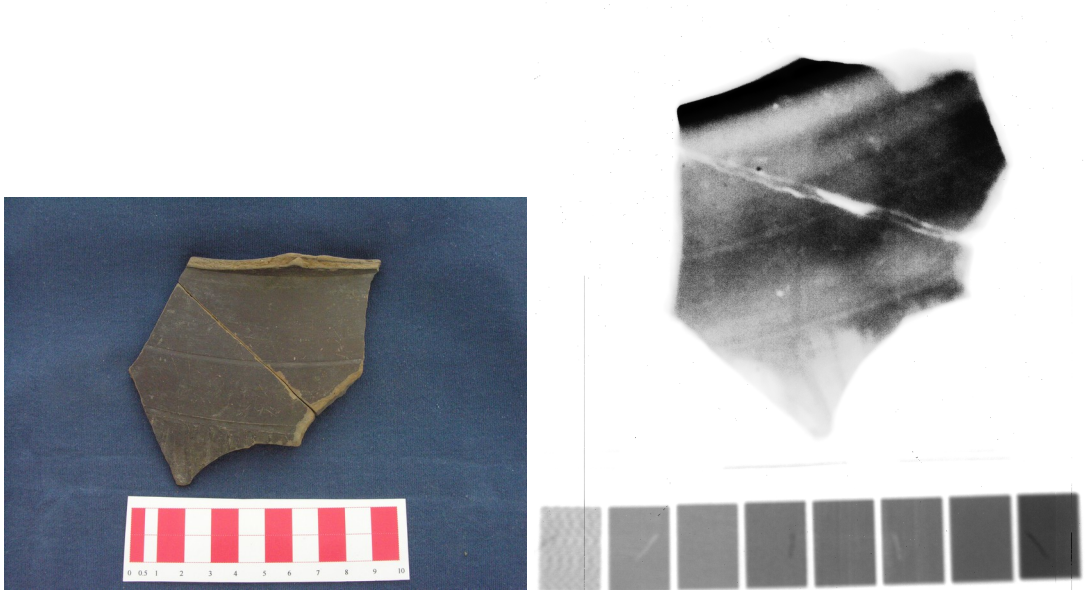
(a) Exterior (b) Interior

Figure B.205: Huizui Ceramic 0228



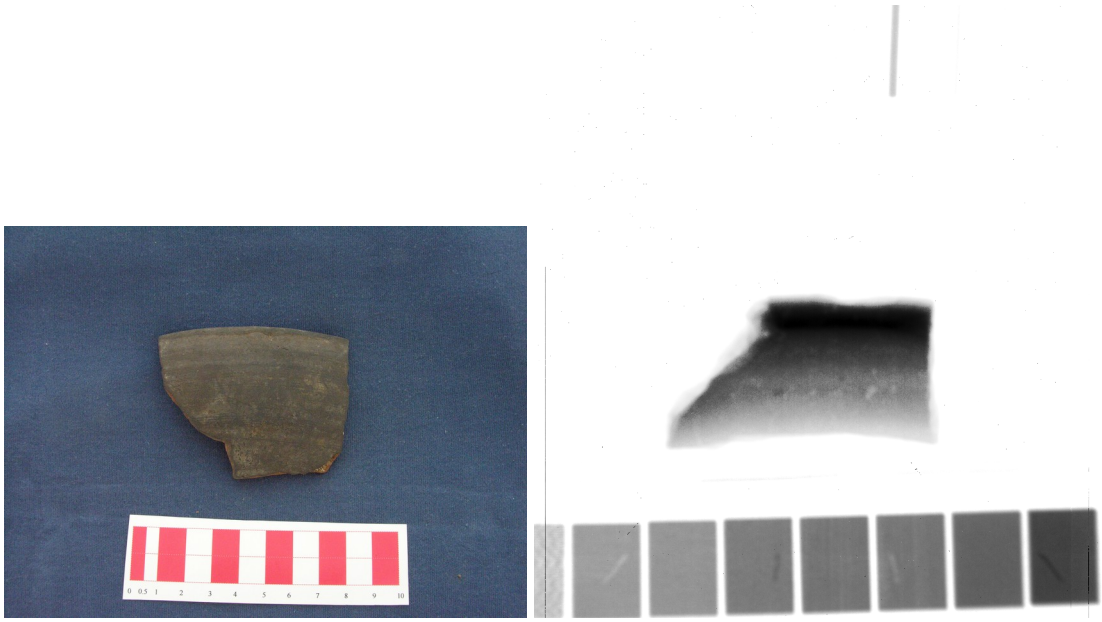
(a) Exterior (b) Interior

Figure B.206: Huizui Ceramic 0229



(a) Exterior (b) Radiograph

Figure B.207: Huizui Ceramic 0230 [MAE 2479]

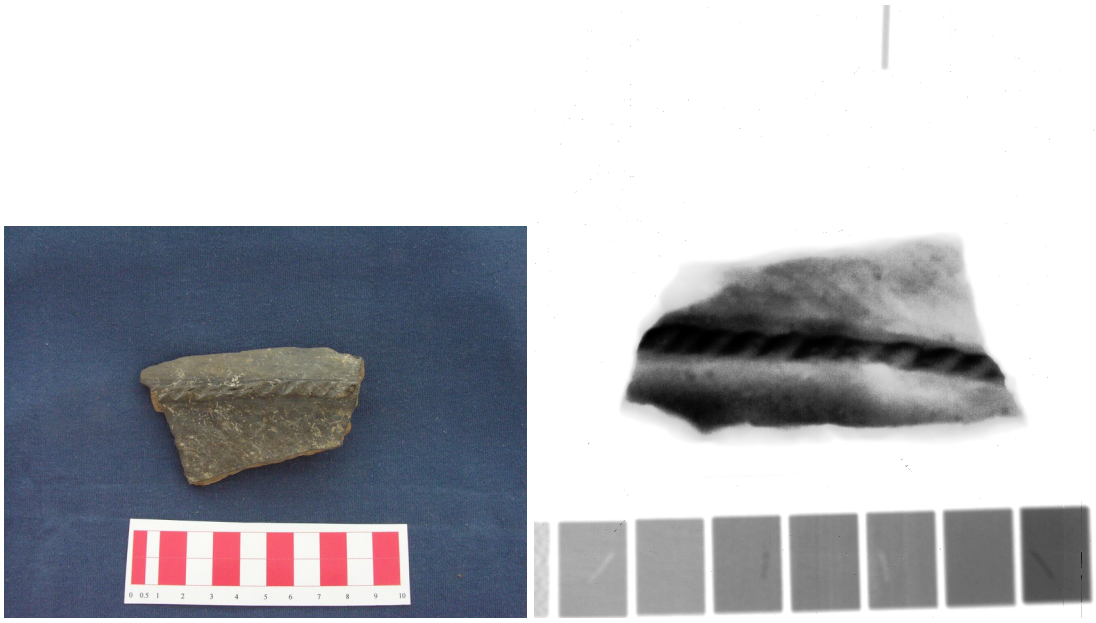


(a) Exterior (b) Radiograph

Figure B.208: Huizui Ceramic 0231 [MAE 2480]

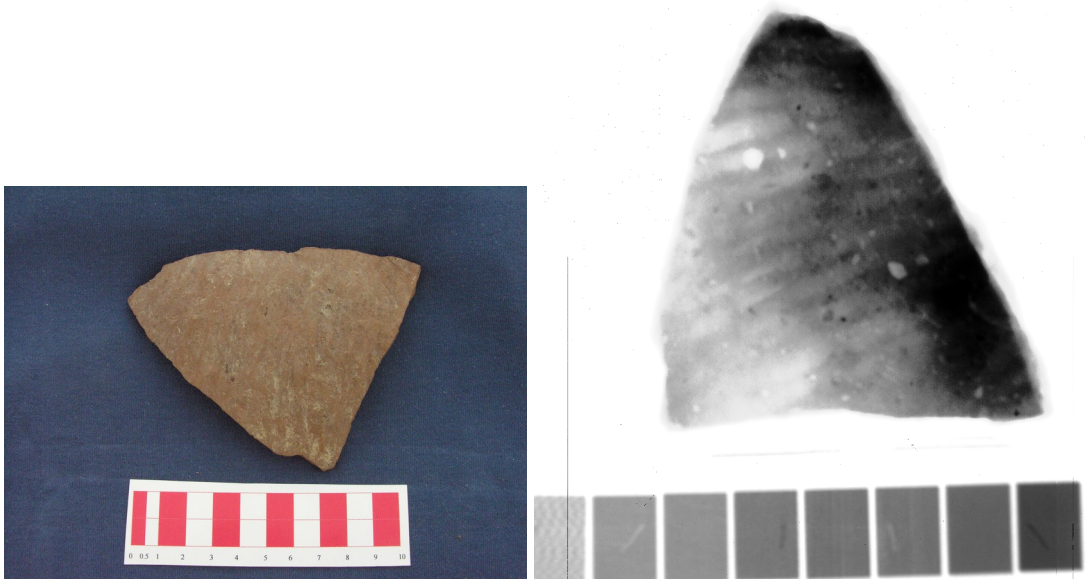
(a) Exterior (b) Interior

Figure B.209: Huizui Ceramic 0232



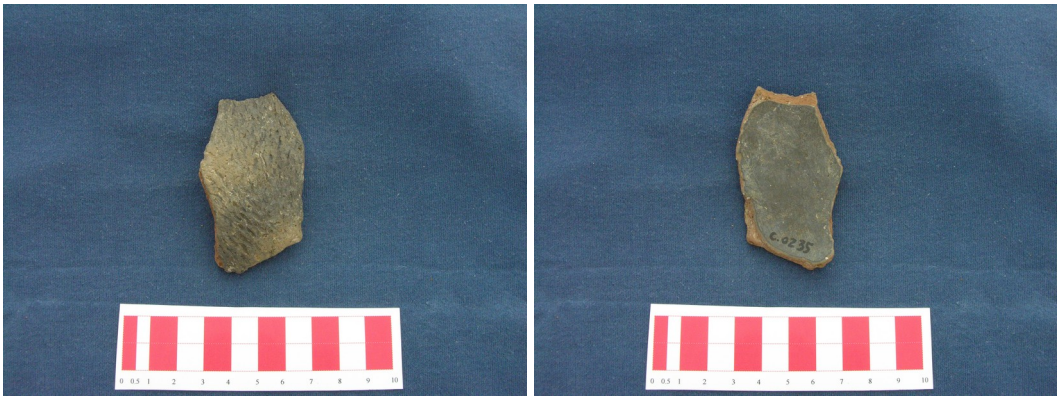
(a) Exterior (b) Radiograph

Figure B.210: Huizui Ceramic 0233 [MAE 2481]



(a) Exterior (b) Radiograph

Figure B.211: Huizui Ceramic 0234 [MAE 2482]

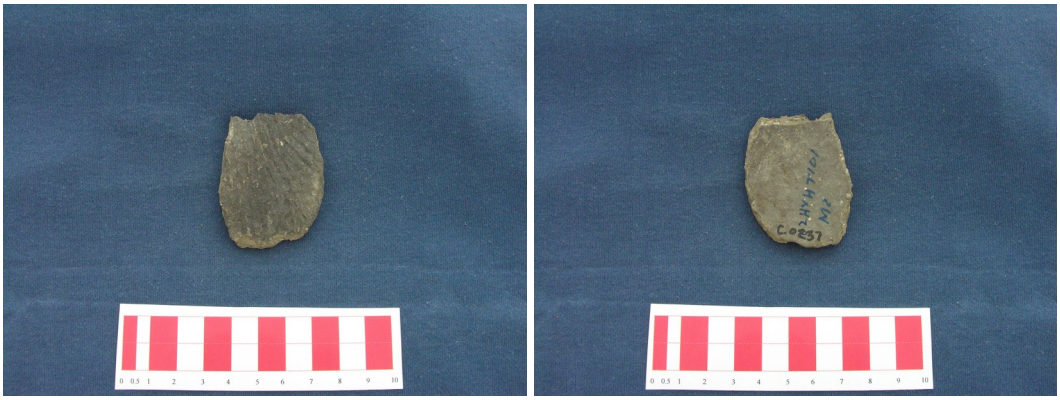


(a) Exterior (b) Interior

Figure B.212: Huizui Ceramic 0235

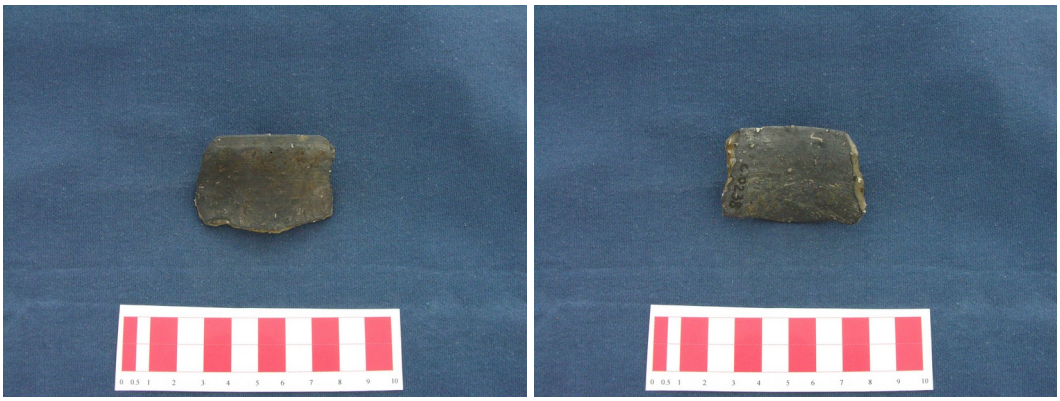
(a) Exterior (b) Interior

Figure B.213: Huizui Ceramic 0236



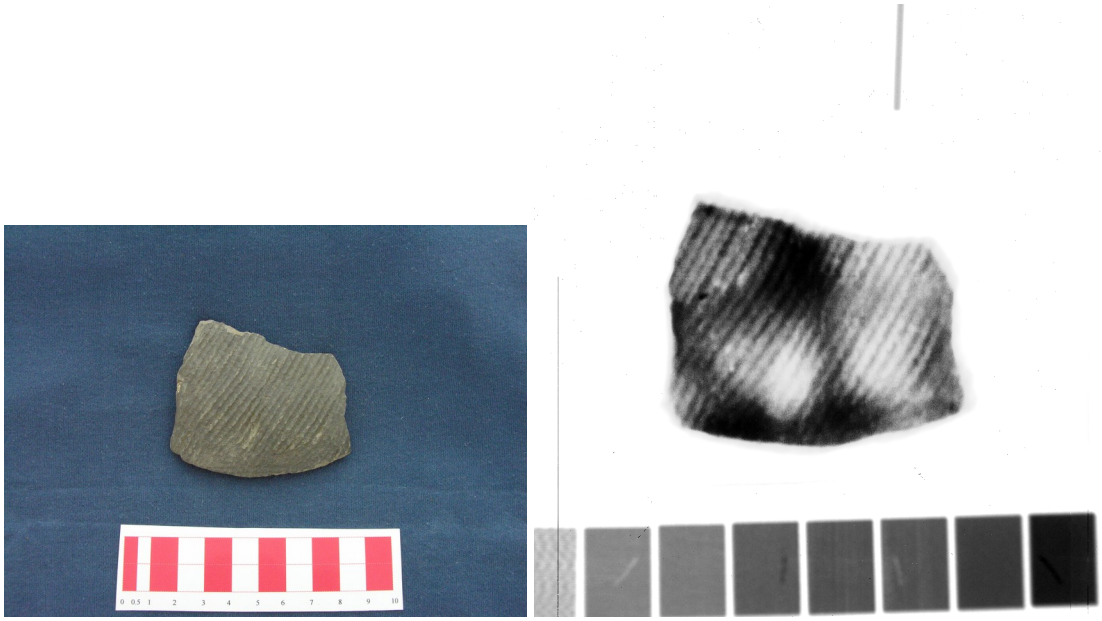
(a) Exterior (b) Interior

Figure B.214: Huizui Ceramic 0237



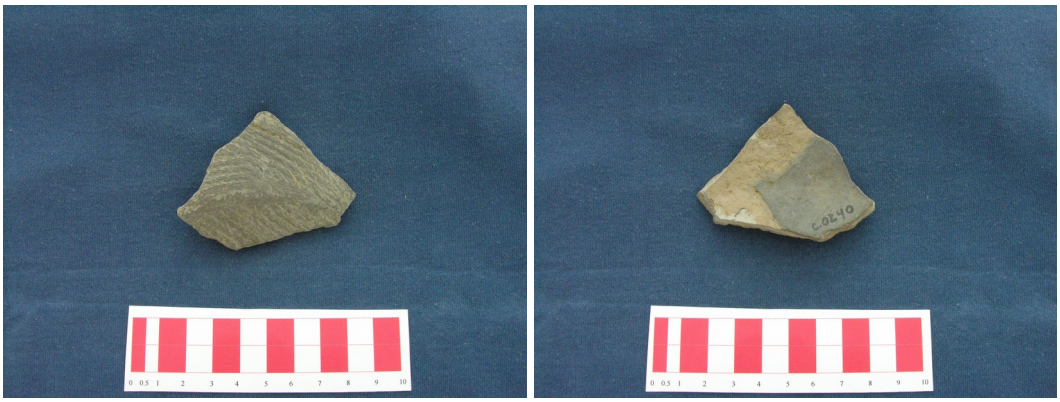
(a) Exterior (b) Interior

Figure B.215: Huizui Ceramic 0238



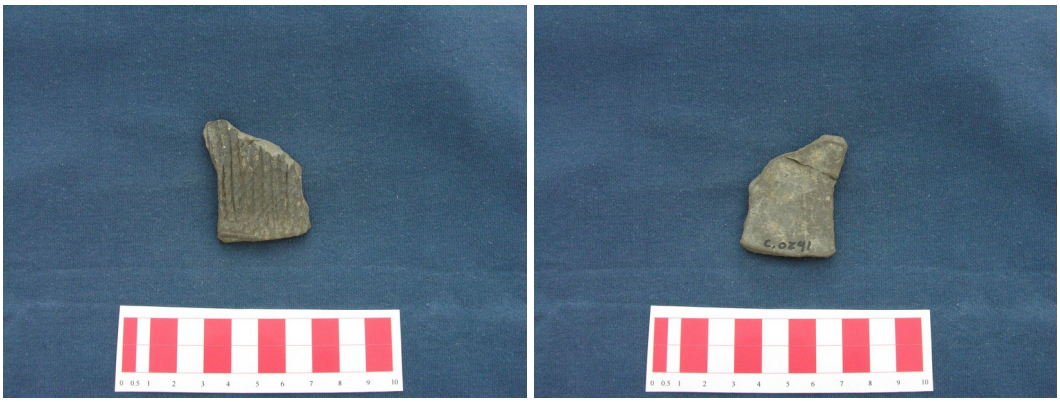
(a) Exterior (b) Radiograph

Figure B.216: Huizui Ceramic 0239 [MAE 2483]



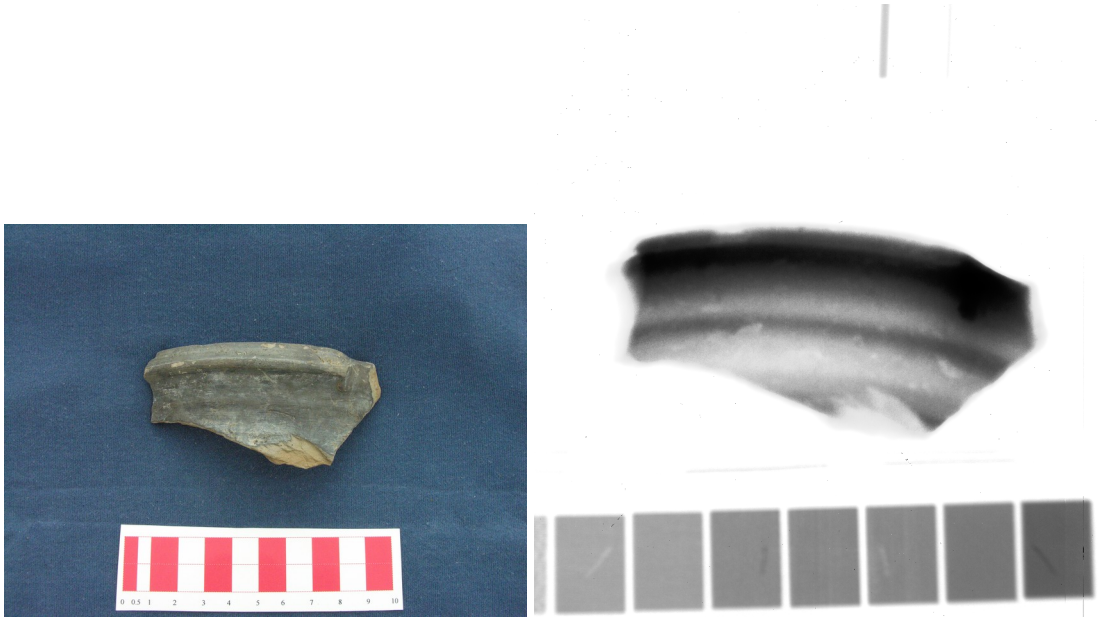
(a) Exterior (b) Interior

Figure B.217: Huizui Ceramic 0240



(a) Exterior (b) Interior

Figure B.218: Huizui Ceramic 0241



(a) Exterior (b) Radiograph

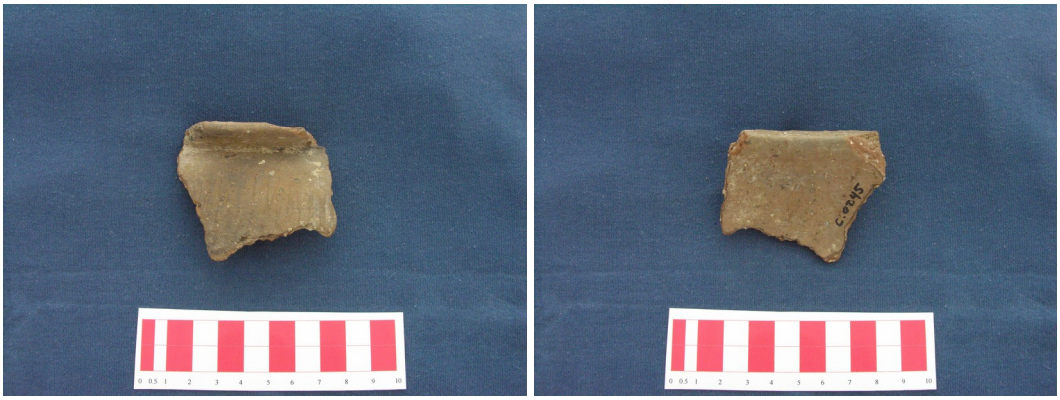
Figure B.219: Huizui Ceramic 0242 [MAE 2484]

(a) Exterior (b) Interior

Figure B.220: Huizui Ceramic 0243

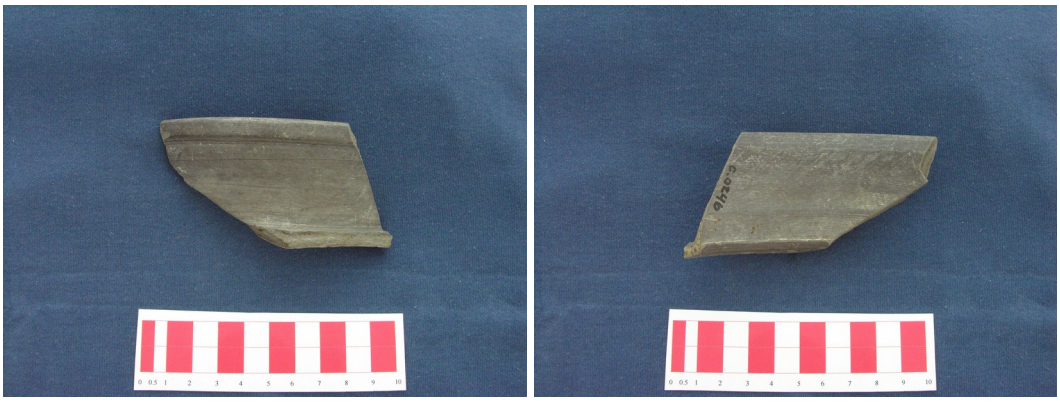
(a) Exterior (b) Interior

Figure B.221: Huizui Ceramic 0244



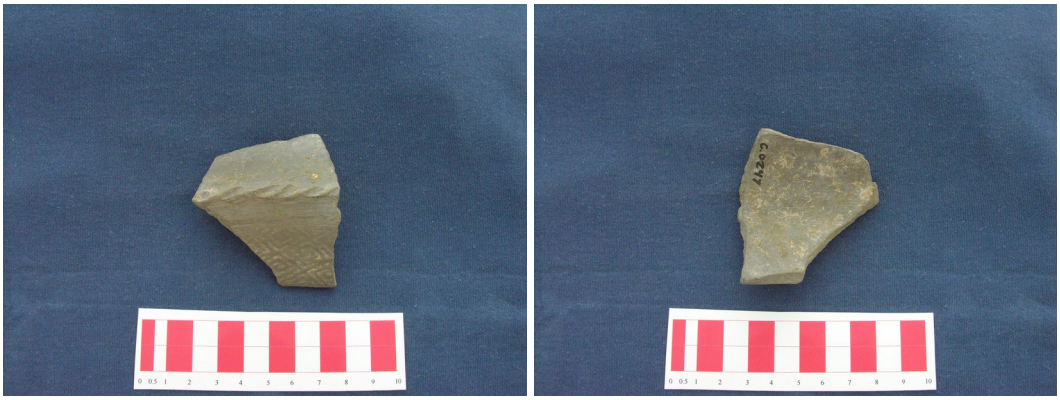
(a) Exterior (b) Interior

Figure B.222: Huizui Ceramic 0245



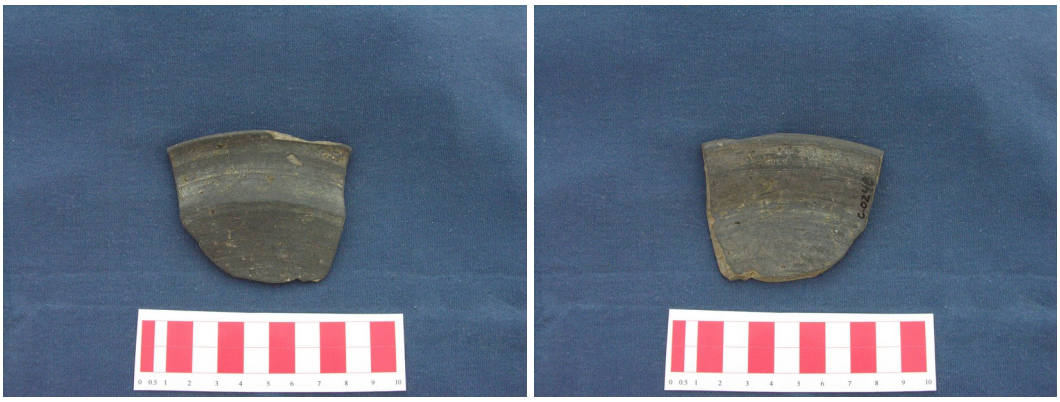
(a) Exterior (b) Interior

Figure B.223: Huizui Ceramic 0246



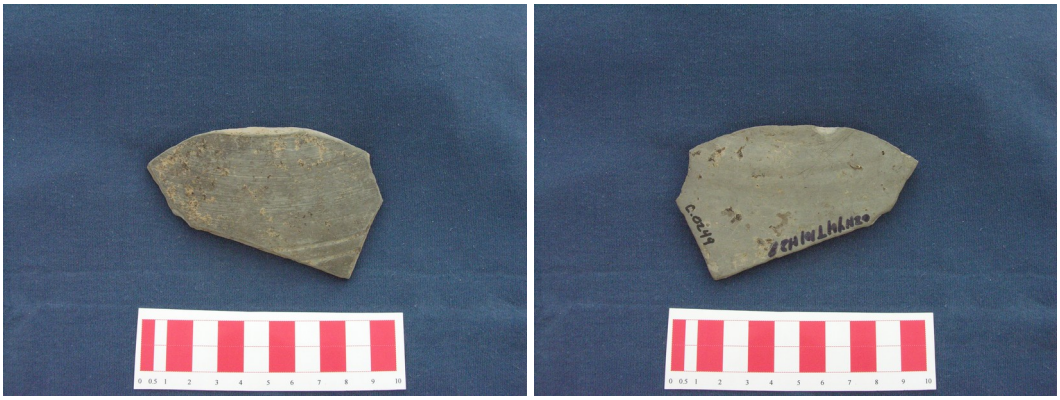
(a) Exterior (b) Interior

Figure B.224: Huizui Ceramic 0247



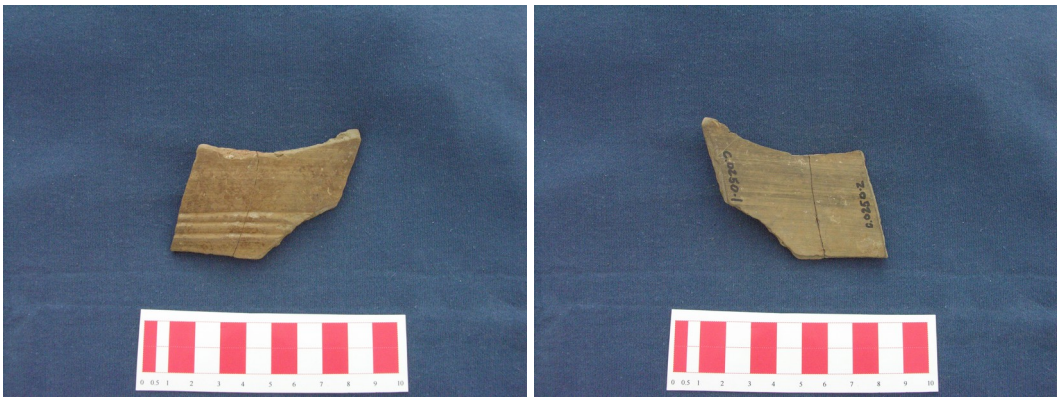
(a) Exterior (b) Interior

Figure B.225: Huizui Ceramic 0248



(a) Exterior (b) Interior

Figure B.226: Huizui Ceramic 0249



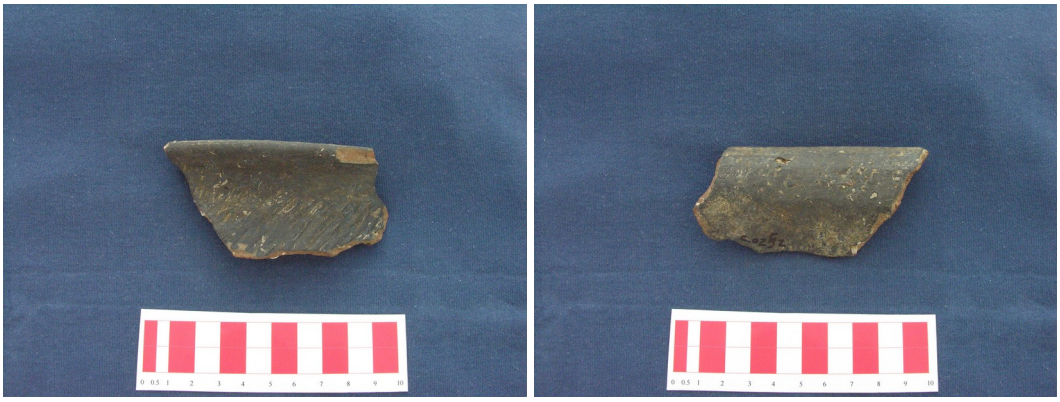
(a) Exterior (b) Interior

Figure B.227: Huizui Ceramic 0250

(a) Exterior (b) Interior

Figure B.228: Huizui Ceramic 0251 [MAE 2485]

No radiograpgh for this sherd was acquired.



(a) Exterior (b) Interior

Figure B.229: Huizui Ceramic 0252

(a) Exterior (b) Interior

Figure B.230: Huizui Ceramic 0253 [MAE 2486]

No radiograpgh for this sherd was acquired.

(a) Exterior (b) Interior

Figure B.231: Huizui Ceramic 0254

(a) Exterior (b) Interior

Figure B.232: Huizui Ceramic 0255

(a) Exterior (b) Interior

Figure B.233: Huizui Ceramic 0256 [MAE 2487]

No radiograpgh for this sherd was acquired.

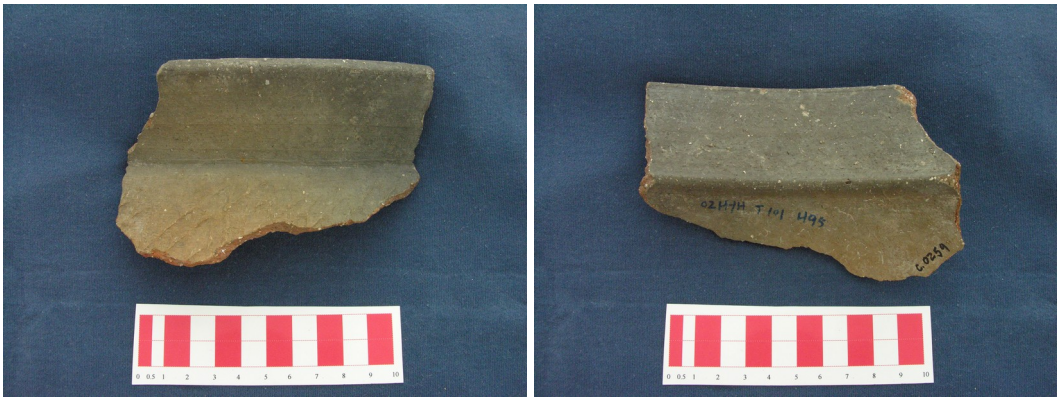
(a) Exterior (b) Interior

Figure B.234: Huizui Ceramic 0257 [MAE 2488]

No radiograpgh for this sherd was acquired.

(a) Exterior (b) Interior

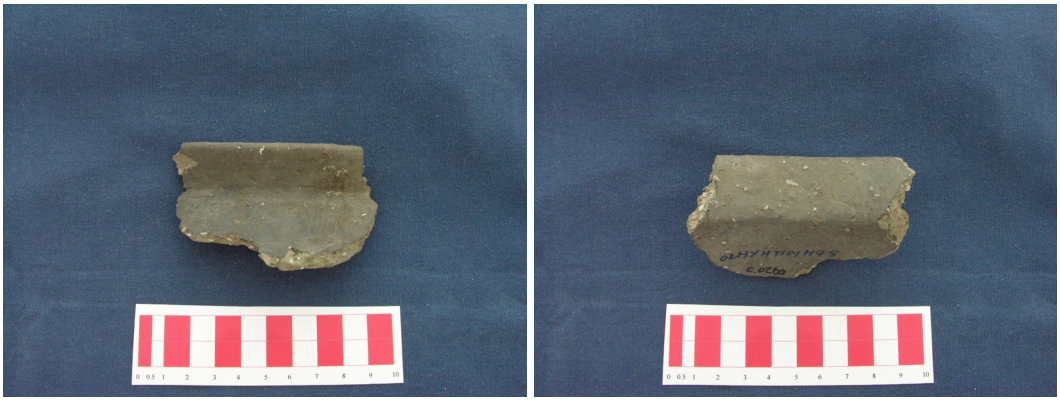
Figure B.235: Huizui Ceramic 0258



(a) Exterior (b) Interior

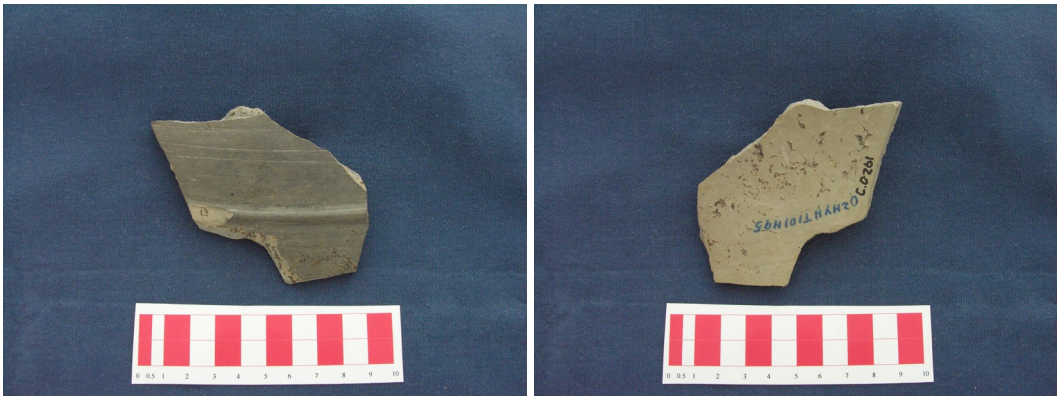
Figure B.236: Huizui Ceramic 0259 [MAE 2489]

No radiograpgh for this sherd was acquired.



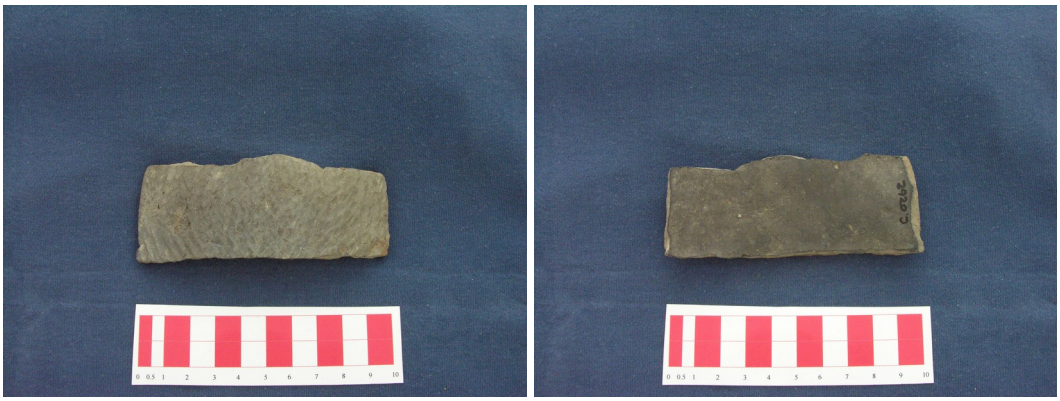
(a) Exterior (b) Interior

Figure B.237: Huizui Ceramic 0260



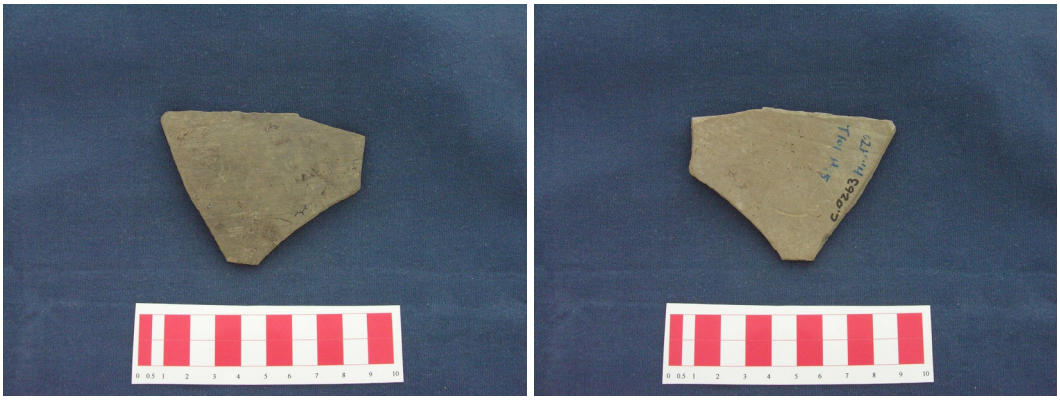
(a) Exterior (b) Interior

Figure B.238: Huizui Ceramic 0261



(a) Exterior (b) Interior

Figure B.239: Huizui Ceramic 0262

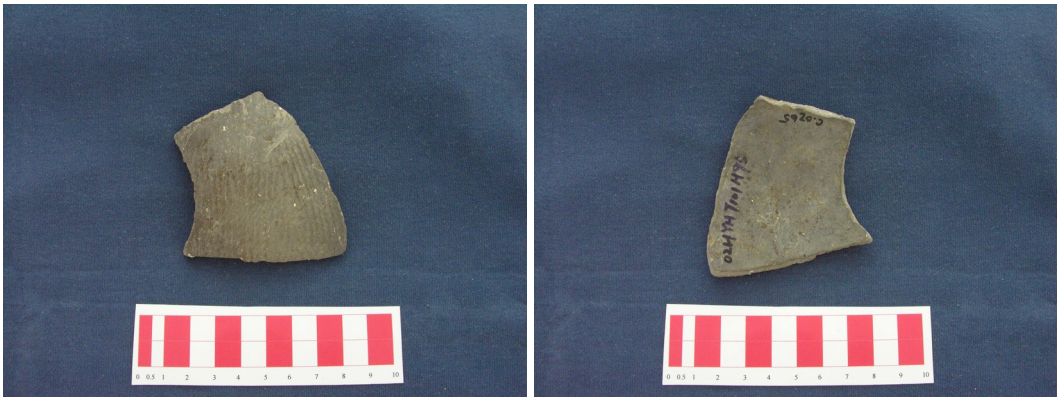


(a) Exterior (b) Interior

Figure B.240: Huizui Ceramic 0263

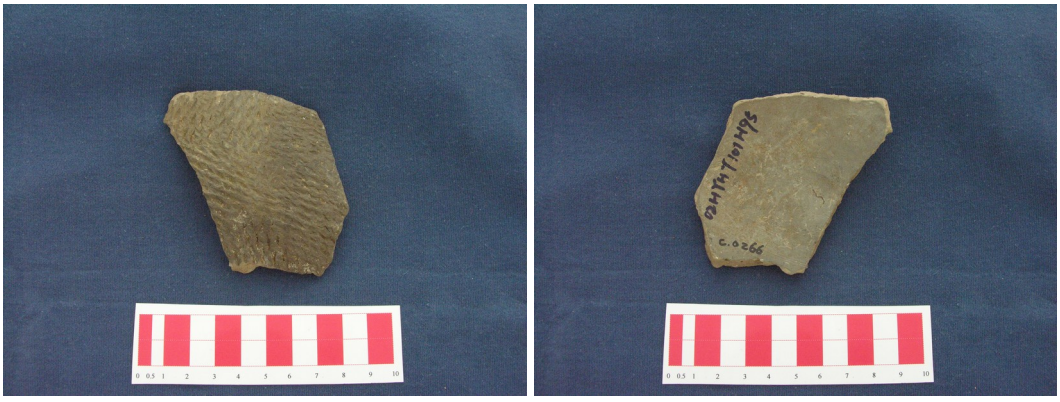
(a) Exterior (b) Interior

Figure B.241: Huizui Ceramic 0264



(a) Exterior (b) Interior

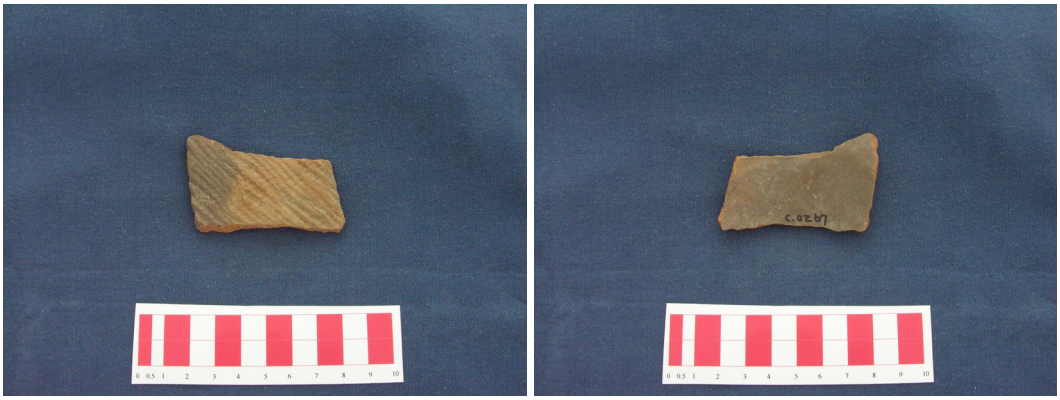
Figure B.242: Huizui Ceramic 0265



(a) Exterior (b) Interior

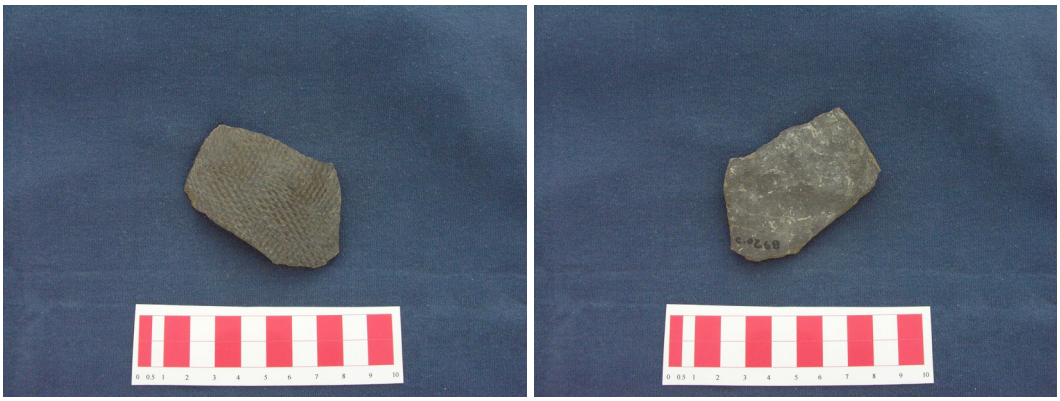
Figure B.243: Huizui Ceramic 0266 [MAE 2490]

No radiograpgh for this sherd was acquired.



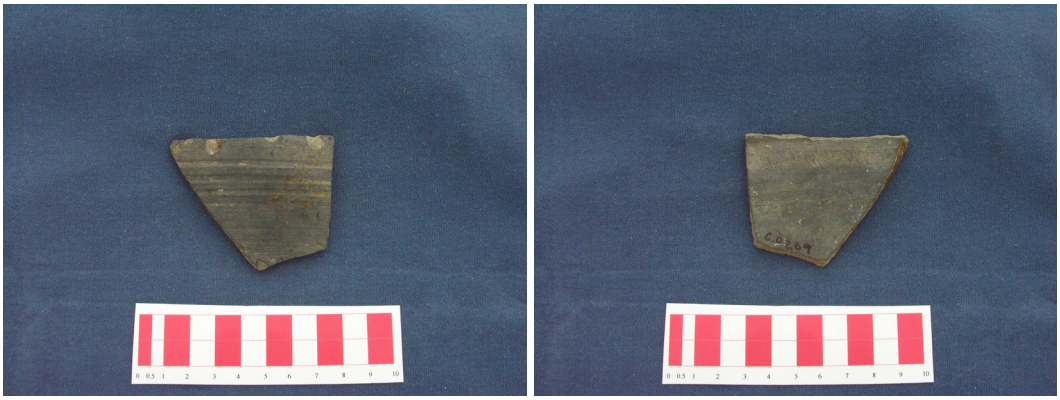
(a) Exterior (b) Interior

Figure B.244: Huizui Ceramic 0267



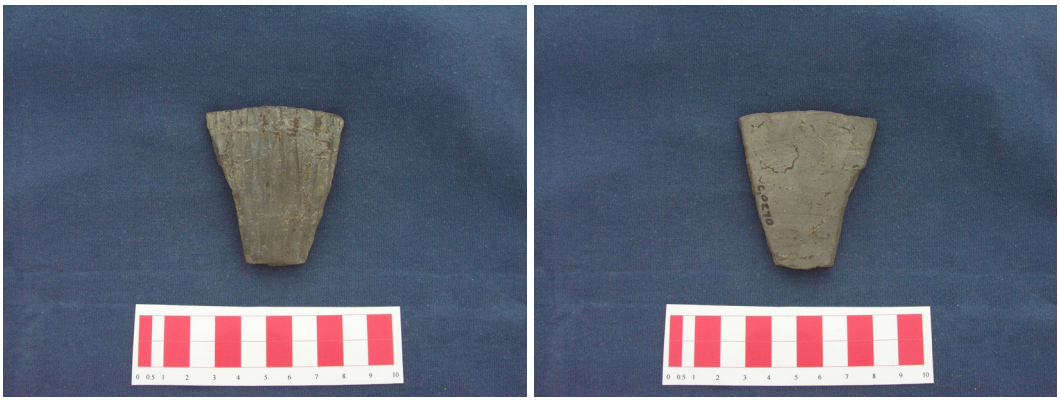
(a) Exterior (b) Interior

Figure B.245: Huizui Ceramic 0268



(a) Exterior (b) Interior

Figure B.246: Huizui Ceramic 0269



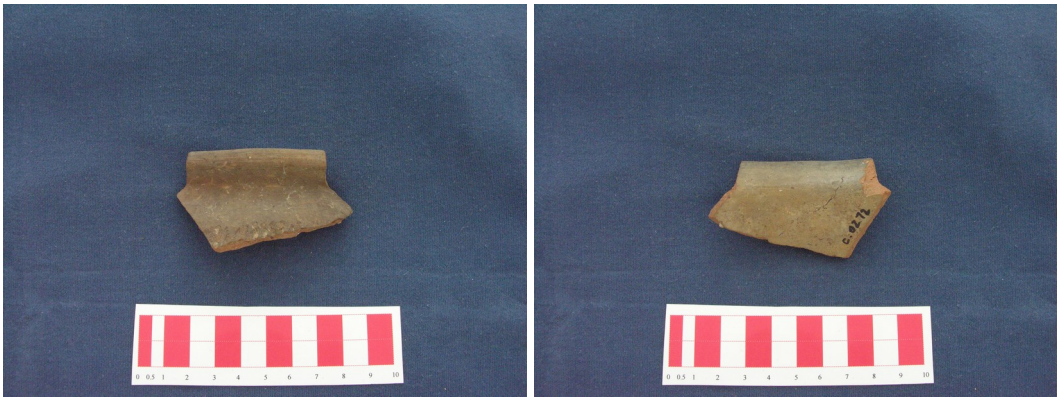
(a) Exterior (b) Interior

Figure B.247: Huizui Ceramic 0270

(a) Exterior (b) Interior

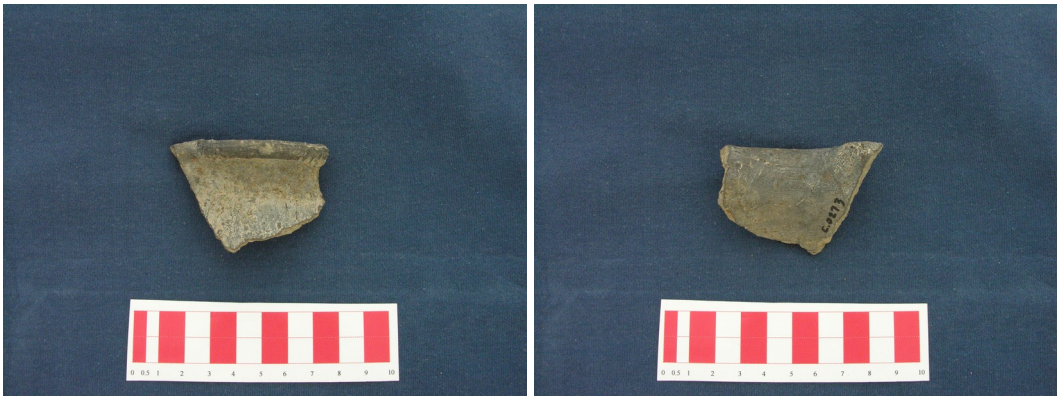
Figure B.248: Huizui Ceramic 0271 [MAE 2491]

No radiograpgh for this sherd was acquired.



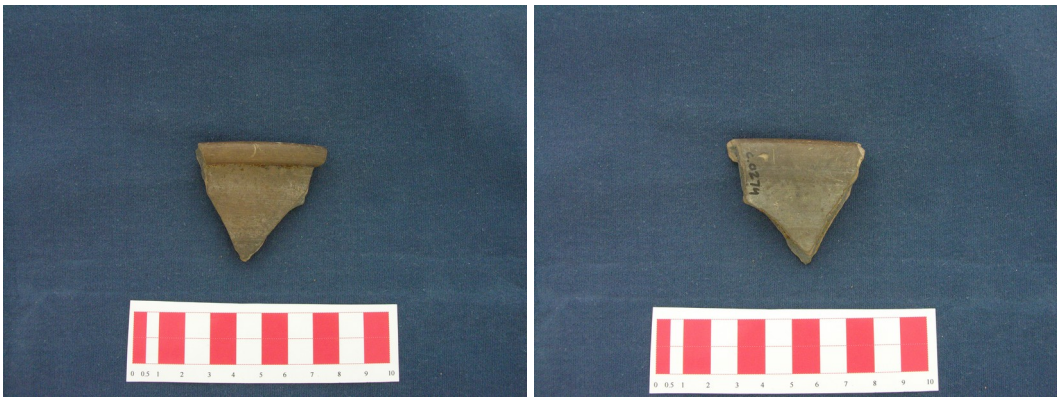
(a) Exterior (b) Interior

Figure B.249: Huizui Ceramic 0272



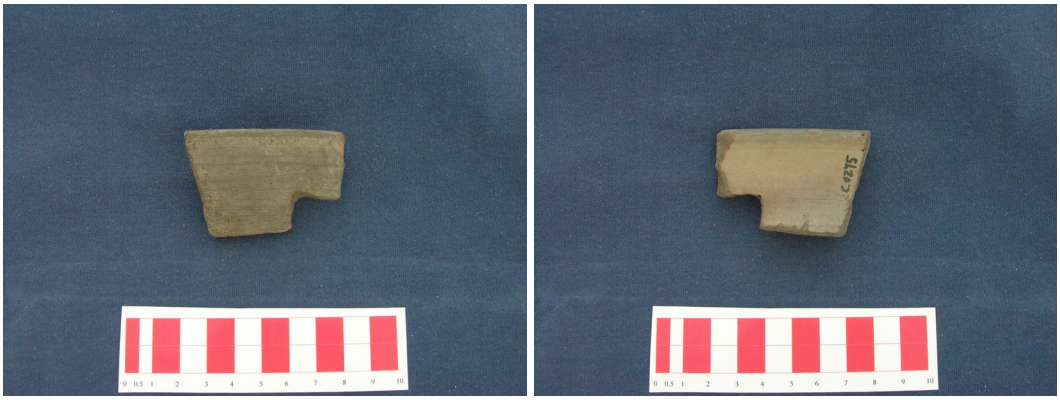
(a) Exterior (b) Interior

Figure B.250: Huizui Ceramic 0273



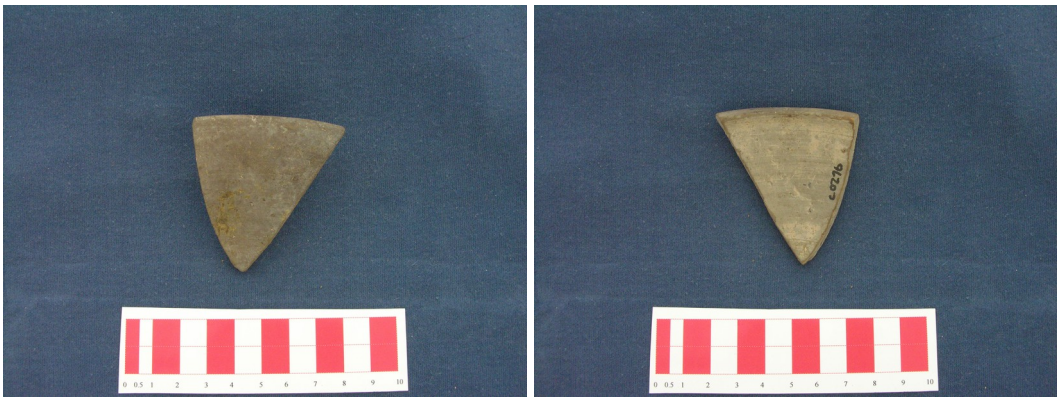
(a) Exterior (b) Interior

Figure B.251: Huizui Ceramic 0274



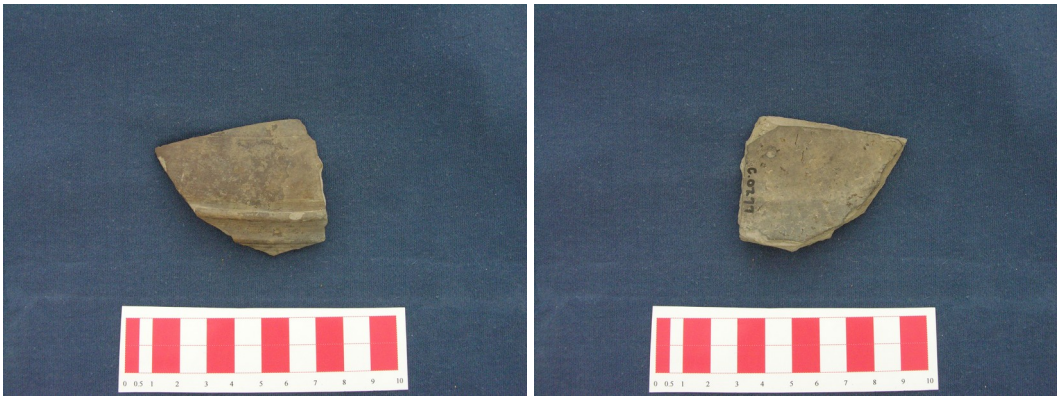
(a) Exterior (b) Interior

Figure B.252: Huizui Ceramic 0275



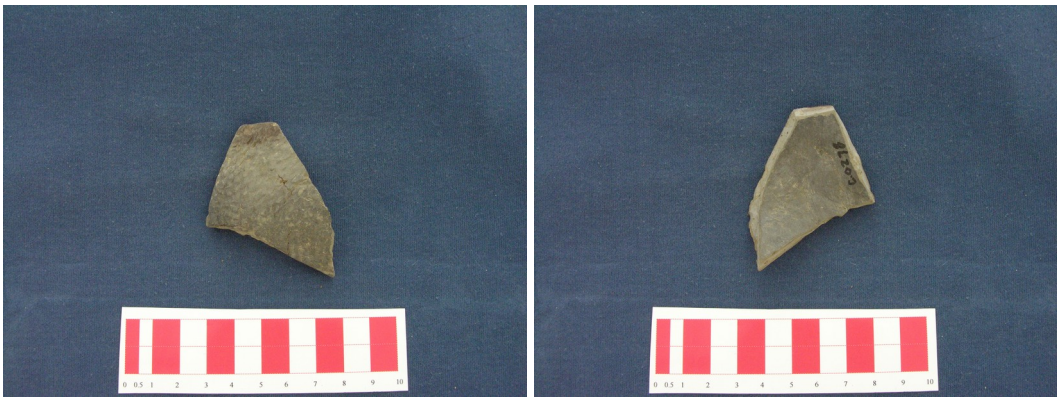
(a) Exterior (b) Interior

Figure B.253: Huizui Ceramic 0276



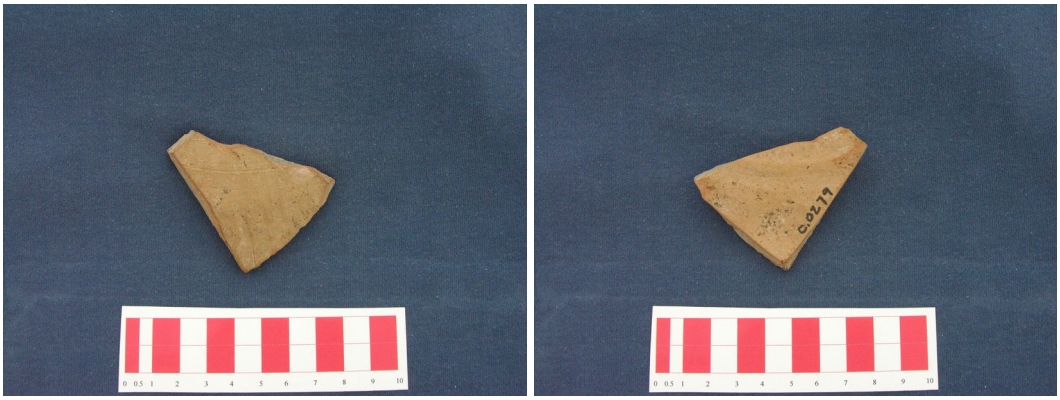
(a) Exterior (b) Interior

Figure B.254: Huizui Ceramic 0277



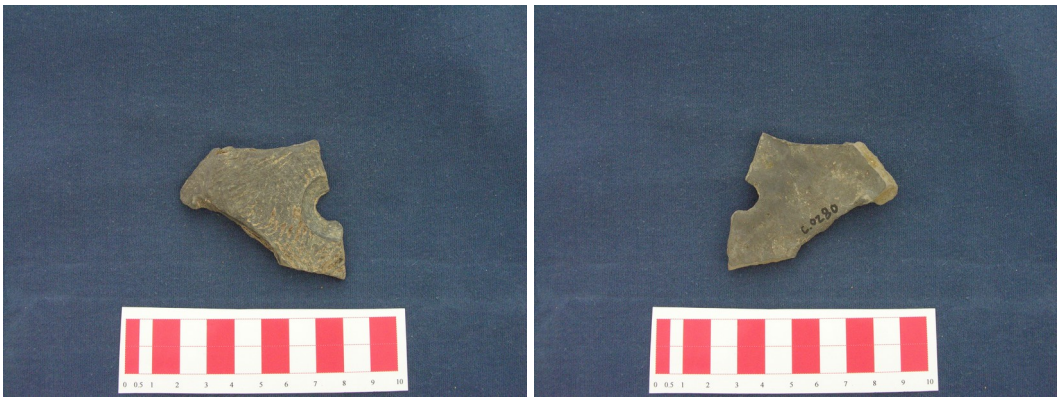
(a) Exterior (b) Interior

Figure B.255: Huizui Ceramic 0278



(a) Exterior (b) Interior

Figure B.256: Huizui Ceramic 0279



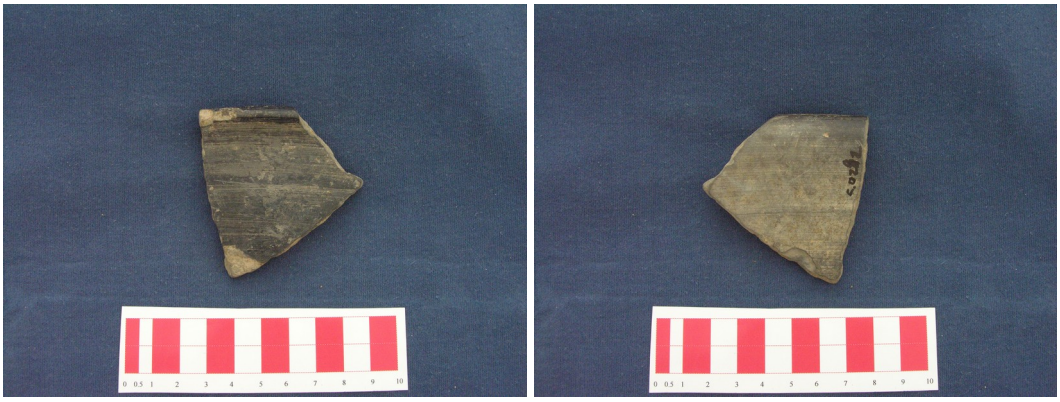
(a) Exterior (b) Interior

Figure B.257: Huizui Ceramic 0280

(a) Exterior (b) Interior

Figure B.258: Huizui Ceramic 0281 [MAE 2492]

No radiograpgh for this sherd was acquired.

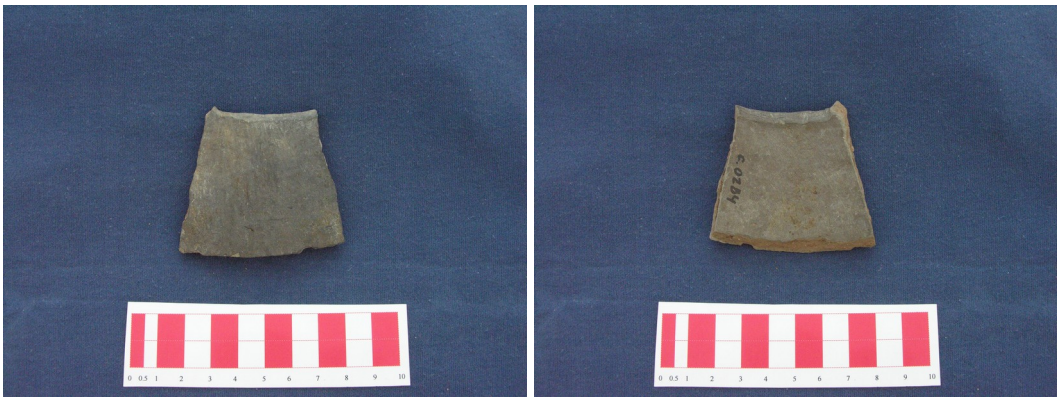


(a) Exterior (b) Interior

Figure B.259: Huizui Ceramic 0282

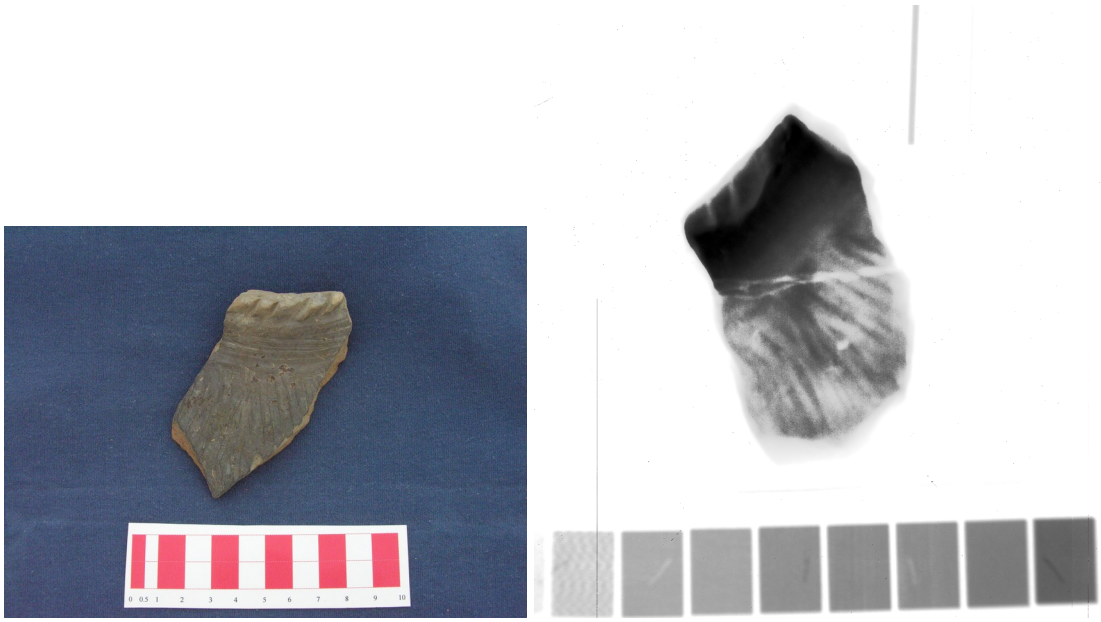
(a) Exterior (b) Interior

Figure B.260: Huizui Ceramic 0283



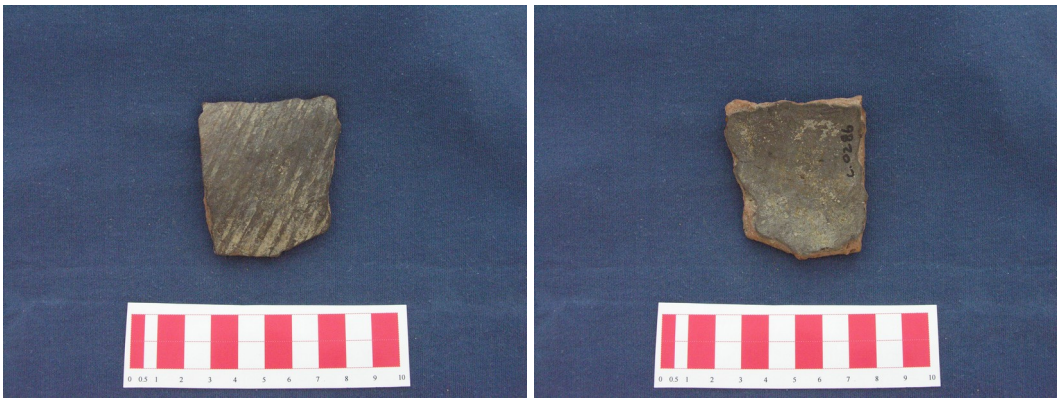
(a) Exterior (b) Interior

Figure B.261: Huizui Ceramic 0284



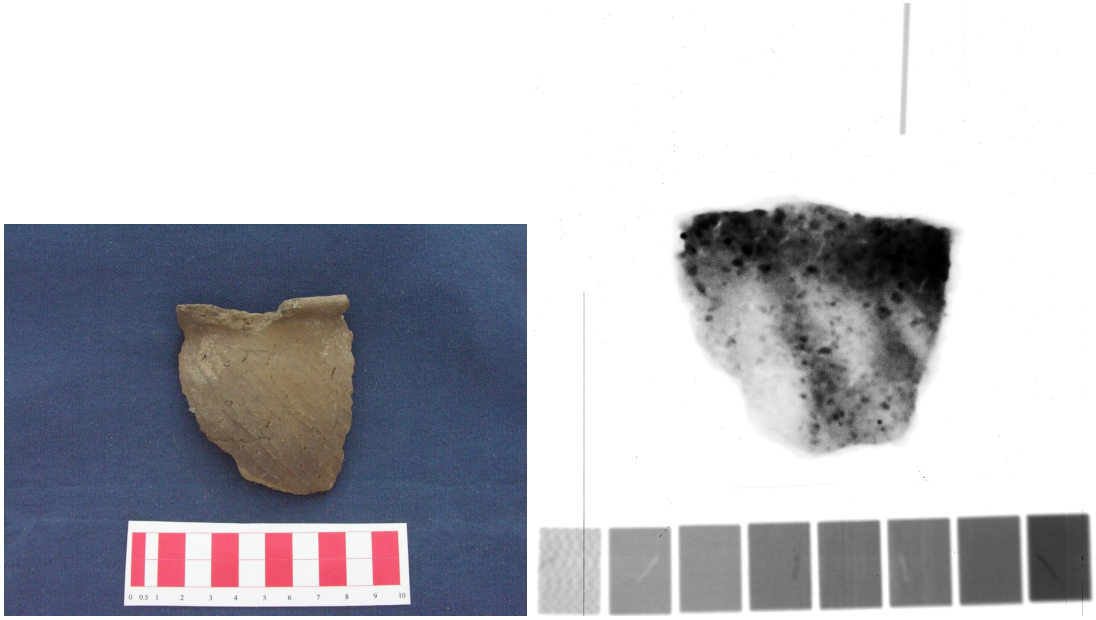
(a) Exterior (b) Radiograph

Figure B.262: Huizui Ceramic 0285 [MAE 2493]



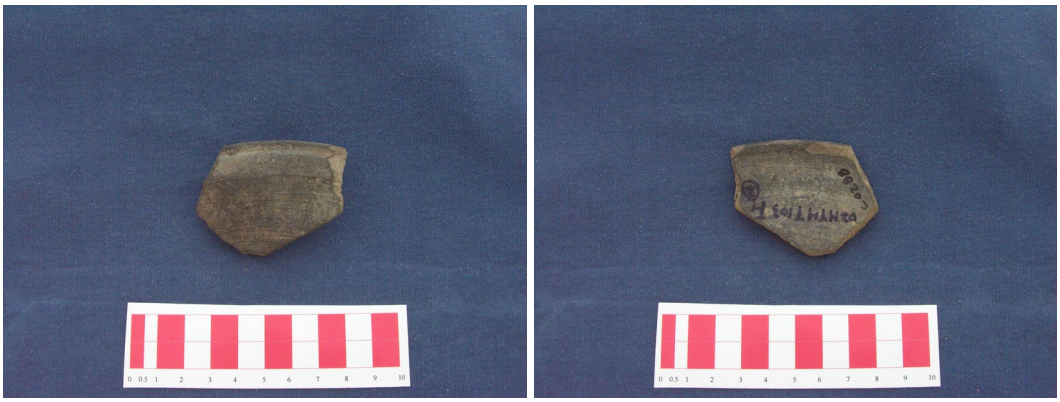
(a) Exterior (b) Interior

Figure B.263: Huizui Ceramic 0286



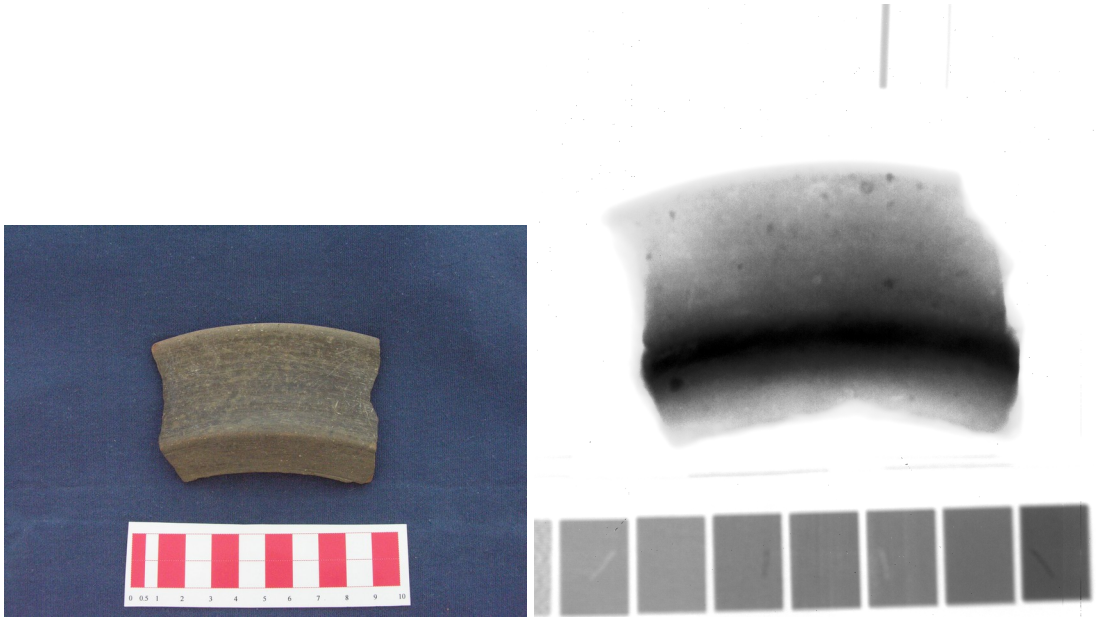
(a) Exterior (b) Radiograph

Figure B.264: Huizui Ceramic 0287 [MAE 2494]



(a) Exterior (b) Interior

Figure B.265: Huizui Ceramic 0288

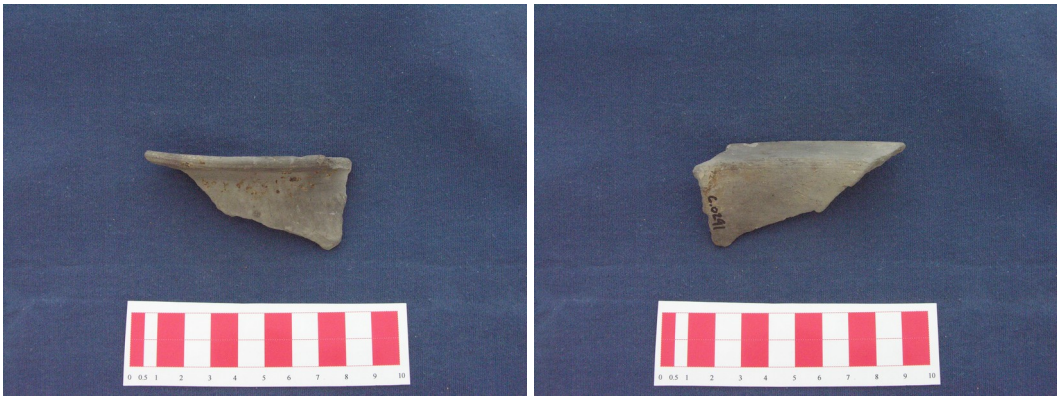


(a) Exterior (b) Radiograph

Figure B.266: Huizui Ceramic 0289 [MAE 2495]

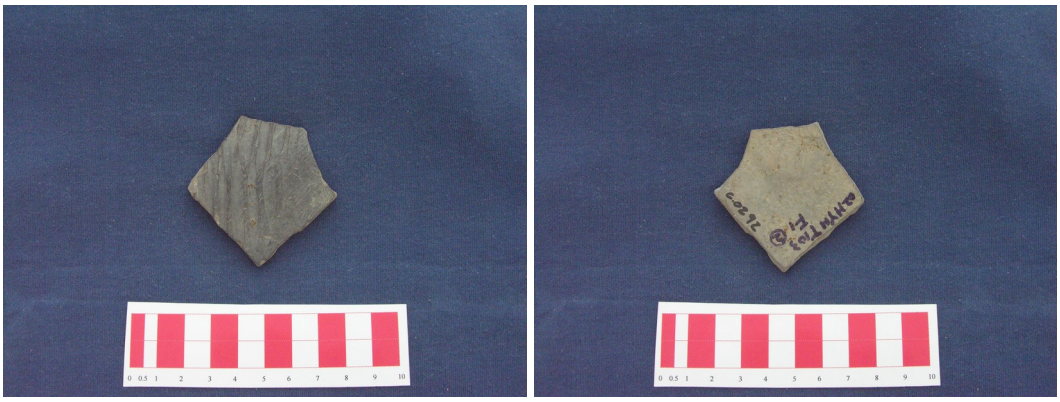
(a) Exterior (b) Interior

Figure B.267: Huizui Ceramic 0290



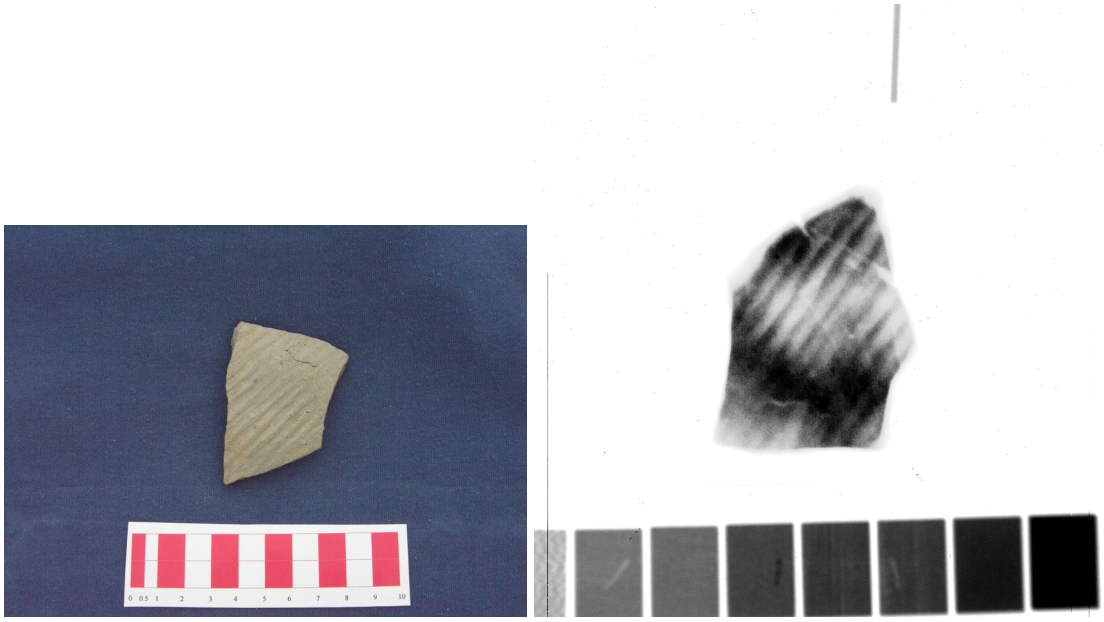
(a) Exterior (b) Interior

Figure B.268: Huizui Ceramic 0291



(a) Exterior (b) Interior

Figure B.269: Huizui Ceramic 0292

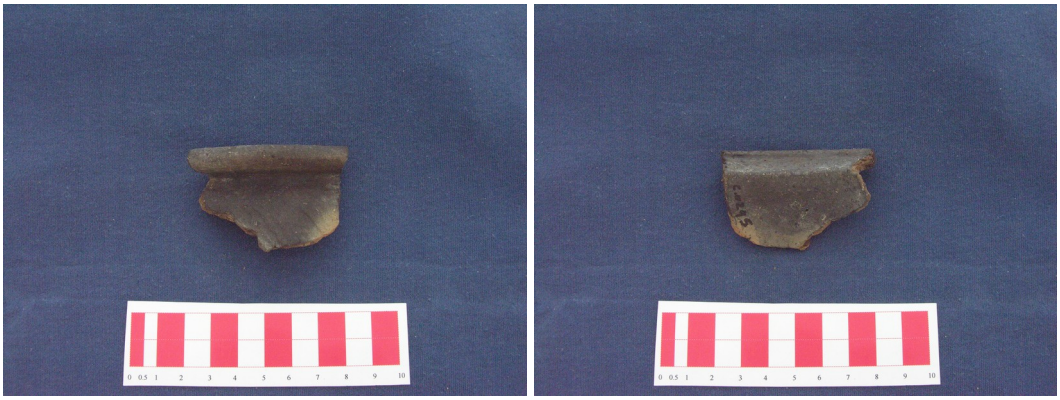


(a) Exterior (b) Radiograph

Figure B.270: Huizui Ceramic 0293 [MAE 2496]

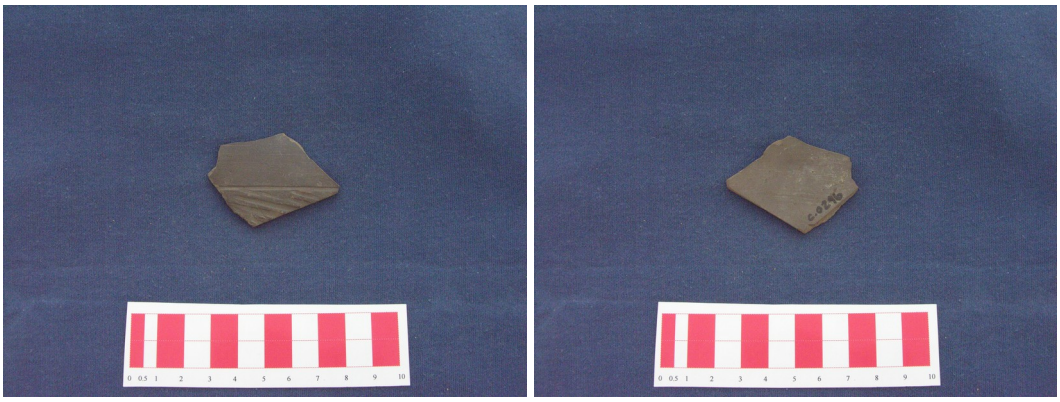
(a) Exterior (b) Interior

Figure B.271: Huizui Ceramic 0294



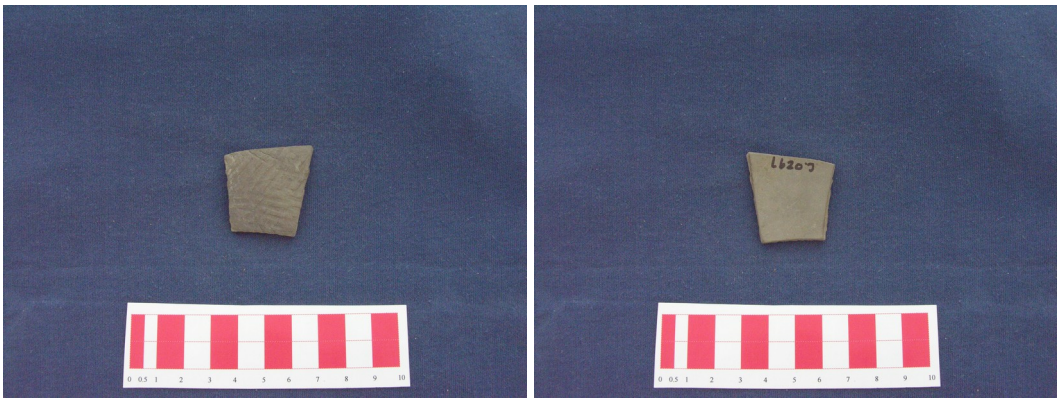
(a) Exterior (b) Interior

Figure B.272: Huizui Ceramic 0295



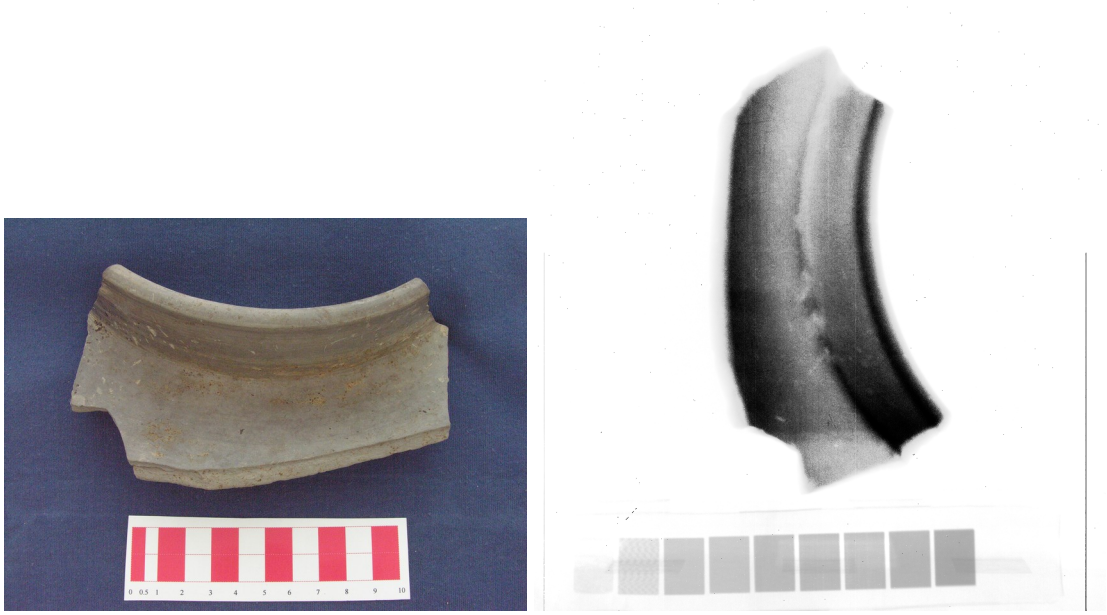
(a) Exterior (b) Interior

Figure B.273: Huizui Ceramic 0296



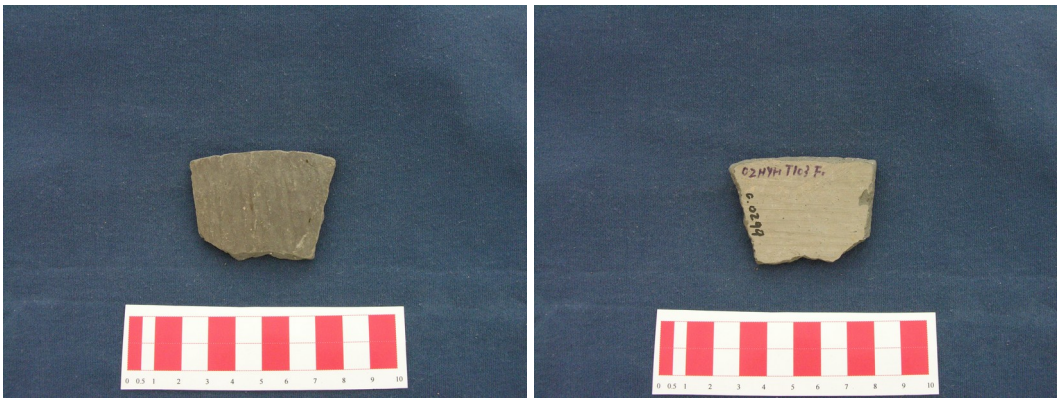
(a) Exterior (b) Interior

Figure B.274: Huizui Ceramic 0297



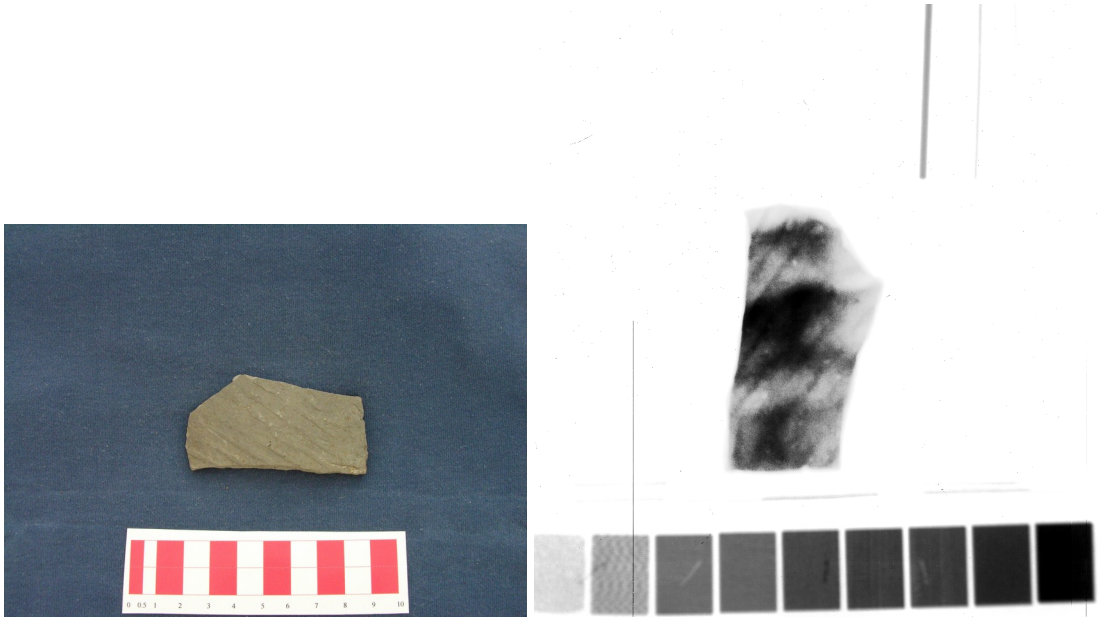
(a) Exterior (b) Radiograph

Figure B.275: Huizui Ceramic 0298 [MAE 2497]



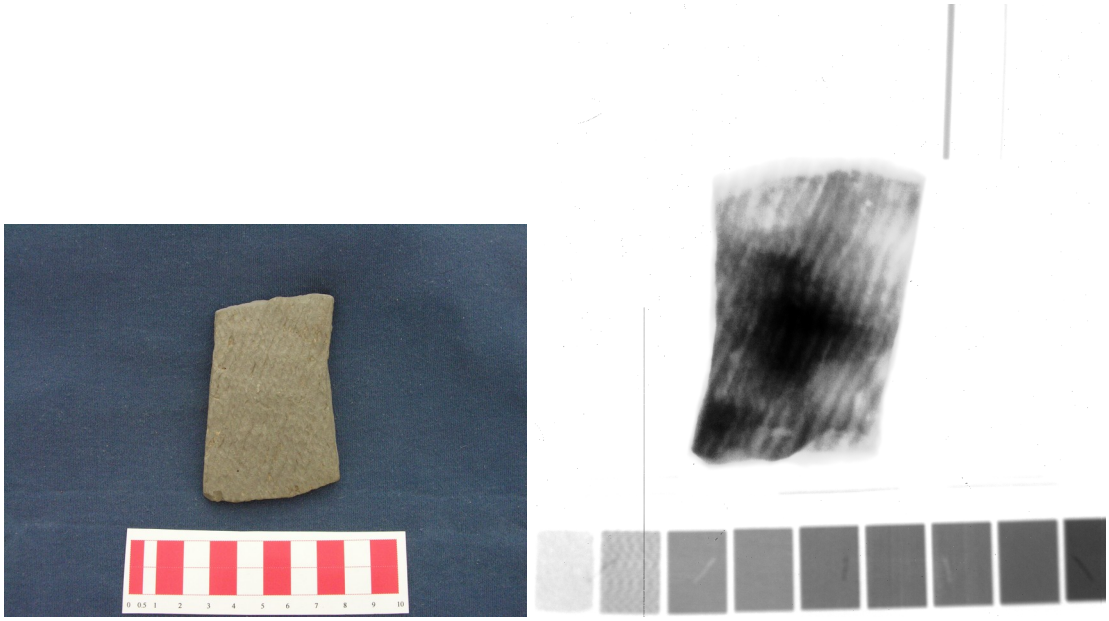
(a) Exterior (b) Interior

Figure B.276: Huizui Ceramic 0299



(a) Exterior (b) Radiograph

Figure B.277: Huizui Ceramic 0300 [MAE 2498]



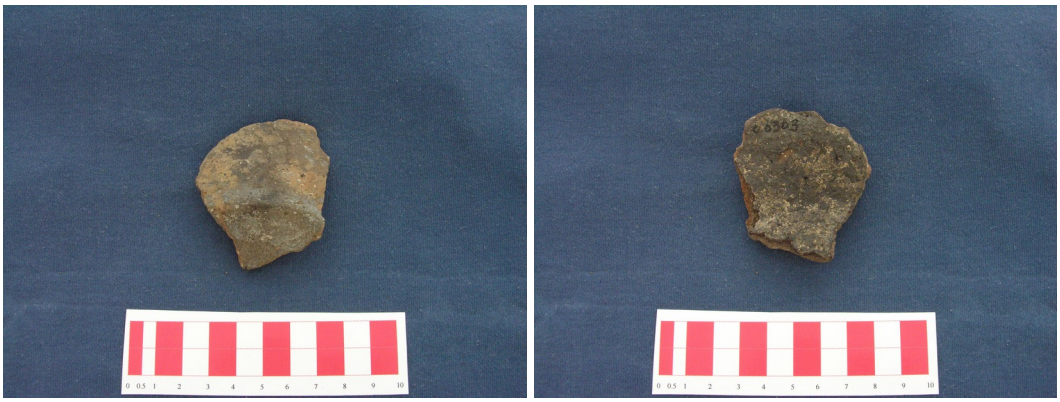
(a) Exterior (b) Radiograph

Figure B.278: Huizui Ceramic 0301 [MAE 2499]

(a) Exterior (b) Interior

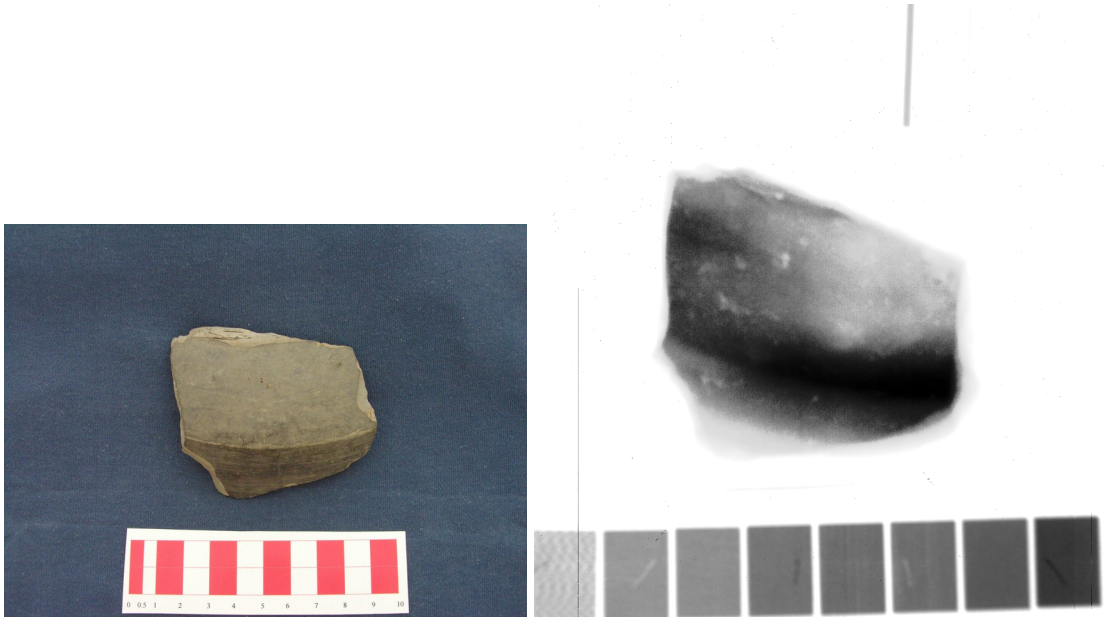
Figure B.279: Huizui Ceramic 0302 [MAE 2500]

No radiograpgh for this sherd was acquired.



(a) Exterior (b) Interior

Figure B.280: Huizui Ceramic 0303



(a) Exterior (b) Radiograph

Figure B.281: Huizui Ceramic 0304 [MAE 2501]

(a) Exterior (b) Interior

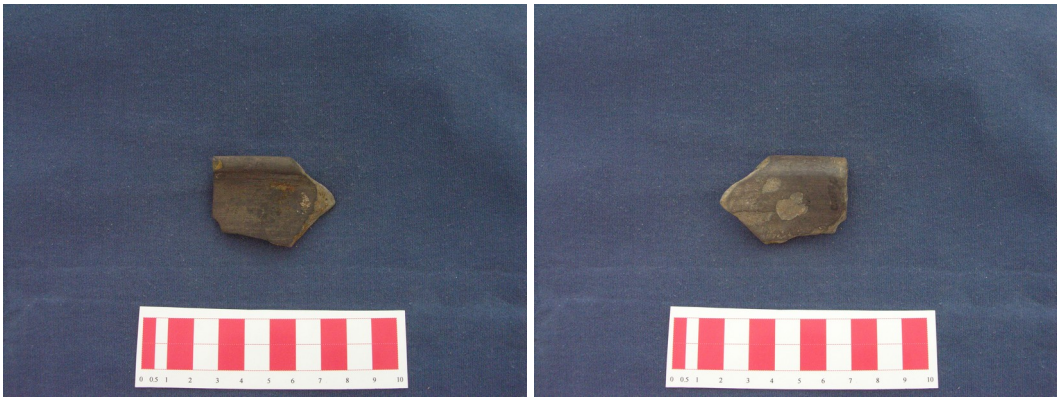
Figure B.282: Huizui Ceramic 0305

(a) Exterior (b) Interior

Figure B.283: Huizui Ceramic 0306

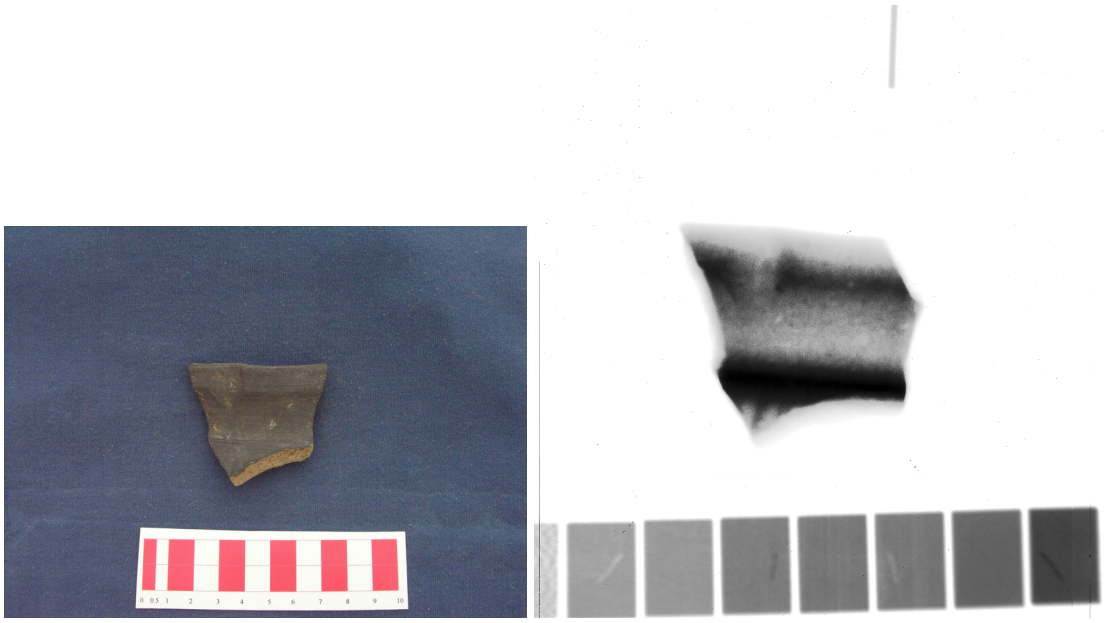
(a) Exterior (b) Interior

Figure B.284: Huizui Ceramic 0307



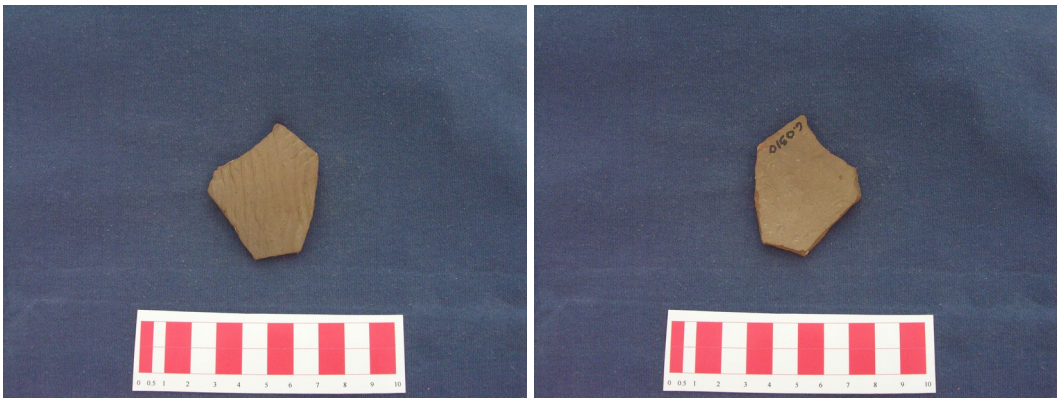
(a) Exterior (b) Interior

Figure B.285: Huizui Ceramic 0308



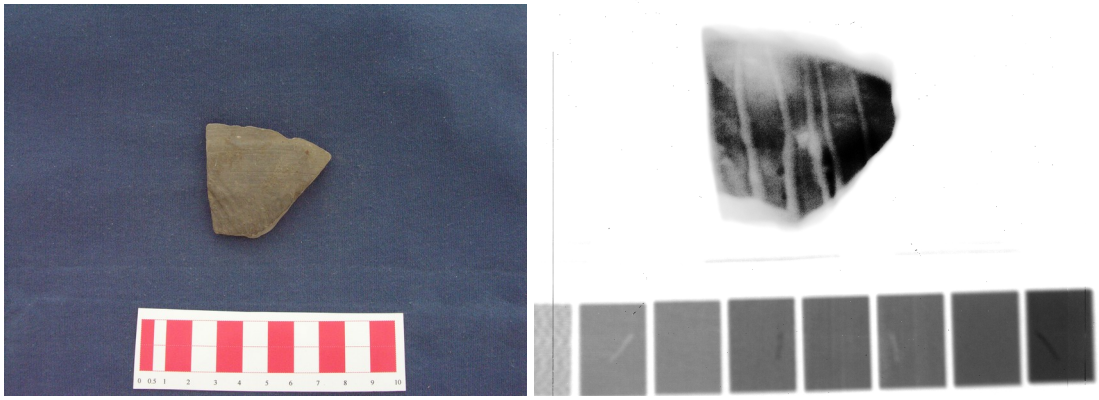
(a) Exterior (b) Radiograph

Figure B.286: Huizui Ceramic 0309 [MAE 2502]



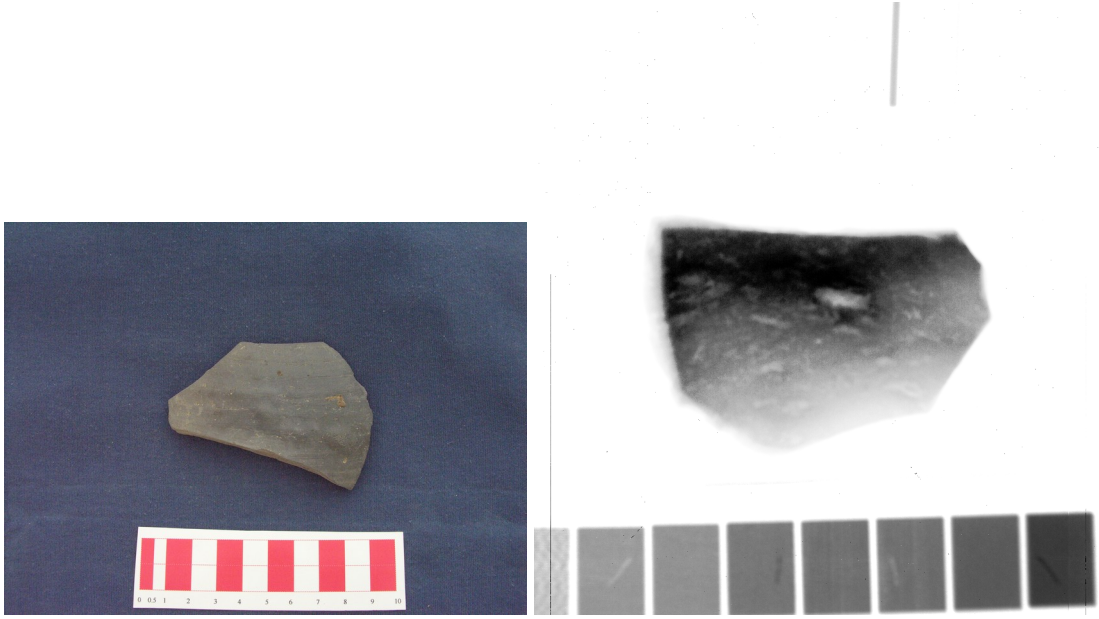
(a) Exterior (b) Interior

Figure B.287: Huizui Ceramic 0310



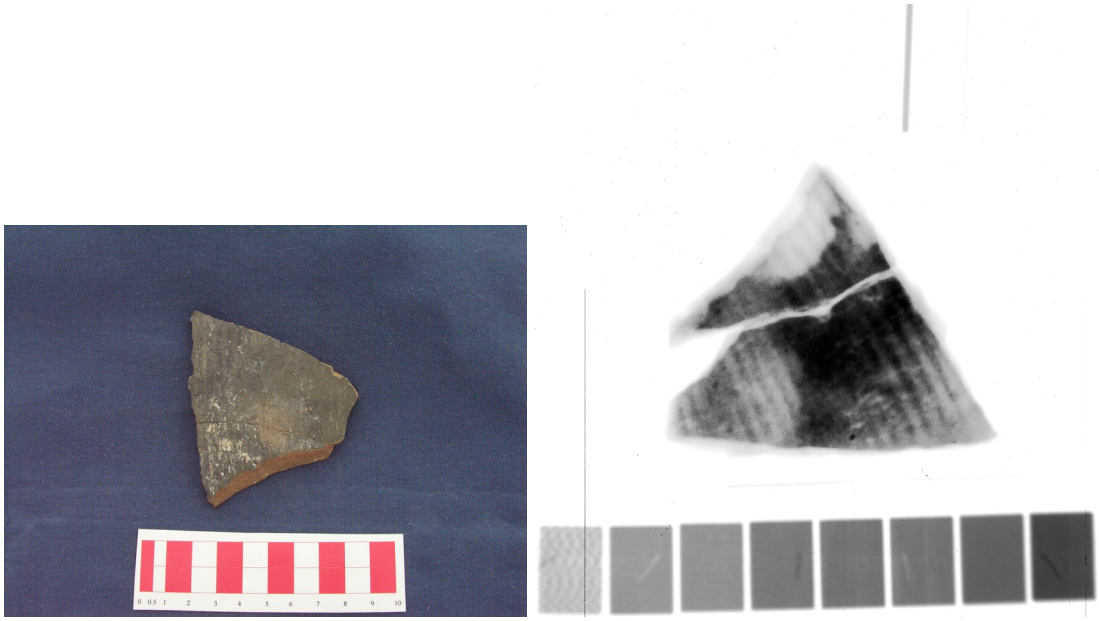
(a) Exterior (b) Radiograph

Figure B.288: Huizui Ceramic 0311 [MAE 2503]



(a) Exterior (b) Radiograph

Figure B.289: Huizui Ceramic 0312 [MAE 2504]

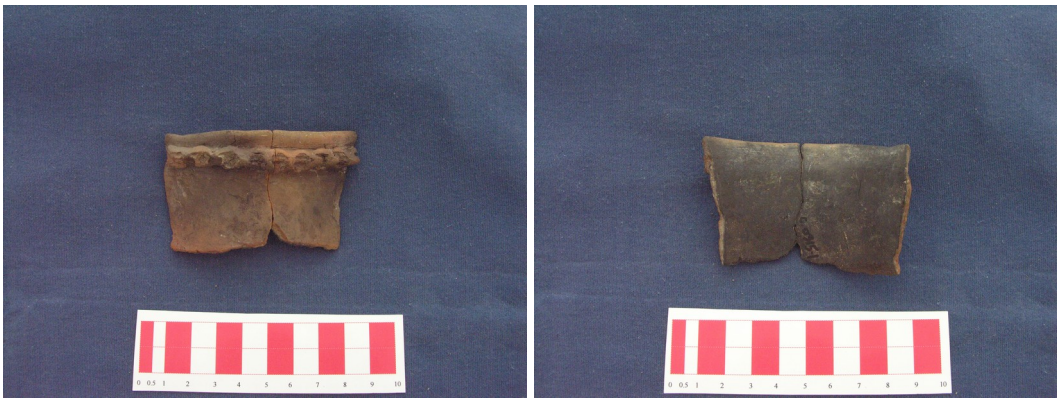


(a) Exterior (b) Radiograph

Figure B.290: Huizui Ceramic 0313 [MAE 2505]

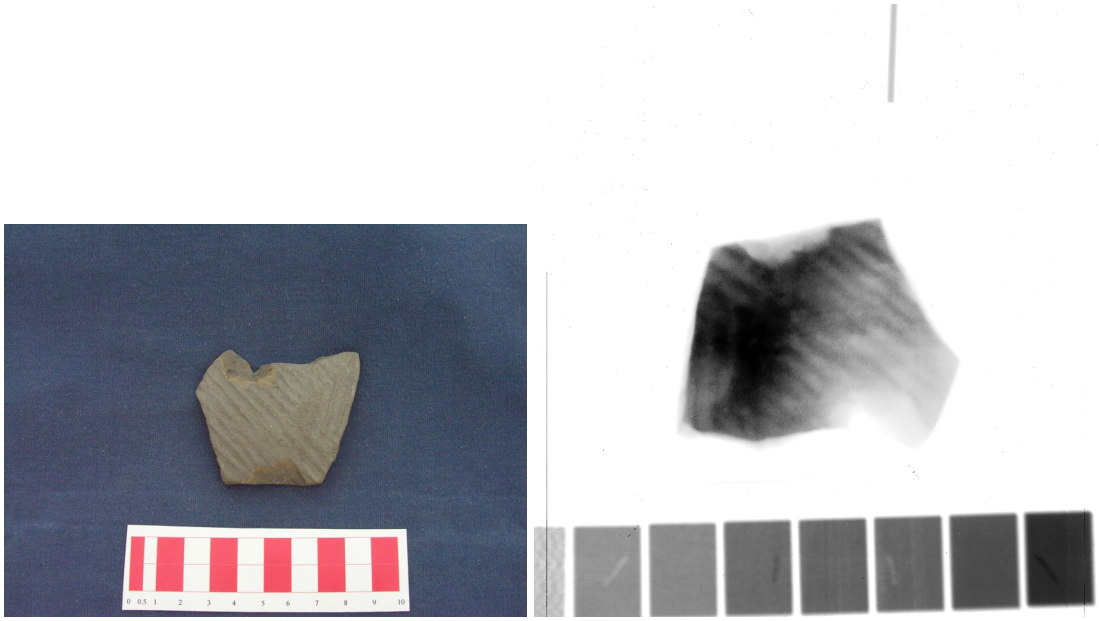
(a) Exterior (b) Interior

Figure B.291: Huizui Ceramic 0314



(a) Exterior (b) Interior

Figure B.292: Huizui Ceramic 0315

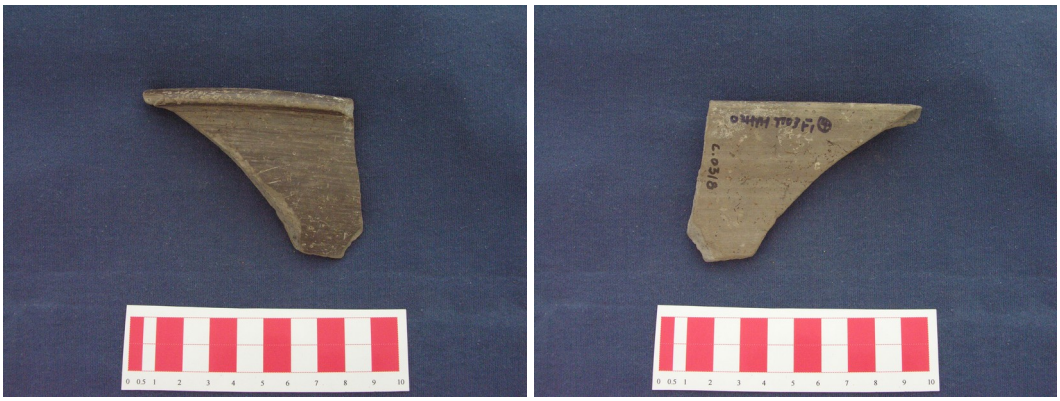


(a) Exterior (b) Radiograph

Figure B.293: Huizui Ceramic 0316 [MAE 2506]

(a) Exterior (b) Interior

Figure B.294: Huizui Ceramic 0317

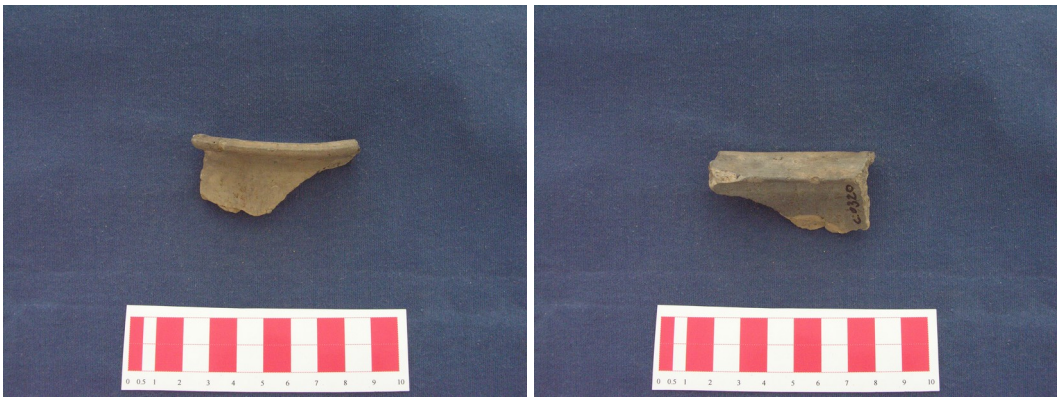


(a) Exterior (b) Interior

Figure B.295: Huizui Ceramic 0318

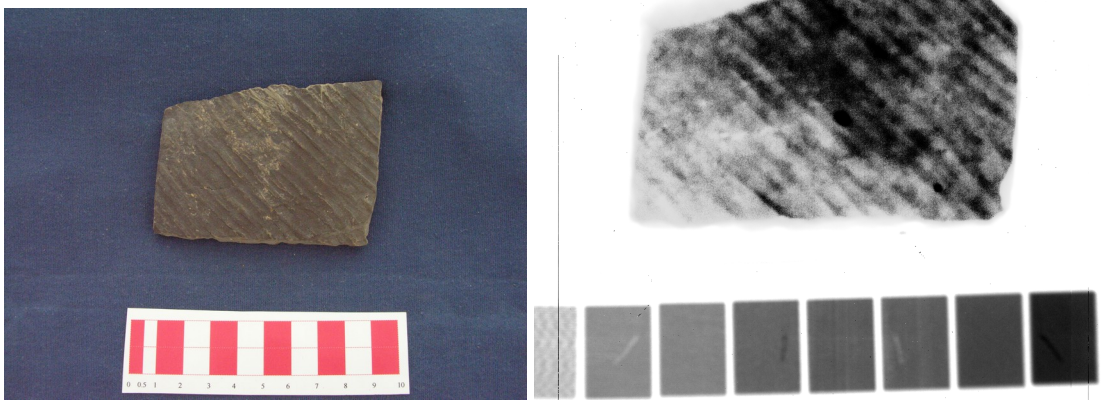
(a) Exterior (b) Interior

Figure B.296: Huizui Ceramic 0319



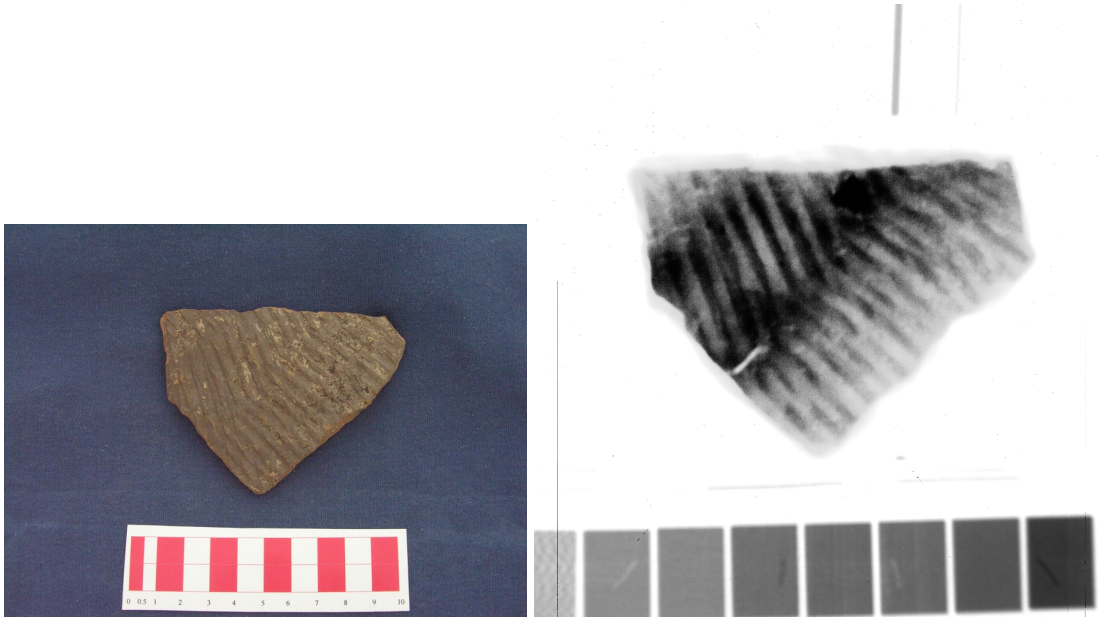
(a) Exterior (b) Interior

Figure B.297: Huizui Ceramic 0320



(a) Exterior (b) Radiograph

Figure B.298: Huizui Ceramic 0321 [MAE 2507]

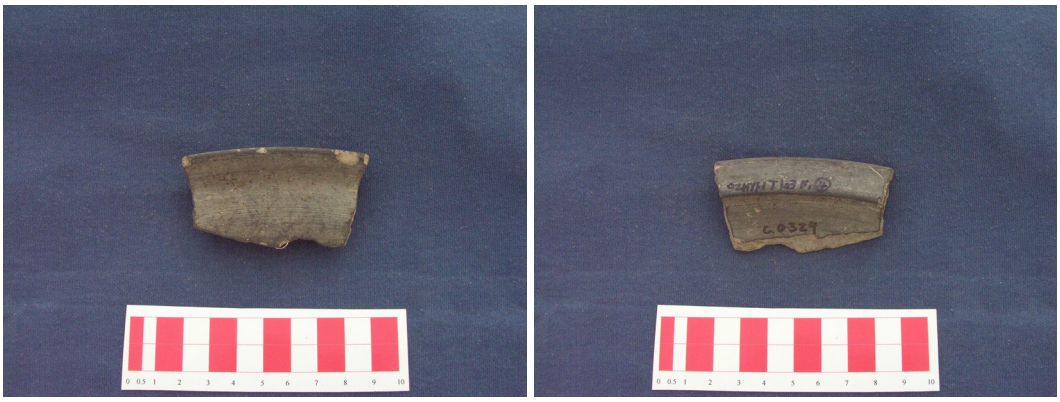


(a) Exterior (b) Radiograph

Figure B.299: Huizui Ceramic 0322 [MAE 2508]

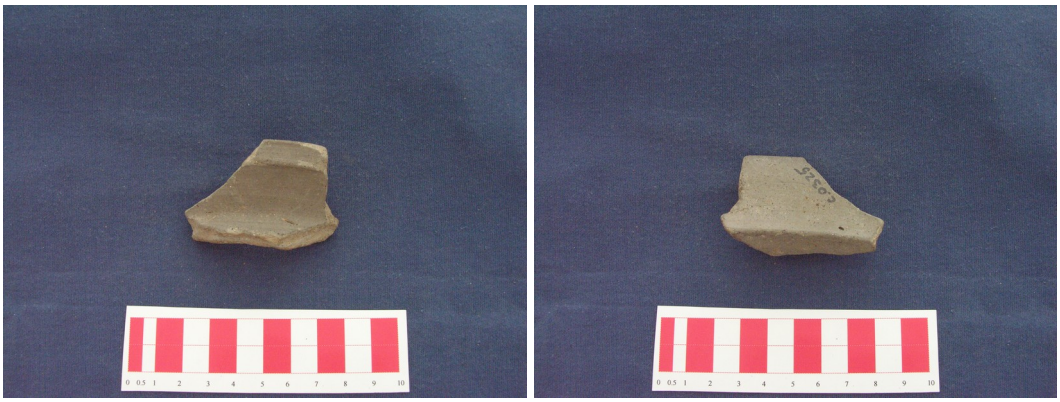
(a) Exterior (b) Interior

Figure B.300: Huizui Ceramic 0323



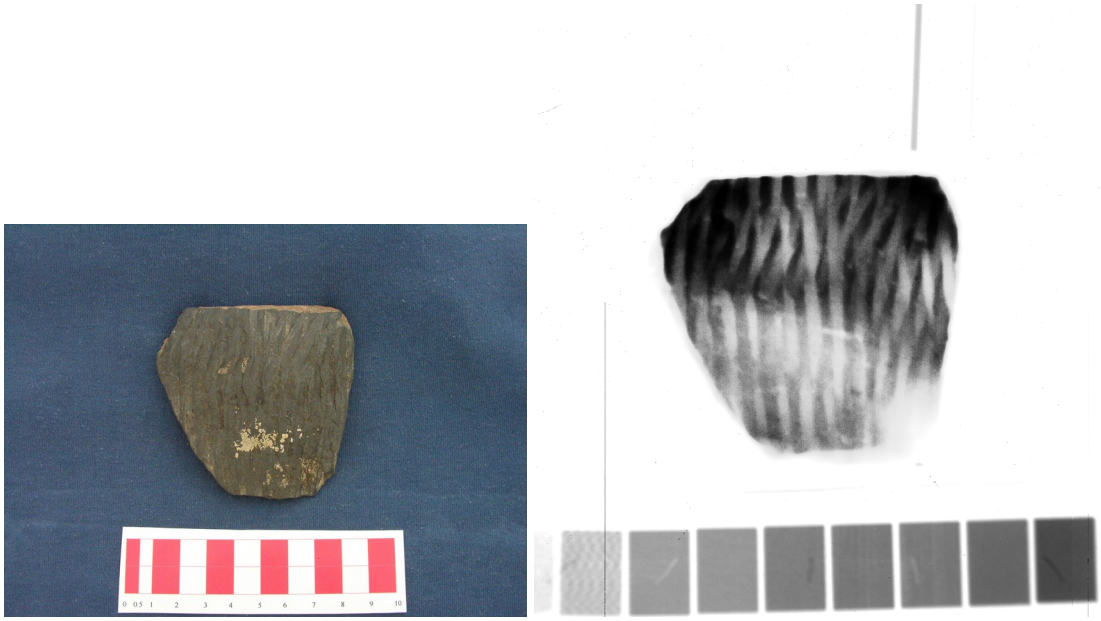
(a) Exterior (b) Interior

Figure B.301: Huizui Ceramic 0324



(a) Exterior (b) Interior

Figure B.302: Huizui Ceramic 0325

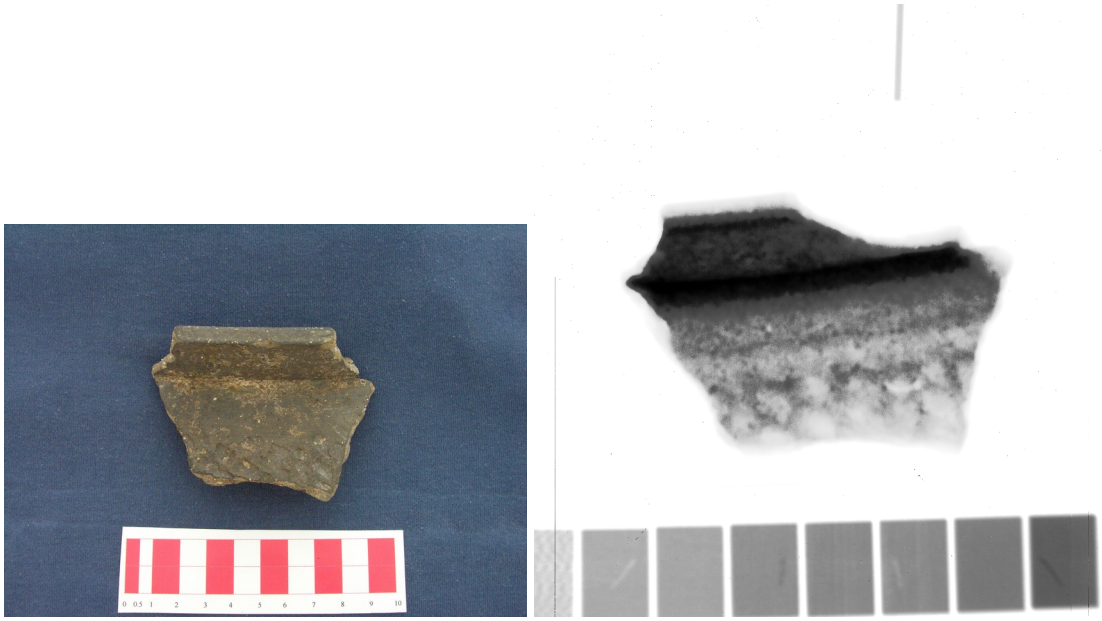


(a) Exterior (b) Radiograph

Figure B.303: Huizui Ceramic 0326 [MAE 2509]

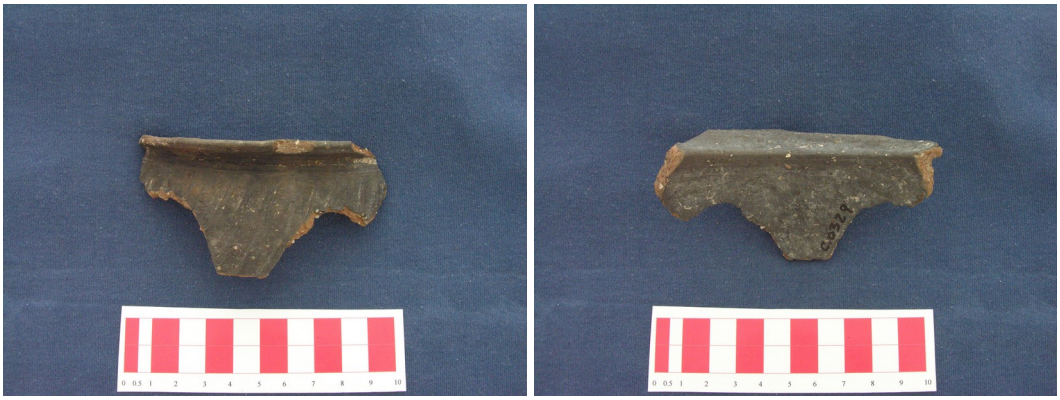
(a) Exterior (b) Interior

Figure B.304: Huizui Ceramic 0327



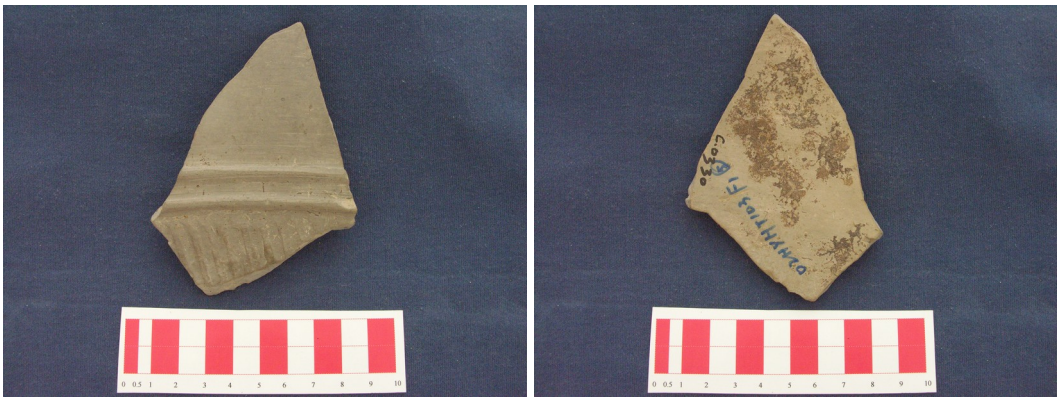
(a) Exterior (b) Radiograph

Figure B.305: Huizui Ceramic 0328 [MAE 2510]



(a) Exterior (b) Interior

Figure B.306: Huizui Ceramic 0329

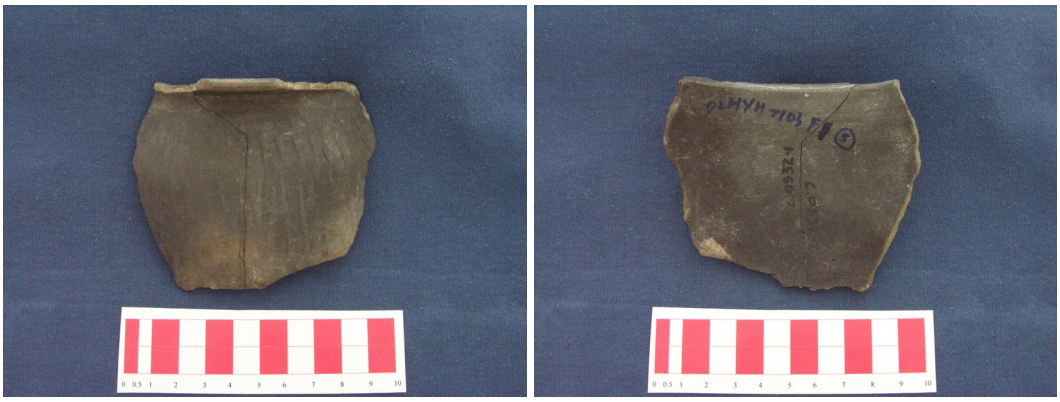


(a) Exterior (b) Interior

Figure B.307: Huizui Ceramic 0330

(a) Exterior (b) Interior

Figure B.308: Huizui Ceramic 0331

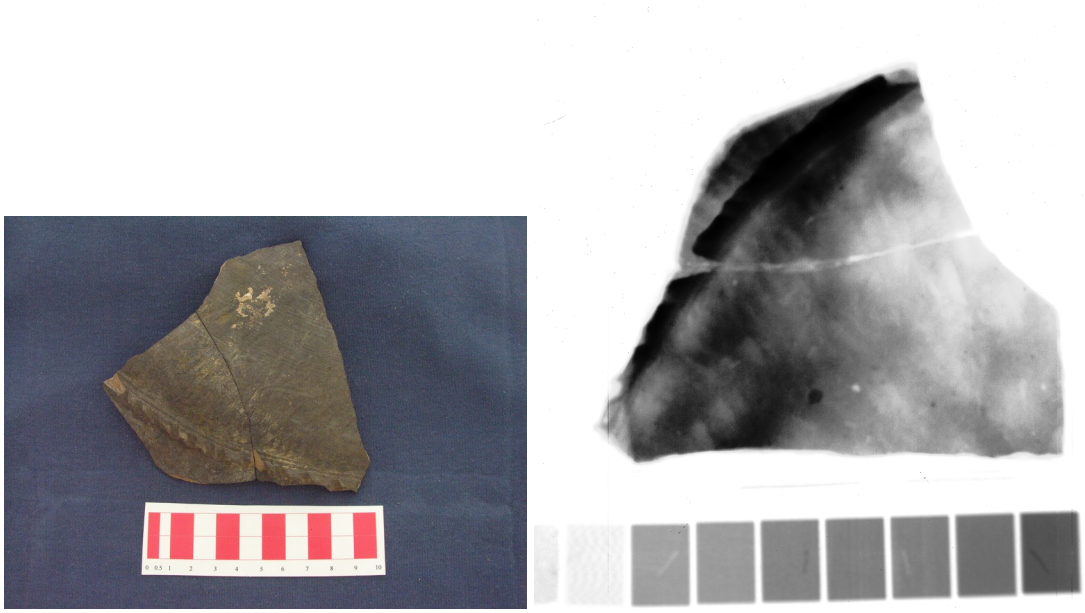


(a) Exterior (b) Interior

Figure B.309: Huizui Ceramic 0332

(a) Exterior (b) Interior

Figure B.310: Huizui Ceramic 0333



(a) Exterior (b) Radiograph

Figure B.311: Huizui Ceramic 0334 [MAE 2511]

APPENDIX C

SITES CATALOGUE

There are nine sites located within the Luoyang Basin that span the Longshan and Erlitou periods, including the Erlitou site itself. These sites fall within a 30-35 km radius from the approximate "center" of the basin, and fall within the Yiluo River drainage, or along the river itself. I have tried to select a range of site sizes for use in this study.

Cuoli Site [矬李]

Reports: Luoyang Museum (LM 1978a)

Coordinates: 34°35'49.13"N
112°24'21.84"E

Total Area: 35 000 m^2

Excavation Area: unknown

Excavation Units: three units (size unspecified)

Features: Longshan Culture (periods 2 & 3): 2 floors, 12 ashpits, 4 burials, 1 well; Erlitou Culture (periods 4 & 5): 5 ashpits, 2 ovens

The Cuoli Site is located 12.5 km south of Luoyang City in Luoyang Municipality, Xindian Township, situated between the Yi and Luo Rivers (Figure 2.9 on page 35). The site was investigated on several occasions, particularly in the fall and winter of 1975. Three test units (of unspecified size) were opened in the northern part of the site. There were three cultural levels uncovered at the site, the lowest is predominantly Yangshao culture, the second is Longshan culture, and the uppermost is from the Erlitou culture.

The site was divided into five phases, the first belongs to the Yangshao culture, phases 2 and 3 belong to the early and later Longshan culture respectively, and phases 4 and 5 belong to the Erlitou

Cuoli	Wangwan	Xugawang	Meishan	Erlitou
Phase 1	p1			
Phase 2	p2(?)	p2		
Phase 3	p3		p1	
Phase 4			p2	p1
Phase 5				p2

Table C.1: Concordance of phases at the Cuoli site

culture (Table C.1). Of the Longshan remains, phases 2 and 3, the excavators match the phase 2 remains at Cuoli with the Longshan culture remains of the Xugawang site in Zhengzhou prefecture. Phase 3 at Cuoli, labelled Late Longshan culture by the excavators, is linked to phase 1 at the Meishan site, both of which belong to phase 3 at the Wangwan site. Of the Erlitou remains, phases 4 and 5, the excavators link phase 4 at Cuoli with phase 2 at the Meishan site and phase 1 at the Erlitou site, while phase 5 at Cuoli is linked with phase 2 at the Erlitou site (LM 1978a).

Early Longshan period (phase 2) artifacts uncovered at Cuoli include a small number of stone and bone implements, and one jade bracelet. A small number of pottery vessels were also uncovered, including *ding* tripod, *zeng* steamer, *pen* basin, *wan* bowl, *gai* vessel lids, while a large number of *guan* jars were found. For the late Longshan period (phase 3), quite a few stone implements were recovered along with a small number of bone and shell implements. As in the early Longshan, one jade ornament was also recovered. There are numerous pottery vessel forms represented, including *ding* cauldrons, *jia* cups, a *zeng* steamer, *pan* plates, various types of *guan* jars, *pen* basins, *wan* bowls, *dou* stands, and notably one pottery *he* pitcher.[1]

Of Erlitou period artifacts at Cuoli, phases 4 and 5, they are generally greater in number compared with the Longshan period, pottery vessels in particular. As in previous levels, a very small number of stone, bone, and shell implements were recovered from phase 4 levels, along with one jade shovel.

1. See Chapter 5, Figure 5.2 and Figure 5.3 for drawings of these vessel forms.

Pottery vessel forms include many of those found in Longshan period levels, but in phase 4 the introduction of new vessel forms into the repertoire continues, and in addition to a *he* pitcher, several *zun* jars, and a *gui* tripod were recovered. However, by phase 5 there is a slight decline in numbers of all classes of artifacts, with very few stone and bone implements recovered. Pottery vessels as well are generally less numerous, the exception being *guan* jars, and only *zun* jars of the new vessels forms remain.

Erlitou Site [二里头]

Reports: Xu Xusheng 1959 [2005];[2] Chinese Academy of Social Sciences, Institute of Archaeology, Luoyang Excavation Team (CASS-IA-LET 1965 [2005]); Chinese Academy of Social Sciences, Institute of Archaeology, Erlitou Excavation Team (CASS-IA-EET) 1974; CASS-IA-EET 1975; CASS-IA-EET 1976; CASS-IA-EET 1982; CASS-IA-EET 1983; CASS-IA-EET 1983; CASS-IA-EET 1984; CASS-IA-EET 1985; CASS-IA-EET 1986; CASS-IA-EET 1991; CASS-IA-EET 1992; CASS-IA 1999; CASS-IA-EET 2004 [2005](a); CASS-IA-EET 2004 [2005](b)

Coordinates: 34°41'36.00"N
112°41'28.26"E

Total Area: 3 000 000 m^2 (3 km^2)

Excavation Area: *see below*

Excavation Units: *see below*

Features: *see below*

The Erlitou site is located in Luoyang Prefecture, Yanshi County, Dizhen Township approximately 20 km east of Luoyang City and 8 km southwest of Yanshi City (Figure 2.9 on page 35). The Erlitou site was first discovered in summer 1959 by a team led by Xu Xusheng during a survey of sites looking for "Xia ruins" in western Henan. At the time, the archaeological culture that would become known as the Erlitou Culture had been previously defined from assemblages at the Zhucun, Donggangou, and Luodamiao sites (CASS-IA 1999:1).

The first round of excavations began in fall 1959 by the Luoyang Excavation Team of the Institute of Archaeology (CASS-IA-LET), and by spring 1964 the LET had excavated the site nine times.

2. Early reports on the Erlitou site in article form have been reprinted in "Studies of the Erlitou site in Yanshi" edited by Du Jinpeng, Xu Hong, and Zhu Bian (2005), and are used here because of better print quality and potential corrections to the original text.

1. The first excavation in fall 1959 opened three groups of test units, the first just north of Old Sijiaolou Village in quadrants Ⅰ and Ⅳ where five units were opened totaling 74m^2(Ⅳ T1-T3, Ⅰ T4-T5), the second just west of Gedangtou Village in quadrants Ⅱ and Ⅴ where eight units were opened totaling 240m^2 (Ⅱ/Ⅴ T101-T108), and the third northwest of Gedangtou Village in quadrant Ⅱ where ten units were opened totaling 210 m^2 (Ⅱ T201-T210).
2. The second excavation in spring 1960 continued work in Ⅱ/Ⅴ T101-T108 and opened three additional units (Ⅱ/Ⅴ T110-T112) adding 90m^2 to the original total. The team also excavated a new group of units in quadrant Ⅷ where eight more units totaling 210m^2 (Ⅷ T11-T17, T19) were opened.
3. The third excavation in fall 1960 continued work in Ⅱ/Ⅴ T101-T108 and opened fourteen additional units (Ⅱ/Ⅴ T109, T113-T124, T126) adding 420m^2 to the original total. In addition, two units were added to the quadrant Ⅷ group (T18, T20) which added 60m^2 to that group. Finally, work continued in Ⅳ T1-T3 just south of Xinzhuang.
4. The fourth excavation in fall 1961 started uncovering the palace 1 foundation (D1), from east to west laying out rows of 10x10m units. The first row was T11, T12, T13, etc., the second row T21, T22, T23, etc. though only units T25, T34, and T35 were opened, totaling 300 m^2 the first season. This first stage of the foundation excavation only uncovered the southeastern corner, so four test trenches were opened in order to determine where the northeast, northwest, and southwest corners were located.
5. The fifth excavation in spring 1962 continued work on the palace 1 foundation, opening T14, T22-T24, T32-T33, T36A-B, T37A-B, T38A-B, T39A-B, T45, and T55A-B, in total 900 m^{2}that season.
6. The sixth excavation in fall 1962 uncovered even more of the palace 1 foundation, opening T36C-D, T37C-D, T38C-D, T39C-D, and T53-T59, in total 850 m^2 that season.
7. The seventh excavation in spring 1963 continued work on the palace 1 foundation, opening T13, T17-T19, and T26-T29, in total 850 m^2 that season on the foundation. At the same time, units

T4-T26, T28-T32 totaling 645 m^2 were opened in quadrant Ⅳ, and units T1 and T2 totaling 86.5 m^2 were opened in quadrant Ⅸ. Earthenware pots, copper slag, and broken pottery molds were recovered from the units in quadrant Ⅳ, while fired pottery from a kiln site was uncovered from the units in quadrant Ⅸ.

8. The eighth excavation in fall 1963 continued work on the palace 1 foundation, opening T63, T72, and T73, totaling 300 m^2 that season. In addition, to the south of the palace 1 foundation, twelve more units were opened (V T202-T207, T210, T212-T216) totaling 259 m^2 toward exploring the environs south of the palace.

9. The ninth excavation in spring 1964 continued work on the palace 1 foundation, opening T64-T69, T74-T79, T84-T89, T95-T99, T106-T110, and T116-T120, totaling 3300 m^2 that season. In addition, a row of postholes from north to south were found in units T98, T109, and T119.

The second round of excavations began in fall 1972 by the Erlitou Excavation Team of the Institute of Archaeology (CASS-IA-EET), and by spring 1987 the EET had excavated the site eleven more times.

10. The tenth excavation in fall 1972 resumed excavation on the palace 1 foundation. However, a different excavation strategy was used: the western half of the foundation was divided into rows from north to south labeled A, B, C, and D, such that the first row was A, B, C, D; the second row was 2A, 2B, 2C, 2D; and so on for each subsequent row. In this way the western half of the foundation would essentially mirror the excavation units of the eastern half. During this excavation units Ⅵ T12A-T13A, T10B-T12B, T10C-T13C, and T11D-T13D were opened, in total 1200 m^2 that season.

11. The eleventh excavation in spring 1973 continued work on the palace 1 foundation, opening units Ⅴ T2C-T9C, T2D-T10D, T2E-T11E, and half-size units T4F, T6F-T7F, totaling 2850 m^2 this season on the palace foundation. In addition, units T211-T214 in quadrant Ⅲ were opened, and units T21-T22 in quadrant Ⅷ were opened, totaling 615 m^2 for these additional units.

12. The twelfth excavation in fall 1973 continued work on the palace 1 foundation, opening units T2A-T9A, T2B-T9B, T12E-T13E, and half-size units T9F-T13F, totaling 2050 m^2 this season.

13. The thirteenth excavation in fall 1974 continued work on the palace 1 foundation, opening units T126-T129, totaling 400 m^2 for this season.

14. The fourteenth excavation in spring 1975 saw the final work on the palace 1 foundation; the new units were opened, but extensive clearing and recording of the foundation took place. However, units T215-T217 were opened and H240 was excavated in quadrant Ⅵ, while unit T215 in quadrant Ⅲ was opened.

15. The fifteenth excavation in fall 1975 concentrated on excavating burials around the site, opening KM3 in quadrant Ⅵ, KM4 in quadrant Ⅴ, KM5 in quadrant Ⅷ, and M1 in quadrant IV. Furthermore, in August of that year locals had discovered a burial just south of Sijiaolou Village which became KM7 (in quadrant Ⅶ) and later excavated that fall.

16. The sixteenth excavation in spring 1976 focused shovel pits and excavation of pit burials KM 6 and 10 in quadrant Ⅲ, pit burial KM 11 in quadrant Ⅴ, and burial M7 in quadrant Ⅳ.

17. The seventeenth excavation in fall 1976 continued work from the spring excavation.

18. The eighteenth excavation in fall 1977 excavation began on palace 2 foundation (D2), opening an area of 4366 m^2 the first season. Because this foundation is rather small, the team used the open area method of excavation which focused on uncovering the foundation extents rather than excavate by units. At the same time, excavation continued on units T1-T4 in quadrant Ⅵ.

19. The nineteenth excavation in spring 1978 continued uncovering the palace 2 foundation, including a south-facing entrance and pathway.

20. The twentieth excavation in fall 1978 opened the large burial associated with the palace 2 foundation (M1), as well as pit burial KM8 in quadrant Ⅴ. They also note that, although palace 2 is smaller than palace 1, the preservation of palace 2 foundation is much more complete.[3]

3. The first twenty excavation seasons are covered and summarized in CASS-IA 1999

The third round of excavations began in the fall of 1980 by the Erlitou Excavation Team of the Institute of Archaeology (CASS), and by spring 1987 the EET had excavated the site eleven more times.

21. The twenty-first excavation in fall 1980 saw the excavation of one burial (M3) in quadrant Ⅴ and two burials (M2, M4) in quadrant Ⅲ. In addition, more extensive excavations began in quadrant Ⅵ, starting with two 2.5x5m trenches (T1, T2) and one unit of indeterminate dimensions but equaling 124 m^2 (T3), in total 149 m^2 this season. In these units they uncovered 1 foundation, 1 stone-paved road, 6 ashpits, 1 well, and 6 burials.

22. The twenty-second excavation in spring 1981 saw the excavation of M1 and M2 in quadrant V, as well as the opening of several units (of unknown size or number, but at least 25) totaling 910 m^2 in quadrant III which uncovered 1 floor, 23 ashpits, and 5 burials. In addition, excavation continued in the area around M2 and M4 in quadrant III (opened the previous season), excavating M1, M3, M5, and M6.

23. The twenty-third excavation in fall 1981 returned to the quadrant V cemetary first excavated the previous fall, opening burials M3-M6.

24. The twenty-fourth excavation in summer and fall 1982 excavation began in quadrant IV where Yangshao remains had been previously discovered, uncovering 2 floors. In addition, a ^{14}C sample was taken from F1, giving a date of 4885±159 bp. Meanwhile, excavation started on ten 5x5m (estimated size) units in quadrant IX,[4] opening approximately 210 m^2 this season. The team uncovered 1 floor, 29 ashpits (including storage pits and water wells), and 19 burials (CASS-IA-EET 1985 [2005]).

4. There appears to be a discrepancy between the preliminary report published in 1985 (CASS-IA-EET 1985 [2005]) and the "news" story published in 1984 (Zheng, et al.). In the earlier annual news report, the quadrant is listed as "Ⅳ" throughout the entry, but in the later preliminary report the quadrant is indicated as "Ⅸ" (technically it appears almost uniformly as "九" and not in roman numerals). It is unclear whether this was the result of a transposed roman numeral in one of the reports (i.e. "Ⅹ" for "Ⅴ" or vice versa). Such a mistake may explain why the character "nine" is used in the later preliminary report (1985 [2005]) instead of the roman numeral for "nine" as is the norm.

25. The twenty-fifth excavation in spring 1983 continued excavation in the units opened the previous season in quadrant IX, uncovering an additional 2 burials.

26. The twenty-sixth excavation in fall 1983 continued excavation on the Yangshao remains uncovered in quadrant IV the previous fall.

Gaoya Site [高崖]

Reports: Chinese Academy of Social Sciences, Institute of Archaeology, Luoyang Excavation Team (CASS-IA-LET 1964); Beijing University, Department of History, Archaeology Team (BUDHLAT 1964); Luoyang Prefecture Second Cultural Relics Excavation Team and Yanshi County Bureau of Cultural Heritage Management (LP2CRET-YCCCHM 1996)

Coordinates: 34°38'51.66"N
112°41'8.46"E

Total Area: (1960) west locus 32 500 m^2 and east locus 210 000 m^2; (1988) 500 000 m^2

Excavation Area: (1960) 30 m^2; (1988)[5] 250 m^2

Excavation Units: (1960) six 5x2m trenches; (1988) five 5x10m trenches[6]

Features: (1960) west locus 9 ashpits; (1988) 15 [24?][7] ashpits, 3 floors

The Gaoya site is located in Luoyang Prefecture, Yanshi County, Gaolong Township, 12 km southwest of Yanshi City and 18 km east of Luoyang City (Figure 2.9 on page 35). The site was first discovered in 1959 during a survey of neolithic sites along the Yi River by the Institute of Archaeology Luoyang Excavation Team along with several other sites: Zhaochengcun, Miaowan, Gaoya, and Nanzhai all have Yangshao Culture components; Gaoya, Bangezhai, and Zhaiwan all have Longshan components. Though dating was determined using the small amount of pottery from surface collection, they determined that the Gaoya site had late Yangshao and Longshan components (CASS-IA-LET 1964:17-18).

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5. The report says that an area of 300 m^2 was excavated (LP2CRET-YCCCHM 1996:1). However, with only five units accounted for (see note 6 below) the actual excavated area must be the area given here.

6. In the report, the excavators say they have taken the "standard" 10x10m unit used in China and subdivided it into four parts labeled A, B, C, D, and then excavated only two subdivisions of any given unit; this results in effectively opening 5x10m trenches. There appear to only be five units laid out, but because the unit labels are somewhat oddly numbered (T1, T4, T12, T23, T24) no clear determination can be made.

7. The reports says that there were 10 Longshan period ashpits, but only 1 of them was complete.

Gaoya	Wangwan
(phase 3?) H1	p3
(phase 2?) H3	p2
(phase 1?) H5	p1

Table C.2: Concordance of phases at the Gaoya site

The site was later excavated in June of 1960 by a team from the Department of History at Beijing University. This team divided the site into east and west loci following the terracing on either side of Gaoya Village. At the west locus the excavators opened up three 5x2 meter trenches (T1-3), and reported that just below the tilled level was a Longshan level, a Yangshao-Longshan transition level, and finally a Yangshao level. At the east locus the excavators opened three more 5x2 meter trenches (T4-6), and reported early Shang period or possibly Erlitou period remains, as well as Zhou and Northern Dynasties period remains (BUDHLAT 1964:545-6). Of note, in the course of this excavation the Beijing University team also surveyed four other sites in the area: Miaowan [苗湾],[8] Huiju [灰咀],[9] Jueshan [掘山],[10] and Jiuliugou [酒流沟].

The excavators link the three phases at the Gaoya west locus with phases at the Wangwan site, though they do so primarily through uncovered ashpits (Table Table C.2): T3 H1 is linked with Wangwan phase 3 (Longshan period); T3 H3 is linked with Wangwan phase 2 (Yangshao-Longshan transition); T3 H5 is linked with Wangwan phase 1 (Yangshao period). The east locus phases are labelled as early Shang period, but no direct linking is mentioned (BUDHLAT 1964:549).

The Gaoya site was more recently excavated by a joint team from Luoyang Prefecture and Yanshi County in October of 1988. The majority of the remains appear to have been from the early neolithic, Peiligang and Yangshao, with the late neolithic Longshan and early bronze Erlitou periods having a

8. The Miaowan site was also included in the Luoyang Basin survey (CASS-IA-EET 2005).

9. The Huiju site was previously investigated by the Henan Province Bureau of Culture: (HPBCCRET 1961).

10. The Jueshan site was also included in the Luoyang Basin survey (CASS-IA-EET 2005).

small presence in what was excavated (LP2CRET-YCCCHM 1996:15-18). Due to the small number of remains from either the Longshan or Erlitou periods it is not possible to make any kind of definitive link with the respective periods from other sites.

Artifacts recovered from the Longshan period, by investigation or excavation, include: (1959) *guan* jars, *weng* urns, flat-bottom *li* tripods, and *dou* stands (CASS-IA-LET 1964:16); (1960) *weng* urns, *guan* jars, *wan* bowls, *dou* stands, *pen* basins, and *jia* cauldron feet, as well as two stone *dao* knives, a single bone *cha* fish fork, and two pottery *fanglun* spindle whorls (BUDHLAT 1964:543-4); (1988) *guan* jars, *pen* basins, *bo* bowls, as well as one stone *ben* adze (LP2CRET-YCCCHM 1996:16).

Huizui Site [灰嘴]

Reports: Henan Province Institute of Cultural Relics and Archaeology(HPICRA 1990); Chinese Academy of Social Sciences, Institute of Archaeology, Henan First Team (CASS-IA-H1T 2010a,c)

Coordinates: 34°34'27.30"N
112°45'37.50"E

Total Area: (1959) 55 200 m^2; (2002/3) east locus 90 000 m^2; (2004) west locus 40 000m^2

Excavation Area: (1959) unknown; (2002/3) east locus 200 m^2; (2004) west locus 79.7 m^2

Excavation Units: (1959) unknown; (2002/3) east locus eight 5x5m units; (2004) three 5x5m units, one 4.5x2m trench

Features: (1959) 5 floors, 23 ashpits, 1 burial; (2002/3) 5 floors, 1 well, 113 ashpits, 3 burials; (2004) 1 floor, 32 ashpits, 2 wells

The Huizui site is located 20 km southwest of Yanshi City in Luoyang Prefecture, Yanshi Municipality, Goushi Township (Figure 2.9 on page 35).[11] The site was excavated on multiple occasions, the first from April to September 1959 by the Henan Province Bureau of Culture, Cultural Relic Excavation Team (predecessor of HPICRA).[12] Unfortunately the report does not describe the excavation strategy, how many units, what size units, etc.,[13] but the excavators do make some linkages with nearby sites (Table C.3 on the following page). They link the Longshan Culture remains at Huizui with Wangwan phase 3 and with the Longshan remains at the Kelawang site in Zhengzhou Prefecture (HPICRA 1990:32). Linkages with Wangwan were made through similarities between *jia* tripods and

11. The Huizui site is discussed in more detail in 5 on page 109 of Chapter 5.

12. The 2002-2003 report indicates that an earlier excavation by HPBCCRET at the "Huiju" [灰咀] site (1961) is in fact the east locus of the Huizui site. The report goes on to indicate that the excavation report used here as the "first" excavation (HPICRA 1990) was in fact simply the west locus of the Huizui site.

13. As can be discerned from the excavation year (1959) and the year of publication (1990) the 30-year lull likely contributed to the loss of such details in the report.

Huizui	Wangwan	Dahecun	Kelawang	Erlitou
Yangshao	p2	p4		
Longshan	p3	*p5?*	Longshan	
Erlitou				p2 & p3

Table C.3: Concordance of phases at the Huizui site

zeng steamers, while for linkages with Kelawang several pottery vessels forms were used: *bei* cups, *pen* basins, *guan* jars, *dou* stands, and *gai* vessel lids.

The site was subsequently excavated by the Institute of Archaeology Henan First Team in November of 2002 and 2003. In the report the excavators indicate that much of the cultural remains mentioned in the earlier report (HPICRA 1990), in particular Erlitou period levels, had been lost in the intervening 30 years since the first excavation in 1959 (CASS-IA-H1T 2010a:394). Despite the apparent loss of cultural remains, however, the 2002/3 excavation nevertheless reached an average depth of 4 meters, recovering Yangshao, Longshan, and Erlitou period artifacts. This excavation was at the east locus of the site where the excavators opened eight 5x5 meter units adjacent to each other, creating a large 10x20 meter open area excavation. In the Longshan levels, five floors and 98 ashpits were discovered, while the Erlitou levels revealed one well, fifteen ashpits, and three burials (CASS-IA-H1T 2010a:405-6 and 415).

The excavators link the Yangshao period levels at the site with phase 4 at the Dahecun site and phase 2 at Wangwan, meshing very well with the earlier report which concluded the Longshan period levels belong to phase 3 at Wangwan (see above), a conclusion supported by the results of this excavation (Table C.3). They also link the Erlitou period levels at Huizui with phases 2 and 3 at the Erlitou site (CASS-IA-H1T 2010a:419-420).

The Institute of Archaeology conducted another excavation from October to December of 2004 at the west locus of the Huizui site. The west locus also suffered a great deal of soil loss and removal due to agricultural activities and earthwork projects, but the eastern section of the west locus has had

an apple orchard or gardens in the intervening years, and as a result has not suffered the same degree of soil removal with an estimated loss of only one meter (CASS-IA-H1T 2010c:37). The excavators opened three 5x5 meter units with a one meter retaining berm on the north and east walls (should units be added in either direction), and one 4.5x2 meter trench. This excavation extended approximately one meter below the surface (except for the wells), and as a result the only cultural levels were from the Erlitou period. Nevertheless, one floor was uncovered, along with 32 ashpits, and two wells.

The Erlitou period remains at the west locus parallel that of the east locus at Huizui, and the excavators also date it to phases 2 and 3 of the Erlitou site (CASS-IA-H1T 2010c:45). Artifacts recovered include pottery, stone objects, but very few bone or shell objects. Pottery forms include: various sub-types of *guan* jar, *ding* cauldrons, *zeng* steamers, *qigai* vessel lids, *yu* basins, flat-bottom *pen* basins, *dou* stand, three-footed *pan* platter, and *bei* cups. Stone implements include: *chan* shovels, *lian* sickles, *fu* axes, *zao* chisels, and *li* sharpening stones.

Ligou Site [里沟]

Reports: Gongyi Municipal Office of Cultural Heritage Management (GMOCHM 1995); Zhengzhou Prefecture Cultural Relics Excavation Team and GMOCHM (ZPCRET-GMOCHM 1995); ZPCRET and GMOCHM (ZPCRET-GMOCHM 2001)

Coordinates: 34°44'12.24"N
112°58'17.04"E

Total Area: 100 000 m^2

Excavation Area: (phase 2) 166 m^2; (phase 3)242 m^2

Excavation Units: (phase 2) two 5x10m units, two 5x5m units, one 4x4m unit; (phase 3) two 10x10m units, two 5x10m units

Features: (phase 1) six ashpits; (phase 2) four ashpits; (phase 3) thirteen ashpits

The Ligou site is located south of Gongyi City [巩义], Zhengzhou Prefecture, Gongyi County, Beishankou Township along and just north of Gongyi's South Ring Road (Figure 2.9 on page 35). Three excavations were undertaken at the site, the first in July of 1993 by the Gongyi City Office of Cultural Heritage Management which uncovered the site ((1995)). Because of the construction on the South Ring Road, a salvage excavation was undertaken in August of 1993 by GCOCHM with the assistance of the Zhengzhou Municipal Institute of Cultural Relics and Archaeology (ZPCRET-GMOCHM 1995). Continued development in the Ligou Village district south of Gongyi led these two agencies to conduct a third round of excavations at Ligou in October of 1994 (ZPCRET-GMOCHM 2001).

Initial investigation of the site in July of 1993 was through gully walls, natural cuts in the soil, and did not involve actual excavation. Nevertheless, because of the depth of these cuts a decent picture was produced with regard to general periodization and trends in ceramic design. Indeed, the excavators were able to determine that the Ligou site shares many features found in other sites of the area (GMOCHM 1995:303). In total the investigators identified seven general phases at the site (Table C.4 on the next page): Early Yangshao (phase 1), Middle Yangshao (phase 2), Late Yangshao

Ligou	Houzhuangwang	Jiankou	Wangwan	Dahecun
Phase 1				
Phase 2				
Phase 3				
Phase 4	upper	p2	p2(?)	p4
Phase 5		p3		p5
Phase 6			p3	
Phase 7				

Table C.4: Concordance of phases at Ligou site

(phase 3), Late Yangshao-Early Longshan Transitional (phase 4), Early Longshan (phase 5), Late Longshan (phase 6), and Spring and Autumn-Warring States (phase 7). Only the first six phases, Early Yangshao Culture to Late Longshan Culture, are discussed later in the report. Based on their finds they link Ligou site phase 5 (Early Longshan) with Dahecun site phase 5, and see affinity with vessels from Miaodigou site period 2 in western Henan.[14] Of note, they also see influence from the Late Qujialing [屈家岭] Culture of Hubei Province in some of the Ligou phase 5 *dou* stands, *pen* basins, and *guan* jars (GMOCHM 1995:304). Moving to Ligou phase 6, Late Longshan, the investigators draw parallels with the Late Longshan Culture of Wangwan site phase 3 (GMOCHM 1995:304).

Subsequent excavations in August of 1993 (ZPCRET-GMOCHM 1995) opened five test units, two 5x10m units (T1 and T2), two 5x5m units (T4 and T5), and one 4x4m unit (T3). Within these units, at least eight ashpits, or *huikeng*, (H1-H8) were uncovered and excavated. In the units excavated, two phases were identified, roughly corresponding to the Yangshao to Longshan transition (phase 4), and Longshan (phases 5 & 6) cultures. For phases 4 and 5 at the Ligou site, the excavators similarly draw parallels with the Dahecun site phases 4 and 5, and see influence from the Miaodigou and Sanliqiao sites of western Henan Province.

14. Referenced in the report as "Yu Xi" [豫西]

The second round of excavations in October of 1994 (ZPCRET-GMOCHM 2001) opened up four new test excavation units, two 10x10m units (T6 and T7) and two 5x10m units (T8 and T9). In addition, a total of thirteen ashpits (H10-H22) were uncovered and excavated as well. The excavators essentially confirmed the periodization of phases at the Ligou site determined in the earlier excavation such that the Ligou site primarily covers the Late Yangshao and Early Longshan periods (ZPCRET-GMOCHM 2001:24).

Shaocai	Erlitou
Phase 1	p1
Phase 2	p2
Phase 3	p3
Phase 4	p4

Table C.5: Concordance of phases at the Shaocai site

Shaocai Site [稍柴]

Reports: Henan Province Institute of Cultural Relics and Archaeology (HPICRA 1993)

Coordinates: 34°42'13.98"N
112°55'16.02"E

Total Area: 1 000 000 m^2

Excavation Area: 690 m^2

Excavation Units: (1960) three 10x10m units, two 5x10m units; (1963) one 7.5x10m unit, one 5x5m unit

Features: 5 floors, 45 ashpits, 7 burials

The Shaocai site is located 7.5 km to the southwest of Gongyi City and 12 km east of Yanshi City, in Zhengzhou Prefecture, Gongyi County, Zhitian Township. The site is situated on the terrace where the Wuluo and Yiluo Rivers converge, and the Yiluo River flows from west to east north of the site (Figure 2.9 on page 35). The site was discovered in 1959 while the archaeology team of the Henan Province Bureau of Culture (the predecessor of HPICRA) was conducting site surveys, looking for Xia Culture-period sites. A test excavation was conducted from April to September of the following year, opening a total of five units. Then, in 1963 an archaeology work team from the Beijing University History Department continued the test excavation, opening two additional units (HPICRA 1993:1).

The excavators divided the site into four phases based on artifacts recovered in the four cultural levels and their stratigraphic relationship (Table C.5 on the previous page). Phase 1 at Shaocai has been linked to phase 1 at the Erlitou site based on affinities in form between several vessel types, notably two types of decorative *guan* jars and a three-footed deep *pan* platter. Shaocai phases 2 and 3 follow, linking with phases 2 and 3, respectively, at the Erlitou site based on pottery form affinities. Finally, phase 4 at Shaocai is linked to the upper phase at the Erligang [二里冈] site (HPICRA 1993:41). Considering the addition of a phase 4 at the Erlitou site (CITE), it seems reasonable to infer that phase 4 at Shaocai could be linked to phase 4 at Erlitou, continuing the previous progression. However, the excavators go on to mention several differences between the pottery assemblages at Shaocai and Erlitou. First, Shaocai phases 1 and 2 designs are predominantly horizontal basket pattern, making up 40% of the assemblage, while cord pattern vessels were fewer in number making up 20% of the assemblage. During phases 1 and 2 at Erlitou, cord pattern designs make up the majority of the assemblage (CITE). They also note that the most numerous vessels forms at Erlitou during phases 1 and 2, *ding* cauldrons and single-handle *guan* jars, are rarely seen at Shaocai (HPICRA 1993:41). Finally, because of the linkages between phases 1 and 2 at Shaocai and phases 1 and 2 at Erlitou, using ^{14}C dates from the Erlitou phases, Shaocai phase 1 dates to 1920$\pm$115 bp and 1900$\pm$130 bp; likewise, Shaocai phase 2 dates to 1765$\pm$100 bp (HPICRA 1993:42).

Tanxiaoguan	Dahecun	Ligou
Phase 1	p2	
Phase 2	p3	
Phase 3	p4	p4
Phase 4	p5	p5

Table C.6: Concordance of phases for the Tanxiaoguan site

Tanxiaoguan Site [滩小关]

Reports: Henan Province Institute of Cultural Relics and Archaeology (HPICRA 2002)

Coordinates: 34°48'54.90"N
113° 5'40.32"E

Total Area: 200 000 m^2

Excavation Area: 250 m^2

Excavation Units: three 5x10m units, four 10x10m units

Features: 1 foundation, 1 pottery kiln, 21 ashpits, 2 burials, 11 urn burials

The Tanxiaoguan Site is located in Zhengzhou Prefecture, Gongyi Municipality, Zhanjie Township, 3km southeast of where the Yiluo River joins the Yellow River, and 15km northeast of Gongyi City (Figure 2.9 on page 35). Though the site is fairly large in size, in the early 1970's a water channel was cut through the northern part of the site, removing an estimated 5000m^2 of cultural remains. Nevertheless, above the concrete water channel cultural remains approximately 2m thick can be seen. Most recently, due to highway construction through the site, a salvage excavation was conducted in 1992 from early October to late November.

The excavators link Tanxiaoguan phase 1 with phase 2 at the Dahecun site through similarities between *pen* basins and *bo* bowls, while *guan* jars, *pen* basins, and *bo* bowls link Tanxiaoguan phase 2 with phase 3 at Dahecun, though the evidence is less substantial than that for phases 1, 3, and 4

(Table C.6 on the previous page). Tanxiaoguan phase 3 is linked to phase 4 at Dehecun with numerous *guan* jars, *pen* basins, *gang* vats, *bo* bowls, and *hu* kettles. They also link Tanxiaoguan phase 3 with phase 4 at the Ligou site[15] based on *guan* jars and *pen* basins. Finally, Tanxiaoguan phase 4 is linked with phase 5 at Dahecun through similarities between *ding* cauldrons, *guan* jars, *bei* cups, and *wan* bowls, while only *ding* cauldrons, *guan* jars, and *gang* vats are used to link Tanxiaoguan phase 4 to phase 5 at the Ligou site (HPICRA 2002:34).

The excavation report is not organized by phase and as result it is impossible to tell what artifacts belong to which phase. Nevertheless, artifacts recovered from the site includes a large number of pottery vessels: *ding* cauldrons, *gang* vats, *pen* basins, *bo* bowls, *wan* bowls, *weng* urns, *hu* pitchers, *dou* stands, *ping* bottles, *bei* cups, and *huan* bracelets. Other artifacts, though fewer in number, include stone tools: *chan* shovels, *fu* axes, *dao* knives, and *huan* bracelets; bone implements include *zhui* awls, *zao* chisels, and *ben* adzes.

15. In the Tanxiaoguan report, they reference links with phase 1 and 2 at the Ligou site. However, the periodization they refer to comes from the latest Ligou report (ZPCRET-GMOCHM 2001) in which only late Yangshao and early Longshan phases were discussed in the report. In accordance with the earlier, more complete report (GMOCHM 1995), I have changed the phases linked to the Ligou site to those discussed in the summary for Ligou above.

Wangwan Site [王湾]

Reports: Beijing University Archaeology Field Team (BUAFT 1961); Beijing University College of Cultural Relics and Archaeology (BUCCRA 2002)[16]

Coordinates: 34°41'26.70"N
112°19'12.24"E

Total Area: 20 000 m^2

Excavation Area: (1959) 1785 m^2; (1960) 1840 m^2

Excavation Units: (1959) sixty-nine 5x5m units [North Locus]; (1959) nine 5x5m units [West Locus] and (1960) fifty-six 5x5m units, plus 3 5x10m (approx.) trenches [South Locus]

Features: 9 floors, 179 ashpits, 119 burials, 1 pottery kiln

The Wangwan Site is located in the northwestern part of Wangwan Village, just west of Gushui Township and 17.5 km west of the Laocheng district of Luoyang in Luoyang Municipality (Figure 2.9 on page 35). The site is located in a cluster of other ancient sites[17] all located within 10 km of each other along the banks of the Jian and Luo rivers. The Wangwan site itself was first discovered in summer 1958 by the Luoyang Excavation Team of the Institute of Archaeology (CASS-IA-LET 1964) which conducted test excavations which uncovered the Western Zhou components of the site. The site was subsequently excavated by faculty and students of the Archaeology Field Team at Peking University, first in fall/winter 1959, with a follow-up excavation in spring 1960. A preliminary report on the findings at the site was published a year later (BUAFT 1961).

In the first excavation season, which lasted from mid-October to almost mid-December, the excavators set up a grid of approximately 7 by 12 5x5 meter units (though not all units in the grid were

16. These two groups are essentially the same entity that has gone through a few name changes in the intervening 40 years.

17. Other sites include: Sunqitun [孙旗屯] (HPCRET-SFG2T 1955), Jianxi [涧西] (IA-CASS-LET 1956), and Shijiawan [史家湾] which was investigated in the winter of 1959 after the fall excavations at the Wangwan site. While no report for Shijiawan seems extant, the investigators determined that the multi-component site included Banpo phase Yangshao Culture remains in the lowest strata, and ended with early Western Zhou remains in the uppermost strata.

opened) in what would become the "northern locus" of the site. Longshan remains were found below Western Zhou and Northern Dynasties levels. Below the Longshan levels were Yangshao-Longshan Transitional layers, followed by Yangshao layers. Of the neolithic remains, a total of three phases and eight sub-phases were defined: Yangshao (two sub-phases), Transitional (three sub-phases), and Longshan (three sub-phases). During this season, the excavators also opened up nine 5x5 meter units just to the west of the earlier "northern locus" units, labeling this the "west locus" of the site.[18]

The second excavation season in spring 1960, which lasted from late March to late May, moved just south of the original ("north locus") excavation, setting up a 5 x 11 unit grid of 5x5 meter units, though not all units were opened, and the northeastern section of the grid was opened an additional 2 units to the east and north. This part of the site became to "south locus" and clarified the site periodization established in the first season. One of the main revisions was a somewhat "simplified" periodization of three phases and six sub-phases: Yangshao, phase 1 (sub-phase I); Yangshao-Longshan Transitional, phase 2 (sub-phases II, III, and IV); Longshan, phase 3 (sub-phases V and VI).

Between both field seasons, Longshan remains (phase 3) included numerous vessel classes, divided into "functional" categories: cooking vessels (*guan*, small *guan*, *ding*, *li*, *jia*, and *zeng*); eating vessels (*wan*, *ding*, and *pan*); drinking vessels (single-handle *bei*, single-handle *guan*, *jue*, and *he*); and storage vessels (small-mouth *guan*, small *guan*, double-body *pen*, *pen*, *gang*, and ring-foot vessels). The excavators went on to label the two Longshan sub-phases as "early Longshan" (V) and "late Longshan" (VI), and further note that within the late Longshan remains are some vessel forms that share characteristics of early Erlitou period vessels.

18. Note, however, that the "Excavation Area" numbers for the first season (1959) do not include the west locus, whose numbers are instead included in the total for the second season in 1960.

Xiaopangou Site [小潘沟]

Reports: Luoyang Museum (LM 1978b)

Coordinates: 34°47'23.70"N
112°38'40.62"E

Total Area: 200 000 m^2

Excavation Area: more than 450 m^2

Excavation Units: five 10x3m trenches, three 10x10m units, three 3x1m trenches

Features: 3 floors, 35 ashpits, 9 burials

The Xiaopangou site is located 1.5 km southwest of the Mang Hills in Luoyang Prefecture, Mengjin County, Songzhuang Township (Figure 2.9 on page 35). The site was discovered by the Luoyang Museum in January 1976 during a survey of rural villages in the area, and excavation was subsequently undertaken from March to May of the same year. Three quadrants were designated, the first closest and to the northwest of Xiaopangou Village; the second is just to the west of the first, and the third section is west of the second. The majority of the work was undertaken in the first section, with three 10x3 meter trenches and three 10x10 meter units, followed by the third section where two 10x3 meter trenches and three small 3x1 meter trenches. No units were opened in the second section (LM 1978b:244).

Xiaopangou is a multicomponent site with cultural levels around three meters thick. A complete series of occupations from the Yangshao period, early Longshan, and late Longshan periods. There are also some Western Zhou and Warring States ashpits have intruded on some late Longshan ashpits. The site has few remains from the Yangshao to Longshan transition or early Longshan, the majority being of late Longshan period.

Using pottery, the excavators linked the primary cultural phase, late Longshan period, to phase 3 of the Wangwan site and phase 1 of the Meishan site (Table C.7 on the following page). They note

Xiaopangou	Wangwan	Meishan	Erlitou
Phase 0	p2(?)		
Phase 1	p3	p1	
Phase 2			p1(?)

Table C.7: Concordance of phases at the Xiaopangou site

in particular that the large-mouth *guan* jar, tall straight-rim *guan* jar, curved-body *pen* basin, ring-foot *pan* platter, *weng* urn, and *wan* bowls all bear resemblances to forms from those two sites (LM 1978b:255).

Artifacts recovered include a large number and variety of pottery vessel forms, including *guan* jars, *yan* steamer vessels, *pen* basins, *wan* bowls, *pan* platters, *dou* stands, *weng* urns, *gai* vessel lids, and one possible *jia* cup. There were also a small number of stone, bone, and shell implements found. Most notably, however, is the recovery of 4 jade objects, including a *huang* tablet, *chan* shovel, and *shi* ornament. This is notable because finding jade objects in Longshan period cultural levels is unusual in Henan Province.

Index sites	phases	**Luoyang Basin sites**	**Cuoli**	**Gaoya**	**Huizui**	**Ligou**	**Shaocai**	**Tanxiaoguan**	**Xiaopangou**
Dahecun	p2							p1	
	p3		p4					p2	
	p4				YS	p4		p3	
	p5		p5		*LS*	p5		p4	
Wangwan	p1		p1	p1					
	p2		*p2*	p2	YS				*p0*
	p3		p3	p3	LS				p1
Meishan	p1		p3						p1
	p2		p4						*p2*
Erlitou	p1		p4				p1		*p2*
	p2		p5		ELT		p2		
	p3				ELT		p3		
	p4						p4		

Table C.8: Master Concordance