

GROUND STONE TOOL PRODUCTION AT HUIZUI, CHINA: AN ANALYSIS OF A MANUFACTURING SITE IN THE YILUO RIVER BASIN

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ABSTRACT

Current studies of Neolithic and Bronze Age ground stone tools in China focus upon typology with little emphasis on issues such as manufacturing techniques or craft specialisation. In order to improve on our knowledge of Chinese ground stone technology, a study was completed of a ground stone assemblage from Huizui, an Erlitou stone tool manufacturing site located in Henan Province, China. Issues addressed include the location of the sources of raw material, what tool types were produced on site, the manufacturing techniques utilised to produce different tool types, and the distribution of tools upon completion. In addition, this study also attempts to answer larger scale questions relating to craft specialisation, the changes over time in stone tool assemblages, and what role the Huizui site played in the regional economy of the Erlitou state.

Lithic studies of the Neolithic and Bronze Age periods of China have focused mainly upon typological studies that discuss the presence/absence of particular tool types. These types of study limit the role that stone tools play in the discussion of Neolithic and Bronze Age cultures, with more emphasis being placed on pottery and prestige items. However, as studies internationally have shown, lithics can be used to answer a variety of questions regarding production, site use, craft specialization and trade/exchange relationships.

In order to build up the profile of lithic studies in the Yiluo Basin of central China, a study was undertaken of a ground stone tool production site located in Henan Province. The site, known as Huizui, dates from the Neolithic Period to the Early Bronze Age. This was an important time period in early Chinese history, when the first states developed in central China. The earliest state, the Erlitou, is the primary focus of this study. The urban centre of Erlitou, located in

Yanshi County, Henan Province, contains palace and temple remains, craft specialist workshops, and evidence for social stratification in the form of burials with elite goods (Chang 1986:310; Thorp 1991; Institute of Archaeology 1999). However, little is known about the urban centre's relationship with its hinterland, as few studies have been completed of regional Erlitou sites (Liu *et al.* 2002-2004; Liu *in press*).

One specific issue that needs to be examined is the role that the hinterland played in the economic system of the Erlitou Period. Li Liu's (2003) study of craft workshops at Erlitou showed that both elite and utilitarian goods of bronze, pottery and bone were produced on-site. But there is no evidence for any on-site production of stone tools, despite the large number found there (Institute of Archaeology 1999). The lack of stone workshops at Erlitou suggests that production occurred off-site. Therefore, my study focused upon the stone tool manufacturing site at Huizui. The results indicate that stone tools made at Huizui may have been exported to the primary centre at Erlitou (Ford 2001).

HUIZUI

The site of Huizui is located on the west bank of the Liujian River in Yanshi County, western Henan province, 15 km south of Erlitou and 5 km north of the Song Mountains (Figure 1). The major lithic materials that occur in the vicinity are limestone, diabase and different types of sandstone. Two sandstone quarries are located within 1 km of the site, and thin section analysis conducted by Cameron Cairns of La Trobe University has shown that these were the source of the sandstone grinding slabs found at Huizui. Different types of limestone were utilised at Huizui, but the dominant material was oolitic limestone. Survey by Guowei Xu and Justin Gorton (2003:117) of the Earth Sciences Department of La Trobe University has established that this came from two outcrops located on the northern flanks of the Song Mountains, one at 200 - 300 m above sea level, the other at 650 - 700 m. The exact sources of the diabase and one type

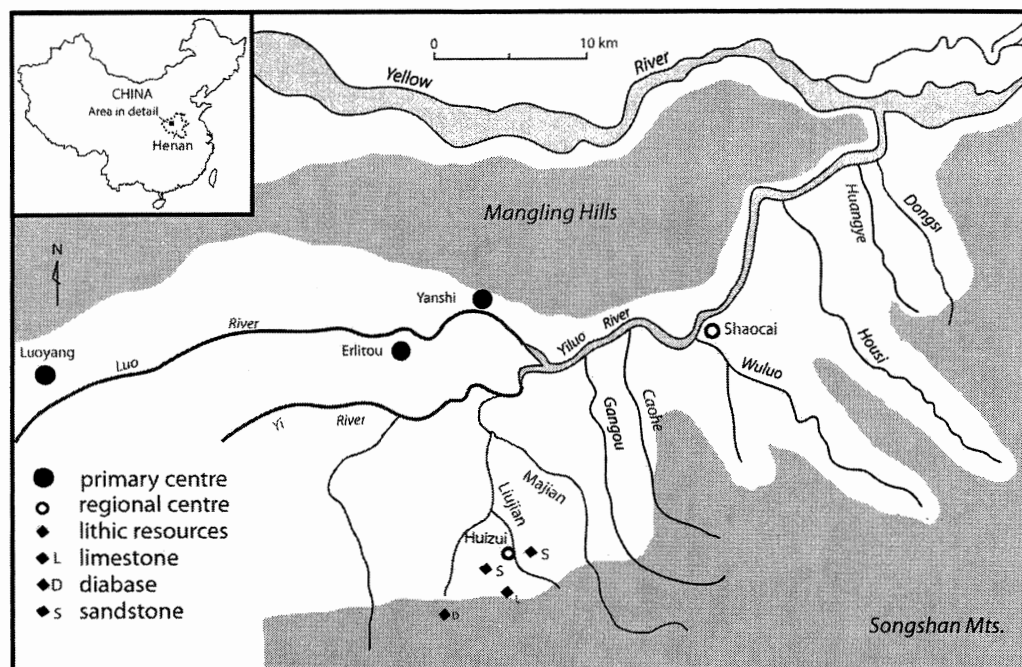


Figure 1: The Yilou River Basin.

of sandstone remain unidentified, although a possible source for the diabase is located near Shanzhang, less than 10 km southwest of Huizui (Yanshi County 1992:132).

Huizui was originally excavated in 1959 (Henan Cultural Bureau 1961; Henan Institute 1990), resurveyed in 2001 (Li 2002 - 2004; Institute of Archaeology 2003), and has been excavated since 2002 by the Yiluo River Survey Project. It is a multicomponent site, dating to the Yangshao (5000 - 3000 BC), Longshan (3000 - 2000 BC), Erlitou (1900 - 1500 BC), Early Shang (1600 - 1300 BC) and Eastern Zhou (770 - 221 BC) periods. The 2001 survey mapped the boundaries of the different time periods, based on the presence of diagnostic artefacts. During the Yangshao and Longshan periods, the site was limited to no more than 10 ha located in the eastern section (the site is divided into eastern and western sections based on the presence of a large gully between these two areas). During the Erlitou period, Huizui expanded to its largest size of 25 ha, extending to occupy the western section of the site, and was perhaps a secondary regional centre of the Erlitou culture (Liu *et al.* 2002-2004). During the Shang and Zhou periods, the site reduced in size to approximately 5 ha and was again located only in the eastern section.

The size of Huizui during different time periods is important for analysing the surface collections from the site. Although most of the stone artefacts collected from the eastern section of the site appear to have originated in disturbed Erlitou strata, they are currently undatable. The

stone artefacts recovered from the western section, however, can be attributed to the Erlitou period as only Erlitou cultural remains have been found in this area.

The 2001 survey at Huizui collected 442 stone artefacts. The 1959 excavation, which was located in the eastern part of the site, also recovered 133 stone artefacts. Both assemblages were analysed for the current study. The main focus of this discussion is on the Erlitou period assemblage, both from the 1959 excavation and from the survey in the western section of the site.

To understand the life histories of the Huizui stone tools, a typological analysis and an attribute-based analysis were conducted. The typological analysis examined the presence/absence/relative proportions of tools, classified according to existing Chinese typologies (Wang 1990; Institute of Archaeology 1999). The results were compared against Mesoamerican and Pacific assemblages (Binns and McBryde 1972; Best 1974; Dickson 1980; Rovner and Lewenstein 1997). There are limitations to accuracy primarily resulting from a lack of usewear analysis, but current studies are attempting to rectify this situation.

The attribute analysis was designed to answer several different questions. Raw materials were recorded in order to identify possible sources. Tool blanks were examined to determine whether raw materials were quarried or obtained as river cobbles. Evidence for cortex (where relevant) indicated whether tool blanks were flaked initially at Huizui, or underwent flaking elsewhere.

Any visible evidence for manufacturing techniques was used to analyse reduction strategies, and evidence for usewear, in the form of abnormal striations, chipping, edge rounding and grinding, was studied using a low magnification hand lens. Resharpening was recorded by the presence of reflaking along the working edge and/or old bevels. Measurements were used to compare specific tool types from Huizui with those of the same raw material from Erlitou.

Using both typological and attribute analysis, five tool types were identified as having been produced on site - spades, knives, axes, adzes, and chisels. Other tool types were also identified (Table 1), but without evidence for production.

As can be seen from Table 1, spades were the most common tool type at Huizui, making up 24% of the total assemblage and 33% of the Erlitou assemblage. This represents a marked increase from the Longshan period, when only 17% of the stone tools were spades. The majority were made from limestone (96%), mainly of oolitic limestone from the nearby Song Mountains. The first stage in spade production (Figure 2) involved flaking the tool blank to shape and thin it. Both the lateral margins and the body of the spade were bifacially or unifacially flaked, and most of the flake scars on the surface of the blank are small. These flake scars overlap earlier, long invasive flake scars which do not have identifiable impact points. The tool blanks were almost halved in thickness from the beginning of flaking to the final product. The varying techniques used to flake the tools and the general disarray of flake scars suggests that the main aim was to remove excess material quickly, roughly shaping the blank before it was subjected to other manufacturing processes.

The second stage of spade manufacture was the hammer dressing of the lateral margins and, occasionally, the body of the spade as well. Hammer dressing was used to prepare the tool for grinding as it removed flaking ridges, making it easier to grind down evenly. The tool blank was then ground before being polished over its entire surface. Two of the spades also show evidence of hafting, in the form of a pecked hole, also ground and polished to smooth the edges.

The properties of limestone may be the key to why grinding was used to finish the tools. Limestone is softer than other raw materials, making it easy to grind and repolish when worn (Garber 1989:15), thus allowing quick resharpening. The limestone at Huizui also has a strong interlocking structure of metamorphosed carbonate mud (Cameron Cairns, pers. comm. 2001), which means that it is brittle, difficult to flake accurately, and liable to shatter. It is also very homogenous (Cameron Cairns, pers. comm. 2001) and so grinds evenly with no protruding particles, leaving a

smooth and polished finish. However, it is not clear why such a smooth finish was required for such a utilitarian tool.

During the Erlitou period, the large number of spade blanks (72) produced, compared to the number of finished spades (12), suggests that more spade blanks were produced than were ever finished and used at Huizui. Some were probably taken to Erlitou, which has finished spades that thin section analysis shows to be from the same source as those made at Huizui (John Webb pers. comm. 2004). A typological study is currently being conducted of the Erlitou assemblage itself for comparison, but the lack of tool blanks and evidence of manufacture at Erlitou suggests that the spades came from Huizui.

The second major tool type produced at Huizui was the axe (Figure 3), with a total of 25 dating to the Erlitou period (Table 1). Eighty five percent were made from water-worn diabase cobbles, probably from the local river bed. River cobbles are especially reliable for stone tool production because any flaws inherent in the raw material will have been 'found out' by the fluvial processes to which the cobble was subjected (Dickson 1981:108). Production of the axes began by flaking their lateral margins and distal edges. The lateral margins were then hammer dressed, and both the body and butt of the tool were ground. The final stage of manufacture involved polishing the bevel to a high gloss.

During the Erlitou period, 91% of the finished tools exhibited macroscopic usewear, suggesting they were used on site. Thirty six percent also exhibited reworking, either by repolishing of the working edge or by flaking away old dull edges, suggesting a high rate of recycling. One of the finished axes also shows evidence of hafting through the drilling of a hole in its medial section, a technique unusual for axes but popular for knives and other cutting implements.

The intense curation of the axes and their small numbers suggest that they were only produced for use on site. However, the small number is puzzling, since Huizui is well known to locals for its extremely abundant ash deposits from numerous large pits (hui means "ash"). The 2002-3 excavations at Huizui revealed a large amount of burnt limestone in Longshan period ash pits (Institute of Archaeology 2003), suggesting large scale lime production, an activity that would have required many stone axes to cut fuel.

It is apparent, therefore, that spade production was more important than axe production at Huizui. This may be due to a collecting bias - axes are highly visible and more likely to be collected by local villagers. Ongoing excavation may indicate whether there is a case to be made for mass production of axes.

The third major tool type produced at Huizui was the adze (8 were found), predominately made from diabase

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Table 1: Stone tool types found at Huizui

Artefact Type	Erlitou assemblage	Percentage of Erlitou assemblage	Longshan assemblage	Percentage of Longshan assemblage	Yangshao assemblage	Percentage of Yangshao assemblage	Undatable Artefacts	Total
<i>Tool Types</i>								
Spade	84	33.3	9	16.7	0	0	46	139
Axe	25	9.9	7	13	0	0	8	40
Knife	16	6.3	7	13	0	0	10	33
Chisel	11	4.4	7	13	0	0	1	19
Adze	8	3.2	2	3.7	0	0	5	15
Grinding Slab	8	3.2	2	3.7	1	33.3	21	32
Scraper	6	2.4	2	3.7	0	0	15	23
Triangular Point	6	2.4	11	20.4	0	0	0	17
Hammerstone	4	1.6	0	0	0	0	7	11
Sickle	3	1.2	2	3.7	1	33.3	0	6
Pestle	2	0.8	0	0	0	0	0	2
Spear	2	0.8	0	0	0	0	0	2
Arrowhead	1	0.4	2	3.7	0	0	0	3
Hand axe	1	0.4	0	0	0	0	1	2
Mortar	1	0.4	0	0	0	0	1	2
Gui	1	0.4	0	0	0	0	0	1
Roller	1	0.4	0	0	0	0	0	1
Stone Bead	1	0.4	0	0	0	0	0	1
Stone Ball	1	0.4	0	0	0	0	0	1
Spindle Whorl	1	0.4	0	0	0	0	0	1
Grooved Stone	1	0.4	0	0	0	0	3	4
Bracelet	0	0	2	3.7	1	33.3	0	3
Chimestone	0	0	0	0	0	0	1	1
Dagger	0	0	0	0	0	0	1	1
Weight	0	0	0	0	0	0	1	1
<i>Miscellaneous Objects</i>								
Stone Slab	1	0.4	1	1.9	0	0	0	2
Cylindrical Object	1	0.4	0	0	0	0	0	1
Circular Object	0	0	1	1.9	0	0	0	1
Worked Stone	0	0	1	1.9	0	0	0	1
<i>Manufacturing Debris</i>								
Indeterminate	31	12.3	0	0	0	0	64	95
Unworked Stone	20	7.9	0	0	0	0	66	86
Flake	10	4	0	0	0	0	3	13
Core	5	2	0	0	0	0	4	9
Fragment	0	0	0	0	0	0	5	5
Total	252	100	54	100	3	100	265	575

cobbles like the axes. The manufacturing process was also the same, except that adzes have asymmetrical bevels necessary for dressing wood rather than cutting it. Eighty percent of the finished adzes exhibit macroscopic usewear and sometimes resharpening, suggesting on site use.

The fourth tool produced at Huizui was the chisel (Figure 4), smaller than an adze and polished over the entire surface. The majority (73%) were also made from diabase cobbles. The finished chisels exhibit macroscopic usewear

and evidence for resharpening, suggesting use on site. Indeed, an overall pattern of production and use of woodworking tools at Huizui can be identified. Unworked diabase cobbles were formed into blanks for adzes, axes and chisels, which when complete were used on site and carefully curated, as shown by the high rates of edge rejuvenation.

The fifth tool type produced at Huizui was the knife, which may have been used as a cutting implement (Figure 5).

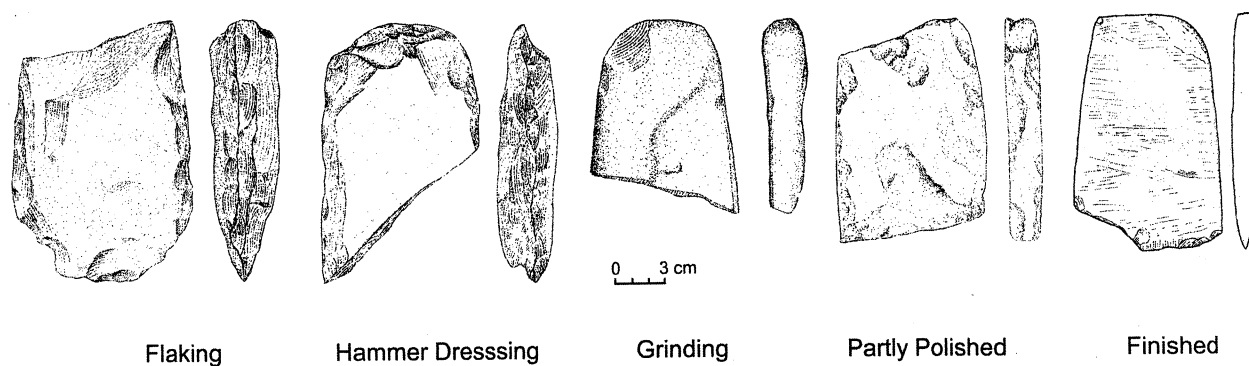


Figure 2: Limestone Spade Reduction Strategy.

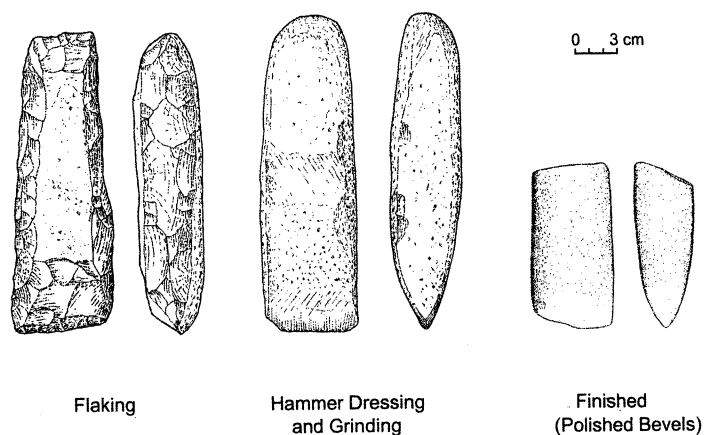


Figure 3: Axe Reduction Strategy.

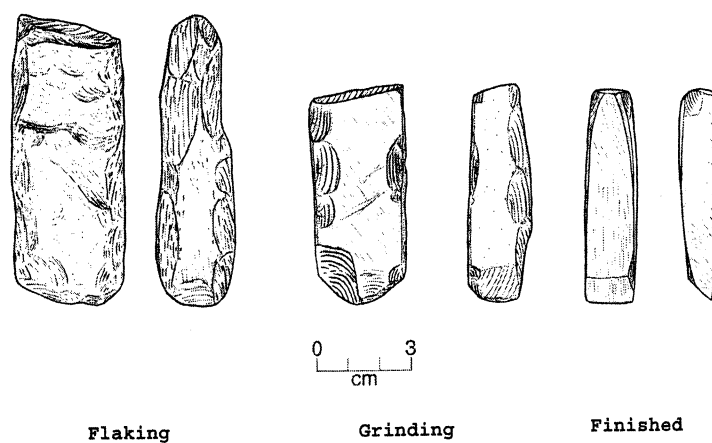


Figure 4: Chisel Reduction Strategy.

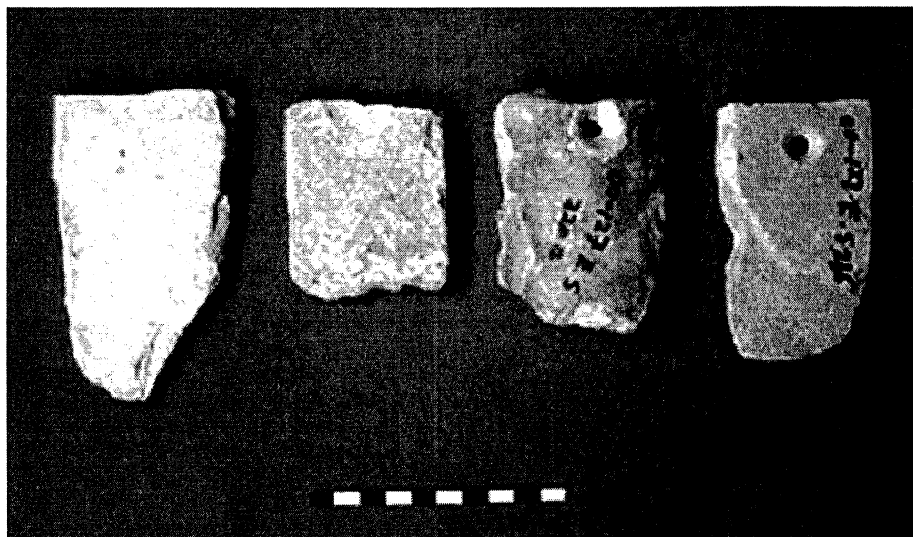


Figure 5: Knife Tool Blanks Displaying Different Stages of Hafting.

Most (69%) are of micaceous fine sandstone, an effective raw material because it is in thin sheets. Blanks were flaked and then ground and polished all over, including the working edge. Hammer dressing was not necessary for this material. No source for the micaceous fine sandstone has been identified, nor have any unworked slabs been recovered from the site. This suggests that early stages of knife manufacture occurred off site, possibly at the quarry.

Six knives have hafting holes (Figure 5), some only pecked and unfinished, others drilled through and polished to smooth the edges. Of the finished Erlitou knives, 86% show evidence of usewear in the form of chipping, edge rounding or abnormal striations (striations not attributable to manufacture). This high use rate suggests that the knives were used locally. None appear to have been resharpened.

Thus, examination of the major tool types produced at Huizui suggests an emphasis on the production of limestone spades. Although other tools were manufactured, all were used locally and not made in large numbers, unlike the spades, which seem to have been for export to other sites such as Erlitou.

CRAFT SPECIALISATION

Craft specialisation was investigated at Huizui utilising two approaches, one inter-site and the other intra-site. Using Johnson's (1996) inter-site model, I identified the existence of specialisation at Huizui through standardisation in form and production. Macroscopically, there is little to distinguish one tool within a tool type from another, and all appear to have undergone the same manufacturing processes. This would suggest that tools were produced to predetermined

forms. Another of Johnson's indicators of specialisation is high volume production, and Huizui witnessed intensive production of limestone spades.

Huizui may also show evidence for what Nassaney (1996) defined as spatial specialisation, a situation that occurs when sites on a regional level produce different goods, for which they each maintain a production monopoly. If parts of an economy are segmented in this way, it could make them more open to control by local elites. At this stage, it is not known whether Huizui exhibited spatial specialisation of this type, although future excavation of the manufacturing area may answer this question.

However, Erlitou has also yielded stone tools made from lithic materials other than those identified at Huizui (Institute of Archaeology 1999), and this suggests that Huizui was perhaps not alone in supplying the major centre. Other sites during the Erlitou period are known to have produced other resources for transport to Erlitou, such as copper, tin and salt (Liu and Chen 2001, 2003).

CHANGE OVER TIME

K.C. Chang (1986:411) hypothesised that stone tool assemblages in China changed little from the beginning of the Neolithic in 7000 BC through to the Eastern Zhou termination in 221 BC. Comparison between the Longshan and Erlitou assemblages at Huizui also reveals very few changes in technology. The differences that do occur are in the compositions of the two assemblages. There was an increase in the absolute number of stone tool types during the Erlitou period, especially in relation to domestic tools such as pestles and spindle whorls, and in ritual objects with the discovery of a gui (ritual tablet) and a possible chimestone blank (Table 1). This change hints at a rise in social complexity through development of ritual, although it is not known whether these objects were produced for export or were used on site. One main difference between the composition of the Longshan and Erlitou assemblages at Huizui was, however, an increasing domination of woodworking tools during the Erlitou period, rising to 46% from 30% in the Longshan period. This might indicate an increase in construction on site, or the production of more woodworking tools for export. If a trade link between Erlitou and Huizui can be identified, the increase in economic

specialisation during the Erlitou period will have important implications for the development of the first states in China.

CONCLUSIONS

From the preceding review of the Huizui assemblage, it can be seen that Huizui functioned as a stone tool manufacturing site, producing at least five tool types. From the analysis of these tool types, an understanding of the manufacturing processes carried out has been gained, and this information can be compared to that available concerning other ground stone technologies.

The analysis of the production system of the five tool types has led to some conclusions about the nature of stone tool production on site. Knives, chisels, axes and adzes were produced for local use. Limestone spades appear to have been mass produced for export. Although the distribution pattern of the spades needs to be further investigated, it is hypothesised that some were exported to the urban centre at Erlitou. This hypothesis is based on the lack of evidence of stone tool production in Erlitou itself, and on the finding there of spades of similar type and raw material to those produced at Huizui. This production-distribution relationship between Huizui and Erlitou does need further investigation, but it would appear to be in line with other resource procurement systems of the Erlitou culture, with the urban centre obtaining the resources it needed from regional areas (Liu and Chen 2001:11).

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