Title
Mining, Trade and State Formation in Early China

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Publication Date
2018

Peer reviewed|Thesis/dissertation

UNIVERSITY OF CALIFORNIA

Los Angeles

Mining, Trade and State Formation in Early China

A dissertation submitted in partial satisfaction of the

Requirements for the degree Doctor of Philosophy

in Archaeology

by

Tao Shi

2018

ABSTRACT OF THE DISSERTATION

Mining, Trade and State Formation in Early China

by

Tao Shi

Doctor of Philosophy in Archaeology

University of California, Los Angeles, 2018

Professor Min Li, Co-Chair

Professor Lothar von Falkenhausen, Co-Chair

This dissertation aims at exploring the trade strategy and center-periphery relations in the process of state formation in early China. The focus is the Longshan and Erlitou periods (ca. 2300-1520 BCE). Instead of a center-based perspective, this research focuses on peripheries and discusses the impact of peripheral societies on the formation of the political-economic landscape of early states. By taking resource extraction and distribution as a departure point, I discuss the production modes, economic forms and social contexts in three resource-rich regions, which were significant sources of key resources in early China. Based on my estimation on scales of mining and mining landscapes, I argue that turquoise and copper mining and mining-related productions were all local, small-scale and village-based activities during the two periods. The current evidence shows that early states did not place direct control over resource extraction and distribution in these peripheral regions. Moreover, based on the arguments and comparative cases

in other regions of the world, I further argue that the strategy of resource procurement of early states was never monopolistic. Rather, the Longshan and Erlitou-period states adopted a decentralized strategy to procure key resources. By considering Erlitou as a phenomenon of regeneration after Longshan collapses, I argue that the center-periphery relations maintained a strong continuity in this transitional period.

The dissertation of Tao Shi is approved.

Nancy Levine

Charles S. Stanish

Min Li, Committee Co-Chair

Lothar von Falkenhausen, Committee Co-Chair

University of California, Los Angeles

2018

To my parents

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Acknowledgement

Durig the five-year study at the Cotsen Institute of Archaeology, many individuals and institutions have supported me. First of all, I would like to express my great gratitude to Professor Lothar von Falkenhausen and Professor Li Min. Professor von Falkenhausen has invested great time and energy on my study at UCLA. His seminars have greatly expanded my knowledge of archaeology, anthropology and art history in China and other regions of the world. I am particularly grateful for his careful reading on my dissertation, and his insightful comments helped me gain more constructive ideas, which are not only important for this dissertation, but also beneficial for my further work. Additionally, his concerns to my life in LA have helped me quickly adapt here and lived a colorful life in the past five years. Professor Li invested much energy on my dissertation. The discussions with him helped me find the direction of my dissertation and make the plan of my resource survey during 2016 and 2017. The conceptual framework of my dissertation is largely nourished from his new book. Also, his careful reading and insightful comments helped me shape the entire the structure of my dissertation. Professor von Falkenhausen and Professor Li set a good example for me to follow in my career as a scholar and a teacher in the future.

I would also like to thank my other committee members for their work on my education and dissertation, which helped me a lot improve my dissertation. Professor Nancy Levine provided me with insightful comments from her expertise of anthropology, and gave me many constructive suggestions on how to refine my ideas in the publication stage. Professor Charles Stanish gave me valuable advice about the fieldwork and dissertation writing. Also, his guide during my fieldwork in Peru exposed me in a totally different archaeological context, and gave me a chance to absorb the knowledge of Peruvian archaeology.

The Cotsen Institute of Archaeology provided me with a fantastic academic atmosphere. In the five years of studying here, I benefited from many world-class scholars in Cotsen, such as Richard Lesure, John Papadopoulos, Willeke Wendrich, Greg Schachner, and Thomas Wake. I am particularly grateful for John Papadopoulos for his support of funding. Dr. Hans Barnard spared much of his time to teach me the knowledge of thin-section petrography for ceramic analysis, and kindly shared his laborotary and ceramic materials. Dr. Cathy Costin from the California State University, Northridge, contributed her theoretical knowledge to my dissertation and shared many anthropological and archaeological literatures about ancient production. Besides, I would like to deeply appreciate the financial supports from Archaeology IDP in Cotsen Institute of Archaeology, UCLA graduate division, UCLA Center for Chinese Studies, Asian Languages and Cultures Department, Art History Department, and Near East Languages and Cultures Department, Luce Foundation, Chiang Ching-kuo Foundation Scholarly Exchange. Their financial supports were the most fundamental for my study and fieldwork in the last five years.

I also want to take this chance to express my great gratitude to many Chinese archaeologists. Professor Zhang Chi 张弛, my former advisor in Peking University, gave me a precious chance to study the materials of the Baligang site. The materials of 20 years excavation from this site have laid a solid foundation for my future work in the sphere of Chinese archaeology. Dr. Zhang Tian’en 张天恩 and Ma Yongying 马永赢 gave me a valuable chance to study the materials of Shangluo City during the third national archaeological survey in the Shaanxi Provincial Institute of Archaeology. I would also like to thank Dr. Gao Jiangtao 高江涛 and Pang Xiaoxiao 庞小霞 in Chinese Academy of Social Sciences (CASS) for their permission to participate in their survey about ancient transportation during 2017. I am particularly grateful to Mr. Liu Zuopeng 刘作鹏 and Chen Shutong 陈书彤 for their warm reception and openness on archaeological materials during my four visits to the Shangluo City Museum. Thanks to Fang Hui 方辉 from Shandong University, Wang Xiaojuan 王小娟 from Shanxi University, Hu Changchun 胡长春, Song Guihua 宋贵华, Chen Shuxiang 陈树祥 and Xi Qifeng 席奇峰 from the Hubei Provincial Institute of Archaeology, Wang Hui 王辉 from Gansu Provincial Institute of Archaeology, Liu Bin 刘斌 and Chen Minghui 陈明辉 from Zhejiang Provincial Institute of Archaeology, Zhao Haitao 赵海涛 from CASS, Zhang Li 张莉 from Zhengzhou University for their coordination and kindly reception when I visited their excavation fields and storage of archaeological materials.

I need to thank my cohort for their kindly support and help from the beginning of my study at UCLA: Deborah Sneed, Caroline Macleod, MaryAnn Kontonicolas, Jacob Damm and Wen Chenghao 温成浩. Since the master study at Peking University, I have been studying together with Chenghao for ten years. His enthusiasm on archaeology always encouraged me and stimulated us to travel in many cultural heritages in Mexico and the United States during the five years. I also need to thank Ben Nigra for his guidance of Peruvian archaeology when we excavated in Chincha. Discussions with my colleages in the East Asian lab, Ellen Hsieh 谢艾伦, Richard Ehrich, Hsiu-Ping Lee 李修平, and Kirie Stromberg, always inspired me and stimulated me to learn more and explore more spheres in academics. My colleagues in China, Xiang Jinhui

向金辉, Sun Yufeng 孙宇峰, and Chen Dongyang 陈东阳, lent me many supports when I was doing fieldwork in China. My friends in LA, Yuen Hsieh 谢侑恩 and Jiang Jia 蒋佳 gave me many inspiring ideas on sociological and anthropological theories, which will be beneficial for my academic life in the future.

Lastly and the most importantly, I would like to thank my parents for always supporting and encouraging me to pursue a higher education on the road of my life. I hope they will stay healthy and happy for ever.

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China. Paper presented at the 83th annual meeting of the Society for American Archaeology, Washington D.C., April 12, 2018.

1 Introduction

The emergence of Erlitou as a post-collapse regeneration sets up a new background to investigate the transition to the Chinese Bronze Age and state formation in early China (Zhang Li 2012; Li 2018). With the emergence of the Erlitou urban center, the Luoyang Basin not only witnessed many technological innovations, but also the formation of the Central Plains-centered political-economic landscape (Liu and Chen 2003). Li Min (2018) recently points out that the highland Longshan society was an important predecessor for the eventual rise of Erlitou, whereas the reproduction of many economic institutions of the highland Longshan society greatly contributed to the regeneration of Erlitou after the collapse of the Longshan society. Based on the previous studies, this dissertation attempts to focus on the formation of the Erlitou political-economic landscape. Specifically, I aim to investigate how the Erlitou regeneration impacted its trade strategy and the formation of a Central Plains-centered political landscape.

The two interrelated questions are: what strategies did Erlitou adopt to manage its exchange with peripheral regions? And how did the peripheral regions respond to the emergence of a new political system in the Luoyang Basin and the formation of a new trade partnership? Archaeologists have paid much attention to the central regions during the Longshan and Erlitou periods, but neglected the peripheral and hinterland regions. Hence, this defiency justifies my focus on the periphery for this dissertation. I will discuss the production modes, economic forms and social contexts in the peripheral regions by taking resource extraction and distribution as a focus.

My choice of this approach is based on these three reasons. First, although the center-periphery interactions of early states have been discussed for a long time in Chinese archaeology, detailed analyses on the socio-economic systems in the peripheral regions are still scarce. Second, although the peripheral regions were much less complex and less developed than central regions, their political and economic forms were vital to understand the center-periphery relationship. Third, craft production of precious items was vital for maintaining the kingship in the Central Plains (Chang 1990; Liu and Chen 2003), and resource extraction and distribution were the first and second steps of most types of craft production. Therefore, understanding resource extraction and distribution, and their social implications will be fundamental to understand the political-economic landscape in early China.

Based on these considerations, I investigate mining and mining-related productions in three regions: the Shangluo Corridor, the Zhongtiao Mountains, and the Middle Yangzi River Basin. The Shangluo Corridor not only contains the largest deposit of turquoise resources in China, but also is an important corridor connecting the highland regions, the Luoyang Basin, and the Middle Yangzi River Basin, which are all critical regions for state formation in early China. I will base my research on my survey of the turquoise mines in this region, and discuss the social mechanism of turquoise mining and the relationship between turquoise mining and the local communities. For the Zhongtiao Mountains and the Middle Yangzi River Basin, which were important copper deposits for the states in early China, I will discuss the modes of metallurgical productions in the two regions, and their relationship with states in early China. Since I did not carry out survey in this region, I base my investigation on published archaeological materials.

1.1 Conceptual framework

1.1.1 Collapse, regeneration, and exchange

In archaeology, the term collapse is often used to look at the failure of a social system and its adaptation to a new circumstance. According to Schwartz (2006: 5-6), collapse contains some of the following characteristics: division of states into smaller political entities; abandonment of urban centers; decentralization of governmental functions; economic failure; and breakdown of civilizational ideologies. As suggested by many theorists (eg. Yoffee and Cowgill 1988; McAnany and Yoffee 2010), collapse is not a complete singular event, but a process of breakdown of a political system and drastic restructuring of social institutions (Yoffee 2005: 134; Conlee 2006: 99). From this perspective, archaeologists are interested in de-structuring collapse into several social institutions, and looking at the continuity or demise of some social institutions after collapse. Thus, the concept of resilience is devised to characterize the vulnerability of a social system and its ability to maintain its cultural aspects, such as kinship, economy, and worldview, when it faces challenges (McAnany and Yoffee 2010).

The conceptualization of collapse and resilience stimulates archaeologists to explore what happened after societal collapse. One of the many topics is regeneration. Regeneration consists of the reconstruction of similar kinds of institutions of the pre-collapse societies after a period of decentralization (Schwartz 2006: 7). However, regeneration does not mean a reconstruction of a specific complex society, but a reappearance of a similar social complexity (ibid). To explore regeneration of a society, archaeologists are interested in the continuity or change of social institutions in the process of regeneration. They tend to look at what social institutions were abandoned by a new political entity, and what pre-collapse social institutions were involved or transformed in a new sociopolitical system. Many archaeological studies emphasize the contributions of the pre-collapse sociopolitical, economic, ideological and other institutions in the process of regeneration. For example, Stark (2006) points out that the history of Khmer civilization can be seen as cycles of fragmentation, collapse, and reorganization from Funan to Angkor states (500BCE to 1250 CE). Although the political centers shifted and the royal dynastic succession frequently broke, the organization of domestic economy and the ways in which elites, as indicated by Chinese annals and indigenous inscriptions, adopted Indic ideologies to acquire wealth and legitimize their power were continuous through a long time. The continuity of economic and ideological institutions was an important reason for the longevity of the Southeast Asian classical states.

Long-distance exchange network was an important factor in collapse or regeneration of complex societies. Regeneration of a complex society often involves the reproduction or transformation of the pre-collapse exchange network. For example, Masson et al. (2006) points out that the regeneration of a post-classic Maya society at Mayapán in the Yucatán peninsula involved the reproduction of various economic institutions. The strategy of importing raw materials for elite-based shell working and commoner-based stone toolmaking parallels the earlier pattern in the Classic period. However, the amplification of long-distance trade resulted in the growth of merchant groups, which led to the competition of social powers and more factionalized political organization, which was the most obvious institutional change during the post-Classic period. Moreover, Morris (2006) also argues that trade was an important factor in the regeneration of the complex societies in Greece during 1500-500 BCE.

1.1.2 Postcolonial critique on the Center-Periphery Model

The main goal of this dissertation is to look at the formation of political-economic landscape in the process of the transition to Chinese Bronze Age and the state formation in early China. The main focus is the role of exchange and resource procurement during this process. One of the primary models about exchange and resource procurement is world systems theory. Initially proposed by Wallerstein (1974), world systems theory has been widely adopted to discuss the political and economic development of ancient societies. World systems theory emphasizes the domination of centers in multi-polity interactions. In a world system, the core enjoys advantages of political centralization and the most developed technology, and imposes political, economic, or military control over peripheral regions. Peripheral regions, on the other hand, are subordinate to the core and always responsible for providing raw materials and less-sophisticated products to the core region.

Post-colonial critique of this type of analysis highlights a varied and dynamic viewpoint to analyze how two societies interacted with each other from a bottom-up perspective. This critique on the domination of cores argues that the influence travels in both ways between the core and peripheral regions. Hence, scholars turned from centers to peripheries and laid the emphasis on the indigenous roles in the interactions between centers and peripheries (Lyons and Papadopoulos 2002). For example, Stein (1999: 16-26) points out that the world systems theory and its applications have three pre-assumptions: core domination, asymmetric exchange, and the primary role of the long-distance interaction in shaping the political economy of the periphery. The assumption of core dominance negates any agency of the peripheries. Through a detailed analysis of the archaeological remains at the Hacinebi site, which was established during the fourth millennium BC in Turkey, Stein (1998, 1999, 2002) argues that the Uruk colonization could not be directly equated with economic or political hegemony over the local community; rather, the people of the periphery and the Uruk merchant groups were involved in a symmetric exchange system at the Hacinebi village (Stein 1999).

Dietler (2010: 49) also argues that world systems theory tends toward structural reductionism, and it is only able to explain the economic macrostructures. The unidirectionality of world systems theory cannot explain the variety of local experiences of colonial situations for both the colonized and colonizers, and the contribution of the peripheral regions to the economic macrostructure. Therefore, a multiscalar strategy is always needed. On the one hand, the detailed microscale analysis of a single settlement is needed to investigate the daily life of local communities; on the other hand, archaeologists also need to look at the macrohistory in a broader perspective. Through a symmetric analysis of the colonizers and native people in the Rhône Basin of France during the first millennium BC, he concludes that the colonial encounters in this region were politically autonomous in most of this history, but they were also entangled in the relationships among Etruscans, Carthaginians, Romans and other Greeks (Dietler 2010: 337). The entanglement was normally decided by small groups of native people based on their own interpretation on exotic goods and cultural interests. No polity could impose their wills over the native communities.

1.1.3 Mobility

The social transformation occurring in the vast regions in the heartland of China from the Longshan to the Erlitou period, and the uneven distribution of natural resources motivate me to incorporate the concept of mobility into the theoretical perspective in this dissertation. Mobility refers to a population's ability and need to move (Wendrich and Barnard 2008). It occurs on multiple scales ranging from a daily scale to even a millennium scale (Barnard and Wendrich 2008). The pattern of mobility is fluid, ranging from an entire population that is mobile to a sedentary population in which only a small amount of people move frequently.

Motivation is important to interpret mobility. Many factors can influence the mobility pattern. Subsistence economy is always considered as an important factor, especially the society with a hunter-gathering or pastoralist economy (Barnard and Wendrich 2008). Natural resource was also an important incentive. For example, metal resources were probably a driving factor to facilitate the eastward expansion of metallurgical production in the Eurasian Steppe from the fourth millennium BCE (Kohl 2007). The large turquoise deposits in the southwestern United States were also the stimuli for the states in Mesoamerica to expand northward (Harbottle and Weigand 1992). The merchant groups were highly mobile and were a dominating power in this trade network of turquoise between Mesoamerica and North America from the Formative Age. Mobility was involved in the construction of sociopolitical complexity. An ethnographical study suggests that the mobility of metalsmiths in southern Nigeria were closely related to their prestige and ranks (Nearth 1979). The travelling agents were not only able to obtain religious authority with their mercantile talents, but also were an important balancing factor among different villages to sustain the vitality of political, religious and economic institutions of the Igbo society in southern Nigeria. In addition, ideology was a factor to stimulate movement. For example, Fowles (2011: 62) points out that the migration was ingrained in Pueblo religions and rituals in North America. "The ritualization of movement may well have played an essential role in keeping migration on the table as a behavioral option or model to be activated when the need arose”. In this dissertation, the motivation was important for understanding the mobility of the highland Longshan society and Erlitou, and the introduction of mining knowledge into peripheral regions during the Longshan and Erlitou periods.

1.1.4 Summary: mining in the context of regeneration

Exchange is an important issue that the studies of regeneration need to consider. Archaeologists often explore the impact of collapse and regeneration on the maintenance or transformation of the pre-collapse exchange network. Regeneration was not only related to how states continued or changed pre-collapse trade strategy to exchange with other societies, but also how other polities acted in response to the involvement in a new trade partnership. Hence, studying the exchange system after regeneration requires a symmetric analysis of the socio-economic systems in the core and peripheral regions. Erlitou’s economic institution has been recently studied by some archaeologists as a phenomenon of post-collapse regeneration (eg. Zhang Li 2012; Li 2018). This dissertation attempts to focus on its hinterlands and periphery. Mining of raw materials was one of the most important economic activities in hinterland and peripheral regions. Studying mining can let us understand the production modes of resource extraction in the peripheral regions and the relationship between centers and peripheries in early China. In addition, the uneven distribution of resources and high demands for them resulted in prospectors’ high mobility, which involved the interactions among traders, miners, states, etc. In this dissertation, the high mobility of prospectors was important for us to understand the introduction of metallurgical knowledge into the heartland China, thus an important topic for this dissertation.

1.2 Chronology

The main focus of this dissertation is the Longshan and the Erlitou periods. The Erligang period will also be covered to some degree. I first briefly introduce the chronological framework here. This dissertation sets the rise of the Taosi society as the start, and the rise of Erlitou as the end of the Longshan period (Li Min 2017). Based on the radiocarbon dating at Taosi, the start of the Taosi society is dated to ca. 2300 BCE (Zhongguo and Shanxi 2015: 1112-1115). The Erlitou period started in ca. 1800 BCE and ended in ca. 1520 BCE (Zhongguo 2014: 1215-1238). Normally, the Erlitou period is divided into four phases, but the exact length of each phase is not determined (Zhongguo 1974). For the purpose of this dissertation, it is sufficient to divide the Erlitou period into two: the Early and Late Erlitou. The Early Erlitou includes the first and second phase of the Erlitou period, and the Late Erlitou includes the third and fourth phases. The start date of Late Erlitou may be set at approximately 1600 BCE (Zhang and Qiu 2001; Zhongguo 2014: 1219). Moreover, the Erligang period could be dated to ca. 1550-ca.1400 BCE (Zhongguo 2014: 1222; Zhang and Qiu 2001). After setting the basic timescale of the Longshan, Erlitou and Erligang periods, I list the chronologies of major archaeological sites and cultures mentioned in this dissertation in Table 1-1.

Site/Culture	Longshan period (2300-1800 BCE)	Erlitou period (1800-1520BCE)		Erligang period (1550-1400 BCE)
		Early Erlitou	Late Erlitou	
Qijia culture[1]	√	√	√	
Shandong Longshan culture[2]	√			
Zhukaigou Culture[3]	√	√	√	
Taosi Culture[4]	√			
Post-Shijiahe Cultures[5]	√	√		
Lower Xiajiadian Culture[6]		√	√	
Erlitou		√	√	√
Dongxiafeng		√	√	√
Laoniupo	√	√	√	√
Zijing	√			
Donglongshan	√	√	√	√
Xiawanggang	√	√	√	
Liaowadianzi	√	√		
Qinglongquan	√	√		
Dasi	√	√		
Liying			√	
Xiazhai	√	√		
Zhengzhou				√
Nanguan			√	√
Panlongcheng			√	√
Jingnansi			√	√

Table 1-1 Chronology of major archaeological sites and cultures mentioned in this dissertation

1 Archaeological sites of the Qijia culture mentioned in this dissertation include Huangniangniangtai, Qinweijia, Dahezhuang, Gamatai, Zongri, Xinzhuangping, Shenna, and Mogou. The date of the Qijia culture is based on Wang Hui (2012) and Dong Guanghui et al. (2014).

2 Archaeological sites of the Shandong Longshan culture mentioned in this dissertation include Liangchengzhen and Yaowangcheng.

3 Archaeological sites of the Zhukaigou culture mentioned in this dissertation include Shimao, Lushanmao, Xinhua, Zhukaigou, and Shengadaliang. The date of the Zhukaigou culture is based on Neimenggu and E’erduosi (2000).

4 Archaeological sites of the Taosi culture mentioned in this dissertation include Taosi, Fangcheng-Nanshi, and Zhoujiazhuang. The date of the Taosi culture is based on Zhongguo et al. (2015).

5 Archaeological sites of the post-Shijiahe cultures mentioned in this dissertation include Dalupu, Xiezidi, Shijiahe site complex, and Jinjiling. The start of the post-Shijiahe cultures was probably dated to the 2300/2200 BC (Deng Zhenhua 2015: 23-24). The end date of the post-Shijiahe cultures is still undetermined. Based on radiocarbon dating of the Shijiahe site complex, Deng Zhenhua (2015) concludes that the end date of the post-Shijiahe cultures is possibly 2000 BCE. However, the earliest succeeding cultural assemblage excavated at Panlongcheng (Hubei 2001) and Jingnansi (Jingzhou 2009) only started from Late Erlitou. The cultural assemblage between 2000 BCE to the Late Erlitou is still scarce in the Middle Yangzi River Basin. Pottery vessels from Panlongcheng, like long-neck vases, which are similar to those excavated in the post-Shijiahe assemblage from the Xiaojiawuji site, suggest that it is of high possibility that the post-Shijiahe cultures lasted to the Early Erlitou.

6 The archaeological site of the Lower Xiajiadian culture mentioned is Dadianzi.

Apart from the Longshan, Erlitou and Erligang periods, other periods will also be mentioned in this dissertation. Since they are not the main focus of this dissertation and will not be frequently mentioned, I list the dates of these periods here: the Yangshao period (ca. 4300-2300 BCE)[7], the Qujialing period (ca. 3100-2500 BCE, Hubei et al. 2017), the Shijiahe period (ca. 2500-2200 BCE, Hubei et al. 2017), the Late Shang period (ca. 1200- ca. 1046 BCE, Zhang and Qiu 2001), the Western Zhou period (ca. 1046 BCE-770BCE, Zhang and Qiu 2001), the Eastern Zhou period (770 – 221 BCE)[8], the Han Dynasty (206 BCE – 220 CE), the Tang Dynasty (618-907 CE), the Yuan Dynasty (1271-1368 CE), the Ming Dynasty (1368-1644 CE), and the Qing Dynasty (1644-1912 CE).

1.3 Structure of this dissertation

This dissertation contains eight chapters. Chapter 2 provides an overview of the physical landscape, the transportation routes and the distribution of several types of key resources which were critical for understanding the formation of political-economic landscape in early China. Chapter 3 introduces the cultural background in this dissertation. The focus is the regeneration of Erlitou after the collapses of Longshan societies in the heartland of China (Zhang Li 2012; Sebillaud 2014; Zhang Chi 2017a). Hence, I will focus on the urban centers and their material cultures during the Longshan and Erlitou periods.

I discuss the production modes of mining and mining-related productions in three important

[7] According to recent data of radiocarbon dating, the start date of the Yangshao period was 4300 BC (Deng Zhenhua 2015: 18; Xi'an 2017: 1441). The end date of the Yangshao period is still undetermined. Here I adopt Yan Wenming's viewpoint, and the Miaodigou II culture into the Yangshao period (Yan Wenming 1989). Therefore, The end of the Yangshao period could be dated to 2300 BCE.

[8] The Eastern Zhou period includes two sub-periods: the Spring and Autumn period (ca. 770-ca. 450 BCE) and the Warring States period (ca. 450 – 221 BCE).

resource-rich regions from Chapter 4 to Chapter 7: the Shangluo Corridor, the Zhongtiao Mountains and the Middle Yangzi River valleys. In Chapter 4, I discuss comparative cases in other regions of the world, such as the southwestern United States, Near East and Europe. The focus of the comparative perspective is how to analyze the scales of ancient mining and mining landscapes and how to distinguish a local or a state-controlled mining industry. Based on my field survey, in Chapter 5 and Chapter 6, I discuss turquoise mining along the Shangluo Corridor during the Longshan and Erlitou periods. Based on my observation on the ancient mining sites and the local microlandscape, I point out that turquoise mining was small-scale and local, and a state-controlled resource mining did not exist along the Shangluo Corridor. In order to make a comparison with the Shangluo Corridor and better understand the copper-based center-periphery interactions in early China, Chapter 7 investigates copper mining in the Zhongtiao Mountains and the Middle Yangzi River valleys. Based on currently published materials, I adopt different approaches to analyze the metallurgical industries in the two regions. In the Zhongtiao Mountains, I estimate the scale of mining based on occurrence characteristics of copper resource, and analyze the production mode of metallurgy based on the archaeological information of Dongxiafeng. For the Middle Yangzi River valleys, I adopt a long-term perspective to contrast different mining landscapes around two important mines. The results of my analyses are similar: the metallurgical industries in the two regions were local, small-scale, and village-based during the Longshan period and early Bronze Age. State-controlled metallurgical industries did not exist during the two periods.

Chapter 8 summarizes the investigations of resource extraction during the Longshan period and the early Bronze Age, and critiques the previous studies on the formation of political-economic landscape of early Bronze Age. On the one hand, I argue that the monopolistic resource extraction and distribution was never achieved by the states during the early Bronze Age. Current evidence shows that resource extraction was a local, village-based, and sporadic activity. When metallurgical knowledge was introduced into the heartland of China, the local population quickly absorbed it and adapted it to the new circumstances. On the other hand, the early states were more interested in securing their procurement networks of resources, instead of resources themselves. The Erligang state probably set up administration in trading posts to exchange with mining communities for key resources. However, no evidence suggests the Longshan and Erlitou centers set up trading posts for resource acquisition. Resource extraction and distribution was probably more loosely and less formally organized during the Longshan and Erlitou period. The pattern of resource procurement from the Longshan to the Erlitou period suggests a strong continuity. The regeneration of Erlitou reproduced the trade strategy of pre-collapse Longshan centers on resource procurement.

2 Geographical background

This chapter introduces the basic framework of the landscape which was involved in this dissertation. The aim of this chapter is to look at the relationship between the landscape and political powers in ancient times. Three aspects will be introduced: physical landscape, transportation routes, and key natural resources.

2.1 Physical landscape and transportation routes

The physical landscape of the early China, in a broad perspective, can be divided into two macro-regions – the lowlands and the highlands (Figure 2-1; Li 2018: 22-23). The lowlands include the alluvial plains of the Huai River, the lower Yellow River, and the Middle Yangzi River; the highlands can be geographically equated with the northern part of the secondary terrace of China, including the regions spanning from the Liao River Basin to the east of the Hexi corridor. Several regions will be discussed in this dissertation, including the Middle Yangzi River Basin, the Loess Plateau, the Ordos Plateau and the Luoyang Basin. Hence, I need to first describe them here. For the purpose of this dissertation, I divide the Loess Plateau and the Ordos Plateau into several parts: the western highlands, the northern highlands, the Jinnan Basin and the Guanzhong Basin.

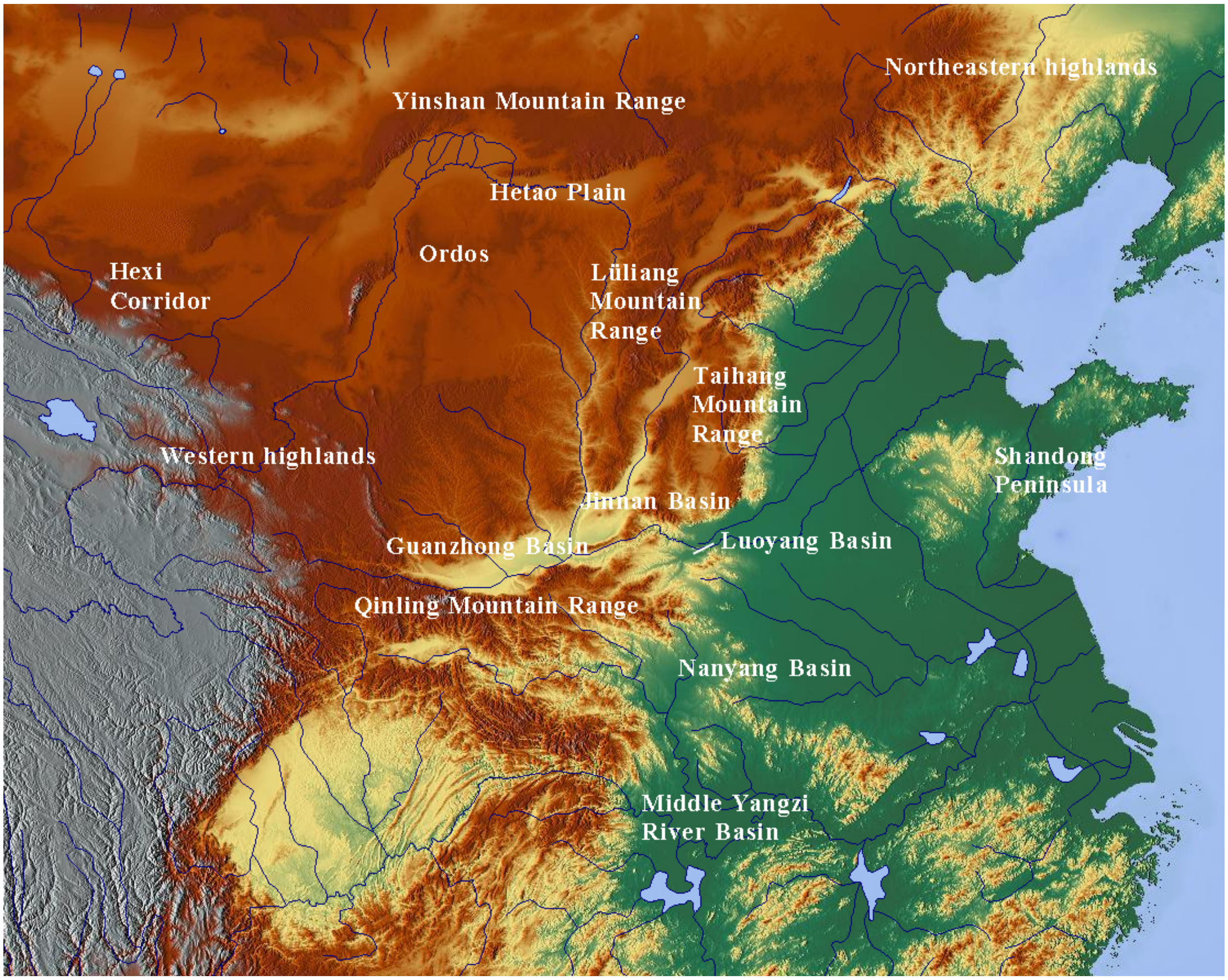

Figure 2-1 Landscape in this dissertation

To the west is the western highlands (Li 2018: 24), which are located to the west of the Guanzhong Basin, and to the east of the Hexi corridor. Following the Hexi corridor along the piedmont of the Qilian Mountain Range, the ancient travelers could reach the vast Xinjiang regions and enter the Eurasian Steppe. The pastoralists in the steppe followed this route and entered the western highlands, and inspired local people to start the metallurgical traditions during the late third millennium BC (Fitzgerald-Huber 1995; Li Shuicheng 2005). To the east end of the western highlands is the Liupan Mountain Range, which is the geographic boundary between the western highlands and the northern highlands. Most of the western highlands are covered with loess. The biggest river in the western highlands is the Yellow River, which flows from the southwest to northwest, and becomes the most efficient way to connect the northern highlands. The susceptibility of loess to erosion and the cutting effect of the Yellow River and its tributaries created many intermountain basins, where many ancient sites and modern cities are located. Apart from the Yellow River, the other two important communication routes are the upper Han River and the Wei River, which connects the Middle Yangzi River Basin and the Guanzhong Basin with the western highlands respectively.

The northern highlands include the Ordos Plateau, the Hetao Plains, the Loess Plateau in northern Shaanxi, and the northern part of the Lüliang Mountain and the Taihang Mountain Ranges. The northern highlands are surrounded by several mountain ranges: the Liupan Mountain Range and the Helan Mountain Range to the west, the Yinshan Mountain Range to the north, and the Taihang Mountain Range to the east. The Loess Plateau in northern Shaanxi is situated between the Ordos and the Guanzhong Basin. Due to the long-term erosion by rainfalls and the Yellow River, the physical landscape of the Loess Plateau is characterized by many gullies with dotted tablelands on mountain ridges. To the north of Ordos Plateau, the desert in the center of the Ordos Plateau divides the oases suitable for agriculture along the Yellow River into several parts. Because of mountains to the west and north, which hold the summer monsoonal moisture, and the Yellow River, several regions along the Yellow River are fertile and suitable for agriculture or for pastoralism. These regions along the Yellow River were called the Hetao Plain and were the focus of rivalries between agriculturalists and pastoralists throughout Chinese history. Through the valleys in the Yinshan Mountain Range, the ancient travelers could reach the Mongolian plateau and Altai regions by walking along the northern piedmont of the Altai

Mountain Range.

The Guanzhong Basin is situated in the south of the Loess Plateau. Created by the geological faulting movement during the Tertiary period of the Cenozoic era (Nie Shuren 1981: 8-9) and the sedimentation of the Wei River and its tributaries, this region is one of the most fertile plains on the Loess Plateau. To its south, the Qinling Mountain Range rises abruptly, creating many steep peaks along the southern edge of the Guanzhong Basin. Some small and short rivers, which originate from the Qinling Mountain Range and flow into the Guanzhong Basin, become the passageways to enter the Qinling Mountain Range. Different from the southern edge, the northern edge of the Guanzhong Basin was not steep, but is a gentle slope extending to the Loess Plateau in northern Shaanxi. As a west-east corridor-shape plain, the western edge of this region is the alluvial cone of the Wei River, which flows out from the steep Long Mountains. However, the Wei River was possibly not the primary route to enter the western highlands in early ages because of the narrow and impassible channels created by the Wei River (Li 2006: 35-36). Rather, ancient travelers probably preferred to follow the Jing River in northern Shaanxi and entered the western highlands. The Yellow River flows in the eastern end of the Guanzhong Basin. The Jinnan Basin is situated to the south of the Lüliang Mountain Range and to the east of the Yellow River. The formation of the Jinnan Basin was resulted by geologic faulting movements and the sedimentation of the Fen River and its tributaries. Several rivers, such as the Yellow River, the Jing River, and the Fen River, are important passageways to connect the Guanzhong Basin and the Jinnan Basin with the northern highlands.

The Luoyang Basin is the most vital region for the formation of the kingship in the early China.

As the most important center in the early China, the Luoyang Basin enjoys advantages of the physical landscapes. The lower Yi-Luo River Plain is large enough to provide a large population with agricultural products. The Yi-Luo River flows northward into the Yellow River, creating an important waterway to enter the lowland plains or highlands. To the southeast and east of the Luoyang Basin is Mt. Song, which is the natural obstacle between the lowland plains and the Luoyang Basin. The rivers which originate from Mt. Song flow respectively into the lowlands and the Luoyang Basin, forming the natural passageways between them. Moreover, Mt. Song also provides raw materials, such as stone and timber, to the communities in the circum-Mt. Song regions during the Longshan and Erlitou periods (Zhang Hai 2007). To the west and the south, the eastern branches of the Qinling Mountain Range are the geographic obstacles with the Guanzhong Basin and the Nanyang Basin. Several rivers originate from the eastern Qinling Mountain Range, the most important of which are the Yi River and the Luo River. The two river valleys and the watershed in the Qinling Mountain Range were the main communication routes to the west and south of the Luoyang Basin in the early times.

The Qinling Mountain Range is a west-east mountain range stretching from the east part of the western highlands to the lowland regions. Geographically, it connects almost all the important cultural areas in this dissertation, the western highlands, the Guanzhong Basin, the Luoyang Basin, and the Middle Yangzi River Basin, by three main rivers roughly flowing from west to east: the upper Han River, the Dan River and the upper Luo River. The Han River connects the western highlands with the Middle Yangzi River directly. The Dan River is the longest tributary of the Han River, and it connects the upper Han River with the sources of the Luo River and the Ba River. To cross the watersheds with the Ba River and the Luo River, ancient travelers could follow the two rivers and arrive at the Guanzhong Basin and the Luoyang Basin respectively. The landscapes that the three rivers flow are mostly steep valleys. The lower Dan River and the east end of the upper Han River valleys are wider and more flat. Hence, archaeological sites are mostly located in the two regions. These rivers, especially the Dan River, Ba River and the Luo River, were important communication routes in early China. Through these river valleys, the key resources in the Middle Yangzi River and the Qinling Mountain Range were flowed into the highland regions and the Luoyang Basin. The east part of the Qinling Mountain Range, which is also called the Shangluo Corridor, will be the main focus in this dissertation.

Apart from the regions in the highlands above, the Middle Yangzi River in the lowlands is also important in this dissertation. The low altitude and the assembly of several large rivers not only resulted in the formation of many large lakes, but also frequent floods. The sedimentation of these rivers and lakes made the Middle Yangzi River Basin fertile and suitable for agriculture. The important grain, rice, was probably domesticated in this region (Hunan 2006). To the north of the Middle Yangzi River Basin, the Dabie Mountains are the main obstacles between the Middle Yangzi River Basin and the Huai River Basin. The lower Han River was probably the most efficient way to connect the Middle Yangzi River with the highland regions and the Luoyang Basin. The other important water is the Yun River, which connects the Middle Yangzi River with the southeastern border of the Nanyang Basin. This route is also called "Sui-Zao corridor", which is the Yun River valley between the Dabie Mountain and the Dahong Mountain. The archaeological findings in this region show that this route was probably important for ancient copper transportation (Chen Gongrou 1995). Some low mountains are located to the south of the Middle Yangzi River Basin. Some of these low mountains contain deposits of the largest amounts of copper and rare metals in China. To the west, the large mountains to the east of the Sichuan Basin are almost impassible obstacles, leaving only the Yangzi River as the main communication route.

2.2 Key resources

The constant flow of key resources was important for the state formation in early China (Liu and Chen 2003). Even though some resources could be extracted locally, such as timber, stone, and clay, some key resources, such as tin, copper, lead, turquoise, cinnabar, were located in the distant regions. In this section, I briefly introduce the spatial distribution of the crucial resources, including metals, turquoise, and cinnabar.

2.2.1 Metal

Three kinds of metal resources, copper, tin and lead are important for metallurgy during the Longshan and Erlitou period. Liu and Chen (2003: 37-44) list important copper mines in ancient and modern China. In these copper mines, four regions possess the largest quantities of China's copper deposits: the Middle and Lower Yangzi River, the Yunnan-Guizhou plateau, the Zhongtiao Mountains, and the western highlands to the Hexi corridor (Figure 2-2). The four regions contain two thirds of the total amount of the copper deposits in China. In these regions, the Middle Yangzi River contains the largest volume of copper deposits. Besides, the south Great Khingan-North Yanshan Mountain Range is also richly deposited with copper resource. In Liu and Chen's work (2003: 42), they point out that the most important areas of copper deposits for state formation in early China are two: the Zhongtiao Mountains and the Middle Yangzi River Basin. The copper mines in the Zhongtiao Mountains were the nearest source of copper for the early states in the Central Pains, and the Middle Yangzi River Basin contains the largest copper deposits in China. Some other regions were also probably exploited in early times, such as the eastern Qinling Mountain Range (Huo Youguang 1990, 1993; Henan et al. 2001), but they were probably small and easily exhausted (Huo Youguang 1990, 1993). In this dissertation, I will focus on the metallurgical productions in the Zhongtiao Mountains and the Middle Yangzi River valleys.

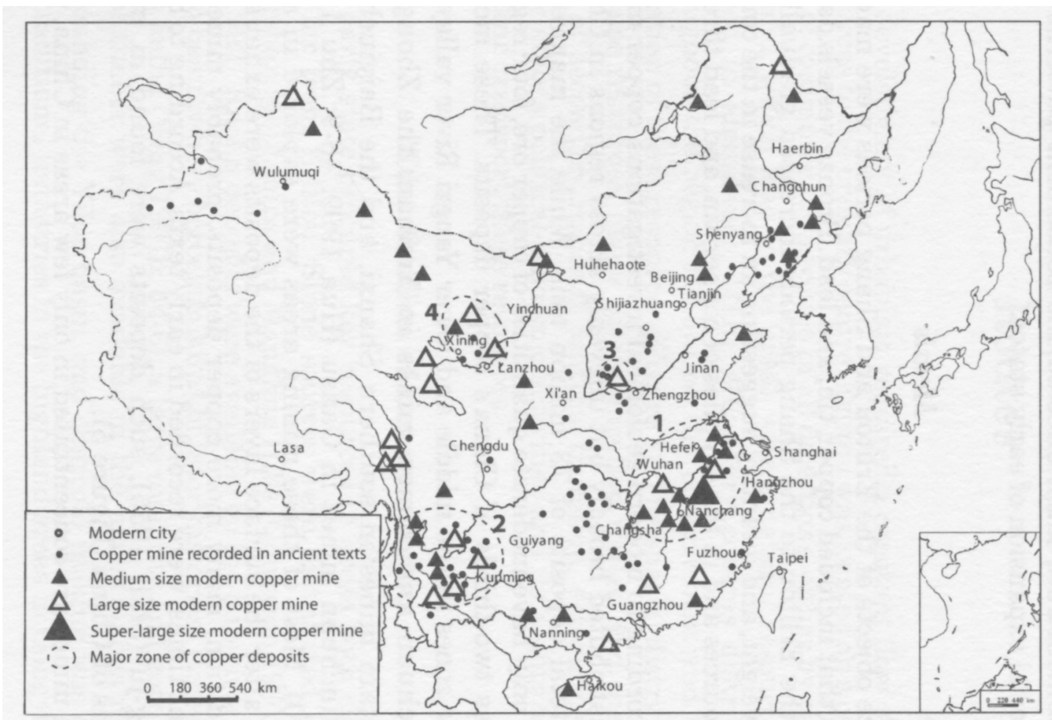

Figure 2-2 Distribution of copper deposits in China
(Liu and Chen 2003: 38, Figure 5)
1. Middle Yangzi River valleys 2. Yunnan-Guizhou Plateau 3. Zhongtiao Mountains 4. Western highlands-Hexi corridor

The distribution of tin deposit is quite uneven in China (Figure 2-3). Most of the tin resources were located in southern China, including Yunnan, Guangxi, Guangdong, Hunan, Jiangxi provinces. In eastern Inner Mongolia, the deposit of tin is also large. There are also some small tin mines in the Gansu, Sichuan, Qinghai provinces, but the amounts of them are too low. Although it was recorded that there were tin mines in the Luoyang Basin and the eastern Taihang

Mountain Range (Shi Zhangru 1955), these mines appear to be exhausted due to their small deposits. The distribution of lead resource is different from that of copper and tin (Figure 2-4). The distribution of lead is relatively even in China. Even though that more than half of the lead deposit are located in the southwest China, the south China, and the Inner Mongolia, there are still some deposits in the Luoyang Basin and its nearby regions.

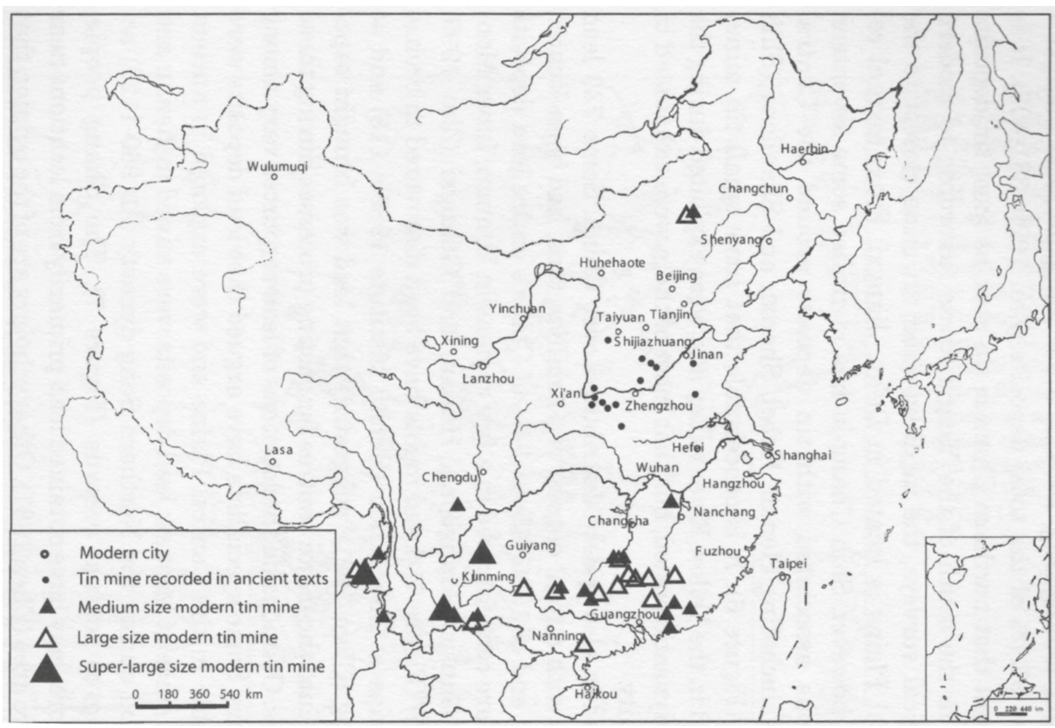

Figure 2-3 Distribution of tin deposit in China
(Liu and Chen 2003: 40, Figure 6)

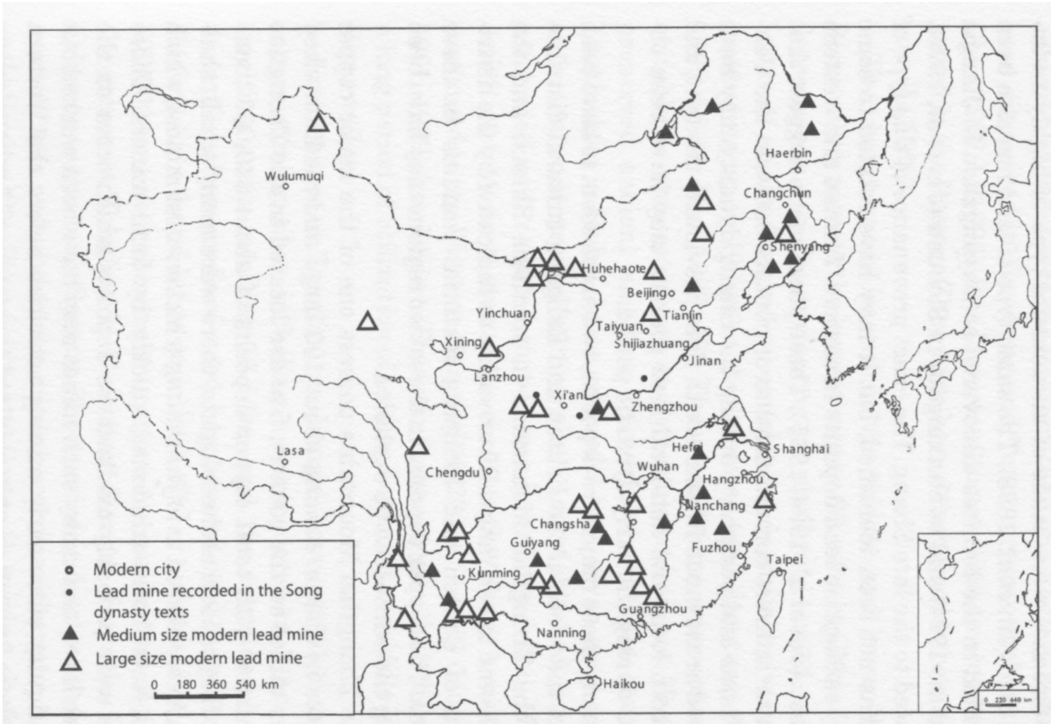

Figure 2-4 Distribution of lead deposits in China
(Liu and Chen 2003: 41, Figure 7)

2.2.2 Turquoise

Turquoise is a supergene mineral that normally occurs in fractures of rocks and is related to copper porphyry deposits (Pogue 1974). It generally forms from oxidation or weathering within an ore deposit (Hull 2012). Because of its color and preciousness, it has been used as a kind of gemstone for a long period in many regions of the world. In China, turquoise was used to make ornaments as early as 6000 BCE (Pang Xiaoxia 2014). From then on, turquoise was widely involved in the material cultures in many regions. The turquoise objects were widely distributed during the Neolithic Age, spanning from the upper Yellow River valley to the lower Yangzi River plain, and from North China to the Upper Yangzi River valley (ibid). Turquoise was also adopted in the Bronze Age in many regions, such as northeast China, the Luoyang Basin, and the western highlands (Fang Hui 2007; Gansu and Xibei 2009a, b; Zhongguo 2014: 337-338).

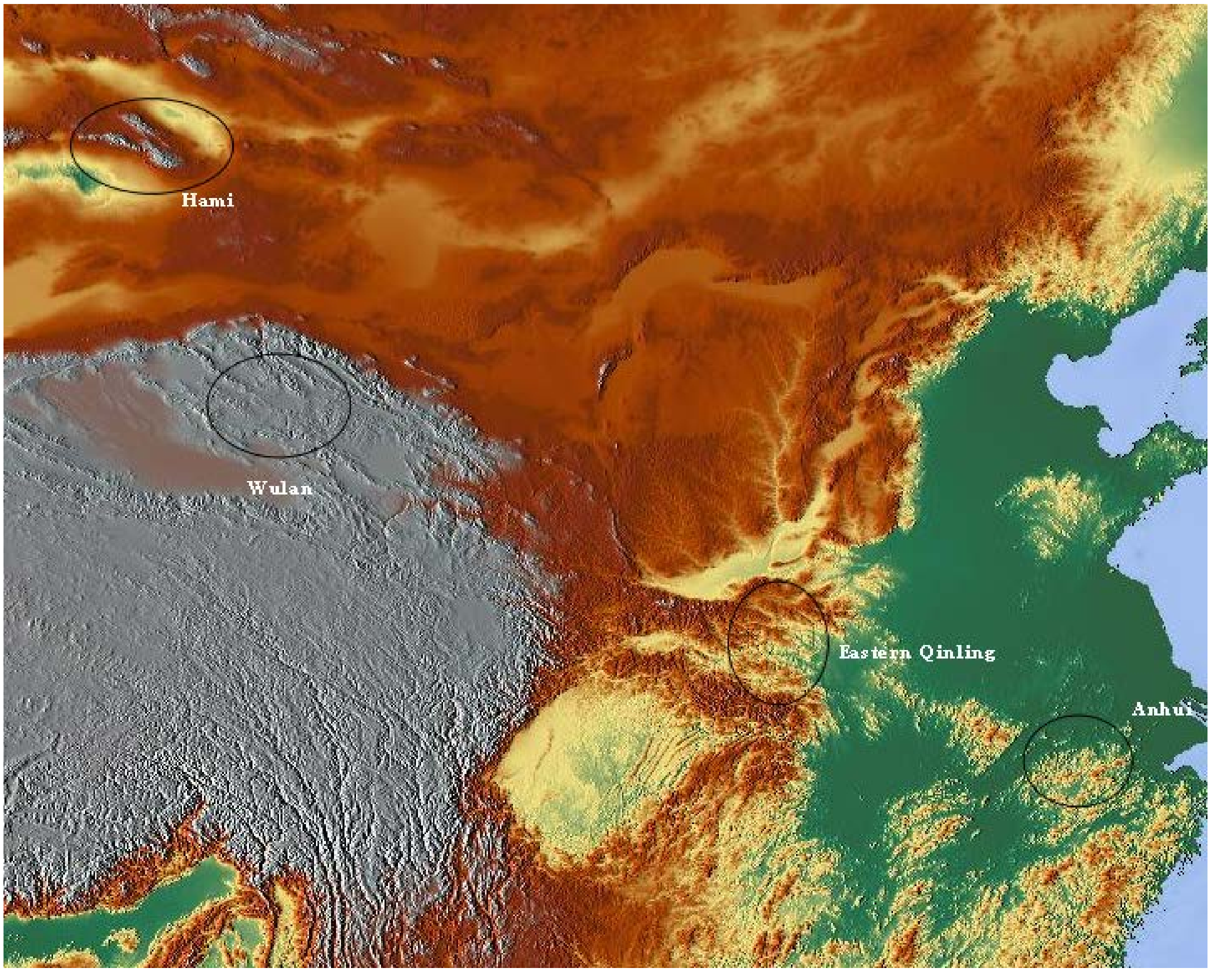

Figure 2-5 Distribution of main turquoise deposits in China
(based on Ye Xiaohong et al. 2014; Yue Deyin 1995)

The modern geological investigations show that turquoise mines are unevenly distributed in China. Most of turquoise mines are distributed in four regions: the eastern Qinling Mountain range, east of Anhui province, Wulan county of Qinghai province, and Hami city of Xinjiang (Ye Xiaohong et al. 2014). Generally, the formation mechanism of turquoise mines in Anhui province was different from the other three regions. Turquoise mines in Anhui province was mineralized in the process of volcanic eruptions in the Nanjing-Wuhu Basin (Hu and Zhang 2008; Yue Deyin 1995); rather, the turquoise mines of the other three regions were formed because of eluviation

(Tu Huaikui 1997).

The geoarchaeological investigations in above regions show that exploitation of turquoise resources in eastern Qinling Mountain range and in Hami city started very early and was continuously exploited through history. For example, the recent investigation in Luonan County indicates that mining of turquoise in the eastern Qinling Mountain Range started from 2000 BCE (Xian Yiheng et al. 2016a; Xian Yiheng 2016; Beijing and Shaanxi 2016). Considering the scarcity of data left in workings, the date of exploitation in Luonan County was probably much earlier. In Hami city, the investigations at the Heishanling turquoise mine during late 1990s show that the Hami turquoise deposit was probably exploited in prehistory (Luan Bing’ao 2001). In the Yuan Dynasty, the textual record by Tao Zongyi attests that the eastern Qinling Mountain Range, the Hexi corridor, and Iran were the main turquoise sources during the Mongolian period (Chen Chunxiao 2015).

2.2.3 Cinnabar

Cinnabar was an important resource in the political economy during the early China. It had been involved in mortuary practice since the Middle Yangshao period, and was probably institutionalized as a status indicator of elites during the Longshan, Erlitou and Erligang periods (Fang Hui 2015). In many sites during the Longshan and Erlitou periods, such as Taosi and Erlitou, it has been discovered that a great deal of cinnabar was laid as a layer under corpses in many high-status tombs. Here I briefly introduce the spatial distribution of cinnabar mines in China.

The spatial distribution of cinnabar was basically the same with that of mercury. The chemical component of cinnabar is mercuric sulfide (HgS), which is the basic material to extract pure mercury. Although mercury occurs in two forms: cinnabar and native mercury, the formation of native mercury is normally difficult. Most of mercury has to be extracted from cinnabar (Zhao Kuanghua 1984). Although the geological texts normally record the distribution of mercury, nearly all of locations recorded in texts are cinnabar mines.

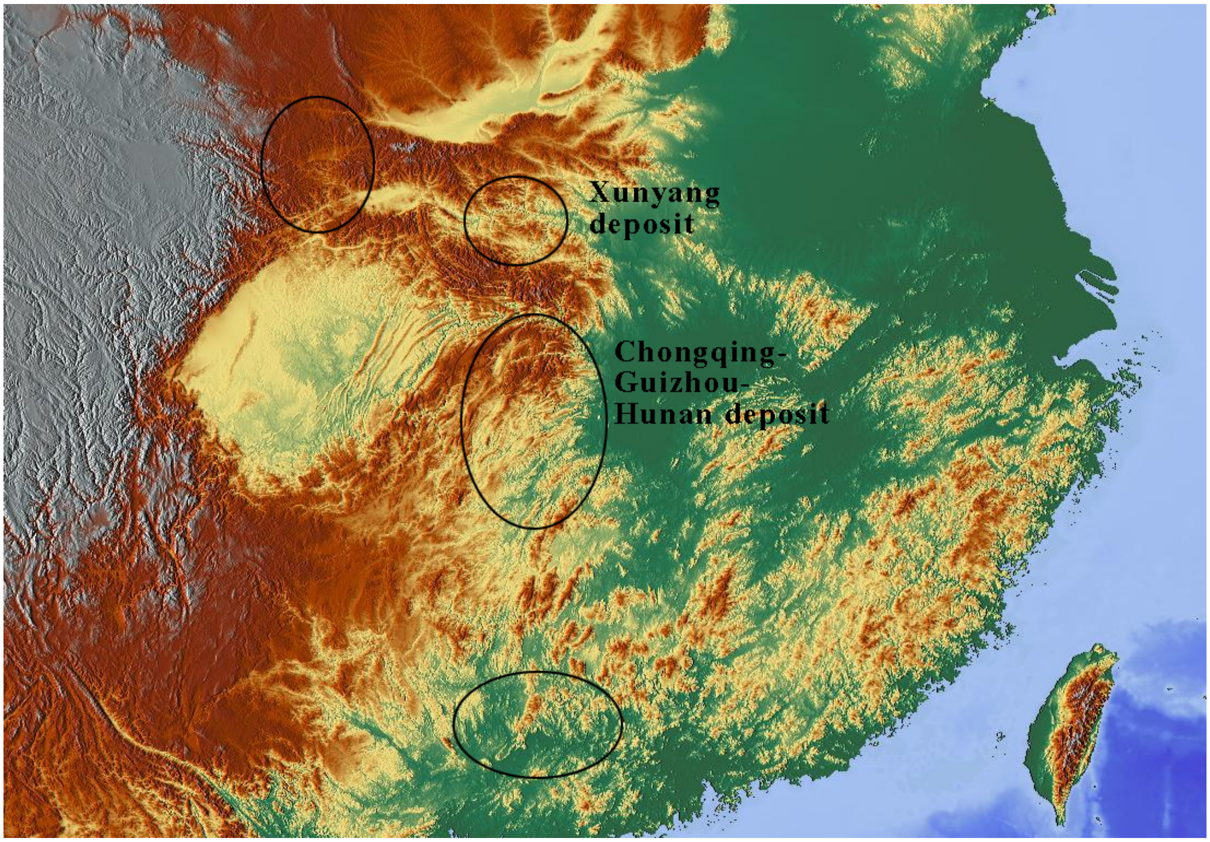

Figure 2-6 Distribution of main cinnabar deposits in China
(based on Xia Xiangrong et al. 1980: 312-317)

Basically, cinnabar mines are also distributed unevenly in China. Most of cinnabar mines are distributed in southwest China and northwest China, and some are distributed in Central China. Southwest China occupies more than half of the total cinnabar deposit in China, especially

Guizhou province. The cinnabar mines in the Wanshan Special Zone in eastern Guizhou province contain the largest deposit in China (Li Yingfu et al. 2014). Eastern Sichuan province and Chongqing city also possess considerable amounts of cinnabar. To the east of Guizhou and Sichuan mines, another important cinnabar deposit in southwest China is in the west of Hunan province. The cinnabar mined from Yuanling County was famous not only for its large quantity, but also for its best quality (Fang Hui 2015). Moreover, northwest China is also a region with rich deposit of cinnabar. In the cinnabar mines of northwest China, Xunyang County in the southeast of Shaanxi province was the most important region (Xia Xiangrong et al. 1980: 314).

Geoarchaeological study on cinnabar mining during early China has not been widely conducted. However, ancient texts record a good deal of information about cinnabar mines in the ancient time. Based on study of ancient texts, Xia Xiangrong et al. (1980: 312-317) listed the important locations of cinnabar mines which were exploited in history, including the Fulin district of Chongqing city, Yuanling city of Hunan province, Hechi city of Guangxi province, Xunyang and Fengxian counties of Shaanxi province, Wudu county of Gansu province, and Guizhou province (Figure 2-6). Most of these important cinnabar mines are located in mountainous areas from southeast of Chongqing to Guangxi province. Considering the distance from the regions with tradition of using cinnabar during the Longshan and Erlitou periods, three districts are possibly important: Xunyang deposit, Chongqing-Guizhou-Hunan deposit, and Fengxian-Wudu deposit.

2.3 Summary

This chapter briefly introduces the landscapes which were important in this dissertation. The imbalance between the uneven spatial distribution of key natural resources and the demands for them was an important encouraging factor for the formation of exchange network during the Longshan and Erlitou periods. Through river valleys, key resources, such as copper, turquoise, cinnabar and maybe timber, were transported into the major centers during the Longshan and Erlitou periods. In the process of mining and transportation, not only objects were transported, but various types of knowledge, religious beliefs, aesthetics, were also exchanged. In the next chapter, I will introduce major centers in the highland and Luoyang Basin, setting the stage for my further studies.

3 Setting the stage: the transition to Chinese Bronze Age

The emergence of Erlitou marked the advent of Chinese Bronze Age. It is an important period for the state formation of China. Moreover, the rise of Erlitou established the Central Plains-based political tradition (Li 2018: 175). What happened during the Longshan and Erlitou periods? How to understand the establishment of Central Plains-based political tradition? This dissertation describes the social transformation from the Longshan to the Erlitou period. The focus will be laid on the urban centers in the two periods, trying to lay the foundation for further discussions on peripheral regions below (Figure 3-1).

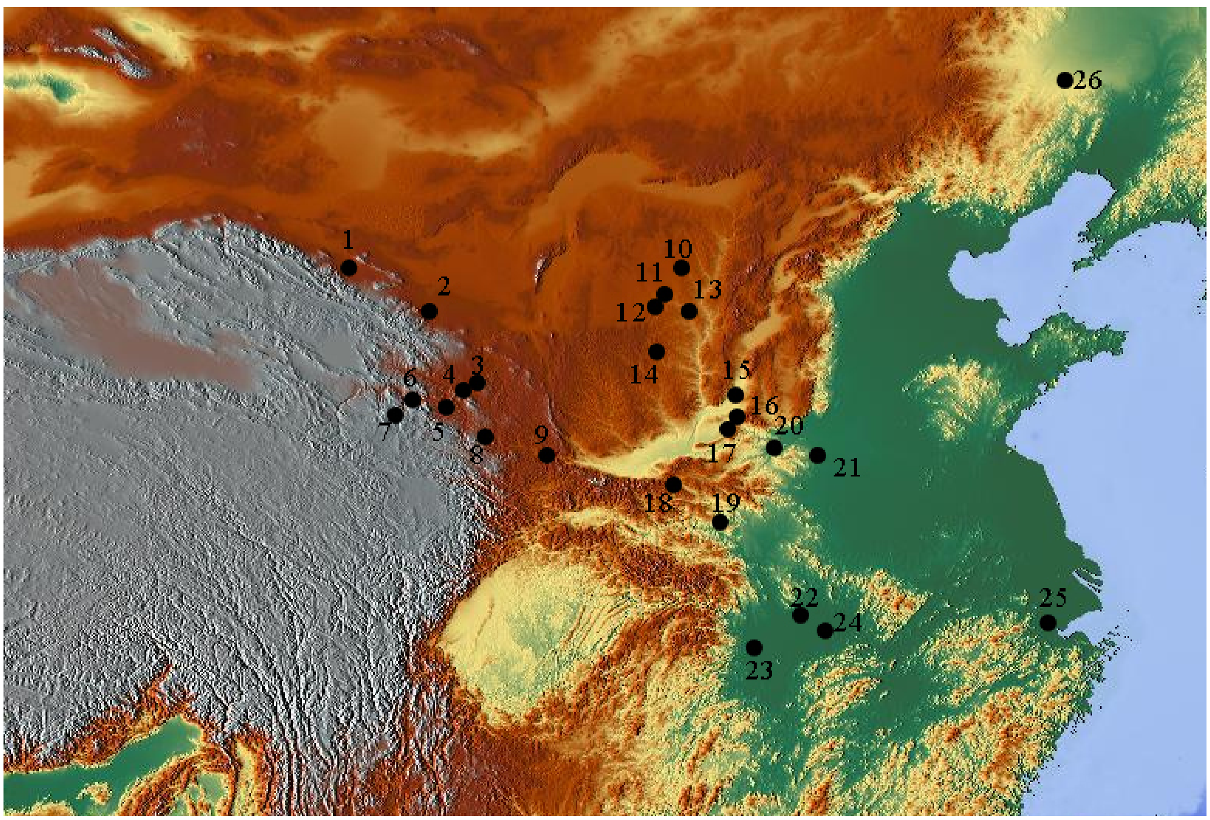

Figure 3-1 Major archaeological sites mentioned in this chapter
1. Xichengyi 2. Huangniangniangtai 3. Dahezhuang 4. Qinweijia 5. Xinzhuangping 6. Gamatai 7. Zongri 8. Mogou 9. Shizhaocun 10. Zhukaigou 11. Xinhua 12. Shengedaliang 13. Shimao 14. Lushanmao 15. Taosi 16. Zhoujiazhuang 17. Dongxiafeng 18. Donglongshan 19. Xiawanggang 20. Erlitou 21. Xinzhai 22. Shijiahe 23. Jingnansi 24. Panlongcheng 25. Liangzhu 26. Dadianzi

3.1 The Longshan period: rise of highland Longshan centers

During the Longshan period, the Chinese Neolithic societies underwent radical changes. On the one hand, the major centers in the Yangzi River Basin, Liangzhu and Shijiahe, collapsed; on the other hand, the highland regions and the Shandong peninsula became new political arenas (Zhang Chi 2017a; Li Min 2017). The rise of the highland centers marks the change of political landscape in the start of the Longshan period. New technology, metallurgy, and new species, such as sheep, goat, and wheat, were introduced into these regions, and largely changed the lifestyles of local communities in fringe areas of the Loess Plateau. In this section, I will briefly introduce the material culture of the highland communities during the Longshan period.

3.1.1 Against the backdrop of climate change

With the end of the Holocene Optimum, around 2500BC, continental East Asia entered into a period of decrease of temperature and moisture, due to the retreat of East Asian monsoon and the change of the earth orbit (Rosen 2008; Wu and Liu 2004). The climate change during the late third millennium BC was recorded in many types of paleoclimatic archives. In the Tibetan Plateau, the $\delta^{18}O$ testing of the Dunde ice core suggests an obvious temperature decrease that occurred from 4500 BP (Yao and Thompson 1992). In the nearby Qinghai Lake region, the multi-proxy analysis of the sediment core from the Qinghai Lake, including pollen, carbonate, TOC, TN and $\delta^{13}C$ of organic matter, shows that the warm and wet period came to its end at about 4500 BP (Shen et al. 2005). In Central-southern Inner Mongolia, the studies of the grain-size distribution of core sediments at Daihai Lake has shown a decreasing trend with fluctuating precipitation from 4400 BP to 3100 BP (Peng et al. 2005). In the western highlands, the multi-proxy analysis of the core from Lake Yiema in Gansu Province also attests that the desiccation processes started at 4200 BP (Chen et al. 1999). In southern China, the $\delta^{18}O$ analysis of stalagmite in the Dongge Cave in Guizhou province also suggests that the period of 4400-3900 BP saw an abrupt lowering of the intensity of Asian monsoon, which possibly was responsible for the sharp hydrological change in East Asia (Wang et al. 2005).

Concurrent with the climate change in the late third millennium BC, floods frequently occurred in many regions during this period. For example, the set of slackwater deposits in the Qishui River valley in the Guanzhong Basin show that the extraordinary floods occurred during 4.2-4ka BP, resulting in the abandonment of the preceding settlement and the construction of the Longshan-period settlements in higher elevations in this region (Huang et al. 2010; Huang Chunchang et al. 2011; Zha Xiaochun et al. 2007). Several other examples were also identified elsewhere in the Guanzhong Basin, attesting to the extraordinary floods during 4.2-4.0ka BP (Li Yuqin et al. 2009; Li Xiaogang et al. 2009). In the western highlands, the devastating floods not only forced the Qijia people to move from the secondary to the tertiary terrace of the Yellow River (Yang Xiaoyan et al. 2004), but also inundated and destroyed the Lajia settlement of the Qijia culture (Xia Zhengkai et al. 2003). In the Qinling Mountain Range, several locations also yield the evidence of flood events about 4.2ka BP (Liu Tao et al. 2013).

The climate change during the Longshan period resulted in the change of vegetation, especially in the fringe areas of the loess Plateau. The terrace sections at Sujiawan and Dadiwan sites in the eastern part of Gansu province yield clear evidence that the herbaceous pollen reached 80% of the total amount of pollen, and the content of organic matter and the finer grain sizes in the geomorphologic samples decreased rapidly, suggesting that the forest-steppe vegetation was largely transformed to steppe (An et al. 2004, 2005). In the western highlands, the pollen data from the Qinghai Lake also attests to the change of vegetation from forest steppe to steppe after 4500 BP.

3.1.2 Social transformation in the fringe areas of the Loess Plateau

With climate change during the late third millennium BC, the fringe areas of the Loess Plateau, namely the western and northern highlands, underwent social transformation during the Longshan period. The subsistence economy abruptly changed in fringe areas of the Loess Plateau. Before the Longshan period, the subsistence economy was dominated by dryland agriculture represented by foxtail millet and broomcorn millet (Jiang Yuchao 2017). The source of meat depended on hunting and animal husbandry that was represented by pig feeding. Zooarchaeological work attests that the meat resources of the northern and western highland communities were dominated by wild animals, whereas domesticated animals, such as pigs and dogs, only constituted a small proportion of the faunal remains before the Longshan period (Hu and Sun 2005; Hu Songmei et al. 2012, 2013, Yu Chong et al. 2011). With the climate change during the Longshan period, the subsistence economy in the two regions changed rapidly. Even though the agricultural system was still dominated by foxtail millet and broomcorn millet, new animal species, sheep, goat and cattle, dominated the meat resources (Zhang Chen 2013; Yang Ying 2014; Ye Maolin 2015; Li Liang 2012: 39; Jiang Yuchao 2017; Hu Songmei et al. 2016; Hu Songmei et al. 2008; Xue Xiangxu et al. 2005). The wide adoption of these herbivorous animals in the western and northern highlands transformed the local agriculturalists to agro-pastoralists (Zhang Chi 2017b).

Second, with the rapid decline of turquoise use in the lowland regions, the fringe areas of the Loess Plateau saw the rise of turquoise production during the Longshan period, especially in the western highlands (Pang Xiaoxia 2014). Turquoise was popular in the Qijia communities, as evidenced by the significantly increased number of turquoise objects, expanded spatial distribution of turquoise use, and the increased number of sites during the Longshan period (Figure 3-2). Compared to the turquoise tradition in the lowland regions, the turquoise use in the western highlands had its own characteristics. One the one hand, most of the turquoise ornaments were made to the tubular beads, of which the lengths were normally longer than the diameters. This is different from the lowland turquoise tradition before the Longshan period, which was characterized by pendants drilled for wearing (ibid, Qin 2016). On the other hand, inlay technology was widely adopted in the highland regions, including the western highlands and the Jinnan Basin. The tesserae were usually inlaid with some black adhesives on the back board, probably different from those discovered at the Shandong peninsula, where turquoise tesserae were normally fixed with filaments during the Longshan period (Qin 2016).

Figure 3-2 Turquoise objects excavated from Qijia communities
(based on Qinghai and Beijing 2016, color plate 10 and 11; Shi Youyong 2015, Figure 2).
1-3. Turquoise beads excavated from Gamatai 4. Turquoise tesserae from Guanghe County in Gansu province

Third, metallurgy started to prosper in the western and northern highlands during the Longshan period (Figure 3-3). Many archaeologists have demonstrated that metallurgy in the fringe areas of the Loess Plateau was introduced from Central Asia during the Longshan period (eg. Fitzgerald-Huber 1995; Li Shuicheng 2005). The data from the northern highlands have not been fully published, but those from the western highlands show that use of metal objects was widespread during the Longshan period. Until now, metal objects have been excavated in more than 10 sites in the western highlands, such as Huangniangniangtai, Qinweijia, Dahezhuang and Gamatai (Gansu 1978; Zhongguo 1974; Zhongguo 1975; Qinghai and Beijing 2016). Different from the Bronze Age communities in the heartland of China, where bronze vessels were closely related to religious practices and the ranking system (Chang 1983), the metal objects in the western highlands were not closely correlated with the social status of their users (Wang Hui 2012). The metals discovered in the western highlands include implements, weapons, ornaments and others, which were mostly used practically. Only the large spearhead discovered in the Shenna site in Qinghai province was probably used in a ritual context (Gao Jiangtao 2015).

Figure 3-3 Some metal objects excavated from Qijia communities
(Based on based on Qinghai and Beijing 2016, color plate 9; Lin Meicun 2015: 58, Figure 11)
1. Mirror from Gamatai 2. Buttons from Gamatai 3. Spearhead from Shenna 4. Axe from Shenna

Scientific testing on the Longshan-period metal objects suggests that the metallurgical technology in the western highlands was diversified, as shown by the alloying and shaping techniques. As to the alloying techniques, the metal objects excavated at Huangniangniangtai and Dahezhuang were mostly made of copper, while those excavated at Xinzhuangping and

Qinweijia include lead-tin bronze, tin bronze, and copper (Beijing gangtie 1981; Sun and Han 1997). Arsenic alloy was identified at the Zongri site (Xu Jianwei 2010). The scientific testing on the metals from Mogou and Gamatai also attests to the diversity of alloying techniques, including copper, lead bronze, tin bronze, copper and arsenic alloy (Xu Jianwei 2009; Xu Jianwei et al. 2016; Luo Wugan et al. 2016). On the other hand, the studies also show that forging and casting, as the two main shaping techniques, were both adopted in the Qijia communities during the Longshan period (Beijing 1981; Sun and Han 1997; Xu Jianwei 2010; Xu Jianwei et al. 2016; Xu Jianwei 2009: 58). The co-existence of diverse technologies shows that the western highlands did not undergo a slow developmental process like West Asia (Lin Meicun 2015); rather, several technologies were introduced and adopted more or less simultaneously into the western highlands during the Longshan period.

Even though a large amount of metal objects has been excavated in the western highlands, smelting and casting remains were absent during the Longshan period. In the Hexi corridor, however, a large amount of smelting remains was discovered at the Xichengyi site in Zhangye city. In addition, copper mines and many smelting sites were also discovered in the upper Hei River basin, where the Xichengyi site is located (Li Yanxiang et al. 2015; Gansu et al. 2014, 2015). The finds from Xichengyi suggest that the Upper Hei River valley was possibly a metallurgical center during the Longshan period. This metallurgical center not only produced copper objects, but also arsenic alloy and tin bronze. The diversity of technology indicates that the local artisans had probably mastered the knowledge of metal ores, so that they could use different techniques in metalworking (ibid).

In the ritual system, lastly, more elements of the Inner Asia origins were involved in the construction of religious beliefs in the fringe areas of the Loess Plateau. In the northern highlands, the ritual configuration represented by stone-wall enclosures and stone sculptures indicates the connection with Central Asia and North Asia (Figure 3-4; Li Min 2017). In the western highlands, the cobble-enclosed features close to the cemeteries excavated at Qinweijia, Dahezhuang, and Shizhaocun were similar to those discovered in contemporaneous Xinjiang and Central Asia (Xinjiang 2013, 2014). Moreover, the discovery of maceheads, a metal spearhead, and turquoise-inlaid metal plaques also reflect possible linkages to Central Asia in the religious sphere (Li Shuicheng 2004; Gao Jiangto 2015; Chen Xiaosan 2013).

Figure 3-4 Wall of the palatial platform at Shimao in Shaanxi Province
(Shaanxi et al. 2017: 53, Figure 15)

On the other hand, the religious contributions from the lowland regions should not be underestimated, as reflected by the large quantities of jade objects. In the northern highland, jade objects were widespread in many Longshan communities, such as Shimao (Figure 3-5; Dai

Yingxin 1977), Lushanmao (Ji Naijun 1984), and Xinhua (Shaanxi and Yulin 2005). In the western highlands, jade objects were discovered, by survey or excavation, in more than 50 sites in the Qijia communities (Wang Yumei 2012: 6). The jade assemblage in the northern and western highlands could be divided into categories, including ritual objects, ornaments, implements and others. Some ornaments were probably used in ritual activities as accessories of costumes. Jade ritual objects include *Zhang* scepters, *cong* cylinders, *bi* disks, *huang* pendants, multi-*huang* disks, loops, multi-perforated choppers, spades, *yue* axes, notched *bi* disks, and others. With the collapse of Liangzhu, the centers of jade use shifted to the highland regions during the Longshan period.

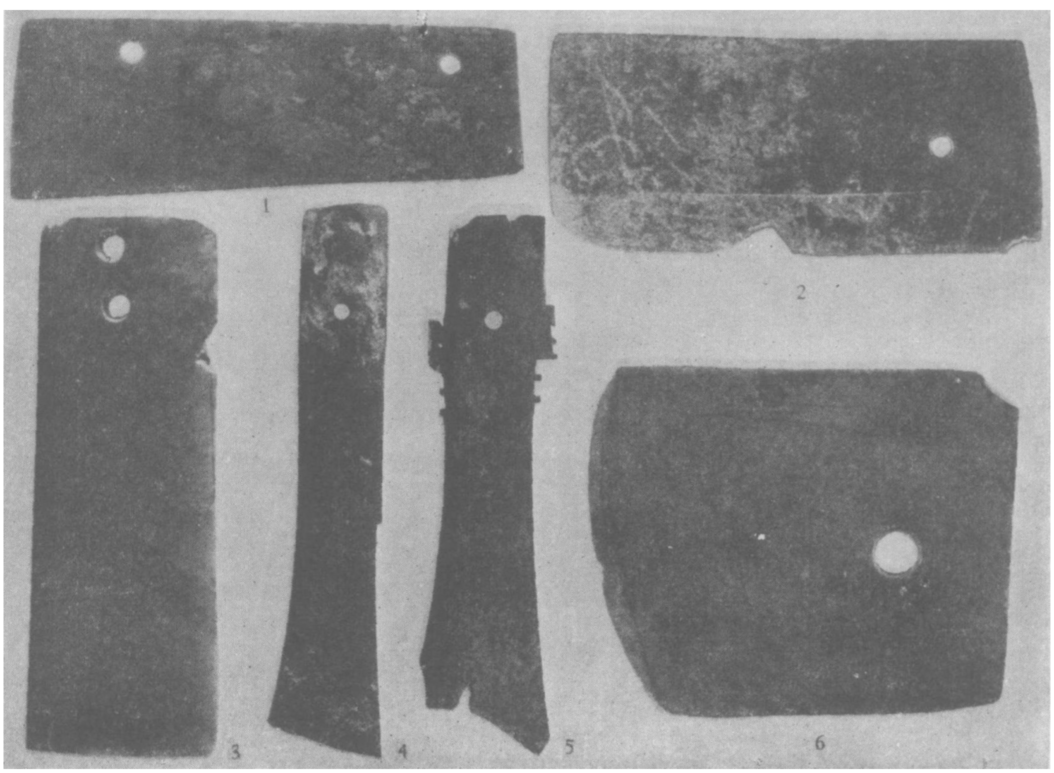

Figure 3-5 Jade objects from Shimao
(Dai Yingxin 1977, Plate 4)
1-2. Choppers 3, 6. *Yue* axe 4-5. Scepters

3.1.3 Increased mobility

The fringe areas of the Loess Plateau underwent social transformation during the Longshan period. Several factors of the social transformation probably resulted in the increased mobility of the Longshan communities in the western and northern highlands. As a departure, first, the dominance of pastoral economy largely changed the lifestyles of the northern and highland communities. In order to procure more fodder for herbivorous animals, the mobility of the local communities increased to a large extent. Examples that the adoption of herbivorous animals increased mobility of local communities could be discovered in many regions of the world (eg. Cribb 1991). The subsistence economy of the western and northern highlands, during the Longshan period, was similar to that in the Central Asian regions (Zhang Chi 2017b), and it probably facilitated the increase of mobility of local communities during the Longshan period. Second, the development of craft production, especially adoption of metallurgy and large-scale use of turquoise and jade, probably also increased the mobility of local communities. The natural resources which were critical for craft production, like turquoise, were not available locally, but had to be transported from distant regions, as introduced in chapter 2. The uneven distribution of resources and the high demands for them encouraged the prospecting for these resources, probably spurring the mobility of the local communities in the western and northern highlands (Li Min 2017). Even though probably not obvious, third, the involvement of many elements of Central Asian-origin in the local religious sphere also probably changed the attitudes of the local communities towards mobility. Contemporaneous Central Asian societies were highly mobile cultural groups (eg. Frachetti 2008), and the external impacts on the religious beliefs were probably another source of the increased mobility of local societies in the fringe areas of the Loess Plateau.

Increased mobility was probably the reason for the cultural expansion of the societies from the western and northern highlands (Li Min 2017). The cultural expansion of the western highland communities was clearly reflected by the distribution of the double-loop beakers, triple-loop beakers, double-ring jars, and large bronze spearheads, which were typical traits of the Qijia material culture. Following main river valleys connecting the western highland to the east, northeast, and southeast, material culture of Qijia characteristics spread to nearly the entire highland regions. In the northern highlands, the Qijia-style double-loop beakers were discovered at several sites, such as Zhukaigou, Shimao, Xinhua, Shengadaliang (Neimenggu and E'erduosi 2000; Dai Yingxin 1977; Shaanxi and Yulin 2005; Shaanxi et al. 2016). Following the Wei River, Qijia-style pottery vessels were not only widespread in the Guanzhong Basin, but also arrived in the Luoyang, Jinnan and Jinzhong basins (Luoyang 1980; Zhongguo and Shanxi 2015; Jilin et al. 2004; Guojia et al. 1999), and even eastern piedmont of the Taihang mountain range (Hebei 1975). To the southeast from the Guanzhong Basin, Qijia-style pottery vessels were also distributed to sites along the Shangluo Corridor, such as Donglongshan and Xiawanggang (Shaanxi and Shangluo 2011; Henan and Changjiang 1989).

Similar to that of the western highland communities, cultural expansion of the northern highland societies during the Longshan period also left evidence spanning from the Liaodong and the Shandong peninsulas to the western highlands and the Middle Yangzi river. The most obvious evidence is the distribution of jade scepters (Figure 3-6, Deng Cong et al. 2014), which have been discovered in four sites in the Shandong peninsula (Li Xueqin 1994; Deng Cong et al. 2014), the Middle Yangzi River basin (Jingzhou 1999), the Luoyang Basin (Zhengzhou and

Beijing 2005), the western highlands (Wang Yumei 2012: 16), the Shangluo Corridor (Shaanxi and Shangluo 2011; Henan and Changjiang 1989). Besides jade scepters, pottery vessels with the northern highland styles were also discovered in the Jinnan Basin and the Luoyang Basin (Zhongguo and Shanxi 2015; Zhengzhou and Beijing 2005: Beijing 2002).

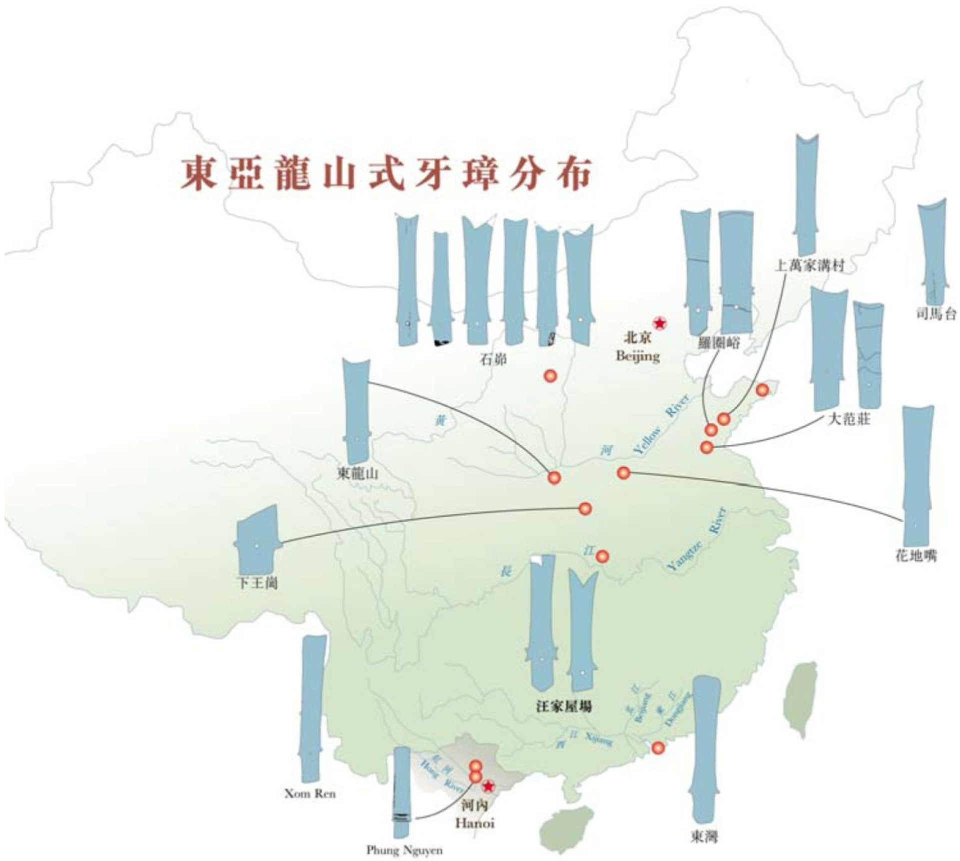

Figure 3-6 Distribution of Longshan-style jade scepters in East Asia
(Deng Cong et al. 2014: 60, Figure 6)

Increased mobility of the societies in the northern and western highlands laid the foundation for the rise of the Luoyang Basin during the first half of the second millennium BC (Li Min 2017). With the collapse of the centers in the Jinnan and Shandong regions, the Luoyang Basin rose as the political center in the heartland of China. Its metallurgical industry was by no means the result of the local technological innovation, but introduced from the western and northern highlands in the transition from the Longshan to the Erlitou period (Fitzgerald-Huber 1995; Li Shuicheng 2005). The introduction of metallurgy from Central Asia to the fringe areas of the Loess Plateau was not only about techniques of metalworking, but also a new type of knowledge involving understandings of techniques, landscape, and resource distribution (Miller 2007). During prospecting and procurement of resource related to metallurgy, knowledge of metallurgy was transmitted into the Luoyang Basin (Li Min 2017, 2018). In this process, the increased mobility of societies in the fringe areas of the Loess Plateau played an important role.

3.1.4 Rise of the Jinnan Basin: Taosi

The rise of the Jinnan Basin was another important process during the Longshan period. During the Longshan period, the Jinnan Basin prospered and underwent rapid population growth, as evidenced by the surface surveys in the Yuanqu and Yuncheng Basin (Zhongguo 2007; Zhongguo et al. 2011). Besides, current materials also show aggregation of population during the Longshan period, as evidenced by emergence of many mega-sites, such as Taosi (Liang and Yan 2002), Fangcheng-Nanshi (Shanxi 1996), Dongyangcheng (Houma 1992), and Zhoujiazhuang (Zhongguo et al. 2015).

Measuring 280 hectare in size, Taosi stood out as the most outstanding settlement in the Jinnan Basin during the Longshan period. If to consider the settlement area beyond the wall enclosure, the whole area of the Taosi site complex could reach as high as 400 hectare (Liang and Yan 2002). The partitioning based on the specialized function at Taosi could be observed, including the storage district, cemetery, sacrificial district, and craft production area (Gao Jiangtao 2007).

The palatial district has been identified in the northeast of this wall-enclosed settlement (ibid). In the palatial district, several large-scale architectural foundations have been discovered (Zhongguo et al. 2008). To the southeast of the enclosure, a rammed-earth foundation was also excavated. Based on the relationship between the solar movement and cylinders of this foundation, excavators hypothesize that this architecture was probably constructed with the goal of serving as an observatory (Zhongguo et al. 2004).

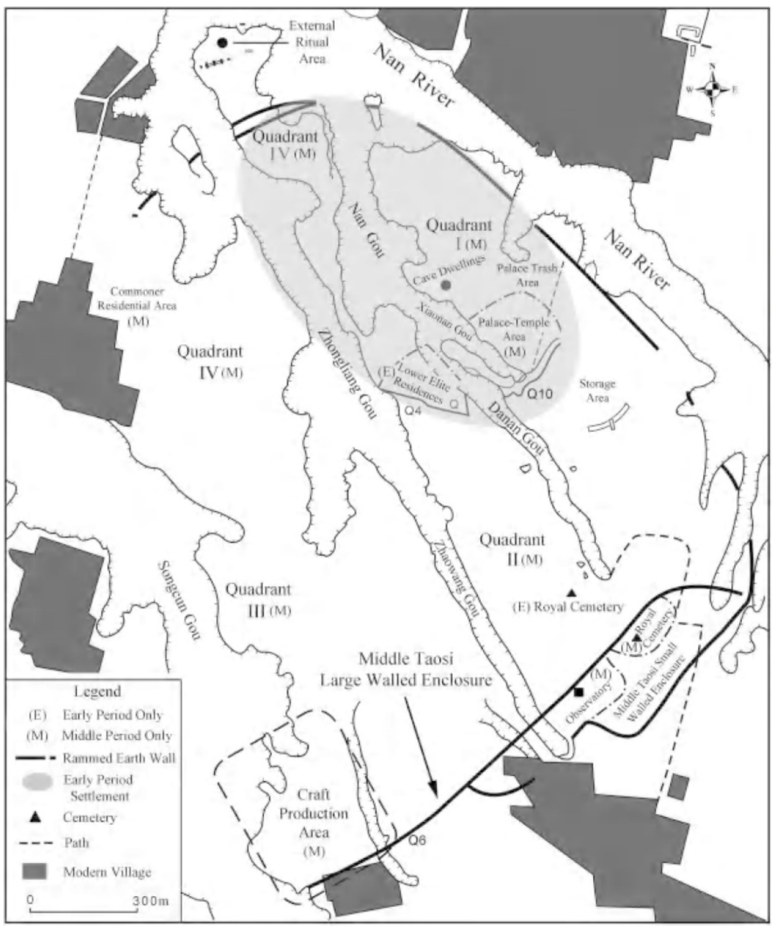

Figure 3-7 The layout of the Taosi site
(He 2013: 262, Figure 13.2)

The discovery of a large-scale cemetery also attests to the outstanding status of Taosi during the

Longshan period. Based on grave goods and tomb sizes, excavators divided tombs into six tiers, which mark the social and economic differentiation at Taosi. The large-size tombs, which are often considered as high-elite tombs, only occupied the smallest amount of the total numbers of tombs (Zhongguo et al. 2015). The occupants of these large-size tombs were usually interred with a large quantity of goods, such as sacrificial animals, culinary assemblage, and musical instruments (ibid). The relatedness among scales of tombs, the quantities, types and positions of grave goods suggests that the interment of grave goods probably followed several rules based on number, texture, delicacy, and fixed positions (Gao Wei 1989). It further suggests that the mortuary practice of Taosi, at least for the high-status tombs, was probably institutionalized during the Longshan period (ibid).

Similar to the fringe areas of the Loess Plateau, jade and turquoise were also widely used in the Taosi society. The jade objects at Taosi could be divided into three categories: ritual objects, weapons, and ornaments. Most of the styles of jade objects at Taosi resemble those discovered in the western and northern highlands, and the Shandong peninsula, such as *yue* axes, *cong* cylinders, *bi* disks, double-perforated choppers, spades, chisels, *huang* pendants, *huan* disks, and others, showing the scope of interaction network represented by jade. The jade human face in tomb IIM22 shows the interaction with the Middle Yangzi River basin during the Longshan period (Zhonguo et al. 2003). Turquoise was another important type of object in the lapidary inventory at Taosi. Except for a small number of perforated pieces that were used as pendants, which were probably a local or lowland tradition, the dominant use of turquoise was to cut turquoise into tesserae and inlay them on headdresses or wrist bands with some black adhesive (Zhongguo and Shanxi 2015), resembling the styles and technology of the western highlands.

More than that, a few amounts of beads at Taosi also attest to the shared repertoire of turquoise making with other Longshan centers.

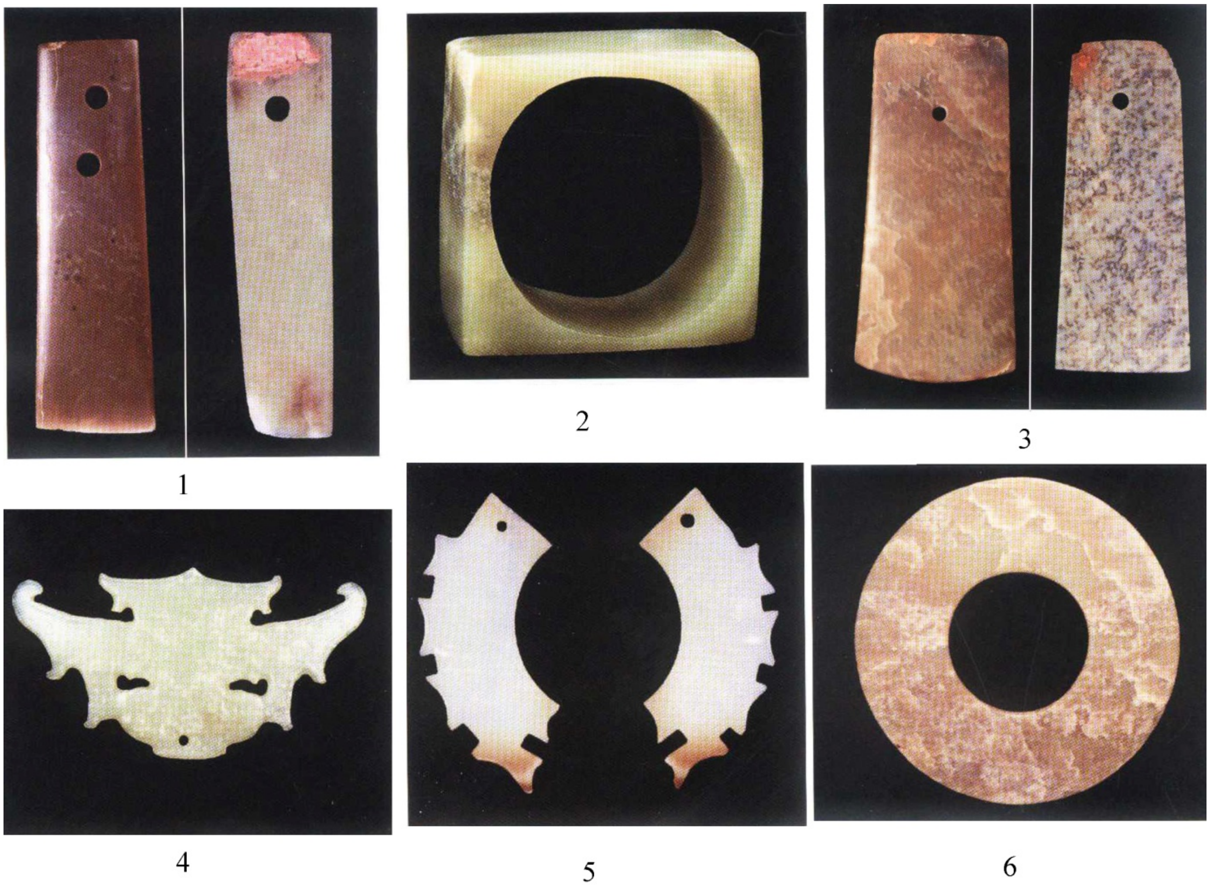

Figure 3-8 Jade objects from IIM22
(adapted from Zhongguo 2003: 5-6, Figure 3-8)
1. Spades 2. *Cong* cylinder 3. *Yue* axes 4. Anthropomorphic head 5. *Huang* pendants 6. *Bi* disk

Different from other Longshan centers, Taosi started a tradition of large-scale cinnabar use in mortuary practice. Even though cinnabar was also laid in tombs before the Longshan period, the frequency was still low (Fang Hui 2015). It was Taosi that cinnabar was widely used in mortuary practice and became an institutionalized mortuary practice in the Jinnan Basin during the Longshan period, and this tradition was inherited by the Erlitou and Erligang societies after collapse of the Taosi society (ibid). Cinnabar was usually laid as a layer under coffins or corpses, or used as a pigment on the surface of some grave goods. In the tomb M2001, which is considered as one of highest elites' tomb, cinnabar could be observed everywhere, especially those to the right of the corpse (color plate 11, Zhongguo et al. 2015). Cinnabar was so largely used that it infiltrated into human bones and dyed them red (ibid: 458). On the other hand, cinnabar was also widely painted on the surface of grave goods, such as pottery and wood vessels, which were normally laid in the elite tombs (Li Minsheng et al. 1994; Li Naisheng et al. 2008).

Figure 3-9 Photo of Tomb M2001
(Zhongguo and Shanxi 2015, color plate 11)

Increased mobility of societies in the fringe areas of the Loess Plateau probably brought metallurgy into the Jinnan Basin during the Longshan period. During the Middle to Late Taosi phase, about 2100-1900 BC, four metal objects have been discovered, including a copper bell, an arsenic cogwheel, a copper loop, and a possible arsenic fragment (Gao and He 2014). The cogwheel and the bell connects the Jinnan Basin with the northern highlands, as evidenced by recently discovered similar metals at the Shimao site, while the existence of the ceramic double-handle beakers shows that the Qijia communities were also probably responsible for the introduction of metallurgy into the Jinnan Basin. However, metal objects during this period are still few, so it is not clear how developed metallurgical technology was in the Jinnan Basin during the Longshan period.

3.1.5 Summary

Taosi, Shimao and Qijia did not arise independently, but they arose as part of a larger interrelated process. Li Min (2017, 2018) uses the definition of "highland Longshan society" to characterize the dynamic development and interaction of cultures in the highland regions from the Taihang Mountain Range to the Hexi corridor. In his definition, various highland communities shared a similar culinary assemblage, which was centered on pouch-legged tripods, such as *li* and *jia*, and double loop-handled beakers in terms of style, technology and decor, and participated in the trade and religious network based on jade (Li Min 2017, 2018).

I agree with Li Min's characterization on the "highland Longshan society" and adopt it as a foundation to investigate the transition from the Chinese Neolithic to Bronze Age. The definition of "highland Longshan society" in fact emphasizes the significance of trade in social dynamics among societies in the highland regions. The trade network among highland regions even extended into the Shandong peninsula and the Yangzi River Basin, as attested by the existence of large quantities of similar jade and turquoise objects in the Shandong peninsula, and jade objects in the Middle Yangzi River Basin. It should be noted that formation of the interregional trade network not only related to exchange of goods, but also a process of sharing similar knowledge, religious beliefs, aesthetics, and so on (Li Min 2017). During the Longshan period, however, different regions also enjoyed their specifics, such as metallurgy in the northern and western highlands, mortuary use of cinnabar in the Jinnan Basin. With the collapse of the Longshan communities in the Jinnan Basin and Shandong peninsula, Erlitou arose in the Luoyang Basin and inherited all the contents of the Longshan centers, laying the foundation of the Luoyang Basin-based political tradition.

3.2 Rise of the Luoyang Basin in the early Bronze Age

Starting from ca. 1800 BCE, the rise of Erlitou marked the start of the Chinese Bronze Age. During this period, Erlitou developed into a mega-center after the collapses of some Longshan centers in the heartland of China (Sebillaud 2014; Zhang Chi 2017a), and established a Luoyang Basin-based political tradition (Li 2018: 175). After the Erlitou period, Zhengzhou inherited the tradition of Erlitou and continued the Central Plains-centric political landscape (Liu and Chen 2003).

3.2.1 Erlitou regeneration

Instead of only focusing on the social process of the Luoyang Basin and the nearby regions, this dissertation looks at the rise of Chinese Bronze Age in the social context in the heartland of China. The archaeologists have recently defined the rise of Erlitou as a process of regeneration in the heartland of China (Zhang Li 2012; Li 2018). The concept of Erlitou as a regeneration is supported by the fact of Longshan collapses at the end of the Longshan period. Sebillaud (2014) and Zhang Chi (2017a) illustrate the Longshan collapses based on the settlement data in multiple regions in the heartland of China. For example, in the Shandong peninsula, the survey in Southeast Shandong yields that the number of the Longshan-period sites reached 536, but that of the Erlitou-period sites was only 19 (Zhong Mei 2012). Meanwhile, the mega-sites, Liangchengzhen and Yaowangcheng, disappeared during the Erlitou period, when the largest site was only measured 9 hectare in size (ibid). The survey in the Yuncheng Basin of the Jinnan Basin shows that the site number during the Erlitou period did not decrease rapidly[9], but the total area of the sites abruptly decreased from more than 1000 hectare to 228 hectare (Zhongguo et al. 2011). The decrease of site numbers and area clearly shows that the major Longshan centers underwent social collapses during the beginning of the Erlitou period.

On the other hand, the population growth in the Luoyang Basin and nearby regions marked its outstanding status during the Erlitou period. Although there was also a population decline at the beginning of the Erlitou period, the Luoyang Basin quickly revived to prosperity, as attested by a rapid increase of site numbers from the second phase of the Erlitou period (Chen Xingcan et al. 2003; Zhang Chi 2017a; Sebillaud 2014). However, this process should not only be considered as the natural growth of population; rather, immigrants from other regions after the collapse events probably contributed more to the rapid demographic growth in the Luoyang Basin, as testified by the diverse origins of Xinzhai-Erlitou ceramic assemblage (Liu and Chen 2003: 58; Zhang Li 2012: 180). In the Erlitou ceramic assemblage, the horizontal-ring jars, long-neck vase,

[9] The site number in the Yuncheng Basin during the Longshan period was 84, and that during the Erlitou period was 68

pen basin, tripod basin were probably originated from the east Henan and the Shandong regions (Luan Fengshi 2006); the *ding* tripods with triangular legs, basin-shaped *zeng* steamer, and so on, probably originated from the upper Huai and upper Han River valleys (Zhang Li 2012: 154-155); the large quantities of appliqué-rimmed pots, small jar-shaped *ding* tripods were introduced from the Guanzhong Basin (Zhang Tian'en 2009). The egg-shaped *weng* urns reflect that the Luoyang Basin was closely connected with the northern highland regions (Zhengzhou and Beijing 2005). The ceramic vessels with multiple origins indicate that immigrants from other regions contributed to the rapid population growth in the Luoyang Basin.

The concept of Erlitou as a regeneration sets up a new backdrop to investigate the transition to the Chinese Bronze Age. It indicates that the outstanding status of the Luoyang Basin during the early Bronze Age was not because of its local political and social evolution, but because of the collapse of the Neolithic societies in other regions of the heartland of China (Zhang Chi 2017a). On the other hand, the immigrants from other regions brought new lifestyles, technologies, aesthetics, and religious beliefs into the Luoyang Basin, creating a new material culture which had not predecessors in the Luoyang Basin (Xu Hong 2001; Zhang Li 2012: 180; Li 2018). Based on this concept, the rise of the Luoyang Basin and the collapses of major Longshan centers at the transition from the Longshan to the Erlitou period were actually interrelated, which together shaped the social situation of the Erlitou period.

3.2.2 Descendant of the Longshan material culture

The emergence of Erlitou, as a regenerated center, rebuilt and reconfigured the socio-political system and started a new political tradition centered at Luoyang Basin (Zhang Li 2012; Li 2018).

The critical contents of Erlitou material culture, especially the elite culture, had prospered in the highland Longshan centers. With the collapse of major Longshan centers in other regions and population concentration into the Luoyang Basin, Erlitou inherited nearly all elements of the material culture in major Longshan centers (Li 2018: 174). This process was not only the inheritance of material culture, but also the convergence and transmission of various types of knowledge into the Luoyang Basin (Zhang Li 2012; Li 2018: 174).

Erlitou

The rise of the Luoyang Basin and the nearby regions was marked by the emergence of the Huadizui and Xinzhai sites located to the west and east of Mt. Song. The diverse origins of the culinary assemblage, lithic objects and ritual objects suggest the population movement after the collapse of major Longshan centers around 1900 BCE (Zhengzhou and Beijing 2005; Zhang Li 2012). However, the ephemeral sparkling of Huadizui was soon eclipsed by the emergence of Erlitou. Starting from the second phase of the Erlitou culture, Erlitou, which is located at the center of the Luoyang Basin, stood out as the largest settlement in the heartland of China (Xu Hong et al. 2004). Archaeologists uncovered a 300-hectare settlement at Erlitou, which was partitioned into several specialized functional sections, including a palatial precinct, craft workshops, and a sacrificial area.

The palatial precinct with more than ten hectare stood in the center of the Erlitou site. According to current data, the palatial precinct, which was enclosed by two crossroads, started to appear during the second phase of the Erlitou site (Xu Hong et al. 2004). The archaeologists have found two rammed-earth foundations dating to the second phase in the northeast of the palatial zone

(Zhongguo 2014: 626-699). Several elite tombs, in which the occupants were interred with metal objects, jade, dragon-shape turquoise inlaid object, lacquerwares, and so on, have been discovered in a foundation. The Erlitou urbanization reached its peak during the third phase, and the prosperity continued until the fourth phase (Xu Hong et al. 2004). During the third phase, the palatial precinct was enclosed by the newly built walls, which followed the direction of the previous crossroads. In the palatial precinct, at least two groups of architectural foundations have been identified (Zhongguo 2014). The southwestern group is comprised by four rammed-earth foundations, in which the largest one is the palace no.1, which reached nearly ten thousand m^2. A 900-m^2 edifice was constructed on the top of the palace no.1 foundation. In the eastern group, three rammed-earth foundations were organized in a north-south axis (Zhongguo 2014: 626-700). In these foundations, the no.2 foundation, which measures 4200 m^2 in size, was well preserved. The facilities of architecture and a tomb have also been excavated at the no.2 foundation.

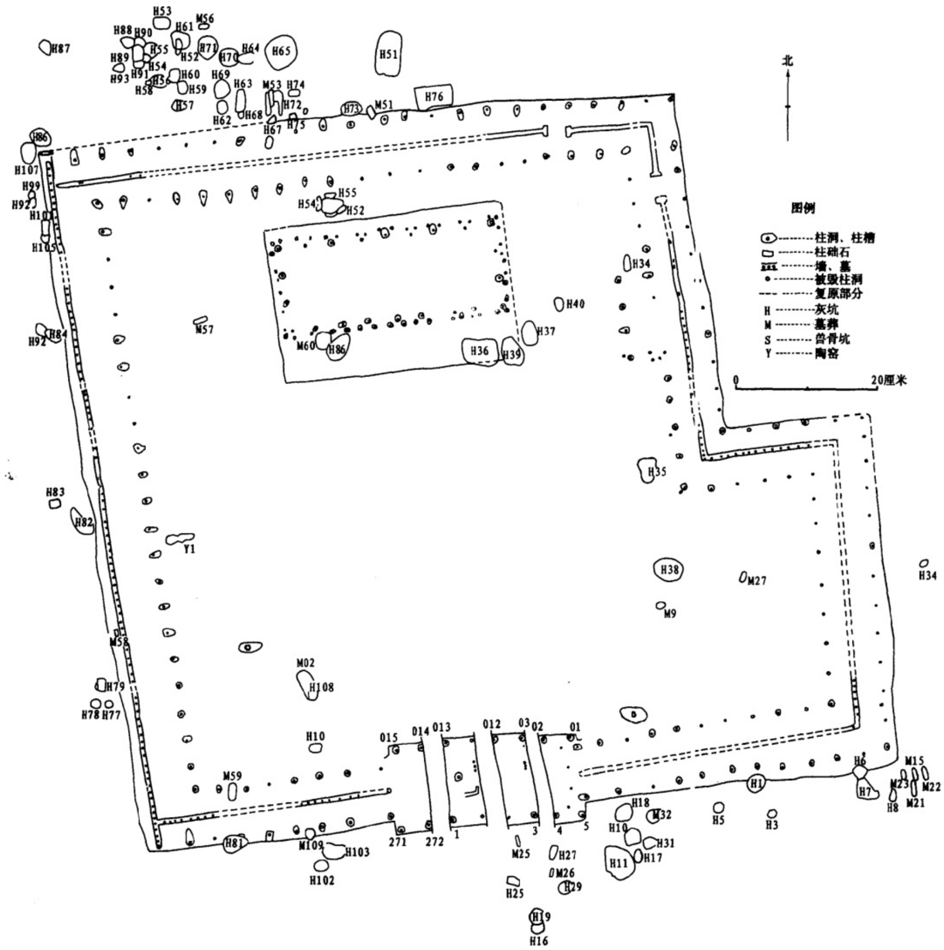

Figure 3-10 Plan of palace no.1 excavated at Erlitou
(Zhongguo 1999: 139, Figure 84)

The association among the palatial precinct, elite residence and craft workshops suggests that the Erlitou elites were deeply involved in craft production. Out of the palatial city, archaeologists discovered many rammed-earth foundations to the east, northeast, south, west and northwest. Considering that the elite burials are also located in the same districts, these rammed-earth foundations were probably constructed for elite residency (Xu Hong et al. 2004). Close to the palatial city and elite residences, several workshops have been identified and excavated, including a turquoise workshop next to the southern wall of the palatial precinct, a metallurgical workshop two hundred meters to the south of the palatial city, and a bone workshop to the south of the no.4 rammed-earth foundation in the eastern group of architectural foundations (Zhongguo 2014: 7, 1659). The close association with craft workshops indicates that craft production, especially of elite items, was probably controlled by the state (Liu and Chen 2003). Based on a case in the classic Maya (Inomata 2001), it is also possible that some of the Erlitou elites directly participated in craft production. In the southeastern corner of the palatial precinct, a wall which possibly enclosed the turquoise and bronze workshops was built during the fourth phase of the Erlitou site (Zhongguo 2014: 324-337), possibly because of the need of securing the resource provision for elite craft production.

That Erlitou developed to a mega-site after the Longshan collapse was by no means a result of the local evolution of the Luoyang Basin. The sudden appearance of Erlitou had no basis in the Neolithic cultures in the Luoyang Basin (Xu Hong 2001). The surveys show that large settlements normally measure 15-30 hectare in size in the regions around Mt. Song (Wei Xingtao 2010), which is much smaller than major Longshan centers in other regions. In this sense, Erlitou continued the pattern of mega-sites that was popular in the highland regions and the Shandong peninsula during the Longshan period (Campbell 2014: 22). On the other hand, even though the data of the layout of Longshan centers is still scarce, a survey in the Taosi site suggests that partitioning based on specialized functions in the urban construction had been achieved during the Longshan period (Gao Jiangtao 2007). Rather than a departure, as a post-collapse phenomenon, Erlitou obviously continued the mega-site pattern and the architectural forms of the Longshan centers.

Material culture

The sudden appearance of the large amount of metallurgical evidence shows that Erlitou opened up the tradition of large-scale use and making of metal objects in the heartland of China. However, the origin of metallurgy of Erlitou could not be clearly identified on a local basis. Even though evidence, including smelting and metal objects, has been discovered in the Longshan assemblages of several sites in the regions around Mt. Song, their reliability is still in debate. The emergence of a developed metallurgy of Erlitou should be attributed to the contribution of societies in the fringe areas of the Loess Plateau (eg. Fitzgerald-Huber 1995; Li Shuicheng 2005). Archaeologists have demonstrated that metallurgy in the heartland China was the result of interaction with the western highlands. The recent findings at Shimao further suggest that the northern highlands were probably another source of the Erlitou metallurgy (Rawson 2017). The existence of a double loop-handled beaker, a contracted-mouth *he* tripod, and egg-shaped *weng* urns show that communities in the western and northern highlands had arrived at the Luoyang Basin during the Longshan and Formative Erlitou periods (Luoyang 1980; Beijing 2002: 83; Zhengzhou and Beijing 2005; Zhang Li 2012). In the process of prospecting and procuring resources, the western and northern highland communities possibly introduced metallurgical knowledge into the Luoyang Basin (Li Min 2017).

Erlitou's metallurgy emerged with a developed form. As introduced above, the close association between the bronze foundry and the palatial precinct suggests Erlitou's elites' deeply involvement in metal production (Liu and Chen 2003). Three workplaces uncovered at Erlitou show that the bronze foundry was probably set up during the second phase of the Erlitou period, which was contemporaneous with the emergence of Erlitou as a mega-site (Zhongguo 2003:

111-113). In this bronze foundry, a large quantity of metallurgy-related remains has been collected, including fragments of molds and furnaces, copper slag, malachite, and small metal objects. The studies on the slag of Erlitou suggest that there existed a dichotomy between smelting and casting (Chen Guoliang 2006; Li Jinghua 2004). It is possible that the Erlitou bronze foundry was only responsible for casting final products, and Erlitou imported copper ingots from copper-ore-rich regions (ibid).

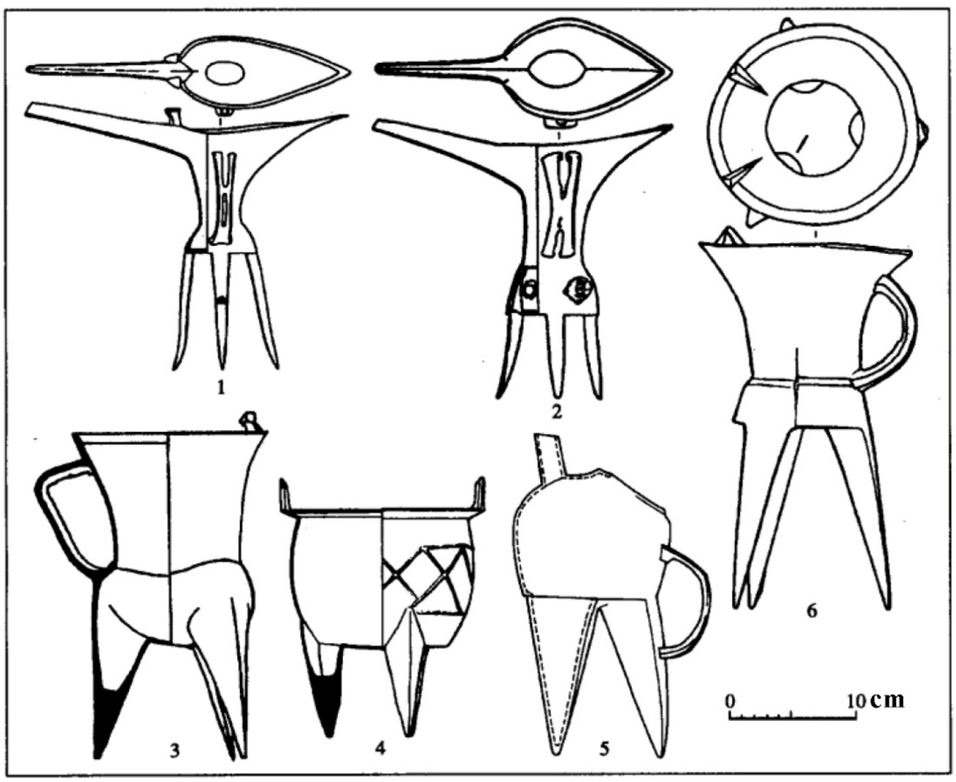

Figure 3-11 Bronze ritual vessels excavated from Erlitou
(Zhongguo 2003: 105, Figure 2-10)
1-2. *Jue* tripods 3, 6. *Jia* tripods 4. *Ding* tripod 5. *He* tripod

Apart from knowledge contribution from the western and northern highlands, Erlitou indeed achieved some technical innovations on metallurgy, in which the most important was production of bronze ritual vessels from the third phase of the Erlitou period (Figure 3-11). The piece-mold technique used to produce bronze ritual vessels always asks for a much larger investment of labor, time, and specialized knowledge (Chang 1983: 106), so they were normally precious and interred into high-elite tombs (Li Zhipeng 2008). These bronze ritual vessels include four types of tripods: *ding*, *jia*, *jue* and *he*, which all copied their ceramic counterparts excavated at Erlitou (Zhongguo 2003: 109). The interment of ceramic vessels in graves as a religious practice was deeply rooted in local Neolithic societies. By incorporating metallurgical technology into production of vessels, Erlitou successfully combined the new technology and traditional religious practice in the heartland of China, and created a new material form in the local ritual system.

Jade was widely involved in elite culture at Erlitou. However, the tradition of using jade was not rooted in the Luoyang Basin during the Longshan period. Until now, only few jade objects have been excavated in the local Longshan-period sites. Jade was suddenly involved in the ritual sphere in the formative Erlitou period (Zhang Li 2012: 158), when collapses of major Longshan centers occurred in the Jinnan Basin and the Shandong peninsula. At Huadizui, archaeologists excavated several types of jade objects, including a *yue* axe, a spade, a *cong* cylinder, and a scepter (Zhengzhou and Beijing 2005), all of which resembling styles of ritual jade objects in major Longshan centers. Erlitou inherited the tradition of jade use of the Longshan centers in its elite culture. Most of jade objects were excavated in tombs, suggesting their distinctiveness in the ritual sphere. Apart from the *ge* daggers, which were probably the innovation of Erlitou (Hao Yanfeng 2008), the other types were also used in major Longshan communities. Moreover, jade assemblage of Erlitou was dominated by ritual objects and ornaments, in which the ritual objects include *bi* disks, *gui* tablets, *Zhang* scepters, *cong* cylinders, *ge* daggers, *huang* pendants, long perforated choppers, and so on. To make these jade ritual objects, jade raw materials were all firstly cut into thin slices, and then processed into final products with techniques of perforation, polishing, inlay, carving, and notching, which had already been adopted into lapidary industry in major Longshan communities. No matter the styles or processing techniques, Erlitou in fact inherited the jade tradition of the Longshan centers.

Turquoise constituted another important part of lapidary industry at Erlitou. The excavations in the workshop to the south of the palatial precinct have yielded more than 4300 pieces of turquoise, including final and semi-final products, and multiple types of wastes (Zhongguo 2014: 338). The tomb occupants interred with turquoise products were also interred with other types of luxurious goods, such as white pottery vessels, bronze ritual vessels, and jade objects, suggesting that turquoise was also one of the indicators of elite culture (Fang Hui 2005). Moreover, the closeness of turquoise workshop to the palatial precinct also suggests that turquoise production was probably directly controlled by the Erlitou state. The turquoise products include two kinds: beads and inlaid plaques. Besides, there are thousands of turquoise raw materials, semi-products, and wastes discovered at Erlitou (Zhongguo 2014: 125-126). The beads are mostly tubular. The inlaid plaques have not been widely excavated at Erlitou. Until now, only three intact inlaid plaques have been excavated at Erlitou (Zhongguo 1984, 1986, 1992). These turquoise inlaid plaques were all made into a mask design with small turquoise tesserae inlaid on metal backings. Apart from the three inlaid plaques, a dragon-shape turquoise inlaid object was processed with similar techniques, but the backing had decayed when it was excavated (Zhongguo 2014: 1005). The tradition of using turquoise items had no predecessors in the Luoyang Basin during the Longshan period. Rather, it was widespread in Longshan communities in the highland regions and the Shandong peninsula. The technologies of processing turquoise into tubular beads, tesserae for inlaying were shared in these Longshan centers (Pang Xiaoxia 2014; Qin 2016). The technological combination of turquoise inlay and metallurgy was also probably a technological tradition of the western highlands and Xinjiang oasis (Chen Xiaosan 2013).

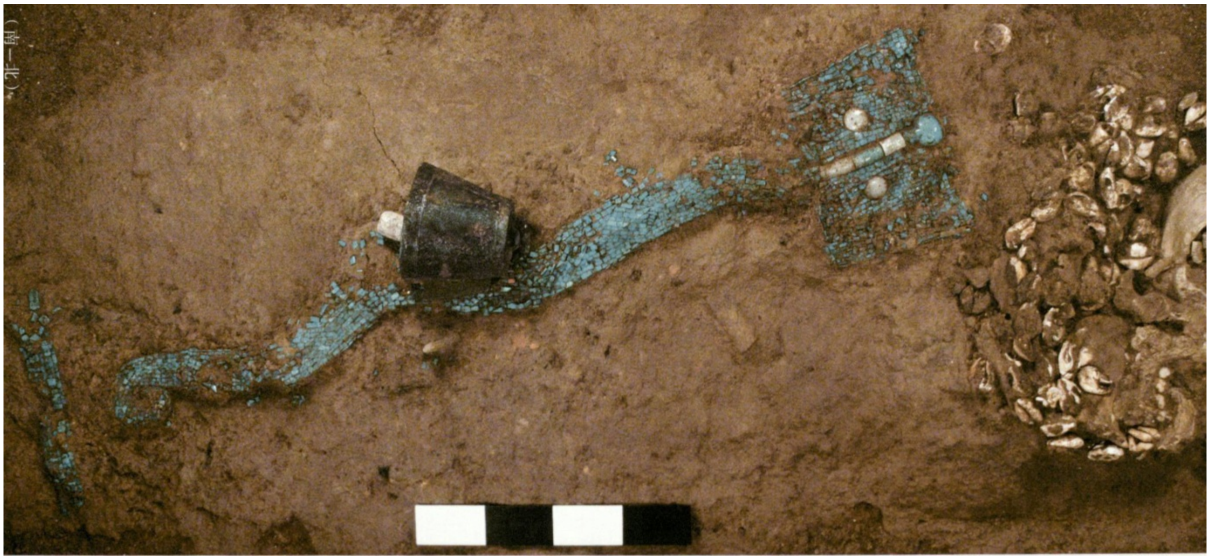

Figure 3-12 Dragon-shape turquoise inlaid object excavated at Erlitou
(Zhongguo 2014, colored plate 120)

Cinnabar was also widely adopted in mortuary practices of Erlitou. Li Zhipeng (2008) classified tombs of the Erlitou culture into five levels of hierarchy, in which the first two hierarchies of tomb occupants were mostly interred with cinnabar, indicating that cinnabar was mostly used in elite mortuary practices. Fang Hui (2015) argues that the widespread interment in elite tombs shows that cinnabar use was institutionalized in mortuary practice at Erlitou. In these tombs, cinnabar was normally laid as a layer under corpse. As introduced above, cinnabar was only used in the elite mortuary practice in the Jinnan Basin during the Longshan period. In terms of context, restrictive access, means of interment, Erlitou obviously inherited the cinnabar tradition of mortuary practice from the Taosi society. After the demise of Erlitou, Erligang continued its cinnabar tradition (Fang Hui 2015).

Although there existed some technical innovations, such as bronze vessels, jade *ge* daggers, Erlitou basically inherited the material culture of major Longshan centers (Li 2018: 174). The dynamic process of networking brought convergence of multi-origin material cultures into the Luoyang Basin. Some of material cultures in the Longshan period were widespread in most of major Longshan communities, such as turquoise, jade, but some others only existed in some specific regions, such as mortuary use of cinnabar in the Jinnan Basin, metallurgy in the western and northern highlands. Therefore, the Erlitou regeneration was actually the process of convergence of elite cultures with diverse origins into the Luoyang Basin (Zhang Li 2012; Li 2018).

Political-economic landscape

The relationship between craft production and kingship, and the large quantity of elite items determined Erlitou's high demands for natural resources. The construction of this mega-site and many palaces, and large-scale agricultural activities required supply of timber and stone, which could possibly be acquired in nearby Mt. Song regions (Zhongguo 2010). However, some key resources, such as copper, cinnabar, and turquoise, had to be extracted and transported from distant regions. During the third phase of the Erlitou period, hence, Erlitou started to expand and acquired resources in the resource-rich regions, resulting in the formation of the Central Plains-centered political-economic landscape in the early China (Liu and Chen 2003).

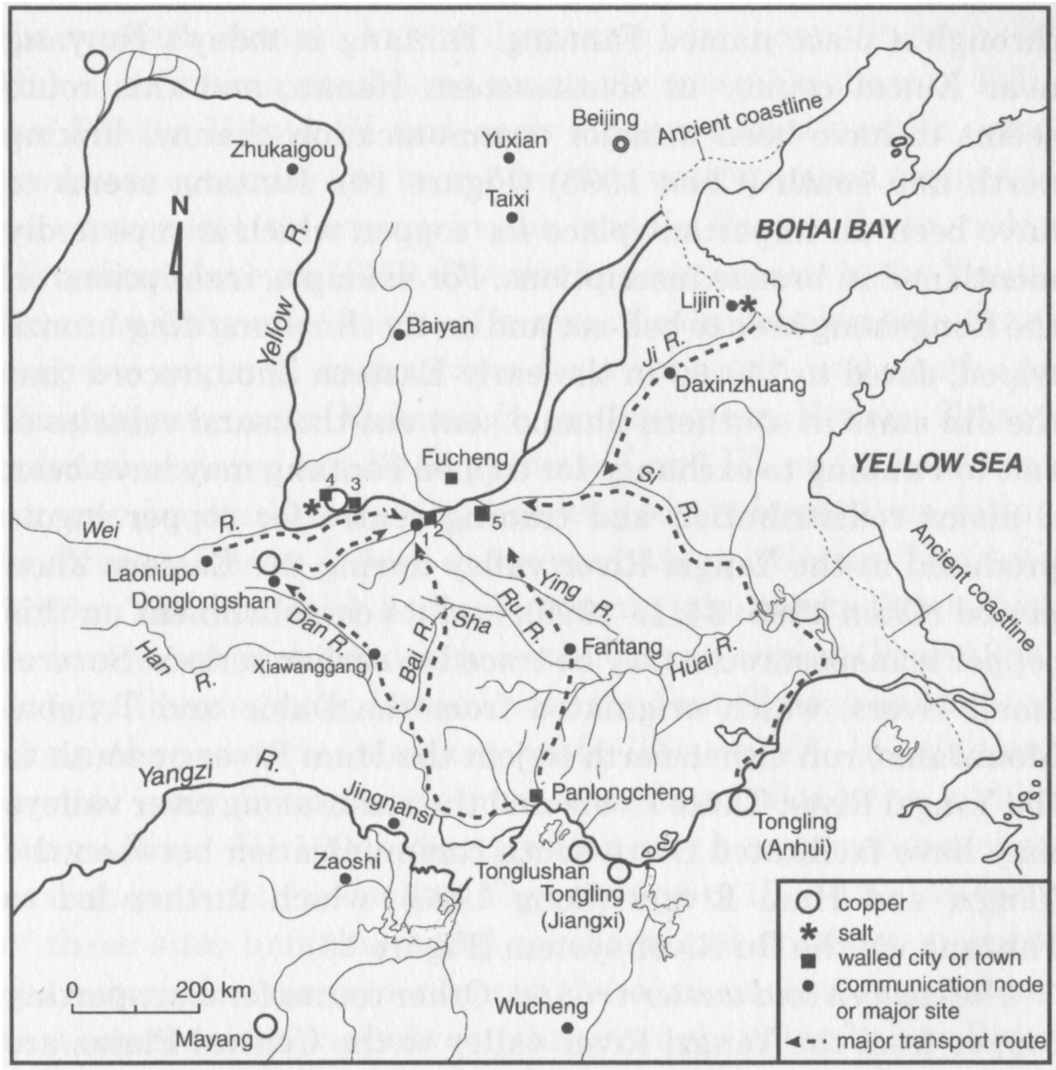

Figure 3-13 Waterway sytem and resource flow during the Erlitou and Erligang periods (Liu and Chen 2003: 51, Figure 10).

1. Erlitou 2. Yanshi (Erligang period) 3. Nanguan 4. Dongxiafeng 5. Zhengzhou

The waterway transportation system constituted the geo-political and geo-economic framework of Erlitou (Figure 3-13). To the north, the Erlitou travelers could get in touch with copper and salt resources in the Jinnan region through the Yellow River and valleys of the Yuanqu Basin, as evidenced by the excavations at Nanguan (Zhongguo et al. 1996; Zhongguo et al. 2014) and Dongxiafeng (Zhongguo 1988). Through the valleys along the Shangluo Corridor, the Huai Rivers, and the Nanyang Basin, Erlitou probably acquired the natural resources of the Middle

Yangzi River regions, as shown by the Erlitou-style assemblage at eg. Panlongcheng (Hubei 2001) and Jingnansi (Jingzhou 2009).

The formation of the political-economic landscape of Erlitou was a reproduction of preexisting exchange network after the collapses at the end of the Longshan period (Zhang Li 2012; Li 2018: 215). As mentioned above, the wide use of elite items in major Longshan centers facilitated the exchange of key resources, such as copper, turquoise and cinnabar, and laid the foundation for the political-economic landscape based on resource flow. With the emergence of Erlitou and the collapse of major Longshan societies, the Luoyang Basin became the center of resource flow. However, the northern and western highlands continued to prosper. In the western highlands, the radiocarbon dating on several sites show that the Qijia culture probably continued to 1500/1400 BCE (Dong Guanghui et al. 2014; Wang Hui 2012). The large quantities of metal objects, maceheads, and turquoise ornaments from the Mogou cemetery suggest that the Qijia society continued to prosper during the Erlitou period (Gansu and Xibei 2009a, 2009b). In the northern highlands, Shimao probably continued to stand as a regional center. The surveys suggest that the population was still large in the northern highlands, even though the site numbers decreased slightly (Cao Jian’en 2014; Shanxi et al. 2012: 923). Moreover, the lower Xiajiadian society emerged as a new hotspot in the northeastern highlands during the Erlitou period. The surveys in the Chifeng and Banzhijian River show that population increased rapidly during this period (Zhongguo et al. 2002; Chifeng 2003). The Dadianzi cemetery shows that it inherited the elite culture of the highland Longshan societies (Zhongguo 1998). These societies continued to interact with each other and maintained the pre-existing trade network (Li 2018: 220-225). The material culture excavated from archaeological sites in contact zones, such as Donglongshan

(Shaanxi and Shangluo 2011) and Dongxiafeng (Zhongguo 1988), which I discuss below, suggest that societies from the fringe areas of the Loess Plateau continued to prospect and procure resource from resource-rich regions. In this regard, the formation of the political-economic landscape of Erlitou was a continuation and reconfiguration of the political-economic landscape of the highland Longshan societies (Zhang Li 2012; Li 2018).

3.3 Conclusion

The transition from the Longshan to the Erlitou period was the most vital period in the formation of the Central Plains-based political-economic landscape. Two processes were important during the Longshan and Erlitou periods. First is the rise of the highland Longshan centers, which was characterized by shared culinary assemblage and religious network, and increased mobility because of the demands for natural resources (Li Min 2017). Second is the rise of the Central Plains during the Erlitou period. This dissertation sees Erlitou as a phenomenon of regeneration after the Longshan collapses (Zhang Li 2012; Sebillaud 2014; Zhang Chi 2017a; Li 2018). The rise of the highland Longshan society laid the foundations for the Erlitou regeneration (Li 2018). In the process of regeneration, Erlitou inherited nearly all the economic, political and ideological institutions of the highland Longshan society. The production of bronze ritual vessels indicates the institutional change after regeneration (Chang 1983). Moreover, the pre-existing exchange network continued to exist during the Erlitou period. The maintenance of pre-collapse exchange network contributed to the formation of the Erlitou political-economic landscape after regeneration (Zhang Li 2012; Li 2018).

The above discussion on the process of Erlitou regeneration has laid the foundation for my further discussion. It depicts the geopolitical and economic macrostructures during the Longshan and Erlitou periods. The scenario of the shifting centers leaves a question: what was the role of peripheries in this process? The previous studies mostly focus on these centers but neglected detailed analyses of peripheral regions. How did the emergence of Erlitou as a political center impact the daily life of the native communities in peripheral regions? How did peripheral regions act in response to the cultural expansion from the Luoyang Basin during the third phase of the Erlitou period? In order to better understand the machnism of formation of the political-economic landscape in the process of Erlitou regeneration, I will shift my focus away from these central regions, and discuss the production modes, economic forms and social contexts in their hinterland and peripheral regions based on my anslysis of mining and mining-related productions.

4 Towards a comparative perspective

Mining and its related productions will be the main focus of this dissertation. Chinese archaeology has focused on the history and technology of mining for a long time, with a special emphasis on copper mining (eg. Li Yanxiang 1993; Liu and Lu 1997). Archaeologists have been paying much attention to provenance identification and making techniques based on various methods of scientific testing (eg. Li Yanxiang 1999; Li Jianxi et al. 2018). However, the social dimensions of mining have been long neglected. Therefore, this study tries to touch on social aspects of mining during the transitional period from the Longshan to Erlitou period. Due to the insufficiency of case studies in Chinese archaeology, in this chapter, I will review ethnographical and archaeological studies of mining in other regions of the world, trying to develop a comparative perspective of assessing mining in early China. The main focus of this comparative perspective is the social aspects of mining. For this dissertation, two types of mining are discussed: turquoise (also applicable to mining of other gemstones) and copper mining.

4.1 Technology

The search for mines often requires ancient miners' familiarity with their nearby landscapes (O'Brien 2015: 196). Miners had to develop their own understandings of various geologic conditions and distinguish types of mineralization based on empirical knowledge and experience. Generally, bedrock exposure was essential for ancient miners to find the deposits (O'Brien 2015: 196). Prehistoric miners used many geological indicators to search copper deposits. For example, in the Mediterranean regions, ancient miners could find copper deposits based on the presence of gossan (O'Brien 2015: 197). The Native Indians in northern Canada used prehnite as an indicator to find copper in the detrital deposits (Richardson 1823, in Ball 1941: 9). Color was also an important indicator of copper. The copper compounds, such as malachite and azurite, were often green or blue at the surface outcrops (O'Brien 2015: 197-198). Moreover, the weight of mineralized rock fragments was also important to know the amount of metal content (O'Brien: 198). In some regions, geobotanical indicators were basic to discover rich copper deposits. For example, *Elsh. Ltziaspienderns* grow widely in the Tongling copper mines in Jiangxi Province of China (Liu and Lu 1998). The flowers of this plant become red in autumn, and this is an important indicator for ancient miners to detect copper deposits in the Tongling region.

Mining was a tedious process in ancient times. It required intensive labor and time investment. Cross-culturally, however, the technologies involved in mining were relatively few. Not many types of tools were used in early mining. Stone hammers and mauls were probably the most widely used tools for breaking rock deposits in the prehistoric contexts. These hammers and mauls were normally grooved or side notched for hafting. In western Zacatecas of Mexico, stone mauls were widely used in turquoise mining in the Chachihuites culture (Weigand 1968). These mauls were mostly grooved and hafted with wood handles. In the Chachihuites culture, three types of mauls could be identified based on their shapes and textures. The three types of mauls probably served different functions in mining. In the southwestern United States, some ethnographical and archaeological investigations reveal that similar stone hammers and mauls were widely used in gemstone mining through a long time period (Figure 4-1; Ball 1941: 12; Snow 1973; Welch and Triadan 1991). These hammers were usually made of igneous rocks or cobbles, and were presumably produced near mining locations (Snow 1973). Apart from stone hammers and mauls, other stone tools, such as picks, were also reported in the southwestern United States and northern Mexico (Weigand 1968; Leonard III and Drover 1980). For copper mining, stone hammers and sledges were also widely used in antiquity. For example, similar stone hammers were collected in most mining regions in the prehistoric Europe, such as Mount Gabriel in Ireland (O'Brien 1990), Rudna Glava in Serbia (Jovanović 1980) and the Mitterberg mining district in Austria (Kyrle 1916). Stone hammers were also used as basic mining tools in Phu Lon in northeast Thailand in early first second millennium BCE (Pigott 1998).

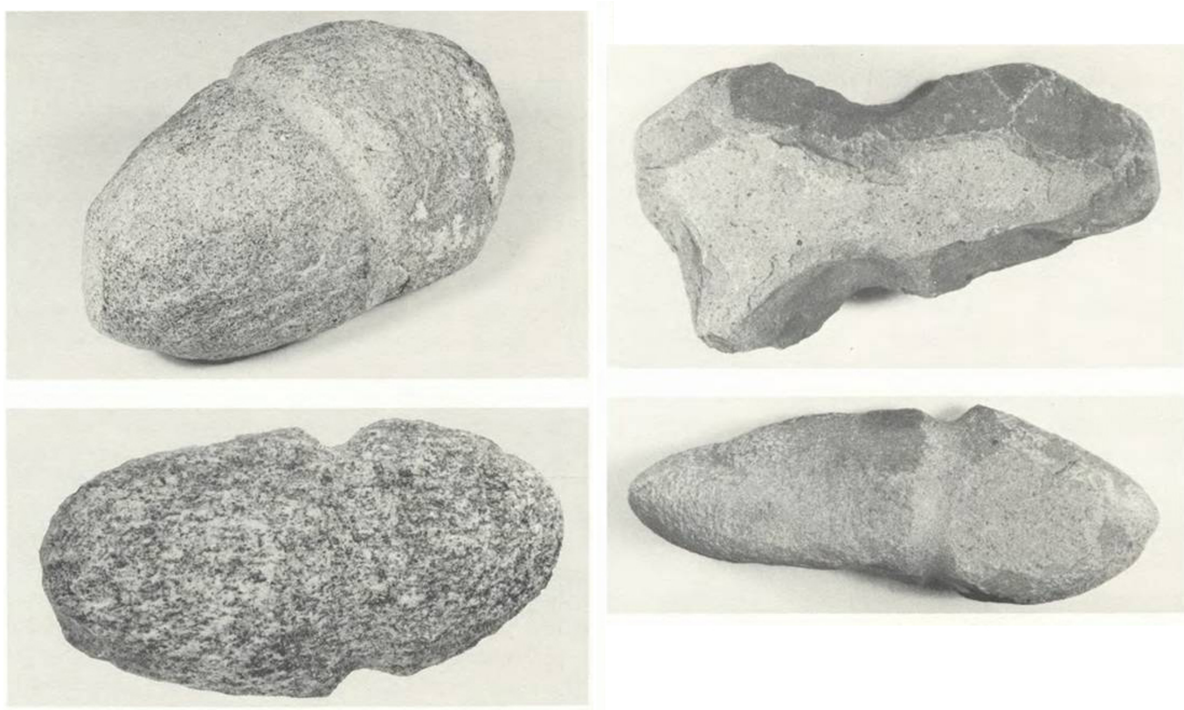

Figure 4-1 Prehistoric turquoise mining tools in the southwestern United States (adapted from Snow 1973: 36, Figure 5)
Left: full-grooved maul of monzonite (top) and full-grooved hammer of hornblende gneiss (down)
Right: notched pick (or hammer) of latite (top) and full-grooved hammer of latite (down)

Besides stone, other materials were also used to make prehistoric mining tools. For example, ethnographers record that American Indians also used deer- or caribou-horn picks and wood, horn, stone, and copper gads as mining tools (Ball 1941: 12). In Europe, archaeologists have found a large amount of prehistoric wooden, antler, animal bones and metal tools in some of mining regions (O’Brien 2015: 208). Antler picks were probably the most widely used tools in prehistoric Europe. They have been discovered in regions spanning from southeast Europe to England (O’Brien 2015: 208-209; Jovanović 1980). Some of mining tools are perishable, so they are not easily discovered in archaeology.

The extraction of gemstones and copper ores probably involved the use of fire and water before using hammers or mauls to break rocks. Miners would first set a fire against the rock face and then suddenly quench it with water, creating some fractures in the rock. Based on ethnographic records, use of fire and water was widespread in gemstone mining among American Indians from Lake Superior to Mexico (Ball 1941: 12). The archaeologists found bits of charcoal and fragments of possible skins of water bags in the prehistoric workings, attesting that this method had been adopted through a long time in North America (Snow 1973). In Europe, fire was also adopted in the mines of Mitterberg in Austria (Figure 4-2; O’Brien 2015: 205). However, O’Brien (2015: 204) points out that the use of fire and water was normally constrained by fuel supply and spaces of mine workings, so it was not adopted in all mining endeavors. Snow (1973) also suggests that water was often unavailable in the southwestern United States, and heating probably causes a change of turquoise color, so this method was probably used sparingly by prehistoric Indians.

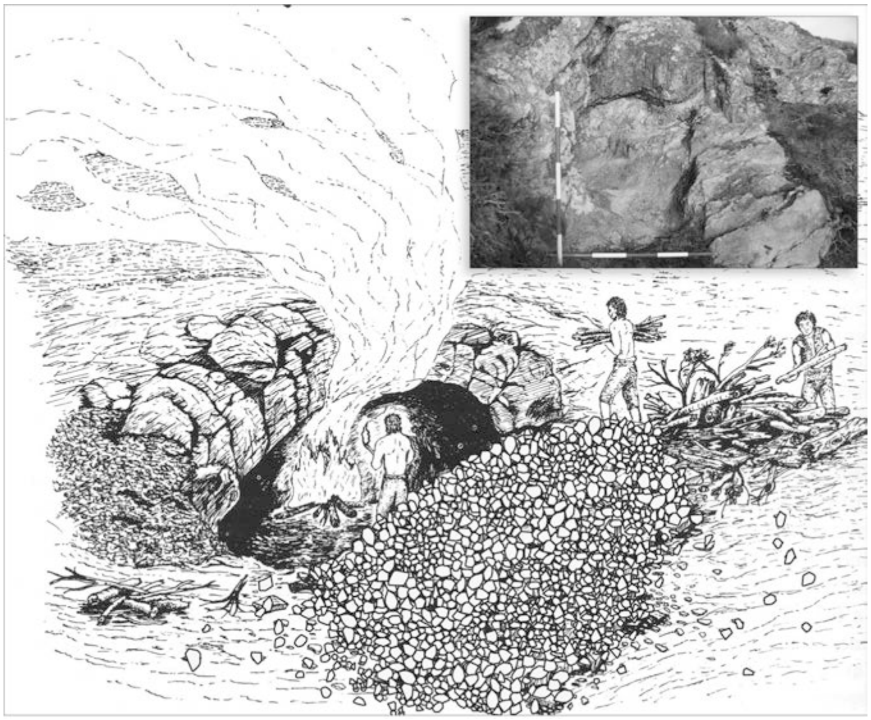

Figure 4-2 Artist reconstruction of fire-setting in Ireland
(O’Brien 2015: 205, Figure 8.3)

Ancient miners normally started by exploiting surface outcrops, and then dug into deeper deposits. Traces of surface operations are not easy to identify, since later mining usually destroyed them. In order to mine deeper deposits, several ways were used, such as quarries, vertical shafts, tunnels, and trenches. The prehistoric extraction sites in arid North America usually occur as quarries, trenches, and pits, but shafts and tunnels were also used with lower frequency (Shepherd 1980: 7-22). In Rudna Glava in Yugoslavia, prehistoric miners obviously preferred vertical shafts, although they also excavated horizontal galleries (Jovanović 1980). Some workings also show a cave-like appearance in Prehistoric Europe (O’Brien 2015: 203). Most of mine workings are small in size, both in arid North America, where prehistoric mining workings are mostly less than 10m deep (Shepherd 1980: 7-22) and in Europe (O’Brien 2015: 203). But in some large mines, deep tunnels or shafts were also discovered, such as the Los

Cerrillos turquoise mine (Ball 1941: 24), Great Orme and El Aramo (O'Brien 2015: 203). Ventilation was probably a reason for shallow workings, especially in regions where fire-setting was used (O'Brien 2015: 217). Besides, visibility was also important in deeper workings, as evidenced by wooden splints discovered at Cueva de María Lizardo in the Chalchihuites culture of northern Mexico (Weigand 1968), Mitterberg, Caint-Véran, and Mount Gabriel in the prehistoric Europe (O'Brien 2015: 217-218). Most of the wooden splints were probably used as lightings in deep mine workings (Weigand 1968; O'Brien 2015: 217-218).

4.2 Scale of mining

Early mining was undertaken at different scales. On the one end, it was conducted on a very small scale with short duration, extracting a small amount of ores for local use. On the other extreme, it was carried out on a large scale with intensive operations (O'Brien 2015; Knapp 1998). Small-scale mining usually involves a small number of miners, probably at the household or communal level. The miners in small-scale operations were probably also farmers or herders, who presumably also dealt with subsistence production and other domestic or communal activities. Therefore, scheduling was important for early miners in small-scale operations (Hagstrum 2001). Hence, mining in small-scale operations was normally part-time, either seasonal or sporadic. "Oftentimes, such small-scale operations were also a consequence of the geographical setting, such as when deposits are situated in hostile landscapes that only allow an impermanent and seasonal access" (Stöllner 2014).

The existence of small-scale mining has been demonstrated by ethnographers and archaeologists in many regions all over the world. In North America, for example, an ethnohistory records a

70-year-old miner in southeastern California saying that he always went to mine turquoise with four or five men (Drover 1980). Based on their calculation of the waste mined from one locus of Canyon Creek turquoise mine in Arizona, Welch and Triadan (1991) claim that the labor force involved in turquoise mining was unlikely to exceed ten persons simultaneously. In Egypt, even though epigraphic records suggest that several hundreds of laborers were involved in gemstone and quarry mining during the Middle Kingdom period, the nuanced estimation on the sizes of the mines and the volume of waste suggests that a single mine could only contain a limited number of people (Bloxam 2006).

Since ancient metal mines are mostly still being exploited in modern times, it is often hard to estimate the scale of ancient mining by calculation of waste and mine size. Based on ethnographical records and other indirect evidence, however, it is possible to know some details. Ancient metal mining was also often organized on a small scale. The investigation of a major prehistoric mining complex located at Phu Lon on the Mekong River in northeast Thailand suggests that mining was probably carried out on a communal level (Pigott 1998). The geology of Phu Lon, the presence of multiple exploiting groups, the domination of production of simple artifacts, and the absence of long-term occupation suggest that mining was not carried out under a direct control by a strong polity. Instead, the mining activity appeared to involve multiple autonomous small-scale communities. In Cyprus, the excavation at a small copper workshop at Ayia Varvara Almyras also suggests that copper mining was carried out on a small scale (Kassianidou 1998). Based on the size of the copper mine, the copper content of ores, and the amount of slag and furnaces excavated in the archaeological sites, it is estimated that the amount of copper produced locally was only a total of one ton during all three phases of occupation from

600 – 150 BCE (ibid). Moreover, ethnographic evidence also shows that, in Sub-Saharan Africa, iron mining was mostly conducted on a family level (Herbert 1993, 1998). The miners were normally local agriculturalists, who carried out mining activities on a seasonal basis.

Large-scale mining normally involves large quantities of participants. Such mining is usually a state-controlled or capital-intensive activity, and undertaken by full-time workers or specialists. Since large-scale mining is normally carried out in a specific location, permanent mining communities are often built up near mines in order to minimize the cost of resource extraction, processing and transportation (O'Brien 2015: 269; Raber 1987; Stöllner 2014). In order to maintain a long-term extraction, some defensive infrastructures would also have to be constructed. I have not found any examples of large-scale gemstone mining in archaeology and ethnography, but there are some examples of large-scale metal mining. For example, a study of Iron Age metal production in the southern Levant shows that an industrial-scale copper production existed in the Edom lowlands (Levy 2009). This industrial-scale production was attested by several lines of evidence, such as tremendous quantities of slag, a close association between metallurgical sites and copper mines, a cemetery for officials or workers supervising the copper-ore-rich region, and construction of a military fortress (ibid). Similarly, the close association with mines, the presence of administrative buildings, the well-organized operational sequences, and the large volumes of mines suggest that the Inca state controlled copper exploitation in several mines and carried out large-scale mining activities in Northern-Central Chile (Cantarutti 2013; Salazar et al. 2013). The intensive mining activities and administrative monitoring during the Roman Empire were also evidenced by the archaeological investigations in the Iberian Peninsula (Edmondson 1989).

4.3 Mining landscape

The formation of a mining landscape was closely related to the scale of exploitation, geographical settings, and socio-economic characteristics. Through studying the spatial organization of diverse metallurgy-related features, archaeologists can not only know the organization of production, but also understand the social, economic, and political impacts on production. Some aspects of mining landscape have already mentioned above.

Mining landscape varies based on various factors, such as geological settings, accessibility of ores, abundance of fuels for smelting, knowledge of specialists, and political or social investments. Stöllner (2014) points out that different spatial structures of mining are closely related to different production modes. Extensive mining, which is usually sporadic or seasonal, "is normally associated with small-scale expeditions and can still be found in some traditional societies today" (Stöllner 2014: 137). Miners who adopted the mode of extensive mining often lived in workings, or built simple and impermanent camps that were located closely to mines, so "such exploitations often left nearly invisible traces and were often obliterated by later and more intensive periods of winning" (ibid). Ethnographic literary sources record many cases of extensive mining, such as the Sub-Saharan African Iron mining societies and the North American gemstone mining societies (Herbert 1993; Ball 1941). Kohl (2007: 178) also argues that prospectors in the Eurasian steppe adopted a "gold rush" strategy to acquire copper ores from the fourth millennium BCE. The miners probably often occupied the small settlement near ore sources seasonally, and transported the ores by wagons [for smelting and processing] to places where they lived during the other times of the year. In archaeology, ancient campsites in mines are difficult to identify, especially in those mines which have been continuously exploited until now. In the southern Sinai, several stone-built shallow enclosures, which measure 3-6 meters in diameter, were discovered in mining areas (Bloxam 2006). These enclosures were probably impermanent camps for storage of ores or temporary workplaces during the Middle Kingdom of Egypt (ibid). Campsites with small sizes were also discovered in several turquoise quarries and mines in North America (Johnston 1964; Snow 1973).

On the other hand, intensive mining at a specific deposit normally led to concentration of several production units. Mining archaeologists used the concept of "mining district" to characterize the concentration of several production units, such as mines and smelting sites (O'Brien 2015: 293; Stöllner 2014). Formation of a mining district usually asks for prerequisite of geographical, social or economic stability (Stöllner 2014), such as continuous capital or political investment. The aforementioned cases in the Inca and Roman Empires, and in the southern Levant clearly show that ancient intensive mining was usually a state-controlled enterprise, resulting in the concentration of production units, such as monitoring infrastructures, smelting sites, mines, and others.

Since mining communities, no matter whether they were engaged in intensive or extensive mining, were vulnerable to later exploitations, other types of information should be also taken into account, such as the amount of smelting remains in mining communities, the relations between mining communities and other communities, the existence of an administrative system, and so on. In order to investigate the mining landscape of western Cyprus from the 8th century BC to the 15th century AD, for example, Raber (1987) devises a model to distinguish state-controlled mining industries from village-based small-scale ones. In his model, the archaeological correlates of a state-controlled, large-scale and full-time industry could be summarized as follows: existence of a mining district; existence of large quantities of metallurgical features in a few large sites; distinctive traces of permanent facilities and equipments; and obvious alteration of landscape. The archaeological information relating to a local, village-based, seasonal metallurgical industry could be summarized as follows: small metallurgical sites; little evidence of specialized architectures or permanent metallurgical facilities; small quantities of smelting waste or by-products; and local consumption of products.

Moreover, Raber thinks that there existed a third type: a transitional, mobilized, and local industry. The third type of metallurgical industry shares most of characteristics with the village-based, local, seasonal industry, but its products were presumably more widely distributed. I do not agree with Raber’s division between the two types of local industries. In fact, exchange always occurred in ancient times. The small-scale, village-based, local industries also often participated in interregional long-distance exchange systems. For example, ethnographic sources record that gemstones were traded into the Mesoamerica from regions of several thousand miles away, from both North and South America (Ball 1941). As I just mentioned, the excavations of gemstones in the North America were normally small-scale and village- or tribe-based. The scientific testing also attests the long-distance exchange between Mesoamerica and the southwestern United States was started and maintained since the Formative Age (Figure 4-3, Harbottle and Weigand 1992; Hull and Fayek 2012; Hull 2012). Therefore, the division of the two types of local industries is too arbitrary and is normally difficult to distinguish in archaeology. It is more appropriate not to make the division between the two types of local industry in this dissertation.

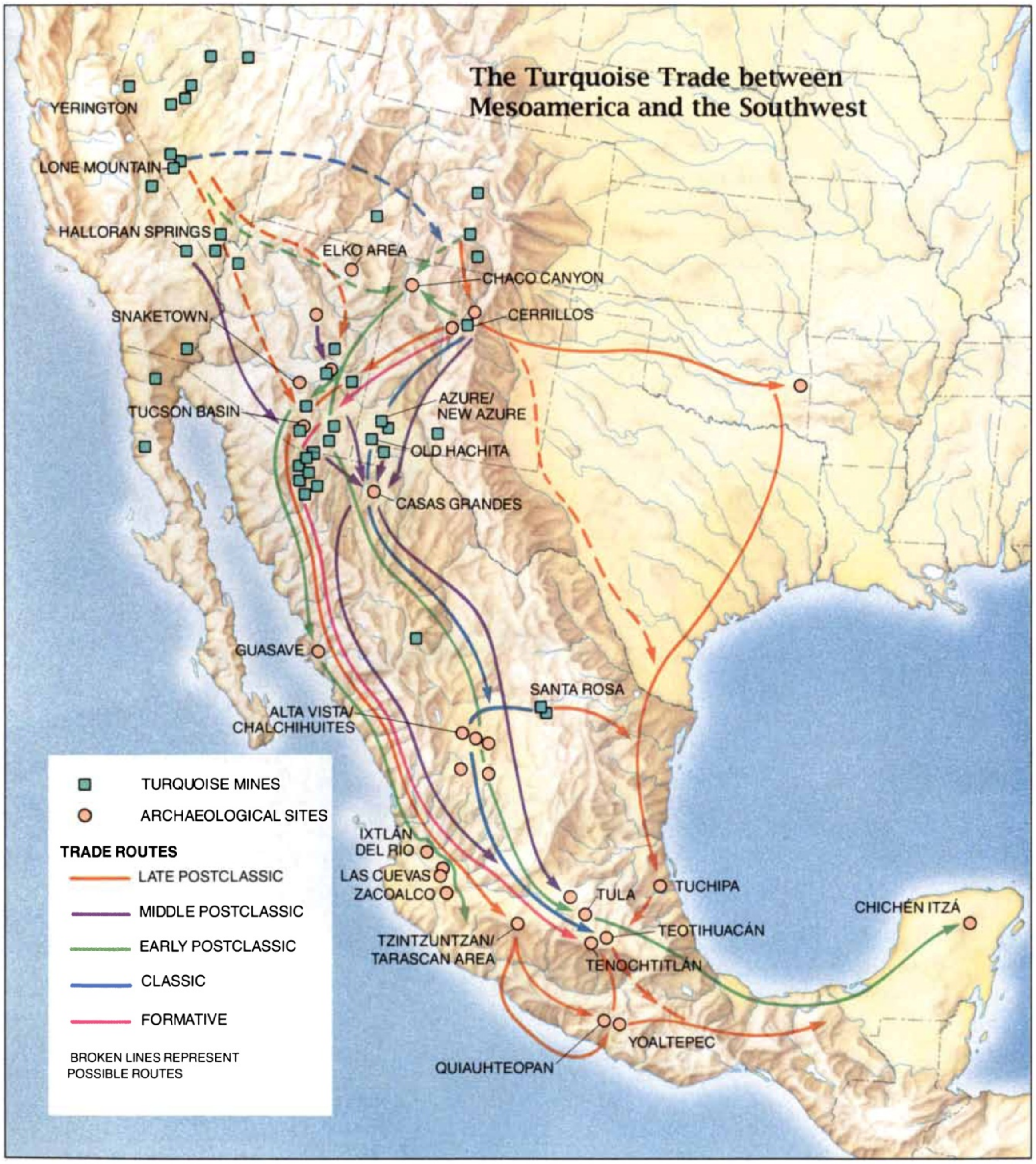

Figure 4-3 The turquoise trade between Mesoamerican and American Southwest (Harbottle and Weigand 1992: 82)

In my opinion, moreover, archaeologists should not have the evolutionary pre-assumption that a small-scale, local-based mining industry would necessarily develop into a state-controlled large-scale mining industry. Change or maintenance of production modes always depends on various social, political, economic, and other factors. A state-controlled large-scale production could also devolve into a village or community-based industry, as evidenced by the change from a state-controlled into a local mining industry in Cyprus after the retreat of the Roman Empire (Edmondson 1989).

4.4 Summary

The investigations of early mining have been widely carried out in the sphere of Chinese archaeology for a long time and have achieved many accomplishments. However, most of the previous studies focus on the technological issues of mining, neglecting its social aspects. Some studies discuss mining in a broad political-economic framework, but do not analyze the modes of mining in detail. Based on previous studies and my field survey, I will analyze the modes of mining in three resource-rich regions, and discuss their relations with the central areas. By briefly reviewing studies of mining in other regions of the world, a comparative perspective of assessing the role of mining in early China could be achieved in this dissertation. To take mining as a focus, the primary goal here is to understand how peripheral regions played roles in the process of state formation during the transition from the Longshan period to the Bronze Age. What was the organization of resource extraction in peripheral regions? How did different cultural groups participate in mining in peripheral regions? What types of relationship existed between centers and peripheries?

To answer the questions, I will mainly focus on the aforementioned two aspects below: the scales of mining and mining landscape. I will assess the scale of mining based on two strands of evidence. First, I will estimate the labor force involved in mining based on ancient mining features, such as mine workings and mining waste. If it is not applicable, second I will discuss indirect evidence, such as geologic conditions and physical landscapes, to infer which type of scale was probably most beneficial for local communities. To assess the mining landscape, I will focus on the settlement patterns in mining areas and along transportation routes. It is important to know whether a mining district existed in a specific resource location. Besides, the results of provenance testing will be plumbed to explore the exchange systems between centers and peripheral regions.

5 Mining and archaeology in the western Shangluo Corridor

The increasing demand for key resources vital for the Longshan and Erlitou political economy had to be reconciled with their highly uneven distribution. The high demands and uneven distribution required movement of resources between different regions. Among these regions connecting the Loess Plateau and lowland plains, the Shangluo Corridor occupied an outstanding status because of its access to resources. The largest deposits of key resources, such as copper, cinnabar, and turquoise are all distributed in the Middle Yangzi River Basin and the Qinling Mountain Range, which made the Shangluo Corridor the vital transportation routes connecting with major highland Longshan centers and Erlitou.

The Shangluo Corridor is the most convenient and efficient route for the highlands' access to resources (Figure 5-1). The Ba River and the Dan River, which originate from the same mountain range and flow toward different directions, connect the Guanzhong Basin and the Middle Yangzi River Basin. To the north, resources could flow into most of the centers around the Loess Plateau through the Ba River valley. To the east, the Luo River originates from the mountains close to source of the Dan River. After following the tributary of the Dan River valley to the watershed, ancient travelers would cross into the Upper Luo River valley, which led to the Luoyang Basin, where Erlitou was situated. To the south, the Dan River is more advantageous for members of highland societies to enter the lowlands than the upper Han River: it is much shorter than the Upper Han River, and the geography along the Dan River is also more favorable for transportation than that along the upper Han River for ancient highland travelers to reach the Nanyang Basin and the Middle Yangzi River Basin.

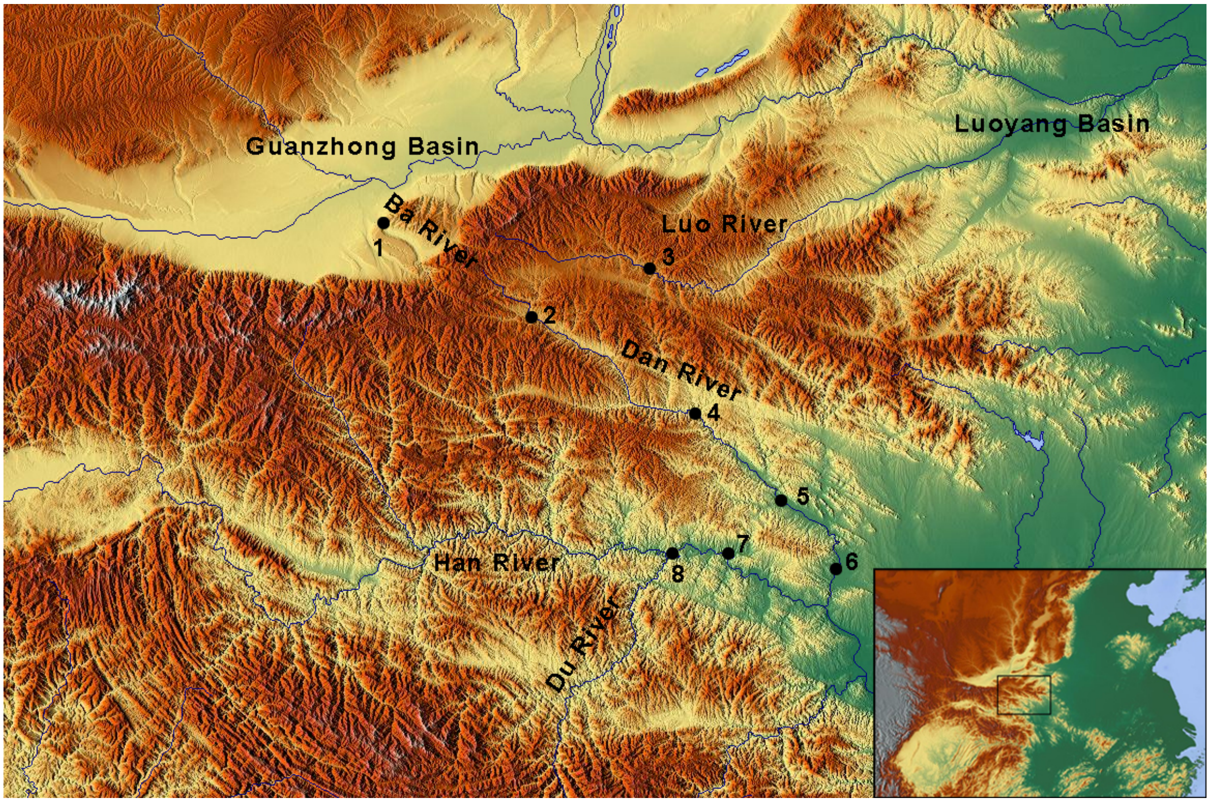

Figure 5-1 The Shangluo Corridor and some major archaeological sites
1. Laoniupo, 2. Donglongshan, 3. Longtouliang, 4. Guofenglou, 5. Xiawanggang, 6. Xiongjiazhuang, 7. Liying, 8. Liaowadianzi

The connectedness of the Shangluo Corridor in multiple directions defines its status as one of the vital communication routes for Neolithic and Bronze Age interaction. During the Longshan and Erlitou periods, it is an important route for knowledge flowing between highland regions, the Luoyang Basin, and the Middle Yangzi Rivers. What was the significance of the Shangluo Corridor during the process of the rise of the Central Plains during the Bronze Age? How did extraction and transportation through the Shangluo Corridor play a role in the rise of the Bronze Age states in the Central Plains? To answer the questions, a detailed analysis of mining and exchange system in the Shangluo Corridor is necessary. I will divide the Shangluo Corridor into two sub-units, the western and the eastern Shangluo Corridor, and then discuss them respectively. In this chapter, I will focus on mining and cultural landscape of the western part of the Shangluo

Corridor based on turquoise mining and currently published archaeological materials. In my discussion, the western Shangluo Corridor includes the Ba River, Upper Dan River and Upper Luo River valleys (Figure 5-2).

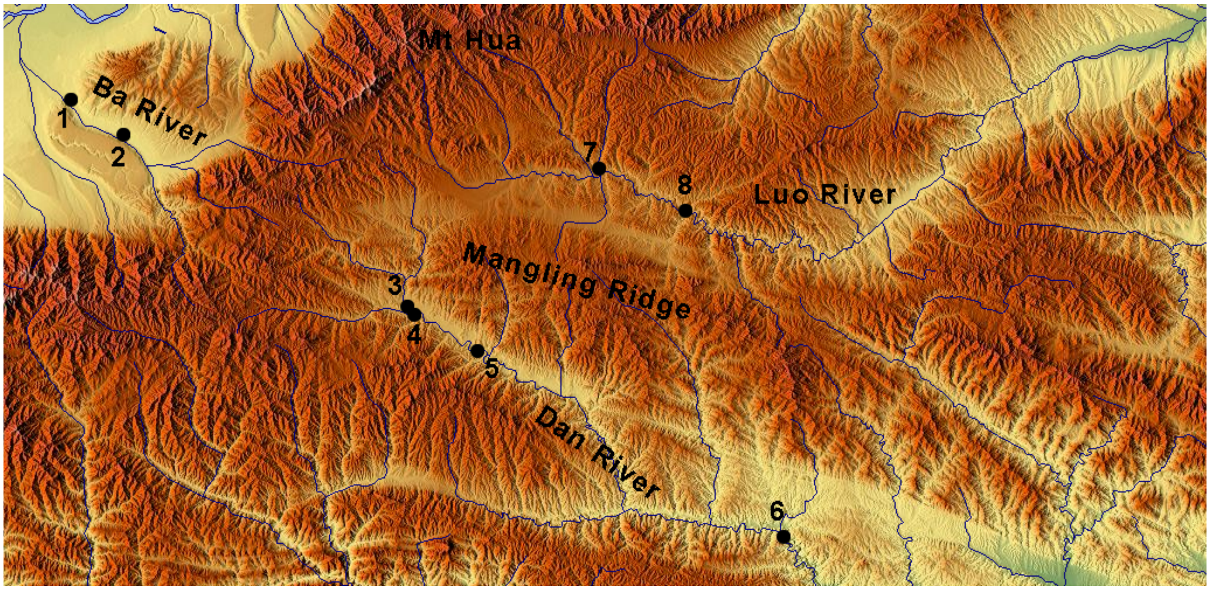

Figure 5-2 Major archaeological sites during the Longshan and Erlitou periods in the western Shangluo Corridor
1. Laoniupo 2. Xiehu 3. Donglongshan 4. Zijing 5. Ganhekou 6. Guofenglou 7. Hekou 8. Longtouliang

5.1 Mining in the Upper Luo River Valley

Several kinds of resources are deposited in the western part of the Shangluo Corridor, such as copper, lead, tin, and turquoise. However, not many ancient mining sites have been reported. It is possible that the low quality and quantity of deposits led to a quick exhaustion of resources in antiquity (Liu and Chen 2003: 37). The Hongyan Hill copper mine in Luonan County is an example. According to textual records, this copper deposit was exploited on a large scale before the Tang dynasty (Huo Youguang 1990, 1993). Mining activities stopped during the Ming dynasty, perhaps because of exhaustion of copper ores. Copper was an important resource in

Luonan County, but lead and tin were also exploited, as indicated by tin and lead anomalies identified during geological surveys in the soil of the mountains in the southern part of Luonan County (Huo Youguang 1990). In the western Shangluo Corridor, evidence of early Bronze-Age metal mining has not been reported. However, a recently identified turquoise mining site, the Hekou site, informs on early gemstone mining in this region, which will be the focus of my analysis below.

5.1.1 The Hekou site

From the source to the Luoning County seat, the Luo River mostly flows in the valleys of the eastern branches of the Qinling Mountain Range. The river valley starts to become wider and more flat from the Luoning County seat, and this flat corridor extends to Luoyang City. The Hekou site is located at the west bank of the Xiyu River, a tributary of the Luo River, in Luonan County of Shaanxi Province (Figure 5-3). In the 1980s, the archaeologists who discovered this site thought that it was a Paleolithic site, but recent surveys have identified it as a turquoise mining site. Besides the Hekou site, archaeologists discovered a total of ten mining site in the Xiyu River valley (Beijing and Shaanxi 2016). Ceramic sherds and radiocarbon dating on charcoal and bones show that the exploitation of the Hekou turquoise mine started at least from approximately 2000 BC (Xian Yiheng et al. 2016a; Beijing and Shaanxi 2016). Considering the scarcity of data left at mining sites, the start date of exploitation might have been even earlier. By comparing the samples from Hekou with those from the Erlitou, Xiajin and Taosi sites, it is suggested that the highland Longshan societies and Erlitou had acquired turquoise from the Hekou mine (Li Yanxiang et al. 2018; Xian Yiheng et al. 2016a).

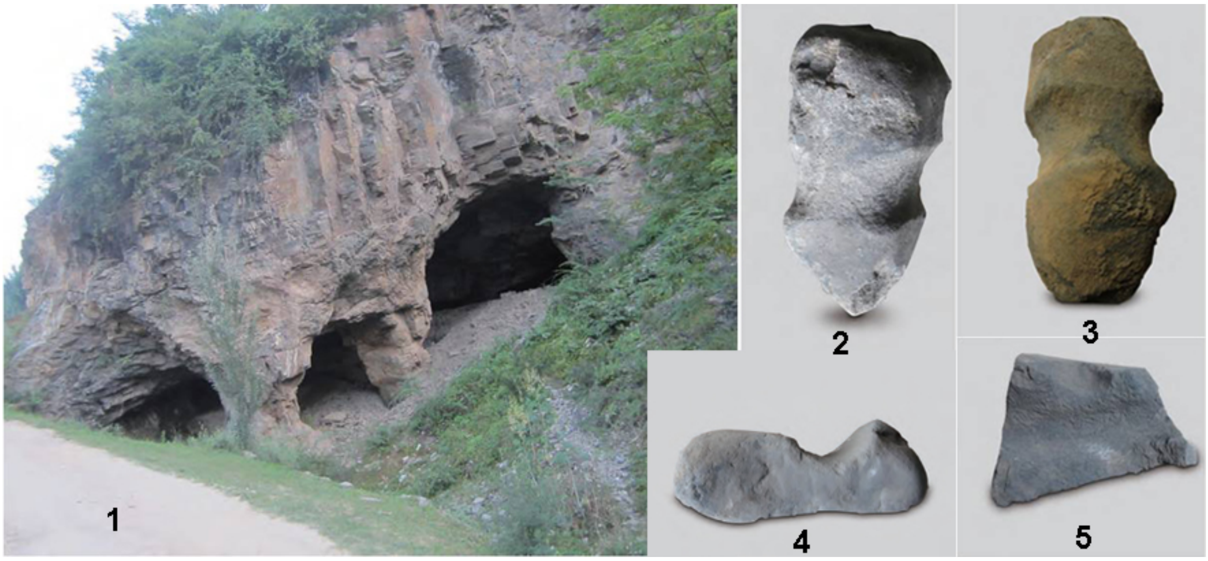

Figure 5-3 The Hekou mining site and stone mining tools
(based on Beijing and Shaanxi 2016: 12, 15-16, Figure 2, 12, 17, 18 and 19)
1. the exterior scene of the Hekou mining site 2-3. Full-grooved hammers 4-5. Stone whetstones

Technology

The ten mining sites are all distributed in the lower Xiyu River. According to my survey, no obvious traces of early mining have been discovered in the upper Xiyu River valley. Similar to most of the North American mines, turquoise occurs in veinlets and nodules in fractures and voids of rocks. No large quantities of remaining turquoise ores have been discovered in fractures of rocks, perhaps suggesting that this turquoise mine had been exhausted in antiquity. Several small platforms and grooves, which were excavated for working above the ground, were discovered in a tunnel of the Hekou site (Beijing and Shaanxi 2016). Besides, traces of knocking have also been identified on the surface of rocks at the Hekou site.

Similar to many early mining sites in many regions of the world, stone hammers were the main tools for breaking rocks at the Hekou site (Beijing and Shaanxi 2016; Xian Yiheng et al. 2016b). As in the Chalchihuites culture in Mesoamerica (Weigand 1968), stone hammers at Hekou also consist of several kinds (Xian Yiheng et al. 2016b), which were probably made for different types of work in mining. Larger hammers were probably used for breaking hard rocks, while smaller hammers were probably used for more delicate work. Archaeologists have also discovered stone whetstones and balls, which were probably tools of producing stone hammers (ibid). The trace of using fire was also discovered at another mining site D2, suggesting that the aforementioned method of fire-settings and water was adopted in the Hekou mine.

Several strands of evidence suggest that ancient miners took full advantage of the local environment. The existence of stone hammers and their production tools show that production of mining tools occurred at or near the Hekou site. This is similar to gemstone mining activities in North America (Snow 1973). The Hekou site is located only 5 meters to the west bank of the Xiyu River, where large quantities of pebbles could be collected and processed into mining tools. Water that is necessary for cooling burnt rocks could also be drawn from the Xiyu River. Plants, mostly bushes and small trees, could be acquired easily in local mountains and used for fire setting.

Estimation of scale

The mining sites along the Xiyu River were well preserved, so it is possible to calculate the labor input involved in mining based on the volume of the mining sites and the wastes that were produced. By observing the mountain where these mining sites are located, it is clear that the local landscape was not largely altered by later communities. That is to say, the original shape of these mining sites has been to a large extent well preserved. Even though landslides occurred, they did not bring major changes to these mining sites. However, the construction of the modern village road next to these sites probably removed part of minig deposit from the Hekou site. Moreover, since the Hekou site is close to the river bank, it is also possible that much of the debris from mining have been swept away by the river. Hence it is better to calculate the labor force of mining based on volume of the tunnels. Since the area's other mining sites are much smaller, I will focus on the Hekou site.

It should be noted that the shapes of tunnels are not regular. The Hekou site is comprised of three tunnels (Figure 5-4, Beijing and Shaanxi 2016). The front tunnel has three openings, in which the highest is 8.8 meters high. The front tunnel is 15 meters long in south-north axis and 5-7 meters wide in west-east axis. The highest point inside the front tunnel is 6 meters above the ground. Based on the plan, the shape of the front tunnel is similar to a rectangle (Beijing and Shaanxi 2016). I select the largest size of each measurement, so the volume of the front tunnel could be calculated into 924 m^3 (8.8×15×7 meters).

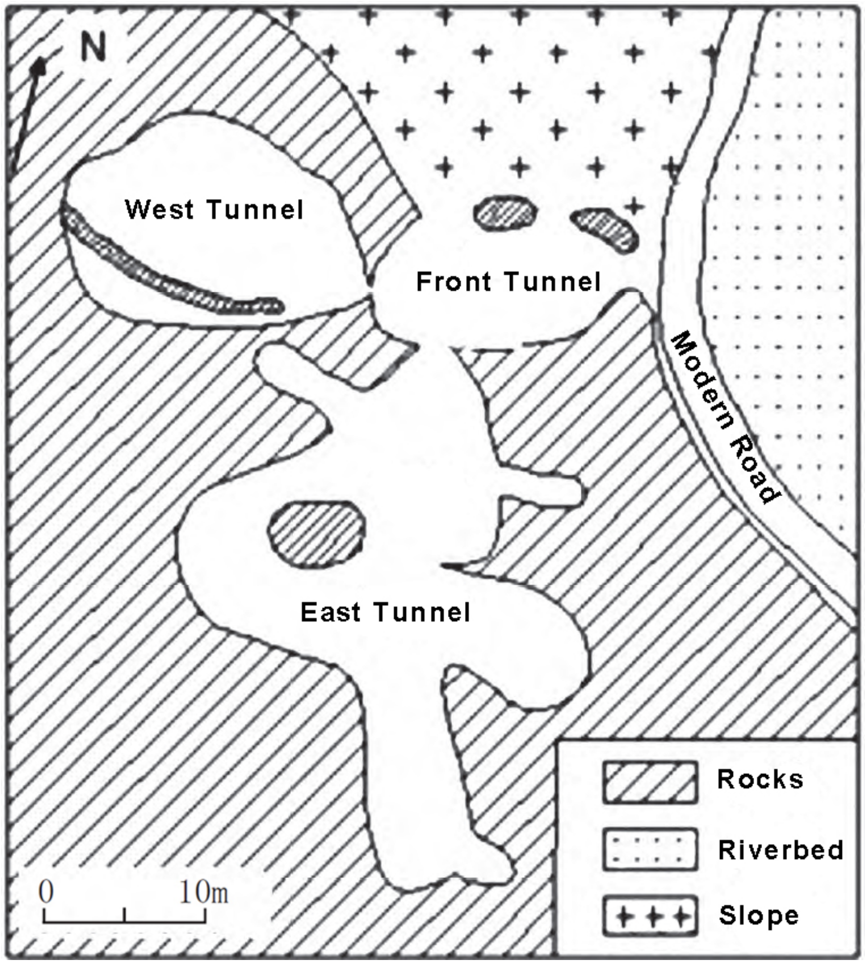

Figure 5-4 Plan of the Hekou site
(based on Beijing and Shaanxi 2016: 12, Figure 3)

Two back tunnels are located to the south of the front tunnel. The east tunnel is irregularly shaped, with four lateral tunnels excavated into the rocks. The length from its entrance to the southern wall is about 20 meters, and the largest width is 16 meters. Four lateral tunnels are respectively 4.5, 7.8, 11.6, and 5 meters in length and 2.5, 5, 6, and 2 meters in width. The west tunnel is more regularly shaped, with 14 meters long and 8 meters wide. To calculate the volume of the two tunnels more easily, I select the largest size of each measurement, and see the two tunnels as regularly-shaped cylinder. For the four lateral tunnels of the east tunnels, I consider them as regular cuboids. The excavation report does not point out the exact heights of the two tunnels. Based on my visit, the height of the east tunnel is at least five meters. I use the largest height of the front tunnel, 8.8 meters, in my calculation. Therefore, the volume of the two back tunnels at the Hekou site could be calculated as follows:

The primary tunnel of the east tunnel: $\pi \times 10^2 \times 8.8 \approx 2764m^3$.

The west tunnel: $\pi \times 7^2 \times 8.8 \approx 1355m^3$.

The four lateral tunnels of the east tunnel: $8.8 \times (4.5 \times 2.5 + 7.8 \times 5 + 11.6 \times 6 + 5 \times 2) \approx 1143m^3$.

Therefore, the total volume that I calculate is $924+2764+1355+1143= 6186\ m^3$.

Based on an experimental study of limestone bedrock excavation, a worker with a hardwood post could remove roughly 1700 kg ($1m^3$) of limestone blocks per day (Eramus 1965). The local rock of the Hekou mine is denser and harder than limestone, so ancient miners probably needed to spend more time and energy to break them. By using stone hammers, fire and water, $0.5m^3$/day should be a reasonable speed of mining at Hekou. Therefore, the total number of days that should be spent on the Hekou site is: $6186\ m^3/0.5m^3$ per day $\approx$ 12372 days. That is to say, a single miner would have needed approximately 34 years to excavate the Hekou site. However, I may have exaggerated the volume of the mining tunnels and greatly underestimate the mining speed of ancient miners. In fact, rocks in local mountains mostly appear in a stratified structure, so that early miners could use several strikes to break a large volume of rocks. Moreover, a mining activity was normally not carried out by individuals, but by several persons' cooperation. By considering these factors, the mining speed at Hekou was probably much faster than the result that I calculate.

Based on the result of my calculation, therefore, I argue that the scale of ancient turquoise mining at the Hekou site was very small. The radiocarbon dating and ceramic sherds attest that the Hekou site had been excavated for approximately 1500 years, much longer than my calculation of labor and time investment based on the volume of tunnels. The only reasonable explanation is that the Hekou site was not intensively mined; rather, early mining at Hekou was small-scale, probably at a household or communal level. Also, it seems likely that early turquoise mining at Hekou was carried out sporadically or seasonally. Mining was only a part-time activity. Ancient miners probably had to handle other domestic or communal activities well with turquoise mining, similar to aforementioned examples in other regions of the world.

On the other hand, the characteristics of turquoise deposit in Luonan county probably also determine the scale of mining. As introduced above, turquoise normally occurs in veinlets and nodules in factures or voids of rocks. Turquoise veins normally do not extend very long, and turquoise ores are also not distributed evenly in a specific location. Therefore, miners could not stay in a mine and exploit it continuously through a long time; rather, they had to move frequently to look for new ores or lodes from place to place. The high mobility results in the absence of intensive and large-scale mining in a specific turquoise deposit in Luonan County.

5.1.2 Mining Landscape in the Upper Luo River

The model of sporadic small-scale mining expeditions at the Hekou and other mining sites in Luonan County implies that permanent habitations related to resource mining did not exist nearby in antiquity; rather, ancient miners probably constructed impermanent small-size campsites near mines, or temporarily resided in the workings of mining sites. As mentioned in the last chapter, many examples of mining campsites have been described by ethnographers and archaeologists in many regions of the world. To the east of the Hekou site is a small area of flat land, which was probably fit for residence. Although no traces of settlements have been discovered here, ancient miners might have constructed impermanent campsites here.

Nearly all Neolithic and Bronze Age sites are distributed on the terraces or tablelands of the Upper Luo River. Several sites dating to the Longshan and Erlitou periods have been discovered, among which only the Longtouliang site has been excavated. The Longtouliang site is located on a tableland extending from the mountain range to the south of Goutan village in Lingkou Township in Luonan County (Shaanxi Sheng Shangluo 1983). It is only forty kilometers to the north of the Donglongshan site, and about three hundred kilometers to the southwest of the Luoyang City seat. From the perspective of its terrain configuration, the Longtouliang site was like a gate across the Luo River valley, controlling communication along the Luo River. Moreover, Longtouliang is only ten kilometers away from the Hekou site, and not far from copper mines to its south (Huo Youguang 1990, 1993). Considering the geographical configuration and close proximity to resource, therefore, the material culture of Longtouliang could provide much information about cultural and mining landscape during the Longshan and Erlitou periods.

Based on the excavation report and my site visit, the Longtouliang site is very small, measuring 100 by 70 meters. The tableland where the site is located rises about 20 meters above the ground. The edge of the tableland is steep, and the rock base is exposed. Only the top of the tableland is covered by soil. Based on the geologic condition, it is possible that the tableland maintains its original shape to a large extent, and the Luo River did not bring too much soil erosion. No modern construction exists on this tableland. Therefore, 7000 sq m was possibly the size of the original settlement. To the west and east of the tableland are large areas of flat lands, which were formed by the sedimentation of the Luo River. No archaeological traces dating to the Longshan and Erlitou periods have been discovered in the two large flat lands. They were probably agricultural lands for the Longtouliang community.

The materials excavated from the Longtouliang site suggest that this community was primarily engaged in agriculture, instead of mining. Two types of materials have been excavated (Figure 5-5). Pottery vessels attest that Longtouliang was occupied during the Longshan and Erlitou periods. The stone tools include an axe, two knives, an adze, and a spade, which were all agricultural tools. No tools related to mining, such as hammers or mauls, have been excavated. Considering the large agricultural lands and the materials excavated from the Longtouliang and Hekou sites, early mining during the Longshan and Erlitou periods was more likely to be a contingent activity. Specialized mining industry did not exist in this region. Local agriculturalists exploited turquoise during intervals of agricultural and other activities, and mining tools were usually produced contingently at mining sites, instead of being produced in their community.

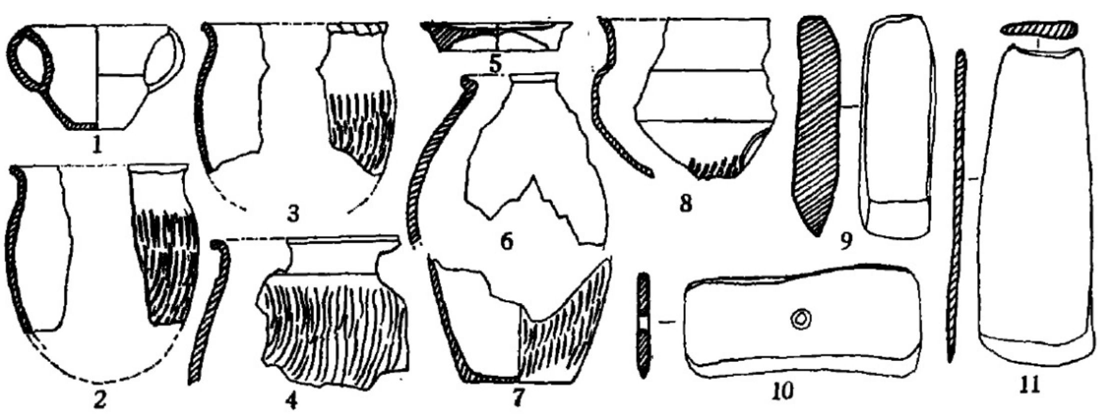

Figure 5-5 Ceramic vessels and stone tools excavated at the Longtouliang site (Shaanxi sheng Shangluo 1983: 16, Figure 6)

Moreover, the ceramic assemblage at Longtouliang shows the cultural interactions along the Luo River Valley. The double-handled beaker are stylistically similar to the one found in the Longshan-period assemblage of the Donglongshan site (Shaanxi and Shangluo 2011: 59), and those in the Longshan and Early Erlitou assemblage in the Xiawanggang site (Henan and Changjiang 1989), which I describe below, indicating that the beaker from the Longtouliang site should be dated to the Longshan period and the Early Erlitou. As introduced in Chapter 3, the prosperity of highland Longshan societies stimulated highland people to prospect and procure natural resources. The existence of this double loop-handle beaker suggests that the highland cultural groups were involved in the exploitation of natural resource in the mountains of Luonan County during the Longshan period and the Early Erlitou. Although the local societies in this area had no tradition of using turquoise and metal then, they were probably involved in the exchange network with the highland cultural groups. The other pottery vessels, including large-mouth *zun* urns and deep jars, are associated with the Late Erlitou material culture in the Luoyang Basin, suggesting the cultural expansion of Erlitou during the Late Erlitou.

5.2 Gateway communities in the western Shangluo Corridor

As defined by Hirth (1978: 37):

> Gateway communities develop either as a response to increased trade or the settling of sparsely populated frontier areas. They generally are located along natural corridors of communication and at the critical passages between areas of high mineral, agricultural, or craft productivity; dense population; high demand or supply for scarce resources; and at the interface of different technologies or levels of sociopolitical

complexity. They often occur along economic shear lines where cost factors change and where there are economic discontinuities in the free movement of merchandise. The function of these settlements is to satisfy demand for commodities through trade and the location of these communities reduces transportation costs involved in their movement.

Gateway communities are not necessarily controlled by any polities. The western Shangluo Corridor is an important gateway. It controls the entries into highland regions, the Dan River, and the Luoyang Basin and undertook movement of trade items into consumption centers in highland regions and the Luoyang Basin from the eastern Qinling Mountain Range and the Middle Yangzi River Basin. In the western Shangluo Corridor, two settlements, Laoniupo and Zijing-Donglongshan, were important gateway communities during the Longshan and Erlitou periods.

5.2.1 Laoniupo

Laoniupo served as a vital gateway community from the Shangluo Corridor to the Guanzhong Basin. Geographically, it is located at the intersection between the Qinling Mountain Range and the Guanzhong Basin. Through the Ba river valley, Laoniupo controls connections between the highland regions and the Shangluo Corridor. During 1985-1989, excavations uncovered assemblages dated to the Neolithic and Bronze Age (Liu Shi'e 2001). Here, I focus on the assemblages during the Longshan and Erlitou periods.

The Longshan assemblage of Laoniupo includes two residential units, three ash pits and three tombs. Based on typology of pottery vessels, it is clear that the Longshan-period material culture of Laoniupo closely resembles the material culture in the highland regions, such as *li* tripods, single-handled *li* tripods, double-loop handle beakers, small *guan* jars, and long-collar *guan* urns.

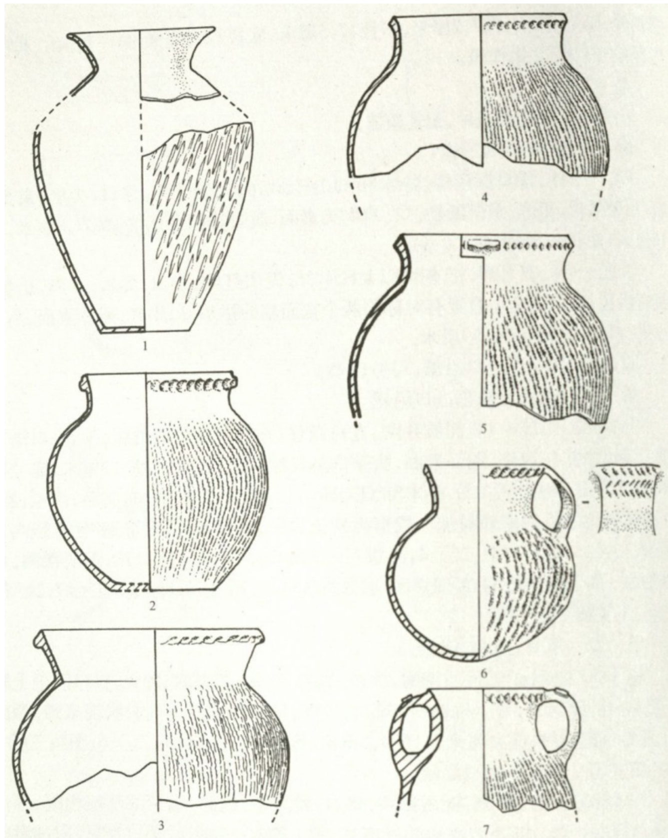

Figure 5-6 Characteristic ceramic vessels during the Early Erlitou at Laoniupo
(Liu Shi'e 2001: 40, Figure 20)
1. Long-collar *guan* jar 2-7. Appliqué-rimmed *guan* pots

The Erlitou-period assemblage of the Laoniupo site has been dated to the Early Erlitou (Zhang Tian'en 2000, 2009; Duan Tianjing 2006: Jing Zhongwei 2003). The excavations uncovered three ash pits and seven tombs. Similar to the Longshan assemblage, the pottery vessels from three ash pits also show the characteristics of the highland Longshan material culture, such as long-collar *guan* urns, appliqué-rimmed *guan* pots, and double-loop handle beakers (Figure 5-6). The material culture from the seven tombs shows a close association with the Qijia material culture in the western highland (Figure 5-7; Figure 5-8). These tomb occupants were interred with pottery vessels, stone *bi* disks, turquoise ornaments, and even cowrie shells. The pottery vessels include slim long-collar *guan* jars with cord decor, single-loop beakers, double-loop beakers, triple-loop beakers, and a thin-body cup. Apart from the thin-body cup, the other pottery vessels resemble the Qijia material culture in the western highland, especially those discovered at the Chuankouhe site (Figure 5-9; Liu Shi’e 2001; Zhang Tian’en 2000, 2004, 2009; Duan Tianjing 2006; Jing Zhongwei 2003).

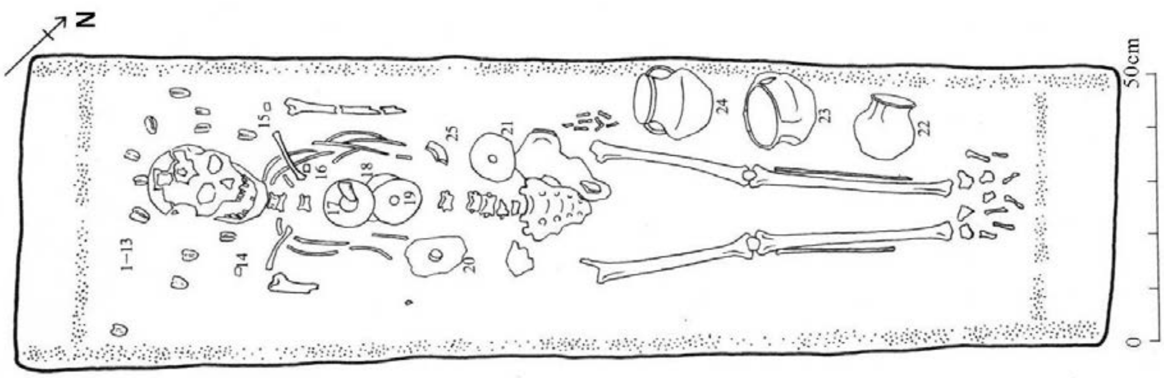

Figure 5-7 Tomb 86XIII1M39
(Liu Shi’e 2001: 49, Figure 30)
1-13. Cowriel Shells 14-16. Turquoise beads 17-21, 25. Stone *bi* disks 22-24. Ceramic jars

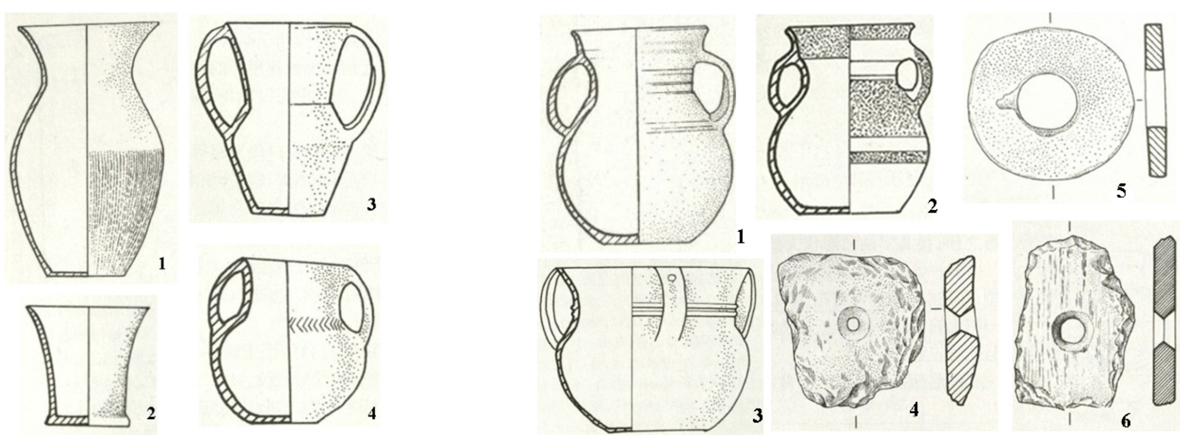

Figure 5-8 Some grave goods in the Erlitou-period tombs at Laoniupo
(based on Liu Shi’e 2001: 49, Figure 31-34)
Left: M1 1. Slim long-collar *guan* jar 2. Thin-body cup 3-4. Double loop-handle beakers
Right: M39 1-2. Double loop-handle beakers 3. Triple loop-handle beaker 4-6. Stone *bi* disks

Apart from pottery vessels, the other Erlitou-period remains at Laoniupo also attest to the possible association with the Qijia material culture in the western highland. For example, the occupants of the five tombs were interred with 21 stone *bi* disks, which were mostly laid between chests and knees of the deceased. The interment of stone *bi* disks in tombs was a characteristic of mortuary practice in the western highlands during the Longshan period, as evidenced by the large amount of stone *bi* disks at Huangniangniangtai (Gansu 1978). The tombs M38 and M39 yield a total of 22 cowrie shells, which were also widely adopted in the western highlands from the Longshan period (Peng and Zhu 1999). Moreover, turquoise beads and pieces also indicate the possible association with the Qijia material culture in the western highlands, as described in Chapter 3.

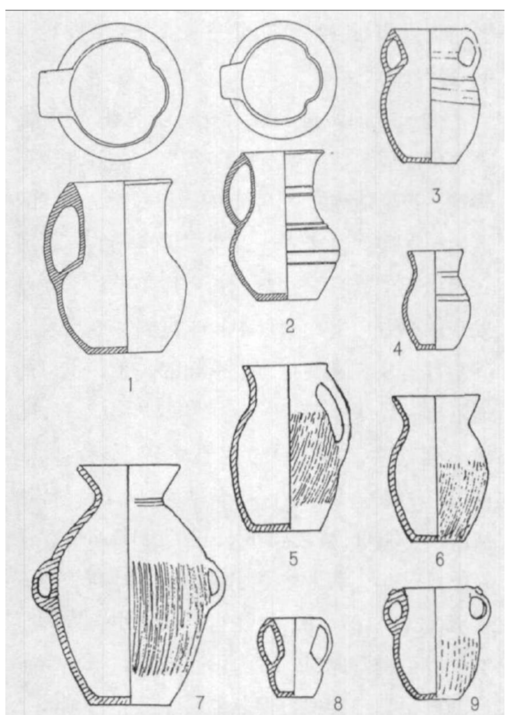

Figure 5-9 Ceramic assemblage excavated from the Chuankouhe site
(Zhang Tian'en 2009: 22, Figure 2)
1-2. Single loop-handle beakers 3, 8-9. Double loop-handle beakers 4, 6. Small *guan* jars
5. Single loop-handle *guan* jar 7. Double ring-handle *guan* pot

The Erlitou-period assemblage at Laoniupo demonstrates that it continued to be dominated by the highland cultural groups during the Early Erlitou. With the collapse of the Taosi society in the Jinnan Basin during this period, the cultural groups from the western highlands infiltrated the Ba River valley. Multiple lines of evidence, especially pottery vessels and stone *bi* disks, show the linkage of identity of the deceased in seven tombs of Laoniupo associated with Qijia material culture in the western highlands. It is possible that a small group of people migrated from the western highlands into the Guanzhong Basin and further south into the Shangluo Corridor (Zhang Tian'en 2009).

5.2.2 Settlement pattern of the Upper Dan River

The Dan River originates from the Qinling Mountain Range to the northwest of the present Shangluo city. After flowing in the valleys for nearly 30 kilometers, the Dan River enters the Shangluo-Danfeng basin, which is a 15 kilometers long and two kilometers wide corridor. The Shangluo-Danfeng basin along the Upper Dan River is historically called "Shangshan-Wuguan Passageway" and was considered as the most vital connection route to the Guanzhong Basin in ancient China (Li Xiaocong 2004: 245-249). The Dan River enters the valleys to the east of the Danfeng County seat, and runs out of valleys in Jingziguan Township of Xichuan County. From Jingziguan Township to Danjiangkou City, the terrain gradually turns wider and more flat. The Danjiangkou area, which is the alluvial fan that the Dan River flows into the Han River, is the largest plain along the Dan River, but most of this plain is currently underwater due to the construction of the Danjiangkou reservoir. Before analyzing materials excavated at the Zijing and Donglongshan sites, here I first present the long-term settlement pattern.

The archaeological sites along the Dan River are mostly distributed in the Shangluo-Danfeng Basin, and the Lower Dan River from Jingziguan to Danjiangkou city (Guojia and Henan 1991: 228; Guojia and Hubei 2002: 184; Guojia and Shaanxi 1998: 351, 354-357). The distribution of the Neolithic and Bronze Age sites is similar to that of other periods. My survey along the Dan River from Shangluo city to Jingziguan Township, and the investigation into the collection of the third national survey from Shaanxi Provincial Institute of Archaeology attests to this. Even though some sites are located in valleys, the pottery sherds collected in these sites are few. Those sites in valleys are small, probably due to the limited space available and erosion through history.

Here I present the changing settlement pattern from the Yangshao to the Erlitou period, by integrating information of my archaeological survey and the data from the third national survey[1]. I take the Yangshao period into consideration, in order to more clearly look into change of settlement pattern through a long-term perspective. The statistics of sites attest to the trend of gradual depopulation from the Yangshao to the Erlitou period. Survey data collected along the Dan River from Shangluo City to Jingziguan Township show that the number of sites decreased rapidly. The number of sites dating to the Yangshao period, according to the frequency of pottery sherds, is 41, but that decreased to 16 in the Longshan period, and only 3 in the Erlitou period. Since the duration of the Yangshao period (approximately 2000 years) is much longer than the Longshan period (approximately 400-500 years), it is hard to indicate the abrupt decease of site number from the Longshan to the Erlitou period. However, the duration of the Longshan period and the Erlitou period (approximately 300 years) was similar. It can be concluded that an abrupt

[1] I give my sincere thanks to Mr. Zhang Tian'en and Ma Yongying from Shaanxi Provincial Institute of Archaeology for permitting me to examine the collection obtained in the Shangluo City region during the Third National Archaeological Survey.

decease of population occurred during the Erlitou period. The result of my survey resembles the collapse phenomenon in northern China in the central regions from the Longshan to the Erlitou period.

On the other hand, the spatial distribution of these sites also shows that the settlement pattern underwent a diachronic change from the Yangshao to the Erlitou period. During the Yangshao period, a total of 25 sites are distributed in the Shangluo-Danfeng Basin, while 7 in valleys from the Danfeng County seat to Jingziguan Township. Besides, a total of 9 sites are located in valleys of tributaries of the Upper Dan River. In the Longshan period, a total of 7 sites are discovered in the Shangluo-Danfeng Basin, 4 in valleys of the main stream of the Dan River from Danfeng to Jingziguan, and 5 in valleys of tributaries. All of the 3 sites dating to the Erlitou period are distributed in the Shangluo-Danfeng Basin. In a long-term perspective, the prehistoric communities left tributaries of the Dan River and moved to the main stream of the Dan River.

The long-term change of the settlement pattern probably attests that the primary focus of the human use of the Dan River valley gradually shifted from sedentary settlement to transportation (Liu and Chen 2002: 100). With population concentration in the highland regions in the Longshan period, and then to the Luoyang Basin in the Erlitou period (Sebillaud 2014; Zhang Chi 2017a), the depopulation in the Dan River valley probably shows that the human occupation along the Dan River increasingly served as a connecting corridor.

5.2.3 Zijing-Donglongshan

Even though several sites are distributed in the Upper Dan River valley, only three sites dating to the Longshan and Erlitou periods have been excavated: **Zijing, Donglongshan and Guofenglou**. The excavation materials of the Guofenglou site have not been published yet, but the materials of Zijing and Donglongshan could provide much information about ancient exchange and community organization. Zijing is located on the secondary terrace to the south of the Dan River, seven kilometers to the east of the Shangluo urban district. The terrace is about five meters above the riverbed, and the area of Zijing in preservation now is ten hectare. The relationship of Zijing with Donglongshan is close. The Donglongshan site, which also measures ten hectare, is located on a tableland to the north of the Dan River, only two kilometers to the west of the Zijing site. According to the excavations at Zijing and Donglongshan, they were both occupied during the Longshan period (Shangxian et al. 1981; Wang and Zhang 1987; Shaanxi and Shangluo 2011). Therefore, the two sites should be considered as a whole during the Longshan period. The Donglongshan site was occupied during the Erlitou period, namely during both the Early and Late Erlitou, while the Zijing site had probably been abandoned during that time.

The Zijing and Donglongshan sites, in a broader perspective, are located at the crucial connection point of communication along the Dan River. As introduced above, they are located at the westernmost of the Shangluo-Danfeng Basin. To the north is the watershed between the Dan River and the Luo River, while to the west is the watershed between the Dan River and the Ba River. These three rivers are originated from the circum-Mt. Hua region; therefore, to connect the Middle Yangzi Basin with the Luoyang and Guanzhong Basin, Zijing and Donglongshan were located as critical exchange nodes during the Longshan and Erlitou periods. Besides, copper, lead, tin and turquoise mines are deposited to the north of Donglongshan, also making Zijing-Donglongshan distinctive in terms of mining and exchange during the Neolithic and

Bronze Ages.

To take a closer look at the landscape, Donglongshan is also advantageous. It is located on the secondary and tertiary tablelands to the north of the Dan River. The tablelands belong to a branch extending from the Mangling Mountain Range into the Shangluo-Danfeng Basin and arriving at the bank of the Dan River. The secondary and tertiary tablelands are twenty and thirty meters above the ground respectively. It is a plain to the west and east of Donglongshan, and the Dan River southeastward at the foot of the tablelands where Donglongshan is situated, providing enough agricultural lands for residents at Donglongshan. Moreover, the landscape configuration of Donglongshan was also beneficial for residents to monitor the western end of the Shangluo-Danfeng Basin.

Ceramic assemblage

The ceramic assemblage of Zijing and Donglongshan clearly reflects that the westernmost part of the Shangluo-Danfeng basin was strongly connected with the highland regions during the Longshan period. At Zijing, the pottery assemblage closely resemble the material culture in the highland regions, including pouch-legged *li* tripods with single handle, pouch-legged *jia* tripods, appliqué-rimmed pots, long-collar *guan* jars, and double and single loop-handled beakers (Figure 5-10). Similar to that of Zijing, the Longshan assemblage of Donglongshan was also dominated by highland-style pottery vessels. However, the occurrence of round-bottom pots with cord decor on the surface and mushroom-handled lids reveals connections with the Middle Yangzi River Basin and the circum-Mt. Song region respectively (Hu Pingping 2014: 23-24).

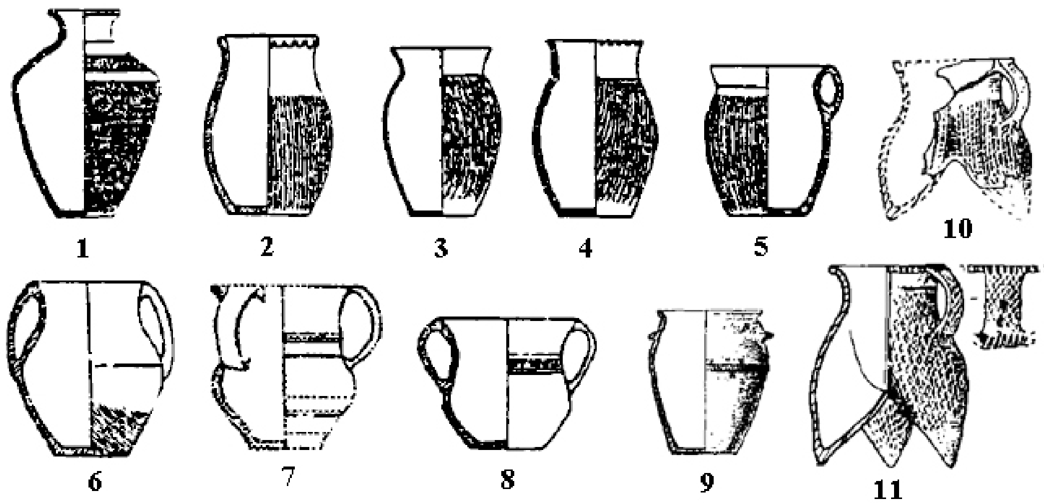

Figure 5-10 Longshan ceramic assemblage of Zijing
(based on Shangxian 1981: 41, Figure 14; Wang and Zhang 1987: 13, Figure 19)
1. long-collar *guan* jar 2, 4. Appliqué-rimmed pots 3. Small jar 5. Single ring-handle *guan* jar 6, 8. Double loop-handle beakers 7. Triple loop-handle beaker 9. *Guan* jar
10-11. Pouch-legged *li* tripods with single handle

Zijing was abandoned during the Early Erlitou, namely the first and second phases of the Erlitou culture. During the Early Erlitou, Donglongshan stood out as the most important site in the westernmost of the Shangluo Corridor. The ceramic assemblage during the Early Erlitou at Donglongshan shows connections towards multiple directions (Figure 5-11). Strong connections with the highland regions continued during the Early Erlitou, as attested by the existence of appliqué-rimmed pots, long-collar *guan* jars, single-handled jars with cord decor, single, double and triple loop-handled beakers, and so on. However, pottery vessels also reflect cultural connections with other regions. The large quantity of round-bottom pots with cord design indicate the connection with the Middle Yangzi River Basin, especially the west of Middle Yangzi River basin (Hubei 1988, 1996; Yidu 1985). Also, large-mouth *zun* urns, *gu*-style cups, and ring-legged *dou* bowls show the association with the Erlitou material culture in the Luoyang Basin (Shaanxi and Shangluo 2011: 277-278). These connections and parallels presumably reflect multiple cultural groups participating in the exchange along the Dan River.

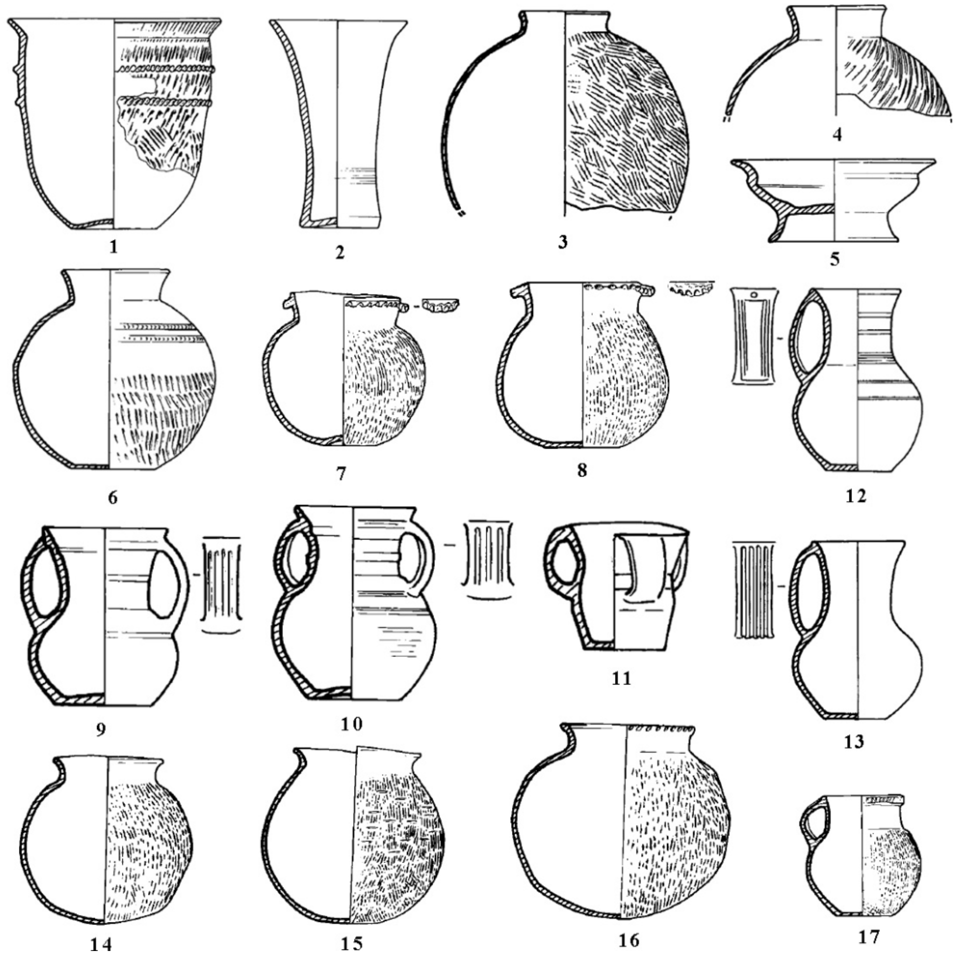

Figure 5-11 Pottery vessels during the Early Erlitou at Donglongshan
(based on Shaanxi and Shangluo 2011: 104-123, Figure 66, 71-75, 78)
1. Large-mouth *zun* urn 2. *Gu*-style cup 3-4. Small-mouth *guan* jars 5. Ring-legged *dou* bowl 6. Long-collar *guan* jar 7-8. Appliqué-rimmed *guan* jars 9-10. Double loop-handle beakers 11. Triple loop-handle beaker 12-13. Single loop-handle beakers 14-16. Round-bottom pots 17. Single-handled jar

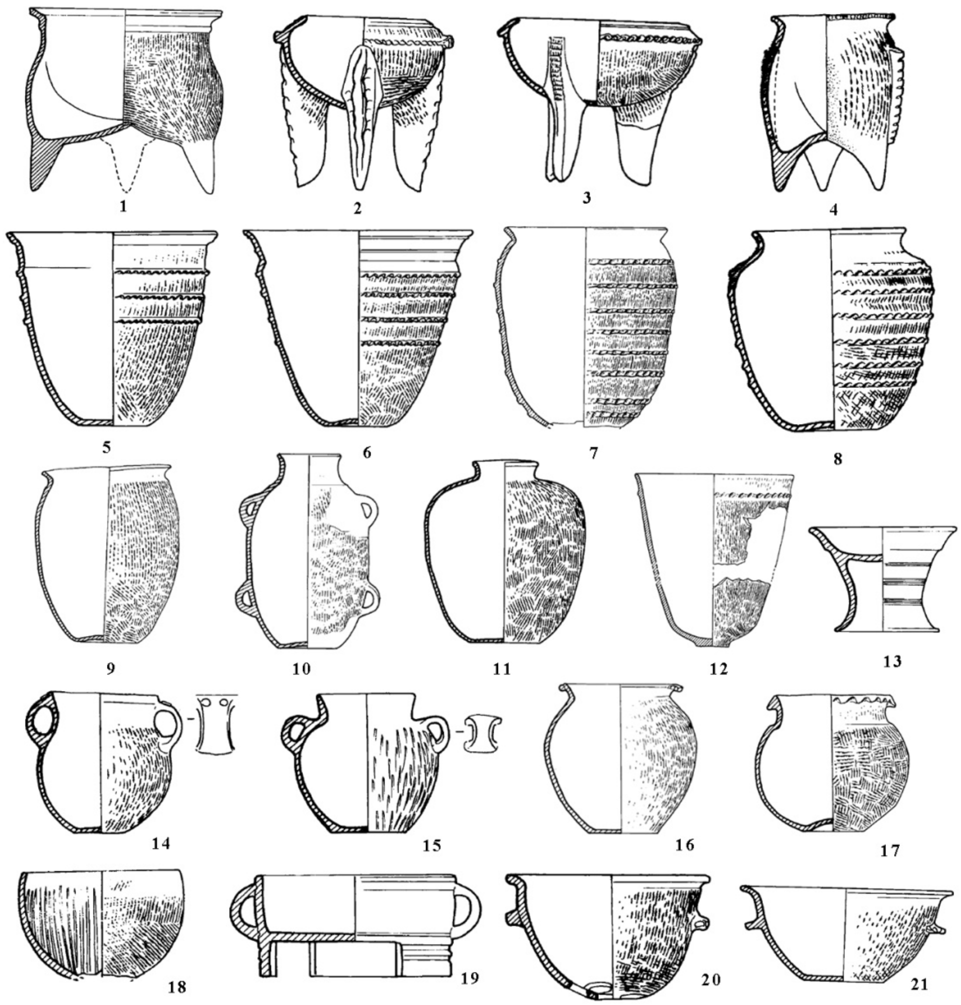

Figure 5-12 Pottery vessels during the Late Erlitou at Donglongshan
(based on Shaanxi and Shangluo 2011: 158-181, Figure 101, 102, 104, 106-110, 112, 113, 115, 117)
1, 4. Pouch-legged *li* tripods 2-3. Contracted-mouth d*ing* tripods 5-6. Large-mouth *zun* urns 7-8. *Zun* vats 9. Long-body *guan* jar 10. Four ring-handle *hu* pot 11. Small-mouth *guan* pot 12. *Gang* vat 13. Ring-legged *dou* tray 14-15. Double ring-handle *guan* jars 16. *Guan* jar 17. Appliqué-rimmed *guan* jar 18. Grinding bowl 19. Triple-legged *pen* basin 20. *Zeng* steamer 21. *Pen* basin

During the Late Erlitou, as in many other regions, the ceramic assemblage at Donglongshan attests to the cultural expansion of the Erlitou society (Figure 5-12). Pottery vessels at Donglongshan are stylistically consistent with those excavated in contemporaneous sites in the Luoyang Basin during this period (Shaanxi and Shangluo 2011: 279-280). Most of pottery vessels can be found with similar styles at the Erlitou site, such as contracted-mouth *ding* tripod with triangular legs, large-mouth *zun* urns, *pen* basins, grinding bowls, *zeng* steamers, ring-legged *dou* trays, lids with mushroom-shaped handles, and small-mouth pots with cord design (ibid). Some highland ceramic styles, like appliqué-rimmed pots, were shared with the contemporaneous Luoyang Basin, but the quantity of them is much lower than those during the Early Erlitou. The connection with highland regions did not cease during this period, as shown by the existence of double loop-handled beakers and stone *bi* disks, but the quantity is very low.

Cemetery

Part of a cemetery dating to the Longshan and Erlitou periods has been uncovered (Figure 5-13). During the Late Erlitou, several tombs have also been excavated. These tombs provide information about social organization of Donglongshan. Here I first focus on the cemetery of Longshan period and the Early Erlitou, and then briefly analyze Late-Erlitou tombs.

Identity of the deceased:

Since the tombs during the Longshan period contain no grave goods and their dates were only established on the basis of stratigraphy, it is hard to assess the identity of the deceased. Therefore, I focus on tombs of the Early Erlitou. Even though ceramic assemblage shows that the cultural connections of Donglongshan were multi-directional, the deceased during the Early Erlitou were probably originated from the western highlands. A total of 38 Early Erlitou tombs have been uncovered, which are all primary burials with single person buried inside. In these tombs, nearly all grave goods are single and double loop-handled ceramic beakers and stone *bi* disks. Single and double loop-handled ceramic beakers closely resemble the Qijia material culture discovered in the Chuankouhe site in the western highlands (Zhang Tian’en 2009). The stone *bi* disks, which characterize the Qijia mortuary practice as seen at Huangniangniangtai (Gansu 1978), also indicate close connection of the deceased with the western highlands (Zhang Tian’en 2009). Similar to tombs excavated at Laoniupo, the people from the western highlands probably migrated to Donglongshan and participated in the exchange network along the Dan River. As introduced in chapter 3, the demand for natural resource was probably a stimulus of population movement from the western highlands into the Shangluo Corridor.

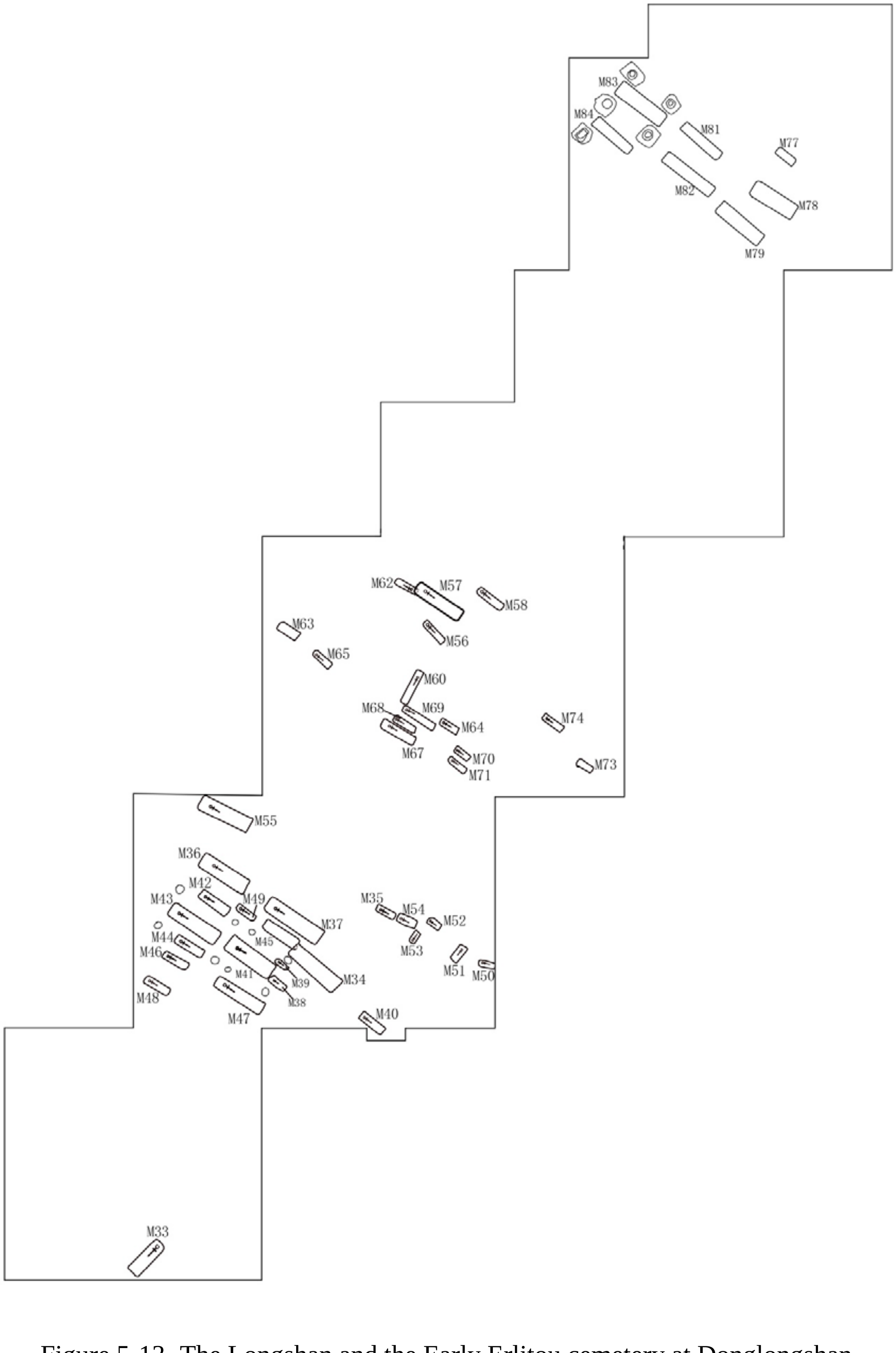

Figure 5-13 The Longshan and the Early Erlitou cemetery at Donglongshan (based on Shaanxi and Shangluo 2011: 22-23, Figure 11 and 12)

Organization of cemetery:

The spatial distribution, orientation and relations among tombs suggest that the cemetery was being contructed continuously from the Longshan to the Erlitou period. According to the excavation report, the assemblage during the Longshan period and the Early Erlitou has only been excavated in Section III, indicating that actual area of occupation during the Longshan period and the Early Erlitou would be much smaller than the total area of the Donglongshan site. Nine tombs are dated to the Longshan period, while 40 tombs are dated to the Early Erlitou. A total of 46 tombs are shaft tombs. All the Longshan tombs are oriented northwest, which is the same with most of the Early Erlitou tombs. Although the Longshan tombs are distributed in a limited space, they were not obviously separated from the Early Erlitou tombs. Moreover, no obvious evidence of intrusive relations was discovered. Only small areas in the southeast of tomb M62 and M45 were intruded by tomb M57 and M34, but they were not severely damaged. The formation process of this cemetery was also consistent with the continuing strong connections with the highland regions reflected by the ceramic assemblage during the Longshan period to the Early Erlitou.

Apart from a tomb M33 in the far southwest, the whole cemetery could be divided into three groups. The south group includes 1 urn burial and 22 shaft tombs. The shaft tombs were organized around the tombs M41 and M43, which contain the largest quantity of grave goods in the south group, and tombs M36 and M37. Postholes are discovered around the tomb M41 and M43, suggesting the existence of architecture outside. Most of the deceased are infants and children, whose tombs are distributed among the adult tombs. The adult tombs include M34-37, M40, M41, and M43. The juvenile tombs include M38-39, M42, M44-46, M48, and M49-55. Infants and children' tombs share the same orientation and burial forms with adult tombs. In the east of the south group, the situation is a little different. Infants' and children' tombs are distributed to the east of an adult tomb M35. Generally, it can be observed that the infants' and children' tombs were distributed close to adults. Since DNA testing on these bones has not been conducted, no information could attest to the exact genetic ties between specific adults and juveniles. However, this type of burial arrangement indicates that the organization principle of the south group was based on the relationship between adults and juveniles. It is of high probability that the south group was organized on a kinship basis. Moreover, the two pairs of tombs, M41 and M43, and M36 and M37, were the center of the south group. All the other tombs were distributed around the two pairs. In the two pairs, the occupants of M41 and M36 were adult female, while the occupants of M43 and M37 were adult female. This spatial distribution suggests that the adult tombs in the south group were probably organized on a male-female basis. The most possible relationship between males and females was marital.

The middle group includes 16 shaft tombs during the Longshan period and the Early Erlitou. The spatial distribution of the middle group is not as clear as the south group. The Longshan tombs are distributed in the southeast of middle group. The excavation report has ambivalent description of the deceased of these Longshan tombs. The identification report of human bones says that all the Longshan tomb occupants are juveniles, but the main texts say that occupants of tomb M67, M68 and M69 are adults. By observing figures of these tombs, the occupants of tomb M67 and M69 were probably older than others. I hypothesize that these Longshan tombs were probably organized around M67 or M69. The other tomb occupants in the middle group were mostly juveniles. Only the occupant of tomb M66 was a 30-year-old female, which was accompanied by two children' tombs to her east. It is hard to estimate on what principle the middle group was organized.

The north group only includes seven shaft tombs. The seven shaft tombs were organized into three rows: M83 and M84, M81 and M82, and M78, M79 and M77. Similar to the south group, these adult tombs were arranged on a male-female basis. Occupants of tomb M79, M82 and M83 are males, while those of tomb M78, M81 and M84 are females. The occupant of tomb M77 is juvenile and was probably attached to M78 and M79. The most possible relationship between male and female in each pair was also marital.

Although the organization of the middle group is not clear, to sum up, the south group and north group of tombs show that this cemetery during the Longshan period and the Early Erlitou was more likely to be organized based on marital- and kinship-based relations. No evidence of profession- or rank-based organization is identified from this cemetery at Donglongshan, suggesting that an administrative system was probably not established during the Longshan period and the Early Erlitou.

Status differentiation:

Based on currently excavated materials, I argue that the cemetery during the Longshan period and the Early Erlitou shows no direct evidence of hierarchical order. This can be observed from several aspects. First, these tombs only fit the sizes of the deceased. Adult tombs were normally 1.9-2.4 meters in length and 0.6-0.8 meters in width. No obvious difference on size has been observed. The size of juvenile tombs was also based on the size of occupants. Second, the use of coffins did not follow any rules. Their occurrence did not correlate with such variables as age, sex, number of grave goods, and spatial distribution. For example, archaeologists discovered that 11 tombs contain coffins. In these tombs, the occupants of M42, M44, M45 and M46 were juveniles. Apart from four juveniles, the tomb occupants with coffins include four adult males and three adult females. Archaeologists uncovered totally 15 adult tombs in this cemetery, but only seven had coffins. Moreover, a total of 22 tomb occupants were interred with grave goods, but only 10 were interred in coffins. Tomb M45 did not contain any grave goods but a coffin. The above analysis shows that coffin did not serve as an indicator of status in this cemetery. Third, the grave goods are dominated by pottery vessels and stone *bi* disks. The number of pottery vessels ranges from zero to two, showing no status differentiation based on quantities of pottery vessels. Stone *bi* disks were discovered in seven tombs (Figure 5-14). Apart from one tomb, the other tomb occupants were all adults. However, stone *bi* disks are easy to be made. Many drilled cores have also been discovered at Donglongshan, attesting that the stone *bi* disks were produced locally. Besides, nearly half of stone *bi* disks at Donglongshan are excavated from strata and ash pits, suggesting that they were not precious items. All of these facts suggest that stone *bi* disks probably did not serve as an indicator of hierarchy at Donglongshan. Other grave items, such as few pieces of cinnabar, small stone disks, are obviously not able to be hierarchical indicators either.

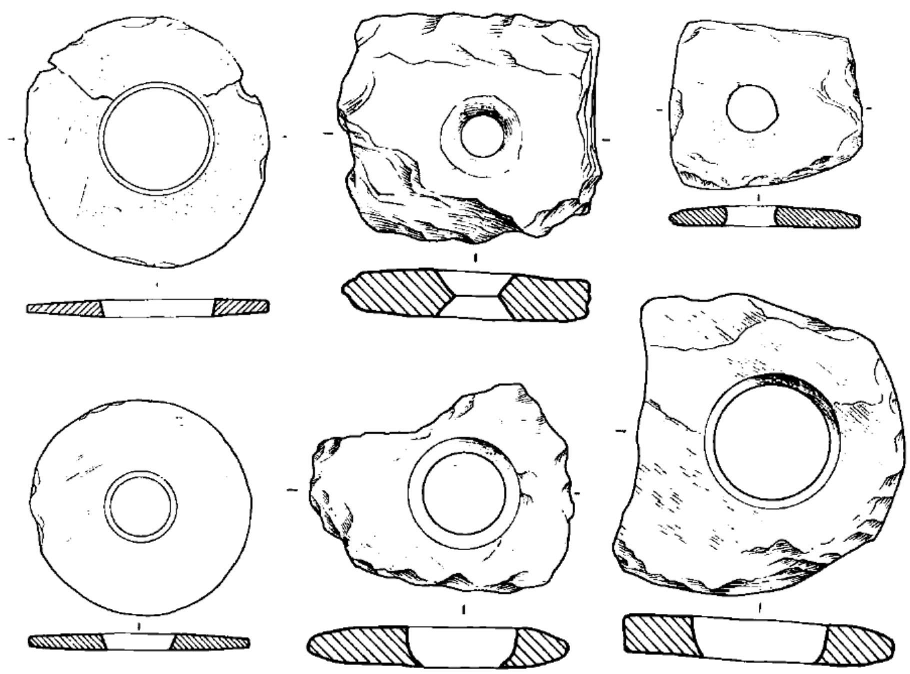

Figure 5-14 Stone *bi* disks during the Early Erlitou at Donglongshan
(Shaanxi and Shangluo 2011: 131, Figure 83)

Two pairs of tombs need more analysis: tomb M41 and M43, and M83 and M84 (Figure 5-15). The two pairs of tombs are respectively the center of south and north grave group. The postholes suggest that architectures were constructed on top of them. The male tomb occupants in M43 and M83 were interred with a large quantity of grave goods. In M43, 22 stone *bi* disks are excavated, occupying half of stone *bi* disks interred into tombs. In M83, three stone *bi* disks, one jade axe and one jade scepter, one stone tablet, and two lacquer objects are excavated. The two jade objects were widely used in the religious sphere in the highland Longshan centers, especially the jade scepter, which is a significant indicator of the interaction network with the highland Longshan and the Erlitou world (Deng Cong et al. 2014). The interment of these jade objects suggests that the deceased of M83 was probably closely related to religious activities and enjoyed a religious prestige at Donglongshan. The architecture on these tombs and the large quantity and quality of grave goods suggests that the four tomb occupants probably enjoyed higher social status than others, especially the male occupants in M43 and M83. However, current evidence could not demonstrate the existence of a hierarchical order at Donglongshan cemetery. First, the scales of the four tombs were not different from others. All these tombs only fit the sizes of the deceased. Second, no independent district was segmented for the four higher-status tombs. This suggests that the four tomb occupants did not differ too much on social class or hierarchy with others, but were still organized into a kinship-based community. Third, the grave goods of M41 and M84 do not show any distinctiveness from other tombs. For example, the tomb occupant of M41 was interred with a ceramic vessel and five stone *bi* disks, and that of M84 was interred with a ceramic vessel and eight stone *bi* disks. No coffin has been excavated in M84. This shows that the two female tomb occupants, who were closely related to the male tomb M43 and M83, were not more superior to others in hierarchy. Fourth, the four tomb occupants were all more than 40 years old, and other tombs in the south and north groups were organized in the center of the two pair. Therefore, the higher status of the two pairs of tomb occupants was more probably due to their advanced age or religious prestige. No direct evidence could show the existence of a hierarchical order at Donglongshan.

Besides, eight Late Erlitou tombs, including an urn burial and seven shaft tombs, have also been excavated. Similar to the Longshan and Early Erlitou tombs, these Late Erlitou tombs does not show social distinction. The scales of these tombs are only fit for the bodies of the deceased. Except for one tomb, which contains a pottery vessel, the other tomb occupants were interred with no grave goods.

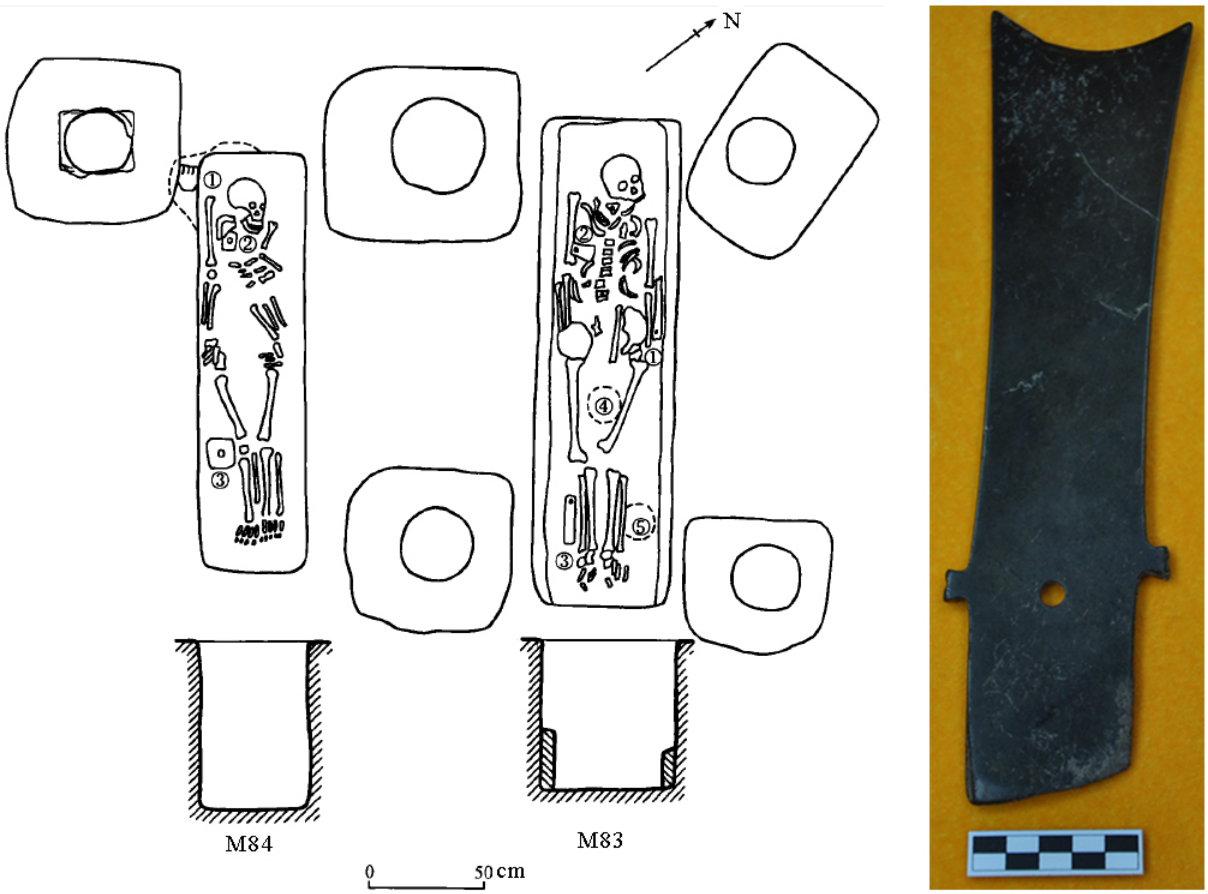

Figure 5-15 Left: Plan of tomb M83 and M84
(based on Shaanxi and Shangluo 2011: 91, Figure 57)
Right: Jade scepter from M83 (photograph by the author in the Shangluo City Museum)

To briefly summarize, the currently excavated tombs show that a hierarchical order was probably not established at Donglongshan during the Longshan and Erlitou periods. The organization of the cemetery was probably based on a kinship and marital relation. This suggests that an administrative or regulatory system had not been constructed during the Longshan and Erlitou period.

Economy

The production at Donglongshan mainly includes subsistence economy and craft production.

Stone tools can provide information about subsistence economy at Donglongshan. Nearly 200 stone tools of Donglongshan during the Longshan and Erlitou periods were mainly agriculture-related tools, such as axes, adzes, chisels, knives, sickles, and so on. These stone tools were also found in most of Neolithic and Bronze Age communities in the heartland of China. Compared with stone tools, remains of craft production related to mining are few. Only one small piece of turquoise has been discovered during the Early Erlitou. Archaeologists discovered two small metal pieces, and two small chunk of smelting slag in the Late Erlitou assemblage, showing that the Donglongshan community had carried out metallurgical activities during this period. The Donglongshan people probably acquired natural resources from mountains to its north, and processed them at Donglongshan. Compared with agriculture-related production, lapidary and metallurgical work occupied a small proportion in economy, suggesting that the primary work of the Donglongshan community was still agricultural, such as plant cultivation, woodworking, and so on. Mining was probably still a small-scale and sporadic activity during the Longshan and Erlitou periods. It is also because of this that mining tools, such as stone hammers, have not been discovered in local communities. Local miners normally fashioned mining tools near the mines.

5.3 Discussion

By investigating mining and archaeological remains of the Longshan and Erlitou periods in the western Shangluo Corridor, I summarize the key points as follows:

(1) The estimation of the scale of mining in Luonan County suggests that early mining was probably a small-scale and part-time activity;

(2) The primary work of local communities was agriculture-related productions;

(3) The communities were more probably organized on the basis of kinship or marital relationship. No obvious evidence shows that a profession- or hierarchy-based order existed. This suggests that an administrative system was probably not established in the western Shangluo Corridor;

(4) Remains of craft production related to mining in communities are few;

(5) The sphere of exchange during the Longshan and Erlitou periods was broad.

The above strands of evidence show that mining fits the model of local, village-based, and small-scale industry during the Longshan and Erlitou periods. Although the western Shangluo Corridor was occupied by highland communities during the Longshan period and the Early Erlitou, and then by Erlitou communities during the Late Erlitou, current evidence demonstrates that state-controlled mining did not exist in this region. No evidence of full-time specialists, intensive mining, administrations, and defensive fortresses has been discovered in mines and local communities. Rather, a local, small-scale and village-based production probably dominated in this region. Local communities were more probably autonomous, at least in the sphere of production, instead of being state-controlled.

Based on the materials from Donglongshan, this production mode continued to the Erligang period. Even though organization principle of the Erligang-period cemetery was probably different from the Longshan period and the Early Erlitou, no evidence shows the existence of a hierarchical order in the Donglongshan community during the Erligang period. The scales of tombs were also only fit for the sizes of the deceased. The grave goods only include pottery vessels and bone objects, indicating that no obvious status differentiation existed among tomb occupants. The large quantity of agricultural tools shows that the economy was still dominated by agriculture-related productions. Although seven metal objects have been excavated, no smelting and casting remains have been excavated. All these lines of evidence suggest that mining was probably also carried out on a local, small-scale, and sporadic basis.

The small-scale and extensive production does not mean a simpler or less advanced production mode (Stöllner 2014), and societies with the small-scale and extensive production could also participate in interregional exchange system. The long-term settlement pattern suggests that local communities gradually moved from tributaries to the main stream of the Dan River from the Yangshao period to the Erlitou period. This trend was probably due to the goal of maximizing benefits of agriculture, craft production and exchange. The valley bottoms of the main stream of the Dan River not only had more agricultural and residential lands, which were probably more secure for economic stability, but also more efficient for ancient exchange with other cultural groups.

The ceramic assemblages of Donglongshan and Laoniupo suggest that highland communities actively participated in the exchange system along the Shangluo Corridor during the Longshan period and the Early Erlitou. With a goal of prospecting and procuring natural resources, cultural groups in the highland regions, especially from the western highlands associated with the Qijia cultural tradition, came to the western Shangluo Corridor and participated in exploitation of resource in mountains of the western Shangluo Corridor. The existence of round-bottom pots, *gu* cups, and mushroom-handled lid also indicates exchange with the Middle Yangzi Basin and the Luoyang Basin respectively. During the Late Erlitou, cultural expansion of Erlitou abruptly changed ceramic assemblage at Donglongshan. “This phenomenon may indicate a rapid replacement of material culture on the periphery caused by population expansion or colonization form, and cultural assimilation with.” (Liu and Chen 2003: 82) However, assimilation into the Erlitou culture does not mean the Erlitou state’s direct control over mining industry and exchange. No matter whether we define the highland Longshan centers, such as Taosi and Shimao, as states (eg. Dai Xiangming 2016; Gao Jiangtao 2009), or whether we define Erlitou as a state (eg. Liu and Chen 2003), current data shows no evidence of state-controlled resource extraction and transportation in the western Shangluo Corridor. To change the previous top-down perspective to a bottom-up perspective, and investigate the Hekou mine and the local communities in detail, I can conclude that a small-scale, local, village-based mining activity dominated the western Shangluo Corridor during the Longshan and Erlitou periods, even in the Erligang period. The local communities were most probably autonomous.

6 Mining and archaeology in the eastern Shangluo Corridor

In this chapter, I mainly analyze mining and archaeological information in the eastern Shangluo Corridor. The eastern Shangluo Corridor includes the lower Dan River valley, and the upper Han River valley from Danjiangkou city in the east to Ankang City in the west. I will first introduce my survey of nine turquoise mines in southeast Shaanxi and northwest Hubei provinces, and estimate the scales of early turquoise mining based on the cultural landscape and the modern mining activities. Then I will analyze archaeological information and production mode based on the excavated sites during the Longshan and the Erlitou periods.

6.1 Survey of turquoise mines

The eastern Qinling Mountain Range is known as the largest deposit of turquoise in China up to this date. Most of the turquoise mines are distributed in the region from southeast Shaanxi province to northwest Hubei province. This region contains not only the largest quantity, but also highest quality of turquoise in China. Besides, turquoise mines have also been found in Xichuan County of Henan province, but the quantity is probably much lower than in Shaanxi and Hubei provinces.

6.1.1 General information

The turquoise deposits in northwest Hubei and southeast Shaanxi provinces, according to the geologic investigations during the 1980s, are concentrated in three zones (Figure 6-1; Ma Yuxing 1989, in Ye Xiaohong et al. 2014). Most of turquoise mines are aggregated in the north and south zones. The middle zone only contains three mines. The north zone includes the largest quantities of turquoise mines. Some turquoise mines, such as the Yue'ertan and Muyingzhai mines, are located in the mountains near the Han River (Figure 6-1; Figure 6-2). Through about five to ten kilometers walking, miners can arrive at the bank of the Han River from the valley bottom of the two mines. Some of the other mines are not located along the Han River, but near its tributaries, such as the Yungaisi mine. The distance from the valley bottom of the Yungaisi mine to the bank of the Han River is approximately15 kilometers. The mines near Guanyin Township are also near a small tributary of the Han River. The turquoise could be easily transported to other regions through the Han River. As for the mines in the southern zone, the Huangcheng mine is located near the Du River, which is the largest tributary of the Han River, but other mines are located in valleys away from major rivers.

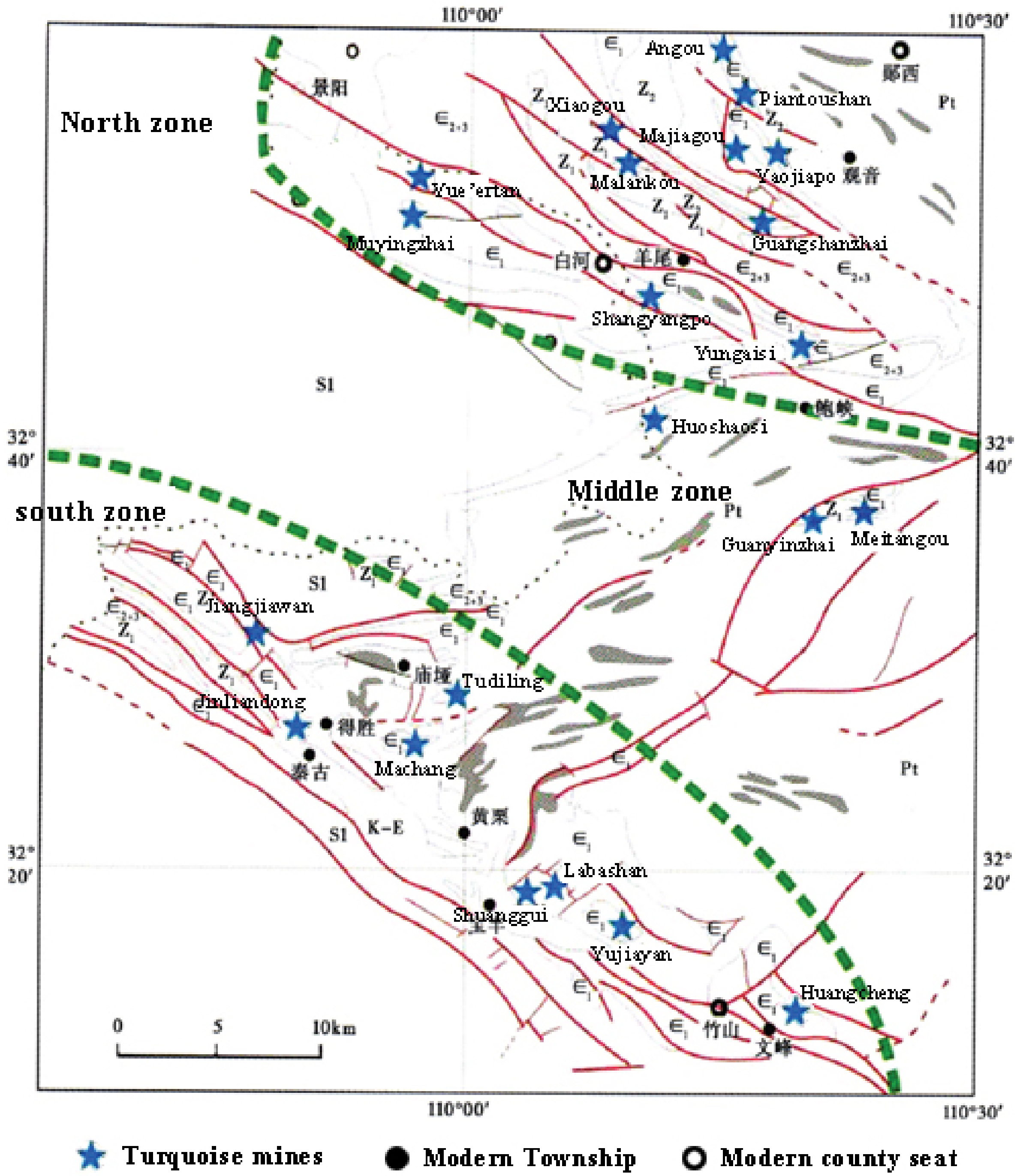

Figure 6-1 Turquoise mines in Northwest Hubei and Southeast Shaanxi Provinces (Ma Yuxin 1989, redrawn by Ye Xiaohong et al. 2014: 214, Figure 1)

Recent scientific testing suggests that the turquoise mines in north Hubei and southeast Shaanxi provinces had been exploited during the Longshan and Erlitou periods. For example, Li

Yanxiang et al. (2018) tested 15 samples of turquoise objects from two Longshan sites in the Jinnan Basin, Taosi and Xiajin, and sourced these samples to three mines: Hekou in Luonan County, Labashan in Zhushan County, and Bailongdong in Baihe County. Aside from Hekou, the Labashan and Bailongdong mines are distributed in the south and north zone respectively. Two other provenance studies attested that Erlitou probably acquired turquoise resource from the Yungaisi mine (Ye Xiaohong et al. 2014) and the Hekou mine (Xian Yiheng et al. 2016a). The distances among these mines are great, but the turquoises in these mines were exchanged into the Longshan and Erlitou centers. It is likely that most of turquoise along the Shangluo Corridor had been exploited during the Longshan and Erlitou periods.

6.1.2 The result of survey

In order to understand ancient turquoise mining in the eastern Shangluo Corridor, I conducted a survey in turquoise mines of northwest Hubei, southeast Shaanxi, and southwest Henan provinces during 2016-2017. I investigated nine locations (Figure 6-2). Similar to the Hekou mine, turquoise also occurs in veinlets and nodules in fractures and voids of rocks. Besides turquoise, many other types of minerals, such as marble, barite, mica, and sulphur, were also largely deposited in this region. Compared to turquoise, deposits of these minerals are much larger than turquoise in volume.

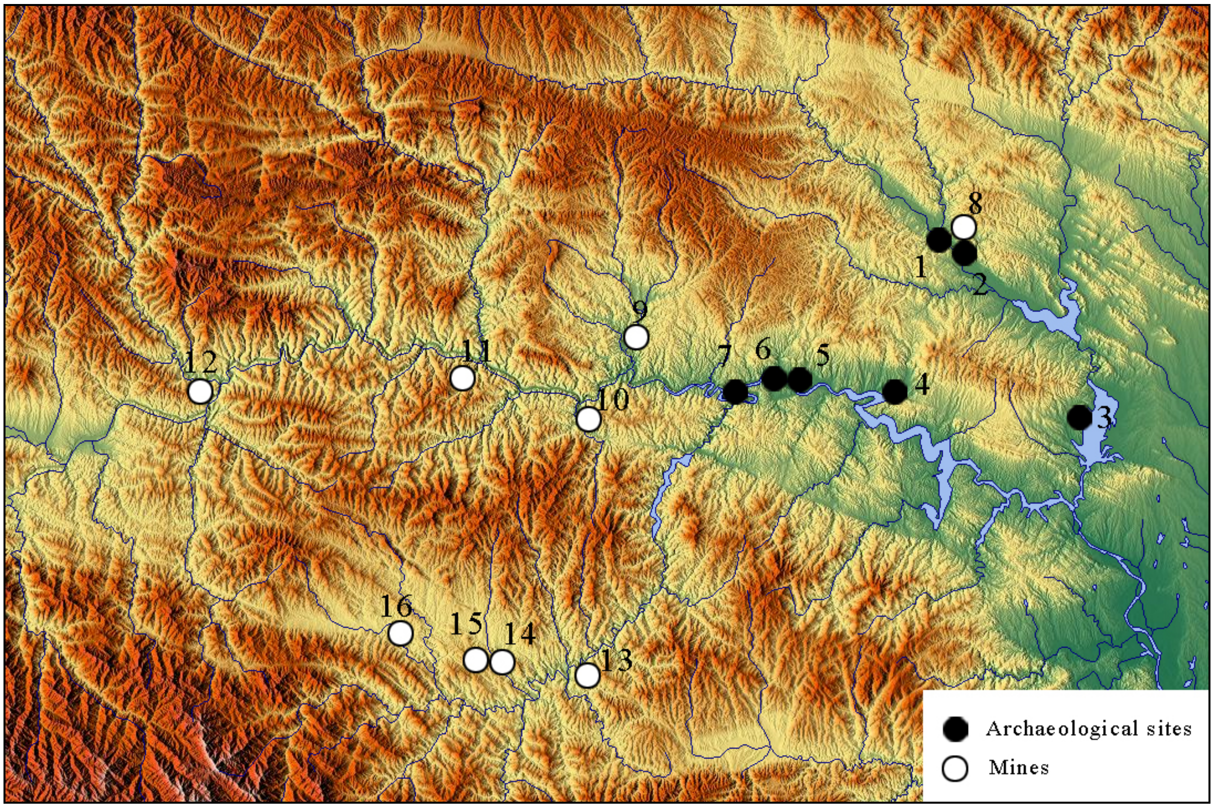

Figure 6-2 Major sites mentioned in this chapter
1. Xiazhai 2. Xiawanggang 3. Xiongjiazhuang 4. Liying 5. Qinglongquan 6. Dasi 7. Liaowadianzi 8. Dashiqiao 9. Yaojiapo 10. Yungaisi 11. Yue'ertan (Bailongdong) 12. Qingtonggou 13. Huangcheng 14. Yujiayan 15. Labashan 16. Jinliandong

The turquoise mines are all located deep in the mountains. Although the linear distance from some turquoise mines to the Han River is only several kilometers, it usually takes me at least 20-30 minutes to arrive at the valley bottom below the mines, since the narrow and winding roads largely limited the speed of driving[1]. Because all mines are located near the top or hillside of mountains, it usually takes another one to two hours to climb up to the entrance of workings. To take the Yue'ertan mine as an example, most of the workings are located deep in the

[1] For example, the roads to valley bottom of the Bailongdong mine workings and to the Yungaisi mine workings are both narrow and winding. I estimated that the speed of driving to the two mines was about 40 km/h or less. To follow the creeks at the valley bottoms, I imagine that ancient miners probably needed at least two hours to arrive at the foothills of the two mines.

mountains. The linear distance from the valley bottom to the villages on the southern bank of the Han River is about three to five kilometers. The workings are located at mountain tops or hillsides, instead of at the foot of mountains. The Bailongdong (White Dragon cave) mining tunnel cluster is such a case (Figure 6-3). The Bailongdong cluster includes more than ten tunnels, all of which are located at the top of one mountain. The linear distance from Yue’ertan village on the southern bank of the Han River is about five kilometers. After a 30-minute driving from Yue’ertan village to the foothill, it took me another one hour and a half to walk onto the Bailongdong cluster (Figure 6-4). Walking to the Yungaisi mine was the easiest journey. Since Yungaisi was the most famous turquoise mine in China, modern infrastructure was much better than that in other mines, but it still took a 40-minute driving to arrive at the platform near the top of the Yungai Mountain through the narrow and winding road (Figure 6-5).

Figure 6-3 Landscape of the Bailongdong mine viewed from the Bailongdong cave (photographed by the author)

Figure 6-4　On the way to the Bailongdong mining cluster (photographed by the author)

Figure 6-5　Landscape of the Yungaisi mine viewed from Yungaisi (photographed by the author)

Since many mines are still being mined nowadays, most traces of ancient mining traces have been obliterated. Three types of damage can be identified. First are sites where the ancient mines have been completely destroyed by modern activities. Modern miners have continued excavating using modern machinery, which has destroyed the former entrance and all other ancient traces. In this case, ancient mining traces could not be identified. Second, ancient tunnels are damaged but there are still visible traces of ancient mining activities that could be identified. The Bailongdong cave is such a case, which I will introduce below. Third are sites where dirt and debris of long-term exploitations have totally buried ancient mines. In this case, investigators could not observe any traces of ancient mining, and could not know whether or not ancient mining tunnels have been damaged or destroyed by modern mining activities unless an excavation is undertaken. As shown in Figure 6-6, for example, a large amount of dirt and debris has buried a valley of the Yungai Mountain, where the Yungaisi mine is located. According to the description of a local villager, who was possibly a part-time miner, many old workings have been buried underneath.

Figure 6-6 The dirt and debris at the Yungaisi mine
(photographed by the author)

Although most of ancient mining traces have been destroyed, I discovered two probable ancient mining sites. The first is the Bailongdong Cave (Figure 6-7), which is the primary tunnel of the aforementioned Bailongdong cluster. All of the mining tunnels, at least ten, of the Bailongdong cluster are located on one cliff face near the top of the mountain. Most of these tunnels are modern, with regularly round shapes and flat grounds. These modern tunnels are mostly not deep, with five to ten meters long. Some of these modern tunnels were left with modern machines inside. However, the primary tunnel of the Bailongdong cluster, the Bailongdong cave, was probably excavated in antiquity. Outside the entrance, the inscription of a stelae attests that the Bailongdong cave was mined at least in the Qing Dynasty, approximately 100-300 years ago (Xian Yiheng 2016: 85). The entrance of Bailongdong is 10-15 meters high and about 5 meters wide. Beyond the mine entrance is a 20-m-long slope paved with mining debris and dirt. At the end of the slope a horizontal tunnel has been dug, probably following a turquoise vein. Considering that this horizontal tunnel is round in shape with a level floor, which is similar to modern tunnels, it was probably excavated in modern times. The transition between the slope and the horizontal tunnel preserves stairs made out of small slabs that were probably constructed to avoid collapse of the slope. Several lateral tunnels have been excavated on both sides of the primary tunnel. These lateral tunnels are all modern and some of them have even penetrated to other mining tunnels. These small lateral tunnels are round in shape and relatively short, with modern remains left inside, suggesting that they were all excavated in modern times. It is hard to find ancient mining traces in this tunnel, but the stele and the difference in shape from modern mining tunnels show that the Bailongdong cave may have been mined during the Qing Dynasty. The aforementioned scientific testing suggests that the Bailongdong region was mined during the Longshan period. Due to the absence of diagnostic cultural remains, it is difficult to determine whether the Bailongdong Cave was mined at such an early period. Currently, mining at the Bailongdong cluster has been forbidden by the government, but mining activities are still being carried out in mountains nearby.

Figure 6-7　The entrance of the Bailongdong cave
(photographed by the author)

The second probable ancient working was preserved at the Labashan mine (Figure 6-8). There are many modern tunnels and shafts at Labashan. These workings are all located on a cliff face of the Labashan Mountain. As I observed, the slope of this cliff face was up to about 60 degrees. A large volume of dirt and debris have filled the valley below the cliff and have probably buried old workings underneath. At the top of the mountain, one tunnel without a defined shape was discovered. As mentioned above, modern mining is usually done with machines, the tunnels are round in shape and the floors of the tunnels are often flat. Ancient miners used stone, bronze, or iron tools, with which it was obviously more difficult to break hard rocks. They thus looked for fragile parts that were easier to dig, resulting in irregularly shaped tunnels. Due to the large amount of debris and waste, no ancient objects have been collected at this site.

Figure 6-8 A probable ancient mining tunnel in the Labashan turquoise mine (photographed by the author)

Aside from turquoise mines, I also investigated a cinnabar mine, Qingtonggou, in Xunyang County (Figure 6-2). As mentioned in Chapter 2, the cinnabar mines in the Xunyang region were one of the most important cinnabar resources in the ancient China. It is the closest source of cinnabar to the Longshan and early Bronze Age centers with a tradition of ritual use of cinnabar, such as the Jinnan and Luoyang Basins. The cinnabar mines are distributed from Zhen'an County in Shangluo city to the Anxi River in Xunyang County. It has been estimated that the Xunyang mines possesses 85.2% of the total amount of the cinnabar resources deposited in the Qinling Mountain Range (Wang Xueli 2013). It is also hypothesized to have been a source of mercury in the tomb of the first Emperor of the Qin Dynasty. The modern state-owned enterprise has stopped operations in this region, but private mining has still continued. Like turquoise mining sites, cinnabar-mining workings are distributed high in the steep mountains, either on the slopes or mountain peaks. It took me a 90-minute driving from the nearest township to the foothill and another half an hour climbing to reach them[1]. The modern mining activities are mostly carried out on mountain slopes, and the large tunnels have been excavated everywhere. Older mines, with smaller and irregularly shaped tunnels, can be sporadically discovered among them. According to a local villager, who is also probably a miner, at least 1000 old workings exist in the deep mountains. It would take more than half a day to reach them. I did not survey these old workings in deep mountains.

6.1.3 Estimation of scale

Compared to the Hekou mining site, it is not easy to estimate the scale of turquoise mining northwest Hubei and Southeast Shaanxi provinces, since most of ancient mines in these areas have been destroyed or are buried underneath modern dirt and debris. However, the Bailongdong cave is partly preserved and the scale of mining there could be roughly calculated. As mentioned

[1] Although the road to the Qingtonggou mine is winding, the width is much better than the road to the Yungaisi and Bailongdong turquoise mines. The driving speed to the Qingtonggou mine, as I estimate, was 60-80 km/h.

by Stöllner (2014), on the other hand, the scale of mining is closely related to the microlandscape around the mines. The small-scale operations are normally adopted when deposits are located in hostile landscapes that only permit impermanent access (Stöllner 2014). Therefore, my estimation of scale will take microlandscape into account.

First, I calculate the volume of the Bailongdong cave. As mentioned in above, the entrance of the Bailongdong cave is 10-15 meters high and 5 meters wide, and the slope in the cave is 20 meters long. The inner space of the cave shrinks from the entrance to the other end of the slope. As with the Hekou mine, I also use the largest size of each measurement of the cave and see the shape of the Bailongdong cave as a cuboid. In this case, the volume of the Bailongdong cave can be calculated to 1500 m^3 (15m×20m×5m). As at the Hekou site, here, I also use 0.5m^3/day as the reasonable speed of mining, so the total number of days to mine the Bailongdong cave should be 3000 days, about 8.2 years of unstopped mining by one person. As mentioned above, the stele shows that the Bailongdong cave was mined at least more than 100 years ago, and modern miners are still carrying out mining in this region. The ambivalence between the calculated and the real investment of time suggests that mining at the Bailongdong cave would only fit the model of extensive mining, which is characterized by the small-scale labor force involvement and the seasonal or sporadic activities. Considering that I exaggerate the size of the Bailongdong cave and that the history of mining at Bailongdong was probably much longer, as shown by scientific testing mentioned above, the scale of mining at Bailongdong in antiquity was probably much smaller than the result that I calculate here.

Second, the microlandscape of the Bailongdong cluster also suggests that local mining carried out in antiquity was probably small-scale (Figure 6-3). As introduced above, all of the mining tunnels are distributed on a cliff face of a mountain. The cliff rises at 45-60 degrees, so that no large areas of flat lands exist outside the workings. Most of the lands outside these mining tunnels are slopes. Even though some flat lands exist outside some of the mining tunnels, they are still small in size. The flat land outside the Bailongdong cave is the largest one, which measures only 10-15 m^2 in size. It can be clearly observed that the flat land outside the entrance of the Bailongdong cave was processed in modern times. The small areas of flat lands outside these mining tunnels does not permit large numbers of miners and other personnel to reside there, let alone the construction of other large-scale infrastructure; this would be an impediment against intensive mining of the turquoise resources here.

Aside from the Yue'ertan mine, the other mines in northwest Hubei and Southeast Shaanxi provinces are also located in steep mountainous terrain. In these mines, as well, no large flat lands exist near the workings. For example, the workings in Labashan are all distributed on a cliff face of the Labashan Mountain. Outside the entrance of the probable ancient mining tunnel, the land for a person's standing is only five m^2 based on my observation. The spaces outside these workings nearby are also small, the largest being approximately 10 m^2. The construction of a modern unpaved road has damaged the original landscape of this region. Near the Labashan mine, some modern miners constructed a house, which includes five rooms. This house does not permit large numbers of workers carrying out mining simultaneously here. In the Yaojiapo mine, the workings are distributed in the valleys of hillsides (Figure 6-9). These valleys also have no large lands for construction of permanent habitations. Due to the long-term excavations in the Yungaisi mine, a large volume of dirt and debris has covered the mountain valleys, so the landscape is not as steep as the Labashan and Bailongdong mine. However, by observing the visible workings, mostly modern ones, the spaces outside them are also limited. The bottoms of these mountains are deep valleys, and mostly not wide. This kind of landscape does not permit large human groups to live there permanently. My survey in these regions attests to the absence of ancient permanent habitations or infrastructures in these valleys.

Figure 6-9 Landscape of the Yaojiapo mine viewed from the entrance of a mining tunnel (photographed by the author)

Because of the steep landscapes, small-scale mining was probably the most efficient way in this region. Even today, the turquoise mining in this region is being also carried out part-time on a small scale. The several mining groups that I met across during my survey were all not large. The largest mining group only included only 10-20 workers simultaneously at most. Aside from microlandscape, the occurrence characteristics of turquoise could also be a reason for the small-scale mining. Similar to the Hekou mine, turquoise normally occurs in veinlets and nodules in fractures and voids of rocks in southeast Shaanxi and northwest Hubei Provinces. On the one hand, as mentioned in chapter 5, the sporadic occurrence of turquoise results in that intensive mining in a specific deposit would not be efficient. On the other hand, based on my observation in several mines, turquoise pieces are normally fragile. They need more careful excavation and collection than some metals like copper. This type of excavating and collecting turquoise also permits no large-scale mining.

Similar to turquoise mining, cinnabar mining was also probably carried out on a small scale in antiquity. The workings of cinnabar mines are also dug on cliff faces in mountains. I did not find large land areas near the mines, where the miners could have resided and carried out agriculture and other domestic activities while mining. No Longshan and Erlitou-period archaeological sites have been found in these mountains. Hence, it may be claimed that, similar to turquoise mining, early cinnabar mining was also probably carried out on a small scale.

6.2 Mining landscape and archaeology in the eastern Shangluo Corridor

In the previous section, I discussed the strategy of early resource exploitation in the eastern Shangluo Corridor. In this section, I will focus on the role of local communities, which were all distributed along the main canals of the Han and Dan Rivers, in mining and exchange during the Longshan and Erlitou periods. Several early Neolithic and early Bronze Age sites are distributed in the Zhushan County seat, but they have not been excavated, so I will not discuss them.

6.2.1 Settlement pattern

The eastern Shangluo Corridor includes several rivers, in which the two most important are the lower Dan River and the upper Han River. The Dan River is the longest tributary of the Han River. At Jingziguan Town, the Dan River flows out of the valleys in the Qinling Mountain Range, and into the flat regions. The wide and flat lands made this area appropriate for residency. Many archaeological sites have been discovered in the lower Dan River valley. Turquoise deposits exist in the nearby mountains along the Lower Dan River. Local communities, no matter whether ancient or modern, could easily get access to these turquoise mines. The Upper Han River flows in the valleys between the Qinling and Daba Mountain Ranges, and connects the western highlands to the Middle Yangzi River Basin. Although the upper Han River flows through steep valleys, the geologic processes such as sedimentation of the Han River and its tributaries have created several areas of flat lands along the main canal of the upper Han River from Shiyan city to the Danjiangkou city, in which most of the archaeological sites dated to the Longshan periods and early Bronze Ages are distributed. Many archaeological sites in the eastern Shangluo Corridor were excavated prior to construction of the Danjiangkou reservoir. Even though few excavation reports have been published yet, current data are enough to discuss local communities' mining and exchange during the Longshan and Erlitou periods.

By adopting a similar long-term perspective to the upper Dan River valley, this discussion on diachronic settlement pattern focuses on the number of sites in the Yunxian and Danjiangkou regions from the Yangshao to the Erlitou period. The settlement pattern in this region went through the same diachronic process with that of the upper Dan River valley. Based on a survey covering the flooded area of the Danjiangkou reservoir, it can be preliminarily concluded that the site number decreased from the Yangshao period to the Longshan period (Changjiang 1996). However, the decease of site number from the Yangshao to the Longshan period could not be directly equated with population decline, since the duration of the Yangshao period was much longer than that of the Longshan period. Statistics of sites from the Longshan to the Erlitou period has not been done yet, but the decease of site number is obvious, as shown by the fact that more than ten sites dated to the Longshan period have been discovered, but the number of the Erlitou period is only two. Similar to the western Shangluo Corridor, the decrease of site number resembled the collapse phenomenon in the transition from the Longshan to the Erlitou period.

Many sites during the Longshan and Erlitou periods have been excavated in the eastern Shangluo Corridor (Figure 6-2), the most important of which are Xiawanggang (Henan and Changjiang 1989), Xiazhai (Henan and Henan 2011, 2017), Liaowadianzi (Wuhan 2007; Hubei 2007, 2014), Qinglongquan (Zhongguo 1991; Wuhan and Hubei 2010), Dasi (Zhongguo 1991, Hubei 2013), and Liying (Wuhan and Yunyang 2014). I discuss these sites below.

6.2.2 Ceramic tradition

The ceramic assemblage during the Longshan period and the Early Erlitou presents a complicated content. Even though the excavation report of Xiawanggang divides them into two periods: the Longshan period and the first phase of the Erlitou period (Henan and Changjiang 1989), pottery vessels during the two periods did not yield much difference in styles. Therefore, scholars have many different viewpoints on the dating of these materials. For example, many scholars believe that pottery vessels in the eastern Shangluo Corridor are stylistically similar to those excavated in the Erlitou site, proposing that these materials should be dated to the Erlitou period (Zhao Zhiquan 1986, 1989; Li Longzhang 1988; Dong Qi 2000: 122-129). Other scholars think that these materials should be dated to the Longshan period, either classified as a cultural type of the “Central Plains Longshan culture” (Li Wenjie 1982), or as an independent “Luanshitan Culture” (Fan Li 1998).

Because of its complexity, it is difficult to define the characteristics and date the ceramic assemblage in the eastern Shangluo Corridor during the Longshan period and the Early Erlitou. Therefore, I will not try to divide the Longshan and early Erlitou ceramic assemblage into phases, but combine the two periods as a whole. The reasons why I combine the two periods as whole include three. First, as mentioned above, the ceramic assemblage during the Longshan period and the Early Erlitou presents basically similar characteristics. This phenomenon suggests that the Longshan ceramic assemblage probably continued to be used during the Early Erlitou. Second, the Longshan and early Erlitou pottery vessels of the Xiawanggang site largely diverge from the late Erlitou ones, which stand for the cultural expansion of Erlitou from the Luoyang Basin during the third phase of the Erlitou period (Changjiang 1989: 337). Third, the recent excavations at the Xiazhai site also yield a ceramic assemblage similar to those of other sites during the Longshan period and the Early Erlitou (Henan and Henan 2011, 2017). The radiocarbon dating of human bones from several burials in the cemetery at Xiazhai shows that it lasted about 600 years, approximately from 2300 – 1700 BCE, suggesting that this cemetery was continuously used from the Longshan period to the Early Erlitou (ibid).

Except for the Liying site, the ceramic assemblages from the Longshan period and the Early

Erlitou have been excavated in all other aforementioned sites (Figure 6-10). The pottery vessels excavated in these sites show strong connections with the upper Huai River Basin, as evidenced by the large amount of basin-shaped *ding* tripods with triangular legs, high-stand *dou* trays, large ring-footed plate, small flat-base jars, tripod plates, small single-handled *ding* tripods, ring-footed *gui* trays, ring-handled *zeng* steamers, and small-bottom *weng* urns. The presence of round-bottom pots and high-collar *weng* urns presents the evidence of connections with the Middle Yangzi River Basin during the Longshan period. The existence of a stoneware ceramic jar with stamped geometric patterns even extended the connection to regions farther south (Peng Shifan 1987: 344-347). Moreover, double loop-handled beakers, triple loop-handled beakers, ring-handled jars, and ring-handled bowls are associated with contemporaneous material culture in the highland regions (Fan Li 1998). By comparing the frequency of pottery vessels, the eastern Shangluo Corridor was more closely connected with the upper Huai River Basin during the Longshan period and the Early Erlitou. The pottery vessels with highland and Middle Yangzi origins occupy a relatively low proportion. This is different from the contemporaneous ceramic assemblage in western Shangluo Corridor, where the highland-style pottery vessels dominated during the Longshan period and the Early Erlitou.

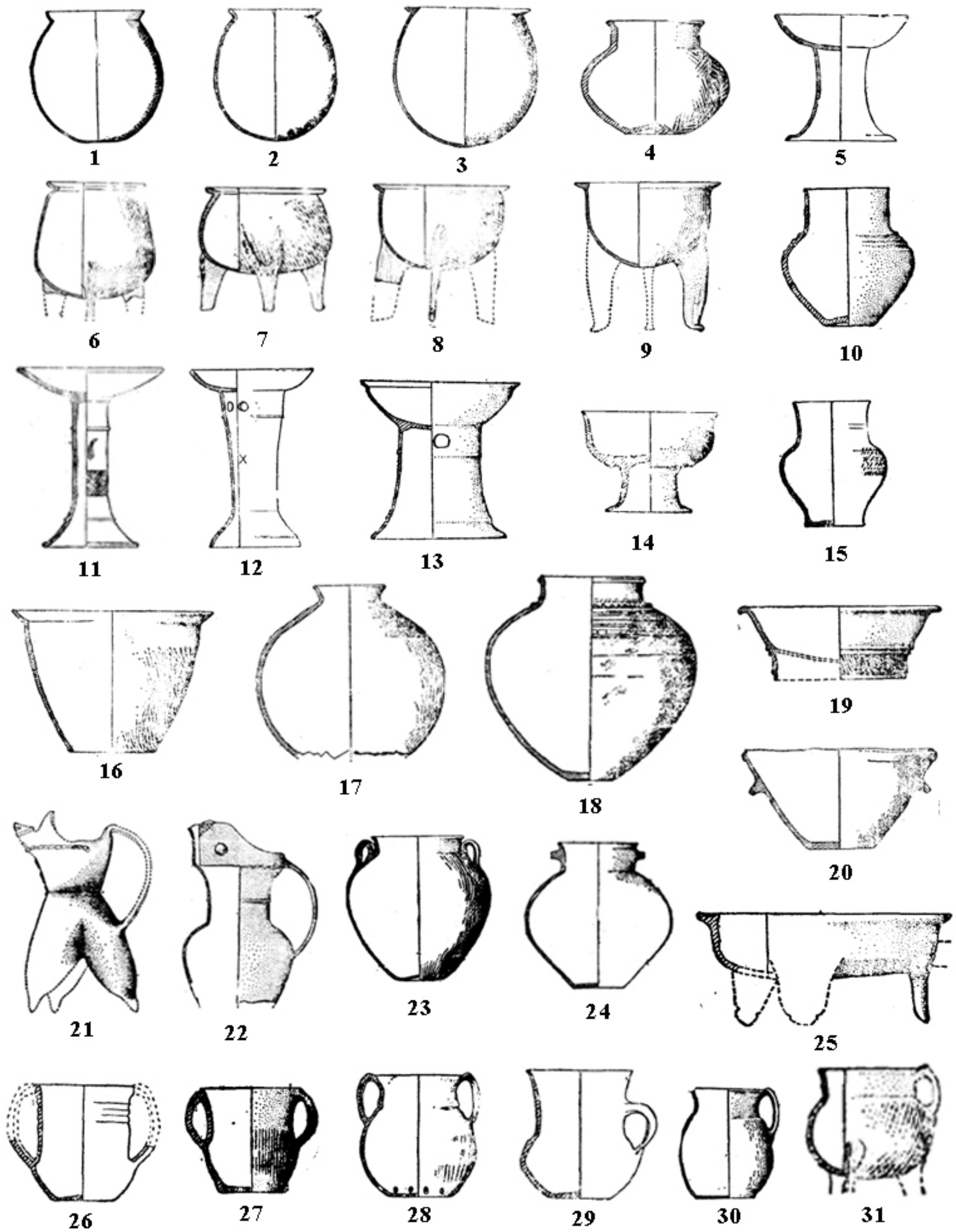

Figure 6-10 Pottery vessels of the Longshan period and the Early Erlitou at Xiawanggang (based on Henan and Changjiang 1989: 252-260, 280-283, Figure 246-253, 268-269, 271)
1-3. Round-bottom pots 4. Stoneware ceramic jar 5, 11-13. High-stand *dou* trays 6-9. *Ding* tripods with triangular legs 10, 15. Long-neck *hu* vases 14. Ring-legged *dou* bowl 16. *Zeng* steamer 17. Small-mouth *guan* jar 18. Small-bottom *weng* urn 19. Large ring-footed plate 20. *Pen* basin 21. Pouch-legged *he* tripod 22. Flat-base *he* kettle 23. Ring-handle *guan* jar 24. Long-collar *guan* jar 25. Triple-legged *pen* basin 26-28. Double loop-handle beakers 29-30. Single loop-handle beakers 31. Single ring-handle *ding* tripod

The continuous interaction with the highland regions, especially the western highlands, should be emphasized here. Even though no similar high frequency to those in Donglongshan exist in ceramic assemblage, the existence of single, double and triple loop-handled beakers shows continuous connections between the eastern Shangluo Corridor and the western highlands from the Longshan period to the Early Erlitou. The findings of the large bronze spearheads excavated from Xiawangang and stored in the Nanyang Museum are also a clear evidence of connections with the western highlands (Figure 6-11, Gao Jiangtao 2015). This kind of bronze spears was excavated at Xiawanggang during 1970s, but they were broken into pieces and had not been identified then (Henan and Changjiang 1989). Even though the date of these spears is still in debate[1], most of scholars agree that they were introduced into the eastern Shangluo Corridor during the Longshan and Erlitou periods (eg. Gao Jiangtao 2015; Hu Baohua 2015; Liu Rui et al. 2015). The design repertoire of these large bronze spears originated from Seima-Turbino Phenomenon in the Altai region. Probably produced in the western highlands by Qijia cultural groups, these bronze spears were introduced into the eastern Shangluo Corridor through the Dan River valley (ibid). Moreover, the jade objects, including a scepter and a *bi* disk, and two tubular turquoise beads also resemble the material culture in the highland regions during the Longshan period and the Early Erlitou.

[1] Hu Baohua (2015) lists the different viewpoints: some scholars (eg. Zhu Naicheng, Bai Yunxiang) argue that these spearheads should be dated to the period between the Erlitou period and the Western Zhou period; Zhao Haitao argues that the date of them was the Middle and Late Western Zhou period.

Figure 6-11 The large spearheads recently excavated at Xiawanggang
(Gao Jiangtao 2015: 161, Figure 1: 8)

The interaction with the highland regions during the Longshan period and the Early Erlitou was probably attributed to the highland societies' high demands for natural resources, such as metal and turquoise. Based on current materials, the highland-style pottery vessels occupy a small proportion of the ceramic assemblage in the eastern Shangluo Corridor. Different from western Shangluo Corridor, highland communities did not dominate this region during the Longshan period and the Early Erlitou. As analyzed above, early mining in this region was probably carried out on a relatively small scale. The labor force involved in mining was small. Therefore, whether mining in this region was conducted by a small group of highland miners or by the local communities is still unknown based on current evidence. Either pattern is possible.

In any case, the tradition of using turquoise and metal objects was not rooted in the local material cultures. These natural resources mined from the eastern Shangluo Corridor were probably exchanged and transported into the highland regions during the Longshan period. The local societies were probably involved in the exchange network with the highland cultural groups during the Longshan period. As shown by the large quantity of round-bottom pots excavated in many sites, such as Xiawanggang, Liaowadianzi, and even Donglongshan, on the other hand, societies in the Middle Yangzi River Basin also probably participated in exchange with highland Longshan societies during the Longshan period and the Early Erlitou. Some of key resources from the Middle Yangzi River Basin, such as cinnabar and copper, were probably involved in the exchange along the Shangluo Corridor. The pieces of copper ores and metallurgical remains excavated in several sites in Hubei Province (Hubei et al. 2003, Hubei sheng Jingzhou et al. 1999, Hubei and Zhongguo 1994, Chen and Gong 2015; Hubei and Suizhou 2011; Hubei et al. 2013, Hubei and Huangshi 2010) suggest that copper had probably been mined and exchanged into the Shangluo Corridor during the Longshan period and the Early Erlitou. I will discuss copper mining in the next chapter.

The Late Erlitou assemblages have been uncovered in many sites, but most of these sites only yield few materials. Three sites, Xiawanggang, Liying, and Xiongjiazhuang, have yielded a little more materials (Figure 6-12). The excavation at Xiongjiazhuang has not been published yet. Here I only focus on the Xiawanggang and Liying sites (Henan and Changjiang 1989; Henan and Henan 2011, 2017). During the Late Erlitou, namely the third phase of the Erlitou period, the Xiawanggang and Liying sites were dominated by the ceramic assemblages associated with the Erlitou material culture in the Luoyang Basin, such as appliqué-rimmed *guan* jars, basin-shaped *ding* tripods, basin-shaped *zeng* steamers, ring-footed *dou* plates, large-mouth *zun* urns, and contracted-mounth *ding* tripods (Henan and Changjiang 1989). Similar to the western Shangluo Corridor, the dominant Erlitou-style pottery vessels suggest the rapid cultural expansion of the Erlitou society from the Luoyang Basin during the third phase of the Erlitou period.

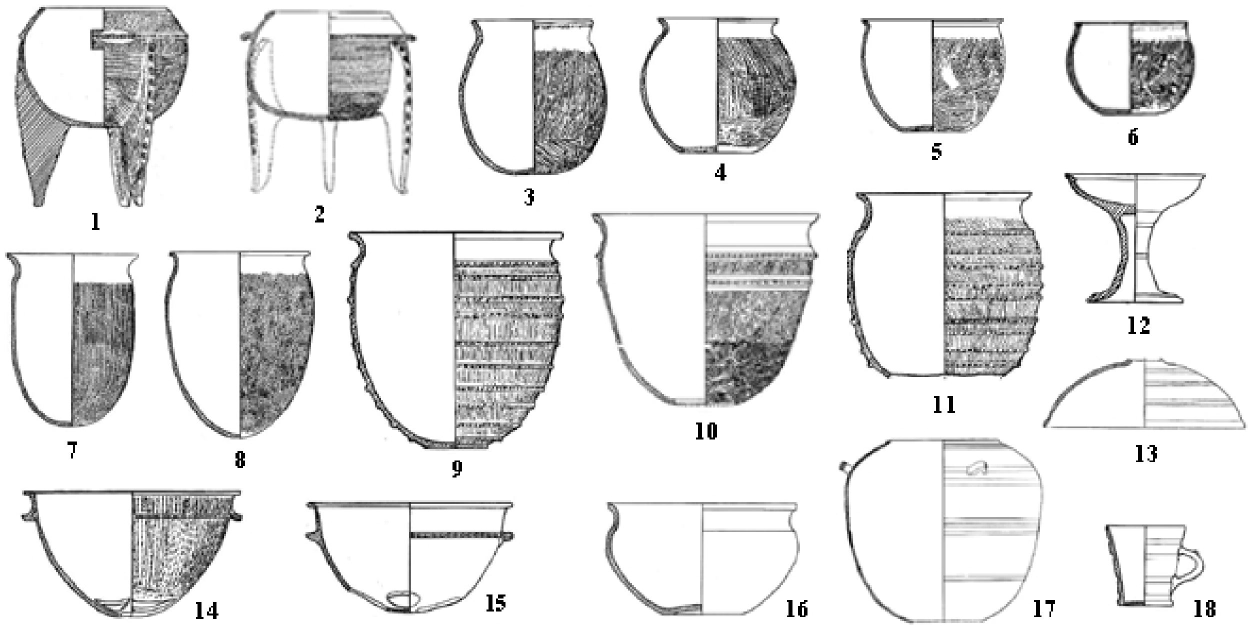

Figure 6-12 Pottery vessels excavated at the Liying site
(Wuhan and Yunyang 2015: 7-12, Figure 9-15)
1-2. *ding* tripods 3. Appliqué-rimmed *guan* jar 4-6. Oblate *guan* jars 7-8. Long-body *guan* jars 9-11. Large-mouth *zun* urns 12. Ring-footed *dou* plate 13. Lid 14-15. *Zeng* steamers 16. *Pen* basin 17. Contracted-mouth *zun* urn 18. Single ring-handle cup

6.2.3 Local communities

This section mainly focuses on the organization of local communities in the eastern Shangluo Corridor based on materials of residential units and graves. Currently, archaeologists only uncovered several residential units in Xiawanggang, Liaowadianzi, and Xiazhai sites. In the Xiawanggang site, the archaeologists uncovered 77 tombs during the Longshan period and the Early Erlitou (Henan and Changjiang 1989). These tombs include two types: 48 urn burials and 29 shaft tombs. The spatial distribution of shaft tombs shows no rule of organization of the cemetery. No coffins were discovered in tombs. Half of the occupants in these shaft tombs were interred with grave goods. These grave goods include pottery vessels, stone arrowheads, bone arrowheads, chisels, and spears. The pottery vessels in these tombs were all utilitarian. Only two residential units from the Longshan period and the Early Erlitou have been excavated. The two residential units are both semi-subterranean with 5 and 6.5 m^2 in size. No goods have been discovered in these two residential units. Moreover, archaeologists only uncovered six tombs of the Late Erlitou, including three shaft tombs and three urn burials. These shaft tomb occupants were interred with no grave goods.

At the Liaowadianzi site, archaeologists uncovered a large assemblage from the Longshan period and the Early Erlitou. However, as the excavations have not been fully published, the detailed description of the materials is still unknown. The currently available materials indicate that Liaowadianzi was probably not a high-status settlement, and it was probably not carefully planned prior to construction (Hubei 2014, Wuhan 2007). The residential units were mostly round subterranean and semi-subterranean construction, with an area of less than ten m^2 in size. More than 20 shaft tombs have been uncovered. The spatial distribution of shaft tombs is not clearly demarcated with residential units, reflecting that the planning of Liaowadianzi was probably not well designed. These shaft tombs were small-sized, and few grave goods were excavated from them.

The Xiazhai site was probably an important community in the Neolithic Age (Henan and Henan 2017). The total area of Xiazhai reaches as large as 60 hectare. Part of a cemetery dating to the Longshan period and the Early Erlitou has been uncovered at Xiazhai (Figure 6-13, Figure 6-14). Archaeologists uncovered 72 tombs, including 27 shaft tombs and 45 urn burials. The preliminary report says that all of these shaft tombs were small and only fit for the deceased. This is similar to the cemetery at Xiawanggang, Liaowadianzi and Donglongshan. The spatial distribution of shaft tombs follows no rules. No traces of coffins have been identified in these shaft tombs. Only five tomb occupants were interred with totally ten grave goods, including pottery vessels and stone tools, which were all utilitarian goods and show no elaboration in quality.

Figure 6-13 The cemetery excavated at the Xiazhai site
(based on Henan and Henan 2017: 60, Figure 2)
Red: shaft tombs Blue: urn burials

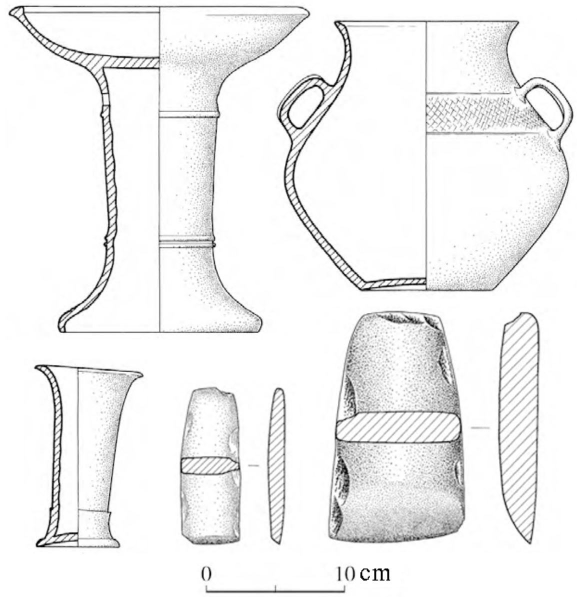

Figure 6-14 Grave goods in M7 in the Xiazhai cemetery
(based on Henan and Henan 2017: 65, Figure 7)

Although the current evidence is still little, it is informative about the organization of local communities during the Longshan period and the early Bronze Age. Previously, scholars argue that settlements in the Shangluo Corridor, such as Liaowadianzi, Xiawanggang, and Donglongshan, probably served as important state-controlled transportation nodes during the early Bronze Age (Liu and Chen 2003: 78). Based on cases in other regions of the world, it is hypothesized that some remains should exist in those state-controlled mining communities or transportation nodes, such as monitoring or administrative infrastructures, internal hierarchical differentiation between officials and workers, careful settlement planning, and possible professional differentiation. However, materials of cemeteries and residential units excavated at Liaowadianzi, Xiazhai, and Xiawanggang do not reflect a hierarchical order or status differentiation in local communities during the Longshan and Erlitou periods, suggesting that an administrative system had not been established during the Longshan and Erlitou periods. The other types of infrastructures were also absent from the Longshan and Erlitou assemblages in the eastern Shangluo Corridor. Therefore, current evidence does not support the claim of state-controlled mining communities or transportation nodes in the eastern Shangluo Corridor. Although current materials are not many, finds of the three sites, especially Xiazhai, which measures 60 ha, are probably not coincident. It is more possible that these communities in the eastern Shangluo Corridor were autonomous during the Longshan period and the early Bronze Age.

6.2.4 Economy

Besides the extraction of natural resources, the investigation of the economy of this region touches on two aspects: subsistence economy and craft production. Studies on subsistence economy based on plant and faunal remains have been carried out recently. Based on his analyses based on plant samples from numerous prehistoric sites, Deng Zhenghua (2015) concludes that the subsistence economy of the eastern Shangluo Corridor was dominated by dryland agriculture, which was represented by foxtail millet cultivation. Rice and wheat only occupied a small proportion in subsistence economy. Until now, studies on faunal remains of the Longshan and Erlitou periods have not been conducted. A study on the faunal remains at Xiawanggang before the Longshan period shows that one domesticated animal species, pig, had dominated the meat resource before the Longshan period (Lin Minghao 2011). Domesticated animals likely remained the major source of meat resource during the Longshan and Erlitou periods.

Production tools excavated in several sites could attest to the status of different types of economic forms. Only the excavation reports of the Xiawanggang and Dasi sites give statistics for production tools. Table 6-1 shows the number of major production tools in the two sites during the Longshan and Erlitou periods. From Table 6-1, it can be clearly observed that the numbers of production tools in the eastern Shangluo Corridor were same with the majority of Neolithic and Bronze Age sites in early China. The production tools, such as stone axes, adzes, chisels, sickles, net-sinkers, and spindle whorls, are related to the general work of agricultural communities. Moreover, arrowheads were probably used for both hunting and defense. The mining tools, such as hammer, maul, or picks, have not been clearly identified in these sites. Some stone net sinkers are similar to style and size of stone hammers discovered at the Luonan mining site. It is also possible that some of the net sinkers were actually mining hammers, but the quantity was still low. Even though being located close to natural resources, on the whole, the economic system of local communities shows no difference from most of agricultural communities in other regions of China during the Neolithic and the Bronze Ages. The economy was still dominated by agriculture-related production in local communities.

The other remains related to resource extraction in the eastern Shangluo Corridor are also few. In the Xiawanggang site, two tubular beads and an eardrop made of turquoise are excavated in the Longshan to early Erlitou assemblage. Also, a piece of turquoise pendant is also excavated in the Late Erlitou assemblage. As mentioned above, moreover, the bronze spears are also excavated at Xiawanggang. Since no smelting or casting remains are discovered, it is also possible that these bronze spears were not locally made. Compared to agriculture, the current evidence suggests that craft production related to mining industry was minor in the Xiawanggang site during the Longshan and Erlitou periods.

Sites and periods Tools		Xiawanggang		Dasi
		LS – EE	LE	LS-EE
Stone tools	Axe	169	69	37
	Adze	22	6	36
	Spade	16	9	40
	Chisel	101	24	27
	Knife	70	32	12
	Sickle	10	6	2
	arrowhead	37	20	4
	Net sinkers	69	3	12
	scraper	12		
	Others	6	9	2
Bone tools	Arrowhead	234	68	24
	Awl	67	19	3
	Chisel	34	11	1
	Others	6	3	13
Ceramic tools	Spindle whorls	221	75	
	Others	11	4	

LS-EE: the Longshan period to the Early Erlitou
LE: the Late Erlitou

Table 6-1 Statistics of major production tools at Xiawanggang and Dasi
(based on Henan and Changjiang 1989: 242-250, 271-278; Zhongguo 1991: 191-197)

At the Liying site, traces of metal smelting or casting from the Late Erlitou have been identified (Zhang and Chen 2016). In ash pit H37, several pieces of crucible and furnaces were excavated (Figure 6-15). The number of crucible pieces is seven, some of which were similar to cups in shape. The bottom of these crucible pieces is thick. The inner sides of them are adhered with a thin greenish layer, which are probably residues of copper. Three pieces of furnaces have also been identified. By observing their shape, one may infer that the diameters of these furnaces were probably very large. The identification of furnaces and slag shows that metallurgical activities presumably existed in the upper Han River valley during the Late Erlitou.

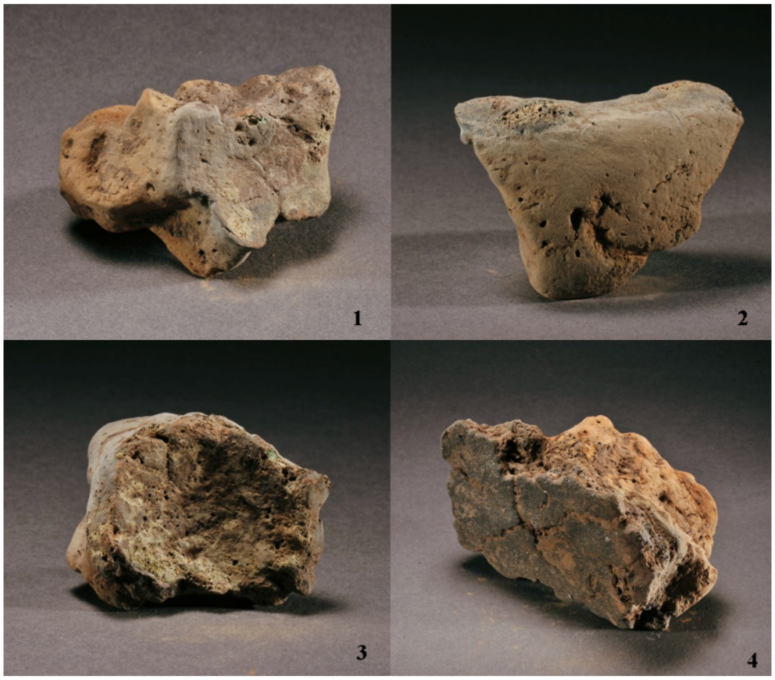

Figure 6-15 Some of the metallurgical remains excavated from the Liying site
(Zhang and Chen 2016: 120, Figure 4,6,8,10)
1-3. crucible fragments 4. Furnace fragment

However, it is more likely that metallurgical activities at Liying were carried out on a small scale. The excavations at Liying uncovered totally 46 ash pits and 8 ash trenches, but only one ash pit has yielded the above-mentioned metallurgical remains. The frequency of metallurgical activities was very low. Moreover, remains of furnaces and crucibles are very small pieces. It is possible that these these crucible pieces belonged to one or a few individuals. Considering the low frequency of remains in ash pits and small pieces of metallurgical remains, the metallurgical industry at the Liying community were more likely to be very small-scale.

6.3 Discussion

Based on the analysis of mines, mining landscape, and local communities in the eastern Shangluo Corridor, several strands of evidence could be listed as follows:

(1) The turquoise mines are all distributed deep in mountains and it normally takes a long time to prospect.

(2) The calculation on the volumes of mining tunnels suggests that ancient mining of turquoise was carried out on a small scale.

(3) The landscapes of turquoise mines determine that permanent habitations were impossibly constructed in antiquity. The mining infrastructures were probably impermanent in early China.

(4) The local communities decreased in number in a long-term perspective. During the Longshan and Erlitou periods, settlements were mostly located on tablelands or terraces along the upper Han River and its large tributaries. No settlements have been discovered near mines.

(5) The primary work of local communities was still agriculture. Craft production related to mining, such as turquoise and copper, was minor in the local communities of the eastern Shangluo Corridor.

(6) The local communities were all loosely organized during the Longshan and Erlitou periods. No evidence of status or hierarchical differentiation, fortresses, monitoring infrastructures, and professional differentiation has been identified in the archaeological materials.

(7) The scientific testing and the ceramic analysis show that the local communities were involved in long-distance exchange networks during the Longshan and Erlitou periods.

The above strands of evidence fit the model of a local, village-based, and small-scale mining and mining-related production. Based on the current materials, it is still unknown whether the small-scale mining was carried out by the highland groups in this region or by local communities. The absence of permanent habitations and regulation infrastructure suggests that intensive mining was probably not adopted by early miners. Instead, mining was more possibly carried out by local agriculturalists on a contingent or part-time basis. The local settlements, which were previously considered as state-controlled transportation nodes (Liu and Chen 2003), yield no data of an administration or regulation system. Rather, materials from the cemeteries and residential units suggest that the local communities were probably autonomous during the Longshan and Erlitou periods.

Similar to the western Shangluo Corridor, even though mining was small-scale, local communities also participated in long-distance exchange networks during the Longshan and Erlitou periods. The local resources, such as turquoise and cinnabar, were exchanged into the highland centers during the Longshan period and into the Central Plains during the Erlitou period. The cultural groups in the Middle Yangzi River Basin also participated in exchange with the highland regions and the Central Plains through the eastern Shangluo Corridor. The large quantity of key resources from the Middle Yangzi basin, such as copper, cinnabar, and timbers, were transported into the highland centers during the Longshan period and into the Luoyang Basin during the Erlitou period. Through the exchange with the highland centers during the Longshan period, metallurgy started to develop in the Middle Yangzi River Basin, laying the foundation for the political-economic landscape during the early Bronze Age.

7 Metallurgical industries in the Jinnan and Middle Yangzi regions: a comparison

This chapter discusses copper mining in the Zhongtiao Mountains and the Middle Yangzi River valleys, which were strategically significant to the state formation in early China. With the introduction of metallurgical knowledge from the fringe areas of the Loess Plateau, copper mining, smelting and casting started to burgeon in the heartland of China. As mentioned above, the Shangluo Corridor was an important route connecting the highland regions, the Middle Yangzi, and the Luoyang Basin. The metallurgical knowledge was transmitted into the Middle Yangzi River valleys and the Luoyang Basin through the Shangluo Corridor, laying the foundation for Erlitou's metal procurement from the Zhongtiao Mountains and the Middle Yangzi River valleys. As indicated below, metallurgical activities appeared in the two regions from the Longshan period. Archaeologists and metallurgists have paid attention to resource flow for a long time, but neglected a detailed analysis on the social contexts in the two regions. After discussing the resource extraction and exchange network along the Shangluo Corridor, hence, it is necessary to discuss the copper mining and mining-related productions in the two regions.

My choice of discussing copper mining in the Zhongtiao Mountains and the Middle Yangzi River valleys is based on two reasons. First, as the most important copper resources for the Bronze-Age states, the modes of mining and mining-related production in the two copper-rich regions are vital for archaeologists to reconstruct the center-periphery relationship and the role of native communities in the resource-based exchange system. Second, the analysis of copper mining and mining-related activities in the two regions can provide a comparative perspective with turquoise mining along the Shangluo Corridor, and let archaeologists know the similarities or differences on extractions of different raw materials.

The archaeological work has long been carried out in the two regions. Based on currently published materials, I adopt different approaches to analyze the two regions. In the Zhongtiao Mountains, I estimate the scale of mining based on occurrence characteristics of copper resource, and analyze the production mode of metallurgy based on the archaeological information of Dongxiafeng. For the Middle Yangzi River valley, I adopt a long-term perspective to look at the mining landscapes around two important copper mines: Tonglüshan and Tongling. Although the long-term perspective will digress to some extent on the findings from much later periods than the time span that I focus on in this dissertation, it will help us to clearly distinguish different mining landscape, which were much related to different political-economic patterns in the regions.

7.1 Copper mining in the Zhongtiao Mountains

The Zhongtiao Mountains are undeniably the most important copper deposit for early states during the Longshan period and the early Bronze Age. Although the Zhongtian Mountains contain a large number of copper mines, most of ores are low-grade. Based on modern geologic investigation, the content of copper in ores ranges from 0.24-2% (Zhongguo 1995: 235-236, from Liu and Chen 2002: 87). Oxidized ore deposits are distributed unevenly. In some areas, the depth of oxidized ores is 10-12 meters in depth, but others 0-50 meters (Xia Xiangrong et al. 1980: 255). Oxidized ores include two types: malachite and azurite. In general, oxidized ores normally occur as the surface outcrop, and are not largely deposited. Archaeologists discovered many small and shallow copper mines, which are normally called chicken-nest mines. These small and shallow mines are probably copper oxides (Liu and Chen 2003: 42). Ancient miners firstly exploit copper oxide at the surface level, and then go deeper for other types of copper ores (O'Brien 2015: 200-203).

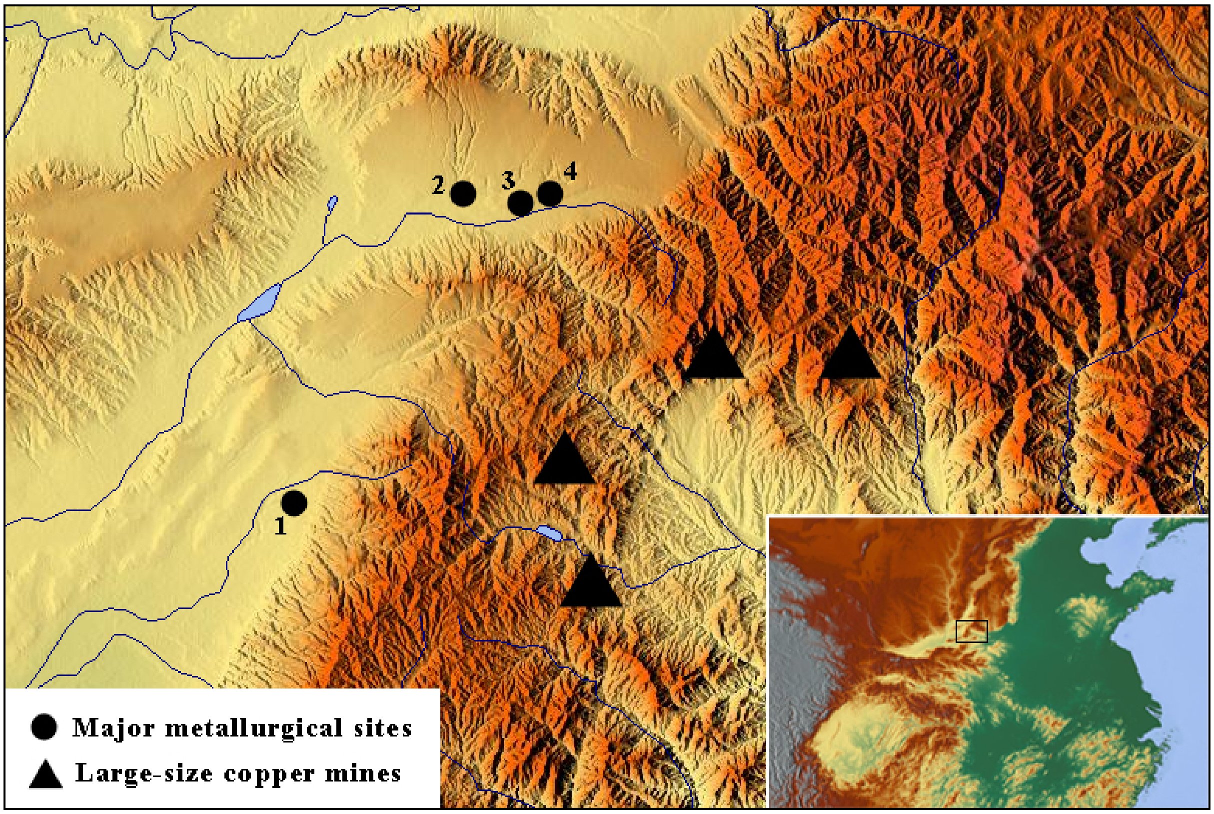

Figure 7-1 Major metallurgical sites During the Longshan, Erlitou and Erligang periods, and large-size copper mines in and around the Zhongtiao Mountains
(based on Zhongguo 1988: 2, Figure 2; Zhongguo et al. 2011, colored plate 106-108; Liu and Chen 2003:86)
1. Dongxiafeng 2. Zhoujiazhuang 3. Xiwubi 4. Shishulin

Geoarchaeological surveys on ancient mining activities in the Zhongtiao Mountains have been conducted and shown that copper mines of this region were exploited very early (Figure 7-1). The survey to the north of the Zhongtiao Mountains attests that copper was mined and smelted probably as early as the Longshan period (Li Jianxi 2011; Zhongguo et al. 2011: 435). Archaeologists also discovered mining hammers in several mines in the Zhongtiao Mountains (Li Jianxi 2011: 33-37), indicating that mining was widely carried out at least during the Eastern

Zhou period (Xian Yiheng et al. 2016b). The survey in some other sites shows that copper sulphide had been exploited during the eastern Zhou period (Li Yanxiang 1993).

7.1.1 Scale of mining and mining landscape

It is hard to estimate the scale of mining in the Zhongtiao Mountains during the Longshan period and the early Bronze Age, since surveys usually do not report the sizes of mining tunnels, trenches, or shafts. The workings reported on to-date are difficult to date, since no datable objects were identified. Li Yanxiang (1993) reports that the size of a mining tunnel in the Matigou site is 20 meters long, 10 meters wide and 10 meters high. If I follow the method of calculation in last two chapters, the total time input on this tunnel by one miner should be 4000 days, approximately 11 years. However, he does not report the date of the Matigou mining site, so I cannot claim whether this tunnel was mined through long-term small-scale mining or through intensive mining in a short period of time.

However, we can hypothesize the scale of mining based on the characteristics of copper ores. The occurrence characteristic of copper oxide is key to interpreting the model of early mining in the Zhongtiao Mountains. According to current evidence, metallurgical exploitation before the Western Zhou period only focused on copper oxide (Liu and Chen 2002: 86). Oxidized copper deposits normally occur as surface outcrop, and can be easily exhausted. In the Zhongtiao Mountains, copper ores are normally low-grade, and oxidized ores are not deposited in large quantities in any specific location. Hence, ancient miners presumably had to move frequently to search for new oxidized copper exposures. The aforementioned many small and shallow chicken-nest mines are probably a result of this “flitting” model of mining (O’Brien 2015: 203).

This type of “flitting” model of mining on surface workings required ancient miners to focus on exposures across a wider landscape. Therefore, the concentration of permanent mining facilities in a specific deposit could not be achieved. The “flitting” model of mining was also widely adopted in the prehistoric Europe, such as the Mount Gabriel-type mines in Ireland, where 30 workings were all relatively small, ranging from less than one meters to 12 meters in depth (ibid). Based on the occurrence characteristics of copper oxides and the comparative cases in the prehistoric Europe, I believe that small-scale operations, rather than large-scale copper mining, were probably adopted by local miners in the Zhongtiao Mountains during the Longshan period and the early Bronze Age.

The mining landscape is also hard to investigate, since a systematic survey on the spatial organization of mining has not been carried out until now. Most of surveys so far have focused on metallurgical technology, such as the process of metal production and the start date of some specific technologies, but the social aspects of copper mining have not been paid much attention to. However, some strands of evidence could also be teased out based on currently available materials. Until now, the surveys have not discovered traces of permanent facilities or infrastructures near copper mines in the Zhongtiao Mountains. A recent survey also suggests that most of copper ores were probably transported into some metallurgical communities, such as Dongxiafeng and Nanguan, and probably smelted there during the Longshan, Erlitou and Erligang periods, instead of being locally processed (Li Jianxi 2011). The examples of long-distance transportation for cooper ore smelting are also found in the Vinča culture in the Balkans during the sixth and fifth millennium BCE (O’Brien 2015: 232-233). Hence, concentration of permanent habitations probably did not occur during the Longshan, Erlitou, and

Erligang periods. As mentioned above, the “flitting” model of mining probably also determines the impossibility of concentration of permanent mining facilities in early China.

Not many metallurgical communities from the Longshan to Erligang periods have been discovered in archaeological surveys near the Zhongtiao Mountains (Figure 7-1). For metallurgical evidence during the Longshan period, the survey in the eastern Yuncheng Basin only discovered one piece of metal in the Zhoujiazhuang site (Zhongguo 2011: 71). The report also tells that smelting slag was also collected in the surface survey in the eastern Yuncheng Basin, but the detailed information has not been described (ibid: 435). Moreover, several metal objects have also been excavated in the Taosi site farther away (Gao and He 2014). The finds of metallurgical traces during the Erlitou and Erligang periods are a little more plentiful than those of the Longshan period, yielding more evidence about copper mining and metallurgical landscape in the Zhongtiao Mountains. The Erlitou and Erligang metallurgical communities, including Dongxiafeng (Zhongguo 1988), Shishulin (Zhongguo et al. 2011: 39-40), and Xiwubi (Zhongguo et al. 2011: 47-48), are located on the banks of rivers in the transitional zones between mountains and plains. The plains could provide these metallurgical communities with sufficient agricultural land, while miners could also efficiently travel and transport through river valleys. This type of spatial distribution of metallurgical sites was probably the result of balancing agricultural and metallurgical production, resembling the mining landscapes in the eastern Alps in the earlier second millennium BCE (Shennan 1998) and western Cyprus from the 8th century BCE to the 15th century CE (Raber 1987). Through analyses on cultural remains from sites in the eastern Alps and the western Cyprus, the scholarly consensus is that metallurgical communities in the two areas were autonomous, and both carried out part-time and small-scale copper industries on a local basis (Shennan 1998; Raber 1987). However, the comparative cases are not direct reflections of the metallurgical industry around the Zhongtiao Mountains. A detailed analysis on metallurgical sites is needed.

7.2 Dongxiafeng

The exploitation of copper mines in the Zhongtiao Mountains had started since the Longshan period, but the data is still scarce (Li Jianxi 2011). With the collapse of the Taosi society, the Jinnan Basin underwent depopulation after the Longshan period (Sebillaud 2014: 222-223). The currently discovered archaeological sites during the Erlitou and Erligang periods are all much smaller than those in the Longshan period. During the Erlitou period, Dongxiafeng, which was only 25 hectare in size, was one of the largest sites in the Jinnan Basin (Zhongguo 1988: 2). It is located at the both banks of the Qinlong River in the northern piedmont of the Zhongtiao Mountains. Because of the close geographical relations with copper and salt mines, Dongxiafeng was a crucial center for resource exploitation during the Erlitou and Erligang periods (Liu and Chen 2003).

The excavations at Dongxiafeng uncovered the assemblages of the Longshan, Erlitou and Erligang periods, but the Erlitou- and Erligang-period assemblages were predominant (Zhongguo 1988). Based on ceramic typology, the Erlitou-period assemblage could be divided into four phases, which were contemporaneous with the four phases of the Erlitou culture in the Central Plains. A large quantity of features have been excavated, such as tombs, ash pits, residential units, wells, kilns, storage houses, and round architectures. The existence of metallurgical evidence suggests that Dongxiafeng was able to smelt copper and cast bronze objects (ibid). What was the significance of Dongxiafeng in bronze metallurgy during the Erlitou period? How was metallurgical activities carried out at Dongxiafeng? Below I analyze the archaeological information to answer the questions.

7.2.1 Ceramic assemblage

Based on the ceramic assemblage, Erlitou was deeply involved in resource exploitation in the Jinnan Basin (Figure 7-2; Zhongguo 1988: 214). The pottery analysis of Dongxiafeng shows that nearly one third of the total pottery vessels are stylistically associated with the Erlitou material culture in the Luoyang Basin, such as the basin-shaped *ding* tripods, small-mouth *guan* jars, high-stand *dou* trays, *pen* basins, big-mouth *zun* urns, pinched-rimmed *guan* jars, long-collar *zun* urns, square *ding* quadripods, *jue* tripods, pouch-legged *he* tripods, and so on. The Erlitou-style pottery vessels suggest that Dongxiafeng was strongly connected with the Erlitou society in the Luoyang Basin, possibly due to copper and salt exchange. The watershed between the Yuanqu basin and Xiaxian County was not difficult to cross. Ancient travelers could easily arrive at the Nanguan site in the Yuanqu Basin and then enter the Yellow River system.

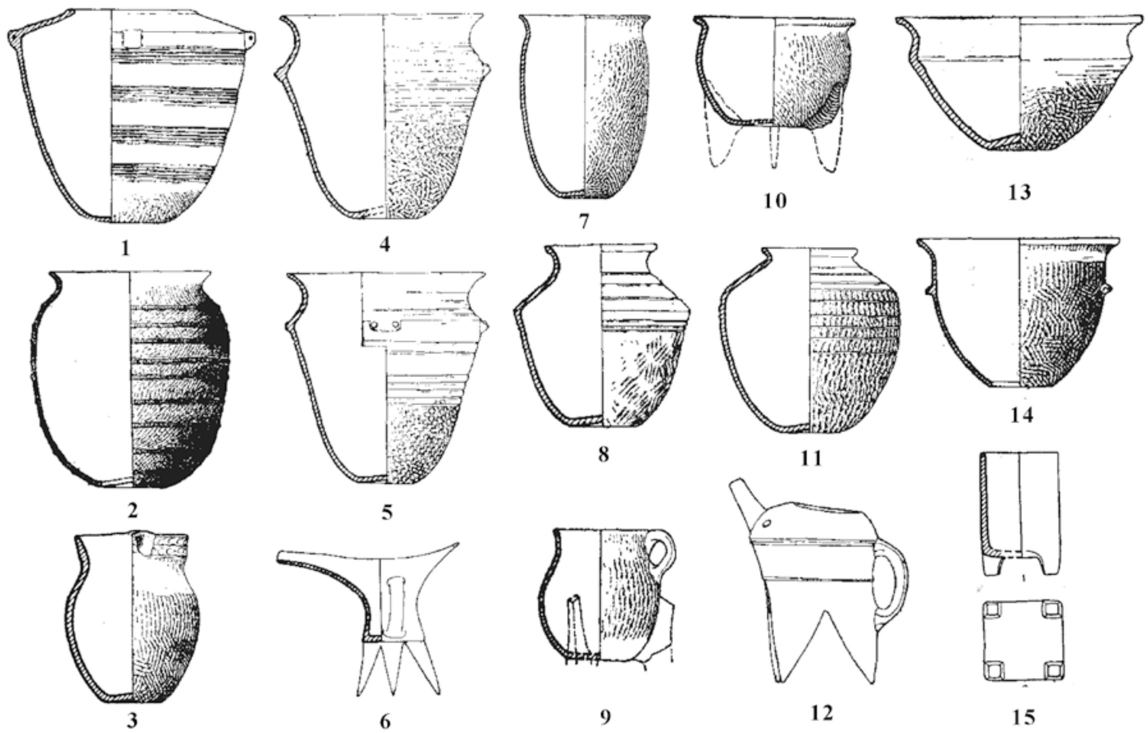

Figure 7-2 Erlitou-style pottery vessels excavated at Dongxiafeng
(based on Zhongguo 1988: 24, 27, 48, 83, 87, 89, 90, 96, 130, 132, 137, 139, Figure 27, 29, 45, 82, 84-86, 90, 125, 126, 129, 130)
1. contracted-mouth *weng* urn 2. *Lei* urn 3. Pinched-mouth *guan* jar 4-5. Large-mouth *weng* urn 6. *Jue* tripod 7. Deep-body *guan* jar 8. Long-collar *guan* jar 9. Single-ring *ding* tripod 10. Basin-shaped *ding* tripod 11. Small-mouth *guan* jar 12. Pouch-legged *he* tripod 13-14. *Pen* basin 15. Square *ding* quadripod

However, the Erlitou-style pottery vessels do not dominate the Erlitou-period ceramic assemblage at Dongxiafeng. The types of Erlitou-style pottery vessels are various, but apart from small-mouth *guan* jars, big-mouth *zun* urns, and *lei* urns, the numbers are small (Yu Mengzhou 2004). On the other hand, the importance of ceramics with local characteristics should not be underestimated (Figure 7-3). For example, the primary type of cooking vessels at Dongxiafeng, mainly single-ring *guan* jars, *li* tripods, *yan* tripods, which probably originated from the local Longshan-period culinary assemblage, were highly different from those of contemporaneous Erlitou-culture site, such as deep-body *guan* jars and *ding* tripods (Yu and Xia 2010). Moreover, decors on the surface of culinary vessels at Dongxiafeng were always dominated by cord pattern, which was also different from those of Erlitou, which underwent the change from basket-shaped strips to cord pattern (Yu Mengzhou 2004). In this regard, the large quantities of local-style pottery vessels suggest that local communities were probably also deeply involved in the resource exploitation in the Jinnan Basin.

More importantly, the large quantity of egg-shaped *weng* urns and long-collar *li* tripods at Dongxiafeng show that the connections with the northern highlands continued during the Erlitou period (Figure 7-3). The settlement data in the Hutuo River and the Lower Hun River suggests that the Zhukaigou culture probably continued to prosper during the Erlitou period (Shanxi et al. 2012: 916-925; Cao Jian'en 2014). Shimao probably continued to stand out as the largest site in the northern highlands. The recent discovery at Shimao shows that bronze metallurgy was also developed in the northern highland, generating the possible demands for copper mines in the Zhongtiao Mountains. The existence of egg-shaped *weng* urns and long-collar *li* tripods at Dongxiafeng suggests that the northern loess highland communities were also probably involved in the resource procurement of copper resource in the Jinnan Basin.

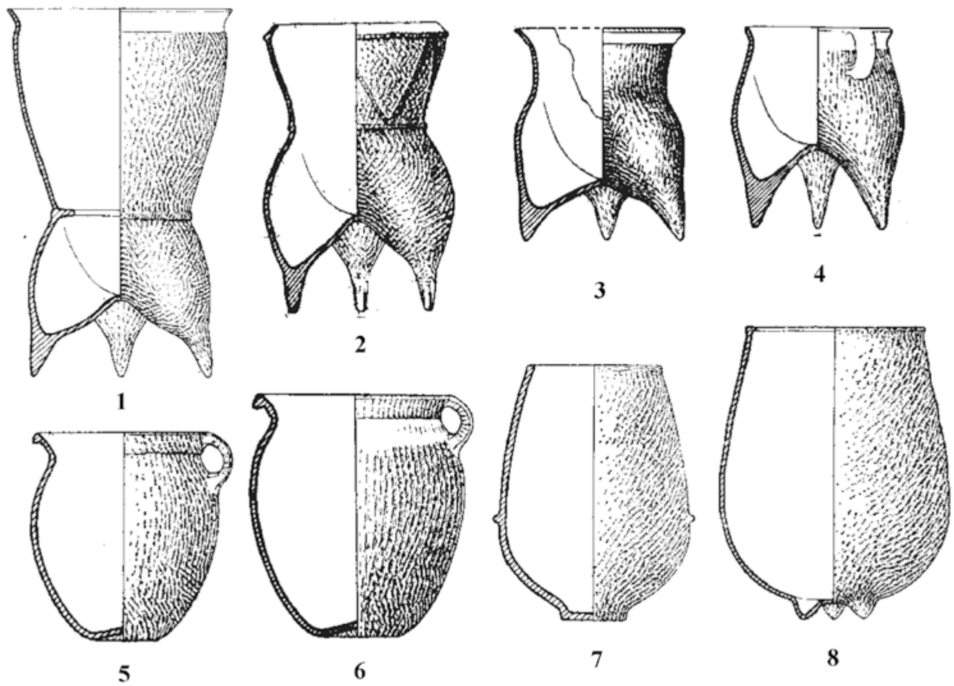

Figure 7-3 Other types of pottery vessels during the Erlitou period at Dongxiafeng
(based on Zhongguo 1988: 40, 85, 92, 140, 142, Figure 40, 83, 87, 131, 132)
1. *yan* tripod 2. long-collar *li* tripod 3. *li* tripod 4. Sing-ring *li* tripod 5-6. Sing-ring *guan* jars 7-8. Egg-shaped *weng* urns

The diversity of population origins during the Erlitou period could also be attested by the tombs excavated at the Dongxiafeng site. No matter the shapes, burial forms or orientations, the tombs at Dongxiafeng were laid without any rules. The shapes of tombs include shaft tombs, cave dwelling burials, and other types, in which the shaft tombs dominated. The burial forms include different types of extended and flexed burials. The orientations of these tombs include east, west, northeast, southeast, south and southwest. Similar to the culinary assemblage, the different mortuary practices indicate the origins of the population at Dongxiafeng during the Erlitou period were diverse. The communities from the Luoyang Basin, northern highlands, and the Jinnan Basin were all probably involved in resource procurement in the Zhongtiao Mountains.

7.2.2 Metallurgical remains

Based on currently published materials, metallurgical remains started to exist from the third phase of the Erlitou period (Figure 7-4). Considering metallurgical remains during the Longshan period have been discovered in the Jinnan Basin, it is possible that metallurgy also existed during the first and second phases of the Erlitou period at Dongxiafeng. Metallurgical remains excavated at Dongxiafeng include metal objects, stone molds, and smelting slag. Metal objects, 14 pieces in quantity, are comprised of weapons and implements, including arrowheads, chisels, and knives. Seven stone molds, which were used for casting axes and chisels, have been excavated. Besides, several pieces of smelting slag have also been excavated. More than 20 pieces of slag during the third phase of the Erlitou period and more than 10 pieces during the fourth phase of the Erlitou period have been excavated.

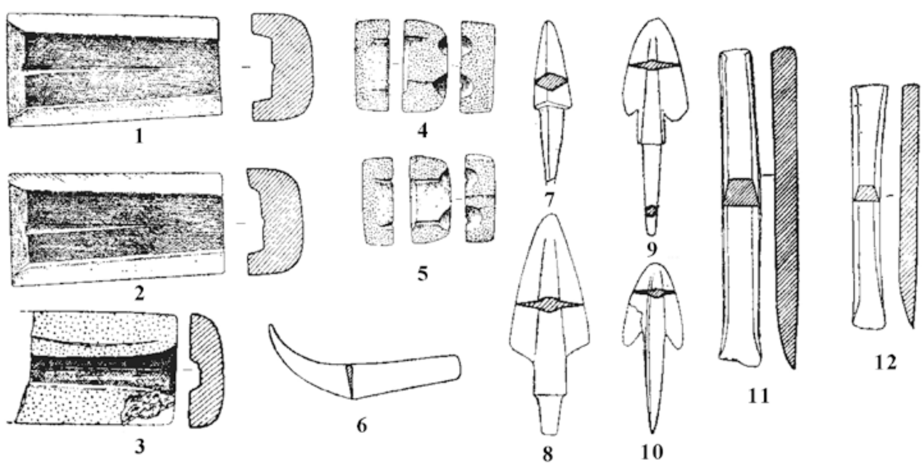

Figure 7-4　Metallurgical remains during the Erlitou period at Dongxiafeng
(based on Zhongguo 1988: 75, 77, 120, 123, Figure 78, 79, 120, 121)
1-5. stone molds　　6. Bronze knife　　7-10. Metal arrowheads　　11-12. Metal chisels

Based on these remains, on the whole, I can discuss the mode of metallurgical production at Dongxiafeng during the Erlitou period. The quantity of stone molds and smelting slag excavated at Dongxiafeng is very low, and the sizes of all the metal objects are also very small. The current data suggests that, first, production of these metal objects did not ask for a large volume of raw material investment, and second, the productivity of the Dongxiafeng community was very low during the Erlitou period. Here, I take the Polis regions in the western Cyprus as a comparative case. According to Raber’s study (1987), copper metallurgy from the ca. 8th century BCE to the 15th century CE in the Polis region was always based on local, village-based, and seasonal industry. The highest average annual copper production was 13 metric tons during the Pre-Roman period, while the lowest was 7.7 metric tons during the Late Medieval period. To take the Late Medieval period as a case, eight metallurgical sites have been discovered in the Polis region, so the productivity of each metallurgical site was 0.9 metric tons/year on average. The lowest average productivity of each metallurgical community was 0.37 metric tons/year during the Late Roman period, when the average annual copper production was 9.5 metric tons by 26 metallurgical sites. Even the lowest average productivity of each metallurgical site in the Polis region was much higher than that of the Dongxiafeng community, in which only 14 small metal objects have been excavated in the Late Erlitou assemblage, dating to an approximately 100-year time span. The huge gap in productivity between the two regions can only be explained by such a circumstance: bronze metallurgy at the Dongxiafeng community was carried out on an extremely small scale and sporadically during the Erlitou period. The small-scale and sporadic smelting and casting activities at Dongxiafeng coincided with the small-scale copper mining in the Zhongtiao Mountains.

Apart from the Erlitou period, in fact, the metallurgical remains during the Erligang period (the fifth and sixth phases of the Dongxiafeng site in the excavation report) suggest that even then, bronze metallurgy was still carried out on a very small scale. A total of 27 metallurgical remains during the Erligang period have been uncovered, including three stone molds, four metal knives, 13 arrowheads, five pieces of smelting slag, and one *jue* tripod. With no difference from that of the Erlitou period, the small amount of metallurgical remains shows that the productivity was still very low during the Erligang period.

Compared to agricultural and other production tools, metallurgy only occupied a small proportion in the economic system of the Dongxiafeng community. Based on statistics of production tools excavated at Dongxiafeng during the Erlitou and Erligang periods, it is clear that agriculture was the primary work of the Dongxiafeng inhabitants (Diagram 7-1). Agricultural tools were mainly stone tools, including axes, adzes, spades, knives, sickles, and so on. Some of the agricultural tools were also made of bone and freshwater mollusk shell. Textile production tools are comprised of ceramic and stone spindle whorls, and bone needles. Hunting was indicated by arrowheads made of bone, stone and freshwater mollusk shell. I sum up all metallurgical remains, including production tools, final products, even pieces of smelting slag. However, the quantity of metallurgical remains was still the lowest during all periods. It clearly shows that metallurgical activity was probably a minor aspect of the Dongxiafeng economy during the early Bronze Age.

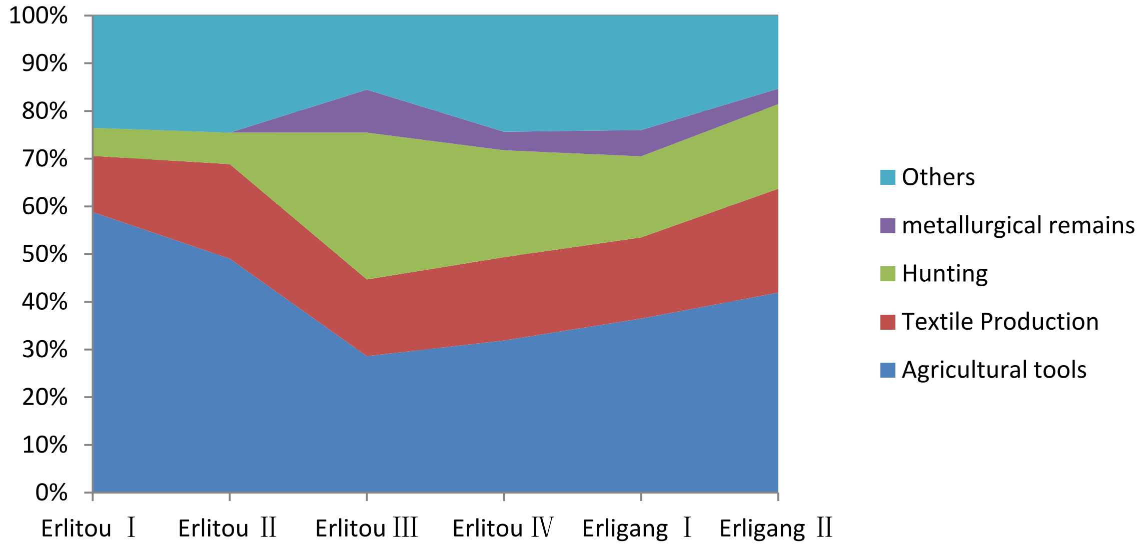

Diagram 7-1 Comparison of production-related remains during the Erlitou and Erligang periods (based on Zhongguo 1988: 20-22, 31-38, 48-49, 68-79, 98-100, 114-125, 145-148)

Aside from metallurgical remains, the metallurgical spaces could also provide us with the information about the production mode of metallurgy around the Zhongtiao Mountains. The metallurgical remains are mainly distributed in two areas at the Dongxiafeng site. One is located in the central area of Dongxiafeng. In excavation area V, metallurgical remains were excavated from two ash pits H501 and H504, and from strata T5524:4B and T5501: 3D (Figure 7-5). Stone molds were mostly excavated from H501. The metallurgical area was surrounded by ditches, where many cave dwellings were also constructed during the Erlitou period. The other area yielding metallurgical remains was located in the eastern part of Dongxiafeng, namely the excavation area I and IV. The distribution characteristics of metallurgical remains may be summarized as follows:

1) These metallurgical remains are scattered;

2) As shown in excavation area V, the metallurgical area was located close to residential infrastructures, such as houses and wells, and to the other facilities of craft production, such as

ceramic kilns. It shows that a specialized workshop for metallurgy probably did not exist during the Late Erlitou.

3) The excavations do not yield any traces of permanent facilities of bronze metallurgy, such as large-scale fixed furnaces. Rather, the scattered few metallurgical remains and closeness to other facilities suggest that impermanent facilities of metallurgy were probably utilized during the Erlitou period.

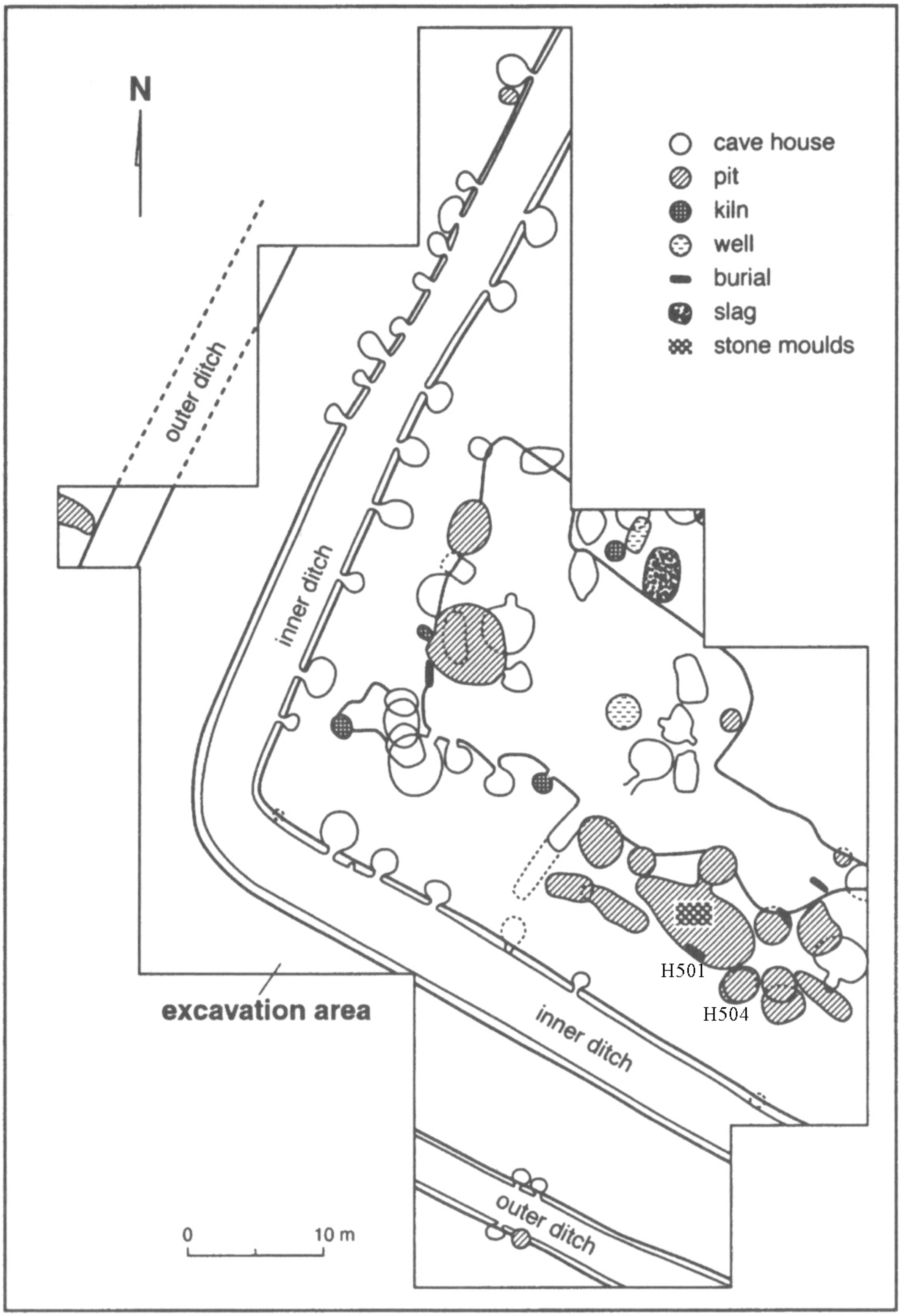

Figure 7-5 Plan of excavation area V at Dongxiafeng
(based on Zhongguo 1988, redrawn by Liu and Chen 2003: 72, Figure 16)

In their recently published paper, Li Jianxi et al. (2018) argue that excavation area V was a specialized metallurgical workshop that was probably controlled by local elites. However, current materials do not support their argument. It is more likely that the residents at Dongxiafeng did not purposefully open up a specialized metallurgical workshop during the Erlitou period; rather, metallurgical activities were probably carried out contingently at the household level when local residents collected sufficient raw materials.

7.2.3 Organization of community

The archaeological materials of investigating organization of the community include residential units and burials at Dongxiafeng. The excavations at Dongxiafeng uncovered 53 residential units during the Erlitou period. Among these residential units, a total of 41 units were dated to the third phase and 12 were dated to the fourth phase of the Erlitou period (Zhongguo 1988). The residential units at Dongxiafeng were mostly cave dwellings, which were dug into the vertical walls of the ditches (Figure 7-5). Other facilities and residential units were excavated in the area surrounded by ditches. These residential units were mostly small in size. Liu and Chen (2003) argue that these residential units probably belonged to craftsmen at Dongxiafeng, and the restricted residential layouts and poor living conditions show that the social status of these craftsmen was very low. Moreover, the concentration of these small dwellings and the existence of small-size burials suggest that craft production at Dongxiafeng was a state-controlled enterprise during the Erlitou period (Liu and Chen 2003: 73).

However, my comparison with the sizes of residential units in other communities suggests a very different scenario. The data of residential units in the Jinnan Basin during the Longshan and

Erlitou periods will be mentioned in my comparison. Aside from the Dongxiafeng site, residential units have not been reported in the other Erlitou-period sites, so I compare the residential units of the Dongxiafeng site with those of several Longshan-period sites (
Table 7-1). The Longshan-period residential units include three types: cave dwellings, semi-subterranean houses, and ground-level houses. Since most of residential units are excavated from Taosi and Dongxiafeng, and the other sites have only yielded a small amount of residential units, I separate these residential units into three categories: Dongxiafeng, Taosi and others. As shown in Table 7-1 and Table 7-2, apart from six residential units which exceed 15 m^2 in size (one in Dongxiafeng and four in Taosi), the area of other residential units were all lower than 15 m^2. At Dongxiafeng and Taosi, most of the residential units were even less than ten m^2 in size.

Site name	Number of Residential units
Dongxiafeng (Erlitou period)	48
Dingcun (Longshan period)	2
Qushetou (Longshan period)	3
Fangcheng (Longshan period)	1
Nanlijiao (Longshan period)	1
Taosi (Longshan period)	26

Table 7-1 Number of residential units in the Longshan and Erlitou sites in the Jinnan Basin (based on Zhongguo 1988, appendix 10, 19; Zhongguo and Shanxi 2015:125-126, table 3-1; Zhongguo 1964: 271; Zhongguo and Shanxi 1988: 290; Shanxi 2002: 30-31; Shanxi 1991: 883)

Site / Area range (m^2)	Dongxiafeng (n=48)	Taosi (n=26)	Others (n=7)
0-5	17 (35%)	9 (35%)	2 (29%)
5-10	25 (52%)	9 (35%)	2 (29%)
10-15	5 (10%)	3 (12%)	3 (43%)
15-20	0	1 (4%)	
20--	1 (2%)	4 (15%)	

Table 7-2 Areas of residential units in the Longshan and Erlitou sites in the Jinnan Basin (based on Zhongguo 1988, appendix 10, 19; Zhongguo and Shanxi 2015:125-126, table 3-1; Zhongguo 1964: 271; Zhongguo and Shanxi 1988: 290; Shanxi 2002: 30-31; Shanxi 1991: 883)

The tables above show that the areas of residential units at Dongxiafeng were not different from its Longshan predecessors in the Jinnan Basin. Apart from several large houses and large-scale rammed-earth foundations at Taosi (Zhongguo et al. 2008), most of residential units were small in size during the Longshan and Erlitou periods. Therefore, the restricted inner space does not suggest that the residential units of Dongxiafeng belonged to craftsmen and that the social status of these "craftsmen" were low. Rather, ordinary households lived in restricted residential units during both the Longshan and the Erlitou periods. The claim that Dongxiafeng was a state-controlled stronghold lacks archaeological evidence. Moreover, excavations of the residential units also yield no evidence of state control during the Erlitou period, such as hierarchical differentiation of living conditions. All of the objects excavated in the residential units are utilitarian utensils, such as ceramic vessels, stone tools, and bone tools. Therefore, the current evidence suggests that Dongxiafeng during the Erlitou period, similar to the Longshan communities, was only a common agricultural community in the Jinnan Basin, rather than being a state-controlled metallurgical center and transportation node.

Apart from residential units, the cemetery is another indicator of community organization. A total of 30 Erlitou-period tombs have been excavated, including two in phase I, six in phase III, and 22 in phase IV. Since the number of the tombs of phase I and phase III is few, and the excavation report does not publish the layout of tombs in phase IV, it is impossible to analyze the organization of the Dongxiafeng cemetery. All of the tombs were poorly built (Figure 7-6). Most of the graves only fit the sizes of the deceased. Moreover, there are seven cases that the tomb occupants were buried into deserted cave dwellings. The placements of the human skeletons were in disorder, and it is obvious that some of the deceased were bound when they were buried, suggesting that these tomb occupants probably died unnaturally, either as sacrificial victims or captives. The grave goods were mostly utilitarian pottery vessels, such as *ding* tripods, *guan* jars, and *pen* basins. A few turquoise ornaments and oracle bones have also been excavated. The currently available evidence related to mortuary practice shows no distinctive differentiation on social status or hierarchy, suggesting that there was not an administrative system like at Erlitou. Similar to the contemporaneous communities along the Shangluo Corridor, it is more likely that Dongxiafeng was not a state-controlled but autonomous community during the Erlitou period.

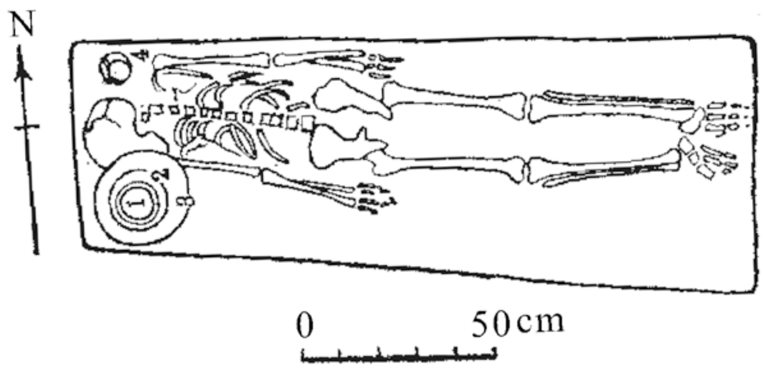

Figure 7-6 Tomb M511 during the Erlitou period
(based on Zhongguo 1988:19, Figure 22)
1-4. ceramic vessels

7.3 Metallurgical industry in the Zhongtiao Mountains

Based on the analysis above, mining and bronze metallurgy around the Zhongtiao Mountains during the Longshan and Erlitou periods fit the model of a local, village-based, and small-scale industry. Although it is more complicated than turquoise industry, current evidence about metallurgical industry around the Zhongtiao Mountains yields a similar result. With respect to copper mining, for example, copper oxides were probably mined in a flitting model in the Zhongtiao Mountains; no permanent facilities related to intensive mining have been discovered in the Zhongtiao Mountains. They suggest that copper mining in the Zhongtiao Mountains was carried out on a small scale. For bronze metallurgy, few metallurgical remains have been excavated; no permanent facilities and specialized workshops have been excavated; the average productivity was extremely low; organization of Dongxiafeng was the same as that of the Longshan communities in the Jinnan Basin; no evidence of an administration, as reflected by the palatial precinct and elite tombs at the Erlitou site, existed at Dongxiafeng. The current evidence shows that metallurgy in local communities was also probably carried out on a small scale and on a sporadic or contingent basis. The metallurgical site, Dongxiafeng, was more likely to be an autonomous community, instead of being controlled by the Erlitou state from the Luoyang Basin. The ceramic vessels show that multiple cultural groups participated in copper mining or exchange during the Erlitou period. The presence of various exploiting groups also hardly indicates a controlled context in the Jinnan Basin.

The local, village-based, and small-scale metallurgical industry presumably continued during the Erligang period. During the Erligang period, metallurgical remains are still few. A total of only 27 metallurgy-related items have been uncovered. The economy was still dominated by agriculture. All tombs were small, and tomb occupants were also interred with utilitarian ceramic vessels. No permanent facilities or infrastructures related to metallurgy have been found, suggesting no existence of specialized workshops or regulatory agencies like palatial precinct and specialized workshop observed at Zhengzhou (Henan 2001), Panlongcheng (Hubei 2001) and Nanguan (Zhongguo et al. 2014; Zhongguo et al. 1996). During the Erligang period, the large numbers of Erligang-style ceramic vessels were excavated at Dongxiafeng, suggesting the cultural expansion of the Erligang culture into the Jinnan Basin. However, as suggested in

Chapter 5 and 6, the assimilation into the Erligang culture does not mean the Erligang state's direct control over the mining industry in the Zhongtiao Mountains. The current evidence shows that Dongxiafeng was probably still an autonomous community, and metallurgy was still a local, village-based, and small-scale industry.

Our previous studies related to bronze metallurgy have laid too many focuses on the urban centers in the Central Plains, namely Erlitou and Zhengzhou, so that resource extraction was normally considered as a result of political control on peripheries (eg. Liu and Chen 2003; Tong Weihua 1998). A detailed analysis on mining and metallurgy in the peripheries has long been neglected. Through my preliminary analysis, a state-controlled enterprise in the Jinnan Basin probably never existed during the early Bronze Age; rather, copper mining, smelting, and casting were always local, small-scale and sporadic. Therefore, the center-periphery interactions based on copper resource flow need to be re-assessed. I will discuss it in chapter 8.

7.4 Early copper mining along the Middle Yangzi

The Middle Yangzi River region was another important region of copper provision in early China. It contains the largest copper deposit in China. The copper mines are located in Hubei, Jiangxi, and Jiangsu provinces. Daye (Hubei province), Dexing, Ruichang, Jiujiang, Qianshan, Dongxiang (Jiangxi province), and Tongling (Anhui province) are the most important early sources of copper supply in China. The copper mines in this area are characterized by high-grade ores and large-scale reserves. Through long-term weathering effect, the lodes of copper oxides are thick and long. The thickness of an oxidized copper deposit can reach 30-100 meters, and its length hundreds of meters. The content of copper in the oxidized ores normally reaches five to six percent, but some can reach 10-20 percent (Liu Shizhong et al. 1994; Liu Shizhong 1991; Liu and Lu 1997). Typical copper oxides in this region include malachite and azurite. These copper oxides, as well as native copper, are appropriate for exploitation in early China (Liu Shizhong 1991).

Remains of early mining in the Middle Yangzi River region have been not only discovered at many sites, but they are also preserved in a good condition. Along the Yangzi River valley from Daye city of Hubei province to Nanjing city of Jiangsu province, a large amount of mining and metallurgical sites have been found. In the area extending more than 500 kilometers, mining and metallurgical sites were concentrated in three regions (Figure 7-7): Daye-Yangxin region, Jiujiang-Ruichang region and Tongling-Nanling region (Wei Guofeng 2007: 26). According to current data, early mining activities had been conducted in all of the three areas.

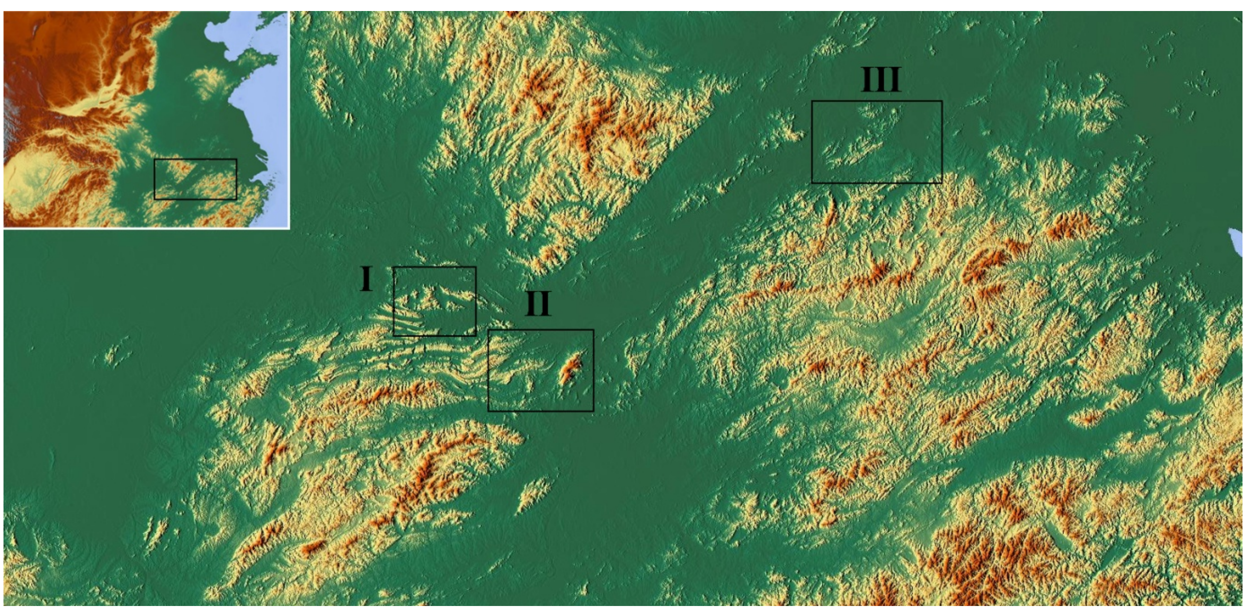

Figure 7-7 Distribution of mining and metallurgical sites in the Middle Yangzi River valleys (based on Wei Guofeng 2007: 26, Figure 2.2)
I. Daye-Yangxin district II. Jiujiang-Ruichang district III. Tongling-Nanling district

In the Daye-Yangxi district, mining activities were possibly carried out during the Longshan period, as attested by metallurgical remains in the Dalupu and Xiezidi sites (Hubei et al. 2013: 63; Hubei and Huangshi 2010). A survey in the district of Daye city has discovered more than ten Erlitou-period sites, which were probably related to copper mining and smelting (Huangshi 1984). The direct evidence of early mining comes from Tonglüshan, which is the most important copper mine of Daye city (Huangshi 1999). The archaeologists uncovered mining and smelting assemblages at the Tonglüshan site. Based on currently available data, two types of mining methods were probably adopted: surface and underground workings. Seven locations of surface workings have been discovered by archaeologists, but their dates are not clear. Underground working was widely adopted in Tonglüshan. The excavations uncovered seven underground working locations, including nearly 500 tunnels and shafts, and collected a large quantity of mining tools made of wood, bamboo, iron, bronze and stone, which were not only used for breaking rocks, but also for transporting ores, lighting, and so on. Two smelting sites have also been excavated. More than ten furnaces and uncountable smelting wastes have been uncovered. It is calculated that the smelting slag in Tonglüshan amounted to 400 thousand metric tons and accumulated to a thickness of three meters. The analysis of ceramic sherds and radiocarbon dating suggest that underground mining at Tonglüshan was already being conducted ca 3260±80 BP, contemporaneous with the Late Shang period. However, the two smelting sites are respectively dated to the Spring and Autumn period and the Warring States period.

The Tongling site in Ruichang City was an important mining site in the Jiujiang-Ruichang district. It is located 24 kilometers to the west of the modern Ruichang City. The area of the mining site is 70,000 m^2, while smelting activities were carried out in a district of more than 170,000 m^2 (Liu and Lu 1997). As at Tonglüshan, workings also include two types: surface and underground workings. The excavations in the mining regions uncovered more than one hundred features, including tunnels, shafts, workers' shelters, mining pits, ore processing areas, and so on. Archaeologists excavated mining tools and utensils made of ceramics, bronzes, stones, reeds, and woods. The radiocarbon dating of timber supports in a shaft shows that the copper mines of Tongling had been mined at least during approximately 3300 BP, which was contemporaneous with the Shang period. Ceramic vessels and bronze implements correspond with the result of radiocarbon dating (ibid). However, smelting areas have not been excavated. The slag at this site was estimated to amount to several hundreds of thousand metric tons (ibid; Lu and Liu 1997).

In the Tongling-Nanling district, mining remains are much more plentiful than in the aforementioned two districts. It has been found, by surveys at multiple mines in this region, that mining workings and tools were similar to those of the other two regions. The pottery sherds and radiocarbon dating at the Jiangmuchong, Wanyingshan, and Muyushan mining sites show that the copper mines in this region were exploited at least during the Western Zhou period (Wei Guofeng 2007: 29). However, the recent finds from the Shigudun site, where smelting remains were excavated, date the earliest smelting activities in this area to the Erlitou period (Anhui 2013). The Shigudun site is located close to the Tongling copper mine (different from the Tongling site in Ruichang city) in this region. It is possible that the exploitation of local copper resources in this district began well before the Western Zhou period.

Even though many mining sites have been discovered in the Middle Yangzi River valley, their social implications have not been understood. Currently, Tonglüshan is the site where archaeological work has been sufficiently carried out. Archaeologists have surveyed and uncovered many mining and smelting sites in and near the Tonglüshan mine. Hence, below I will focus on the case of Tonglüshan, trying to discuss the organization of copper production in this region in antiquity. Although excavations have not been widely carried out, the survey data in the district of Tongling city of Anhui province can also be used as a supplement in my discussion.

7.5 Tonglüshan and Tongling: contrasting patterns of mining landscape

In the Middle Yangzi River valley, as introduced above, copper oxides are largely deposited. The deposits of copper oxides are much deeper than in the Zhongtiao Mountains. Therefore, it is possible that early mining of copper oxides was carried out on a large scale. It may not be appropriate to estimate the scales of early mining in the Middle Yangzi River valley based on the occurrence characteristics of copper oxides. Hence, I mainly focus on the mining landscape in the Tonglüshan and Tongling regions. In order to better understand the organization of copper production in this region, I will adopt a long-term perspective, and contrast different patterns of mining landscape through time (Figure 7-8, Figure 7-12). The economy and organization of communities will also be discussed in this section.

7.5.1 Tonglüshan

Dalupu

The Dalupu site is located about 15 km to the southeast of the Tonglüshan mine. The distance of Dalupu to the nearest mountain of copper mine to the west is also several kilometers. It is located on a tableland in a small intermountain basin. A small stream flows in front of the Dalupu site. The total area of the Dalupu site is only eight hectare. The excavations at the Dalupu site have yielded assemblages of two periods: the Longshan period (possibly continued to the Early Erlitou), and the Late Shang – Western Zhou period (Hubei et al. 2013).

The metallurgical remains from the Longshan period are not many, only including four pieces of ores, one piece of furnace debris, and four pieces of slag. The ceramic assemblage from features where the metallurgical remains were excavated was associated with the post-Shijiahe material culture. As mentioned in Chapter 1, the post-Shijiahe cultures probably lasted to the Early Erlitou, so the metallurgical remains could also be possibly dated to that time. The small amount of metallurgical remains suggests that metallurgy probably only occupied a low proportion of local economy. Moreover, the Dalupu site does not yield other metallurgy-related remains during the Longshan period. Compared with metallurgy, agriculture probably dominated the economy of the Dalupu community, as evidenced by the large amount of agriculture-related production tools, such as stone tools and ceramic spindle whorls (Diagram 7-2).

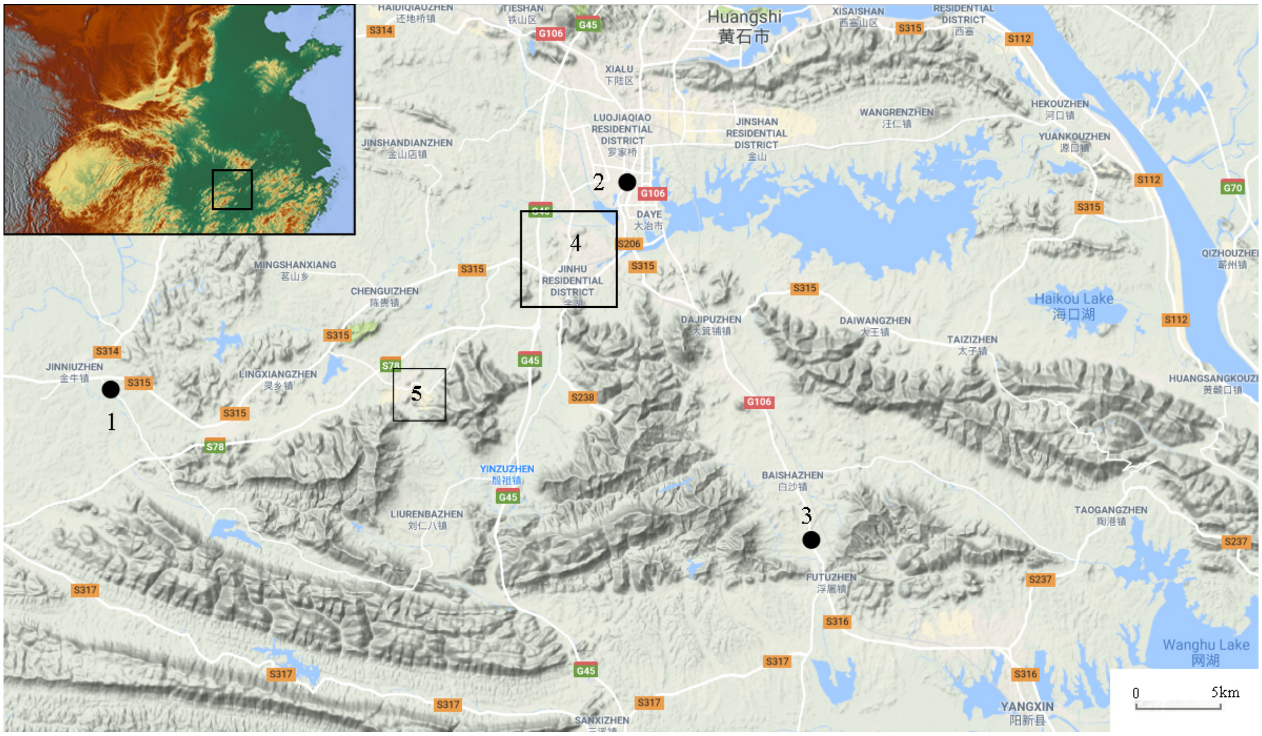

Figure 7-8 Major sites in the Tonglüshan region mentioned in this chapter
1. Xianglushan 2. Xiezidi 3. Dalupu 4. Tonglushan mining and smelting sites 5. Tongshankou copper mine

The amount of metallurgical remains during the Late Shang – Western Zhou period increased significantly. Apart from the tiny pieces that the archaeologists do not collect, the metallurgical remains include 14 pieces of ore, 31 pieces of smelting slag, and two pieces of furnace debris. The excavators published the information of all features, based on which we can know scale and frequency of the metallurgical activities during this period. Smelting slag has been widely excavated from the late Shang – Western Zhou-period layers. Among a total of 196 ash pits, 55 yielded pieces of smelting slag, occupying 28% of the total number of ash pits[1]. However, the amount of smelting slag in each feature is very small. Single pieces of smelting slag in features

[1] Most of smelting slag has been excavated from ash pits. The excavation report has listed the information of all ash pits. Since the information of ash pits in the description of main paragraphs and in the attached charts are different, here I choose data from the attached charts.

are normally only several centimeters in length. The small amount and increased frequency of smelting slag suggest that metallurgical activities had been more widely or frequently carried out than the Longshan period, but the scale of each activity was still small at the Dalupu community during this period. Moreover, seven possible furnace bases have been excavated. They are all 1-1.5 meters long and less than 1 meter wide. In their sizes, these small furnaces resemble the small-scale productions at Dalupu. Metal objects and molds have also been excavated, suggesting that the Dalupu community could not only smelt copper, but also cast the final products. This contrasts significantly with the metallurgical sites after the Western Zhou period. I will discuss this below.

Although metallurgical remains increased significantly, metallurgy probably still occupied a small proportion of economy at the Dalupu community (Diagram 7-2). During the Late Shang – Western Zhou period, a total of 106 stone tools have been excavated, in which the most are agricultural production tools, such as knives, axes, spades, and adzes. Textile production was also probably important in the economy, as evidenced by 87 ceramic spindle whorls. Moreover, 43 ceramic pats and bearing bases, which were tools for making ceramics, have been excavated, suggesting that ceramic production was another important part of the economy of Dalupu. Compared to these tools of agriculture and other craft productions, metallurgical remains only occupy a small proportion of the economy-related finds from the Dalupu community.

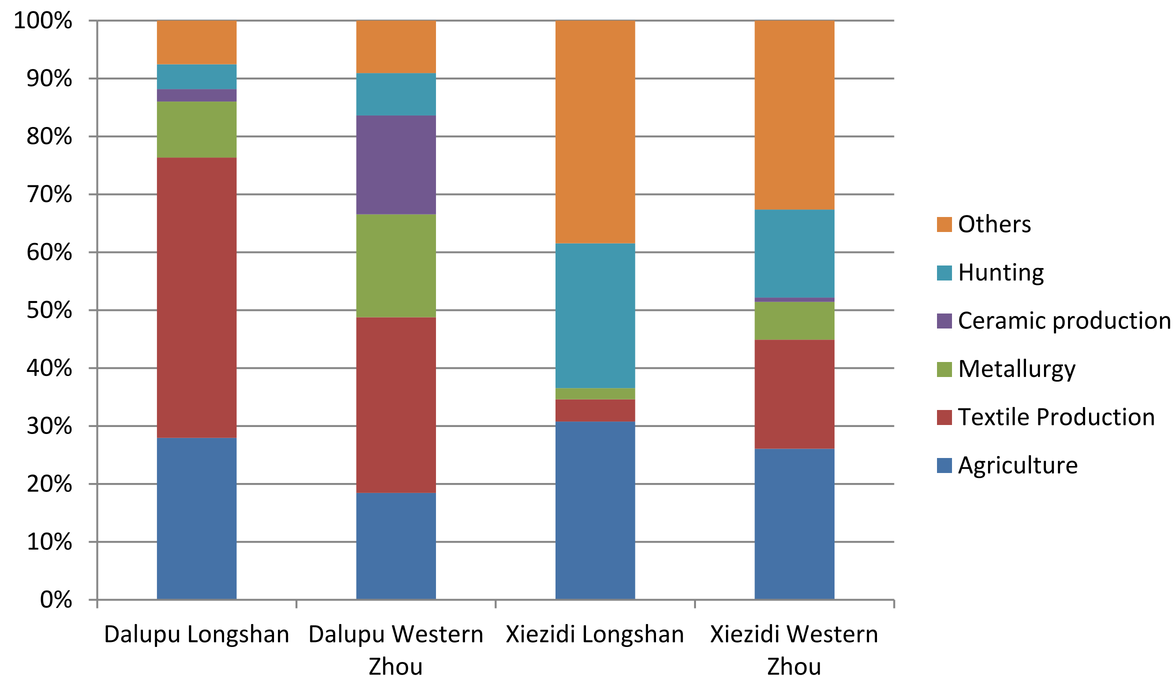

Diagram 7-2 Comparison of production-related remains at the Dalupu and Xiezidi sites (based on Hubei et al. 2013: 59-63, 269-285, 290-298; Hubei and Huangshi 2010: 20-22, 40-44)

Therefore, although the frequency of bronze metallurgy had increased significantly during the Late Shang – Western Zhou period, it was still carried out on a small-scale level, such as household production. With no difference from most of communities during the Neolithic and the Bronze Age, the economy of Dalupu was still dominated by agriculture and agriculture-related production activities, such as ceramic and textile production.

Xiezidi

The Xiezidi site is located in a plain, five kilometers to the north of the Tonglüshan copper mine. Archaeologists uncovered assemblages of two periods: the Longshan period and the Western Zhou period (Hubei and Huangshi 2010). Similar to Dalupu, the Longshan ceramic assemblage was associated with the post-Shijiahe material culture which has been excavated at the Shijiahe site complex. The Longshan metallurgical remains are few, only including a piece of malachite and a stone anvil, which was used for smashing copper ores. Metallurgical remains during the western Zhou period increased significantly. During this period, the metallurgical remains include two bronze arrowheads, one hematite whetstone, one copper ingot, one string of lead-tin alloy, two ceramic molds, one piece of furnace debris, and three undefined bronze objects. Although metallurgy probably became more important and developed during the western Zhou period, the economy of the Xiezidi community was still agriculture-based (Diagram 7-2). Moreover, a study of plant remains also shows that the Xiezidi community based their economy on rice cultivation (Tang Liya et al. 2014).

Xianglushan

The Xianglushan site is located in a plain to the southwest of the Tonglüshan copper mine. It is about 30 kilometers away from the Tonglüshan mine, and 20 kilometers from another important copper deposit, the Tongshankou copper mine (Hubei et al. 2015). The Xianglushan site has not been excavated, but a survey of this site has identified assemblage of the Longshan period and the Western Zhou period. A total of 25 metallurgical remains have been collected in the Western Zhou assemblage, including 11 pieces of furnace debris and 19 pieces of smelting slag. Besides, one stone axe, one stone adze, and two ceramic spindle whorls. Since this site has not been excavated, it is not possible to estimate the mode of metallurgical production. However, current materials at least show that agriculture and bronze metallurgy were both carried out in the Xianglushan community during the western Zhou period. Metallurgy was not the only production activity at the Xianglushan community.

Smelting sites in the Tonglüshan mine

Many smelting sites are distributed in the Tonglüshan mine. According to a recent survey, at least 15 metallurgical sites existed in the Tonglüshan mine (Figure 7-9; Huangshi 1999; Hubei and Daye 2012). These sites are all distributed at a distance of about 100 – 500 meters around the copper mines at Tonglüshan. Due to the modern exploitations, most of these sites are not well preserved. Only one site, Lujianao, was preserved relatively well. It exceeds three hectare in size. The archaeologists discovered smelting strata in all these smelting sites. According to geologists' estimate, the smelting slag of Tonglüshan exceeds 400,000 metric tons in weight (Huangshi 1999: 12). The sites are all located on hillsides. Such a location is not only beneficial for ore transportation, but also for the provision of wood fuel (Hubei and Daye 2012). Based on ceramic sherds collected, the earliest site is dated to the Eastern Zhou period, while the latest is dated to the Qing Dynasty (ibid). This attests that metallurgical activities were continuously carried out in the Tonglüshan copper mine for more than 2000 years. Four sites have been excavated.

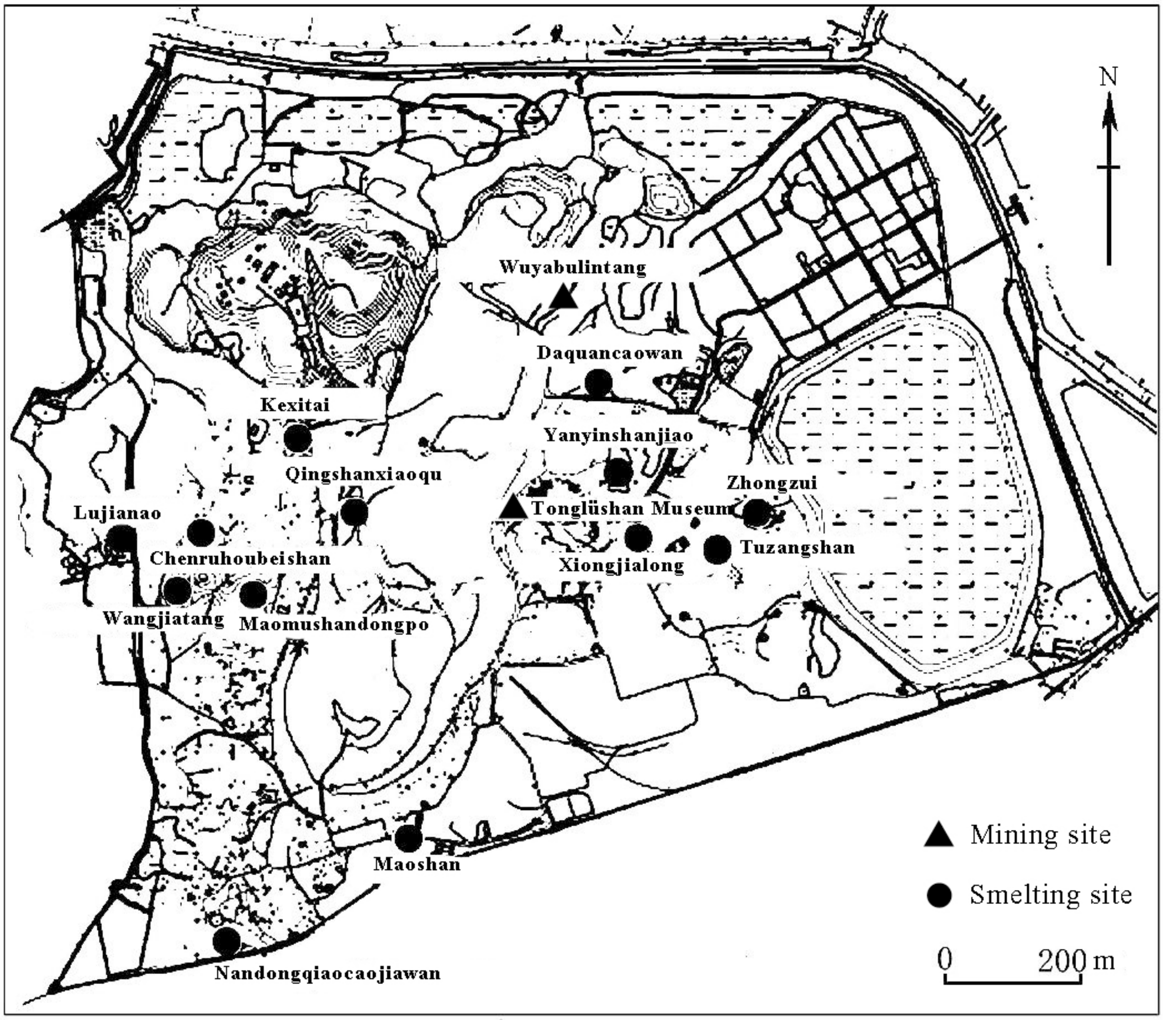

Figure 7-9 Distribution of smelting sites around the Tonglushan mine
(based on Hubei and Daye 2012: 19, Figure 1)

Yanyinshanjiao:

The Yanyinshanjiao site is located at the northeastern piedmont of the Big Yanyingshan Mountain. The excavations uncovered assemblages of four periods: the Spring and Autumn period, the Warring States period, the Han Dynasty and the Qing Dynasty (Hubei and Daye 2013). All of the remains excavated in this site are related to metallurgy. The Spring and Autumn assemblage is the most important. The features of this period include a layer of leach tailings, a beneficiation field, a clay pool, and a furnace, constituting an intact operational sequence of metal production from beneficiation, ore washing, smelting to ingot making. Since no casting remains, such as molds, have been excavated at Yanyinshanjiao, the excavation report thinks that this site probably specialized in production of copper ingot. Objects excavated at Yanyinshanjiao are comprised by iron ores, copper ores, native copper, smelting slag, furnace debris, splints, bamboo objects, and a small amount of ceramic sherds. It should be noted that no agriculture-related production tools, such as stone axes, adzes, ceramic spindle whorls, and so on, have been excavated. The large amount of objects related to metallurgy, and absence of agricultural production tools, shows that, different from Dalupu, Xiezidi and Xianglushan, Yanyinshanjiao was a specialized metallurgical community.

Smelting site at mine XI

It is located at the northern piedmont of the Tonglüshan Mountain (Huangshi 1999). The excavations have uncovered ten smelting furnaces at this site. Around some furnaces, some ancillary facilities, such as slag pits, stone anvils, ore pits, kaolin clay pits, have also been uncovered. Archaeologists found ores, smelting slag, copper ingots, and a bronze adze. No molds for casting metal objects have been excavated. Considering the discovery of furnaces, smelting slag, copper ingots and the absence of molds, it is highly possible that, similar to Yanyinshanjiao, the smelting site at mine XI specialized in the production of copper ingots. Ceramic sherds attest that this smelting site existed during the Late Western Zhou and the Spring and Autumn periods, but all smelting furnaces are dated to the Spring and Autumn period. Hence, it is possible that the large-scale copper production started during the Spring and Autumn period. Agriculture-related production tools have not been excavated either.

Lujianao:

Lujianao is located to the west of the Tonglüshan Mountain (Hubei and Daye 2013). Archaeologists uncovered assemblages from the Han Dynasty to the Qing Dynasty. Most of assemblages are dated to the Han period, including furnaces, working shelters, smelting slag, ores, charcoal grain, ceramic sherds and bricks. Molds and agriculture-related production tools are also not found at the Lujianao site, suggesting that Lujianao also probably specialized in production of copper ingots, rather than casting final products.

Besides, the Kexitai site is another smelting site that has been excavated. It is located 500 meters to the northwest of the Tonglüshan Mountain (Huangshi 1999). Archaeologists only uncovered two smelting furnaces at Kexitai. Ceramic sherds and thermoluminescence dating show that they were used during the Late Warring States period.

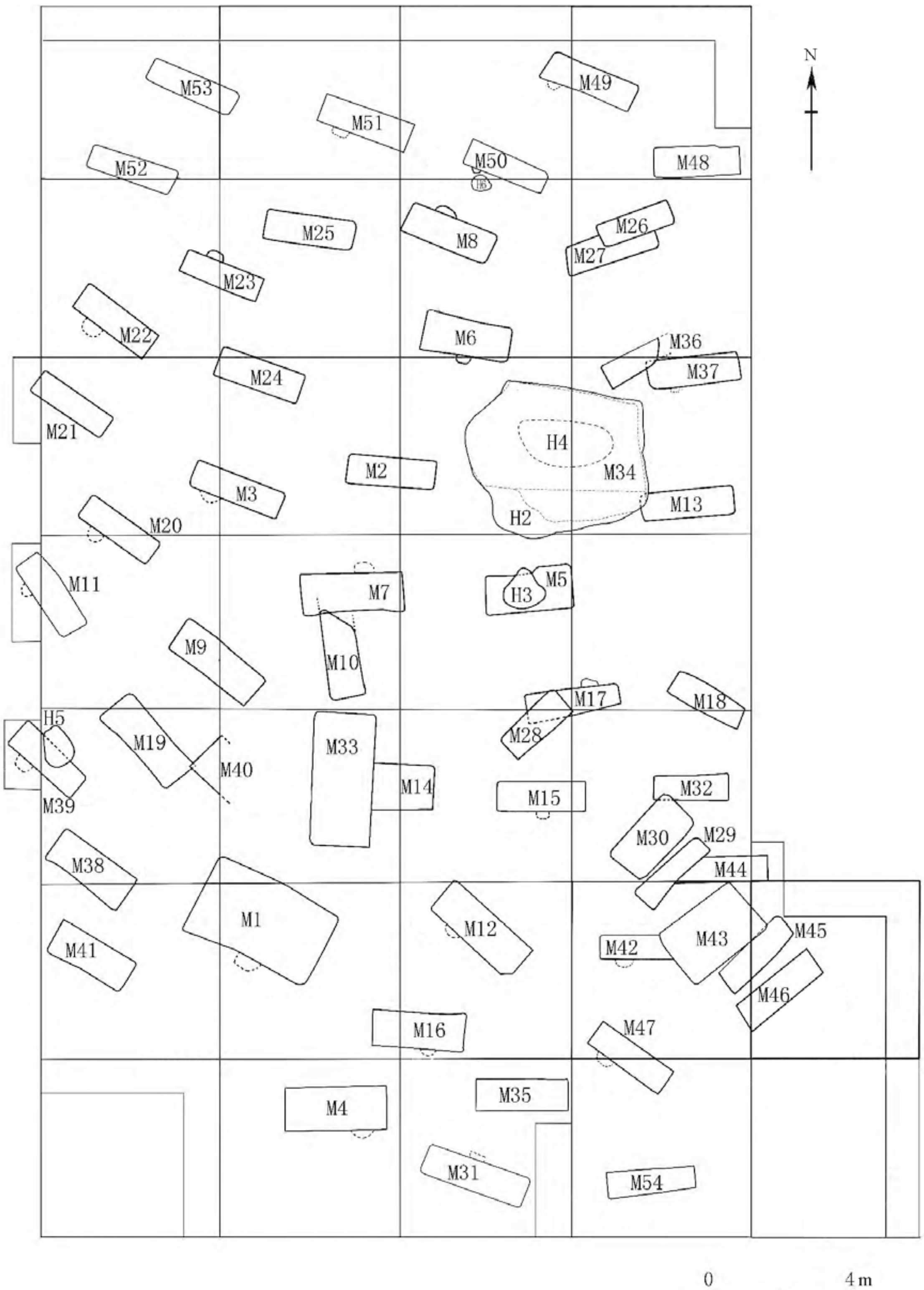

Figure 7-10 Plan of the Sifangtang cemetery
(based on Hubei and Daye 2015: 37, Figure 2)

Sifangtang cemetery

The Sifangtang cemetery is located to the north of mine VII in the Tonglüshan Mountain (Figure 7-10). The area of this cemetery is 1.5 hectare (Hubei and Daye 2015). The archaeologists uncovered a total of 123 tombs, of which three are dated to the Western Zhou period, and 120 are dated to the Spring and Autumn period (Chen Shuxiang et al. 2017). The mine VII was exploited during the Spring and Autumn period, contemporaneous with Sifangtang. Therefore, the Sifangtang cemetery was closely related to copper mining and production at mine VII in Tonglüshan. The deceased of the Sifangtang cemetery were probably workers and staffs, who were responsible for exploiting and monitoring mine VII (Hubei and Daye 2015).

Two characteristics of the Sifangtang cemetery need to be addressed. First, the differentiation of the scales of tombs suggests the existence of status differentiation at Sifangtang (Diagram 7-3). Two types of tombs could be distinguished. One type only includes two tombs: M1 and M34. The two tombs are much larger and deeper than other tombs. The occupant in tomb M1 was interred into double coffins, while others were only interred into single or no coffins. This evidence suggests that the status of the first type of tomb occupants were higher than that of the other tombs. The sizes of the other-type tombs are similar. The largest size exceeds three m^3, and the smallest is smaller than 2 m^2. Moreover, the tomb size, quantity of grave goods, and the existence of coffins show no obvious relation, suggesting that the occupants of these small tombs were similar in status and wealth (Chen and Chen 2015). On the other hand, grave goods in M1 only include a pouch-legged *li* tripod, three small jade objects and four pieces of snails. The quantity of grave goods in M1 does not largely exceed those in other tombs, and jade objects are also excavated in small tombs. It suggests that the status differentiation between the two groups of tomb occupants was probably not distinctive (Chen and Chen 2015). The status differentiation suggests that a regulatory system of copper mining at Tonglüshan had been probably built up. The occupants of these tombs were all probably low-status staffs of the mining industry in the Tonglushan mines (ibid; Chen Shuxiang 2017). Second, military forces have been involved in copper mining, as evidenced by that bronze weapons, such as *ge* daggers and a *pi* sword, have been excavated in 13 tombs (Figure 7-11, Hubei and Daye 2015; Chen and Chen 2015; Chen Shuxiang et al. 2017). The existence of the military force suggests that copper mining has been intentionally controlled and protected during the Spring and Autumn period.

Figure 7-11 Bronze weapons excavated from tomb M9 at Sifangtang
(based on Hubei and Daye 2015: 41, plate 6)
1. *ge* dagger 2. *Pi* sword

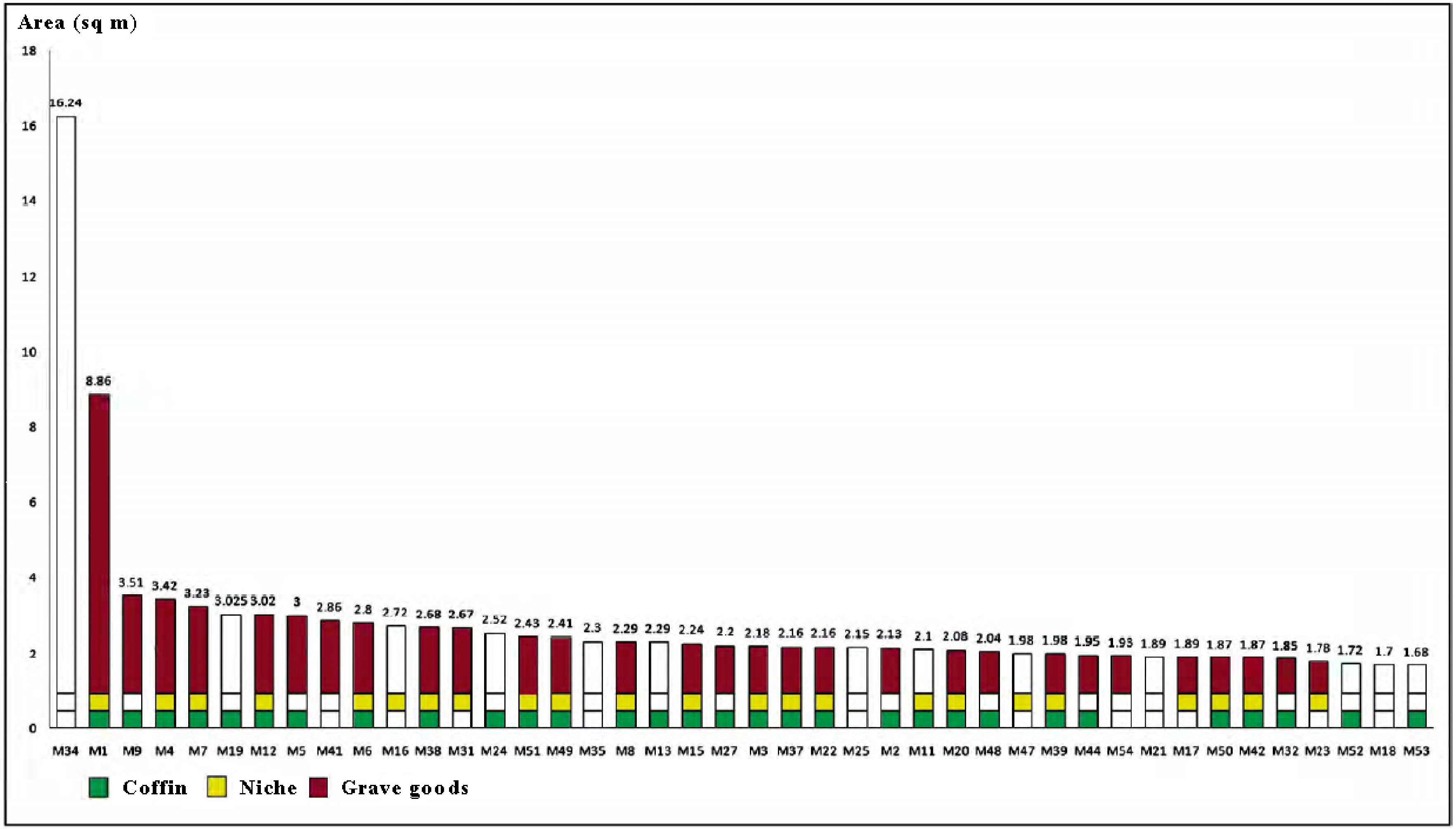

Diagram 7-3 Relationship among scale, coffin, and grave goods at Sifangtang
(Chen and Chen 2015: 97, Figure 1)

Contrasting patterns of mining landscape

Based on the description of metallurgical sites in the Tonglüshan region above, it is easy to distinguish two types of mining landscape. The first type of mining landscape existed before the Spring and Autumn period and the representative sites are Dalupu, Xiezidi and Xianglushan. Its characteristics could be summarized as follows:

1) Metallurgical communities were distributed in plains or small basins, which were normally five to 20 kilometers away from major copper mines;

2) The scales of metallurgical activities were normally small, even though the frequency of metallurgy increased through time. It is possible that the metallurgical activities were organized on a household or a slightly larger basis before the Spring and Autumn period;

3) The economy of these communities was still dominated by agriculture and agriculture-related craft production, such as textile and ceramic productions.

4) These metallurgical communities were not only responsible for smelting, but also for casting final products.

5) No permanent facilities existed in the Tonglüshan mines before the Spring and Autumn period, although the radiocarbon dating has attested that Tonglüshan had been mined since the Late Shang period.

The above characteristics fit the model of a village-based, local, and seasonal metallurgical industry. The primary work of local agriculturalists was always agriculture-related productions. Metallurgy was probably a sporadic or contingent activity during intervals of agricultural activities. However, it does not mean that there was no development of metallurgy. From the Longshan to the Spring Autumn period, the frequency of metallurgical remains increased, suggesting that bronze metallurgy became more and more widely adopted by local communities, even though the basic economic pattern did not change during this period. With the increasing demand for copper resource in the Bronze-Age centers, the Tonglüshan region probably underwent a gradual intensification of copper resource extraction through time before the Spring and Autumn period.

During the Spring and Autumn period, however, the mining landscape in the Tonglüshan region started to change. The characteristics of the mining landscape after the Spring and Autumn period could be listed as follows:

1) The metallurgical sites were located close to mines in the Tonglüshan region. Metallurgical sites are all located at hillsides close to mining tunnels or shafts, in order to make the best use of transportation and fuel resource. The concentration of metallurgical sites to copper mines formed what archaeo-metallurgists call a "mining district" (eg. Stöllner 2014; O'Brien 2015).

2) Molds have not been excavated, suggesting that these metallurgical sites are not responsible for casting final products, but only to produce copper ingots, which were probably transported to larger metallurgical centers and casted into final products.

3) The status and professional differentiation suggests that an administrative and protection system in the Tonglüshan mines has been established.

4) The economy of the metallurgical communities was dominated by metallurgy. No evidence of agricultural work has been identified. Local miners probably did not participate in subsistence production.

These characteristics fit the model of a state-controlled, large-scale and full-time metallurgical industry. The existence of an administrative system and military forces suggests that a direct political control was deeply involved in the copper production. In order to reduce the cost of transportation, metallurgical sites were concentrated close to mines, forming mining districts. Local workers were mostly full-time metallurgical specialists. These phenomena show that the states started to intensively exploit the Tonglüshan mine. Moreover, community specialization also started to emerge. On the one hand, these communities did not undertake any tasks of agricultural and other productions. These communities around the Tonglüshan mine specialized in metallurgy. On the other hand, the fact that communities only produced copper ingots also shows that the content of production had been strictly regulated and controlled.

7.5.2 Tongling

Apart from the Tonglüshan region, the Tongling region in Anhui province yields a similar mining landscape (Figure 7-12). The surveys in Nanling County of Tongling City discovered a total of 26 metallurgical sites, of which twelve were dated to the Zhou period and ten were dated to the Han to Tang Dynasties (Anhui and Nanling 2002). The Zhou-period metallurgical sites are all distributed in small basins or low hills, which are distant to copper mines, while the later metallurgical sites are mostly distributed close to copper mines (ibid). The Jiangmuchong site is located in a small tableland, several kilometers to the south of the Dagongshan copper mine. The ceramic sherds collected at Jiangmuchong attest that this metallurgical site lasted from the Western Zhou period to the Spring and Autumn period. Archaeologists not only collected large quantities of smelting slag and ceramic sherds, but also a stone adze (ibid; Liu Pingsheng 1988), suggesting that the Jiangmuchong community probably carried out agricultural production and bronze metallurgy. The metallurgical sites after Zhou period were mostly distributed close to mining sites (Anhui and Nanling 2002). In these metallurgical sites, agriculture-related production tools have not been collected in surveys. Although the survey data was not very precise, they still show that the mining landscape in the Tongling region was similar to that in the Tonglüshan region. Based on the evidence from the survey in Nanling County and the excavation at the Shigudun site, the change of mining landscape probably also occurred during some time in the Spring and Autumn period (ibid; Anhui 2013).

Compared to the Tonglüshan region, archaeological work, especially excavations, has not been fully carried out in the Tongling region. However, a recent excavation at the Shigudun site near Tongling City yields valuable information about the mining landscape before the Spring and Autumn period. The Shigudun site is only 7500 sq m. in size. Archaeologists uncovered assemblages from the Erlitou period to the early Spring and Autumn period (Anhui 2013). The Shigudun site is located at a basin to the south of the Yangzi River and several kilometers to the north of a copper mine. Metallurgical remains were excavated in the Erlitou and Zhou-period assemblage. The clear evidence of metallurgical remains during the Erlitou period is only three pieces of furnace debris. The scarcity of metallurgical remains shows that metallurgy was probably carried out on a very small scale.

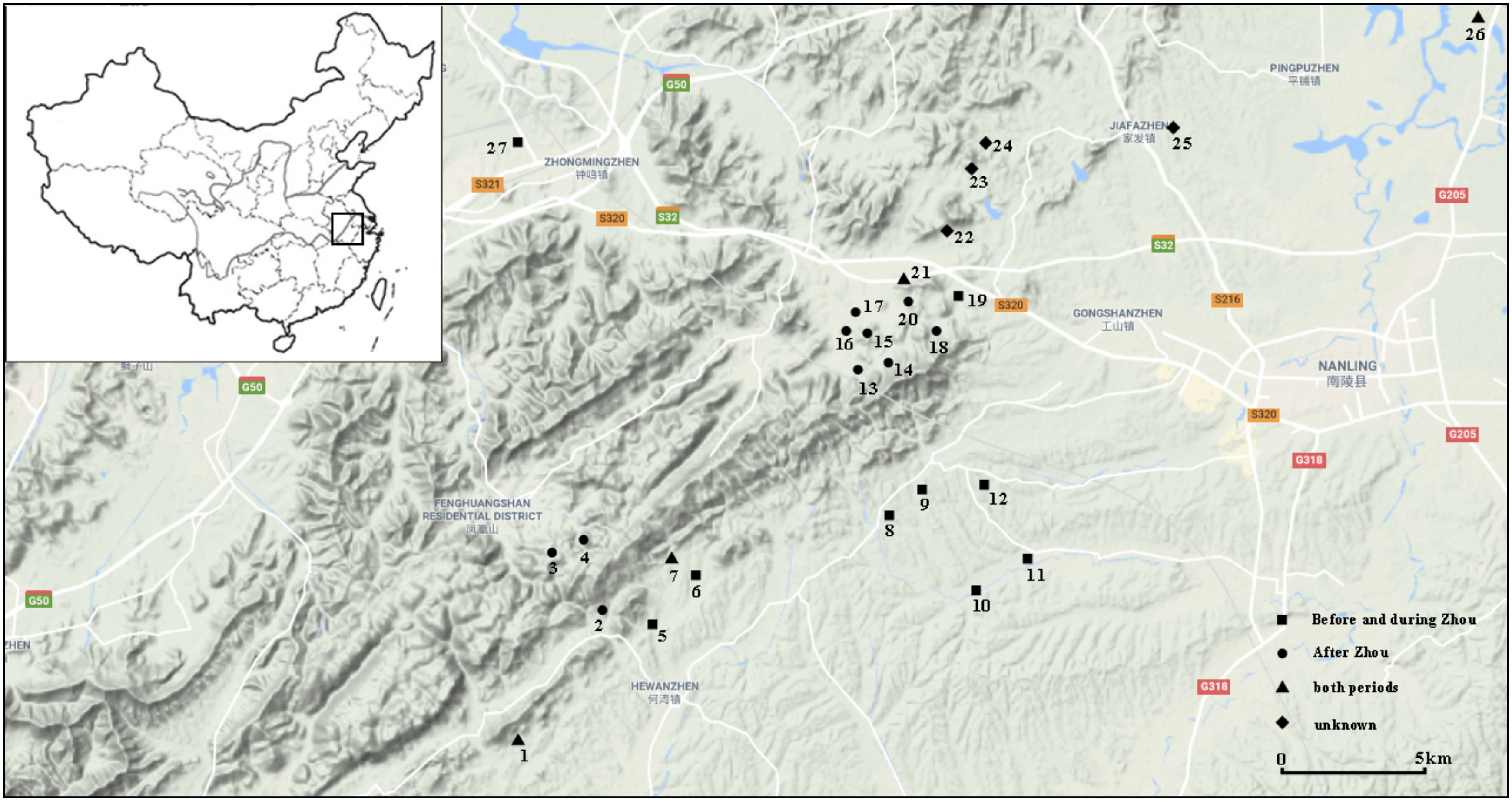

Figure 7-12 Relationship between metallurgical sites and landscape in Nanling County of Tongling City (based on Anhui and Nanling 2002; Anhui 2013)

1. LengshuiChong 2. Zhaishan 3. Tieshanqiao 4. Dayuanling 5. Banbianchong 6. Liujiajing 7. Shuilonghu 8. Jiangmuchong 9. Tiesiling 10. Lutangchong 11. Chongkou 12. Qiaocun 13. Shatanjiao 14. Shangmuchong 15. Talimu 16. Jintangling 17. Yanwoling 18. Wanchong 19. Cuijialao 20. Mayaoshan 21. Xiajiaba 22. Laillongshan 23. Gutangchong 24. Xiafenlu 25. Laoyachong 26. Qiancun 27. Shigudun

Similar to Dalupu, Xiezidi, and Xianglushan in the Tonglüshan region, metallurgical remains increased significantly at Shigudun during the Western Zhou and the early Spring and Autumn periods. Various types of metallurgical remains have been excavated, including metal weapons and vessels, ores, support bases, furnace debris, smelting slag, and ceramic and stone molds (Figure 7-13). Agriculture-related production tools have also been excavated, such as chisels, adzes, spades, and axes. The preliminary report does not list the amount of each type of remains, so it is difficult to estimate the scale of metallurgy in each period. However, it at least indicates that bronze metallurgy at the Shigudun community was not a specialized activity. Local agriculturalists had to schedule multiple types of productions. In spite of the small area of this site and the multiple types of productions, it does not mean metallurgical technology at Shigudun was simple. At Shigudun, a stone mold for casting implements and a ceramic mold for casting bronze vessels have been excavated. Decors of many curves, which usually appeared on bronze vessels during the Western Zhou period, can be observed in the inner side of the ceramic mold. This stone mold with the decors of curves suggests that the Shigudun community was not only able to cast final products, but also could produce technique-sophisticated vessels. These strands of evidence indicate that the metallurgy at the Shigudun community, similar to Dalupu, Xiezidi, and Xianglushan, was also a local, village-based and seasonal industry. Rather than being directly controlled by states, Shigudun was possibly an autonomous community, which could both smelt ores and cast complicated final products.

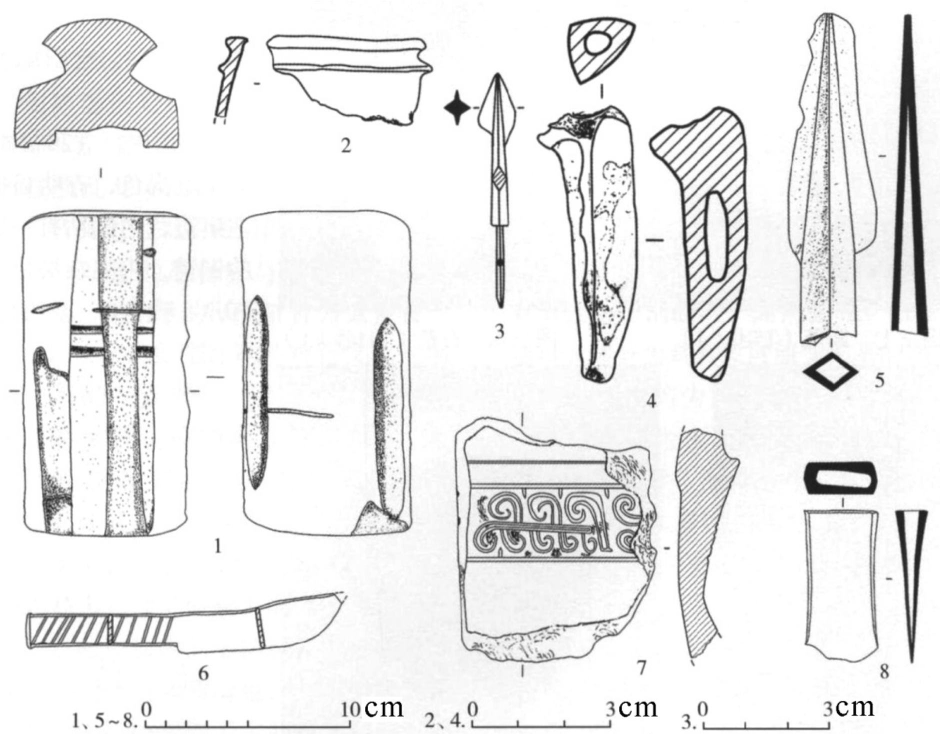

Figure 7-13 Metallurgical remains during the Western Zhou and Early Spring and Autumn period
(Anhui 2013: 19, Figure 34)
1. Stone mold 2. Rim fragment of a vessel 3. Arrowhead 4. Bronze leg fragment
5. Spear 6. Knife 7. Ceramic mold 8. adze

Although the information on the mining landscape in the Tongling region is still limited, the current evidence indicates that, similar to the Tonglüshan region, two types of mining landscape probably also existed before and after the Spring and Autumn period. Since the characteristics of the two types of mining landscape have been described above, I do not need to state them again.

7.6 Conclusion

The results of my above anslyses show that their modes of copper production were similar during the Longshan period and the early Bronze Age. Copper mining in the two regions was probably always carried out on small scales, and the metallurgical industries were village-based and sporadic activities. Although metallurgy was more and more widely carried out by local communities, the basic production mode did not change. State-controlled metallurgical industries probably did not exist in the two regions during the Longshan period and early Bronze Age. Rather, as shown by the mining districts in the Middle Yangzi River valley, state-controlled metallurgical industries probably appeared during the Spring and Autumn period. Moreover, no evidence shows that local mining communities in the Jinnan Basin or the Middle Yangzi River were state-controlled; rather, they were more probably autonomous during the Longshan period and early Bronze Age.

8 Discussion

Based on my analysis of turquoise and copper mining in the three significant regions, I argue that resource extraction was a community-based, local and sporadic activity in early China. In the Longshan and Erlitou centers, large quantities of turquoise and metal objects, as well as cinnabar, have been excavated. How did these centers acquire resource during the Longshan and Erlitou periods? What was the relationship between the so-called “center” and “periphery”? And how can we understand state formation in early China based on center-periphery interactions from a bottom-up perspective?

8.1 Myth of monopoly? Resource absorption?

Studies on resource supply during the early Bronze Age have received attention for a long time in archaeology. Most previous studies think that key resources, such as copper, were vital for states in early China. Therefore, early states had to monopolize resource extraction and distribution. For example, K. C. Chang (1990) thinks that bronze ritual vessels were critical for sustaining shamanistic kingship in early China, so royal houses of the early states had to monopolize resources of bronze production, in order to get access to the ritual power. His viewpoint was agreed to by many archaeologists (eg. Jin Zhengyao 2000). The most systematic discussion has been done by Liu and Chen (2003). They adopt K. C. Chang’s viewpoint and also think that bronze ritual vessels were the source of ideological power and status symbols in the Erlitou and Erligang periods. According to Liu and Chen (2003), the political system during the early Bronze Age was a centralized system. In order to quest for bronze alloys, early states expanded territorially into the Middle Yangzi River and Jinnan Basin, and set up outposts to control resource extraction and distribution. Moreover, early states also set up outposts along major rivers to secure transportation of bronze alloys and salt. They think that this centralized political-economic system could be characterized as a “tributary mode of production” (Liu and Chen 2003: 133-134). In the case of early China, the tributary mode of production means the states exerted the strongest control over all strategic elements of production.

All of these studies base their conclusions on such logic: the centers in early China owned the best quality of technology, and precious items, especially bronze ritual vessels, were so critical for elites to sustain their kingship in urban centers, so the early states had to make every endeavor to control every element of production. In order to secure the access to key resources for production, early states had to set up regional or secondary centers to control resource extraction and transportation in different regions. However, the previous studies did not investigate how key resources were extracted and distributed in early times, resulting in some misunderstandings. On the other hand, many studies focus on the provenance of previous items excavated in urban centers based on various methods of scientific testing, but neglect the social mechanism of how precious items were acquired from mountains, such as the modes of production and the scales of mining, which were crucial to understand the resource acquisition strategy of early states. Because of these shortcomings, this study adopts a social approach to look at early mining, and hopes to contribute to our understanding of state formation in early China.

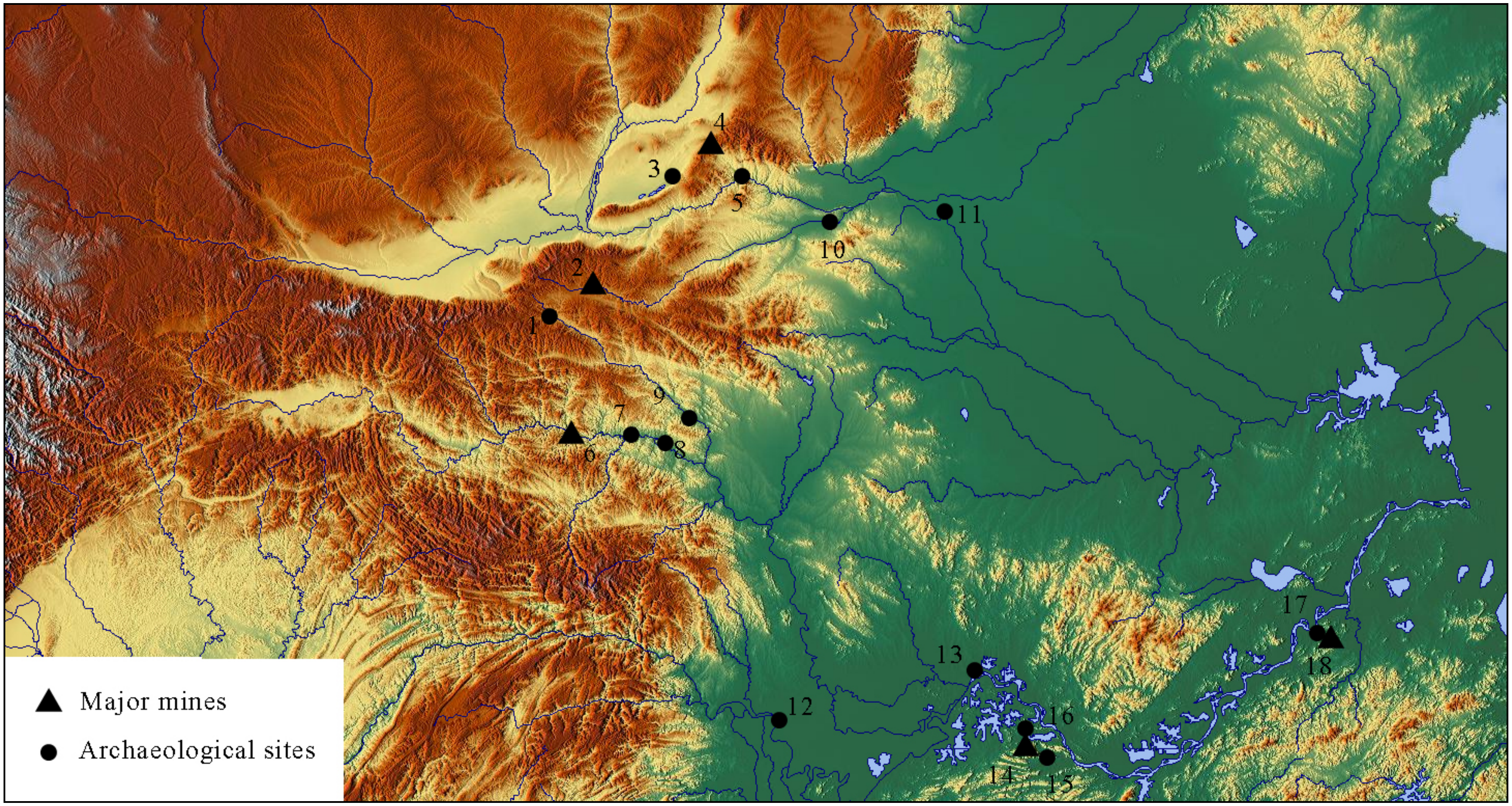

Figure 8-1 Major sites mentioned in this chapter

1. Donglongshan 2. Hekou mining sites 3. Dongxiafeng 4. Zhongtiao Mountains copper mines 5. Nanguan 6. Bailongdong turquoise mine 7. Liaowadianzi 8. Liying 9. Xiawanggang 10. Erlitou 11. Zhengzhou 12. Jingnansi 13. Panlongcheng 14. Tonglüshan copper mine 15. Dalupu 16. Xiezidi 17. Shigudun 18. Tongling copper mines

Monopoly means exclusive ownership in a literal sense. In the case of early China, monopoly means that the royal power in the Central Plains was based on a complete control of production-related elements, such as resource extraction, distribution, production and consumption. Under this hypothesis, therefore, states need to protect the status of exclusive acquisition of resources based on multiple strategies, such as military involvement and administration for regulating resource extraction on the one hand. In order to achieve the maximum benefit, on the other hand, states need to exploit as large amounts of resources as possible under a certain cost that have been input by early states, so intensive mining becomes the best strategy to assure efficiency and achieve monopoly. As mentioned in Chapter 4, ancient states in other regions of the world normally adopted intensive mining as their strategy of resource acquisition under a monopoly system.

My analysis in chapter 5-7, however, has found that state-monopolized resource extractions probably did not exist in early China. This dissertation mainly focuses on two types of important resources: turquoise and copper. Cinnabar was also touched on. I looked at the extraction of resource from two aspects: scale of mining and mining landscape. I investigated the scale of mining based on the occurrence characteristics of resources, the physical geography of mines, and the calculation of early mine workings. Based on my survey in the Shangluo Corridor, I pointed out that turquoise normally occurs in the form of veinlets and nodules in fractures and voids of rocks. The turquoise mines are normally located on steep slopes. The location of the turquoise and the physical geography did not permit large-scale, intensive mining in this region. Therefore, early miners probably adopt a flitting model to exploit local turquoise resource. The calculation based on the volume of mine workings at the Hekou site and the Bailongdong cave attests to the small-scale turquoise extractions. The investigation of mining landscape shows that communities near the turquoise mines were probably not directly controlled by any state polities; rather, they were more probably autonomous communities. Compared to agriculture, turquoise mining was probably a minor and sporadic activity. A few traces of copper smelting at Donglongshan and Liying also attest to the sporadic metallurgy in the early Bronze Age.

Since I did not take a survey in the Zhongtiao Mountains and the Middle Yangzi River regions, I base my research on the currently published materials. Since the metallurgy during the Longshan period and the Erligang periods was based on copper oxides, which normally occur as outcrops near the surface of copper mines, I hypothesize that a flitting model of mining was also adopted in copper mining during the Longshan period and early Bronze Age. More convincing evidence comes from the mining landscapes, especially in the Middle Yangzi River region. Based on the archaeological evidence of Dalupu, Xiezidi and Shigudun, the metallurgical communities were all located at least several kilometers from copper mines, and their economy was dominated by agricultural, textile and ceramic productions. Metallurgy only occupied a small proportion in the economic system of these communities. No evidence of an administration or a military force has been identified in these communities. Permanent facilities related to metallurgy were also not identified in these metallurgical communities. All these strands of evidence show that state-monopoly resource extractions did not exist in the sphere of bronze metallurgy during the Longshan period and the early Bronze Age; rather, the mode of village-based, local, and sporadic metallurgical industries were more possibly adopted by local communities.

Based on my above analysis, I argue that resource monopoly was probably not the mode that early states in China acquired key resources. Then the question is: how did the urban centers during the Longshan period and early Bronze Age acquire key resources? Spence et al. (1984) devises a model and Bloxam (2003: 160, 2006) deduces as “resource absorption”, which states that states were more interested in securing the procurement networks, rather than the resources themselves. Under the concept of resource absorption, the state intervention existed, but they did not dominate all aspects of production (Spence 1981). They probably focused on the control of resource transportation, not of mining (Bloxam 2006).

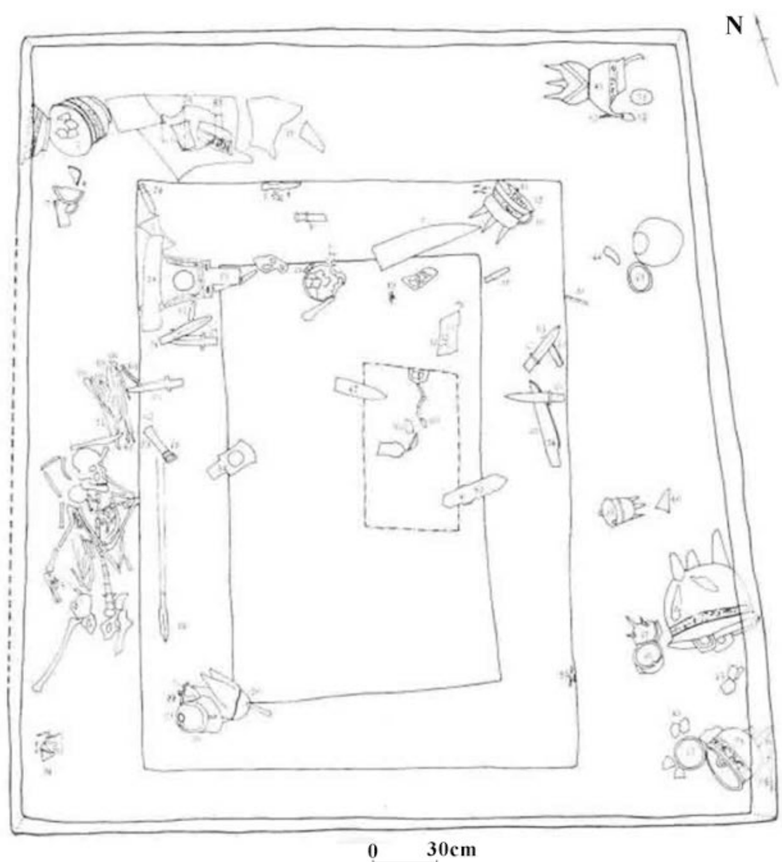

Figure 8-2 Plan of Tomb PLZM2 at Panlongcheng
(Hubei 2001: 154, Figure 100)

The current evidence suggests that the Erligang state probably adopted the strategy of resource absorption. During the Erligang period, the Erligang state set up multiple outposts in its hinterlands, such as Panlongcheng in the Middle Yangzi River Basin and Nanguan in the Yuanqu Basin. The archaeological remains excavated in these sites show that the Erligang state had probably built up administrations in these sites. For example, at Panlongcheng (Hubei 2001), archaeologists have discovered a wall-enclosed settlement measured 7.5 hectare in size. A palatial precinct stood at the northeast of the enclosure. The tombs excavated outside the wall enclosure show a distinctive status differentiation. In several tombs, large quantities of bronze ritual vessels, bronze weapons, jade objects, and ceramics have been excavated (Figure 8-2). These tombs clearly show that a hierarchical order had been established at Panlongcheng (Hubei 2001: 499-501; Jiang Gang 2005). Smelting slag and crucibles have also been excavated (Hubei 2001). The palatial precinct, the hierarchical order, and the metallurgical remains suggest that an administrative system related to copper resource existed during the Erligang period. The bronze objects and most of the ceramic vessels resemble the material culture of Zhengzhou, suggesting that Panlongcheng was probably an outpost of the Erligang state (Hubei 2001: 501-504). The archaeologists also discovered a similar Erligang assemblage at the Nanguan site in Yuanqu County, such as a wall-enclosed settlement measured 13 ha, a rammed-earth foundation in the enclosure, elite tombs, and smelting slag, suggesting that the Erligang state probably also set up an outpost at Nanguan (Zhongguo et al. 1996; Zhongguo et al. 2014). The Panlongcheng and Nanguan sites are both distant from copper mines. Panlongcheng is located about 100 kilometers from the Tonglüshan copper mines. The copper mines in the Zhongtiao Mountains are mostly located to the north of the Yuanqu County seat, so Nanguan is also located about 40 kilometers away from these major copper mines. The distance restricted the outposts’ direct exploitation of resources to achieve their monopoly. However, the Nanguan and Panlongcheng sites are both located at strategic positions of waterway transportation to the Zhengzhou. The existence of administrative systems in the two outposts suggests that the resource procurement was probably regulated by the state during the Erligang period. The most reasonable hypothesis is that state officials or state-controlled merchants in these outposts exchanged raw materials with cultural groups near mines and transported them to the urban centers in Zhengzhou and Yanshi.

During the Longshan and Erlitou periods, however, the evidence of resource absorption is still not clear. Along the Shangluo Corridor, as analyzed above, the sites have not yielded evidence of existence of any administrations. Local communities, as suggested by the cemetery of Donglongshan, were more possibly organized on a kinship or marital basis, instead of on a hierarchical basis, suggesting that an administrative system probably did not exist at Donglongshan. The communities in the Middle Yangzi River, such as Jingnansi (Jingzhou 2009) and Panlongcheng (Hubei 2001), and in the Jinnan Basin, such as Dongxiafeng (Zhongguo 1988) and Nanguan (Zhongguo et al. 1996; Zhongguo et al. 2014), do not show any evidence of administrations. Therefore, the resource acquisition was possibly more loosely organized during the Longshan and Erlitou periods than was the case later on. Opposite to the resource absorption model, Spence et al. (1984) devises an "entrepreneurial" model of resource flow. It says that each workshop or production unit developed its own procurement network, "either mounting its own mining expeditions to the source region or establishing independent contact with a particular indigenous group there that mined the materials, refined it, and then passed it to the representatives of the workshop" or production unit. A variant of the entrepreneurial model is that independent traders took charge of resource exchange. Based on current evidence, turquoise and metal productions were closely associated with the elite groups in the urban centers during the Longshan and Erlitou periods, as mentioned in Chapter 3, so it is hard to imagine that elite intervention did not exist in the sphere of resource flow. Therefore, I am inclined to consider that the strategy of resource absorption was also adopted by the elite groups, but it was much more loosely and less formally organized during the Longshan and Erlitou periods. No matter what strategy of resource procurement was adopted by early states, the previous claim of state monopoly on resource extraction has to be modified.

8.2 State formation in early China

Based on the discussions above, I can then briefly look at the center-periphery interactions and discuss the process of state formation in early China. Past studies on center-periphery interactions focus too much on the primary centers in early China, leading to a neglect of peripheral complexity. Hence, it forms an impression of unidirectionality of the center-periphery relationship: dominant center and passive periphery (Stein 1999: 16; Dietler 2010: 335). As Stein (1999: 19) says, “the assumption of core dominance denies any kinds of agency to the periphery”. In early China, the large urban centers, Erlitou and Zhengzhou in the Central Plains enjoyed technological, political, and economic advantages, and they controlled the power of redistribution. The territorial expansion of primary centers led to construction of outposts, which also became regional centers and enjoyed regional political advantages. Regional centers undertook the tasks of controlling raw materials and providing them to centers, while centers redistributed high-tech craft products to peripheries (Liu and Chen 2003). The archaeological reasoning is always core-based under this paradigm.

Undeniably, the urban centers in early China indeed enjoyed technological advantages, especially the production of bronze ritual vessels. It reflects that the urban centers probably had the ability of recruiting more experienced and innovative artisans and achieving better efficiency on the organization of production. The close association with workshops reflects that state was indeed deeply involved in craft production (Liu and Chen 2003: 64). However, it only suggests that monopoly existed in urban centers, but not domination on all elements of production. The absence of monopoly on resource extraction was possibly because the political strength of early states was still not enough, or the states had no intention to achieve monopoly when considering cost-efficiency of monopolizing productions. It is hard to imagine any states politically restricting the access to natural resources which could only bring small benefit and could only be mined sporadically. The lack of detailed knowledge on landscapes in peripheral regions probably also limited the ability of the early states to control resource extractions. Therefore, even though resource absorption was adopted to acquire resource during the Erligang period, it is hard to imagine that political control had been established in the hinterlands by the Erligang state. Under the political-economic framework, in fact, current materials show that political control was possibly not established even in the upper Luo River, let alone other distant regions. It is possibly more appropriate to see the outposts, such as Panlongcheng and Nanguan, as trading posts, which were responsible for the exchange with peripheral regions, but not politically controlling the peripheral regions and monopolizing production and distribution.

From the perspective of resource extraction in periphery, therefore, natural resources in early states were physically “free”. The communities in peripheral regions, as I analyzed in aforementioned chapters, were probably also “free”. These communities were responsible for the whole production chain of metallurgy from prospecting, mining, smelting, to casting on a local basis. However, the economic activities of these communities in the peripheral regions were dominated by agriculture, instead of mining. Mining was probably a minor work to supplement agriculture. On the other hand, the local communities in the peripheral regions probably actively participated in the exchange with other cultural groups, as suggested by the ceramic vessels, such as the round-bottom pots, which were excavated in several sites during the Longshan to the Erlitou period along the Shangluo Corridor, such as Donglongshan (Shaanxi and Shangluo 2011), Xiawanggang (Henan and Changjiang 1989), and Liaowadianzi (Wang and Fu 2007). The inventory of items exchanged along the Shangluo Corridor probably included copper, cinnabar, timber, and alligator bone plates.

Moreover, the participation of multiple cultural groups in the exchange network from the Longshan period not only met the resource demands of highland centers and Erlitou, but also facilitated transmission of metallurgical knowledge from the highland regions into peripheral regions, such as the Zhongtiao Moutains and the Middle Yangzi River valleys (Li 2018). The native communities in the two regions quickly absorbed the knowledge of smelting and casting metals, and realized the significance of copper ores. As mentioned above, the familiarity of the local landscape was vital for miners to prospect copper deposits (O’Brien 2015: 196). The various geologic conditions and different types of mineralization required miners’s empirical knowledge based on their local experience. Hence, ancient miners in resource-rich regions needed to have a longstanding history of exploiting and using copper ores. For example, copper minerals were first appreciated as sources of pigments in Balkans. Their significance was only realized after the local adoption of metallurgy, which stimulated native people in Copper Age settlements to actively search for copper ores (O’Brien 2015: 196). Similarly, the ethnography also records that the American Indians were full of knowledge about the minerals in their territories (Ball 1941). When the earlist Spanish arrived, the natives' knowledge of occurrence of gold, silver, emerald, and turquoise facilitated the mining expeditions of the spansih by many decades.

The Middle Yangzi River basin is a good example to look at the local adoption of metallurgical knowledge. The native cultural groups in the Middle Yangzi River Basin had a long history of using oxidized copper ores before the Longshan period. The archaeologists have found oxidized copper and native copper ores in several sites during the Qujialing and Shijiahe period (Chen and Gong 2015; Hubei et al. 2017; Hubei sheng Jingzhou et al. 1999: 236), attesting to the long-term history of exploitation of local copper ores. The use of these oxidized copper ores is still unknown. These oxidized copper ores were possibly used as ornaments or pigments during this time period. When the metallurgical knowledge was introduced into the Middle Yangzi River Basin, the native people quickly realized the significance of copper deposits and started to incorporate metallurgy into their economies, as evidence by the metallurgical evidence from the Dalupu site (Hubei et al. 2013). Although the metallurgical technology was less developed than Erlitou, the local small-scale metallurgical industry was established and continued through a long time. Of course, since the Longshan-period metallurgical evidence is scarce in the Middle Yangzi River regions, the pattern of introduction and local adoption of metallurgical knowledge needs more findings. However, the transmission of metallurgical knowledge through the Longshan exchange network and the local adoption and operation of metallurgy in the peripheral regions set up the foundation for Erlitou's trade strategy and the formation of political-economic landscape in early China.

To briefly synthesize the above discussions, we can obtain a very different scenario from previous understandings on state formation in early China. Based on a top-town perspective, as a post-collapse phenomenon, the Erlitou regeneration involved a process of the reproduction of many economic, political, and ideological institutions of the highland Longshan society and the appearance of new institutions, as represented by the production and use of bronze ritual vessels (Zhang Li 2012; Li 2018). Therefore, this path of transition was an incremental and continuous process, instead of an event. This process also suggests a strong continuity of resource supply from the Longshan to the Erlitou period. The Shangluo Corridor is an important reflection of this continuity. The archaeological evidence from Donglongshan suggests that this community was occupied by the highland cultural groups during the Longshan period and the Early Erlitou, and then by an Erlitou group during the Late Erlitou. This change was a continuous process without a clear temporal gap, suggesting that the Erlitou-period exchange network along the Shangluo Corridor was constructed on the basis of the network of resource supply during the Longshan period and the Early Erlitou. From a bottom-up perspective, my analysis on resource extraction in peripheries also shows a strong continuity from the Longshan to the Erlitou period. The Erlitou regeneration did not change its trade strategy with its hinterlands. The Longshan and Erlitou centers adopted a similar strategy of resource acquisition, which was much more loosely and less formally organized than the later periods. The center-periphery interactions were always bidirectional. The local adoption of metallurgy in peripheral regions was also important for the formation of Erlitou political-economic landscape. Rather than passive, peripheries were active agents in the process of state formation in early China.

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