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Plant-based subsistence strategies and development of complex societies in Neolithic Northeast China: Evidence from grinding stones

Li Liu [a,*], Neil A. Duncan [b], Xingcan Chen [c], Ping Ji [d]

[a] Stanford University, United States
[b] University of Central Florida, United States
[c] Institute of Archaeology, CASS, China
[d] Inner Mongolia Institute of Archaeology, China

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ABSTRACT

In China, grinding stones (mainly slabs and elongate handstones) first appeared during the Upper Paleolithic period, and were one of the dominant tool types in many early Neolithic sites. Grinding stones were primarily used for processing plant foods and other materials. They gradually disappear in the archaeological record after 5000 BCE in the Yellow River region at the time when millet-based agriculture may have intensified. However, grinding stones were continuously used by people throughout the entire Neolithic period in the Liao River region of Northeast China. The different trajectories in food processing methods (with or without grinding stones) in the two regions are likely related to diverse types of plants exploited; and we need to understand what plants were involved. By employing residue (starch and phytoliths) and usewear analyses, this study investigates the functions of grinding stones recovered at the Baiyinchanghan site in the Liao River region, dating to three successive Neolithic cultures (Xinglongwa, Zhaobaogou, and Hongshan) from ca. 5800–3000 BCE. The results suggest that the people utilized a broad-spectrum subsistence strategy throughout the entire Neolithic, using various wild, cultivated, and domesticated plants, including tubers/roots, cereals, beans, and nuts. The earliest domesticates in the Xinglongwa period include millets and Job's tears. Rice may have been introduced to the region for the first time during the Hongshan period, coinciding with the rise of regional elite and intensified interactions with other Neolithic cultures in the south. This study sheds new light on the plant-use strategies of the grinding-stone users who developed complex societies in the Neolithic Liao River region.

1. Introduction

Grinding stones have become under intensive study in Chinese archaeology in the past decade, with a focus on residue and usewear analyses toward the goal of understanding plant-use patterns from the Paleolithic and Neolithic periods. These studies have revealed a wealth of information about the subsistence strategies of ancient peoples leading to a better understanding of important social changes in the past that were correlated with subsistence.

Grinding stones, primarily slabs and elongate handstones, but also mortars and pestles to a lesser extent, have a deep temporal history and a wide spatial distribution in China. Their first appearance can be traced back to the late Pleistocene, around 24,000 cal BCE, or earlier, in the middle Yellow River valley. They appear to have been used to process a variety of wild plants, including underground storage organs (USOs), grasses, and beans, based on usewear and residue analyses (Liu et al., 2010a, 2010b, 2013, 2015a, 2015b; Yang et al., 2009, 2015). Grinding stones became widespread over northern and southern China during the early and middle Holocene, coinciding with Neolithization in these regions. In addition to the locally available wild plants, domesticated cereals, such as millets, Job's tears, and rice were also processed. Starch analyses from grinding stone residues indicate that in some areas USOs are predominant, while in other areas wild and domesticated cereals make up the majorities in starch assemblages. After 5000 BCE, grinding stones began to decline in number in the Yellow River region where the Neolithic Yangshao culture flourished. This change coincides with the development of millet-based agriculture, revealed in the macrobotanical remains (Lee et al., 2007; Zhao, 2011). Apart from the Central Plain, grinding stones continued to be used in many other regions. In the Liao River region, for instance, grinding stones were the major tool types in lithic assemblages throughout almost the entire Neolithic era. It has been suggested that these tools were used mainly for processing wild foods during the early periods of the Neolithic, but for grinding domesticated crops in the late Neolithic Hongshan period (Liu, 2004: 93). This suggestion, however, needs to be investigated. As a case study of Neolithic grinding stones, in this paper we focus on the Baiyinchanghan site in the Liao

* Corresponding author at: Department of East Asian Languages and Cultures, Knight Building, Stanford University, Stanford, CA 94305, USA.
E-mail address: liliu@stanford.edu (L. Liu).

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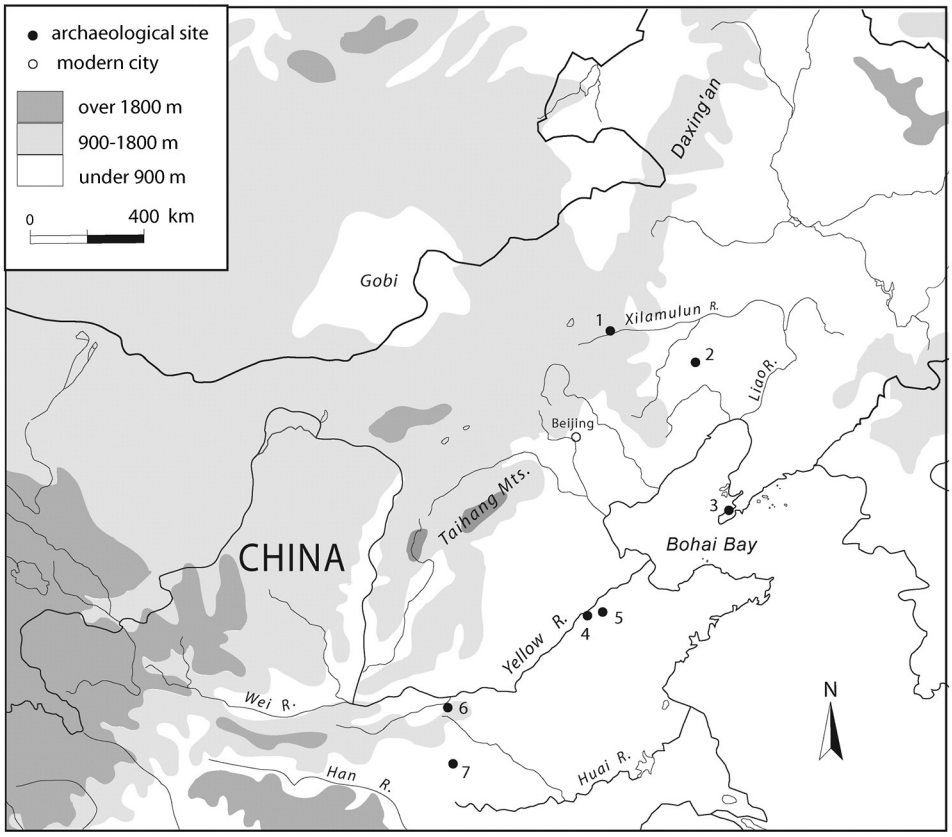

Fig. 1. Distribution of sites discussed in this paper. 1: Baiyinchanghan; 2: Xinglonggou; 3: Wenjiatun; 4: Yuezhuang; 5: Xihe; 6: Huizui; 7: Jiahu.

River valley, dating to ca. 5800–3000 BCE. Utilizing microbotanical and usewear analyses, we reveal what plants were processed with these tools, then discuss changes of plant use in relation to development of social complexity through time.

2. Environmental and archaeological background

Baiyinchanghan is located in Linxi county, Chifeng city, southeast Inner Mongolia. This region is also referred to as Liaoxi, the western part of the Liao River. It resides in a temperate zone with a continental monsoon climate. The hilly landscape of Linxi county today is characterized by agro-pastoralist economy. In the past, during the early and middle Holocene, the climate was wetter and warmer than at present and dominated by steppe vegetation; forest patches were relatively common during the period of 7200–4700 cal BCE (Jiang et al., 2006).

There was a long sequence of Neolithic developments in the Liao River valley, including five consecutive cultures, namely Xiaohexi, Xinglongwa, Zhaobaogou, Hongshan, and Xiaoheyan, dating from pre-6200 BCE to 2000 BCE. Corresponding to the arrival of the mid-Holocene climatic optimum, the Xiaohexi and Xinglongwa cultures are associated with the emergence of the earliest Neolithic communities and the presence of the first domesticated millets in Northeast China. The Zhaobaogou culture exhibits further development of social complexity, such as the emergence of intra-community-level hierarchy, construction of public ritual monumental structures, and practice of ritual feasting at the household level. The Hongshan culture exhibits the highest level of social development in the Neolithic Liaoxi region, particularly characterized by its monumental construction of ritual landscape and an elite material culture focused on jade ritual objects. Ritual feasting appears to have been conducted at public ceremonial structures, suggested by the concentration of animal bones found near the Goddess Temple. The end of the Hongshan culture (ca. 3000 BCE) concurred with an episode of cold and dry climate, and the following Xiaoheyan culture experienced a decline of human population density and the disappearance of the elite material culture (Li, 2008; Liaoning Institute of Archaeology, 1997; Liu and Chen, 2012). The rise and fall of early complex societies in the Liao River region has attracted great interest archaeologically, but most studies have focused on settlement patterns and elite material culture (e.g., Chifeng International Collaborative Archaeological Research Project, 2003; Li, 2008; Peterson et al., 2010). There is an insufficient amount of knowledge about how food production, particularly plant use, changed through time in relation to social development (Shelach, 2006).

Previous studies on plant use and human diet in the Liao River region provided contradictory interpretations. Based on stable isotope analyses, it has been suggested that substantial millet consumption by humans, indicated by C4 signal from human skeletal remains, began in the Xinglongwa period and continued to increase through time (Liu et al., 2012). According to studies of macro-botanical remains from the Xinglonggou site, millets account for 40% of the seeds of the Xinglongwa period (Sun, 2014), but nuts and fruits became predominant in the

Table 1
Stone tools found in three periods at Baiyinchanghan.

	Total stone tools	Microlith no.	Microlith %	Stone tool excl. microlith	Slab	Hand-stone	Mortar	Pestle	Disk	Grinding stone no.	Grinding stone %
Xinglongwa	284	34	12%	250	14	37	12	6	13	82	33%
Zhaobaogou	86	5	6%	81	1	8	1	2	5	17	21%
Hongshan	133	61	46%	72	3	19	1	8	5	36	50%