Journal of Archaeological Science 93 (2018) 82–93

Contents lists available at ScienceDirect

Journal of Archaeological Science

journal homepage: http://www.elsevier.com/locate/jas

Innovation in bone technology and artefact types in the late Upper Palaeolithic of China: Insights from Shuidonggou Locality 12

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ARTICLE INFO

Article history:
Received 18 November 2017
Received in revised form
1 March 2018
Accepted 6 March 2018

Keywords:
Bone tools
Specialized tool-kit
Sewing equipment
Knife handle
Tardiglacial
Northern China

ABSTRACT

Information on Palaeolithic bone technology from China is sparse. Here we present the results of a techno-functional analysis of a bone tool assemblage recovered from Shuidonggou Locality 12 (SDG12), layer 11, Northern China, dated to c. 12-11 cal ka BP. Six bone tool artefact types are identified: wedges, awls, spear points, a knife handle, a possible sewing implement, and a notched carpal. Two other artefacts could not be attributed to a specific type. The artefacts are made of *Procapra przewalsikii*, *Lepus* sp., *Sus* sp., *Equus przewalskii*, and unidentifiable bone fragments from medium/large size mammals. At least three methods are used to extract blanks: percussion of altered limb bones, longitudinal splitting of *Sus* sp. canine and large rib, and probably, the groove-and-splinter technique. Grinding and scraping are the dominant shaping techniques together with grooving, notching, polishing, drilling, flaking, and retouching. Tool type variability and function fit the hypothesis according to which the SDG12 and similar sites would be residential camps in which hunter-gatherers produced artefacts enabling them to cope with cold environmental conditions. Our results, however, indicate that not all bone tools match the expectations associated with a serial specialist production. Expedient wedges and awls may have been produced by any member of the group, and whenever the need arose. The SDG12 bone tool assemblage provides a significant contribution to our knowledge about hunter-gatherer adaptations to the Tardiglacial environments of Northern China.

1. Introduction

Formal bone tools are defined as objects that were cut, carved, polished, or otherwise modified to produce fully shaped implements such as points, awls, harpoons, and wedges (Klein, 1999). Prior to 45 ka BP, only a handful of African and Australian sites have yielded formal bone tools (Brooks et al., 1995; Yellen et al., 1995; McBrearty and Brooks, 2000; Henshilwood et al., 2001; Jacobs et al., 2006; d'Errico and Henshilwood, 2007; Backwell et al., 2008; d'Errico et al., 2012a; b; Campmas et al., 2015; Backwell and d'Errico, 2016; Langley et al., 2016). After 45 ka BP, formal bone tools are found in Eurasia and are particularly abundant in European Upper Palaeolithic toolkits (e.g., Conard and Bolus, 2003; d'Errico et al., 2003, 2012c). Instances of complex bone technologies in other regions of Eurasia, such as China, are rare (Zhang et al., 2016a). Clear evidence for the production of formal bone tools in Northern China comes from Zhoukoudian Upper Cave (Pei, 1939), Xiaogushan (Zhang et al., 1985; Huang et al., 1986; Zhang et al., 2010a), Shizitan (Song et al., 2016), and Shuidonggou (Guan et al., 2012; Pei et al., 2012; Yi et al., 2013). Sites that yielded formal

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https://doi.org/10.1016/j.jas.2018.03.003
0305-4403/

bone tools in Southern China include Chuandong (Zhang, 1995; Mao and Cao, 2012), Maomaodong (Cao, 1982), Zhadong (Chen et al., 2004), and Ma'anshan Cave (Zhang et al., 2016a), etc. The technology of these early bone artefacts is often insufficiently documented and their function remains hypothetical (Mao and Cao, 2012 and references therein). In China, the newly published analysis of the bone tools from Ma'anshan Cave, Guizhou province, represents one of the first attempts to describe in detail this category of Palaeolithic material culture (Zhang et al., 2016a). It identifies evolutionary trends in bone technology from 35 to 18 ka BP, and records the earliest known barbed points outside Africa.

In this paper, we analyze another key bone tool assemblage from China, recovered from Shuidonggou Locality 12 (SDG12). Dated to between 12.2 and 11.1 ka BP, this assemblage is exceptional for its excellent state of preservation and the variety of tool types it comprises. Photographs of selected artefacts from this assemblage appeared in the literature (Yi et al., 2013, 2014; Zhang et al., 2016b). However, no detailed technological analysis of key artefact types has been published except for some needles (Zhang et al., 2016b). Our analysis highlights technological features peculiar to the Ordos Plateau and artefact types previously unrecorded at Palaeolithic sites from Asia. It also represents a unique opportunity to document formal bone tool types found in association with microlithic technologies (*cf.*, Wang, 2005).

It has been proposed that microblade technologies, grindstones, and specific bone tools found at this and other sites represent an adaptation to the cold environments of the LGM and the Younger Dryas in the loessic landscapes of Northeast Asia (Chen, 1983; Yi et al., 2013). Slotted bone handles fitted with microblades, bone needles, awls, and technologies devoted to the manufacture of hunting nets would have been used to procure rabbit skins and produce sophisticated winter clothing (Yi et al., 2013). As far as bone technology is concerned, this interpretation is only based on a preliminary description of a few bone tools without documenting the technologies and know-how involved in the production of the bone artefacts found at the site. The aim of the present paper is to reconstruct these aspects of human behaviour and identify the function for key categories of bone artefacts recovered at SDG12. This will allow us to test, on a category of material culture other than lithics, the pertinence of the "serial specialist" hypothesis (Binford, 1980, p. 17), i.e., the idea that the SDG12 hunter-gatherers subsistence strategy would have relied on standardized tool production to face seasonal challenges in the Tardiglacial environments of Northern China (Yi et al., 2013).

2. Archaeological context

2.1. Site location, stratigraphy, and chronology

Located on the second terrace of the Biangou River floodplain (Ningxia Hui Autonomous Region, Northern China), 3 km southeast from the well known Shuidonggou Locality 1 (Licent and Teilhard de Chardin, 1925; Boule et al., 1928; Pei et al., 2012), SDG12 is an open-air site discovered in 2005 during an archaeological survey of the exposed river bank (Liu et al., 2008; Gao et al., 2009; Pei et al., 2012; Yi et al., 2013). In 2007, salvage excavation was carried out over a 12-m^2 area and a depth greater than 9 m. A total of twelve geological layers were identified based on granulometry and sediment colour (Fig. 1). Archaeological material was only recovered from the c. 50-centimetre-thick ashy layer 11, all other layers being sterile. Sediments from this layer were sieved with a 2-milimetre mesh. The layer was further subdivided into five sub-levels, level 1 (youngest) to 5 (oldest). Lithics from these sub-levels are typologically and technologically similar, and are considered as a single assemblage (Yi et al., 2013). The dating of a charcoal from the middle part of layer 11 provided a ^{14}C age of 9797 ± 91 BP (11,164–11,378 cal BP). OSL ages from layers 10 and 12 are consistent with the ^{14}C determination when the standard error is taken into account (Liu et al., 2008). These ages suggest that the site was occupied toward the end of, or immediately after, the Younger Dryas Cold Event (c. 12,900–11,700 cal BP; Rasmussen et al., 2014).

2.2. Lithic technology

The SDG12 lithic assemblage, comprising more than 9000 pieces, is typical of the Late Pleistocene microlithic industries found in China (Gao et al., 2009; Pei et al., 2012; Yi et al., 2013, 2016) and in adjacent regions from Central Asia to Alaska (Goebel, 2002; Brunet, 2012; Gómez Coutouly, 2012; Tabarev, 2012; Takakura, 2012; Kato, 2014). It is dominated by microblade cores and highly standardized microblades, which were likely obtained by pressure flaking (Pelegrin, 2012), but also includes end-scrapers, notches, points, borers, and burins (Gao et al., 2013; Yi et al., 2013). A variety of grinding tools are represented (Yi et al., 2013). A fragment of an axe and small discs, shaped by grinding, were also found as well as a large number (>13,000) of burnt stone fragments (Gao et al., 2013). The lithic assemblage composition indicates that stone knapping, osseous tool shaping, plant processing, and woodworking were carried out at the site (Yi et al., 2013, 2014).

2.3. Faunal assemblage and taphonomy

The faunal assemblage comprises more than 10,000 remains, 1821 of which were identified to species, or to order for microfauna. *Lepus* sp. (57.4%) dominates the faunal spectrum followed by *Procapra przewalskii* (22.2%), *Bubalus* sp. (6.8%), *Meles meles* (5.7%),

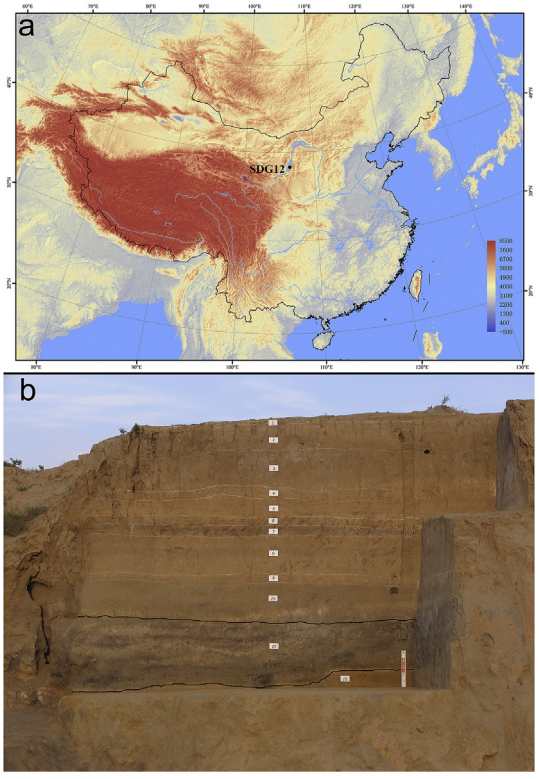

Fig. 1. a: location of Shuidonggou Locality 12; b: photo of the stratigraphy indicating the geological layers and their limits (b, modified after Pei et al., 2012).