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The easternmost Middle Paleolithic (Mousterian) from Jinsitai Cave, North China

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ABSTRACT

The dispersal of Neanderthals and their genetic and cultural interactions with anatomically modern humans and other hominin populations in Eurasia are critical issues in human evolution research. Neither Neanderthal fossils nor typical Mousterian assemblages have been reported in East Asia to date. Here we report on artifact assemblages comparable to western Eurasian Middle Paleolithic (Mousterian) at Jinsitai, a cave site in North China. The lithic industry at Jinsitai appeared at least 47–42 ka and persisted until around 40–37 ka. These findings expand the geographic range of the Mousterian-like industries at least 2000 km further to the east than what has been previously recognized. This discovery supplies a missing part of the picture of Middle Paleolithic distribution in Eurasia and also demonstrates the makers' capacity to adapt to diverse geographic regions and habitats of Eurasia.

1. Introduction

The dispersal of Neanderthals and their interactions with anatomically modern humans (AMHs) and other hominin populations (i.e., Denisovans) in Eurasia are critical issues in human evolution research (e.g., Mellars, 2004; Soficaru et al., 2006; Reich et al., 2010; Conard and Richter, 2011; Higham et al., 2014). Neanderthals and associated Middle Paleolithic industries disappeared from much of Europe by or shortly after 40 ka (Higham et al., 2014). They were largely replaced by non-indigenous AMHs who were the bearers of Upper Paleolithic culture variants. In East Asia, AMHs were present quite early, although some controversies remain (Michel et al., 2016), with the earliest dates being between 120 ka and 70 ka in south and central China (Shen et al., 2002; Liu et al., 2010a, b, 2015, 2016; Bae et al., 2014) and 40 ka in North China (Shang et al., 2007; Fu et al., 2013). Some fossils (Woo and Peng, 1959; Wu et al., 2014; Li et al., 2017) and modern DNA from contemporary East Asian populations show evidence of Neanderthal admixture (Vernot et al., 2016), but no definite Neanderthal fossils have been reported from East Asia to date. For many years now, there have been debates about whether the term 'Middle Paleolithic,' associated with Neanderthals in western Eurasia, was even applicable to China and adjoining areas. Researchers have argued that the term Middle Paleolithic has no real meaning in most of East Asia (Ikawa-Smith, 1978; Gao and Norton, 2002; Norton et al., 2009; Li, 2014; Seong and Bae, 2016), in the sense that contemporaneous assemblages lack the diagnostic elements, such as Levallois debitage, that define Middle Paleolithic industries in western Eurasia.

Here we describe the lithic assemblages from Jinsitai Cave, a site located in North China about 20 km south from the China-Mongolia border. They more closely resemble the Mousterian assemblages from central and western Eurasia than the contemporaneous

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artifact material from central and northern China. This finding shows that hominins carrying Mousterian-like Middle Paleolithic technology appeared in North China at least 47–42 ka and persisted there until around 40–37 ka. The discoveries at Jinsitai supply a missing part of the picture of Middle Paleolithic hominin dispersal in Eurasia and show that the makers of these assemblages had the capacity to adapt to diverse geographic regions. It also has important implications for understanding lithic variability and population dynamics in North China during the Late Pleistocene.

Jinsitai Cave (45°14′23.4″ N, 115°28′32.7″ E; 1401 m above sea level) is located in the low foothills of the Donghaierhan Mountains, 25 km west of the town of Alatanheli (Dongwuzhumuqin Banner, Inner Mongolia, North China; Fig. 1a). The cave, which is around 120 m^2 in area, is situated in a granite hill (Fig. 1b). The Jinsitai Cave was first excavated in 2000–2001 (Wang et al., 2010), but several factors have limited our understanding of the site: 1) the initial excavations were not well controlled and the provenience of the archaeological finds was recorded only by stratigraphic layer; 2) the stratigraphy and chronology remained partially unresolved; and 3) the lithic assemblages were not properly described. Aiming to resolve these problems, the Institute of Vertebrate Palaeontology and Palaeoanthropology of Chinese Academy of Sciences (IVPP, CAS) and the Inner Mongolia Museum reinvestigated the cave in 2012–2013. Here we aim to describe the findings from the more recent excavations, in which archaeological finds were accurately placed in a three-dimensional matrix and the archaeological sequence has been well dated (Fig. 2a).

2. Materials and methods

The 2012–2013 excavations of Jinsitai Cave covered a maximum area of 10 m^2 (Fig. 2c). Nine clear stratigraphic layers were identified and exposed over a depth of approximately 3.6 m. The sediments are composed mainly of yellow-brown gravels, clayey silt, clay, and silty sand with granite breccia (Fig. 2b). The uppermost eight layers contain archaeological materials representing multiple time periods. Layer 9, the base of the stratigraphic sequence, is archaeologically sterile. Layers 1 and 2 contained Bronze Age and Neolithic assemblages with ceramics and freshwater shell beads. Layers 3 and 4 yielded late Upper Paleolithic artifact assemblages with pressure microblades and bifacially thinned points. The assemblages from Layers 5 and 6 are relatively small and non-diagnostic. Layers 7 and 8 yielded Middle Paleolithic artifact assemblages, which are the main focus of this paper.

Accelerator mass spectrometry (AMS) radiocarbon dating was conducted on bone and charcoal samples from the 2012–2013 excavations. Three different labs were involved in dating the samples: the AMS Centre, School of Physics, Peking University (BA); Beta Analytic Inc. (Beta); and Keck Carbon Cycle AMS Facility, Earth System Science Department, University of California, Irvine (UCIAMS). The dating method used in the AMS lab of Peking University (PKU) has been described in detail (Wu et al., 2012), and the sample processing protocols for Beta Analytic can be found on their website (Beta, 2017). Radiocarbon measurement procedures at the UC Irvine Keck laboratory and the ultrafiltration pretreatment method for bones were described in Southon et al. (2004). The wide ranges of ages obtained from the labs of Peking University and Beta Analytic Inc. suggested that contamination by recent humic materials might be a serious problem at Jinsitai. In an effort to remove as much recent contamination as possible, the UCIAMS samples were subjected to an overnight alkali treatment with 0.05 N NaOH after decalcification and prior to gelatinization and selection of a high molecular weight fraction by ultrafiltration. All dates have been calibrated using OxCal4.2 software (Ramsey, 2009) and INTCAL13 (Reimer et al., 2013).

3. Results

3.1. Radiocarbon dates

A total of 27 ^{14}C dates have been obtained from bones and charcoal at Jinsitai. The 15 dates coming from layers 8 and 7 are of most concern here (Table 1). The set of dates shows a broad range of ages. However, many of the ages should be dismissed due to problems with context or pretreatment. Seven dates were obtained from layer 8, six from bones and two from a single isolated charcoal sample. The dates from charcoal are clearly much younger than those from bones, but they are close to the dates from layers 5 and 6, where a fireplace and concentration of ash were found (Fig. 3). Because no similar features were noted in layer 8, it is very likely that the charcoal sample is intrusive from those upper layers. Dates on bones span a range from >43,500 to 34,690 ± 270 yr BP. However, all but two of the ages represent whole collagen dates. Because of the well documented contamination problems (e.g., Ramsey et al., 2004; Southon et al., 2004), we conclude that the ages of 47,034 to 43,720 and 44,289 to 42,306 cal yr BP (95% confidence intervals), obtained from bone samples treated by the ultrafiltration method, are the best estimates of the age of layer 8

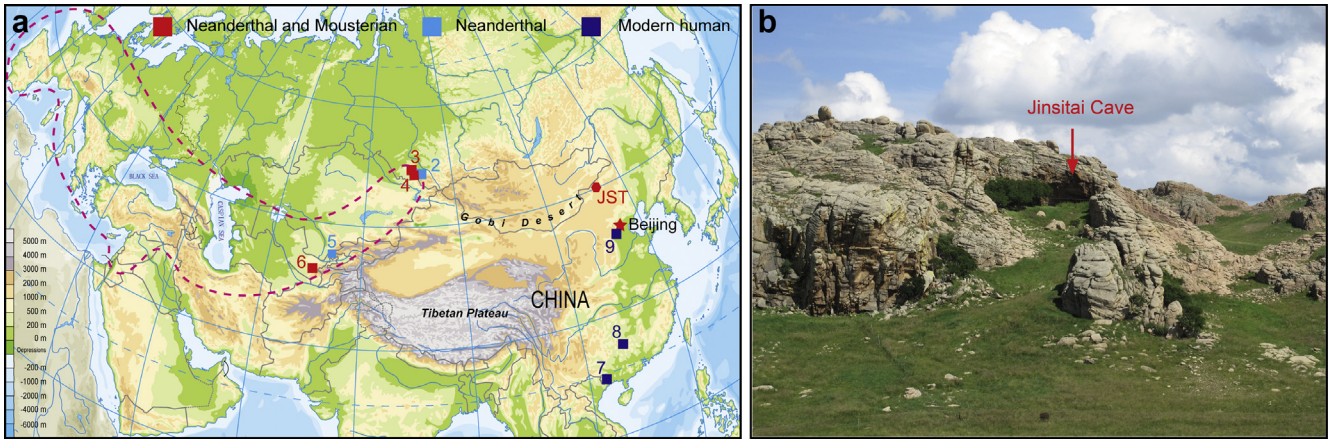

Figure 1. a) Geographical location of Jinsitai (JST) Cave. Neanderthal and Mousterian sites in Central Asia and Siberia are marked on the map, as well as early modern human sites in China. 2 = Denisova, 3 = Okladnikov, 4 = Chagyrskaya, 5 = Obi-Rakhmat, 6 = Teshik-Tash, 7 = Zhiren, 8 = Fuyan, 9 = Tianyuan. The red stippled line circumscribes the area with known Neanderthals associating with Mousterian industries. b) View of the entrance to JST Cave. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)