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First direct dating of a presumed Pleistocene hominid from China: AMS radiocarbon age of a femur from the Ordos Plateau

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Abstract

Human remains from the Xarusgol Valley, Ordos Plateau, northwestern China, have been considered to date to the Late Pleistocene. In order to ascertain their true age, direct AMS ^{14}C dating of a femur collected in the early 1920s was conducted. The results demonstrate that the femur is very young, with one sample of 'post-bomb' age and the other sample *c*. 200 years old. This first direct dating of a Chinese fossil hominid underscores the need to apply the same methodology to other Chinese modern human fossils currently believed to be of Pleistocene age.

Keywords: Hominid fossil femur; AMS radiocarbon dating

Introduction

China has yielded the most abundant hominid fossils of Pleistocene age in East Asia (Wu and Poirier, 1995). However, none of these fossils have been directly dated by radiometric methods. Although the importance of direct age determination of prehistoric human remains in China was highlighted more than thirty years ago by Barnard (1972), very little progress has been made until now with respect to humans of presumed Pleistocene age. In other parts of the world, direct dating of ''Pleistocene'' human fossils has yielded radiometric age estimates that question the supposed antiquity of the remains (e.g., Pettitt et al., 2000; Conard et al., 2004; Street and Terberger, 2004; Higham et al., 2006). Human fossils from Europe, such as Vogelherd, Hahnöfersand, and Weißenthurm, once believed to date from the Pleistocene, have now been identified as Holocene in age (Conard et al., 2004; Street and Terberger, 2004). Here we establish the age of one of the ''Pleistocene'' modern human fossils from the Ordos Plateau in northern China. We present the results of accelerator mass spectrometry radiocarbon dating (hereafter, AMS ^{14}C) and a discussion of the implications of this study for the Paleolithic anthropology and archaeology of East Asia.

The valley of the Xarusgol (originally called Sjara-osso-gol and also Salawusu) River lies in the southeast of the Ordos Plateau in Uxin Qi (Dabqig) County, Nei Mongol (Inner Mongolia) Autonomous Region and Shaanxi Province, People's Republic of China (Fig. 1). The Xarus Valley contains several geological formations of which the Xarus Formation and the overlying Chengchuan Formation are, based on faunal correlation, of Pleistocene age (e.g., Boule et al., 1928; Han and Xu, 1985). Paleontological surveys in the Xarus Valley in the early 1920s and archaeological reconnaissance from 1956 to 1980 yielded 23 human fossils including an incisor and cranial and postcranial bones, most of which were recovered during the late 1970s (Huang and Wei, 1981). The best-known human fossil from this region and, along with the Zhoukoudian

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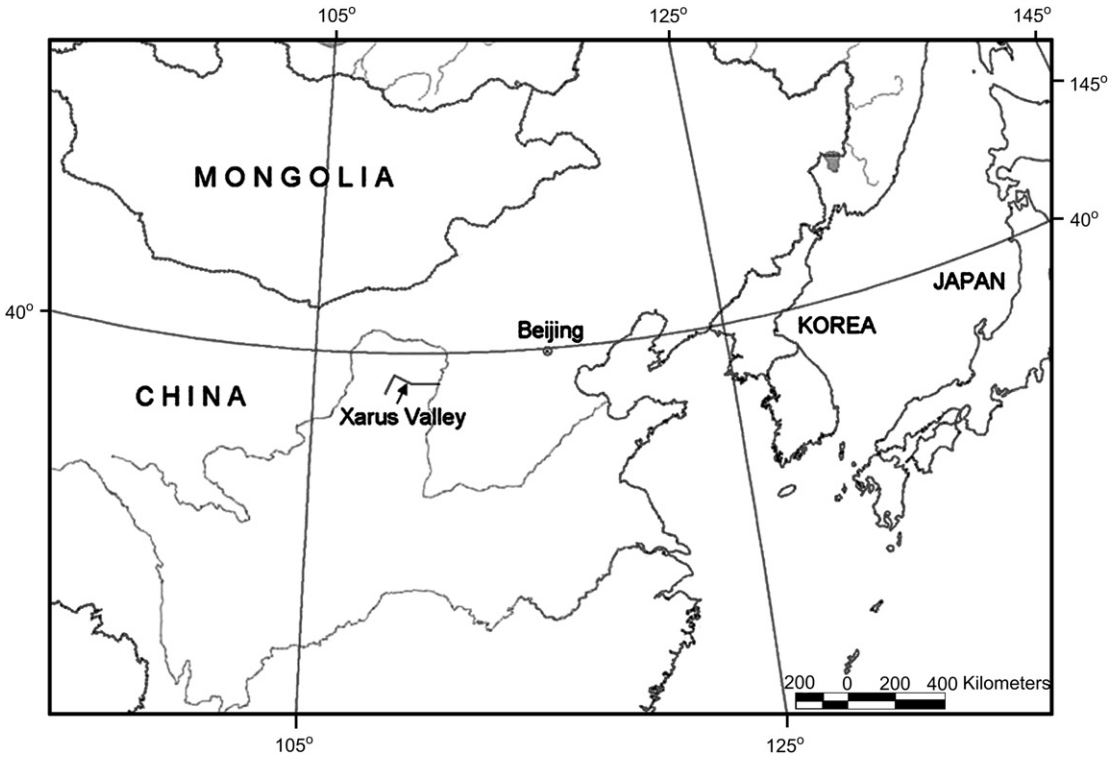

Fig. 1. Map showing the location of the Xarus Valley on the Ordos Plateau in northern China.

Locality 1 *Homo erectus* teeth (e.g., Black, 1927), the first acknowledged Paleolithic human fossil from China (Licent et al., 1927), is an incompletely developed upper left human incisor that was collected from the surface in 1922 (Licent et al., 1927; Wu and Poirier, 1995). Lithic artifacts and abundant vertebrate fossils have been excavated and surface collected at several localities in the Xarus Valley. The vast majority of animal fossils and the lithic artifacts were recovered from terraces of the approximately 40 m thick fluviolacustrine Lower Xarus Formation, with most of the human remains thought to derive from terraces T2, T3, and T5 (e.g., Dong et al., 1981; Huang and Wei, 1981; Wu and Poirier, 1995:170, 172–173). The fossil vertebrate collection from the Ordos is the type fauna of the North Chinese Late Pleistocene (e.g., Han and Xu, 1985; but see Aigner, 1981:245). Uranium-series (U-series) and radiocarbon dates subsequently confirmed the Pleistocene age of the Xarus fauna (see below).

A Pleistocene age of the human fossils has long been presumed based on their level of fossilization and their apparent derivation from deposits that yielded fossils of extinct animals (e.g., Huang and Wei, 1981; Wu and Poirier, 1995; and see Licent and Teilhard de Chardin, 1925). This age was indirectly supported by U-series dating of animal teeth from the Lower Xarus Formation, including the Fanjiagouwan and Yangshugouwan localities, which yielded Late Pleistocene age estimates from 49,500 to 29,700 years ago (Yuan et al., 1983). A ^{14}C date of 35,340 ± 1,900 years BP on a charcoal sample (PV 177) from a Paleolithic cultural layer in the Lower Xarus Formation also supported this early age determination (Tang and Gai, 1986). Thus, the Ordos *Homo sapiens* (Wu and Poirier, 1995:233) are considered by some authors to be the direct ancestor of modern humans in China (e.g., Chia, 1951; Institute of Vertebrate Paleontology and Paleoanthropology, 1980:127; Jurmain et al., 2000:371).

In 1923, E. Licent found a partial human femur during surface survey of the Ordos region with P. Teilhard de Chardin (Licent et al., 1927; Wei, 2005). The find was thought to have eroded from a sandy layer in the lower part of a Xarus River terrace. The femur was recently relocated by Qi Wei (pers. comm., 2002) at the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP), Chinese Academy of Sciences, Beijing, labeled as IVPP No. PA 62. Although the femur is one of several bones suggested to be of Pleistocene age (Chia, 1951; Institute of Vertebrate Paleontology and Paleoanthropology, 1980:127), according to Woo and Chia (1955), only the human incisor has this age estimate. In the 1950s, an attempt was made to determine the relative age of the PA 62 femur by using fluorine analysis. The fluorine content of the femur is 0.38%, whereas mammalian fossil bone from the Xarus Valley has a 1.10% content (Chiu, 1955). Based on this finding, the femur was considered younger than the fossil mammals (Chiu, 1955), assuming that fluorine accumulation increases with length of burial (Oakley, 1969).

In order to ascertain the age of the femur by direct dating, a sample of the PA 62 femur was submitted by Qi Wei for ^{14}C dating in April 2003. The sample was subdivided into two parts for chemical pretreatment at two ^{14}C research facilities: the Institute of Geology and Mineralogy, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia, and the NSF-Arizona AMS Laboratory, University of Arizona,