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Chronology of the Youfang site and its implications for the emergence of microblade technology in North China

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ABSTRACT

The Youfang Paleolithic site, located in the eastern Nihewan Basin, Hebei Province, China, was discovered in 1984. However, the microblade assemblages which were excavated from the site lacked reliable chronological data. In this study, an optical dating technique was applied to nine samples from Late Pleistocene eolian sequences at the site. The ages of three samples from artifact-bearing deposits were in the range of ca. 26–29 ka with depths between 2.1 m and 2.9 m obtained with medium-grained quartz, corresponding to Marine Isotope Stage 3 (MIS3). These displayed evidence of a longer-term climate trend, in which the climate became gradually warmer and more humid. The sample from the upper culture layer was dated to 26.4 ± 2.1 ka. Five samples taken from the lower culture layer yielded ages between ca. 28 ka and 43 ka. The results suggest that human occupation at the Youfang site ranged from ca. 26 ka to 29 ka. Indeed, the Nihewan Basin yields the oldest microblade site in northern high latitudes (40° N), and offers a unique opportunity to study the emergence and characteristics of microblade technologies in northeast Asia. Nevertheless, extensive archeological field surveys and excavations are still needed to understand further the developmental process of microblade technologies in the region.

1. Introduction

The transition from Early Paleolithic to Late Paleolithic in North China (ca. 30,000 years ago) was mainly marked by the appearance of both blade and microblade technologies, in addition to the presence of art/symbolism (Gao and Norton, 2002). Microblade technology included the making of microblade tools: typical examples of this category of artifact are microblade cores, microblades and tools made with microblades, generally mounted in bone or wood to form complex tools (An, 1978; Goebel, 2002; Elston et al., 2011), rather than 'small tools'. Microblade technology was a catalyst for a major revolution in lithic technology in northern China for societies based upon hunter–gatherer practices which then experienced high levels of mobility driven by socio-economic and climatic changes. Archeological discoveries of lithics were first made at the dawn of the 20th century, and numerous archeological sites with microblade assemblages have been found (and subjected to detailed study) since the early 1950s. There are now more than 200 archeological sites or site clusters with microblades identified throughout many provinces including Heilongjiang, Liaoning, Jilin, Inner Mongolia, Hebei, Shanxi, Sha'anxi, Henan, Ningxia, Gansu, Qinghai, Xinjiang, among others (see e.g. Tong, 1979; Chen, 1984; Chen and Wang, 1989; Bettinger et al., 1994; Lu, 1998; Gao et al., 2013; Qu et al., 2013) (Table 1 and Fig. 1).

At present, however, where and when microblade technology originated and how the technology developed remains controversial. For instance, most scholars subscribe to the view that the Lake Baikal region of Siberia was the cradle of microblade technology and North China was simply one of the areas to which it spread (see e.g. Pei, 1955; Keates et al., 2007; Kuzmin, 2007; Elston et al., 2011); some scholars (see e.g. Smith, 1974; Jia, 1978) have hypothesized that North China was the source of microblade technology and that, from there, the technology spread to other parts of Asia and across Beringia to North America.

The ages obtained for some typical Upper Paleolithic sites with microblades in northern China are shown in Table 1. Three sites, at Longwangchan in Sha'anxi Province, Chaisi/Dingcun 77:01 and the

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Table 1
The ages of the layers bearing microblades for Upper Paleolithic sites mentioned in the text of northern China.

Sites name	Longitude/ Latitude	Layer	Material	Lab no.	Dating method	Age			Reference
						Uncal. BP	Cal. BP (68%)	ka	
Longwangchan Loc. 1, Shaanxi	N36°09′45″, E110°26′15″	Layer 4 (0.43 m)	Charcoal	BA06005	AMS ^{14}C	21,405 ± 75	25,189–25,854	–	Zhang et al., 2011
		Layer 4 (0.63 m)	Charcoal	BA06006	AMS ^{14}C	20,915 ± 70	24,683–25,232	–	Zhang et al., 2011
		Layer 4 (0.73 m)	Charcoal	BA06009	AMS ^{14}C	20,995 ± 70	24,771–25,498	–	Zhang et al., 2011
		Layer 4 (0.73 m)	Charcoal	BA091131	AMS ^{14}C	20,710 ± 60	24,489–24,931	–	Zhang et al., 2011
		Layer 5 (1.18 m)	Charcoal	BA06008	AMS ^{14}C	21, 920 ± 80	25,963–26,673	–	Zhang et al., 2011
		Layer 5 (1.23 m)	Charcoal	BA06007	AMS ^{14}C	21,740 ± 115	25,455–26,531	–	Zhang et al., 2011
		Layer 5 (1.43 m)	Charcoal	BA091132	AMS ^{14}C	22,105 ± 50	26,185–26,870	–	Zhang et al., 2011
		Layer 5 (1.53 m)	Charcoal	BA091133	AMS ^{14}C	22,200 ± 75	26,260–27,353	–	Zhang et al., 2011
		Layer 6 (2.23 m)	Charcoal	BA091129	AMS ^{14}C	24,145 ± 55	28,551–29,303	–	Zhang et al., 2011
		Layer 6 (2.43 m)	Charcoal	BA091130	AMS ^{14}C	22,230 ± 55	26,288–27,395	–	Zhang et al., 2011
		Layer 4 (0.2 m)	*FG quartz	L1387	OSL	–	–	21.4 ± 1.1	Zhang et al., 2011
		Layer 4 (0.4 m)	FG quartz	L1388	OSL	–	–	23.0 ± 1.0	Zhang et al., 2011
		Layer 4 (0.6 m)	FG quartz	L1389	OSL	–	–	26.8 ± 1.2	Zhang et al., 2011
		Layer 5 (0.8 m)	FG quartz	L1390	OSL	–	–	24.2 ± 1.0	Zhang et al., 2011
		Layer 5 (1 m)	FG quartz	L1391	OSL	–	–	22.6 ± 1.0	Zhang et al., 2011
		Layer 5 (1.2 m)	FG quartz	L1392	OSL	–	–	22.8 ± 1.1	Zhang et al., 2011
		Layer 5 (1.4 m)	FG quartz	L1393	OSL	–	–	23.1 ± 1.1	Zhang et al., 2011
		Layer 5 (1.6 m)	FG quartz	L1394	OSL	–	–	25.2 ± 1.3	Zhang et al., 2011
		Layer 6 (1.8 m)	FG quartz	L1395	OSL	–	–	25.6 ± 1.2	Zhang et al., 2011
		Layer 6 (2 m)	FG quartz	L1396	OSL	–	–	25.1 ± 1.2	Zhang et al., 2011
		Layer 6 (2.2 m)	FG quartz	L1397	OSL	–	–	25.8 ± 1.2	Zhang et al., 2011
		Layer 6 (2.4 m)	FG quartz	L1398	OSL	–	–	28.7 ± 1.4	Zhang et al., 2011
		Layer 6 (2.6 m)	FG quartz	L1399	OSL	–	–	27.7 ± 1.3	Zhang et al., 2011
		Layer 6 (2.8 m)	FG quartz	L1400	OSL	–	–	28.6 ± 1.3	Zhang et al., 2011
		Layer 6 (3 m)	FG quartz	L1401	OSL	–	–	28.8 ± 1.4	Zhang et al., 2011
Chaisi/*DC 77:01, Shanxi	N35°50′, E111°25′	Sand-gravel layer	Shell	ZK-0635	*Conv.^{14}C	25,650 ± 800	29,683–31,318	–	IA-CASS, 1991
Xiachuan Loc.1, Shanxi	N35°27′, E112°02′	IT1(2)	Charcoal	ZK-0385	Conv.^{14}C	15,940 ± 900	18,212–20,266	–	IA-CASS, 1991
		IT2-6(2)	Charcoal/mud	ZK-0384	Conv.^{14}C	21,090 ± 1000	24,042–26,668	–	IA-CASS, 1991
		IT8(2)	Charcoal	ZK-0417	Conv.^{14}C	23,220 ± 1000	26,484-29120	–	IA-CASS, 1991
Xiachuan Loc.2, Shanxi		–	Charcoal	ZK-393	Conv.^{14}C	20,700 ± 600	23,964–25,608	–	Chen and Wang, 1989
Xiachuan *SSY, Shanxi		IIIT1-2(2)	Mud	ZK-0494	Conv.^{14}C	17,860 ± 480	20,716–22,125	–	IA-CASS, 1991
		IVT101-103(2)	Peat	ZK-0497	Conv.^{14}C	18,040 ± 480	20,937–22,274	–	IA-CASS, 1991
Xiachuan *SWP, Shanxi		–	Charcoal	ZK-762	Conv.^{14}C	13,900 ± 300	16,534–17,492	–	Chen and Wang, 1989
		–	Charcoal	ZK-634	Conv.^{14}C	19,600 ± 600	22,746–24,210	–	Chen and Wang, 1989
Shizitan, Shanxi	N36°02′, E110°32′	*C-zone (0.35–0.5 m)	Burnt bone	BA 93186	AMS ^{14}C	10,490 ± 540	11,404–12,823	–	Yuan et al., 1998
		C-zone (0.5–0.8 m)	Burnt bone	BA 93187	AMS ^{14}C	12,660 ± 190	14,606–15,444	–	Yuan et al., 1998
		C-zone (1.15–1.3 m)	Burnt bone	BA 93188	AMS ^{14}C	13,590 ± 220	15,991–16,966	–	Yuan et al., 1998
		C-zone (1.46–1.78 m)	Burnt bone	BA 93189	AMS ^{14}C	14,340 ± 250	17,208–17,849	–	Yuan et al., 1998
		*E-zone (2.7 m)	Bone	BA 93190	AMS ^{14}C	11,490 ± 110	13,245–13,536	–	Yuan et al., 1998
		East zone (5.3 m)	Bone	BA 93191	AMS ^{14}C	14,720 ± 160	17,635–18,395	–	Yuan et al., 1998
Xueguan, Shanxi	N36°24′, E111°05′	–	Charcoal	BK81016	Conv.^{14}C	13,170 ± 150	15,659–16,536	–	IA-CASS, 1991
PY-03, Ningxia	N 35.8°, E106.6°	–	Charcoal	CAMS94203	AMS ^{14}C	18,350 ± 70	21,688–22,323	–	Ji et al., 2005
PY-04, Ningxia	N35.8°, E106.6°	–	Charcoal	CAMS94202	AMS ^{14}C	10,670 ± 40	13,422–13,688	–	Barton et al., 2007
Pigeon Mountain, *QG3, Ningxia	N38.04°, E105.85°	*S-profile, stratum E	Charcoal	Beta 97241	Conv.^{14}C	10,230 ± 50	11,808–12,099	–	Elston et al., 1997
		S-profile, stratum F	Charcoal	Beta 86731	Conv.^{14}C	11,620 ± 70	13,373–13,646	–	Elston et al., 1997
		S-profile, stratum G2	Charcoal	Beta 97242	Conv.^{14}C	12,710 ± 70	14,793–15,415	–	Elston et al., 1997
		*SW-profile, stratum D	Charcoal	Beta 86732	Conv.^{14}C	10,020 ± 60	11,373–11,708	–	Elston et al., 1997
		SW-profile, stratum D	Charcoal	Beta 97346	Conv.^{14}C	10,130 ± 70	11,522–11,946	–	Elston et al., 1997
Shuidonggou Loc. 12, Ningxia	N38°19′40″, E106°29′49″	Layer 11	Charcoal	LUG06-54	AMS ^{14}C	9797 ± 91	13,078–13,296	–	Liu et al., 2008;
		Layer 11	Quartz	IEE1110	OSL	–	–	11.6 ± 0.6	Pei et al., 2012
Youfang, Hebei	N40°14′, E114°41′	Upper layer of the artifact horizon	FG quartz	–	OSL	–	–	14 ± 4	Tsuneto et al., 2009
			Polymineral	–	OSL	–	–	14 ± 3	Tsuneto et al., 2009
			FG quartz	–	OSL	–	–	16 ± 3	Tsuneto et al., 2009
			Polymineral	–	OSL	–	–	16.2 ± 2	Tsuneto et al., 2009