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Late Pleistocene representative sites in North China and their indication of evolutionary human behavior

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ABSTRACT

As in many other regions of the world, the Late Pleistocene in China underwent rhythmic changes of climate, which caused some obvious changes in mammalian fauna, natural landscape and human cultural adaptations. This paper is a brief introduction of four representative Late Pleistocene sites in North China, which are dated at periods between Middle and Upper Palaeolithic, and demonstrated common or particular features from geographic and geological aspects, archaeological and environmental characters, and chronological position. A large transformation happened, reflected by culture remains, showing that environmental changes profoundly influenced human behaviour and inspired new forms of culture appearance. This indicates the clear existence of Middle Palaeolithic at least in North China, which became a foreshadowing for the coming Upper Palaeolithic.

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1. Introduction

Compared to the classical Middle and Upper Palaeolithic culture sequence in Europe, Late Pleistocene lithic materials in China seem to lack a clear divisional criterion for Middle and Upper Palaeolithic. Geological sediments and climate change show that the Late Pleistocene is a new stage, and has a corresponding mark on sedimentation and mammalian faunas, particularly in North China. In the perspective of archaeology, North China refers to the area north of the Qinling Mountains. After the Lower Pleistocene “Nihewan fauna” and the Middle Pleistocene “Zhoukoudian fauna” (Black et al., 1933), the Late Pleistocene is characterised by the “Salawusu Fauna” (Dong et al. 2010). In North China, besides the cave deposits, well-developed fluvial-lacustrine deposits were developed in all periods of the Pleistocene. Extensively distributed and thick loess deposits existed in Pleistocene time. The Wucheng Loess, Lishi Loess, and Malan Loess, with interspersed palaeosols, respectively indicate Lower, Middle, and Late Pleistocene (Liu and Ding, 1984). All these are fundamental conditions to build up a general chronological sequence for Chinese Palaeolithic culture. What is further needed is to recognize more precisely those culture features with more details for constructing a clear culture sequence for each period. This paper considers four representative Palaeolithic sites of Late Pleistocene in North China, presenting their

culture content along with new emerging culture phenomena, accompanied by evidence of environmental change and some reliable new dating.

2. Representative sites of Late Pleistocene in North China

In North China, a series of Late Pleistocene sites between Middle and Upper Palaeolithic displays transitional characters of the period (Huang and Hou, 1998). Some old culture elements remain in the lithic industry. Meanwhile, the appearance of bone tools indicates evolutionary human behaviour under a background of climate change from warmer to relatively colder conditions. The four sites in this paper illustrate the culture visage and characters of this time. The four sites are dated 70.0–20.0 ka (Table 1), all belonging to the Late Pleistocene. These sites all consist of fluvial-lacustrine formations, although the cave site of Xiaogushan contains sediment from an outside fluvial source. Geographically, Salawusu represents the environment of the Inner Mongolian Plateau, Shiyu represents the Loess Plateau, Xiangushan in Liaodong Peninsula represents the most southern environment of the Northeast region, and Yanjiagang represents the Northeast Songnen Plain (Fig. 1).

2.1. Salawusu

Salawusu site (37°10′59″N, 108°10′58″E; Fig. 2) was discovered in the early last century (Licent and Teihard de Chardin, 1925) in the

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Table 1
The chronology of the Yanjiagang, Shiyu, Xiaogushan and Salawusu Paleolithic sites.

Site	Layer	Method ^a	Material ^a	Age, ka ^b	Reference
Yanjiagang site	Cultural layer	Conv.	Animal bone	27.0 ± 0.6	Wei et al., 1986
Shiyu	Cultural layer	Conv.	Animal bone	33.3 ± 1.1	Dating Laboratory, 1977
Xiaogushan ^c	Ash layer	AMS	Animal bone	36.7 ± 1.0	Yuan, 1993
	Layer 5	Conv.	Charcoal	10.0–4.0	Zhang et al., 2010
	Layer 4	Conv./AMS	Charcoal/bone	17.0	
	Layer 3	Conv./AMS OSL	Charcoal/bone, quartz	30.0–20.0	
	Layer 2	Conv./AMS OSL	Charcoal/bone, quartz	60.0–30.0	
Salawusu	Layer 1	OSL	Quartz	70.0	
	Cultural layer	IRSL	Feldspar	61.0–68.0	Yin and Huang, 2004

^a Conv. and AMS refer to radiocarbon dating using conventional and AMS methods, the dating materials are bone and charcoal. OSL refers to optically stimulated luminescence (OSL) dating on quartz or feldspar grains.

^b For radiocarbon dating, the values refer to calibrated ages (calibrated using the program CalPal v1.5 by Weninger, Radiocarbon Laboratory, University of Cologne).

^c For the Xiaogushan site, the chronology was established using the results of radiocarbon and OSL dating.

Maowusu desert of southern Inner Mongolia. During almost a century of studies, ages, fauna, stone artifacts, and human fossils have been investigated in several excavations. Salawusu is the site of the standard fluvial-lacustrine profile and standard fauna for the Late Pleistocene in North China (Huang et al., *in press*). New dating gives the age of this site as 110–70 ka BP. Archaeological study on excavated artifacts has ascertained the original locality of producing raw materials. Analysis on typology and technology has also made progress (Huang and Hou, 2003). Breuil (1928) had divided this industry into Non-Microlithique and Microlithique. The latter one actually appears to be more apparent. In short, Salawusu lithic typology has abundant side scrapers, end scrapers, notches, borers, burins and denticulates, mostly very small (Fig. 3). Bone tools which were made on antler or antelope horn were also excavated and collected in the field work, but the bone artifacts were not published.

The Salawusu people looked for raw materials 40 km away from their living valley where it exceedingly lacked proper stone materials. Raw materials were used sufficiently by the tool makers (Huang and Hou, 2003). Compared with the same period, the knapping techniques of the Salawusu people were rather unique in working on very small materials. Moreover, horn implements associated with most microlithic tools reflect the developing hunter economy.

2.2. Shiyu

Shiyu site (112°17'N, 39°25'E) is located at Shiyu village of Shuozhou city, near the margin of the Loess Plateau of Shanxi Province. The site is on terrace 2 of the Shiyu River (Fig. 4). It was discovered in 1963 with one human occipital bone, 15,000 pieces of stone artefacts, one ornament and thousands of mammalian teeth



Fig. 1. Geographic position of four Late Pleistocene sites in north China.



Fig. 2. Landscape of Salawusu site.

together with burned stone and bones. The lithic industry is primarily small tools with various types of points, scrapers, burins and one arrow head (Jia et al., 1972) (Fig. 5). Among the abundance of bone fragments, what is really attractive is the bone tools and

significantly knapped bone (Fig. 6). There is a bone point (Fig. 6-3) which was elaborately retouched.

The site has been dated as $33,000 \pm 1100$ BP and $36,700 \pm 1000$ BP through conventional ^{14}C and AMS (Dating Laboratory, 1977;

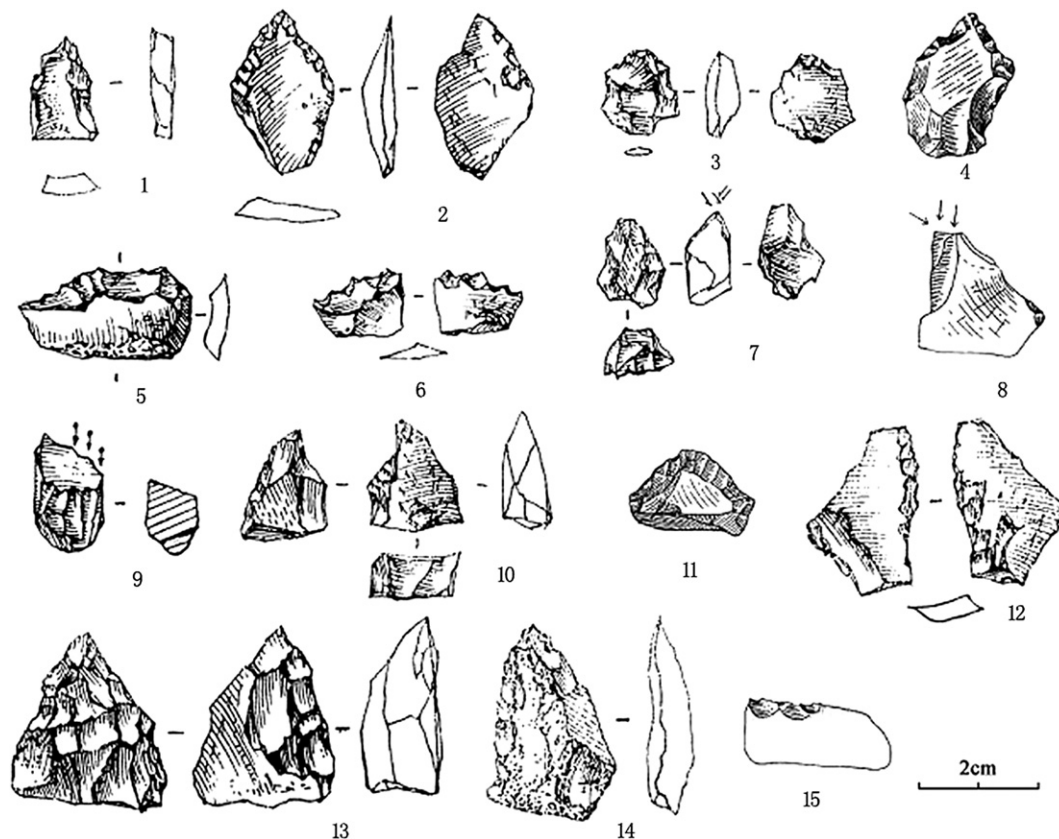


Fig. 3. Stone artifacts of Salawusu site (after Huang and Hou, 2003).



Fig. 4. Landscape of Shiyu site.



Fig. 5. Stone artifacts of Shiyu site.

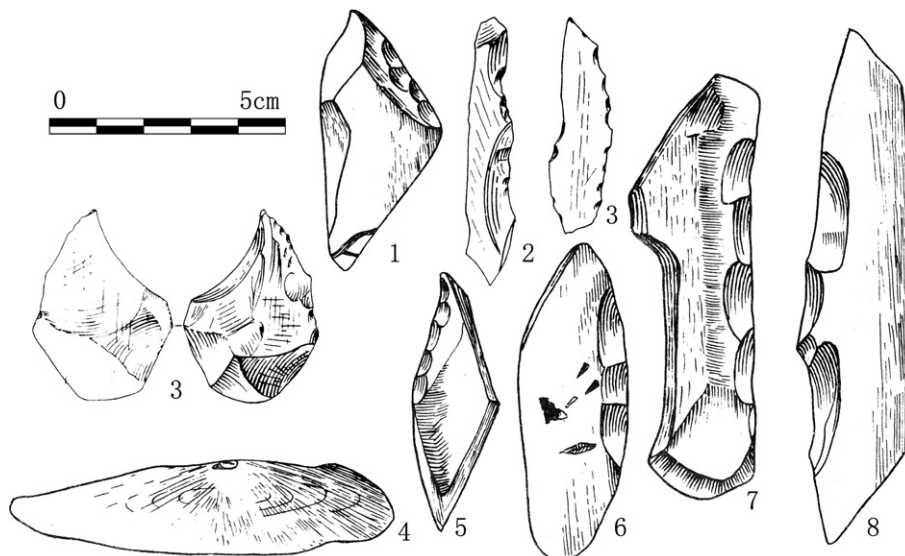


Fig. 6. Bone artifacts of Shiyu site.

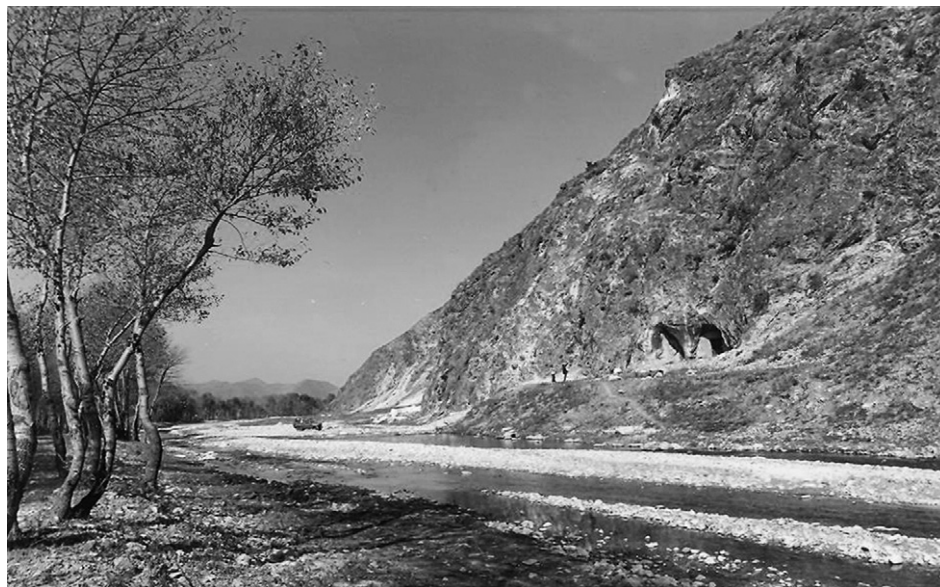


Fig. 7. Entrance view of Xiaogushan site.

Yuan, 1993). Due to numerous fossil remains of *Equus hemionus* and *Equus przewalskii*, the Shiyu people are called *E. hemionus* and *E. przewalskii* hunters. The exquisite small tools and fine bone artefacts make Shiyu an important site to illustrate the vivid picture of the life of people who lived on the Loess Plateau during that time.

2.3. Xiaogushan

Xiaogushan cave site (40°34'53"N, 122°58'33"E; Fig. 7) is located in the north of Liaodong Peninsula. It was found in 1981 and excavated several times. By methods of conventional ^{14}C , AMS, and OSL the ages of several cultural layers were dated as 80 ka–17 ka.

The fauna has archaic species in Chinese Late Pleistocene sites, with a large number of extinct ones (Huang and Fu, 2009).

The Xiaogushan lithic industry is mainly made on vein quartz and quartz diorite. Heavy-duty and light-duty tools coexist together at the site. The former type includes choppers, handaxe and spheroid, and the latter includes borers, becs, side scrapers, discs, denticulates, notches, burins and points (Fig. 8). Bone tools and ornaments are noticeable cultural remains (Fig. 9). Most were from layer L2-3, which was dated 56–20 ka BP. Bone artifacts appear very exquisite, comparable to some artifacts from some Magdalenian sites in Europe, which are much younger. A totem with some ideological meaning was also very outstanding. Xiaogushan is the single recorded Paleolithic site in East Asia with such



Fig. 8. Stone artifacts of Xiaogushan site (after Huang and Fu, 2009).

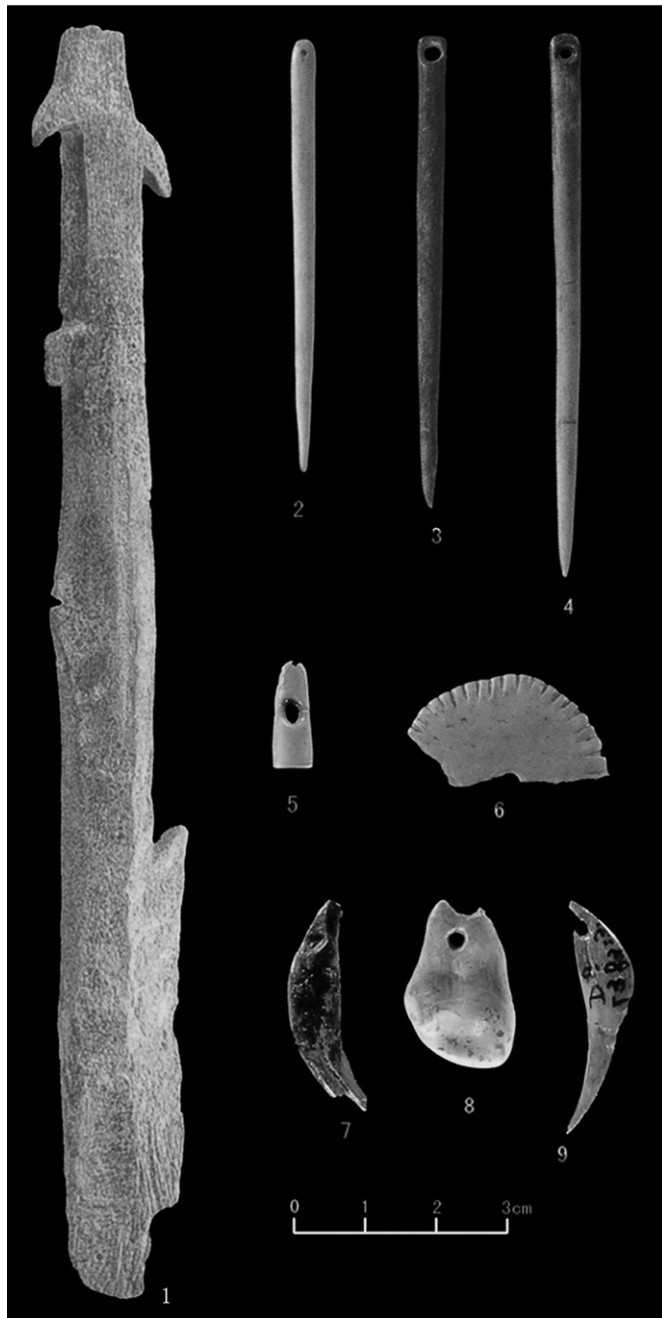


Fig. 9. Bone artifacts and ornaments of Xiaogushan site (after Huang and Fu, 2009).

artefacts (Huang and Fu, 2009). The cultural visage shows us a complicated construct of lithic industry with a grade of maturity, and indicates that Xiaogushan represents a composite economy combining rather advanced techniques of stone tool making, hunter strategy, collecting and fishing behavioural ways of life.

2.4. Yanjiagang

In Heilongjiang province, Yanjiagang site (45°37'N, 126°19'E) is located southeast of the city of Haerbin. It was first excavated in 1982 and experienced four stages of field work. Unearthed at the site was a fragmentary piece of human cranium belonging to *Homo sapiens*, 24 species of mammals of the "Mammuthus-Coelodonta Fauna", very few stone artifacts, burnt bone, and charcoals. The

most remarkable remains are two overlying skeleton circles (Fig. 10). One has more than 200 pieces of bones and formed an elliptic circle. The other used more than 300 pieces of bones and formed a semi-circle. In the former circle, the bones were identified as 6 wild ass, 5 bison, 2 woolly rhinoceros, 1 red deer, and 1 wolf. The latter circle included 5 woolly rhinoceros, 5 wild ass, 3 bison, 4 red deer, 1 spotted hyena, 1 wolf, and 2 gazelles (Northeastern expedition team, 1987). These bones were arranged in order, and half show artificial marks. Charcoals were left inside the circles. Researchers thought they were built as a shelter house in open air for hunters, or at least represent a temporary camp.

3. Fauna and environment

For better understanding the temporal and environmental differences of the four sites, the faunas of them are analyzed and compared below.

3.1. Materials and methods

The fauna data of Salawusu are based on the description by Qi (1975), and those of Shiyu, Xiaogushan and Yanjiagang based on the descriptions by Jia et al. (1972), Dong et al. (2010), and Northeastern expedition team of Heilongjiang Managing Committee for Cultural Relics et al. (1987) respectively. The faunas were compared with supposed archaic and extant faunas in pairs in turn to determine the Brainerd-Robinson's (B-R) similarity coefficients. All compared faunas were sequenced in Table 2 according to Brainerd-Robinson's rule and similarity coefficients (Chen, 1983, 2005). The faunas closely related will appear side by side in the ranked table.

The chronological sequence of the compared faunas is estimated by sorting the Brainerd-Robinson's similarity coefficients between the supposed archaic fauna and the faunas from four sites. The coefficients are referred here as antiquity coefficients in Table 3, as well as extinction rate (percentage of extinct taxa over total taxa of the fauna) of the faunas. The two methods result in different outcomes, and their synthesis was regarded as the recommended conclusion based on large mammal material.

The ecological composition of the faunas was based mainly on diet preferences of the fauna components. The diet and habitat preferences of the extant taxa were based on the information from Nowak and Paradiso (1983) and Wang (2003). For extinct taxa, those of the closest extant relatives of extinct taxa were taken as equivalents. The ratios of different diet preferences were also compared in percentage. Granivores are included in browsers in the present analyses.

3.2. Results

The sequenced faunas according to B-R similarity coefficients and B-R rule are listed in Table 2. The fauna closest to archaic is from Shiyu, followed by Salawusu, and then Yanjiagang and Xiaogushan. Based on B-R antiquity coefficients alone (Table 3), the sequence is Shiyu (45), Xiaogushan (44), Yanjiagang (37), and Salawusu (36). Based on extinction rate (Table 3), it is Xiaogushan (30%), Shiyu and Yanjiagang (26.67%), and Salawusu (21.88%).

The faunas are biochronologically very close to each other. The conclusion is that Shiyu fauna is a little older than the others. The other three faunas are nearly contemporary.

3.3. Environment

The presence of *Coelodonta antiquitatis* in all faunas indicates a relatively cold climate during the existence of the faunas. The

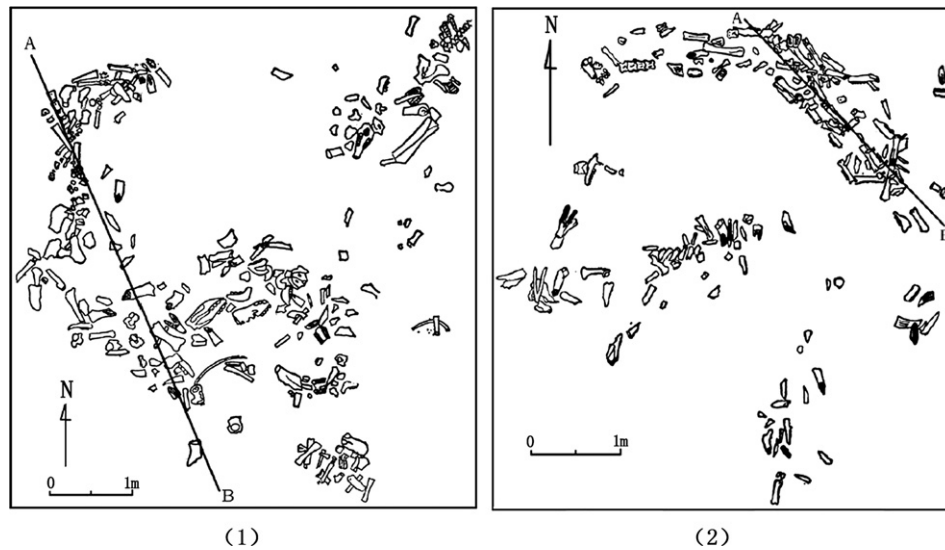


Fig. 10. The semi-circle campsites of Yanjiagang site (after Yu et al., 2010).

Table 2

Similarity sequence according to Brainerd-Robinson's rule and similarity coefficients.

	Archaic	Shiyu	Salawusu	Yanjiagang	Xiaogushan	Extant
Archaic	142					
Shiyu	45	142				
Salawusu	36	50	142			
Yanjiagang	37	48	37	142		
Xiaogushan	44	37	33	33	142	
Extant	0	26	35	34	27	142

Table 3

Biochronologically sequenced large mammal faunas based on B-R Antiquity Coefficient and extinction rate.

	B-R antiquity	Total species	Extinct taxa	Extinct rate%
Xiaogushan	44	40	12	30.00
Shiyu	45	15	4	26.67
Yanjiagang	37	30	8	26.67
Salawusu	36	32	8	25.00

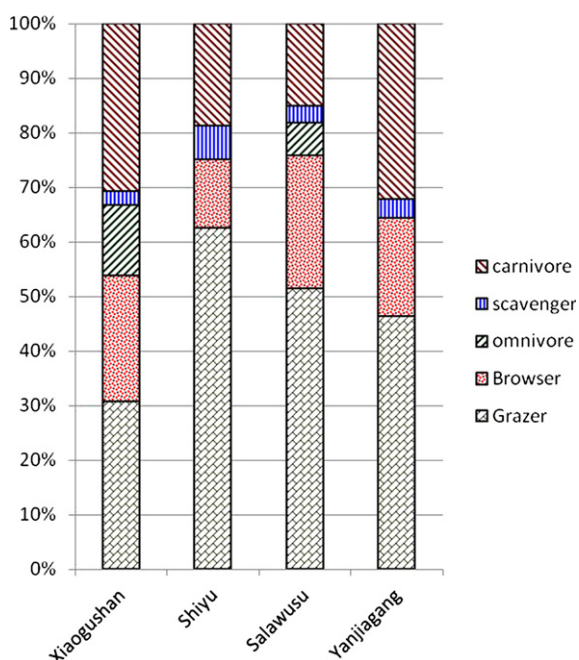


Fig. 11. Ecological comparison of the faunas from four sites.

comparison of ecological composition of faunas (Fig. 11) shows that the percentage of browsers in the Xiaogushan fauna is much greater than that of the Shiyu fauna, and the percentage of grazers of the Shiyu fauna is much greater than that of the Xiaogushan fauna. It implies that the forests or woodlands at Xiaogushan had a larger extent than at Shiyu, and the grasslands were more extensive at Shiyu than at Xiaogushan, a result of a drier climate at Shiyu than at Xiaogushan. Zoogeographically, Xiaogushan and Yanjiagang faunas represent the Northeast China province, and Salawusu and Shiyu faunas are generally considered as representative of the North China province. The most important difference between them is that *Mammuthus* is absent in Salawusu and Shiyu faunas. Northeastern China was colder than North China.

4. Conclusions

The Late Pleistocene is a meaningful period in the evolution history, as two significant transitions happened in this period. Firstly, human beings evolved to anatomic *H. sapiens* from the former archaic *H. sapiens*. Secondly, the life style and cultural characteristic changed: stone artifacts were developing into more types with special functions with more concentrated working. Furthermore, bone tools were much widely used.

As in all other regions of the world, the Late Pleistocene in China was marked by climate change, and represented a new period of life style for human beings (Coon, 1971). These four sites are good examples to help to sketch out the cultural view of people living in North China during the Late Pleistocene. Chronologically and culturally, Middle Paleolithic cultures were potentially developed in China. The ongoing work is to define them more clearly. If there is a missing period (Gao, 1999), the stone artifacts and associating other remains from the four sites mentioned above have not

revealed it. After reviewing the Paleolithic materials in China, it is difficult to make a different conclusion to that presented here.

An obvious phenomenon shown here is the development of bone tools. Exquisite bone tools give a clear view of the change in the livelihood model. Meanwhile, the ornaments and the campsites are also the symbols of evolution of the human culture.

In future, many previously discovered materials needs to be restudied. It is also understandable that these sites were not capable of supplying all complete detailed information, although they still present some key evidence to show their main important content. Along with new improved methods for dating and new excavation work on recently discovered sites, Middle Paleolithic culture in China hopefully will be described much more clearly than before. Some new works are underway. A future report on this topic will be more complete, with more qualitative and quantitative work.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at [doi:10.1016/j.quaint.2012.03.035](https://doi.org/10.1016/j.quaint.2012.03.035).

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