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Technological Analysis of the Upper Paleolithic Microblade Industry in the Eastern Portion of Northeast, China

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Abstract

Many new Paleolithic sites or localities have been found in eastern portion of Northeast China during 2000—2007. All of them are open-air sites. This paper summarizes major Paleolithic archaeological discoveries and research achievements made in the region, and it also analyses and concludes existent problems and future working direction. According to these cultural characteristics of sites, this paper analyses cultural characteristics and industry types, points out some problems such as chronology and stratigraphy. From behavioral and adaptive perspectives and through analyzing typological, morphological and technological features of the stone assemblage, this paper addresses several theoretical issues regarding this industry, such as the nature of typological and stylistic variability, the capability and strategies of hominids in exploiting raw materials and modifying stone tools, the influence of raw materials placed on lithic technology and artifact stylistic features, and behavioral options exercised by hominids at the sites. This study thinks that these new Paleolithic sites belong to microblade-based micro-tool industry in final Upper Paleolithic period, lithic assemblages have close cultural relationships with many sites from Korean peninsula, Mongolia, Far East, Trans-Baikal, Baikal and Primorskiy in Russia.

Keywords: Northeast, The Upper Paleolithic, The Micro-tool Industry, Technological analysis

1. Introduction

Humanity is a special species in all living things on the earth. Its particularity lies in, humanity can manufacture and use simple and complicated stone tools (Gao, 2001, pp.183-196). For many sites, stone tools constitute our only source of information. But this is not enough. Stone artifacts have the potential to answer questions well beyond just manufacture technique or simple subsistence practices; they can also be employed to account for issues of behavior, lifestyle, social and economic structures, and organizational principles. The resolution of these currently identified problems will be of paramount importance in developing analytical techniques during the next few years.

The eastern portion of Northeast in China encompasses the Bu'erhatong River, the Hailanjiang River, the Tumenjiang River and the Nangangling Mountain, part of the geomorphologacally diverse Changbaishan Mountainous region (Zhao, 2003, pp.55). In this region, the Tumenjiang River is one of the major water arteries. A high concentration of Upper Paleolithic sites has been recorded in a short section of the river valley. We have found 16 Upper Paleolithic sites or localities since last century (Wang & Chen, 2005, pp.26-35). We have also found 6 Upper Paleolithic sites during recent years. They include Shirengou (Helong City), Liudong (Helong City), Qingtou (Helong City), Beishan (Hunchun City), Xishan (Fusong City), Shajingou (Antu City) and Xianrendong (Huadian City) in Jilin Province, China (Table 1) (Chen & Wang, 2008, pp.183-204). All the sites are associated with the surface layer of the second terrace and the third terrace of the Tumenjiang River and its tributary, Hailan River. This layer can be correlated with the regional stratigraphic scheme of Holocene-Pleistocene sediments in Tumenjiang River and The Changbai Mountainous region. The sediments are a light, yellowish-gray loess-like loam, in some places including one or two horizons. They have yielded numerous stone artifacts. The present article mainly focuses on lithics from six sites above, which yielded the most representative samples of stone artifacts (about 2000 specimens) reflecting various characteristics. Previously, based on data generated through typological and statistical analyses, the Upper Paleolithic sites in the Northeast in China were divided into three industrial types: the Flake-based Small Tool Industry, the Peddle Tool Industry and the Microblade-based Micro-tool Industry (Zhang & Wei, 1998, pp. 171-197). These sites are integrated into a complicated chronological local culture.

In this work, a series of technological and attributes analyses are applied to explain a chain of operations associated with the processing and exploitation of lithics by prehistoric people. These analyses include at least aspects:

(1) raw materials selection and exploitation (evaluating the raw materials sources; assessing general technological strategies related to specific raw materials, reconstructing the relations between primary reduction techniques and these raw materials, etc.); (2) reduction strategy (analyzing and elaborating the technological system; regulating the sequence of techniques at different stages of Microblade reduction); (3) manufacture and utilization of tools (analyzing primary and second modification, retouch technology and morphology of stone tools); (4) developmental trends of Upper Paleolithic industries in the Northeast in China and cultural comparison with Korean peninsula, Mongolia, Far East, Trans-Baikal, Baikal and Primorskiy in Russia.

Since excavations and investigations began in 2002 stratigraphy and geochronology have been major concerns of archaeological research at Paleolithic sites in Northeast China. However, we do not achieve available some dating samples (such as animal bones, wood carbon and ashes) from cultural stratum in sites. According to available chronological estimates and stratigraphic evidence (the Pleistocene sequences of soft sediments at these sites), these new finds belong to the Late Upper Paleolithic.

From behavioral and adaptive perspectives and through analyzing typological, morphological and technological features of the stone assemblage, this paper addresses several theoretical issues regarding this industry, such as the nature of typological and stylistic variability, the capability and strategies of hominids in exploiting raw materials (obsidian) and modifying stone tools, the influence of raw materials placed on lithic technology and artifact stylistic features, and behavioral options exercised by hominids at the sites.

2. The Final Upper Paleolithic Industry

From behavioral and adaptive perspectives and through analyzing typological, morphological and technological features of assemblage, these sites belong to the Microblade-based Micro-tool Industry in final Upper Paleolithic. Stone assemblage (n=1942) include retouched tools, cores (flake cores and microblade cores), flakes, blades, microblades, chips and chunks. Flakes, cores, blades, microblades, chunks and chips occupy 81.47% of artifacts assemblage. Retouch tools (n=204) constitute 10.5% of assemblage. The raw materials used for the stone assemblage are wealthy. Obsidian is the predominant raw material used for producing stone artifacts at the site, followed by quartz. Primary reduction is characterized by percussion with a hard hammer, bipolar flaking and pressure technique. Retouched tools include used flakes, scrapers, burins, backed knife, borer; scrapers are the dominative tool type. Major blanks for tools fabrication are flakes. Modified tools appear to be retouched by hammer percussion and pressure technique. Tools are mainly retouched on the dorsal surface. Most of tools are finely retouched. Tool types are standardized. Tools are mainly small, followed by middle and large in size. The extent of raw material consumption in general is quite high, evidenced by the prominence of chips and debris producing by manufacturing and sufficient modification of the retouched tools.

3. Core reduction technology

At least two major core reduction technologies are recognized in cores and flakes from these sites. One is direct hard or soft hammer percussion, percussion flake and core are the most prominent character in stone tools assemblage, and the other is indirect percussion, microblade core, blade core, microblade and blade are the most prominent character in stone tools assemblage. Furthermore, according to physical characteristics of obsidian (high rigidity, high quality and fragile), we can not really distinguish bipolar fragments from all the flakes. As a result, we consider that human may probably use the bipolar flaking in sites.

The characteristics of platform of microblade cores and flaking scars on the working face have direct relationships with core reduction technology and raw material economy. Primary reduction was mostly accomplished by flat parallel flaking. The process probably started with the partial removal of the cortex through the detachment of short spalls. Judging by the character and morphology of microblade core, all such microblades were struck from a selected and prepared platform, so the cores acquired the stable shape, such as wedge-shape, boat-shape, conical and cylindrical core. Microblade cores were exploited after the removal of one or two primary spalls aimed at shaping a crest, a character needed for the detachment of a blade blank. This is evidenced by products of flaking varying in size and proportions. According to the analyzing results, we can recognize microblade cores in the prepared stage and flaking stage, and there are some flaking scars (n=2—5) on the working surface of cores, platform angles of cores range from 62° to 97°. It indicates that hominids at sites have high cognitive ability on selecting raw materials and retouching tools.

The overwhelming majority of flakes are broken flakes (74.13%), complete flakes are rare. Observing it from flake types, major platforms of flakes are striking-platform, followed by cortex-platform, it indicates that hominids at the sites often prepare platform of cores. Systematic striking-platform preparation can be recognized either on cores or on flakes. The dorsal surface of flakes exhibit well-controlled fine detaching, evidenced by regular and parallel scars. Flakes with scars bestrewed on the dorsal surface occupy 25.11% of all flakes. I2-2 and I2-3 (Wei, 2001, pp.85-96) are predominant types; it indicates that these flakes are secondary flake removals. Direction of most flakes scars on the dorsal surface is consistent with core reduction. According to analyze the characteristics of edges of flakes, the edges of flakes are variety; mainly parallel and triangular, flakes with irregular edges are rare. Moreover, we can also recognize few bipolar fragments.

The overwhelming majority of microblades and blades are middle parts, followed by proximal and distal part, complete microblades and blades are rare. The ridges of microblades and blades are variety, mainly single and double ridges, followed by crotched ridge. Pleistocene hominids are proficient in mastering truncation technique of microblades and blades; they choose straight middle part as the edge of composite tools. Debitage is defined as a detached piece that is discarded during the reduction process. It has recently become one of the most controversial and apparently least understood artifacts types. After being neglecting by researchers for decades as prehistoric trash or debris, debitage has gradually gained importance as an artifact that can help interpret aspects of prehistoric human technology, economy and organization. Debitage and chunks are by-products of retouching process or core reduction, they have a very important significance to study retouch technology and analyze human behaviors. As obsidian is the predominant raw material used for producing stone artifacts at these sites, we can have some replicative experiments of core reduction and retouching process about obsidian, experiments are designed to determination which variables best distinguish between different techniques or technologies. We may apply principal components of experiments to archaeological assemblage, and analyze function (such as quarry, workshop or campsite) of sites through calculating percentage relationships between tools and debitage.

4. Retouch technology

Pleistocene hominids often chose flake with sharp edge as used flakes at Upper Paleolithic micro-tool industry in Northeast China. Most of used flakes were mainly middle part of flakes, blades or micro-blades; some ones were used as edge of composite tools. The overwhelming majority of edge angle is sharp, followed by blunt angle. We can recognize that some specimens do exhibit obvious, continuous and tiny scars. Indeed, we must check the inferences about used flakes by use-wear analysis in the future.

Generally speaking, modified tools appear to be retouched by direct hard hammer percussion, followed by pressure technique. Most of tools were mainly retouched unifacially. Pieces made on flakes were modified overwhelmingly on the dorsal surfaces (56.28%), followed by the ventral surface (17.96%), multiple direction, alternating retouch and opposite retouch. Most of tools are small and regular. Most modification scars are parallel, sharp, shallow, regular, smooth or denticulate cutting edges and similar in size, indicating that modification of these pieces was normally well-controlled. Major blanks for tools fabrication are flakes (78.54%), followed by some microblades, blade, chunks and pebble.

The overwhelming majority of retouched tools are sidescrapers, followed by endscrapers. Sidescrapers are varied, such as concave, convex, round, straight scraper. They were retouched by direct hard hammer percussion, followed by pressure technique. Scrapers were mainly retouched unifacially. Pieces made on flakes were modified overwhelmingly on the dorsal surfaces, retouched part concentrate on a certain side of blank, not proximal or distal part. This indicates that such consistent edge can necessarily represent discrete functional types.

5. The utilization of raw materials

Lithic raw material is the most important means of production for Pleistocene hominids. The availability and quality of raw material, the ability to exploit the raw material, and the rate at which raw material were consumed all represent substantial limiting factors for hominid adaptations and the nature of lithic technology. Raw materials are inherent in each artifact and are useful in characterizing the lithic assemblage. Knowledge gained from sourcing lithic artifacts can be employed on several different levels (George H.Odell, 2004, pp.89-91). Eleven types of rock were used; they include obsidian, jasper, quart, andesite, alterative shale, quartzite, vein quartz, rhyolite, hornfels, volcanic tuff and agate. The raw material most often exploited at sites was locally available obsidian (97.21%). The obsidian resource is abundant in Northeast China. Obsidian combines high abundance and high quality. Therefore, Pleistocene hominids are apt to choose obsidian for making stone tools.

The quality and quantity of available raw material for chipping affects the choices made regarding material selection and conservation. Raw materials can be acquired by several means, including planned collection trips to quarries, opportunistic collecting, or trade. Raw materials collection strategies will condition the reduction strategies used to produce finished tools. Obsidian is a kind of dark glassy volcanic rock formed by the rapid solidification of lava without crystallization. It has conchoidal fracture and glassy luster, with striped structure. Its specific gravity is very light (about 2.13-2.42), and its water capacity is under 2% (Liang, 2003, pp. 63). According to the physical property of obsidian, hominids prefer to choose it for making tools. The main sources of raw materials used by Paleolithic inhabitants of sites are exposed in the lower portion of the terrace and peddle beaches located in close proximity to the sites. There are about 510 Cenozoic volcanoes, which are located in the Changbaishan mountain area. They include Longgang volcanic cluster in Jilin Province, Wudalianchi volcanic cluster, Erkeshan volcanic cluster and Keluo volcanic cluster in Heilongjiang Province. Eruptive activity of volcanic cluster gives birth to a lot of clastic sediment, which the half of sediment is made up of pyroclastic rock. Distributing area of lava and pyroclastic rock exceeds 50000 km^2 (Liu & Xiang, 1997, pp. 7). It makes hominids understand the advantage of obsidian and obtain obsidian of high quality very easily during exercises.

Raw material most often exploited at these sites is locally available obsidian (97.21%). According to stone artifacts assemblage and the exploitation of raw materials, we know that hominids prefer to select obsidian as the main raw material for core reduction and retouching tools. In addition, we also have recognized some used flakes with sharp edge, occupying considerable percentage. We believe that hominids employ a special strategy of “adjusting measures to local conditions” and “obtaining raw material from local sources”.

6. Conclusion and discussion

The structure of a stone tool assemblage and the nature of artifact variability on a regional scale are closely related to several factors, including the availability and quality of raw material, the strategy by which it was procured, the particular activities in which stone tools were made and used, and the role of the sites within a settlement or mobility system (William Andrefsky Jr., 2001, pp. 75). Most of The final Upper Paleolithic sites are located on the piedmont alluvial plain and the second terrace in eastern portion of Northeast China. Pleistocene hominids exploit water and biological resources around the Tumenjiang River and its tributary. These sites consist mainly of blade and microblade cores, flakes, chips, chunks, tools. Most of tools are finely retouched. Such characteristics are shared by many other Paleolithic sites in North China. They have been termed generally as microblade-based micro-tool industry. Some scholars think that lithic assemblages have been divided into three industry types: flake-based small tool industry, peddle tool industry and microblade-based micro-tool industry in Northeast China, these sites in eastern portion of Northeast China belong to the third industry. Microblade-based micro-tool industry derived from small tool industry during the Upper Paleolithic period, it is a distinctive industry type. However, it didn’t replace small tool industry; developed trends of two industry types are two parallel technological traditions. Such characteristics are shared by many other Upper Paleolithic sites in North China and neighborhoods, such as Shibazhan at Huma County and Daxingtun at Qiqiha’er in Heilongjiang Province, Hutouliang, Youfang, Jijitan, Xiachuan and Zhiyu in Nihewan Basin (Zhao, 2003, pp. 1-155); Hahwagyeri site in the Kangwon-Do region, Sukjangri site in the Chungcheong-Namdo region and Suyanggae site in the Chungcheong-Bukdo of Korean Peninsula (Lee & Yun, 1992, pp,135-146); many sites in Hokkaido Island and Kyushu Island of Japan (Derevianko A.P. 2005, pp. 2-29); Shorokhovo I, Ilyinka II, Shumikhha I and Bedarevo II in the Southeastern portion of Western Siberia (Markin S.V., 2005, pp.372-379), Karakol culture in Southwestern Siberia and Selemdja culture in the southern Far East (Derevianko A.P., 2001, pp. 70-103). Multidisciplinary research at cave and open-air sites has provided data illustrating the formation of microblade-based micro-tool industry during the final Upper Paleolithic period. It is expected that we will reveal similarities among these sites through analyzing technological models. Present, most scholars agree that the abrupt appearance of blade-microblade artifacts in North China is the result of the immigration of or influence from populations to the north, namely Mongolia and South Siberia (Gao, 2000, pp. 156-165).

However, the present inferences can in no way be regarded as conclusive. It is impossible to resolve the issues of reconstruction of microblade-based micro-tool industry of Upper Paleolithic population of the North China without analyses of faunal remains from sites and without consideration of a wider range of dating data. In future, we should carry through comprehensive archaeological investigation and excavation, at the same time, we put up particular researches in virtue of many subjects' methods and means so that search out new and possible points of breakthrough, this paper expects that we will obtain more information about behavioral potions adopted by hominids in the region.

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Table 1. The Upper Paleolithic sites or localities in the Eastern Portion of Northeast, China

Site	Geographical coordinate	Time	Date, years BP	Topographic feature	Unearthed area	Stone artifacts	
						Collection	Excavation
Shirengou	42°11′20″ N 128°48′45″ E	2004	15000•	piedmont belt	$52m^2$	24	1307
Liudong	42°19′11″ N 129°6′23″ E	2002	UP•	2nd terrace	—	227	4
Beishan	49°8′3″ N 130°15′8″ E	2002	20000•	2nd terrace	—	51	1
Xintunzi Xishan	42°33' N 127°16'11” E	2002	UP•	valley	$70m^2$	0	30
Shajingou	42°36′05.4″ N 128°16′02.9″E	2006	UP•	3rd terrace	$2\ m^2$	77	5
Qingtou	42°48′51.9″ N 128°58′20.7″ E	2006	UP•	2nd terrace	—	197	19

Remarks: “—” refers to indistinct unearthed area; “UP” refers to the Upper Paleolithic; “•” refers to speculated date.