PEBBLE SEMICIRCLE STRUCTURE FROM A LOWER PALEOLITHIC SITE IN SOUTHERN CHINA

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Abstract

An area of hominid activity, a pebble semicircle structure, was identified in the Maozhushan site in Ningguo, Anhui Province, prompting a study of lower Paleolithic human behavior in southern China. The semicircle structure was recovered with a series of small pebble circles within and with stone tool artifacts. The site formation study points to minimal natural modification at the site, suggesting some degree of human intention in the organization of the structure. Geostratigraphic and comparative ESR dates suggest that the age of the site falls between the Late Lower Pleistocene and the early Middle Pleistocene. Given the evidence at present, the Maozhushan site may have been a central campsite of the Shuiyiangjiang River Paleolithic complex recently identified in Lower Yangtze River of China.

INTRODUCTION

Hominid behaviors of the Lower Paleolithic have been the subject of many studies by archaeologists and paleoanthropologists. Cultural remains appearing on sites in a patterned distribution in a relatively primary context and in association with lithic technology are usually inferred to reflect hominid living adaptation strategies (see papers in Petraglia and Korisettar, 1998). However, scientists have identified very few structural remains in Lower Paleolithic sites that show purposeful construction and which would suggest a cognitive development and behavior pattern of early hominids. Nevertheless, some archaeological evidence indicates that structures were built by hominids in the Lower and Middle Pleistocene periods.

For example, in Bilzingsleben, Germany, Middle Pleistocene localities with patterned distributions of artifacts and faunal remains were found. Two circular concentrations of lithic artifacts were identified concurrently with large stones and bones, providing possible evidence of a structure foundation (Mania, 1986, 1991). Another of this kind, the Terra Amata site in Nice, France, was initially thought to be an Acheulian Shelter, although later research suggested that site modification was likely the result of natural agency (Lumley, 1969; Villa, 1983). Similar patterned arrangements or concentrations of stones and bones were also identified at sites like Latham in Syria (Clarke, 1967, 1968) and Olorgesailie in Kenya (Isaac, 1977), but the formation of artifacts could be attributed to natural processes, rather than intentional hominin behavior.

Recently, similar features suggesting Paleolithic settlements have been found in southern China. The excavations of the Jigongshan site in Hubei Province unearthed a 500 m² living floor, revealing an accumulation of thousands of stone artifacts and pebbles in circular patterns. The excavators propose that it might have been a
seasonal campsite or workshop during the early Upper Pleistocene (Wang, 1999, 2003; Liu and Wang, 2001). In this report, we will introduce another discovery from southern China – a pebble semicircular occupation of the Lower Paleolithic.

MAOZHUSHAN SITE 
AND STRATIGRAPHY

The Maozhushan (Bamboo Hill) site was first identified in 1996 and excavated the following year. Beneath a 3 m thick layer of net-patterned red clay, a typical geoformation of the Middle Pleistocene in southern China, the excavators found a cultural deposit. Due to the stunning discovery of a large pebble semicircle, the entire site was re-surveyed and lithic artifacts were analyzed in 1998. The results of this preliminary investigation are described below.

This site is located 4.5 km northwest of Ningguo City, Anhui Province (Fig. 1), on riverine terrain about 65 m above sea level. The settlement lies on the second terrace (T2) of the Shuiyangjiang River, a second tributary of the Lower Yangtze River, where three upstream rivers (Xijihe River, Zhongjinhe River, and Dongjinhe River) join to form the Shuiyangjiang River. The site covers hilly landscape of nearly 4,000 m², of which an area of 13-15 m² was exposed in 1997 winter field season.

The sediments were divided into four layers (Fig. 2). From top to bottom: 1) yellow silt clay layer 1.5 m thick; 2) a brownish red silt clay layer with grayish white lacework, commonly called the net-patterned red clay 3.3 m thick. Cultural remains were identified at the bottom of this layer; 3) grayish white sandy clay with numerous weathered pebbles, less than 1 m thick. The sediment contained a large quantity of grayish white lacework gradually getting thinner from the north to the south; and 4) quartz sandstone of Devonian bedrock about 10 m thick. Our analysis suggested that the top two layers (layers 1–2) were probably eolian dust deposits. Layer 3 might be an alluvial flooding deposit. Layer 4 was fluviolacustrine sediment (Yang et al., 1991).
PEBBLE SEMICIRCLE

The most notable discovery is a large stone structure made of more than 1,100 pebbles (Fig. 3). This feature has a semicircular shape with a 10 m long east–west axis; the short axis is 6 m long. Over 100 stone artifacts were recovered; however, no faunal remains were found.

The opening of the pebble semicircle faces northeast. The western edge of the structure measures about 7.4 m long from the northern point to the extreme southern point and the eastern edge is about 3.3 m long. Inside the structure is an open space about 4.7-x-4 m², where no pebbles or artifacts were found. At least 1,167 individual pebbles were counted constituting the stone edge ring that is as wide as 2 m. The height of the stone ring varies, inclining from southwest to northeast along the long axis. It is assumed that the opening of semicircle was intended to face the river valley.

The stone ring was made primarily with a single layer of stones; only a few double layers of pebbles were found in some segments. One segment that was constructed with three layers of pebbles was identified in the excavation square C4.

The pebbles were principally composed of quartz sandstone and feldspar sandstone (85.5%). Others included quartzite (7.8%), siliceous (4.6%), and flint, vein quartz, and limestone (0.6%). The average pebble size was 81 mm long, 60 mm wide, and 39 mm thick. The percentages of sub-roundness, roundness, and super-roundness of the pebbles accounted for 44.1%, 36.4%, and 6.7%, respectively. Most pebbles showed no weathering (64.9%), while slightly weathered and heavily weathered pebbles accounted for 29.3% and 5.8%, respectively. These percentages implied that for the structure, the hominids at the Maozhushan site might have selected pebbles for raw materials that had a rounded, large size, and no weathered or slightly weathered pebbles.
SMALL PEBBLE CIRCLES

What is more interesting about this discovery is that twenty small pebble circles, ranging 20–30 cm in diameter, were found on the edge of the pebble semicircle. The outer edges of these small pebble circles were parts of the pebble ring structure, leaving a small hollow center. Most of the inner circles were regular in shape, and others irregular. Lithic artifacts were recovered from nine of the small circles (Fig. 4).

In the samples taken from two small circles

Fig. 3. Plan view of pebble semicircle at the Maozhushan site
(F9 and F20), we noticed that sediments within the features were the same texture and color as the sediments outside the small circles. No charcoal or faunal remains were found inside. These circles might have been the remains of post moulds but no direct evidence permitted us to point to this hypothesis. The samples of sediment taken from inside the circles were analyzed at the Structure Center of the University of Science and Technology of China, and the result suggested that the chemical composition of carbon, hydrogen, and nitrogen within the sediment had no great different from those outside circles. The function of these small pebble circles needs to be further investigated.

STONE ARTIFACTS
A total of 154 stone artifacts were recovered from the pebble semicircle at the Maozhushan
site. They were scattered evenly throughout the structure and no patterned clusters of lithic artifacts could be identified. Typologically, the lithic assemblage primarily consisted of chunks (31.9%), cores (24.7%), and flakes (19.5%). Tool types included scrapers, hammers, choppers, points, picks, spheroids, and drills (Figs. 5–6). Most of these tools were made on pebble cores, with only eleven pieces made on flakes (eight scrapers and three points). The sizes of the stone tools thus are relatively large, with average length, width, thickness at 82 mm, 69 mm, and 43 mm, respectively (Table 1).

The stone artifacts show generally similar characteristics with the pebbles of the semicircle in size, raw materials, and weathering condition. The raw materials for making these stone tools were primarily quartz sandstone and feldspar sandstone, followed by quartzite, quartz, chert, and the others. While the percentage of stone tools made of quartz sandstone and quartzite (70.1% and 13.6%) was higher than that of pebbles from the semicircle structure, feldspar sandstone was lower (5.2%). The degree of weathering displayed by the raw materials showed no great difference from that of the semicircle pebbles. This similarity may indicate that the raw materials for both lithic artifacts and semicircle pebbles might have been obtained from the same place, and that the pebbles might have been intentionally selected as raw material for tool production.

SITE FORMATION IN RELATION TO THE NATURE OF PEBBLE SEMICIRCLE

A portion of the pebble semicircle overlapped directly the gravel of layer 4, and thus we question whether the formation of this feature was the result of nature causes. We compared both the lithic artifacts and the semicircle pebbles to pebbles from two other sources: one source was the underlying gravel from Layer 4; and the other source was Terrace 2 (T2) gravel sediment of the Shuiyangjiang River near the southeastern hill slope of Maozhushan. The raw material types, degree of weathering, and degree of roundness suggest some difference and similarities.

Fifty-one samples randomly selected from the underlying gravel layer show that the average size of raw materials fall between that of the semicircle and T2 gravel pebbles. The raw material types were similar to the semicircle pebbles. It is also suggested that the degree of weathering was
heavier than that of the semicircle pebbles, but that the roundness was weaker. Secondly, samples of 45 pebbles from T2 gravel suggested that their average sizes were the smallest among the three compared groups. The difference was that 82.2% of pebbles from this group were quartz sandstone, and 17.8% are siliceous. The materials of this group displayed the heaviest roundness and light weathering.

In general, the average sizes of the semicir-
Lithic artifacts from the Maozhushan site

<table>
<thead>
<tr>
<th>Class</th>
<th>N</th>
<th>%</th>
<th>Mean length mm</th>
<th>Mean width mm</th>
<th>Mean thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>38</td>
<td>24.7</td>
<td>85</td>
<td>93</td>
<td>85</td>
</tr>
<tr>
<td>Flake</td>
<td>30</td>
<td>19.5</td>
<td>57</td>
<td>50</td>
<td>18</td>
</tr>
<tr>
<td>Chunk</td>
<td>49</td>
<td>31.9</td>
<td>80</td>
<td>55</td>
<td>26</td>
</tr>
<tr>
<td>Hammer</td>
<td>6</td>
<td>3.9</td>
<td>101</td>
<td>66</td>
<td>30</td>
</tr>
<tr>
<td>Chopper</td>
<td>10</td>
<td>6.5</td>
<td>138</td>
<td>120</td>
<td>51</td>
</tr>
<tr>
<td>Scraper</td>
<td>8</td>
<td>5.2</td>
<td>49</td>
<td>51</td>
<td>20</td>
</tr>
<tr>
<td>Point</td>
<td>3</td>
<td>1.9</td>
<td>60</td>
<td>36</td>
<td>18</td>
</tr>
<tr>
<td>Pick</td>
<td>5</td>
<td>3.2</td>
<td>170</td>
<td>110</td>
<td>72</td>
</tr>
<tr>
<td>Spheroids</td>
<td>4</td>
<td>2.6</td>
<td>77</td>
<td>67</td>
<td>57</td>
</tr>
<tr>
<td>Drill</td>
<td>1</td>
<td>0.6</td>
<td>40</td>
<td>30</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>154</td>
<td>100</td>
<td>82</td>
<td>69</td>
<td>43</td>
</tr>
</tbody>
</table>

Table 1

The measurements of the pebbles were largest. The measurements were closer to those of the pebbles from the underlying gravel than they were from the T2 gravel. The physical features of the raw material of the semicircle pebbles were also more similar to that of the underlying gravel than they were to the T2 gravel. However, the difference was the lower degree of weathering found in the semicircle pebbles than the underlying gravel, and the roundness was higher. It was suggested that the materials of the pebble semicircle might have been obtained from the underlying gravel.

The geomorphological study of the Shuiyangjiang River suggested that the net-patterned red clay was the result of a continuous process of eolian-dust accumulation (Fang et al., 1992; Li et al., 1997). Therefore the pebble semicircle from layer 2 could not have been formed by river alluvium or other natural dynamics.

In addition, the pebble semicircle was formed in regular geometric shapes with hollow centers and zigzag contour edges. The spaces between each pebble of the structure were filled with pure clay without granule gravel. Most portions of the edges were lined up with single layer of pebbles. The evidence suggested an intentional arrangement by a hominid.

During the 1997–1998 field seasons, we also surveyed the site by digging 22 1 m² test pits along with one 7-x-5 m excavation unit. Each test pit was 10–15 m apart. No more pebble structures or other features were found; neither were there found similar pebble clusters that were formed by natural causes. For this reason, we believe that hominids might have built the pebble semicircle for special purposes, but its function remains unknown at present.

DATE OF THE PEBBLE SEMICIRCLE

It is unfortunate that there were no faunal remains found in the pebble semicircle, which could have been sampled directly for ERS dating. However, we selected two samples from the middle section and bottom section of the net-patterned red clay layer, respectively, which encompassed the deposit of the structure, and one additional sample from the underlying layer (Fig. 2). The ESR dating results by the Structure Centre of University of Science and Technology of China suggested age ranges from about 420 Kyr, 631 Kyr and 665 Kyr, respectively (Table 2). Thus, the age of the pebble semicircular structure was estimated to be around 631 ka BP.

Furthermore, the Chenshan site, about 27 km northwest of Maozhushan, yielded a number of ESR dates. One sample taken from the middle–lower section of the same type of sediment as the red clay layer of Maozhushan had an age of 680 ka BP (Fang, 1997). Ten samples obtained
Pebble semicircle structure

Table 2

<table>
<thead>
<tr>
<th>Original number</th>
<th>Laboratory number</th>
<th>Layer</th>
<th>Depth cm</th>
<th>Age Kyr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NGD1A</td>
<td>middle section of Layer 2</td>
<td>200</td>
<td>420</td>
</tr>
<tr>
<td>2</td>
<td>30NGD2A</td>
<td>bottom section of Layer 2</td>
<td>250</td>
<td>631.2</td>
</tr>
<tr>
<td>3</td>
<td>NGD3A</td>
<td>upper section of Layer 4</td>
<td>330</td>
<td>664.9</td>
</tr>
</tbody>
</table>

from the top to the bottom of the sediment provided dates ranging between 126 and 817 ka BP (Yang et al., 1996). In addition, a few paleomagnetic dates from the gravel layer in the Lushan Mountain area (equivalent to the underlying gravel at the Maozhushan site) suggested the deposit beneath the structure is no older than 900 ka BP (Xing, 1989). Litho-stratigraphy in the study region indicated that layer 1 of the Maozhushan site is equivalent to the upper part of the Chenshan deposit, belonging to the late Middle Pleistocene. The Maozhushan layer 2, equivalent to the lower part of the Chenshan deposits, should fall between the late Lower Pleistocene and the early Middle Pleistocene.

SUMMARY

Thus far, the more than 20 Paleolithic localities recently identified in the Shuiyangjiang River Valley comprise the first Paleolithic settlement concentration in the lower reaches of the Yangtze River (Fang et al., 1992). These sites were found within a 1,500 km² area that included Chenshan, Guanshan, and Wulipeng (Fig. 1) – possible large open campsites. The discovery of the Maozhushan site in 1996 revealed an important open campsite of the Middle Pleistocene in the study region. The Lower Paleolithic structure at Maozhushan is the earliest structure created by an early hominin ever found in China.

We cannot clearly interpret the function of this structure based on the current evidence. However, it should be noted that most of the pebbles are suitable for tool making. All pebbles for the semicircle structure were collected and transported by early hominids. Cores, flakes, hammers, and chunks accounted for 80.6% of all stone artifacts, indicative of possible on-site tool manufacture.

Some small circles together with stone artifacts present in the ring of the pebble semicircle could be evidence of the use of post moulds and a possible implication of the earliest wooden shelter. However, there is lack of faunal remains and the organic component of the sediment is no different from those outside the circles. One possibility could be that, due to acid earth in the study region of southern China, organic materials decomposed completely. It is evident that most feldspar sandstone pebbles in situ have been weathered badly.

Some tools showed traces of possible use. Macro-edge damaged stone tools (n = 21), a possible sign of use, accounted for 13.6% of the entire lithic assemblage. Specimen 1005 from Pit J5 had a pointed edge, placed upright and inserted into the clay with the point downward when it was unearthed. Based on this evidence we suggest that the pebble semicircle might have been a seasonal living structure where tool making activities were conducted; however the specific function of this structure needs further investigation. Judging from the evidence, the Maozhushan site may have been a central campsite of the Shuiyangjiang River Paleolithic complex.

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