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The Hualong Cave upper Paleolithic site in Dongzhi County, Anhui

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Abstract

The Hualong Cave Site of Paleolithic Age in Dongzhi County, Anhui Province yielded rich animal fossils, bone implements bearing clear processing traces and use-wears, and more than 100 pieces of stone implements. On the animal fossils, the animal gnawing marks and artificial cutting traces were found together; the stone implement assemblages and the preservation features of the animal fossils implied that these animal bones were utilized by the human beings, but these human beings were not hunters but scavengers eating remnants of the preys left by the predator animals. The stone implements of Hualong Cave Site were mainly made of siliceous rock and the choppers took smaller proportion than scrapers, showing the characteristics of the lithic industry in the late Paleolithic Age.

Keywords: Bone implements; Hualong Cave Site (Dongzhi County, Anhui); lithics; stone implements; Upper Paleolithic Age

The excavation in 2006

Reported previously as the Meiyuan Hill Palaeolithic Site, the Hualong Cave Site is located at Pangwang Village in Dongzhi County, Anhui Province. It is situated at the foot of Shike Hill, about 4km from the Yangtze River to its northwest. The other sides of the site are surrounded by hills now covered by dense forest. In July through September 2006, the site was excavated by Anhui Provincial Institute of Cultural Relics and Archaeology. When the excavation of Hualong Cave was initiated, a grid of 91 units (13 by 7) each of which covers a square area of 1sq m was laid out along the slope. The team disclosed a total area of 37sq m, with more than 4.2m in depth. Each horizontal level was excavated with a depth of 20cm, and all artifacts and bone specimens were three-dimensionally plotted. It has an advantage to control spatial relationship with plotted data, even if the excavators could not accurately differentiate natural strata. Each unearthed lithic and bone specimen was packed with a Ziploc plastic bag to avoid damaging and confusing. These measures were helpful for the following researches.

The plan of excavated area and the distribution of stone and bone implements are shown in Figure 1, indicative of artifacts being scattered evenly throughout the excavated units. It shows there is clearly no central activity area; or that has not yet due to the excavated area is quite small. According to distribution of artifacts in depth, it seems that the original surface was an east-to-west bulge, the northwestern side slightly lower.

Within such limited area, there are a large number of animal bones uncovered, most of them are fragments. Among them, two human teeth and two skull pieces were identified in the field. These were later taken to the Institute of Paleoanthropology and Vertebrate Paleontology (IVPP), Chinese Academy of Sciences and examined by physical anthropologist, Mr. Wu Xinzhi. A vertebrate paleontologist, Mr. Jin Changzhu, identified 16 species of animals, which includes Chinese rhinoceros, Oriental Stegodon, brown bear, giant panda, wild boar, muntjac, deer, antelope, bovids, badger, turtle and others. All of species are common of the Late Pleistocene fauna of South China (here South China means the region to the south of Qinling Mountains–Huai River).

Stratigraphy

The Hualong Cave Site is located southeast of Yangtze River, only 4km away from the main stream. If there had no embankment built in recent years, the site would be very close to the margin of flooded area. About 10m down the site, there is a creek still used by villagers for water. Now the nearby hills are densely covered by growing forest. Bedrock could only be observed alongside a road to the hillside and in the creek bed. Only limestone and igneous rock had been spotted there. The bedrock

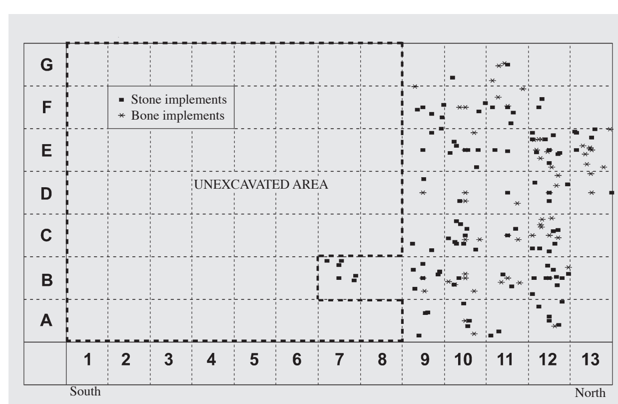

Figure 1 The scatter pattern of excavated area in Hualong Cave Site, showing the distributions of stone and bone implements.

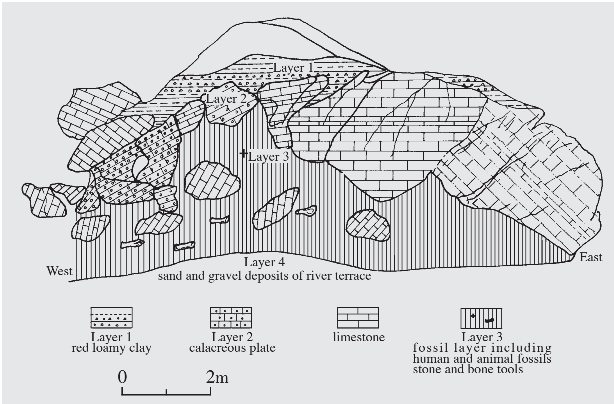

Figure 2 The stratigraphy of Hualong Cave Site.

of Hualong Cave Site consists of limestone, which is easily eroded, having formed into cave, crevice, funnel and similar karst landforms. As for the Hualong Cave Site, further investigations are still needed in order to determine whether it was a true cave or other forms. After excavation the site is no longer presented in form of a cave. Furthermore, in the fieldwork logs, there are no records mentioning stalagmite, stalactite and other features that are commonly seen in a karst cave. However, considering that animal bones are generally hard to be preserved because of the acid soil of South China, it is still reasonable to temporarily regard it as a cave (or rock shelter) or a crevice, where there are abundant remains of animal bones.

The excavators divided the strata of the entire site into four layers from the top (Figure 2):

Layer 1: Red loamy clay. It is red-yellowish in color, compact in soil texture, containing plant remains and limestone breccias, with a depth varied from 50 to 80cm.

Layer 2: Calcareous plate. Calcareous clement is very hard, glued on the limestone rocks, grayish-yellow, mixed with animal bones, with a depth from 75cm to 165cm.

Layer 3: Red-brown clay. It contains a large number of animal bones, human skull pieces and teeth and stone and bone implements. Parts of animal bones have gnawing marks and cut marks on the surface. This layer is also hard, with a depth from 125 to 175cm. Most of animal bones have similar inclination and dip angle. It implies that their positions could have been transformed by the water flow.

Layer 4: Sand and gravel deposits of river terrace with mud. It contains limestone breccias and few animal bones, depth unknown.

Stone implements

The lithic assemblage contains 119 artifacts, including 10 choppers (four of which are also cores), 18 scrapers, one burin, and six cores, the rest include complete flakes, broken flakes, and chunks. The raw materials consist of siliceous rock, quartz, limestone and igneous rock, the former two types of which are predominant in the assemblage. Siliceous rocks are mostly angular and blocky without rounding traces. In contrast, quartz materials come from gravels, which still remain clear natural cortex. It means that they might have different sources. Our preliminary investigation on raw materials shows there are only limestone and igneous rock near the site. Siliceous rock and quartz materials probably were brought into the site from somewhere else.

Current studies suggest lithic materials from the Hualong Cave Site are represented by pebble-core tool industry with appearance of flake tools in South China. Similar lithic industries appeared in areas, for instance, the upper layer of Jigongshan (Hubei), Yan'er Cave (Hunan), and the lower layer of Xianrendong (Jiangxi). The chopper and chopping tools discovered in Hualong Cave, however, are completely different from those typical choppers of South China, which are generally manufactured by pebble cores. The choppers found in Hualong Cave were made of siliceous blocks as raw materials, and they were acted on as cores from which sharp flakes were produced. This is a distinct feature of Hualong Cave's lithic assemblage. Scrapers have a predominant proportion in the assemblage, and most of them are also made of siliceous rocks. As far as these features are concerned, the lithic industry of Hualong Cave largely resembles the Upper Paleolithic industry of South China. Flakes lack intentional retouch on the edges. The edges used for chopping are natural sharp ridges of siliceous rock block, small flake scars are left after use (Figure 3).

Bone implements

Formal bone tools are conventionally regarded as a kind of behavior related to anatomically modern humans (AMH). In East Asia, they should be categorized as artificial products of Upper Paleolithic Age, or very close to that period, since AMH arrived there relatively later than in West Asia. However, the identification of bone implements has been highly debated, and it is still unresolved. Fortunately, formal bone implements are relatively easy to be recognized because of intentionally modified shape and clear evidence of artificial retouch or use-wear. There are 23 bone implements identified after reexamining the collection of bone implements. They can be classified into awl, scraper, point, chopper, and utilized bone flake (Figure 4). At least seven bone implements have apparent polish surfaces. One awl (specimen number, TC12 ③ :00054) shows very strong evidence of artificial modification. It remains at a length of 3.5cm, and width of 1.5cm. The whole surface is polished, and its tip has clear luster after a long-term use (Figure 4:1). Except this formally made awl, other six polished bone implements all use long bone splinters as raw materials. Few retouched scars on the implement are observed but polished surface not limited on the tip. This suggests that these bone implements could likely be expedient tools, without careful design and maintenance. Ethnographically, this kind of activity is often seen in hide processing. There is also a bone chopper, which is directly made on a part of limb bone, probably from a bovid animal. It shows a clear small flat surface after being impacted on repeatedly. Neither possesses evidence of retouched remains, possibly expediently used. We can assuredly say there are bone implements in the Hualong Cave Site. In our study, we raised a question about bone implements with several experts and colleagues, and we also observed the bone implements found in the Oriental Square Site (Beijing), Lingjing Site (Henan), Shiyu Site (Shanxi), Shuidonggou Locality 12 Site (Ningxia) and Xiaogushan Site (Liaoning). We found that it was easy to differentiate polished bone implements, which have polished or frictional surfaces, especially on the tip. We are mostly concerned retouched bone implements without indications of polish remains. This kind of bone implements from Hualong Cave Site generally possess an even and continuously retouched scars located on the bone's outer surface (e.g., Figure 4:5), and they also show evidence of intentional design to realize some tool functions. In this sense, bone implements of Hualong Cave have more reliable criteria in identifying them than those materials that we have observed.

Figure 3 Typical stone implements.
1. Siliceous chopper/core (TB10 ③ S:028); 2. Siliceous scraper (TA12 ③ S:117); 3. Quartz scraper (TE11 ③ S:033); 4. Siliceous scraper (TC10 ③ S:101); 5. Quartz scraper (TD9 ③ S:098).

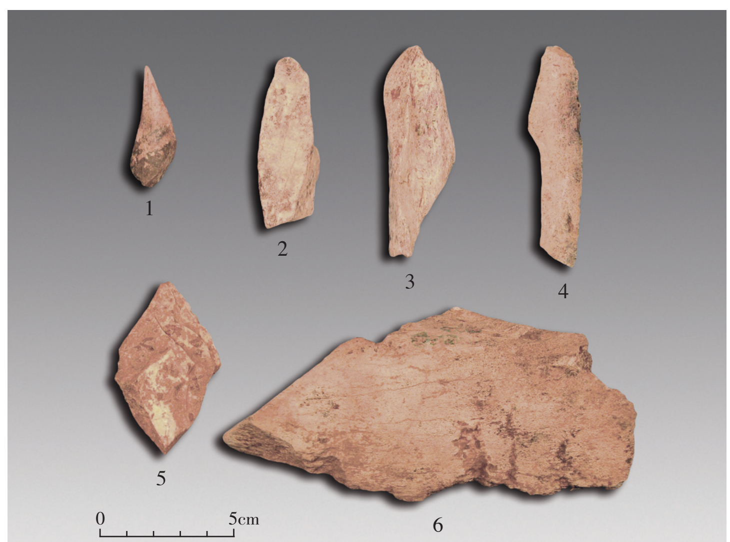

Figure 4 The bone implements of Hualong Cave.
1. Awl (TC12 ③ :00054); 2. Scraper (number unknown, from TB11); 3. Scraper (TE10 ③ :01552); 4. Flake (TE12 ③ :01059); 5. Point (TA10 ③ :00029); 6. Point (TB10 ③ :00106).

Faunal remains

The most intriguing aspect about the Hualong Cave Site is rich faunal remains. Their relationship with human behavior must be clarified. That is, did they all come from human hunting? Who were the scavengers, human beings or carnivores? There are ten boxes of bone specimens, each box about 10kg. Most of bone specimens are unidentifiable splinters, more than 50,000 pieces roughly counted. There are 895 identifiable limb ends among them, other specimens including 2466 pieces of limb shaft, 491 pieces of skull and vertebra, and 221 teeth. In the identifiable specimens, most of them come from bovid, then deer. Other animals such as stegodon, rhino, tapir, bear, wild boar, tiger and some small carnivores can only be witnessed in their teeth. As for the extent of preservation, the bone parts of bovid and deer are relatively complete, the whole body bones from skull to toe were all found.

In general, carnivores and rodents habitually collect and gnaw bones, and even some artiodactyls occasionally have that behavior. Except the well-known hyenas, porcupine and wolf are the candidates for bone collection and gnawing marks. In the specimens found at the Hualong Cave Site, we counted 121 pieces of bones with gnawing marks. The difference between animal tooth marks and cut marks in butchering is not so easy to tell as some textbooks say, especially when bones had been weathered on the ground and transformed in various processes of deposit. Shipman (1981) summarized the differences between animal tooth marks and cut marks under a scanning electronic microscope. Tool marks show many parallel striations within a main groove, because the cutting edges are usually irregular. In contrast, tooth marks often show no fine marks within main groove, but there are sometimes small perpendicular ridges produced by the "chattering" of the teeth across the surface as the animal applied force. Another difficulty is to differentiate tooth marks from chopping marks left by choppers or other chopping tools. Our chopping experiment on fresh cattle limb bones suggests that chopping marks are more often strip-like, sometimes with sharp notches produced by the edges. In the specimens of Hualong Cave, the feature shown on bone surfaces is spot-like, frequently perforated through bones.

The field observations from zooarchaeologists suggest that carnivores tend to chew particular skeletal elements, including the neural spines of vertebrae and the angles of mandibles because of the hematopoietic tissues in these bone parts. For the same reason, they also prefer the ends of long bones, scapular blades, and ilia. Interestingly, Brain (1980) found that the carpals and tarsals of primates can be completely devoured, but the same portions of bovids bear have very little meat that result in carnivores often leave them intact. Other researchers noted that ribs may be cracked into small splinters, with only a few inches of each rib close to the vertebra column escaping destruction (Hill 1980). The discovery from the Hualong Cave Site is quite consistent with these observations. Although there are 82 identifiable bovid ribs found, they are severely damaged. In a sharp contrast, the bovid carpals and tarsals are almost all intact. The tooth marks and damage pattern of bones clearly prove that the bone materials had been scavenged by carnivores.

Moreover, three pieces of bone specimens show evidence of trampling by large animals or squeezing under the strata. For instance, one of them is the third tarsal of a bovid animal, on which there is an evident pit with the size of a quarter, and bone surface was not lost yet. Trampling may also lead to some marks resemble artificial cut marks.

Bones excavated from the Hualong Cave Site show very diverse weathering degrees, some fresh, some loose and crisp. The specimens with tooth marks are more strongly weathered. It could possibly mean that only parts of the animal body were exposed on the ground for scavenging by carnivores, and the rest might not have been brought into the site or have been tore away by other carnivores. There is another reason that the deposit of bone remains found in the Hualong Cave Site experienced a long-term and repeated use by carnivores. The site is located in the foot of a hill and near a creek, so it is easy to deposit sediments from slope wash and diluvial processes in the site, and then some bone specimens were buried earlier than other, resulting to different weathering degrees.

Part of the bone specimens look black, seemingly burnt, but the strength of these bones shows no difference from other non-black bones. To clarify this question, we did experiments in which we bought cattle limb bones and burnt them for different time lengths. We found that the bone would break easily after they had been burnt for seven minutes. This indicates that the burnt bones become crisper. The inner parts of bones were still fresh, although black carbonized layer appeared on the bone surfaces. The pattern of breakage is a jigsaw-shaped, whereas the fracture of fresh bones is smooth. When the burning time doubled, it was much easier to crash the bones. The bone surfaces became drier and had crackles, the carbonized layer thickened. After an hour of burning, the bones turned to be gray-white and can be easily mashed. The results of the experiments are not in accord with the black bones found in the Hualong Cave Site, which presumably related with the metallic pollution from underground water.

Human behavior and the site

Stiner and Kuhn (1992) presented several trends between human scavenging and hunting based on the research of the Middle Paleolithic in west-central Italy (Table 1). No doubt human beings could practice both, since there is no reason even for modern hunter-gatherers to reject any good chance of scavenging animal carcasses that are still edible. Moreover, both of activities could take place in the same site, that is, ancient people hunted and butchered their prey here, and sometimes just scavenged. These activities overlapped with each other; as a result, archaeologists would find highly mixed assemblages, not only in faunal remains, but also in lithic artifacts. This question could get more complicated if other animals, for instance, carnivores, also occasionally occupied the site and contributed bones and marks to faunal remains. The data from the Hualong Cave Site show some interesting patterns about the relationships over human hunting, scavenging and carnivore intruding.

Considering different lithic traditions existed in Europe and East Asia, it is not suitable to fully use lithic assemblage to differentiate activities involved in human hunting from scavenging. Faunal remains are a more preferable proxy to reflect differences between the two activities. The faunal materials from the Hualong Cave Site is a typically species-dominated assemblage, in which bovid bones have the proportion of more than 90%, and their representation of body parts is the most sufficient. Counted according to the third tarsal, there are at least three individuals (12 pieces in total) of bovid animals. Relatively, the representation of other animals is fragmentary. This bovid-dominated faunal assemblage can reasonably relate to human hunting. As a kill site, Hualong Cave had been repeatedly used by ancient hunters, so there are abundant bovid bone remains left exclusively by these hunters.

Quite a few cutting and chopping marks are found on some bones (31 pieces counted). Here chopping marks have clearer characteristics that can be differentiated from tooth marks of carnivores. But cut marks are not so easy to be identified, since abrasions on hard objects during the process of burial and excavation could also

Table 1 Differences in bone remains and lithic artifacts between scavenging and hunting.

	Animal bones	Lithic artifacts
Scavenging	1. Incomplete anatomical bone parts; 2. Relatively less preservation of limb bones; 3. Possibly transport head back to shelter.	1. More non-local raw materials; 2. More retouched tools; 3. Using blanks of stone tools; 4. More centripetal flaking, larger flakes.
Hunting	1. Bone parts more complete; 2. More limb bones.	1. More local raw materials; 2. Less retouched tools; 3. More platform flaking, smaller flakes.

lead to V-shaped cutting notches that are very similar to cut marks. Fortunately, the cut marks of Hualong Cave are not randomly scattered on the bones, but they distribute more frequently near the ends of long bones, and usually only one or two marks are found on one bone specimen. According to Lupo (1994), normal butchering of dead animal when their bodies are still warm would hardly leave evidence of cutting and chopping marks, but things are going to be different when animal carcasses turn to be stiffened. Delayed processing of dead bodies is one of major factors that could form artificial marks on bones, same as scavenging. Generally, hunters will not intentionally delay the butchering of their preys, so delayed processing should be more related with encountering dead animals, or driving away carnivore and getting their preys. Both actions in a broad sense are still scavenging behavior. Although ethnographic data like the Hadza hunters present some information that the butchering preys could be delayed for many reasons, there is still high probability that the ancient hunters scavenged in Hualong Cave.

Additional evidence comes from tooth marks on bone artifacts, indicating that carnivores did scavenge the bones. The question is which agent, carnivores or human beings, first utilized the bones. We did an experiment to examine the two possibilities. We bought some fresh cattle limb bones, and chopped them to get bone pieces similar to the raw materials of bone artifacts. An interesting point is that fresh limb bones are still covered by a layer of fascia and the surface is very greasy, hard for handling, although they have been defleshed. Because of the buffering effect of fascia, it is difficult to produce large bone fragments as the size of bone implements found in the site. For instance, when car windows break, they shatter into little pieces, never large ones. However, if the layer of fascia was decayed into the air, and greasy surface became clean, the bones are quite suitable for bone implement making. As we saw in the field, these bones are the best choice to tool makers if only they are not weathered so long to damage their strength. Therefore, it is reasonable to infer that carnivores were the first agent to crash the bones, and then human tool makers picked those large bone pieces, on which fascia and grease had been decayed but still strong enough for tool making. If the sequence is reversed, that is, human first, then carnivores, it would be hardly believable that carnivores could get any useful nutrients from a discarded bone tool.

In the experiment, we also found that fatty marrow retrieved from the limb bones was like a strip of soft dough, but not in a liquid form. We threw it to a dog nearby, but the animal did not seem to like the raw food. We went on to burn the limb bones, as above-mentioned, and the bones were much easier to break open after seven or eight minutes of burning. Then we threw several strips of marrow to the dog again. The dog devoured them quickly although they were still very hot. This observation seems to suggest that ancient people should burn the bones for a few minutes if they wanted to break open bones easily and got more tasty fatty marrow. Unfortunately, the black color of bones in Hualong Cave probably did not result from burning as the experiment indicated.

Although carnivores might have been the first to come in contact with the bones that were made into bone implements, it does not mean that the bovid-dominated faunal assemblage was all transported by carnivores. In fact, human hunters could have played a more important role in the deposit of bones, and they could also be scavengers who processed stiffened animal carcasses. Meanwhile, carnivores haunted nearby and sometimes dwelled in the site, and left tooth marks on the dismembered skeletons. Then, human group came back and scavenged the bones gnawed by carnivores to make bone implements, while the fascia and grease on the bones had been cleaned by microorganisms. This plausible scheme explains features in the faunal assemblages, including the marks left by animals and humans on the same bone implement. Finally, the lithic assemblage has a mixed collection of features represented hunting and scavenging. Both local and non-local raw materials were used, and retouched scrapers were accompanied with choppers made by siliceous rock nodule with few significant modifications.

Discussion about the date

The Hualong Cave Site was dated using the U-series method, but it is not published yet. The main reason is that the material used for dating came from calcite attached to the rock by the cultural layer. This date is earlier than 200kaBP. Obviously, it is not consistent with the faunal assemblage in which no extinctive species have been found. And the bovid-dominated faunal is related with big-game hunting, which is generally a phenomenon of the late Pleistocene. In Hualong Cave, tip-polished awl was discovered with other finely retouched bone tools. Formal bone tools have never been found earlier than the Upper Paleolithic in China. Furthermore, half of raw materials of lithic artifacts in Hualong Cave are from siliceous rocks that probably came from somewhere outside the site. This is a very typical characteristic of the Upper Paleolithic in South China. The chopper and chopping tools dominated the early Paleolithic period are not found there at all. The so-called choppers unearthed from the Hualong Cave Site are produced from the siliceous rock nodules with very few modifications. In short, current evidence all supports that Hualong Cave is an Upper Paleolithic site, most likely, an early Upper Paleolithic site, since the late Upper Paleolithic sites of South China generally do not have big-game faunal assemblage and the lithic artifacts are better produced.

Summary and conclusions

Hualong Cave is a Paleolithic cave site with abundant lithic artifacts, but it presents an excellent case that shows a cycle among human hunting, scavenging and carnivore dwelling. This site seems to have multiple functions to the ancient hunter-gatherers. Here they might hunt bovid animals and butcher them, and they also possibly scavenged some animal carcasses so that they left cut marks on the bones. Following the occupation of humans in the site, carnivores did ever stay there, and scavenged the animal skeletons. Not only carnivores left tooth marks on some bone specimens, but also cracked the limb bones into large bone fragments, which became raw materials for bone implements when human group returned to the site. This cycle of occupational history in Hualong Cave manifests that the utilization of site by humans is quite flexible. They made full use of the opportunities in food foraging and exploited raw materials for tool making, although they could generally tend to hunt big games. The faunal assemblage at the Hualong Cave Site is fully bovid-dominated, and the behavior of big-game hunting is similar to what is found in the late Pleistocene epoch. The appearance of formal bone implements and the composition of raw materials in lithic production show a predominant feature of the Upper Paleolithic in South China. In the current chronological framework of this region, the date of the Hualong Cave Site would most likely be set in the early stage of Upper Paleolithic.

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Postscript

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