



# A preliminary study on human behavior and lithic function at the Wulanmulun site, Inner Mongolia, China



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## ABSTRACT

The Wulanmulun site, located in southwestern Inner Mongolia (China), is an important Paleolithic discovery in the Ordos Plateau in addition to the sites of Salawusu and Shuidonggou. About 4200 stone artifacts, 3400 fossils, and abundant hunting evidence of hominid were uncovered in 2010. In order to explore stone tool function and human behavior at Wulanmulun during the Middle to Late Pleistocene, we have selected 140 specimens excavated from Locality 1 of Wulanmulun in 2010 for use-wear analysis. The results suggest that 58 specimens retain evidence of use-wear, accounting for 41.4% of the observed samples. Many stone artifacts display use wear, and several show wear from hafting. The working motion was dominated by defleshing and slicing, and the main contact materials were animal substances. Animal processing might have been one of the main working tasks at Locality 1 of Wulanmulun, as numerous animal bone fragments with obvious cut marks and burnt bones were also found *in situ*.

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## 1. Introduction

For archaeologists and anthropologists, human evolution refers to physiological and cognitive development, changes in social behavior, and changes in subsistence strategies. Understanding past behaviors contributes to our knowledge of human evolution. Stone tools, including tools and weapons, are known as a good primary source of information that indicates the development of intelligence, technology, information and adaptability of prehistoric occupants. Due to greater risks caused by the physical conditions in prehistory, hunter-gatherers had to adopt different strategies to cope with climate fluctuations, environmental changes, and constraints on available resources in different areas. In accordance with the concept of *chaîne opératoire* (Schiffer, 1972; Sellet, 1993), every step of the life of stone artifacts including material procurement, manufacture, use, repair, and waste is closely related to “function”. Understanding the function and purpose of different tool-kits helps us to interpret adaptive behaviors related to human economy and social changes in prehistory. Currently, the

functional study of stone tools can be conducted along several paths: a) We can suggest that the function and design of tools can be inferred in terms of their morphological and technical characteristics by typological or technical-typological analyses; b) Ethnological studies can provide suggestions for the use of various tools; c) The most appropriate or possible function of tools can be suggested through experimental archaeology; d) According to the coexistence of different kinds of evidence, the function of the tool-kit can be understood by its context; and e) Use-wear and residue analysis can provide direct evidence for tool usage.

The Wulanmulun site (39°35.152' N, 109°45.659' E), on the left bank of the Wulanmulun River in Ordos, Inner Mongolia, in North China, was discovered in May 2010 by local people. It is considered as another new important discovery of prehistoric culture in Ordos region after the sites of Salawusu (Sjaraosso-gol) (Boule et al., 1928) and Shuidonggou (Teilhard and Licent, 1924) were discovered by the French in 1922 in the neighboring Ningxia Province (Hou et al., 2012; Wang et al., 2012).

The first trial excavation was carried out at Locality 1 by the Ordos Antiquity & Archaeology Institution and soon with the Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences afterwards. The main part of deposition, with a depth of about 5–8 m, can be divided into eight layers, in which seven archaeological layers are recognized according to their

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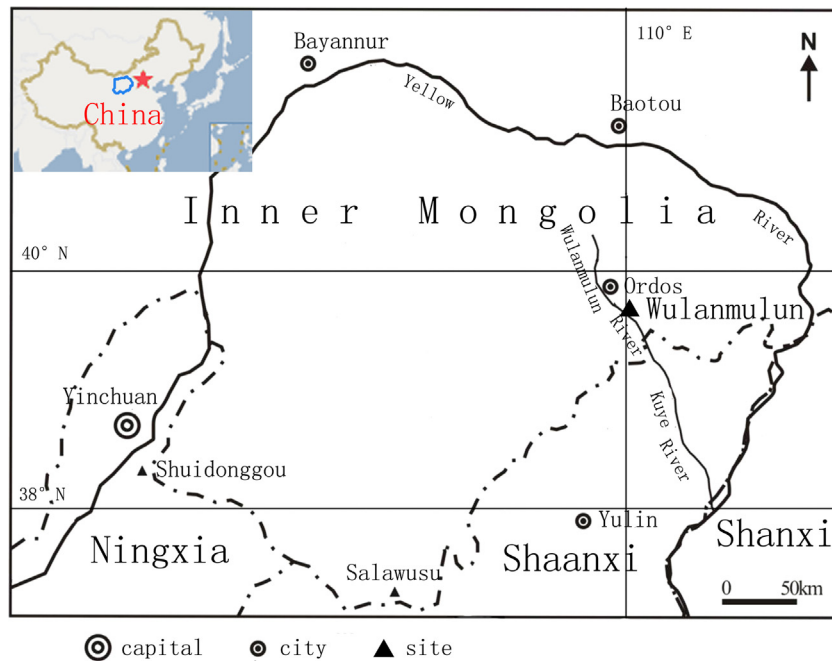


Fig. 1. Location of the Wulanmulun site.

geological context, the mammalian fauna, and stone artifacts (Fig. 1).

More than 1500 stone artifacts were recovered and include various types of cores, flakes, and flake tools. As a whole, the lithic assemblage is the product of a core and flake technology. Single platform cores are very common. Used flakes were obviously needed with longer and rather straight edges that were accompanied by natural or steep backs. Prepared platforms can be observed on few flakes. There was abundant debris produced by flaking cores or retouching. Retouched pieces are mostly made on flakes. There are different types of scrapers with concave, convex, straight, and concave–convex working edges. Denticulates and notches were very much in evidence and can be divided into subtypes. Borers, drills, and various types of points were frequent, and there were some end-scrapers, becs, and burins. Many of these tools could have served more than one purpose (Hou et al., 2012).

A total of 1213 pieces of mammalian bones were obtained from seven archaeological layers. Based on the numbers of fossil specimens, *Coelodonta antiquitatis* are the most numerous species, followed by *Equus przewalskii* and *Megaloceros ordosianus*. Judging by the condition of deciduous and permanent teeth, juvenile *C. antiquitatis* are more numerous than adult ones. The other taxa are mostly dominated by adult specimens or difficult to judge due to the fragmentary and insufficient state of the specimens. The Wulanmulun fauna evidently belongs to the *Megaloceros ordosianus-E. przewalskii* fauna i.e. the Salawusu fauna.

Fossils were preserved in a fragmentary condition from parts of teeth, ribs, crania, mandibles, scapulae, vertebrae, and limb bones. Bone tools such as scrapers, points and knives were often made from large mammal limb bones. Cut marks on bones were common and indicate meat consumption. Burnt bones were rare but indicate cooking.

The dating results were given as 70–30 ka by primary OSL and  $^{14}\text{C}$  in an earlier report (Hou et al., 2012; Wang et al., 2012). Analysis of sedimentation proves that the site was in a lacustrine situation, but the climate deteriorated into dry desert and no further human activity happened in the final Pleistocene.

The Institute of Zoology, Chinese Academy of Sciences, has identified the ~1000 mollusks collected in the cultural strata. The results show that most molluscs are aquatic gastropods; there are few terrestrial gastropods and bivalves. According to the paleoecology shown by the fossils, we can deduce that the precipitation of Wulanmulun was high, and the environment may have been a warm temperate forest–steppe in the late Pleistocene (Li and Yuan, 2013).

Since 2011, excavations and regional archaeological surveys have been carried out annually. Forty eight Paleolithic localities with stone artifacts and faunal remains have been discovered within the 40 km drainage basin of the West Wulanmulun River (ATWS, 2013). Up to the end of 2012, more than 13,000 stone artifacts, 15,000 fossils mammal and abundant evidence of hominid use of fire were excavated from Localities 1 and 2. An overwhelming majority of the stone raw material is locally available quartzite.

## 2. Analytical methods and materials

Use-wear analysis was developed to infer tool function on the basis of microscopic traces of wear left on its edge or surface. Since the translation of Semenov's (1964) *Prehistoric Technology*, use-wear analysis has become a principal method for inferring the functions of stone tools in Europe and North America. There are two major techniques for lithic use-wear analysis: the high-power (100–400 $\times$ ) and the low-power technique (5–200 $\times$ ). The former concentrates on the formation and distribution of use polish at relatively high magnifications under either incident light microscopes or scanning electron microscopes (Keeley, 1980), while the latter focuses on traces of edge-damage, microscopic fracturing and abrasion visible at relatively low magnifications under reflective-light stereoscopic microscopes (Tringham et al., 1974; Odell, 1980). After decades of experiments and practices, it has been shown that each use-wear technique has its own particular advantages and weaknesses (Shea, 1987). Because of its convenience, the low-power technique has been employed in several studies in

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