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Spatial distribution of Paleolithic sites in Bose Basin, Guangxi, China

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ABSTRACT

The Paleolithic stone tool industry from the Bose Basin (Guangxi, China) is best known for the presence of Acheulean-like bifacially and unifacially-worked handaxes found in the same horizon with tektites dated to 803,000 BP. One point that is often not included in discussion of the Bose lithics is the variability in the distribution of sites and artifacts across the basin. This paper reports the results of an analysis of the spatial distribution of the lithics and sites in the Bose Basin based on a multidisciplinary approach utilizing geomorphological observations, Geographic Information Systems, remote sensing, and computer graphics. Analyses include data collected during a comprehensive systematic archaeological field survey conducted in the basin between 2009 and 2010. The results indicate that the density of sites and stone artifacts per site decrease when moving from the northwest to the southeast. Perhaps the most interesting finding is that the handaxes are concentrated in only certain areas of the basin, a pattern similar to the typical western Old World Acheulean, rather than the Oldowan, where the artifact types appear to be more evenly distributed.

1. Introduction

The Bose (Baise) Basin, situated in western Guangxi Zhuang Autonomous Region in southern China (23°33′–24°18′N, 106°07′–106°56′E), is about 800 km^2 (~80 km in length and ~15 km in width). Paleolithic artifacts were originally discovered in the basin in 1973, when a petroleum research team surveying in the northwest area of the basin accidently discovered a dozen stone artifacts in what came to be known as the Shangsong site (Li and You, 1975). Between 1982 and 1988, about 50 sites were found and thousands of stone artifacts were surface collected by local Guangxi museums. Between 1988 and 2000, an international research team carried out a systematic multidisciplinary study of the geology, archaeology and chronology of many of these sites. As a result of these field investigations, it was determined that some stone artifacts and tektites were excavated *in situ* from the fourth terrace [seven terraces exist in the basin (see Hou et al., 2000; Wang et al., n.d.)]. The associated tektites were dated to 803,000 BP (Guo et al., 1996; Hou et al., 2000).

The reason why the Bose Basin Paleolithic stone artifacts came to the attention of the international scientific community is the presence of bifacially worked handaxes (Huang, 1990; Yuan et al., 1999; Hou et al., 2000), the representative stone tool type of the typical western Old World Acheulean lithic industry. The importance of handaxes east of the Movius Line (Movius, 1949) could not be overstated (for recent discussion see Corvinus, 2004; Wang, 2005; Norton et al., 2006; Lycett, 2007; Norton and Bae, 2009; Petraglia and Shipton, 2009; Lycett and Bae, 2010; Lycett and Norton, 2010; Mishra et al., 2010; Simanjuntak et al., 2010; Wang et al., n.d.). Although the findings of the Bose Basin handaxes called into question the validity of the Movius Line, two questions were quickly raised. First, at the time of the Hou et al. (2000) publication, all of the handaxes from the basin were in fact surface collected with weak stratigraphic association. Second, it was suggested that the tektites found throughout the region were probably redeposited and thus the age may not be reliable (Koeberl and Glass, 2000). Nevertheless, more recent excavations at the Fengshudao site (Zhang et al., 2010; Wang et al., n.d.) and the Damei site (Wang et al., 2008), both located in the Bose Basin, resulted in the discovery of *in situ* handaxes found in association with tektites. Thus, the isotopic age of the tektites can precisely calibrate the age of the Bose artifacts (see Wang et al., n.d. for more detailed discussion).

In order to better understand the distribution of sites and artifacts across the basin, a systematic investigation was conducted from May 2009 to July 2010. This fieldwork and computer analysis

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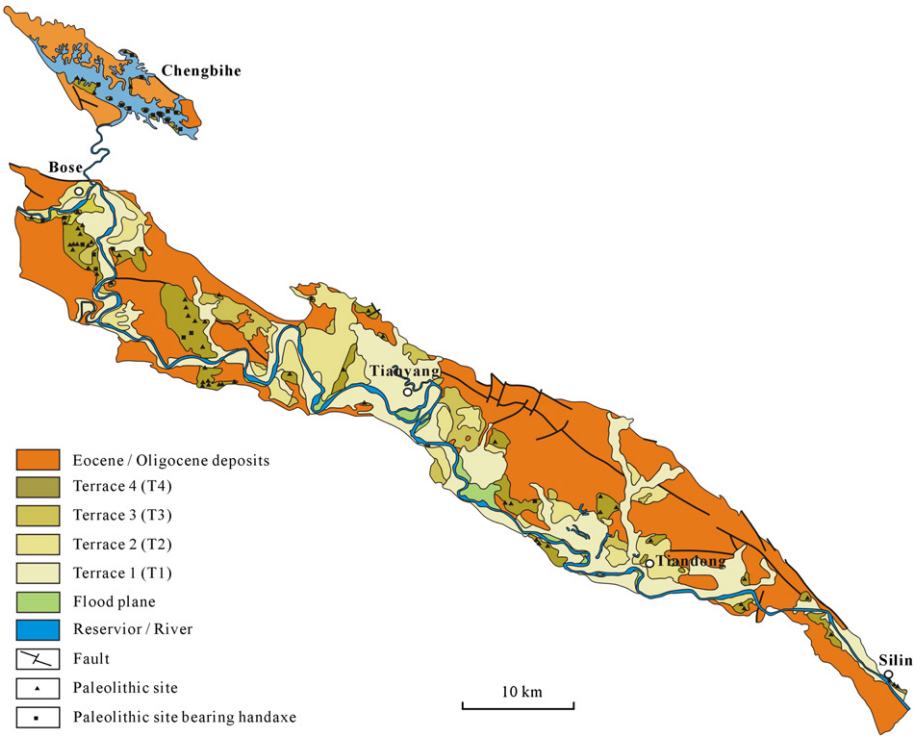

Fig. 1. The geomorphology and site distribution of Paleolithic sites in the Bose Basin.

resulted in the most comprehensive understanding of the variability in Paleolithic spatial distributions in the basin. This study includes data accumulated from 114 localities that were previously known and recently identified during these more recent field surveys (see also Huang et al., 2012).

2. Methods

In order to investigate spatial variability in archaeological contexts, a current popular method is Geographic Information System (GIS) technology (Lock and Stancic, 1995; Wheatley and

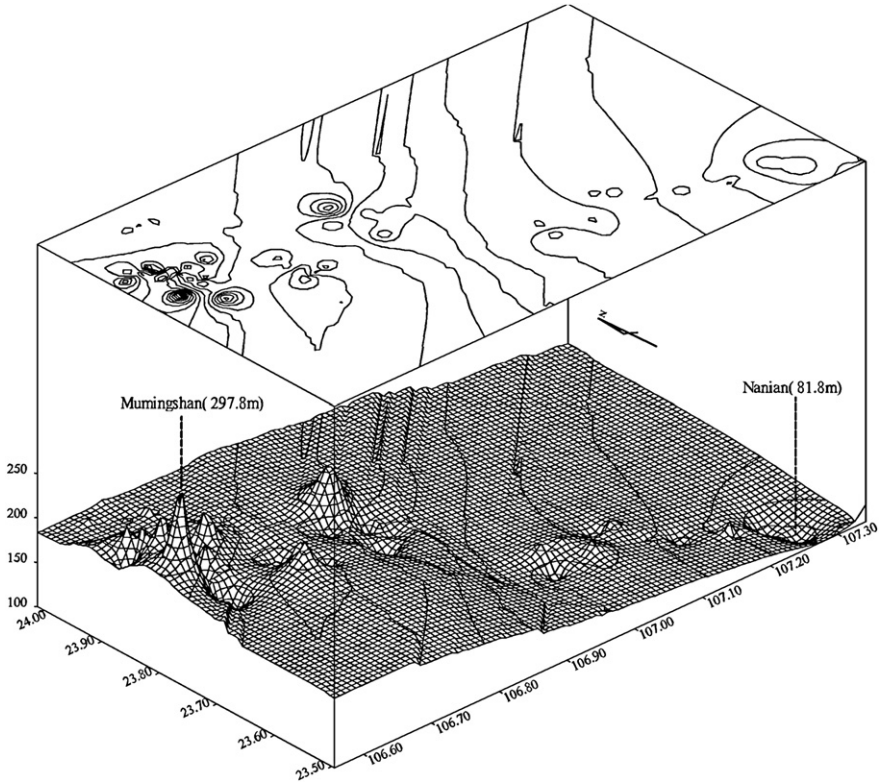

Fig. 2. DEM and overlapped isoline map of Bose Basin Paleolithic sites.

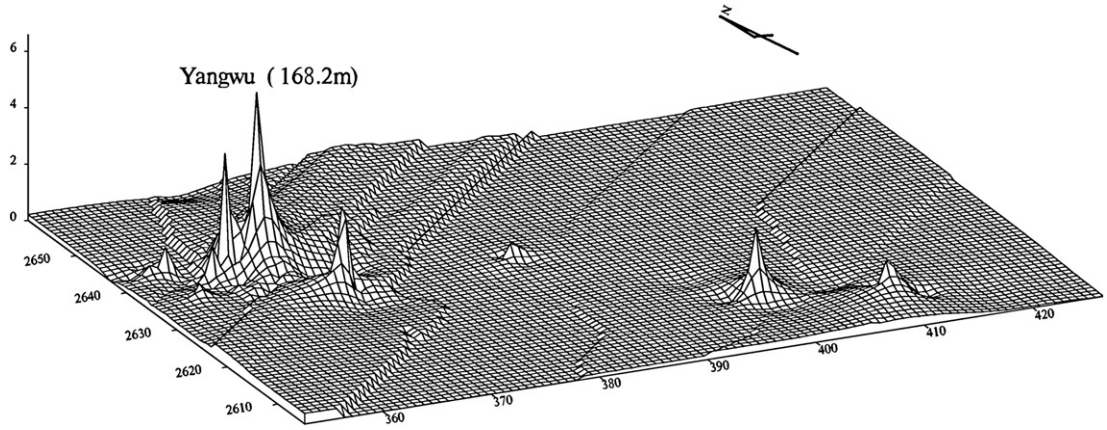

Fig. 3. DEM of handaxe distribution in the Chengbihe area.

Gillings, 2002; Connelly and Lake, 2006; Mehrer and Wescott, 2006). Studies often concentrate on the expression of planar figures in association with spatial analysis, application of Quaternary environmental modeling and simulation, and digital elevation models (DEM) of lacustrine formation. This study combines observations of the geomorphology, GIS and remote sensing (RS), utilizing three dimensional digital mapping, to better understand the variability in the spatial distribution of sites and stone artifacts in the basin, particularly in the context of the geological composition of the basin itself.

The extracting of spatial information on the site and artifact distribution variability is based on vectorization of a map produced by the Regional Geographical Survey of the Bose-Tiandong area based on a 1 to 200,000 longitude-latitude frame, using the basic element oriented information extraction system in Map GIS-RSP (Liu and Luo, 2004; Xu and Wei, 2005), image elements from high-resolution SPOT5 satellite imagery by multi-scale segmentation, and fractal net evolution approaches. This data extraction was complemented by direct visual interpretation and geological investigations by the authors. Coordinates of Paleolithic sites and artifact distributions were projected onto the geological maps by data conversion, projection conversion and comprehensive mapping (Lin and Tang, 2001; Chen et al., 2008). A spatial database of the elevations and handaxe quantities were set by GPS data input, utilizing GIS spatial analysis tools, establishing a triangulated digital terrain model (DTM), and then plotting an overlapped map of DEM of Paleolithic site and artifact distributions along elevation isolines. The triangulated DTM was generated using quantitative information on handaxe distribution in the Chengbihe ("he" = "river") portion of the Bose Basin.

3. Results

3.1. Geomorphology and distribution of Paleolithic sites and artifacts

Controlled by the Youjiang fault, the Bose Basin is long and narrow, and developed along the Youjiang River in a northwest to southeast direction. The northwest Bose Basin is formed of Triassic sandstone, represented primarily by low-lying hills. The Chengbihe has formed a separate gorge in this region. The southeast part of the basin is comprised of Paleozoic limestone, karstic forest, depressions and well-developed valleys. The Bose Basin is infilled by Eocene sandstone and mudstone intercalated with coal and petroleum layers, up to thousands of meters thick in some areas. After a long period of erosion, a series of thick fluvial sediments, consisting of an upper unit of sandy clay and a lower unit of conglomerates, were deposited in the basin. Later, this floodplain was uplifted to form a series of terraces; each was formed separately, one after another, but with similar sedimentary characteristics. Paleolithic stone artifacts are broadly distributed across the fourth terrace, and Neolithic artifacts are preserved on the first terrace. At present, there is no evidence of hominin activity on the second and third terraces (Fig. 1).

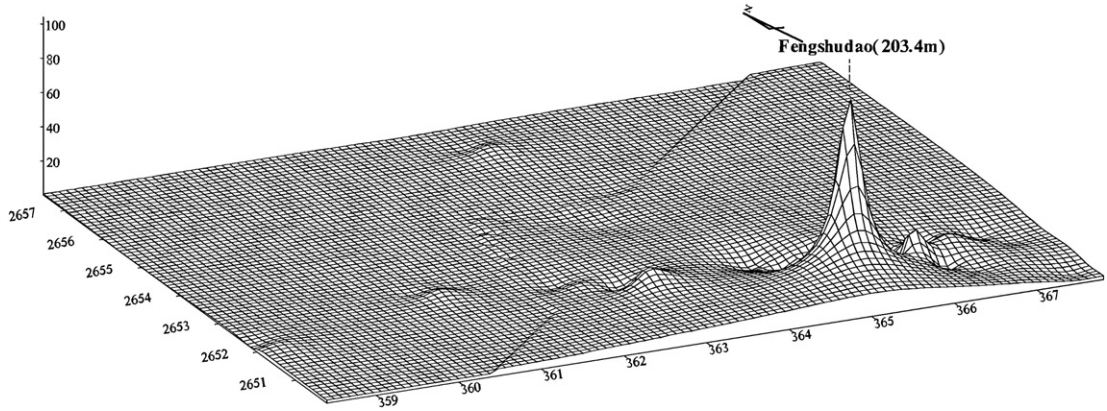

Fig. 4. DEM of handaxe distribution in the Youjiang valley.

3.2. Spatial distribution of Paleolithic sites

A total of 114 Paleolithic sites have been identified in the basin, situated at an average elevation of 149.2 m above sea level (m asl) (Fig. 2). Twenty-one sites are located in the Chengbihe region, with an average elevation of 181.1 m asl. Forty-three localities are distributed in the Bose area, with an average elevation of 185.1 m asl. Eighteen sites were identified in the Tianyang district, with an average elevation of 168.1 m asl. Thirty localities are distributed in the Tiandong area, situated at an average elevation of 120.8 m asl.

3.3. Spatial distribution of handaxes

Handaxes are present throughout the entire basin (Figs. 3 and 4). However, their spatial distribution is biased toward the Chengbihe area (northwest region), decreasing in frequency as one moves from the northwest to the southeast. One possible explanation for this pattern is that the large cobbles utilized to manufacture the handaxes were more readily available in the northwest.

4. Conclusion

Inside the Bose Basin densities of sites and quantities of stone artifacts tend to decrease when moving from northwest to southeast (see also Huang et al., 2012). Perhaps the most interesting finding here is that the handaxes are concentrated in only certain areas of the basin, a pattern similar to the western Old World Acheulean, rather than the Oldowan, where the artifact types appear to be more evenly distributed (Hay, 1976; Potts et al., 1999). The variability in site and artifact distributions in the Bose Paleolithic is a key point not recognized in earlier studies (e.g., Hou et al., 2000). The current study (see also Huang et al., 2012) shows fairly clearly that the Paleolithic in the region is not spatially uniform. Moving forward, it would not be too surprising if future studies reveal that the Bose Paleolithic is not temporally uniform as well.

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