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Metric and geometric morphometric analysis of new hominin fossils from Maba (Guangdong, China)

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ABSTRACT

We present an analysis of a set of previously unreported hominin fossils from Maba (Guangdong, China), a cave site that is best known for the presence of a partial hominin cranium currently assigned as mid-Pleistocene *Homo* and that has been traditionally dated to around the Middle-Late Pleistocene transition. A more recent set of Uranium series dates indicate that the Maba travertine may date to >237 ka (thousands of years ago), as opposed to the original U-series date, which placed Maba at 135–129 ka. The fossils under study include five upper first and second molars and a partial left mandible with a socketed m3, all recovered from different parts of the site than the cranium or the dated sediments. The results of our metric and 2D geometric morphometric ('GM') study suggest that the upper first molars are likely from modern humans, suggesting a more recent origin. The upper second molars align more closely with modern humans, though the minimum spanning tree from the 2D GM analysis also connects Maba to *Homo neanderthalensis*. The patterning in the M2s is not as clear as with the M1s. The m3 and partial mandible are morphometrically intermediate between Holocene modern humans and older *Homo sapiens*. However, a minimum spanning tree indicates that both the partial mandible and m3 align most closely with Holocene modern humans, and they also may be substantially younger than the cranium. Because questions exist regarding the context and the relationship of the dated travertine with the hominin fossils, we suggest caution is warranted in interpreting the Maba specimens.

Introduction and background

The Maba (or Ma-pa in earlier transliterations) hominin site is located in Shizhishan ('lion hill' in English), near Maba village, Shaoguan City, Guangdong Province, China (Fig. 1). Maba is best known for the discovery of a partial hominin cranium (Wu and Peng, 1959) in a narrow trench in 1958 by local farmers digging in the cave for fertilizer (Howells, 1977; Wu and Wu, 1985; Wu and Poirier, 1995; Bae, 2010). This specimen has been only incompletely analyzed to date (see Bae, 2010; Wang, 2011).

Maba is actually a series of inter-connected natural passages with several cave entrances (e.g., Feisuyan, Yinyan, Shuidong) that developed over a long period of time as groundwater filtered through natural faults in the limestone hill. Adjacent to the Maba site and considered a part of Shizhishan is a second low lying hill. According to the local Chinese researchers, it is thought that the two low lying hills once comprised one larger hill. The second hill is very similar to the first with multiple caves and naturally winding passages that connect the caves. Although vertebrate fossils were found in the second cave, no hominin fossils or archaeological materials of note have been reported.

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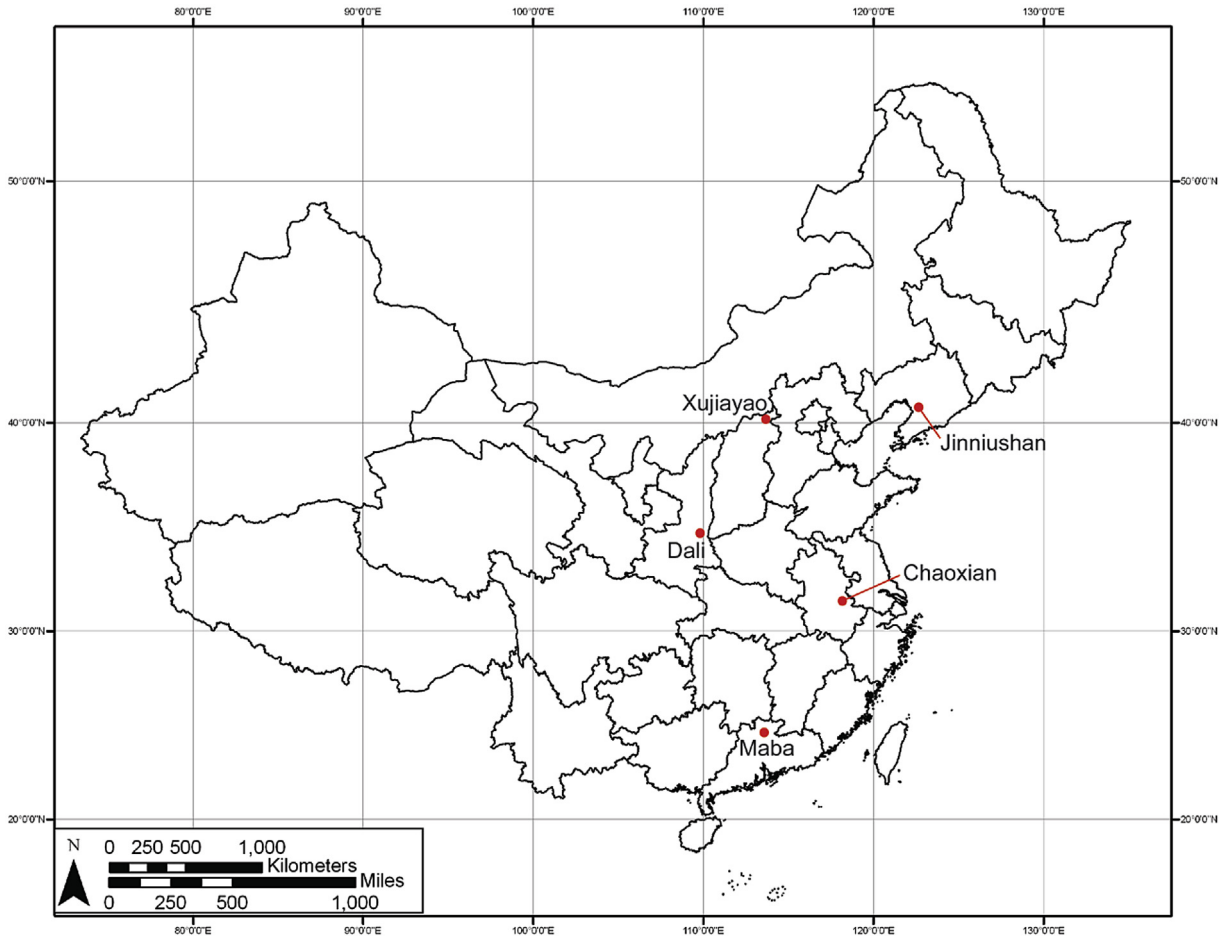

Figure 1. Map of China with location of Maba and other important Mid-Pleistocene *Homo* localities (Xujiayao, Jinniushan, Dali, Chaoxian).

No Paleolithic archaeological traces (e.g., lithic or bone artifacts, hearths, fire-cracked rock, etc.) have been reported from Maba. A detailed taphonomic study of the Maba faunal assemblage to identify presence/absence of hominin behavioral traces has yet to be conducted.[1] A Neolithic deposit is present at the top of Shizhishan, roughly 40–50 m to the west and 20–30 m above where the Maba cranium was found. The Neolithic deposits do not appear to be related in any way to the Maba materials discussed here. Following the discovery of the Maba cranium, the Guangdong provincial and Qujiang district governments decided to preserve the site, which involved much modification of the original passages and cementing over some features.

A diversity of Late Pleistocene fauna was identified at Maba, including such extinct taxa (at least for southern China) as *Rhinoceros sinensis*, *Stegodon orientalis*, *Palaeoloxodon namadicus*, and *Crocuta crocuta* (Wu and Poirier, 1995). *Ailuropoda* was identified in the faunal assemblage, which could suggest the presence of a heavily bamboo forested environment. However, no micromammal bones assigned to *Rhizomys sinensis* (bamboo rat) were reported. The presence of *Rhizomys*, which lives primarily on bamboo roots, could also be used as indirect evidence of a more heavily bamboo forested environment (Lycett and Bae, 2010). No non-human primates were identified in the Maba faunal collection; these are also useful indicators of a heavily forested environment (Norton et al., 2010). A more detailed analysis of the faunal assemblage is warranted in order to better understand the paleoenvironment around Maba.

Chronology

Several different dates for Maba exist based on biostratigraphy and Uranium-series geochronology. Based on biostratigraphy, the Maba site has been assigned to the Late Pleistocene (Han and Xu, 1989). The original U-series date of 135–129 ka (thousands of years ago) places Maba at the very end of the Middle Pleistocene (Yuan et al., 1986). However, a second set of U-series dates averaging >237 ka was more recently published (Gao et al., 2007), leading to the suggestion that the minimum age of Maba should be > 237 ka, rather than ~130 ka. Although the two U-series dates are widely divergent, both derived from samples collected from the same flowstone. Gao et al. (2007), using more modern methodologies, suggest that the >237 ka date is more reliable than the original ~130 ka date. It should be noted that the flowstone is actually about 20 m south of the location of the Maba cranium and even farther away from the locations of where the materials being presented

[1] The excavations at Maba occurred at a time when no systematic program existed to completely retain all faunal materials, particularly the difficult-to-identify bone fragments (see Norton and Gao, 2008 for similar difficulties with the analysis of the Zhoukoudian Upper Cave faunal materials). Thus, except for the most easily identifiable teeth and cranial fragments that are currently stored in the Maba Museum and elsewhere (e.g., Institute of Vertebrate Paleontology and Paleoanthropology), it would be difficult to track down a more complete sample of the original faunal assemblage.