Quaternary International xxx (2015) 1–7

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

U-series dating of hominin fossil-bearing Panlong Cave in Guangdong Province, southern China

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ARTICLE INFO

Article history:
Available online xxx

Keywords:
Panlong Cave
Archaic *Homo sapiens*
U-series dating
Middle Pleistocene
Southern China

ABSTRACT

Two hominin teeth and an abundance of faunal remains were recovered from Panlong Cave in Guangdong Province, southern China in 1987. The site has remained largely unknown to the prehistoric community mainly for the lack of reliable chronological constraints. This paper reports high-precision mass spectrometric U-series dating of eight calcite samples from the extant cross-section. Based on the dates on the overlying flowstone layers, the hominin teeth should be definitely older than 292 ± 10 ka. Furthermore, as indicated by the U-series ages on the secondary calcite formations the fossiliferous deposits should be older than 441 ± 18 ka. These dates support the paleontological inference that Panlong Cave may predate the nearby Maba hominin site. The hominin specimens from the site may thus represent an early member of the *Ailuropoda-Stegodon* fauna and one of the oldest non-*erectus* Middle Pleistocene hominin fossils in southern China.

1. Introduction

Panlong Cave (PLC, Dragon Cave) is located at the northern fringe of Yunfu City, Guangdong Province, southern China (Fig. 1). It is a complex cave system developed inside the Carboniferous limestone of Shizishan (Lion Hills). Its main entrance (N 22°56′46″, E 112°02′39″) opens to the west and is ~76 m above sea level and ~8 m above the present ground surface. The cave has halls and corridors profusely decorated with speleothem formations. For this reason, it has been extensively reconstructed into a tourist attraction since early 1980s. In the course of reconstruction works, the deposits inside a branch cave named as Yaomo Grotto (Demon Grotto, Fig. 2) were found to be fossiliferous. An excavation program was carried out in 1987 by a joint team from Sun Yat-Sen University and Museum of Yunfu City (Wang et al., 1990). This led to the recovery of an abundance of mammalian fossils, among which two hominin teeth were identified (Fig. 3). No trace of cultural remains was found.

A preliminary study of the PLC finds was undertaken by the excavators (Wang et al., 1990). Though no description in detail was given, the two hominin teeth were assigned to *Homo sapiens*. The mammalian fossils were classified into 23 taxa (Table 1), most of which are typical members of the *Ailuropoda-Stegodon* fauna in southern China caves throughout Pleistocene (Wang et al., 1990). Based on broad-brush ^{14}C dating of a calcite sample (27 ± 1 ka) and Amino Acid Racemization (AAR) dating of 26 fossil teeth (1.2–14.6 ka), the site was attributed to terminal Late Pleistocene–Holocene (Wang et al., 1990; Chen et al., 1995).

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http://dx.doi.org/10.1016/j.quaint.2015.11.107
1040-6182/

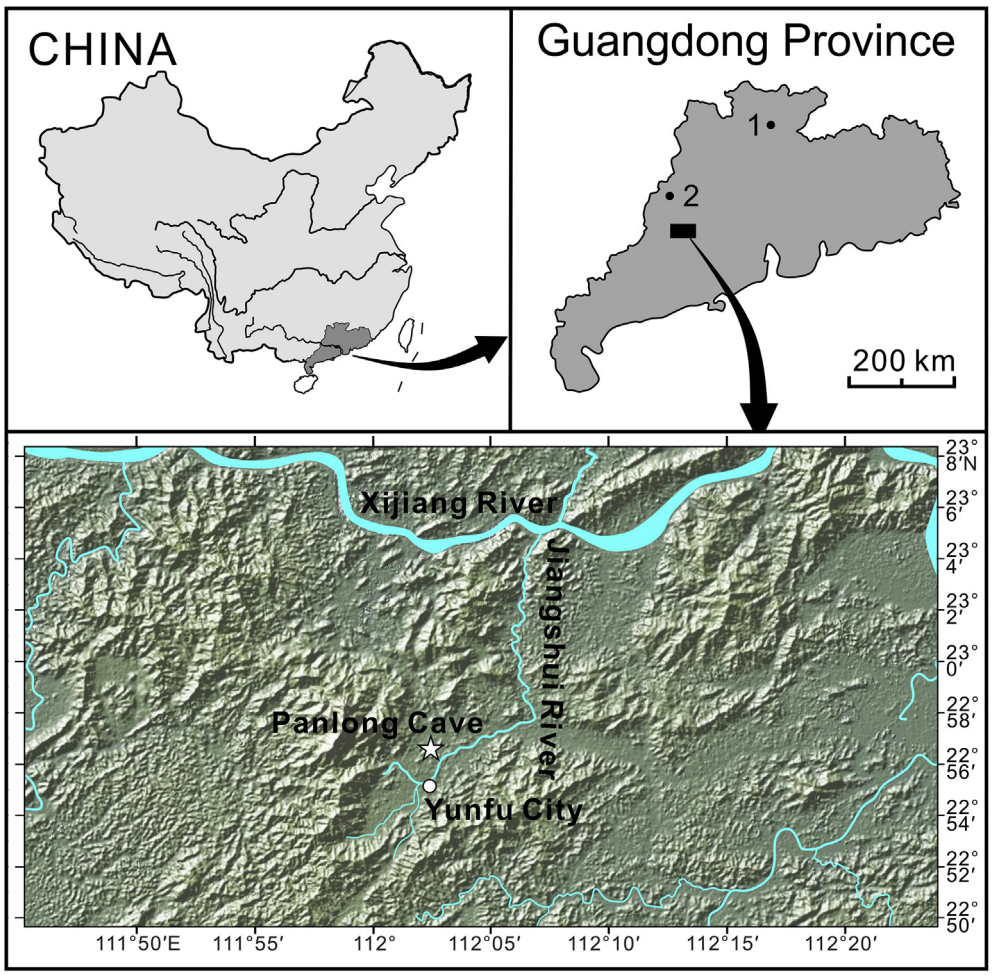

Fig. 1. Map showing geographical location of Panlong Cave and two nearby hominin sites (1, Maba; 2, Dongzhongyan).

Table 1
List of Panlong Cave fauna.

Higher taxon	Species
Primates	*Macaca* sp.
	Pongo sp.
Proboscideans	*Stegodon orientalis*
	Palaeoloxodon namadicus
Carnivores	*Ailuropoda melanoleuca fovealis*
	Panthera tigris cf. tigris
	Acinonyx sp.
	Viverra sp.
Perissodactyls	*Megatapirus augustus*
	Rhinoceros sinensis
Artiodactyls	*Sus scrofa*
	Cervus sp.
	Bubalus sp.
	Bison sp.
	Muntiacus muntiak
	Cervus unicolor
	Capricornis sp.
	Megalovis sp.
Rodents	*Hystrix* sp.
	Rhizomys sp.

Reproduced from Wang et al. (1990) with the classification of some taxa being corrected by Qiu and Zhang (2008).

Probably because of the overly young age results, the PLC finds have remained largely unknown to the prehistoric community. About two decades later, Qiu and Zhang (2008) revisited the site. By comparing the PLC hominin teeth with those from the nearby sites of Maba (Wu and Poirier, 1995) and Dongzhongyan (Qiu et al., 1986), attributed to Middle and Late Pleistocene, respectively, these authors came to a conclusion that the morphometrically more robust PLC specimens should be reassigned to archaic *H. sapiens*. Besides, Qiu and Zhang (2008) compared the faunal composition of these sites, and considered that PLC should be penecontemporaneous with or even older than Maba. The latter site was previously assigned to around the Middle-Late Pleistocene transition mainly based on U-series dating of the fossil teeth (Yuan et al., 1986). However, on account of the U-series dates on flowstone layers in the Southern Branch Cave of the site, Maba hominin should be at least ~230 ka, and most probably older than ~278 ka (Shen et al., 2014). Under such a circumstance, the previous ^{14}C and AAR dating of PLC must be far too young to be realistic. A re-examination of its chronology with well-established dating technique is thus warranted.

With the aforementioned issue in mind, we visited the site in 2009. Several *in situ* flowstone layers as well as clusters of secondary calcite crystals were found intercalated in the depositional sequence. These speleothem formations, being quite pure and dense, are ideal materials for U-series dating. During this and subsequent field excursions, a total of eight calcite samples with clear stratigraphic significance were collected. Here we report the results of high precision mass spectrometric $^{230}Th/^{234}U$ dating of these samples, and try to discuss their implications in the frame of Middle Pleistocene hominin evolution in East Asia.

Please cite this article in press as: Tu, H., et al., U-series dating of hominin fossil-bearing Panlong Cave in Guangdong Province, southern China, Quaternary International (2015), http://dx.doi.org/10.1016/j.quaint.2015.11.107