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Taphonomy of the Tianyuandong human skeleton and faunal remains

Yolanda Fernández-Jalvo [a, *], Peter Andrews [b], HaoWen Tong [c]

[a] Museo Nacional de Ciencias Naturales (CSIC), José Gutiérrez Abascal, 2, 28906, Madrid, Spain
[b] Natural History Museum, Cromwell Road, London, SW7-5BD, UK
[c] Key Laboratory of Evolutionary Systematics of Vertebrates, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, 142 Xi-Zhi-Men-Wai St., Beijing, 100044, China

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ABSTRACT

Tianyuan Cave is an Upper Palaeolithic site, 6 km from the core area of the Zhoukoudian Site Complex. Tianyuandong (or Tianyuan Cave) yielded one ancient (though not the earliest) fossil skeleton of *Homo sapiens* in China (42–39 ka cal BP). Together with the human skeleton, abundant animal remains were found, but no stone tools were recovered. The animal fossil remains are extremely fragmentary, in contrast to human skeletal elements that are, for the most part, complete. We undertook a taphonomic study to investigate the circumstances of preservation of the human skeleton in Tianyuan Cave, and in course of this we considered four hypotheses: funerary ritual, cannibalism, carnivore activity or natural death. Taphonomic results characterize the role of human action in the site and how these agents acted in the past. Because of disturbance of the human skeleton during its initial excavation, it is not known if it was in a grave cut or if there was any funerary ritual. No evidence was found for cannibalism or carnivore activity in relation to the human skeleton, suggesting natural death as the most reasonable possibility.

Introduction

We describe here the taphonomy of the human remains from Tianyuandong near Beijing, China (Shang and Trinkaus, 2010). Taphonomic investigations carried out in Late Pleistocene East Asian sites show that early *Homo sapiens* could successfully exploit a difficult environment, obtaining a variety of animal resources (Norton and Gao, 2008a, 2008b; Norton and Jin, 2009; Prendergast et al., 2009). Therefore, these Late Pleistocene East Asian humans could regularly acquire supplies of animal protein and fat, and primary access to carcasses (Norton and Gao, 2008a). In this respect, Hu et al. (2010) found isotopic signatures indicating that the Tianyuandong human individual had a diet rich in animal protein, with indications of fresh water fish consumption. Knowledge of the behaviour of the Tianyuandong human individual, strategies and way of life as well as the context of the site is especially relevant to better understand cultural and palaeoanthropological implications of this early *H. sapiens* (Barton et al., 2007, Prendergast et al., 2009).

Tianyuandong (or Tianyuan Cave) is located 62 km from Beijing and 6 km from the cave site of Zhoukoudian (39° 28′ 29″N; 115° 52′ 17″E). The cave is part of this same karstic complex, (Fig. 1) and it is recorded as Zhoukoudian Site 27 (Tong et al., 2006; Li and Tong 2008). The site is a small cave shelter discovered in 2001 by workers of the Tianyuan Tree Farm (Zhoukoudian Town). They discovered the cave while searching for mineral deposits, and on extracting the minerals they collected some animal and human bones.

Four stratigraphic levels have been distinguished at Tianyuandong (Shang and Trinkaus, 2010). From top to bottom: Level I, interbedding of soil with cemented breccias; Level II, a layer of fragmented deposits without sorting; Level III, a layer of breccias without full cementation; and Level IV, the basal gravel bed.

Excavations were undertaken in 2003 and 2004 by members of the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP), led by one of us (HWT). These two seasons have provided information on the distribution of the fossils in relation to stratigraphy. Eight human fossil elements were recovered from the systematic excavations and, together with most faunal remains, they came from Level III. Fossil bones from Level I have a very characteristic taphonomic signature, with abundant damage on the bone surfaces produced by rodent (porcupine) gnawing and by weathering (Tong et al., 2008). The other two levels in the cave lack

* Corresponding author.
E-mail addresses: yfj@mncn.csic.es (Y. Fernández-Jalvo), pjandrews@uwclub.net (P. Andrews), tonghaowen@ivpp.ac.cn (H. Tong).

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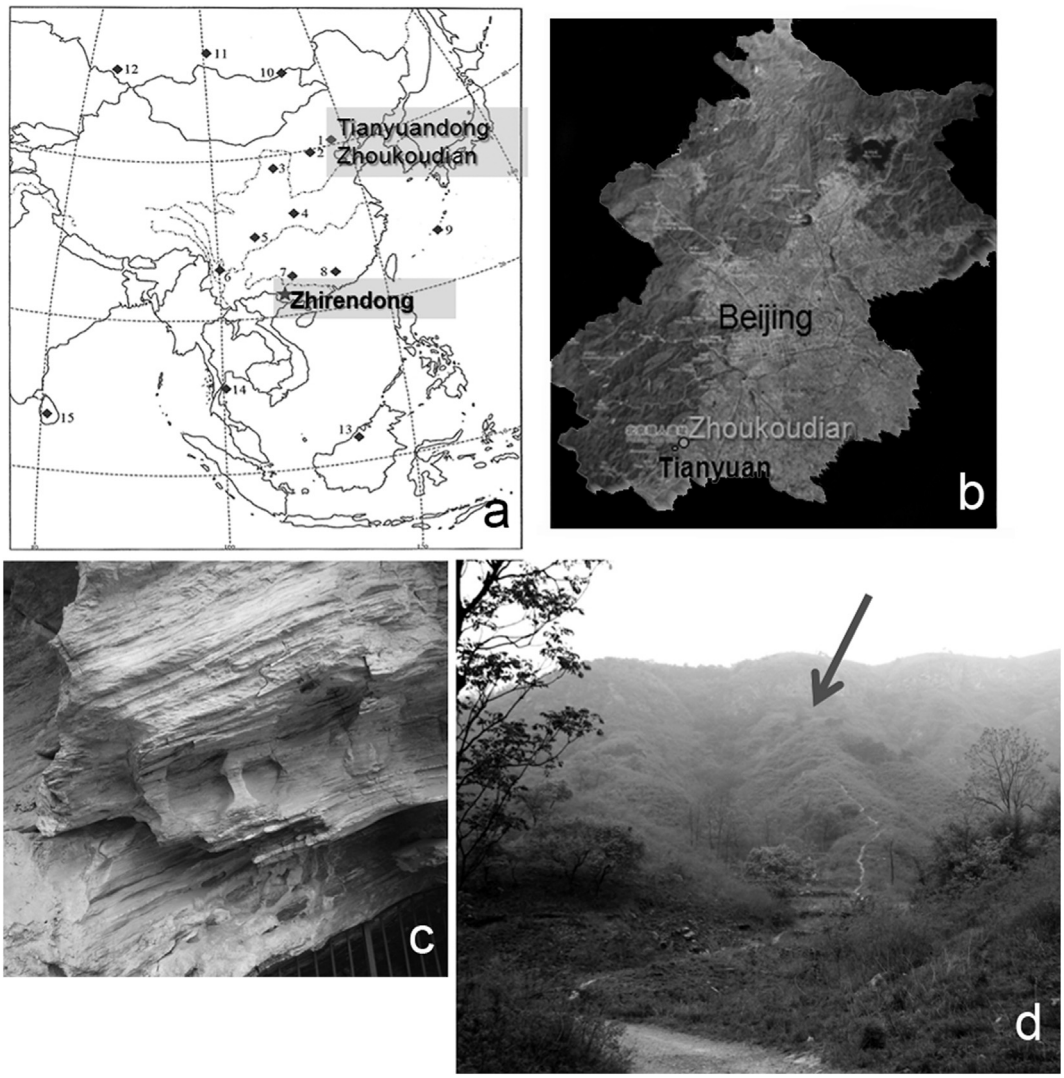

Figure 1. a: map of China, location of Tianyuandong (near Beijing and Zhoukoudian karstic complex) and Zhirendong in Southern China (taken from Shang and Trinkaus, 2010). b: Location of Tianyuan site in the Zhoukoudian site karstic complex area (location map displayed at Zhoukoudian Museum). c: view of the highly laminar bed rock in which the Tianyuan rock shelter was formed. d: location of Tianyuandong (grey arrow) and surrounding landscape.

human fossils. Taxonomic identifications of the animal remains have been made by Tong et al. (2006), Shang et al. (2007), Li and Tong (2008), Trinkaus and Shang (2008) and Shang and Trinkaus (2010). Six animal bones and one human fossil (femur), all from Level III, have been dated by radiocarbon techniques providing age estimates of ~35,500 to ~33,500 ^{14}C BP (MIS 3) or ~42–39 ka cal BP (Shang et al., 2007; Shang and Trinkaus, 2010).

The human anatomical elements represent a single individual of about 40–50 years old, probably male (Shang and Trinkaus, 2010). The majority of the skeleton was extracted by workers before its importance was realised, and the only information we have is that the human remains were clustered together and taken from a blind chamber within the cave (Fig. 2). Eight human skeletal elements were subsequently recovered from this area in stratigraphic context during more careful excavations (Shang and Trinkaus, 2010). No stone tools have been recovered from the site, but abundant broken fragments of faunal remains were found accompanying the human skeleton. A short taphonomic report focused on the human skeleton was previously published (Fernández-Jalvo and Andrews, 2010). Here we describe the complete taphonomic study in full context including the taphonomy of the fauna, the fossil distribution and the site formation.

Material and methods

Most human fossils from Tianyuandong ($n = 24$) came from the initial clearance of the site by workers of the Tianyuan Tree Farm (Zhoukoudian Town). Eight additional human fossils (1 M, four manual phalanges, a metatarsal and two pedal phalanges) were recovered in stratigraphic context during the systematic excavations in 2003. The total number of faunal bones from Level III studied here is 748, plus 116 specimens from the upper Level I, all of them recovered during the 2003 excavation season. Fossil dimensions (length, width and thickness) have been measured with callipers and fossil surfaces and taphonomic modifications were analyzed with a portable light binocular microscope (10× to 40× magnification) and a geological hand lens (10×). Some specimens were analyzed and photographed on the conventional scanning electron microscope (SEM, Jeol JSM 6100) based at the IVPP, at secondary electron emission mode without any coating, working at