



# A taphonomic study on the skeletal remains of *Cervus (Sika) grayi* from layer 3 of the Peking man site at Zhoukoudian during the 2009–2010 field seasons



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## ARTICLE INFO

### Article history:

Available online 28 November 2015

### Keywords:

Zhoukoudian

Taphonomy

Palaeolithic

*Homo erectus pekinensis*

## ABSTRACT

Re-excavation of the Peking man site at Zhoukoudian was initiated in 2009. A taphonomic analysis of the skeletal remains of *Cervus (Sika) grayi*, a dominant species from Layer 3 of the extant West Section of the site strongly negates a role played by hominins in the accumulation and modification of the bones. Instead, it is argued here that some individuals of this medium-sized deer species were probably trapped in the cave by accident and eventually preserved *in situ* in the Quaternary sediments. The virtual absence of stone artifacts and human skeletal remains from the 2009–2010 field seasons has further strengthened this conclusion. Bearing in mind evidence of a series of cave collapse episodes, we tentatively propose that the cave morphology during the formation of Layer 3 at the West Section was probably inhospitable to *Homo erectus pekinensis*.

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## 1. Introduction

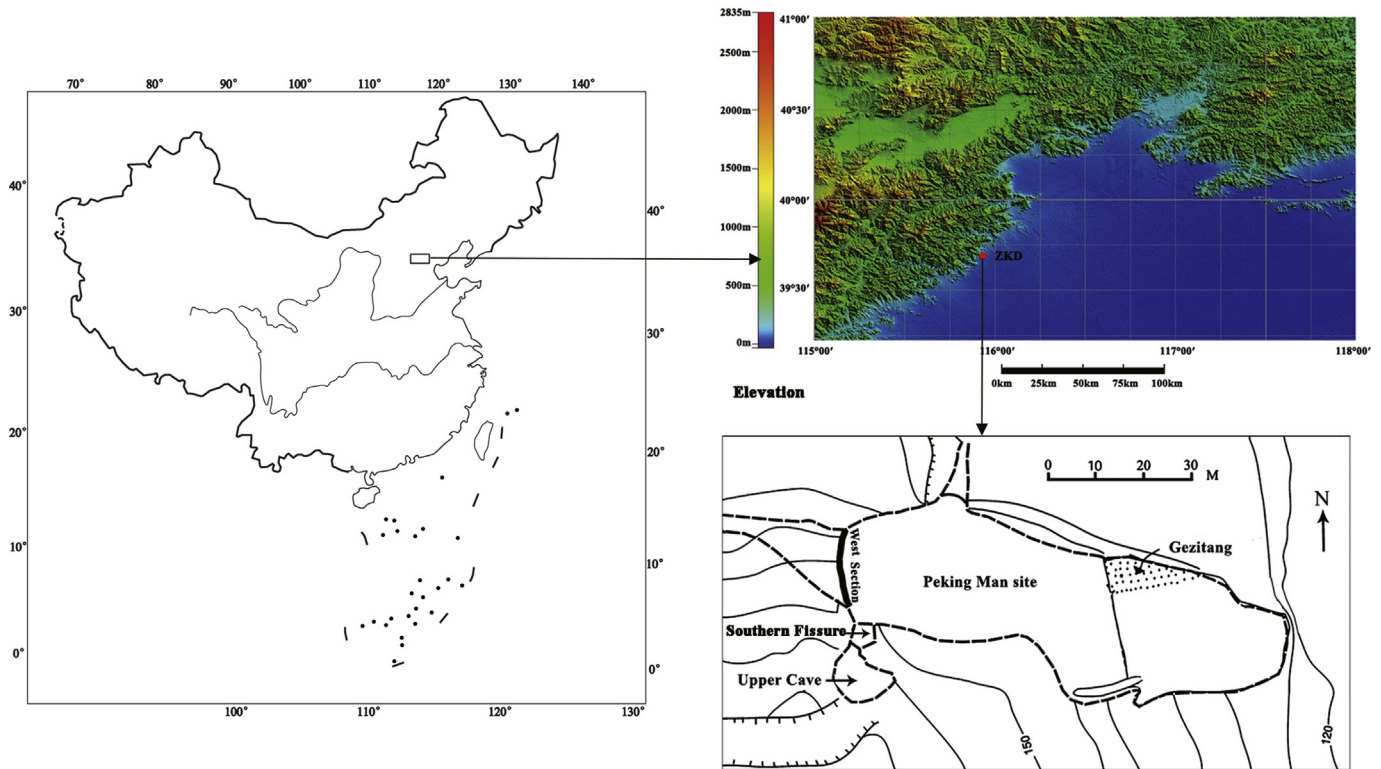
Taphonomic analyses of the faunal remains with updated methodologies and techniques have been carried out at *Homo erectus* sites from Africa, Europe and South-east Asia (Gaudzinski, 2004; Belmaker, 2006; Bouteaux, 2008; Bouteaux and Moigne, 2010; Domínguez-Rodrigo et al., 2014). However, such in-depth evaluations of the skeletal remains of the Pleistocene animals from the archaeological sites of China, particularly those associated with *H. erectus*, are so far largely lacking.

Located about 50 km southwest of Beijing, China, the Peking man site at Zhoukoudian (Locality 1) was initially excavated in the early twentieth century (Fig. 1). Skeletal remains of at least 40 *H. erectus* individuals, along with large numbers of animal bones and stone artifacts were unearthed during the 1920s and 1930s (Jia and Huang, 1990; Norton and Gao, 2008). Since then, several small-scale excavations have been conducted intermittently at the site,

adding more contributions to the list of finds from the cave. Academic discussions concerning this cave site over the last few decades have largely centered on whether hominins actually occupied the cave or whether their bones and animal skeletal remains were introduced by carnivores (Binford and Ho, 1985; Binford and Stone, 1986; Jia, 1989; Boaz et al., 2000; Boaz and Ciochon, 2001, 2004; Boaz et al., 2004; Yang et al., 2014). For several decades, the spatial co-occurrence of the numerous animal bones and lithic tools from the site was interpreted as evidence of hominin exploitation of animal species in the cave, especially of ungulates (Wu and Lin, 1983). Later studies concerning site formation processes in the cave, on the other hand, strongly dismissed the roles played by hominins in the accumulation and modification of these animal bones. For example, based on a short visit to the site and a cursory examination of a minor fraction of the recovered fossils therefrom, Binford and his colleagues (Binford and Ho, 1985; Binford and Stone, 1986) largely dismissed the long-held concept that the cave was the home base of Peking man but instead attributed most, if not all ungulate remains in the cave to the scavenging behaviors of the giant hyena, *Pachycrocuta brevirostris*. However, considering the palimpsest records of most archaeological sites in the early period of human evolution (Domínguez-Rodrigo et al., 2007), and especially the long sequence of human presence at Locality 1 (Wu

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**Fig. 1.** Location of the Peking man site at Zhoukoudian (bottom map modified after Goldberg et al., 2001, Fig. 2). Note the West Section and the Southern Fissure to the west of the Peking Man site.

and Lin, 1983), one may reasonably suppose different ways of animal bone accumulation and varying extents of hominin involvement in the formation of separate strata at the site. In this study, we specifically focus on the skeletal remains of *Cervus (Sika) grayi* from Layer 3, the uppermost stratum excavated during the 2009–2010 field seasons at Zhoukoudian.

It is now recognized that archaeological sites may also represent settings in which animals remains could have been concentrated by agents other than humans, and the main aim of this study is therefore to unravel the taphonomic history of the faunal remains of *Cervus (Sika) grayi* from this layer and try to identify the agents responsible for the accumulation and modification of these bones in the cave ca. 300,000 years ago (Huang, 1993, 1995; Grün et al., 1997).

## 2. The West Section of the Peking man site at Zhoukoudian and the re-excavations

As a result of many years archaeological campaigns conducted at the site, the majority of the sediments have been removed from the cave; and currently only the West Section, representing roughly one third of the sediments originally deposited in the cave, is preserved *in situ*. However, because of differential weathering, some layers have been more adversely affected than others. As example, Layer 4, which is somewhat loose, has been heavily eroded, but Layers 3, 5, 8 and 9 which are well-cemented were only slightly weathered. The alternating protruding and eroded portions of the section caused it to become unstable. In some places, cracks up to 10–30 cm wide could be seen, and large blocks of sediments overhanging the underlying strata were even likely to collapse from the main body of the section. To remove these potential threats to the safety of the deposits and to guarantee the preservation of the

site, archeologists from the Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences proposed a round of salvage excavation at the site at the beginning of this century. Upon acquiring permission from the governmental authorities, excavation of the main deposits of the West Section of the site was resumed in 2009 after a suspension of almost 50 years.

An in-depth geological analysis at the end of the 1970s had already provided a well-established stratigraphic sequence for Locality 1 (Yang et al., 1985) and we have therefore, following recent publications (Weiner et al., 1998; Goldberg et al., 2001; Shen et al., 2009), adopted this framework and delineated the limits of current strata according to its detailed account of the sediments. A numerical age for Layer 3 was also set roughly at 300,000 years before present (Zhao et al., 1985; Huang, 1993, 1995; Grün et al., 1997; but see; Shen et al., 2001).

In the first two years' field work at Layer 3, a 1 × 1 m horizontal control unit and a 10–20 cm vertical control unit were employed, depending on the extent of homogeneity of the sediments (Fig. 2); the excavated area in this layer fluctuated somewhat from 20 to 25 m<sup>2</sup> between different levels owing to the irregularities and variations in contour of the extant section. Bearing in mind the possibility that the cave deposits are palimpsests, we used a Nikon DTM 352 total station to record the spatial distributions of excavated materials and to facilitate mapping of the stratigraphy of the site. In this way, we had robust control in the new excavations over excavated items, both vertically and horizontally. For the convenience of excavation, small tools (i.e. hand trowels, hand shovels, tweezers, cleaning brushes, etc.) were used during the excavation of the fossiliferous parts of each level and heavy tools were utilized in parts of cave deposits of minimal archaeological bearing. Instead of explosives, as employed in the 1920's and 1930's, an electric jackhammer was occasionally used during the excavation to break

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