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New material of Early Pleistocene *Sus* (Artiodactyla, Mammalia) from Yangshuizhan in Nihewan Basin, North China

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ABSTRACT

Although the Early Pleistocene *Sus lydekkeri* has been uncovered from several localities in northern China, the fragmental state of the specimens results the discussion on its taxonomic status and its relationship with European *Sus strozzii*. A nearly complete skull with mandible was unearthed *in situ* from upper Nihewan Formation at the horizon paleomagnetically dated 1.6 Ma during the excavation conducted in 2013 at Yangshuizhan in the Nihewan Basin in North China. The skull is better preserved than that from the Middle Pleistocene of the Peking Man Site, the type locality of *S. lydekkeri*. As the best preserved skull of *S. lydekkeri*, it bears some key characters previously little known, e.g. the developed canine flange, small and flattened tympanic bulla, and rather weak hamulus pterygoideus of pterygoid. The morphology and metric analyses show that the material from Nihewan belongs to *S. lydekkeri* instead of *S. strozzii* and the latter is a distinct species different from *S. lydekkeri*. The interaction between early human and suid started at least as early as the Early Pleistocene based on the fact that *S. lydekkeri* is present in many early human or Palaeolithic sites.

1. Introduction

During his study on mammalian fauna excavated from the Peking Man Site (PMS) of Zhoukoudian, Zdansky (1928) established a new species, *Sus lydekkeri*, based on a few maxillary and mandibular fragments as well as some isolated teeth. More material was unearthed from PMS, including a nearly complete skull, several skull and mandible fragments that made the collection of the species from PMS representing at least 200 individuals (Young, 1932a). The amount of specimens evidently enriched morphologic information for establishing taxonomic diagnostics. The later discoveries of *S. lydekkeri* specimens from at least 18 sites or localities elsewhere, notably from Nihewan (Teilhard de Chardin and Piveteau, 1930), Lantian Man Site of Gongwangling (Hu and Qi, 1978), Hexian Man Site (Huang et al., 1982), Nanjing Man Site (Huang, 1996; Dong, 1999), Yunxian Man Site (Échassoux et al., 2008), Tuozi Cave (Dong et al., 2007; Dong and Fang, 2008), remarkably increased the hypodigms of the species. All later finds are less well preserved than those from PMS. In addition, the material of *S. lydekkeri* collected from Nihewan and described by Teilhard de Chardin and Piveteau (1930) was considered as closer to European *Sus strozzii* than to Chinese *S. lydekkeri* (Qiu, 2000).

With the discovery of *Gigantopithecus* mandibles from a karst cave in Waleng Hill in Liucheng, southern China, large amounts of suid specimens were unearthed from the cave deposits. Some new suid species were established in classifying the material (Han, 1987), including *Sus peii*, a suid with similar size and morphology to *S. lydekkeri*. *S. lydekkeri* has been found mostly in northern China, and *S. peii* has been uncovered mostly in southern China, with some overlap of the two species along certain areas of the Yangtze. The morphological resemblance among *S. lydekkeri*, *S. peii* and *S. strozzii* and the adaptability and dispersal capacity of the suids resulted in discussions whether *S. lydekkeri*, *S. peii* and *S. strozzii* are independent species or geographic varieties of a same species (Dong, 2008; Dong and Fang, 2008).

A few well-preserved mammalian fossils were uncovered during a paleomagnetic field investigation at Yangshuizhan (YSZ)

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section near Hongya village in Nihewan basin (Ao et al., 2013). A series of excavations at the locality were then carried out by the present authors from 2013 to 2015, and a well preserved and nearly complete skull with mandible of *S. lydekkeri* was unearthed *in situ*. The skull is more complete than that from PMS, and here we describe the material and discuss the relationship between Chinese *S. lydekkeri* and *S. peii* and European *S. strozzii*.

2. Regional setting

The Yangshuizhan locality administratively belongs to Hongya Village, Xinbu Town, Yangyuan County, Zhangjiakou Municipality, Hebei Province in North China. The locality (GPS: 40°07′53.12″N, 114°39′55.68″E, 939 m) is 1.22 km south (heading: 174.68°) of Hongya Village, 44.55 km east (heading: 85.42°) of Nihewan Museum at Yangyuan Downtown and 149.45 km west (heading: 280.22°) of Tiananmen Square in Beijing. The locality is on the western bank of the Huliu River and on the northeast side of the Liuleng Mountain, in the northeastern Nihewan Basin.

Extensive exposures of horizontal Nihewan Formation composed of the Late Cenozoic fluvio-lacustrine and eolian deposits and the underlying eolian red clay are found along the SW–NE trending Sanggan River and SE–NW trending Huliu River, including at Yangshuizhan locality. The exposed Nihewan Formation at the locality was measured at 131 m and divided into upper and lower two parts (Ao et al., 2013). The upper part is composed of grayish-green and grayish yellow silty clays and clayey silts intercalated with fine-grained sand and conglomerate layers, while the lower part red silty clay intercalated with conglomeratic silts. Two fossiliferous layers within 10 m' interval named YSZ I (ca 39–40 m) and YSZ II (ca 49.5–50.5 m) and dated paleomagnetically 1.6 Ma and 1.8 Ma respectively were found in the upper part of the Nihewan Formation (Ao et al., 2013). Our excavations carried out from 2013 to 2015 were focused on YSZ I. The excavated fossiliferous layer, or YSZ I, is composed of brownish yellow fine-grained sandy clay, with a thickness of 3.05–2.12 m. It tilts slightly from the northwest to the southeast (Fig. 1).

A very complete skull of *Equus huanghoensis*, a left mandible of *Nyctereutes* sp., a humerus of *Acinonyx* sp. and a large number of mammalian bone fragments were collected from YSZ I by Ao et al. (2013). Our excavation conducted in 2013 unearthed a nearly complete skull of *Sus lydekkeri* with mandible (HY13-58) which is the main subject of the present study. The associated mammalian fossils unearthed in our excavations from 2013 to 2015 include 2–3 species of canids, a felid, 2–3 species of equids, 2 species of cervids and 1–2 species of bovids, which are under preparation for detailed identification. The mixture of browsers and grazers of the mammalian fauna from YSZ I indicates a mosaic environmental composition of forests and grasslands.

3. Material and methods

The material studied in this paper is a well-preserved female skull (HY13-58.1) with mandible (HY13-58.2) of the same individual *in situ* unearthed from Yangshuizhan locality (Fig. 1) and housed at the Nihewan National Nature Reserve Management Office of Hebei Province. The skull measurement methods follow those of von den Driesch (1976), skull terminology follows that of Sisson (1975) and the dental nomenclature follows those of Pickford (1986) and Van der Made (1996). The upper teeth are abbreviated in upper case and the lower ones in lower case.

Fig. 1. The Early Pleistocene deposits at Yangshuizhan locality. The arrow points the location and horizon YSZ I where the skull (HY13-58) of *Sus lydekkeri* was unearthed.