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Early human settlements in the southern Qinling Mountains, central China

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A B S T R A C T

China is a key area of early human settlement in East Asia, with numerous Paleolithic localities indicating an early Pleistocene presence of hominins in northern and southern China. Considerable research has been devoted to determining possible migration routes for hominins linking the two areas. In this paper, we report the discovery of several loess-covered Paleolithic sites in the Hanzhong and Ankang Basins along the Hanjiang River in the southern piedmont of the Qinling Mountains (QLM) in central China. A chronology is developed for these sections using a combination of detailed optically stimulated luminescence dating, magnetostratigraphic analyses, and pedostratigraphic correlation with the well-dated loess–paleosol sequence of the central Chinese Loess Plateau. The results indicate that the age of the oldest lithic assemblage at the Longgangsi locality 3 Paleolithic site in Hanzhong Basin is ~1.20 Ma, thus making this locality as one of the oldest sites in central China. Our work also indicates that hominins occupied the Hanjiang valley at several times: ~1.2, 0.9, ~0.6, and ~0.1 Ma. We propose that the Hanjiang River Valley was a probable hominin routeway through the QLM because many sites corresponding to these different phases were also discovered to the north of the QLM. Future study on the Hanjiang River Valley is important for verifying the hypothesis of an early human migration route between southern and northern China.

1. Introduction

China is a key area of early human occupation in East Asia. The extensively accepted center of early human occupation in China is the Nihewan Basin (Hebei Province) in northern China with numerous site localities, such as Majuangou, Donggutuo, and Xiaochangliang (Zhu et al., 2001, 2004; Deng et al., 2006, 2008). Several important areas of early human occupation exist in southern China, such as Yuanmou Basin (Zhu et al., 2008) and Longgupo (Han et al., 2012, 2017) (Fig. 1). The loess–paleosol sequence in northern and central China is an important terrestrial archive of paleoclimate and environment (Liu, 1985; An et al., 1990; Ding et al., 1994; Lu et al., 2000) as well as an important source of Paleolithic artifacts and of hominin occupation records (Liu, 1999).

The Qinling Mountains (QLM), which acts as a barrier to the southward transport of eolian dust, lie to the south of central Chinese Loess Plateau (CLP). Nevertheless, thin loess deposits and associated paleosols extensively occur on the southern slopes of the QLM on river terraces and small tablelands along the Hanjiang River (Sun et al., 2012, 2016; Wang et al., 2014a, b; Wang and Lu, 2014) (Fig. 1). This area is also one possible pathway of early human migration between southern and northern China during the Pleistocene, as highlighted by the numerous Paleolithic localities recognized on both sides of the QLM (Norton et al., 2010; Sun et al., 2016).

Around the QLM, several loess-covered Middle Pleistocene

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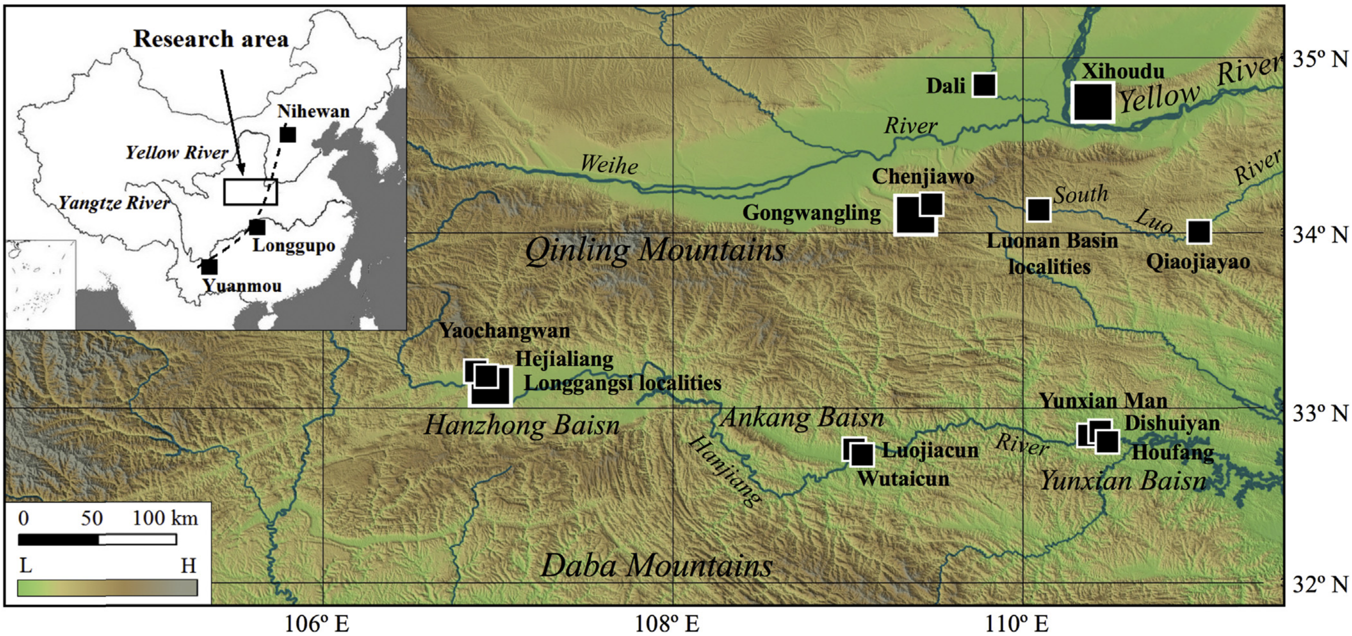

Fig. 1. Locations of Longgangsi Paleolithic localities in Hanzhong Basin, Wutaicun, and Luojiacun sites in Ankang Basin, southern QLM, central China, and archeological sites investigated around the QLM (Large black squares: Paleolithic sites older than ~1 Ma; small black squares: Paleolithic sites younger than ~1 Ma).

hominin fossils and Paleolithic stone tools have been found and dated (Fig. 1). These include the Chenjiawo (0.65 Ma) (Dai and Ji, 1964; An and Ho, 1989) and Dali Man sites (0.27 Ma) (Wang et al., 1979; Xiao et al., 2002; Yin et al., 2011; Sun et al., 2017) to the north of the QLM, various localities in the Luonan Basin (~0.6–0.8 Ma) (Wang et al., 2008b; Lu et al., 2007, 2011a; Sun et al., 2013, 2014) and the Qiaojiayao site (~0.6 Ma) (Wang et al., 2008a; Lu et al., 2011b) in its eastern piedmont, and the Yunxian Man site (~0.90 Ma) (Li and Etler, 1992; Yan, 1993; Feng, 2008) in its southern one. However, in the northern region of the QLM, only two localities have been dated to the Early Pleistocene: Gongwangling (~1.15 Ma; An and Ho, 1989, or ~1.63 Ma; Zhu et al., 2015) and Xihoudu (~1.2 Ma; Zhu et al., 2003 or ~1.4 Ma; Kong et al., 2013). No Early Pleistocene site has been previously found in the southern piedmont of the QLM (Fig. 1).

To test the hypothesis of a migration route between southern and northern China (Norton et al., 2010; Sun et al., 2016), a search was conducted for Paleolithic localities along the Hanjiang River in the southern piedmont of the QLM, one of the possible routeways through the QLM.

2. Geologic setting

The QLM possesses an average elevation of 2000–3000 m above sea level (asl) and is a natural barrier corresponding to the boundary between the southern and northern climatic regimes of China (Zhang et al., 2012). To the north, the climate is arid and semi–arid; while to the south, it is humid and sub-humid, and a significant occurrence of the subtropical forest is present (Lei, 2000; Xie et al., 2004). Rivers originating on the northern slopes of the QLM flow into the Yellow River; meanwhile, on the southern slopes, they become tributaries of the Yangtze River (Fig. 1).

The Hanjiang River originates on the southern slopes of the QLM, flows through several intermountain depressions between the QLM to the north and the Daba Mountains to the south (Yang and Ma, 1987) (such as the Hanzhong, Ankang, and Yunxian Basins), and then flows eastward to join the Yangtze River in Wuhan City. The eolian sediments in these basins vary in thickness from approximately 2 to 20 m overlying fluvial sediments in river terraces located on both sides of the Hanjiang River valley (Sun et al., 2012; Guo et al., 2013).

The lower part of the studied sections comprises fluvial deposits (clays, silts, sands, and gravels), while the upper part comprises loess deposits (Fig. 2), in which the sediment grain size is finer and the sediment accumulation rate is lower than in the deposits of the CLP (Lu et al., 2007; Sun et al., 2012, 2016). The loess is significantly affected by post-depositional weathering and pedogenesis, resulting in sequences of alternating loess and paleosol layers which can be correlated with the CLP (Fig. 2). However, in contrast with the CLP, the loess deposits covering the terraces of the QLM area contain small but significant amounts of sand. The sand content of the loess and paleosol layers may have been deflated and transported from the adjacent dry floodplain. Although flood deposits have been found in a few loess sections along the Hanjiang River (Guo et al., 2015; Mao et al., 2016), we did not observe any evidence of past flood levels or sedimentary structures that may have been produced by flowing water, such as cross bedding and scour surfaces, at the followings sites: Hejialiang, Longgangsi 2, Longgangsi 3, Luojiacun, and Wutaicun sections (Fig. 3A and B).

In the course of several field investigations along the Hanjiang River, we have discovered many exposed sections with typical sequences comprising basal fluvial deposits overlain by loess deposits (Fig. 3A and B). For each terrace level, field observations enable the identification of the position of the bedrock steps, and the stratigraphy and sedimentology of the fluvial deposits and overlying loess–paleosol sequences. The elevations of the limit between bedrock and gravel layers were measured using a Trimble R8 GNSS System (S. Fig. 1).

2.1. Hanzhong Basin

Four river terraces (Shen, 1956; Yang and Ma, 1987) were previously identified along the Hanjiang River in Hanzhong Basin. Based on previous research by Shen (1956), the result of a