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Indications of pedogenesis in Lower Pleistocene tool-bearing sediments in Northern Armenia and regional paleoclimatic reconstruction

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ABSTRACT

Indications of the Early Pleistocene paleopedogenesis were analyzed in multilevel sections of pedosediments at Early Acheulian sites within the Lori Plateau in Northern Armenia, with the purpose of reconstructing the paleoclimatic conditions during the initial stage of early human occupation of this region. At the study sites, lithic tools typical of the Acheulian technocomplex dating back to 1.4–1.9 Ma were found. The sections of studied pedosediments were shown to contain material from former paleosols that developed higher up the slope, then were eroded and transported by colluvial processes (presumably during catastrophic events) and finally redeposited in an inverted order at the foot of the slope. Three evolutionary stages of Lower Pleistocene paleosols were identified, which allow for paleoclimatic reconstruction of the initial stages of early human occupation of this region. In the earliest chronointerval, ~1.9–1.77 Ma, Vertic Cambisols and Colluvic Regosols Humic developed in the region, in savanna-like landscapes under (sub)tropical climatic conditions. Towards the end of this period, ~1.77 Ma, the climatic conditions remained sub(tropical), but became more humid, with the development of Stagnic Cambisols and Andosols with an abundance of redoximorphic features. During the latest period studied, between 1.77 and 1.4–1.5 Ma, the development of Luvisols indicates a stronger leaching environment under a permanently humid climate with significant cooling. Early hominin communities had to adapt to the cooler environment to be able to continue their uninterrupted development into the Middle Pleistocene.

1. Introduction

The importance of research on Pleistocene sediments is greatly enhanced if they bear traces of human occupation. Archaeological sites with insufficiently known Lower Pleistocene pedosediments are of particular interest. Most previous examples of paleopedological research are linked to studies on early hominin dispersal in Eurasia based on geoarchaeological analysis of loess sequences known as 'Loessic Paleolithic' (Ranov and Schäfer, 2000; Ranov, 2001). However, there are only very few studies on this topic outside loess regions.

Such studies outside loess regions have recently been undertaken on newly-discovered Lower Paleolithic multilevel sites within the Lori Plateau in Northern Armenia. The Lower and Middle Pleistocene deposits exposed in these sites contain lithic tools including hand-axes that are typical of the Acheulian industry or technocomplex (Aslanyan et al., 2007; Lyubin and Belyaeva, 2011; Belyaeva and Lyubin, 2013). The oldest layers yielding Early Acheulian lithic tools were excavated at the Muradovo and Karakhach sites (the latter also being investigated in the present study, see Fig. 1). These two sites are situated in the foothills of the Javakheti Ridge at the western border of the Lori Plateau, which more correctly should be defined as an intermountain depression (Gabrielyan and Kharazyan, 1967). On the basis of U-Pb and K-Ar

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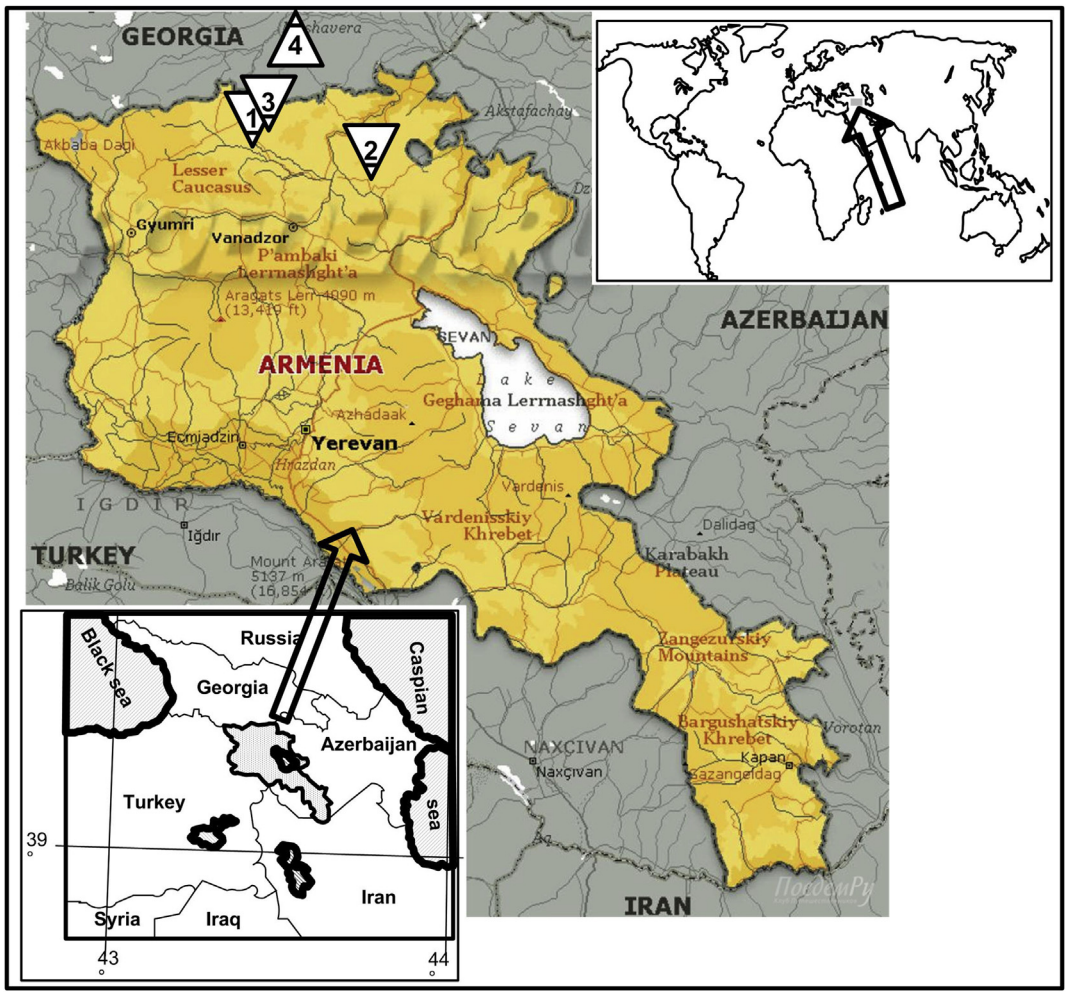

Fig. 1. Study sites and other nearby archaeological site locations. 1 – Karakhach; 2 – Kurtan I, 3 – Muradovo; 4 - Dmanisi.

dating of volcanogenic deposits below and above the pedosedimentary unit comprising Acheulian technocomplex as well as paleomagnetic readings of the entire pedosedimentary sequence at the Karakhach site, it was revealed that this locality was occupied by the early hominins during the Olduvai subchron of normal polarity, 1.9–1.77 Ma (Presnyakov et al., 2012; Trifonov et al., 2014, 2015). A similar age was attributed to the lower part of the Muradovo sediment sequence that contained lithic tools of the same Acheulian technocomplex (Belyaeva and Lyubin, 2014). Before the discovery of the Karakhach site, reliably dated Early Pleistocene sites in SW Asia were represented only by Dmanisi, Georgia (1.85–1.75 Ma, Oldowan industry) (Ferring et al., 2011) and Ubeidiya, Israel (~1.4 Ma, Early Acheulian industry) (Bar-Yosef and Belmaker, 2011). It should also be pointed out that Acheulian tool-makers lived at Karakhach and, probably, Muradovo at the same time as early hominins who produced a much more archaic Oldowan industry at Dmanisi, which is located just 35 km northwards (Belyaeva and Lyubin, 2014).

Evidence of Middle Acheulian industry was also found just 30 km eastwards of Karakhach – in the Kurtan I quarry at the foot of the Bazum Ridge (which is also being investigated in the present study, see Fig. 1). On the basis of chronostratigraphical and archaeological studies, tool-bearing paleosols at this site were dated at 1.4–1.5 Ma and attributed to the Early–Middle Pleistocene transition (Presnyakov et al., 2012; Trifonov et al., 2014).

Similarities between lithic tools recovered from Karakhach and Kurtan I sites suggest that they belong to the same Acheulian technocomplex of the Early and Middle Pleistocene (Belyaeva and Lyubin, 2014).

Calcareous features in the uppermost layers of pedosediments were earlier studied by the authors at Muradovo and Kurtan I, Points 1 and 2 (Sedov et al., 2011; Khokhlova et al., 2015). Here we revealed that such calcareous pedofeatures could not be regarded as indicators of environmental changes that occurred in the Early and Middle Pleistocene, because they formed within those layers much later, from the Late Pleistocene to the Middle Holocene, under lacustrine conditions.

Although the existing paleoclimatic archives provide a detailed reconstruction of global climatic trends, there is a need for additional data on regional-scale patterns of paleoenvironmental change. Such data can be obtained from paleosol research due to the high spatial resolution of paleopedological records (Targulian and Goryachkin, 2004). In particular, colluvial pedosedimentary sequences reflect the responses of geomorphic processes to paleoclimate change, e.g., paleosol buried under colluvial deposit may indicate a transition from stable to dynamic land surface (Yaalon, 1971; Richter and Yaalon, 2012; Retallack, 2008; Sauer et al., 2015).

In the present study, the paleopedological analysis was the main method of paleoenvironmental reconstruction due to the absence of faunal remains and pollen in the ancient pedosediments. We provisionally applied the term 'paleosols' to the layers that actually contained residues of former paleosols slightly mixed up with

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