



Loess in Armenia – stratigraphic findings and palaeoenvironmental indications



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ABSTRACT

Current loess research indicates a better understanding of the factors that determine the ways that loess (dust) accumulation and soil formation has responded to the rapid and variable Late Quaternary climatic changes across Europe and Western Asia. Lack of evidence of loess in the region between the Black Sea and Caspian Sea creates a critical gap in the geographical distribution of this deposit and hence inhibits our ability to examine properly the spatial distribution and processes of formation. The recent discovery of loess-palaeosol sequences in Armenia allows us to overcome this problem and preliminary investigations have yielded encouraging results. A research programme has been established to characterise, analyse and date sequences from NE-Armenia that are up to 45 m thick. This paper presents first results of this study and reports three well-developed pedocomplexes below a Holocene soil. The magnetic properties of the loess indicate mainly Caucasian sources and all palaeosols exhibit clear magnetic enhancement. Luminescence dating of the upper part of the sequences identifies deposition between 150 and 39 ka. During that period, loess deposition took place during MIS 6/4 and 3. A multiphase pedocomplex that documents progressive climate transition from initially humid to arid conditions, could be placed into MIS 5, although we found striking temporal offset between the phase of most intense soil formation and the Last Interglacial climatic optimum. Furthermore, colluvial slope deposits and erosional discordances provide information on distinct phases of landscape instability that are linked to interglacial periods and the transition to glacial conditions.

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1. Introduction

About 10% of the earth's land surface is covered by loess (Pécsi, 1990; Muhs and Bettis, 2003). However the contribution of loess to form land surfaces and the ecological importance of loess seems to be underestimated. Loess contributes to soils, even in lower latitudes (Zöller and Faust, 2009) and to periglacial cover beds and improves the physical characteristics and the fertility of soils. Thick loess sequences provide a valuable archive by which it is possible to reconstruct environmental history during the Quaternary, in particular the Middle to Upper Pleistocene. A major challenge for loess research is the correlation of different archives and time-planes over long distances. For this purpose stratigraphic reliability is a prerequisite, and this has been enhanced by the addition of

additional informative archives. This study aims to fill a significant gap in the global distribution of loess. Hitherto, loess distribution maps fail to show loess in the region between Europe and Western Asia (e.g. Jefferson et al., 2003; Muhs and Bettis, 2003; and others) (Fig. 1 inset). In this paper, loess-palaeosol sequences from Armenia, in that critical region between Europe and Western Asia described, analysed and interpreted for the first time.

These loess deposits are situated in an intramontane basin of the Lesser Caucasus, a point of intersection of the large Ukrainian/Eastern European loess area (e.g. Marković et al., 2015), the Southern Russian loess area (e.g. Bolikhovskaya and Molodkov, 2006), the Iranian loess deposits (Frechen et al., 2009) and the loess deposits of Central Asia (e.g. Dodonov and Baiguzina, 1995) (Fig. 1 inset). The studied sites show both pure loess layers and palaeosols or pedocomplexes developed therein. The archives provide valuable information ideal for the reconstruction of palaeoenvironmental and palaeoclimatic conditions, as well as palaeoedaphic characteristics. The aim of this study is to give a first

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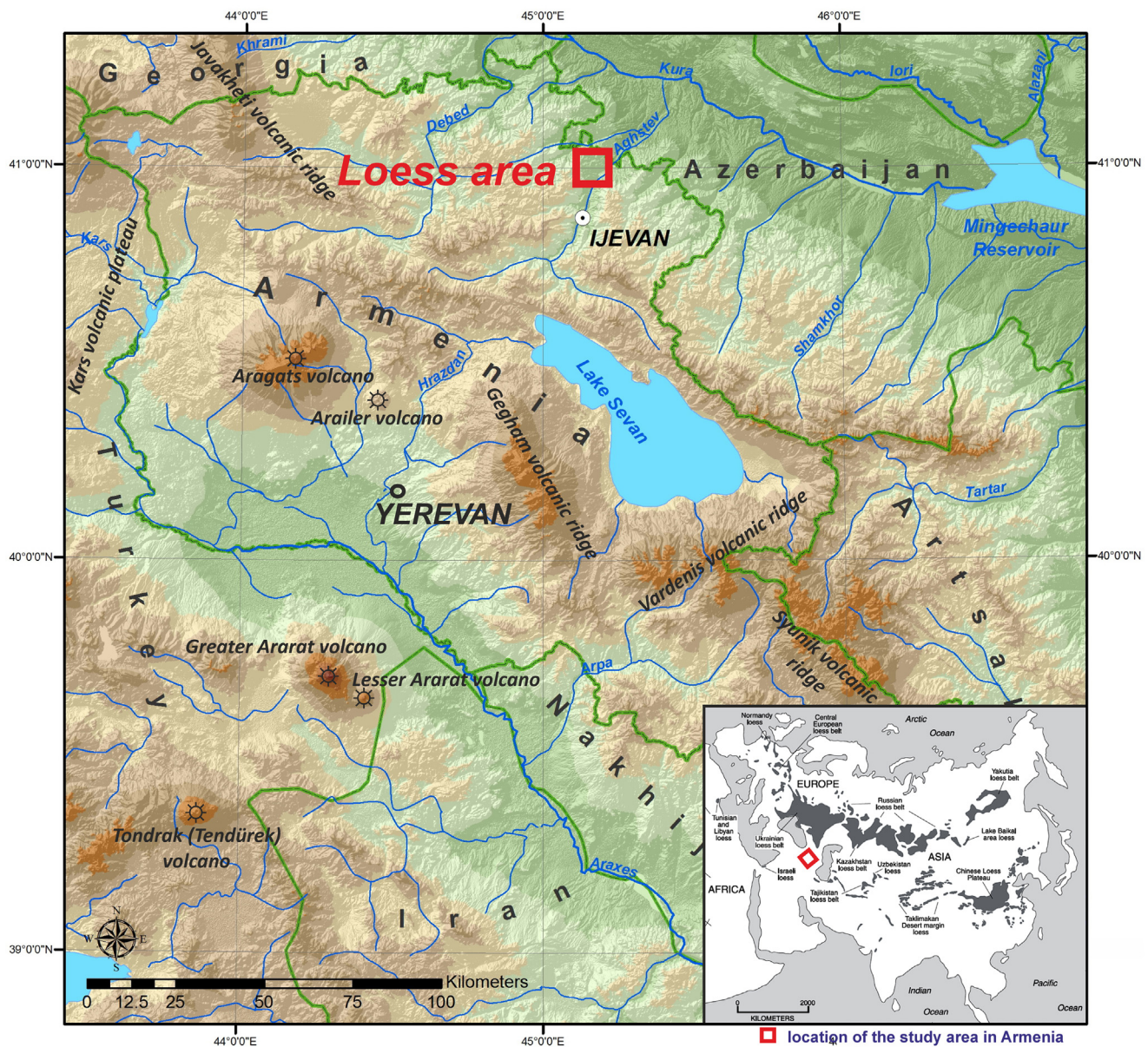


Fig. 1. Study area near Ijevan, Tavush province (NE-Armenia). Caucasian volcanic sources are indicated. Inset map showing distribution of loess in Eurasia From Muhs and Bettis (2003).

overview of this loess record with some general information regarding loess distribution and sedimentation patterns, and to provide a first insight in the stratigraphic succession of unaltered loess deposits, palaeosols, colluvial slope deposits, and volcanic ashes. This is then considered in terms of its global significance.

2. Geographical setting

The studied loess palaeosol sequences are situated in the north-eastern part of Armenia around the town of Sevkar (41°N , $45^{\circ}10' \text{E}$; Fig. 1) at an altitude between 680 and 960 m above sea level (a.s.l.). The profile sections are located in a tectonically formed depression within the catchment of the Aghstev River that drains into the Kura lowlands of Azerbaijan. The basement is composed of Late Cretaceous volcanic and volcano-sedimentary rocks. Deeply incised river valleys characterise the landscape and huge Quaternary landslide blocks and Quaternary

deposits line these valleys. Loess deposits form an extensive bedrock coating and hence level uneven surfaces of steeper slopes (Fig. 2B). Frequently, loess deposits built elongated ridges up to 14 m thick, 150 m wide and 1–2 km long (Fig. 2A) that appear to be similar to loess dunes (small forms of “gedras”) described by Leger (1990) and Antoine et al. (2001). These loess ridges mainly stretch from NW to SE or are related to leeward positions, and it is in these locations that the thick loess-palaeosol sequences developed (Fig. 2C).

The present climate of the loess area is characterised by an annual amount of precipitation ranging from 450 to 550 mm and a mean annual temperature of about 11°C . The most humid month is May with more than 80 mm mean precipitation, in contrast to wintertime (November–March) when only 20–30 mm mean precipitation per month is registered. January is the coldest month with a mean temperature of about 0°C . Warmest month is July with a mean temperature of about 23°C .

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