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The loess record from the section at Kurtak in Middle Siberia

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Abstract

Loess, loess-like sediments and the intercalated palaeosols along the bluffs of the river Yenisei provide a detailed Upper Pleistocene climate archive for the southern part of Middle Siberia. The section at Kurtak is one of the most detailed loess/palaeosol sequences in Middle Siberia. Two major periods of sediment accumulation were recorded in the sequence: the stratigraphically oldest one post-dating the last interglacial palaeosol and pre-dating the Kurtak Pedocomplex (oxygen isotope stage (OIS) 3); the younger one post-dating the Kurtak Pedocomplex and predating the Holocene soil. Three major phases of soil formation occurred during the Upper Pleistocene. The Kameny Log Pedocomplex (OIS 5e) consists of at least two pedogenetic episodes, a lower clayey chernozem forming during a more humid and warmer climate than today, and an upper chernozem representing a drier climate than today, the latter one including a well-pronounced carbonate-rich horizon. The Sukhoy Log Pedocomplex consists of a chernozem-like palaeosol and two kastanozjems (OIS 5c-a) and the Kurtak pedocomplex (OIS 3) with two chernozem-like palaeosols and up to three humic-rich layers. Additionally, weakly developed gleyed horizons are considered to represent palaeohydrological groundwater high levels. The results indicate a synchronous evolution of climate and environment change in both the more oceanic driven climate of West and Central Europe and Middle Siberia, as evidenced by luminescence dating results.

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1. Introduction

The loess records of West and Middle Siberia provide excellent high-resolution terrestrial archives of climate forcing for the past 130,000 years and older periods. The largest areas covered by loess and loess-like sediments are located in tectonic depressions of the West and Central Siberian platform, in the Altai

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and Sayan mountains and on their piedmont plains. In the study area, aeolian deposits are exposed along the bluffs of the rivers Yenisei and Ob in the north of the Sayan mountain ridge (Figs. 1 and 2).

In southern West Siberia, up to nine pedocomplexes are intercalated in the loess, post-dating the magnetic polarity change representing the Brunhes/Matuyama boundary (Arkhipov et al., 1997; Volkov and Zykina, 1991; Zykina et al., 2000a,b). The early Middle Pleistocene period is characterized by intercalated palaeosols of sub-boreal meadow forest-type and forest-steppe-type indicating an extended duration of soil formation, a higher annual temperature and increased humidity. In that part of the sequence representing the Middle Pleistocene, the intercalated palaeosols are similar to modern soils indicating a more continental climate. During the Upper Pleistocene, steppe-soils and dry steppe-soils formed under less warm and dry climate than during the Middle Pleistocene. Each soil formation was followed by a cold and wet cryogenic phase.

The present climate of southwest Siberia is intensely continental, with dominant winds from the southwest (Moskvitin, 1940), a mean annual precipitation of 588 mm at the Kurtak site and a mean annual air

temperature of $+0.1^{\circ}$ to -3.1° °C at the Balakhta site. In winter, the area of interest is meteorologically dominated by an anticyclone resulting in severe and dry continental climate with relatively thin snow cover. Therefore, the surface and the topsoils are deeply frozen in winter. Thawing occurs late in the year resulting in late microbiological activity in the soils.

The study area with the section at Kurtak is situated along the bluffs of the river Yenisei in the southwest of Krasnoyarsk. It is one of the most detailed Upper Pleistocene key sites in southern Middle Siberia (Fig. 2). Kurtak is a small village situated in the northeastern part of the North Minusinsk basin about 150 km southwest of the city of Krasnoyarsk. The profiles are exposed for about 12 km along the bluffs of the Krasnoyarsk water reservoir at 55.1° N and 91.4° E (Figs. 2 and 3). The southwestern flank of the Yenisei valley has an erosional topography and shows active deflation, whereas the northeastern flank is an area of sediment accumulation. After the construction of the water reservoir to the south of Krasnoyarsk, the Yenisei valley was flooded up to 65 m above its natural level. At present, the mean annual water level is at about 245 m asl. The slopes have

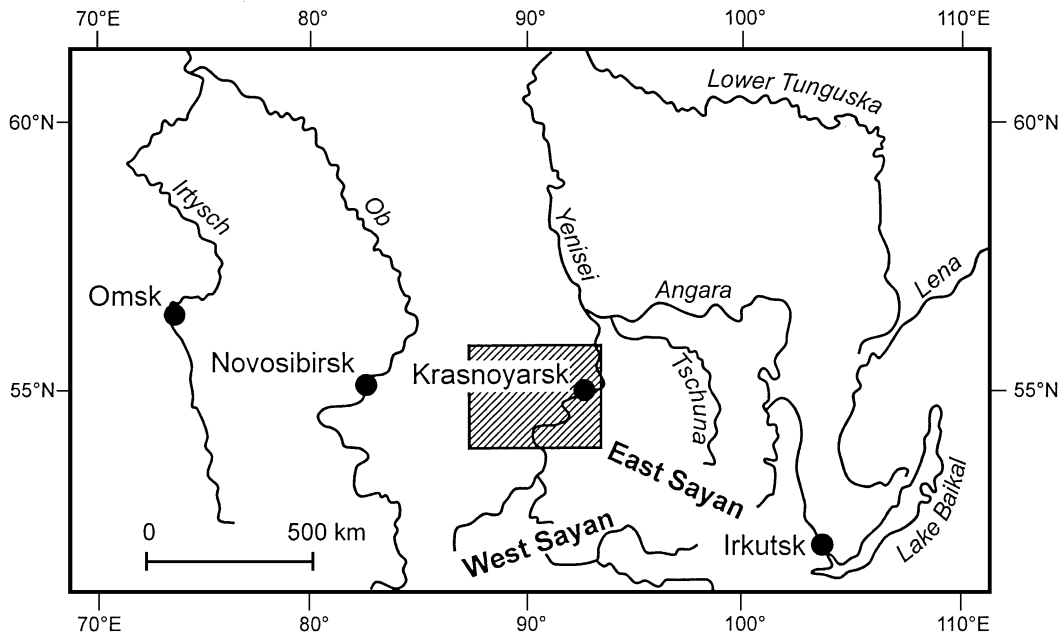


Fig. 1. Map showing the location of River Yenisei in Middle Siberia and the study area.

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