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Sarykul paleosol in Southern Urals sediments (Russia)

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ABSTRACT

Sarykul paleosols in the Southern Urals (Russia) with a stable position in geological sediments are considered. The Brunhes-Matuyama boundary was found in these paleosols and they were used as a source of information on the environment. Data were obtained during the study of the Sarykul paleosols in four sections located in the mountain part of the Southern Urals on the Miass River erosion-accumulation terrace and at the eastern edge on the trans-Uralian peneplain. Saykul paleosols have a relatively thick and compact humic horizon with a tongued lower boundary. The paleosols are dark grey with high TOC content that is not usual for the Early Pleistocene paleosols. The materials showed that Sarykul paleosols formed on different parent rocks may have various characteristics of the mineral part (texture, pH, magnetic susceptibility, carbonate content, ratio of exchangeable cations), while their humic substances characteristics (humic and fulvic acid ratio, humic acid characteristics of elemental composition and structure) are very similar. Climate conditions during Sarykul paleosol formation changed from relatively warm and humid to less warm and more humid. The study of Southern Urals Sarykul paleosols has shown that they can serve as a reliable marker of the final Early Pleistocene due to their specific characteristics, not analogous to the modern soils.

1. Introduction

The Southern Urals is characterized by a complex natural development history. Sarykul paleosols are well distinguished in geological sediments of this territory. The transition between Brunhes and Matuyama was found in the Sarykul formation, capped by the palaeosols (Stefanovskii, 2006). For this reason, they can indicate the Early–Middle Pleistocene boundary. Hence, these paleosols formed near 780 ka can be used as stratigraphic and paleogeographic markers and a source of information on the environment as well. However, data on them are extremely scarce.

All paleosols reflect relatively warmer periods of past climate. The position of paleosols near the Brunhes-Matuyama paleomagnetic reversal makes them interesting. On the one hand, they are used for correlations of stratigraphy of terrestrial sediments with marine isotope stages (Wang et al., 2006; Liu et al., 2008). On the other hand, the pedogenic properties of these soils are being carefully studied (Gendlera et al., 2006; Velichko et al., 2006; Faustov et al., 2009; Nawrocki et al., 2015; Zykin and Zykina, 2015) in searching for gaps in sequences and for conducting local correlations between sites within particular regions. According to Ryskov et al. (2008), Velichko et al. (2006), paleosols in the end of the Early Pleistocene were formed under the conditions of subtropical zone in the south and the central part of the East European Plain. At the same time, significant changes in climate over the last 0.8 Ma have not been revealed in East Central Europe (Ujvari et al., 2014). Thus, the data about the paleoclimate of the Early Pleistocene final are not numerous and the paleoenvironment model of this Pleistocene period has some gaps.

The Sarykul paleosols in the Southern Urals have not been studied earlier from the pedogenic position. Miass and Baturino are the most well-known among the Southern Urals sites where Sarykul paleosols horizons are clearly traced. Miass is in the sediments of a quarry in which clay is currently being mined. Baturino is in lacustrine and lacustrine-alluvial deposits of a former coal quarry (Fig. 1). Stratigraphic position, correlations, lithology-mineralogical and pollen-spectra characteristics of these objects, descriptions of molluscs, ostracods, bones of vertebrates in some of them, and the possible formation conditions were discussed earlier (Stefanovskii

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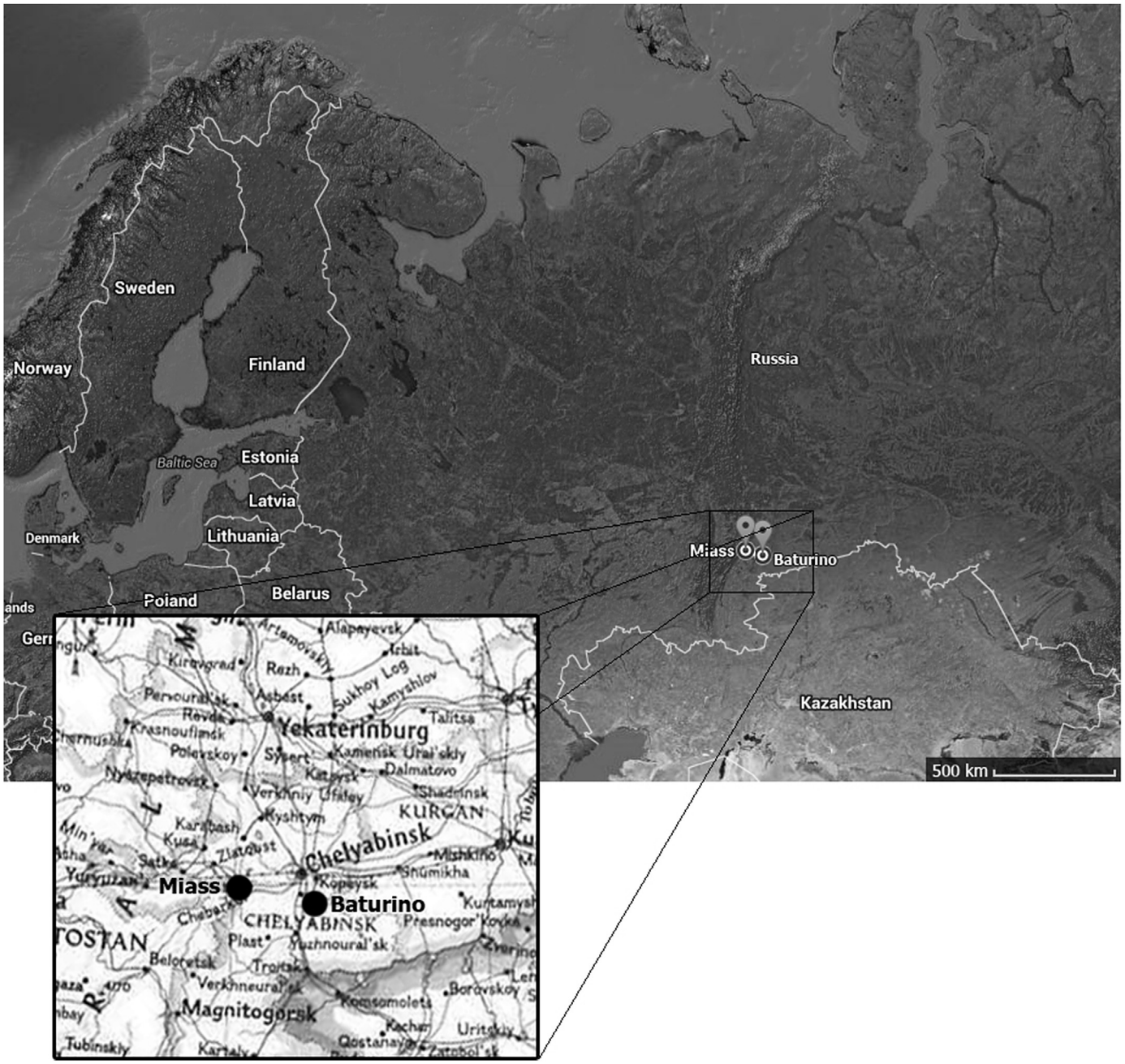

Fig. 1. Location of the study sites.

and Borodin, 1995, 2002; Borodin and Pogodina, 2000; Stefanovskii, 2006;; The Quaternary …, 2014; et al.).

However, systematic materials on the composition and properties of Sarykul paleosols are absent. There are no doubts that paleosols reflect and preserve the information about the conditions of formation in their properties and this information can be used for diagnostics and reconstruction of paleoenvironment (Yaalon, 1971; Sokolov and Targulian, 1976, 1977; Dergacheva, 1997, 2003; Retallack, 2001; Fedeneva and Dergacheva, 2006; Soil Memory, 2008; Dobrovolckiy and Dergacheva, 2012). Thus, the aim of the current study is to reveal the details of Southern Urals Sarykul paleosols and their formative conditions at the end of the Early Pleistocene on the basis of the set of pedogenic characteristics.

2. Study sites and methods

2.1. Study sites

Sarykul paleosols were disclosed in two sites, with two sections in each (Fig. 1, Table 1). Site Miass is located in the mountain part of the Southern Urals on the Miass River erosion-accumulation terrace (two sections are called Miass). Baturino is at the eastern edge in the trans-Uralian peneplain (two sections are called Baturino). The distance between the areas of our research is about 100 km. Parent material in the Baturino site is represented by thin layers of quartz silty sands, silts, and kaolinite-hydromica clays, while for Miass site it is known only that the parent material for

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