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## GENESIS AND GEOGRAPHY OF SOILS

# Natural and Anthropogenic Changes in the Soils and Environment of the Moskva River Floodplain in the Holocene: Pedogenic, Palynological, and Anthracological Evidences

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**Abstract**—Several series of well-developed paleosols of different ages have been examined on the Moskva River floodplain. In the beginning of the Holocene, forest-steppe biomes were widespread in this area, and dark-humus (Black) soils with stable humate humus and without features of textural differentiation predominated on the floodplain. The presence of meadow-steppe vegetation communities during this period is confirmed by the results of palynological and anthracological analyses. The lower paleosol in section RANIS 2 is represented by the deep humus horizon with $^{14}C$ dates from 5500 to 8400 BP and the carbonate-accumulative horizon; it also contains large and deep tunnels of burrowing animals typical of chernozems. Wood charcoal is absent, and pollen of *Artemisia* and *Chenopodium* species predominates. Paleosols of the second half of the Holocene are represented by gray-humus and soddy-podzolic soils (Luvisols). In these soils and in the alluvial sediments, beginning from the Subboreal period, pollen of trees predominates; there are abundant charcoal of spruce and burnt spruce needles. In that time, forest-steppe and broadleaved forest biomes on the floodplain were replaced by southern taiga biomes. The second half of the Holocene is also specified by the human impacts on the local landscapes. Palynological and anthracological data attest to the large-scale burning of forests for pastures in the Bronze Age and, later, for cropland. The paleosol of the Iron Age is enriched in humus. It contains tunnels of burrowing animals related to the stage of anthropogenic meadows. It also contains pyrogenic calcite. The recent centuries have been characterized by extremely high floods triggered by the human activity; they have been accompanied by the fast accumulation of coarse-textured alluvial sediments and the formation of weakly developed alluvial soils.

*Keywords:* paleosols, paleobotanical methods, extreme environmental conditions, forest zone, dark-humus soils

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## INTRODUCTION

Studies of the series of buried soils that are often present on floodplains are of great interest for the reconstruction of the environment and human life in the Holocene (Fig. 1) [4, 6, 14, 20, 53]. Floodplains are characterized by the complicated stratigraphy; floodplain sediments may include buried soils, peat layers, and specific sediments of oxbow depressions that can be studied with the use of the methods of paleogeography [29, 41, 51]. Floodplain sediments may also include cultural layers (archaeological deposits) of different ages, which makes it possible to study anthropogenic processes that have taken place in river valley landscapes [27, 53]. The series of buried soils and cultural layers are known for the floodplains of the Moskva, Oka, and other rivers in the center of the European part of Russia [2, 6, 8, 14].

Often, the series of buried soils on floodplains encompass the entire Holocene history. Seven major soils dated from the Allerød and Early Holocene to the modern time are described on the floodplains [1, 19]. These soils differ in their taxonomic attribution, age and duration of formation, and character of covering sediments ensuring the degree of preservation of the initial soil features in the buried state and controlling the degree of the anthropogenic transformation of the soils [1, 18, 26]. Certain cycles in the development and burying of the soils have been identified [19]. It is argued that layered and, usually, poorly developed floodplain soils forming under conditions of regular