

Morphological evidences of polygenetic soil formation of soils on bipartite sediments

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Base tills of Moscow (Late Saalian, Warthe, MIS6) glaciation form important component of landscapes in northern Europe, including the center of the Russian Plain. They are often covered only with a thin veneer of sands, sandy and silty loams, so that surface soils are formed on bipartite sediments.

Such bipartite sediments are among the oldest parent materials for surface soils subjected to pedogenesis starting from Late Moscow time till now. This was confirmed by numerous OSL datings of cover layer and spatial field studies. An assemblage of features was formed within several climatic cycles, they were subdivided to pre-depositional and syn-depositional (both lithological), post-depositional (cryogenic and pedogenic).

A hierarchical morphological approach was used to study an assemblage of pedogenic features on macro-, meso-, microscale. And allowed us to subdivide structural peds to several types, characterized by own type of faces and edges. It was shown that different types of coatings cover certain types of structural units. We have described six types of coatings: 1) thin non-laminated yellow clay coatings 2) thin non-laminated brown clay coatings 3) dark-brown reticulate coatings 4) silty-humic coatings 5) silty coatings 6) compound multi-layered clay cutans. Some multi-layered cutans consist of up to five types described above. Their total thickness reach 4-5 mm. Simultaneous analysis of ped types interposition with a set of coatings on them answered the question about the order of their formation.

Based on the study of the assemblage of morphological features we consider a set of critical points in their development: stage 0 – bipartite sediments at deposition (MIS6); stage I – initial cracking, development of prismatic structural units (MIS6-5 transition); stage II – development of the first generation of trans-horizon cracks (soil formation, MIS 5e); stage III – frost cracking, development of platy structure and frost fissures (MIS4, MIS2); stage IV – development of the second generation of trans-horizon cracks (Holocene). The features of interstadial pedogenesis (MIS3) known from the pedosedimentary sequences in slope deposits of this region could not be separated in the bipartite sediments at this stage of research.

Impact of a pedogenesis during the last interglacial (MIS5e) is resulted in the formation of pedogenic structural architecture (cracks, superimposed on earlier prismatic units, subangular blocky peds) and well-developed multi-layered clay cutans. These lead to the formation of a sequence of Bt horizons. Holocene pedogenesis being mostly of eluvial-illuvial character, probably strengthens initial lithological discontinuity of bipartite parent material. Soil horizonation is clearly seen within the upper unit (a sequence of A and E or Bw horizons), while the boundary between the basal till and the frost fissures remains abrupt.

Clear record of final stages of sedimentation and ancient pedogenesis within profiles of day-surface soils in glacial tills may help to derive reliable palaeoclimatic interpretation from the last interglacial - glacial cycle till present. Correlation of these records with other archives in glacial and periglacial areas opens attractive research perspectives.

Research was supported by the Russian Foundation for Basic Research, Project №17-04-01221 and the Russian Science Foundation, Project №14-27-00133.