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Soils of Maritime Antarctica: influence of ornithogenic factor on soil development, functions and processes

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Antarctic soils are known as very diverse in morphology, chemistry, texture and mineralogical composition. Differences in geographical locations and existence of so-called Antarctic oases, which are isolated from each other by ice sheets and snow masses causes significant pedodiversity of Antarctic continent. In severe climatic conditions of Antarctica birds play an important role in transportation of organic matter to the coastal landscapes. This study is aimed to investigation of ornithogenic factor in soil formation on King George and Ardley islands (South Shetland Islands). Our work revealed that redistribution of guano components affects significantly the speed of soil cover spatial development and formation of new polypedons of soils in environments of rookeries. Analysis of mesomorphological organization of soil aggregates showed different rates of association between guano remnants and mineral grains in humus horizons, which is caused by variability in both fine earth content and guano decomposition rate. In this study, 13C-NMR spectroscopy was performed to analyze soil organic matter of Ornithosols, Post-Ornithosols and Cryosols not affected by bird activity. We found that the humic acids (HAs) of the cryoturbated, buried areas had lower amounts of alkyl aromatic and protonized aromatic compounds. In contrast, the HAs from the surface layers contain less alkyl carbon components. Our data showed that the portion of aromatic compounds is little higher in soils under materials transported by birds compared to soils under mono species of bryophyta or lichens communities. This is probably caused by the fact that birds use mainly remnants of Deschampsia antarctica (which contains increased portion of phenyl-propanous organic precursors) for nest building. The free-radical content was higher in the surface layers than in the buried layers due to the presence of fresh organic remnants in superficial soil samples. Measurements of electrical resistivity of soil and permafrost layers were performed with a portable device LandMapper with vertical electrical resistivity sounding approach (VES). Permafrost table depth in studied soils ranged from 89 to 100 cm. Cryoturbation process and supra-permafrost accumulation of moisture which are widespread in the studied soils, lead to cryogenic mass transfer, heterogeneity of soil mass, and complication of the profile distribution of electrical resistivity values. The character of parent material determines temperature and water regime in soil, rate of cryopedogenesis, dynamics and thickness of active layer and permafrost table. This study was supported by RFBR, grant 18-04-00900 “Ornithogenic soils of Antarctica: formation, geography, biogeochemistry and bioindication”.