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The biological factors influence on the conversion of mineral components of Extremely Arid Desert Soils (Kazakhstan)

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Extremely arid soils of stony deserts (hamadas) along the southern periphery of the Ili Depression are considered to be analogous to extremely arid soils of Mongolia, also named as “ultra-arid primitive gray-brown soils.”
In general, the morphology of extremely arid soils of hamadas in the Ili Depression is similar to that of the soils of stony deserts in other parts of the world, including the Gobi, Atacama, and Tarim deserts.
The diagnostics of the active communities of microorganisms were performed according to the method of Rybalkina–Kononenko.
The exact identification of the living forms of microorganisms to the species level is not always possible with the use of this method. However, it allows us to study the physiological role of the microorganisms and their ecological functions, including the relationships with the soil matrix and other organisms. In particular, it is possible to estimate the contribution of the microorganisms to the transformation of mineral soil components.
The obtained materials allow us to conclude that the extremely arid desert soils are characterized by the very high biological activity during short periods of the increased soil moistening after rare and strong rains. The diversity of living forms is very considerable; both prokaryotes (cyanobacteria, actinomycetes, and iron bacteria) and protists (green algae, diatoms, and dinoflagellates) are developed in the soil.
Thus, during a short period after the rains, these microorganisms pass from the stage of anabiosis to the stage of active growth and reproduction. Then, upon drying of the soil, the biotic activity of the soil slows down and, finally, terminates. The organisms remain in the state of anabiosis until the next rain.
During the period of active growth, the microorganisms compose a specific consortium of different species and exert a profound impact on the soil properties. They participate in the transformation of the soil minerals with the formation of amorphous substances that are clearly seen in biofilms on the surface of gravels of the desert pavement and on the walls of vesicular pores in the crust and subcrust (AKL) horizons of the soil. The organomineral compounds are accumulated in the vesicular pores due to the synthesis and mineralization of the microbial biomass. This is a specific feature of the humus-accumulative process in the extremely arid desert soils.
The biogenic transformation of iron-containing minerals, the mobility of iron, and its accumulation in films and coagulated microforms is largely due to the living activity of iron bacteria. These iron pedofeatures are specific of the extremely arid desert soils. We suppose that some part of vesicular pores in the AKL horizon has a microbiological origin, because separate bacterial cells may form intracellular gas vacuoles and extracellular gas bulbs, as well as membrane sacs and cell dilatations that can shape the vesicular pores.
In general, our data indicate that soils, including extremely arid desert soils, serve as reservoirs of the microbial diversity and ensure the development and preservation of diverse microorganisms with specific mechanisms of adaptation to the sharp changes in the environmental conditions. This biota-protecting role of soils is particularly well pronounced during the climatic pessimum.
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