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Phosphorus biogeochemistry in alpine ecosystems of the Northern Caucasus

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The study of phosphorus biogeochemistry in an alpine landscape of the Northern Caucasus has been spent in the Teberda Biosphere Reserve on the experimental plot with total area of 3.9 ha (150 m wide, 260 m long, altitude differences 100 m) and on the plots of long-term experiment on studying of nutrients application influence on alpine ecosystems located in the eastern slope of Mt. Malaya Khatipara. Results of studying of phosphorus concentrations and store in alpine soils and plant phytomass indicated differences for diverse alpine ecosystems along geochemical gradient. Although biological accumulation of phosphorus in the upper part of soil profiles was general characteristic of all ecosystems, it is shown that geochemical redistribution of phosphorus from eluvial to accumulative parts of a landscape is the main thing in the course of phosphorus and its labile compounds accumulation in soils of the alpine communities of accumulative habitats. In turn, biological accumulation of phosphorus in soils of different alpine ecosystems redistributes an element in a soil profile with different intensity depending on capacity of biological cycle. The biological factor causes also prevalence of organic compounds among of phosphorus migrating forms in modern soils and in a landscape. As inorganic (0.01-0.02 mg/L) as organic (up to 0.17 mg/L) phosphorus leaching in the eluvial soils was from 2 to 5 times lower compared with soils of accumulative positions in a landscape. Soil phosphorus fractionation on organic and inorganic compounds of different geochemical mobility and biological availability indicated differences of phosphorus state for diverse alpine ecosystems along the experimental plot. The minor proportion of 0.5 M NaHCO3 (pH 8.5) extractable labile organic and inorganic phosphates was general characteristic of all studied soils, although especially low proportion of labile phosphorus compounds was typical for lichen heath soil, while soils of snow-bed communities contained higher proportion of labile phosphorus. Organic phosphorus mineralization was highest in soils of grassland and meadow communities of transit landscape positions where conditions for biological activity are more favorable. Lower mineralization in the eluvial lichen heath soil is controlled by depletion of mineralizable substrate with nitrogen and phosphorus, while in accumulative snow-bed and bog soils lower mineralization is probably controlled by high concentration of available inorganic phosphorus and high soil moisture. The study of soil phosphorus state and biological circle transformation as a result of long-term phosphorus application indicated phosphorus redistribution between different fractions of phytomass and between different soil phosphorus compounds. The main part of phosphorus has been fixed in the form of stable inorganic phosphates (about 50%). Below ground phytomass accumulated about 20% of the total applied phosphorus, and 10-15% has been accumulated in the sum of above ground phytomass and available inorganic soil phosphates. Lysimetric studies indicated that applied phosphorus migration to the lower horizon was different in various alpine ecosystems. Phosphorus leaching in the soil of lichen heath was minimal, while in the soils of snow-bed communities of the bottommost topographical positions leaching can be significant.