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Nitrogen-15 natural abundance of different soil N pools as a tool for assessing N transformation processes in alpine soils

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Nitrogen availability, net N mineralization, nitrification and 15N natural abundance of total soil N and small soil N pools (N–NH4+, N–NO_3–, DON and microbial biomass N) were studied in a toposequence of alpine ecosystems in the Northern Caucasus. The toposequence was represented by (1) low productive alpine lichen heath (ALH) of the wind-exposed ridge and upper slope; (2) more productive Festuca varia grassland (FG) of the middle slope; (3) most productive Geranium gymnocaulon/Hedysarum caucasicum meadow (GHM) of the lower slope and (4) low productive snow bed community (SBC) of the slope bottom. Nitrogen transformation in the alpine soils produces distinct N pools with different 15N enrichment: DON/microbial biomass N > total N > N–NH4+ > N–NO_3–. Grassland and meadow soils of the middle part of the toposequence are characterized by higher nitrogen transformation activities and higher δ15 values of total N and N–NH4+. Field incubation of alpine soils increased δ15N of N–NH4+ from –2.6 – +2.0‰ to +6.1 – +15.7‰The N–NO_3–produced in the incubation experiment had extremely low (negative) δ15N values (up to –14‰. We found a positive correlation between δ15N of different soil N pools (total N, N–NH4+ and N–NO_3–) and net N mineralization and nitrification. Nitrification controls the formation of 15N enriched N–NH4+ pool while N mineralization probably had an important role in regulation of 15N enrichment of DON pool in alpine soils. Overall, our results support the hypothesis that 15N is more enriched in N-rich and more depleted in N-poor ecosystems. We conclude that δ15N values of different soil N pools could be a good indicator of microbial N transformation in alpine soils of the Northern Caucasus.
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