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# Fallout and Environmental Radionuclides for Estimation of Recent Environmental Changes in Maly Azau Glacier Area (Central Caucasus)

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Over the last decades, glaciers of Central Caucasus are undergoing intensive retreat in response to recent climate change. Fallout radionuclides (FRN's) and environmental radionuclides (ERN's) both are useful instruments in studies of soils and sediments on glacial landforms that can help to define the direction of the sedimentation process and relative age of moraines as well as the lithological difference between different landforms.

The study area is situated on the South-Western slope of the Elbrus mountain - between the tongues of Maly Azau and Bolshoy Azau glaciers near Maly Azau proglacial lake. Due to the intensive fluctuations of Maly Azau Glacier the terrain of adjacent area is a complex of bottom moraine deposits together with recent ablation moraine deposits, patches of outwash planes (sandurs), and proglacial lake sediments of different age. The area is eroded by active stream channels from the meltwater of the glacier and former stream channels. The sediments deposited due to the exogenous processes overlay the magmatic rocks. The slopes of Elbrus are composed mostly of tuff, dacite, rhyolite that are highly affected by weathering and therefore provide material for moraines and screes.

The selection of sampling points aimed to obtain information from different geomorphological units: three moraines corresponding to different stages of Maly Azau glacier retreat (frontal moraine, moraine presumably formed in 1950-1970-s and more recent moraine).The objective was to assess if soil characteristics and pattern of FRN's and ERN's are affected by different stages of ice retreat. In samples of soils and sediments from the depth of 2-4 cm FRN's ($^{137}$Cs, $^{210}$Pb) and ERN's ($^{40}$K, $^{226}$Ra, $^{232}$Th, $^{238}$U) activity was studied also such characteristics as grain size, soil organic carbon (SOC) content and SOC fractions content were studied.

The results show strong positive correlation ($R^2$=0.91) between $^{137}$Cs activity and the stage of ice retreat and also positive correlation ($R^2$=0.97) between SOC and stage of ice retreat: samples from frontal moraine were characterized by higher FRN's activity and higher SOC content in comparison to samples from more recent moraines. Frontal moraine received the most significant dose of radionuclides from Chernobyl accident and probably from nuclear tests of 1961-1963. In addition, the development of soil processes was the most intense on frontal moraine, which is proved by relatively high content of SOC. The $^{40}$K activity in sediments show higher values in sediments of presumably more recent moraines, this lithological difference is also reflected in the colour of sediments: sediments that are more recent contain more black rocks that can be dacite and andesite lavas, while sediments of frontal moraine contain reddish rocks that could refer to volcanic tuffs and pumices.

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