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Erosion and sediment enrichment ratio in volcanic soils

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Patagonian Andean region is widespread affected by soil degradation and erosion processes. The subhumid sector, which corresponds to the transition (ecotone) between the Andean forests and the Patagonian steppe, has suffered the highest human pressure and overgrazing, accelerating the soil erosion processes.

Near Esquel town (Subhumid sector of Chubut province, Argentina), where soils are mainly developed from volcanic ashes, erosion studies based on fallout radionuclides (Caesium-137) and simulated rainfalls were performed. Studies based on Caesium-137 showed that soil losses in the last 50 years were higher than 30 m^3 ha^{-1} $year^{-1}$ under different land uses.

Rainfall simulation experiments, carried out under the same conditions (Rain fall intensity: 100 mm h^{-1} for 30 minutes; Drop diameter: 2.5 mm; Drop velocity: 5.3 m s^{-1}) showed that erosion rates are highly affected by land use. Potential erosion rates in degraded rangelands varied between 143 and 750 g m^{-2}, depending on soil characteristics (such as texture and presence of non-crystalline materials), soil cover and slope. In mature exotic conifer afforestations, with soil completely covered by litter, soil erosion was negligible, varying between 0 and 10 g m^{-2}. Erosion rates increased both in young afforestations with open canopies (8 a 44 g m^{-2}), and in mature afforestations where fresh litter and duff layers were removed (35 a 200 g m^{-2}).

In the different studied systems, soil losses involved not the detachment of individual particles, but of soil micro aggregates rich in organic matter. Sediments enrichment ratio was always higher than 1, varying between 1.2 and 1.8. These results show that the sediments were enriched with organic matter, as compared to the contributing soils, indicating its selective removal. The erosion studies performed evidence the high erodibility of volcanic soils when their cover is lost, and the close link between erosion and carbon losses in these systems.