Vegetation and parent material influence on pedogenic rates in the Western Italian Alps

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Climate changes have huge impacts on alpine ecosystems. One of the most visible effects is glacial retreat, which caused the exposure of previously glaciated surfacessince the end of the Little Ice Age (190-190 years ago).These surfaces are open-air laboratories, verifying theories regarding ecosystem and soil development.

In order to increase our knowledge on the effect of vegetation andsubstrate on pedogenic processes and rates, we sampled soils and surveyed plant communities in the proglacial areas of the Lys and Verra Grande glaciers, in the Italian north-western Alps (Valle d'Aosta). Sampling sites were located on dated sites, based on literature or historical images. Chronofunctions of organic carbon, nutrients and spodic properties were calculated, based on the results of standard analytical data of soil samples, derived from all genetic horizons.

Glacial till is attacked by weathering processes immediately after deposition and stabilization, such as loss of soluble compounds, acidification, primary mineral weathering. The speed of these processes are largely increased after the establishment of a continuous vegetation cover, thanks to organic matter accumulation caused by litter input and root decomposition below the soil surface. The speed of plant colonization, in turn, depends on early weathering of the parent material, which releases nutrients according to the primary mineral composition. Observing a lithological gradients from sialic (gneiss), serpentinite with small gneiss addition and pure serpentinite below timberline, we can observe the different rates of subalpine climax vegetation encroachment: on gneiss (Lys glacier), patches of larch-Rhododendron forest were formed in less than 90 years, and a quasi-climax subalpine forest was formed on extensive surfaces deposited before 1921. The same vegetation type established itself in more than 150 years on serpentinite with small gneiss inclusions, while the same time span was not sufficient for the formation of a continuous vegetation cover on pure serpentinite. This different rate of plant primary succession depends on nutrient scarcity (P in particular) on pure serpentinite and on toxic heavy metal concentrations and it is reflected in the reduction of the soil organic matter and nutrient accumulation through biocycling in initial serpentine soils. Chronofunctions of organic matter and nutrient accumulation are however complicated by the onset of podzolization which starts soon in the larch-Rhododendron subalpine forest. In fact, genetic eluvial horizons form in just 60 years, while diagnostic albic horizons are developed after ca. 90 years, evidencing an early start of the podzolization processes, particularly on gneiss, where chronofunctions of spodic properties evidence the formation of "true Podzols" in around 600 years. The same process starts later on serpentinite with small gneiss inclusions, immediately after the encroachment of the subalpine climax vegetation. On pure serpentinite, no evidences of podzolization are visible in the first few hundred years.

Under grazed grassland below timberline and alpine prairie above timberline, acidification and weathering were slightly slower than under forest, and no redistribution with depth of Fe and Al oxi-hydroxides was observed. Organic matter accumulation was faster and longer-lasting than below forest vegetation, thanks to a reduced leaching; on serpentinite-rich parent materials, all chronofunctions showed a slower rate of accumulation of pedogenic compounds

The chronofunction of pH decrease, organic matter and nutrient accumulation or leaching and of spodic properties were thus different in relation to the lithological composition of the morainic parent material. The encroachment of coniferous forest with Ericaceae represented an important

pedogenic threshold, allowing the development of podzolization processes in a shorter time in comparison to other land covers.