



High mountain soil sequence at the Páramos of Cotopaxi volcano, Ecuador

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Very little is known about high-mountain cryopedogenesis under Páramo vegetation in the Andes. We studied soils along a typical toposequence at the periglacial zone on the northern flank of Cotopaxi volcano, Ecuador, emphasizing the cryopedogenesis process and altitudinal soil climatic regime, in soils ranging from 3980 to 4885m, above the tree line and below the snow line. At each site, a complete set of instruments (sensors and datalogger) were installed to monitoring air and soil temperatures and moisture, at five soil depths, in three different elevation points; in addition we selected, described and sampled six representative soil profiles, according to local variations in vegetation cover, topography, presence of snow and elevation; soils were studied concerning the petrographic composition, mineralogical, physical and chemical properties of different soil fractions. The geology of the Cotopaxi volcano is complex due to recent volcanic activity. Petrographically, the most recent ejected material is of Andesite-rhyolitic composition, with large deposits of tephra, and solifluxion lobes forming a mixed debris mantle. The landforms are characteristic of a stratovolcano, with conical and symmetric formations, with a dissected, broad base with gentle slopes, changing to steep slopes and eroded, rugged peaks, displaying periglacial erosional features. Also, we find cumulative sedimentary materials of periglacial origin in the lower parts of the landscape. Soil monitoring temperatures for one year showed that the surface soil is warmer than the air temperature for the three elevations, even under snow cover, indicating a strong thermal insulation of these volcanic soils. No permafrost was detected at the 200 cm section. The volcanic soils are stratified, with alternating layers of ash and lapilli, with pumices, with predominantly coarse textures and low clay content, features that may contribute to the observed insulation. Mineralogical analyzes indicated the presence of easily weathered minerals such as apatite, olivine, pyroxenes and feldspars, resulting in high exchangeable levels of Na, P and K, and the large amounts of Fe, present in the ferromagnesian minerals in the volcanic parent materials. The six profiles described were classified according to the WRB (FAO): 3 was classified in the class of Regosol, 2 as Leptosols, and 1 as Cryosol, and the Soil Taxonomy, 3 was classified in the class of Inceptisol, 2 as Entisol and 1 as Gelisol.