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Mobility of major and trace elements in andosols from Iceland: correlating extent of chemical weathering with climatic conditions at soil formation sites

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Element mobility within volcanic soil profiles developed in diverse climatic conditions in Iceland is assessed. Soils were selected from areas with good monitoring of annual temperature and precipitation and the degree of weathering and elemental behavior was compared. Most soils in Iceland develop in parent materials of volcanic origin, including a variety of basaltic and andesitic tephras, hyaloclastites and glacial tillites. Most Icelandic soils are subject to considerable flux of eolian deposition and in times receive tephra ejecta from volcanic eruptions. In this study, samples were carefully extracted from brown and gleyic andosol horizons for major and trace element analysis. Each horizon is representative of a pedogenetic stage. Preliminary results show that the major elements TiO_2, Al_2O_3 and Fe_2O_3 (T) (mean wt% = 3.4, 19.2, 17.3) appear immobile relative to the parent material (p.m. mean wt% = 1.6, 14.6, 10.9) and are found enriched within more mature horizons. The base cations MgO, CaO and Na_2O (mean wt% = 4.11, 7.23, 1.8) are depleted in these horizons (p.m. mean wt% = 9.1, 11.8, 2.0) showing mobilization during pedogenesis. The trace elements reveal no strong enrichment/depletion trend with a range of mobility from mobile to immobile Rb, Zn, Y, Sr, Ba, Ni, La, Cr, Cu, Nd, V, Zr and Nb. Soils developed in colder and dryer climatic conditions in Iceland (MAT = -1°C and MAP = <700mm) show less the effects of chemical weathering (CIA-K = 45) while soils developed in warmer and wetter climates (MAT = 4°C and MAP = >1000mm) show higher levels of weathering (CIA-K = 50-65) and element mobilization. The parent materials have a CIA-K weathering index of 37. The relationship of the covariance of the climate parameters with extent of chemical weathering may be quantified as climofunctions to deliver proxy climate data under cool to subarctic conditions. Our results may yield reasonable tools for determining past climate variations from weathered tephras found as paleosols in the Neogene lava piles of Iceland and other volcanic provinces.