Geophysical Research Abstracts
Vol. 17, EGU2015-14007, 2015
EGU General Assembly 2015

Physical and chemical properties of young soils of the Icelandic highlands

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Most of the Icelandic soils are of volcanic origin, classified as andisols (carbon content 1-12%), many of which are strongly affected by erosion and so, formation of new soils is of great interest. The effect of land cover type on the weathering patterns and the formation of new soils are of interest. The southern Icelandic highlands are characterised by harsh climate, shallow soils and limited vegetation cover. We hypothesise that in the highland regions of Iceland the progression of land cover from unvegetated to vegetated sites will impact soil development. This study describes the physical and chemical properties of highland soils in Iceland. Soil samples were collected from 12 sites in September 2013, nine sites were fully vegetated and three unvegetated: grassland (G1-G8), with moss, *Carex Bigelowii* and dwarf shrubs, sandy fluvial wetland (S) and unvegetated gravels (M1-M3).

All soils with vegetative cover were characterized by weak or structureless soil ranging in texture from loamy sand to silty clay loam, while at unvegetated sites soil texture was structureless and sandy. On average, the bulk density of soils (range 0.53 – 1.16 g cm^{-3}) were lower at vegetated sites than unvegetated sites. The soil depth is greater in the vegetated sites, indicating greater soil development. The average % carbon (%C), % nitrogen (%N), overall % soil organic matter (%SOM), of vegetated sites were higher than for unvegetated sites, indicating the difference in soil development: vegetated sites (mean), 1.60%C, 0.10%N, 4.9%SOM; unvegetated sites (mean), 0.27%C, 0.02%N, 1.81%SOM.

All soils had significant amounts of amorphous clay minerals such as allophone, imogolite, ferrihydrite or aluminium-humus complexes and also high aluminium and iron percentages, and high phosphate retention. All of which are characteristic for andisols. There were strong associations between Fe and Al and the soil C, which are indicative of Al and Fe complexed with humus or allophane and ferrihydrite clays. The allophane and ferrihydrite content was 3.5-7.7% and 2.4-5.3%, respectively. The soils in the study had a high clay content, generally greater than 10% for all soil types. However, selective dissolutions with oxalate and with pyrophosphate indicate that more organic carbon was associated with the Fe and Al of vegetated sites than observed for the vegetated sites. These results also indicate more organic associations in sites with vascular plants and mosses vs mosses only. The %C, %SOM, Fe/Al associations, soil structure and soil depth all indicate that there is gradient of increasing soil genesis form unvegetated to vegetated sites, with evidence of greater organic associations in sites with vascular plants. Even though the soils at the vegetated sites are andisols, they are still immature , while the less developed soils at the unvegetated sites are vitrisols ($<$1% C) and have not yet developed into andisols. Nevertheless, both soils are still undergoing pedological transformation.