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Controls on salt mobility and storage in the weathered dolerites of north-east Tasmania, Australia

Margaret Sweeney and Leah Moore
Dryland Salinity Hazard Mitigation Program, Institute for Applied Ecology, University of Canberra, ACT, Australia

Changes in land use and vegetation due to agriculture, forestry practices and urbanisation can mobilise naturally occurring salts in the landscape and accelerate the expression of land and water salinisation, potentially threatening built and natural assets. Some salts are released during rock weathering or are derived from marine sediments or wind-blown dust, but in Tasmania most originate from salt dissolved in rainfall that is concentrated during evaporation. The volume of salts deposited over north-east Tasmania from precipitation exceeds 70kg/ha/year. The dominant lithology of the salt affected regions in Tasmania is dolerite which breaks down to form secondary minerals including: smectite and kaolinite clays and Fe-bearing sesquioxides. The weathering of Tasmanian dolerites, sampled from fresh corestones, weathering rinds and sequentially through the soil horizon, has been examined petrographically and geochemically.

The EC1:5 increases with weathering to a maximum 4.9 dS/m and decreases in the pedogenic zone. This confirms field observations that deeply weathered dolerite can serve as a significant store for salt in the landscape. The water associated with dolerite weathering is typically a bicarbonate fluid. The pH1:5 decreases as the samples weather and increases in the pedogenic zone. Clay content increases with distance from corestones (sandy clay loam to heavy clay), and this is also reflected in the density (2.6-1.3 gm/cm3) and loss on ignition (1.3-13.3 wt%). The patterns for Na are complicated as it is enriched through NaCl accession and removed during the weathering of plagioclase. The net enrichment of Cl (up to 5239 ppm) implies decoupling of Cl from Na during weathering. Potassium, Ca and Sr are mobilised from the profile as plagioclase weathers, and silica is progressively lost from the profile with the weathering of silicate phases. Iron is initially mobilised with the weathering of pyroxene and mafic accessory minerals, but is rapidly fixed in the weathering profile as Fe-oxides (hematite, goethite) in veinlets and in association with secondary clays. Pedogenic processes mobilise iron near the land surface. Elements that remain immobile during weathering are Nb, Zr and Ti which partition in resistant accessory phases including zircon.

Ongoing X-Ray diffraction and microprobe analysis will further characterise the regolith materials that comprise the salt stores in the landscape. Complementary analysis of rainwater chemistry to determine the patterns and volumes of salt deposition from atmospheric aerosols will allow more accurate quantification of the salt flux in north-east Tasmania.

Exploring the complex interactions of biophysical parameters such as rainfall, soil, geology, vegetation and hydrology, the study area can be divided into Hydrogeological Landscape (HGL) units. Preparation of an HGL characterisation for the study area and development of a detailed landscape evolution model will provide an understanding of how regolith materials are distributed in the landscape, how and where salt is stored and how water moves through or over the materials. Describing the association of dolerite with salinity will enable evaluation of land management in other dolerite (or basalt) dominated landscapes.