Controls on salt mobility and storage in the weathered Jurassic dolerites of north-east Tasmania.

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Weathered dolerite in the Great Western Tiers, Tasmania. Painted by M. Sweeney 6th March 2016

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Abstract

In Tasmania most salts in the landscape originate from precipitation and accumulate in landscapes after evaporation occurs. Changes in land use and vegetation due to agriculture, forestry practices and urbanisation can accelerate salinity effects leading to land degradation and potentially threatening infrastructure and ecosystems. Researchers of salinity hazards (Moore *et al.*, 2014) identified that salinisation was associated with deeply weathered dolerite in some regions around Launceston. Previous studies did not consider dolerite to be a significant salt store, meaning that the volume of salt stored in the landscapes may have been underestimated. There also has not been research into the geomorphic and structural controls on salinity and the flux of salt into the region.

The chemical composition of rainwater from an array of bulk deposition collectors was studied from Spring 2013 to Winter 2014. The average salt flux was 79 ± 10 kg/ha/yr in the study region, ranging from 170 ± 12 kg/ha/yr in the north to 42 ± 6 kg/ha/yr inland. The sites closer to the north and east coast were more influenced by marine sources compared to samples collected inland and during drier months, that had a stronger terrestrial influence. The geomorphic factors affect the chemical composition, volume of rainfall and flux of salt from windblown dust and oceanic aerosols.

The geochemical composition and mineralogy of dolerite-derived regolith has been examined in order to understand the association between salinity and weathered dolerite. Dolerite breaks down to form smectite (mostly montmorillonite), kaolinite and Fe-bearing sesquioxides. Salt can be stored in the pore spaces between these minerals, by adsorption and in their interlayer spaces (smectite). The electrical conductivity of 1:5 soil/waters suspensions is higher in the more weathered dolerite material (maximum 4.9 dS/m). The clay content and salinity of the dolerite regolith profiles varies, depending on the local geomorphic context. There are fault-bounded pockets of colluvium and highly-weathered, *in-situ* dolerite material, where 2:1 montmorillonite clays dominate. These regions have the capacity to store large volumes of salts.

By exploring the complex interactions of geomorphology and other biophysical parameters the study area has been divided into Hydrogeological Landscape (HGL) units. The HGL units have a range of structural and geomorphic controls which affect the configuration of the regolith (salt

store) and where there are impediments to flow. Associated conceptual models describe the regolith distribution, how and where salt is stored and how water moves through the landscapes.

The amount of salt moving through the surface catchments has been examined using the bulk deposition model as inputs, and loads calculated from flow and electrical conductivity data from stream gauging sites as outputs. Sub-catchments importing more salt than exporting, have high salt stores, and geomorphic features that impede the flow of water leading to higher rates of evaporation. Sub-catchments with greater outputs than inputs are characterised by high rainfall and steep slopes combined with either low salt stores (well- or moderately well-drained soils and thin regolith cover) or moderate to high salt availability or both.

By examining climate change models, it is predicted that there will be an increase in salt deposition and a larger volume of salt stored in the regolith in regions that are low-lying and have geomorphic impediments to flow (very high risk HGLs). This will impact most upon those regions that are currently close to equilibrium (i.e. those that currently fluctuate between exporting and storing salt). Unless the land susceptible to salinisation is managed carefully, a greater area will be impacted by land and water salinisation.

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