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Rapid mapping of regolith materials and the relationships between weathering depth, rainfall and salt mobilisation in complex erosional landscapes of the Mt Lofty Ranges in South Australia.

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In the Mt Lofty Ranges, a long weathering history, dating back to the Middle Mesozoic, combined with more recent tectonic activity resulting in faulting, uplift and associated erosion, has led to a complex landscapes where old highly weathered landforms are juxtaposed with more youthful landforms with relatively little regolith development. The combined interpretation of airborne gamma-ray spectrometry and terrain indices derived from a digital elevation model along with ground data has provided new insights into the distribution of regolith materials and related salinity in the Mt Lofty Ranges of South Australia. Modelling and interpretation of airborne gamma-ray data is used to separate highly weathered landforms from areas characterised by thin soil and slightly weathered bedrock. Highly weathered materials include leached ferruginous soils, mottled colluvial and alluvial sediments and highly weathered kaolinised bedrock. Weathered bedrock or saprolite is typically mottled with iron fragments and nodules common in the upper part of the profile. Iron induration is mostly associated with segregations of iron in the mottled zone of the weathering profile. These highly weathered materials are recognised in the airborne gamma-ray imagery by low K and elevated Th.

Highly weathered landscapes identified through the interpretation of the airborne gamma-ray imagery have a higher capacity to store cyclic salts (i.e. those salts derived from rainfall) than less weathered landscapes. Weathering increases the capacity of the landscape to store salts because clays generated by the breakdown of primary rock minerals have generally much higher porosity and lower permeability than the original bedrock. Water movement through these landscapes is generally sluggish, allowing evapo-transpiration processes to concentrate salt in the upper part of the weathering profile.

Although the thickness and composition of the regolith determines the capacity of the landscape to store salts, rainfall largely determines the rates of recharge and groundwater fluxes which in turn largely determine the concentration of salts in the profile. The influence of rainfall on the storage of salt is particularly strong in the study area due to the very sharp rainfall gradient between the western (wetter) and eastern (drier) sides of the Lofty Ranges. The highest salt stores are associated with discharge sites in weathered landscapes (valley floors, base of colluvial fans) on the eastern side of the study area. The lowest salt stores are associated with thin soils and regolith in areas of high rainfall. These thin regolith landscapes have a limited capacity to store salts and are regularly flushed by rainfall. The highest salt exports in streams are associated with deeply weathered landscapes in areas of high rainfall.

The relationships between regolith, rainfall and salt are summarised in a series of 3D hydrogeomorphic conceptual models for the Lofty Ranges. Modelled thematic maps based on these relationships have been used to generate salt store and discharge maps to assist in managing the environmental impacts of salinity in the region.