High spatial resolution geochemical mapping of surface processes: A case study in Ireland

SASKIA E. RYAN[1]* AND QUENTIN G. CROWLEY[1]

[1]Department of Geology, School of Natural Sciences, Trinity College, Dublin 2, Ireland (*correspondence: ryans22@tcd.ie)

The island of Ireland shows a high degree of bedrock variability over a relatively small area, is variably covered by Quaternary deposits of differing provenance, hosts a complex network of isolated surface water catchments and experiences seasonal influxes of marine-derived aerosols. These conditions make Ireland an ideal case study location for a multi-element geochemical and isotope proxy study of rock weathering, soil formation, as well as geochemically constrained biosphere studies.

The Chemical Index of Alteration (CIA) of topsoils collected as part of the TELLUS projects has been calculated for a large geographic area, with a high sample density. It is possible to link CIA with both bedrock composition and the extent of glacial/marine derived input. Coastal areas show soils with secondary Na and Ca enrichment from marine sources, indicating a considerable geochemical contribution from the marine environment to these regions.

Multi-element proxies for cation reservoir interactions are useful for determining specific element bioavailability. In particular, Rare Earth Element (REE) data demonstrate how plant material can be used as a proxy for characterising substrate geochemistry. The high spatial complexity of local hydrology, as indicated by stream water REE data, reflects local surface water interaction with both bedrock and surficial geology.

High precision Thermal Ionisation Mass Spectrometry (TIMS) strontium isotope ($^{87}Sr/^{86}Sr$) analyses of rock, soil, plant and surface waters are used to compliment other geochemical proxies. Data from 19 biosphere samples across a small geographic region show a considerable range for vegetation (0.708102 to 0.712990), soil leachates (0.708622 to 0.713345) and stream waters (0.708281 to 0.710651). These data highlight the high degree of spatial variability in $^{87}Sr/^{86}Sr$ and the inherent requirement for high density sampling in order to isotopically characterise distinct reservoirs and their interactions. This research contributes to an improved understanding of the processes affecting the transfer of Sr through the biosphere and compliments both national and European-wide initiatives to produce large-scale Sr isotope distribution maps.