

The use of soil geochemistry to map tectonic assemblages: Case study based on the Tellus Survey, Northern Ireland

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The underlying bedrock geology of Northern Ireland provides a stratigraphic record from the Mesoproterozoic to the Palaeogene. However, more than 80% of the bedrock is covered by superficial deposits, comprising glacial till, post-glacial alluvium and peat. These surficial deposits are the result of processes related to weathering, groundwater effects, comminution, transport and sorting. The Tellus soil survey, generated by the Geological Survey of Northern Ireland, includes 6862 sites that were sampled at 20cm below surface on a semi-regular grid with each site representing ~2 km². The soil geochemical analyses used in this study were carried out using XRF technology with additional Au, Pd and Pt analyzed using Fire Assay. Values reported at the lower limit of detection < LLD were replaced by imputed values in order to minimize any biases introduced by LLDs. A total of 50 elements, plus loss-on-ignition were used to characterize the geochemical signature of the soils. Logratio transforms were applied to deal with the compositional nature of the data. Each sample site was linked with the corresponding Age Bracket based on a 1:500k regional geology map by the Geological Survey of Northern Ireland, plus a derived map of lithologies and a map of surficial materials. A number of multivariate metrics (PCA, MAF) were used to distinguish between the processes associated with lithologies and surficial processes in both the multi-element logratio- and the geospatial- domains. The results show that soil geochemistry can be used to distinguish between bedrock and surficial processes, along with measures of uncertainty, and to effectively map tectonic assemblages.