A GEOCHEMICAL APPROACH TO UNRAVELLING ICE SHEET HISTORY USING BOTH TELLUS AND TELLUS BORDER SOIL GEOCHEMICAL DATA

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1. INTRODUCTION

Using geochemistry to establish the provenance of subglacial sediment (ill) represents a novel approach to investigating regional ice flow patterns in Ireland. The north of Ireland has a diverse geology and a complex glacial history (Figs. 1 & 2) that offer the potential to identify subglacial transport across lithological boundaries.

Till and soil geochemistry are closely linked (Dempster et al., 2013). In this study we are linking the geochemistry of the Tellus Border and Tellus soil samples as a proxy for till geochemistry to determine the bedrock provenance for the till. This can be used to identify the degree and direction of subglacial transport which can therefore infer information of ice bed processes and subglacial bedform generation.

2. METHOD

Principal component analysis (PCA) has been applied to between 23 and 27 elements for a total of 5729 soil samples that occur on till in the study area, both at regional scale and in targeted areas based on drumlin flow set areas (Fig. 1b).

PCA assigns each element a loading value which is used to calculate scores for each sample point. It follows that if a sample point is dominated by high loading elements it will have a high score, and if low loading elements are dominant it will return a low score. Sample point scores are therefore representative of groups of elements that can be linked to bedrock source areas. The scores are mapped to assess the degree and direction of subglacial transport.

3. RESULTS

Figure 3 shows PC1 score distribution for the combined Tellus Border and Tellus samples. The region is broadly split into two high score (orange-red) found predominantly in the east and low scores (light-dark blue) predominantly in the west. Element loading is presented in Figure 4.

The distribution of high scoring areas in particular shows a very strong relationship to bedrock boundaries, following the outcrop of the Antrim Lava Group (basalt) and Down-Longford Terrane (greywacke and shale) (Fig. 1a). The igneous centres that intrude the greywacke and shale can be identified by low scores over their extent, which also continue southward onto the country rock. The strong link to bedrock can also observed at flow set scale (Fig. 5) where a linear group of high scores is closely associated with a specific group of the Down-Longford Terrane. High scores in Figure 5 represent the element group Sr, V, CaO, Sc, Ni and Cr.

4. SUMMARY

The regional results show a strong geochemical link between till and local bedrock, with rapid geochemical changes observed across lithological boundaries (Fig. 3). This link is also observed at flow set scale (Fig. 5). Examples of subglacial transport of material up to 8km from its likely source area are presented in Figures 6 & 7.

5. CONCLUSIONS

1. Till in the northern sector of the Irish Ice Sheet is primarily local in origin.
2. Subglacial bedforms in the region therefore also display a primarily local bedrock signature, so have likely formed from in situ or from locally derived till.
3. Transport distances of subglacial material are low, consequently rates of evacuation of debris to the ice margins were also low.

REFERENCES