Late Cretaceous rapid arc growth in the Arequipa area of southern Peru

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During the Late Cretaceous and Paleocene, intense magmatic activity along the Toquepala arc resulted in the building of a continuous relief along the Peruvian margin. This arc growth coincided with the only known significant uplift along coastal southern Peru [1] and can thus be considered to have been a major factor in this uplift.

Our study has focused on a batholith segment extending in the Arequipa area over 60x40 km for a ≥7 km thickness. We confirm that granitoids were emplaced mainly between 90 and 60 Ma, into the Proterozoic basement, a dominantly mafic Liassic (200-175 Ma) plutonic suite, and Jurassic strata. The Late Cretaceous–Paleocene suite consists of numerous plutons, dykes and sills with compositions varying from gabbro to granite.

We analysed trace elements, and Sr and Nd isotopic ratios on a collection of 100 samples principally located along 3 cross-sections of the batholith. The obtained geochemical compositions are in good agreement with data available from the literature [2]. Given the large lithological range, covering a wide spectrum of chemical compositions, Rb-Sr systematics was used to identify two magmatic suites. Samples represent either the Liassic or the Late Cretaceous-Paleocene suite, which are easily distinguished in a Rb-Sr isochron plot. Samples plotting along the 60 Ma isochron were separated and their measured $^{87}Sr/^{86}Sr$ isotopic ratios were used to determine LLD (liquid lines of descent) for gabbro-granite series within the batholith. Using $^{87}Sr/^{86}Sr_m$ as an indirect proxy for fractional crystallization, we propose a simple but powerful method to estimate the nature and compositions of primitive magmas in a plutonic environment.

These results are critical to estimating crustal growth and thickening in the Arequipa area. They will also be analysed in terms of magmatic flux for a better understanding of the mantle vs. crustal contribution to Andean arc magmatism.

[1] Wipf, M. (2006) ETH Zurich PhD n°16383. [2] Boily, M., et al. (1989) JGR **94** n°B9, 12483-12498.

Unravelling glacial sediment provenance through soil chemistry in the north of Ireland.

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Background and method.

Reconstructing palaeo-ice sheets provides important information on how they respond to and drive climatic changes over long timescales. Traditional approaches to reconstructing palaeo-ice sheets rely heavily on geomorphological evidence. However, recent work on ribbed moraines [1] and drumlins [2], which are used to reconstruct ice flow direction, major ice flow pathways and drainage conduits, indicates that using geomorphology alone can potentially produce misleading results if small areas are investigated. Furthermore, ascertaining ice flow direction in regions where no bedforming events have occurred can present difficulties. An alternative approach to investigating former ice flow direction is to use geochemistry to determine glacial sediment provenance, from which transport direction can then be established.

This study presents results from the first regional geochemical investigation of glacial sediment provenance in Ireland using soils developed in areas of till superficial geology. The soil samples were gathered as part of Geological Survey of Northern Ireland's Tellus survey [3] which collected soil samples at a density of 1 sample per $2km^2$ accross all of Northern Ireland. The Tellus samples were supplemented by an additional 81 samples taken at a density of approximately 1 sample per $4km^2$ around the margins of the Tellus survey where no previous sampling had occurred. Bulk geochemistry was determined by X-ray Fluorescence from which 28 lithophile and rare earth elements were selected. Principal Component Analysis (PCA) was then applied to these elements using 3917 soil samples from across the entire region. PCA is a variable reduction procedure that allows groups of elements to be identified, and is used here to infer underlying till geochemistry. Since till geochemistry is a product of its parent materials, the PCA groupings can aid identification of the original bedrock source and thus the sediment provenance and ice transport direction.

Results and conclusion.

The results show that most till deposits in the study area are closely related to local bedrock, with changes of geochemical composition occurring across lithological boundaries. This suggests that the majority of tills have been locally derived and that till transport in this sector of the British-Irish Ice Sheet was low, with rapid comminution and low evacuation rates of entrained debris.

[1] Dunlop & Clark (2006) *Quaternary Science Reviews* **25**, 1668-1691. [2] Spagnolo *et al*. (2010) *Sedimentary Geology* **232**, 119-129. [3] http://www.detini.gov.uk/deti-energy-index/tellus-project/introduction-to-the-tellus-project.htm