Investigating the use of geochemical signatures in glacial margins as a means of identifying ice margins and ice flow direction

Angie Turner1, Richard Waller2, Guido Meinhold3, Jonathan Lee4, Enmmrs Phillips5
1School of Geography, Geology and the Environment, Keele University, Staffordshire, UK.
2British Geological Survey, Keyworth, UK. Corresponding author: Angie Turner a.c.turner@keele.ac.uk

Numerous attempts have been made to constrain the maximum extent of the late Devenian British-Irish ice-sheet (18-25 ka BP) through mapping ice-marginal landforms, e.g. end moraines and lateral meltwater channels. However, in the south-west Pennines (Figure 1) geomorphological signatures are unclear and uncertainty remains regarding the location of the ice margin with five different ice limits for the Late Glacial Maximum having been proposed by previous authors (Figure 2). This has implications for understanding the retreat of ice sheets and the complex engineering solutions required when working in formerly glaciated terrain. This project focusses on the analysis of till geochemistry in order to determine whether it can assist in the identification of former ice limits in inland locations where the geomorphological signatures are absent or unclear.

Geochemical analysis of glacial tills

Major element analysis was carried out on 54 sediments from 14 different boreholes along the M6 in the Cheshire Plain, with some boreholes providing multiple samples to a maximum depth of 15 m below ground level. Three sites in the southwest Pennines were also analysed (Figure 2).

Multivariate statistical analysis

A number of different multivariate methods were used to investigate the difference between the till samples (Figures 3-7) with the aim of finding out whether the boreholes contained homogenous sediments at all depths, or evidence of variation in geochemistry which could be attributed to ice flow direction and source are lithology.

This initial analysis has identified a number of boreholes containing homogenous sediments at all depths, and also those showing a distinct geochemical difference within the borehole. It also clearly determined a spatial variation in geochemistry related to the input of different lithologies into the sediments (Figures 8-10), indicating that the method can be used to identify ice flow direction and source are lithology.