Lithological Control on Soil Chemistry and Microbial Diversity

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Introduction

- Determining the relationships between microbial communities and the soil chemistry can aid in understanding biochemical cycling and identifying microorganisms for use in a variety of applications such as manufactoring, processing and remediation and nano-particle production.
- The aim of the investigation is to study the effects of parental lithology on the biogeochemical properties of soils.
- Full soil profiles from above various lithological units across Northern Ireland were collected fig. 2.
- Initially, the geochemistry of the various soil profiles will be characterised as shown in fig. 1.

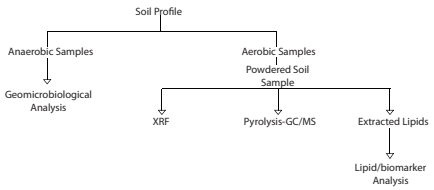


Fig. 1 Schematic of sampling protocol of aerobic soil profile

Site Selection

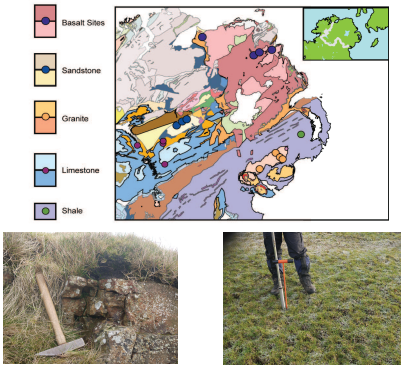


Fig 2. Map of selected sites across five different lithologies (Basalt, Granite, Shale, Sandstone and Limestone in Northern Ireland.

X-Ray Fluroescence

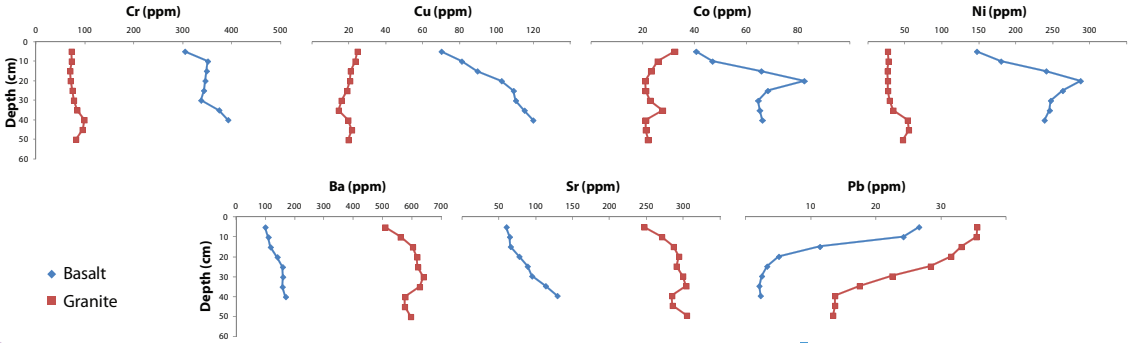


Figure 3 shows the distribution of trace elements through two soil profiles above different lithologies (SI - Basalt and Tu - Granite.

- Figure 3 shows the variation of trace element chemistry between two profiles above two different rock types; basalt (SL) and granite (TU)
- Cr, Cu, Co and Ni was found to be at significantly higher concentrations in the basalt than the granitic soil profile. This is attributed to their abundance in the minerals olivine, pyroxene in the basalt rock
- Ba, Sr and Pb was found in higher concentrations within the soil profile above the granite (attributed to their common occurence in feldspar minerals within the bedrock.

Lipid Analysis

Organic analysis of soils above basalt show a predominately higher plant origin as indicated by high abundances of higher molecular weight *n*-alkanes, *n*-alkanols and *n*-alkanoic acids *fig. 4.*

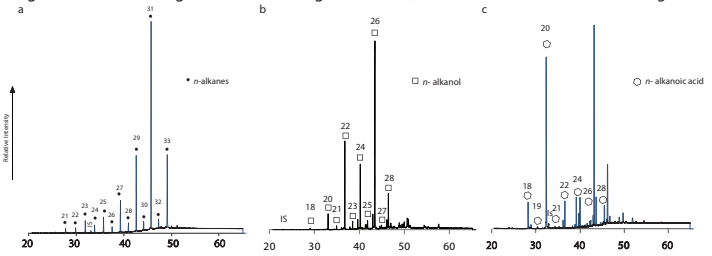


Figure 4 a, b and c shows the distribution of n-alkanes, n-alkanols and n-alkanoic acids through the soil profile (at the 5-10 cm depth interval) from site SL above basaltic rock

Combining the inorganic and organic chemistry

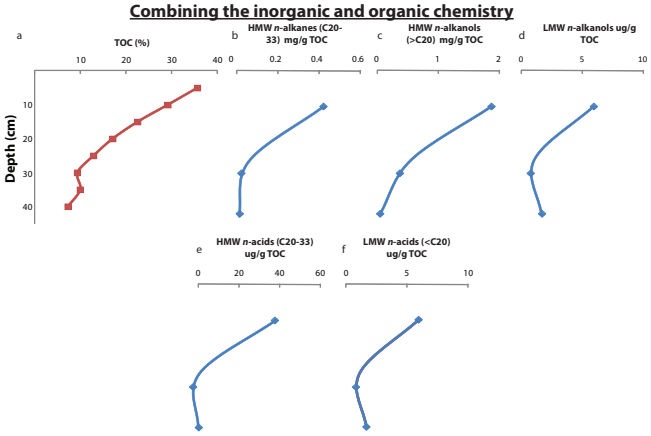


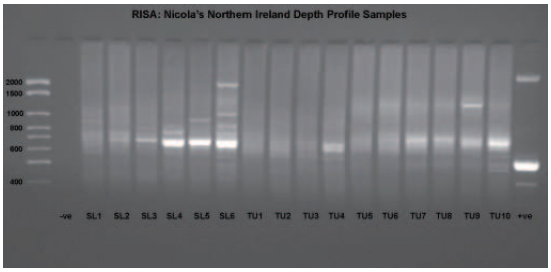
Figure 5 a shows the TOC % values with depth at site SL. b- f show the changes in the concentration of the functional groups per unit of organic carbon.

Element	TOC %	HMW n-alkanes (C20-33) TOC mg/g	HMW *n*-alkanols (>C20) TOC mg/g sed.	LMW *n*-alkanols TOC ug/g sed.	HMW *n*-acids (C20-33) TOC ug/g	LMW *n*-acids (<C20) TOC ug/g sed.
Cr	-0.697	-0.457	-0.597	-0.327	-0.372	-0.254
Mn	-0.921	-0.995	-0.998	-0.970	-0.981	-0.949
Co	-0.719	-0.981	-0.936	-0.999	-0.995	-1.000
Ni	-0.783	-0.923	-0.846	-0.968	-0.955	-0.984
Cu	-0.993	-0.987	-1.000	-0.954	-0.967	-0.928
Zn	0.495	0.899	0.959	0.829	0.855	0.783
I	0.623	0.801	0.889	0.709	0.742	0.653
Pb	0.967	0.998	0.974	0.997	1.000	0.988

- Cr shows the lowest correlations with TOC and all biomarker groups
- Mn, Cu and Pb shows high correlations between TOC and all biomarker groups (*fig. 5.*)
- Co, Ni , Zn and I show low to moderate correlations with TOC but a higher relationship between specific biomarker functional groups (*fig. 5.*).
- Future work will include comparing the functional groups of the organic biomarkers to the soil chemistry for soil profiles above several rock types (in addition to basalt; granite, sandstone, limestone and shale)

RISA Analysis

- Preliminary biological analysis using RISA as a screening exercise was completed on samples through the soil profile from above basalt (SL) and granite (TU) bedrock where samples were ranked numerically according to depth at 5 cm intervals.
- This shows that the bacterial communities do change with depth
- Closer to the soil surface (SL1-3 and TU1-5) the bacterial communites are diverse whilst those towards the base of the soil profile the comunites show a reduced diversity.



Future Work - Geomicrobiology

- Utilising various DNA sequencing technologies will enable the determination of communities present and assess how the differences inchemistry affect the communities present in this environment.
- This will enable better understanding of the biochemical cycling within soils.