Micromorphology and mineralogy of interbasaltic palaeosols at Giant's Causeway, Northern Ireland

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Past Humid Tropical to Sub-Tropical Environment

Interbasaltic palaeosols formed from intensive chemical weathering of Tertiary basalts durings a period of volcantic inactivity in Northern Ireland (NI) [1]. The composition and palaeolandscape of these palaeosols indicate that they formed in a humid tropical to sub-tropical environment [2].

Micromorpholgy and Mineralogy of the Palaeosols

Thin section and x-ray diffraction (XRD) analysis of palaeosols from Giant's Causeway, NI revealed iron oxides (Fig. 1), hematite [Fe_2O_3] and magnetite [Fe_3O_4], in very red zones. Gibbsite [$Al\,(OH)_3$] and titanium oxides, anatase [TiO_2] and ilmenite [$FeTiO_3$], were also detected in these sections. Kaolinite [$Al_2Si_2O_5\,(OH)_4$] was detected by XRD throughout the soils, while tubular kaolinite (halloysite) was identified in more highly weathered zones. In some sections of the palaeosols, there are small segregated areas of iron oxides surrounded by green and grey zones (relic reduced condtions) which indicate past hydromorphic conditions.

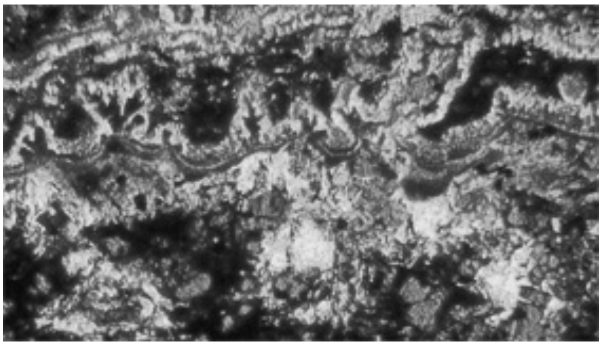

Figure 1: Iron oxides in the matrix and as branched formations in voids. (scale: micrograph 500 μm wide)

[1] Hill *et al*. (2000) *Chem. Geol*. **166**, 65-84. [2] Smith and McAlister (1995) *Geomorphology* **12,** 63-73.

Biogeochemical consequences of changes in root-derived carbon inputs to soil in a forest exposed to CO_2 enrichment

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The release of organic compounds to soil by plant roots strongly influences soil biogeochemistry by stimulating microbial activity, acidifying soil, complexing metals and promoting redox reactions. We sought to better understand the ecosystem consequences of changes in carbon (C) supply from roots to soil in a 28 year-old loblolly pine stand exposed to elevated atmospheric CO_2 (ambient + 200 ppm) and nitrogen fertilization (11 g m^{-2} yr^{-1}) at the Duke Forest FACE site, NC. Over a two-year period, trees exposed to CO_2 enrichment increased the release of root exudates by ~50% in nutrient-poor soils, resulting in a doubling of microbial activity in the upper mineral soil ($p < 0.05$). Fumigated trees that received nitrogen (N) fertilizer did not exhibit any significant increases in exudation or microbial activity. We then sought to examine how changes in C supply may influence rhizosphere biogeochemistry by adding model root exudates to soil via artificial roots. Increases in C supply stimulated microbial respiration in all soils ($p < 0.05$), with the largest changes occurring in nutrient-poor soils. Moreover, increased C supply induced significant changes decreases in N and increases in P availability as a result of changes in microbial activity and to a lesser extent, changes in soil pH. Collectively, our results suggest that dynamic processes occurring at fine spatial scales (e.g. in the rhizosphere) may disproportionately influence biogeochemical responses to global environmental change.