Composition of organic matter stabilised by mineral interactions in subsoil horizons

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Subsoil horizons located below the A horizon are known to store important amounts of organic carbon characterised by high mean residence time. The organic matter compounds present in subsoil horizons are mainly stabilised by mineral interactions [1, 2]. The aim of this paper is to report the composition of SOM in close interaction with soil minerals in several soil types under temperate as well as tropical climate.

Bulk chemical composition of SOM in subsoils is soil type specific and suggests, that pedological processes determine the stabilisation of specific compounds. Analytical pyrolysis showed, that polysaccharides, as well as nitrogen containing compounds can contribute in higher amounts to SOM stabilised by mineral interactions Wet chemical analysis showed, that plant-derived aromatic compounds, such as lignin were not stabilised by mineral interactions in subsoil horizons. The characterisation of hydrolysable polysaccharides emphasises the importance of microbial-derived compared to plant-derived compounds for carbon stabilisation by mineral interactions in subsoil horizons (Fig. 1) [3].

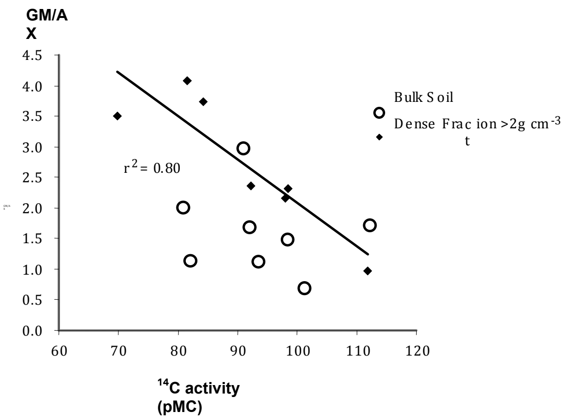

Figure 1: Relationship between the ^{14}C activity and the microbial versus plant-derived sugars (GM/AX ratio) of bulk soil horizons and the dense fractions (data from [3]).

[1] Rumpel *et al*. (2002) *Org. Geochem*. **33**, 1131-1142. [2] Eusterhues *et al*. (2007) *Org. Geochem*. **38,** 1356-1372. [3] Rumpel *et al*. (2010) *SBB* **42**, 379-382.

Characterisation of mine waste: A case study of Frongoch tailings

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Results are presented of a petrographic examination of mine wastes collected from a tailings lagoon at the abandoned lead-zinc, Frongoch Mine, in the Ystwyth catchment, mid-Wales, UK. The ore mineralisation is derived from quartz-sulphide vein deposits associated with ENE trending faults and fault breccias in Silurian turbidite host rocks. Characterisation of mine waste is fundamental to determining the contaminant source and flux (in this case leachable lead and zinc), which is required for catchment scale prioritisation of remediation. We have used specialist sampling and sample preparation techniques to enable detailed petrographic analysis of the tailings deposits to aid the interpretation of the hydraulic testing. This established that despite the structured nature of the tailings, laboratory determined vertical hydraulic conductivities of undisturbed samples were relatively high (3.4×10^{-4} to 2.5×10^{-1} m/day). The presence of vertical flow paths was also indicated by field observations of soluble eflorescent minerals at the tailings surface during the hot, dry summer of 2006.

Undisturbed samples were collected, using Kubiena tins, from the walls of a trench cut into the tailings. The undisturbed samples were resin impregnated within the tins using a process of sequential liquid displacements that retains the internal structures of unconsolidated sediments [1]. Petrographic thin sections and polished blocks were prepared for optical and scanning electron microscope analyses.

The tailings consist of finely bedded muds, silts and sands comprising highly angular fragments of vein minerals and country rock. Vegetative matter from surrounding peat deposits is intermixed. Parallel lamination is common. There are also ripples, cross-beds and erosional surfaces. Fluid escape structures, fine scale (mm) slumping, rare burrowing, syneresis fracturing and sub-vertical fracturing associated with larger scale (cm +) slumping are identifiable. Fluid movement is expected to be mainly channelled along bedding planes. Deformation structures provide vertical pathways; this is illustrated by the presence of secondary deposits, primarily lead sulphates derived from oxidative alteration of sulphides, lining many of these structures. There is an association between the secondary deposits and vegetative matter.

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[1] Smart and Tovey (1982) Oxford Un. Press.