

Isotopic fractionation of Mo, Cu and Zn during weathering: The record from soils and rivers

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Understanding the cycling of trace metals and their isotopes between the continents and oceans is critical in order to use them as geochemical proxies to investigate palaeoclimatic processes. Dissolved Mo and Cu in rivers is isotopically heavier than the continental rocks they drain [1, 2]. It has been suggested that the retention of light Mo in soils [1] and partitioning of Cu between particulate and dissolved phases within rivers [2] are the processes responsible. The few isotope measurements of Zn in rivers so far indicate a complex system influenced by anthropogenic inputs as well as fractionation during weathering [3]. This study aims to improve our knowledge of isotopic fractionation of Mo, Cu and Zn during weathering and transport to the oceans, thereby providing a more robust foundation for the application of these isotope systems to palaeo-oceanographic questions.

We have collected river and soil samples from three soil chronosequences in Wyoming (USA), Switzerland, and Scotland. Dissolved Mo, Cu and Zn in the streams draining these young landscapes is isotopically heavy. In isotope composition vs concentration plots they define new arrays distinct from global river compilations for Mo, Cu and Zn [1, 2]. Preliminary data from sequential leaching experiments on the Scottish soils suggest Mo and Cu behaviour in soils is complex, with significant fractionation between physico-chemically defined soil fractions e.g. Fe/Mn oxides and exchangeable/carbonate phases. Data collected so far also suggest, as expected from the river data, anthropogenic and weathering influences on Zn isotopic composition in soils.

These and additional data will be used to investigate the cause of isotope fractionation for Cu, Mo and Zn during the transport of these elements from the crust to the oceans.

[1] Archer & Vance (2006) *Nature Geosci.* **1** 597–600.
[2] Vance *et al.* (2008) *EPSL* **274** 204–213. [3] Chen *et al.* (2008) *Env. Sci. Tech.* **42** 6494–6501.

C and N dynamics in soil microstructures: A joined STXM/NEXAFS and NanoSIMS approach

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Significant debate surrounds the question whether the abundance of certain mineral phases might serve to predict the mean residence time of soil organic matter (SOM). Several factors may contribute to the difficulties in using mineralogy as a predictor for SOM turnover. While minerals differ widely in the nature and extent of surface reactivity, long-term protection of organic molecules by sorptive interactions appears to be limited to those organic materials directly bonded to protecting mineral surfaces. A new functional view of carbon turnover dynamics in soil has gained ground over the last years. In this view, the two-dimensional concept of soil as a system composed of adsorbent (mineral surface) and adsorbate (SOM) has been extended to a three-dimensional view of soil consisting of a multitude of largely independent microstructures composed of intimate associations between microbiota and mineral building blocks.

We used a combination of scanning electron microscopy (SEM), synchrotron-based STXM/NEXAFS spectroscopy and high-resolution imaging mass spectrometry (NanoSIMS) to investigate the biogeochemical cycling of carbon and nitrogen in such soil microstructures. In this contribution, we present initial results on how the incorporation of ¹³C- and ¹⁵N-labeled microbial cell residues into artificial mineral matrices and whole soils can be used to assess SOM turnover dynamics within specific microstructures.