

Controls on microbial sulfur isotope fractionation in littoral sediments

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Stable sulfur isotope analysis is a key component in palaeoenvironmental reconstructions from the Archean to Cenozoic. Although S isotope fractionation in low temperature marine settings is well studied [e.g. 1,2], the variability of fractionation between different environments and the controls on the magnitude of fractionation in natural microbial populations remain unclear. In this study we have determined the activity of sulfate reducing prokaryotes at 14 different localities, representing a range in surface water salinity, sediment geochemistry (C/N = 3 to 20), porewater sulfate concentration (0.3 to 98 mM) and pH (6.5 to 11.0). Sediments were obtained from freshwater, hypersaline lake, tidal and estuarine sites in France, USA (California) and The Netherlands and incubated at various temperatures from 10 to 50°C in flow through reactors with sulfite provided in excess whilst the site available electron donor was supplied from within the sediment.

Microbial sulfate reducing activity, recorded as steady-state potential sulfate reduction rate, varied from <10 to 80 nmol/cm³/h, with sulfur isotope fractionation ($\epsilon_{\text{SO}_4^2-\text{H}_2\text{S}}$) covering the entire range of 5 to 50 per mil, previously observed in pure culture and sediment incubation experiments [1]. Isotope data obtained from periods of steady state sulfate reduction, under optimum growth conditions, indicate a clear negative trend between potential rates and $\epsilon_{\text{SO}_4^2-\text{H}_2\text{S}}$, supporting the 'standard model' of isotope fractionation [1,3]. More extreme variability in $\epsilon_{\text{SO}_4^2-\text{H}_2\text{S}}$ was observed at low potential rates and high temperature. Offsets in $\epsilon_{\text{SO}_4^2-\text{H}_2\text{S}}$ were observed between sites suggesting that changes in microbial population size and structure (either the active sulfate reducers or changes in fermentation pathways providing labile organic matter) exert a strong control on isotope fractionation.

[1] Canfield *et al* (2006), *GCA* **70** 548-561. [2] Bruchert (2004), *GSA special paper* **379** 1-16. [3] Rees (1973), *GCA* **37** 1141-1162.

Soil organic matter loss pathways in agricultural lands

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A compilation of literature data presented in this work suggested that the average composite relative slope loss of soil organic carbon (OC) and nitrogen, after the conversion of grassland to arable tilled land is reducing in time following a logarithmic pattern. The first year loss is one order of magnitude greater than composite average slope, observed after many years (Figure 1).

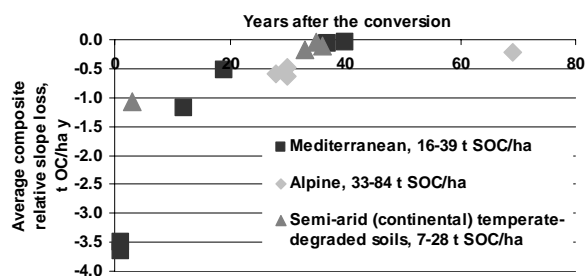


Figure 1: Average composite relative slope loss of soil OC, after the conversion of native grassland to arable tilled land, (normalized for 10 cm soil depth).

In this work we aimed at making a gross estimation of the slope loss of OC and ON in arable tilled lands, in two climate extremes environments: Midwest USA (IA) and Mediterranean (GR). Quantitatively and qualitatively changes, brought about by tillage in five soil aggregate fractions, as well as particle (intra and inter POM) and density fractions (free, occluded, and strongly associated with minerals) within them, were studied (OC, TN, polysaccharides, FTIR, 13C NMR).

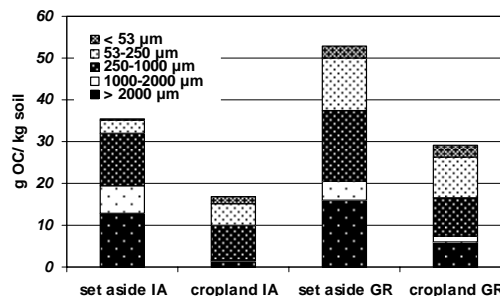


Figure 2: Soil OC content and distribution among aggregates.