

## The Rusty Sink: Iron Promotes the Preservation of Organic Matter in Sediments

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The biogeochemical cycles of iron (Fe) and organic carbon (OC) are strongly interlinked. In oceanic waters, organic ligands have been shown to control the concentration of dissolved Fe [1]. In soils, solid Fe phases provide a sheltering and preservative effect for organic matter [2], but the role of iron in the preservation of OC in sediments has not been clearly established. Here, we determine the amount of organic carbon, associated with reactive iron phases in sediments of various mineralogies collected from a wide range of depositional environments, using an iron reduction method previously applied to soils [3]. Our findings suggest that  $21.5 \pm 8.6$  per cent of the organic carbon in sediments is directly bound to reactive iron phases, representing a global mass of  $19$  to  $45 \times 10^{15}$  g of organic carbon in surface marine sediments [4]. This pool of OC is different from the rest of sedimentary OC, with  $^{13}\text{C}$  and nitrogen-enriched organic matter preferentially bound to Fe which suggests that biochemical fractionation occurs with OC-Fe binding. We propose that these organic carbon-iron associations, formed primarily through co-precipitation and/or direct chelation, promote the preservation of organic carbon in sediments. Since reactive iron phases are metastable over geological timescales, they serve as an efficient “rusty sink” for OC, a key factor in the long-term storage of organic carbon and thus contributing to the global cycles of carbon, oxygen and sulphur [5]. New data showing Fe-OC interactions in water column suspended particles will also be presented.

[1] Johnson et al. (1997) *Marine Chemistry* **57**, 137-161.

[2] Kaiser et al. (2000) *Organic Geochemistry* **31**, 711-725.

[3] Wagai et al. (2006) *Geochimica Cosmochimica Acta* **71**, 25-35.

[4] Lalonde et al. (in press) *Nature*.

[5] Berner (2003) *Nature* **426**, 323-326.

## O isotopes in the Azores: mantle melting versus AFC

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The Azores archipelago in the central North Atlantic has been studied widely over the last few decades, one reason being its formation history that is related to a slow-upwelling mantle plume. The plume sources identified in these ocean islands are predominantly inferred from Sr-Nd-Pb-(Hf) radiogenic isotope data along with major and trace element geochemistry. Contrastingly, few studies have dealt with the variability in stable isotopic composition. Here, we present a detailed isotopic study of oxygen isotope ratios ( $^{18}\text{O}/^{16}\text{O}$ ) in olivines, clinopyroxenes and plagioclases that allow to infer on the quantitative and qualitative involvement of altered oceanic crust (AOC) during ascent of the magmas. This is particularly important when aiming to place constraints on the primary O isotopic composition of the mantle plume source. Furthermore, such estimates can be combined with other newly available isotope data of boron (B) and Lithium (Li) of the Azores lavas.

We provide a comprehensive data set of phenocryst O isotope data obtained by laser fluorination along with their individual mineral chemistry measured by electron microprobe on the same grain. The phenocrysts originate from lavas from the entire archipelago, namely Faial and Pico (central Azores) and São Miguel (east Azores), and, for the first time, include data for the two islands west of the mid-Atlantic ridge (MAR), Flores and Corvo. The samples were selected from geochemically well characterised host lavas such that the newly obtained O data are placed in a tight geochemical and petrological background.

Our data indicate that the eastern Azores lavas are characterized by O ratios (i.e.  $\delta^{18}\text{O}_{(\text{ol})}$  4.7-5.2 ‰) slightly lighter than the primitive mantle range ( $\delta^{18}\text{O}_{(\text{ol})} \sim 5.2 \pm 0.2$  ‰), while the western lavas fall within the latter range. However, we find that decreasing forsterite contents in olivines are tightly correlated with decreasing  $\delta^{18}\text{O}$ . Such systematic is also observed in Hawaii<sup>2</sup>, which is explained by assimilation of hydrothermally altered material during the crystallization-differentiation process [1]. We test whether assimilation fractional crystallization (AFC) models sufficiently describe the  $\delta^{18}\text{O}$  systematic of the Azores lavas, and if the highest forsterite olivines can be used to distinguish the  $\delta^{18}\text{O}$  signal of the plume source. Our data are also compared with those of the MAR [2] to better evaluate the nature and distribution of enriched components in the north Atlantic mantle.

[1] Wang, Z. & Eiler, J. M. (2008) *EPSL* **269** (3-4), 377-387.

[2] Cooper, K. M., Eiler, J. M., Asimow, P. D. & Langmuir, C. H. (2004) *EPSL* **220** (3-4), 297-316.