Oxygen isotope evidence for slab-derived silicate melt in Lau basin back-arc lavas

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Geochemical variations in back-arc basin lavas have been attributed to varying proportions of compositionally distinct mantle and slab-derived components in their sources. Possible slab components (fluids, melts, or rocks from sedimentary, mafic or ultramafic parts of the lithosphere) are heterogeneous in oxygen-isotope compositions ($\delta^{18}O$). Consequently, $\delta^{18}O$ values of back-arc lavas can provide information on the origin (e.g., the part of the slab from which they were derived), amounts, and properties (fluids vs. melts) of slab components delivered to the back-arc mantle.

We present here new laser-fluorination, oxygen-isotope data on fresh basalts from the Lau back-arc basin, collected along the Eastern Lau Spreading Center. This suite spans a continuously decreasing distance from the Tonga arc, from north to south. Variations in $\delta^{18}O$ in these samples are subtle (5.4-5.8‰), at the low-end of those previously documented for the Lau basin lavas (5.5-6.1‰ [1]), and comparable to the $\delta^{18}O$ range for mid-ocean ridge basalts [2] generated within a single laboratory and using a common set of standards. High values of $\delta^{18}O$ in these samples are associated with low distances to the arc, high degrees of melting (low $Na_{8.0}$), and geochemical indices of source enrichment (i.e., high H_2O/Ce K/Ti, U/Th, Ba/Nb). These results suggest that the principal enriched component in the sources of our samples is (i) derived from the upper part of the slab; (ii) present in abundances of less than few percent; and (iii) most likely a silicate hydrous melt, not an aqueous fluid.

The "mixing" trends between low-$\delta^{18}O$ depleted peridotite and high-$\delta^{18}O$ slab component defined by Lau basin basalts resemble similar trends previously defined by oxygen-isotope studies of mid-ocean ridge basalts (MORB) using the same analytical methods [2]. This suggests that the enriched components in the sources of some MORBs may be related to those in the sub-arc mantle sources of back-arc basin magmas.

[1] Macpherson & Mattey (1998) *Chem. Geol.* **144**, 177-194.
[2] Eiler *et al.* (2000) *Nature* **403**, 530-534.

The fungi-biotite interface: Nanoscale evidence of weathering

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An estimated 90 % of plant species exhibit symbiotic associations with ectomycorrhizal (EM) fungi in soils [1]. In return for carbon fixed via photosynthesis, the fungal network transfers a large array of elements to the plant root system. In the world's largest vegetation system – boreal forest -, virtually all nutrient uptake and carbon release from living roots occurs through EM fungal networks [2]. Fungal hyphae, as most other soil microorganisms, are in close contact with the mineral surface and therefore rock weathering is thought to be maximal at the microbe-mineral interface However, the proceesses and mechanisms that control fungi-mineral interactions have so far not been studied.

In this study, the weathering of biotite induced by *Paxillus involutus* hyphae grown for 3 months in symbiosis with *Pinus sylvestris* was investigated. The experimental approach was designed to replicate two fundamental aspects of the plant-fungi-soil continuum: (i) the tree-EM fungi symbiotic relationship and (ii) unsaturated hydric conditions. Focused Ion Beam (FIB) sections along individual hyphae were investigated at the nanoscale using high-resolution analytical TEM. In all FIB sections, a very intimate contact between hyphae and biotite (< 0.1 nm) was observed reflecting the strong attachment of the fungi to the biotite surface. Furthermore, hyphae tips exerted a strong mechanical forcing at the biotite-fungi interface as evidenced by diffraction halos and changes in biotite crystal orientations. As exposure time between biotite and fungi increased this mechanical focing is followed by a chemical alteration of the biotite which is evidenced by a K depletion in the upper biotite layers and by the development of vermiculite subdomains near the interface with the hyphae. The results show that biomechanical stresses of the biotite structure derive from the fungal hyphae attachment and that these predate and induce subsequent chemical processes.

[1] Leake, J.R. *et al.* (2004) *Can. J. Bot.* **82**, 1016-1045.
[2] Read, D.J. *et al.* (2004) *Can. J. Bot.* **82**, 1243-1263.