

The mantle sources of continental flood basalts from oxygen isotope composition of primitive olivine phenocrysts

ILYA BINDEMAN¹ AND VADIM KAMENETSKY²

¹Geological Sciences, 1272 University of Oregon, Eugene OR 97403 (bindeman@uoregon.edu)

²School Earth Sciences, Univ Tasmania, Hobart, Australia

Recognition of potential mantle sources of intraplate magmas requires a study of primitive melts that are not readily available from Phanerozoic large igneous provinces. Rare examples of primitive lavas in the cratonic settings contain high-Fo olivine [1], those isotopic, trace element compositions and melt inclusions can be useful in understanding parental melts and their respective mantle sources. We report oxygen isotopic variations in these primitive olivines found in continental flood basalt provinces: Emeishan (China), meimechites of Siberian Traps, North Atlantic large igneous province (Baffin Island, W. Greenland, Mull Island), and Columbia River Basalts. Olivine (up to 90-93 mol% Fo) have widely varying trace element (Ni, Mn, Ca) abundances [1]. We report analyses of olivines by laser fluorination relying on 0.5-1.5 mg of material and $\pm 0.05\%$ precision. With the exception of one Emeishan sample ($+5.92 \pm 0.05$) the $\delta^{18}\text{O}$ values of 18 olivine separates are within a very narrow range (4.79 to 5.25‰), similar or slightly lower than in the model MORB mantle. The calculated proportion of the pyroxenitic component in the mantle source, as deduced from trace element compositions of olivine, ranges from <10 to 60%, but lack significant correlation with $\delta^{18}\text{O}$, which suggests that the bulk sources of continental LIP have the same O isotope composition as the source of MORB. Additionally, lack or poor correlation of the olivine $\delta^{18}\text{O}$ with the major and trace element compositions and Sr-Nd-Pb isotopes of the studied magmas and potential mantle temperatures may suggest that the pyroxenite component has either similar O isotope compositions to peridotite with insignificant regional $\delta^{18}\text{O}$ variations, or pyroxenite-derived melts re-equilibrated with the ambient peridotite mantle through reactions before segregation or/and during porous flow en route to the surface. These results may also suggest plume-like distribution of pyroxenite component in peridotite mantle, and mixing of melt of variable $\delta^{18}\text{O}$ in mantle.

[1] Sobolev *et al.* (2007) *Science* **316**, 412-417.

Fungal implication in secondary calcium carbonate accumulation in soils and caves

S. BINDSCHEDLER^{1*}, L. MILLIERE¹, G. CAILLEAU¹, D. JOB² AND E.P. VERRECCHIA¹

¹Biogeosciences Laboratory, Institute of Geology and Paleontology, University of Lausanne, Anthropole, CH-1015 Lausanne

(*correspondence: saskia.bindschedler@unil.ch)

²Laboratory of Microbiology, Institute of Biology, University of Neuchâtel, Emile Argand 11, CH-2009 Neuchâtel

Fungi are often associated with secondary CaCO_3 in soils and caves, mainly with two features, Needle Fibre Calcite (NFC) and calcitic nanofibers. The origin of these two features remains controversial. Both biological and physicochemical processes have been proposed to explain their formation. NFC has been observed inside organic sleeves, interpreted as fungal hyphae. Furthermore, field observations, as well as size and structure homology between NFC bundles and fungal strands have confirmed involvement of fungi. Investigations of calcitic nanofibers, often observed together with NFC, may provide new insights regarding the relationship between these two features and fungi.

Electron microscope observations show that nanofibers could originate from the partial decay of the fungal cell wall. During organic matter decay cell wall nanofibrils (e.g. chitin and β -glucans) are released into the soil where they are exposed to mineralizing pore fluids, leading to their calcitic pseudomorphosis. To test this hypothesis of a biological origin of calcitic nanofibers an experimental approach was chosen: first, fungal hyphae were partially digested with enzymes selectively hydrolysing non-fibrous material from the fungal cell wall. In a second step the remaining fibrillar components were exposed to conditions similar to those in natural environments in order to induce CaCO_3 nucleation. Fungal remains and CaCO_3 precipitates were analyzed by TEM and SEM.

Calcium plays a crucial role in fungal metabolism. It is translocated in the hyphae and can accumulate in the cell wall and vacuole. We propose that when exposed to carbonate saturated solutions CaCO_3 can precipitate on fungal organic template.

As a result, when associated with NFC bundles, nanofibers could indicate relicts of organic sheaths, supporting the hypothesis of a genetic link between fungi, nanofibers, and consequently NFC. On a global scale, this emphasizes the important roles of both organic matter and fungi in the coupled carbonate-carbon cycle.