

On the significance of ultra-magnesian olivines in basaltic rocks

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The temperature regime in the Earth's mantle is of prime importance for models of mantle convection and a key test of the mantle plume hypothesis. Olivine thermometry is commonly used to constrain mantle potential temperatures in basaltic magmatic provinces. Ultra-magnesian olivines, here defined as Fo > 92, are common in Archean komatiites and occasionally observed in Phanerozoic LIPs. The presence of ultra-magnesian olivines is generally interpreted as evidence for melts with extremely high MgO concentration and high eruption temperatures. Such melts are considered to be a hallmark of a hotter mantle in the early Earth and of thermal anomalies related to Phanerozoic mantle plumes. Estimating primary melt compositions and temperature based on mineral and rock data is a common approach but subject to large uncertainties. A better alternative is direct study of melt inclusions trapped with early-formed crystals and isolated from the rest of the magma. Here we present data of olivine-hosted melt inclusions and their host crystals from the Henties Bay-Outjo (HOD) dyke swarm in NW Namibia. These dykes are interpreted to have been feeders to the Etendeka volcanics and are characterized by the local presence of high MgO (picritic) compositions. The composition of melt inclusions trapped in ultra-magnesian olivine (Fo_{93.3}) from the HOD contradict the predicted 24 wt. % MgO for parental melts and 1680 °C mantle potential temperature based on olivine whole-rock models [1]. Instead, the trapped melts do not exceed 17.5 wt. % MgO and the maximum potential temperature indicated by these compositions is 1520 °C. Most olivines in the HOD rocks with Fo > 85 are too Mg-rich to be in equilibrium with the whole-rock composition, indicating that the grains are entrained xenocrysts from earlier, more magnesian melts. We show that ultra-magnesian olivines can be produced by protracted melt extraction from the mantle source and that this process also leaves a distinctive depletion in the incompatible trace elements.

[1] Thompson, & Gibson (2000) *Nature* **407**, 502–506.

A poor man's enzyme? Effects of reactive Mn(III)-oxalate complexes on structurally intact plant cell walls

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Manganese (III)-ligand complexes such as Mn (III)-oxalate are potent and highly diffusible oxidizers for lignin model compounds [1, 2]. Although there is clear indication for their potential role in lignin decomposition processes in soils [3, 4], few reports exist on mechanistic aspects such as substrate specificity, reaction kinetics and oxidizing power of Mn (III)-oxalate complexes reacting with structurally intact plant materials. This is of particular importance in the context of soil organic matter decomposition since lignin cannot be viewed as a single substance [5], but has to be seen as an integral component of ligno-carbohydrate complexes (LCC) in fresh plant cell walls (e.g. in litter, root and wood).

Here we tested the hypothesis that Mn (III)-oxalate complexes may act as a 'pretreatment' for structurally intact LCC components in plant cell walls. The diffusible oxidizers are thought to be small enough to penetrate and react with composite LCC in cell walls, thereby increasing porosity which permits access to more efficient lignin- and cellulose-decomposing enzymes. This was investigated by reacting cell walls of single *Zinnia elegans* tracheary elements with Mn (III)-oxalate complexes in a continuous flow-through micro-reactor. The uniformity of these individual plant cells allowed us to examine Mn (III)-induced changes in cell wall chemistry and ultrastructure on the micro-scale using fluorescence and electron microscopy as well as IR and X-ray spectromicroscopy. This presentation will discuss the specificity of Mn (III)-complexes for certain cell wall functionalities, the impact of such reactions on cell integrity, and potential implications for soil C cycling.

[1] Wariishi *et al.* (1992) *J. Biol. Chem.* **267**, 23688–23695.
[2] Perez & Jeffries (1992) *Environ. Microbiol.* **58**(8) 2402–2409.
[3] Hofrichter (2002) *Enzyme Microb. Tech.* **30**(4) 454–466.
[4] Berg *et al.* (2010) *Biogeochemistry* **100**, 57–73.
[5] Thevenot *et al.* (2010) *Soil Biol. Biochem.* **42**, 1200–1211.