



LA-(HR-)ICPMS study of serpentinites from ODP Site 920 (23°N MAR): insights on transfers and trace element distribution during serpentinization

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The numerous ultramafic-hosted hydrothermal systems discovered during the last ten years emphasized the importance of mantle peridotite alteration as means of chemical exchange between the mantle and the ocean at slow- and ultra-slow spreading ridges. Yet, little is known on the chemical variability of serpentinites at the ridge and the local scale. This is determinant for constraining mass transfers at ridge axis and then the input budget in subduction zones.

We present the results of the detailed petrostructural and geochemical study of serpentinized harzburgites (60-100 % alteration) sampled at ODP Site 920 (23°N, Mid-Atlantic Ridge). A previous detailed microstructural and major element study of pseudomorphic textures and veins of site 920 serpentinites has indicated two main stages of serpentinization which accompany the progressive unroofing of mantle rocks. These stages are distinguished by their mode of mass transfer: a first diffusion-dominated stage occurring below 2 km in depth at $150^{\circ} < T < 350^{\circ}\text{C}$, followed by a second advection-dominated stage at shallower levels (Andreani et al. 2007). These results are used to select the zones of interest for the present geochemical investigation and are then integrated in their interpretation in terms of evolution of trace element (re-)distribution during the serpentinization history. The serpentinite composition was determined on bulk rock and on primary and alteration minerals by ICP-MS and HR-ICP-MS coupled to laser ablation respectively.

Serpentinites samples have depleted trace element bulk rock compositions (mostly $< 0.2 \times \text{PM}$) typical of that of refractory mantle peridotites, except for highly mobile elements such as U (up to $10 \times \text{PM}$), B (4-45 ppm), As and Sb (up to 10 ppm). This suggests that the bulk rock geochemistry of the serpentinites has preserved the peridotite primary signature for most trace elements (Godard et al., this session). In contrast, in situ analyses of alteration minerals indicate extensive chemical exchanges at the thin section scale. Bastite (formed after pyroxene) has compositions similar to that of orthopyroxene or clinopyroxene whereas mesh texture serpentine (formed after olivine) has enriched trace element compositions compared to olivine. All secondary phases are characterized by flat REE patterns indicating relative enrichments in light REE. Mobile elements are also more abundant in the secondary phases (e.g., As 0.1-5 ppm, B 20-100 ppm). The composition of the serpentine mesh and associated veins varies strongly within a same sample. The strongest enrichments in mobile element are observed in the mesh, where main fluid pathways between olivine grains were probably located, and in the last generation of serpentine veins. This is consistent with a small-scale chemical transfer between the altering primary phases during the whole alteration history and a more abundant element arrival by larger scale transfers during the last stage of alteration. Mass balances between primary and secondary phases, and at the sample scale, are estimated in order to better characterize the control of serpentinization on the bulk rock composition of abyssal peridotites.

Andreani M., Mevel C., Boullier A-M., Escartin J., 2007. Dynamic control on serpentine crystallization in veins: constraints on hydration processes in oceanic peridotites. *Geochemistry, Geophysics, Geosystems*, 8, 1-24, doi:10.1029/2006GC001373 .