Experimental study of the fate of metals during metasomatism of the mantle unit of the Troodos ophiolite by aqueous fluids coming from the underlying slab

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The Troodos ophiolitic complex in Cyprus, known to host numerous metal-rich volcanogenic massive sulfide (VMS) deposits, formed in a supra-subduction zone context during the late Cretaceous. Primary sulfides contained in the magmatic rocks of the ophiolite display high concentrations of precious and base metals, and are thought to be the main source of metals present in VMS. Also, some boninitic magmatic suites from the pillow-lava unit show evidence of an interaction between the depleted mantle underlying the ophiolite and aqueous fluids coming from the downgoing plate below the mantle wedge. Besides, it was shown that dehydration fluids escaping from the altered oceanic crust during subduction may contain important amounts of ligands such as sulfur and chlorine. This suggests that those fluids are likely to carry significant quantities of metals through the overlying mantle, and thus are able to metasomatize and enrich the mantle source of the magmatic rocks of the ophiolite by depositing metals as sulfides or oxides, or even secondary silicate mineral phases. The purpose of this project was to experimentally test this hypothesis in order to check whether the metals contained in the VMS may – partly or totally – originate from the downgoing slab. We have conducted piston-cylinder experiments at 1 GPa, 1000°C and variable fO_2 conditions by using the double capsule technique with three different fO_2 buffers: Co-CoO (reducing), Ni-NiO (intermediate), and Fe_2O_3-Fe_3O_4 (oxidizing). A fresh natural lherzolite was reacted with an aqueous NaCl (0.5 m) and Na_2SO_4 (0.5 m) solution for one week in presence of various metals (Cu, Mn, Ni, Co, Zn, Pb, Mo, Au, Ag). The run products were analyzed by LA-ICPMS to estimate the metal contents of the new metasomatic mineral phases. Results demonstrate the importance of fO_2 during metasomatic events for the metal budget of the mantle source of the ophiolite.