Dolomitization of serpentinized harzburgite from the Atlantis Massif

FRIEDER KLEIN

Woods Hole Oceanographic Institution, (fklein@whoi.edu)

Ophicarbonate breccias consisting of fragments of serpentinized peridotite and carbonate cement have been reported from outcrops at the Atlantis Massif, MAR[1]. While the carbonate cement precipitates due to mixing of high-pH, Ca-rich serpentinization fluids with seawater, the direct replacement of serpentinite by dolomite is more difficult to explain. Here, I report on observations made in a dolomite-altered, strongly serpentinized, partly steatitized harzburgite, from the IODP Leg 304, Hole 1309B at the Atlantis Massif. Dolomite appears in mesh and hourglass texture of completely serpentinized olivine adjacent to a talc-tremolite altered shear zone. The dolomite in these samples is surrounded by a zone of serpentine (Mg# 98), and magnetite, which traces the former (sub-) grain boundaries of olivine. Orthopyroxene is partly serpentinized to bastite, which subsequently underwent partial steatitization but not dolomitization. Both clinopyroxene and Cr-spinel are unaltered.

Dolomite in serpentinite can form by conductive heating of seawater[2]; however, in samples from Hole 1309B petrographic observations and microprobe analyses suggest a direct replacement of brucite and serpentine by dolomite. Phase relations in the system $MgO-CaO-SiO_2-H_2O-CO_2$ indicate that brucite is the first mineral being replaced by dolomite at relatively low CO_2, aq actvities, while dolomitization of serpentine and talc requires higher CO_2, aq activities. However, it remains to be resolved whether the CO_2 is of magmatic or of seawater origin. The Mg needed for the formation of dolomite is likely contributed by brucite and/or serpentine themselves, whereas Ca may have been transported from the adjacent talc-tremolite shear zone. Alternatively, the Ca may have been contributed by the dissolution of the Ca-Tschermaks component of partly serpentinized orthopyroxene.

This pilot study indicates that serpentine and brucite can act as a sink for CO_2 in the oceanic lithosphere, in particular where seawater and/or magmatic fluids interact with hybrid mafic/ultramafic lithologies.

[1] Kelley, D.S. *et al.* (2005) *Science* **307**, 1428–1434. [2] Eickmann, B. *et al.* (2009) *Chemical Geology* 268 (1-2) 97–106.

Chromium mobility in hydrous fluids at upper mantle conditions

O. KLEIN-BENDAVID[1], T. PETTKE[2] AND R. KESSEL[1]

[1]The Fredy & Nadine Herrmann Institute of Earth Sciences, the Hebrew University of Jerusalem, Jerusalem, Israel, 91904 (*correspondence: ofrak1@gmail.com)
[2]Institute of Geological Sciences, University of Bern, CH-3012 Bern, Switzerland

Chromium is a minor component in the earth's mantle and is considered to be immobile in aqueous fluid under crustal and most mantle conditions. Exceptions to this are for example K-rich diamond forming fluids, shown to contain up to 1 wt% Cr_2O_3 (on a volatile free basis). A series of high-P experiments on the solubility of Cr_2O_3 in KCl bearing water were done using rocking multi anvil diamond trap techniques (1000 and 1200 °C; 4 and 6 GPa) combined with cryogenic LA-ICP-MS in order to determine Cr mobility in saline fluids (e.g. diamond forming fluids) under mantle conditions and its possible involvement in deep metasomatism. Chromium solubility in KCl-bearing water increases with salinity (KCl). At 250 μg/g KCl, Cr solubility in water is between 100 and 200 μg/g, independent of pressure. At 4 GPa, an order of magnitude increase in Cr-solubility is observed only for the 3 wt% KCl solution, while at 6 GPa such increase is observed already at 1.3 wt% KCl. No significant effect of temperature is observed. Metasomatic Cr-rich mineral assemblages are encountered in both subduction zone and deep lithospheric mantle environments, where alkali-rich hydrous fluids, similar to those examined in this research, are regarded as major metasomatic agents. In some cases, unique minerals found as micro- and macro- inclusions within diamonds (e.g. chromite and phlogopite) have significantly different compositions than common mantle minerals and are much richer in Cr. Thus, saline hydrous fluids can be considered an important metasomatic agent at deep lithospheric mantle conditions and appear to be efficient in transporting elements such as Cr during rock water interaction.