

Veined peridotite xenoliths from the Avacha volcano, Kamchatka: Fluid types and fluid-rock interaction in supra-subduction mantle

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Peridotite xenoliths in subduction-related volcanic rocks are direct samples of the mantle wedge. These peridotites are generally thought to have reacted with fluids originating from downgoing slab, yet many show no or only minor whole-rock enrichments in incompatible elements [1, 2]. The composition and sources of the subduction fluids can be better constrained from studies of metasomatic veins in the peridotite xenoliths.

We report petrographic, major and trace element data obtained on eight veined harzburgite xenoliths from the active Avacha volcano in southern Kamchatka peninsula, Russia (see also [1]). Four types of veins of likely mantle origin are identified in the Avacha xenoliths. (1) Coarse orthopyroxenite and websterite with diffuse margins may be related to an ancient event that produced opx and silica enrichments in the host harzburgites [1]. (2) Thin veins filling fractures in coarse olivine and opx and containing empty cavities with accessory amphibole attest to recent fluid-assisted recrystallisation of their host minerals after brittle fracturing. (3-4) Thin, fine-grained, cross-cutting veins are made up of subhedral opx ± olivine as well as variable cpx, amphibole, accessory glass and sulfides. When cut by such veins, wall-rock olivine has only thin recrystallisation rims whereas coarse opx is partly transformed to produce metasomatic cpx and amph.

These latter veins, formed shortly before the transport of the xenoliths to the surface, are of particular interest because they contain direct crystallisation and *in situ* fractionation products of melts with likely subduction-related origins. The vein opx have high Mg# (≥ 0.90), low Al_2O_3 (0.2 to 1.5 %) and high Cr_2O_3 (<0.5wt%) and are depleted in light REE relative to heavy REE. The cpx and amph are low in alkalis and show fractionated REE patterns with variable moderate enrichments in middle and light over heavy REE. The amph have low Zr/Sm and Nb/La and high U/Th and Ba/Th ratios. Comparisons of mineral assemblages and compositions in the veins with those in high pressure crystallisation experiments and natural subduction-related volcanic rocks suggest likely affinities with Ca- and Ti-poor boninitic liquids.

[1] Ionov (2009) *GCA*, this volume. [2] Ishimaru *et al.* (2007) *J. Petrol.* **48**, 395-433.

Siderite, magnesite and dolomite solubility products as a function of temperature

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During the last decade, increasing fundamental researches have focused on the short and long term effects of massive injections of carbon dioxide in various geological environments (depleted oil or gas reservoirs, saline aquifers, basalts...) to assess the feasibility of sequestering large amounts of anthropogenic CO_2 either in the form of trapped CO_2 gas or, better, in the form of stable solid carbonate phases. Most geochemical models indicate that injection of CO_2 into deep sedimentary formations will lead to the precipitation of various carbonate minerals, including calcite, dolomite, magnesite, siderite, as well as dawsonite. However, accuracy of geochemical modeling depends strongly on reliable thermodynamic and kinetic data, which is not always the case, depending on temperature.

So, although numerous studies focus on the determination of the solubility product of siderite at low temperature, various ionic strengths, and CO_2 pressure, the values of its solubility product at 25°C are widespread and its standard enthalpy of formation differ by more than 10 $kJ \cdot mol^{-1}$. Furthermore, only available experimental data on the solubility product of magnesite and dolomite are at 25°C where a large discrepancy also exists.

In the continuity of our previous study on the stability of dawsonite [1], we acquired experimental measurements on the solubility product of natural siderite (from Peyrebrune quarry, France), dolomite (Sainte Colombe, France) and synthesized magnesite from 25 to 200°C at 0.1 molal NaCl and saturated vapor pressure. *in situ* pH values are obtained by means of a hydrogen-electrode concentration cell (HECC), whereas non-dispersive infra red technique (NDIR) has been used to analyze total aqueous carbonate, avoiding the problem that can be encountered with alkalinity measurements.

[1] Bénézeth *et al.* (2007) *GCA* **71**, 4438–4455.