



Multi-stage melt-rock interactions in peridotite xenoliths inferred from micro textural and chemical evidences.

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Studies of mantle-derived xenoliths rapidly brought to the surface by alkaline magmas provide valuable informations about the chemical and mineralogical processes that have affected the underlying mantle. However, the important point is to differentiate between processes occurring in the mantle or during transport to the surface. For example, the presence of amphibole and mica clearly indicates textural and chemical modifications of the lithospheric mantle by metasomatism prior to xenolith entrainment. On the other hand, reactional textures, which commonly contain glasses, have been much debated for more than a decade and interpreted either as mantle-originated textures (resulting from partial melting or metasomatism [1-4], or as post-entrainment textures [5, 6].

In this contribution we present evidences for multi-stage history of melt-rock interactions in a suite of anhydrous and hydrous spinel peridotites from Devès, Massif Central (France). The nodules are fresh, encased in a thin basaltic rim in sharp contact with the peridotite, and have not been affected by any invasion of basaltic melt along fractures. All samples are olivine-rich lherzolites (60-72 vol%) with variable orthopyroxene (7-26 vol%) and clinopyroxene (1-18 vol%) [7]. The low clinopyroxene abundances in hydrous samples probably reflect their transformation, as will be discussed.

- Part 1. Evidence for mantle metasomatism.

In the hydrous samples, amphibole is a low Ti (0.5 wt% TiO₂), Cr- and Mg-rich pargasite (1.2 wt% Cr₂O₃, mg* = 88). It occurs as disseminated crystals commonly associated with relict spinel or as veins, and some xenoliths show a cross-cutting hornblendite selvage. The amphibole shows compositional variations a function of increasing distance from the selvage in major (lower Ti, Fe and K, higher Cr, Mg, Na) and trace elements (decrease in REE). Olivine and pyroxenes also show compositional trends analogous to those of amphiboles. Thus, both cryptic and modal mantle metasomatism are recorded in these xenoliths which show a progressive metasomatism imprint along percolation paths.

- Part 2. Reactional textures.

The reactional sites are mainly of three types: amphibole, spinel, and orthopyroxene reaction zones. Spongy textures on the rim of clinopyroxene are rarely found. A common feature of all the reaction zones is the presence of fresh glass, which also occurs as thin veinlets along grain boundaries and as fracture filling in primary olivine and pyroxene. -1) Amphibole reaction zones: secondary clinopyroxene, olivine, spinel, ± plagioclase, formerly volatile-filled bubbles, and small (10 µm) patches of fresh colourless glass are observed around amphibole. -2) Orthopyroxene reaction zones: they consist of olivine, glass and clinopyroxene.-3) Spinel reaction zones: sieve-textures developed on spinel rim in contact with glass. Secondary spinels are enriched in Cr compared to the spinel core. In some cases, the rim is composite with an inner rim enriched in Al and an outer Cr-richer rim. In the three types of reaction zones, the compositions of the secondary phases are similar and differ from that of the primary phases, while the glass composition is highly variable depending on the site considered.

From thermobarometry, fO₂ estimates and chemical reaction simulations, we discuss the origin and the timing of formation of the different reactional sites and emphasize two points: the role of the breakdown of amphibole on the development of these reactions, both in the hydrous and anhydrous xenoliths, and the involvement in the glass formation of fluids/melts with different compositions and origins.

[1] Franz and Wirth, 1997, Contrib. Mineral. Petrol., 129, 268-283; [2] Carpenter et al., 2002, Mineral. Petrol., 74, 149-162; [3] Coltorti et al., 2000, EPSL, 183, 303-320; [4] Bonadiman et al., 2005, J. Petrol., 46, 2465-2493; [5] Yaxley et al., 1997, EPSL, 148, 433-446; [6] Shaw et al., 2006, Contrib. Mineral. Petrol., 151, 681-697; [7] Wagner and Deloule, 2007, Geochim. Cosmochim. Acta, 71, 4279-4296.