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Carbonatite melt in the Indian oceanic upper mantle (Kerguelen Archipelago, TAAF)

B.N. MOINE (1,4), G.DELPECH (2), M. GREGOIRE (3), S.Y. O'REILLY (4), J.P. LORAND (5), C. RENAC (1), and J.Y. COTTIN (1,4)

(1) Université Jean Monnet, Département de Géologie-Pétrologie-Géochimie, UMR–CNRS 6524, St. Etienne, France, (2) Université Paris Sud-Orsay, UMR CNRS 8148 IDES, Paris France, (3) Laboratoire Dynamique Terrestre et Planétaire, UMR- CNRS 5562, Observatoire Midi-Pyrénées, 31400 Toulouse, France, (4) GEMOC, Department of Earth and Planetary Sciences, Macquarie University, NSW 2109, Australia, (5) Muséum National d'Histoire Naturelle, FRE-CNRS 2456 Paris

(moineb@univ-st-etienne.fr / Fax: 33477485108 / Phone: 33477481513

Some mantle-derived xenoliths (amphibole-bearing dunites) from Kerguelen archipelago (Indian Ocean) contain interstitial pocket carbonates in triple junction or droplets at grain boundaries. The carbonates are mainly Mg-bearing calcite (X_{Ca} 0.96) with MgO content $<$1.4 wt%. Some Mg-bearing calcites are associated with euhedral dolomite and Mg-free calcite, mafic silicate glass with low alkali and Al_2O_3 content and with fine grain spinel, Ni-Fe-sulfides and magnesio-wüstite. These oxides and sulfide phases are concentrated at the carbonate/silicate glass boundaries. Spherical fluid inclusions (Bubbles of CO_2?) occur within the Mg-bearing calcite. Trace element analysis of the Mg-bearing calcite obtain by laser ablation-ICP-MS display high contents in rare-earth elements (REE$>$900ppm), Sr (1500-6000ppm) and Ba (300-500ppm) with enrichment in light REE (La/Sm_N=23) . The microstructural features and trace element composition of Mg-bearing carbonates suggests that Mg-bearing calcite represent quenched carbonate melts rather than crystal cumulates of dolomite and calcite that display low trace element contents. Carbonate melt reacts with olivine and amphibole to produce mafic silicate glass, clinopyroxene and Fe-Ti-oxides. The mafic silicate glass could be interpreted as immiscible silicate fraction of an evolved melt produced by the dissolution-percolation of the original carbonate melt (Moine *et al.*, 2004).

Two samples containing Mg-bearing calcite were analysed for Sr isotopic composition by in situ laser ablation MC-ICP-MS technique. The high Sr and low Rb contents of the carbonates allowed in-situ analyses of Sr isotopes with very good confidence (2sigma$<$ 0.05 per mil). Both average isotopic compositions are broadly similar with Sr^{87}/Sr^{86}=0.7054 and are slightly higher than the Kerguelen plume "signature" (Delpech 2004). Due to their high Sr contents, the carbonate melt buffer the Sr isotopic composition of percolated rocks. However, carbonate pockets of a same sample display isotopic variations since 0.7047 to 0.7061. Despite the high temperature, isotopic homogenisation was not achieved between carbonates, suggesting that the carbonate melt network in the dunite may not have been pervasive and/or strictly connected. As a result, local heterogeneities could be produced in some melt pockets by reaction and mixing with a reacting "old" high Rb/Sr reservoir such as pre-existing amphibole.

This study provides further evidence for the occurrence of carbonate melts percolating the upper mantle and demonstrates that these melts can be preserved and confined at mantle-crust boundary in hot oceanic uppermost mantle (in dunitic or wehrlitic mantle). Furthermore, Mg-bearing calcite trapping induce local heterogeneities in trace-elements and Sr isotopes ratios at the cm-scale in the uppermost lithospheric mantle, and that their Sr isotopes may not strictly represent the source of the metasomatic agent.

References :

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