Preliminary data on UHP fluid preserved in impure marbles from the Dora-Maira Massif

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The investigation of the tectono-metamorphic evolution of subducted marbles at mantle depth is fundamental for our understanding of the deep processes responsible for the deep carbon cycle. Moreover, the recent discovery of micro-diamond at Lago di Cignana (Frezzotti et. al., 2011) demonstrates, for the first time, the possibility to mobilize carbon through UHP carbonate dissolution, without the need of decarbonation reactions. In this contest, the evolution of the fluid phase during subduction and exhumation of impure marbles is promising to follow the fate of carbonates during deep subduction.

In the UHP Brossasco-Isasca Unit (BIU) of the Dora-Maira Massif, some dam- to hm-scale lenses of impure marbles are scattered in the paragneiss of the Polymetamorphic Complex. Previous studies on the Costa Monforte lens indicate that these marbles underwent Alpine metamorphic peak at ~4.0 GPa and ~730 °C (Castelli et. al., 2007) and that multiple events of dissolution-precipitation of dolomite occurred during UHP prograde to early-retrograde evolution in presence of a complex, solute-rich aqueous fluid (Ferrando et. al., 2017).

In order to more precisely asses the composition and nature of this fluid, a sample of impure marble with a very-simple mineral assemblage has been selected for fluid inclusion study. The selected sample is a banded marble mainly composed by different proportions of Mg-calcite, porphyroblasts of dolomite, porphyroclastic and neoblastic diopside and olivine, with minor retrograde antigorite, tremolite and Mg-chlorite (Ferrando et. al., 2017). The UHP peak mineral assemblage consisted of aragonite (now converted to calcite), dolomite, diopside and olivine. Micro-Raman analyses on primary multiphase aqueous inclusions, occurring within the core of peak diopside, allowed the recognition of the assemblage Mg-calcite + talc ± tremolite ± dolomite ± H_2O_{liq} ± a non-Raman active phase that in optical microscopy results to be a cubic daughter mineral (i.e. a chloride). SEM-EDS analysis on open inclusions, revealed appreciable Cl content in tremolite and talc (Ferrando et. al., 2017). This finding point to a dominantly aqueous, saline COH fluid, containing Ca, Mg, and Si as dissolved cations. This solute-rich fluid is likely responsible for the dissolution-precipitation of carbonates at UHP conditions.

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Ferrando, S., Groppo, C., Frezzotti, M.L., Castelli, D., Proyer, A. (2017) Dissolving dolomite in a stable UHP mineral assemblage: Evidence from Cal-Dol marbles of the Dora-Maira Massif (Italian Western Alps). American Mineralogist 102(1): 42-60.

Frezzotti, M.L., Selverstone, J., Sharp, Z.D., Compagnoni, R. (2011) Carbonate dissolution during subduction revealed by diamond-bearing rocks from the Alps. Nature Geoscience 4(10): 703.