

HP-UHP fluid inclusion post-entrapment evolution predicted by molecular and electrolytic fluid models

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Fluids released from a subducting plate regulate the long-term chemical cycles. So, a reliable characterisation of these fluid is of primary importance to understand metasomatic, oxidation, and melting processes affecting the overlying mantle wedge. UHP fluids are composed by solvent COHNS molecular volatiles and by solute non-volatile elements bounded to inorganic and organic species. Both direct (fluid inclusion, FI) and indirect (thermodynamic modelling, TM) approaches to study these fluids have reliability issues: the chemical fingerprint of UHP FI can be easily modified by post-trapping processes, while TM of solute-bearing fluids at UHP conditions is still in its infancy.

In this work, we evaluated the compositional data from primary (Type I) FI trapped within peak diopside from a chemically simple marble (DM675) from the UHP Brossasco-Isasca Unit of the Dora-Maira Massif (Western Alps). These tri-phase multisolid aqueous inclusions (5-25 μm in diameter) consist of $\text{H}_2\text{O}_{\text{Liq}}$ + different kinds of solids (Cc/Mg-Cc \pm Tlc \pm Dol \pm Serp \pm Tr \pm Sulp \pm Gr) + bubble ($\text{H}_2\text{O}_{\text{v}}$ \pm N_2 \pm CH_4); Fig. 1]. Classical molecular-fluid TM allowed to model post-trapping reactions between FI and host diopside (i.e., discrimination among daughter, step-daughter, and incidentally trapped minerals). Electrolytic-fluid TM allowed modelling the chemical composition of the peak solute-bearing aqueous fluid (H_2O : 88.5 wt%; solutes: 11.34 wt%; CO_2 + H_2S + CH_4 : 0.17 wt%) generated by progressive rock

dissolution. The comparison between the modelled fluid composition with that reconstructed from FI allows to recognise kind and extent of post-trapping chemical re-equilibration occurred within UHP FI. Applying this multidisciplinary approach, we demonstrate that the most impacting post-trapping process in UHP FI is the H_2O loss, with consequent preservation of the geochemical information in those FI lacking relevant post-trapping host-diopside chemical contamination. So, the electrolytic fluid TM is highly supportive of the classical FI study to retrieve geochemical information on deep subduction fluids.

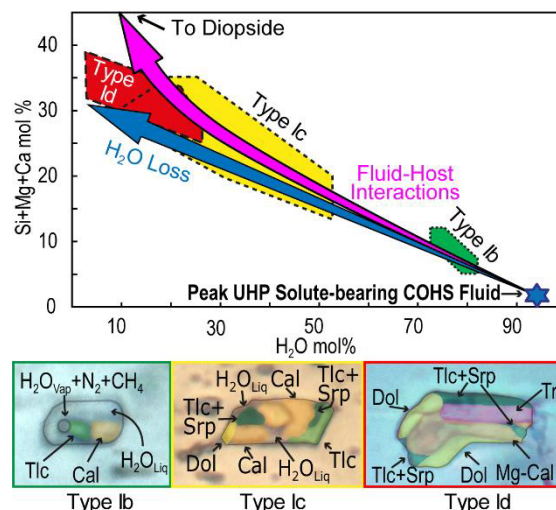


Fig. 1: FI compositions compared to the modelled peak electrolytic fluid with the most representative example of Type I FI post entrapment modification stages.