

# HP-UHP fluid inclusion evolution predicted by molecular and electrolytic fluid models: implications for HP-UHP metamorphic fluid composition

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Subduction fluids are fundamental in regulating long-term chemical cycles and their reliable characterisation is of primary importance for our understanding of processes related to mantle wedge metasomatism, oxidation and melting. UHP fluids are composed by solvent C-O-H-N-S molecular volatiles and by solute non-volatile elements (e.g., Si, Al, Ca, Mg, Fe, K, Na, Cl) bounded to inorganic and organic species. Both direct (fluid inclusion, FI) and indirect (thermodynamic modelling, TM) approaches to study these fluids have reliability issues due to the complexity of the investigated processes. The chemical fingerprint of UHP FI can be easily modified by post-trapping processes (e.g., solvent loss, chemical interaction with host mineral), while TM of solute-bearing fluids at UHP conditions is still in its infancy.

In this work, we apply and compare the data obtained by FI study and TM on UHP FI (Fig. 1) trapped within peak diopside from a chemically simple marble from the UHP Brossasco-Isasca Unit of the Dora-Maira Massif (Western Alps). Classical molecular-fluid TM allowed to model post-trapping reactions between FI and host diopside, and then to discriminate among daughter, step-daughter and incidentally trapped minerals present within the inclusions. Electrolytic-fluid TM allowed to model the chemical composition of the peak solute-bearing aqueous fluid (H<sub>2</sub>O: 96.3 mol%/88.5 wt%; solutes: 3.7 mol%/11.34 wt%; CO<sub>2</sub>+H<sub>2</sub>S+CH<sub>4</sub>: 0.09 mol%/0.17 wt%) generated by progressive rock dissolution. The comparison between the modelled composition with that reconstructed by FI study allows to recognise the type and the extent of post-trapping chemical re-equilibrations (up to 35 mol% of host diopside contamination and 18-99 mol% of the original H<sub>2</sub>O lost by diffusion and decrepitation; Fig. 1) occurred within UHP FI. Applying this multidisciplinary approach, we demonstrate that the most impacting FI post-trapping process is the H<sub>2</sub>O loss, with consequent preservation of the geochemical information in those FI lacking relevant post-trapping host-diopside chemical contamination (Fig.1). Moreover, we also show how FI complemented with electrolytic fluid TM can be employed to retrieve geochemical information on deep subduction fluids and the fluid and rock geochemistry of C-bearing systems (especially regarding all the multiple C-oxidation states contemporaneously in equilibrium at the same time). Finally, this work demonstrates the potentiality of this type of multidisciplinary work in developing a more complete and meaningful geologic model of the petrologic processes occurring during deep subduction, thanks to the ability of FI studies and TM to access different and complementary information, that would not be accessible otherwise.

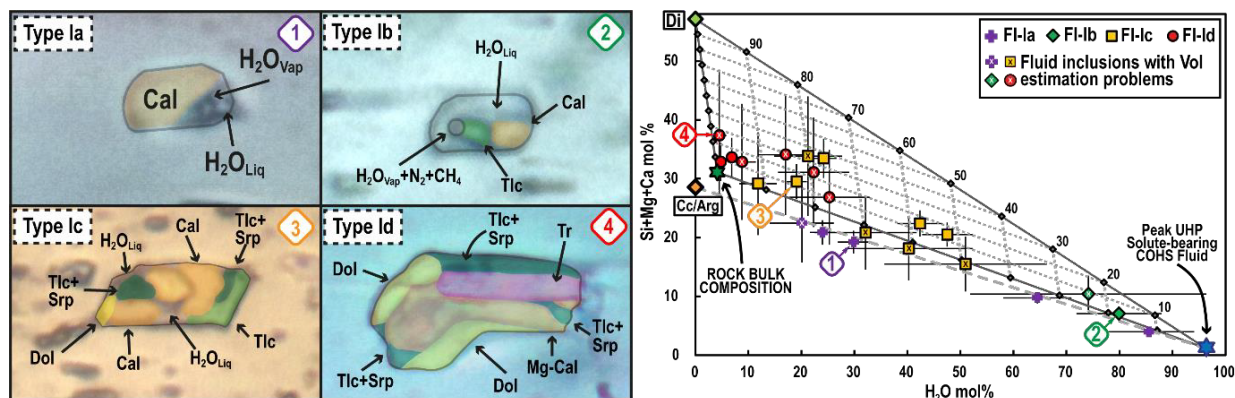


Figure 1