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REVIEW

FLUIDS IN THE CRUST

The chemical behavior of fluids released during deep subduction based on fluid inclusions†

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ABSTRACT

This review combines fluid inclusion data from (HP-)UHP rocks with experimental research and thermodynamic models to investigate the chemical and physical properties of fluids released during deep subduction, their solvent and element transport capacity, and the subsequent implications for the element recycling in the mantle wedge. An impressive number of fluid inclusion studies indicate three main populations of fluid inclusions in HP and UHP metamorphic rocks: (1) aqueous and/or non-polar gaseous fluid inclusions (FI); (2) multiphase solid inclusions (MSI); and (3) melt inclusions (MI). Chemical data from preserved fluid inclusions in rocks match with and implement "model" fluids by experiments and thermodynamics, revealing a continuity behind the extreme variations of physico-chemical properties of subduction-zone fluids. From fore-arc to sub-arc depths, fluids released by progressive devolatilization reactions from slab lithologies change from relatively diluted chloride-bearing aqueous solutions ($\pm N_2$), mainly influenced by halide ligands, to (alkali) aluminosilicate-rich aqueous fluids, in which polymerization probably governs the solubility and transport of major (e.g., Si and Al) and trace elements (including C). Fluid inclusion studies point to a reconsideration of the petrological models explaining deep volatile liberation, and their flux into the mantle wedge.

Keywords: Subduction zones, fluid inclusions, UHP metamorphic rocks, volatile cycling, mantle wedge, deep subduction, Review