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# Fluids geochemistry at extreme conditions in subduction zones

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## Abstract

High pressure slab-derived fluids (aqueous fluid, hydrous melt or supercritical fluid?) are major vectors for mass transfer and element recycling in subduction zones. The quantitative estimates of mass recycling the Earth's interior are, however, limited by the poor understanding of the atomic-scale mechanisms that control the mobilization and transport of elements during fluid-rock interactions in deep settings. In the last decade, new experimental designs combining high-pressure vessels and advanced micro-analytical techniques have opened the possibility for monitoring *in situ* the chemical composition, the molecular-scale structure and thermodynamic quantities for high-pressure fluids. Here, we will discuss emerging views on the mechanism of mobilization and recycling of trace elements and the nature and redox state of the slab flux in the light of hydrothermal experiments based on synchrotron techniques and the analysis of fluids trapped in synthetic fluid inclusions (SFI) at high pressure. Specifically, we will present results on the speciation, solubility and partition of trace and redox sensitive elements (e.g, REE, HFSE, Fe) in the eclogite-fluid system that illustrate the key role of coordination chemistry in the recycling of elements upon slab dehydration. The picture that is emerging from these studies is that ligand-bearing aqueous phases may have comparable efficiency to hydrous silicate melts in the mobilization and fractionation of trace elements, and that their role as mass transfer agents in subduction-related processes may have been underestimated until now. Finally, we will provide estimates of element fluxes and the oxidizing capacity of fluids released upon slab dehydration in the shallow upper mantle and discuss the implication for the geochemical signature of arc magmas.

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