

F and Cl release by hydrous melting of subducted oceanic crust

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In this study, we quantify the distribution of F and Cl between residual minerals and hydrous melts at upper-mantle conditions. The aim is to characterize the release of halogens upon melting of subducting oceanic crust by means of high-P-T piston cylinder experiments. Upon subduction, when the slab is sufficiently heated, slab melting will occur and transfer volatile elements to overlying arc mantle. F and Cl are potentially useful geochemical tracers of water in arc magmatic processes, but to our knowledge, no F or Cl partitioning data exists that is directly applicable to slab melting. The present study is necessary to establish F-Cl systematics as an anion-based diagnostic petrogenetic tracer for metasomatic processes and magma generation at the source of arc magmatism.

We will present results from an extensive set of equilibrium crystallization experiments on a starting composition representative of subducted hydrous metabasalt. The starting composition was enriched by addition of equilibrium liquid (based on Klimm et al., *Journal of Petrology* 2008) to optimize the experimental textures for SIMS and EPMA analyses. Experiments were performed in Au₈₀Pd₂₀ double capsules and buffered by the Re-ReO or Ni-NiO equilibrium, at pressures of 1.3 to 3.0 GPa and temperatures of 750 to 1000 °C.

Mineral assemblages in equilibrium with trondhjemitic liquids vary over the P,T-range (e.g. for P = 2.5GPa we observe amphibole + clinopyroxene + garnet + epidote + rutile at 750 °C, amphibole + clinopyroxene + garnet + allanite + rutile at 850 °C, and clinopyroxene + garnet at 900 °C). We will present detailed phase assemblage and compositional data at the conference. Most significantly, we find that F partitions mainly into the silicate liquid and amphibole (with $D_F(\text{Amph/Liq}) \approx 1.5$ and a bulk D for amphibolite of ≈ 0.6 , and for eclogite of ≈ 0.11). In contrast, Cl is incompatible in all minerals, and it partitions preferentially into aqueous fluid when this is present as a separate phase besides high-Si melt before quenching (i.e., at low P and T in our experiments).

Our results strongly suggest a decoupling between F and Cl as subducted slab undergoes progressive dehydration and hydrous melting. Chlorine appears to be released more readily in the subduction history, whereas F is released upon melting of the slab, with retention of significant concentrations in the solid residue as long as amphibole is stable.