$D_F^{Hbl/Flu}$ at lower crust P-T conditions determined by direct measurements on extracted fluids

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Fluorine is a volatile element in magma, which can serve as a geochemical tracer for volatile element transport. Its distribution between an aqueous fluid and minerals was previously determined by mass-balance calculations in experimental studies.

Here, we report experimentally determined solubility of F in aqueous fluid. The solid starting materials contain 4.8%, 1.9%, or 0.5% F, and an approximately 1-3 times quantity of pure water was added right before an experiment. The experiments were conducted at 1GPa and from 750 to 947°C, for the duration of 2 to 9 days, in gold capsule, with or without Ni/NiO buffer, using piston cylinder high-pressure apparatus. After quench, the liquid part was retrieved into a known volume of deionized water and the fluorine concentrations in aqueous fluids were determined with mass-balance calculation and high pressure liquid chromatography (HPLC). The solid part is measured by an electron microprobe. Fluorine concentrations obtained by HPLC are consistent within the uncertainties of the mass-balance calculations. $D_F^{Hbl/Flu}$ is 11.8 ± 0.8 for Hbl-Nbg-Flu system, 18.2 ± 1.1 for Hbl-Chd-Flu system, and 98.3 ± 25.0 for Hbl-Chu-Flu system. Because mass-balance results show F concentration is zero in Hbl-Chu-Flu system, the HPLC values are considered more accurate. Moreover, the discrepancies show that $D_F^{Hbl/Flu}$ changes with the phase assemblage, which indicates that these values perhaps are constrained with F saturation governed by a mineral other than hornblende.

Above all it suggests that this direct analytical method provides a better precision than the mass-balance approach.