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Behavior of hydrogen, fluorine and carbon in apatite during high temperature processes

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The volatile in apatite is widely used to investigate magma evolution, invert the volatile content of magma and measure the rate of magma ascent [1, 2]. To evaluate the role of volatiles in apatite in the record of magmatic processes, it is indispensable to known the chemical behavior of volatiles in the apatite for a hot and open system during cooling process of magma. Several studies have determined the diffusivities of F, Cl and OH [3, 4]. The results from Beran (1993) and Li et al. (2020) are similar despite multi-component diffusion used in Li et al. (2020). Therefore, it is unknown whether and how fluorine influences the behavior of other volatiles at high temperature. In addition, behavior of carbon in apatite at high temperatures is poorly known either.

In this study, we used the F-poor Imilchil and F-rich Durango apatite samples to analyze the behavior of fluorine, hydrogen and carbon at 1100, 1000 and 900°C, respectively, with FTIR and EPMA. The results show that (1) diffusion coefficient of OH is 2-3 orders of magnitude higher than that of F for both the samples; (2) the OH and F diffusion coefficients and diffusion activation energies of the F-poor Imilchil apatite are both higher than those of the F-rich Durango apatites, indicating fluorine impacts on OH diffusion; (3) no C diffusion occurs in both of the samples at these temperatures.

The above results reveal the mobilities of multiple volatiles coexisting in apatite, which provide new diffusion mechanisms of F and OH in apatite. For the F-rich apatite, H tends to leave the lattice in the OH form, while in the form of HF for the F-poor apatite. Additionally, the stable carbon in apatite gives the possibility for apatite used as a good carbon recorder during magmatic processes.

[1] Li, W. R. et al. (2021), *Journal of Petrology*. **62**, 1-35.

[2] Webster, J. D. et al. (2015), *Elements*. **11**, 177-182.

[3] Li, W. R. et al. (2020), *Earth and Planetary Science Letters*. **550**, 116545.

[4] Brenan, J. et al. (1993), *Chemical Geology*. **110**, 195-210.