Apatite as a tool for understanding the volatile contents of late-stage lunar magmas.

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Apatite is a common accessory mineral in lunar basalts with volatiles as esential sructural components in its crystal lattice. It may not be possible, therefore, to use Henrian partition coefficients (D) for back-calculating OH contents in the melts from which apatite crystallised. Very few experiments have been performed to investigate apatite/melt volatile partitioning under lunar conditions. Previous experimental work has shown volatile partitioning, between apatite and melt, to be composition dependent, yet most experiments have been performed in bulk-basaltic compositions. As apatite is a late-stage mineral, generally found in mesostasis pockets in lunar basalts, it doesn't appear on the solidus until ~95 % crystallisation. At this late stage, the equilibrium melt is likley to be highly evolved in composition.

Here, a average bulk mesostasis composition was calculated from four Apollo basalts for use as a starting material. Experiments were performed on an end-loaded piston cylinder using a talc-pyrex assembly. Initial experiments investigated F partitioning into fluroapatite devoid of other volatiles. This provided a baseline for further experiments in which the volatile abundances were varied, providing independent information on volatile partitioning into apatite from lunar composition melts. The F, Cl and OH abundance in the experiment products were analysed with a NanoSIMS 50L ion probe. Results support recent modelling work in that OH partitioning into fluroapatite is dependant on the availability of other volatiles in the melt. These results also show, however, that F partitioning into apatite is not dependant on the availability of OH and Cl in the melt. $D_F^{apatite/melt}$ can, therefore, be used in calculations that aim to back-calculate OH in surrounding melts. The caveat to this is that degassing of the melt may have occurred prior to apatite crystallisation and, therefore, determining source region volatile contents requires further calculations.