Measurement of hydrogen in igneous feldspars by FTIR and SIMS: progress towards a quantitative geohygrometer

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Renewed interest in hydrogen incorporation in feldspars has been driven by recognition of their potential to record magmatic water contents, both in terrestrial [1,2,3] and lunar systems [4]. Yet, problems remain with quantification of trace H in feldspars. Accurate measurement by FTIR is limited by the need to collect polarized spectra from three mutually perpendicular directions. This can be impractical when crystals are small and/or twinned or compostionally zoned, as commonly observed for phenocrysts or feldspars grown in experiments. SIMS or NanoSIMS are attractive alternatives to FTIR, offering high spatial resolution, high precision, and the feasibility of detection limits below 5 ppm H_2O [5]; accuracy, however, depends on establishment of good standards.

We compared new FTIR and SIMS data for 19 previously studied [6,7] feldspars, including plagioclase, anorthoclase, sanidine, orthoclase, and microcline. FTIR-SIMS correlations for individual sets of samples with similar IR spectra yield excellent statistics ($r^2 = 1$) if one near end-member anorthite is excluded (suggesting the possibility of a significant matrix effect related to Ca). However, differences in calibration slopes for microcline vs. sanidine vs. plagioclase/anorthoclase provide evidence that the IR absorption coefficient has a significant wavenumber dependence. We have also identified some errors in previous work that improve the calibration of the IR absorption coefficient determined by NMR [6]. We are using these fundamental calibration efforts as a basis for further studies of natural and experimental samples to develop a precise feldspar geohygrometer.

[1] Johnson (2005) *GCA* **69**, A743 [2] Seaman *et al* (2006) *Am Min* **91**, 12-20 [3] Hamada *et al* (2013) *EPSL* **365**, 253-262 [4] Hui *et al* (2013) *Nat Geosci* **6**, 177-180 [5] Mosenfelder *et al* (2011) *Am Min* **96**, 1725-1741 [6] Johnson & Rossman (2003) *Am Min* **88**, 901-911 [7] Johnson & Rossman (2004) *Am Min* **89**, 586-600