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Crystal/Melt Distribution of Water During Crystallization of Felsic Magma

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Introduction: Fourier transform infrared spectroscopy was used to identify water and/or hydroxide in large and small plagioclase feldspar phenocrysts and groundmass glass in felsic volcanic rocks from the ~ 1 million year old Purico volcanic complex of Chile.

Methods and Materials A Nicolet Magna 860 Step-Scan FTIR spectrometer was used in transmission mode to collect spectra on ~12 x 12 micron areas. Samples were 40-micron-thick self-supporting polished rock slabs.

Results: Preliminary data indicate that spectra collected from large plagioclase feldspar crystals are essentially flat in the 3000-4000 wavenumber range. Small plagioclase feldspar crystals have distinct broad peaks in the same wavenumber range, indicating the presence of water and/or hydroxide in these nominally anhydrous crystals. Predictably, spectra of glass shard-rich groundmass shows large peaks in the 3000-4000 wavenumber range, consistent both with high water concentrations in felsic magmas, and with high probability of the presence of adsorbed water in the poorly welded matrix material.

Conclusions: These preliminary results indicate that water might be incorporated into structurally anhydrous crystals during middle to late stages of crystallization sequences as early-formed truly anhydrous crystals form and leave the host melt increasingly enriched in water. Future goals are to quantify water and/or hydroxide concentrations in crystals and groundmass, and to establish crystal/melt distribution coefficients for various stages in the sequence of crystallization of felsic magmas.