Investigating titanomagnetite abundance in rhyolite pumice

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Examining the role of nm sized titanomagnetite in heterogeneous bubble nucleation is a crucial step in understanding eruptive processes. Homogeneous nucleation is the inferred form of nucleation for crystal poor systems. However, [1] shows that large decompression rates (several 10's of MPa/s) and drastic changes in pressure are needed to support this hypothesis (often >100 MPa). In contrast, heterogeneous nucleation occurs at ~1/4 the pressure change. The inference of homogeneous nucleation rests on a failure to resolve nm titatnomagnetite crystals petrographically, an inference that is called into question by the observance of nm-sized oxide in rhyolite tuff using magnetic characterization [2]. The aim of our study is to evaluate whether nm sized titanomagnetite crystals are present in nominally aphyric rhyolite tephra produced in a variety of sub-Plinian to Plinian eruptions.

Our study includes nominally aphyric materials from Medicine Lake, California, USA, (73.5 wt.% SiO_2, subplinian, 1100 AD); Diamante, Chile (74.3% SiO_2, plinian, 0.45 Ma); and Novarupta, Alaska, USA, (77.2% SiO_2, plinian, 1912). We determine the connected porosity and the permeability of raw and cored pumice following established methods [3]. Clasts/cores drawn from the average and $\pm 2\sigma$ representatives of the distribution are subjected to low-temperature magnetic remanenance experiments to detect the transition from stable single domain to superparamagnetic behavior of titanomagnetite grains (<0.05 μm) as they warm from 20 K to 300 K, which permits the calculation of magnetic particle volume and abundance. These techniques permit evaluation of the particle size distribution in the sub-micron size range [2] and thus evaluation of the possibility that magnetite crystals exist in these explosively erupted materials at number densities comparable to bubbles.

[1] Shea et al. (2017) *J Volcanol and Geotherm Res,* **343**, pp. 155-170. [2] Worm et al. (1999) *J Geophys Res,* **104**, pp. 25415-25425. [3] Takeuchi, Shingo (2005, 2008) *J Volcanol and Geotherm Res,* **58**, pp. 87-100.