Differentiation and storage of the Huckleberry Ridge Tuff rhyolite

M. L. MYERS[1], P. J. WALLACE[1] AND C. J. N. WILSON[2]

[1]University of Oregon, Eugene, Oregon 97403, USA (correspondence: mmyers3@uoregon.edu)
[2]SGEES, Victoria University, Wellington 6012, NZ

The fine-grained (ash to fine lapilli) fallout deposit at the base of the Huckleberry Ridge Tuff (HRT: Yellowstone Plateau Volcanic Field) contains evidence for intrafall reworking, reflecting episodic initial explosive activity preceding the voluminous HRT ignimbrite eruptions. Based on detailed stratigraphic sampling, we analyzed volatiles, and major and trace elements in melt inclusions (MI) in loose but glass-coated quartz crystals to investigate differentiation processes and storage conditions prior to the caldera-forming phases of the eruption. Individual MI analyses allow for the reconstruction of melt compositions during crystallization, whereas reentrants (unsealed MIs) provide insights into the evolution of the magmatic system leading up to eruption.

Major element compositions of MIs are high-silica rhyolite in the studied stratigraphic levels (SiO_2 = 75.5-77.5 wt.%). MIs in the initial fall layer (< 2-3 cm from base) have the highest SiO_2 contents and most evolved trace element compositions. Concentrations of U (6-10 ppm), Sr (2-12 ppm), Cl (1200-1800 ppm), and B (9.5-16.5 ppm) plotted versus Rb (180-260 ppm) show continuous arrays. This range requires ~40% crystallization of the least evolved MIs (found in the middle and upper portions of the fall deposit) to yield the more evolved compositions in MIs in the initial fall layer. MIs in the basal layer also contain the highest volatile concentrations (~4.4 wt.% H_2O, 500 ppm CO_2, implying minimum pressures of 140-170 MPa, equivalent to depths of 5-6 km) whereas the middle and upper portions of the fall deposit contain MIs with lower and more varied volatile concentrations (H_2O ~2.5-3.5 wt.%, CO_2 ~200 ppm). Variability in MI data for rapidly diffusing elements H and Li is attributed to diffusive loss during pre- or syn-eruptive decompression. Using a diffusion model [1], the timescales for H loss from the majority of MIs are on the order of 1-6 days, with some up to several weeks.

For MIs and reentrants in the same quartz crystal, the reentrants have more evolved compositions, suggesting that the crystals were erupted with the same magma in which they had grown. The range of MI compositions at each stratigraphic level, however, shows that crystals from different parts of the magma body were co-erupted. Our results thus provide evidence for chemical stratification in the earliest erupted portion of the HRT magma body.

[1] Cottrell *et al* (2002). *G³*, **4**, 1-26