Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.30313

Distribution of H_2O bubble in highly hydrated albite melts with varying pressure and temperature

EUN JEONG KIM[1], YERIN JEON[2], JIHWAN KIM[2], PROF. HYUN NA KIM, PHD[1,2], SUN YOUNG PARK[3], YOUNGSEUK KEEHM[2], HYEON-SEOB KIM[4] AND BYUNG-DAL SO[4]

[1]Yellow Sea Institute of Geoenvironmental Sciences Laboratory, Kongju National University
[2]Kongju National University
[3]Korea Institute of Geoscience and Mineral Resources
[4]Kangwon National University

The explosiveness of volcanic eruptions depends on magma viscosity and its volatile content (e.g., H_2O and CO_2). While the outgassing process of volatiles in magma has been extensively studied, less is known about degassing behavior and properties of highly hydrous magma (e.g., magma containing more than 10 wt% H_2O). Recent studies suggest that rhyolitic magma in subduction zones can reach supercritical conditions [1-3], yet the degassing mechanisms of such highly hydrous rhyolitic melts remain unclear. In this study, we investigate the formation of H_2O bubbles in hydrous albite melts, as a model system for rhyolitic melts, under high-pressure conditions of 0.5-1 GPa (15-30 km depths). We aim to elucidate the relationship between bubble dynamics, atomic structure changes in magma during degassing, and volatile exsolution mechanisms. High-pressure experiments were conducted using a piston-cylinder apparatus at 0.5-1 GPa and 1000-1200 °C with albite glasses containing ~13 wt% H_2O. The formation of H_2O bubbles in albite glasses was analyzed using scanning electron microscopy and the ImageJ program. The results show that bubbles exhibit heterogeneous distributions in size at 0.5 GPa, whereas at 1 GPa, the bubbles are distributed more homogeneously. Fitting of the cumulative bubble-size distribution suggests that bubble formation mechanisms mainly depends on the temperature with coalescence being the dominant growth mechanism at high temperatures, while Ostwald ripening occurs at lower temperatures. Raman spectra of bubble-bearing albite glasses show that the degree of polymerization (NBO/T) of the melt remains nearly constant despite extensive vesiculation, suggesting that bubble formation does not significantly alter the melt structure. The effect of temperature may be significant when the highly hydrous and viscous rhyolitic magma undergoes degassing: enhanced coalescence at low pressure and high temperature condition can facilitate effusive eruptions while maintaining a similar atomic structure. Further investigations are needed to better understand structural changes in magma during degassing, to improve our understanding of the physical and chemical processes controlling volatile exsolution in subduction zone magmatism.

[1] Ni et al. (2017) *Earth-Sceince Reviews* 167, 62-71
[2] Taniuch et al. (2020), *Scientific Reports* 10, 8698
[3] Bureau & Keppler (1999) *Earth and Planetary Science Letters* 165, 187-196