

## Significance of vapor bubbles to the volatile budget of melt inclusions from West Zealandia seamount, Mariana arc

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Vapor bubbles are common in glassy silicate melt inclusions. They can develop during post-entrapment cooling and crystallization because the melt phase contracts more than the host crystal and crystallizing minerals resulting in the formation of a void within the melt. If the melt contains volatiles, such as H<sub>2</sub>O or CO<sub>2</sub>, that become less soluble with decreasing pressure, the decrease in pressure associated with melt contraction causes some of the volatiles to exsolve into the void (bubble) (1, 2). A significant proportion of the volatiles originally dissolved in the melt at the time of entrapment can reside in the bubble once the inclusion and its host have been erupted and quenched. If the volatiles in melt inclusion-hosted vapor bubbles are not considered, this could result in a significant underestimation of the original volatile budget of the trapped melt. Volatiles in the vapor bubble can be analyzed directly by Raman spectroscopy and then added to the volatiles still dissolved in the melt to reconstruct the volatile content of the melt at the time of entrapment (e.g., 1, 3). Alternatively, prior to analysis of the quenched, glassy melt inclusion, the inclusion can be heated until the bubble dissolves and the melt inclusion rehomogenized (e.g., 3). However, for an inclusion that has already been analyzed, if a vapor bubble was present, sample preparation is likely to have opened the bubble resulting in its volatiles being lost. In this case, calculations based on the volume of the inclusion, the volume of the vapor bubble and the ideal gas law can indirectly estimate the contribution from the vapor bubble to the overall volatile budget of the melt inclusion (e.g., 4).

The melt phase of olivine-hosted glassy basaltic melt inclusions from West Zealandia seamount (16° 53' N) in the southern Mariana arc have already been analyzed for H<sub>2</sub>O and CO<sub>2</sub> (by FTIR spectroscopy), major elements, S and Cl (by EPMA), and trace elements (by LA-ICP-MS). Dissolved volatiles range from 1.9-4.5 wt % H<sub>2</sub>O, below detection (20 ppm)-856 ppm CO<sub>2</sub>, 952-2260 ppm S and 454-2590 ppm Cl. Vapor bubbles were present in most of the inclusions, but as the inclusions were prepared for micro-analysis, the bubbles have been opened and the vapor phase lost. As a result, after correction for post-entrapment crystallization and Fe-loss, the measured volatile concentrations underestimate the original volatile content of the melt, and indirect calculations of the amount of volatiles that these bubbles could contribute to the overall volatile budget of each inclusion need to be performed. Firstly, we estimate the volatiles that were in the bubble based on the volume of the bubble after quenching, using photomicrographs of the inclusions collected during their preparation for analysis. However, because the bubble may grow during the final quench from eruption temperature to the glass transition temperature on a timescale too fast to allow significant diffusion of volatiles from the melt to the vapor phase, this may result in an overestimation of the volatiles residing in the bubble. Thus, secondly we estimate the volatiles that were in the bubble based on the volume as a function of the difference between the trapping and pre-eruption temperatures calculated using the olivine liquidus temperature of the measured melt inclusion composition and the extent of Fe-loss that has occurred in the melt inclusions during cooling between trapping and eruption. We will evaluate the effects that volatiles in the vapor phase estimated in these two ways have on the total volatile budget of each inclusion. In turn, we will examine how this affects inclusion trapping pressures inferred from the volatiles in the melt inclusions, and the significance this has for interpreting the magma plumbing system and crustal structure beneath West Zealandia.

1 Moore et al., In Press, Am Min.

2 Wallace et al., In Press, Am Min.

3 Hartley et al., 2014, EPSL, 393, 120.

4 Shaw et al, 2008, EPSL, 275, 138.

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