H_2O contents of Ca-rich plagioclase phenocrysts from arc volcanic front

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Ca-rich plagioclase is commonly found in island arc basalt at volcanic front. Experimental studies [1, 2, 3] have shown that composition of plagioclase becomes enriched in Ca with increasing H_2O content in melt. Therefore, composition of plagioclase can be an indicator of H_2O content of magma at the time of crystallization.

However, in Izu volcanic arc, H_2O-rich nature in basaltic magmas has not proved yet. Analyses of basaltic melt inclusions hosted by Ca-rich plagioclase yield lower H_2O content (≤~2 wt.%) [3, 4]. Lower H_2O content in melt inclusions may be explained by post-entrapment volatile leakage [3].

In order to confirm H_2O content at the time of plagioclase crystallization, we analyzed trace quantities of H_2O in Ca-rich plagioclase obtained from the 1986 eruption of Izu-Oshima volcano (34°N 44', 139°E 24'), using polarized infrared spectra [5]. Analytical results clearly demonstrate that H_2O content becomes higher with increasing An content of plagioclase. Assuming partition coefficient of H_2O between plagioclase and melt = 0.004 [6], H_2O content in melt changes widely from 3 to ≥6 wt.%, which is consistent with melting experiments of hydrous basalt to crystallize Ca-rich plagioclase. Analyses of H_2O in plagioclase phenocrysts suggest that H_2O content of island arc basaltic magmas is higher than that of melt inclusions.

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Syn-eruptive magma crystallization

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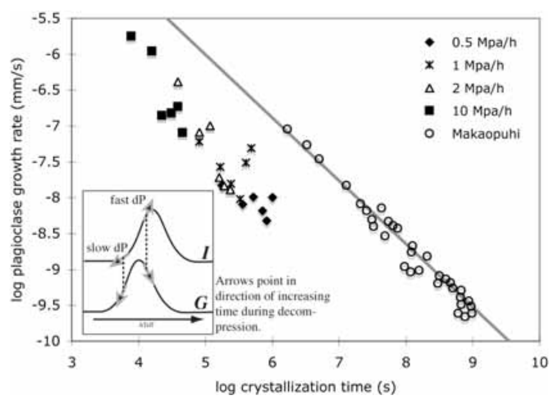
The potential consequences of decompression-driven crystallization for modulating eruptive style are now widely recognized. The next step in interpreting natural crystal textures is to understand the crystallization response to decompression for a range of compositions and ascent rates. Experiments are underway on natural rhyodacite to understand how plagioclase nucleation rate (***I***), growth rate (***G***), crystal size distributions, morphologies, melt inclusions, and the effective undercooling (ΔT_{eff}) develop with time.

A family of experiments varying in quench pressure at each of four decompression rates (0.5, 1, 2, and 10 MPa h^{-1}) reveals that ***I*** progressively increases with time by nearly 3 orders of magnitude at large *dP/dt*, yet decreases by a similar amount at low *dP/dt*. In contrast, ***G*** decreases with progressive decompression at all decompression rates. In combination with known functional dependence of ***I*** and ***G*** on ΔT_{eff}, these observations suggest that slow ascending magmas maintain small ΔT_{eff}, while magmas ascending ≥0.06 m s^{-1} progressively lag behind equilibrium (Fig 1 inset).

G is a power law function of crystallization time (Fig.1), with time dependence similar to that of plagioclase in Makaopuhi basalt (Cashman 1993) and ***G*** values that are greater as a consequence of shorter crystallization times. The offset may reflect higher melt viscosity and nuclei density in the silicic magma.



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