What the microlite systematics between microlite number density and crystallinity means

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Microlites crystallize by the effective supercooling induced by the decompression and the water exsolution from melt (or vesiculation) during magma ascent. From the resent study, the systematic correlations among textural characteristics of microlites (microlite systematics) in sub-plinian eruptions of basaltic andesite are found as follows (Toramaru et al 2007 JpGU meeting) : (1) a positive correlation between bubble number density and microlite number density (pyroxene). (2) a positive correlation between microlite number density and crystallinity (pyroxene). (4) a negative correlation between vesicularity and crystallinity. (4) a negative correlation between vesicularity and mircrolite number density. The present talk concerns the second systematics (2) that is, a positive correlation between microlite number density and crystallinity. At the previous talk we considered that the crystallinity is a measure of amount of decompression and microlite number density is a measure of decompression rate, on the basis of the numerical study and the laboratory experiment by Couch et al (2003). In addition we argued that a specific relation among decompression rate, amount of decompression and growth time (inverse of ascent velocity) is needed for the presence of the systematics. In the present talk, we examined this idea from the water content in groundmass glass by FT-IR analysis and the local bulk compositions of groundmass by SEM analysis.

Analytical results for scoria from the Izu-Oshima 1986B subplinian eruption show 1) the water contents in groundmass glass have no variation (0.13+-0.02wt%) and no correlation with the crystallinity, 2) the local bulk composition of groundmass has variation within 5wt% correlating with the crystallinity or microlite number density.

From no correlation between the crystallinity and water content in groundmass glass, the idea that the crystallinity is controlled by the amount of decompression is ruled out. From the correlation between the local bulk composition of groundmass and the crystallinity, it can be inferred that the water-free liquidus of plagioclase and/or pyroxene varies with the local melt compositions resulting in the crystallinity variations if the temperature is uniform. From MELTS calculation, the increase in SiO2 content by 5 wt% results in 15% in crystallinity decrease, corresponding to 26K in the decrease of water-free liquidus of plagioclase. This value is sufficient to explain the observed variation of crystallinity. On the other hand, microlite number density has the significant variation even if the influence of diffusivity and liquidus by the difference of bulk compositions is taken into account. This means that the decompression rate controlling microlite number density has a significant variation correlating with the bulk composition of melt.

In conclusion, the positive correlation between crystallinity and microlite number density represents the variation of the liquidus (crystallinity) and decompression rate (microlite number density) through their unique relation to the bulk chemical compositions.