Apparent temperatures estimated from pyroxene phenocrysts in dacites from Unzen, Kuju and Sakurajima

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Though recent lavas from Unzen, Kuju and Sakurajima volcanoes are all dacitic in composition, the former two volcanoes have abundant numbers of dome. The latter is abundant in lava flows. This difference may probably come from viscosities. Magma viscosity is dependent on its composition and temperature. Their compositions, however, are almost the same, besides their H2O contents that have not yet been well known. Magma viscosity decreases with increasing temperature. This reaction makes us expect higher temperatures for Sakurajima lavas and lower temperatures for Unzen lavas. To confirm this, we estimated magma temperatures for Heisei lava samples from Unzen volcano, dacite samples from Kuju volcano, historical lava samples from Sakurajima volcano, by employing two-pyroxene thermometry devised by Lindsley (Lindsley, 1983). The results we got are just opposite what we expected.

Apparent temperatures for samples from Sakurajima volcano are well concentrated at about 850C. Those for samples from Kuju volcano are scattered around at about 900C. Apparent temperatures for samples from Unzen volcano are unexpectedly high and much more scattered. The temperatures range from 700C to 1000C. The temperatures are jumping around at about 1000C.

Phenocrysts are more abundant in samples from Unzen and Kuju than from Sakurajima. Phenocrysts in samples from Unzen and Kuju volcanoes are plagioclase, hornblende, clinopyroxene, orthopyroxene, biotite, magnetite and quartz, however, are less abundant in Kuju samples. Phenocrysts in samples from Sakurajima volcano are plagioclase, clinopyroxene, orthopyroxene and magnetite. There is no biotite, nor hornblende nor quartz phenocrysts. The higher phenocryst abundances suggest higher viscosities of the Unzen and Kuju dacite magmas. The presence of quartz phenocrysts in Unzen and Kuju dacite samples suggests their magma temperatures are surely lower than those of the Sakurajima samples. The lower temperatures further suggest the higher viscosities of the Unzen and Kuju dacite magmas than those of Sakurajima magmas. This temperature relation, however, is inconsistent to the apparent temperatures we got.

Quartz phenoctysts in Unzen and Kuju samples have corroded form, suggesting that they met temperatures higher than their crystallization. The same may be said to the plagioclase phenocrysts since they have zones of dusty inclusions. Accordingly the Unzen and Kuju lava samples seem to have heated before the extrusion. This may be due to intrusion of basaltic magma into the chambers. The intrusion is indicated by the abundant magmatic inclusions in Unzen and Kuju dacite lava samples. The scattering of the apparent temperatures of Unzen lava samples may suggest the heating is not homogeneous and the heated part is not well mixed with other part of the magma. On the other hand, magmatic inclusions are very few in the historical lava flows at Sakurajima volcano. These lava flows, however, have been found to represent mixed magmas. The injection and mixing are indicated from bimodal distribution of their plagioclase phenocryst compositions (Yanagi et al., 1983). The bimodal distribution indicated the injection of basaltic magma into the resident magma in the chamber beneath Sakurajima volcano. The lack of magmatic inclusion in the lava flows may indicate the resident and injected magmas were well mixed. This is very consistent with the homogeneity in the apparent temperatures.