# New model of crystallization kinetics and CSD: Its applications to Shinmoedake 2011 eruptions

ATSUSHI TORAMARU[1*] AND TSUYOSHI KICHISE[2]

[1]Department of Earth and Planetary Sciences, Kyushu University, toramaru@geo.kyushu-u.ac.j
[2]Department of Earth and Planetary Sciences, Kyushu University, kichiset@gmail.com

We propose a new model of crystallization in which the rates of nucleation and crystallization (crystal volume fraction) are assumed to be constant. From the scaling argument, it is shown that the growth rate is inversely proportional to time. The model yields a log-linear CSD as a solution to the population balance equation with the growth rate. The slope and intercept of CSD are controlled by the ratio of nucleation rate to crystallization rate: they increase with the ratio. Taking into account the composition change as a function of time corresponding to a change in temperature (cooling-induced crystallization) or pressure (decompression-induced crystallization), we calculate the core compositions of crystals and the zoning profile as function of crystal size. Calculated crystal compositions in the case of decompression-induced crystallization can successfully explain observed correlations between core compositions of plagioclase microlites and sizes in pumice from the Shinmoedake 2011 subplinian eruptions. Some of plagioclase microlites show zoning profiles that An content characteristically decreases from core to rim, which also can be explained by the model. The observed positive correlation between slopes (or intercept) of CSD and bulk density of pumice suggests that higher bulk densities of pumice expense longer times in the conduit in the subplinian eruptions.