

## Heterogeneities in Crystal from YTT (74 ka) and the Implications for Toba Magma Chamber Systems

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Toba Caldera Complex, Indonesia is well known as the largest Quaternary caldera (87x33 km) that formed by four major eruptions among which the biggest one is the eruption of the Youngest Toba Tuff (YTT) about 74,000 years ago. Textural study of the pumice clast from YTT has been done to estimate the decompression rate by using bubble number density data. The result shows that decompression rate of Toba Caldera forming eruption varies in two order magnitude ranging from  $10^6$ – $10^8$  Pa/s. Southern pumices show the lower value than pumices from northern caldera. Similarly, new data about lithic distributions and mineral components of YTT from the northern and southern caldera showed several different characteristics. This fact suggests a possibility of different magma generation processes between southern and northern deposits. Therefore, understanding both conduit and chamber processes is needed to reveal the origin of differences in deposits. This study aims to elucidate magma chamber condition by characterizing the deposit especially crystals from YTT eruption.

Characterizations of Toba Tuffs have been made but not been enough to discuss YTT in detail. In this study, we focus on spatial heterogeneities in YTT deposits. Samples from four different locations were employed for the analyses. Component analysis was carried out on components larger than 2 mm. Whole-rock geochemical data were obtained by XRF. Petrography analysis for 37 thin sections was conducted using optical microscope. Textural analysis was carried out for 170 free-crystals and 25 selected thin sections using microphotographs taken by SEM and further analyzed using image processing software. Chemical analysis for free-crystals was carried out by SEM-EDS, while for pumices grain of 22 thin sections was conducted using EPMA.

Geochemical data showed that YTT magma is rhyodacitic to rhyolitic in whole-rock compositions with wide range of SiO<sub>2</sub> (69.15–76.83 wt.%). There are differences in abundance and type of pumices, free-crystals, and lithic in each location. Major minerals are plagioclase, biotite, sanidine, and quartz. Common characteristics of northern and southern part deposit is that most of crystals are fractured, some forming aggregates, has anhedral shape and wide variation in size (0.003 mm<sup>2</sup>–13.113 mm<sup>2</sup>). However, there are differences between northern and southern deposits: presence of amphibole with larger size, orange quartz, sieve texture, patchy zoning, oscillatory zoning, crystal clots, domination of quartz and sanidine as free-crystals, and wider range of anorthite (An<sub>25</sub>– An<sub>87</sub>) is mostly found in northern deposits.

Plagioclase composition from northern part shows bimodal distribution suggesting that crystallization does not occur simultaneously by single process. Furthermore, plots of anorthite number versus size and of average anorthite number versus crystal content show random distribution, suggesting the complex crystallization of plagioclase: other processes than fractional crystallization in magma chamber. Moreover, presence of antecryst and disequilibrium textures in northern deposit indicates intervention from older rocks or even other systems. Heterogeneities in crystal from northern and southern deposits suggest that YTT deposits are generated by multiple eruptions from independent, at least two magma chambers.

Keywords: Toba Caldera, the Youngest Toba Tuff (YTT), Heterogeneities in Crystal, Conduit Process, Chamber Process, Multiple eruptions