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Crystal Size Distribution analysis of Merapi Andesites and cogenetic inclusions

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Mt. Merapi in Central Java, Indonesia, is one of the most active stratovolcanoes on Earth [1]. Previous petrographic and geochemical studies [e.g. 2-4] identified the presence of a large plumbing system with a complex and multiphase history involving accumulation, magma mixing, crustal assimilation, equilibration and degassing. This study uses Crystal Size Distribution (CSD) analysis [5, 6] of recent Merapi eruptive products to assess if the different crystal populations and the complex history identified by geochemical techniques can be resolved by CSD. Moreover, CSD analysis can give additional information on processes occurring during storage and ascent as well as information on the timing of such processes [5, 6].

CSD analyses of plagioclase in four Merapi andesites indicate the presence of two main crystal populations. However, geochemical studies identified up to four plagioclase crystal types based on major and isotope chemistry. The comparison of isotope and major element transects with the CSD analyses indicate that phenocrysts >2 mm, represent a period of crystal growth that involved accumulation and crustal assimilation. This is followed by textural re-equilibration and a second phase of crystal growth, represented by plagioclase phenocrysts and microcrysts <2 mm in size. CSDs of igneous medium to coarse grained cogenetic inclusions indicate a third <1 mm crystal population, potentially indicating induced decompressional crystallisation by degassing and amphibole breakdown, and or crustal assimilation. Secondary processes such as resorption and compaction are recorded in the omission of intermediate crystal sizes in CSD plots for some igneous inclusions.

Although CSD analysis provides additional information about processes that occur beneath Merapi, petrographic and geochemical information were required to draw unique conclusions. Fluctuations in magma chamber conditions recorded by crystal geochemistry did not always form a new textural crystal population resolvable by CSD analysis. Merapi has a long eruptive history with emission of significant volumes of magma and regular replenishment. In order to produce the relatively homogenised whole rock and CSD data a large steady state magmatic system beneath Merapi is required.

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