

Explosive versus effusive eruptive activity at Merapi volcano, Java, Indonesia.

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1872 Merapi volcanic activity was even more violent and explosive than the 2010 events (VEI 4). Here we examine Merapi past explosive versus effusive activity through a detailed analysis of selected lava flows and domes, juvenile components from different types of pyroclastic flow deposits and lapilli ejecta from sub-plinian-style eruptions, ranging in age from Proto-Merapi to the recent activity.

The textures, petrology and geochemistry of the older Merapi units are revisited giving particular attention to the contrast in crystal sizes of the volcanics relative to those of the inclusions and xenoliths as well as to the associated mineral assemblages and compositions in order to identify the various stages of magma genesis and evolution. Moreover, special attention is given to the 1872 eruptive products and their comparison to the 2010 ejecta.

Crystal size distribution (CSD) theory is applied to obtain information on growth and residence times of plagioclase crystals in the various magma storage zones in the sub-volcanic plumbing system and to gain insight on open-system processes such as the frequency of magma replenishment and possible rates of crustal assimilation. From Intercept-Slope (I-S) relations, in comparison to other large magmatic systems, the staging zones for some Merapi eruptives appear to be similarly extensive in terms of volume and longevity. This suggests that, in addition to understanding eruption mechanics, the eruptive record of Merapi may also be valuable in understanding the ongoing evolution of other major magma chambers.

Coupled with petrographic results, like a freshly-crystallized amphibole observed in the 2010 deposits (Costa et al., 2013 and Preece et al., 2013) and in older deposits, it may provide a clue to the identification of precursors for very explosive events (VEI 4) by carrying the signature of a large, undegassed magmatic batch from a source deeper than where 20th century lava dome magmas were stored before extrusion.