Revealing shallow magmatic ascent processes during the 2006 and 2010 eruptions of Merapi volcano: evidence from textural and compositional variations of feldspar microlites

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The interplay between magma ascent, degassing and changing magmatic properties are widely recognized as critical factors controlling the style of silicic volcanic eruptions. Microlite textures in samples from the prolonged dome-forming eruption of Merapi in 2006 provide a record of changing magmatic ascent conditions and shallow conduit processes throughout the eruption. Analysis of microlite textural parameters, including measurements of areal number density (N_A), mean microlite size, crystal aspect ratio and groundmass crystallinity (ϕ), combined with the monitoring record and field observations, indicate that magma ascent paths change between continuous ascent at varying rates from a deeper magma storage region, to ascent being temporarily stalled at shallow depths in the latter stages of the eruption [1]. Plagioclase microlite compositions show evidence of decompression-induced degassing, often displaying rims of anorthoclase and more K-rich alkali feldspar (sanidine). Anorthite contents also support the textural data of later erupted magma being temporarily stalled at shallow depths. Crystal size distributions (CSDs) are interpreted to show that both growth-dominated and nucleation-dominated crystallisation regimes existed during the 2006 eruption, resulting from changing conditions of undercooling (ΔT) during variable magma ascent paths. By contrast, microlite textural analysis and feldspar microlite compositions of samples from the fast-growing lava dome of the second phase of the 2010 eruption prior to the cataclysmic events on 5 November indicate faster ascent rates, a crystallisation regime more strongly dominated by nucleation due to high ΔT and possible interaction of the 2010 magma with more mafic magma from depth.

The differences in ascent processes have key implications for determining the eruptive behaviour at Merapi, i.e. effusive vs. explosive activity, as well as the associated hazards.

Reference: [1] Preece *et al.*, (2013) J. Volcanol. Geotherm. Res. (in press)