Strontium isotope systematics of experimentally produced melts: understanding magma-carbonate interaction at Merapi volcano, Indonesia

F.M. DEEGAN[1]*, V.R. TROLL[1,2], C. FREDA[2], C. MCLEOD[3], J. MALARKEY[3], J.P. DAVIDSON[3], J.P. CHADWICK[4]

[1]Uppsala University, Uppsala, Sweden (*correspondence: Frances.Deegan@geo.uu.se)
[2]Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy
[3]Durham University, Durham, United Kingdom
[4]Vrije Universiteit, Amsterdam, Netherlands

There is considerable evidence for ongoing, late-stage interaction between the magmatic system at Merapi volcano, Indonesia, and local crustal carbonate. In order to resolve the interaction processes in detail, we have performed a series of time-variable carbonate dissolution experiments in silicate melt using Merapi basaltic-andesite and local limestone as starting materials, at magmatic pressure and temperature. Major element profiling of the experimental products has identified strongly contrasting compositional domains of glass: a Ca-enriched zone containing up to 36 wt% CaO, and an unaffected, Ca-normal zone containing 8 to 10 wt% CaO.

To investigate the systematics of strontium isotopes and trace elements (TE) during carbonate assimilation, we have used micro-sampling and high-precision analytical techniques to measure $^{87}Sr/^{86}Sr$ ratios and TE concentrations over the magma-carbonate and intra-melt interfaces in two of our experimental products. The isotope variation between the different glass compositions is distinct, with $^{87}Sr/^{86}Sr$ ranging from 0.705641 in the Ca-normal glass to 0.706532 in the Ca-enriched glass. The upper end of this range is considerably more radiogenic than the range reported for Merapi whole rock volcanic products (0.70501 to 0.70583, Gertisser & Keller, 2003 *J Pet*, **44**, 457-489). Our data hence support a model of assimilation of crustal carbonate with highly radiogenic $^{87}Sr/^{86}Sr$ (0.708799) at Merapi volcano. Given that the starting materials used in the experiments have markedly distinct $^{87}Sr/^{86}Sr$ values we here present new and detailed insights about the behaviour of Sr isotopes during carbonate assimilation, with a focus on the processes that operate across the carbonate-melt interface and the intra-melt transitions. Strontium is a reliable tracer of magma-crust interaction and so we anticipate that our results will significantly help to quantify our comprehension of magma-carbonate interaction processes occurring at Merapi volcano.