

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

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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 ⁸⁷Sr/⁸⁶Sr 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 ⁸⁷Sr/⁸⁶Sr 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, [1]). Our data hence support a model of assimilation of crustal carbonate with highly radiogenic ⁸⁷Sr/⁸⁶Sr (0.708799) at Merapi volcano. Given that the starting materials used in the experiments have markedly distinct ⁸⁷Sr/⁸⁶Sr 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.

[1] Gertisser & Keller (2003) *J. Pet.* **44**, 457-489.

How much biogenic SOA is present in the Northeastern U.S.?

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Secondary organic aerosol (SOA) produced from biogenic volatile organic compounds (VOCs) is widely assumed to be one of the most important classes of organic aerosol in the Earth's atmosphere. Here, we present two approaches to determine the contribution of biogenic SOA to the water-soluble organic carbon (WSOC) observed from the NOAA WP-3D research aircraft during the ICARTT campaign in the northeastern U.S. in 2004.

First, we explored whether measurements of carbonyl sulfide (COS) can be used as an inverse, long-lived tracer of biogenic emissions. COS is a long lived trace gas with an ocean source and a surface sink through the uptake by vegetation. As a result, COS is relatively constant versus altitude but shows marked decreases in the lower atmosphere when an air mass has been exposed to vegetation. We found that lower mixing ratios of COS in the boundary layer were on average associated with higher mixing ratios of biogenic VOCs and their gas-phase oxidation products, but not with much higher mass loadings of WSOC. The results suggest that biogenic SOA contributed less than 1 $\mu\text{gC m}^{-3}$ to most air masses observed during ICARTT.

Second, we added biogenic emissions to the Lagrangian transport model Flexpart, and used the model to calculate the integrated amount of biogenic VOCs in the air masses observed during ICARTT, in other words the mixing ratio that would be observed in the absence of chemical removal. The model gives a relatively good description of the observations of biogenic VOCs and their gas-phase oxidation products, but not of the mass loading of WSOC. The model results suggest that SOA from isoprene and monoterpenes was only small, but consistent with modeled emissions and SOA yields reported from smog chambers.