Timescales of magmatic processes related to the AD 2000 eruptions at Miyakejima, Japan

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Integrating the petrological and geophysical records of magmatism is necessary to improve our understanding of the types and timescales of processes that precede volcanic eruptions. Studies of recent eruptions in Japan provide opportunities for this improvement, due to the high-resolution network of monitoring equipment installed for active volcanoes. We present results from a diffusion chronometry case study of pyroclasts from an explosive eruption at Miyakejima on 18 August, 2000. Previous petrological studies have shown that this eruptive event was preceded by magma mixing, which makes it a suitable candidate for testing whether the timescales determined from crystal zoning patterns can aid the interpretation of geophysical data.
Timescales for magma mixing were calculated by modelling diffusion profiles in normally zoned olivine crystals, which record a late-stage magma hybridization event. Mineral chemistry and orientation data were collected by electron probe microanalysis (EPMA) and electron backscatter diffraction (EBSD) techniques, respectively. Utilization of multiple elements and correction for diffusion anisotropy ensured that the calculated timescales incorporated recent methodology developments in this field. The new and existing petrological constraints were compared with the time series of monitoring data during the eruptive episode. These comparisons highlight the difficulty of definitively attributing geophysical signals to magma recharge events where complex volcano-magmatic processes occur.

Keywords: magma mixing, diffusion timescales, volcanic eruption

