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Temporal and spatial geochemical evolution of magmas on Lombok and Sumbawa, Sunda Arc, Indonesia

M.A. Elburg (1,2), J.D. Foden (2), P.Z. Vroon (1)

(1) Faculty of Earth and Life Sciences, Free University, Amsterdam, The Netherlands, (2) Department of Geology and Geophysics, University of Adelaide, Australia

The geochemistry of island arc magmas is often assumed to vary in a systematic way; low-potassium magmas are found near the front of the arc, and in older eruptive cycles, whereas compositions change towards more potassium-rich near the rear of the arc, and with increasing maturity of the arc. This systematic across-arc change (referred to as the K-h relationship, with h referring to the height over the Benioff zone) is violated by the islands of Lombok and Sumbawa in the Indonesian arc, where a medium-K volcano (Rinjani) lies at approximately the same height over the Benioff zone as the high-K volcanoes Tambora and Sangeang Api (h≈165-190). Moreover, the now-extinct volcanoes of Sangenges and Soromundi ($\sim$ 1.5 Ma) are characterised by even higher potassium contents, but lie at more trench-ward positions (h≈150-165), in disagreement with both the K-h and the temporal systematics of arcs.

Older low-K magmatic products on south Sumbawa (present-day h≈105km) are the Batu Hijau intrusives (5-3.8 Ma) and overlying lahars and dykes (estimated age $\sim$ 2 Ma). The combined difference in age and position between the Sumbawa low-K and high-K magmas means that the same slab material which was present underneath the low-K magmatic centres underlay the high-K volcanoes at a later date. Significant differences in Sr, Nd and Pb isotopes between the low- and high-K magmas precludes that the increase in potassium contents is only related to smaller degrees of melting of the metasomatised mantle. This implies that either the flux from the underlying slab into the mantle must have changed as a response to increasing pressure and temperature; or that some of the magmatic compositions are not a direct reflection of slab-induced melting of the convecting mantle.

The strong variation in magma compositions over time seen on Sumbawa contrasts

with the situation on Lombok, where older, more trench-ward volcanic products are only slightly less potassic and isotopically similar to the present-day Rinjani magmas.