

Magma generation processes and timescales leading to the great 1815 eruption of Tambora volcano, Sumbawa, Indonesia

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The cataclysmic eruption of Tambora volcano, Sumbawa, Indonesia on April 10-11, 1815, has long been recognised as one of the largest explosive eruptions in recorded history. It produced ~30-33 km³ of fairly homogeneous trachyandesitic magma, a comparatively rare magma type in volcanic arc settings.

To develop a fuller understanding of the processes and timescales involved in the formation of such large bodies of homogeneous potassic arc magmas, we have investigated the petrology and major and trace element geochemistry of the 1815 Tambora products from a suite of samples that span the entire eruption stratigraphy. In addition, we have analysed Sr, Nd and Hf isotopes in pumice clasts from pyroclastic fall deposits and ignimbrites erupted in 1815. These data are discussed together with U, Th and Ra isotope disequilibria obtained on 1815 pumices and constituent mineral phases used to place constraints on the rates of magma genesis and evolution beneath Tambora.

Our results suggest that basaltic magmas parental to that erupted in 1815 originated from small degrees of partial melting of an Indian Ocean MORB-type mantle source, similar to that of the main volcanic front of the Sunda arc, to which had been added fluid-mobile elements from subducted oceanic crust and small amounts of subducted sediments, supposedly as a partial melt. We propose that primary, mantle-derived magmas were injected into the deep lower arc crust, where incomplete crystallisation of these magmas produced evolved trachyandesitic melts. These then ascended rapidly to shallower crustal levels where they accumulated in a magma reservoir ~3-4 km below the surface, entraining plagioclase crystals that are now preserved as anorthite-rich resorbed plagioclase phenocryst cores in the 1815 eruptive products. Numerous pulses of compositionally similar magmas over a period of a few thousand years resulted in the incremental assemblage of the large volume of homogeneous trachyandesitic magma erupted from Tambora in 1815.