Examining the cause of rejuvenated volcanism in Samoa

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Compared to other ocean islands like Hawaii, rejuvenated volcanism in Samoa is unusual in its duration, volume and geochemical composition. Rejuvenated lavas with relatively enriched isotopic compositions may have erupted for over 2 Ma from a single rift that extends across three islands. Rejuvenated lavas are particularly voluminous on Savai'i, where this eruptive series effectively repaved the entire island. The volume of lavas erupted during the rejuvenated stage on Savai'i constitutes an estimated 2.5% of the volcano, compared to <<1% in other ocean islands. An explanation for these observations may lie in the plate tectonic setting of the Samoan islands near the Tonga trench. Tectonic stresses were suggested to be responsible for enhancing both shield and rejuvenated-stage volcanism [1], although recent work has shown that the submarine base of the Samoan volcanoes fits a hotspot progression [2] and is thus consistent with the mantle plume hypothesis. Alternatively, combining hotspot processes with tectonic stresses may enhance rejuvenated volcanism.

Existing data on Savai'i consist of subaerial samples from the rejuvenated stage [e.g. 1, 3], while the underlying shield is exposed on the submarine flanks of the volcano, characterized by a distinct and extreme isotopic composition [4]. The transition between these stages is key in distinguishing between the different models for the cause of the rejuvenated volcanism. A trachyte cobble from a river draining a 500m deep canyon [3] currently constrains the timing of the rejuvenated stage (2 Ma). Interestingly, this rock type is typically found in Samoan shields, while its isotopic composition is indistinguishable from the rejuvenated lavas. Therefore, it seems the mantle source composition may have changed before the volcano's shield stage ended.

We obtained a new sample set from the canyon, including several deep sections within the volcano's stratigraphy. These samples are investigated for their isotopic compositions to test the interpretation of the cobble data, and to help illuminate the evolution of rejuvenated Samoan volcanism.

[1] Hawkins & Natland (1975) *Earth Planet. Sci. Lett.* **24**, 427–439. [2] Koppers *et al.* (2008) *Geology*, **36**, 435–438. [3] Workman *et al.* (2004) *Geochem. Geophys. Geosyst.* **5**, 10.1016/2003GC000623. [4] Jackson *et al.* (2007) *Nature*, **448**, 684–687.

Plume-influenced melting of a two-component source beneath Iceland

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Combined trace element and Hf-Nd isotope data on postglacial basalts from Iceland are used to evaluate the relative importance of source heterogeneity and plume-influenced melting.

Tracers for degree and depth of melting are correlated, but there is no systematic relation between these parameters and the geographical distance from the inferred plume centre. Good correlations between Hf and Nd isotope compositions and trace element ratios that are sensitive to the degree of melting indicate that at least two source components are sampled systematically as a function of the degree and pressure of melting. The contribution of more enriched melts with low $^{143}Nd/^{144}Nd$ and $^{176}Hf/^{177}Hf$ systematically decreases with decreasing depth and increasing extent of melting. Strong depletion in Rb, Ba, U and Th and enrichment in Nb and Ta compared to La in the most enriched samples from the Reykjanes Peninsula and Western Rift Zone constrain the enriched component to be similar to ancient recycled E-MORB.

The observed relationships between trace elements and isotope ratios can be reproduced with a polybaric melt mixing model that progressively mixes accumulated melts from a depleted MORB mantle and a recycled E-MORB with increasing extent of melting. The two components are sufficient for explaining the entire trace element and isotopic variability in Icelandic postglacial main-rift lavas if melts are extracted from a range of depths and the abundance of the enriched component is variable. In the Northern Volcanic Zone the abundance of the enriched component is small (~2%) and constant, whereas beneath the Reykjanes Peninsula and the Western Volcanic Zone it is more abundant (<10%) and more heterogeneously distributed.

The example of Iceland shows that the manner of melting and mixing partial melts from different sources during melt extraction controls the observed isotope trace element relationships in oceanic basalts and is crucial for understanding the relationship between melt and source composition.