Petrogenesis of arc lavas: Lessons from Bougainville Island

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Bougainville Island represents the northwestern extension of the Solomon Islands Arc. It is broadly a NW - SE trending island initially formed as a response to SW subduction of the Pacific Plate. Subduction ceased upon collision with the abnormally thickened oceanic lithosphere of the Ontong Java Plateau during the Miocene [1].

Arc reversal occurred approximately 10 Myr BP, with subsequent subduction of the Solomon Sea Plate in a NE direction along the New Britain - San Cristobal Trench. Subduction in this direction continues to the present day and is responsible for ongoing volcanism on Bougainville.

Most elemental covariations, involving both the pre-and post-reversal volcanic rocks, appear to reflect simple fractional crystallisation processes (e.g., MgO *vs* SiO_2); an observation ostensibly supported by relatively uniform $^{87}Sr/^{86}Sr$ *vs* $^{143}Nd/^{144}Nd$ and $^{176}Hf/^{177}Hf$ compositions. Yet at any particular silica content, magmatism on Bougainville shows significant variation in K_2O (i.e., by a factor of 2-3), with two arrays defined by the post-reversal magmas. Clearly this is not a case of simple fractional crystallisation!

New data reveal that on Bougainville, the potassium content of magmas is not a function of the distance from the trench, degree of partial melting, or the assimilation of pre-10 Ma crustal rocks. Instead, the elevated K_2O is a feature inherited from the mantle source region involving a slab component that was only subtly different in composition to the mantle wedge.

Importantly, a change in the mantle wedge accompanied the shift from pre- to post-reversal conditions and this is captured in the magmas erupted during these periods. The mantle wedge exerts a significant control on the Pb-isotope composition of the Bougainville magmas, with a clear shift from a wedge of Indian MORB-like composition in pre-reversal magmas, to Pacific MORB-like signatures post-reversal. This highlights the importance of 1) constraining the composition of the mantle wedge in petrogenetic studies and 2) employing a breadth of geochemical approaches to unravel magma-genesis in these complex systems.

[1] Cooper & Taylor (1985), *Nature* 88, 428-430.