A melt inclusion investigation of crustal contamination: A case study at Paricutin Volcano

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Geochemical variability observed in lavas at Paricutin Volcano (Mexico) is often cited as a classic example of assimilation and fractional crystallization processes. Increases in whole rock SiO_2 (wt%), $\delta^{18}O$, and $^{87}Sr/^{86}Sr$, characteristic of crustal assimilation, are observed over the 9 year lifespan (1943-52) of Paricutin Volcano [1].

In this study, the geochemical variations of olivine and orthopyroxene-hosted melt inclusions are utilized to characterize discrete batches of magma present and to examine the timing of crustal contamination during the evolution of the volcanic system. Two compositional groups of melt inclusions are identified in each of the samples included in this study; a high-SiO_2 (58-65 wt%) and low-SiO_2 (50-60 wt%) group. Melt inclusions in the high-SiO_2 group are compositionally similar to scoria groundmass glass, but retain higher SO_3 concentrations (0.017-0.118 wt%) than reported in scoria glass [2]. K_2O/TiO_2 ratios overlap between high- and low-SiO_2 groups within a given sample, possibly suggesting an evolution through fractional crystallization. Melt inclusions, similar to whole rock compositions, record a rapid change in composition during 1947, characterized in part by a dramatic increase in K_2O/TiO_2, rather than a gradual evolution over the volcano's lifespan. Importantly, there is no compositional overlap between melt inclusions in early and late erupted lavas.

Melt inclusion geochemistry suggests that 1) any contamination occurred early, prior to significant crystallization of either olivine or orthopyroxene and that 2) contamination was either a rapid process occuring over a limited timespan, or the change in composition records a transition to erupting a more evolved and contaminated batch of magma, discrete from that erupted from 1943-46.

[1] McBirney *et al.* (1987) *Contrib Mineral Petrol* **95**, 4-20.
[2] Luhr (2001) *Contrib Mineral Petrol* **142**, 261-283.

The ridge filter: How melt supply and magma chambers modulate mantle compositions in MORB

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Mid Ocean Ridges (MOR) have long been appreciated by geochemists for their ability to depict underlying mantle compositions in the lavas they erupt. In many ways, compositions of MORB provide the least complicated, most widespread and most continuous picture of upper mantle compositions of any rock type on Earth's surface. Yet not all ridges sample the mantle in the same way. The effects of magma production, accumulation, mixing and differentiation are important considerations for how ridge volcanism represents the underlying mantle and how one uses MORB to extract the highest definition picture of spatial compositional variations in the mantle.

This presentation will describe ways that MOR volcanism modifies spatial and temporal patterns of mantle compositional variance at normal and hot-spot influenced ridges. Rubin and Sinton [1] demonstrated that the depth, size, mixing efficacy and thermal state of mid-ocean ridge magma chambers is strongly dependent upon melt supply, resulting in non-intuitive yet systematic spatial variations in MORB compositions around the world. Broadly speaking the effect on mantle signatures, such as radiogenic isotope compositions and highly incompatible trace element ratios, is diminished compositional variance as melt supply increases. Mean extent of magma differentiation also increases with melt supply, yielding predictable, coupled major element and mantle tracer patterns in MORB. However, high eruption rates at high magma supply also better preserve temporally variable parental melt compositions in erupted lavas (e.g., at fast spreading ridges [2]). Low melt supply preserves a fuller range of mantle chemical variance, although low eruption frequency reduces the ability of erupted lavas to reflect temporality in parental melt variations.

Interestingly, the relative range of values of a mantle tracer such as $^{87}Sr/^{86}Sr$ in MORB does not vary much through the global ocean ridge system away from hot spots, when only lavas with the most magnesian melts are considered. This suggests that all ridges process and mix parental magmas to similar degree prior to the stage where melts pool and differentiate in shallow, melt-rich magma lenses.

[1] Rubin & Sinton (2007) *EPSL* **260**, 257-276. [2] Bergmanis *et al.* (2007) *G-cubed* **8**, Q12O06.