Crustal recycling above an intracontinental mantle plume: Results from the Columbia river flood basalt province

D. P. COLÓN[1]*, I. N. BINDEMAN[1] AND T. V. GERYA[2]

[1]Department of Geological Sciences, University of Oregon, USA (*correspondence: dcolon@uoregon.edu)
[2]Departement Erdwissenschaften, ETH Zürich, Switzerland

We document extreme isotopic diversity in 16.5-15 Ma rhyolitic magmas that accompanied the eruptions of the Columbia River Flood Basalt Group (CRB) in the northwest USA. Zircon crystals in these rhyolites are highly diverse in their O ($\delta^{18}O$ = -0.6 to +10.5‰) and Hf (ε_{Hf} = -39 to +9) [1] isotope compositions, indicative of strong amounts of crustal input into their host melts, and of extensive hydrothermal alteration of the upper crust in the region driven by heat from the plume. We present new isotopic analyses of zircons from syn-CRB rhyolites which document the presence of melts of multiple distinct compositions of crust in the rhyolites and require the rapid assembly of isotopically diverse melt batches. We link these crustal melting trends to compositional variations within the CRB themselves, further bolserting existing evidence for a crustal contamination origin for much of the diversity of the basalts. We also present new results from 2D finite difference thermomechanical models of the interaction between a mantle plume and overriding continental crust. In the models we investigate variable plume sizes and temperatures, crustal compositions and thicknesses, and volcanic to plutonic melt ratios. We compare these models to constraints from our geochemical observations, and provide new insight into how the composition and structure of continental crust is altered by an occurence of flood basalt volcanism. This comprises a distinct means of recycling of the crust, through the large-volume melting of crustal materials, followed by their incorporation into large new intrusions or their eruption on the surface as rhyolitic lavas and ignimbrites. We compare these results to the plume tail-crust interaction and multi-cyclic caldera complex formation in the post-CRB Snake River Plain province. Plume-driven crustal recycling has had profound impacts on the makeup and stratification of continental crust throughout Earth's geologic past and understanding it is crucial for constructing a complete picture of the evolution of the continents.

[1] Colón et al. (2015) *Lithos* DOI: 10.1016/j.lithos.2015.02.022