Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.31718

Delineating signatures of crustal contamination from crustal recycling using geochemical and Sr-Ca isotopic composition of flood basalts

SOUMYAROOP BHATTACHARYA AND RAMANANDA CHAKRABARTI

Indian Institute of Science

Subduction introduces crustal materials into the mantle which leads to mantle heterogeneity. Recent studies on carbonatites have argued that isotopic signatures of crustal recycling-induced mantle heterogeneity are more conspicuous in younger carbonatites with eruption ages <200 Ma while older carbonatites show relatively homogenous, mantle-like compositions. Among oceanic basalts, signatures of mantle heterogeneity are more prevalent in ocean island basalts (OIB) compared to mid-oceanic basalts (MORB) and this has been documented using both radiogenic isotopic tracers and metal stable isotopes. However, OIBs are < 200 Ma old and hence, long-term mantle heterogeneity cannot be delineated using OIB. However, the record of plume-related magmatism on continents or continental flood basalts (CFB) extends further back in time and might allow us to investigate mantle heterogeneity further back in time. However, compositions of CFB can potentially be affected by syn-eruptive crustal contamination. Hence it is critical to delineate the signatures of crustal contamination from crustal recycling in these mantle-derived magmatic rocks.

Calcium isotopes present a unique opportunity to delineate crustal contamination from crustal recycling. ^{40}Ca is a decay product or ^{40}K and more radiogenic $^{40}Ca/^{44}Ca$ ratio along with $^{87}Sr/^{86}Sr$ can be used to trace (granitic) crustal contamination. Stable Ca isotopic composition of crustal carbonates is lower than mantle rocks and hence, stable isotopes of Ca ($\delta^{44/40}Ca$) are a powerful tracer of crustal recycling. In this study we have analyzed 43 whole-rock basalt samples from different volcano-stratigraphic units of the Deccan Volcanic Province (DVP), India for their trace and major element concentrations using ICPMS and Sr isotopic ratios using TIMS. Geochemical compositions and $^{87}Sr/^{86}Sr$ (0.703970 – 0.719783) is consistent with published values for these lithologies with samples from Bushe Formation showing signatures of crustal contamination. Radiogenic and stable Ca isotopic ratios of standards were measured using TIMS using internal normalization and double spiking, respectively, and the precision is better than 0.2 epsilon units and 0.08 per mil, respectively. Calcium isotopic data for the Deccan volcanics will allow us to investigate the extent of heterogeneity in the Reunion mantle plume.