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Ilka Kleinhanns

Isotope Geochemistry Group, Department of
Geosciences, University of Tuebingen

Understanding mantle reservoirs, mantle melting and recycling of surface material into the mantle: A stable chromium isotope perspective

Earth's silicate mantle is far from homogenous and with the means of geochemical signals such as radiogenic Sr-Nd-Hf-Pb isotopes various depleted and enriched mantle reservoirs are constrained. These endmember reservoirs are commonly named the mantle zoo (DM, PRIMA; EM1/2, HIMU, FOZO). Over the last decades the general processes of recycling of different lithospheric surface materials to the deep mantle has been accepted to explain observed signatures, but debate remains about the exact nature of added material to enriched mantle reservoirs. Mostly, studies investigate basalts as probes into the deep mantle to understand the nature of this recycling factory and the tapping of deep/old reservoirs. Recently, it has been shown that transition metal stable (e.g. Cr, Fe or Zn) isotopes offer new insight into melting and mixing processes of different mantle reservoirs.

In this presentation, constraints derived from the Cr stable isotope system will be discussed. Approaches to constrain the $d^{53}\text{Cr}$ of bulk silicate earth (BSE) based on komatiite or peridotite investigations yield values similar to $-0.12 \pm 0.06 \text{ ‰}$ being indistinguishable to the average composition of ordinary and carbonaceous chondrites. The oceanic crust (MORB), however, shows distinctly lighter Cr isotope signatures with $d^{53}\text{Cr}$ values around -0.24 ‰ , giving evidence to resolvable stable Cr isotope fractionation within Earth's high-temperature reservoirs. This consistently light isotope value of MORB offers new insight into the understanding of mantle processes and will be explored within this presentation.