Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.18644

Origin of enriched mid-ocean ridge basalts: A perspective from uranium and molybdenum isotope ratios

JOEL B RODNEY[1], MORTEN B ANDERSEN[2], BRAMLEY MURTON[3] AND TIM ELLIOTT[1]

[1]University of Bristol
[2]Cardiff University
[3]National Oceanography Centre

Presenting Author: joel.rodney@bristol.ac.uk

Contrasting origins of incompatible element rich portions of the upper mantle as represented by enriched-mid ocean ridge basalts (E-MORB) have been proposed. Many have argued for the involvement of recycled mafic oceanic crust [e.g., 1]. Others have invoked low degree partial melts of uppermost mantle, that metasomatize overlying oceanic mantle lithosphere and are subsequently recycled into the upper mantle [2, 3]. Both models have gained recent champions from the perspectives of novel geochemical techniques [4, 5].

To add to this debate, we present uranium (U) and molybdenum (Mo) isotope data on non-plume influenced E-MORB from the northern mid-Atlantic ridge. Samples show U and Mo isotope ratios indistinguishable from bulk silicate Earth but distinct from normal-(N)MORB and show no correlations with tracers of mantle enrichment in E-MORB. Elevated ^{98}Mo in E-MORB, as found in our samples, is compatible with small but not large degrees of melting, as previously discussed [5]. However, low degrees of melting even under reduced conditions are unlikely to fractionate U isotopes given their high incompatibility [6]. Thus, chondritic U isotopic compositions in E-MORB requires additional explanation. Super-chondritic U isotopic compositions, as seen in modern N-MORB are likely the result of crustal recycling after the onset of deep ocean oxygenation at ~600Ma [7]. Therefore, E-MORB sources with chondritic U isotopic compositions require formation prior to this time. Together, our Mo and U isotope data help constrain the style and timing of E-MORB formation. We further investigate our preferred scenario using mass balance models of crustal recycling to evolve the U and Mo isotopic compositions seen in mantle derived rocks.

[1] Prinzhofer et al., (1989) EPSL, 92, 2, 189-206. [2] Kostopoulos & Murton., (1992), GSSP, 60, 133-154. [3] Niu et al., (2002) EPSL, 199, 327-345. [4] Yang et al., (2020) Sci. Adv, 6, 26. [5] Chen et al., (2022) EPSL, 578, 117283. [6] Fonseca et al., (2014) EPSL, 404, 1-13. [7] Andersen et al., (2015) Nature. 517, 356-359.