Researchers reveal source of enriched mid-ocean ridge basalt

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Combinations of stable molybdenum (Mo) isotopes and radiogenic isotopes have great potential for researchers studying mantle heterogeneities, especially those with subduction-related processes.

However, the current Mo isotope database for mid-ocean ridge basalts (MORB) is very small and the possible effects of magma generation and evolution on Mo isotopes remain debated.

Recently, Dr. Chen Shuo and Dr. Sun Pu from the Institute of Oceanology of the Chinese Academy of Sciences (IOCAS) and their collaborators have revealed the source of enriched mid-ocean ridge basalt by Mo isotope systematics of lavas from the East Pacific Rise (EPR).

The study was published in *Earth and Planetary Science Letters*.

The researchers investigated the Mo isotopic compositions on well-characterized MORB samples on and off-axis across morphologically typical ridge segments of EPR and seamounts lavas on the flanks of EPR between 5°N and 12°N.

They found large Mo isotope variations in the MORB samples, which were unlikely caused by MORB melt generation and evolution processes but reflected mantle isotopic heterogeneity.

"MORB Mo isotope compositions varied systematically with geochemical parameters indicating mantle enrichment," said Dr. Chen. This is most likely resulted from two-component mixing between an incompatible element depleted endmember with low $\delta^{98/95}$Mo (~-0.21‰) and an incompatible element enriched endmember with high $\delta^{98/95}$Mo (~-0.05‰).

In light of the association of heavier Mo isotopes composition with the geochemically more enriched MORB, they ruled out the prevailing model of recycled ocean crust with or without sediment.

Instead, based on their new data and modeling, they suggested that the

enriched endmember was most consistent with localized low degree melt enrichment within the depleted MORB mantle, most likely at the lithosphere-asthenosphere boundary in Earth's history.

The study reveals that recycled oceanic mantle lithosphere, metasomatized by low degree melt, plays a key role in the formation of enriched MORB (E-MORB) source lithologies. In addition, it also highlights that Mo isotopes can be an effective tool for studying upper mantle processes.

More information: Shuo Chen et al, Molybdenum isotope systematics of lavas from the East Pacific Rise: Constraints on the source of enriched mid-ocean ridge basalt, *Earth and Planetary Science Letters* (2021). DOI: 10.1016/j.epsl.2021.117283

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