Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.33910

Molybdenum isotope tracing of the missing molybdenum in the continental crust through orogenic cycles

ER-LIN ZHU AND QIONG-XIA XIA

School of Earth and Space Science,University of Science and Technology of China

The missing molybdenum (Mo) and heterogeneous Mo isotope in the continental crust constitute a significant geochemical puzzle that constrains understanding crustal differentiation. Here, we present Mo contents and Mo isotope data for syn-exhumation granites from the Sulu-Dabie orogenic belt, in combination with published data from gneisses, granulites, eclogites, syn-collisional and post-collisional granites, representing different products during orogenic evolution. Integrated with phase equilibria under compressional and extensional tectonic settings, we evaluate the Mo partition and isotopic fractionation between major Mo-host phases. The results reveal that syn-collisional and syn-exhumation granites exhibit light Mo isotope and Mo depletion influenced by a decompression melting where rutile + phengite + clinopyroxene breakdown to form titanite + ilmenite + biotite. In contrast, post-collisional granites exhibit heavy Mo isotope and Mo enrichment influenced by a heat-induced melting where titanite + ilmenite + biotite breakdown to form orthopyroxene. The contrasting behaviors of Mo are directly linked to the stabilization of titaniferous phases, which have high compatibility for Mo and exhibit various Mo isotopes, effectively sequestering Mo in the lower crust. We therefore propose that the missing Mo in the continental crust originates from mineralogically controlled crustal anatexis during orogenic cycles, where the residual phases shift systematically from rutile-dominated to titanite-ilmenite-dominated assemblages. Subsequent relamination and remelting of such residues under extensional setting facilitate the release of previously sequestered Mo from the lower crust back to the upper crust. Mo record in granites throughout Earth’s history thus could provide critical insights into the framework of plate tectonics and secular evolution of continental crust.