Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.16393

Metal stable isotopic perspective on genetic relationship between HIMU and EM1 component

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The origin of HIMU (High μ, $\mu={}^{238}U/{}^{204}Pb_{t=0}$) and EM1 (Enriched Mantle 1) components have been investigated over the past four decades, but their genetic relationship has been rarely discussed. Here we compare Mg, Fe and Zn isotopic compositions of HIMU lavas from Cook-Austral chains and St. Helena Island, and EM1 lavas from Pitcairn Island, to establish a genetic link between HIMU and EM1 components in the deep mantle. HIMU-type OIBs have MORB-like $d^{26}Mg$ and $d^{57}Fe$, and moderately high $d^{66}Zn$ values (higher than MORB), indicating that HIMU lavas are generated by melting of carbonated peridotite. The Pitcairn basalts have the lowest $d^{26}Mg$ and highest $d^{66}Zn$ values among OIB samples and are also obviously distinct from MORBs, revealing that Pitcairn EM1 components originate from subducted carbonate-bearing sediments. Furthermore, high $d^{57}Fe$ of Pitcairn points to an eclogitic lithology in its mantle source. We propose that subducted ancient, carbonate-bearing crustal materials (sediments + oceanic crust) experienced decarbonation, and the released carbonatitic liquids modified the surrounding peridotite, thus resulting in the formation of carbonated peridotite. Carbonated peridotite and decarbonated residual crustal materials are thus complementary reservoirs that evolved into HIMU and EM1 components, respectively.