The eclogite mantle reservoir: $^{176}Hf/^{177}Hf$, Nb/Ta and Zr/Hf of rutile

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Some eclogitic xenoliths may represent recycled material, and thus may provide information on subduction components in the mantle. Such mantle rock types are also subject to modification by mantle fluid processes. We analysed Hf isotopic and trace-element compositions of eclogitic rutile by LAM MC ICPMS and ICPMS to obtain new constraints.

Zr/Hf in rutile (n=11) varies from 19.6 to 61.9 (mean: 40.1) and Nb/Ta from 10.3 to 39.5 (mean: 23.7; chondrite: 34.3 and 19.9, respectively, Münker et al., 2003). $^{176}Hf/^{177}Hf$ in single samples is extremely variable (within-sample ε_{Hf} variation in ten samples averages 84), due to low Lu/Hf in rutile and partial isotopic equilibrium with high-Lu/Hf garnet. Mean $^{176}Hf/^{177}Hf$ broadly correlate with whole-rock Lu/Hf.

Zr/Hf and Nb/Ta in rutile are weakly anti-correlated (r^2 = 0.37) and 8 of 11 samples have Nb/Ta > 20, contrary to the positive correlation and subchondritic Nb/Ta observed for samples from the major terrestrial reservoirs (Münker et al., 2003). Subchondritic Nb/Ta is associated with high long-term whole-rock Lu/Hf and $^{176}Hf/^{177}Hf$ ascribed to rutile+garnet-controlled melt depletion (Schmidt et al., 2004). Superchondritic Nb/Ta, low $^{176}Hf/^{177}Hf$ and variable Zr/Hf are associated with whole-rock HFSE abundances >> potential crustal protoliths. The enriching agent may be representative of a metasomatised, high-Nb/Ta subcontinental lithospheric mantle component as seafloor weathering and subduction-related processes are not expected to entail HFSE addition.

References

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