Os-Hf-Nd isotope Constraints on subcontinental lithospheric mantle evolution, Slave Craton (Canada)

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The Slave Craton is an amalgamation of Meso- and Neoarchaean terranes, which is underlain by strongly stratified subcontinental lithospheric mantle (SCLM) with a ultradepleted shallow (SL) and a less depleted deep layer (DL) (Griffin et al., 1999). We have analysed the $^{187}Os/^{188}Os$ of peridotitic sulfide from the deep layer by LAM MC ICPMS and the $^{176}Hf/^{177}Hf$ and $^{143}Nd/^{144}Nd$ of garnet (gt) and clinopyroxene (cpx) from peridotitic kimberlite-derived xenoliths by solution MC ICPMS to obtain constraints on the origin and evolution of the SCLM.

$^{187}Os/^{188}Os$ of DL-sulfide ranges from 0.1002 to 0.4732 (γ_{Os} = -21.1 to +272), giving T_{RD} up to 3.9 Ga. A subset of samples lies on an isochron with an age of 3.27±0.24 Ga. This is older than the 2.7 Ga overlying terrane but coincides with crustal ages in the neighbouring terrane, suggesting subcretion of older beneath younger mantle during collision.

Nd-Hf isotope date were obtained from 2 SL-harzburgites and 8 DL-lherzolites. The two SL-harzburgites were metasomatised by a carbonatite-like melt leading to low ε_{Nd} (-54) in one sample ($^{176}Hf/^{177}Hf$ not measurable) and moderate ε_{Nd} (2.6) but high ε_{Hf} in another sample (+181). Both samples are argued to be at least 3.2 Ga old, suggesting that the SL has been subducted beneath 2.7 Ga crust along with the DL. The age of metasomatism is more difficult to constrain, due to multiple modification of parent/daughter, but the minimum age for the oldest metasomatism (lowest ε_{Nd}) is 2.3 Ga. Cpx in a DL-lherzolite with low ε_{Nd} (-14.4) but radiogenic Hf (+43) may record the same metasomatic event. However, for most of the DL this older metasomatism was obscured by a younger overprint involving a silicate melt, which led to both Nd and Hf addition, and ε_{Hf} and ε_{Nd} around 0. The age of the younger metasomatism is constrained to <350 Ma based on near-constant εNd at variable Sm/Nd.

Reference

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Proterozoic mantle lithosphere beneath the East African Rift (Southern Ethiopia): *In situ* Re-Os evidence

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The Os isotope compositions of sulfides in spinel lherzolites hosted by Quaternary alkali basalts from NE of the Turkana Depression, S. Ethiopia, reveal the presence of Proterozoic subcontinental lithospheric mantle (SCLM) beneath the continental rift setting in East Africa. Most of the sulfides have subchondritic $^{187}Os/^{188}Os$ (<0.129). A large range in $^{187}Re/^{188}Os$ (0.003-0.809) suggests recent addition of Re, perhaps reflecting the Paleogene mantle plume activity, which not only caused the East Africa Rift but also significantly perturbed the SCLM in the region. Sulfides with low $^{187}Re/^{188}Os$ (<0.075; Griffin et al., 2002) yield similar T_{MA} and T_{RD} model ages of 1.1±0.2 Ga, interpreted as the depletion age of the SCLM beneath the region. Re-Os mixing lines defined by sulfides in single samples give an initial $^{187}Os/^{188}Os$ (0.1184) consistent with formation of some volumes of the SCLM at ~1.3 Ga. T_{RD} model ages of sulfides can provide minimum estimates for the SCLM age and record later metasomatic events. All model ages of the sulfides suggest a main SCLM depletion age at 1.1 Ga with a later metasomatic event at 0.4-0.5 Ga. A few older ages (1.5-1.8 Ga) suggest the presence of older parts of the SCLM, but no Archean model ages were found. The SCLM depletion age of 1.1 Ga is consistent with the known Meso-Neoproterozoic crustal evolution event of the East African Orogen (Stern, 2002), and the 0.4-0.5 Ga may be related to closing stages of the Paleozoic Pan-Africa orogeny. The sulfide Re-Os data show that Proterozoic SCLM has survived the extensive continental rifting due to the mantle plume.

References

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