Abstract title

ORIGIN AND EVOLUTION OF THE LITHOSPHERIC MANTLE BENEATH THE SLAVE CRATON (CANADA)

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Abstract

The subcontinental lithospheric mantle (SCLM) beneath Lac de Gras (central Slave Craton) is strongly layered, with an ultra-depleted shallow and a less depleted deep layer (Griffin et al, 1999, 2003). Unusual sulfides ($(Ni,Co,Fe)_{3-x}S_2$) from the deep SCLM layer could be interpreted as having crystallised from carbon-bearing metal-rich sulfide melts expected in the lower mantle. Some sulfides from the deep layer lie on a 3.27 0.34 Ga isochron with supra-chondritic initital Os isotopic composition. The initial $^{187}Os/^{188}Os$ may be the signature of a high-Re/Os source, such as the lower mantle or outer core. These results, along with the recognition of ultra-deep diamonds (Davies et al, 1999), suggest formation of the deep SCLM layer by subcretion of plume material from the lower mantle. The age shows that significantly older mantle resides beneath the 2.7 Ga eastern part of the Slave Craton, where the Lac de Gras kimberlites intruded. This age paradox may be reconciled by underthrusting of ancient continental mantle from the neighbouring 4.0-2.7 Ga terrane, during 2.7 Ga collision. Nd-Hf isotope data on peridotites from the shallow layer suggest that it, too, is at least 3.2 Ga old and that it was part of the mantle package thrust beneath the eastern terrane. During this event the shallow arc-related SCLM coeval with the 2.7 Ga Terrane and shallow mantle of the CSBC may have been interleaved, allowing both mantle types to be sampled by the Lac de Gras kimberlites. Highly depleted spinel lherzolite may well represent SCLM that is complementary to the Contwoyto Terrane. Subsequently, the SCLM experienced Proterozoic metasomatism by carbonatitic or similar melts, resulting in low Sm/Nd but high Lu/Hf, as inferred from the highly radiogenic Hf and unradiogenic Nd of garnet in some harzburgites. Other samples show evidence for interaction with silicate melts leading to HFSE addition and low $^{176}Hf/^{177}Hf$. The isotopic and trace-element relationships in garnets can be explained by interaction with silicate melts that progressively lost HREE and Y to the garnet-bearing mantle and became increasingly enriched in LREE and volatiles (carbonatite-like melts). Younger metasomatism, by melts that originated from a source similar to the host kimberlites, preceded kimberlite magmatism and led to variable resetting of Nd and Hf isotope ratios. This young disturbance is inferred from negative internal isochron ages and near-constant ƒÕNd at variable Sm/Nd of some samples.