Most abyssal peridotites are old!

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Melting of uprising convective mantle at mid oceanic ridge produces two complementary products: a depleted mantle residue and igneous crusts (e.g. MORBs). Abyssal peridotites (AP) are assumed by to be representative of this residue, as such they should provide key insights into the nature, of the MORB source mantle i.e. the convective upper mantle. However, whole-rock Os isotopic composition of AP is often extremely unradiogenic and yields unexpected old Re-depletion ages (T_{RD}≈2Ga) in such a young environment.

Magmatic sulfides are the main carrier of highly siderophile elements in the mantle including Os and Re. Recent studies have shown that several sulphide populations characterised by different micro-structural occurrences and compositions coexist at the thin section scale and record the various episodes of melting and melt/rock reaction events. Therefore, by establishing the Re-Os isotopic systematic of various sulfide populations, one could shed some new light on the intricacy of melt extraction and percolation processes beneath mid-oceanic ridge.

Two populations of magmatic sulphides have been recognized in most AP from all geodynamic settings. Type-1 sulphides are associated with primary silicate assemblage, their composition and trace elements abundance (e.g. $Pd/Ir_N<1$,) indicate that they are residual after melting. Type-2 sulfides are associated with "impregnation" Cpx_2. This feature along with their high metal/sulfur compositions (Ni-, Cu-rich) and their high Pd/Ir ($Pd/Ir_N>1$) demonstrates that these sulphides were precipitated during melt-rock reaction. AP from the Kane fracture zone (MAR) Type-1 sulfides have $^{187}Os/^{188}Os$ as low as 0.110, which is indicative of a long term evolution in a low Re/Os environment (i.e. depleted mantle) and yield T_{RD} age ca 2.5 Ga. Type-2 sulfides in contrast have radiogenic composition up to 0.20. This is typical of Os-sulfide systematic observed in most AP. However, in Leg 209 (15ºN-MAR), Type-2 sulfides have a narrow range of extremeley unradiogenic Os yielding T_{RD} age ca. 2.6 Ga and are older than Type-1 sulfides (ca. 2.3Ga). Associated Cpx_2 are extremely depleted in trace elements (e.g. REE). This indicates that the percolating melt was derived from an old and depleted mantle reservoir. Similar melt compositions have been found as inclusion in MORB phenocrysts.

Magmatic sulfides and whole-rock in AP from various geodynamic setting (MAR, SWIR, EPR) and from ophiolites (Ligurides, Oman) yield systematicallyT_{RD} ages older than 2Ga and thus suggest a widespread occurrence of old and depleted mantle reservoirs (as Proterozoic SCLM) in the MORB source mantle.