In situ Re-Os dating of sulfides in Kaapvaal xenoliths

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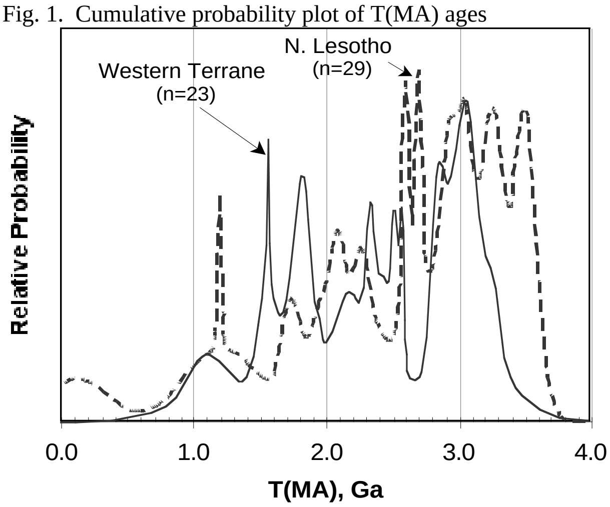
In situ Re-Os isotopic analyses (Pearson et al., 2002) have been obtained on >100 sulfide grains exposed by serial sectioning of xenoliths from N. Lesotho (n=10), and from Finsch (n=5) and Kimberley (n=7), representing the subcontinental lithospheric mantle (SCLM) beneath the SE Terrane (SET) and the Western Terrane (WT), respectively, of the Kaapvaal Craton. Sulfides can be broadly divided into two groups: (1) high Os, low Re/Os and Pt/Os, γOs<1; (2) low Os, low to high Re/Os, high Pt/Os, γOs to +300. These correspond to the "enclosed" and "interstitial" groups of Alard et al. (2000), but both types may occur enclosed in primary silicates, reflecting recrystallisation in the SCLM. The age distribution of sulfides with ^{187}Re/^{188}Os <0.08 and Pt/Os <0, interpreted as MSS residual from melting or crystallised from sulfide melts show distinct differences between the terranes (Fig. 1). The SET data extend to older ages, mirroring the differences in maximum crustal age. Distinct spikes at 2.7-2.8 Ga in the SET, and 2.4-2.5 Ga in the WT, reflect the time when each terrane joined the craton. The abundance of mid-Proterozoic ages in the WT relates to the rifting and compression of the western margin of the Kalahari Supercraton during this time. The peak of Archean ages in each locality overlaps only the oldest whole-rock ages of xenoliths from that locality. Whole-rock analyses of our samples give similarly mixed ages, reflecting the presence of >1 sulfide generation. These data push back the mean age of SCLM stabilisation for each terrane, and indicate the potential for correlating specific episodes of SCLM modification with crustal events on a terrane scale.

Fig. 1. Cumulative probability plot of T(MA) ages



References

Alard et al. (2000) *Nature* **407**, 891-894

Pearson et al. (2002) *GCA* **66**, 1037-1050

Extreme unradiogenic Os isotopes in Hawaiian mantle xenoliths: implications for mantle convection

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We have examined Os-isotope variations in a suite of lherzolite xenoliths from Salt Lake Crater (SLC; Oahu, Hawaiian Islands) in order to better constrain the extent and origin of Os-isotope heterogeneity in the oceanic lithosphere. Os-isotopes in the SLC xenoliths span a large range (0.113 < ^{187}Os/^{188}Os < 0.129) and extend to significantly less radiogenic values than previously reported in Abyssal Peridotites (AP, average ^{187}Os/^{188}Os = 0.125). The samples also display a positive correlation between Pt/Os (0.9 - 2.7) and ^{187}Os/^{188}Os.

We consider 3 options to explain the unradiogenic Os composition of the SLC xenoliths:

1- Xenoliths could sample sub-continental lithospheric mantle (SCLM). Such unradiogenic values have not previously been reported from oceanic settings but are common in SCLM xenoliths. However, at present there is no evidence to suggest that the Hawaiian xenoliths sample rafted or subducted SCLM (the olivine mode-composition correlation in the SLC xenoliths is similar to the trend define by oceanic peridotites).

2- The SLC xenoliths have historically been thought to sample the oceanic lithosphere. However, their unradiogenic Os composition contrasts with the radiogenic values reported for AP. Although seawater alteration may have elevated the AP ^{187}Os/^{188}Os , this process alone cannot account for the difference in average Os-isotopic composition between the SLC xenoliths and AP. ^{187}Os/^{188}Os values in other OIB xenoliths and leached Cr-spinel from AP are still significantly higher than in the SLC xenoliths. Another possible explanation for this discrepancy is that shallower portions of the oceanic upper mantle (i.e., the top of the melting column as sampled by AP and other OIB xenoliths) have had the ^{187}Os/^{188}Os values elevated through interaction with radiogenic melts. This hypothesis is supported by positive correlations between Pt/Os and ^{187}Os/^{188}Os observed in the SLC xenoliths and in some AP suites. This hypothesis would require either the presence of a large radiogenic component such as pyroxenite veins or disequilibrium melting at the grain scale.

3- Alternatively, the SLC xenoliths could derive from the Hawaiian plume. P-t estimates from a recent petrographic study of garnet-bearing SLC xenoliths are consistent with a high pressure (transition zone) origin of the xenoliths [1]. Previous isotopic studies [e.g., 2] showed that a recycled oceanic crust component is present in the Hawaiian plume. The Hawaiian xenoliths could represent a recycled piece of ~2 Ga old depleted oceanic lithosphere, i.e. the counterpart of the recycled oceanic crust.