LU-HF AND RE-OS SYSTEMATICS OF LAMPROITES: CONSTRAINTS ON THEIR PETROGENESIS

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Lamproites show some of the most extreme unradiogenic Hf and Nd isotope compositions of any mantle-derived magmas and are a reflection of their ancient and variably enriched sources. Recent experimental studies have provided models that can be further evaluated with Hf and Os isotopic data because of the characteristic isotopic compositions developed by mineralogically varied lithospheric assemblages. In particular, Nowell et al. (Ext. Abst. 7th International Kimberlite Conference, 1998) found large deviations below the mantle Hf-Nd isotope array which require explanation. We have analysed additional lamproites from several continents for Lu-Hf and Re-Os isotope compositions to further constrain their petrogenesis.

Each lamproite suite is characterised by very unradiogenic eHf and eNd values that require a component with time-integrated very low Lu/Hf and Sm/Nd. While eNd values show substantial overlap, each lamproite suite has a distinct and very limited range in eHf values forming horizontal "arrays" that trend off beneath the mantle Nd-Hf array. Ancient metasomatised peridotitic lithospheric mantle is characterised by compositions lying on or substantially above the mantle Nd-Hf array with very radiogenic eHf values (up to 2500) at eNd values within approximately 20 units of bulk Earth. This, together with lamproite $\gamma_{Os}$ values that are almost exclusively suprachondritic (to values $>100$), suggests that peridotitic lithosphere alone is not the source for lamproites and an additional component is required. The horizontal lamproite Hf-Nd arrays can be interpreted as mixing lines that reflect interaction of melts derived from a mixed ancient pyroxenitic/mafic and metasomatised peridotite lithospheric source.
consistent with "veined mantle" petrogenetic models (e.g., Foley, 1992). The nature of the arrays requires a mixing line with extreme curvature, which in turn implies the pyroxenitic and periodititic source endmembers have very different Hf/Nd ratios. This model can also explain the coupled Hf-Os isotope systematics observed in lamproites. An alternative model is that the distinctive Nd-Hf isotope compositions of lamproites represent an ultra-deep source component, as advocated for kimberlites. These models will be evaluated.