Geochemistry and petrogenesis of a South African diamondiferous eclogite

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A recently collected diamond-bearing eclogite from the Roberts Victor Mine of South Africa was studied for its major and trace element chemistry and mineral compositions, to gain insight into the relationships between eclogite and diamond petrogenesis. The relatively magnesian basaltic bulk composition of this xenolith is characteristic of other Roberts Victor eclogites. Its high Na_2O in garnet and K_2O in clinopyroxene puts this eclogite in the Group I classification group of McCandless and Gurney (1989), in common with most diamondiferous eclogites. Garnet-clinopyroxene Fe-Mg exchange thermometry yields an estimate of 1114°C at 30 kbars, also similar to estimates from other Roberts Victor Group I eclogites.

However, in contrast to most Group I eclogites, the reconstructed bulk rock rare earth element pattern of this rock (determined by ion probe analysis of unaltered garnet and clinopyroxene) is light rare earth depleted, with a positive europium anomaly, indicative of a plagioclase-rich cumulate gabbroic protolith metamorphosed to eclogite facies during emplacement into the lithosphere. In this regard, and in its textural character, (MacGregor and Manton, 1986) the xenolith is more similar to Group II eclogites. This contrast in classification may point to diamond growth during metasomatic reenrichment of an originally depleted cumulate rock matrix, and emphasizes the diversity of protoliths in which diamonds may form through metasomatic processes.

References

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Tracing metasomatic agents by noble gas isotopes

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Elemental and isotopic compositions of noble gases trapped in ultramafic rocks provide valuable information regarding the processes that affected the terrestrial mantle. Here I present some of such examples we found in fresh suites of xenoliths from SE Australia (e.g., Matsumoto et al., 2000) and in orogenic peridotites from Horoman (Matsumoto et al., 2001) and from Finero complexes (Matsumoto et al., 2005, submitted) with a particular emphasis on mantle metasomatism.

Based on analyses on above mentioned suites of rocks, we identified at least four kinds of characteristic noble gas components:

(1) A MORB-type isotopic component
(2) A Plume-like component
(3) A hybrid component with mantle-He and air-Ar
(4) A highly radiogenic component

Irrespective of their isotope signatures, these components are preserved in fluid inclusions without being significantly disturbed by ingrowths of radio- and nucleogenic noble gas isotopes. Therefore, these noble gas signatures should reflect those of mantle domains from which respective metasomatic agents had been derived. A MORB-like component is the most widespread in variably metasomatised mantle xenoliths from SE Australia, whereas the plume-like neon is rare and only found in metasomatic apatite, indicating an involvement of mantle plume to this particular metasopmatic event (e.g., Matsumoto et al., 1997 and 2004). A Hybrid of mantle-He and air-Ar can be regarded as a signature characteristic of the subduction zone settings, and is often found in orogenic lherzolites. We also found that this component is highly concentrated in thin apatite-rich layer of Finero lherzolite that hosts LREE-enrichment. This can be taken as rather direct evidence for metasomatic introduction of incompatible elements and noble gases with the same agent. Also, it is possible identify more than two different noble gas components coexist in a single specimen, suggesting multiple episodes of metasomatism. These demonstrate the usefulness of noble gas isotopes to constrain tectonic setting of the metasomatism and source of its agent.

References

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