No need for involvement of a hidden mantle reservoir in the origin of lamproites from Mediterranean

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Recent discussion about Hf-Nd isotope geochemistry focused on the composition of lamproites and kimberlites as possible evidence for the existence of a hitherto unrecognized 'hidden' terrestrial reservoir. This was triggered by the discovery of an apparent discrepancy between terrestrial Hf-Nd isotopes and the BSE chondritic reference value, which could be resolved by the existence of a new geochemical reservoir with Hf-Nd isotopic values below the terrestrial array. Most lamproites do not follow the Hf-Nd array defined by other terrestrial samples, but have variable Nd at almost constant Hf isotopic values. This triggered an attractive hypothesis about their role in the evolution of the Earth and their potential to sample the 'hidden' reservoir. Here, we present Hf, Sr, Nd and Pb isotope results on Mediterranean lamproites that can be used to further test this possibility.

Mediterranean lamproites are derived from multi-component melts, which combine depleted and enriched end-members(s). The extremely variable radiogenic isotope composition of lamproites points to the importance of mixing relations between three contrasting geochemical components which appear in $^{206}Pb/^{204}Pb$, $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ space: a crustal component, an ultra-depleted mantle component derived from the lithospheric mantle and a convecting mantle-originating component. It is the third component which is the most relevant for the deflection of lampoites from the terrestrial Hf-Nd array.

Our modelling shows that the convective-mantle derived component has high Sr and Nb contents, low $HFSE^{4+}$ relative to LREE, significantly higher Nb/Ta and Zr/Hf ratios, and lower Zr/Nb and Zr/Ta ratios relative to OIB and chondrite, whereas isotopic compositions are similar to OIB. This geochemical signature is considered as a "hallmark" of mantle carbonatite. In Hf-Nd isotopic space, this component is responsible for the shift of the lamproite values from terrestrial array. We interpret this shift as a mixing hyperbola between carbonatitic melts derived from sublithospheric mantle and lamproitic melts. The deviation from the array is due to the large range in Hf/Nd ratios that vary from up to 0.20 in lamproitic melts to <0.01 in asthenospheric melts, caused by extremely high Zr and Hf concentrations in lamproites (up to 1000 and 30 ppm, respectively), and very low Hf contents in carbonatitic melts. We discuss a geodynamic scenario which provides a suitable environment for the interaction of coeval asthenosphere-derived and lamproitic melts throughout the Mediterranean region.

REE in the oldest zircons, Okhotsk terrane

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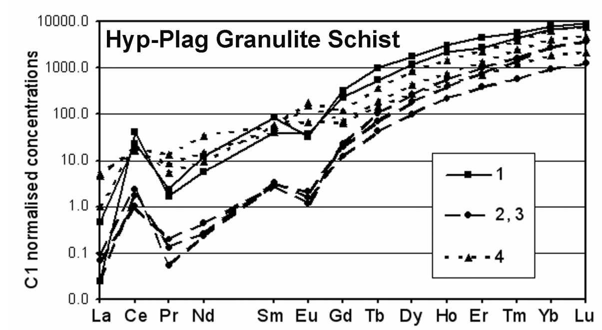
For accurate definition of genetic characteristic of zircons from mafic granulites and gneisses and to find a solution of gneisses and granite-gneisses correlation, REE distribution in zircons had been studied, using SIMS SHRIMPII.

Hyp-Plag granulite schist displays two oldest zircon generations: 1 (3.6-3.7Ga) with volcanic and 2 (3.5Ga) with magmatic inclusions. Volcanic zircons contain max consentrations of REE and (Lu_n/Sm_n=104-198, Eu/Eu^*=0.2-0.39). Ulta-metamorphic zircons (2) and recrystallized grains (3) contain less REE, espessially LREE, REE pattern is steeper (Lu_n/Sm_n=370-1305, Eu/Eu^*=0.15-0.27).



Some zircons (4) correspond to Proterozoic metamorphic and metasomatic events are represented by altered discordant grains of high U contents and positive Eu anomalies (Lu_n/Sm_n=120-129, Eu/Eu^*=2.1-2.9). Its REE consentrations are close to that of zircon 1, but REE pattern for most altered grains is flat (Lu_n/Sm_n=40,Eu/Eu^*=1.16). Granite-gneisses zircons displays two types of REE distribution: for ultra-metamorphic cores (3.3Ga) (Lu_n/Sm_n=27-117, Eu/Eu^*=0.1) and for metamorphic rims (2.7 Ga) (Lu_n/Sm_n=165-428, Eu/Eu^*=0.2-0.5). Cores in zircons of granite-host gneisses (3.28 Ga) show REE pattern (Lu_n/Sm_n=45-166, Eu/Eu^*=0.1-0.2) similar to that for cores of granite-gneisse zircons.

I. Chondritic normalised REE patterns of zircons with volcanic inclusions from Hyp-Plag granulite schist are similar to that of zircons from gabbro (Hoskin, 2000) and correspond to magmatic pattern. It conforms to geochemical data and verifies belonging of such zircons to mafic volcanic protolyth.

II. REE patterns of zircons with magmatic inclusions show distribution similar to zircons from leucosome of garnet-free granulites (Rubatto, 2002). III. Cores of zircons from gneisses and granite-gneisses show similar REE patterns, that indicate their origin from common protolyth.

References

Rubatto D., (2002), *Chemical Geology*, **184**, 123-138.
Hoskin W.O. & Ireland T.R., (2000), *Geology*, **28**, 627-630.