Rare earth elements in the core?

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Introduction

It was traditionally assumed that all REE are in the silicate geosphere only and that in Sm-Nd system the Bulk Earth corresponding to chondrites is identical to the Bulk Silicate Earth (BSE). But these assumption have never been proved. The objective of this study was to check them and find out if the Earth core can contain REE.

Results

The mantle xenoliths which judging by HREE concentrations, Al_2O_3/MgO and CaO/Al_2O_3 in them are identical to chondrites, and hence to a primitive mantle, were studied. Model Pb-Pb isotope ages (T_{CHUR}) of such xenoliths correspond to 4510±30 Ma. At the same time E_{Nd} and $^{87}Sr/^{86}Sr$ in these xenoliths are typical of the MORB source.

Discussion

The results evidence that the MORB source composition in not really identical to DM but to BSE or, which is the same, to perochemically primitive mantle. It means that deficit of LREE in the MORB source displayed by the value ε_{Nd}=+10 arose at the earliest stage of the planet evolution and is not connected with formation of the crust or EM, as it was traditionally assumed. Accordingly, all kinds of the mantle material having ε_{Nd} <+8 have to be considered as an EM. The DM (ε_{Nd}>+12) is petrogenetically fruitless, has no volcanic derivatives and is represented only with xenoliths. Moreover, if the ratios of refractory elements such as REE, in initial planetary material in reality corresponded to those in chondrite one, just kipping the balance requires that deficient LREE in BSE be concentrated in the Earth core as a complementary reservoir. It is supported by the presence of phosphates and phosphides enriched with REE in irons [1]. So, the most probably the core is not an inert reservoir for REE.

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Reference

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NANO-SIMS U-Pb dating of monazite

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We have developed ^{238}U-^{206}Pb and ^{207}Pb-^{206}Pb dating method of monazite by using a NanoSIMS NS 50 ion microprobe installed at Ocean Research Institute, The University of Tokyo. A ~4 nA O^- primary beam was used to sputter a 5-μm-diameter crater and secondary positive ions were extracted for mass analysis using a Mattauch-Herzog Geometry. Multi-collector system was modified to detect $^{140}Ce^+$, $^{204}Pb^+$, $^{206}Pb^+$, $^{238}U^{16}O^+$, and $^{238}U^{16}O_2^+$ ions at the same time. A mass resolution of ~5500 at 10% peak height was attained with a flat peak top, while the sensitivity of Pb was about 4 cps/1nA/ppm. A monazite from North-Central Madagascar with a U-Th-Pb chemical age [1] of 525.2±8.2 Ma (2σ) obtained by EPMA was used as the standard for Pb^+/UO^+ - UO_2^+/UO^+ calibration. There is a positive correlation between the Pb^+/UO^+ and UO_2^+/UO^+ ratios of the standard. A simple linear regression was more appropriate than the quadratic relation to fit the trend. The $^{207}Pb/^{206}Pb$ ratios were measured by a magnet scanning.

U-Pb ages of 44 monazite grains extracted from a sedimentary rock in Western foothills of Taiwan were analyzed. Observed ages were compared with the U-Th-Pb chemical ages of the same sample [2]. ^{238}U-^{206}Pb ages agree well with those of the chemical except for a few samples. The discrepancy may be due to common Pb effect by an over-estimation of radiogenic Pb by the chemical age. The ^{207}Pb-^{206}Pb ages also agree with the chemical age while there are a few discordant samples in addition to several samples with common Pb signature. Taking into account of concordant samples, there are three main age groups, 230Ma, 440Ma and 1850Ma. The age distribution suggests that the provenance of detrital monazites is possibly North China Craton [3,4].

References

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