Noble gas isotopic compositions of zircons above the Bangombé natural fission reactor

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The Oklo-Okelobonde-Bangombé uranium deposits in the Repiblic of Gabon, are known as natural fission reactors because large-scale fission reactions occurred in the deposits 2.0 Ga ago. Significant amounts of fission products have been still remained in and around the reactors. Isotopic analysis is a useful technique to understand the behavior of fission products in and around the natural reactors. In our previous study, *in situ* isotopic analyses using a Sensitive high Resolution Ion MicroProbe (SHRIMP) showed that a part of depleted U and fissiogenic light rare earth elements were incorporated in U-bearing minerals and zircons around the Bangombé reactor [1, 2]. In this study, *in situ* isotopic analyses using a laser extraction techniques were applied for the determination of noble gas isotopic compositions in fine zircon grains from the clay layer above the Bangombé reactor.

Prior to the noble gas measurement, crystallization ages, U content and crystallinity of the zircon grains were analyzed by SHRIMP, Electron Probe Micro Analyzer and Raman microscope, respectively. The U-Pb formation ages of the zircons showed 2910±22 Ma. The U contents were in a wide range (<0.01–0.11 wt.%), and the crystallinity decreased with increasing the U content. Noble gases, He, Ne, Ar, Kr and Xe, were extracted by ablating individual zircons (> 100 μm) with a pulsed Nd:YAG laser beam, and were measured with a modified VG5400 MS-III at the University of Tokyo.

High ^{3}He/^{4}He ratios in all zircons suggest the production of ^{3}He by ^{6}Li (n, α)^{3}H reaction. ^{20}Ne/^{22}Ne and ^{21}Ne/^{22}Ne ratios in low-cristallinity grains showed significantly high values. Moreover, ^{38}Ar/^{36}Ar ratios in low-crystalinity zircons were higher than those in high-crystalinity zircons. The results suggest the significant occurence of alpha reactions for the production of ^{21}Ne, ^{22}Ne, ^{38}Ar in low-crystallinity zircons because of the high-U contents. On the other hand, in high crystallinity zircons, neutron capture reactions predominantly occurred rather than alpha reaction, and produced ^{36}Ar. The Kr and Xe isotopic anomalies provided clear evidence for the addition of ^{238}U spontaneous-fission fragments.

[1] Hidaka *et al.* (2005) *GCA* **69**, 685–694. [2] Kikuchi *et al.* (2007) *GCA* **71**, 4716–4726.

Lithium isotopic fractionation in the spinel lherzolite xenoliths from Boeun, Korea

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Spinel lherzolite xenoliths with protogranular to porphyroclastic textures from Boeun, Korea, were enclosed in Miocene alkali basalt. Lithium concentration and isotopic compositions of olivine, clinopyroxene, and orthopyroxene separates from the spinel lherzolite, as well as those of whole-rocks of the spinel lherzolites and alkali basalt, were determined by ICPMS and MC-ICPMS, respectively, after the column procedures.

The olivines, orthopyroxenes, and clinopyroxenes in the metasomatised spinel lherzolites are enriched in lithium concentrations, whereas those in unmetasomatised spinel lherzolites are depleted in lithium concentration.

The lithium isotopic compositions (δ^7Li) of olivines (-5.4 to +3.5 ‰), orthopyroxenes (-11.4 to -0.1 ‰), and clinopyroxenes (-14.4 to -4.7 ‰) ranged far beyond the normal mantle (+4 ± 2 ‰).

The larger variations of δ^7Li and $\Delta^7\mathrm{Li}_{\text{olivine-Cpx}}$ (5.7 to 15.7 ‰) with the La, Yb, Al_2O_3, and MgO contents of clinopyroxenes indicate that the partial melting and mantle metasomatism under the mantle condition and surface contamination did not affect the lithium isotopic fractionation. In addition, the lithium isotopic fractionation during transport from mantle to surface did not happen because of the texture and homogenous chemical compositions of the minerals in the spinel lherzolites. Large variations of lithium isotope compositions between the minerals may be caused due to the different lithium isotope diffusion velocity after eruption by cooling.