
It has been considered that the Moon is depleted in volatile elements and the \(^{238}\text{U}/^{204}\text{Pb}\) (\(\mu\)) of the mantle of the Moon is high as inferred from \(^{206}\text{Pb}/^{204}\text{Pb}\) (200-400) of mare basalts. However, it was shown that sources of orange and green glasses evolved in a low \(\mu\) environment of \(<29\) (1) and \(\sim30\) (2), respectively. Recently, we found that lunar meteorite, Asuka 31 gabbro, evolved from a source with \(\mu\) of \(\sim7\) (3), comparable to the Earth's mantle value.

In order to understand the Pb isotopic evolution of the Moon, U, Th and Pb partitioning for ultramafic minerals, metal/silicates (4), and metal sulfide/silicates are needed. U partitioning in basaltic minerals (5,6) has been rather extensively studied. However, only Pb partitioning is reported for chrome diopside (7), because of difficulties in measuring Pb.

We report U, Th, and Pb abundances for minerals separated from three southern African low- and high-temperature peridotites in order to obtain relative partition coefficients. Garnet, clinopyroxene, orthopyroxene, and olivine were hand-picked from the 40-80 mesh fraction of crushed peridotites. Garnet was also hand-picked from heavy mineral concentrates of smaller size fractions (80-150 mesh). Separated minerals were first washed with acetone and ethanol in an ultrasonic bath (15 min. for each) in order to remove contamination and small powders adhering to mineral grain surfaces. OPX and OLV gave slightly turbid alcohol wash. The minerals were then leached twice with 2N HF+ 0.5N HNO\(_3\) for 15 minutes each in an ultra-sonic bath. U, Th and Pb concentrations in the alcohol wash, leachates, and residues were determined. After washing and leaching, the original masses of GAR, CPX, OPX, and OLV were reduced about 0.3, 20, 25, and 10\%, respectively, on one occasion. Because of extremely low concentrations of these elements in the minerals, we repeated the analyses in order to make sure of the concentrations and some measurements are still being taken. Only a part of the data can be reported at present. The elemental concentrations in OLV in a high temperature garnet lherzolite sample (FRB 1012) from Jagersfontein is one order of magnitude lower than that in OPX and more than two order of magnitude lower than CPX. This relationship is similar to those reported for minerals in xenoliths from Hawaiian volcanic rocks (8). Two Pb determinations for OLV gave 0.204 and 0.209 ppb, which providing a good confidence. (Pb blank of 20 and 22 pg). These values are one order of magnitude lower than that in OLV from a Hawaiian xenolith. However, the repetition did not agree for U (0.078 and 0.095 ppm) and Th (0.078 and 1.47 ppm). Using the lower numbers, observed

* Present address: Dept. of Earth Sciences, Utsunomiya University, Utsunomiya 321 Japan.
μ and κ for OLV are 16.1 and 0.83, respectively. Single determinations for μ and κ for CPX and OPX are 12.1 and 4.74 and 9.7 and 3.36, respectively.

Using experimentally determined DPb (7) and DU (6) for CPX, partition coefficients of these elements in other ultramafic minerals can be obtained. If the high DPb/DU values for OLV and OPX obtained so far are correct values, it is considered that μ values for the early cumulates from the lunar primary magma ocean was low, and μ of later cumulates gradually increased. With anorthositic magma rising to form the crust, late-stage cumulates probably had higher μ values (300-400), and residual liquids (the source for KREEP) consequently had tremendously high μ (>600). The chalcophile element Pb enters in sulfides as shown by Pb concentrations in troilite of Canyon Diablo and Odessa (4.2-6.9 ppm) while U concentration is <0.1 ppm (9). DPb between metal and silicate is 2.5 (4). Thus incomplete separation of metal and sulfide between core and mantle may have further reduced μ values for early cumulates.

References: