

Noble gas study of olivine megacrysts in kimberlites from Monastery, South Africa

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As a preliminary result of noble gas study, it has been reported that two olivine megacrysts in kimberlites, formed around 90Ma, from Monastery, South Africa (SA) showed excess ^{129}Xe accompanied with relatively low $^{40}\text{Ar}/^{36}\text{Ar}$ ratios as low as 279.3 by the heating method (Kaneoka et al., 1985). Excess ^{129}Xe compared with atmospheric ^{129}Xe is generally attributed to the decay products of now extinct nuclide ^{129}I and has been identified in CO_2 well gases, ultramafic nodules and oceanic basalt glasses.

Based on such information, early degassing of terrestrial atmosphere has been discussed (e.g., Staudacher and Allegre, 1983). Further, the occurrence of excess ^{129}Xe has been argued to be accompanied with high $^{40}\text{Ar}/^{36}\text{Ar}$ ratios (Allegre et al., 1983; Manuel and Sabu, 1983). Hence, if the occurrence of excess ^{129}Xe with low $^{40}\text{Ar}/^{36}\text{Ar}$ as reported by Kaneoka et al. (1985) is confirmed, it implies the possibility for uneven distribution of excess ^{129}Xe within the Earth and gives us another constraint on the early history of the Earth.

In this study, in order to verify the previous results and study the conditions of noble gases in the subcontinental mantle in more details, we have performed noble gases analyses for olivine megacrysts by increasing the number of samples with recent highly precise mass spectrometry and applying both the crushing and the heating methods.

Six olivine megacrysts in kimberlites from Monastery, SA were investigated by the crushing method for noble gas analyses to diminish the effects from cosmogenic and radiogenic components. Based on the observed $^3\text{He}/^4\text{He}$ and $^{40}\text{Ar}/^{36}\text{Ar}$ ratios, present samples seem to be divided into three groups. First, MO44 and MO45 showed about 7Ra (6.6-6.9Ra) in $^3\text{He}/^4\text{He}$ ratios with $^{40}\text{Ar}/^{36}\text{Ar}$ ratios of around 1000 (868-1350). Second, MO34, MO36 and MO48 showed almost the same as the first group in $^3\text{He}/^4\text{He}$ ratios (4.0-6.8Ra), but had more low $^{40}\text{Ar}/^{36}\text{Ar}$ ratios (297-408). Third, MO41 showed the $^3\text{He}/^4\text{He}$ ratio of 1.3Ra with the $^{40}\text{Ar}/^{36}\text{Ar}$ ratio of 1670.

No significant data were obtained for Ne, Kr and Xe isotope ratios due to very small amounts of degassed gases.

Further, some of these six samples were also investigated by the heating method (degassing temperature: 700C, 1700C) to obtain enough amounts of Ne, Kr and Xe for measuring their isotopic ratios, and to clarify the detailed isotope signatures by comparing these results by the both methods. Although more noble gases were degassed compared to those by the crushing method, the $^3\text{He}/^4\text{He}$ and $^{40}\text{Ar}/^{36}\text{Ar}$ ratios were almost the same obtained by the heating method, and the occurrence of excess ^{129}Xe could not be identified within their analytical uncertainties. However, the sample (MO36) in which the occurrence of ^{129}Xe with almost atmospheric $^{40}\text{Ar}/^{36}\text{Ar}$ ratio had been reported has not yet been investigated. Including this sample, it is intended to measure further the other samples by the heating method.