Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.17216

Noble gas analysis of fluid/melt inclusions in ultramafic rocks from West Greenland for constraining Archean mantle evolution

NANAE FUKUSHIMA[1], DR. HIROCHIKA SUMINO[2], TOMOAKI MORISHITA[3], JUAN MIGUEL GUOTANA[3], IKUYA NISHIO[3], KENICHIRO TANI[4], PEDRO WATERTON[5], KRISTOFFER SZILAS[5], HIKARU SAWADA[6], MASAFUMI MURAYAMA[7] AND KENTA YOSHIDA[6]

[1]The University of Tokyo
[2]University of Tokyo
[3]Kanazawa University
[4]National Museum of Nature and Science
[5]University of Copenhagen
[6]Japan Agency for Marine-earth Science and Technology (JAMSTEC)
[7]Kochi University

Presenting Author: fukushima-nanae322@g.ecc.u-tokyo.ac.jp

To constrain the volatile element evolutions of the early Earth's mantle, noble gas analyses of Archean ultramafic rocks were performed. The samples are peridotites and chromitites from the Isua Supracrustal Belt (ISB) and the Ujaragssuit nunat area in western Greenland, respectively, which are one of the oldest lithologic packages on the Earth. The ISB is an arch-like package about 30 km long and 4 km wide, subdivided into two terranes, southern (3.8 Ga) and northern (3.7 Ga). The northern terrane contains ultramafic bodies ranging in size from a few meters to several hundred meters, including dunite lenses A and B. Both have different and complex metamorphic histories. The Ujaragssuit nunat area is about 20 km southeast of the ISB, where ultramafic bodies are distributed as lenses of several meters to several hundred meters in 3.8 Ga banded gneiss. The chromitites in ultramafic bodies were metamorphosed in the Archean ages, and their origin is not yet well understood. In all samples, fluid/melt inclusions ranging from a few microns to several hundred microns were observed by an optical microscope and a microfocus X-ray CT scanner.

Olivines and chromites separated from the ISB dunites and the Ujaragssuit nunat chromitites, respectively, were used for noble gas analyses. The stepwise crushing method in vacuo was mainly applied to extract gases from fluid inclusions. The noble gas isotope ratios of all the samples indicate significant contributions of radiogenic/nucleogenic noble gases derived from U and Th. Assuming all the ^{4}He in the samples were radiogenic in origin, the required U concentration is much higher than the literature values for ultramafic rocks in the same area, which cannot be explained even with its old age. This means that fluids/melt with high ^{4}He concentrations were secondarily trapped in the minerals. The ^{4}He/^{40}Ar ratio is higher than that of the present-day crust and mantle, suggesting that it may originate from a reservoir with a high U/K ratio. We will perform noble gas analyses of neutron-irradiated samples to further constrain the metasomatic environments by determining the U and K concentrations and halogen element compositions.