Noble gas and carbon isotopes in the archean carbonatites from the Sillinjarvi mine, central Finland

Takuya Matsumoto[1]; Yasuharu Kudo[1]; Teruyuki Maruoka[2]; Jun-ichi Matsuda[3]; Hajime Shimoda[4]; Mitsuo Makita[5]; Tomoaki Morishita[6]

[1] Earth and Space Sci., Osaka Univ; [2] Univ. Tsukuba; [3] Earth and Space Sci., Osaka Univ.; [4] GSJ, AIST; [5] Earth Sci., Kanazawa Univ; [6] Earth Science, Kanazawa Univ.

Noble gas isotope signatures of the present and past mantle provide important information regarding the evolution of the earth.However, there are certain degrees of difficulty in obtaining appropriate mantle-derived rocks that bear pristine noble gas signatures. Commonly targeted oceanic basalts and their phenocrysts can provide information of the mantle sources younger than 200 Ma. For ancient mantle, diamonds and Archean komatiites have been subjected for noble gas analysis (e.g., Wada and Matsuda, 1998; Matsumoto et al., 2002), but these are still inadequate to cover the earth's history. Carbonatites (igneous rocks with more than 50% carbonate minerals) might be an alternative kind of targets with their occurrence in ages from Achaean to recent, and their unique ability to gather important trace elements (including volatiles such as noble gas) during their formation. Also, noble gas information, if extracted from the carbonatites, would help to further understand the origin of carbonatitic melts in the mantle. In this project, we aim to obtain noble gas information from some Archean cabonatities collected in the Sillinjarvi carbonatite complex which is located in eastern Finland close to the city of Kuopio. It consists of a steeply dipping lenticular body roughly 16 km long with a maximum width of 1.5 km and a surface area of 14.7 km2 intruded into granite geneiss. The carbonatite within the Siilinjarvi complex occurs as a central tabular 600-700 m wide body of calcite and dolomite-bearing phlogopite rocks running the length of calcite- and dolomite-bearing phlogopite rocks running the length of the complex surrounded by a fenite margin.Majority of rock type in this complex is phlogopite-rich rocks. Typical modal composition is: 65% phlogopite, 20 carbonates (with a 4:1 calcite: dolomite ratio, 5% richterite and 10% apatite with other relatively minor accessory minerals include narite, strontianite, monazite, pyrochlore, baddeleyite, ilmetnite, magnetite, pyrite etc...). A concordant zircon U-Pb age of 2609 +/- 6 Ma (Lukkarinen et al., 2003) shows that Siilinjarvi is one of the oldest carbonatites in the world. However, their ultimate origin, whether they are from mantle or from crust, is still an open question. We collected more than 20kg of rocks from the bottom of the currently active mining pit in 2003. Thus, the samples are only recently excavated to the surface, implying that these samples are less susceptable to the air-addition by alteration and to the augmentation of cosmogenically produced isotopes (such as He-3 and Ne-21). We analyzed full set of noble gas isotopes from mineral separates (apatite, phlogopite, richterite, carbonates and magnetites) by stepped crushing or by the stepped heating gas extraction. In addition to noble gases, some of the samples are subjected to the carbon isotope analysis as well. Information of carbon isotope from these carbonatite samples also of great interest as they would be a valuable adjunct to noble gas isotopes, and to further understand the behaviror and cycle of carbon over the history of the earth.