Report for the Joint Use/Research of the Institute for Planetary Materials, Okayama University for FY2023

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Category: ☑International Joint Research ☐General Joint Research ☐Joint Use of Facility ☐Workshop

Name of the research project: Isotopic provinces of Northeast Asia

Principal applicant: Tikhomirov Petr

Affiliated institution and department: Schmidt Institute of Physics of the Earth (Moscow, Russian Federation)

Collaborator

Name: Kobayashi Katsura

Affiliated institution and department: Institute for Planetary Materials

Research report:

This research continues the geochronological and geochemical study of magmatic complexes of NE Asia performed at the Pheasant Memorial Laboratory (PML) of the Institute for Planetary Materials (formerly, Institute for Study of the Earth's Interior) during 2005-2007, and later in 2020-2022.

The main purpose of the research conducted in 2023 was to improve the existing knowledge on the isotopic provinces of NE Asia, with possible corrections on the regional tectonic and petrogenetic models. According with the possibilities available during the planned stay of collaborators from Schmidt Institute, 27 rock samples were selected for elemental and Sr-Nd-Pb isotopic analyses, including 14 samples from the Oloy volcanic belt (Jurassic through Early Cretaceous), and 13 samples from the East Chukotka segment of the Okhotsk-Chukotka volcanic belt (OCVB, Early through Late Cretaceous).

The preparation of rock powders and the analysis for major and trace element contents were performed by the collaborators from the IPM at the previous stage of the research, in 2021-2023. In October through December 2023, the isotopic analysis of Sr, Nd, and Pb has been implemented at IPM by P. Tikhomirov, I. Lebedev, and T. Bagdasaryan (Schmidt Institute) under the supervision from K. Kobayashi and C. Sakaguchi (IPM). The obtained results are internally consistent. Briefly, the following points are to be noted:

(1) the volcanics of the Nyrvakinot Formation (ca. 90-87 Ma) of the OCVB's East Chukotka

segment display the contribution from moderately depleted ($\varepsilon Nd \geq 2.5$, $Sr^i \leq 0.7045$, and $^{206}Pb/^{204}Pb \leq 18.55$) and moderately enriched ($\varepsilon Nd \leq -2.2$, $Sr^i \geq 0.7059$, and $^{206}Pb/^{204}Pb \geq 18.9$) magma sources. Similar isotopic ratios for mafic and silicic rocks confirm the hypothesis that the relatively young mafic underplates were the main magma sources for the silicic magmas of the OCVB;

(2) the youngest volcanic unit of the East Chukotka segment of the OCVB (the Nunligran Formation, ca. 75-71 Ma) is composed by the derivatives from a relatively uniform and moderately depleted source ($\varepsilon Nd = 2.5$, $Sr^i = 0.7040$, and $^{206}Pb/^{204}Pb \leq 18.4$), which is not consistent with the hypothesis about the intraplate nature of the 'upper basalts' of the OCVB (e.g., Filatova, 1988);

(3) the magmas of the Oloy volcanic belt originate from the depleted MORB-like source ($\varepsilon Nd = 8.0$, $Sr^i = 0.7035$) but their Pb isotopes display the wide compositional range ($^{206}Pb/^{204}Pb$ between 18.26 and 18.84). The rocks from the Oloy belt have a substantially lower $^{208}Pb/^{204}Pb$ ratios than any of OCVB volcanics studied whatsoever. This implies that the Oloy belt and the OCVB have had different magma sources, although the OCVB segments superposed on the complexes of the Oloy belt display the origin from relatively depleted sources (e.g., Tikhomirov et al., 2016), similar to those of the Oloy belt.

We are going to use the results obtained at IPM in 2023 to prepare at least two articles in international journals. The first article is under preparation (here, we discuss the temporal and spatial variations of the chemical and isotopic composition of the OCVB East Chukotka segment).