Geodynamics of the layered mafic – ultramafic intrusions in the East Sayan (Russia)

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Within the Central Asian folded belt, the most of the layered low-titaniferous and high-aluminous peridotite-troctolite-gabbro massifs are comparable with the products of Early Paleozoic island arc magmatism by the time of their formation [1]. In addition, their spatial relation to axial parts of island-arc systems is being discussed. One of the representatives of this formational type is the Talazhin mafic-ultramafic intrusive massif in the northwestern part of the Eastern Sayan studied by us. It is composed of troctolites, which dominate over plagiodunites, as well as lenses anorthosite, and gabbro with high anortite ratio (An_{75-99}). The relatively high Fe content in olivine (Fa_{20}) and similarity in behavior of trace elements to island-arc high-aluminous basalts indicates that the massif rocks are comagmatic with IAB-type volcanites. Mineralogical characteristics of gabbro of the Talazhin massif are similar to the allivalite and eucrite xenoliths in modern island-arc volcanites. The geochemical features of the massif rocks indicate that their generating is a result of crystallization differentiation of high-aluminous olivine-bearing basalt magma. The rocks are characterized by high magnesium at low concentrations of HFSE (Ti, Zr, REE), as well as enrichment in LREE, and the positive Eu-anomaly. Sharp minimums for Ta and Nb, and maximums for Ba and Sr can be seen in the spider diagrams. It is suggested that the formation of the Talazhin massif occurred as a result of magma forming in the suprasubduction setting.

This study was funded by the Russian Ministry of Education and Science (projects 14.B37.21.0686, 14.B37.21.1257).

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Ordering of isotope composition for H, N and O between planets

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Hydrogen, Nitrogen and Oxygen are among the most abundant elements of the universe. Isotopic compositions of these elements between molecules are highly variable in molecular clouds. Due to highly volatile nature of these elements, the chemical forms are easily changed between vapor and solid (ice) by environmental temperature and pressure. Thus, the standard planetary formation model of the solar system suggests that inner planets deplete these elements, but outer planets enrich as major elements. Isotopic compositions for planets of these three elements should be determined spontaneously according to the standard planetary formation processes. Therefore, the isotopic variation between planets would be an important key to clarify how to form planets in the solar system. In this report, we propose new systematic approach to infer isotopic compositions for H, N and O of outer planets.

We have proposed a model for oxygen isotopic evolution in proto-planetary disk [1], and infered O isotopic compositions of outer planets [2]. The augmented model based on [2] in this study assumes the initial condition of isotopic compositions of molecules observed in molecular clouds and in chondrites, and includes two key points, i.e., 1) temporal preservation of chemical species fractionated in mass and 2) astronomical space separation by dynamic coupling/decoupling due to the chemical form changes for H, N and O in the disk.

The model infer systematic increase of heavier isotope components of H, N and O for outer planets towards increasing redial distance from the sun, whereas relatively uniform isotopic composition for inner planets. Infered H isotope variations between outer planets are quantitatively consistent with observation data by planet explorations [e.g. 3]. We infer enrichments of ^{15}N in the order of Jupiter, Saturn, and Uranus/Neptune. The $^{15}N/^{14}N$ ratio of Uranus/Neptune would be larger than the Earth's value. Oxygen isotope systematics between outer planets would be mass independent and ^{16}O component would be depleted in the order from Jupiter towords Neptune. The isotopic compositions of inner planets suggest significant accretions of ices from outer solar system during planetary growth and as late veneer.

[1] Yurimoto & Kuramoto (2004) *Science* **305,** 1763-1766. [2] Kuramoto & Yurimoto (2005) I*n Chondrites and the Protoplanetary Disk* **341,** pp. 181-192. [3] Hartogh *et al*. (2011) *Nature* **478,** 218–220.

DOI:10.1180/minmag.2013.077.5.25