FOZO-HIMU connection: Link to chemical heterogeneity of MORB and variable degree of dehydration

G. SHIMODA*[1] AND T. KOGISO[2]

[1] Geological Survey of Japan, National Institute of Advanced Industrial Science and Technology, Tsukuba 305-8567, Japan (*correspondence: h-shimoda@aist.go.jp)
[2] Graduate School of Human and Environmental Studies, Kyoto University, Kyoto, 606-8501, Japan (kogiso@gaia.h.kyoto-u.ac.jp)

It has been considered that source materials of HIMU and FOZO could be recycled oceanic crust. From this perspective, the arising question is what process is responsible for the geochemical difference between HIMU and FOZO. Additionally, coupled production of low Rb/Sr and high U/Pb and Th/Pb ratios of HIMU and FOZO has been controversial. To solve the issue, many studies have been conducted to evaluate the origin of the HIMU source using hydrothermal alteration and/or dehydration reaction. These studies can successfully explain the origin of HIMU and FOZO source. However, they may neglect effect of global chemical trend of MORB composition that should result in variation in isotopic composition of recycled MORB. In addition, variation in condition of subduction process (e.g., amount of dehydrated fluid) should greatly affect the isotopic composition of recycled oceanic crust.

In the present study, geochemical modeling has been conducted to evaluate the origin of HIMU and FOZO reservoirs on the basis of global chemical trend of MORB and variation in subduction processes. For the modeling, MORB compositions from East Pacific rise and Mid-Atlantic ridge are compiled from published data (PetDB: http://www.earthchem.org/petdb). The results suggest that crystal fractionation at a mid-ocean ridge can increase U and Th concentrations relative to Pb content, producing high U/Pb and Th/Pb ratios in evolved MORBs. In addition, high degree of dehydration beneath a subduction zone can increase U/Pb and Th/Pb ratios of subducting oceanic crust compared to less dehydrated oceanic crust, suggesting that strongly dehydrated oceanic crust can be a suitable source for HIMU and less dehydrated MORBs can produce material with FOZO isotopic signature. In this context, magma evolution at mid-ocean ridges and variable degree of dehydration beneath subduction zones play an essential role in producing the isotopic variations between HIMU and FOZO.

Occurrence of >3.9 Ga “Nanok” gneiss from Saglek Block, northern Labrador, Canada

M. SHIMOJO[1]*, S. YAMAMOTO[1], S. AOKI[1], S. SAKATA[2], K. MAKI[2], K. KOSHIDA[1], A. ISHIKAWA[1], T. HIRATA[2], K.D. COLLERSON[3] AND T. KOMIYA[1]

[1]Department of Earth Science and Astronomy, The University of Tokyo, Komaba, Meguro, Tokyo, 153-8902, Japan (*correspondence: shimojo@ea.c.u-tokyo.ac.jp)
[2]Laboratory for Planetary Sciences, Kyoto University, Japan
[3]The University of Queensland, Brisbane Qld 4072, Australia

The Saglek Block is underlain by the Early to Late Archean suites including ca. 3.73 Ga Uivak I Gneiss, ca. 3.62 Ga Uivak II Gneiss, ca. 3.24 Ga Lister Gneiss and ca. 2.5 Ga granite [e.g. 1]. Those rocks underwent high-grade metamorphism, locally reaching granulite facies at 2.8-2.7 Ga [1]. Additionally, presence of over 3.8 Ga, up to 3.91 Ga, zircon cores in the Uivak I Gneiss suggested pre-Uivak I Gneiss rocks [1, 2], named as Nanok Gneiss [2]. However, the origin of the old zircon cores is still unclear: inherited from pre-Uivak I materials or precipitated from an older suite of the Uivak I felsic magma. Thus, we examined the internal structures of zircons using cathodoluminescence (CL) images and conducted laser-ablation ICP-MS U-Pb dating.

The result of the 11 orthogneiss samples from the south of St. John's Harbor is the following. The CL images or microscopic observations clearly display that most of the zircon grains comprise three domains: Zone I to III, respectively. Zone I is located in their central regions, and display clear oscillatory zoning. It is characterized by low U contents and high Th/U ratios. The Zone II lacks obvious oscillatory zoning, and is very dark. It is characterized by high U contents and low Th/U ratio, compared with Zone I. Zone III is a very thin layer in the outermost part of grains or does not exist. The U-Pb ages of Zone I and II shows a peak at 3.96-3.85 Ga and around 2.7 Ga, respectively. Those ages are well-correlated with observations of CL images, U contents and Th/U ratios. The age of the Zone II is in agreement with metamorphic age of previous study. Hence, the age of Zone I can be interpreted lower limit of the magmatic age of the protoliths of the orthogneisses, older than the conventional age of the Uivak Gneiss [1]. We concluded that the granitoid, the precursor of the Nanok Gneiss, were emplaced at 3.96 Ga in the Saglek block, Labrador.

[1] Schiøtte *et al*. (1989) *Can. J. Earth Sci*. **26**, 1533-1556. [2] Collerson (1983) *Lunar planet. Inst. Tech. Rep*. **83-03**, 28-33.

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