Preliminary report for zircon geochronology of tonalitic gneiss at Mt. Reed in western part of the Napier Complex, East Antarctica

Kenji Horie[1, 2], Mami Takehara[1], Tomokazu Hokada[1, 2], Sotaro Baba[3], Atsushi Kamei[4], Ippei Kitano[5], Prayath Nantasin[6], Nugroho Setiawan[7], Davaa-ochir Dashbaatar[8] and Yoichi Motoyoshi[1,2]

[1]*National Institute of Polar Research*

[2]*The Graduate University for Advanced Studies (SOKENDAI)*

[3]*University of the Ryukyus*

[4]*Shimane University*

[5]*Kyushu University*

[6]*Kasetsart University*

[7]*Gadjah Mada University*

[8]*Mongolian University of Science and Technology*

The Napier Complex in East Antarctica has attracted considerable interest from a viewpoint of long Archaean crustal history from 3800 Ma to 2500 Ma (e.g., Harley & Black 1997) and >1000˚C ultrahigh-temperature (UHT) metamorphism in a regional scale (e.g., Sheraton et al., 1987; Harley & Hensen 1990). Especially, Mt. Sones and Gage Ridge regions in the Napier Complex are famous as evidence of Hadean to Eoarchean (Black et al., 1986; Harley & Black 1997). For other regions, previous workers also reported possibility of the early Archean crust. Fyfe Hills and Mt. Cronus regions in the western part of the Napier Complex are the areas where ancient >3800-3600 Ma zircon ages have been obtained. Compston and Williams (1982) reported upper intercept U–Pb zircon ages of >3800 Ma for granitic orthogneiss from Fyfe Hills. Asami et al. (2002) reported >3600 Ma zircon ages using electron microprobe for quartzo-feldspathic gneiss from Mt. Cronus. On the other hand, Horie et al. (2012) reported that orthogneisses, quartzofeldspathic gneisses, and quartzites collected from both area showed 3000 Ma or younger protolith ages. It is quite important to confirm the reported early Archaean crustal ages to make more detailed discussion about the Archean crustal history of the Napier Complex. In addition, the timing of ultrahigh-temperature metamorphism is in argument either >2550 Ma or <2480 Ma (Kelly and Harley, 2005).

In this study, a tonalitic gneiss (23-1A-06) was analyzed by a sensitive high resolution ion-microprobe (SHRIMP IIe) at the National Institute of Polar Research, Japan. The sample was collected at Mt. Reed located close to Mt. Sones during the field work at the 2016-2017 Japanese Antarctic Research Expedition. Geochronological reports of Mt. Reed are absence and this study is first geochronological report. The sample was pulverized by a high-voltage pulse power fragmentation device (SELFRAG Lab) to preserve the external morphology of zircons and avoid contamination (Takehara et al., 2017). After pulverizing, the zircon grains were concentrated using conventional mineral separation techniques, including heavy liquid separation with methylene iodide and magnetic separation. An adequate amount of 100 zircon grains was randomly handpicked and the external morphologies were observed in the low vacuum mode of a scanning electron microscope (LV-SEM; JEOL JSM-5900LV). The zircon grains were then mounted together with reference zircons in epoxy resin discs. After curing, the discs were polished to a cross-section through the grains and backscatter electron (BSE) and cathodoluminescence (CL) images were obtained in order to reveal the internal structures of individual zircon grains using the LV-SEM with a Gatan mini CL detector.

Zircon grains collected from the sample have rounded habits and are typically <250 μm in size. Some grains show irregular shapes but most grains have crystal face. CL images of the zircons revealed that bright CL-response domains surround dark CL-response domains. The dark CL-response domains contain mineral inclusions such as quartz, K-feldspar, albite, K-feldspar, ilmenite, and rutile, whereas the minerals inclusions are absence in the bright CL-response domains. 129 U–Pb zircon analyses were performed on 100 grains. U–Pb data of the zircons are scattered from 2858 to 2344 Ma and show several age peaks centered at 2798, 2712, 2660, 2478, and 2449 Ma. The components of the youngest age peak were obtained from the bright CL-response domains with crystal face, which suggests that the last crystal growth occurred at ca. 2449 Ma. Detailed observation by using Gatan ChromaCL2 installed with a field emission SEM (FE-SEM; JEOL JSM-7100F) revealed that the dark CL-response domains have patchy texture forming during regional metamorphism and suggests that it is necessary to pay attention to discuss about geochronological data.

References

Asami, M., Suzuki, K. and Grew E.S. Chemical Th–U-total Pb dating by electron microprobe analysis of monazite, xenotime and zircon from the Archean Napier Complex, East Antarctica: evidence for ultra-high-temperature metamorphism at 2400 Ma, Precambrian Research, 114, 249–275, 2002.
Black, L.P.,Williams,I.S. and Compston,W. Four zircon ages from one rock: the history of a 3930Ma-old granulite from Mount Sones, Enderby Land, Antarctica. Contributions to Mineralogy and Petrology, 94,427–437, 1986.
Compston, W. and Williams, I.S. Protolith ages from inherited zircon cores measured by a high mass-resolution ion microprobe, Abstract of Fifth International Conference on Geochronology, Cosmochronology, Isotopic Geology, Nikko, Japan, 63–64, 1982.
Harley, S.L. and Hensen, B.J. Archaean and Proterozoic high-grade terranes of East Antarctica (40–80°E): a case study of diversity in granulite facies metamorphism, In: Ashworth, J.R., Brown, M., (Eds.), High-temperature Metamorphism and Crustal Anatexis. Unwin Hyman, London, 320–370, 1990.
Harley, S.L. and Black, L.P. A revised Archaean chronology for the Napier Complex, Enderby Land, from SHRIMP ion-microprobe studies, Antarctic Science, 9, 74–91, 1997.
Horie, K., Hokada, T., Hiroi, Y., Motoyoshi, Y. and Shiraishi, K. Contrasting Archaean crustal records in western part of the Napier Complex, East Antarctica: New constraints from SHRIMP geochronology, Gondwana Research, 21, 829–837, 2012.
Kelly, N.M. and Harley, S.L. An integrated microtextural and chemical approach to zircon geochronology: refining the Archaean history of the Napier Complex, east Antarctica, Contributions to Mineralogy and Petrology, 149, 57–84, 2005.
Sheraton, J.W., Tingey, R.J., Black, L.P., Offe, L.A. and Ellis, D.J. Geology of Enderby Land and western Kemp Land, Antarctica, Bulletin - Australia, Bureau of Mineral Resources, 223, 1–51, 1987.
Takehara, M., Horie, K., Tani, K., Yoshida, T., Hokada, T. and, Kiyokawa S., Timescale of magma chamber processes revealed by U–Pb ages, trace element contents and morphology of zircons from the Ishizuchi caldera, Southwest Japan Arc, Island Arc, 26, 1–14, 2017