Preliminary report for zircon geochronology of tonalitic gneiss at an unnamed nunatak in western part of the Napier Complex, East Antarctica

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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 (170219-1A-05) was analyzed by a sensitive high resolution ion-microprobe (SHRIMP-IIe) at the National Institute of Polar Research, Japan. The sample was collected at an unnamed nunatak located between Mt. McMater and Mt. Riiser-Larsen during the field work at the 2016-2017 Japanese Antarctic Research Expedition. Geological and geochronological reports of the unnamed nunatak 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., 2018). 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 (TEMORA2 for U–Pb analysis and OG1 for Pb–Pb analysis) 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.

Most zircon grains collected from the sample have rounded habits and are typically >200 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.

37 U–Pb zircon analyses were performed on 37 grains. U–Pb data of the zircons are scattered from 3388 to 2469 Ma and show several age peaks centered at 3225, 3175, 3144, 2910, 2800, 2572, and 2485 Ma. The components of the youngest age peak showed Th/U ratios lower than 0.1, which suggests that the last crystal growth occurred at ca. 2485 Ma regional metamorphism.

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