First geochronological report of tonalitic gneiss at Harvey Nunatak in western part of the Napier Complex, East Antarctica

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The Napier Complex in East Antarctica is well known as a region which has both of evidence of ultrahigh-temperature (UHT) metamorphism (e.g., Sheraton et al., 1987; Harley & Hensen 1990) and long Archaean crustal history from 3800 Ma to 2500 Ma (e.g., Harley & Black 1997). In particular, Mt. Sones and Gage Ridge regions 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. For example, the Fyfe Hills and the 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; Asami et al., 2002). On the other hand, 3000 Ma or younger protolith ages were also reported from the Fyfe Hills and the Mt. Cronus regions (Horie et al., 2012), which is quite important to confirm the reported early Archaean crustal ages in order to promote a discussion about the Archean crustal history in the Napier Complex. Moreover, the timing of ultrahigh-temperature metamorphism is still in argument either >2550 Ma or <2480 Ma (Kelly and Harley, 2005).

We first focused a tonalitic gneiss (170223-2A-09) and analyzed it by a sensitive high resolution ion-microprobe (SHRIMP IIe) at the National Institute of Polar Research, Japan. The sample was collected at the Harvey Nunatak located close to Mt. Reed and Mt. Sones during the field work at the 2016-2017 Japanese Antarctic Research Expedition (JARE). The area is also the farthest from the sea which JARE has visited before and geochronological data of the Harvey Nunatak had never been reported. The sample was crushed by a high-voltage pulse power fragmentation device (Selfrag Lab) to preserve the external morphology of zircons and prevent contamination (Takehara et al., 2017). The zircon grains were concentrated by processes of heavy liquid separation with methylene iodide and magnetic separation. An adequate amount of 50 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) by LV-SEM and optical microscopic images were obtained in order to reveal the internal structures of individual zircon grains.

Zircon grains of the sample (170223-2A-09) show rounded habits. Some grains have unclear crystal faces and/or irregular surfaces. Most grains are 100-150 μm and partly more than 400 μm in size. The zircon grains have mostly fractures but slightly inclusion based on the observation of transmitted light images by optical microscope. BSE images show that some zircon grains have darker BSE-response domains, which suggests a possibility of depletion of contents of Zr and/or Si or hydrothernal alteration of zircon in these domains. Based on the evidence, there is a possibility that hydrothermal alteration in zircon are found even in the ultrahigh-temperature metamorphic region. In some of the darker BSE-response domains in zircons, there are small inclusions (~3 μm) of galena (PbS). U–Pb data of the zircons show mostly concordant data and discordance (Disc.(%) = 1 − (^{206}Pb/^{238}U age)/(^{207}Pb/^{206}Pb age)} × 100 (e.g, Song et al., 1996)) of the data are in the range of -5 − +9%. Preliminary weighted mean of ^{207}Pb/^{206}Pb age is 2485.1±3.4 Ma (95% confidence) and MSWD is 1.6. However, the zircons show typically high U contents (average is ~2500 ppm). When U-Pb ages of zircons showing high U contents (particulary, >2500 ppm) are determined by SHRIMP, it is necessary to consider the correction of the matrix effect derived from the high U contents (Williams & Hergt, 2000; White & Ireland, 2012). In presentation, we will discuss geochronological interpretaion of the zircons based on more detail geochemical information.

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