Pressure-temperature-time evolution of high-grade metamorphic rocks from Tenmondai Rock in the northeastern part of the Lützow-Holm Complex, East Antarctica

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The Lützow-Holm Complex (LHC) of East Antarctica is regarded as one of the high-grade metamorphic terranes formed through collisional orogeny during late Neoproterozoic-Cambrian Gondwana amalgamation, and increasing metamorphic grade from the northeastern part (amphibolite facies) to the southwestern part (granulite facies) of the complex has been inferred by previous studies (e.g., Hiroi et al., 1991). The pressure-temperature evolution of high-grade metamorphism and its time scale are important to unravel metamorphic processes during the collisional event. In the LHC, for example, older (~650-580 Ma) and younger (~560-500 Ma) age populations were proposed by U-Pb-Th dating of zircon and monazite from Skallen and Skallevikshalsen in the southwestern part of LHC, due to which polymetamorphism is argued based on trace and REE chemistry of zircon, monazite, and garnet (Hokada and Motoyoshi, 2006; Kawakami et al., 2016). Although some recent studies examined metamorphic *P-T* conditions in the northeastern part of the LHC (e.g., Akarui Point, Iwamura et al., 2013; Nakamura et al., 2013), detailed petrological and geochronological studies on this area are still limited.
Tenmondai Rock area is one of exposures in the amphibolite-granulite transition zone in the complex. It is dominantly composed of garnet-biotite gneisses and migmatites with layers of garnet-biottie gneisses and amphibolites as well as intruded granitoids. Some previous studies reported limited petrological and geochronological data from this region such as the peak *P-T* conditions of ca. 750˚C and 7.2-7.5 kbar (Hiroi et al., 1983) and Rb-Sr whole rock isochron age of 780±70 Ma (Nakajima et al., 1988). In this study, we performed detailed petrological and geochronological investigations of various metabasites and garnet-biotite-sillimanite gneiss from this region to unravel *P-T-t* evolution of the lower-grade part of the LHC.
The metabasites are dominantly composed of hornblende and/or orthopyroxene, plagioclase, garnet, and biotite. Orthopyroxene + plagioclase symplectite surrounding garnet in one sample suggests isothermal-decompression probably along a clockwise *P-T* path. Garnet-biotite-sillimanite gneiss (metasediment), which comprises garnet, plagioclase, quartz, K-feldspar, biotite and sillimanite, contains intercalated kyanite-bearing quartzo-feldspathic leucosome possibly formed by prograde partial melting. The application of hornblende-plagioclase geothermometer and garnet-hornblende-plagioclase-quartz geobarometer for one metabasite (Ts11021001A) yielded 747-855˚C at 8 kbar and 8.02-8.62 kbar at 800˚C, respectively. Similar *P-T* ranges (805-847˚C at 8 kbar, and 6.5-9.25 kbar at 800˚C) were obtained from other metabasite sample (Ts11021106A) using garnet-orthopyroxene geothermometer and garnet-orthopyroxene-plagioclase-quartz geobarometer. The results of ternary feldspar geothermometer for garnet-biotite-sillimanite gneiss (Ts11021008B) and kyanite-bearing leucosome (Ts11021008A) also show a temperature range of 700-850˚C.
U-Pb dating for magmatic cores of zircon in metabasites by LA-ICP-MS yielded early to middle Neoproterozoic (ca. 900-750 Ma) ages. In addition, the detrital cores of zircon in garnet-biotite-sillimanite gneiss (Ts11021008B) and kyanite-bearing leucosome (Ts11021008A) show predominant Meso- to Neoproterozoic (ca. 1200-800 Ma) ages with small amount of Paleoproterozoic (ca. 2000 Ma) ages. These results suggest Neoproterozoic magmatism and deposition of sediments derived from predominant

Meso- to Neoproterozoic provenances and potential older (Paleoprotrozoic ages) crust. On the other hand, late Neoproterozoic-Cambrian (ca. 620-500 Ma) metamorphic ages have been yielded from homogeneous rims of magmatic zircon grains from both metabasites and pelitic gneisses. Kyanite-bearing leucosome also contains slightly older metamorphic zircons (ca. 640-630 Ma). The age range is consistent with the results of previous studies, and may suggest multiple growth of zircon during high-grade metamorphism.
This study will also discuss REE chemistry of metamorphic zircon and garnet, and time scale of metamorphism at the lower-grade part of the LHC.

Keywords: the Lützow-Holm Complex, P-T-t evolution, zircon U-Pb dating, rare earth element

