Proterozoic Sm-Nd ages of ultrahigh-temperature metamorphic rocks from Tonagh Island, Napier Complex

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The Napier Complex, East Antarctica is one of the oldest Archaean complexes in the world. It is also recognized as metamorphic terrane having undergone ultrahigh-temperature (UHT) metamorphism. We performed garnet isochron dating in Sm-Nd system of the ultrahigh-temperature metamorphic rocks collected from Tonagh Island, western part of the Napier Complex. The Sm-Nd isochron ages show c. 1900 Ma and 1500 Ma. Occurrence and mineral chemistry of garnet reveals that formation of the garnet would be formed at retrograde event after the ultrahigh-temperature metamorphism, suggesting that the ages of c. 1900 and 1500 Ma reflects a tectonothermal event followed by peak metamorphism (> 2500 Ma) in the Napier Complex.

The Napier Complex, East Antarctica is one of the oldest Archaean complexes in the world. It is also recognized as metamorphic terrane having undergone ultrahigh-temperature (UHT) metamorphism, characterized by spinel-quartz, sapphirine-quartz and orthopyroxene-sillimanite-quartz associations (e.g. Sheraton et al., 1987).

Tonagh Island is located at the southern end of Amundsen Bay. The island is divided into five geological units, Unit I to V. The dominant rock type is a layered gneiss, which is composed of felsic, mafic and pelitic gneisses on the scale of several centimeters to meters in thickness. Metamorphic P-T conditions are up to 1.1 GPa and 1100 C (Hokada et al., 1999). Timing of peak metamorphism of the Napier Complex is considered to be prior to 2500 Ma proposed by numerous dating.

We measured Sm-Nd dating of the ultrahigh-temperature metamorphic rocks collected from Unit I. Sapphirine bearing Grt-Opx gneiss appears as a thin layer between a felsic gneiss and an ultramafic rock, and is composed mainly of sapphirine, orthopyroxene, garnet and plagioclase. An inclination line connecting with garnet, whole rock, sapphirine and felsic fraction gives an age of 1876 +/- 61 Ma. The isochron is controlled largely by garnet composition because of high 147Sm/144Nd ratio of the garnet. The age of c. 1900 Ma, therefore, is regarded as garnet isochron age in the Sm-Nd system. The Grt-felsic gneiss is a member of the layered gneiss, and consists mainly of plagioclase, quartz, orthopyroxene and garnet with trace amounts of apatite, zircon and opaque minerals. The inclination line between garnet and whole rock of the gneiss yields a reference isochron age of 1897 Ma.

Reaction textures are preserved in the Spr bearing Grt-Opx gneiss and the Grt-felsic gneiss. In the Spr bearing Grt-Opx gneiss, garnet exsolutions occur as thin films at the grain boundaries of pyroxene grains. The garnet forming reactions had a specified effect with decreasing Al2O3 content in orthopyroxene (Hokada et al., 1999). Garnet - quartz symplectite and quartz are present at the boundary between orthopyroxene and plagioclase in the Grt-felsic gneiss. This indicates the reaction texture of orthopyroxene + plagioclase producing to garnet + quartz. The garnet forming reaction, therefore, would reflect retrograde event after the ultrahigh-temperature metamorphism. These lines of evidence suggest that the age of c. 1900 Ma reflects a tectonothermal event of the garnet formation followed by peak metamorphism (> 2500 Ma) in the Napier Complex.

The Fe-rich Grt-Py gneiss occurs as a lens in the felsic gneiss, and is coarse grain with black color. This gneiss is composed of iron-rich pyroxene, garnet, and trace amounts of quartz, apatite and opaque minerals. Garnet occurs as interstitial mineral between pyroxenes. Small-grained clinopyroxene and quartz are coexisted with garnet. Internal isochron in Sm-Nd system connecting with whole rock, garnet and pyroxene yields an age of 1537+/-11 Ma. Similar age (c. 1600 Ma) is reported from the Rayner Complex (Kelly, 1999). A tectonic event of c. 1600 Ma, therefore, would locally take place in the Napier and Rayner Complexes.