Magma activities in Sør Rondane, eastern Dronning Maud Land, East Antarctica: Implications for amalgamation of the Gondwana supercontinent

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The formation of the Gondwana supercontinent resulted from the collision of the East- and West-Gondwana continents. The time of collisional event is regarded as geological time scale from the late Neoproterozoic to early Cambrian. The Sør Rondane Mountains (SRM), eastern Dronning Maud Land, East Antarctica, are situated within the Pan-African suture zone related to the formation of Gondwana supercontinent. The geology of SRM is divided into the northeast terrane (NE terrane) and the southwest terrane (SW terrane) in terms of lithology and metamorphic processes. These two terranes were welled during the Late Proterozoic (640 to 600 Ma). The NE terrane is composed mainly of metamorphic rocks, whereas the SW terrane consists of metamorphic rocks (Layered gneiss complex) and the tonalite (Tonalite complex). Post-kinematic intrusive rocks, granitoids, syenite, lamprophyres, and dolerites intruded into the both of SW and NE terranes.

The Layered gneiss complex in the SW terrane ubiquitously bears metamorphosed igneous rocks with various compositions. These igneous activities started at c. 1100 Ma and ceased at c. 650 Ma having two pulses with 1000 to 900 Ma and 770 to 630 Ma. The Tonalite complex consists mainly of the tonalite associated with the microgabbro occurring as magmatic enclaves and dikes. Although the Tonalite complex underwent low-grade metamorphism, zircon U–Pb dating indicate that the main igneous activities occurred during 1000 to 930 Ma.

Granitoid magmas are generally produced by partial melting of middle and lower crusts. The Nd isotopic data of granitoids, therefore, give important information for evolution of continental crust. The metamorphosed granitoids from the SW terrane show positive epsiolon-Nd values corrected to each intrusive age. Therefore, the SW terrane as a whole was derived from a juvenile crust during Neoproterozoic time from 1100 Ma to 650 Ma. The plausible tectonic setting for the formation of the SW terrane would be an oceanic arc. The SW terrane was situated at plate convergent boundaries for almost 450 million years. On the other hand, the epsilon-Nd values of post-kinematic granitoids, ranging from 620 to 500 Ma, possess almost zero to less than zero. It means that the old continental materials contributed to the formation of the post-kinematic granitoid magmas.

The syenite formed the magmatic activities from 560 to 550 Ma. At that time, SRM was situated at the extensional setting after the compressional event in the eastern Dronning Maud Land. The syenite also appears in the Yamato Mountains (YM), 300 km east of the SRM. The magmatic ages of the Yamato syenite are almost similar to those of the syenite from SRM. In addition, both syenites are geochemically originated from high-K basaltic magmas produced by partial melting of lithospheric mantle. In this scenario, the syenite magmatism of SRM and YM would be caused by up-welling of mantle asthenosphere as an acting heat source, probably accompanying lithospheric thinning. The region covering SRM and YM would, therefore, record an extensional collapse after amalgamation of the Gondwana supercontinent.

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