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Evolution of continetal lithosphere in the Sor Rondane Mountains, East Antarctica

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The Sor Rondane Mountains is situated within the collision zone between the West and East Gondawana and the time of collition is regarded as the late Proterozoic (650-600 Ma). The mountains consist of greenschist- to granulite-facies metamorphic rocks and various kinds of intrusive rocks. The tonalite complex is exposed in the southern part of the mountains and its magmatic age is considered to be at the middle Proterozoic (990-920 Ma). This tonalite would originaly be formed at the subduction related tectonic setting priore to the collision event. Large amouts of microgabbro occure as mafic magmatic enclaves (MMEs; 990 Ma) and dikes (950 Ma) in the tonalite complex. Unmetamorphosed lamprophyre dikes intrude the tonalite complex and gneisses during the late- to post-collisional stages. The intrusive age of the lamprophyre is of 560 Ma. The magma processes of the tonalite complex together with the late- to post collisional lamprophyre dikes, therefore, provide us useful information of the evolution of continental lithosphere during the formation of Gondwana supercontinent.

The microgabbro represents the low-K and tholeiitic series, and is geochemically classified into Low-Ti and High-Ti microgabbros. The MMEs and dikes of microgabbros are equivalent to the Low-Ti and the High-Ti microgabbros, respectively. The Low-Ti and High-Ti microgabbros shows geochemical signature similar to the Oceanic Arc Basalts and the Back-Arc Basin Basalts, respectively. The middle Proterozoic magma processes would, therefore, proceed at a subduction zone with back arc spreading in an oceanic arc environment. The lamprophyre corresponds to alkaline rocks in the TAS diagram, and are characterized by high abundances of LIL elements and REE, especially Rb, Ba, Sr and LREE. The trace element abundances normalized to primitive mantle display enrichment of LILE and depression of HFSE with Nb and Ta negative anomalies. The lamprophyre is plotted in the within-plate field and a part of the island arc field that is close to the within-plate field on some discrimination diagrams. Considering the geochemical features, the lamprophyre was formed in a within-plate tectonic setting by the mixing of subduction-related materials.The initial Sr isotopic ratios (SrI) range from 0.7022 to 0.7040 (epsilon SrI = -14 to 12) for the Low-Ti microgabbro and from 0.7024 to 0.7030 (eSrI = -14 to 1) for the High-Ti microgabbro. The initial epsilon Nd values for the Low- and High-Ti microgabbros are calculated within the same range (eNdI = -0.1 to +0.5). On the other hand, the isotopic compositions of the lampropyre show SrI = 0.7043 - 0.7044 (eSrI = +7.6 to +9.2) and eNdI = -0.62 to -0.34.

The geochemical studies including Sr-Nd compositions reveal that the microgabbros have been originated from a depleted source, whereas chemical compositions of the lamprophyre is more enrichment rather than those of the microgabbros. Consequently, the magma processes in the Sor Rondane Mountains reflect the evolution of lithosphere from the middle Proterozoic to the early Paleozoic; the depleted mantle at the initial subduction stage then changing to the enriched mantle at the continental collision stage. This lithospheric evolution can be explained by interaction between the depleted mantle and the enriched materials (e.g., slab-derived fluids, melting product of subducted crustal rocks, or reaction with fossil wedge mantle) during closure of the Mozanbique Ocean.

Keywords: Gondwana supercontinent, Antarctica, Sor Rondane Mountains, tonalite, microgabbro, lamprophyre