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SHRIMP U-Pb zircon geochronology and geochemistry of a Paleoproterozoic (1.96 Ga) tonalite in northwestern Gyeonggi Massif

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The Gyeonggi Massif (GM) in central part of Korean Peninsula is one of major Precambrian provinces in East Asia. Recent studies have revealed Paleoproterozoic and Mesoproterozoic granitic magmatism in GM which possibly related with assembly and breakup of the supercontinent Columbia, however their geochemical features and tectonic environments are not well known yet. This study reports U-Pb zircon age and geochemical constraints on newly found Paleoproterozoic tonalite in northwestern GM.

The tonalite occurs as a small rock body in Kanghwa Island, about 50 km northwest from the central part of Seoul. It is well-foliated medium-grained rock which consists of plagioclase, quartz, biotite, hornblende, clinopyroxene, with trace amount of titanite, apatite and zircon. Fine-grained dioritic enclaves are associated with the tonalite. In cathodoluminescence image, zircon grains show the primary magmatic zoning and the secondary recrystallized zone with dark luminescence. SHRIMP U-Pb zircon analysis yields an upper intercept age at 1960 ± 20 Ma with poorly constrained lower intercept at 794 ± 190 Ma ($n=21$ of 24, MSWD=1.13). Whole-rock geochemical compositions of five tonalite samples have intermediate SiO_2 contents (63.5–66.0 wt%), high-K calc-alkaline ($\text{K}_2\text{O}=3.08\sim 3.28$ wt%), and metaluminous [$\text{Al}/(\text{Ca}+\text{Na}+\text{K})=0.93\sim 0.98$] characteristics. Chondrite-normalized REE display weakly fractionated patterns with slightly negative to positive Eu anomalies ($\text{Eu}/\text{Eu}^*=0.69\sim 1.07$) in the diagram. In the primitive mantle-normalized trace element patterns, the samples are rich in large ion lithophile and light rare earth elements, but are depleted in Th, Ta, Nb, P, Hf, Ti and heavy REE. The samples plot in the volcanic arc granite field in tectonic discrimination diagrams.

The U-Pb zircon age and whole-rock geochemical characteristics indicate that the tonalite is corresponding to the early stage of Paleoproterozoic magmatism in North China Craton (1.95–1.75 Ga) which is related with assembly of the supercontinent Columbia, and formed through the geodynamic processes associated with basaltic magma underplating.