Geochemistry of cordierite-bearing metasedimentary rocks, northern Yeongnam Massif: implications for provenance and tectonic setting

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The metasedimentary rocks together with various granitoids are the main constituents in Taebaeksan gneiss complex, northern Yeongnam Massif. Chemical compositions of sedimentary rocks may reflect the nature of the provenance and could be crucial for understanding the evolution of early continental crust. Previous workers have suggested that the provenance and tectonic studies based on the geochemistry of sediments are applicable to the Precambrian samples. In this study we analyzed the major, trace and REE elements of metasedimentary rocks to understand their provenance and tectonic setting during sedimentation.

The overall geochemical characteristics of metasedimentary rocks are similar to those of average shale of the post-Archean. Major element chemistry indicates mature and sorted nature of the sediments. The degree of weathering in the source rocks the is not uniform, as inferred from a large scatter in chemical indices of weathering (CIW). The immobile trace elments such as Th, Sc, and REE can be used to discriminate various sedimentary processes. The Th/Sc ratios (0.9 - 4.4) are larger than those of the upper crust and average shale, suggesting that the felsic source predominates. The contents of Ni and Cr and the variations in the ratio of compatible to incompatible elements are similar to the average post-Archean shale. Uniform chondrite-normalized REE pattern with the LREE enrichment (LaN/SmN = 4.9 ± 0.4) and slight negative Eu anomalies (Eu/Eu* = 0.7 ± 0.1) also support this observation. The presence of negative Eu anomaly indicates that intracrustal igneous processes involving plagioclase separation have affected the provenance rocks. The LREE enrichment implies the major role of felsic rocks in source rocks. The eNd (1.9 Ga) values of metasediment rocks vary from 9.4 to 6.7, corresponding to TDM of 2.9 - 2.7 Ga. On the other hand, the 147Sm/144Nd ratios are 0.1079 - 0.1101, corresponding to typical terrigenous sediments.

The geochemical features of metasedimentary rocks such as high abundances of large ion lithophile elements, high ratios of Th/Sc and La/Sm, commonly high Th/U ratios, negative Eu anomalies, and negative eNd, suggest a provenance consisting virtually entirely of recycled upper continental crust in passive margin environment. Tectonic discrimination diagrams based upon major element compositions also support this suggestion. In conjunction with igneous activity and metamorphism in the convergent margin setting at 1.8 - 1. 9 Ga, the transition from passive margin to active margin characterize the Paleoproterozoic crustal evolution in northern Yeongnam Massif.