GEOCHEMICAL CHARACTERISTICS AND REE PATTERNS OF SUBDUCTION-RELATED CRETACEOUS VOLCANIC ROCKS IN THE KYEONGSANG BASIN, KOREA

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This study reports REE patterns and geochemical characteristics of 398 bulk samples of volcanic rocks. The Cretaceous volcanic rocks, which in the total-alkalis diagram (Le Bas, 1984) comprise basalt, basaltic andesite, andesite, dacite, and rhyolite, are distributed in the vicinity of the south-eastern part of the Korean Peninsula. Sedimentary rocks form the basement in the study area covered by volcanic rocks. Most mafic rocks (basalt–basaltic andesite–andesite, BA series) are composed of pyroclastic volcanic breccia, lithic lapilli tuff and cryptocrystalline lava-flow. Most felsic rocks (andesite–dacite–rhyolite, DR series) consist of lithic ash-flow welded tuff, crystal lapilli tuff, thick glassy lava, and vitric ash flow tuff with accidental fragments of andesitic and sedimentary rocks. Intermediate dykes intruded both the rocks of BA and DR series.

The contents of MgO, CaO, Fe_2O_3, Al_2O_3, TiO_2, MnO, and P_2O_5 in the Cretaceous volcanic rocks decrease with increasing SiO_2. On the basis of variation diagrams such as Al_2O_3 vs. MgO, CaO vs. MgO, Th vs. trace elements (Ba, Sr, Zr, Rb, Ge, La, Nb), Th/Yb vs. Ta/Yb, and Ce_N/Yb_N vs. Ce_N (Gill, 1981), these rocks seem to represent mainly a calc-alkaline differentiation trend. There is a slight inflection point and Daly gap between 63–65 wt. %, while a continuous trend exists in the variation diagram. Variation trends in Harker diagrams for the major and trace elements suggest that the BA series and DR series are not related by a simple crystal fractionation process. Under 66 wt. % of silica content, fractionation of olivine and clinopyroxene is predominant, while that of plagioclase takes place mainly above 66 wt. % (Wilson, 1989). REE patterns indicate strongly non-cogenetic origin of the BA and DR series. K–Ar, Rb–Sr, and fission track ages of the Cretaceous volcanic rocks range from 80 to 71 Ma (Campanian) in BA series and from 68 to 62 Ma (Maastrichtian to Paleogene) in DR series, respectively.

Petrogenesis of orogenic andesitic rocks and associated explosive rocks continues to be a topic of vigorous debate in the petrologic community. Based on the trace and rare earth elements distributions in bulk rock samples, the Cretaceous volcanism is related to an orogenic process (subduction-related continental magmatic arc). According to the tectonic discrimination diagrams, such as Ba/La and La/Th ratio, Rb vs. Y + Nb, the volcanic rocks in the Kyeongsang basin are related to a destructive continental margin and belong to high-K orogenic suites. The REE patterns provide a sensitive indicator of continuous differentiation of plagioclase in DR series. This DR series was derived from andesitic calc-alkaline magma that underwent low-pressure fractional crystallization dominated by plagioclase at <30 km (Le Roex, 1985), where olivine and clinopyroxene first fractionated as the predominant phenocryst phase in BA series in depths of 80–120 km.