

Geochemical Study of the Ulsan Ultramafic Rock in the Gyeongsang Basin; Genetic Implication

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Introduction

The Ulsan ultramafic rock is located within the Cretaceous Gyeongsang volcano-sedimentary basin at the southeastern edge of the Korean peninsula. They have the unique occurrence. In this area, both the partially serpentinized ultramafic rocks (dunite and harzburgite) and the carbonate rocks (non-magnesian calcite) are probably exposed as a small roof pendant within the Upper Cretaceous sequence and were intruded by granophyric, porphyritic granite. Although the ages of both the ultramafic rock and carbonate rocks are unknown, they may be considered to represent the basement of the Cretaceous volcano-sedimentary piles in the study area. This study focused on the genetic implications of the ultramafic masses, and was based on petrological, mineralogical and geochemical studies. Finally the purpose of this study is specifically to provide the origin of the ultramafic rock and carbonate rock.

Petrology and Geochemistry

The Cretaceous sedimentary and volcanic rocks the southern Korea unconformably overlie highly deformed Precambrian crystalline basement of the Yeongnam Massif. The Middle Cretaceous to early Paleogene Bulgugsa suite of granitic rocks includes a range from tonalite and granodiorite through granite to alkali-feldspar granite, and is predominantly of the magnetite series (Lee et al. 1987). These granitic rocks are epizonal and invariably display characteristics of subvolcanic emplacement (Jin et al. 1981, Choi and Wee 1994).

Key words: Gyeongsang basin, Ulsan, ultramafic rock, skarn.

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These granitic intrusive is exposed in the eastern part of the ultramafic rock. It consists of hornblende-biotite granite being called "Gadae-Ri Granite Pluton" (stock), and the K-Ar age is 58 Ma on biotite (Lee and Ueda, 1977). The Bulgugsa intrusive suite and volcanic rocks of the Hayang and Yucheon groups are considered to be comagmatic, subduction-related complex (Lee et al. 1987). The calcic Fe-W skarn deposit at Ulsan occurs as a nearly vertical ore pipe within carbonate rock at the direct contact with the Upper Cretaceous volcanic rocks containing thin layers of pelitic sedimentary rocks.

Ultramafic Rock

The Ulsan ultramafic rock mainly consists of the olivine, orthopyroxene, clinopyroxene, spinel, amphibole, chromite, serpentine and anthophyllite. The Ulsan ultramafic rock is characterized by low Al_2O_3 (0.9-2.4 wt.%), CaO (0.9-2.7 wt.%), Na_2O (<0.1 wt.%) and higher #Mg (88.9-93.6), MgO (37.5-45 wt%). REE analyses of the ultramafic rock were normalized by the C1-chondrite value (Sun and McDonough 1989). The bivariate plots of subduction-conservative element pairs (Yb vs. Sc) were constructed (Pearce and Parkinson, 1993). The bulk compositions of Ulsan ultramafic rock represents 10-20% partial melting; suggesting the residual mantle origin.

Carbonate Rock

From the measurements of oxygen and carbon isotope ratios ($\delta^{13}\text{C}=1.2-4.6\%$ relative to V-PDB, and $\delta^{18}\text{O}=13.5-22.1\%$ relative to V-SMOW) of fresh or partly altered limestone at the Ulsan skarn deposit, it suggested that the origin of carbonate rocks is marine carbonate rather than carbonatite. Moreover, the calculated isotope compositions ($\delta^{13}\text{C}=-7.67\%$, and $\delta^{18}\text{O}=6.75\%$ relative to V-SMOW) of the hydrothermal fluid in the main Fe stage of skarn formation imply that this fluid was magmatic water derived from differentiated granitic melts. Stable isotope systematics of the Ulsan Fe-W skarn deposit was examined from the measurements of stable isotope ratios of carefully inclusions. Based upon the carbon isotope compositions of fresh unaltered host limestones, it is suggested that the Ulsan carbonate rock has a marine origin (Choi et al., 2003).

Discussion and Conclusions

The Ulsan ultramafic rocks and carbonate rocks undergo the serpentinization, and hydrothermal

alteration (skarn formation) and associated iron mineralization during Tertiary, respectively. The carbonate rock has the unique occurrence. Yang et al. (2003) suggest that those carbonate rock is carbonatite origin. The REE patterns of the carbonate rock also show depleted value. If this carbonate rock is carbonatite, they will be shown the en-riched REE patterns related to fentization. Kim et al. (1990) and Choi et al. (2003) interpreted that the carbonate rock undergone the hydrothermal alteration was originated from marine limestone. It shows the continuous water-rock interactions from the marine carbonate rock to the skarn formation by hydrothermal fluid. In summary, these carbonate rock consists of pure calcite and is not related to the ultramafic rocks by evidences of the REE pattern or stable isotope data.

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