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Slab retreat induced magmatism in the East Asian continental margin during the Cretaceous: A case study of the Early Cretaceous Seolhwa Igneous Complex, South Korea

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The widespread Cretaceous magmatism of East Asia was mainly controlled by the subduction dynamics of the paleo-Pacific plate. Closely positioned near the paleo-trench, on the active continental margin, lies the Korean Peninsula. Therefore, the timing and characteristics of magmatism in this region provide key information on the tectonic evolution of East Asia.

The Early Cretaceous Seolhwa Igneous Complex (SIC) located on the southwestern margin of the Korean peninsula, comprises two rock suites: the granodioritic northern suite (NS) and dioritic southern suite (SS). The two suites have similar trends in major and trace element variation and trace element patterns which suggests they share a common magma source and similar evolution history. Also, the major element mass balance model consistent with modal data confirms that NS granodioritic compositions can be produced by fractionation of the melt with SS dioritic compositions.

The SS diorites have Mg# over 60 and high Ni and Cr contents of respectively 69-210 ppm and 70-510 ppm. This indicates a significant contribution of mantle-derived melts. Yet their enriched Sr-Nd isotopic signatures [$^{87}Sr/^{86}Sr_i$ =0.7136~0.7138, εNd(t)=-15.1~-14.1], negative Nb-Ta anomaly, enrichment of LILE, and depletion in HFSE shows the contribution of the crustal materials, possibly via mantle metasomatism. Such isotopic enrichments are not found in the Late Cretaceous igneous rocks in Korea and Japan which are attributed to arc front magmatism. So, we suggest the Early Cretaceous SIC originate from the metasomatized lithospheric mantle.

The NS granodiorites exhibit signs of crustal assimilation with abundant inherited zircons and increasing enrichment of Sr-Nd isotopes [$^{87}Sr/^{86}Sr_i$ =0.7129~0.7168, εNd(t)=-13.8~-17.3] with rising silica contents. Isotope mixing models show the assimilation of the regional crustal rocks around 40-60% to the SS diorites can explain this enrichment pattern. The SHRIMP U-Pb estimated emplacement age of the SIC is 117-110 Ma, which corresponds to the beginning of Cretaceous magmatism in Korea after ~40 Ma of magmatic hiatus. This coincides with the timing of the shift in tectonics of the East Asian region to an extensional setting induced by slab roll-back. The extension may have induced asthenospheric upwelling which resulted in the melting of the metasomatized lithospheric mantle.