Geochemical interpretation of Ulleung Island volcanic rocks: Implication for the new magmatic model for plume-slab interaction in East Asia

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Ulleung Island has been considered as an intraplate volcanic island located in the East Sea/Japan Sea. The alkaline tephra originated from Ulleung Island has played an important role in understanding of the intraplate alkaline volcanism during the Quaternary. Ulleung Island on volcanism that occurs far from plate margins is abstruse with the current paradigm of plate tectonics. The Ulleung Island volcanic complex is unlikely to result from a mantle plume rising at the base of the mantle.

Ulleung Island is consisted of basaltic lava, agglomerate succession, and trachytic/phonolitic pumiceous tephra. The analyses of chemical compositions of glass shards in Ulleung tephras is necessary to identify each unit. During the Quaternary, at least six pumiceous tephras (UT-1~6) covered the island for this research. Based on the relationships of SiO_2, the Al_2O_3, Na_2O, K_2O, and Fe_2O_3 contents of the tephras increase as SiO_2 increases and decrease MgO as SiO_2 increases in Ulleung tephras. The trace elements in tephra show intra-plate type characteristics. Sr-Nd-Pb isotopic data from the literature of volcanic glass shards suggest that the mix in magma source might have involved EM1 and EM2-components of Quaternary tephras from Ulleung Island, South Korea.

This study has two principal objectives: First, multiple Ulleung tephras are expected to detect and identify the Ulleung Island. In order to accurately identify and correlate the tephras, it is necessary to consider stratigraphic position as well as geochemical characteristics. The chemical composition of volcanic glass shards is a useful tool for evaluating mixtures of multiple layers. The heavy mineral composition can also be used to identify tephra units. In order to reveal the distribution of each tephra unit to a high degree of certainty, characteristics such as heavy mineral and chemical compositions of each unit must be determined in greater detail itself. Second, we propose that the anomaly represents lithospheric mantle that had been accompanied by beneath the sinking lithosphere of the Philippine Sea Plate and was erupted through a slab-tear in the subducting slab. We suggest that this subduction-induced upwelling process produces mantle-upwelling that feeds the Ulleung Island volcanoes. Subduction-induced upwelling may also may explain back-arc volcanism at other subduction zones in East Asia.

Keywords: Ulleung Island volcano, intraplate, plume-slab interaction

