# Melt generation process in the upper mantle beneath the Chugaryon volcano in Korea

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Melting in the upper mantle is a dynamic process. In order to reveal melting processes, we need to extract melting history from natural samples. Time-series study of primitive magmas from individual volcanism is potentially one of the best strategies for understanding melting dynamics in the upper mantle. Since back arc continental basaltic volcanisms have undifferentiated chemical composition and precise geological information, they can be good subjects for time-series study of melting in the upper mantle.

Chugaryong volcano is a Quarternary intraplate basaltic volcanism in the center of the Korean Peninsula filling the valley of the basement of Precambrian gneiss and Jurassic granite. Although previous studies reported wide range of K-Ar ages (0.1~0.6Ma) and geochemical variations, geological relationships between several flow units have not been revealed yet. We made systematic geological, chronological, geochemical and petrologic investigations on southern part of the Chugaryong volcano (Chongokri area) and discuss the origin of temporal variation of chemical compositions.

We newly revealed two stratigraphic units: the Chongok and the Chatan basalts, which can be separated by a distinct unconformity such as erosive valley and soil. The K-Ar dating of separated groundmass plagioclase and fission track dating of zircon from underlying burnt soils revealed eruption ages of the Chongok and the Chatan basalt as 0.50 Ma and 0.15 Ma, respectively. Both the basalts are almost aphyric (~5 vol%) and have olivine phenocrysts and clinopyroxene and plagioclase microphenocrysts. All olivine phenocryts exhibit normal zoning and have chromian spinel inclusions (Cr#=20~40). Although there is no large difference in Fo#, NiO, MnO, and CaO contents of olivine phenocrysts between the two basalts, spinel inclusions of the Chatan basalt show systematically higher Cr# than that of the Chongok basalt. The Cr# of spinel show a slight increase with decrease of Fo# of the host olivine for the two basalts, displaying two nearly parallel trend in the Fo#-Cr# spinel plot.

The Chongok and the Chatan basalts have discrete whole rock chemical compositions irrespective of modal composition. The Chongok basalt (9.1~10.0 wt% in MgO) is higher in $TiO_2$, $Al_2O_3$, $Na_2O$, $K_2O$ $P_2O_5$, $Cr_2O_3$, Rb, Ba, Nb, Sr, and Zr and lower in $FeO*$, $SiO_2$, and CaO than the Chatan basalt (9.2~10.4 wt% in MgO) for a given MgO content. The Chongok basalt is also higher in $K_2O/TiO_2$ and Zr/Y and lower in $CaO/Al_2O_3$, Zr/Rb, and Zr/Nb than the Chatan basalt for a given MgO content. Precise kai-square test for the major element concentrations, which cannot be reproduced by assimilation of crustal material, revealed that the chemical variation within each basalt can be reproduced by fractionation of olivine, clinopyroxene, and plagioclase. The difference between the two basalts, however, cannot be reproduced by any crystal fractionation from each other.

The difference in incompatible element ratios, which cannot be reproduced by crystal fractionation, suggests difference of primary melt produced by distinct melting condition or source mantle composition. Assuming batch melting of homogeneous anhydrous peridotite on the basis of the common appearance of anhydrous spinel lherzolite xenolith from the central Korean Peninsula, the differences in major and trace element and mineral compositions can be reproduced by an increase of melting degree and a decrease of melting pressure from the Chongok to Chatan basalts. Our petrologic and geochemical investigation with extremely precise geological and geochronological study revealed that geochemical variation of volcanic rocks of the Chugaryon volcano, which has been interpreted as magma heterogeneity, preserves high resolution information of mantle melting.

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