Mingling-induced crystallization from Saruana Lava, Chokai, Tohoku Japan, and the origins of end member magmas

Tsukasa Ohba[1], Hajime Oikawa[1], Shintaro Hayashi[1], Toshiro Takahashi[2], Yuka Hirahara[2], Masao Ban[3], Akihiko Fujinawa[4], Jun-Ichi Kimura[2], Takashi Miyazaki[2], Qhan Ching[2]

[1]Akita University, JPN, [2]IFREE/JAMSTEC, JPN, [3]Yamagata University, JPN, [4]Ibaraki University, JPN

E-mail: t-ohba@gipc.akita-u.ac.jp

Crystallization process during magma mixing was investigated for Saruana lava, West Chokai, Tohoku Japan, by extensive petrological analyses on phenocryst minerals. Examined rocks are basaltic andesite containing phenocrysts of cpx, opx, olivine, plagioclase, magnetite, spinel, apatite, and minor hornblende. Magma mixing is suggested by petrological evidence such as: disequilibrium relation of Fe-Mg partitioning in mafic minerals, complex chemical zoning, dissolution textures, heterogeneous compositions in a single lava, etc. Basic cores of mafic minerals, calcic part of plagioclase, and chromian spinel were derived from the mafic end member magma (high Mg-basalt), whereas Mg-poor pyroxene cores, sodic plagioclase cores, magnetite, and apatite were from the felsic end member (crystal-rich andesite). Each phenocryst crystallized in at least two different host magmas in terms of large variations in Mg-values of mafic minerals and An in plagioclase. In a cpx crystal that have an Mg-rich core (Mg-values:85-87), the core is surrounded by an oscillatory-zoned intermediate margin with polygonal growth bands surrounded by an Mg-poorer thin rim. In an Mg-poor-cored pyroxene, a round Mg-poor core (Mg-values:65-67) is surrounded by an Mg-richer margin of which zoning pattern is similar to the Mg-rich-cored cpx. The oscillatory zoning was formed in the cooled and partially hybridized mafic magma during the thermal equilibration between the magmas. The shape of the core is rounded and this implies dissolution of the Mg-poor pyroxenes by heating of the host felsic magma or by incorporation of the Mg-poor phenocryst into a hot mafic magma. All complex zoning profiles of the orthopyroxene and the plagioclase phenocrysts can be accounted for by the similar process with that for cpx. Whole-rock chemistry and isotopic compositions provided further insight into chemical natures of end member magmas and their origins. Major element composition of the felsic end member is similar to that of the underlying lava, which is a typical calc-alkaline andesite. The mafic end member is an Mg-rich high-K basalt of which composition is similar to that of the basaltic lava occurred in a drillhole near the vent of Saruana lava. Sr, Nd, Pb, and Hf isotopic analyses imply that the source of the basaltic magma is as depleted as MORB source. The isotopic nature of the source mantle is different from those for the volcanic front where the source mantle is more enriched.