Constraints on the chemical evolution of magma at Fuji volcano from plagioclase phenocrysts.

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Volcanic eruption brings materials from inside the Earth to the surface. Studying such volcanic materials is important to know how magma is evolved and how eruption is triggered. Chemical evolution of magma is considered to proceed through various processes such as fractional crystallization, degassing, assimilation and mixing. In this study, we have conducted petrology, geochemistry and Sr isotopic study of plagioclase phenocrysts to constrain the chemical evolution at Fuji volcano in Japan.
The studied samples are basaltic lavas, gabbros, pumices, and scoriae from Fuji volcano. All the samples except the lavas are products of the latest eruption, the Hoei eruption in 1707. Pumices and scoriae of the Hoei eruption were collected from three outcrops and scoria cone in the first crater of the Hoei eruption. Gabbroic xenoliths brought by Hoei eruption were also collected near the second crater. In addition, two lava samples which belong to Kofuji group were collected by drilling into the northwestern flank of Fuji volcano (Yoshimoto et al., 2010).
Major element compositions of plagioclase phenocrysts from the samples were determined by EPMA, whereas their trace element abundances and Sr isotopic composition were measured by LA-ICPMS at the University of Tokyo. In addition, water contents in some plagioclase phenocrysts were investigated by FTIR at JAMSTEC.
The results revealed that there are two distinctive trends for the chemical evolution of magma at Fuji volcano (Fig.a). One is characterized by the decrease of anorthite content (An) with the increases of La abundance and Eu-anomaly in plagioclase crystals. The other trend is characterized by the decrease of An with the increase of Mg abundance and with insignificant changes of La abundance. The former evolutionary trend was observed mainly in the gabbro xenoliths and Hoei pumices, whereas the latter was identified in the basaltic lavas and Hoei scoriae. The finding suggests that the source magmas of the gabbros and Hoei pumices evolved under similar conditions and those of the lavas and Hoei scoriae did so as well. This is consistent with the inference that the dacitic and basaltic source magmas of the Hoei pumices and scoriae existed in different magma chambers(e.g. Yoshimoto et al., 2004).
The negative correlation between An and Eu-anomaly observed in the gabbro and pumice plagioclase indicates that their source magmas became more reductive so that the proportion Eu^{2+} relative to Eu^{3+} increased as crystallization proceeds. Such reduction of magma can be caused by assimilation of sediments enriched in organic materials or by sulfur degassing (Moussallam et al., 2016). Our Sr isotopic analyses indicate that the core and rim of the plagioclase have identical Sr isotopic ratios within analytical uncertainty, precluding significant sediment assimilation. Thus, we envisage that the source magmas of the gabbros and Hoei pumices experienced degassing during the chemical evolution.
Our FTIR analyses revealed that plagioclase crystals in the Hoei pumices and scoriae have water under the detection limit (sample thickness: 100 micro-meter). The IR spectra of plagioclase crystals exhibit flat spectra between 3000 and 4000 cm^{-1}. This is somewhat enigmatic, given that the studied pumices and scoriae contain many vesicles and also that glass-inclusions of the Hoei scoriae contain 1~4 wt % H_2O

(Iida et al., 2004). There is no clear explanation for this at present.

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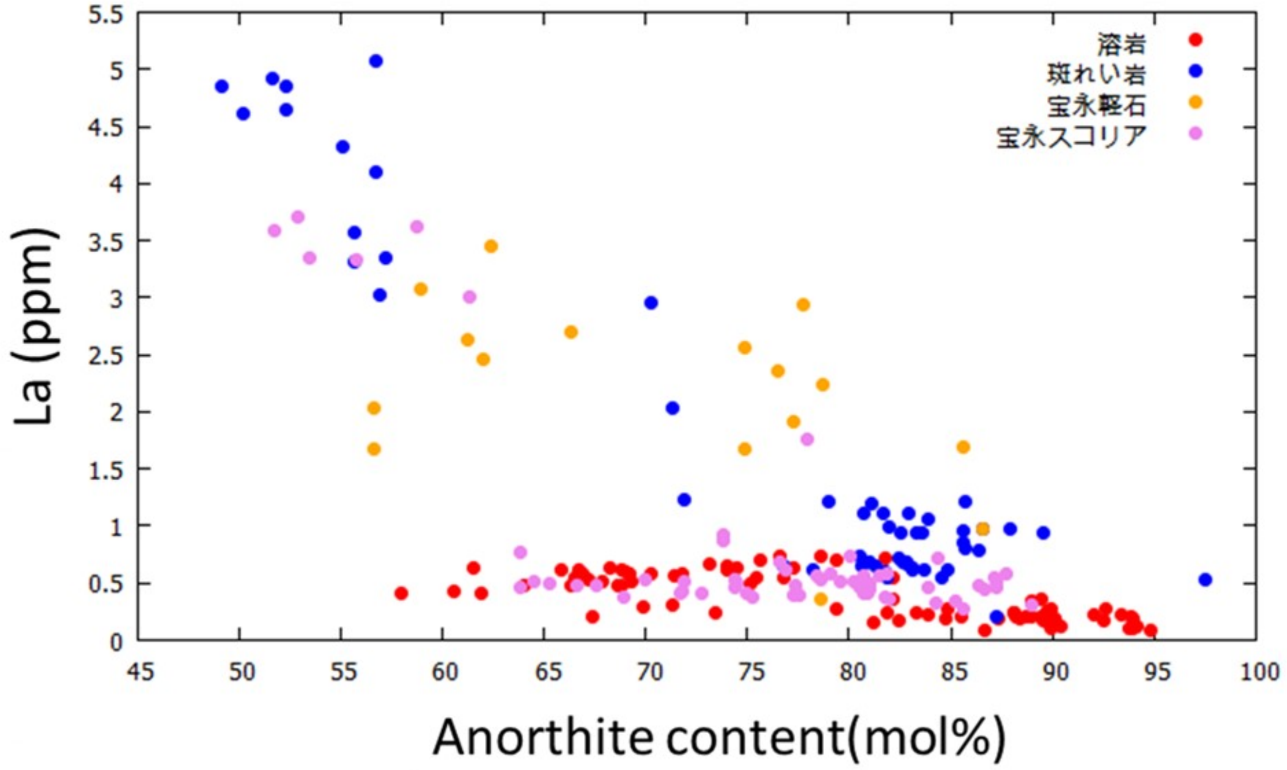

Fig. a

