Chemical evolution of magma at Fuji volcano constrained from geochemistry of the 1707 Hoei eruption.

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Fuji volcano in Japan has been erupted mainly basaltic products for 100 thousand years (Fujii 2007). The Hoei eruption in 1707 erupted dacitic pumices and andesitic scoriae before erupting basaltic rocks as main products. These silicic products are crucial to the understanding of magma processes under Fuji volcano. Previous studies on the Hoei eruption focused mainly on whole-rock compositions of eruptive products. Yet, as whole-rock compositions record the final stage of magma evolution. In this study, therefore, we aimed to reveal the chemical evolution of magma from phenocrysts that are considered to record various stages of magma evolution.

The studied samples are pumices, scoriae and gabbroic xenoliths brought by the Hoei eruption. The pumices and scoriae were sampled from three outcrops and near the Hoei Crater I. The gabbroic xenoliths were collected near the Hoei Crater II. We have conducted geochemical study of whole-rocks and plagioclase phenocrysts, and Sr isotopic study of plagioclase phenocrysts. Major element compositions of the whole-rocks were determined by XRF, whereas those of plagioclase phenocrysts were determined by EPMA. Both of their trace element abundances and Sr isotopic compositions of plagioclase phenocrysts were measured by LA-ICP-MS.

Plagioclase phenocrysts included in the pumices and scoriae have different major and trace element compositions. Plagioclase phenocrysts in the pumices indicate higher La concentrations than those in the scoriae (Fig. a). This suggests that plagioclase phenocrysts crystallized after more prominent fractional crystallization in the host magmas of pumices than in the host magma of scoriae. Because there are plagioclase phenocrysts having both high anorthite (An) contents (~85) and high La concentrations in pumices, the fractional crystallization must proceed without changing Ca/Na considerably. Thus it is inferred that fractional crystallization of olivine was dominant before the crystallization of plagioclase in the host magma of pumices.

In addition, La/Y ratios of plagioclase phenocrysts whose An contents are lower than ~65mol% increase with the decrease of An contents (Fig. b). Further, most of these plagioclase phenocrysts are found in pumices. This trend can be explained by the onset of clinopyroxene crystallization when An_{65} plagioclase phenocrysts crystalize, because the clinopyroxene/melt partition coefficient of Y is ten times higher than that of La (Hart, 1993).

These compositional differences of phenocrysts between pumices and scoriae suggest that the host magmas of pumices and scoriae have undergone different fractional crystallization processes. The host magma of pumice firstly underwent considerable fractional crystallization of olivine, which could proceed in a hydrous magma chamber. Then, when An_{65} plagioclase phenocrysts crystallized, clinopyroxene phenocrysts started to crystallize, which could occur in a shallow (about 2-3 kbar) magma chamber. On the other hand in the host magma of scoriae, plagioclase phenocrysts are thought to crystallize from the early stage of the fractional crystallization. This can be occurred in a dry (≦1.6 wt%) magma chamber (Hamada and Fujii, 2008). Thus, our results indicate that magma differentiation proceeded under two different processes beneath Fuji volcano and that these two distinctive magmas contributed the Hoei eruption.

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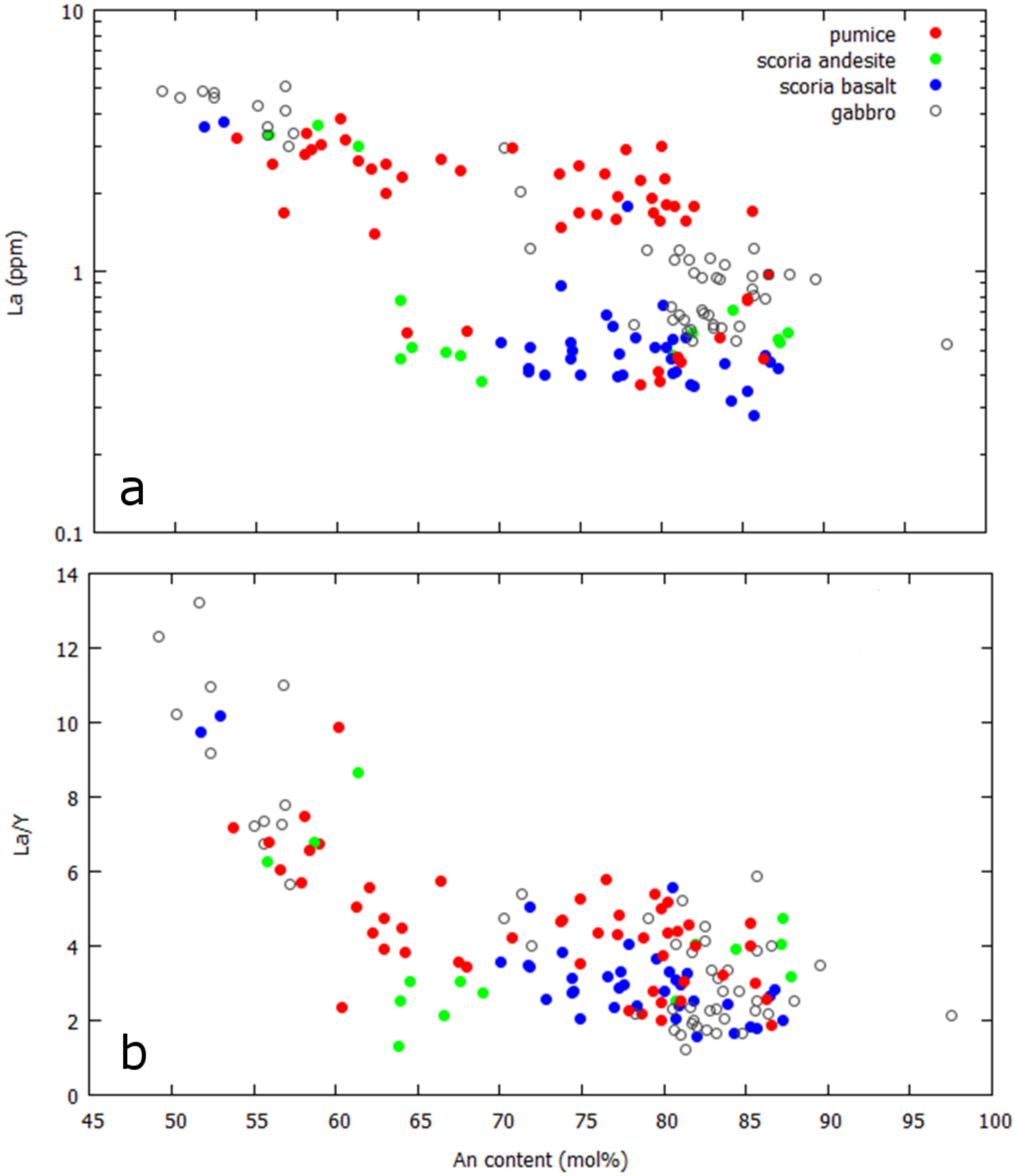
pumice
scoria andesite
scoria basalt
gabbro
La (ppm)
10
1
0.1
a
La/Y
14
12
10
8
6
4
2
0
b
45
50
55
60
65
70
75
80
85
90
95
100
An content (mol%)

