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Evolutionary Processes of the Coexisted Tholeiitic and Calc-alkaline Magma Series, Marumori volcano, Iwate Prefecture.

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Introduction

Takakura volcanic chain is located at the southern end of the Sengan geothermal area extending near the volcanic front of the northeast Japan around 40N. This volcanic chain consists of Kotakakura, Takakura, and Marumori volcanoes sitting in a row from NE to SW. Although magma plumbing system for the tholeiitic (TH) series of Takakura volcano was examined in detail by Nakaya(2010MS), petrology of the Marumori volcano has not been well-characterized yet. In order to reveal the evolutionary processes of the coexisting tholeiitic(TH) and calc-alkaline(CA) magma series and genetic relationship between the two series, geology, petrography, and petrochemistry of the two magma series at the Marumori volcano were investigated in this study.

Geology

Eighteen (9 tholeiites, 9 calc-alkaline) lava flows originated from a common eruption vent were identified on the bases of the topographic features, lithofacies, and petrological characteristics. Although the lavas effused continuously with no dormancy, the development history of the Marumori volcano could be divided 4 stages by alternatedly changed dominant magma types of TH and CA.

Evolutionary processes of tholeiitic magma

TH series can be further divided into two temporally coexisted groups showing distinctive LIL/HFS ratios. The low-LIL/HFS groups show basaltic (SiO_2=52-54wt%) composition, whereas high-LIL/HFS group are andesitic (SiO_2=55-60wt%). In each of the two TH groups, good parallelism in the spidergram patterns are observed among the members, suggesting that the members were related through fractional crystallization. A major element least-squares calculation supports the fractional crystallization as the most plausible evolutionary mechanism in the two isolated TH magma chambers.

Evolutionary processes of calc-alkaline magma

The CA series displays a linear variation trend in the Harker's diagram, suggesting that magma mixing process was the essential effective evolutionary process for the CA magma plumbing system. There are petrological evidence which supports this hypothesis including: 1) Heterogeneous lithofacies and lithology in the autolith-bearing lavas, 2) bimodal plagioclase core composition, with coexistence of normal zoning in the An-rich grains, and reverse zoning in the An-poor rim, and 3) disequilibrium coexistence of orthopyroxene and clinopyroxene phenocrysts.

Genetic relationship

Distinctive incompatible element characteristics between the low- and high-LIL/HFS TH series must be reconciled with a view that the two series were derived independently from their distinct parent magmas.

CA magma series were to have evolved by mixing of non-cognate magmas, with mafic endmember of 53-55wt% SiO_2 (similar to that for the mafic inclusion) and felsic endmember of 65wt% SiO_2 (just like IM4 lava unit). The chemical characteristics suggest that incorporation of alkali elements with silica to the low-LIL/HFS TH parent magma might give rise to the CA mafic endmember.

Keywords: Sengan geothermal area, tholeiite, calc-alkali, crystallization differentiation,, magma mixing