Application News

No. P110

Electron Probe Microanalyzer

Element Mapping of Volcanic Rock from Mt. Asama

Introduction

The minerals contained in rocks record physicochemical information from the time when the rocks were formed. Accordingly, it is possible to determine the thermal history and origins of rocks by a detailed investigation of the concentration distribution of their elements.

Here, element mapping of volcanic rock from Mt. Asama in Japan was carried out using a Shimadzu EPMA™-1720HT EPMA electron probe microanalyzer. The thin-slice specimen for this analysis was provided by Mr. Hideto Yoshida (Technical Director, Technical Division, School of Science) Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo.

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Element Mapping of Volcanic Rock from Mt. Asama

Fig. 1 shows the results of a wide-area EPMA mapping analysis of Na, Mg, Al, Si, Ca, Ti, Mn, and Fe, which are the main elements in volcanic rocks. The concentrations of each element were obtained as the weight percent (wt%) of their oxides. In these mapping results, a banded structure called "zoning," which is formed as a result of changes in the chemical composition from the core toward the rim, can be observed in the minerals. Although the concentration variation range differs depending on the element, here, changes in all the elements except Si were observed.

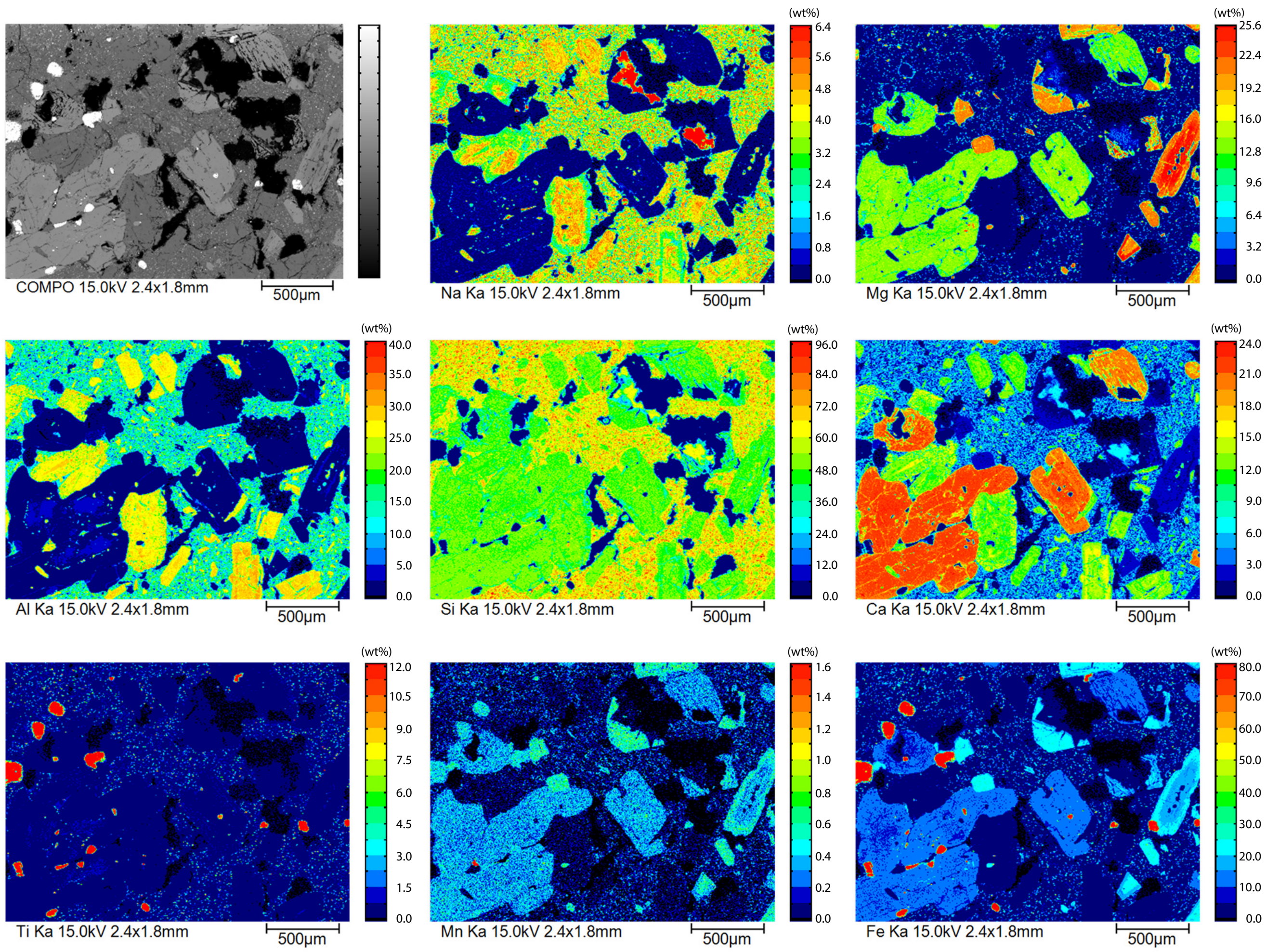

Fig. 1 Wide-Area Element Mapping of Volcanic Rock from Mt. Asama

Phase Analysis

A phase analysis was carried out based on the results of element mapping of the rock. Three sets of three elements were selected, and ternary system scatter diagrams of the concentrations of these elements (the wt% of their oxides) were illustrated, as shown in Fig. 2. Clusters can be observed in all the scatter diagrams. These clusters could be classified as magnetite from the ternary scatter diagram of SiO_2-FeO-TiO_2, augite and orthopyroxene from the diagram for CaO-MgO-FeO, and plagioclase from the diagram for K_2O-Na_2O-CaO. Fig. 3 shows the phase diagram obtained from these results. In the case of the plagioclase, a Ca-rich component exists in the rim area. As this analysis shows, phase analysis provides a simple technique for visualization of the distributions of minerals in rocks.

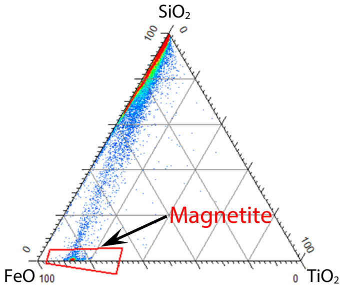

Fig. 2-1 Ternary Scatter Diagram of SiO_2-FeO-TiO_2

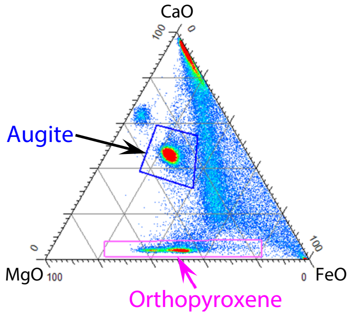

Fig. 2-2 Ternary Scatter Diagram of CaO-MgO-FeO

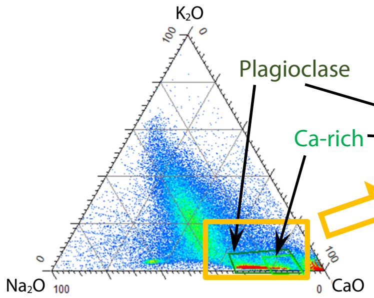

Fig. 2-3 Ternary Scatter Diagram of K_2O-Na_2O-CaO

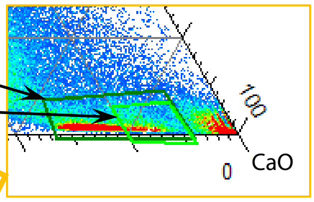

Fig. 2-4 Enlarged View of Fig. 2-3

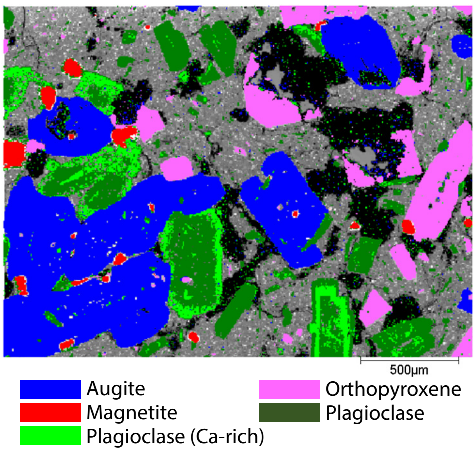

Fig. 3 Phase Diagram

Detailed Element Mapping for Orthopyroxene

It is known that Al in orthopyroxene forms a zonal texture due to the effect of pressure and temperature changes on rocks in the process by which mantle materials rise from underground (Ozawa K., 1997). Therefore, focusing on orthopyroxene in the volcanic rock from Mt. Asama, element mapping analysis was carried out for Mg, Al, Si, Ca, Ti, Mn, and Fe. As before, the concentrations were obtained as the wt% of oxides of each element. Fig. 4 shows the results. The concentrations of Al and Ti are high in the core area, and several lumpy parts with high concentrations were detected. The concentrations of these elements decreased moving toward the outer side. Although the results for Mg were not as clear as those for Al, Mg showed a distribution with a low concentration in the core area and high concentration in the rim area. Fe showed an inverse correlation with Mg, as the concentration of Fe was high in the core area and low in the rim area. In contrast to this, a large zonal texture was not seen with Si, Ca, and Mn. These results indicate the changes in temperature and in the chemical composition of the liquid phase when orthopyroxene grew, and in addition, differences in the element diffusion rates after growth. Thus, it is possible to clarify physicochemical process of mineral growth and elucidate the origins of rocks by carrying out a detailed investigation of the zonal textures of their constituent elements.

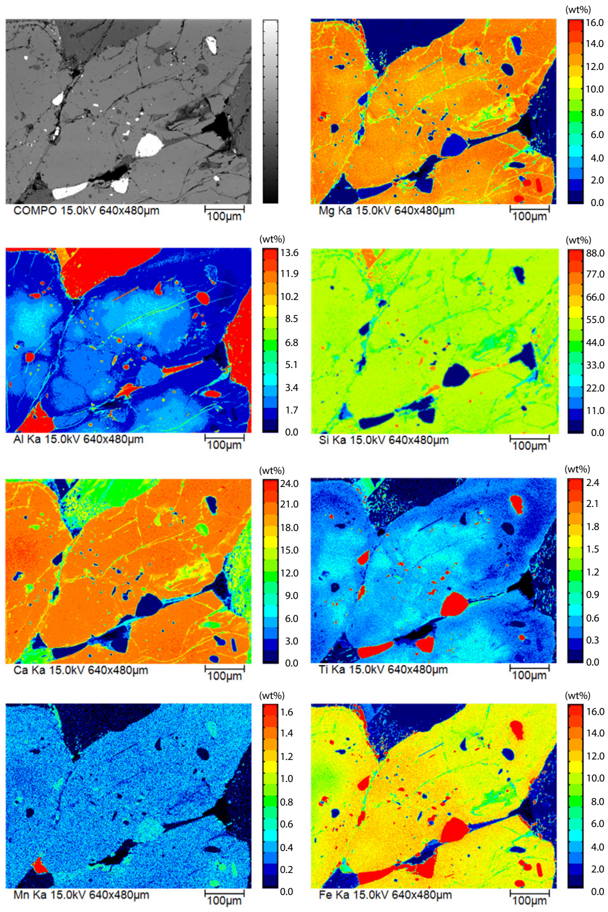

Fig. 4 Detailed Element Mapping of Orthopyroxene

<Reference>
Ozawa K., 1997, Mem. Geol. Soc. Japan, No. 47, p. 107-122

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