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Investigation into transition magma after Caldera forming, Izu-Oshima Volcano, eastern Japan

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Izu-Oshima is a volcanic island located at the northernmost end of Izu-Ogasawara islands. The volcanic activity has been divided into ”pre-caldera stage”, ”caldera forming stage”, and ”post-caldera stage” (Nakamura, 1964). Twelve significant eruptions occurred after the caldera formation (about 1500 years ago), and these ejecta are called ”Younger Oshima Group” (referred to as YOG) (Nakamura, 1964).There have been several petrological studies that investigated temporal evolution of YOG magmas, showing that Mg# of the whole rocks tends to decrease monotonously with time after the caldera formation (e.g., Fujii et al., 1988). It has also been suggested that the magmas were essentially derived from a single evolving magma chamber without significant replenishment of a primitive magma (Kawanabe, 1991). In this study, to understand magmatic processes in more detail, we are performing a geochemical analysis on YOG products. As a preliminary report, here we present petrography and whole-rock compositions of eruptive products from YOG. We also evaluate the magmatic system with respect to alignment of craters from which YOG magmas were ejected.

In this study, 44 rocks were collected from YOG, as well as from products of the 1950 and 1986 eruptions, according to the geological map of the volcano (Kawanabe, 1998). The samples are lavas and scoria, and are basalt ˜basaltic andesite un composition. The phenocryst content ranges 1.5˜10 vol.%. The phenocryst assemblage consists of plagioclase, orthopyroxene, clinopyroxene, and magnetite. The samples can be petrographically divided into those including many magnetite microphenocrysts (Type1), those including plagioclase glomerocrysts (Type2), and those without magnetite microphenocrysts and plagioclase glomerocrysts (Type3). SiO_2 contents range from 52 to 58 wt.%, but the contents of the samples other than those from the 1986 flank eruption are limited to 52˜54 wt.%. In some Type2 samples, Al_2O_3 contents correlate positively with the modal abundance of the plagioclase phenocryst, but most samples have limited range in Al_2O_3 contents (14˜15 wt.%) regardless of the abundance of the plagioclase phenocryst. The concentration ratios of incompatible trace elements (e.g., Ba/Zr) are essentially constant. In a histogram of the An content of the cores of the plagioclase phenocryst, a remarkable peak is observed at An=90 throughout the eruption stages in YOG. On the other hand, the An content of the rims of the plagioclase phenocrysts tends to decrease from older to younger samples. The plagioclase phenocrysts with reverse zoning are commonly observed in samples from the caldera forming stage, while they are scarce in samples from the following stages.

The ratios such as Ba/Zr are constant in the YOG samples, which suggests that the magmas were derived principally from a single primary magma. The observation that reversely-zoned plagioclase phenocrysts occur especially in samples from the caldera forming stage may suggest that magma mixing was dominated in the early stage of YOG, but it did not play an important role in most of the evolution after the caldera formation. On the flank of the main edifice, craters are aligned on two different NW-SE lines, and the flank craters of the 1986 eruption seem to be aligned on a line between them. We found that whole-rock compositions of the ejecta differ with respect to craters from the three lines. This observation may suggest that three discrete magma chambers with variable degrees of differentiation have been present beneath each line, while they were derived from a single primary magma.

Keywords: Izu-Oshima, petrology, volcanology, magma-plumbing system