

Formation process of plagioclase aggregates of the 1991-1995 eruption at Unzen

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We conduct the petrographical description, the textural analysis including crystal size distribution (CSD) analyses and chemical analyses for plagioclase phenocrysts which show frequently the aggregate texture in volcanic rocks of the eruption. In this study, to know the basic information before discussing the magmatic system of the 1991-1995 eruption at Unzen, we focus on plagioclase aggregates and their formation process. Plagioclase phenocrysts can be classified into two types on the basis of textural observation using optical microscopes. Type S phenocrysts exist as a Solo crystal without forming aggregates. Type A phenocrysts have the Aggregate texture in which a phenocryst recognized in hand specimen consists of two to several single crystals. The dusty zone can be found in both types. We conduct CSD analyses for type S, type A and component crystals of type A (type A_{comp}). We conduct chemical analyses for cores and rims of type S and type A_{comp}. Results from CSD analyses show that CSD plots of all types follow the exponential distributions. It is remarkable that CSD plots of type S have steeper slopes and smaller maximum crystal sizes than those of type A_{comp} have. Results from chemical analyses also show the difference in core Anorthite (An) contents; type S has broader range (around An 35-60) than type A_{comp} has (around An 40-55). These results suggest the difference in a magmatic system where each type of plagioclase phenocrysts has crystallized. We propose two models that can explain the characteristics of CSD plots and core An content of the plagioclase phenocrysts; the coalescence model and the separation model. Assuming the coalescence model, we suggest that nucleation rate has increased at a certain time and aggregations have occurred at a certain time interval. On the other hand, assuming the separation model, we suggest that the injection of a high-temperature mafic magma including high-An solo crystals has melted country rocks including plagioclase with core An 40-55. We also suggest that fragments separated from country rocks have assimilated with the mafic magma. Because the slight differences in the CSD trends and the compositional ranges between type S and A_{comp}, which has been detected in this preliminary analysis, may be an important clue to discriminate which process is realistic, we will have to conduct more comprehensive and detail analysis including correlations between size and compositions, trace element compositions, etc.

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