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Behavior of fine ash particles generated from the explosive volcanic eruption- an case study of the Pinatubo 1991 eruption-

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One of the factors of explosive volcanic eruption is the fragmentation of magma. It is very important in order to estimate the grain size distribution of pyroclastic material just after fragmentation (i.e. the initial size distribution of magma), considering the mechanisms of fragmentation of magma. In the case of explosive volcanic eruption such as Plinian eruption, however, numerous amounts of fine ash particles would be generated and dispersed into the atmosphere. Furthermore, fine ash particles also should be dispersed into wide area as the co-ignimbrite ash, if the pyroclastic flow were occurred during the eruption. Thus, in order to deduce the initial size distribution of magma from a pyroclastic deposit, it is needed to find out the information as to the amount and the grain size distribution of fine ash which would be dispersed from eruption cloud. We have attempted to estimate the initial size distribution of the pyroclastic material erupted in the Pinatubo 1991 ejecta, as the case study of an estimation of the initial size distribution of magma deduced from an explosive volcanic eruption. In a concrete way, we divided pyroclasts into two types; air fall tephra and pyroclastic flow, and then estimated each of total amount and size distribution using tephra-dispersal model and mass balance of the crystal content of plagioclase crystal in magma and pyroclasts. Finally, combining them using the proportion to total amount of ejecta, the initial size distribution has determined. As the results, we obtained that the total amount of pyroclasts in the Pinatubo 1991 climactic eruption phase is about 3x10^12kg of air fall tephra and 9.2x10^12kg of pyroclastic flow (including in co-ignimbrite ash), and that the initial size distribution of the pyroclasts shows asymmetric distribution around 1.5 phi.

In the above estimates, we assumed that the fine parts of layer C2, which was fallen as muddy rain, preserve the characteristics of fine ash particles which were dispersed into the atmosphere, and those of layer B also shows the characteristics of co-ignimbrite ash. However, the estimates of the total amount and the initial size distribution of the pyroclasts strongly depend on the content of plagioclase free crystals and the grain size distribution of the fine ash. Thus, in order to obtain the appropriate initial size distribution from pyroclastic deposits, we must evaluate the variation as to the content of plagioclase free crystals and the size distribution of fine ash.

The grain size distributions of fine ash estimated by utilizing the scattering of a laser beam through a stream of particles resemble irrespective of the difference of the distance, the direction the nature of the pyroclasts; the finer fractions of the Plinian phase (e.g. the finer fractions of layer C2), co-ignimbrite ash (e.g. the finer fractions of layer B), and finer fractions of the pyroclastic flow. Furthermore, the fine ash particles are characteristically depleted in the fractions finer than 9.0 phi. It implies that the degree of sorting during transportation of these pyroclasts had not been different.

Nevertheless no systematic changes of the grain size distribution of fine ash observed between the pyroclasts, the contents of plagioclase free crystals changes to the pyroclasts to another; 20 wt. % of the fine fractions of the pyroclastic flow, 27 wt.% of the finer fractions of the Plinian phase, and 35 wt.% of the co-ignimbrite ash. In order to evaluate this discrepancy between the grain size distributions and content of plagioclase in fine ash, we now are carrying out the quantitative analyses of plagioclase in fine ash using XRD, and check the deviation of the content of plagioclase crystal. Furthermore, we also have been carried out the morphological study as to fine ash particles and plagioclase free crystals using SEM, and attempt whether morphological features show the characteristics of grain size distributions of fine ash.