

Cluster analyses for volcanic pyroclasts using grain shapes

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Our motivations for this study are: 1) classify volcanic ash using statistical techniques, and 2) identify eruption styles from parameterized grain shape of pyroclasts. One of the extractable factors which we can infer eruption styles and mechanisms is grain morphology of ejected pyroclasts. They would tell us characteristics of magma vaporization and fragmentation (e.g., Heiken and Wohletz, 1985). Numbers of researchers have been tried to parameterize grain shapes and discussed its formation and fragmentation story. Thanks to the development of grain analyze instruments and techniques, we can parameterize visuals (shape and intensity) for thousands of grains easily in short time. Previous studies have applied an automated particle analyzer (APA) for grain shape of volcanic ash. Leibrandt and Le Pennec, 2015 tested several measurement conditions, then presented an efficient protocol. Using this protocol, Liu et al., 2015 compared the characteristics of grain shape parameters among components (dense, vesicular, and shards) and eruption styles. Thus, we are closing to know eruption style and characteristics by grain shape analysis using the APA. To simplify this system, first we should test this method in simpler cases, i.e., monogenetic volcanoes.

This study verified several patterns of clustering for volcanic pyroclasts. We used 47 samples which were collected in several places of Japan and Iceland. These pyroclasts were formed in three types of monogenetic eruptions; magmatic, phreatomagmatic, and rootless. Each sample consist of more than 100 grains. We measured grain shapes and intensities using an APA: Morphologi G3STM (Malvern InstrumentTM) in AIST. Using parameterized grain data, we performed cluster analyses on R software (R Core Team, 2016) with the hierarchical procedure (Ward's method) and Euclidean distance. In test analysis using analog grains, it is found that scaling of each parameters before clustering are unnecessary. We performed clustering in 2 steps; make grain types and clustering among samples using percentages of each grain type. In this presentation, we will show processes and results of our clustering, and consider better way to apply the cluster analysis to natural volcanic products.

Keywords: cluster analysis, pyroclast, grain shape