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Stratigraphic variation in characteristic of pyroclastic deposits during the 2011 subplinian eruption of Mount Shinmoe

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In general, we observe stratigraphic variation in characteristic of pyroclastic deposits (i.e. grain size and color), which may reflect temporal behavior of eruption intensity. However, the connection between stratigraphic variation of pyroclastic deposits and temporal behavior of eruption intensity cannot be straight found according to settling sequence because pyroclastic deposits may experience sorting process during the transportation and erosion process after the deposition. These processes make it difficult to precisely interpret time development of plinian eruption from analysis of pyroclastic deposits. Fortunately, we have a chance namely three subplinian phases of the 2011 Sinmoedake eruption January (26, 27 morning, and 27 evening), which represent the minimum influence of loss of materials. Furthermore there are additional constraints which are from different sources of observations concerning the eruption sequence such as satellite images. This opportunity allows us to consider the effect of sorting process during transportation on the stratigraphic variation of pyroclastic deposits.

We collected samples at two localities, Miike elementary school (about 7.5 km far from vent; nearer) and Natsuo elementary school (about 11 km far from vent; farther) on 29th and 30th, January. In order to observe the temporal change of deposits, we divided into 8 or 5 layers in sampling. We conducted grain size analysis for each layers by using sieve (phi=-2, -1, 0, 1) and calculated statistical properties based on Inman (1952). As a consequence, characteristic of stratigraphic variation of grain size in terms of median or mean showed two peaks at nearer locality and one peak at farther locality. Furthermore, values of dispersion increase around peaks of median or mean. In addition, we classify the sample (ash particle) into four categories depending on color (i.e. they are White, Gray-Brown, Black, and Reddish-Black), and determined number fraction of grains in each categories from counted numbers of grains. As a result, it is found that: (1) a fraction of Gray-Brown particles occupies the major part (about nine tenths) of deposits, (2) a fraction of Reddish-Black particles decreases with stratigraphic height, (3) a fraction of Black particles correlates with change of median or mean, (4) a fraction of White particles increases with stratigraphic height.

Assuming that a single plinian eruption makes a single peak of median or mean of grain size distribution, analyzed deposits correspond to two subplinian eruptions. Together with isopach data (AIST) and satellite image (Meteorological Agency) on January 26th and 27th, we can conclude that pyroclastic deposits corresponded to eruptions of 26th (16:10-18:35) and 27th (02:10-04:40). As a result, it reveals order of sedimentation, reflecting characteristic of size and color of pyroclastic deposits. From changes of number fractions of grains in each category depending on color, we speculate where particles of each category are originated from; grains of Black and Reddish-Black come from vent, grains of White come from the rim of magma chamber, and grains of Gray-Brown correspond to magma. It is also confirmed that the deposit at farther distance, contains smaller sedimentary particle size.

This study provides some extensive information of stratigraphic variation. Hereafter we need another approach to estimate how eruption intensity changes in a single eruption by considering the effect of sorting process.

Keywords: Pyroclastic Deposit, Stratigraphic Variation, Eruption Intensity