Facies and thickness variations and emplacement mechanism of Aso-4 pyroclastic flow

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Pyroclastic flows, normally high-temperature and high-speed, cause devastations in and around the volcanic area. Especially, caldera-forming, large-scale pyroclastic flows (ignimbrites) affect quite large areas, and more precise evaluation of affected area and understanding of emplacement mechanism are needed. The 90ka Aso4 pyroclastic flow is one of the largest volcanic events in Japan (VEI=7), and reached as far as 160km from the source. We studied emplacement mechanism of Aso4 pyroclastic flows based on facies and thickness variations.
The total number of 3,596 thickness point datasets was collected using geological maps, boring data, published papers and topographic maps. The thickness of the welded points was converted to non-welded condition based on average densities of welded part (1,800 kg/m^3) and non-welded part (1,200kg/m^3). The thickness variation map was made based on point datasets using Kriging method. The maximum thickness locations that is thicker than 60m were distributed not near the caldera, but NNW 42.5km from source (NW of Oguni town), SSW 33km (N of Kunimi dake) and SE 29km (Takachiho valley). These areas are located relatively deep valley. The reason of the thick deposit in the deep valley can be explained more than a few hundred meters-thick turbulent pyroclastic flows were cascaded the caldera outer slope and most of the deposits in the relatively steep slopes were concentrated in the deep valley. The deposit thickness in the wide valley in eastern and western parts were relatively thin (<40m).
The grain size variations were studied mainly on Aso4A deposit from NW, N, E and SE directions. The maximum pumice and thick sizes were examined at 55 outcrops in total. The maximum size of pumices and lithics of 8 samples in each outcrop were measured (Fig.). The maximum size of pumices (47.2cm and 46.2cm) are located not near the caldera, but about 25-30km from the source. The maximum size gradually decreases up to 3 cm at 72km. The maximum size of pumices at outcrops in Yamaguchi prefecture (132-162km from the source) show 0.4-0.9cm. The maximum size of pumices varies vertically in an outcrop. The pumice sizes in the basal part was relatively smaller than the main part. The pumice sizes in the pumice-concentration zone were relatively larger than the main part. The pumice sizes in the welded and non-welded parts show minor differences. The maximum pumice size in the lag breccia facies located within 20km from the source show small values (2.3 to 5.3 cm). On the other hand, maximum sizes of lithics show maximum of 43 and 45.6cm at 10-15 km from the source. The maximum size of lithics gradually decreased with travel distance and showed 0.3 cm at 117 km from the source. A 8m-thick lag breccia facies are observed at the bottom of 15m-thick Aso4A pyroclastic flow deposit located at 11 km SE from source. The lag breccia facies were subdivided into 3 units and bottom of the basal unit was not observed. The lag breccia facies consist of fines-depleted matrix and subrounded large-amount of large lithics (70cm in maximum) and small amount of pumices. Large lithics in the lag breccia units show stratified structures such as horizontal alignments with 20-50cm thick intervals.
The lag breccia facies are located within 20km from source. The facies are formed due to detachment of large lithics from the highly turbulent pyroclastic flow near the source. The fines-depleted facies support the highly turbulence. The subrounded lithics in the lag breccia facies indicate that the lithics were not fall origin, but rounded due to interaction at the bottom of turbulent pyroclastic flow. The horizontal alignments of large lithics indicate the lag breccia facies were not formed in mass freezing, but formed incrementally at 20-50cm-thick intervals (depositional subunits; DSU). The alignment of large lithics suggest that lithics were concentrated at the bottom of the turbulent pyroclastic flow (boundary layer) and

increased the interaction between the lithics and formed concentrated at the top of the DSUs. The maximum size of the pumices was observed at Oguni town (North) and Taketa town (East). These areas located topographical barriers and change of the slope points. The pyroclastic flows stagnated temporarily and accumulated the large pumices at these areas. (The relationship between the maximum size of pumices and lithics and thickness of the deposit are planning to be examined). The gradual decrease of maximum size of pumices and lithic sizes with the travel distance suggests the basal accumulation of pumices and lithics from the turbulent pyroclastic flows.

Keywords: Aso4, Pyroclastic flow, facies, thickness, emplacement mechanism