

Characteristics and Generation Process of Cliff-triggered Pyroclastic Surge Associated with Dome-collapse Pyroclastic Flow

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Pyroclastic flows resulting from collapse of lava domes, so-called dome-collapse type or Merapi type, consist of basal avalanches and overriding ash clouds, many being accompanied or preceding by pyroclastic surge, shock wave-like hot and gas-rich high-speed particle flows. The basal avalanches are gravity-driven and follow valleys, but pyroclastic surges commonly sweep over valley edges and spread over much larger areas. Surges are therefore the most hazardous aspects of dome-collapse type pyroclastic flow, causing deaths at Unzen (1991, 1993), Merapi (1994), Soufriere Hills (1997).

The characteristics of deposits of the 23 June 1993 pyroclastic flow on Unzen volcano reflect a sudden intense fragmentation of lapilli to block-sized clasts when a large flow cascaded down steep cliffs. Breakage produced mainly coarse ash to fine ash-size clasts (MD: 3 phi), its grain size fit for Rosin-Rammler distribution. The thickest deposition of fall-out ash over steep cliffs indicated that sudden fragmentation events were accompanied by severe degassing and high ash-cloud plume at this area. Pyroclastic surge deposits distributed straight from steep cliffs to down-flow area were found. Data imply a surge was generated when the flow rushed down the cliffs, where bouncing hot block disintegrated on impact and explosively discharged highly degassed fines.

The generations of pyroclastic surge were happened at steep cliffs far away from source. The most destructive disasters were caused by this pyroclastic surge associated with dome-collapse type pyroclastic flow.

If our interpretation is correct, hazard mitigation at Unzen and other volcanoes with similar eruption styles must take into consideration for high fragmentation by topographical effects within flow pass used frequently by pyroclastic flows. We therefore urge to include such potential generation style of pyroclastic surges into new hazard maps of volcanoes.