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溶岩ドーム破壊で始まったケルート火山2014年のプリニー式噴火
Plinian eruption preceded by disruption of lava dome at Kelud volcano, Indonesia, in 2014

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Kelud volcano, Indonesia, is an active andesitic stratovolcano that has repeatedly erupted over many centuries. After a quiescent period since the dome-building eruption in 2007-2008, a plinian eruption with a radially spreading umbrella cloud at 18 km height occurred in February 2014. We present results of field observations, and discuss the sequence of this plinian event, with estimation of some physical parameters controlling eruption dynamics.

Eruptive deposits can be divided into three major units, Unit A to C, which corresponds to the main stages of this event. Unit A is pyroclastic density current deposits characterized by massive, poor-sorted, and composed of pumice, lithics and woods fragments. The distribution is limited to the northeastern side of the volcano, and extends up to ~5 km from the summit. In distal area, this unit consists of a thin fine ash layer. Numerous trees blown down on the substrate in the northeast also belongs to the same unit. Unit B is pyroclastic fallout deposits. In proximal area, the unit is characterized by thick fallout deposits containing large pumice clasts and lava blocks. This unit underlies numerous ballistic ejecta originating from andesitic lava dome produced in 2007-2008. In distal area, the same unit is recognized as a thin ashfall layer. This unit is widely distributed from north to southwest. At Jogjakarta ~200 km away, ~2 cm ashfall was observed. This observation is consistent with satellite data showing the plinian plume drifted by strong easterly wind and dispersed mainly western side of the volcano. Unit C is poor-sorted, pumice-rich pyroclastic density current deposits that are distributed along southern and western valleys up to 3-4 km. Multiple, pumice-rich flow lobes are well developed. Large pumice clasts are generally concentrated in the upper part and flow front of the deposits. In the northern side, this unit is recognized as normally graded, fine ashfall layers. After the eruption, a number of secondary phreatic explosions occurred from the valley-filled pumice-rich deposits, and created explosion craters.

Volume of tephra fallout from all stages is estimated to be 0.32-0.46 km^3, using relationships between dispersal area and tephra thickness. A total volume of pyroclastic density current deposits for Stages 1 and 3 was estimated to be ~0.1 km^3 based on the deposit distribution and thickness assumption. Duration of plume development was estimated to be 2.5-3 hours based on satellite images. From the tephra volume and eruption duration, mass discharge rate was calculated to be in the range 5.6?8.6$*10^7$ kg/s.

Our field observation suggests that, in Stage 1, pyroclastic density currents run at least 5 km to the northeastern side with blowing off vegetation including numerous trees. Perhaps, the 2007-2008 lava dome acted as a cap-rock of conduit, and it was partially destroyed from the northern edge. Initially, the eruption couldn't produce a buoyant steady column from an open conduit, but generated energetic and directed pyroclastic density currents (like a blast) from the partially disrupted dome. Then, the dome was completely destroyed and blown away by ascending magma, and the eruption entered the stable plinian phase, Stage 2. Within 3 hours, magma discharge rate decreased, and column collapse began. The eruption stage moved to Stage 3, when pumice-rich pyroclastic density currents occurred. They could run along valleys and buried them with multiple pumiceous flow lobes.

The plinian eruption in 2014 was characterized by a strong eruption plume preceded by blowing off lava dome and generation of energetic pyroclastic density currents. Also other pyroclastic density currents by column collapse followed the plinian eruption. Deposit data suggests that the scale of eruption is ranked as VEI 4 and one of the largest eruptions at Kelud volcano in the last few centuries.

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