

Learn from 2010 Eruptions at Merapi and Sinabung Volcanoes in Indonesia

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In 2010, characteristic eruptions occurred at Sinabung, North Sumatra and Merapi in Central Java, Indonesia. We can obtain important lessons from these eruptive activities for evaluation of volcanic activity and prediction of volcanic eruption.

Sinabung volcano is located north of Toba Lake formed by gigantic caldera eruption. The eruptive activity awoke after >400 years dormancy. The first eruption occurred at 00:10 on August 28. Center for Volcanology and Geological Hazard Mitigation (CVGHM), which is responsible to monitor volcanic activity and issue warning, set up the warning level 4 (highest level) for evacuation of local residence because no monitoring system was installed at the volcano and characteristic of eruption had not been made clear yet. The most important thing is possibility of change of magmatic system after long-term dormant period and large eruptions, such as Pinatubo eruption in 1991 after 600 years dormancy.

In contrast to the Sinabung volcano, Merapi volcano has frequently repeated eruption and has been well-monitored by Volcano Technology Research Center under CVGHM. Time intervals of eruptions ranged one to several years, especially since 15th century. Eruption of the volcano was characterized by pyroclastic flow caused by collapse of lava dome, called "Merapi-type". In 1990s, pyroclastic flows with flow distance < 4-5 km occurred almost every year and larger pyroclastic flow occurred in 2001 and 2006. Typically, a sequence of activity is commenced by occurrence of volcano-tectonic (VT) earthquake at depth of 2-4 km beneath the summit and then followed by emergence and growth of lava dome at

the summit accompanying MP-type earthquakes and rock-falls. Immediately before occurrence of pyroclastic flow, VT earthquake occurred at shallow depth beneath the summit.

The 2010 activity can be divided into 5 periods; (1) precursory period to the first explosion on October 26, (2) the first explosion, (3) tentative declination of activity from October 27 to November 2 (4) continuous occurrence of pyroclastic flow in 3-5 November (climax), (5) declination of eruptive activity after November 6. Based on accelerations of increase in seismicity of VT earthquake and inflation of volcanic body, CVGHM raised alert level 4, one day before the first explosion. Restricted zone was set up within 10 km from the summit and 69,000 local residents evacuated. Unlikely to the previous eruptions, new lava dome did not appear at the summit. By considering precursory activity, volcanic activity can be well evaluated as "explosive" scientifically. However, ability of decision is the most important for evacuation.

Before the climax of eruptivity with continuous pyroclastic flow on November 3-5, no significant activity was recorded. It is still difficult to evaluate volcanic activity under open conduit system after the first explosion. Restricted zone was extended up to 20 km associated with extension of flow length of pyroclastic flow and 380,000 people evacuated. Japan has not been experienced by risk management for such a large number of evacuees. Countermeasure for volcanic eruptions with disaster in wider area should be established quickly.