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Eruption History and Future Scenario of Sinabung volcano, North Sumatra, Indonesia

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Sinabung Volcano is an andesitic stratovolcano located 40 km northwest of Lake Toba, North Sumatra. The activity began after the latest caldera-forming eruption of Toba Lake (ca. 74ka). The eruption history can be divided into two stages (old and young stages) based on topographical and geochemical features. The edifice is characterized by multiple thick lava flows/domes, and their collapsed materials of block-and-ash flow and associated surge deposits. The lava spine is located at the southern end of one of the summit craters which trend in N-S. Pumice-fall deposits by relatively large explosive eruptions, such as plinian- to subplinian types, were not recognized. The last magmatic eruption before 2010 occurred during 9 to 10th century, whose products are mainly pyroclastic-flow deposits, distributed in the SE slope.

The present activities began with phreatic events in August and September 2010. It resumed its activity in September 2013 with phreatic events. After the repeated phreatic to phreatomagmatic events, lava appeared in the summit crater in late December and started its partial collapse on 30 December. Several tens collapses occurred everyday in January 2014. Those pyroclastic flows descended on the SE slope of the volcano and traveled 4.5 km in maximum.

Lavas of the volcano are basaltic andesite to andesite in composition, and andesitic lavas contain hornblende phenocrysts. Although old lava have a SiO2 range similar to young lavas, the old lava are more enriched in K2O than the young lava. The lava spine is highly enriched in SiO2 and extremely depleted in Na2O, a result of high alteration by volcanic gases, suggested by the mineralogical features. Bulk composition of 2010 ash seems to be intermediate between the young lava and the altered lava spine. In contrast, pumice of 2013 eruption has a similar composition of juvenile materials of 9-10th eruption.

Before the 2013-2014 events, highly possible scenario for future eruption have been proposed the similar case of lava-dome eruptions at Unzen, Japan, in 1991-95 and at Soufriere Hills, Montserrat, West Indies, in 1995-present, based on the eruption history. The present eruption at Sinabung follows the proposed scenario of the highest probability.

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