

## Eruptive history and event tree of Semeru volcano, Indonesia

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Semeru volcano, located in the eastern Java, is one of the most active volcanoes in Indonesia. However, history of this volcano is poorly understood due to lack of detail geological and petrological studies. Poor preservation of outcrops and tropical climate also make difficult to obtain a lot field data. Prediction of eruption style and sequence at Semeru volcano is very important for disaster mitigation, but our knowledge on this volcano is very limited. The major purpose of this research is to make the eruption scenario (event tree), based on understanding eruption history of Semeru volcano.

The recent activity of the Semeru volcano is represented by the persistent small-scale Vulcanian and gas burst consisting of short-lived eruption columns several to a hundred times a day. The activity increases every 5 to 7 years producing several km-high eruption columns, ballistic bombs and thick tephra fall around the vent. Dome extrusion in the vent and subsequent collapses produce block and ash flows. The recent activity is limited in the summit area but flank lava flows occurred on the lower SE and E flanks in 1895 and in 1941–1942. Also large-scale lahars exceeding 5 million m<sup>3</sup> each have occurred at least five times since 1884. Lumajang, a city home to 85,000 people located 35 km E of the summit, was devastated by lahars in 1909.

We carried out the field inspection in the southeastern, southwestern flank and the northern slope to the summit in 2016 and 2017. Based on geological surveys and <sup>14</sup>C age determination, the stratigraphy of tephra and lava flows was constructed. Chemical analyses were also carried out for representative samples. The eruptive history of Semeru volcano can be divided into major three stages. The younger stage (after 11<sup>th</sup> Century) is characterized by explosive eruption of andesitic magma, including the PDC event that destroyed the Majapahit Temple in the 15 to 16<sup>th</sup> Century. Co-ignimbrite ashfall from the 1257 Rinjani eruption was also used as a time-marker to determine the stratigraphical relationship in the younger stage. The middle stage (3-10<sup>th</sup> Century) was dominated by effusive eruption mainly of basalt magma in parasitic cones. Scoria cones on the northern foot of Semeru volcano were activated in this stage. The older stage (before 3<sup>rd</sup> Century) was dominated by explosive eruption of andesitic magma. Volcanic rocks of Semeru are chemically bimodal (andesite, 56-61 wt.% in SiO<sub>2</sub>; basalt, 46-53 wt.% in SiO<sub>2</sub>) throughout the eruption history. Furthermore, 3D models of the volcano were made from satellite images of the whole area and drone-images on the summit-crater area. The data is used to estimate the volume of the summit dome and topographical features of the entire volcano, which are essential to calculate discharge rate and to expect the maximum scale of pyroclastic flows and their directions. Based on field inspection, laboratory analyses, and review results, we constructed a preliminary event tree.

Keywords: Semeru volcano, eruptive history, event tree, stratigraphy