

Stratigraphy of 2010 Merapi eruption in comparison to previous large deposits

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During the 20th century Merapi had small (VEI 1–3) eruptions every 2–5 years. But in 2010 the volcano had its largest eruption (VEI 3–4) in the last 140 years. Stratigraphy of deposits on the volcano's flanks shows that large eruptions \geq VEI 4 have also occurred in the past, namely at \geq 2190yBP, 2190 \pm 76 yBP, 300 \pm 60 yBP, 1822 and 1872. Although there are some similarities to 2010 and other recent eruptions there are also important differences in comparison to the large eruptions of the past. The 2010 eruption appears less explosive, as indicated by a low vesicularity of juvenile clasts. The 2010 magma also has higher SiO₂ (55–56%). In comparison, the 300 ybp tephra forms thicker deposits and 52–54% SiO₂; juvenile blocks in the 1872 PDC deposit are scoriaceous and lower in silica (51–52%). These factors show that more mafic and gas-rich magmas were involved in the older large eruptions of Merapi and that such magmas were able to traverse Merapi's complex plumbing system more readily in the past than during more recent small eruptions.

As with previous small 20th century eruptions, seismic and deformation precursors for the 2010 eruption started many months in advance; however, unlike the small eruptions, monitoring parameters reached unprecedented levels during the week preceding the 2010 Merapi eruption. The 2010 eruption occurred continuously and reached its peak on 5 November 2010 at 00:05 Western Indonesian Time (WIB). Lengths of pyroclastic flows increased over the course of the eruption: 7.5km (26 October), 9 km (3 November) and they reached a maximum of 16km from the summit during the paroxysmal event. Based on our analysis of the 2010 deposits, the 26 October eruption began with a phreatic phase characterized by coarse ash containing uncharred plants. This was followed by a directed blast to the south and then by pyroclastic flows and ash fall. Additional explosive eruptions took place on 29 October, 31 October, and 1 November. Rapid lava dome extrusion (25 m³per second) took place at the summit (1 to 4 November) and continued until the paroxysmal eruption, which destroyed the new lava dome, sent an ash column to 17 km altitude and generated PDCs, which reached 16 km from the summit in Kali Gendol. Rapid dome growth (35 m³per second) resumed on 6 November but ended the same day and the eruption was over by the end of the month. Tephra from the 2010 eruption covered an area of \sim 765km² and had a relatively small volume of \sim 19 million m³ (Solikhin et al., in review).