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Migration of seismic activity associated with phreatic eruption at Merapi volcano, Indonesia

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The October-November 2010 Merapi eruption was the largest in more than 100 years. It was characterised by vertical eruptive columns up to 17 km altitude and pyroclastic flows that extended up to 16 km on the south flank. Phreatic activity started after nearly 2 years of quiescence. A dozen small eruptions identified by visual and/or seismic observations took place between August 2012 and April 2014. Another series of phreatic eruptions occurred in May-June 2018, followed by a magmatic eruption that started in August 2018. The powerful phreatic eruption of November 18, 2013 formed a major fracture cutting the complete dome structure. This new fracture was 200m long and up to 40m wide. It was then enlarged by other eruptions of March and April 2014. A small seismic antenna composed of 5 Guralp CMG-6TD stations that integrate a 30 sec sensor and with an aperture of 300m was installed at the end of November 2013 close to the summit. We present in this work the results of a detailed analysis of the April 19, 2014 phreatic eruption. We tried to reconstruct the explosive process, which lasted for over 30 minutes. To this end, we determined the seismic source migration over time. Source depth was obtained by comparing the slowness vector calculated by using 3 stations of the antenna with a slowness vector model obtained by ray tracing in the structure, taking into account the topography and a 1D velocity model. The results show a migration of the seismic source that descends at first, and then goes up at a velocity of about 10m.s-1. This first part of the eruption lasts 5 minutes. We interpret it by a sudden decompression starting approximately 1 km below the dome and then fracturing or re-opening a path under the effect of pressure. The seismic source then remains positioned at the altitude of the dome for over 10 minutes. This phase probably corresponds to the ash emission process. The evolution of the back-azimuth during the migration process indicates a slight inclination of the conduit, presumably in the orientation of the dome fracture, in the NW-SE direction. This direction is consistent with the alignment of regional tectonic structures.