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Asymmetrical hydrothermal system below Merapi volcano imaged by geophysical data.

Svetlana Byrdina (1,2), Sven Friedel (3), Agus Budi-Santoso (4), Wiwit Suryanto (5), Aldjarishy Suhari (5), Jean Vandemeulebrouck (1), Mohhamed H. Rizal (4), and Hendra Grandis (6)

(1) Universite de Savoie Mont Blanc, CNRS, ISTerre, F-73376 Le Bourget du Lac, France (svetlana.byrdina@univ-smb.fr), (2) IRD, ISTerre, F-73376 Le Bourget du Lac, France, (3) Comsol Multiphysics GmbH, Technoparkstrasse 1, CH-8005 Zürich, Switzerland, (4) BPPTKG, Jl. Cendana No. 15, Yogyakarta 55166, Indonesia, (5) Gadjah Mada University, Yogyakarta, 55281, Indonesia, (6) Institut Teknologi Bandung, Jln. Ganesha 10, Bandung, 40132, Indonesia

A high-resolution image of the hydrothermal system of Merapi volcano is obtained using electrical resistivity tomography (ERT), self-potential, and CO_2 flux mappings. The ERT inversions identify two distinct low-resistivity bodies, at the base of the south flank and in the summit area, that represent likely two parts of an interconnected hydrothermal system.
In the summit area, the extension of the hydrothermal system is clearly limited by the main geological structures which are actual and ancient craters. A sharp resistivity contrast at ancient crater rim Pasar-Bubar separates a conductive hydrothermal system (20 – 50 Ωm) from the resistive andesite lava flows and pyroclastic deposits (2000 – 50 000 Ωm). High diffuse CO_2 degassing (with a median value of 400g m −2 d $^{-1}$) is observed in a narrow vicinity of the active crater rim and close to the Pasar-Bubar. The existence of preferential fluid circulation along this ancient crater rim is also evidenced by self-potential data. The total CO_2 degassing across the accessible summit area with a surface of 1.4 · 10 5 m 2 is around 20 td $^{-1}$. Before the 2010 eruption, Toutain et al. (2009) estimated a higher value of the total diffuse degassing from the summit area (about 200 – 230 td $^{-1}$). This drop in the diffuse degassing can be related to the decrease in the magmatic activity, to the change of the summit morphology or to a combination of these factors.
On the south flank of Merapi, the resistivity model shows spectacular stratification. While surficial recent andesite lava flows are characterized by resistivity exceeding 100 000 Ωm, resistivity as low as 10 Ωm has been encountered at a depth of 200 m at the base of the south flank and was interpreted as a presence of the hydrothermal system. We suggest that a sandwich-like structure of stratified pyroclastic deposits on the flanks of Merapi screen and separate the flow of hydrothermal fluids with the degassing occurring mostly through the fractured crater rims, while the liquid water flows down to the base of the volcanic dome.
Our ERT results suggest the existence of a peripheral hydrothermal system below the south and west flanks in agreement with previous electromagnetic studies. In contrast, no evidence of hydrothermal system is found below the north flank, where the resistivity values are too high to be assigned to a hydrothermal system, at least to the ERT investigation depth. A probable cause of this asymmetry could be a non-axial location of the magmatic heat source. Such non-axial location of the magmatic source relative to the edifice is suggested by the shift of the volcanic activity to the south as proposed in the geological model by Camus et al, (2000). In addition, the hypocenters of seismic events located by Budi-Santoso et al, (2013) seem to be distributed to the SW from the active crater suggesting that the magma conduits and likely, the magmatic source, are shifted to the SW with respect to the actual crater.