GEOELECTRICAL MEASUREMENTS AT MERAPI VOLCANO 1997-2002, PART 2: SELF-POTENTIAL

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The recent activity of Merapi volcano has been characterized by quasi-continuous activity with intermitting cycles of lava dome extrusion and gravitational dome collapse, which cause devastating nues ardentes and often form the initial phase of eruptive activity. Of the many facts contributing to instability of the dome a major one fact is frequently mentioned but has received little attention for systematic research: the destabilizing effect of water infiltration or circulation near the dome. As fluid or vapour flows are known to create electrokinetic voltages, self-potential measurements have been performed to better understand the interaction of fluid and magmatic system inside Merapi volcano. We report various aspects of temporal and spatial self-potential surveys as well as laboratory studies.

(1) We describe the hardware concept, including protection measures, of a continuous monitoring system for self-potentials and ground temperature installed in August 2000 at the solfatara Woro only 150 m from the active lava dome.

(2) Relating the data of this station to rainfall, air pressure, solfatara temperature and seismology several effects can be distinguished: (A) \(U-T\) signatures of repeated rain infiltration into the solfatara system show a typical pattern of negative charge accumulation at the hot electrodes near the fumarolic vents. (B) We observe a long-term negative correlation between electrode temperature difference and SP with coupling coefficients between -1.8 mV/K to -2.8 mV/K. (C). In autumn 2000 signals with a clear 12h (S2 but no S1) period are observed. Because of their amplitude (100 to 200 mV/km) it is unlikely that these signals result from magnetotelluric excitation. Furthermore they are not correlated with earth tides, but instead seem to be correlated
but not in phase with air pressure changes. (D) In January 2001, before and during the collapse and eruptive crisis of Merapi, an exceptional positive $U-T$ correlation is observed.

(3) We report the results of self-potential profiling along the southern and western flanks (repeated) and northern flanks. At the lower flanks a strong terrain effect dominates but is less pronounced and possibly masked by poor signal-to-noise ration in the upper regions of the volcano. The results are related to resistivity models, which have been determined for the same profiles.