Volcanic flank soil degassing of carbon dioxide at Gede volcano (West Java, Indonesia)

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Gede Volcano, West Java is part of an andesitic stratovolcano complex consisting of Pangrango in the north-west and Gede in the south-east. The last recorded eruptive activity was a phreatic subvolcanian ash eruption in 1957. Current activity is characterized by episodic swarms at 2-4 km depth, and low-temperature (~160 ℃) crater degassing in two distinct summit crater fumarolic areas. Hot springs occur in the saddle between the Gede and Pangrango edifice, as well as on the NE flank base. The most recent eruptive events produced pyroclastic material, their flow deposits concentrate toward the NE.

A collaborative effort between the Center for Volcanology and Geological Hazard Mitigation (CVGHM) and the Earth Observatory of Singapore (EOS) is since 2010 aimed at upgrading the geophysical and geochemical monitoring network at Gede Volcano. To support the monitoring instrumentation upgrades under way, surveys of soil CO_2 degassing have been performed on the flanks of Gede, in circular and radial traverses. The goal was to establish a spatial distribution of flank CO_2 fluxes, and to allow smart siting for continuous gas monitoring stations. Crater fluxes were not surveyed, as its low-temperature hydrothermal system is likely prone to large hydraulic changes in this tropical environment, resulting in variable permeability effects that might mask signals from deeper reservoir or conduit degassing.

The high precipitation intensity in the mountains of tropical Java pose challenges to this method, since soil gas permeability is largely controlled by soil moisture content. Simultaneous soil moisture measurements were undertaken. The soil CO_2 surveys were carried out using a LI-8100A campaign flux chamber instrument (LICOR Biosciences, Lincoln, Nebraska). This instrument has a very precise and highly stable sensor and an atmospheric pressure equilibrator, making it highly sensitive to low fluxes. It is the far superior choice for higher precision low-flux flank surveys in tropical environments.

The mean flank fluxes measured were 19.8 g/m^2/day in 2011 and 11.7 g/m^2/day in early 2012. The mean flank flux for all the surveys is 17.9 g/m^2/day. Statistical analysis of the data set reveals at least three distinct flux populations. Results from 2011 and 2012 indicate that flank fluxes were as high as 112.5 g/m^2/day, suggesting recent intrusive activity. The spatial distribution of fluxes indicates a strong focus on the NE sector. This finding appears concurrent with an area previously documented as continuously subsiding and filled with recent pyroclastic deposits. The surveys also permit selection and validation of sites for continuous CO_2 monitoring stations, representing medium and low flank flux populations.