Geophysical Research Abstracts
Vol. 16, EGU2014-15541-1, 2014
EGU General Assembly 2014

Identifying open and closed system behaviors at Tungurahua volcano (Ecuador) using SO_2 and seismo-acoustic measurements

Silvana Hidalgo (1), Jean Battaglia (2), Benjamin Bernard (3), Alexander Steele (1), Santiago Arellano (4), and Bo Galle (4)

(1) Instituto Geofísico, Escuela Politécnica Nacional, Quito, Ecuador (silvanahidalgo@hotmail.com), (2) Laboratoire Magmas et Volcans, CNRS UMR 6524, Univ. B. Pascal, IRD, Clermont-Ferrand, France, (3) Universidad San Francisco de Quito, Quito, Ecuador, (4) Chalmers University of Technology, Gothenburg, Sweden

Tungurahua is one of the most active volcanoes in Ecuador. It is located in Central Ecuador, 160 km South of Quito and 8 km South of the touristic town of Baños. Tungurahua had one eruption every century since 1500, with an activity characterized by ash fallouts and pyroclastic and lava flows. The current eruptive period of Tungurahua began in 1999 with multiple episodes of explosive activity that have threatened the local population. The monitoring network is constituted by 5 short period and 5 broadband seismic stations, 4 DOAS permanent instruments, 4 tiltmeters, 2 permanent high resolution GPS, 4 digital cameras and 10 acoustic flow monitors. The correct interpretation of the different data acquired by this network allows a better understanding of the eruptive behavior of Tungurahua in order to provide early warning to the local population.

Tungurahua changed its behavior from a continuously erupting volcano, as it was until 2008, to a sporadically erupting one, showing clear quiescence phases lasting from 40 to 184 days, and intense activity phases lasting from 15 to 70 days. Activity phases are characterized by Strombolian and Vulcanian eruptive styles, producing ash fallouts and in a few occasions pyroclastic flows. In terms of hazard to the local population, one of the goals of monitoring Tungurahura is to forecast the onset and evolution of eruptive phases. In particular the occurrence of large Vulcanian explosions which occur when the conduit is closed is a major issue.

Since 2010 we focused our study on the relation between SO_2 gas emissions, the seismic and acoustic energies of explosions and the tremor amplitudes. The first observation of comparing these different datasets is that the correlation between seismic and SO_2 degassing is not straightforward, and actually the relation reflects the conditions at the vent: open or closed.

The onset of eruptive phases in open conduit conditions can be identified which leads to an effective eruption forecasting. An example of this behavior is the eruptive phase between December 2009 and March 2010 when SO_2 measurements increased 4 days before the amplitude of tremor and 9 days before the occurrence of the first explosions. Conversely, if the vent is closed at the beginning of a phase and no evident seismic precursors are observed forecasting is hardly possible. During an ongoing eruptive phase, the relation between these parameters allows to identify periods when the conduit is totally open as degassing may occur almost without generating any seismicity. Therefore the forecasting of escalating open conduit activity or a partial closing of the system is possible. Such a case was observed and forecasted on December 2011.

In this work, we present observational evidence of these mechanisms which are used to identify possible patterns of evolution of the activity, contributing to a more effective volcanic hazard assessment.