Dissecting the August 2012 Paroxysmal Eruption: Advances and Challenges in Monitoring Open System Activity at Tungurahua Volcano, Ecuador

John J Lyons[1], Mario C Ruiz[2], Benjamin Bernard[3], Hugo Ortiz[2], Silvana Hidalgo[2]

[1]Alaska Volcano Observatory, US Geological Survey, USA, [2]Instituto Geofisico, Escuela Politecnica Nacional, Ecuador, [3]Universidad San Francisco de Quito, Ecuador

E-mail: jlyons@usgs.gov

Tungurahua volcano (5023 m) is an andesitic stratovolcano that looms more than 3 km above the surrounding population centers. Since reactivation in 1999, Tungurahua has been in a relatively open system state characterized by low-level strombolian and vulcanian activity, short periods of repose (days to months), and more violent paroxysmal eruptions capable of producing hazardous pyroclastic flows, subplinian columns, and voluminous ash falls. Transitions from low-level to more hazardous activity can be abrupt and make monitoring challenging. Tungurahua is actively monitored by the Instituto Geofisico (IG) in Quito, in collaboration with national and international partners, using data from broadband seismoacoustic stations, DOAS gas spectrometers, tiltmeters, an ash fallout quantification network, satellite thermal and gas data, and reports from local observers.

Here, we highlight an example of the current open system activity with a multi-parameter analysis of the short-lived paroxysmal eruption that occurred during August 2012. Based on ash fallout and seismoacoustic data, the duration of the eruption was ~20 days, with just 11 days of continuous, elevated energy release. The gas (SO_2), ash, and thermal emissions of the eruption were clearly seen from space, and although the estimated fallout volume (0.3-0.45 x 10^6 m^3) and explosive intensity (VEI=1) is low the ash fall significantly affected local air quality and agricultural production. The seismoacoustic data and observations of the eruption indicate that the eruption began with intermittent gas jetting and tremor that became strong and nearly continuous from 13-21 August, and was associated with strong ash fallouts and the highest SO_2 emissions observed since a DOAS network was installed in 2007. We compare correlation patterns between co-located seismic and infrasound sensors with gas emission and ash fallout data, and identify the patterns indicative of continuous emissions. Tremor and ash emissions abruptly declined on the 21st and strong explosions began to occur, generating small pyroclastic flows and ash columns to 4 km above the vent. The strongest explosive infrasound (>1000 Pa at 5.3 km from the vent) recorded since 2006 was generated on 21 August. Hundreds of explosions were recorded over 21-23 August, prior to a rapid decline in seismic and acoustic output and return to background activity within several days. This eruption sequence provides an example of the current open system activity at Tungurahua volcano, highlights the methods and efforts currently in use to monitor and analyze the activity, and emphasizes the challenges and scientific opportunities provided by open system volcanoes.