Flow and blow: Integration of seismic, infrasound, and video to elucidate surface phenomena (Jeffrey Johnson, Boise State University, Invited Speaker)

Many geophysical sources occur at (or near) the interface of the ground and atmosphere. When these sources occur rapidly, at ~second-long time scales, they can produce prodigious seismic and infrasonic waves, both of which can be readily recorded using seismometers and low-frequency microphones. During opportune conditions the surface sources may also be observed with cameras, which permit elucidation of source processes and quantification of responsible forces.

This presentation features seismo-acoustic signals produced by two active volcanoes, Santiaguito (Guatemala) and Villarrica (Chile), which exhibit a wide spectrum of surface activity including explosions, vigorous degassing, conduit resonance, rock fall and pyroclastic flows, and lahar activity.

At Santiaguito seismo-acoustic sources are examined in conjunction with video of the active vent to provide additional information on the timing and locations of sub-surface and surface movements (see Figure reprinted from Johnson et al., 2014 Geophysical Research Letters; doi: 10.1002/2014GL061310). Rapid inflation of the lava dome is related to both seismic and infrasound radiation. Descent of regular rock fall, and occasional small pyroclastic flows, are also observed and tracked using acoustic array techniques.

At Volcan Villarrica, infrasound and video observations are integrated to tell the story of its lava lake, which is observed to rapidly rise in the days and hours prior to the paroxysmal eruption of March 3rd, 2015. This eruption melted glacier and spawned a lahar, which advanced 10 km at an average speed of 38 m/s, and which was tracked using an infrasound array. Coupled seismo-acoustic observations in the future will be effective for constraining lahars as well as other types of surface geophysical phenomena.

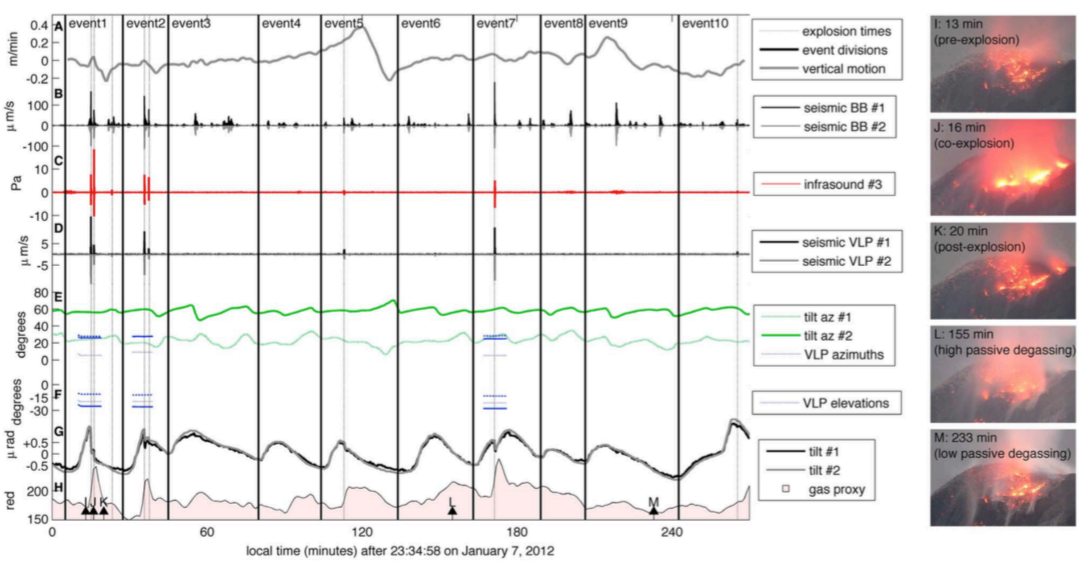

Figure 2. Joint geophysical observations from 4.5 h of typical Santiaguito activity are described. (a) Average vertical velocity of dome surface calculated using PIV [*Johnson et al.*, 2013], (b) broadband (BB; 0.05 to 20 Hz) composite vertical seismic shown for stations #1 (positive polarity; black) and #2 (negative polarity; grey) indicating both explosion and rock fall signals. (c) Infrasound (filtered above 0.25 Hz) pressure transients showing the occurrence of explosive degassing for cycles #1, 2, 5, and 7 (also indicated by vertical dashed lines). (d) VLP-filtered (0.05 to 0.2 Hz) seismic velocity records showing signal associated with explosions. (e) Principal azimuths of the short-duration rectilinear VLP signals and of tilt, for which the median directions are indicated in Figure 1. (f) Elevation angle (relative to horizontal) of VLP principal components. (g) Tilt records from two stations along with (h) gas flux proxy comparison, qualitatively extracted from red color band median intensity. (i–m) Nighttime images of the active dome surface for indicated times. Relatively low degassing periods (Figures 2i, 2k, and 2m). Heightened degassing associated with VLP inflation (Figure 2j) and non-VLP inflation (Figure 2l), respectively. Note that the animations of time-synced infrasound, seismic, tilt, and time-lapse footage for this time interval are provided as dynamic content in the supporting information.