Geophysical and geochemical observations of explosions dynamics at Santiaguito, Guatemala

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Santiaguito lava dome complex in Guatemala, presents an ideal location for the study of eruption dynamics at long-lived silicic eruptions. Here we present the first long-term seismic, infrasound and geochemical dataset over a period of significant activity at Santiaguito that can shed light on the deep and shallow volcanic processes that affect surficial activity. The geophysical instrument network, deployed in November 2014, comprises of seismometers and acoustic sensors located between 0.5 and 7 km away from the active vent. Ash and bomb samples collected during field campaigns over the subsequent two years were used to track changes in geochemistry during eruptive activity.

Since at least the early 1970s, activity at Santiaguito was characterised by regular, small gas-and-ash explosions from the summit crater, sometimes simultaneously with the extrusion of blocky lava flows. In mid-2015, a major shift in activity took place at Santiaguito where the regular gas-and-ash explosions were replaced by irregular, occasionally highly energetic, Vulcanian explosions sometimes accompanied by pyroclastic density currents. Furthermore, this sequence caused the lava-filled summit crater of El Caliente dome, the current eruptive centre at Santiaguito, to be excavated into a crater of ~150m depth. Differences in arrival times of seismic and acoustic waveforms suggest a deepening of the explosion initiation point during the sequence which may be linked to a change in bulk magma composition of eruptive products. The long-term trend in bulk chemical composition has seen a decrease from 66 wt% in 1922 to 61 wt% in recent years. Activity from early 2016 shows a rapid increase in SiO_2 of ~1.5 wt% over a 6-month period. Our dataset illustrates how deep magmatic processes can directly affect surficial activity during an ongoing silicic eruption. The results of the multi-parametric monitoring experiment have specific implications for hazard assessment at Santiaguito, and contribute to our understanding of the processes that control gas-and-ash explosive sequences at lava dome volcanoes.