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Monitoring record of a shift in explosivity at Santiaguito lava dome complex, Guatemala

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Santiaguito dome complex represents a unique opportunity to investigate shifts in eruptive activity, having produced regular (hourly to daily) small-to-moderate gas or gas-and-ash explosions for over 100 years.

The Liverpool Earth Observatory (UK), in collaboration with the Instituto Nacional de Sismologia, Meteorologia e Hidrologia (INSIVUMEH), Guatemala, established a multi-parameter geophysical network at Santiaguito in November 2014. The network, consisting of 5 broadband and 6 short-period seismometers, as well as 5 infrasound sensors, deployed around the active dome complex between 0.5 to 7 km from the vent, has collected a wealth of seismic, acoustic and deformation data. This has been complemented by several campaigns of visual and thermal infrared imaging of activty, and collection of rock and ash samples for laboratory analysis.

Our deployment captured the transition, in the last 12 months, to a new phase of activity at Santiaguito, characterised by the onset of vigorous vulcanian-style explosions producing large, ash-rich, plumes (reaching <5 km height), commonly accompanied by hazardous pyroclastic flows. This shift in activity has led to substantial deepening of the summit crater. The 2014-2016 dataset has allowed us estimate the volume fractions of ash and gas in eruptive plumes. The small proportions of ash inferred in the plumes prior to the shift in activity is in agreement with other studies that suggest these events did not involve significant magma fragmentation in the conduit. The results also agree with the suggestion that sacrificial fragmentation along fault zones in the conduit region, due to shear-induced thermal vesiculation, may be at the origin of such events.

The compelling dataset that documents this transition sees concordant shifts in energy released by explosions, lava dome and flow morphology and bulk chemistry. We conclude that our observations at Santiaguito have the potential to considerably advance our understanding of effusive-explosive transitions at active volcanoes worldwide.