Sequential plug formation, disintegration by Vulcanian explosions, and the generation of granular Pyroclastic Density Currents at Tungurahua volcano (2013–2014), Ecuador

Minard L. Hall, Alexander L. Steele, Benjamin Bernard, Patricia A. Mothes, Silvia X. Vallejo, Guilhem A. Douillet, Patricio A. Ramón, Santiago X. Aguaiza, Mario C. Ruiz

Instituto Geofísico, Escuela Politécnica Nacional, Ecuador

Abstract

Following 84 years of repose, Tungurahua volcano, Ecuador initiated its present eruptive episode in October 1999, but its PDC activity only began in July 2006. A period of highly energetic Vulcanian eruptions started in 2012, those of 14 July 2013, 18 October 2013, and 1 February 2014 being the most important. These eruptions were well-monitored by a 5-station broadband seismic and acoustic array. Repeated repose intervals of ~ 3.5 months between Vulcanian events (VEI ~ 2) suggest that gases in the ascending juvenile magma experienced sequential pressurization cycles, as magma of preceding eruptive events solidified to form plugs that sealed the conduit. Every 34 months plug failure occurred, abrupt decompression followed, and the resulting Vulcanian explosions are associated with the highest seismic and acoustic energies ever registered anywhere. Small to moderate-sized PDC flows associated with the explosions and fountain collapses were generated and traveled ≤ 7 km down the steep N, NW, and W flanks of Tungurahua's cone at velocities of 11 to 18 m/s, although a small lateral blast and its PDC were clocked at 33 m/s descending the N flank. The explosive fragmentation of the plugs (a dense microcrystalline andesite) and the juvenile magma (a vesiculated glassy andesite) comprise the principal rock fragments of the PDC deposits. Each deposit typically consisting of two layers; a thin upper layer of large segregated and abraded clasts with few fines and a thicker lower layer that is fines-rich with few large clasts. Many deposits were studied and photographed within a few days of their formation, which are presented.

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