Replenishment of volatiles into a degassed chamber driving mixing and eruption of Tungurahua volcano

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In July and August of 2006, and May of 2010, multiple 'boiling over' pyroclastic flow-forming eruptions occurred at Tungurahua volcano, Ecuador. These eruptions marked increased explosivity compared to the low-energy events that characterized most of Tungurahua's volcanic behavior between when activity reinitiated in 1999, and 2006. Volatile (H_2O, CO_2, S, Cl) and major-element concentrations of 39 melt inclusions hosted within olivine and pyroxene phenocrysts were analyzed from these events in order to reconstruct the magmatic conditions present before these eruptions as a means to understanding the 'boiling over' process. Heterogeneity within melt inclusions indicate two distinct magma bodies are being preserved, one volatile rich (water ~4.0 wt.% and sulfur ~1800 ppm) within more primitive olivine-hosted melt inclusions and a secondary population of relatively degassed magma from more evolved pyroxene-hosted inclusions. The degassed magma contains water concentrations ~1.0 wt.% and sulfur concentrations between 100 and 500 ppm. The interaction of these two magma batches preserved by melt inclusions is consistent with the model that the 2006 eruption was the result of mafic recharge into a shallow, degassed chamber, and subsequent mixing. Melt inclusions from the 2006 and 2010 eruptive products have similar volatile concentrations and major elemental compositions, indicating that both magma bodies are sampled in both years. We propose that these 'boiling over' pyroclastic flows are the result of the recharge of a volatile saturated magma into a more evolved, degassed magma body.