Cities on Volcanoes 9
November 20-25, 2016
Puerto Varas, Chile
'Understanding volcanoes and society: the key for risk mitigation'

New insights on flank collapse and directed explosions hazards from hydrothermal eruptions at La Soufrière de Guadeloupe (Lesser Antilles)

Jean-Christophe Komorowski[1], Marc Peruzzetto [2], Marina Rosas-Carbajal [1], Anne Le Friant [1], Anne Mangeney [1], Yoann Legendre [3]

[1]Institut de Physique du Globe de Paris, Sorbonne Paris Cité, CNRS UMR-7154,

[2]MINES ParisTech, Paris, France 3 : BRGM, Direction Régional Guadeloupe, Guadeloupe (FWI)

Keywords: flank collapse, directed explosions, hydrothermal, hazards, Guadeloupe

Detecting unrest that could herald the onset of non-magmatic collapse of a hydrothermally-altered and pressurized volcano constitutes a significant challenge. Recent eruptions of Ontake (2014) and Tongariro (2012) underscore the hazards and risks associated with sudden, often unpredictable non-magmatic hydrothermal eruptions at volcanoes characterized by long-lasting non-magmatic unrest. At La Soufrière de Guadeloupe, exegesis and re-analysis of historical chronicles has shown that 3 of 6 historical non-magmatic hydrothermal eruptions (1797-1798, 1836-1837, 1976-1977) have produced: 1) small-volume laterally-directed explosions; 2) small-volume highly mobile high-energy dilute turbulent pyroclastic density currents (PDCs) with runouts ? 1.5-2 km; 3) small-volume collapses of parts of the dome that formed rockslides and/or debris avalanches; and 4) the exurgence of pressurized warm to hot acid hydrothermal fluid from eruptive fractures. We reinterpret the available data on historical eruptions at La Soufrière in light of new field data and the recently published geophysical imaging of the hydrothermal system to determine likely scenarios (geometry, volume) of partial edifice collapses for La Soufrière. We model, using the published SHALTOP code, the emplacement of associated debris avalanches as granular flows for different scenarios. Intensifying since 1998, hydrothermal unrest at La Soufrière involves degassing and circulation of very acid hydrothermal fluids that favor pervasive alteration and mechanical weakening of the core of the dome. Results show that debris avalanches and associated dilute turbulent non-magmatic PDCs could reach several kilometers from the dome into populated areas of the southern flanks of the volcano. Given that flank instability of hydrothermally altered and pressurized regions of a volcano can be triggered by seismic, hydrothermal, magmatic, and meteorologic forcings, our results have implications for risks assessment as well as for continuing monitoring strategies on La Soufrière volcano.