# Numerical Modeling of Volcano Hydrothermal Systems: the case of La Soufrière de Guadeloupe Volcano (West Indies, France)

*Marina Rosas-Carbajal[1]

1. Institut de Physique du Globe de Paris

Numerical modeling is key to understand the dynamics of volcanic-hydrothermal systems and their promptness to eruption. Realistic sets of numerical simulations are rare, due to the limited information available on critical parameters such as rock properties and 3-D hydrothermal structure. At La Soufrière de Guadeloupe, state-of-the-art geophysical, geochemical, and geological studies have contributed to an in-depth characterization of the geometry and dynamics of the shallow hydrothermal system. Using the TOUGH2 numerical code we solve the coupled heat and multi-phase fluid flow in a 3-D model accounting for La Soufrière topography. We consider rainfall infiltration and a diffuse source at the bottom of the model domain that injects deep (magma-derived) hot fluids in a central, large-permeability conduit. With this setup, we study the influence of the magmatic source (mass and temperature), rainfall, and rock properties on fluid and heat flow patterns and vapor/liquid content distributions. A relatively simple model allows us to reproduce the first order geophysical and geochemical characteristics, particularly the total heat and mass output from fumaroles. Topography plays a major role in determining the distribution of hydraulic loads and then the geometry of the main hydrothermal reservoir where fluid circulation, and thus alteration, are higher. Several key system properties can be further constrained, such as permeability and, particularly, the input flow rate of deep hot fluids, which is a priority to evaluate hazardous scenarios. These refinements are based on the identification of steady-state solutions of the hydrothermal structure that match geophysical imaging while reproducing the mass and heat surface outputs.

Keywords: Volcano Hydrothermal System, Numerical Simulations, La Soufriere de Guadeloupe