Relating Deformation and Gas Flux Using a Sealed System Model at Telica Volcano, Nicaragua

Emilie Saucier[1], Peter C. LaFemina[1]

[1]*Department of Geosciences, The Pennsylvania State University, University Park, PA, USA*

Telica volcano, Nicaragua is a persistently active volcano with high rates of geophysical (low and high frequency seismicity) and geochemical (degassing) unrest. The persistent activity is interrupted by sub-decadal phreatic to phreatomagmatic explosions. The current hypothesis for this behavior, based on a decade of seismic, geodetic and degassing observations, is that the volcano-magmatic system changes from open-system degassing to a closed system, driven by sealing of the upper conduit and hydrothermal system through mineralization. The formation of a seal prevents gases from fully escaping the volcanic conduit, resulting in a decrease of the measured gas flux in the volcanic plume, as well as an increase of pressure in the shallow volcanic conduit due to gas accumulation. The increase of pressure causes deformation of the volcanic edifice, and ultimately failure of the seal driving phreatic explosions. Additionally, the shallow gas accumulation is indirectly observed through a decrease in LF seismicity. The aim of this project is to quantitively test this hypothesis by modeling the impact of sealing on the degassing flux and the deformation observed at Telica. The results of the model are compared to the 2011 to 2015 inter-eruptive period and gives insight on the temporal changes of degassing rate and deformation observed at Telica prior to an eruption, in relation to the sealing hypothesis. This model could then give valuable insights into forecasting eruptions at Telica Volcano, using real time data.

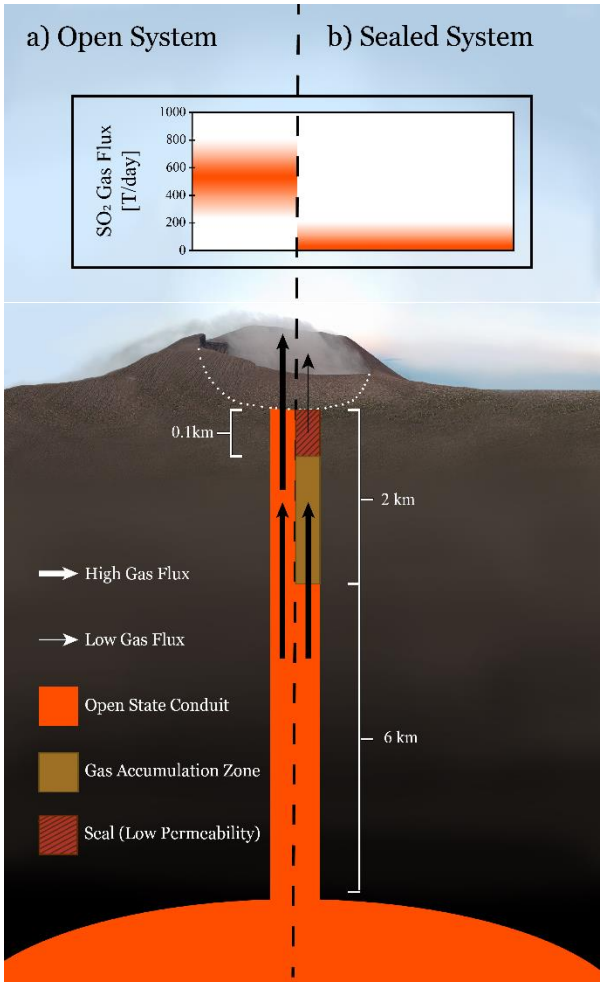

Figure 1: Illustration of the model geometry. The crater of the volcano is connected to the magma chamber by a cylindrical conduit. a) The system is fully open and the degassing rate in the plume is equal to the degassing rate of the magma through the conduit. b) The system is partially sealed and the degassing rate in the plume is less than the degassing rate of the magma through the conduit. As a result, gas accumulates in the shallow part of the conduit driving deformation and ultimately explosions.