Combining InSAR and GNSS to model magma transport during the May 2016 eruption of Piton de la Fournaise Volcano (La Réunion Island

*Valerie Cayol[1], Delphine Smittarello[2], Virginie Pinel[2], Aline Peltier[3], Jean-Luc Froger[1]

1. CNRS, UCA, LMV, OPGC, IRD, Clermont-Ferrand, France, 2. ISTerre, IRD, CNRS, USMB, Le Bourget du Lac, France, 3. OVPF, IPGP, UP, CNRS, La Réunion, France.

Magma propagation is an unsteady and complex process controlled by the magma-crust interaction. For instance, at Piton de la Fournaise volcano (La Réunion, France), intrusions have different velocities depending on the distance of the eruptive fissures from the summit, some intrusions fail to result in eruptions, and eruptive fissures can be located at the summit, on the cone flanks or can be distal. To gain information into the dynamics of magma propagation at the volcano, we invert complementary ground deformation data which cover the 8 hours preceding the May 2016 eruption. Data are inverted using 3-D boundary element models combined with a Monte Carlo inversion method in order to search for the best magma intrusion geometry. We first retrieve the final geometry of the intrusion based on four interferograms, both in ascending and descending tracks, spanning the whole propagation phase. The imaged intrusion consists in a 2700 m long sill located at an elevation of 800 m, connected to the eruptive fissure by a 880 m sub-vertical dike. Using continuous GNSS data and a Sentinel-1 InSAR interferogram acquired during the propagation phase, we show the a-priori brought by InSAR is required to constrain the intrusion depth. Temporal inversions with a 5 min time step evidence that the horizontal part of the intrusion opens a few tens of minutes after the beginning of the crisis. The intrusion then stalls for 5 hours, with no volume increase, until the last part of the intrusion propagates vertically in a fracture narrower than the sill.The unsteady propagation and the final change of direction indicate the presence of structural barriers to propagation, while the lack of volume change and the narrow vertical fracture might be related to magmatic gas in the final part of the intrusion.

Keywords: Joint inversion, deformation data, Piton de la Fournaise volcano

