Basaltic intrusions propagation modeling based on InSAR and GNSS data, application to the May 2016 eruption of Piton de la Fournaise Volcano (La Réunion Island).

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Résumé

Magma stored beneath basaltic volcanoes is often transported by propagation of sheet intrusions (dikes or sills), which can lead to fissural eruptions when intersecting the Earth's surface. The propagation generate seismicity and surface deformation during a few minutes/hours before the eruption begins. The purpose of this work is to study the dynamics of magma propagation, by use of complementary ground deformation data. Our approach consist in jointly inverting InSAR (good spatial resolution) and continuous GNSS (good temporal resolution) data to retrieve information on the intrusion during its propagation. We apply this method on geodetic data (2 Sentinel 1 and 2 Cosmo-Skymed interferograms, 10 continuous GNSS stations) recorded during the May 2016 eruption of Piton de la Fournaise Volcano. We first use 3-D boundary element models combined with a Monte Carlo inversion method to retrieve the final geometry of the intrusion. Then we perform a succession of independant inversions with a 10 min time step to localize the active area on this geometry using continuous GNSS data. Our results show that magma is transported through a sill propagating laterally at an altitude of 600m, which then turns into a subvertical dike in its final part. Although the seismic crisis lasted for more than 7 hours, we show that the sill is in place rapidly (less than 3 hours after the begining of the crisis), propagation seemed to stop, but the volume and pressure continued to increase until the opening of the final and vertical part of the fracture and the eruptive fissure 4 hours later.

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