EGU22-9024
https://doi.org/10.5194/egusphere-egu22-9024
EGU General Assembly 2022

Joint analysis of GNSS and seismic data to track magma transport at Piton de la Fournaise volcano (La Réunion, France)

Cyril Journeau[1], Aline Peltier[2,3], Nikolai Shapiro[1,4], François Beauducel[2], Valérie Ferrazzini[2,3], Zacharie Duputel[2,3], and Benoit Taisne[5]

[1]Institut des Sciences de la Terre (ISTerre), Université Grenoble Alples (UGA), CNRS (UMR 5275), Grenoble, France
[2]Institut de Physique du Globe de Paris (IPGP), Université de Paris, CNRS (UMR 7154), Paris, France
[3]Observatoire Volcanologique du Piton de la Fournaise (OVPF), Institut de Physique du Globe de Paris, Université de Paris, CNRS (UMR 7154), La Réunion, Paris, France
[4]Schmidt Institute of Physics of the Earth, Russian Academy of Sciences, Moscow, Russia
[5]Earth Observatory of Singapore, Nanyang Technological University, Singapore, Singapore

Geophysical measurements from the networks of instruments maintained by volcano observatories for several decades provide a large database that is rich in information concerning magma transport from deep storage zones to its shallow propagation before eruptions. In this study, we analyze multi-year time series of GNSS and seismic data acquired at Piton de la Fournaise (PdF) volcano (La Réunion, France) from 2014 up to now. These observations are sensitive to the dynamics of the magma within the volcanic system and their detailed study allows us to better apprehend its behavior both during pre-eruptive periods, by informing us about the preparation phases before an eruption and also during co-eruptive periods, by following the eruptions time-evolution and the corresponding dynamics.

We propose to scan continuously GNSS data by inverting them in time windows ranging from minutes to days using a point compound dislocation model (pCDM). This approach provides analytical expressions for surface displacements due to a complex source of deformation with variable geometry to model different shapes such as dikes, prolate ellipsoids, or pipes. As a result, we image a deep reservoir around 7-8 km below the PdF summit, as well as, in some cases, the upward magma migration dynamics in the crust over several days toward a shallow reservoir at sea level and the final dyke propagation over a few hours that ultimately feeds the eruptive site.

These observations are systematically compared to seismic data over the same time period and are jointly interpreted. We use both the seismicity catalog of "regular" volcano-tectonic events as well as the results of cross-correlations network-based methods obtained with the CovSeisNet package allowing the detection of “un-regular” signals and the location of their sources, such as micro-seismicity generated during dyke propagation, and long-period seismicity (tremor and LP events).

The joint use of information from geodetic and seismic networks constitutes an important step in improving our knowledge of volcanic systems. While the analysis of GNSS network data enables the imaging of active pressure-sources in the system with an estimation of the volumes of involved magma, the seismic network analysis allows for a more detailed view of the magma dynamics in the volcanic edifice.

How to cite: Journeau, C., Peltier, A., Shapiro, N., Beauducel, F., Ferrazzini, V., Duputel, Z., and Taisne, B.: Joint analysis of GNSS and seismic data to track magma transport at Piton de la Fournaise volcano (La Réunion, France), EGU General Assembly 2022, Vienna, Austria, 23–27 May 2022, EGU22-9024, https://doi.org/10.5194/egusphere-egu22-9024, 2022.

Displays

Display file

Comments on the display

Login to access the discussion