Piton de la Fournaise Flank Displacement during the March-April 2007 eruption

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Résumé

The April 2007 eruption of Piton de la Fournaise was the biggest volcano eruptive crisis of the 20th and 21st centuries. InSAR captured a large (1.4 m) co-eruptive seaward slip of the volcano's eastern flank, which continued for more than a year at a decreasing rate after the end of the eruption. Co-eruptive uplift and post-eruptive subsidence were also observed. While it is generally agreed that volcano flank displacement might be induced by fault slip, we investigate whether this flank displacement might have been induced by a sheared sill, as suggested by observations of sheared sills at Piton des Neiges. To test this hypothesis, we develop a new method to invert a quadrangular curved source submitted to coeval pressure and shear stress changes. This method, based on boundary elements, is applied to co-eruptive and post-eruptive InSAR data. Post-eruptive displacement is well explained by slip and closure of a large fracture sub parallel to the topography (5 km by 8 km), and probably coincident with a lithological discontinuity. The amount of closure is too large and the closure time too short to be explained by a thermally compacting sill, allowing to rule out the sill hypothesis. Co-eruptive displacement can be explained by a smaller (2 km by 2 km) fracture at the same location, submitted to a zero overpressure and a 3 MPa shear stress drop, which confirms that the determined structure is not a sill. We conclude that the fracture is a detachment fold, shallow enough to induce the observed coeval uplift. Rate and state friction is used to understand the causal link between the co and the post eruptive flank displacement.

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