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The temporal and spatial evolution of pre-eruptive seismicity on Piton de la Fournaise, La Réunion Island.

Megan Zecevic (1,2), Louis De Barros (1,3), Christoper Bean (1), Florent Brenguier (4), and Aline Peltier (5)

(1) Seismology Lab., School of Geological Sciences, University College Dublin, Dublin, Ireland., (2) Magnitude, Route de Marseille, 04220 Sainte-Tulle, France (megan.zecevic@magnitude-geo.com), (3) Géoazur, Université Nice Sophia Antipolis, CNRS, Observatoire de la Côte d'Azur, Sophia Antipolis, France., (4) ISTerre, Université J. Fourier, CNRS, OSUG, Grenoble, France., (5) Observatoire Volcanologique du Piton de la Fournaise - Institut de Physique du Globe de Paris, Sorbonne Paris Cité, Univ Paris Diderot, CNRS, France.

Piton de la Fournaise, La Réunion Island, is a very active basaltic volcano with five eruptions between November 2009 and December 2010. Eruptions on Piton de la Fournaise are typically heralded by a seismic crisis that generally follows the volcano-earthquake swarm pattern described by McNutt (2000) with a typical duration of several hours. The seismic crises mainly consist of a volcano-tectonic (VT) swarm, followed by a period of seismic quiescence and then tremor associated with the emission of lava. The VT events are located beneath the summit crater at depths between sea level and 800 m a.s.l.. However, during some seismic crises long-period (LP) events have been identified just after the VT seismicity rate peaks. The LP events have been located beneath the summit crater at shallow depths (< 200 m beneath the surface). We also identified another swarm of events with very high frequency content on a small number of stations during the so-called "quiescent period" between the volcano-tectonic swarm and the eruptive tremor. These high frequency events are shallow and are located close to the future eruption site.

Magma migration on Piton de la Fournaise follows a two-phase pattern – vertical migration followed by a lateral migration to the flank – which is observable on GPS data. In order to identify how the different types of pre-eruptive seismicity are associated with the migration of magma from deep within the volcano to the eruption site, the seismic data are put into context with GPS deformation data and radiated seismic intensity locations. The VT events are associated with the vertical migration of magma from depth, whereas the LP events appear to coincide with the transition from vertical to lateral migration. The high frequency events seem to be associated with the opening of the path for the magma propagating laterally at shallow depth. As these events start to occur while the magma is still in a vertical propagation phase, this seismicity seems to be related with the generic response of the volcano to the stress perturbation and not directly induced by the magma pressure. This new observation brings new insights to short-term forecasting of the eruption location.