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Migrations of seismicity at Piton de la Fournaise volcano

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We apply a template matching approach to detect and localise earthquakes that occurred during three pre-eruptive crises at Piton de la Fournaise volcano in 2014 and 2015. We recover many more events than included in the original catalog and improve the resolution of the earthquake locations. We highlight some persistent features of the volcanic seismicity through multiple eruption phases. The shallow seismicity defines two horizontally extended clusters located beneath the summit crater Dolomieu. These two clusters collapse into a single elliptical structure that holds into a plan. This structure is activated before each of the studied eruptions. Earthquake migration on this structure is also observed preceding two of the eruptions. We also track magma transfer from a deep source by following the migration of the earthquake that occurred in April 2015. Earthquakes migrate upward during around 10 days at a similar location to the 1998 pre-eruptive earthquake sequence. The location of this deep seismicity do not evidence a continuous upward migration of the magma but rather highlights several locations with an abundant seismicity while some other depth intervals are seismically silent. It implies that the magma progress passively through the volcanic edifice at most depth intervals and only few faults, close enough to failure, are responsible for the seismic activity. Between the shallow events and this deep seismicity a zone with no earthquake is interpreted as the seat of a shallow magma reservoir. The volcano tectonic earthquakes recorded on Piton de la Fournaise appears related to the presence of structures near to failure activated by the stress transfer caused by the intruding magma body and seems not necessarily be a direct indicator of the magma location. The planar structure identified below the summit crater could be part of a larger structure possibly linked to a detachment plane which mostly slips aseismically.