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# Basaltic degassing mechanisms and eruptive dynamics revealed by textural, geochemical and geophysical monitoring of Piton de la Fournaise (2014-2017)

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Small-volume proximal eruptions are common at Piton de la Fournaise (La Réunion Island, France). However, the mechanisms driving such basaltic eruptions are still not completely understood. To gain insight, we focused on a well-constrained multidisciplinary dataset for the two short-lived (∼2 day-long) eruptions of June 2014 (0.4 million m3) and July 2015 (2 million m3), which occurred near the SE rim, and on the NE flank, of the central cone, respectively. These two events were part of a new eruptive cycle that began in June 2014 following 3.5 years of quiescence. Geophysical measurements of the eruption coupled with textural and petro-chemical studies of the eruptive products have been used to constrain the source, trigger mechanisms, time and space evolution of the eruptions as well as the ascent and degassing history of the magma. Based on this approach four main groups of pyroclasts were identified in both eruptions: "golden pumice", "fluidal scoria", "spiny-glassy scoria" and "spiny-opaque scoria". Density analyses performed on more than 400 lapilli reveal that while the spiny-opaque clasts are the densest (1600 kg/m3) and most crystalline (55 vol. %), the golden pumice are the least dense (400 kg/m3) and crystalline (8 vol. %). The vesicle connectivity measurements indicate that the fluidal and golden (Hawaiian-like) clasts have more isolated vesicles (up to 40 vol. %) than the spiny (Strombolian-like) clasts (0-5 vol. %). These textural variations are linked to primary pre-eruptive magma storage conditions. While the golden and fluidal fragments track the hotter portion of the melt, the spiny fragments and lava mirror the cooler portion of the shallow reservoir. Exponential decay of the magma ascent and output rates through time revealed depressurization of the source during which a stratified storage system was progressively tapped. Increasing syn-eruptive degassing and melt-gas decoupling led to a decrease in the explosive intensity from early fountaining to Strombolian activity. The geochemical results confirm the absence of new input of hot magma into the 2014 reservoir and confirm the emission of a single, shallow, differentiated magma source, possibly related to residual magma from the November 2009 eruption. Fast volatile exsolution and crystal-melt separation (second boiling) were triggered by deep pre-eruptive magma transfer and a stress field change. In contrast, the July 2015 eruption was triggered mostly by the incipient input of hot magma that was revealed by ground deformation and deep seismicity, and then highlighted both by slight inverse plagioclase zonings and by more primitive bulk compositions of magma in respect to those of February and May 2015. In addition, the golden pumice component was very scarce in the July 2015 eruption and the quenched lava samples were more vesicular (average 53vol.%) in respect to the 2014 lava (average 32 vol. %) in agreement with a less stratified reservoir. To conclude, these results highlight the importance of petrological monitoring in providing complementary information regarding ongoing volcanic activity to be merged with other geophysical and geochemical monitoring tools.