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Eruption and degassing dynamics of the major August 2015 Piton de la Fournaise eruption

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Piton de la Fournaise (PdF) shield volcano is one of the most active basaltic volcanoes in the World with one eruption every nine months, on average. This frequent volcanic activity is broadly bimodal, with frequent small volume, short lived eruptions (< 30 Mm3, most being < 10 Mm3) and less frequent relatively large (50-210 Mm3) and long lasting (months) eruptions. After the major caldera forming event of 2007, the volcano produced several short lived small volume summit to proximal eruptions of relatively evolved cotectic magmas and relatively long repose periods (up to 3.5 years between 2010 and 2014). The August 2015 eruption was the first large (45±15 Mm3) and long lasting (2 months) eruption since 2007 and the only event to be fully monitored by the new gas geochemical network of Piton de la Fournaise volcanological observatory (DOAS, MultiGaS, diffuse CO_2 soil emissions). Regular lava and tephra sampling was also performed for geochemical and petrological analysis. The eruption was preceded by a significant increase in CO_2 soil emissions at distal soil stations (ca. 15 km from the summit), with CO_2 enrichment also being recorded at summit low temperature fumaroles. Eruptive products were spectacularly zoned, with plagioclase and pyroxene being abundant in the early erupted products and olivine being the main phase in the late-erupted lavas. Total gas emissions at the eruptive vent underwent a decrease during the first half of the eruption and then an increase, mirroring the time evolution of magma discharge rate (from 5-10 m3/s in September to 15-30 m3/s in late-October) and the progressive change in magma composition. In spite of significant evolution in magma and gas output, CO_2/SO_2 ratios in high temperature gases remained quite low (< 0.3) and with little temporal change. Geochemical data indicated that this relatively long-lived eruption corresponded to the progressive drainage of most of the shallow part of PdF plumbing system, triggered by a new pulse of deep magma. While erupted magma and high temperature gases were mostly provided by the shallow part of the system, distal sites and summit low temperature fumaroles recorded a deeper triggering mechanism.