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Volcanological Map of the Plaine des Sables, Piton de la Fournaise

Claudia Principe, Andrea Morandi, Andrea Di Muro
and Laurent Michon

The “Plaine des Sables” (PdS) is the main entry door for the visitor approaching the summit area of Piton de la Fournaise (PdF) basaltic shield volcano. The plain, located between 2300 and 2400 m asl and 5 km west of PdF summit crater, owes its name to a m-thick continuous cover of basaltic lapilli that strongly contrast with the dominantly effusive behavior of PdF. Several cones of variable volume and size and related lava flows occur scattered inside the PdS.

This map is the first detailed map of PdS and represents a first attempt to introduce synthemantic units for the study of the Piton de la Fournaise volcanological district. The new cartography is

offered in this first version with a relatively detailed resolution (1:5000) and on a DEM base (courtesy of N. Villeneuve, OVPF). Synthemantic mapping is based on unconformity surfaces, which permit to define key geological events inside the stratigraphic succession of volcanic deposits (Salvador 1987). In the PdS case, this approach allowed grouping the whole PdS activity occurred after the collapse of the “Plaine des Sable” caldera (Plaine des Sables Synthem; <60–24 ka; Merle et al. 2010; Staudacher and Allègre 1993) by means of a first order unconformity represented by the collapse scarp itself. The eastern side of the PdS is bounded by a second scarp related to the younger (<4.8 ka) “Enclos Fouqué” caldera (Bachèlery 1981; Ort et al. 2015). Inside the PdS Synthem, the stratigraphic unit of Bellecombe ashes (#bac) groups at least three eruptive events occurred between 4880 ± 35 BP and 2855 ± 35 BP (Morandi et al. 2016; Ort et al. 2015) and represents the main depositional marker over the whole PdS area. Bellecombe ashes were emplaced during the main explosive (phreatomagmatic) event known at PdF (Bachèlery 1981; Michon et al. 2013; Morandi et al. 2016) and whose source area was partly located inside the PdS itself (Ort et al. 2015). Several cones (e.g. #c) and voluminous lava units (#ol and #oc) predate Bellecombe activity. The age of #oc lavas emitted before Enclos Fouqué collapse by central vents located east of the PdS is in the range 5.1–3.5 ka (Staudacher and Allègre 1993). Lavas range from

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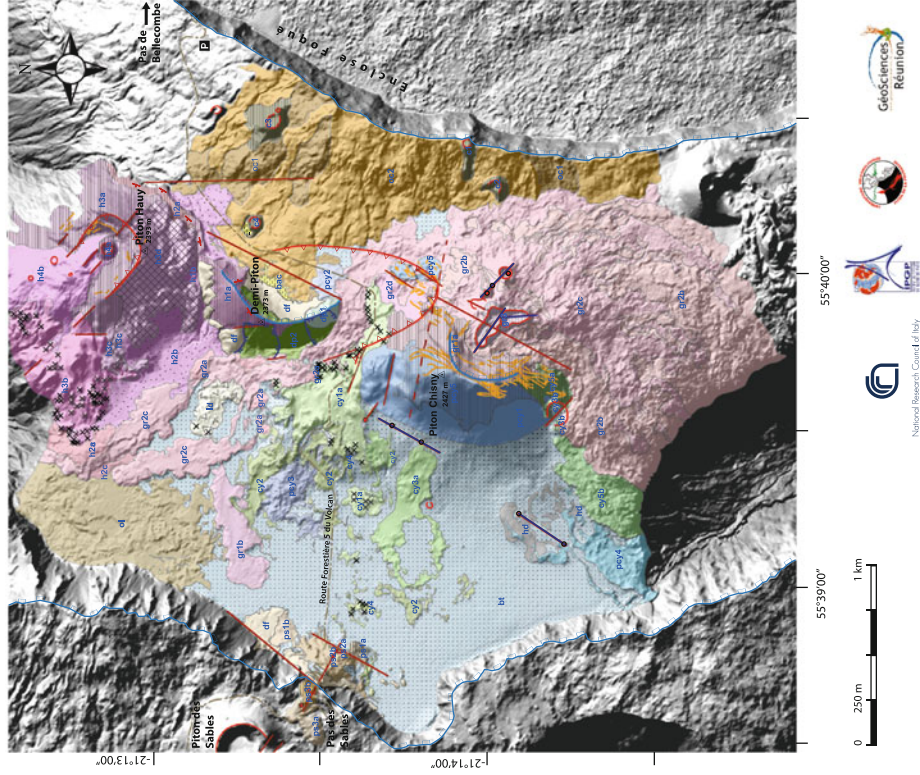
Volcanological map of Plaine des sables, Piton de la Fournaise (Ile de la Reunion)

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Graphics by Andrea Morandi, Antoine Raullin and Simon La Falce

Fig. S1 Supplementary figure: Volcanological map of Plaine des Sables, Piton de la Fournaise (Ile de la Réunion, France)

aphyric to olivine—rich (oceanite) basalts and span the whole range of surface textures known at PdF (Morandi et al. 2015). An outstanding feature of many lavas cropping out in the PdS is the abundance of ultramaphic (dunite-werhlite) nodules, testifying unusually deep magmatic storage levels (Bureau et al. 1998).

Two main lapilli units (Chisny Black Tephra, #bt and Haüy Yellow Tephra #h2) permit stratigraphic correlation across most of the PdS area. Beside typical monogenetic activity widespread on PdF massif, at least three large polygenetic centers can be identified inside PdS: Demi Piton, Piton Chisny, and Piton Haüy (Michon et al. 2015; Morandi et al. 2015, 2016). Their eruptive dynamics ranges from violent lava fountaining (e.g. #bt and #h2) to long lasting effusive behavior (e.g. ‘Gueule Rouge’ lava lake, east of Chisny Rampart; #gr3). With the notable exception of Bellecombe ashes, phreatomagmatic activity seems to play only a very minor role in the activity of the PdS. Bellecombe ashes have been grouped in a single sub-synthem, which permits to propose a relative chronology for the largest cones of the PdS, namely Demi Piton #dp (pre-Bellecombe), Haüy #h and Chisny cones #cy and #pcy (post-Bellecombe). The main age constraints for the youngest part of the volcanic sequence correspond to a radiocarbon age of 1105 ± 60 BP for a lava down the Langevin valley (Bachelery 1981; Tanguy et al. 2011) and an even younger age for the Black Tephra fall emplaced during the late activity of Chisny cone (381 ± 26 BP; Morandi et al. 2016). Mapping of Piton Chisny and Piton Haüy products highlights the presence of two Debris Avalanches deposits (DAD #cy1 and #h3b) and related scarps and hummocks, as well as the morphological evidence of a number of eruptive and non-eruptive fractures.

The unvegetated lapilli cover which gives the name to the Plaine des Sables was mainly originated from the young activity of lava fountaining of Chisny (southern part of the plain) and Haüy (northern part of the plain) eruptive centers. In the central and northern portion of the map, other minor lapilli blankets are present, but have very

limited dispersion, confined close to the source areas (Morandi et al. 2016).

Our work demonstrates that the Plaine des Sables has been the site of frequent and sometimes violent eruptive activity even in recent times, shortly before the beginning of human settlement on the La Réunion island. This excentric activity of PdF was periodically able to shed ashes and lapillis all over and outside the Plain des Sables. The most voluminous eruptions emitted lavas able to propagate down the main valleys, towards the villages and the towns located at the feet of the PdF massif. Most important, this excentric activity does not correspond only to monotonous piling of lavas or mild strombolian activity from a single constant source. PdS activity indeed developed on scattered and sometimes long-living eruptive centers and was able to produce a wide span of eruptive behaviors and volcanic hazards. The Plaine des Sables must therefore be considered as one of the most active and potentially hazardous sectors of the PdF massif (Di Muro 2012 and 2015).

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