



A - Piton de la Fournaise activity

PITON DE LA FOURNAISE (VNUM #233020)

Latitude: 21.244°S

Longitude: 55.708°E

Summit elevation: 2632 m

Piton de la Fournaise is a basaltic hot spot volcano located in the southeastern part of La Réunion Island (Indian Ocean).

The volcano first erupted about 500,000 years ago. Its volcanic activity is characterized by frequent effusive eruptions (with emissions of lava fountains and lava flows) that occur on average twice a year since 1998. More rarely, larger explosive eruptions (with blocks covering the summit area and ash emissions that can disperse over long distances) have happened in the past with a centennial recurrence rate.

Most of the current eruptive activity (97% during the last 300 years) occurs from vents inside the Enclos Fouqué caldera. A few eruptions, however, have occurred from vents outside the caldera (most recently in 1977, 1986, and 1998). Such eruptions can potentially threaten communities that live in the surrounding areas.

Since late 1979, the activity of Piton de la Fournaise is monitored by the Piton de la Fournaise Volcanological Observatory (Observatoire Volcanologique du Piton de la Fournaise - OVPF), which belongs to the Institut de Physique du Globe de Paris (IPGP).

Volcano Alert level: Vigilance

(since October 11, 2020)

(cf. table in the appendix)

Seismicity

In November 2020, the OVPF recorded at Piton de La Fournaise:

- 4 shallow volcano-tectonic earthquakes (0 to 2.5 km depth) below the summit craters;
- 9 deep earthquakes (2.5-5 km depth);
- 165 rockfalls (inside the Cratère Dolomieu or along the cliff of the Enclos Fouqué caldera and the Rivière de l'Est rempart).



Figure 1: Number of shallow volcano-tectonic earthquakes recorded in November 2020 (© OVPF-IPGP).

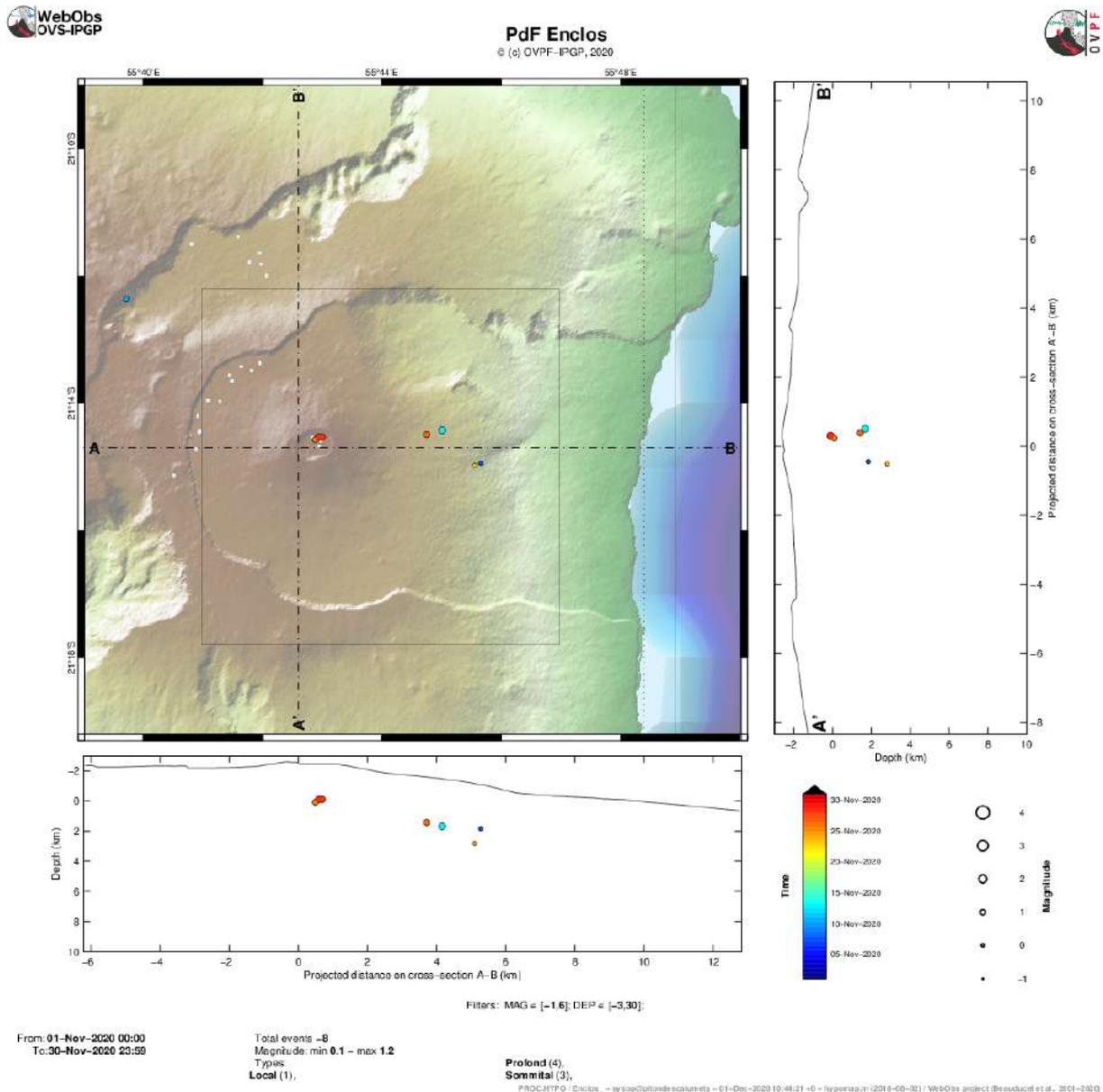


Figure 2: Location map (epicenters) and north-south and east-west cross-sections (hypocenters) of earthquakes at Piton de la Fournaise as recorded by OVPF-IPGP in November 2020. Only localizable earthquakes are shown on the map, while the observatory records more seismic events that are not localizable due to their small magnitude (© OVPF-IPGP).

The seismic activity at Piton de la Fournaise during November 2020 was low, with only 4 shallow volcano-tectonic earthquakes recorded below the summit and 9 deep earthquakes recorded below the eastern flank (Figures 1 and 2).

Deformation

The edifice inflation, which had re-started after the end of the September 28-29, 2020 intrusion, stopped at the end of October (Figures 3 and 4). Since then, the GPS stations did not record any significant signal, with the exception of the GPNG station located in the area of the September, 28-29 2020 intrusion. Between September 30 and November 30, 2020, the GPNG station subsided by about 8.5 cm and moved about 6.5 cm to the east (Figure 6).

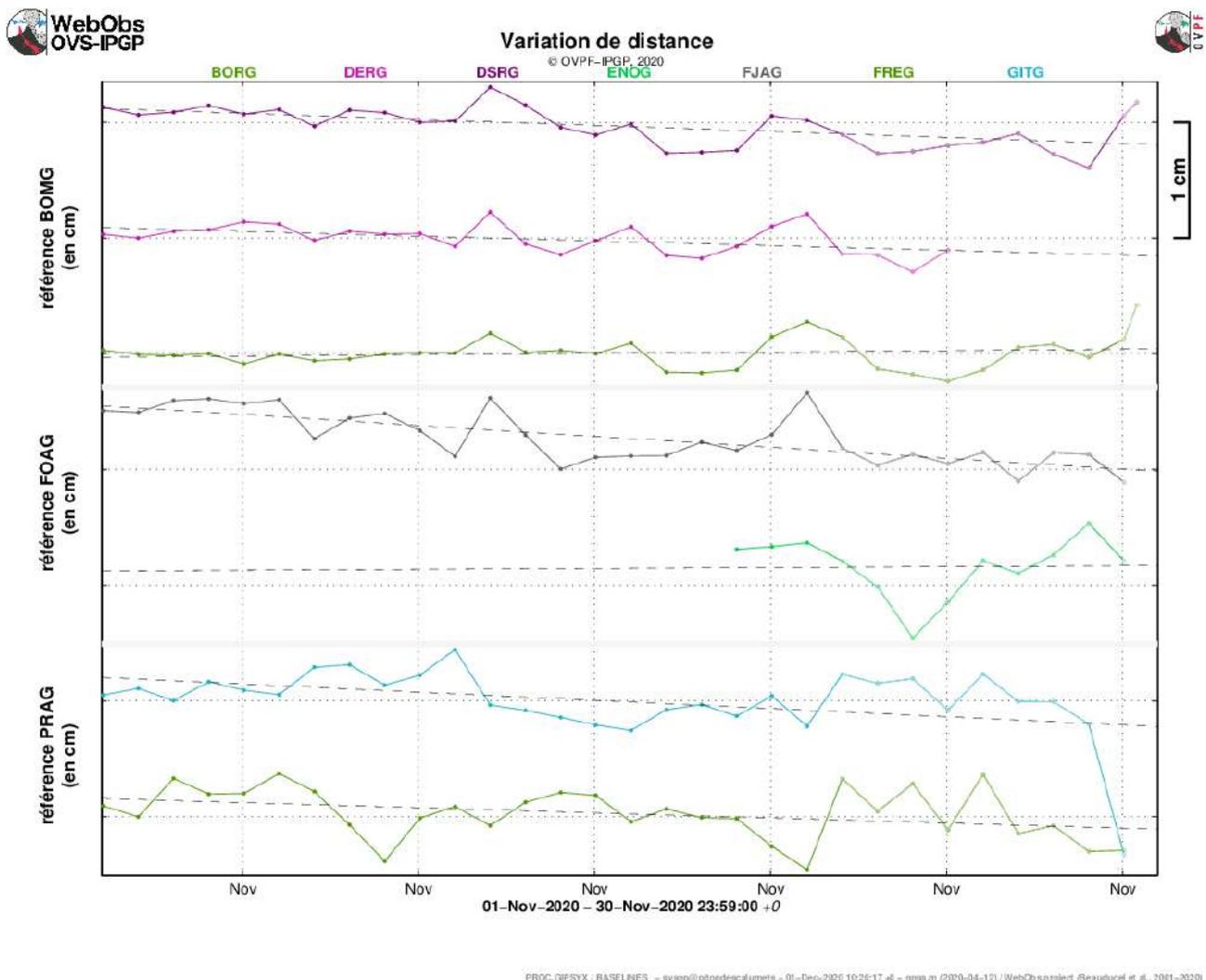
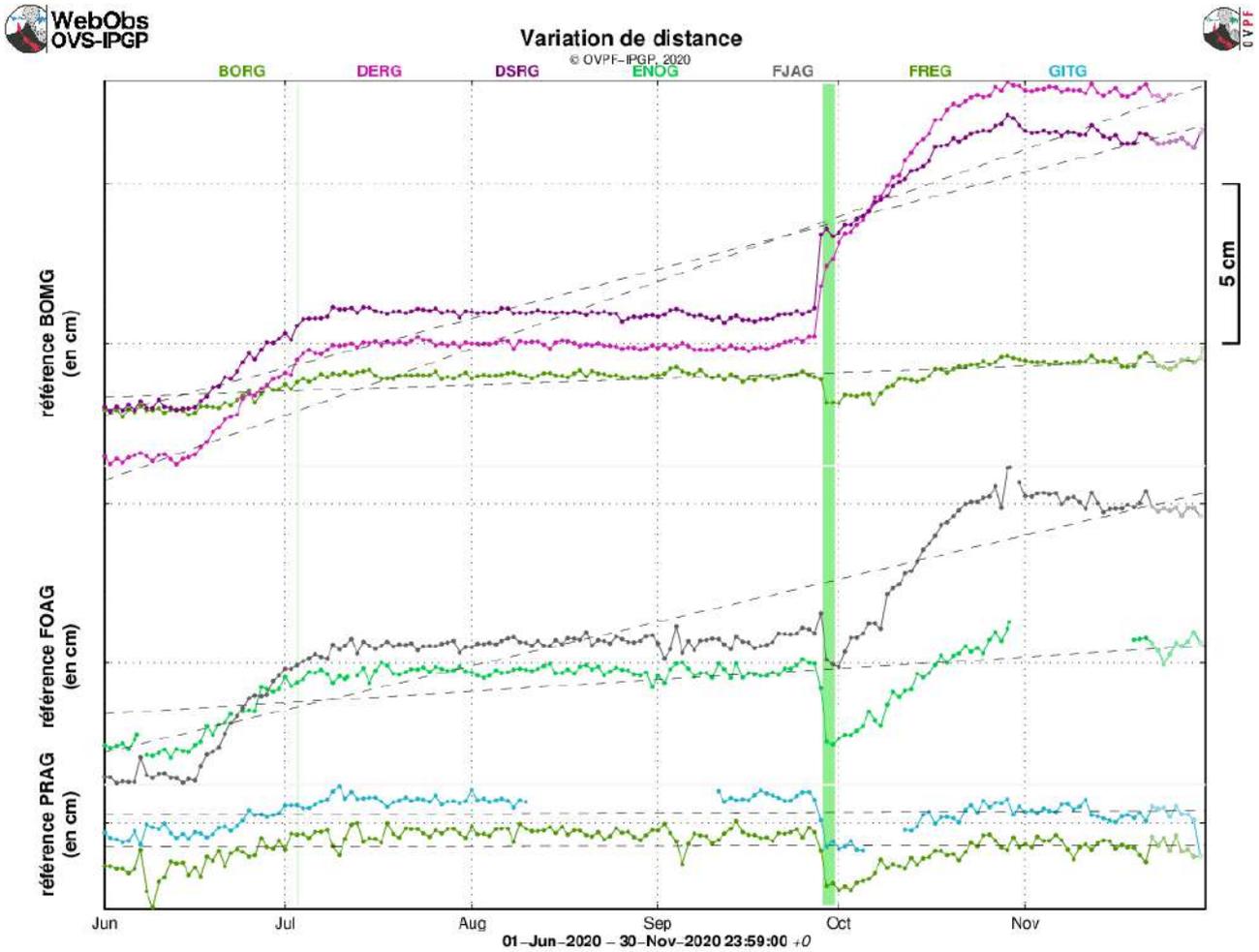


Figure 3: Record of ground deformation over the course of November 2020. The time series plots show the changes in distance between pairs of GPS stations located around the Dolomieu summit crater (reference: BOMG; top graph), the terminal cone (reference: FJAG; middle graph) and the Enclos Fouqué caldera (reference: PRAG; bottom graph), from north to south (see location in Figure 5). Increasing distances (or baseline elongation) indicate volcano inflation, while decreasing distances (or baseline contraction) reflect edifice deflation (© OVPF-IPGP).

* Glossary: The summit GPS signals indicate the influence of a shallow pressure source below the volcano, while distant GPS signals indicate the influence of a deep pressure source below the volcano. Inflation usually means pressurization; and conversely deflation usually means depressurization.



PROC.GIFSXY | BASELINES - symo@ptofdescafr.unets - 01-Dep-2020 10:28:34 +0 - gms.m (2020-04-12) / WebObsproject @esuducel et al., 2011-2020

Figure 4: Record of ground deformation over the past six months (wherein green bars represent intrusions). The time series plots show the changes in distance between pairs of GPS stations located around the Dolomieu summit crater (reference: BOMG; top graph), the terminal cone (reference: FJAG; middle graph) and the Enclos Fouqué caldera (reference: PRAG; bottom graph), from north to south (see location in Figure 5). Increasing distances (or baseline elongation) indicate volcano inflation, while decreasing distances (or baseline contraction) reflect edifice deflation (© OVPF-IPGP).

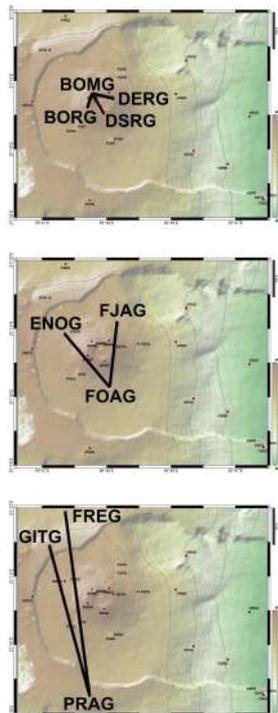


Figure 5: Location map of GPS stations and baselines as discussed in the text and shown in Figures 4 and 5 (© OVPF-IPGP).

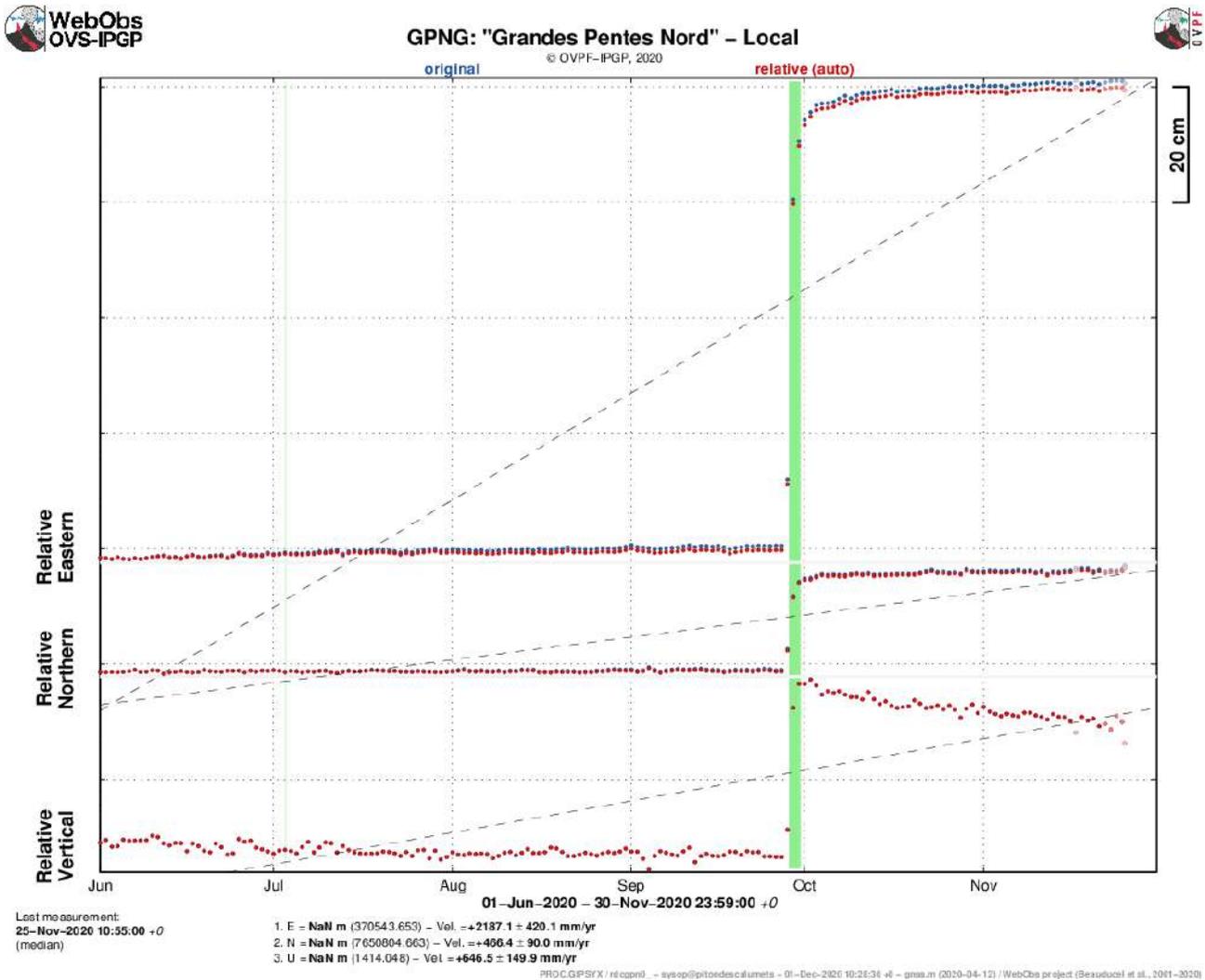


Figure 6: Record of the ground displacements of the "GPNG" GPS station, located in the area of the September 28-29, 2020 intrusion at 1414 m elevation over the past 6 months (wherein green bars represent intrusions). (top) east-west displacements, (middle) north-south displacements, (bottom) vertical displacements. In blue the raw data, in red the data corrected from plate motions (©OVPF-IPGP).

Gas geochemistry

CO₂ concentration in the soil

In the far field (Plaine des Cafres and Plaine des Palmistes sectors): the period following the eruption of October 25-27, 2019 was marked by a new increase of soil CO₂ flux (Figure 7), which attained a first peak just before the February 10-16, 2020 eruption. Before the April 2-6, 2020 eruption, soil CO₂ flux increased significantly and reached the highest values since the network became operational in the two weeks following the eruption.

After April 21, the network has recorded a continuous decrease in CO₂ soil emissions on the volcano flanks in both the distal (Plaine des Cafres and Plaine des Palmistes sectors) and the proximal areas (Gîte du volcan" sector). Starting on mid-August, a new increase in CO₂ flux is recorded on the whole network. A peak has been attained on September 13, two weeks before the September 28-29, 2020 magma intrusion. After the September intrusion, a trend of decrease in soil CO₂ emissions is recorded.

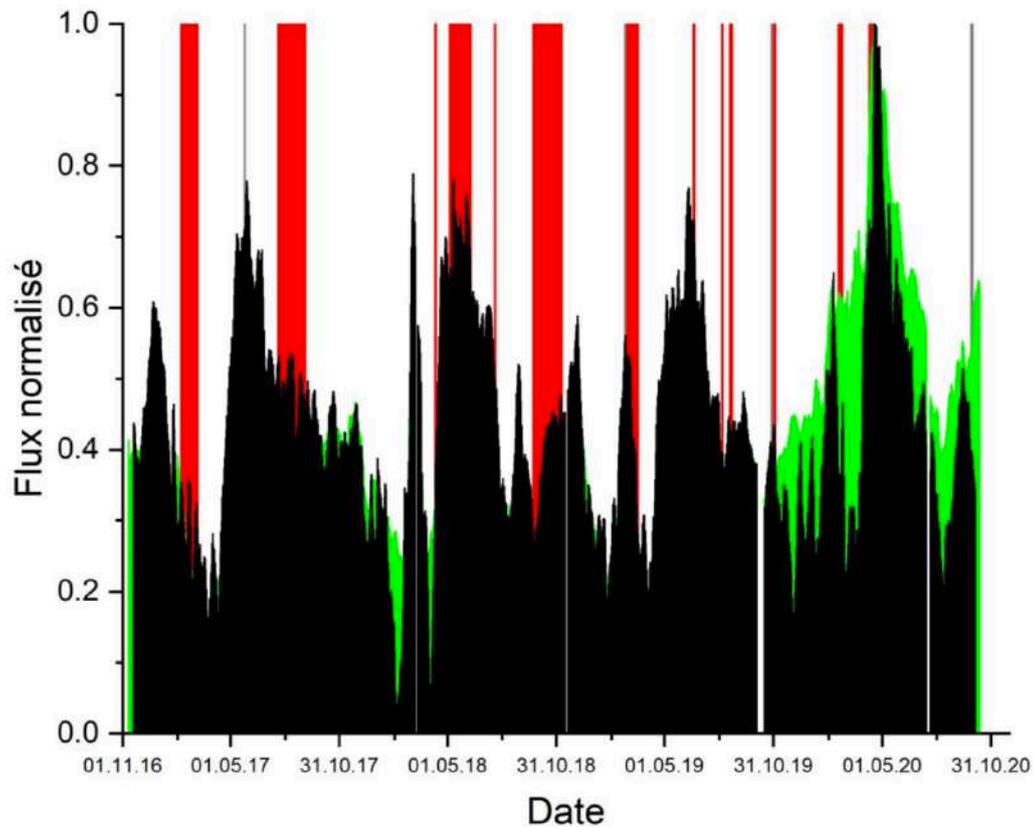


Figure 7: Comparison between the normalized average of uncorrected (15 days moving average; in green) and corrected for influence of environmental parameters (in black) soil CO₂ flux from distal stations since October 2016 (last station set). Red bars: eruptions; Gray bars: intrusions. (© OVPF-IPGP).

* Glossary: CO₂ is the first gas to be released from deep magma (rising from the mantle), so its detection in the far field often means a deep rise of magma. Its near-field evolution may be related to magmatic transfer in the shallowest part of the feeding system (< 2-4 km below the surface).

Summit fumaroles composition obtained by the MultiGas method

Except between November 15 and 20, when a relative increase in CO₂ and SO₂ concentrations were recorded (Figure 8), concentrations remained below or near the detection limit in November 2020.

* Glossary: The MultiGaS method allows measuring the concentrations of H₂O, H₂S, SO₂ and CO₂ in the atmosphere at the summit of the Piton de la Fournaise volcano. Magmatic transfer in the Piton de la Fournaise feeding system can result in an increase in SO₂ concentrations and in the C/S ratio (carbon/sulfur).

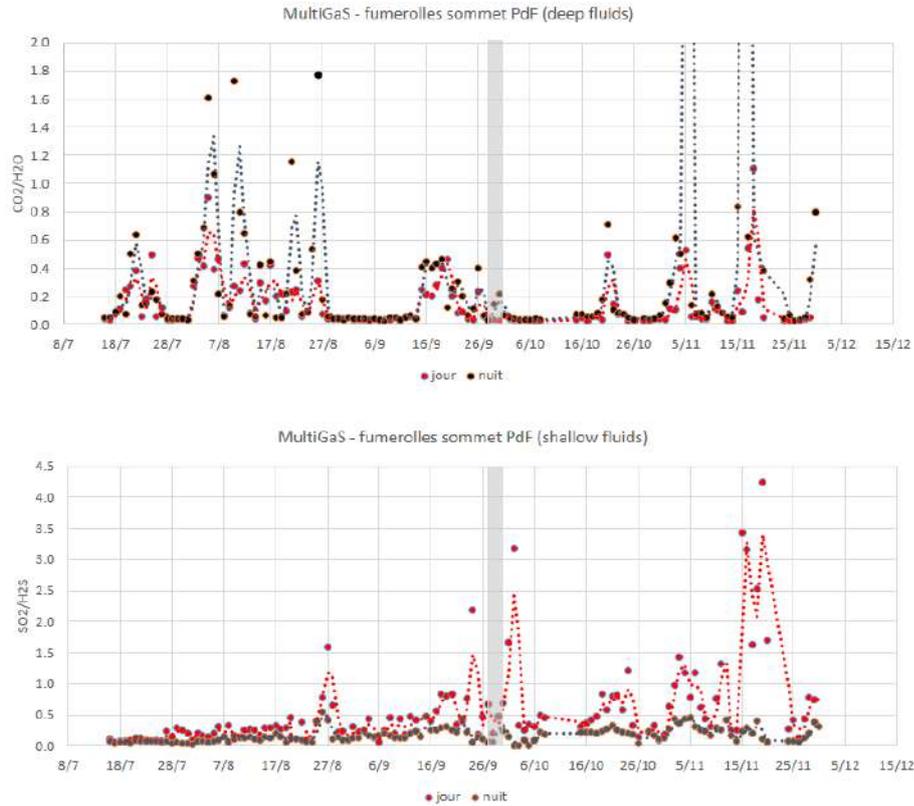


Figure 8: CO₂/H₂O (top) and SO₂/H₂S (bottom) ratios recorded in the Piton de la Fournaise summit fumaroles since July 2020 (© OVPF-IPGP).

SO₂ flux in the air obtained by DOAS method

SO₂ flux below the detection threshold.

* Glossary: During rest periods, SO₂ flux at Piton de la Fournaise is below the detection threshold. The SO₂ flux may increase during magma transfer in the shallowest part of the feeding system. During eruptions, it is directly proportional to the amount of lava emitted at the surface.

Phenomenology

No eruptive activity reported in November 2020.

Summary

Magma recharge and pressurization of the shallow magma reservoir that had resumed following the end of the September 28-29, 2020 intrusion stopped at the end of October. Note that since 2016, magma recharge of the shallow magma reservoir below Piton de la Fournaise is discontinuous and occurs in pulses. For example, several periods ranging from 15 to ~80 days that were characterized by no deformation and low seismic activity have been observed several times between 2016 and 2020.

Seismic-volcano crisis in Mayotte

The « REseau de surveillance VOLcanologique et SISMologique de MAYotte (REVOSIMA) » is the structure in charge of the volcano and seismic monitoring of Mayotte. IPGP operates this network through the Piton de la Fournaise Volcanological Observatory in La Réunion with the support of the BRGM regional office in Mayotte. REVOSIMA is supported by a scientific and technical partnership including Ifremer, CNRS, BRGM, IPGS and RENASS, IRD, IGN, ENS, Reunion University, Clermont Auvergne University, CNES, Météo France, and SHOM.

All information on the REVOSIMA and the activity in Mayotte can be found on the dedicated webpages:

- <http://www.ipgp.fr/fr/reseau-de-surveillance-volcanologique-sismologique-de-mayotte>
- <http://www.ipgp.fr/fr/actualites-reseau>
- <https://www.facebook.com/ReseauVolcanoSismoMayotte/>

December, 1 2020
OVPF-IPGP Director

C - Appendix

Definition of Volcanic Alert Levels for Piton de la Fournaise

from : *dispositif ORSEC974 – D.S « Volcan du Piton de la Fournaise »*

Emergency plan set up by the department responsible for the protection of the population in the event of unrest or activity of the Piton de la Fournaise

• **"Vigilance"**: possible eruption in medium term (a few days or weeks) **or** presence of risks on the sector (rockfalls, increase of gas emissions, still hot lava flows...).

Access to the Enclos Fouqué caldera and to the summit volcano are allowed with restrictions.

• **"Alert 1"**: probable or imminent.

Access to the Enclos Fouqué caldera and to the summit are closed and prohibited.

• **"Alert 2"**: ongoing eruption.

Alert 2-1: ongoing eruption in the Dolomieu crater.

Alert 2-2: ongoing eruption inside the Enclos Fouqué caldera.

Alert 2-3: ongoing eruption outside the Enclos Fouqué caldera.

Access to the Enclos Fouqué caldera and to the summit are closed and prohibited.

• **"Sauvegarde"**: end of eruption or eruption stabilized.

Evaluation of a partial reopening of the Enclos Fouqué caldera access.

Thank you to organizations, communities and associations for publicly posting this report for the widest dissemination.

All information on the Piton de la Fournaise activity can be found on the OVPF-IPGP media:

- website (<http://www.ipgp.fr/fr/ovpf/actualites-ovpf>)
- Twitter (<https://twitter.com/obsfournaise?lang=fr>)
- Facebook (<https://www.facebook.com/ObsVolcanoPitonFournaise/>)

The information in this document may not be used without explicit reference.
