INSTITUT de PHYSIQUE du GLOBE de PARIS

MONTHLY BULLETIN
Observatoire volcanologique du Piton de la Fournaise

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OVPF - IPGP – June 2021

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 June 3, 2021)

May 24, 2021 (16h30) to June 3, 2021 (8h00): Sauvegarde ***(cf. table in the appendix)***

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A. Piton de la Fournaise activity

Seismicity

In June 2021, the OVPF recorded at Piton de La Fournaise:

- 48 shallow volcano-tectonic earthquakes (0 to 2.5 km above sea level) below the summit craters;
- 1 deep earthquake (below sea level);
- 119 rockfalls (inside the Cratère Dolomieu or along the cliffs of the Enclos Fouqué caldera, the Piton de Crac and the Rivière de l'Est).

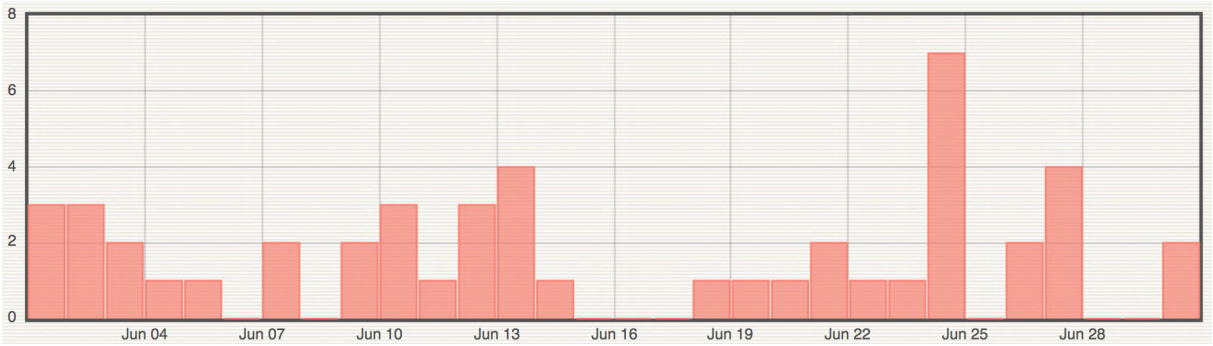

Figure 1: Number of shallow volcano-tectonic earthquakes recorded in June 2021 (© OVPF-IPGP).

The seismic activity at Piton de la Fournaise in June 2021 was low with a mean of less than 2 shallow volcano-tectonic earthquakes per day (Figures 1 and 2).

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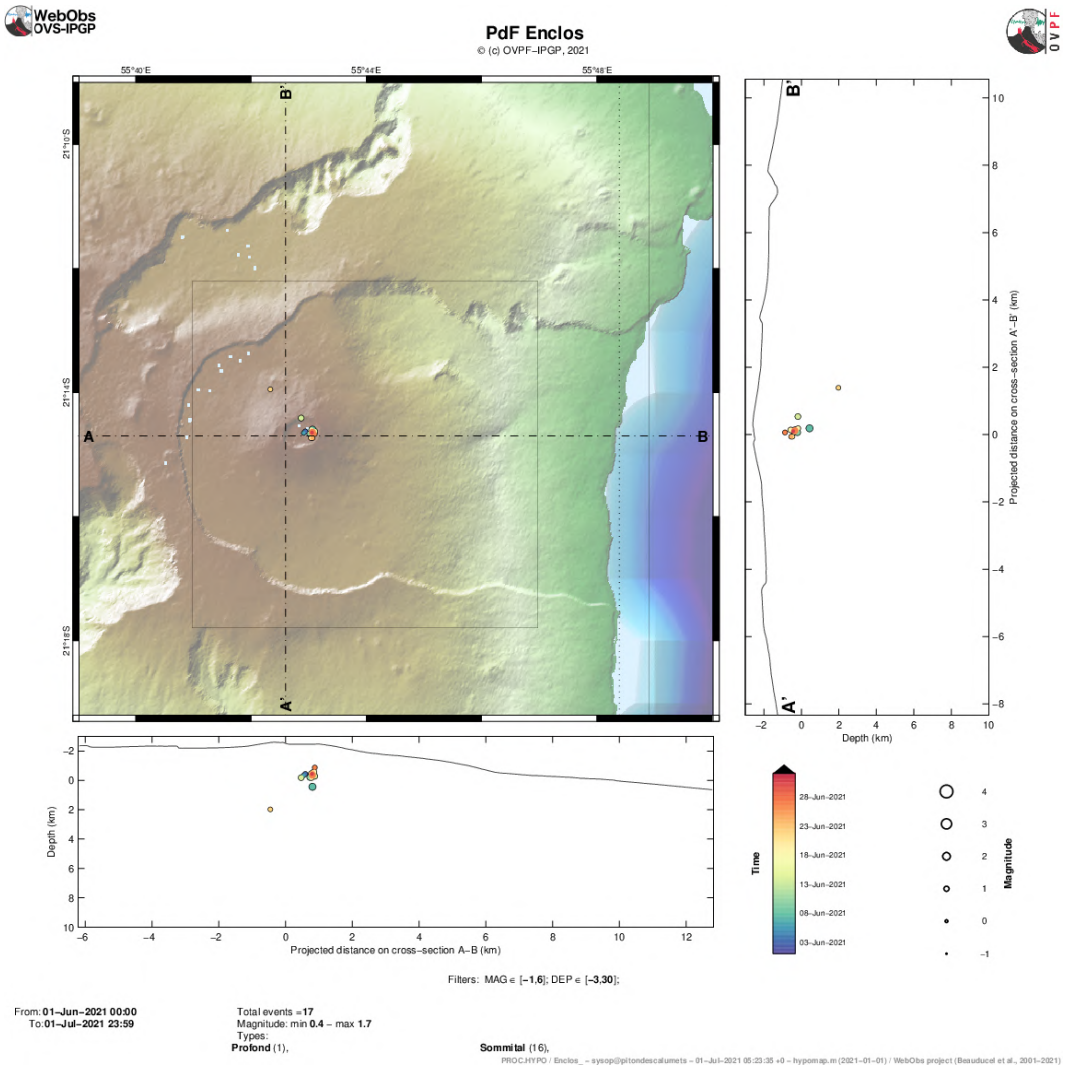

Figure 2: Location map (epicenters) and north-south and east-west cross-sections (hypocenters) of earthquakes at Piton de la Fournaise as recorded by OVPF-IPGP in June 2021. Only localizable earthquakes are shown on the map (© OVPF-IPGP).

Deformation

The summit inflation, which started in April 2021, continued during the month of June 2021 (Figures 3 and 4).
This inflation showed a pressurization of the shallow magma reservoir located at around 2 km depth.

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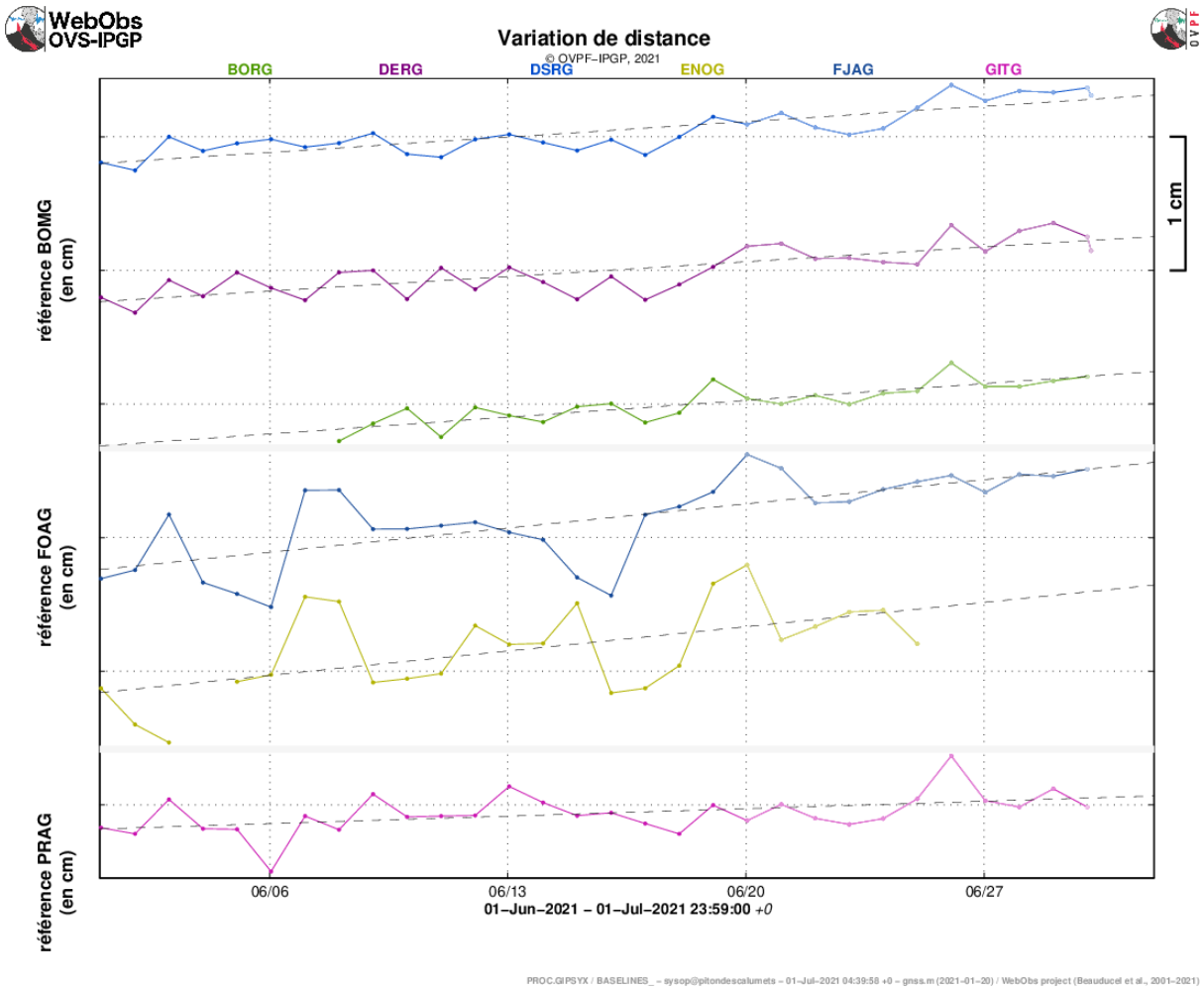

Figure 3: Record of ground deformation over the course of June 2021. The time series plots show the changes in distance between pairs of GPS stations located around the Dolomieu summit crater (reference: BOMG; top graph), the terminal cone (reference: FOAG; middle graph) and the Enclos Fouqué caldera (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).

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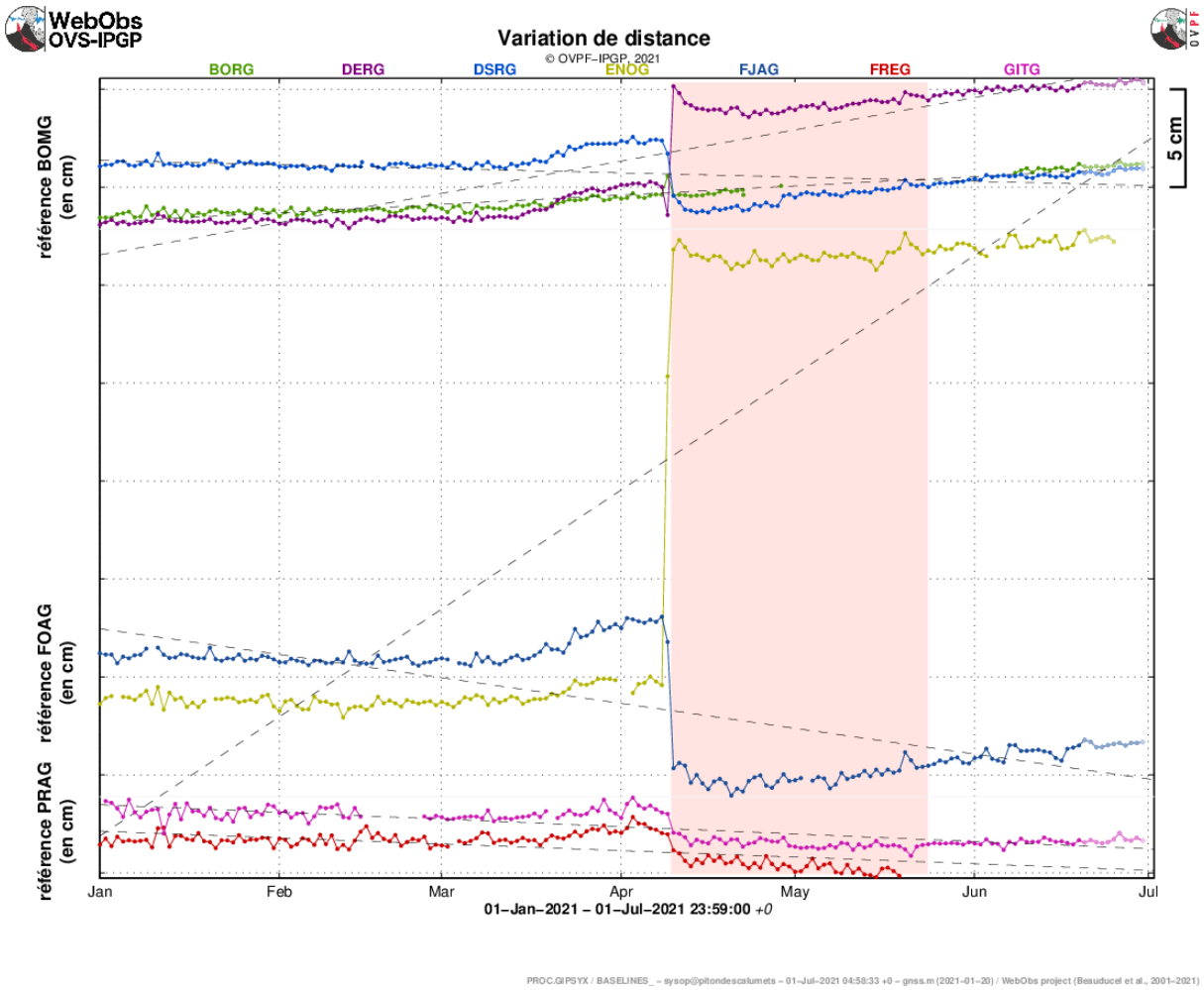

Figure 4: Record of ground deformation over the past six months (wherein red bars represent eruptions). The time series plots show the changes in distance between pairs of GPS stations located around the Dolomieu summit crater (reference: BOMG; top graph), the terminal cone (reference: FOAG; middle graph) 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).

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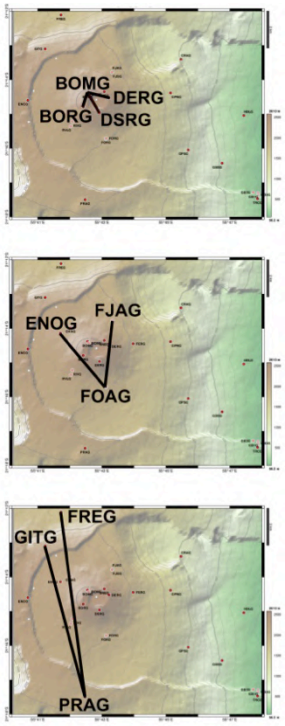

Figure 5: Location map of GPS stations and baselines as discussed in the text and shown in Figures 3 and 4 (© OVPF-IPGP).

** 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.*

Gas geochemistry

CO_2 concentration in the soil

After the December 2020 eruption, a continuous increase in soil CO_2 emissions was recorded in both distal (Plaine des Cafres sector) and proximal sites (Gîte du volcan).

In distal sites, an inversion of the trend (decrease in CO_2 emissions) occurred on February 12, 2021, recording a possible evidence of magma transfer towards shallower crustal levels (Figure 6). A new increase followed this phase, with the strongest acceleration recorded between April 06 and 16.

In proximal sites, the increase was continuous until the beginning of May, heralding the start of the long lasting April 9 – March 24, 2021 eruption.

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Since June 7, 2021, a new trend of increase has started both in distal area and, with a lower intensity, in the proximal area. The rate of the ongoing increase mimics that measured at the beginning of the year.

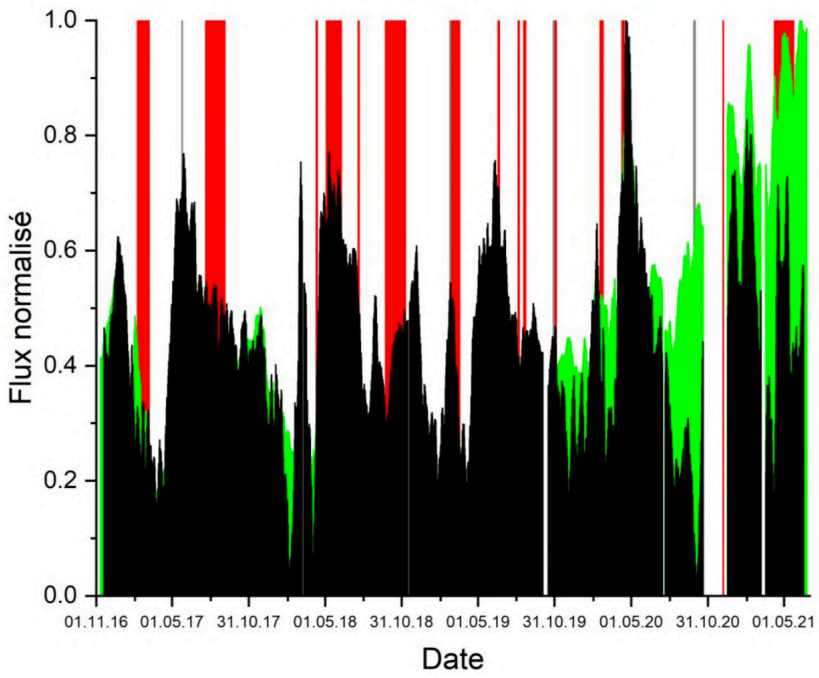

Figure 6: Comparison between the normalized average of uncorrected (15 days moving average; in green) and corrected for influence of environmental parameters (in black) soil CO_2 flux from distal stations since October 2016 (last station set). Red bars: eruptions; Gray bars: intrusions (© OVPF-IPGP).

** Glossary: CO_2 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

The MultiGas station is currently out of service.

** Glossary: The MultiGaS method allows measuring the concentrations of H_2O, H_2S, SO_2 and CO_2 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 SO_2 concentrations and in the C/S ratio (carbon/sulfur).*

SO_2 flux in the air obtained by DOAS method

Flux below the detection threshold

** Glossary: During rest periods, SO_2 flux at Piton de la Fournaise is below the detection threshold. The SO_2 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.*

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Phenomenology

No eruptive activity reported in June 2021.

Summary

The recorded edifice inflation and the high CO_2 concentrations in the soil in June 2021 indicated magma influx from deeper zones into the shallow magma reservoir, that continued after the April 9 - May 24, 2021 eruption.

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B. Seismic activity on La Réunion and in the Indian Ocean basin

Local and regional seismicity

In June 2021, the OVPF recorded:

- 33 local earthquakes (below the island and within a radius of 200 km around the island, Figure 7);
- 2 regional earthquakes (in the Indian Ocean basin).

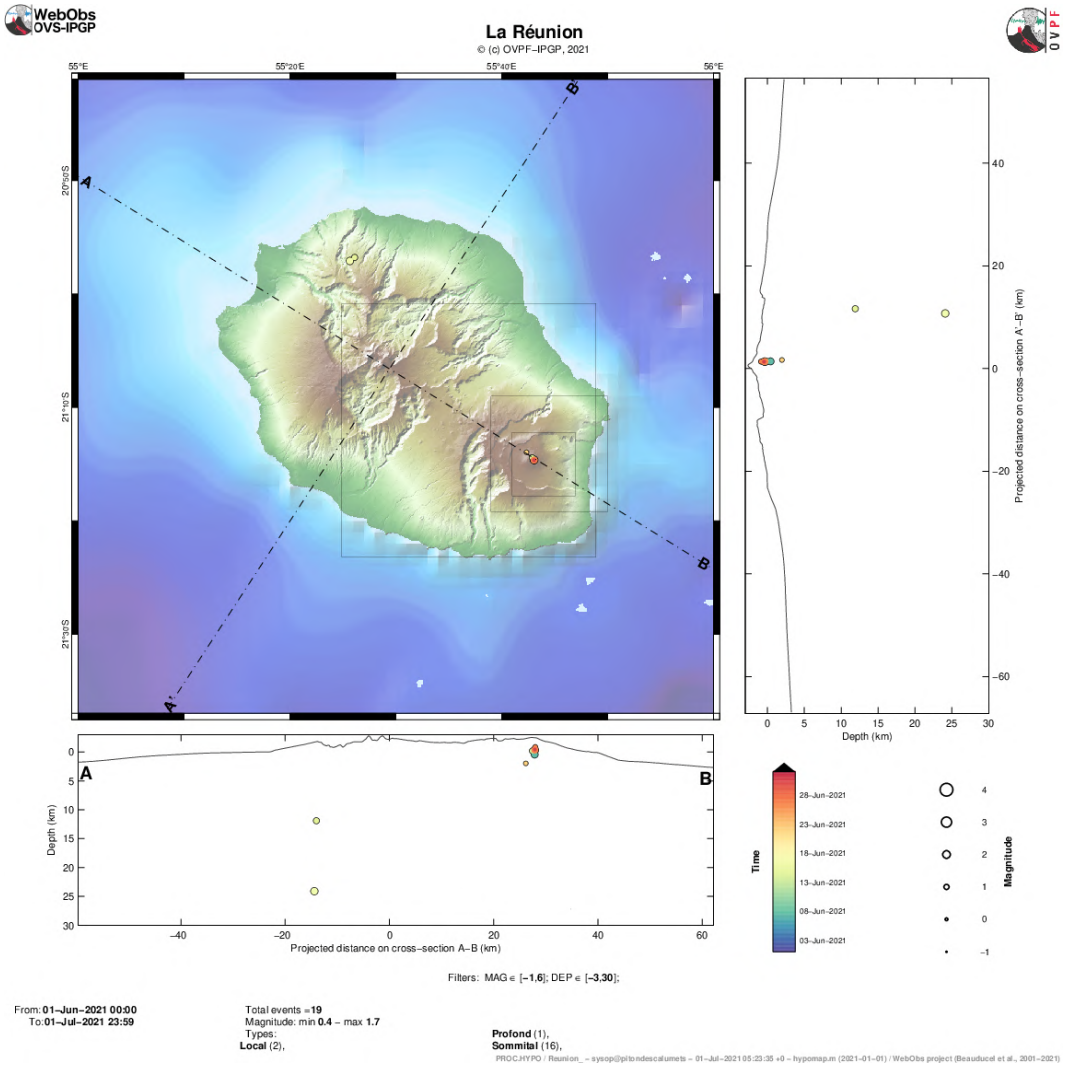

Figure 7: Location map (epicenters) and north-south and east-west cross-sections (hypocenters) of earthquakes below La Réunion Island as recorded by OVPF-IPGP in June 2021. Only localizable earthquakes are shown on the map (© OVPF-IPGP).

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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/

July, 2 2021
OVPF-IPGP Director

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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.

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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:
- Internet website: ipgp.fr/fr/ovpf/actualites-ovpf
- Twitter: twitter.com/obsfournaise
- Facebook: facebook.com/ObsVolcanoPitonFournaise

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