

Spatio-temporal velocity variations observed during the pre-eruptive episode of La Palma eruption inferred from ambient noise interferometry

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Contribution institutions:



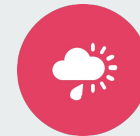
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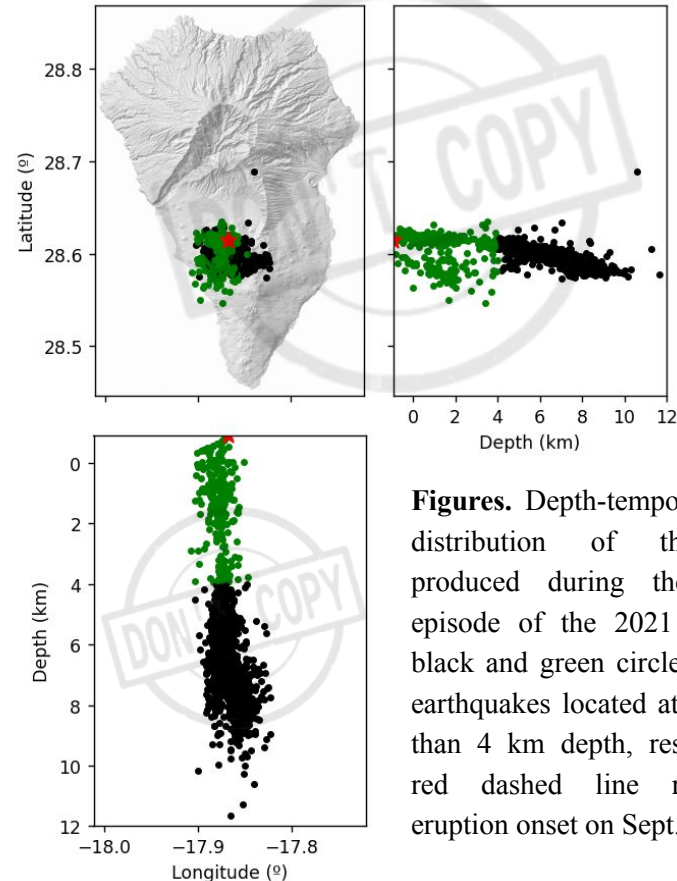
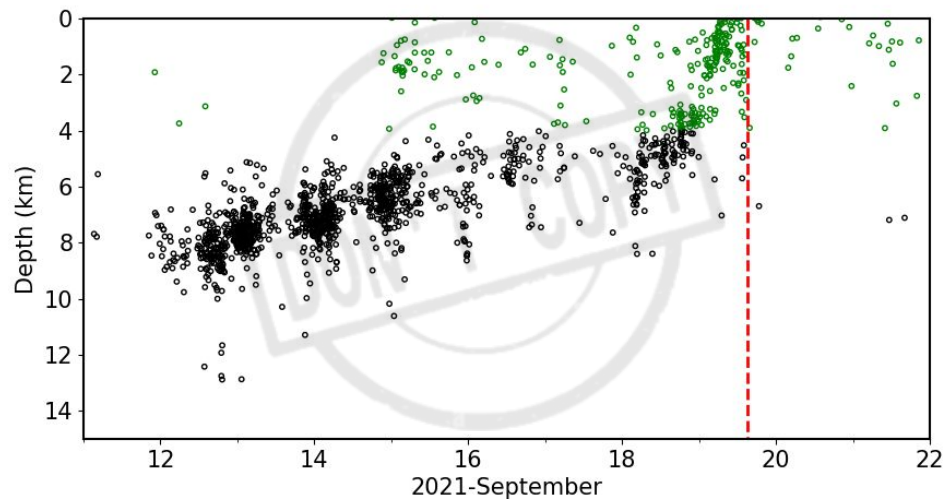
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Financial support:



Chronology of the eruption

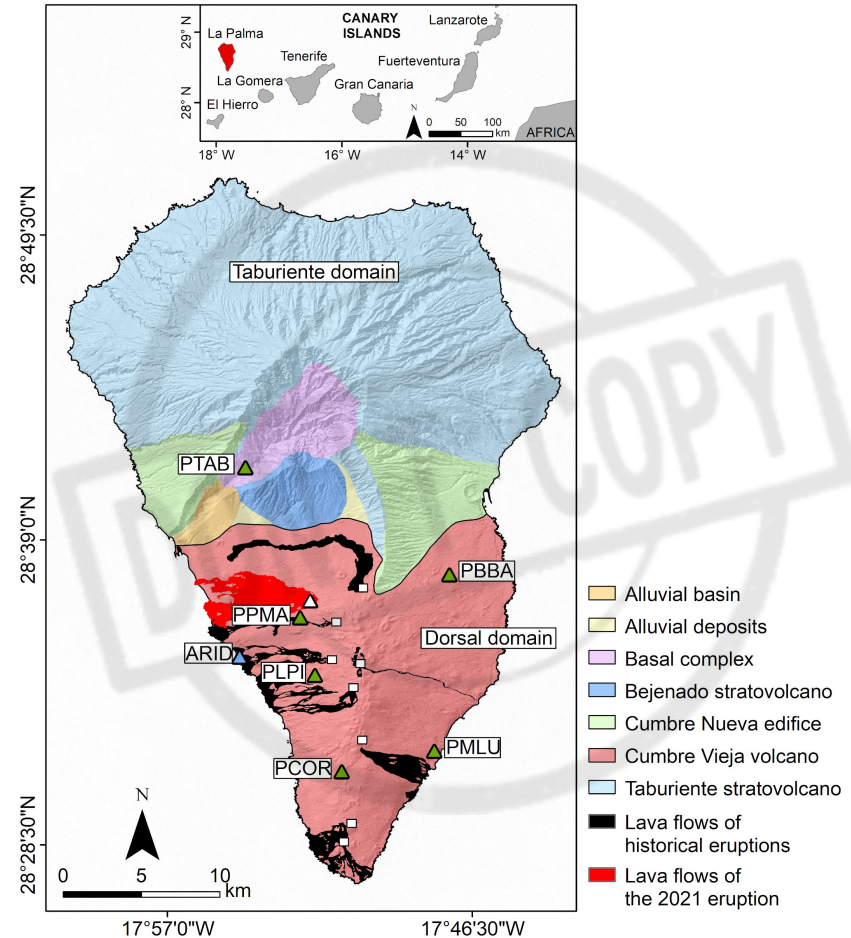


Figures. Depth-temporal and spatial distribution of the seismicity produced during the pre-eruptive episode of the 2021 eruption. The black and green circles represent the earthquakes located at more and less than 4 km depth, respectively. The red dashed line represents the eruption onset on Sept. 19th, 2021.

Methodology

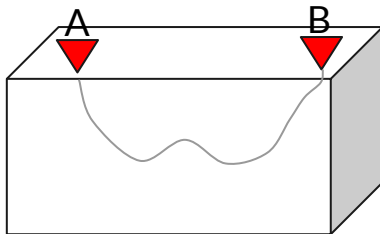
Database

- Six broadband seismic stations of Red Sísmica Canaria (C7)
- The time range used for the analysis covers the interval from Aug. 1st to Sept. 25th, 2021.

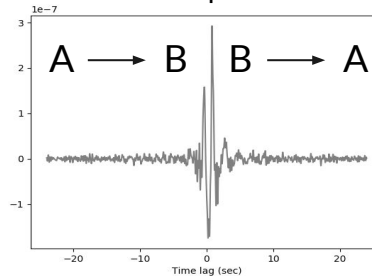


Methodology

Estimation of the relative velocity variations (dv/v)

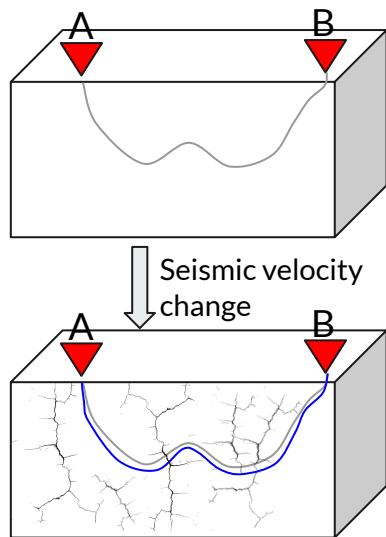


Reference empirical Green's function

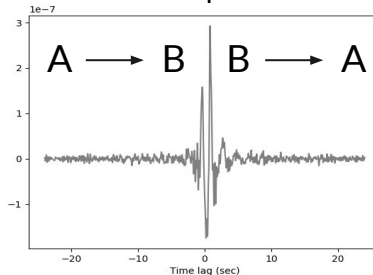


Methodology

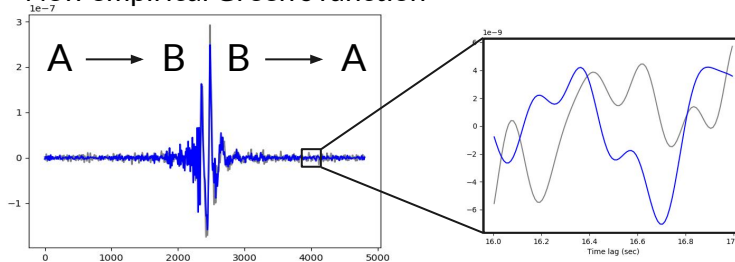
Estimation of the relative velocity variations (dv/v)



Reference empirical Green's function



New empirical Green's function



$$\frac{dv}{v} = - \frac{d\tau}{\tau}$$

Poupinet et al. (1984).

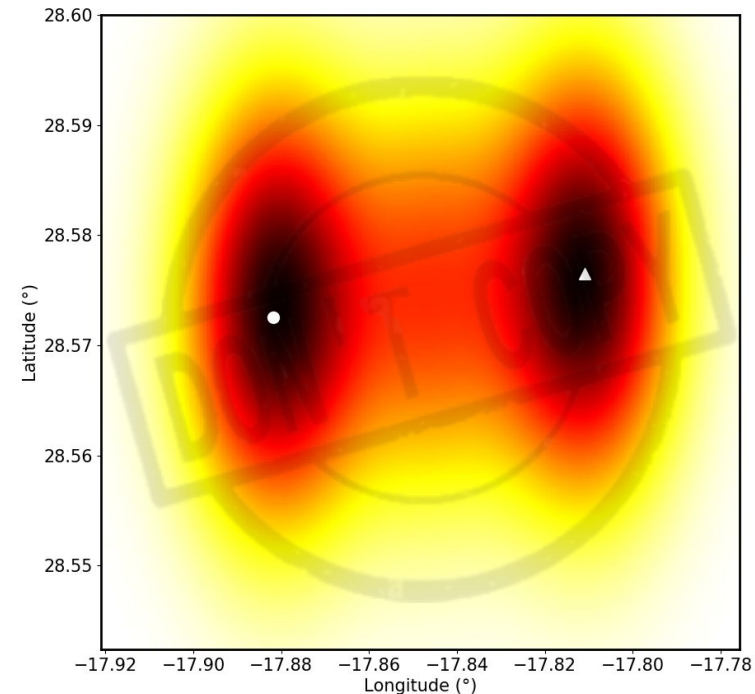
Methodology

Spatial distribution of dv/v (workflow)

1. Determine the relative velocity variation for all the pairs of stations
2. Linear inversion using analytical approach of Del Pezzo and Ibáñez (2020) to calculate the Sensitivity Kernel

Figure. Example of 2D Kernel (equation (2) in the main text) for the station pair PCOR-PMLU (white circle and triangle, respectively).

Sensitivity Kernel for the propagation of scattered waves



Results

Temporal distribution of dv/v

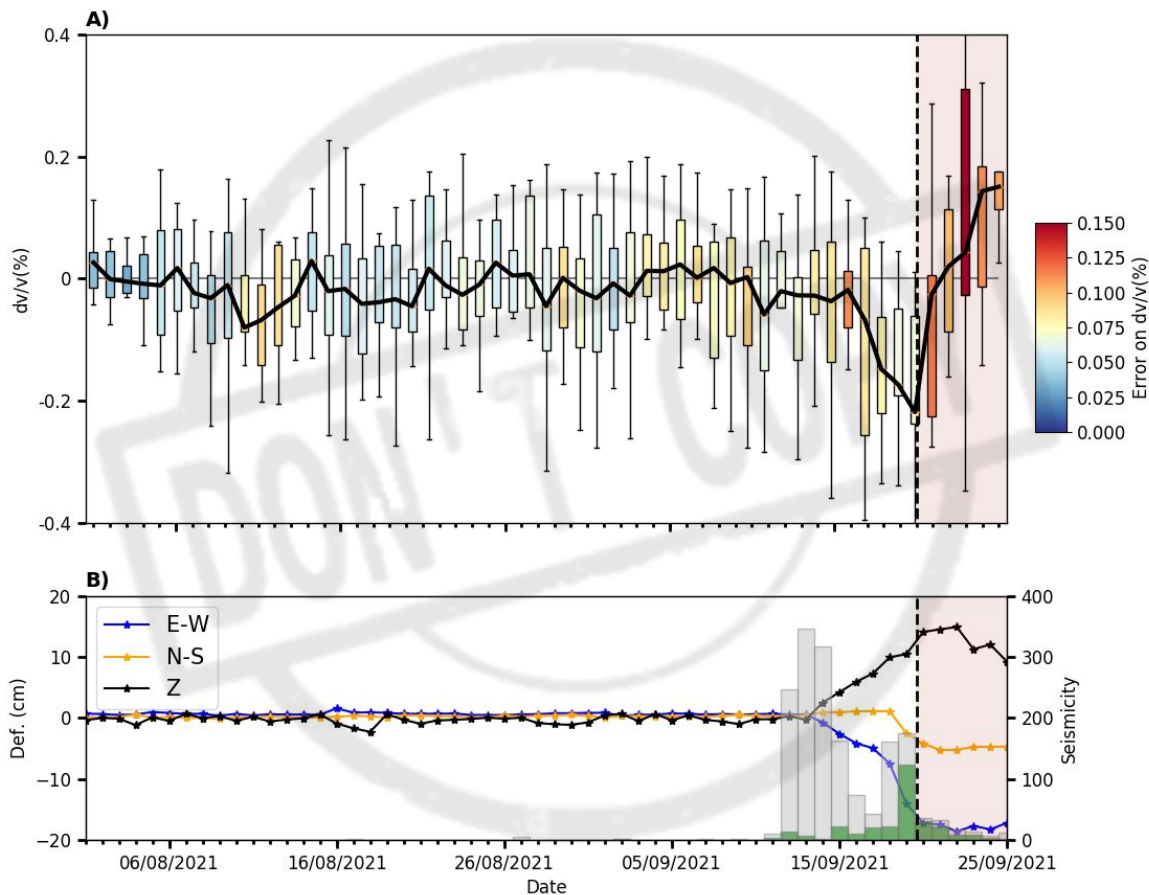
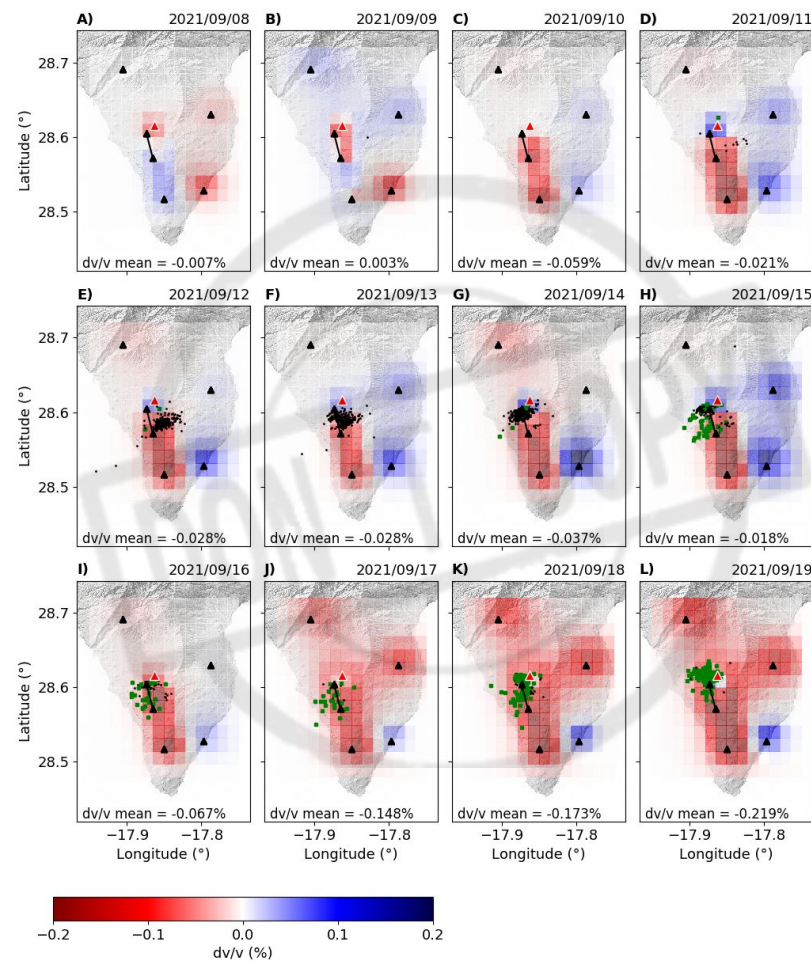


Figure. Comparison of dv/v with the seismicity and deformation produced during the pre-eruptive and eruptive periods (black dashed line showing the eruption onset).z

Results

Spatio-temporal distribution of dv/v

Figure. Spatial distribution of dv/v for different dates. The green circles represent the location of earthquakes shallower than 4 km, and the black circles represent the location of earthquakes deeper than 4 km. Seismic stations appear like black triangles, and a red triangle shows the 2021 eruptive vent. The black line represents the approximate raypath of the pair station closest to the eruption.





Conclusions

- The **decrease of dv/v observed on Sept. 10th**, the day before the seismicity began, could indicate an early ascend **of the hydrothermal fluids**.
- Between **Sept. 11th and 16th**, the dv/v decrease could be related to **increase supply of hydrothermal fluids** realized by the ascending magma toward the surface.
- Between **Sept. 16th and 19th**, the dv/v decrease could be associated with **magma approaching the surface**, which produced a **generalized spatial reduction of dv/v values**.

Thank you for your attention

Cabrera-Pérez, I. et al. Spatio-temporal velocity variations observed during the pre-eruptive episode of La Palma 2021 eruption inferred from ambient noise interferometry.

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