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New observational evidence of CO_2 degassing anomalies on the Piton de la Fournaise and the relationship between seismotectonic structures and CO_2 flux from the soil

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Piton de la Fournaise (PdF) is recognised as one of the world's most active volcanoes in terms of eruptive frequency and the substantial quantity of lava produced, yet this activity seems to be in contrast with an apparent absence of any type of natural fluid emission during periods of quiescence, with the sole exception of a rather modest intracrateric fumarole activity. The most significant gas emissions are evident only during eruptive episodes and disappear at the cessation of these, all of which making PdF a vulcano that is rather hostile to investigations in terms of gas geochemistry, and, therefore, all the more fascinating to explore. Here we report the results of a campaign to measure CO_2 soil flux, focusing on the identification of potential degassing areas and their relation with the main seismotectonic features that involve PdF with the aim of developing a broader understanding of the geometry of the degassing system of the volcano.

In order to assess the possible existence of anomalous CO_2 soil flux emissions, 395 measurements were taken along transepts roughly orthogonal to the known tectonic lineaments linked to PdF, with allowances made for problems presented by the urbanization of the areas involved and in particular some obstacles and difficult morphology. In addition, samples of gas for C isotope analysis were taken at measurement points that showed a relatively high CO_2 value (in general CO_2 flux more than 80 g m-2d-1). The results of the investigation reveal a distribution of anomalous CO_2 degassing which occurs along the main tectonic structures that intersect PdF and which also correspond to areas that have the highest density of pyroclastic cones. Furthermore there is a particularly interesting correspondence between the highest levels of anomalous CO_2 degassing and the distribution of earthquakes occurring at depths greater than 15km. The results of the survey suggest that there is a potential connection between the areas of anomalous degassing and the deep plumbing system of this volcano. A systematic regular monitoring of CO_2 degassing levels of this particularly active volcano in the areas identified by the study would therefore not only provide invaluable information of potential precursors to new inputs of magma, but may also facilitate the prediction of imminent eruptive activity and consequently play a significant role in the planning of civil defence strategies in conditions of high risk.