

Interactive comment on “Integrating field, textural and geochemical monitoring to track eruption triggers and dynamics: a case-study from Piton de la Fournaise” by Lucia Gurioli et al.

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Overview

The authors present a detailed study of the first, rather minor eruption of Piton de la Fournaise that occurred on June 20-21st 2014 after a 5-year period of dormancy. The ultimate goal of the work is to reconstruct the processes responsible for the eruption of these less-voluminous events. They proceed to answer this question through combining textural information for the diverse erupted products with petrologic and geochemical data. The approach is well thought out and the dataset large enough to allow for decoupling of magmatic, ascent, and surficial processes. Although the manuscript

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is well written and the methods and results are quite detailed, the connections between sample locations, type of products collected, and ultimate textural results could be presented in a clearer fashion, which would only serve to strengthen the results and importance of the study. After addressing and clarifying the comments presented below, I recommend that this paper be accepted for publication.

Scientific Comments

L 35-37: This comment also concerns the end of the discussion. Although second boiling is a plausible triggering mechanism, I have two issues with this statement. First, the idea of second boiling, i.e. water exsolution, is directly the result of cooling and chemical evolution of a separate body, and cannot be decoupled. And second, there is some evidence for a mafic recharge event months before the June 20th eruption. Although I agree that there is no evidence for heat or chemical recharge in the erupted products from this minor eruption, ultimately I feel as if a potential recharge event two months before ending 5 years of dormancy is an important observation and should be at least comment on.

L108: What are the typical heights for Strombolian activity?

L133: This deeper seismicity and increase in soil CO₂ seems to suggest that some sort of magma movement/recharge is associated with the beginning of activity. Although decoupled in terms of months from the eruption on June 20th, a comment on how this fits into the plumbing system and inner working for PdF would make a nice addition for the reader.

L152-156: The inflation and deformation trends mentioned would be great to see as a figure (supplemental?), for integration of the information provided here, with the larger story of the PdF system.

Section 2.2: The detail of the samples collected is excellent, however it was challenging as a reader to understand how many samples were collected at each location, and

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then how many of these samples were then focused on in the methodology. Perhaps a general sentence on this could help to transition the reader.

L214: Two bulk samples from the Main Vent. Does that mean the base and the top?

L245: How many sample sites were there? From the Figures it seems as only three samples are being presented: the top and bottom of the Main Vent, and then a sample from the Western Fracture.

L370: How many deposits from the Fractures were studied? It seems that the figures only have the Western Fracture; does that include multiple samples?

L411-415: The first line states that the fluidal and golden clasts have a larger amount of isolate vesicles, but then on 413 it states that these two types with high vesicularity are characterized by fewer amounts of isolate vesicles? Fewer, but still the largest amount compared to the other clast types? Some clarification required.

L422: How much of the lower Ni and Cr concentrations whole rock geochemistry could just be due to crystal content?

L524/L549: Some of the data (MIs and Plagioclase, specifically) point to having a bimodal population. However, this point doesn't seem to come back up in the discussion.

L553: How detailed (in terms of spacing) were these transects compared to the Di Muro et al. dataset? Were BSE images taken? Seems hard to believe that both the 2008 and 2014 have bimodal plag populations, and that the 2014 eruption is a more evolved upper portion of the system, but doesn't contain complex zonation in the plag? I am not trying to discredit the observation if it is valid, but rather more information could help to support this statement.

L559: This is really shallow. How were the H₂O/CO₂ concentrations measured in Di Muro et al. 2016, and in what phase (plagioclase or olivine)?

L575-581: Are these temperature +/- associated with the error in the thermometer, or

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the standard deviation of the plagioclase dataset? Although it does appear to show a decrease in temperature, I wouldn't refer to this range (50 C) as large variability in temperature, especially considering I believe this thermometer has an error bar that will help to overlap the dataset.

L600: What would you expect to see as a geochemical signature of hot gases streaming past ejecta? Do people see evidence for this as a geochemical signature in other systems?

L611-612: Very neat observation!

Section 5.2: A strength to this section is starting with background information on the textural information observed in other systems.

L648-650: I think this is a key point for the community to come out of your paper that should be highlighted more in the conclusions.

L691-696: The information presented here may be more useful earlier in this section so the reader has it for guidance when reading through the results of this study. Just a suggestion.

L711-712: This manuscript has a rich amount of information. One of the weaknesses at the end, however, is the challenge of visualizing how the textural information fits into the eruption/sampling information. Perhaps a schematic depicting the statement that eruption style and thus eruptive products, vary along the length of the fracture system would help guide the reader and bring everything together.

L764: In this presentation, the cooler, crystallizing magma is below the shallow chamber that is being replenished with volatiles? Is this a stable configuration?

L772: This reference to Menand and Phillips seems random. Observed experimentally how?

L772-773: The golden and fluidal fragments vs. spiny fragment lines are a repeat of

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Lines 762-765.

L790-792: I don't understand how to call on cooling, crystallization and water release as a pressurization mechanism, and then state that magma cooling and evolution is not helping to pressurize the source. I think from the MI sentence before I understand that the idea is there is no evidence for evolution controlling what types of products are erupted out, but I don't see how that can translate into the lack of evidence for cooling and evolution driving pressurization.

Figure (Caption) Comments

Figure 1: In many ways this figure is the most important, as it frames where the samples used in this study were taken. However, it is challenging to read and not fully explained. Including: (A). I can't tell the difference between red in orange at this scale. What are the dates? Eruptions or samples collected? Also the units for lat/long should be described. (C). Adding the sample locations to the blow up of C would be useful. Also C needs to be lighter as it is hard to read. Where were the gases collected that are listed as sampled in C? And, were they commented on in this study?

Figure 2: Photo collection is not just from 'the website', but rather several sources. Although I appreciate that the sources are provided, it would be nice to explain what the photo depicts, and why that is important for the study. How do these pictures fit into sample locations/clasts described?

Figure 3: It appears the thermal scale bars for the two images in a) are different. Are they still comparable? Why is the diameter scale different for the Western Fracture, shown in d), compared to a) and e)? Main vent should be capitalized to Main Vent.

Figure 4: I really like this figure. I found myself wondering the distribution of these 4 types. It might be nice to direct the reader to Figure 5 for that information.

Figure 5: Main Cone should be Main Vent for consistency. One thing I found confusing in this paper was keeping track of the different sampling locations and what was being

compared. Does this figure show data for the base and top (not through stratigraphy) from one sample location? If so, it might be nice to clearly state this.

Figure 6: Shouldn't a) and c) be the same if they are both for the Main Vent, where c) is broken down by clast type? What do the stars in c) represent? The diagonal lines in d) look the same, although the caption just refers to a single line. Perhaps explain what the % refer to (I assume the % vesicularity accommodated by isolated vesicles?)

Figure 10: Need to specify if the glasses are melt inclusions or matrix.

Technical Corrections

L119: The last previous sounds awkward. Perhaps just 'The last'?

L327: 'smooth fluidal (Figs. 3d) bombs and lapilli'. Refers to multiple figures, and also reads oddly. Are the bombs and lapilli fluidal?

L225, L445, L451: Lines where paragraph indents are needed

L690: Need another parentheses at the end.

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