

Biogeosciences Discuss., author comment AC2
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Reply on RC2

David Kienle et al.

Author comment on "Geodiversity and biodiversity on a volcanic island: the role of scattered phonolites for plant diversity and performance" by David Kienle et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-107-AC2>, 2021

The authoring team would like to thank the reviewer for the constructive and thoughtful review of the manuscript "Geodiversity and biodiversity on a volcanic island: The role of scattered phonolites for plant diversity and reproductive fitness". Based on the reviewer's comments, we edited and complemented the manuscript. The discussion and the conclusion received the most changes. Below we addressed all comments in detail.

Anonymous Referee #2, 05 Aug 2021

General comments:

The manuscript is about the effects of parent material (phonolite vs basalt) on plant diversity and performance. The manuscript reads well and is statistically sound, but the key results appear rather ordinary as one would expect what has been observed: the diversity and plant performance differs between the two parent materials. Although reference is made that the findings are likely to occur also on other islands (or in any regions with and without phonolites), it rather seems of local relevance in its present form. Therefore, the novelty of the study seems limited or needs to be developed further.

A key short coming is the lack of biogeochemical and microclimatic data. Although the study has an interdisciplinary aim and discusses biogeochemical mechanisms to explain the observed plant diversity pattern, it does not include any data on biogeochemistry or soils (e.g. nutrient status, texture, water holding capacity, soil organic matter) or microclimate.

Reply: We agree that a holistic study including vegetational and additionally also high-resolution biogeochemical data would be best. However, this manuscript approaches the topic from the discipline of vegetation science rather than geochemistry. We are convinced that this study is a first step into acknowledging the vegetational differences between phonolites and basalt and that it builds a basis for subsequent studies to thoroughly test the underlying petrographic and biogeochemical conditions responsible for these differences.

To meet the requirements of a paper published in the journal of Biogeosciences we added

more literature about the petrographic and biogeochemical characteristics of phonolite and basalt. The additional information clearly strengthens our analysis and the discussion of our results.

It even appears that one of the rock types contains serpentinite, but although this has fundamental impacts on plants, data are lacking and it remains unclear to which extent serpentinite contributes to phonolite (or basalt).

Reply: All our plots could be classified as phonolites or basalts. Even though serpentinite is based on basaltic rocks in the genesis, there was no evidence for us in the field or in the relevant literature on the geology of Palma that they could be serpentinites. The typical mineral compositions that make up serpentinites could not be determined.

There is an outstanding amount of scientific work relevant to habitat islands that analyse vegetation on serpentinites or gypsum (Chiarucci et al., 1998; Pausas et al. 2003, Harrison et al., 2006; Kazakou et al., 2010). To put our work in this context, we used findings from these papers to discuss our own results on phonolite.

We are very sorry for this confusion concerning serpentinites. As the above mentioned references to serpentinites in the introduction and discussion are relevant for our paper, we kept those but added a statement to clarify that these are only examples to which we can compare our study.

Moreover, some regions on La Palma are rather dry (no data are given in the manuscript), but the modifying role of parent material on water storage (via texture, color, soil depth etc.) remains unexplored.

Reply: Thank you for the comment. We agree that it is helpful for the reader to know more about the climatic details of the studied sites in general. We improved the manuscript by providing some climate data from publicly available climate models to give the readers an impression about temperature and precipitation. This will also help the reader to understand that we do not have any soils at the study sites and soil depth, for example, is not relevant for this study.

I am trusting the authors that there are geochemical/site differences, but I am convinced that the reader of Biogeosciences (and me) expects the authors to dig deeper and provide a more quantitative links between plants, microclimate, and biogeochemistry.

Reply: We added literature on geochemical difference between phonolites and basalt to strengthen the main points of the paper.

Overall, the novelty of the findings appears rather limited and the amount of data shown seem insufficient for a biogeochemical journal. In my eyes, the authors have to provide additional data requiring a rewriting of the manuscript.

Reply: Thank you for your assessment of the manuscript and the many helpful comments. Radical editing of the manuscript and the addition of biogeochemical literature has increased the quality of the manuscript enormously. We hope to convince you that

this study is a first step towards understanding the drivers of vegetational differences between phonolites and basalt and a baseline for further analysis, including sound plot-specific data on microenvironmental conditions and chemical compositions.

Specific comments:

Line 19, 20 The 3rd sentences reads trivial; I suggest to combine it with the second one.

Reply: The third sentence was combined with the second one following your suggestion and now reads: "A similarity in magmatic origin translates into high global comparability of substrates of volcanic islands on the oceanic crust with, however, slightly chemically or physically differentiated petrography in some places".

Line 21 'traits' is a term that is hardly used by geologists; I would find characteristics more adequate

Reply: Thank you. We exchanged the term 'traits' with 'characteristics'.

L. 23 replace 'accumulating' by 'growing'

Reply: Done accordingly.

L.37 impacts of geodiversity on biodiversity have long been under-researched – I do agree that it has largely been ignored but 'geobotany' is an established field (e.g. Ellenberg)

Reply: Thank you for this comment. We are pleased to read that we share the opinion that the influence of geodiversity on biodiversity has long been ignored. It is also true that H. Ellenberg and others have already discussed and analysed such connections. Geobotany can encompass these aspects, but as a discipline, it has long been seen as a broad concept of the geographic distribution of vegetation or the effect of space itself, missing a clear definition (Rübel, 1927; Vigo, 1998).

L. 86 somewhat early to start in the 'we-form' in the introduction

Reply: Agreed, we changed this sentence into the third person.

L. 90 rephrase the sentence

Reply: The sentence was rephrased, divided into two parts and the information formerly in parenthesis was incorporated into the main text. The passage now reads: "Circulating leachate reaches the rock's surface and evaporates, exposing its dissolved mineral content and enabling the development of secondary mineral assemblages (Spürgin et al., 2019). These can contribute to plant nutrient supply, which is also why ground phonolite rock powder can be used as an effective fertilizer (Faccini et al., 2015)."

L. 126 Hypothese i. Link of plant species richness and growth conditions? This is an interesting one and appears somewhat abrupt and not necessarily the case - it requires some introduction beforehand

Reply: Thank you for this comment. We rearranged the paragraphs to optimise the introduction of hypothesis 1 and to avoid abrupt changes.

L. 139 Methods and information provided are minimal. Please provide climate data and some basic soil (substrate) data (e.g., pH). Climate on La Palma is highly heterogenous and these conditions may also affect vegetation distribution also indirectly via differently textured (=here grain sizes) parent material

Reply: We cannot provide further in-situ data on microclimatic or pH differences between phonolitic and basaltic plots as the fieldwork has been complete in 2018. As our sampling plots were chosen in small distances next to each other (a lot have minimum distances of approximately 20 meters), it is impossible to derive any differences from climate models (which cannot deal with microclimates anyhow). Texture grain sizes could not be investigated since there are no developed soils on these rocks yet.

However, in the methods section, we provided some basic climate data from publicly available climate models about the study sites in general to illustrate the dry conditions and circumstances of plant establishment and soil genesis.

L. 232 surface texture – replace texture as for the biogeochemical reader, texture is related to clay, silt and sand.

Reply: Agreed, we now use the term "surface characteristics".

L. 235 ff brightness and albedo - any soil temperature measurements available? In current times, records on temperature (and moisture) using in situ loggers are a standard measure in biogeochemistry.

Reply: For this study, brightness and albedo measurement are not available due to time constraints. Additionally, this is a low-budget study, and we did not have and data loggers at hand.

Additionally, we checked if satellite imagery on land surface temperature could be an option to obtain temperature data (and others) for our target phonolitic and basaltic outcrops. Such data could be calculated from Sentinel-8 imagery. However, the resolution of 90 m (reaching a resolution of 30 with interpolations) is too coarse for our analysis.

L. 243ff grain size: how would grain size modify water storage? What was the annual/seasonal precipitation at the sites? Do differences between phonolite and basalt vary between the four sites?

Reply: We deleted the term "grain size" to avoid confusion and because it does not add

any explanatory value to the manuscript. We furthermore added, as already mentioned, climate data, including precipitation, to the paper. However, it is not possible to distinguish between phonolite and basalt based on the precipitation data.

L. 281ff serpentinite. Based on the information given, it is unclear, which of the parent materials contains serpentinite.

Reply: We are sorry that the manuscript caused confusion regarding serpentinite. We only examined the rocks basalt and phonolite in this study, no serpentinite. This remark has also been answered in detail in your second remark.