

Clim. Past Discuss., referee comment RC1  
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## Comment on cp-2021-63

Lauren Davies (Referee)

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Referee comment on "No evidence for tephra in Greenland from the historic eruption of Vesuvius in 79 CE: implications for geochronology and paleoclimatology" by Gill Plunkett et al., Clim. Past Discuss., <https://doi.org/10.5194/cp-2021-63-RC1>, 2021

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Review of "No evidence for tephra in Greenland from the historic eruption of Vesuvius in 79 CE: Implications for geochronology and paleoclimatology" by Plunkett et al.

### *General comments*

This manuscript presents a novel methodological approach for studying past volcanic eruptions that is intersectional and of relevance for many research areas. Combining sulphate and cryptotephra records with modelling of volcanic ash, the authors present a convincing argument that is well-structured and well-supported. Given the existing constraints, e.g. limited or no reference data available for many eruptions or volcanoes, I think this presents a thorough summary that has tested the limits of their hypothesis appropriately and represents an important step forward for work in this area. I also agree strongly with the concluding comment of the abstract here regarding a need for formal acceptance of the revised ice-core chronology.

### *Specific comments*

97: It'd be nice to have a comment here on your choice of VEI 4 as a limit, and whether VEI 3 eruptions could erupt ash into the stratosphere in the right conditions (e.g. with a seasonally low tropopause). I don't know if modern observations can speak to this?

Figure 4: Is there a reason why mean values for Mt. Spurr are plotted when single-point data are available, for some modern eruptions at least (e.g. Crater Peak 1992)? If the average data are used I think the uncertainties need to be plotted as well.

169: While the point data that you show here do seem broadly offset between OC1-5 and QUB 1832/33, there is still a good degree of overlap with the compositional field that is plotted from published data. If you're writing this off as a source it would be useful to have a comment explaining why the published data field isn't seen as reliable here.

193-194: As you have whole rock data for Mount Spurr plotted, I think this point should be clarified here (e.g. specifying glass, or single point data, etc).

I'm not overly familiar with data for this volcano myself, but the AVO website's geochemistry search (<https://avo.alaska.edu/geochem/search>) shows whole rock data are available from three additional references by Nye et al. (listed below), which may be comparable to the data from George et al. (2003). Two samples listed as tephra fall pyroclasts from the 1953 eruption (85CNS16 & 17, the latter looks like it was included in George et al.).

Nye, C.J., Beget, J.E., Layer, P.W., Mangan, M.T., McConnell, V.S., McGimsey, R.G., Miller, T.P., Moore, R.B., and Stelling, P.L., 2018, Geochemistry of some quaternary lavas from the Aleutian Arc and Mt. Wrangell: Alaska Division of Geological & Geophysical Surveys Raw Data File 2018-1, 29 p. <https://doi.org/10.14509/29843>

Nye, C. J., Harbin, M. L., Miller, T. P., Swanson, S. E., and Neal, C. A., 1995, Whole-rock major- and trace-element chemistry of 1992 ejecta from Crater Peak, Mount Spurr volcano, Alaska: in Keith, T. E. C., (ed.), The 1992 eruptions of Crater Peak Vent, Mount Spurr volcano, Alaska, U.S. Geological Survey Bulletin 2139, p. 119-128.

Nye, C. J., and Turner, D. L., 1990, Petrology, geochemistry, and age of the Spurr volcanic complex, eastern Aleutian arc: *Bulletin of Volcanology*, v. 52, n. 3, p. 205-226.

209: I would appreciate some discussion here of the parameters used for modelling shard size and shape. Were the grain sizes reported here for the cryptotephra converted into the diameter of an equivalent sphere? What does the fine tephra measurement of ~30 µm relate to here? Cryptotephra data have been used to show that the transport distances of modelled particles are affected by sphericity (e.g. Saxby et al., 2020) so a sentence or two that comments on these details as they relate to your work would be of value here.

208-209: Where do these eruption parameters come from? It's clarified for some of the following examples, but not here.

228-230: Related to the previous point, why is the grain size distribution detailed here for this source but not for the other two?

SI suggestion: related to my two previous comments on eruption source parameters, it might be useful to add a summary table that lists these (with references) for all three sources to the SI.

233: I think that your approach here, and what you describe at the start of this paragraph, is really important. Given that you're investigating an eruption that we don't currently have records of the assumption that it'll be like other eruptions that we do know about may not be valid. The individual initial runs are therefore likely too narrow in range and the testing with 1000 random events gives useful probabilistic bracketing data. I would suggest that this understanding could be emphasised earlier – that you're trying a best approximation from known data but it may fall short and it's more useful to test a range of values – because I think it's the only way we can really usefully study past eruptions. A sentence along these lines could be added to the methods, e.g. around lines 118-121.

#### *Technical corrections*

56: The use of 'rather' here seems like an odd choice of a qualifying word. From what you go on to say, I think this should be stronger.

74: What exactly is meant by an 'unambiguous tephra'? Does the ambiguity (or lack of) relate to whether the grains are indeed volcanic glass, the number and size of shards, their geochemistry, or whether they generally constitute a useful or reliable marker 'horizon'?

99: I think this should be '...none of which are historically dated...' instead of 'none of which is...'.

244: It might be worth stating that this reference is a data archive/record, as this wasn't apparent to me at first glance and it seemed odd that the data weren't included in this publication. I can now see why, having accessed it!

Figure 4: It's a little confusing that the Aniakchak points and the Spurr range are in similar orange colours - my first impression was that they were the compositional range and point data for the same source (as is the case for the other volcanoes). I assume you've chosen similar colours to show they're both from Alaska/Aleutian Arc, but there might be a clearer alternative.

Figure 6: What are the triangle points shown on this plot – Aniakchak? They're not included in the key.

Figure 8: I'd find some extra labels on the plots useful here (e.g. all months, Nov-Feb). When I first looked at this, I was also a little confused because I assumed the four parts would be read left to right in two rows, not in columns. If you keep this layout, I suggest that you highlight the labels more clearly. Lastly, I don't think the blue line in the key matches the blue line on the plot.