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Comment on cp-2021-84

Tammo Reichgelt (Referee)

Referee comment on "Vegetation change across the Drake Passage region linked to late Eocene cooling and glacial disturbance after the Eocene–Oligocene transition" by Nick Thompson et al., *Clim. Past Discuss.*, <https://doi.org/10.5194/cp-2021-84-RC1>, 2021

The authors present a palynological record from the South Orkney microcontinent in the Wedell Sea and associated environmental changes using nearest living relative-based paleoclimate reconstructions, lipid biomarker geochemistry and sedimentological changes. They identify a cooling step in the late Eocene and a vegetation turnover around the EOT boundary, which they associate with regional tectonic changes leading to oceanographic changes. The study is well-conceived and provides some unique data, since obtaining high-resolution and well-resolved terrestrial climate information from southern South America sheds light on the complex opening of the Drake Passage, specifically of the Powell Basin. Opening of the Drake Passage has long been postulated as a possible cause for global cooling at the EOT boundary (as well as the Oligocene-Miocene boundary), but this study can show that there is an offset between the timing of global glaciation at the EOT and regional vegetation and oceanographic reorganization associated with opening of the Powell Basin. I do not see any major flaws in the conceptualization of this study, nor with the conclusions that the authors draw. The results are novel and shed light on an important geological event. The figures are stellar. I suggest minor revisions based on two changes that the authors may want to consider, and one additional problem.

Suggestion 1: Table 2 contains the pollen/spore types and the associated botanical affinity. Most of the botanical affinities are based on Raine et al. (2011) and some on various other references. Raine et al. (2011) is an excellent resource and there is a strong biogeographical connection between New Zealand, Antarctica and southern South America. Still, Raine et al. (2011) base their nearest living relatives predominantly on associations made in New Zealand and to a lesser extent Australia and Antarctica. It might therefore be prudent for the authors to confirm botanical affinities as applied in South American studies, such as those by Viviana Barreda, since this is likely an important floral source at SOM. I put some references that the authors can use for this in my minor comments below.

contemporaneous, although stepwise cooling in response to the opening of ocean gateways surrounding the Antarctic continent may have occurred prior to the EOT.”

- 39: “Uncertainties particularly remain over...” Suggested change: “In particular, large uncertainties remain about...”

- 41-43: “Today the ocean ... and the ocean.” Perhaps provide one or two general references here about the importance of the ACC and ocean current more generally in the distribution of heat, etc. globally. In addition, consider adding a sentence about the importance of the ACC in particular.

- 48: “well dated” -> “well-dated”.

- 56-57: “Our results reveal ... in the region.” A matter of choice; however, this sentence provides one of the main findings in the introduction of the paper. Suggest changing to something more ambiguous.

- 68: “well recovered” -> “well-recovered”.

- 73 – 75: “All palynological ... Utrecht University.” Citation(s) for these standard protocols?

- 76: “x” instead of multiplication symbols “×”.

- 76-77: “Where possible ... and evaluation.” For nearest living relative techniques, you can in addition to establishing relative abundances using 300 counts, account for rare occurrences by scanning the entire slide without counting. Was this done?

- 83-85: “Identification of ... recognised as reworked.” Was the Raine et al. 2011 framework used to identify species that were older than Eocene/Oligocene? I would rephrase this sentence to say what you used to identify older reworked species, rather than saying “easily”.

- 121: The subgenus *Brassospora* is not endemic to New Caledonia, its center of distribution is in New Guinea. The addition of New Guinea into the climate profile of *Brassospora* also makes its distribution in relation to climate less ambiguous, in fact it is quite consistently a montane rainforest component. See for example Read et al. 2005: Phytogeography and climate analysis of *Nothofagus* subgenus *Brassospora* in New Guinea and New Caledonia. Australian Journal of Botany 53. Read et al. give the MAT range of *Brassospora* in New Guinea as 10.6 – 23.5 °C and MAP of 1762 – 7733 mm, consistent with montane rainforest. It has been included in PDF-based NLR reconstructions before. See for example Huurdeman et al. 2021: Rapid expansion of

- 486-487: "the event at site 696 is linked to global cooling at the onset of the EOT, documented by a combination of deep-ocean cooling and global ice sheet growth, marking the step..."

- 491-492: "...records palaeofloral evolution in response to increased..."

- 494: I can never find a proper definition for paratropical. Perhaps say "warm-temperate Nothofagus-dominated forests including typical thermophilic plant types".

Figure 1: very nice figure! I will only point out that on my screen the "North Scotia Ridge" was hard to read. Perhaps make it a somewhat darker hue (or black?).

Table 2: Raine et al. 2011 is a great resource for nearest living relatives, but it's also somewhat risky to apply widely in the Southern Hemisphere, because the nearest living relatives in this database are primarily (though not solely) established based on New Zealand pollen types. There is a lot of biogeographic overlap with southern South America and New Zealand at the Eo/Oligocene boundary. Still, I suggest confirming the appropriateness of these nearest living relative assignments with the South American literature. Primarily Viviana Barreda's papers and Luis Palazzesi. See for example Table 1 in Barreda et al. 2020: Early Eocene spore and pollen assemblages from the Laguna del Hunco fossil lake beds, Patagonia, Argentina. *International Journal of Plant Sciences* 181. Or Table 1 in Barreda et al. 2021: The Gondwanan heritage of Eocene – Miocene Patagonian floras. *Journal of South American Earth Sciences* 107.

Table 2 appears to exclude Araucariaceae. Was this family not included in NLR analysis? I understand for Dilwynites, as it has a strongly relict distribution. However, if the family was excluded for some reason, this should probably be stated in the methodology.

Figure 6: This is a great figure.