

Revision of manuscript cp-2017-148

GENERAL COMMENTS

At the beginning, I would like to apologize for the delay in delivering my review.

It was great to get an opportunity to comment on this paper. For some time now, I have been working on the Oligocene from the North Atlantic region. Even though our study areas are so far from each other, one cannot fully understand the paleoclimatic changes in the high northern latitudes and the global ocean circulation under the early icehouse world, without an insight into the oceanic regime in the southern high latitudes.

This paper provides an important and unique record of the paleogeographical reconstruction of the Oligocene to middle Miocene of the East Antarctica based on dinoflagellate cysts. Authors apply selected dinocysts genera and taxons as proxies for sea-ice reconstruction, nutrients, and temperature. The changes in the composition of dinocysts assemblages is additionally correlated with the sedimentology and organic biomarker data. I find this manuscript interesting and very needed piece of work for our understanding of the oceanic circulation under the early icehouse world conditions.

A concern however, is the way the sedimentological data are incorporated into the text. The results of the present study (i.e. changes in the dinocysts assemblages) need to be clearly presented, and other data (sedimentology, biomarkers) should be carefully included but only as a data supporting the results based on dinocysts. The part about the lithology should not be included in the section with the results but as e.g. the background information. Also, a term "Miocene deposits" (Table 2) doesn't not carry any sedimentological information. Why do the authors not keep the terminology by Salabarnada et al. (submitted this volume) in this case? This expression is not used in the main text, but "Miocene sediments".

The manuscript is well written, however, there is still room for improvement (see my suggestions below). Overall, the manuscript represents a substantial contribution to the scientific progress within the scope of *Climate of the Past*. I am certain that it will be of great interest for readers of the journal.

SPECIFIC COMMENTS

In the Supplementary material, in the sheet with the dinocysts counts I see only *Selenopemphix* cf. *antarctica*. Is that a typo or the specimen observed in the present study only partially resemble the holotype? If it is different from the holotype, then I think that this needs a bit of attention in the text. Bijl et al. (in press) have already discussed which dinocysts are in situ and which not, so I think that the first section of the discussion can be tightened up a bit.

Also, since dinocysts play a key role in this study, I would consider to include a plate with photos of the most important taxa.

Terrestrial palynomorphs can include everything from saccate-pollen to spores or fungal hyphae, and thus suggests e.g. a different depositional setting for the site. Therefore, I think that it may be a bit risky to put them into one category without mentioning any details. One way to fix this is to give appropriate overheads in the "dinocysts counts" spreadsheet in the supplementary excel file (i.e. in situ dinocysts, reworked dinocysts, terrestrial palynomorphs, etc.) and refer to this file in the main text.

The strong upwelling occurring today around Antarctica is causing low abundances of carbonates at the sea-floor. How does the upwelling (suggested in line 363) support the presence of carbonate rich intervals during the Oligocene and Miocene (e.g. line 401)? I think that this needs to be explained a bit more clearly.

TECHNICAL CORRECTIONS

Within the entire text “Margin” with a capital letter in “the Wilkes Land Margin”. Please correct where needed.

It needs to be clearly stated when the authors talk about “dinoflagellates” and when about “dinoflagellate cysts (dinocysts)”.

“sea-ice” or “sea ice”, please choose only one version

Please define: “common” or “abundant”

Abstract:

Please avoid repetitions: “time intervals” line 25,27,44

Lines 25-29: “may bear information to resolve”? please rephrase the two sentences.

Lines 37-38: Consider rephrasing to “Our record shows that a sea-ice indicator, *Selenopemphix antarctica*, occurs only in the earliest Oligocene, following the full Antarctic continental glaciation, and after the Middle Miocene Climatic Optimum”.

Line 39: “during the remainder of the ...” – please rephrase

Line 39: perhaps it is better to write: “the composition of the dinocyst assemblages imply”

Section 1:

Line 51: please rephrase: “...much more ice is...”

Lines 72-84: perhaps these two very long sentences could be made into few shorter ones.

Lines 95-96: marine-ice? I think that “sea-ice” sounds better

Line 96: does it mean “a continent with a low topography”? If yes, then please rephrase “a lower Antarctic”

Line 115: please rephrase “...establishment of age control...”

Line 125: perhaps “recently” instead of “accurately”

Line 127-128: this sentence is poorly constructed

Line 133-134: it sounds a bit weird to compare with “detailed sedimentological descriptions”, I think that it should rather be written that the authors “correlate changes in the dinocyst assemblages with the changes in the lithology” or something like that.

Line 135-139: this sentence is missing something. Please rephrase.

Section 2:

Keep this section in the passive voice.

Line 149: “upper Miocene” not “late Miocene”

Line 165-170: this sentence is poorly constructed. It is not correct to write that “the lithology lacks” something

Line 166-170: diatom ooze and diatom-rich clay: which one is a turbidite and or hemipelagite (see Table 2)?

Line 178-179: this sentence is poorly constructed

Section 3:

Line 196-197. Avoid active voice. Please rephrase both sentences.

For me it sounds a bit weird to say “surface sample”. What about “a sample from the sea surface” instead?

“Another important information” is used in line 227 and 231. Consider rephrasing to avoid repetition.

Line 235-236: What does “N” mean? I think it is better to write “north”. Please rephrase the sentence to make it more clear.

Please explain all the abbreviations used in the text for the first time, e.g. GCM, STF and SAF.

Section 4.1: Please describe the individual groups in the same order as they are mentioned at the beginning of the paragraph.

Line 249-250: “amorphous organic matter (particles)” instead of “amorphous palynofacies”.

Line 252: it should be “rare to common” not “present to common”. In this section it should also be explain how authors define: “rare, “common” and “abundant”.

Line 257: one can not write “dominate the assemblage during the late Oligocene”. It should be either “are the dominating group in the assemblages from the upper Oligocene” or “were dominating/most abundant during the late Oligocene”.

Section 4.2:

Line 266: if it is not an observation made by the authors, I would suggest to add a reference here.

Line 267-269: I suggest to rephrase the sentence: “is common to abundant between 33.6 to 32.1 Ma (earliest Oligocene) and after 14.2 Ma (i.e. during and after the mid-Miocene climatic transition)”

Line 270: please remove “generally”.

Line 270-281: please consider to rephrase this part, so it will be clear what was the assemblage composition in the Oligocene-Miocene and what is today.

Line 289: please remove “noted”

Line 291: Instead of “Of these taxa” it should be “Of the gonyaulacoid taxa” and add “spp.” after *Nematosphaeropsis*.

Line 294: it should be Section 4.3 not 4.5. Please correct in the following headings accordingly, i.e. 4.3.1 and 4.3.2.

Lines 296-306: I am not certain if the part describing the lithology fits in the result section. This is not a result of the current study, but rather a summary of the (already interpreted) lithological observations by Salabarnada et al. However, I see that this is an important part for the manuscript, I suggest to keep it, but incorporate it into the earlier part of the manuscript.

Section 4.5.1:

Line 314: perhaps it should be: “...occur in the reworked glauconitic sandstones of the lower Oligocene age.”?

Line 315: Keep sentences short: “...sandstones. This is in line...”

Line 316: Great, that what one can expect!

Section 4.5.2

Please, avoid expressions as “we compare”, “we note”, etc. Please change it into the passive voice.

Lines 327-328: repetition of “interval”

Line 330: “restricted to” or “limited to” instead of “connected to”

Line 333: “in the Eocene sediments”

Line 334-336: I suggest to rewrite like this: “Within the Oligocene strata *Lejeunecysta* spp. (...) lower abundance in the interglacial deposits and pelagic clays. The taxon is also less abundant in the Miocene.”

Section 5. Discussion

Line 353: why upwelling? Is that the only possibility?

Lines 354-356: circular argumentation, that abundant oligotrophic cyst taxa support oligotrophic dinoflagellate assemblage

Line 357: which taxa? It may be a good idea to list them here as a reminder for readers

Line 359-362: “we interpret that these taxa are part of the in situ pelagic assemblage and reflect warming of surface waters rather than them being reworked” – I think that this needs rephrasing.

What is more, which taxa are considered as indicators of warming? Is this based on the present study or the literature? If on the literature, then please provide proper references here.

Line 366-367: this sentence is poorly constructed

Lines 368-369: active voice should be avoided here

Lines 370-372: grammatically something is missing in this sentence.

Line 381: what does “the average assemblage” means?
Lines 387, 391: add “Site” before U1356
Line 391: please add “succession at Site U1356”.
Lines 393-394: repetition of lines 381-382
Line 365-396: it sounds weird to compare “Oligocene-Miocene surface waters” with “the same Oligocene-Miocene sediments”. Please consider rewriting
Line 407: “i.e.” instead of “e.g.”
Line 420: “more oligotrophic character of the dinocyst assemblages” – please rephrase
Line 430: “an evidence”
Lines 449-450: this sentence is poorly constructed
Line 451: modern dinocysts assemblages?
Line 455: “...ACC. This is in line with numerical...”
Line 460: please explain what does abbreviation MMCO means, perhaps even earlier in the text
Line 465: consider different order, like: “weaker throughout the Oligocene and the Miocene, than at present”
Line 467: please remove “to us”
Line 476: please explain what does abbreviation MMCT means, perhaps earlier in the text
Line 533: “records have recorded” - please rephrase

Section 6

Avoid repeating “fundamentally different” so close to each other (Lines 534 and 542), or “that of today” (line 542 and 543), “compared to today” (lines 548, 550
Lines 545-547: please consider rephrasing this sentence.

Line 608: it should be “data compiled from Site”
Line 611: please use passive voice
Line 613: perhaps it should be “or calibrating our data against age-scale”
Line 622: “sandstones” – please correct in the entire text

Figure captions and references:

“Bijl et al. in press” not in the reference list
“Salabarnada et al. submitted this volume” not in the reference list

Fig. 2 – Why does the colour lines reflecting various lithology have different length? What does (o) and (y) mean? Please align overheads “Miocene” and “Oligocene”. Please explain what the grey colour in the palmag column implies.

“(from Tauxe et al., 2012, but recalibrated to GTS2012 of Gradstein et al., 2012; see Table 1 and modified based on Crampton et al., 2016)” - this sentence is poorly constructed

Fig. 4 and 5 – what is determining the order of the dinocysts? Shouldn't *Spiniferites* cpx be moved to the right? And actually, is *Spiniferites* cpx needed on the figure if it is not even mentioned in the main text? The same with *Corrudinium*, *Cerebrocysta* – these are not mentioned in the text. If they are merged in a complex with *Pyxidinosia* spp. then please clearly state it in the text or supplementary.

Fig. 4 – I think that it is necessary to mark the position of unconformities in e.g. the column with “epoch and stage”. Otherwise, Chattian followed immediately by Burdigalian looks a bit odd. The intervals which look like barren in the column with “Total palynomorphs/dinocysts”, are not marked as such in the following plots in the figure, therefore the figure looks a bit chaotic. The overheads for “total palynomorphs/dinocysts” and “Palynomorph relative abundance” should be

aligned with the overheads to the right (i.e. dinocysts taxa and genera). Also, I would suggest to add a column with sample position on this and the following figure.

Are all other dinocysts recorded in the assemblages “oligotrophic/outside oceanic fronts” as suggested by the color/filling in the plot?

It is not clear to me why “oligotrophic/outside oceanic fronts” has two colors (red and dotted orange). Why are absolute abundances not shown in the same way as the relative abundances?

Fig. 5 – While in Fig.2 Oligocene and Miocene are divided into “late”, “middle” and “early” , on figs 4 and 5 they are divided into stages. Adding a subdivision of the Oligocene and Miocene into “late”, “middle” and “early” on figures 4 and 5 will help readers to directly correlate it with figure 2. This may be a good place to mark a position of the climatic events mentioned in the main text, such as the Oi-1 glaciation and MMCO. Please add that the figure shows the distribution of the “in situ dinocyst”, like in figure 4.

Fig. 6-7: According to table 2 “Miocene deposits” consist partially of turbidites. Isn’t that a bit odd that turbidite deposits yield so many in situ dinocysts?

Fig.7 – I would write something like that: “The distribution of eco-groups within various lithologies encountered in Site...” in the figure caption.

With my best regards

Kasia K. Śliwińska