The authors present a TEX86-based reconstruction of sea surface temperatures (SSTs) for the Queensland Plateau (NE-Australia, ODP Site 811) for the period between 11 and 2 Ma. The dataset presented is a synthesis of new and published data by the authors (Petrick et al., 2023, Sci. Repts.). The described SSTs clearly document the transient cooling in the late Miocene between 7 and 5 Ma known as Late Miocene Cooling (LMC). However, the magnitude of the transient cooling documented is unusually large at ~4 °C. The authors discuss in detail a possible mechanistic relationship between LMC cooling and subsequent reef drowning known as "Pliocene Reef Gap". All biochemical analytical procedures are described in detail and the quality of the data is discussed; technically speaking, the data set presented can be considered excellent.

Science

Chapter 1 (Introduction) provides an overview of global reef patterns in the Miocene and Pliocene on the basis of current literature knowledge. However, the structure of the chapter is not stringent and suffers from duplication and repetition.

Repetition will be removed from the intro.

Also, in many sentences the content is difficult to follow or the relationships between sentences are illogical (e.g. "Therefore", line 39). More problematic, however, is the fact that the corresponding author does not always summarize cited work adequately. For this reason, I checked some of the cited publications again. For example, it is not true that C4 grasses spread worldwide during the LMC (the C3/C4 transition was at ~40° latitude in both hemispheres, and the C4 grasses never reached western Europe and the Mediterranean region; Cerling et al., 1997, Nature)

We were referring to the statement in Herbert et al. (2016) about the expansion of the C4 grasses. After re-reading the statement we will make it clear that this is a tropical expansion

Another example is the interesting Brachert et al. (2020) paper, where I found no discussion of a link between biomineralization performance and sea level changes (line 74), nor modern reef corals to be "hypercalcified" (line 70) or the coral reef habitat to have changed (line 295).

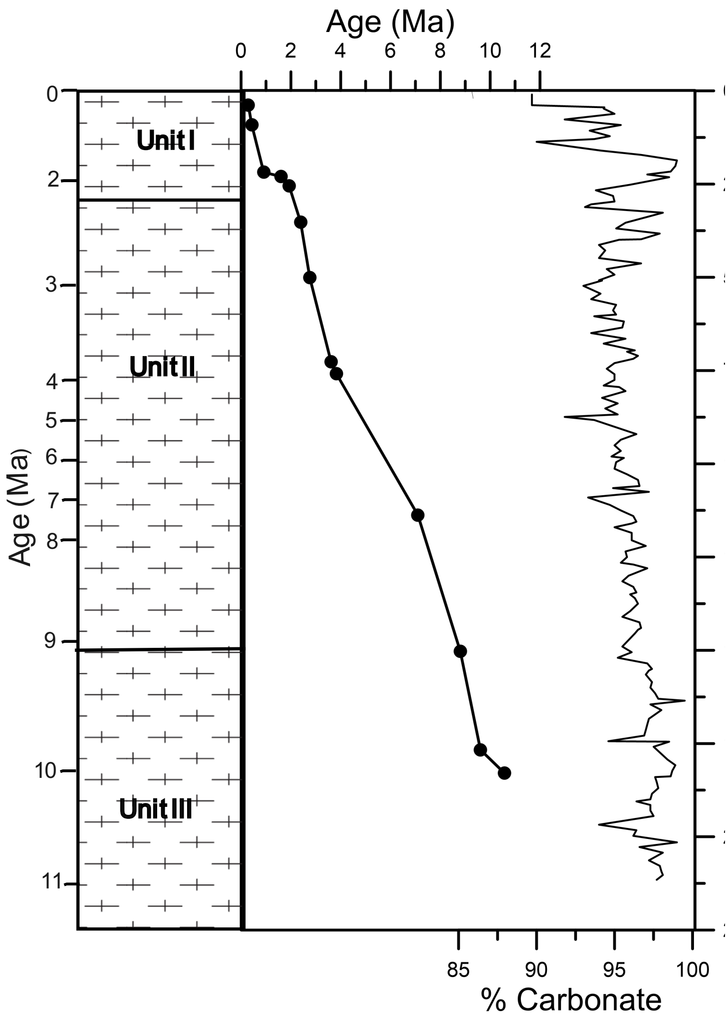
In Brachert et al., (2020) the authors state: "The Neogene corals generally display hypo-calcification, whereas optimal calcification or even hyper-calcification virtually do not occur …" (first two lines of section 3.5). In contrast Fig. 10 and 11 show that modern corals show a wide range, but often are characterized by optimal calcification or even hyper-calcification, which is absent in Neogene corals. This is what we wanted to stress here, but we agree that the wording we used might have been partly misleading. We, therefore, will double-check our statements regarding the change of coral calcification rates during the late Cenozoic.

Furthermore, in the abstract (lines 9-10) the author claims that little is known about changes in “aquatic ecosystems” relative to terrestrial ecosystems – this statement simply denies the incredible wealth of knowledge that exists about ancient oceanic ecosystems.

We intended to address the knowledge about the impact of Late Miocene cooling on shallow-water carbonate ecosystems and apologize for the ambiguous wording. In general, the revised version will provide a clear definition of ecosystems, processes, and the time period in which we focus. We will clarify this by making it clear that in this paper, we are looking at the specific impact on Coral reefs and shifts in these.

The results and discussion chapters (chapters 2 and 3) lack any description of lithologies and depositional sequences encountered at site 811 for the period discussed. As the authors are using a new age model, the lithological information is not readily available from the literature.

The new age model is discussed in the publication of Petrick et al. (2023). We will summarize stratigraphic information provided in this paper and add a figure showing lithological changes discussed in this contribution. (See draft figure below)



Draft Figure: showing the lithologic column for the section of core were we have reconstructed SSTs. Note that for the section of interest, the entire core was made up of Nannofossil Ooze. Units are based on the definition from P. J. Davies et al. (1991)

For an assessment of the TEX86 results, however, it should rather be an integral part of this publication. As is, chapter 3.2 of the results presents a SST reconstruction for the periods before, during and after the LMC. However, this text is rather confusing and the results remain irreproducible, as they lack clear definitions of the time intervals used and the number of measurements used for calculating average SSTs. I suggest the authors insert a table listing all of the information needed.

We will do this by adding the table recommended by the reviewer, as this will clarify the different time periods used in the reconstructions. In figures, reference will be made to the time from of 7-5.4 Ma for the LMC as given by Herbert et al. (2016).

Adding an error bar in the figures (2, 4) may also help the reader in evaluating the data.

The calibration error for the TEX_{86}^{H} temperature reconstruction of 2.5 degrees (Kim et al., 2010) will be added in the revised version.

In the discussion chapter (chapter 4), the authors do not present any discussion of their findings related to lithological data from ODP site 811 nor any other site located nearby, e.g., ODP sites 824 and 825.

We have attached a new figure for ODP Site 811. The core comprises Nannofossil Ooze for the entire section of interest. Also, the unit boundaries do not correspond to any of the changes in SSTs. The other sites nearby (ODP Site 824 and 825) could not be included in the study for the following reasons: The top of ODP Site 825 is too old (12 Ma), and we did not do any temperature reconstructions for this site. ODP site 824 has only two age datums between 2-12 Ma, i.e., at 5 and 11 Ma (Davies & Mckenzie, 1990), respectively. Furthermore, the site is characterized by non-continuous sedimentation and gravity flow deposits. Therefore, we consider it inappropriate to include this record given the age uncertainties. Finally, as shown in Petrick et al. (2023) and repeated here, we interpret the collapse and drowning of the local reef to have occurred between 11-8 Ma and having been initiated by warm temperatures and local changes.

Rather, the authors step directly into a more global discussion with a Mg/Ca dataset from the "nearby" northern Indian Ocean. I agree that the similarity of the two datasets is impressive (Fig. 4). However, given the fact that SSTs ~31 °C before and after the LMC were critically high for coral reef growth (and 3-4 °C warmer than modern SSTs; line 154) and SSTs of the LMC were within the classical reef window range (and modern SSTs), I had expected a discussion on the role of a hot ocean for reef health, both, in the geological past and recent future. This deficit leaves the reader to speculate, whether the Pliocene Reef Gap might be due to the global warming following the LMC?

Impacts of high SST on the coral reef in the area of ODP Site 811 are discussed in detail in Petrick et al. (2023) but we realize the need to add a more detailed explanation here as well. We have argued that warmer SSTs between 8-11 Ma were a stressor for the coral reefs, leading to lower coral extension and therefore, ultimately also reef accretion rates. Because of these low accretion rates, the coral reefs in the area were not able to keep up with a relative sea-level increase caused by a pulse in subsidence. It is an interesting suggestion by the reviewer that the post-LMC warming could have caused reef loss. The age of the loss of many of the reefs in this region is not clear from the geological record. However, in the better-dated reefs (NW Shelf of Australia, Marion Plateau) the final drowning of the reefs seems to occur between 7-6 Ma (Bashah et al., 2024; Ehrenberg et al., 2006; Rosleff-Soerensen et al., 2012, 2016). This means that the numerous changes caused by the SST cooling during the LMC are a more likely candidate to explain the drowning of the reefs compared to the later warming.

Technical aspects

Many sentences are linguistically imprecise and the use of tenses is not always logical (historical facts and developments should be presented in past tense, for example). Although being a rather general bad habit in many scientific publications, I mention wordings like "… the end of the LMC at **our** site…" as inappropriate – it must read as "… the end of the LMC at ODP site 811…" or "… at the site studied…". Spaces are used quite liberally in the text (especially when a citation is given at the end of a sentence). The formatting of the headings (line 213) or the bibliography is "free-style". Overall, I think the manuscript has the character of a draft and needs to be strongly revised or re-written (and shortened).

We are sorry about the shortcomings in proper phrasing and will correct this.

Recommendation

The merit of this publication is the validation of the TEX86 proxy as a robust method for SST reconstructions of shallow-water carbonates. This new approach will allow for a better, direct understanding of the temperature regimes behind shallow-water carbonate deposits and contribute to the ongoing debate on ancient cool, warm, and hot carbonate systems. The publication must be improved technically, however, which requires a major revision.

Work Cited

Bashah, S., Eberli, G. P., & Anselmetti, F. S. (2024). Archive for the East Australian current: carbonate contourite depositional system on the Marion Plateau, Northeast Australia. *Marine Geology*, 107224. https://doi.org/https://doi.org/10.1016/j.margeo.2024.107224

Brachert, T. C., Corrège, T., Reuter, M., Wrozyna, C., Londeix, L., Spreter, P., & Perrin, C. (2020). An assessment of reef coral calcification over the late Cenozoic. *Earth-Science Reviews*, *204*, 103154. https://doi.org/10.1016/j.earscirev.2020.103154

Davies, P., & Mckenzie, J. (1990). *ODP Site Summary, Leg 133, Site 824*. Texas A & M University Ocean Drilling Program.

Ehrenberg, S. N. N., McArthur, J. M. M., & Thirlwall, M. F. F. (2006). Growth, Demise, and Dolomitization of Miocene Carbonate Platforms on the Marion Plateau, Offshore NE Australia. *Journal of Sedimentary Research*, *76*(1), 91–116. https://doi.org/10.2110/jsr.2006.06

Herbert, T. D., Lawrence, K. T., Tzanova, A., Peterson, L. C., Caballero-Gill, R., & Kelly, C. S. (2016). Late Miocene global cooling and the rise of modern ecosystems. *Nature Geoscience*, *9*(11), 843–847. https://doi.org/10.1038/ngeo2813

Kim, J.-H., der Meer, J., Schouten, S., Helmke, P., Willmott, V., Sangiorgi, F., Koç, N., Hopmans, E. C., & Damsté, S. (2010). New indices and calibrations derived from the distribution of crenarchaeal isoprenoid tetraetherlipids: Implications for past sea surface temperature reconstructions. *Geochemica et Cosmochimica Acta*, *74*, 4639–4654.

Petrick, B., Reuning, L., Auer, G., Zhang, Y., Pfeiffer, M., & Schwark, L. (2023). Warm, not cold temperatures contributed to a Late Miocene reef decline in the Coral Sea. *Scientific Reports*, *13*(1), 4015. https://doi.org/10.1038/s41598-023-31034-8

Rosleff-Soerensen, B., Reuning, L., Back, S., & Kukla, P. (2012). Seismic geomorphology and growth architecture of a Miocene barrier reef, Browse Basin, NW-Australia. *Marine and Petroleum Geology*, *29*(1), 233–254. https://doi.org/10.1016/j.marpetgeo.2010.11.001

Rosleff-Soerensen, B., Reuning, L., Back, S., & Kukla, P. A. (2016). The response of a basin-scale Miocene barrier reef system to long-term, strong subsidence on a passive continental margin, Barcoo Sub-basin, Australian North West Shelf. *Basin Research*, *28*(1), 103–123. https://doi.org/10.1111/bre.12100