

Review of “*Impact of the Late Miocene Cooling on the loss of coral reefs in the Central Indo-Pacific*”

By generating the TEX₈₆-based sea surface temperature (SST) record at the ODP Site 811 from the coral sea between ~2-6 Ma, combined with the published data between ~6-11 Ma from Petrick et al., (2023), the authors explored the impact of the late Miocene cooling on the regional coral reef loss. Compared to previously published Uk37-based SST records in the region, SST reconstructed in this study documented an unusually strong cooling in the Central Indo-Pacific, showing ~4 - 5°C drop from ~7 to 6 Ma, which is consistent with the cooling shown in a Mg/Ca-based SST record from the northern Indian Ocean. The authors made efforts to discuss how the temperature change (rapid cooling) could potentially act as a final stressor causing the collapse of coral reef and the known “Pliocene Reef Gap”. I think the dataset presented here is neat and compelling, contributing to the understanding of the temperature changes impacts on shallow-water carbonate systems.

However, this manuscript is poorly written and does not read smoothly. It appears to be a casual draft that lacks proper polishing and organization. Additionally, the text suffers from a lack of clear structure, specifically for the introduction and discussion sections (see major comments). In terms of science, the manuscript does not cite enough related literature and definitely needs a deeper and re-organized discussion section. The discussion section in this manuscript fails to provide sufficient discussion related to the presented data and lacks clear explanations when comparing to other studies (see major comments). Overall, I believe this manuscript requires major revisions before it is ready for publication. Here I attached my major and specific comments, hoping to help the authors to revise.

Major comments:

1. **Introduction:** 1) The introduction is poorly structured, and it lacks leading or summary sentences for paragraphs, resulting in unclear logical connections between them. The introduction is a wired blend of LMC, site background, and the coral reef gap issue. It would be better to move the site background to a later section of the article. To improve clarity and conciseness, I suggest considering combining related content and ensuring a logical flow throughout the introduction. 2) The authors insufficiently cite other people's work in this section; there are several places that require additional references to support the statements (see the specific comments).
2. I think it is worth to add a section to introduce the oceanographic setting for Site 811 in the main context to offer basic information like the location, water depth, SST, salinity and regional currents in the modern ocean, as well as information about site migration and coral reef history in this region (also put the related repetitive materials from the "Introduction" and "Discussion" sections to this section).
3. **Discussion:** This section is poorly structured and lacks organization. It fails to provide sufficient discussion related to the presented data and lacks clear explanations when comparing to other studies.
 - 1) **For section 4.1,** the authors need to put more effort into explaining the driving mechanisms behind the cooling observed at other sites, as documented in relevant literature, instead of solely relying on comparisons of data and proxies. It's quite confusing when they compare the SST at Site 811 to the SST stack from Liu et al., (2022)

without specifying the site locations included in the stack and the proxies used. Similarly, the alignment of SST data at Site 811 with the model from Burls et al. (2021) and the absence of an anomaly in cooling, as noted by Martinot et al., (2022) when compared to the SST record at Site U1443, lack clear explanation. Moreover, only SST data at Site 811 exhibit full recovery after 5 Ma (unlike U1443, which shows a similar cooling trend between 9-5 Ma but lacks data after 5 Ma). What are the potential mechanisms behind this? Is it related to the proxy used or is it a local signal? Furthermore, compared to SST at U1443, SST at Site 811 generally indicates lower values during cold intervals but agrees with high-temperature peaks, a point that has not been discussed. To improve this section, I suggest: 1) Clearly state the related stacks/records (including the proxy and site information) from other studies at the outset when comparing data and refer to Figure 1 when necessary. 2) Rewrite the second paragraph, adding more details on how the models can support the SST data and its relation to CO₂ decrease.

- 2) **For section 4.2**, this section primarily delves into the historical context of coral reef loss in the region since the Miocene. However, the authors fail to link other studies to the data in their study until the end of this section, with only the last two sentences referencing their own results. Much of this background material should be condensed and summarized in the discussion section, with a closer connection to their own data throughout the text. Furthermore, the presence of many illogical transitions (e.g., 'however') disrupts the coherence of the section.
- 3) **For section 4.3**, this section includes seven paragraphs that are poorly organized and somewhat chaotic. For instance, the first three paragraphs need to be merged into one, and the sixth paragraph, which also discusses the impact of cooling to the loss of the coral reef, should be moved to the beginning too. After that, the discussion should flow into other stressors related to the cooling (e.g., changes in currents and terrigenous input). In the third paragraph, It is not clear how the major SST drop became the final trigger for coral reef collapse in terms of the coral's ecological and physical characteristics, which requires more discussion. In the fourth paragraph, additional explanation is needed on how changes in terrigenous input caused by cooling would impact the loss of coral reefs.
4. **Data description:** The authors' description of their data is inconsistent throughout the text. The SST record exhibits a temperature drop of around 4-5°C and the authors mention it as a stronger cooling compared other studies (Section 4.1). However, they also state that the average temperature drop is around 2°C (and consistent with other records) by using confusing average calculation (Section 3.2). I suggest showing the error margins of the temperature reconstruction and include a smoothed line of the data to help identify the absolute SST drop.
5. **Figures:** The LMC time interval boundary is inconsistent in all their figures. The blue-shaded LMC in figure 2 covers a different time interval than that in figures 4 and 5, and the gray bar indicating LMC in figure 4 differs from that in figure 5. I suggest combining figures 2, 4, and 5. Presenting all the records on the same time scale will facilitate a better evaluation of the data and related events.

Specific comments:

1. Lines 16-18: This sentence should be excluded from the abstract but put it in introduction instead since the “reef gap” has been explained in the abstract already.
2. The first part of abstract can be more concise, and it should address more about the indication from the data/results of this study in the second half of the abstract.
3. Lines 30: Using Herbert et al., (2016) as the main and only ref. in the first paragraph to introduce LMC is not enough, need more recent refs.
4. Lines 37: Need to add ref for benthic d13C shift associated with biogenic bloom.
5. Line 59-60: This sentence should be combined with the text later and it does not make sense as a leading sentence for this paragraph.
6. Line 60-62: Too many “however” transitions are used in the whole article and several instances do not align with the logical flow of the text (e.g., line 60).
7. Lines 67-68: Need to add ref when stating that LMC was muted in the benthic d18O record.
8. Lines 82-83: Need to add ref for the “records produced”.
9. Lines 112: Not clear. What is the standard error related to? how about error of calculated temperature?
10. Lines 130: Not clear. What does it mean by “we used the 2/3 index to ensure.....”
11. Lines 132: Is it “supplemental data 1” (line 125) or “supplement 1”?
12. Lines 137-138: I would love to see a covariance plot between SST and BIT. BIT index is high for the dataset and the cutoff the authors using in Figure 3c is about 0.5 (but not exactly at 0.5), which is weird. Based on the similarity between the SST at site 811 and site U1443, I doubt there is serious terrigenous input impact on the samples before ~ 5 Ma but not sure about the younger part. However, after seeing the high BIT index values (most of them higher than 0.2), I think it would be helpful if the authors can offer some other evidence to support that there is little terrigenous derived source influence at site 811 during the Miocene (e.g., information from other studies like organic carbon isotopes) or using lower cutoff in the discussion (if removing those samples still doesn't affect the major trends or conclusions of the paper).
13. Lines 160-162: I am confused about the sentences describing the SST change at site 811. Is it decreasing around 5 °C from ~ 30°C to ~25°C from 7 Ma to 5.9 Ma? I think the temperature is keep decreasing since around 7 Ma and it is not reasonable to calculate the average temperature between 6.7-5.9 Ma and stating that it is about 2 °C cooling at site 811.
14. Line 161: Same as “however”, too many “finally” transitions are used in the whole article, which does not help with logical transitions.