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Climate of the Past Discussions

Interactive comment on "Late Miocene to Recent High Resolution Eastern Equatorial Pacific Carbonate Records: Stratigraphy linked by dissolution and paleoproductivity" *by* Mitchell Lyle et al.

Anonymous Referee #1

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General comments

The manuscript of Mitchell Lyle et al. "Late Miocene to Recent High Resolution Eastern Equatorial Pacific Carbonate Records: Stratigraphy linked by dissolution and paleoproductivity" is supposed to be published in "CPD". In their study, the authors critically discuss causes for the observed CaCO3 deposition in the Eastern Equatorial Pacific over the past 8 Myr, i.e., production vs. dissolution. The study is based on XRF-derived bulk sediment composition data and mass accumulation rates from sites of IODP Expedition 320/321 and ODP Leg 138. The major outcome of the study is apparently the

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identification of five long-term low CaCO3 intervals within the past 8 Myr – two of them as a result of CaCO3 dilution through diatom production, and the other 3 as a result of enhanced CaCO3 dissolution.

The overall story presented is based on an innovative approach and has the potential to be published in CPD. However, I recommend this paper for publication only with the revisions described below. Most importantly, the abstract and introduction lack a working hypothesis and a few sentences on the overall aim of the study. The discussion is thus not easy to follow in various parts and needs some re-structuring.

Specific comments

Abstract: I won't start the abstract with "We report. . .". To me, there are 1-2 sentences missing at the beginning of the abstract summarizing the aim of your study (i.e., what are the scientific questions you want to solve).

Page 1 Lines 12-14: Include information on locality of study sites, i.e., EEP.

Introduction (p. 1, l. 27 to p. 3, l. 7): In this part of the introduction you should make clear what's the aim of your study, i.e., what are yet unresolved scientific questions that you want to answer or what is your working hypothesis. From the introduction as it is now, the aim of your study is not clear to me.

Page 3

Lines 5-7 and 26-29: These are results and therefore should not be part of the introduction.

Lines 9-12: Add the location where your records are from. You want to update the stratigraphy from 0-5.3 Ma, but work on the 0-8 Myr period. What about the 5.3-8 Myr stratigraphy? This should be mentioned here. "We choose 5.3-0 Ma because it has good age control": To me that's not an argument. You can mention that as an additional point but not as a reason of why this interval has been selected.

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Lines 20-23: This is no information relevant for the introduction. Please move this section together with l. 18-20, p. 4 into section 3.2. This will also avoid repetitions. To me it is also not clear why to generate a combined age model for all sites instead of using the original age models? Could you briefly explain that in the "age model section"?

Page 4

Line 1-3: Include in parenthesis the ODP and IODP sites, respectively.

Lines 3-7: I think this information is not relevant to your story, please delete.

Line 9: Change "All 7 sites have continuous orbital-resolving records of estimated CaCO3. . ." to "We generated (correct?) continuous orbitally-resolved records of CaCO3 for all 7 sites. . ."

Lines 9-16: From this section it is not clear to me which records are new, and which records are already published. Please rephrase. Also, why are you mentioning records that go back to 24 Ma while you are only studying the 8-0 Ma interval?

Lines 21-33: I suggest to move these sections to line 8.

Page 5

Lines 12-13: Sites 848 and 850 where tied to the U1338-tied Site 849? Is that correct? Why were Sites 848 and 850 not also tied to U1338? And why have both Sites U1338 and 849 been selected as alignment sites?

Page 6

Lines 2-3: I don't understand: Are these already published data (because of the references) or are these new data?

Page 7

Line 7: "Unpublished opal analyses": If you use these data to calibrate something, you

have to publish them in this paper. Provide them at least in the supporting information.

Section 4: After the methods I expect the results, in which you just describe the data you have generated (i.e. sedimentation rates range from x-y, CaCO3 fluctuates between x and y, MARs vary between x and y, etc.). However, Section 4 is more a discussion. Restructure sections 4-6 accordingly, i.e., either provide a section for the results and another section for the discussion, or provide a combined "results and discussion" section with several sub-sections. I would prefer the latter in order to avoid repetitions.

Line 19-21: I don't understand.

Page 8

Lines 31: "(1) the percentage profiles can be directly measured as the sediment sections are processed": This is not an argument.

Page 9

Line 1: "(3) the results are easily compared to earlier observations at other cores and drill sites": I don't get that point.

Lines 3-5: Delete, because the same information is also given in the next sentence.

Lines 7-8: I think there is a third important factor you should also consider: What about a simple decrease in CaCO3 production due to, e.g. Fe limitation, and thus reduced phytoplankton productivity?

Line 14: Is there a better word for "defects"? What are the "defects"?

Lines 17-23: To me this paragraph does not belong to this section. Move to Section 6.2. Is the cyclicity of CaCO3% described in this paragraph based on a visual evaluation or have you done some phase analysis (I guess you only show a wavelet analysis of the CaCO3:BaSO4 ratio)? "CaCO3 % is high in Pleistocene glacial climate intervals": Is the temporal resolution of your age model sufficient to determine whether CaCO3%

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is highest during peak glacial conditions (as written now) rather than during glacial terminations as observed in previous studies?

Section 5.2: Why does such an anomaly not also occur at nearby Sites U1335 and U1338? Are they too far away from Site U1337?

Page 10

Lines 9-10: Any explanation for that observation?

Page 11

Line 1: This means that opal MAR is unrelated to glacial-interglacial change? It would be nice to highlight glacial or interglacial intervals in the figure.

Line 21: I guess you mean three peaks by "CaCO3 triplet", correct? However, I cannot see them in the figure. Make sure that your figures are large enough in size and/or highlight special features such as the CaCO3 triplet.

Page 13

Lines 10-15: This paragraph should go into the introduction section where you talk about the CCD.

Page 14

Lines 3-9: I can't follow. Please rephrase.

Line 11: You estimate the depth of the CCD based on CaCO3 MAR. The latter you get from equation (1). But how do you transfer CaCO3 MAR into the depth of the CCD? Also, can you provide a data table where you show all the values inserted into equation (1) to get CaCO3 MAR? Provide link to figure.

Section 6.1: How do your CCD estimates compare to that of Pälike et al. (2012)? Could you plot them together? Their CCD is somewhere between 4.2 and 4.8 km for your study interval. How can you explain this difference? Also you get a depth of the

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CCD of >6 km, how realistic is that?

Page 17

Lines 15-16: “In other words, attributing PPLC-4 to one cause is overly simplistic.” I don’t understand, please rephrase.

Page 18

Section 6.4/Lines 25-26: I would not finish a paper like this. Since the paper is very long, I would delete the entire section.

Table 1: Change “Drill Sites in this study” to “Drill sites investigated in this study”. Add ODP and IODP to Sites. “Length of dated record”: Is that information relevant for your study? If not, please delete. “Data available”: Are these data sets that are already available and were worked on in this study (then references are missing), or are these data sets that were generated in this study? Please rephrase respectively.

Table 2: “MIS at Site 849”: Delete “at Site 849”. Magnetic Chron: Not mentioned in the text. I would delete that column.

Figure 1: Start caption with something like “Overview of East Pacific drill sites”. “Sites U1335, U1337, U1338, and 849 have XRF scanning chemical data, while Sites 848, 850, and 851 have CaCO3% estimated from bulk density”: This information is not relevant for the figure. Delete. LMBB/Pliocene ratio: Not mentioned in the text. So if relevant, provide a discussion on this ratio in the main text, if not, delete.

Figure 3: This figure has not been mentioned in the main text; this doesn’t work. As I understand, the only aim of this figure is to show the higher temporal resolution of your new records compared to previously published data of Lyle and Baldauf (2015). So this figure does not contribute to the story presented in your paper. I suggest either to delete this figure, or to move it into the supporting information, but including the data from Lyle and Baldauf as a comparison.

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Figure 4: a) I guess the black lines are a smooth, and the red and brown lines are raw data. Please add this information to the figure caption. b) Different colors refer to different sites? Please explain.

Figure 5: “MAR data are at 10 kyr intervals”: Delete, but make sure that this information is given in the methods. “Sites are arranged from south to north, at their modern position”: Delete. b) Maybe I missed it in the text: Why are these two sites used for CCD estimations? Please add information to the main text. “with two levels of smoothing”: Can you please also show the unsmoothed record? Delete “The 50 kyr smooth. . .time of PPLC 4”. I suggest to remove the CCD record from that figure and to show it in a separate figure together with the CCD record from Pälike et al. (2012).

Figure 6: b) Use different colors for opal MAR and opal:clay. c) Are these only the Mix et al. (1995) data? I don’t get that from the figure caption. Please rephrase accordingly.

Figure 7: To make it easier for the reader, I suggest to add arrows, indicating that low (high) CaCO3:BaSO4 represents high (low) CaCO3 dissolution. Is it possible to fill the 5-8 Ma gap in the CaCO3:BaSO4 record? If no data for Site 849 available, then only based on the records from the remaining sites? Then you can also extend the records shown in Fig. 8 back to 8 Ma.

Figure 8: See my comment to Fig. 7. a) Explain solid and thick lines. b) Enlarge labeling of “power” and “period”. Make dashed “period-lines” more prominent.

Figure 9: Explain solid and thick lines.

Technical corrections:

Several abbreviations are not introduced. Make sure to introduce all of them.

Versus vs vs. Remain consistent.

Bio-SiO2: Do you mean biogenic SiO2? Please rephrase.

Labeling of sites: ODP Sites without “U”, IODP Sites with “U”. Please correct accord-

ingly.

Page 1

Line 12: change “late Miocene-Recent” to “late Miocene to recent”

Line 14: Add ODP

Page 3

Line 15: Delete “The period between” and move “4.5 and 8 Ma” to “LMBB” in the sentence before.

Line 20: Change “We use a combined age model. . .” to “We use a combined age model for all sites investigated by joining. . .”. Delete “data from”.

Page 4

Line 22: Add reference to “At 5 Ma, the sites span from $\sim$4°S to $\sim$4°N”.

Page 5

Line 2: Delete “these”.

Page 6

Line 1: I guess Site 849 is missing in the heading.

Lines 11 and 17-18: Remove, because this information is already given on p. 5, l. 2-3.

Lines 15-17: Change “Unfortunately, Hagelberg et al (1995) did not publish their CaCO3 estimates for the Leg 138 Sites, so we redid the estimate for Sites 848, 850, and 851 along the revised splices presented here” to “Here we provide CaCO3 estimates for Sites 848, 850, and 851 along the revised splices”.

Page 7

Line 2: Remove “unfortunately”.

Page 9

Line 12-13: Repetition. Delete.

Line 24: Change “CaCO3 MAR records. . .” to “Except for Site U1337, CaCO3 MAR records. . .” and remove “however” in the following sentence.

Line 26: Change “. . .that is evidence. . .” to “. . . that is evident. . .”

Lines 27-28: Change “Most of the drill sites in this paper have variability in the bulk sediment MAR, but most of the bulk MAR variation is typically derived from changes CaCO3 MAR. Site U1337 is unique. . .” to “Variability in bulk sediment MARs of the sites investigated in this study is typically derived from changes in CaCO3 MAR. However, Site U1337 is unique. . .”

Page 10

Line 2: Change “in addition to” to “our interpretation becomes supported by”.

Line 12: Add “that we observe” to “intervals”.

Line 23: Change “farther” to “further”.

Lines 25-27: Provide link to figure.

Lines 29-30: Delete “We infer. . .CaCO3 content”.

Page 11

Line 20: Delete “:”

Line 22: What do you mean by “they”?

Page 12

Line 9: Change “glacial carbonate cycles” to “glacial-interglacial carbonate cycles”.

Page 13

Line 31: Delete “for”.

Page 14

Lines 19-20: This information should be part of the figure caption and not of the main text.

Lines 31-34: Repetition of p. 13, l. 4-8. Please restructure.

Page 15

Line 2: Change “. . .XRF scanning data are available, there. . .” to “. . .XRF scanning data are available (i.e., Sites XXX, YYY; ZZZ), there. . .” and remove “at the four drill sites with XRF data” (l. 5-6).

Lines 30-34: This doesn’t work. You already provide a link to Fig 8 earlier. Delete this sentence, but make sure that the information about the smoothed d18O record is given in the figure caption.

Page 16

Lines 2-3: Change “the correlation is still strong when CaCO3:BaSO4 is compared to the smoothed oxygen isotope record” to “that correlation is still strong”.

Line 12: Add “Site” to 607.

Page 17

Lines 6-9: Delete these sentences.

Page 21

Lines 1-2: Delete “In this paper. . .work regionally”.

Lines 4-9: Restructure as follows: “We identified five long- term low CaCO3 intervals within the 7 drill sites we investigated: PPLC-5 (4737-4465 ka), PPLC-4 (3 intervals between 4093 and 2915 ka), PPLC-3 (2 intervals on either side of a CaCO3 high, be-

tween 2684 and 2248 ka), PPLC-2 (2135-1685 ka), and PPLC-1 (402-51 ka). With bulk chemical data and the geographic range of the investigated drill sites it is possible to distinguish between dissolution and production as causes of low CaCO3 intervals in the Pliocene-Pleistocene record. We found that PPLC-5 and PPLC-2 result from CaCO3 dilution through diatom production, and the other 3 result from enhanced CaCO3 dissolution."

Line 16: Delete "whose 3. . .and 3 Ma".

Line 21: Studies from 2016 are not really "new". Replace "new" by "previous".

Page 33

Line 7: Remove "Late Miocene Biogenic Bloom".

Page 38

Line 7: Change "atandardized" to "standardized".

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