



DEPARTMENT OF EARTH AND SPACE SCIENCES  
3806 GEOLOGY BUILDING  
BOX 951567  
LOS ANGELES, CALIFORNIA 90095-1567  
TEL: (310) 825-3880  
FAX: (310) 825-2779

Dear Dr. Fischer,

We thank you for your constructive comments on this manuscript. Please find below the point-to-point response.

On behalf of the co-authors,  
Maxence Guillermic and Aradhna Tripathi

Dear authors

thanks for all the changes. I think this has greatly improved the paper and made the discussion much more differentiated. I had another read of the paper and found a list of language issues that I would ask you to fix (see list below). Please also check the quality/resolution of your figures. At least Figure 5 is very bad resolution in my pdf.

Please send a short list with the changes you did together with the revised version.

All the best Hubertus

Language edits (please note that the line numbers below refer to your new "Authors tracked changes" version)

line 36: "from the Miocene to the late Quaternary"

**Author's response:** This change has been made.

line 59: I would suggest to delete: "from regions...atmosphere."

**Author's response:** This change has been made.

line 64: "into older atmospheric"

**Author's response:** This change has been made.

line 65: "of CO<sub>2</sub> prior to"

**Author's response:** This change has been made.

line 82-85: there is something wrong with this sentence, please fix

**Author's response:** We changed this to: "There was also the realization that temperature-dependent  $K_D$  and B/Ca sensitivities reported from sediment trap, core-top, and downcore studies (Yu and Hönisch, 2007; Foster et al., 2008; Tripathi et al., 2009, 2011; Babila et al., 2010; Osborne et al., 2020) differ from inferences from foraminiferal culture experiments (Allen et al., 2011, 2012) and inorganic calcite (Mavromatis et al., 2015) which complicates the use of the B/Ca proxy, although this type of discrepancy has also been observed with other elemental proxies (e.g., Mg/Ca). »

line 107: "Moreover, although"

**Author's response:** This change has been made.

line 118: "open ocean region"

**Author's response:** This change has been made.

line 133: "support stable air-sea (dis-)equilibrium conditions"

**Author's response:** This change has been made.

line 135: "on prior low-resolution reconstructions"

**Author's response:** This change has been made.

line 143: "correcting for"

**Author's response:** This change has been made.

line 146: "recent times"

**Author's response:** This change has been made.

line 182: "A comparison of"

**Author's response:** This change has been made.

line 233: "on 11B"

**Author's response:** This change has been made.

line 259: "using d11Bborate"

**Author's response:** This change has been made.

line 262: "are provided in"

**Author's response:** This change has been made.

line 269: "1 Myr"

**Author's response:** This change has been made.

line 289: "are met despite large scatter"

**Author's response:** This change has been made.

line 291-92: unclear, clarify this sentence especially on bootstrapping

**Author's response:** This has been changed to: "Two regressions between ice core pCO<sub>2</sub> and boron-based pCO<sub>2</sub> are shown, a simple linear regression (grey line) and a Deming regression that takes into account error in variables (blue line). Bootstrapping was used to calculate uncertainties in the regression models (n=1000, Figure 3C, Table S6). »

line 295-96: I do not agree or misunderstand: The age scales for the marine records may be consistent with each other but they are independent of the ice core age scale. Please clarify sentence.

**Author's response:** This now reads: « The age models for the sites are based on comparisons of the benthic δ<sup>18</sup>O records for both Sites 806 and 807 (Fig. 3A, Zhang et al., 2007 ; Lear et al., 2003 ; Lear et al., 2015) to the published isotopic stack (Lisiecki and Raymo, 2004). »

line 319: "were reconstructed"

**Author's response:** This change has been made.

line 324: ", respectively"

**Author's response:** This change has been made.

line 326: "small (ca. 1°C) change into"

**Author's response:** This change has been made.

line 339: "used in our calculations"

**Author's response:** This change has been made.

line 340: "are provided in"

**Author's response:** This change has been made.

line 382: the part "in concert with ocean circulation " is unclear, clarify

**Author's response:** We removed this part as we intend to make a more general statement. We changed it to: "The study of Miocene climate is thought to provide insights into drivers and impacts of global warming and melting of polar ice (Flower and Kennett, 1994).".

line 399: "suggest that the"

**Author's response:** This change has been made.

line 413: "pCO<sub>2</sub> data increase"

**Author's response:** This change has been made.

line 420: "are found during"

**Author's response:** This change has been made.

line 431: "of pH of"

**Author's response:** This change has been made.

line 461: " "Raitzsch"

**Author's response:** This change has been made.

line 485/86: "regions from 3.3. to 2.7 Ma"

**Author's response:** This change has been made.

line 518: it is debated whether eccentricity directly plays a role. May be write "high amplitude, lower frequency (app. 100 kyr) cycles"

**Author's response:** This change has been made.

line 563: explain K-Pg boundary

**Author's response:** We added: "For example, the 4-5‰ drop in  $\delta^7\text{Li}$  record at the Cretaceous–Paleogene (K-Pg) boundary (Misra and Froelich, 2012) [...]"

line 573-74: fix/clarify sentence "will determine the nature... seawater  $\delta^7\text{Li}$ "

**Author's response:** We changed this to: "However, the congruency of chemical weathering of basalts, depending on regional climatic conditions (warm-wet vs. cold-arid), will determine the shape and position of inflection points in the seawater  $\delta^7\text{Li}$  record. "

line 582: "by a change"

**Author's response:** This change has been made.

line 585: "increasing seawater"

**Author's response:** This change has been made.

line 587: "MCO is synchronous"

**Author's response:** This change has been made.

line 619-20: fix sentence: "and the MCO values...higher pCO<sub>2</sub>"

**Author's response:** We changed Line 621 to: "pCO<sub>2</sub> values increase from the early Miocene to the MCO with estimated MCO pCO<sub>2</sub> values of  $511 \pm 201$  ppm (2 SD, n=3)."

line 621: replace "likely" by "potentially" ???

**Author's response:** This change has been made.

line 626: "for the time interval app. 3.3-3.0 Ma"  
**Author's response:** This change has been made.

line 627: " for the Pliocene"  
**Author's response:** This change has been made.

line 1072: "corrected for"  
**Author's response:** This change has been made.

line 1075: "to recent times"  
**Author's response:** This change has been made.

line 1078: "squares represent data"  
**Author's response:** This change has been made.

line 1094: "pCO<sub>2</sub>" SUBSCRIPT "ice core"  
**Author's response:** This change has been made.

line 1096: "bootstrapping"  
**Author's response:** We changed this sentence, please see edits below.

line 1097-98: fix/clarify sentence\*  
Line 1101: The sentence now reads "Cross plot for the last 0.8 Myr of pCO<sub>2</sub>  $\delta_{11B}$  from this study and pCO<sub>2</sub> ice core (from ice core compilation, Bereiter et al., 2015), grey line is a simple linear regression ( $p = 0.25$ ,  $R^2=0.09$ ), blue line is a Deming regression taking both x and y uncertainties into account ( $p = 0.25$ ). Details of the regression parameters are in Table S6. Ice core CO<sub>2</sub> error was calculated based on 2 SD of reported values, and  $\pm 1$  ky for the age of sediment samples. Boron-based pCO<sub>2</sub> error is calculated based on error propagation described by eq. S17."

line 1102: "temperatures were"  
**Author's response:** This change has been made.

line 1133: "from the compilation by Rae"  
**Author's response:** This change has been made.

line 1135: "using the constant"  
**Author's response:** This change has been made.

line 1152: "color is indicating"  
**Author's response:** We changed to "color indicates"

line 1156: "temperatures"  
**Author's response:** This change has been made.

line 1159: "are compilation data from Rae"  
**Author's response:** This change has been made.

line 1163: "pCO<sub>2</sub> values"

**Author's response:** This change has been made.

line 1164: "pCO<sub>2</sub> values"

**Author's response:** This change has been made.

line 1168: "color is indicating"

**Author's response:** This change has been made.

line 1172: "temperatures"

**Author's response:** This change has been made.

line 1177: " pCO<sub>2</sub> values"

**Author's response:** This change has been made.

line 1190: "color is indicating"

**Author's response:** This has been changed to "color indicates"

line 1194: "temperatures"

**Author's response:** This change has been made.

line 1198: "represent the CO<sub>2</sub> compilation"

**Author's response:** This change has been made.

line 1199: "from the compilation by Rae"

**Author's response:** This change has been made.

line 1209: "color is indicating"

**Author's response:** This has been changed to "color indicates"

line 1213: " temperatures based on literature"

**Author's response:** This change has been made.

line 1217: "from the compilation by Rae"

**Author's response:** This change has been made.

line 1228: "are indications when"

**Author's response:** This has been changed to "indicates"

line 1230: "color is indicating"

**Author's response:** This has been changed to "color indicates"

line 1236: "shown is the timing of"

**Author's response:** This change has been made.

line 1237: "the eruption of"

**Author's response:** This change has been made.