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Climate of the Past Discussions

Interactive comment on "Evidence for the non-influence of salinity variability on the coral Sr / Ca paleothermometer" *by* M. Moreau et al.

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In the submitted manuscript, Moreau and co-authors attempt to assess the influence of salinity on the incorporation of strontium and calcium into coral aragonite. Their empirical approach regresses coral Sr/Ca records (almost all of which is previously published) against OISST and SODA salinity reanalysis data, and concludes that salinity has a negligible effect on Sr/Ca. Although I see merit in their goal of improving geochemical paleothermometers in hopes of generating more accurate paleotemperature records, I believe that in its current form, this research falls far short of that goal.

I have serious concerns with both the criteria for selecting the records to be evaluated and the methods used to do so. The 15 records used are far from comprehensive, but no rationale is provided for why only these select records are included. In a mat-

ter of minutes, I came up with a list of records (see bottom of this review) that likely should be included and may provide for a more robust and meaningful assessment of the effect of salinity on Sr/Ca. This list is undoubtedly incomplete itself and I urge the authors to either be as comprehensive as possible or provide objective and well-reasoned criteria for including/excluding data. As an example, why are only a handful of non-Porites records included? It would seem more reasonable either to focus exclusively on Porites genera or included all massive genera (i.e. Diploria, Diploastrea, Pavona etc.) This might allow the rather short discussion section to be expanded to more interesting/meaningful discussions such as the presence/absence of genera specific salinity effects.

Using their seemingly subjective database of Sr/Ca records, the authors use a series of linear regressions to evaluate the impact of salinity. Their first method applies an average Sr/Ca-SST relationship for Porites sp. corals to derive a coral-based SST and compares its residual with a SODA salinity reanalysis. Given the considerable variability among Porites sp. Sr/Ca-SST calibrations highlighted by Dr. Correge's 2006 review, it does not seem reasonable to use this as a constant among all corals, especially those of other genera. I would remove this method. The second approach simultaneously regresses coral Sr/Ca against both SST and SSS, then (in a rather circular approach) uses this relationship to reconstruct "theoretical" coral Sr/Ca, which is finally regressed against measured coral Sr/Ca. I prefer this multi-regressive approach, but find it unnecessarily convoluted. Would it not be more simple and straight-forward to perform the multiple linear regression, then determine if the slope of the salinity coefficient is significantly different from zero?

My final significant concern regards the new data presented in this paper. It is presented almost as an after thought with little discussion of how Sr/Ca varies in this specimen. At minimum the authors should describe these results in more detail and move the record from the supplement to the main text. Their results should be compared to previous Pacific Porites Sr/Ca-SST relationships and include a discussion of

intervals during which the Sr/Ca-based SST is markedly different from observed (e.g. 1988, 1996). Better yet, presuming there are also CL1 and CL2 cores, perhaps a little more data would allow for a stand alone paper on intra- and inter-coral Sr/Ca variability in Clipperton Atoll Porites that could be compared with Henry Wu's work at the site. Doing so would be a greater contribution to the coral/climate community and would likely have little impact on the major results of the present manuscript.

Additional comments: Page 1784, Lines 19-21. Please provide some references for the extensive use of corals during the last 30 years.

Page 1785, Lines 20-21. Please provide some references that suggest the influence of salinity on coral Sr/Ca is a major question among paleoceanographers.

Page 1785, Lines 27. Replace with "seawater oxygen isotopic composition" to be specific about the isotope system you're discussing.

Page 1786, Line 9. Give salinity units.

Page 1786, Line 10. Provide the genus/species used by Pretet given that this manuscript too investigates corals other than Porites.

Page 1786, Line 25. Provide more details on the sampling of CL3 including date, water depth and lat/lon.

Page 1787, Line 15. Describe if both maxima and minima were peak matched or just one of the two.

Page 1787, Line 19. The inclusion of Siderastrea and Montastrea comes as a surprise here because the introduction is set up in term of Porites only. Either include only Porites in your analysis or expand the introduction to speak more broadly about all coral genera used for paleo reconstructions.

Page 1788, Line 11. State that the equation from Correge 2006 was based only on Porites, but that it is being applied to other genera. Include a thorough argument as to

why it is reasonable to apply this equation across genera, or abandon this approach.

Page 1788, Line 21. State that SODA is a reanalysis product and will not capture the extreme salinity variations that may occur within local atoll/reef environments. In situ timeseries of salinity exists for reef sites and it would be valuable to know how the SODA product compares with monitoring data. I know AIMS maintains extensive monitoring of the GBR and this may be a good place to start.

Page 1788, Line 23. This type of filtering reduces the degrees of freedom between timeseries and inflates r-squared values. The reduced degrees of freedom must be accounted for when calculating a p value to determine if the higher r-squared is significant. Please state if this has been done, and be sure to account for this effect if not done so already.

Page 1789, Line 2. "MLR regression" implies the redundant "multiple linear regression regression"

Page 1789, Line 10. Change records to record.

Page 1789, Line 17. Although it may be reasonable to compare coral aragonite Sr/Ca and foram calcite Mg/Ca it should not be the primary point of discussion. I would prefer an expanded discussion of the authors' results in the context of abiogenic aragonite experiments (e.g. Zhong and Mucci mentioned briefly) and the work of Pretet.

Page 1791, Line 3. Presumably, the underlying mechanism that would cause coral Sr/Ca to vary with salinity is changes in seawater Sr/Ca. I would also include a discussion of seawater Sr/Ca variability both spatially and temporally. Are the sites that exhibit a significant correlation between Sr/Ca and salinity close to riverine water sources with Sr/Ca ratios that differ from typical marine values?

Figure 1: Please give the years for which the average salinity is calculated. Please also include a complementary table that gives the names, salinities, lat/lon and reference for the locations in Figure 1.

Figure 2: This figure would be more useful if it distinguished between site and coral genera. Fore example, each site could use a different symbol and different colors could be used for each genera. Consider removing the inset. I think it has little significance for your analysis.

Figure 3: Please provide a rationale for splitting the data at the specified SSS values.

Supplementary material. In the table of regression statistics, please provide the slope +/- standard error for both the SST and SSS slope of MLRs.

Some of the records that should be added:

Porites sp. Felis et al. (http://hurricane.ncdc.noaa.gov/pls/paleox/f?p=519:1:1246124530464
Stephens et al. (ftp://ftp.ncdc.noaa.gov/pub/data/paleo/coral/west_pacific/amedee2004.txt)
Hendy et al. (ftp://ftp.ncdc.noaa.gov/pub/data/paleo/coral/west_pacific/great_barrier/hendyda
Calvo et al. (http://hurricane.ncdc.noaa.gov/pls/paleox/f?p=519:1:0::::P1_STUDY_ID:6087)
Wu et al. (http://hurricane.ncdc.noaa.gov/pls/paleox/f?p=519:1:::::P1_STUDY_ID:15238)
Dullo et al. (http://hurricane.ncdc.noaa.gov/pls/paleox/f?p=519:1:::::P1_STUDY_ID:8606)
Fallon et al. (https://www.researchgate.net/publication/225745602_Examining_water_temper
shelf_comparison) DeVilliers et al. (http://www.sciencedirect.com/science/article/pii/0016703

Montastrea sp. Kilbourne et al. (http://hurricane.ncdc.noaa.gov/pls/paleox/f?p=519:1:::::P1_s
Saenger et al. (http://onlinelibrary.wiley.com/doi/10.1029/2007PA001572/abstract)

Diploria sp. Goodkin et al. (http://hurricane.ncdc.noaa.gov/pls/paleox/f?p=519:1:::::P1_study_
Kuhnert et al. (http://hurricane.ncdc.noaa.gov/pls/paleox/f?p=519:1:::::P1_study_id:1872)
Hetzinger et al. (http://hurricane.ncdc.noaa.gov/pls/paleox/f?p=519:1:::::P1_study_id:12893,
http://hurricane.ncdc.noaa.gov/pls/paleox/f?p=519:1:::::P1_study_id:12892)

Diploastrea sp. Bagnato et al (http://hurricane.ncdc.noaa.gov/pls/paleox/f?p=519:1:::::P1_ST

Interactive comment on Clim. Past Discuss., 10, 1783, 2014.