

Biogeosciences Discuss., referee comment RC3
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Comment on bg-2021-21

Anonymous Referee #3

Referee comment on "Growth rate rather than temperature affects the B/Ca ratio in the calcareous red alga *Lithothamnion corallioides*" by Giulia Piazza et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-21-RC3>, 2021

The aim of the manuscript of Piazza et al. is to investigate the trace metal composition in a coralline algae species from two basins. From which the authors make an assessment of whether temperature or growth plays an important role in the elemental ratio. The results are intriguing, new and would justify publication, yet not in its present form. Unfortunately, in this version of the manuscript, the authors have not taken full advantage of being the first to do 'something' and there is a bit too more of 'obfuscation' through statistical tests and not enough raw data on show. The advantage of being the first is that you do not have to conform to previous studies, I would like to know a lot more about the raw data (e.g., 'what is the variation in trace metal ratios between the long and short cells?', 'did the authors test multiple branches') rather than solely focusing upon the temperature vs. growth debate. The authors should plot the raw data, plot all element ratios for all sites rather than one (i.e., figure 6), and ensure that the environmental data matches the collection time period.

Major Points:

Environmental data. The environmental data the authors use for the collected samples does not correspond with the date of collection, many of the samples have been compared with averages of temperature and pH for years after their collection dates:

Aegadian Island – Collected 1993, temperature 1986 to 2017, pH 1993 to 2018, DIC 2019-2020

Elba Island – Collected 1990, temperature 1980 -1991, pH 1993 to 2018, DIC 2019-2020

Morlaix – Collected 1991, temperature 1980-1992, pH 1993 to 2018, DIC 2019-2020

Pontian Island – Collected 2017, temperature 1986-2017, pH 1993 to 2018, DIC 2019-2020

I understand the pH and DIC data are sparse, but there doesn't seem to have been any attempt to try and 'translate' these values to the collection time, or discuss the implications (besides lines 150-152).

'Raw' data. Like the other reviewers I miss the data of the individual samples and therefore it is difficult to make a fair assessment of many of the points raised by the authors. I don't know how many samples were actually analysed by the authors, is it one per site, or multiple. Likewise, how many measurements per sample. I would like to see the different elemental ratios per sample per site plotted, highlighting the measurements that represent the long or short cells. I would also plot the growth rate for each band (so that would be equal to length) as a shaded grey line behind.

Growth rate vs DeltaT: Figure 9 seems to be the justification for the much of the title and abstract. I have no problem with four datapoints, if those data points incorporated error bars the showed the full range of the B/Ca. I do however wonder what DeltaT is supposed to represent as a variable, are the authors implying that seasonality controls the absolute value of the B/Ca? That is not testing temperature as the title suggests but the seasonal range in temperature (the datapoint at DeltaT = 9 would be the lowest average temperature site). I note that range of the B/Ca (from the boxplots in figure 8) also eclipses the y-axis of figure 9, the intra sample/site ranges from ~300 to ~950 B/Ca.

DeltaT. The authors use the range of temperature throughout and I am at a loss as to understand why you would compare a variable that is supposed to be a temperature proxy with the seasonality of the site. I could understand if the authors took the difference between max and min of the Element/Ca and compared it against DeltaT, but essentially the authors are comparing an absolute temperature with its supposed range.

Long and short cells. The authors use the Mg/Ca to check if the data is from long and short cells, does this not make Figure 5 completely irrelevant, i.e., the difference between the long and short is because they were split by Mg/Ca ('Long cells were identified as spots with high Mg/Ca and positioning on light growth bands. Conversely, short cells were located in dark growth bands and corresponded to low Mg/Ca ratio.'). The all Mg/Ca (i.e., long+short) vs sites shows (Figure 4) no difference, therefore the only rationale to show figure 5 would be to inform the reader what cut off values you used to define short and long cells.

Sampling at growth bands. Line's 165 and 135 'each growth band change which marked the transition between the cells usually produced in the warm season and those usually produced in the cold season,' you are targeting transitions between Cold and Warm Seasons. So does the growth band really represent the cold season or warm season in its entirety? If you sample the transition between cold and warm by definition you don't sample the extremes (which DeltaT would represent) but do you fully sample the temperature? If a growth band represents a season, comparing the average of X number of growth bands is not entirely comparable with the mean temperature of the site (you could sample 3 cold and 4 warm growth bands, i.e., W-C-W-C-W-C-W, and therefore your average element/ca signal would be biased).

General comments:

Having looked at the other reviewers comments I would add the following:

Probably avoid abbreviating coralline algae as CA if you're talking about [Element]/Ca (e.g., line 13 'Mg, Sr, Li and B in the CA');

Line 21: "These pieces of evidence suggest that growth rates, triggered by the different ΔT and light availability across depth, affect the B incorporation in *L. corallioides*." – does this not contradict your title?

Line 42: define acronym - MAS NMR

Line 83: "in calcifying species, including CA (Barker et al., 2005;" – perhaps split the references between those that did and did not use coralline algae

Line 92 and Line 100: A bit repetitive use of 'in this paper', perhaps at line 100 change to 'With our new measurements we aim to test whether...'

Line 105: If grab samples were used, how sure are you they were collected living specimens. Also in general, is collection date supposed to be read as collected living at this date

Line 120: Missing word - 'Hence once excluded [specimens?] belonging to the genus...'

Line 114- 122: Clarify and expand 'how' (i.e., traits and characteristics used) and 'why' identification was needed, in the 'why' justify species selection.

Line 124: replace included with embedded/fixed/placed

Line 125: replace 'kept drying' with 'left to dry'

Line 125: 'included branches' – replace with 'treated branches'

Line 144 – 149: why 11 years?

Line 160: "The obtained values, expressed in linear extension over year (mm/yr), were crossreferenced with Mg/Ca results in order to check for the correspondence of Mg peaks with growth band helpful in highlighting faint bands and to achieve a more reliable estimate of the algal growth" – is this not circular? I note this is further expanded at lines 216-217 to 'Long cells were identified as spots with high Mg/Ca and positioning on light growth bands. Conversely, short cells were located in dark growth bands and corresponded to low Mg/Ca ratio'

Line 163-165: what is the difference between the growth rates of the light and dark/long and short cells?

Line 200: "Both Li/Ca and Sr/Ca records had positive correlations with Mg/Ca in our samples" is this not because it's a closed sum? With an elemental ratio there is only so much substitution available in the calcite lattice, so what do these correlations show?

Line 277: 'In order to provide high-resolution geochemical data on long and short cells separately, we considered only the results from the spots where the positive/negative Mg/Ca peaks correspond respectively to the light/dark bands resulting from the image analyses.' + Line 281-282: 'In the sample from Elba the growth bands were not clearly visible, preventing the analyses of trace elements on long and short cells separately.' These should occur earlier at sections 2.4 growth and 2.5 data.

Line 299: Is 60m deepwater?

Line 300: 'The results of the statistical analyses on Mg/Ca evidenced a strong relationship with the seawater temperatures extracted from ORAS5 (Table 2), as expected' – Table 2 is only the temperature so we as readers don't know if it is a strong relationship plus the extracted environmental variables in places do not correspond with the sampling dates. Plot the data not as a box plot (fig 4) but as a scatter plot with the full range of values as error bars.

Line 307: 'Temperature covaries with irradiance and both correlate to seasons, which influence primary production, respiration and calcification in *L. corallioides*' - Do you (a) think that there is much irradiance change between 37 and 48N? There is roughly an 2 hr difference in length of day between 30 and 50 N. And (b) temperature lags irradiance, its why September is still relatively warm (as it takes time for the sea to 'warm up' due to seawaters heat capacity) along Europe's coasts.

Line 338: You can calculate the potential difference in light between 40 and 60 m to actually determine if irradiance matters, like so: The light at depth Z is equal to the light at surface multiplied by e^{-kz} , where z is the depth and k is an extinction coefficient which varies from basin to basin.

Line 399: Data availability. Should be deposited in a repository rather than available on request (https://www.biogeosciences.net/policies/data_policy.html).

Line 414: Move 'Environmental data were provided by E.U. Copernicus Marine Service Information' to Data availability, include the url as well as the url of ORAS5.

Figures

Figure 2B: The coralline algae is branching so I wonder how do you determine which is the oldest/youngest and therefore corresponds to your environmental data. For example, if you go up from between the 9th and 10th spots from the left, two branching growth lines meet, one sits slightly above the other (so that branch formed after). And because its branching does that not impact growth rate? I.e., what if the algae invested more time in branching than lengthening a branch?

Figure 2B: Because the growth lines are convex how is growth measured, the longest point between two growth lines or fixed? Or more pertinently if the laser ablation track is used to define the size, how were the laser ablation sites positioned?

Figure 5: If Mg/Ca is used to define the long and short cells this is not an independent test.

Figure 9: $p = 0.051$, technically that is above $p < 0.05$.

Figure 9. The two lowest datapoints with B/Ca values of 460 and 610 look like they are subtly offset between the left and right panels