Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2019-40-AC1, 2019

Biogeosciences Discussions
Open Access
EGU

Interactive comment on "Environmental and biological controls on Na/Ca ratios in scleractinian cold-water corals" *by* Nicolai Schleinkofer et al.

Nicolai Schleinkofer et al.

schleinkofer@em.uni-frankfurt.de

Received and published: 15 August 2019

We would like to thank William Gray for their time and effort in reviewing our manuscript and providing constructive criticism. We are confident that we can revise our manuscript to satisfy all of the reviewer's questions.

Major comments: Crucial information is missing from the methods regarding how pH was measured (probe, photometric dye, ALK+DIC)? What scale is pH on? If it was measured by different methods/on different scales, where efforts made to homogenise the dataset?

Printer-friendly version

Discussion paper

Thank you for your helpful and constructive comments. We added information about the method of pH measurement (L120 – 125). We also added a short comment about the pH effect on Na/Ca which could complicate temperature reconstructions (L563). Interestingly Na/Mg ratios show no correlation with pH.

"The seawater carbonate system data such as pH was taken from the associated cruise report (Flögel et al., 2014) or in case of the Red Sea and the western Atlantic from Mezger et al., (2016) and CARINA. Flögel et al., 2014 used a WTW Multi 350i compact precision hand- held meter to determine pH (Flögel et al., 2014), pH in the Red Sea was calculated from DIC and TA, measured during PELAGIA 64PE158 (Mezger et al., 2016), using CO2SYS (Lewis and Wallace, 1998). pH values are reported using the total scale."

It is important to add a new plot showing the covariance between predictor variables (T,S, pH) in your dataset.

We did not add plots about covariance of predictor variables because we mentioned important covariances in the text (L209, L228). We added all the environmental data and measured data as a supplement table, so these plots can be recreated if necessary.

Given that coral distribution (and thus optimum growth rate) is discussed in relationship to seawater density, why not regress Na/Ca against seawater density? It would be interesting to see if the Na 'peak' around 35 PSU relates to the optimum habitat density. The density vs. E/Ca ratio plots are very similar to the salinity vs. E/Ca plots. In deed the maximum Na/Ca ratios are found around 1028.25 kg/m^3. However, we do not think that these plots provide valuable information within the context of the rest of the manuscript. Nevertheless, we added these plots to this document and they can be easily reconstructed from the data in the supplements

We would however, respectfully disagree that this is a limited dataset. With 45 specimens from 16 locations with a wide temperature and salinity range, it contributes a

substantial amount of Na, Mg and Sr data from CWCs.

Minor comments:

Reviewer 2: L38 I would describe Na/Ca in forams as a 'potential' tool, rather than a 'promising' tool. The relationships seen between Na/Ca and S in different studies conducted on the same species can vary wildly

Response: L39 You are right. Results are not clear enough to justify calling it promising. We changed the wording.

Reviewer 2: L50 it is not clear what you mean here – at a global scale it is not correct to say density is mainly governed by salinity (compare surface of warm salty tropical Atlantic to cold fresh north pacific)

Response: Thank you for that remark, this probably has to be clarified. Generally speaking, you are right. In the ocean, the main control on density is the temperature. However, in this dataset, we have a temperature range of 15°C which translates to density changes of $\approx$ 4 kg/m^3 (constant salinity) and a salinity range of 10 g/kg which translates to a density change of $\approx$ >5 kg/m^3 (constant temperature). Accordingly, in this data set, changes in salinity are more important than changes in temperature. Nevertheless, we deleted this part (L51).

Reviewer 2: L108 see first comment – give the wildly different relationship between Na/Ca and salinity in different studies of same species it is not accurate to say Na in forams is largely function of salinity

Response: We changed the statement (L98)

Reviewer 2: L135 much more information on the pH measurement method is needed here. What scale is pH given on?

Response: L126 We added more information about pH measurements. Values are given in pHT and data was not homogenized

Reviewer 2: L159: why is it important it can measure both axially and radially?

Response: Being capable of measuring both axially and radially is important when measuring alkali metals such as sodium, because these elements are better measured in radial view. Axial view is more affected by excitation disturbance (Ivaldi and Tyson, 1995) which especially influences the easy electron transitions (alkali metals) (Demers, 1979). However, trustworthy results are also possible with axial view (e.g. (Bertlich et al., 2018))

Reviewer 2: L218: given that coral distribution discussed in relation to seawater density, why not plot (and regress) Na/Ca (and Mg/Ca and Sr/Ca) against density? Interesting to see if Na 'peak' at 35 PSU relates to density preference of corals.

Response: Plots of seawater density vs. Mg,Na,Sr/Ca are very similar to the Mg,Na,Sr/Ca vs. salinity plots. Na/Ca vs. density shows a peak at a density of 1028.25 kg/m^3 which is close to the preferred values in the northern Atlantic (1027.35 – 1027.65 kg/m^3)(Dullo et al., 2008) and the Mediterranean sea (1029 kg/m^3)(Flögel et al., 2014). Seawater density was calculated with the formula given in Fofonoff and Millard, (1983) from temperature, salinity and depth. For Mg/Ca and Sr/Ca plots show no significant trends with changing density. (Fig. 1,2,3)

Reviewer 2: L241 you need to add this is essentially driven by one data point at âĹij21.5 oC

Response: L234 We added a remark that data availability for M. occulata and Caryophylliidae is too scarce to draw any firm conclusions. There might be a typo in your comment. You are probably referring to line 214 not 241. We added a comment on this as well (L213)

Reviewer 2: L233: correlation with pH very interesting given limited pH range (and likely large errors). Na/Ca should be regressed against T and pH in a multiple regression to account for both variables.

Printer-friendly version

Discussion paper

Response: Thank you for that comment. We did try a multiple linear regression, but the slope of the multiple regression for temperature is very similar to the single linear regression (-0.33 (multiple linear regression) vs. 0.31). Accordingly, pH does not seem to have a big effect on Na/Ca ratios. Since we can see a trend to lower pH values with increasing temperature the pH-effect on Na/Ca ratios might very well be just an effect of this covariation.

Reviewer 2: L363: try plotting against density

Response: See Major comments and plots

Reviewer 2: L400 and L401: typo on signs in sensitivities

Response: L410 Thank you, we changed it to minus (-)

Reviewer 2: L422-599: given the limitations of the dataset, this section needs to be made much shorter

Response: We deleted lines 476-487 and 516 – 531 but we do not think that we can shorten the section more without deleting important information.

Reviewer 2: L567: there really isn't enough data to say this...

Response: Thank you for that comment. In deed it might be a little bit overzealous to speak of greatly reduced vital effects but the data clearly shows that there are effects that could complicate temperature reconstruction with Na/Ca ratios, which however are minimized when using Na/Mg ratios. We adjusted the wording (L552)

Reviewer 2: L580: it is not all clear what you mean by 'Advantageous to Li/Mg ratios are the missing species-specific vital effects.' – if you are saying there are not vital effects in Na/Ca, there simply isn't enough data to say this

Response: L574 You are right, we deleted the statement

Changes are marked green in the Manuscript

Printer-friendly version

Discussion paper

Additional changes: changed Lophelia pertusa to Desmophyllum pertusum (new accepted species name)

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2019-40, 2019.

Printer-friendly version

Discussion paper

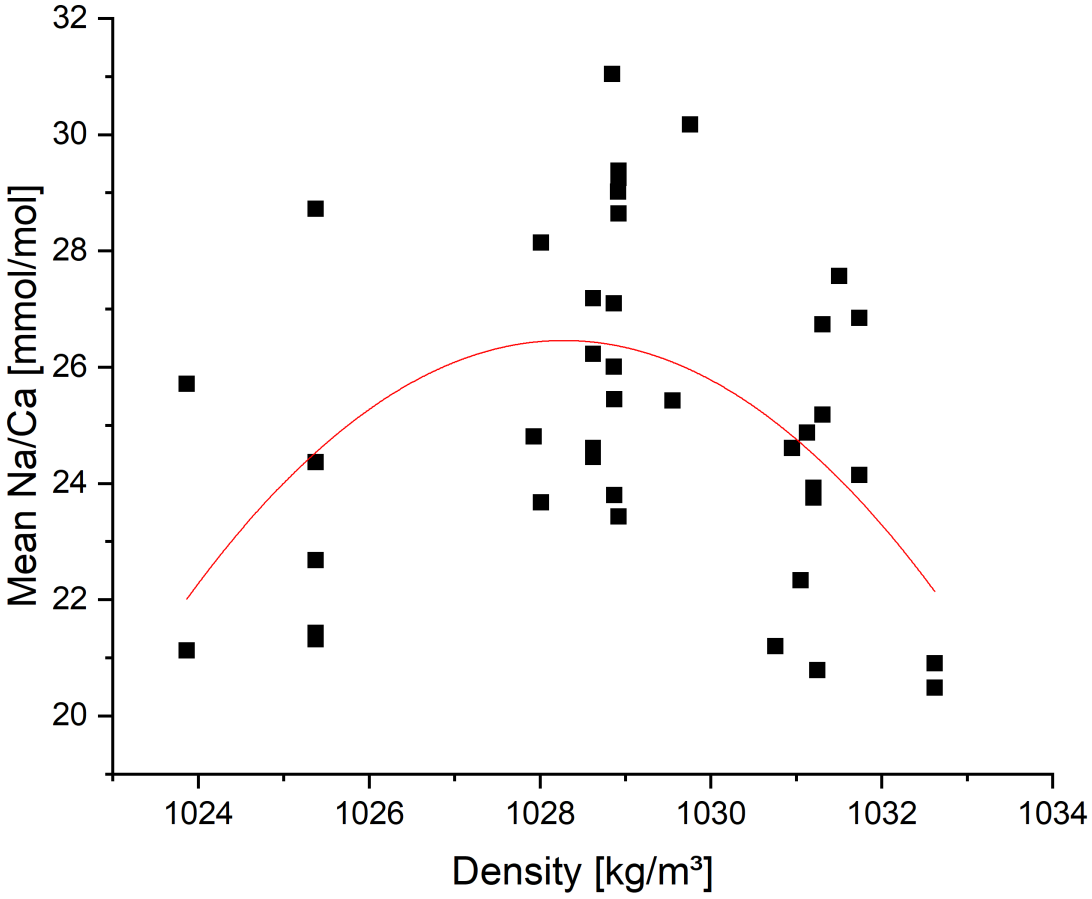

Fig. 1. Na/Ca vs. density

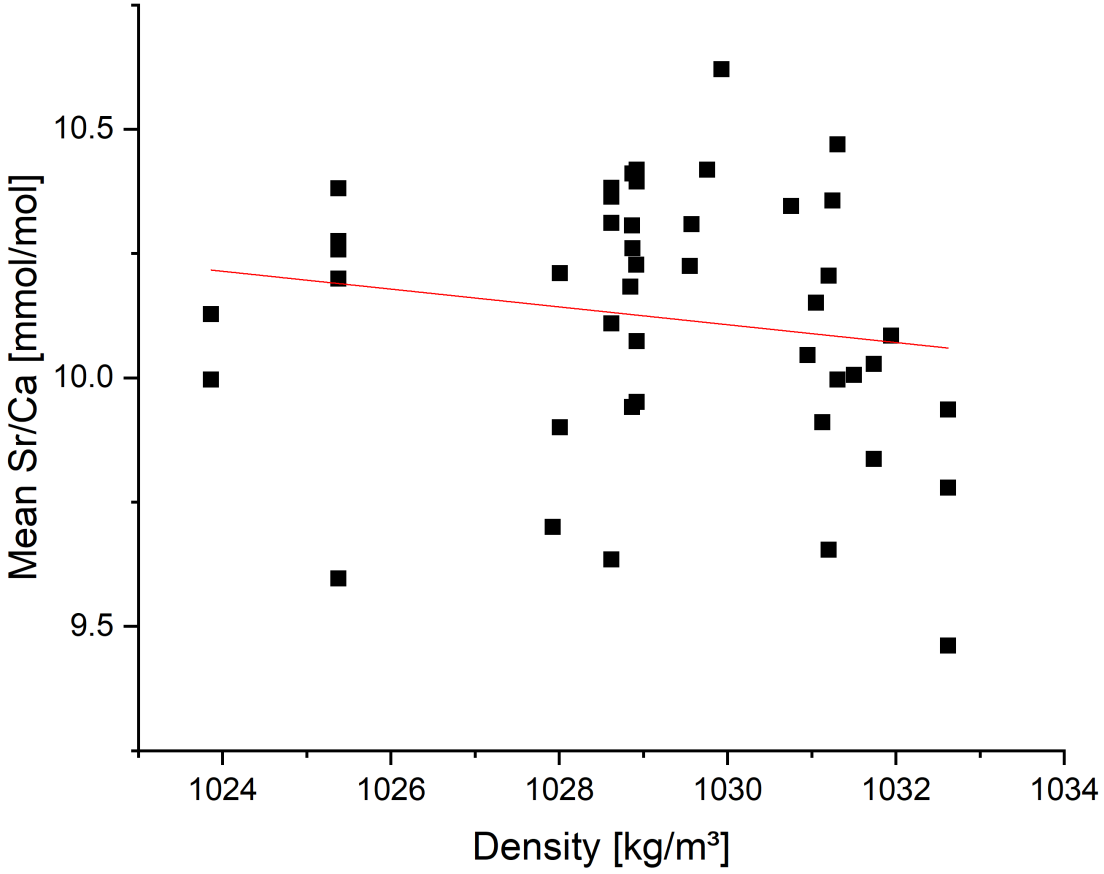

Fig. 2. Sr/Cavs. density

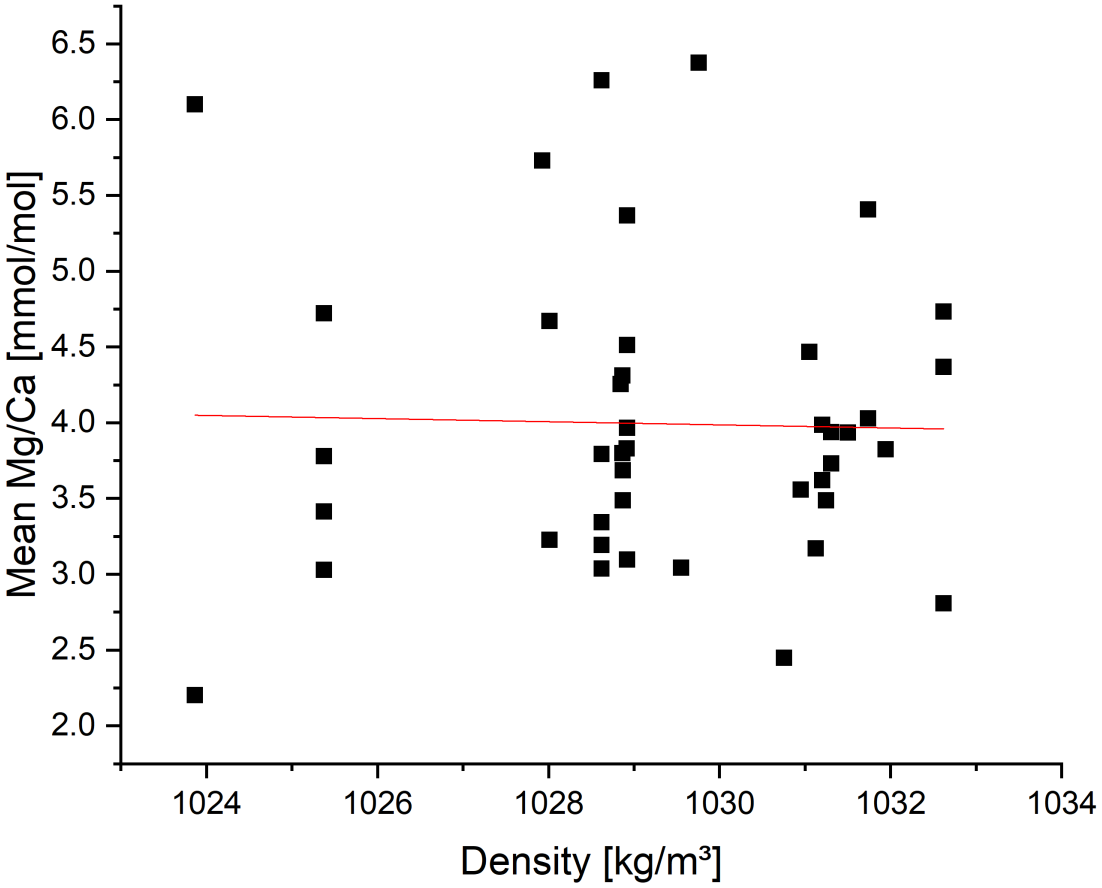

Fig. 3. Mg/Ca vs. density