Referee 1

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Review Biogeosciences: Calibration of Mg/Ca and Sr/Ca in coastal marine ostracods as proxy of temperature Maximiliano Rodríguez, Christelle Not

General

This is an excellent paper extending the Mg/Ca paleothermometry method to two shallow water genera common along coasts of SE Asia. One genus lives in hypoxic low salinity waters. I also like the link to internal modes of climate variability, such as ENSO. The paper carefully evaluates the importance of using many, adult specimens or the best results, a result some other recent papers simply because they do not use enough carefully selected specimens, well preserved adults. The statistics on the Mg/Ca to temp. correlation are impressive when 7 or more specimens are used. Another positive aspect of Rodriguez and Not is the careful selection of hydrological data including excellent water temperature datasets. The figures and maps are excellent and captions are very complete. The geochemical analytical methods are also very impressive. With a few published exceptions for Loxoconcha, the seasonal data in Figure 3 is an important part of understanding time of adult shell secretion. The paper is well referenced. I would suggest Farmer 2011 and 2012 on Arctic Krithe should be mentioned in the discussion for a more complete assessment of inter-generic Mg-temp relationships. Although the paper as a source of new data is fine as it is written, the section 4.4 provides an invaluable review of other genera and demonstrates similar Mg/Ca-temp relationships and I wonder for completeness, they could add to figure 6 and the discussion other genera from other superfamilies [Krithe. . ..]. I look forward to seeing these calibrations applited to Holocene sediment records of climate variability.

We appreciate the positive comments from Reviewer 1. In Fig. 6, we added *Krithe* specimens from Elmore et al., (2012) and Farmer et al, (2012). We added the sentence "Temperature calibrations to Mg/Ca ratios have been developed for specimens of the same superfamily, including the genus *Krithe* (Cadot and Kaesler, 1977; Corrège and De Deckker, 1997; Cronin et al., 1996; Dwyer et al., 1995, 2002; Elmore et al., 2012; Farmer et al., 2012), *Loxoconcha* (Cronin et al., 2003), *Cytheropteron* (Yamada et al., 2014) and *Xestoleberis* (Kondo et al., 2005)." We also added in section 4.4 "*Sinocytheridea impressa* and *N. delicata* show lower Mg/Ca ratios at the same temperature in comparison to other species (Fig. 6). Similar Mg/Ca ratios to *S. impressa* and *N. delicata* have been observed in *Krithe* specimens at seawater temperatures ranging between 10° C and 20° C".

Minor Points

Line 145 correct: ostracod ratios [not ostracods]

Done

Line 253 & 270. Cyprideis torosa [not Torosa]

Done

Referee 2

Anonymous Referee #2 Received and published: 27 November 2020

We appreciate the positive comments of Reviewer 2 on our manuscript. The main concern of Reviewer 2 is the short range of temperatures used in our calibrations. We added a full analysis about the variability of Mg/Ca ratios and temperatures. We also included additional measurements of ostracods collected from Yatsushiro Sea provided by Dr. Gengo Tanaka (Kanazawa University).

This paper contains significant results relating to geosciences by using biotic carbonate. Original point of this paper is that Mg/Ca paleotemperature reconstruction was done by using brackish and very shallow marine species. This is a new approach and important for not only ostracod researchers but all paleoceanographers. However, some revisions are required. I showed my comments as below.

1) Water temperature ranges for Mg/Ca-temperature correlation in this MS was 2ËŽC that is too small to establish the correlations between Mg/Ca and temperature. It is doubtful that the new regression lines for two species could really calculate 1 ËŽC (or less than 1 ËŽC) difference in the past water temperature. For instance, 1 ËŽC easily differs depending on measurement methods and technical errors for bottom water temperature. The best way for revision is that additional ostracod shells from samples in lower or higher water temperatures will be measured. Both species inhabit in the modern seas within wider temperature ranges in the East Asia. If this is impossible, I suggest that the authors will show the basis that the new regression lines could calculated the 1 ËŽC differences of the past water temperature exactly.

We agree with Reviewer 2 about the short range of temperatures. In order to evaluate the uncertainties related to temperature calibrations, we added a full analysis of the variability observed in Mg/Ca ratios and seawater temperatures. We estimated the error of Mg/Ca mean values at each station at a 95% confidence level (Holmes, 2008). For *S. impressa*, we observed that the variability in ostracod Mg/Ca ratios converted to temperature is lower than the range of temperatures used in the calibrations. Therefore, we think we can estimate differences of 1°C using this species. For *N. delicata*, the error for Mg/Ca mean values converted to temperature is around the variation of temperatures used in the calibrations. Therefore, we think more shells are needed to precisely estimate differences of 1° C using these specimens. We added a paragraph in section 4.1, which reads as "We evaluated the sensitivity of the calibration using the natural variability of ostracod Mg/Ca ratios and seawater temperatures in Hong Kong sampling sites. The error (range) of Mg/Ca mean values in each station used for the calibration can be established at a certain confidence level (Holmes, 2008). For *S. impressa*, the error of Mg/Ca mean values in each station ranged from 1.5 mmol mol^{-1} to 4.1 mmol mol^{-1} at a 95% confidence level. For annual and spring calibrations, the temperature mean errors are 0.7° C (0.4° C to 1° C) and 1° C (0.6° C to 1.5° C), respectively. These values are lower than the temperature difference between the stations (1.6° C), which indicates that differences higher than 1° C can be estimated using *S. impressa* calibration curves. For *N. delicata*, the error of Mg/Ca mean values ranged from 1.1 mmol mol^{-1} to 5.7 mmol mol^{-1}. Annual and spring calibrations have the same slope, which produce temperature mean errors of 1.9° C (0.7° C to 3.6° C). This error is similar to the difference in temperatures between the stations. Therefore, more shells of ostracods living at different temperatures would be needed to estimate differences at 1° C for this species".

In addition, we measured ostracods from the Yatsushiro Sea in order to broaden the temperature calibration. We tested different water temperatures with the developed calibration from HK because the water temperature during the ostracod molting for *S. impressa* is unknown. We observed temperature differences of 0.5° C for June and 1.2° C for November between the Mg/Ca-estimated temperatures and the mean temperature calculated across the 10 days before the ostracods collection. This suggests that the calibration is valid, but we can not extend the range of the calibration using the specimens from these months. We think this might be produced by the short period between ostracod molting and collection, but more studies are needed to confirm this. We added in the text the following paragraph "The Mg/Ca ratios of *S. impressa* ostracods from the Yatsushiro Sea are within the range of Mg/Ca ratios found in Hong Kong ostracods (Jun: 21.6±3.8 mmol mol^{-1} and Nov: 18.3±5 mmol mol^{-1}, Fig. 5). Using the Hong Kong calibration developed for April, temperatures in Yatsushiro Sea were estimated to be 21.5° C in June and 20.4° C in November. We compared these temperatures with seawater temperatures recorded a) during the day of sampling (Jun: 21.6° C and Nov: 15° C, in situ), b) the mean of 10 days (Jun: 22.0° C and Nov: 21.6° C, buoy), c) 20 days (Jun: 21.5° C and Nov: 22.1° C, buoy), d) 30 days (Jun: 20.7° C and Nov: 22.6° C, buoy) and e) 60 days (Jun: 18.8° C and Nov: 23.9° C, buoy) before the specimen collection. The estimation of water temperatures using ostracod Mg/Ca ratios in November is not similar to the temperatures recorded the same day of sampling. This is likely due to the exposure of the site to freshwater inputs, which may have affected local water temperatures. In addition, the ostracod calcification may have occurred several days before its collection. The consideration of the mean temperature across the 10 days before the ostracod collection produced the greatest agreement with Mg/Ca-estimated temperatures. Thus, our results suggest that ostracods from the Yatsushiro Sea may have calcified the shells during the last few days before their collection".

2ïijL'ãAˇ ALine 78: Authors used mean values for the last 20 years from the collection ˇ time of the samples. Please describe the reason that the last 20 years are the best for this research.

We used the last 20 years to limit the bias of monthly outliers on the correlation. This allows us to have enough data to determine a robust monthly mean value. Our decision was made considering that a) we have only one data point per month for all Hong Kong stations. Therefore, we only have 20 data points per month for the last 20 years, b) the average of the last 20 years produces a more representative value for the monthly data, c) the EPD records started in 1986, so we could not consider a longer period (e.g 30 or 40 years), and from 1991 we have data of temperature in all the sampling sites where we collected sediment samples. In addition, the sedimentation rate in Hong Kong varies from 0.2 to 5 cm yr^{-1} from open to more enclosed areas. Due to resuspension and bioturbation, samples from the uppermost centimeter probably have ostracod populations from the last 5 years before their collection. Because we do not know exactly when the calcification of the shell occurred, we adopted monthly mean values to produce our calibrations. We added in the manuscript "The records correspond to one or two daily values per month from 1986 to the present date (EPD, 2018). The sedimentation rate in Hong Kong varies from 0.2 to 5 cm yr^{-1} (Owen and Lee, 2004; Tanner et al., 2000), which suggests the presence of specimens from different years. For the calibration, we calculated monthly mean values using the last 20 years of data from the collection time of our sediment samples (i.e. 2012) in order to determine a robust monthly mean value with the maximum amount of available data".

3ïijL'Water conditions including temperature, salinity and pH vary in a wide ranges within a few days in very shallow marine and brackish lakes as authors described in the MS. This is a large problem for temperature calibration because ostracod shells are calcified within a few days. I think comparisons between Mg/Ca in ostracod shells and annual mean values are reasonable methods. However, authors should show the variations in water condition for shorter time scales such as daily mean.

Our data set do not contain daily data (i.e. 30 or 31 values per month). Water parameters (temperature, salinity, pH, among others) have been recorded once per month since 1986 and therefore it cannot resolve daily/weekly variations. We added a paragraph in section 4.1 explaining the daily fluctuation in our sampling sites based on the Copernicus satellite product. We added "We also investigated the potential impact of daily temperature fluctuations on the calibrations. We estimated daily BWT variability by using the Copernicus satellite products. Using the daily data from 1993 to 2018, we calculated the standard deviation for each month. We then determined the average variation for each month across all the years. We performed this calculation on three Hong Kong sampling stations located: a) at the lower section of the PRE, b) outside the PRE and south of Hong Kong Island and c) on the eastern side of Hong Kong island. We found the variations were 1±0.4° C, 0.8±0.5° C and 0.7±0.5° C, respectively. Therefore, daily bottom water fluctuations in Hong Kong waters are unlikely impacting the calibrations obtained." Furthermore, the Agriculture, Fisheries and Conservation Department from Hong Kong has marine stations which record seawater temperatures every 10 mins. These measurements are available from 2014. We were able to obtain data from the station in Ma Wan located close to the Pearl River from 2015 to 2016. The average daily SD in these years was 0.4°C, similar to the results observed by the satellite images.

4) Figures 2 to 6 are low quality. Please make circles and lines clear to see. Particularly, circles for individual sample in fig. 2 are blurred. This problem might be due to the resolution in web systems. Please check them.

We apologize for this inconvenience. We modified Fig 2 to provide a clearer figure. Blurred points were changed for solid dots. We also enlarged Fig 6. We realized that part of the problem was related with the default resolution of the word document. Now it was set in high quality for a better display of the figures.

5) Line 203: It is better that all data of the correlation between the 24 parameters and Mg/Ca will be opened in the supplementary files or the appropriate web sites. Furthermore, data that authors used in the figures of the MS containing Mg/Ca, Sr/Ca values of ostracod shells, temperature and salinity. . .etc are as well.

We agree with Reviewer 2. We added the correlations with the 24 parameters in the supplementary material. The full dataset will be added to an online repository during the submission of the final manuscript.

6ïijL'Line 217: Authors noted that "the elemental composition of marine waters of HK do not seem to control the ostracod Mg/Ca and Sr/Ca ratios according to our data.". Mg/Ca values in water are not enough to identify relationships between Mg/Ca in water and that in ostracod shell in this MS. Further, ecological records of the two species are lack in the present. Usually, periods that the ostracod specimen calcified its shell are unknown in the field study due to duration of life of ostracods as at least a few months. This means that we cannot compare Mg/Ca of individual ostracod shell to Mg/Ca in water when the specimen calcified its shell exactly excepting for cultural experiments. Particularly, water temperature and Mg/Ca of water shifted frequently in brackish and very shallow marines. Hence, I think the sentence shown above says too much.

We modified the paragraph to clearly point out that this is an interpretation based on our data and Fig 4. We also added at the end of the paragraph a statement to clearly mention that our seawater Mg/Ca data does not allow us to unravel a potential relationship with ostracod Mg/Ca ratios. Now the paragraph reads as "Mg/Ca ratios of both species are negatively correlated to salinity (Fig. 4). A potential control of seawater Mg/Ca on ostracod Mg/Ca would be possible if seawater Mg/Ca decreases with salinity. Marine waters have higher Mg and Ca concentrations in comparison to freshwater (Brown et al., 1989; Bruland and Lohan, 2006). Previous studies have shown a mostly conservative behavior of Mg and Ca in estuaries and surrounding areas (Millero, 2006; Patra et al., 2012), where these concentrations increase linearly with salinity. Therefore, a higher Ca concentration over Mg concentration or a lower Mg concentration over Ca concentration toward more saline waters are unlikely in Hong Kong waters. Moreover, ostracod Sr/Ca is similar at different salinities (Fig. 4), supporting the idea that changes in seawater Ca concentrations are not the main control on Mg/Ca and Sr/Ca ostracod ratios. Measurements during 2013 and 2017 at the desalination plant in Tseung Kwan O (Fig. 1 and S6) show water Mg/Ca and Sr/Ca ranging between 4 and 6 mol mol^{-1}, and between 8 to 9 mol mol^{-1} respectively during the year. These values are mostly stable even when monthly salinity decreases to 25 PSU at some Hong Kong stations during the summer, suggesting that the seawater chemistry may not be the primary control on ostracod Mg/Ca and Sr/Ca ratios in Hong Kong waters. Our dataset does not allow us to explore in more detail the potential relationship between these two variables as more data of the seawater chemical composition is needed".

In addition to the comments above, several mistakes are indicated directly in the pdf file. Please check them. This MS is good quality and contains useful records. I hope it will be published in the journal soon.

Typos were corrected.

Sincerely yours,

Please also note the supplement to this comment: https://bg.copernicus.org/preprints/bg-2020-343/bg-2020-343-RC1-supplement.pdf