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Biogeosciences Discussions

Interactive comment on "Carbonate "clumped" isotope signatures in aragonitic scleractinian and calcitic gorgonian deep-sea corals" *by* J. Kimball et al.

J. Kimball et al.

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This article presents clumped isotope measurements in scleractinian and gorgonian deep-sea corals. The data are very interesting, but I think that the discussion needs to be rewritten. As it is, the discussion gives the feeling that gorgonian and scleractinian share identical processes of biomineralization, which absolutely not the case. The discussion should be clearly separated between the two types of deep-sea corals. For example, as far as I know, calicoblastic cells were not detected in gorgonian corals, as well as ECF (see Noé and Dullo, 2006). There are also a lot of imprecisions in the text.

Reviewer comment: A lot of references miss in the reference section: Dunbar and

Wellington (1981), Came et al (2004), Eagle et al (2010), Dennis and Schrag (2010), Douglas et al (2014), Ghosh et al (2007), Gabitov et al (2012), Kimball et al (2014), McConnaughey (2003), Nielsen et al (2012), Petrizzo et al (2014), Saenger et al (2013), Swart et al (1991), Watson and Liang (1995), Watson (2004), Watkins et al (2013), Weber and Woodhead (1972), Thiagarajan et al (2013), Zeebe (1999).

Also some references in the reference section are not cited in the text:

Bigeleisen and Mayer (1947), Ehrlich et al (2006), Jimenez-Lopez et al (2004), McCrea (1950), Noé et al (2008), O'Neil et al (1969), Urey (1947), Wang et al (2004)

Author response: These have been removed or cited.

Reviewer comment: 19117-l18: I think that it is not an 'emerging' approach anymore as it is now known for 10 years.

The word emerging has been removed.

Reviewer comment: 19118-l14: what is the difference between aragonitic scleractinian corals and aragonitic deep-sea corals?

Author response: We have clarified this sentence that now reads:

"Proxy material calibrations thus far have included aragonitic scleractinian zooxanthellate corals (Ghosh et al., 2006; Saenger et al., 2012; Tripati et al., 2015), aragonitic scleractinian non-zooxanthellate deep-sea corals (Ghosh et al., 2006; Thiagarajan et al., 2011), aragonitic otoliths (Ghosh et al., 2007)"

Reviewer comment: 19118-l17: Is there any aragonite in brachiopod shells?

Author response: To clarify we have removed the word aragonite, this sentence now reads:

". . . mollusks and brachiopods."

Reviewer comment: 19118-l19: It is 'Daëron' instead of 'Daeron'. Please correct.

Author response: Corrected

Reviewer comment: 19118-l20: In the reference section, it is Petryshyn et al (2015).

Author response: Corrected

Reviewer comment: 19118-l27: It is Wacker et al (2013) in the reference section.

Author response: Corrected

Reviewer comment: 19119- l10: Is it Defliese et al 2015a or b?

Author response: These have been specified throughout the text.

Reviewer comment: 19120-l11-14: please add references

Author response: Reference added, Thiagarajan et al., GCA, 2011.

Reviewer comment: 19120-l20: I am not sure that there are some d18O data for deep-sea corals in McConnaughey (1989a or b?; 2003). Please add references of Lutringer et al (2005), Rollion-Bard et al (2003, 2010).

Author response: Done

Reviewer comment: 19120-l23: Please add the reference to Lutringer et al (2005).

Author response: Done

Reviewer comment: 19121-l1: please remove one 'Ghosh et al' In this section, I found it very unclear what is attributed to gorgonian or scleractinian (doesn't need to be)

Author response: Done

Reviewer comment: 19122-l6: Replace 'was' by 'were' (no)

Author response: Done

Reviewer comment: 19122-l27: What do you mean by 'sufficient'?

Author response: Changed to: "the required weight of sample for replica . . ."

Reviewer comment: 19123-l25: It is Henkes et al (2014) in the ref

Author response: Henkes 2013 is the corrected references.

Reviewer comment: 19125-l8-9: Is it in PDB? (look at table)

Author response: Its V-SMOW, this has been corrected. We also corrected one table to read VSMOW.

Reviewer comment: 19126-l6: 'Tables' instead of 'Table'. I am not sure that you have to refer to Table 3 here.

Author response: Now reads: "Measured and predicted coral isotopic measurements are presented in Table 4."

Reviewer comment: 19126-l12-13: R2 instead of R. It is not consistent with the rest of the paragraph.

Author response: Corrected

Reviewer comment: 19126-l25: 'Noé' instead of 'Noe'

Author response: Corrected

Reviewer comment: 19130-l4: AFF is not defined.

Author response: Now reads: "suggests there may be mineral-specific acid digestion fractionation factors (AFF),"

Reviewer comment: 19132-l3: Please add references.

Author response: References added.

Reviewer comment: 19132-l10: It is Roark et al (2005) in the ref. In this article, I did not see any d13C and/or d18O data. Please verify. Please add references to Lutringer et al (2005), Rollion-Bard et al (2003, 2010).

Author response: Reference removed and others included.

Reviewer comment: Between the centres of calcification and fibres, in scleractinian corals, you can have these two end-members. So why do you write that the mixing would be between less extreme differences? Also, note that there are no COC in gorgonian corals. Again, for this section, it would be clearer to separate the discussion between gorgonian and scleractinian corals.

Author response: This is a good point and we have added statements about these differences between scleractinian and gorgonian coral, and revised this section to better explain what sets the endmembers for mixing.

"we estimate the maximum artifacts in our data arising from mixing. The estimate for mixing artifacts from Thiagarajan et al. (2011) is based on observed variability in stable isotope values in scleractinian deep-sea coral, and represents an extreme example for this study, as they use δ13C and δ18O values of end members that differ by 12‰ and 7‰ respectively. Such differences in scleractinian coral represent systematic isotopic depletions in centers of calcification compared to fibers (Adkins et al., 2003), as well as variability associated with density bands; no centers of calcification have been reported in gorgonian corals. The calculations from Thiagarajan et al. (2011) represent an estimate of the maximum artifact to arise from mixing for either taxa given the range of carbon and oxygen isotope values observed in scleractinian and gorgonian deep-sea coral. We also observed little variability in δ13C and δ18O of different preparations of the same coral, with standard deviations of <1‰;"

As described in more detail in the response to reviewers below we have separated the models of scleractinian and gorgonian corals.

Reviewer comment: 19133-l18: Is there any reference for the observation of calicoblastic cells in gorgonian corals? Same remark concerning the scheme for the calcifying region. This model was developed for scleractinian corals, not for gorgonian.

Author response: The potential differences in calcification between the two groups of corals is now more acknowledged by creating separate subsections in the manuscript discussing each. The gorgonian coral section now reads:

"The growth structure, mineralogy, and biomineralization of gorgonian coral skeletons is distinctly different from scleractinian corals (Noé and Dullo, 2006). Additionally, the organic matrix-mediated calcification process is largely unexplored and unknown for most gorgonian families. The biomineralization models described for scleractinian corals therefore are not valid when interpreting potential vital effect signals in gorgonian corals. An exhaustive study of the growth structure and fabric of deep-sea isidid gorgonians in the same family as those investigated here, was done by Noé and Dullo (2006). Their findings are based on characterization of the isidid skeletal micro- and ultrastructure in combination with absolute age determinations. From their reconstructions of growth mode and fabric, they propose a biomineralization model. With no calicoblastic cells observed in gorgonians, they propose gorgonin produced from the endodermal epithelium acts as the structural framework, while a viscous slime surrounding the skeleton acts as the matrix, facilitating and regulating mineral growth. Their model however relies on physical observations and lacks geochemical data to inform their interpretations. So while offering some insight into the uniqueness of Isidid biomineralization, the findings are not useful in interpreting the geochemical data observed in this study. Despite the lack of proposed biomineralization models in gorgonian corals, the trends in ïĄď'13C and ïĄď'18O have been explored and found to be similar in pattern to scleractinian corals, but with an offset that agrees with theoretical mineralogical fractionation predictions. The similarity in ïĄď'13C, ïĄď'18O and ïĄď'47 patterns suggests that while the particular biomineralization process is necessarily different in the two groups, there is a functional similarity that results in the conserved patterns in both gorgonian and scleractinian corals."

Reviewer comment: 19134-l19: It is 'Mavromatis et al'. This article is only about fractionation factor for Mg-calcite. I do not see why it is cited here (because isidids are

high-Mg calcite)

Author response: Reference removed.

Reviewer comment: 19135-l4: Are you sure that brachiopod shells are aragonitic?

Author response: This statement has been removed.

Reviewer comment: 19135-l24: Please add 'e.g.' before the list of references as a lot of studies deal with this aspect. Here McConnaughey is misspelled. Is it 1989a or b? Watson (2004), DePaolo (2011), Gabitov et al (2012) and Watkins et al (2013) study inorganic precipitations. Why are they cited here concerning the calcification processes in calcifying organisms?

Author response: This section now reads: "Non-equilibrium partitioning of oxygen and carbon isotopes have been observed in numerous calcifying organisms and inorganic precipitation experiments, and linked to calcification processes (e.g. McConnaughey, 1989a; Spero et al., 1997; Zeebe, 1999; Adkins et al, 2003: Watson, 2004; DePaolo, 2011; Gabitov et al., 2012; Watkins et al., 2013)."

Reviewer comment: 19136-l5: This model is for scleractinian corals! I am not convinced that you can apply it to gorgonian corals.

Author response: See response to comment above which also covers this comment.

Reviewer comment: 19136-l12: Again McConnaughey is misspelled.

Author response: Corrected

Reviewer comment: 19136-l28: Again McConnaughey is misspelled.

Author response: Corrected

Reviewer comment: 19137-l1: It is also calculated/noted in Zeebe and Wolf-Gladrow (2001), Beck et al (2005) and Rollion-Bard et al (2011). Please add.

Author response: Added

Reviewer comment: 19137-l8: It is 'Usdowski et al, 1991'. Please add reference to McCrea (1950)

Author response: Done.

Reviewer comment: 19137-l15-18: So how do you explain the kinetic effects for carbon isotopes if the exchanges are very rapid (please add ref) between DIC species?

Author response: The model referred to in this section accounts for the range in carbon isotopes by proposing it to be a function of two sources of CO2, membrane diffused and seawater leaked, and the proportion of them, a function of pH gradients across the membrane.

Reviewer comment: 19137-l27: Please add references to Lutringer et al (2005), Rollion-Bard et al (2003, 2010).

Author response: Done

Reviewer comment: Please note that the model of Adkins et al (2003) is not compatible with boron isotope data (see Blamart et al, 2007; Rollion-Bard et al, 2010).

Author response: Done

Reviewer comment: 19138-l1: Correct McConnaughey and Rollion-Bard. Please add the models of Allison et al (2010) for zooxanthellate corals and the model of Rollion-Bard et al (2010) for deep-sea scleractinian corals.

Author response: Done

Reviewer comment: 19139-l9: Ref? 19139-l20: Again, please add references to Rollion-Bard et al (2003, 2010). See also the work of Brahmi et al (2012) concerning the different growth rates.

Author response: Tripati et al., 2015 is referenced. Here we discuss clumped isotopes only - that is only the reason we have not referenced other work.

Reviewer comment: 19139-l29: Again McConnaughey is misspelled

Author response: Corrected

Reviewer comment: 19139-l8: same remark 19139-18: It was already shown that the Adkins' model is not compatible with d11B data (see Rollion-Bard et al, 2010)

Author response: This has now been previously addressed in the text.

Reviewer comment: 19140-l26: Please add references

Author response: Added.

Reviewer comment: 19141-l1-3: Please add references

Author response: Done

Reviewer comment: 19141-l12: Is it Ehrlich or Ehrlick?

Author response: Ehrlich, corrected.

Reviewer comment: 19142- l16: See the work of Furla et al (2000) 19142-l19: See the work of Tambutté et al(1995)

Author response: We thank the reviewer for the references. In this case the paragraph is meant to be a summary of our previous discussion and not introducing new work.

Reviewer comment: 19142-l2: 'corals' instead of 'coral'

Author response: Corrected

Reviewer Comment: Between Figures 4 and 5, please use the same colors for the symbols.

Author response: Corrected. All symbols are black.

Reviewer Comment: Figure 6: Precise if it is Defliese et al 2015a or b. Please add error bars (done).

Figures 7, 8, 9: Please add error bars (done). Figure 9: Please enlarge the symbols (done). Figure 11: Please specify that this model is for scleractinian corals. For example, the data of Farmer et al (2015) are not in favor of an elevation of pH (done)

Author response: Corrected

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/12/C10576/2016/bgd-12-C10576-2016-supplement.pdf

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Interactive comment on Biogeosciences Discuss., 12, 19115, 2015.