

Interactive comment on “Ba, B, and U element partitioning in magnesian calcite skeletons of Octocorallia corals” by T. Yoshimura et al.

Anonymous Referee #1

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This study presents Ba, B and U to Calcium ratios measured in 13 specimens of octocorals collected from various water depths and locations in the Pacific Ocean. The manuscript has been submitted in parallel to a companion manuscript on oxygen and carbon isotopes measured in the same specimens (Yoshimura, T., Suzuki, A., and Iwasaki, N.: Mechanism of O and C isotope fractionation in 25 magnesian calcite skeletons of Octocorallia corals and an implication on their calcification response to ocean acidification, Biogeosciences Discuss., 12, 389–412, doi:10.5194/bgd-12-389-2015), and Mg/Ca and Mg isotopes have been published earlier.

My main concern with this manuscript is that it duplicates large portions of the companion isotope manuscript (sections 3.2, 4.2.1, 4.2.2) and those duplicated sections are some of the strongest of this report. The Ba/Ca data show a convincing linear

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correlation with seawater Ba concentrations, which is consistent with previous studies on octocorals, bamboo corals and aragonitic deep-sea corals. While not significantly novel, this result is worth publication, although I recommend some changes below. In contrast, the B/Ca and U/Ca data should be combined with the companion isotope manuscript, so that redundancies can be eliminated. Because both manuscripts are short and the Ba/Ca data merely confirm previous studies, I would recommend combining all data in one manuscript. This recommendation is further based on several inconsistencies in the data presentation and discussion, which will shorten the text upon revision. The combined manuscript should reason why these specific elements are worthwhile to be studied, and the mechanism for U/Ca variations in response to carbonate chemistry changes needs to be reviewed in the introduction as well.

While validating proxies in living organisms from known chemical and physical conditions is a valuable and broadly applied approach, data interpretation is often challenging due to several environmental parameters varying simultaneously. The authors acknowledge that the current manuscript suffers from this difficulty, in that pH and temperature both decrease with water depth and thus preclude unequivocal association of decreasing B/Ca and U/Ca ratios with either one of these parameters. This complicates direct relation of oxygen isotopes to seawater acidity, for which B/Ca may be a proxy. However, the observed patterns are consistent with previous observations in foraminifera and corals (Spero et al. 1997, McConnaughey et al. 1989), where $\delta^{18}\text{O}$ decreases at lower pH (i.e. lower B/Ca ratios at greater depths, but also lower temperatures at depth). While the data shown in Figure 3 are consistent with this expectation, the text is erroneous. For instance, in the abstract (page 414, line 17) the authors say that “that $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ are enriched in light isotopes when conditions are less alkaline”, page 426, line 24: “If B/Ca is assumed to be a function of the pH of the ECF, then light isotopes would be enriched in the calcifying fluid under less alkaline conditions, because B/Ca is positively correlated with $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ values. B/Ca versus $\delta^{18}\text{O}$ regressions are shown as positive (Table 2)”. These interpretations and correlations are erroneous because the relationship between B/Ca and $\delta^{18}\text{O}$ is inverse, as obvious

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in Figure 3. Such an inverse relationship agrees with theoretical studies on O and C isotope partitioning in seawater. The authors should read the studies of Zeebe (1999, 2001). This study still requires removal of the temperature effect on $\delta^{18}\text{O}$ before any pH effect can be evaluated, but I assume the companion manuscript deals with that. Plots of DIC, temperature and pH should be provided.

The Ba/Ca correlation with the seawater Ba concentration is convincing but the data presentation should be modified to include plots of these relationships in aragonitic cold-water scleractinian corals published by Anagnostou et al. (2011) and in calcitic planktic foraminifers by Hönisch et al. (2011). While the relationship of Anagnostou et al. (2011) appears similar to the ones presented in Figure 4, it falls above those relationships, and the foraminifer equation presented by Hönisch et al. (2011) falls below them, consistent with observations from inorganic studies presented in the text. Section 4.2.1 should be corrected accordingly.

There are several redundancies in the text, some typos and some rephrasing is required in various sentences, however, given the substantial rewriting that this manuscript should undergo, I find it premature to dwell on such minor aspects. An aspect that the authors should focus on is a better presentation of the sampling strategy of the individual coral species. Which portion of the skeleton was sampled and how? This is well explained for the intra-skeletal transect but not for the other samples. Furthermore, data of the same species should be plotted with the same symbol in Figure 3, so that species-specific patterns can be identified. It should be discussed how the intra-skeletal variations observed in one specimen relate to octocorals in general. Is this one observation significant for all corals or could it be specific to this one species, or even just this specimen?

Finally, the authors should read and cite Uchikawa et al. (2015), who performed inorganic precipitation experiments for B/Ca. The authors cite Sanyal et al. (2000) but that study did not measure B/Ca ratios but estimated them from B concentration experiments by isotope dilution. The Uchikawa data are more accurate and provide much

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deeper insight into B uptake into inorganic calcite.

Figure 6 is not discussed or introduced in the text and should be removed. Please note also that Yu and Elderfield (2007) studied benthic foraminifers, which follow different B incorporation patterns than planktic foraminifers and respond to $\Delta\text{Carbonate Ion}$. The text should be corrected accordingly. Also, Allen and Hönisch (2012) argue against a temperature effect in planktic foraminifers, this study is cited in a somewhat misleading way. However, the observations made in planktic foraminifers are not necessarily true for corals, where B/Ca has been shown to be sensitive to temperature (e.g. Fallon et al. 2003). Discussion of environmental controls on B/Ca in corals needs to be improved.

Interactive comment on Biogeosciences Discuss., 12, 413, 2015.

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