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Biogeosciences Discussions

Interactive comment on "Light and temperature effect on δ^{11}B and B/Ca ratios of the zooxanthellate coral *Acropora* sp.: results from culturing experiments" *by* D. Dissard et al.

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Answer to anonymous Referee 2

Comment 1: This paper presents experiments and data of interest to the ongoing debate about the use of B-isotopes as proxy for ocean pH variations. In particular, the experiments address question of whether light and temperature can affect B isotopes and the B/Ca ratio in the coral skeleton independent of water pH. The answer appears to be 'yes' Dissard et al. reports that changes in light intensities under constant temperature conditions can induce B isotopic variations in the coral skeleton equivalent to pH variations on the order of 0.05 units and temperature can induce changes equivalent

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of 0.02 pH units under constant light conditions.

I have no problem accepting the quality of the data and the experiments as such. These are difficult to do. Instead, my reading of the manuscript makes me wonder how relevant these conclusions really are. What are the natural pH variations at a given site and how big are they compared to the B isotope effects (and hence potential bias in pH reconstructions) considered here?

Answer: We agree with the reviewer that corals mainly live in environments with large natural fluctuations in pH, which vary significantly depending on several parameters, including depth, light, riverine inputs, CO2 vents, upwelling patterns....(see Hofmann et al., 2011 High-frequency Dynamics of Ocean pH: A multi-ecosystem comparison. PLoS ONE)). Our study does not intend investigating the quality of paleo-pH reconstructions based on coral boron isotope 'per se', but questioning the potential impact of other environmental factors other than pH that have been, so far, largely ignored. Altogether, our results confirm the general applicability of the δ11B-pH proxy as well as provide new insights on the mechanism of internal pH regulation in corals. Comment 2: If one looks at the recent publication by Hofmann et al: (Hofmann GE, Smith JE, Johnson KS, Send U, Levin LA, et al. (2011) High-Frequency Dynamics of Ocean pH: A Multi-Ecosystem Comparison. PLoS ONE 6(12): e28983.doi:10.1371/journal.pone.0028983) it seems clear that most sites will be characterized by substantial natural pH variations, on daily to monthly timescales, at least on the same order as the equivalent B isotope effects reported by Dissard et al. It seems to me that light and temperature variations are not the most prominent of the problems that paleo-pH reconstructions from B isotopes in coral skeletons face. This is further illustrated in Figs 3 and 5 where coral samples subjected to stress plot completely off the trend defined by 'non-stressed' samples. Such stress effects are certainly playing a role under natural conditions on the reef, where the corals are subject to many 'disturbing' processes.

Answer: We agree with the reviewer that the light effect remains insignificant for pH re-

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constructions. This is already clearly stated in the manuscript in section IV.2. 2. Light effect. : "However, changes in light intensities from 200 to 400 μmol photon m-2 s-1, representing average annual light variations for tropical environment where Acropora sp. can be found (e.g. Nouméa lagoon, Quinn and Sampson, 2002), have only biased pH reconstructions by about 0.05 units. These observations support the idea that changes in light and therewith symbionts photosynthetic activities do not significantly compromise δ11B-pH reconstructions for tropical corals. Due to analytical and sampling bias, paleo-pH reconstructions from corals are still broadly limited to a precision no better than $\approx$ 0.05 pH-units. Therefore, variations in light intensities on pH reconstructions for inter-annual resolution can be considered as negligible. Our results thus confirm the general applicability of the δ11B-pH proxy as well as provide new insights on the mechanism of internal pH regulation in corals." The temperature effect however, remains more difficult to quantify as a non linear response to increasing temperature is observed in our results. Here again, and as already stated in answer to comment 1, our study does not directly investigate the quality of paleo-pH reconstructions based on coral boron isotope but we agree that authors should be particularly careful while reconstructing paleo-pH based on coral cores that have been submitted to significant mechanical stress.

Comment 3: For these reasons alone the most questionable aspect of this otherwise well-written paper is the first line of the abstract that states that 'B isotopic composition of marine (bio-)carbonates has been established as a reliable proxy for paleo-pH'. I would encourage the authors to modify the paper taking these considerations into account.

Answer: The sentence was modified as follow: 'The boron isotopic composition (δ11B) of marine carbonates (e.g. corals) is increasingly being utilised as a proxy for paleo-pH, with the strong correlation between δ11B of marine calcifiers and seawater pH being now well documented."

Interactive comment on Biogeosciences Discuss., 9, 5969, 2012.