

## ***Interactive comment on “Abrupt sea surface pH change at the end of the Younger Dryas in the central sub-equatorial Pacific inferred from boron isotope abundance in corals (*Porites*)” by E. Douville et al.***

**Anonymous Referee #1**

Received and published: 12 May 2010

This paper presents an interesting application of the boron isotope paleo-pH proxy using corals as an archive to determine ocean pH response over the de-glacial-Holocene time span. This provides a significant advantage over foraminifera collected from sediment cores, as corals typically have about 5 times higher boron concentrations than forams making analyses easier, and corals can be directly dated using U-Th techniques. This does not replace downcore studies using forams, as a high-resolution study is not possible with corals, but the authors are able to document some interesting trends and make the most of their data, commenting on not just the pH record, but

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also analytical procedures and comparisons to other analytical methods, boron incorporation mechanisms, and paleoceanographic insights.

The authors are very thorough in setting up the study, choosing samples where observational data can be used to groundtruth the proxy using modern samples, and providing details on the collection, sampling, and analysis of the corals. Analytical difficulties have slowed the widespread use of boron isotopes in paleoceanography, and concerns have sometimes overshadowed the benefits of this proxy, whether those concerns are legitimate or not. It is refreshing to see a paper that clearly lays out the analytical procedure, thoroughly documents the robustness of the data, and substantiates the data by comparing their results to coral data from other analytical techniques. This is important, as it not only lends support to their data, but also confirms that previously published data using NTIMS and PTIMS are also robust. While some laboratories appear to be struggling with the ICPMS technique (particularly matrix effects that tend to result in low  $d_{11B}$  values), the labs involved in this study have clearly overcome those problems.

The authors also do a thorough job setting up the necessary calculations used to determine  $pCO_2$ , and they present reasonable assumptions necessary to make those calculations. It is particularly interesting, considering the flurry of activity recently with experimental and theoretical determinations of the boric-acid-borate fractionation factor, that the empirically-determined value remains robust. Of the studies that suggest a much larger value, only one recognized the importance of empirically determined values (Zeebe, 2005). The consistency of the data with coral culture calibrations is convincing. In summary, this is a well-thought out study, clearly presented with robust data supporting reasonable paleoceanographic interpretations. Figures are clear and appropriate. It is difficult to find fault with this work. While some editing suggestions and corrections are listed below, this is clearly a manuscript worth publishing in Biogeosciences, and is an appropriate topic that will be of wide interest to readers of this journal. I highly recommend publication with very minor editing. Suggested ed-

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its: 1) Page 1961 line 8 states the precision for the pH estimation as it relates to the external reproducibility of the boron isotope measurements. The estimated uncertainty is reduced at higher pH values and is much higher at low pH values given a constant analytical uncertainty. 2) Page 1965 line 6: omit the word "first". 3) Page 1967 line 20: the references used are not appropriate—neither were involved in the original work. 4) Page 1968 line 6: Pagani et al reference should be omitted—no study of these factors was presented. The 5) Page 1970 line 25: add a comma after (PDO). 6) Page 1971 line 26: change "dots" to "values". 7) Page 1974 line 17: change "moderate" to "minimal". I am not sure if the authors meant to say "moderate", but the effect of this small temperature change should be less than the analytical uncertainty. 8) Page 1975 line 10: "Theses" should read "These". 9) Page 1975 line 11: omit the "s" from pHs and SSTs. 10) Page 1975 line 17: omit "these". 11) Page 1977 line 5: change "the old" to "ancient".

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Interactive comment on Biogeosciences Discuss., 7, 1959, 2010.