

## ***Interactive comment on “Redox sensitive elements in foraminifera from the Peruvian oxygen minimum zone” by N. Glock et al.***

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We thank the reviewer Zunli Lu for his constructive comments and positive feedback. Below we comment in detail the points of major revision.

The recommended minor revisions in grammar and technical details in the supplement have been followed and are not discussed further here, except one comment regarding the comparison of Mn/Ca and Fe/Ca ratio of a cleaned and an uncleaned specimen of *B. spissa*:

In section 3.3, page 7966, line 15 Zunli Lu asked how much of the difference in the elemental ratios is due to cleaning as oppose to the variability between individual shells. The difference between the two individuals is in the same order of magnitude as the

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intratest variability of these specimens. We discussed this in the revised manuscript in detail in section 4.2.3.

In the following the major points of revision will be discussed. Each of the comments were addressed separately.

Zunli Lu

ZL: 1. The title sounds a little too broad (almost like a review paper) to me compared to the content of this paper. I think the authors may need to rethink about the central question(s) that this dataset can answer, and leave some hints in the title and introduction.

Reply: The title was changed to “EMP and SIMS studies on Mn/Ca and Fe/Ca systematics in benthic foraminifera from the Peruvian OMZ: A contribution to the identification of potential redox proxies and the impact of cleaning protocols”. This title focuses more on the central topic of this study. Furthermore, main parts of the introduction have been rewritten and now describe the central questions of this study in a more intense way.

ZL: 2. From a general audience’s point of view, it might be good to provide more information about the two species. Where can they be found outside of Peru OMZ? What are the oxygenation and nutrient levels (limits) that they are adapted to? Are they sensitive to temperature and salinity? Can factors other than oxygenation killed all of them in some of your sites?

Reply: We provided more information about the habitats and adaptations to oxygen and nutrient levels for both species in the introduction (page 5, line 18–page 6, line 4). The sensitivity to temperature and salinity is discussed in section 4.2.2. (page 17, line 2–10). It is not very probable that fluctuations in temperature or salinity killed *B. spissa* at this location. But we discussed other factors like seasonality in the life cycles or elevated H<sub>2</sub>S concentrations during anoxia.

ZL: 3. The entire discussion probably needs to be organized differently. There are

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several angles to interrogate the dataset: any new findings about analytical techniques; the ecological and physiological (calcification mode) difference between the two species; any common geochemical features in OMZ recorded in forams; what exactly Fe/Ca Mn/Ca are recording; recent local environmental changes. I feel the manuscript touched upon every single question, but haven't thoroughly interpreted the data and organized them in a logical order.

Reply: The discussion part has been reworked in major parts. We address each of the comments separately below.

ZL: "any new findings about analytical techniques"

Reply: The discussion part 4.1 now discusses a bit more in detail the advantage of using elemental mapping with EMP as preanalytical tool for other microanalytical techniques like SIMS. In the new section 4.2.3 it is highlighted that the SIMS is comparable to ICP-MS even if elemental ratios are very low if the spots on the cross-sections are chosen with care.

ZL: "the ecological and physiological (calcification mode) difference between the two species"

Reply: Some of the ecological differences between the two species are now outlined in the introduction (page 5, line 18-page 6, line 4). Furthermore the presence of the accumulations inside the tests of the uncleaned specimens of *U. peregrina* is now discussed in more detail in section 4.1 in respect on the feeding strategies of these species (page 14, line 11-20). Nevertheless, biomineralisation of foraminifera is a strong topic of current research and there are still many unknowns. To discuss the differences in calcification modes between these two species would be out of the scope of our study.

ZL: "any common geochemical features in OMZ recorded in forams; what exactly Fe/Ca Mn/Ca are recording"

Reply: The explanation what Fe/Ca and Mn/Ca ratios are recording is now given in the

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introduction (page 5, line 3–17).

ZL: "recent local environmental changes"

Reply: The local environment changes quite fast due to a strong influence through the El-Nino-Southern-Oscillation (ENSO). Recent local environmental changes regarding ENSO are now discussed in detail in section 4.2.2 (page 17, line 12-28).

ZL: 4. The last paragraph of the discussion about Fe in porewater (Fig 13) could be tied closer to the foram data. Right now it appears to be decoupled from the new data.

Reply: Due to suggestions of the second reviewer the downcore pore-water profiles (former fig. 11&13) were removed completely and substituted for a diagram which shows the direct correlation between Fe/Ca in *B. spissa* and in the surrounding pore waters (fig. 10b in the revised manuscript). This already ties the discussion closer to the new foram data. Furthermore the whole discussion about Fe in pore water was shortened to avoid unnecessary repetition of the already published data.

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