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Interactive comment on "Explosive demographic expansion by dreissenid bivalves as a possible result of astronomical forcing" *by* M. Harzhauser et al.

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In his very positive review, G. Van der Velde criticizes few aspects of the paper, which will be addressed in a point-by-point reply below:

(1) The reviewer correctly mentioned the spreading of Dreisssena rostriformis bugensis in Western Europe and provided references (Matthews et al., 2014; Bij de Vaate et al., 2013). We will include these data in the final version of the MS. We should note, however, that we, among others, cited the Dreissena r. bugenis paper of Heiler et al. (2013), the data of whom are included in the review paper of Bij de Vaate et al. (2013).

(2) Like reviewer 1, G. Van der Velde discussed that data and interpretations are based

on a single core. We refer here to our first reply: As stated in the MS, the characteristic succession of dreissenid coquinas can be observed across a large area of the clay pit area, documenting that the observed pattern is not purely local. Harzhauser and Mandic (2004, Fig. 4) showed that coeval mass-occurrence-layers of dreissenids are documented from the entire shelf of Lake Pannon (e.g. Hungary, Serbia, Slovenia). These occurrences document that the core-record is an expression of a wide-spread phenomenon. In the new version of the MS we will strengthen this point and will add references. Based on the homogeneity of the faunas, coquina-types and sediments across the huge area of Lake Pannon during the investigated time slice, it seems rather unlikely that we observed a purely local phenomenon.

(3) The reviewer asked for lake-depth estimates. As in many paleo-lake studies this is a tricky question. Based on the relative position of the paleo-shoreline and unpublished seismic data, a depth of few tens of meters is most likely. In any case, the deposition was below the wave base, which is estimated for Lake Pannon to have ranged around 10-15 m by Korpás-Hódi (1983). Therefore, the paleo-depth of the studied section ranged most likely between 20-80 meters. A more precise and serious estimate is not possible by data available up to date. We will add a comment on that.

(4) "A drop in atmospheric pressure can cause lack of oxygen" – we fully agree that such wind-related processes will have a major impact on the mixing of the lake water and we consider this the most important factor responsible for the observed pattern. We do not see any evidence that low windiness was coinciding with accumulation of organic material (see below point 5). (5) "Are there periods related to organic matter" – TOC-data are available only for the lower 150 cm of the core (samples 1540-1390) and were published in Kern et al. (2013). The values are rather low ranging between 0.56-1.19% and the fluctuations are not very large. These values are distinctly below those of typical stress environments over-enriched in organic loading with values above 3.5-3.9% (e.g. Hyland et al., 2005; Magni et al., 2008). Moreover, there is no correlation of higher values with low coquina densities or population collapse. Similarly, layers

with very dense coquinas do not coincide with exceptionally low TOC values. Therefore it seems rather unlikely that suspended organic particles were deposited in such high amount that gills of bivalves were clocked as discussed by the reviewer. Furthermore the open-lake depositional settings within a more than 200,000 km^2 large Lake Pannon would certainly buffer eutrophication, restricting it to isolated marginal settings corresponding to current Mediterranean lagoons (Magni et al., 2008). We will add a sentence on that in the discussion.

(6) "perhaps also the water table fluctuated": Significant lake level changes during investigated time interval can be excluded based on the dinoflagellates record, which is typical for "offshore" settings of Lake Pannon with constantly high amounts of Impagidinium (c. 20-40%) (Kern et al. 2013). As shown in other studies on Lake Pannon, such water table changes are very clearly reflected by shifts in the dinoflagellates assemblages (Harzhauser et al., 2008; Kern et al. 2012b). We will add information on that.

Bij de Vaate, A., van der Velde, G., Leuven, R. S. E. W., and Heiler, K. C. M.: Spread of the Quagga Mussel (Dreissena rostriformis bugensis) in Western Europe. Chapter 6. in: Quagga and Zebra mussles: Biology, impacts and control, edited by: Nalepa, T. and Schlosser, D.W., 2nd edition, CRS Press, Boca Raton, 83–92, 2013. Harzhauser, M., Kern, A., Soliman, A., Minati, K, Piller, W.E., Danielopol, D., and Zuschin, M.: Centennial- to decadal-scale environmental shifts in and around Lake Pannon (Vienna Basin) related to a major Late Miocene lake-level rise. Palaeogeogr. Palaeocl., 270, 102–115, 2008. Hyland, J., Balthis, L.W., Karakassis, I., Magni, P., Petrov, A., Shine, J.R., Vestergaard, O., and Warwick, R.: Organic carbon content of sediments as an indicator of stress in the marine benthos. Mar. Ecol-Prog Ser., 295, 91–103, 2005. Kern, A.K., Harzhauser, M., Soliman, A., Piller, W.E., and Gross, M.: Precipitation driven decadal scale decline and recovery of wetlands of Lake Pannon during the Tortonian. Palaeogeogr. Palaeocl., 317–318, 1–12, 2012b. Korpás-Hódi, M.: Palaeoecology and Biostratigraphy of the Pannonian Mollusca fauna in the Northern Foreland

of the Transdanubian Central Range. A Magyar Áll. Föld. Int. Èvkönyve, 96, 1–141, 1983. Magni, P., Rajagopal, S., van der Velde, G., Fenzi, G., Kassenberg, J., Vizzini, S., Mazzola, A., and Giordani, G.: Sediment features, macrozoobenthic asemblages and trophic relationships (δ13C and δ 15N analysis) following a dystrophic event with anoxia and sulphide development in the Santa Giusta lagoon (western Sardinia, Italy). Mar. Pollut. Bull., 57, 125–136, 2008. Matthews, J., Van der Velde, G., Bij de Vaate, A., Collas, F. P. L., Koopman, K. R., and Leuven R. S. E. W. Rapid range expansion of the invasive quagga mussel in relation to zebra mussel presence in The Netherlands and Western Europe. Biol. Invasions, online first, 10.1007/s10530-013-0498-8, 2014.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/10/C6448/2013/bgd-10-C6448-2013-supplement.pdf

Interactive comment on Biogeosciences Discuss., 10, 12009, 2013.