

Interactive comment on “An assessment of latest Cretaceous *Pycnodonte vesicularis* (Lamarck, 1806) shells as records for palaeoseasonality: A multi-proxy investigation” by Niels J. de Winter et al.

Anonymous Referee #2

Received and published: 17 January 2018

The manuscript “An assessment of latest Cretaceous *Pycnodonte vesicularis* (Lamarck, 1806) shells as records for palaeoseasonality: A multi-proxy investigation” of de Winter and coauthors wants to assess the potential of shells of the bivalve *Pycnodonte vesicularis* as recorder of palaeoseasonality. They analyzed several specimens coming from the late Maastrichtian Neuquén Basin in Argentina, using different techniques to check the preservation of the shells (CT scanning, light microscopy, Micro-XRF and cathodoluminescence) and to reconstruct the palaeoclimatic and palaeoenvironmental variations recorded by the bivalve (stable isotope, trace elements and

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clumped isotope analyses). They described in great details the methodology used and deeply discussed the advantages and disadvantages of the different methods. The authors discussed in a proper way their results making comparison with recent closely related genera and with data coming from the literature, providing a huge amount of new information.

Results are reported in great detail, which causes the manuscript to be very long and often not fluid, due to the wealth of information provided. I understand the need to document and discuss in details the trend observed; however, I think that shorten the manuscript would definitely improve the reading. Part of the method descriptions can be moved to the supplementary material, as well as parts of the comparison with other species should be reduced. Also, the discussion (6.4 temperature proxies) and the conclusions should be shortened, as many times they results in a repetition of the same concepts.

The manuscript address interesting scientific questions that are within the scope of Climate of the Past, so I recommend its publication after moderate revision.

Specific comments

A) Paragraph 4.1. According to Figure 1, it seems that only one level with *Pycnodonte vesicularis* is found in the section. The caption specifies that only the main *Pycnodonte* level is shown. From this, I understand that there are more levels with *Pycnodonte* but this is not adequately described and clarified in the text. The authors only said that *Pycnodonte* specimens were collected from the upper 5 m below the Cretaceous-Paleogene boundary. Were the seven specimens analyzed coming from different levels? Some of the differences the authors observed among the specimens may be due to the fact they did not live during the same time interval, thus not experiencing the same environmental oscillations. Also, it is worth to add something about the taphonomic condition of the specimens (e.g., articulated, disarticulated) and the associated fauna, if present.

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B) Lines 436-437 and 449. A salinity decrease by fresh water input can also cause the low $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ values observed, lowering both the $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ values (fresh water is enriched in ^{16}O and ^{12}C) (Gillikin, 2005; Gillikin et al., 2006). The authors should add a sentence on this and better explain why they excluded the salinity effect. Lines 436-437, add a reference to: "Such a relationship between $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ has often been interpreted as a sign of diagenetic alteration."

C) Paragraphs 6.3.1-6.3.3 (mainly lines 703-704). When comparing the isotope values of *P. vesicularis* with related species, the authors have to take in mind the different environmental settings in which the 3 species live (*P. vesicularis*, *N. zibrowii* and *H. hyotis*). As observed by the authors *N. zibrowii* lives in deep water, so its isotope signatures (especially the $\delta^{18}\text{O}$ values) are also controlled by this parameter. The higher $\delta^{18}\text{O}$ values recorded in *N. zibrowii* compared to *P. vesicularis* may be also explained with the deep sea habitat of the former species. So if they want to compare the isotope values, they have to consider species coming from similar environments.

D) Lines 709-712. This sentence is strange; are you sure is the juvenile and not the adult part of the shells showing an ontogenetic trend in $\delta^{13}\text{C}$? Usually bivalves incorporate isotopically light CO_2 in the adult stages, showing an ontogenetic decrease in $\delta^{13}\text{C}$ (e.g., Gillikin, 2005; Gillikin et al., 2006, 2007). The model of Lorrain et al. (2004) suggests that the decrease in $\delta^{13}\text{C}$ through ontogeny is actually caused by increasing utilization of metabolic C (respiratory CO_2 which is ^{13}C -depleted) to satisfy carbon requirements for calcification. As bivalves grow and become older, the amount of available metabolic CO_2 increases, while the amount needed for shell growth is reduced, resulting in more metabolic carbon (^{12}C -enriched) being incorporated into the shell. A similar ontogenetic trend is observed in specimens M6 and M11. The authors should rewrite this part.

E) The authors provide a lot of data in the manuscript, analyzing in details the different methods used. I understand that the primary aim of the manuscript is to assess the potential of *P. vesicularis* shells as recorders of palaeoseasonality. However, the

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authors obtained some useful data for palaeoclimatic reconstructions which are not adequately discussed in the manuscript. How the data in terms of palaeotemperatures and palaeoseasonality fit into the larger context of the Cretaceous climate of the area? Which new information can they add to the knowledge of the late Cretaceous of the Neuquén basin?

Minor comments

A) Be consistent through the manuscript on the use of English or American spelling (paleo -> palaeo, recrystallization, recrystallised, ...)

B) When citing a paper within the manuscript use the same format. Some citations have comma before the year other not, e.g., Kiessling et al. 2005 (line 177) or Woelders et al., 2017 (line 182). Check carefully through the text.

LINE 68-70 Bivalve shells are also important as they have a broad biogeographic distribution, occurring in different environmental settings, from shallow water to deep-sea environments, in freshwater, marine and brackish settings, from near the poles to the equator (e.g., Schöne et al., 2005a) LINE 78 Add other references as Schöne et al., 2005b; Butler et al., 2013 LINES 92-96 Add reference to Crippa et al., 2016 LINE 111 ReconstructionS LINE 130 "The aim of this multi-approach is to characterize the MICROstructure". Refer also in other part of the text to microstructure and not structure, as you are observing shells at micrometrical scale LINE 196 "from the upper 5 m OF below the Cretaceous". Delete OF LINE 200 What do you mean by biodegradation? Please explain LINE 242 It is not Figure 1, please correct LINE 244 "See section 4.1.1 and 4.1.3". May it be section 5? LINES 252 and 274 Gillikin et al., before Lorrain et al. LINE 257 Surge and Lohmann 2008 before Wanamaker et al. 2008 LINE 294 Add space between 100 and μm LINE 345 Add reference to MacDonald et al., 2009 LINE 371 Diagenetic alteration instead of diagenesis LINES 384-385 and 476-477 What about the CL of the vesicular layer? Add an image of this; if not in the main paper, add more images in the supplementary. It is important to document what you

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saw and described. LINE 401 Delete space after record LINES 401-403 Rephrase this sentence LINE 405 "In three out of four specimens", delete OUT LINE 445 What does it mean from the same locality? Same stratigraphic level? LINE 446 Defliese et al., 2015; the year should be in parentheses LINES 471-474 Also, oystreids, due to their layered shell structure, may be more prone to infiltration of fluids inside the shells, which of course affected more the porous chalky fabric than the foliated ones. LINE 477 Laminae instead of lamina LINE 521 Measuring instead of measured LINE 566 "in vesicular calcite this close". Delete THIS LINE 596 ReconstructionS LINE 611 "vesicular calcite into the in the shell". Delete INTO THE LINE 651 Klein et al. before Ullmann et al. LINE 654 Delete "in the Late Cretaceous" at the end of the sentence; it is clear you are referring to the Late Cretaceous LINE 662 Hyotissa not Hytissa; add the name of the author who first describe the species LINE 683 "which complicates interpretation"; it should be "which complicates THE interpretation" or "which complicates interpretationS" LINE 693, 704 and other lines Wisshak et al., 2008, in the reference list is Wisshak et al., 2009 LINE 705 Titschack et al., 2010 before Ullmann et al., 2010 LINE 731 Evaporitic setting LINE 732 Specify in which country Safaga Bay is LINE 732 Add + before 2.17 ‰ LINE 734 "records OF H. hyotis". Add OF LINE 745 "a decrease in salinity in the spring". Delete THE LINE 781-782 It seems strange that during high productivity spring they growth slower, they should do the opposite. Is there any evidence in previous literature on this? LINE 783 Gillikin et al., 2005 before Lorrain et al., 2005 LINE 796 Such a decrease of nearly 10°C between surface and relatively deep sea water is comparable to present day situation? LINE 801 "d18O", change with $\delta^{18}O$ LINE 806-808 During the spring-summer seasons the authors reported a salinity decrease; slow growth may be caused by this? LINE 815 "than parts of the year". Add OTHER parts of the year LINE 847 How was 20 PSU determined? It is a very big variations. For example in the Mediterranean Sea a salinity change of 2 PSU would correspond to a shift of $\sim 1\text{‰}$ in $\delta^{18}O_{sw}$ (Rohling and Bigg, 1998), which is equivalent to nearly 4-5°C in the temperatures calculated from the $\delta^{18}O$ of the shell. The authors observed a 10°C variation, which correspond to $\sim 2\text{-}3\text{‰}$ in $\delta^{18}O$. The salinity 20 PSU

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value seems overestimated. The authors should better explain this assertion LINE 869 10-15 °C at which water depth? LINE 909 reconstructionS LINE 911 vesicular instead of vesicular

Reference list

Please check very carefully the reference list. Some data are missing (pages), many specific names are not in italic, some references are in wrong chronological order, some present in the list are missing in the main text and viceversa. Some of the changes to make are listed hereafter: LINE 979 Add capital letters for places and time LINE 990 Hyotissa hyotis in italic LINES 992 and 994 Switch references, wrong chronological order LINE 992 Brand and Veizer 1981 not in the main text LINE 996 Species name in italic, and vesicularis in lowercase LINES 1006 and 1009 Carriker Melbourne, one is full name the other is Carriker M. LINE 1015 Cleroux et al. not in the main text LINES 1035-1039 All Dettman's references are in the wrong chronological order LINE 1041 Wrong citation of this reference in the text; it should be Dlugokencky and Tans LINE 1078 Gillikin et al., 2005b should be moved before LINE 1140 Is de Lartaud 2000a in the main text (line 389) the same reference? Lartaud 2010a is missing in the main text LINES 1159-1161 Switch references, wrong chronological order LINE 1167 Wrong citation of this reference in the text; it should be Malumian and Nanez (line 168) LINE 1228 and 1230 Switch references, Schöne before Schouten LINES 1230 and 1232 Schöne's references missing in the text LINE 1238 Stenzel, 1956 or 1959? In the text is 1959 LINE 1240 and 1242 Switch references, wrong chronological order LINE 1244 In line 78 and other part of the text wrong reference of Steuber 2005; it should be Steuber et al., 2005 LINE 1250 Surge and Owens, 2003 should be moved before, but it is missing in the text LINE 1262 and 1265 Switch references, wrong chronological order LINES 1268-1270 Same reference repeated LINE 1295 Reference missing in the text. Also, Marali and Schone, 2014; Scourse et al., 2006 are missing in the reference list

Figures

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FIGURE 1 Is it possible to add a legend with the lithologies? Also, in the y-axis of the log correct BOUNDARY FIGURE 2 To be more clear the direction of growth of the shell should be added. FIGURE 3 Images C-G and H, I should be a bit larger. Images C and E are not very clear. FIGURES 5 and 9 Vertical bars have too similar colors (orange and red), change one to be more clear. FIGURE 6 Cross plots showing cross plots, please rephrase. FIGURE 8 "interpretation of annual cyclicity based on Sr/Ca ratios" and on $\delta^{18}\text{O}$ seasonality?

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