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Climate of the Past Discussions

Interactive comment on "Salinity changes and anoxia resulting from enhanced runoff during the late Permian global warming and mass extinction event" *by* Elsbeth E. van Soelen et al.

Anonymous Referee #2

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General comments and specific issues

This is an interesting study that discusses acritarch processes length as new proxy for salinity changes in correspondence to the end-Permian mass extinction. The data are novel and interesting for a wide range of scientists working on palaeoenvironments reconstruction and the end-Permian mass extinction. The manuscript is well written and structured. However, given the novelty of the proxy I think the description and discussion of the used method require a more in-depth treatment, especially from a statistical point of view. Moreover, I think the main conclusion of the manuscript, i.e. salinity changes at the P/T boundary, is not sufficiently supported by the data, which

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are in my opinion over interpreted. I therefore suggest major revision.

Main comments:

1) To study the changes in processes length across the section the authors measured three processes per specimen (Lines 140 – 141). The specimens selected for these study include "only those with a spherical central body and many (>10) simple processes with closed tips" belonging to the Micrhystridium breve Group (lines 137 – 138). Why did the author measure only 3 processes per specimen? How did they select the three processes to measure? In Fig. 3 it seems that the processes of M. breve Group acritarchs vary in length within a single specimen. What is the process length variability in one specimen? How could the selection of only 3 out of 10 processes bias the analysis? These methodological issues must be assessed, discussed and taken into account for the interpretation of the data. I strongly recommend the authors to expand the discussion on the methodological aspect, which I believe is the most important theme of this study.

2) The observed changes in acritarch average processes length are interpreted as the evidence of changing salinity in the water column. This conclusion seems to be based on the assumption that the Micrhystridium acritarchs considered for this study belong to one species. According to the authors, this assumption is suggested by the unimodal distribution of body size and processes length (Fig. 5). However, considering data through time (Fig. 6), there is indeed a difference (lines 192 – 194) in processes length and in body size between the acritarchs extracted from laminated rocks (after the extinction; Wordie Creek Formation) and those from bioturbated rocks (before the extinction; Schuchert Dal Formation). This is actually the main conclusion of the study. So, could these facies-dependant differences in both processes length and body size just mean that different species (with a different body size and length of the processes) are found in the different formations? Do the acritarchs' morphological differences represent a salinity-related mutation in one species through time or do these morphological characters show different Micrhystridium species? Acritarch con-

centrations at Fiskegrav, before and after the extinction, also suggest a change in the community structure, and in fact a change in the marine palynomorphs' assemblage is detected (see below, point 3). Similarly and as an example, van de Schootbrugge et al. (2007; P3, 244, 126–141) found an increase in actritarch abundance and diversity at the Triassic – Jurassic boundary.

3) The authors say that "studies of acritarch process length and palaeoenvironment show that species and individuals with longer processes are generally found in more offshore locations, while in inshore settings acritarchs with shorter processes are more abundant" (lines 293 – 295). These differences have been tentatively attributed to salinity differences between off-shore and nearshore environments (Servais et al., 2004; Palaeontology, 47, 395–414). So, could the change in average process length found in the studied section just be an effect of transport of acritarchs living in different environments? Is it possible that inshore species of Micrhystridium acritarchs with shorter process length, were transported to the more distal setting? The processes length change is coupled to a change in the assemblage from "Veryhachium/Micrhystridium to Micrhystridium/leiosphere dominance" (lines 275 – 276). Leiosphere are common in fluvial-deltaic environments (e.g. Zavattieri & Pramparo 2006; Palaeontology, 49, 1185–1209), and indeed in the Fiskegrav section the reduction of average process length is coupled to an increase in leiosphere abundance (Fig. 6). The authors indeed acknowledge that "during the extinction event the acritarch assemblage changes to a more typical near-shore assemblage, despite the ongoing sea-level rise" (lines 286 – 287), but they do not discuss the possible effect of transport. This is a crucial point that must be discussed to understand whether the observed changes in acritarch morphology reflect actual changes in salinity of the water column or just transport of nearshore species towards more distal environments after the extinction interval.

4) Local vs global signal. Data collected in this study come from one stratigraphic section that has been deposited in a narrow basin. The observed changes in acritarch assemblage, body size, and process length thus represent a very local signal. What is

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the significance of this local change in a global perspective?

5) I think the title of the manuscript does not satisfactorily mirror its content.

Other minor comments

Line 67: Servais et al. (2004) talk about Cambrian – Ordovician acritarchs. Given the fact that acritarchs are a group of uncertain affinity, is there any more appropriate citation supporting the statement that "many acritarchs are, however, found exclusively in marine rocks"? In other words, is this true also for the Permian – Triassic?

Lines 72 – 75: The reference provided (Martens et al., 2009) discusses the effect of salinity in one modern dinocyst morphology. Is it possible to provide any reference about the effects of salinity on acritarchs?

Lines 192 – 194: The numbers, e.g. average body size, average processes length, errors, etc. . ., to support these statements should be presented. This would help the reader. A simple reference to the figure is not sufficient.

Is it possible to introduce in the results the changes in acritarch assemblage later discussed in 286 – 287 and following lines? How could this change affect the measurement and interpretation of acritarch processes length?

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