



Interactive comment on “Non-invasive diagnostics in pathological fossils by magnetic resonance imaging” by D. Mietchen et al.

B. Kröger (Referee)

bjoern.kroeger@museum.hu-berlin.de

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1) Does the paper address relevant scientific questions within the scope of the BG? Yes, the paper presents a new method that is of interest for a wide range of paleontologists and probably also for sedimentologists. Pathological phenomena are investigated that are of interest for paleobiologists. I recommend the paper for publication in the BG.

2) Does the paper present novel concepts, ideas, tools, or data? Yes, the authors show the value, merits and limits of the MRI for investigation of solid rock samples. Moreover, they provide some insight into causes of pathological phenomena in belemnites and healing processes.

3) Are substantial conclusions reached? Yes. a) MRI can provide insight into the internal structures of fossil skeletons. b) Pathological patterns can be illustrated and inter-

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preted in a new way.

4) Are the results sufficient to support the interpretations and conclusions. Yes

5) Are the scientific methods and assumptions valid and clearly outlined. The paper needs some improvement in order to strengthen the argumentation, and to outline the main conclusions.

6) Is the description of experiments and calculations sufficiently complete. The illustrations need some marks and legends that help to orientate within the images. A schematic overview on the features and orientations of a belemnoid guard is needed in chapter 1.2. in order to understand the MRI images..

7) Do the authors give proper credit to related work and clearly indicate their original contribution. Yes. At page 243 § 10 cite also: Hewitt et al. 1999. Buoyancy calculations and ecology of Callovian (Jurassic) cylindrotheutit belemnites. NJb Geol Pal Abh 211: 89-112

8) Does the title clearly reflect the contents of the paper. A large and significant part of the paper deals with paleobiological interpretation of belemnoids and their pathological phenomena. This is not expressed within the title. The content of the case study should be indicated with the title eg. Non-invasive diagnostics in fossils by magnetic resonance imaging. - A case study from pathological belemnoids.

9) Does the abstract provide a concise and complete summary. The abstract needs to be improved. One of the main results is the relatively high image resolution of pattern of internal layers and fractures of the fossil skeletons; this is not indicated within the abstract, yet! Limits and merits of the method are not mentioned in the abstract. The abstract deals on belemnoid paleobiology only, however this is not indicated in title.

10) Is the overall presentation well structured and clear? The main problem of the paper is the tension between the presentation of the case object (Paleobiological issue) and the presentation of the method (MRI in fossil skeletons). Both topic need to be clearly

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separated because I guess that potential readers will be interested in only one of these two aspects. The one that potentially will use the method at very different organisms, the other that is interested in cephalopods/Coleoids. Another problem is that in the description of the pattern of the different specimens interpretation and description is not clearly separated. The descriptions, and the illustrations need clearly to be improved.

11) Is the language fluent and precise. My English is rather poor as you see within my review. I cannot evaluate this. However, the structure of the text and sentences need to be improved at several places.

12) -/ 13) Should any parts of the paper be clarified? The chapter 1.2 would profit from a scheme of belemnoid guard with its features. The chapter 1.3 would profit from a general outline of the pathological phenomena in belemnoids and the value of the investigated specimens within this. Are the observed belemnoids representative of specific phenomena? It also needs to define some terms such as syndrome, orthostrum, dorsal, ventral, distal, alveole etc.. The conclusions need to be improved. Separation of the two aspects (topics) of the paper. The writing style of the conclusions need significantly improved.

14) Yes.

General remarks

When I read the paper some question arose that can probably be answered by the authors and that may improve the value of the paper: What maximum /minimum dimension must have a sample. What are the resolution limits? Is it possible to investigate structures / cavities that have mm dimension or cm dimension? Is the porosity a factor that counts? What type of rock is best to investigate (clay/limestone/chalk)? Makes it a difference for the image quality if the sample is dry or wet. Are there constraints such as sample thickness, water temperature etc.?

I would be happy if the observed phenomena would be classified and evaluated within

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the known pathological syndroms of belemnites? Are these phenomena characteristic for a time, stratum, the belemnites alone or several coleoids such as sepiids? Are such phenomena unique or common? Some of those questions are scattered within the descriptions which is definitively not the place where they belong in the text.

In many places of the descriptions I did not manage to find the described structures within the illustrations; arrows, remarks, circles etc. would definitively help to improve the readability of the illustration especially for non cephalopod specialists.

Specifics

p. 240 Abstract. - The abstract strongly emphasizes on the paleobiology of the belemnoids, but this is contrary to the title were belemnoids are not mentioned but the method. There is no information on the value, merits and limits of the method. At line 12: is "traced back" a correct phrase within the logic of the sentence? 18. "Traits" is something used in cladistics etc. better use "features" or "characters". 20: "arose" better use "caused by" or "resulted in" 23: "whose" should this mean "these"? I do not understand the sentence.

p. 241 13: "The reason for the different treating..." What different treating? You do not mention any different treating above. 26: consider reformulation of the sentence e.g. ... about the "how" to sample, the "where", and the "how much".

p. 242 27. last sentence is redundand.

p. 243 Architecture and normal growth pattern of bellemnite guards. - A schematic drawing or sketch of the entire guard and of the ultrastructure of the layers would help to illustrate the terms introduced herein. 18. what is an "orthorostrum" 26. "antibiotic interactions" is this a valid phrase? My association is penicillin.

p. 244 25. "is with" is this right? Better "at the collection of.." 27. "from the coast of Helgoland"? erratic?

p. 245 23."the cause for ist existence" the cause can not be obstructed only the pattern

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at time point of the traumatic event 23: “In contrast...” this sentence is redundant; delete.

246 pp The following descriptions are poorly organised, difficult to read and in all cases a mixture between description and interpretation. I would suggest, at the beginning of each specimen’s paragraph to provide a clear description with references to the illustrations, followed by the interpretation of the observed pattern.

p. 246 20: “A very similar anomalous...” This belongs in the chapter 1.3

p. 247 4: delete “very” 6: “The irregular growth pattern..” consider reformulation of the sentence. 9: probably the mantle had been torn off 10: isolating small pieces of what?

p. 248 2: small hollow tunnel please indicate in figure 8: “Bubble-like...” start the paragraph with description not with interpretation., delete “very” 15: “can be observed immediately” indicate in figure 25: provide a definition what you mean with syndrome

p. 249 Conclusions. - This chapter needs a general re-organisation. Several parts are redundant and non-informative. I would suggest two parts: discussion of the general results when using MRI for investigation of fossil skeletons and discussion of the value of the observed specific pattern in belemnites for belemnoid lifestyle ecology etc. 13: “has shown” replace for “shows” 14: consider reformulation and shortening of the sentence e.g. “This is perhaps surprising on its own, because fossils ...; it shows that ordinary liquid state pulse...” delete the part “our feasibility....observation that” 18. “What is more” replace for “moreover” 19: delete “So the question is where the signal comes from. Fortunately,” and then “The samples itself already give hints where the signal come from. 24: *syn vivo* italics, “laying the grounds” replace for “cause” 25: delete “were activated rather than inactivated by the pathological incident.” 26: add “such as in PB264..”

p. 250 3: “While this might...”consider reformulation. I do not understand this sentence 6: delete the entire sentence “Fourth, ...” 15: replace “allowed” by “allows”, reformu-

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late, eg. “allows the investigation of small scale three-dimensional growth lamellae. Consistently an interpretation of origins..” 18: you need the distinction between physiological and anatomical here? delete “Furthermore, the notion” replace: “ It is possible to explain the observed apical collar by...” 20: delete “Finally, all...” entire sentence is redundant, delete also next sentence 26. after MR include “ ,such as brachiure visualisation in brachiopods.” Delete “provided that and than new sentence “They exhibit structures where organic and anorganic material is arranged in closely intertwined but seperate layers . Other structure that probably could provide good results are e.g. wood bones an teeth...” +++++this is an important conclusion you must emphasize this: alternations between organic/inorganic layers are good to visualize by MRI++++

251 Consider complete reformulation of the last sentence you mentioned this several times above. Try to avoid redundancies.

Figure captures. - generally: what is the dimension of the bars? What is the magnification of the photomicrographs? Provide explanations of the features illustrated in the figures. What do I see at the individual figures: where are the relevant features? Are individual guards fragments or complete?

Fig. 3. *Goniotheutis quadrata* in italics

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