

The manuscript “On the enigma of *Palaenigma wrangeli* (Schmidt), a conulariid with a partly non-mineralized skeleton” sheds new light on an enigmatic fossil that has been known about for sometime, but requires more advanced analysis than traditional paleontological studies could provide. The authors use their microCT method well, illustrating the fossil in fine detail. The microstructure and morphology are the paper’s strongest attributes and make the most compelling case for the author’s conclusions. The ESEM and EDS data have some of the largest gaps and do not contribute well to the stated conclusions (even though I agree with them!). Overall this is good work and the authors have shown new details of an obscure organisms. I would recommend publication after heavy modification.

See below for further comments, ranked by importance then line.

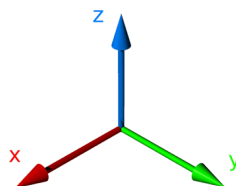
1. EDS Data Concerns: The EDS derived data is the thorniest of issues for this manuscript. It is the weakest instrument argument in the paper, but the sole reason for it even being in the MS (showing the presence of phosphate) is critical to the inferred taxonomy of the fossil. For examples of standard presentations of EDS data I would recommend looking at any article on the subject from James Schiffbauer at the University of Missouri, USA. EDS issues from the manuscript are as follows:

1a: Operating Conditions. What software and operating conditions were used during EDS collection? What kind of BSE detector was used? Was it a ‘copper wafer’ or ‘cone’ style? Why was that detector used? Why did you choose those and why did you use BSE rather than just SEM imagery? Likely it was for image clarity using ESEM conditions, but it wasn’t stated. I was impressed by the crispness of the ESEM images!

1b: Point Counts: Why are there only 2 points analyzed? Yes, there are thousands of counts for each point, but only two points is far to few to account for errors. These errors range from matrix (or other layers) inclusion or cover, time-of-flight issues, angle of materials, differing fossil preservation, or even differing vapor concentrations from the ESEM conditions. I completely understand that rare and limited fossils, with limited surface exposure, can be difficult to image, but it seems like there is more space that can be sampled. The more sampled points, the more robust your conclusions can be! If more sampling does occur, a cross-comparison with the known outgroup (the conulariids) should be considered.

1c: Context: Where are these EDS points taken? It is not clear what specimens these EDS points come from. The sample imaging spots are too zoomed in to give the reader any context to where they are on a specimen nor are they pointed out on the imaged specimens from Fig. 7. If possible, EDS maps are a great resource to show material differences in fossils.

2. CT Figures in Space: Presenting 3D data via 2D media is ALWAYS a hassle and it takes a few goes to get it right. The CT data (which is really microCT) presented here is outstanding and the details of the fossils in figures 2-6 are readily apparent. However, there are times when it is not clear how the fossils are rotated because the reader is not as familiar with the materials as the authors (again, been there). The best way to illustrate 3D specimen movement is with the tried-and-true XYZ cross (see here). The author’s have already standardized the main viewing axis that most CT imagery is viewed from, so adding the XYZ parts in shouldn’t be too difficult. It can also be added to Figure 2 even though that is in a slice/cut form (which, again, has great resolution).



3. Preservation/taphonomy: This is not a critical issue for the manuscript, but it is related to many of the other topics of importance. Are there any other phosphatic organisms from the same samples (or rocks) that can be sampled with the EDS to show a similar preservation style, or at least a consistent signal in the analytical equipment? Can the matrix they have been found in support the preservation that the manuscript concludes then?

Line comments:

Line 22: This is actually microCT and should be mentioned as such throughout the MS.

31: Non-italicized *P. wrangeli*. Make sure to re-check MS for correct formatting.

37: This is a great opener, though the citation gets in the way a bit.

38: The description of the fossil is great, but a reconstruction (even old vs new) is missing as well as a regular light photograph. Those figures do take up space and are not critical, but they give the readers context on this enigmatic fossil.

109: This should start a new sub-section, as this is focused on collection and specimen management more than 'methods' proper. In my copy of this the link to the geo-collection is all there and not a hyperlink, which could be odd formatting, but should be made sure is fixed before publication.

119: We all know what a PDF is so that's a bit odd. The author's don't state that every image in the PDF is a JPG do they? If that's wording that ICZN requires, then so be it.

150: Given how much text is written to describe these specimens, images should probably be provided. I agree with the authors that the MS doesn't need require them, but they could be put in the Supplemental Materials.

207: Is there a way to show the degrees of the pillars in the MS images?

210: This is a commentary more than suggestion: have the authors thought of doing an ontological analysis of this material? That would be interesting to see how each section was added on and what that could say about growth in these organisms.

250: Can the empty spaces be seen on any CT slices? If so, they should be pointed out or a cross-section shown.

275: Are there any other examples of microbial-fungal (maybe even boring sponge?) post-mortem damage on conulariids or other phosphatic organisms from the Ordovician? If so, they should be compared, otherwise this is just kind of hanging out there.

280: I see what you did there. Good opening, but I had to go back to the intro to get it.

300: The EDS data needs some work to make conclusion #1

310: The proposed new family requires way more description than is provided here. Maybe the authors are working on a more formal description in another MS, but without the rest of the usual description

work this could cause taxonomic trouble. The section could end well with just the sentence from line 309 "Taking the general similarities...".

344: I mostly agree with this conclusion, but this is the weakest of the conclusions reached. There is evidence of mud/soft substrate holdfasts for conulariids, but NOT at the sites with *P. wrangeli*, so a correlation is going to be hard to setup. Is there any evidence of any kind (from other fossils maybe) in the sampled rocks for a soft substrate? This conclusion needs refining.