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Interactive comment on "Non-invasive imaging methods applied to neo- and paleontological cephalopod research" *by* R. Hoffmann et al.

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We thank the anonymous referee #3 for their constructive comments. We are responding to the main issues raised by the referee in the following, in each case we include the referee comment followed by our response.

1. The brands and technical details make it a bit long and difficult to read. I think the use of a table that summarize the pro and cons and technical details (minmax size of the sample, resolution, preparation of the sample ect..) would make this part more pleasant to read and help the reader.

We agree with the reviewer's opinion and will provide a table summarizing all pros and cons, technical details etc. in order to make this part more readable.

2. The authors probably wanted to show many aspects, but, as a consequence, it seems a bit too superficial... The different imaging specifications are given in the separate sections of part 3 (methods). In part 4 the applications in cephalopod studies are presented in order to show how non-invasive methods could be used to acquire data concerning specific questions. Also, volume is calculated as an application example how to process data from non-invasive methods. We understand that some confusion may occur between intention of the paper and information that is presented. Parts will be restructured as suggested by the referee. With our paper we compared the specifications for all the instrumentations in order to give the reader a handy guideline to help clarify which method is most suited to their research question. In order to present the intention of the paper more clearly application examples will be included in the table mentioned in our first comment and briefly described in the text, the buoyancy calculation will be described in detail showing how different non-invasive methods can work together.

3. The authors maybe could compare the results obtained with CT to what is obtained with other approaches (invasive of theoretical) on the same sample.

Comparing our results with results obtained from grinding tomography of the same specimen (17 cm in diameter Nautilus shell) is too time consuming but we may include a comparison with results obtained from mathematical equations. However, we adequately referred to the method of grinding tomography, demonstrating the minute differences hard to see with the naked eye in the figure will lead to reasonable changes in the calculated volume (+/- 9.5%) of the shell.

4. For example PVE is mentioned, but how much is the PVE creating an error for a shell reconstruction? It highly depends on the resolution of the scan, so what is the poorest resolution acceptable before introducing too much error with the segmentation for a reconstruction of the shell?

The effect of the PVE is shown by us (see tab. 2 and 3) when comparing the calculated

weights with the actual weight of the Nautilus shell and largely depends on the resolution. Results can be further improved by using a phantom (or reference body) so that the PVE decreases. Actually we are processing a data set derived from hospital CT (resolution about 500 μm) that shows for every case (including reference bodies) a negative buoyancy force. The low resolution hinders selecting almost the first two whorls and the reference bodies become more or less useless here due to the dominance of manual selection. As we stated the resolution needs at least twice the dimensions of structure of interest. Therefore it is reasonable to check for the thinnest septum and apply the appropriate resolution e.g. in ammonoids the thinnest septa are about 5-10 μm thick – a resolution of 2-5 μm is therefore necessary. Without doubts the higher the resolution the closer the calculated weight will be compared to the actual weight.

5. For example the authors could have chosen one species of ammonite with different types of preservation and compare the results obtained with the different data acquisition methods.

As we demonstrated earlier (Hoffmann & Zachow 2011) ammonites filled with sediment, calcite or pyrite are not suitable for normal CT-scanners due to similar absorption properties degrading the signal-noise-ratio, which will result in a similar/identical grey scale or complete absorption of the x-ray e.g. pyrite.

6. Overall this paper will be useful for researchers interested in applying non-invasive techniques on shell material (fossil or recent) in order to calculate the volume of the shell and chambers and is the response to an increasing interest towards this technology from the cephalopod community. Having an accurate non invasive method will indeed help to answer many aspects of fossil cephalopod paleobiology. Maybe this could be pointed out in the introduction and in the conclusion, and then focus the article on one main goal. Agreed.

7. Specific Comments – References

We agree that it is useful to add the mentioned articles. However three of five were not

available when we submitted our manuscript.

8. Specific comments – Figures

Agreed, we will change the figure captions accordingly.

Interactive comment on Biogeosciences Discuss., 10, 18803, 2013.