Referee report

This manuscript presents an impressive study using high-resolution ptychographic X-ray computed tomography to reconstruct the three-dimensional microstructure of a single *Nannoconus* specimen. The work delivers detailed visualisations of the lamellar structure and contributes useful new information to our understanding of biomineralisation and skeletal organisation in this species. It includes clear methodological details and demonstrates the considerable potential of PXCT for investigating calcareous nannofossils at the nanoscale.

However, while the achievement is noteworthy, the manuscript currently reads as a hybrid between a methodological and an interpretative paper, without fully achieving either goal. The central research question, namely understanding the organism and biomineralisation process responsible for *Nannoconus* calcite formation, is only partially addressed, as the biological interpretation remains speculative and is based on observations from a single specimen. In its present form, the manuscript would benefit from a clearer framing of objectives and a more structured, cohesive discussion.

Major comments

The manuscript aims to address the gap in knowledge regarding the producing organism and its biomineralisation process. However, the data presented primarily document the skeletal microstructure rather than the biological identity or process itself. The introduction should therefore be reframed to clarify that the study provides structural constraints on possible biomineralisation mechanisms rather than direct biological evidence.

The study is based on a single *Nannoconus* specimen. While the results are valuable as a demonstration of the method's potential, broader generalisations about *Nannoconus* lamellar architecture or biomineralisation should be made cautiously. Future PXCT analyses on multiple specimens, including lamellae from different positions within the skeleton and from different geological intervals, will be necessary to confirm whether the observed features are consistent across individuals.

The discussion is currently vague and unstructured, moving between topics without developing clear arguments. It would benefit from being reorganised into distinct, coherent paragraphs. Additionally, the manuscript does not address the potential effects of diagenesis on the skeletal microstructure. Although the author states that well-preserved specimens were selected, overgrowths are visible and reported. It would therefore be useful to discuss the preservation state and whether the observed features are primary or influenced by diagenesis to support the PXCT interpretation.

Minor comments

The manuscript contains several syntactical and grammatical issues.
Several statements are unsupported by references.
Some paragraphs are repetitive, and certain sections could be shortened for conciseness.
The manuscript would benefit from some restructuring to enhance readability. For example, points 2 and 3 on stratigraphy could be incorporated into the brief introductory paragraph of Section 2.

Recommendation

I recommend major revision before the manuscript can be considered for publication. With clearer framing of objectives, a more focused and structured discussion, and consideration of diagenetic effects, this paper has the potential to make a significant contribution to the study of calcareous nannofossil biomineralisation and to serve as an important methodological reference for future PXCT-based research.