Experiment report for ES 581

Main proposer: Henning Blom

The objective of the proposal was to image, by propagation phase contrast synchrotron microtomography (PPC-SRµCT), a large collection of dermal elements of both disarticulated and articulated osteostracans from the Later Silurian of the Saaremaa Island (Estonia). The ultimate aim of the project was to generate detailed 3D reconstructions of the inner architecture and histology in order to understand the diversity of osteostracans is achieved from a developmental perspective, which is essential to evaluate how the histology pattern of dermal skeletons of jawed vertebrates originated.

The experiment was very successful. Very little scan time was lost because of beam failure or other technical problems. Basically, all the material was scanned at 0.7µm and 69keV. In total we managed to achieve 65 scans from 53 specimens.

Over a period of 3.5 years the material was reconstructed by Oskar Bremer as part of a post-doctoral research position financed by the main proposer. This resulted in a large 3D dataset that has been presented in two publications (Bremer et al. 2021; 2023; figs 1 and 2), showing that three-dimensional modelling of high-resolution data can provide histological and structural details that can help clarify homology issues and elucidate the evolution of dermal hard tissues in osteostracans.

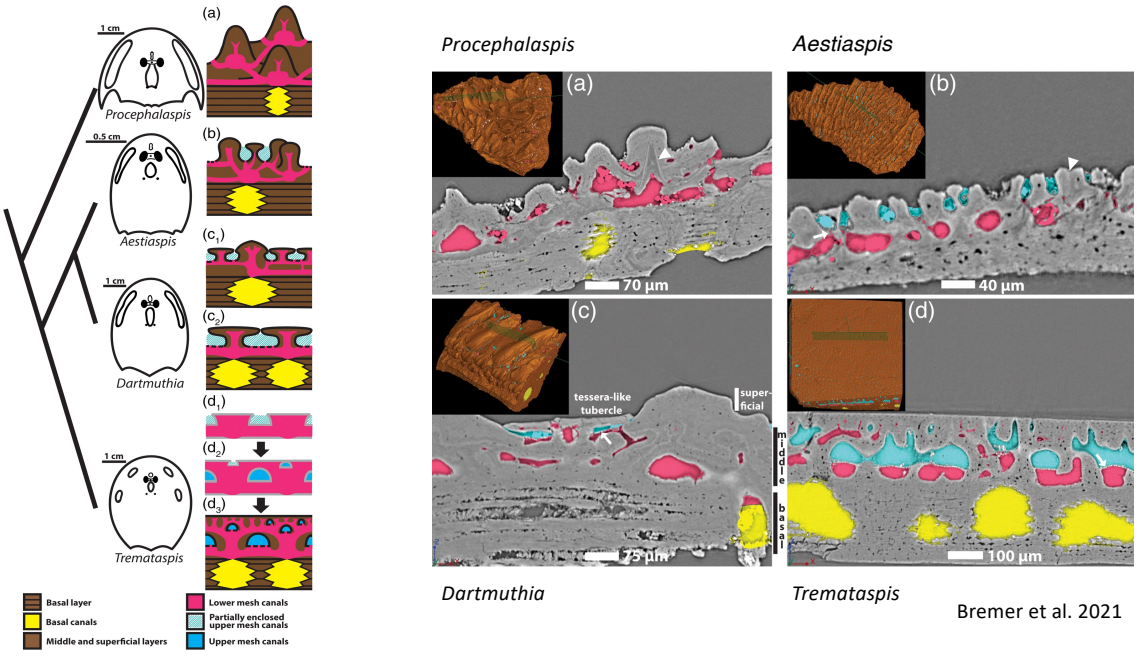
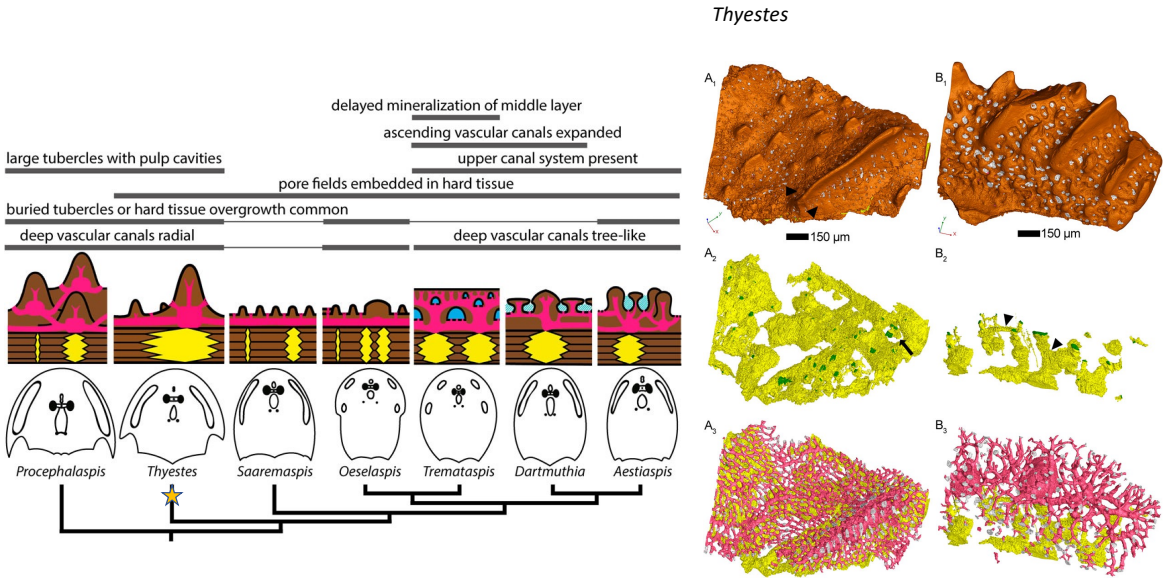


Figure 1. Left: Phylogenetic relations and head shield outlines of the thyestiid taxa included in this study. The schematics to the right illustrate the suggested growth of hard tissues in each taxon. Right: Virtual scan slices and inserts of their respectivepositions on the dermal elements. The different canal systems are highlighted in yellow (basal cavities and canals), pink (lower mesh canals), and teal (upper canals/upper mesh canals).



Bremer et al. 2023

Figure 2. Left: Simplified histological schematics of the investigated taxa placed in a phylogenetic context with head shield outlines displaying morphological similarities. Right: Three-dimensional reconstructions of a *Thyestes verrucosus* head shield fragment.

Some of the generated 3D data have not yet been published, but is expected to be included in additional work for further exploration of osteostracan dermal bone architecture in a phylogenetic context and aiming for a better understanding of the emergence of the jawed vertebrate body plan.

References

Bremer, O, Qu, Q, Sanchez, S, Märss, T, Fernandez, V, & Blom, H. 2021. The emergence of a complex pore-canal system in the dermal skeleton of Trematraspis (Osteostraci). Journal of Morphology. 1– 17. https://doi.org/10.1002/jmor.21359

Bremer, O, Qu, Q, Sanchez, S, Märss, T, Fernandez, V, & Blom, H. 2023. Exploring the three-dimensional vasculature of dermal hard tissues in thyestiid osteostracans using synchrotron radiation microtomography. Journal of vertebrate paleontology, https://doi.org/10.1080/02724634.2023.2196318