

CT-CEPH

A fresh look at Devonian, early Carboniferous and latest Cretaceous to Paleogene nautilid cephalopods from Belgium

Contract - B2/192/P2/CT-CEPH

SUMMARY

Context

X-ray computed tomography (CT) has revolutionised the study of extinct organisms by enabling non-invasive, non-destructive, high-resolution (sub-100 μm to a few μm voxel size) imaging of both external and internal structures, including those fully encased in dense sediment. This technology reveals hidden characters in three dimensions, providing unprecedented morphological detail. Since 2016, the Royal Belgian Institute of Natural Sciences (RBINS) has operated two high-end CT systems—the micro-CT RX EasyTom and nano-CT XRE UniTom—used extensively in large-scale digitisation of RBINS and Royal Museum for Central Africa (RMCA) type collections under the multi-year Belspo projects DiSSCo-Fed and DIGIT-4. With ~300,000 types and 48 million specimens, including ~45,000 type and 3 million general specimens in palaeontology, these institutions are key European research infrastructures.

Objectives

CT-CEPH aimed at gaining better insights in the complex evolutionary history of the Order Nautilida (Phylum Mollusca, Class Cephalopoda, Subclass Nautilia), the lineage leading up to the single surviving externally shelled cephalopod, the extant nautilus. It focused on Devonian, early Carboniferous and latest Cretaceous to Paleogene time slices of nautilid history, intervals during which major steps in their evolution occurred that remain incompletely understood, and for which the Royal Belgian Institute of Natural Sciences (RBINS) and Royal Museum for Central Africa (RMCA) collections hold a large number of important specimens. The project exploited the ongoing mass acquisition of micro-CT datasets, integrating these with traditional taxonomic approaches.

Conclusions

CT-CEPH demonstrated that Belgian nautilid faunas are exceptionally diverse and well preserved, with internal structures—including siphuncle connecting rings—more frequently retained than previously recognised. Results include the first formal record of *Angulithes westphalicus* in Belgium, documentation of the most diverse known latest Maastrichtian nautilid fauna worldwide, documentation of two Eocene nautilids with notable historical context, a discussion on putative cephalopod eggs from the Belgian Carboniferous, and the identification of a new early Carboniferous *Temnocheilus* species represented by the largest specimen of the genus. Devonian records were reassessed and all previously reported occurrences of Nautilida were refuted. The project also confirmed that CT methodology developed for nautilids can be successfully applied to other cephalopod groups, such as stem-group sepiids.

A key outcome is the confirmation that micro-CT imaging is now indispensable in cephalopod research, enabling precise quantification of traditional conch parameters, and novel morphometric traits. CT-CPEH highlights the transformative potential of integrating high-resolution imaging with classical paleontological methods to address longstanding evolutionary questions.

Keywords

Micro-CT imaging, Nautilida, Belgian fossil record, Cephalopod evolution, heritage valorisation