X-RAY MICROCOMPUTED TOMOGRAPHY

X4 POSEIDON – Marine animal shells

Innovation with Integrity

By providing high-resolution, three-dimensional images of internal and external structures, microCT has become a pivotal tool for researchers studying marine organisms such as snails, seashells, and other calcified specimens. This technology allows for detailed morphological analysis, taxonomic classification, and the study of biomechanical properties without the need for physical dissection.

In marine biodiversity research, accurate morphological characterization is essential for species identification and understanding ecological interactions. MicroCT has been instrumental in assessing the effects of environmental stressors, such as ocean acidification and temperature changes, on marine gastropods.

Understanding bioerosion—the breakdown of hard marine substrates by living organisms—is crucial in marine ecology and paleontology. MicroCT is employed to visualize colonization and bioerosion structures in marine shelled organisms across various geological periods. This approach allows for detailed examination of internal features, such as borings and burrows, without damaging the specimens, thereby enhancing our understanding of historical and contemporary bioerosion processes.

MicroCT has become a powerful tool for taxonomic classification and morphological analysis of marine organisms. For example, the intricate shell structures of gastropods (snails) and bivalves (seashells) can be visualized in exquisite detail.

Cover Image: A gastropod shell imaged at 17 µm voxel size

Scan parameters

- Detector: 7 MP flat panel
- Voxel size: range from 12 up to 17 µm
- Source: Transmission type X-ray source
- Energy settings:
  60 kV, 12 W (gastropod, sea urchin)
  80 kV, 16 W (moon snail)
- Filter:
  Al 0.5 mm (gastropod, sea urchin)
  Al+Cu (moon snail)
- Rotation step: 0.16° over 360°

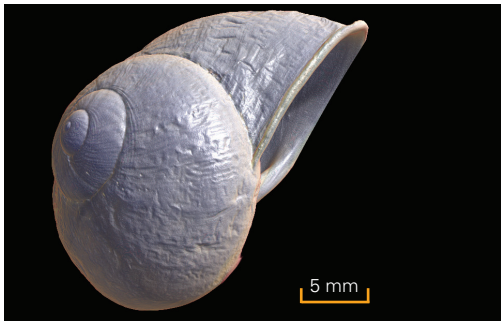

Figure 1: 3D volume rendering of a moon snail shell acquired at an isotropic voxel size of 12 µm

This is particularly useful for studying species with complex shell morphologies, such as those with spines, ridges, or internal chambers. By comparing 3D models of shells, researchers can identify subtle differences between species, aiding in taxonomic classification and evolutionary studies.

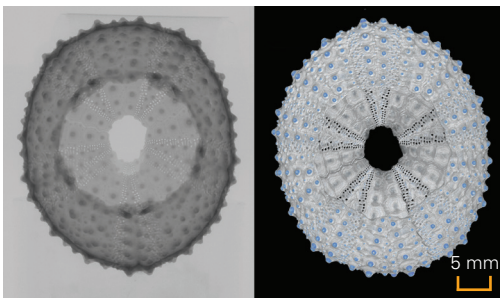

Figure 2: 3D volume rendering of a sea urchin acquired at an isotropic voxel size of 15 µm

Figure 3: Three marine calcareous structures: a sea urchin test (left, Echinoidea), a moon snail shell (middle, Naticidae), and a gastropod shell (right, Muricidae/Buccinidae)

The X4 POSEIDON microCT system, equipped with a flat-panel detector in combination with the transmission type source, allows for precise analysis of the hard structure's internal composition. The high resolution and low noise active pixel performance of the flat panel camera in X4 POSEIDON enables the fast acquisition of a large sample size.

The Bruker 3DxSUITE software package includes all the necessary tools for image processing and analysis, allowing the creation of 3D models through volume and surface rendering algorithms (Figure 1 and 2). It also allows measurements of parameters such as shell or exoskeleton thickness, volume, surface area, porosity, and density, providing insights into morphological adaptations. Biomineralization and calcification patterns can be analyzed by examining mineral density distribution and internal structural integrity.

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