

LABORATORY X-RAY COMPUTED TOMOGRAPHY for CULTURAL and NATURAL HERITAGE

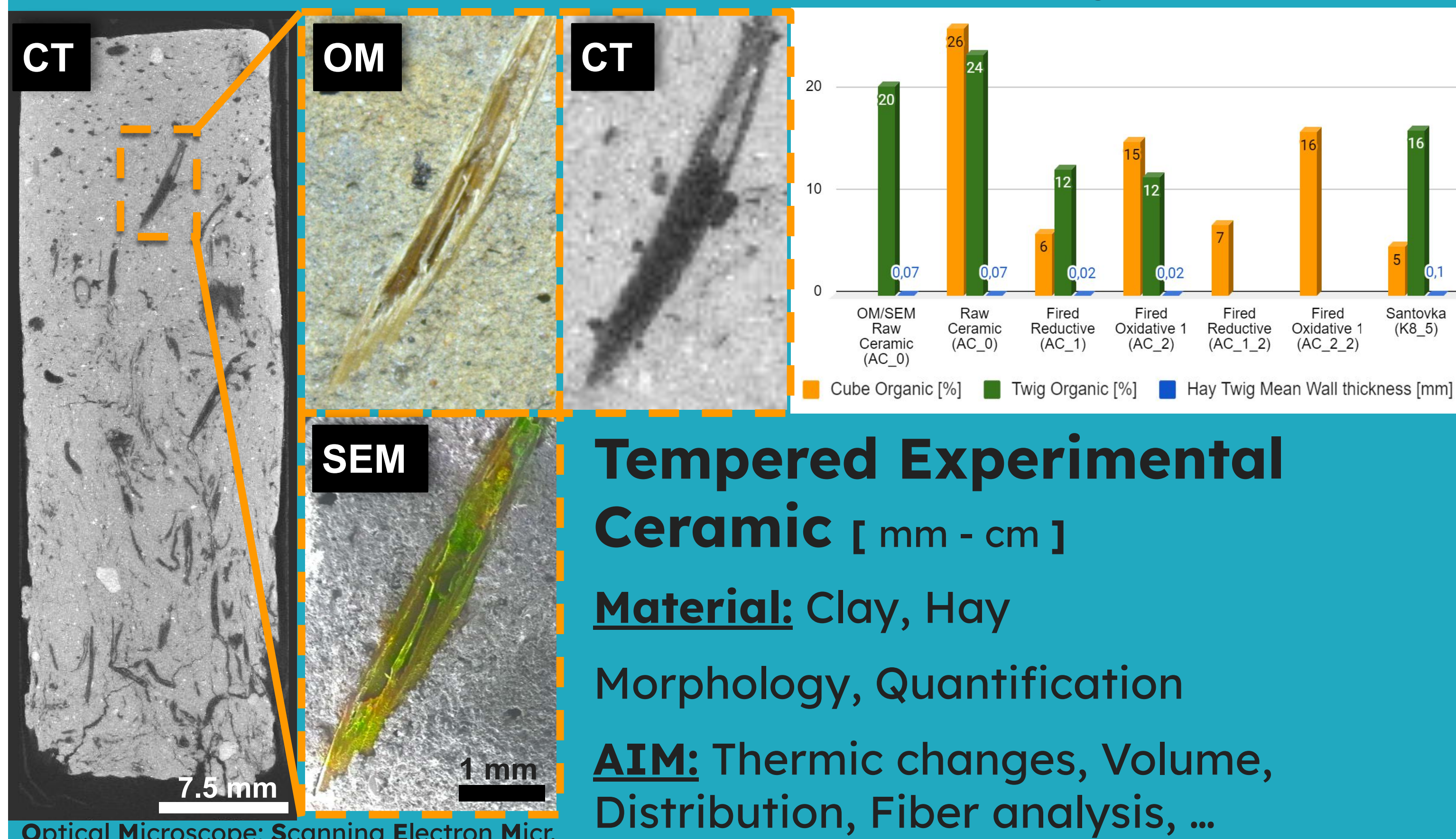
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Computed tomography (CT) uses the density of the objects' components to create **2D** grey images reconstructed as a **3D** volume. CT can be used for **incredible images**, but it has a **richer variety of results** possible continuously improving and increasing. Generally, the larger the sample, the lower the resolution. Therefore, the analysis of **small fragments** can give other information than a whole object.

Morphological modifications^[4]

Heliscan (Thermofisher Scientific); Voxel size 7 µm (binning 2); 120 kV; 130 µA



Tempered Experimental Ceramic [mm - cm]

Material: Clay, Hay

Morphology, Quantification

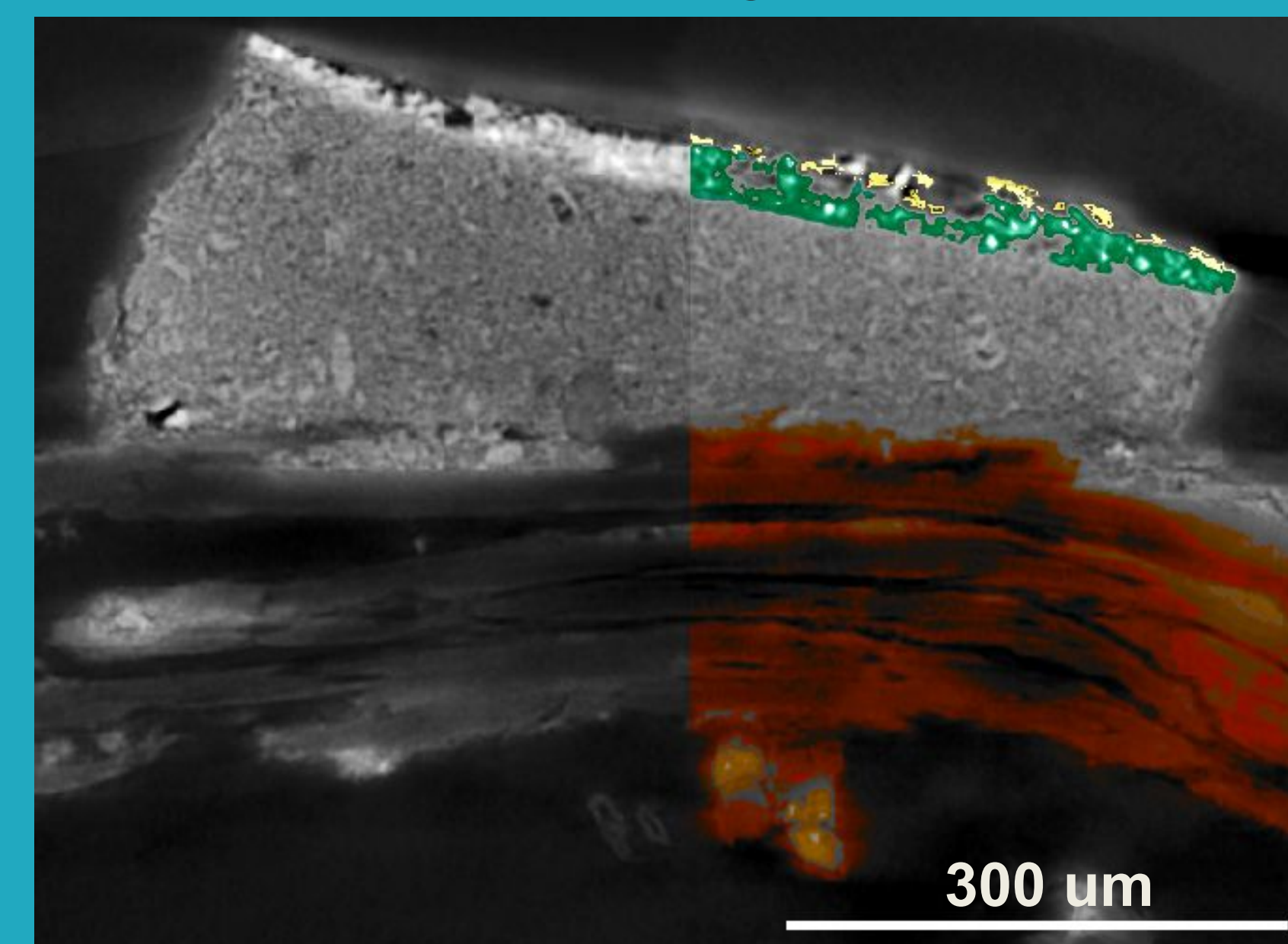
AIM: Thermic changes, Volume, Distribution, Fiber analysis, ...

Material and layering^[1]

Nano3DX (Rigaku); Voxel size 1 µm (binning 2); 50 kV; 24 µA

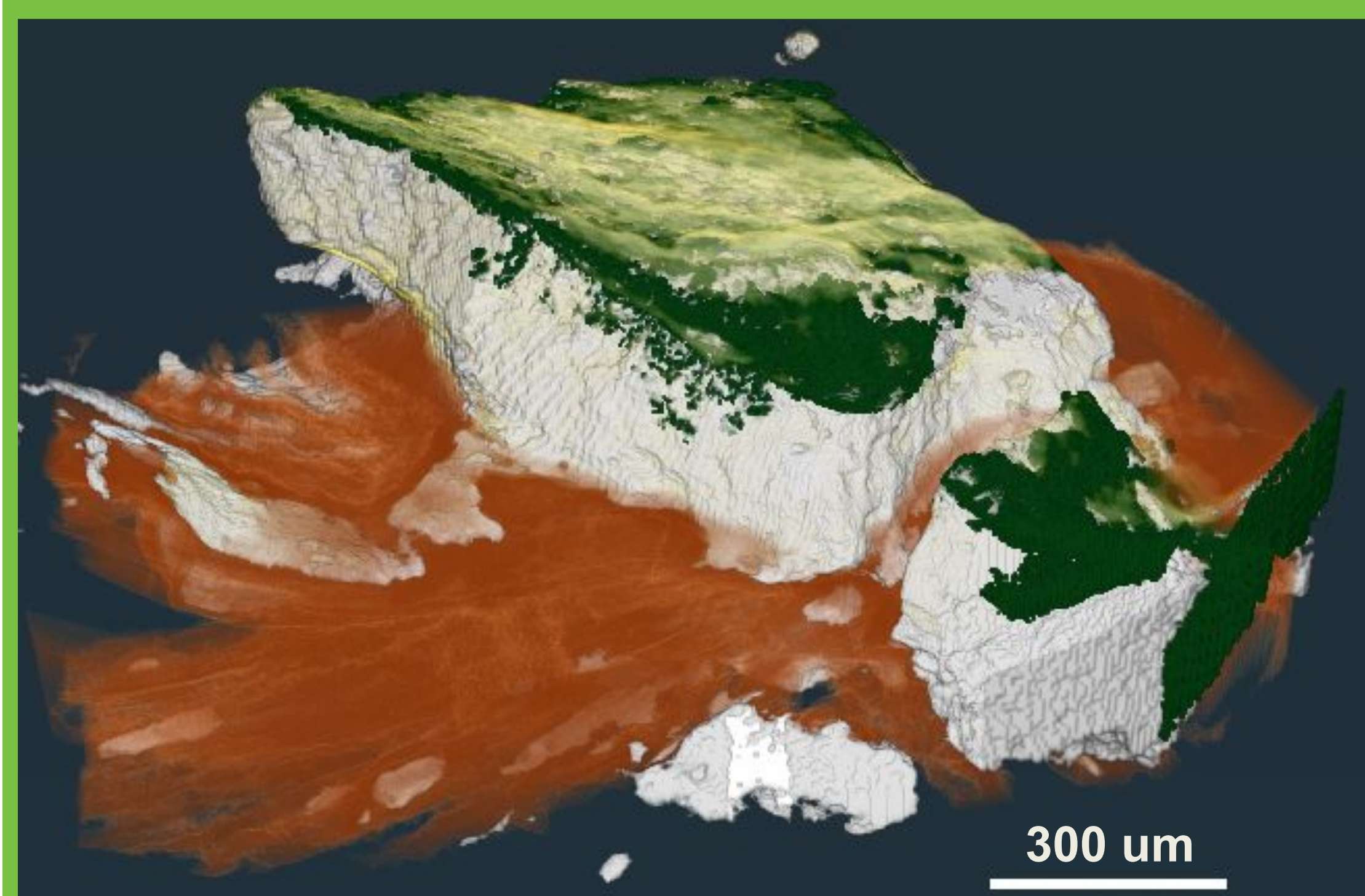
Oil Painting [nm - cm]

Binder
Material
Distribution
Layering
Surfaces
Quantification



AIM: Understanding of the painting technique through layering (repaint, thickness), pigment distribution, brush strokes, ...

From a Fragment [nm - cm]^[1] ...



Microfossils^[2]

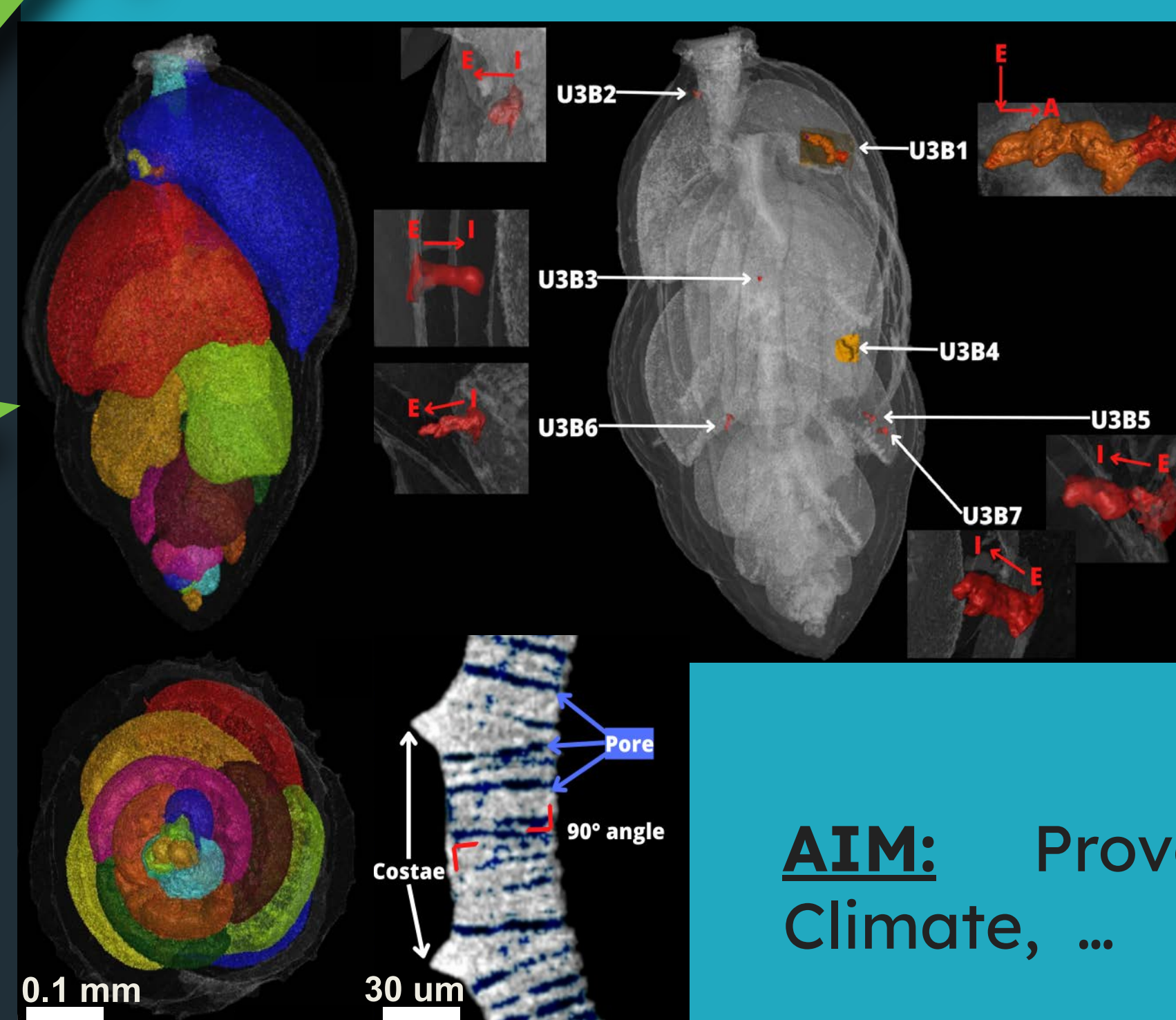
Nano3DX (Rigaku); Voxel size 1 µm (binning 2); 50 kV; 24 µA

Foraminifera [100 - 300 µm]

Material: Si, Ca

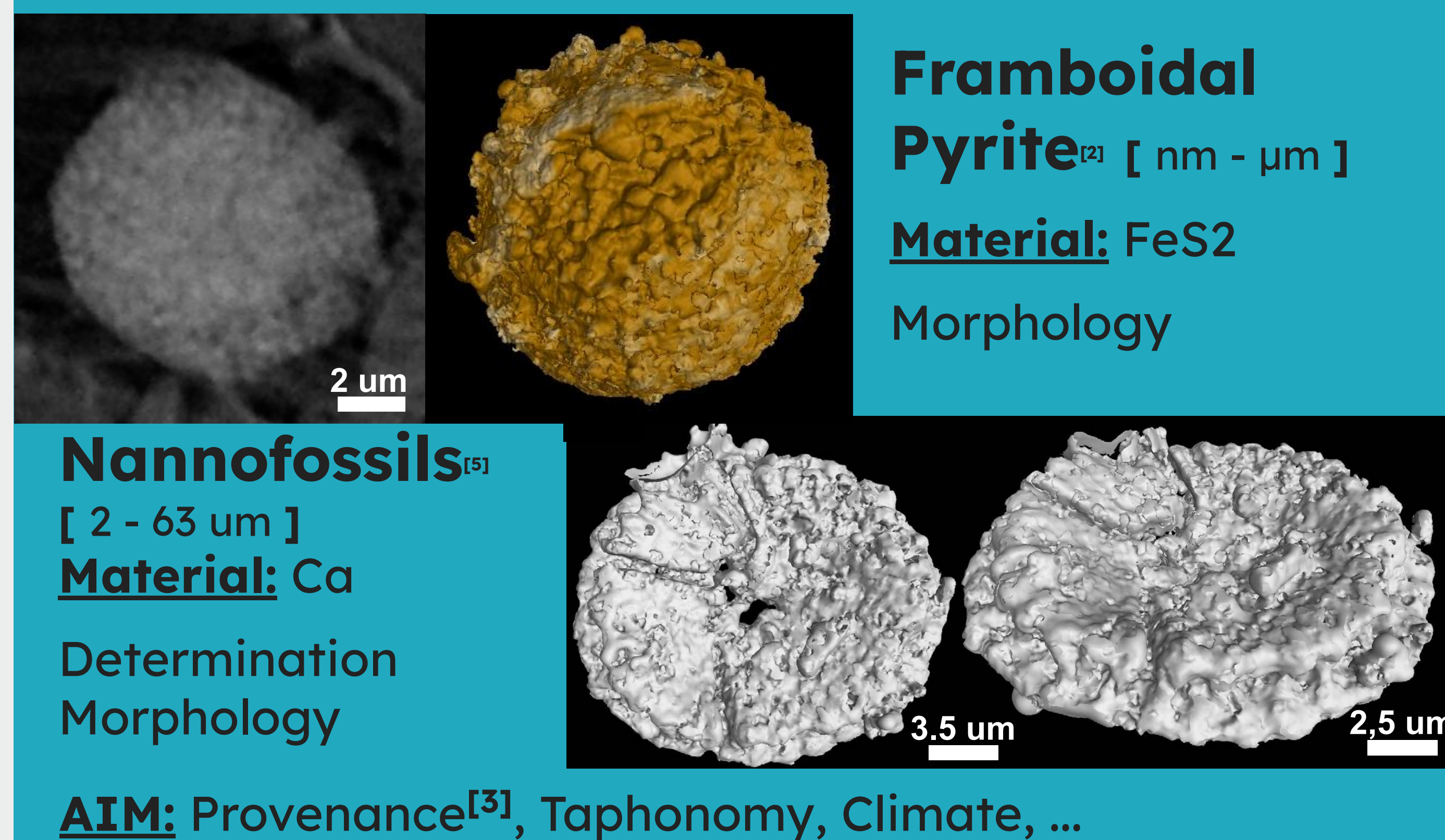
Morphology
Taphonomy
Pores, Bioerosion
Quantification

AIM: Provenance, Taphonomy, Climate, ...



Single particles

Xradia NanoXCT-100 (Zeiss); Voxel size 65 nm (binning 1); 40 kV; 30 µA



Framboidal Pyrite^[2] [nm - µm]

Material: FeS₂

Morphology

Nannofossils^[5]

[2 - 63 µm]

Material: Ca

Determination
Morphology

AIM: Provenance^[3], Taphonomy, Climate, ...

... To a comprehensive characterisation

X-ray computed tomography is a **non-destructive** and already proven method helpful for collections. Its use on smaller fragments is rare, although very interesting. Detection and determination of specific **density-** or **morphology-** related properties and the **spatial distribution** of micro- and nanostructures are important insights that X-ray tomography offers - at **multiple length scales**. The digital **3D** model of the specimen helps in its preparation for other types of analysis (e.g., chemical). The tomographic data retains the structure of the specimen even after later destructive analysis and can be easily shared with the community for more **open science**.

REFERENCES

[1] Jaques, Victory A.J., et al. "X-ray high resolution computed tomography for cultural heritage material micro-inspection." Optics for Arts, Architecture, and Archaeology VIII. Vol. 11784. SPIE, 2021. [2] Jaques, et al. "Exploring the use of submicron computed tomography to analyse microstructures in foraminifera: case study of Miocene *Uvigerina pygmaea*." (In Preparation). [3] Jaques, Victory A.J. "Calcareous nannofossils assemblages for provenance analysis of European paintings: From the sample preparation to the assemblage comparison." (2023). [4] Petřík, Jan, et al. "Technology and origin of grass-tempered ceramics preceding the Neolithic period in the northern Pannonian Basin (Slovakia) (In Preparation). [5] Manuscript in preparation.

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