



Phosphatised microstructures in ancient and modern phosphorites

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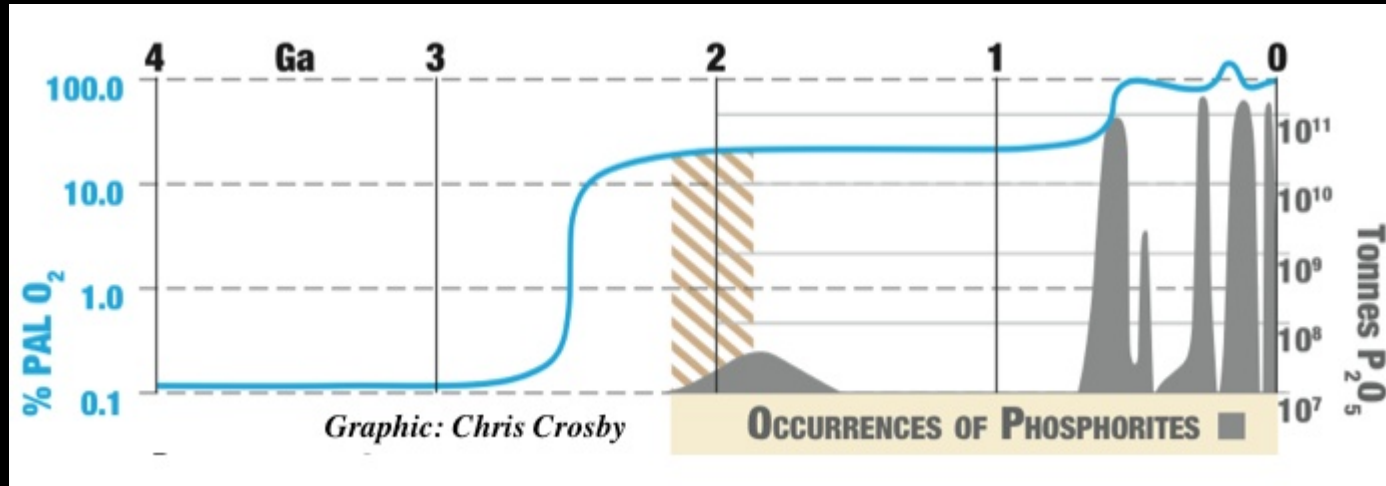
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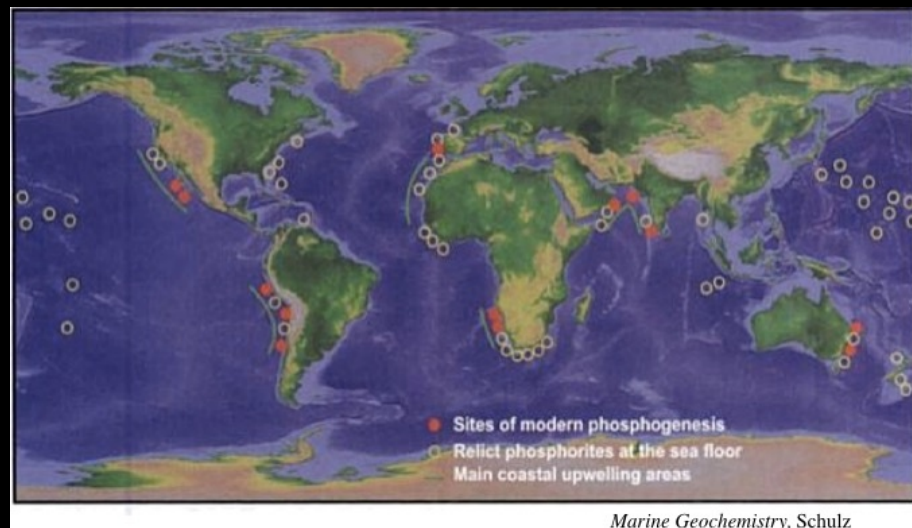
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Phosphogenesis

- Occurs as distinct episodes in geologic time.

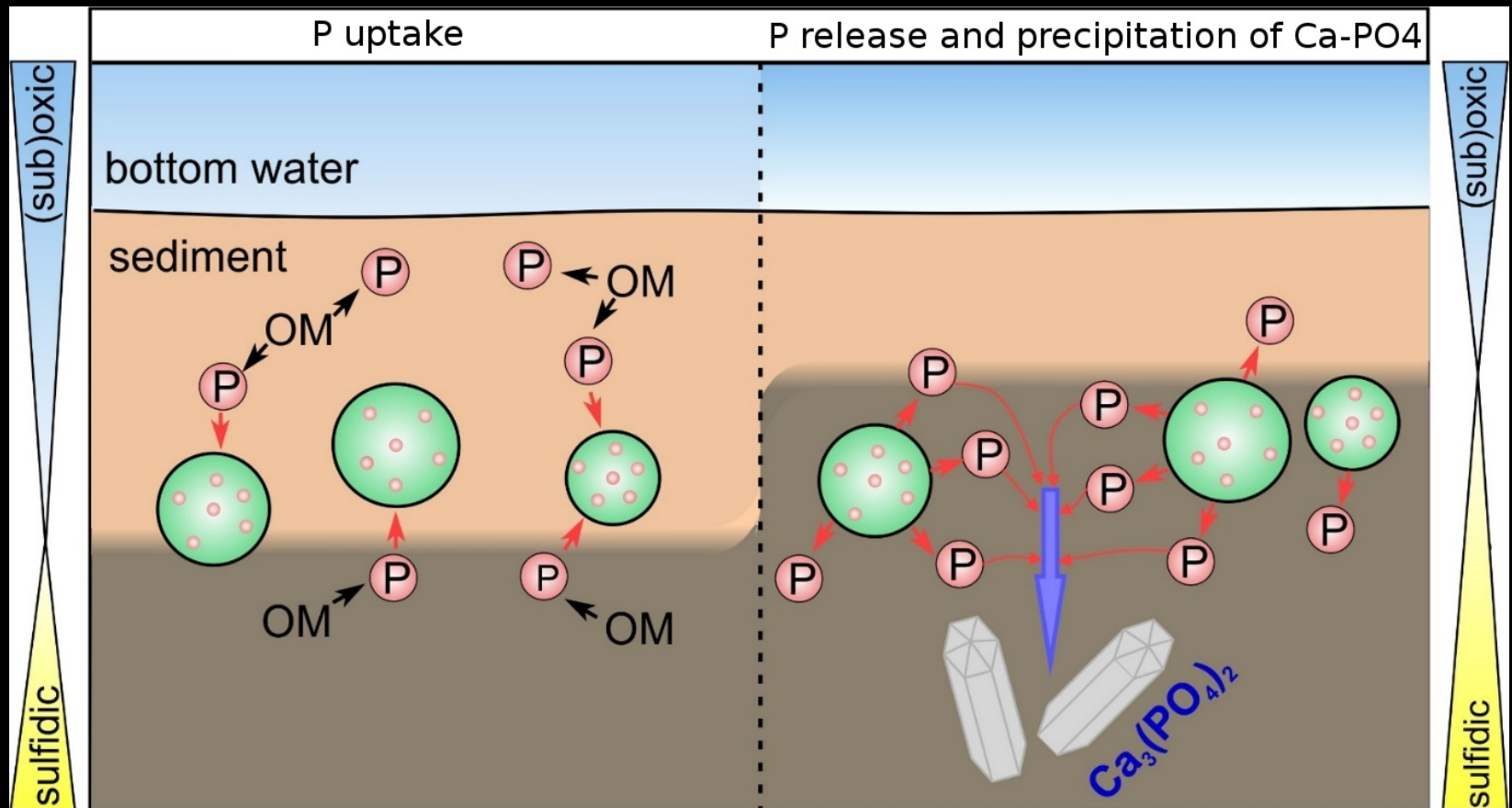


- Wide-spread in modern upwelling zones.



Phosphogenesis

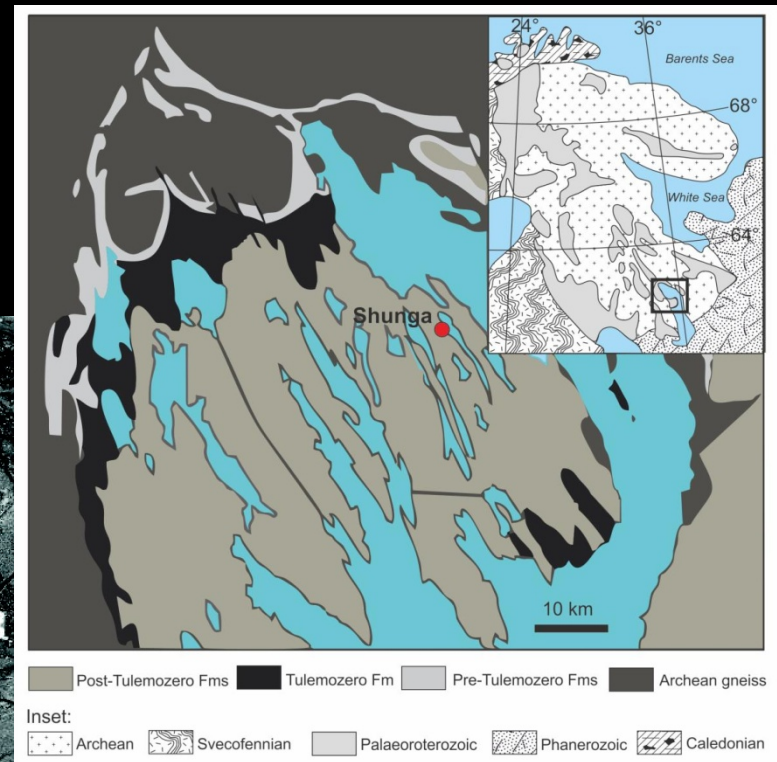
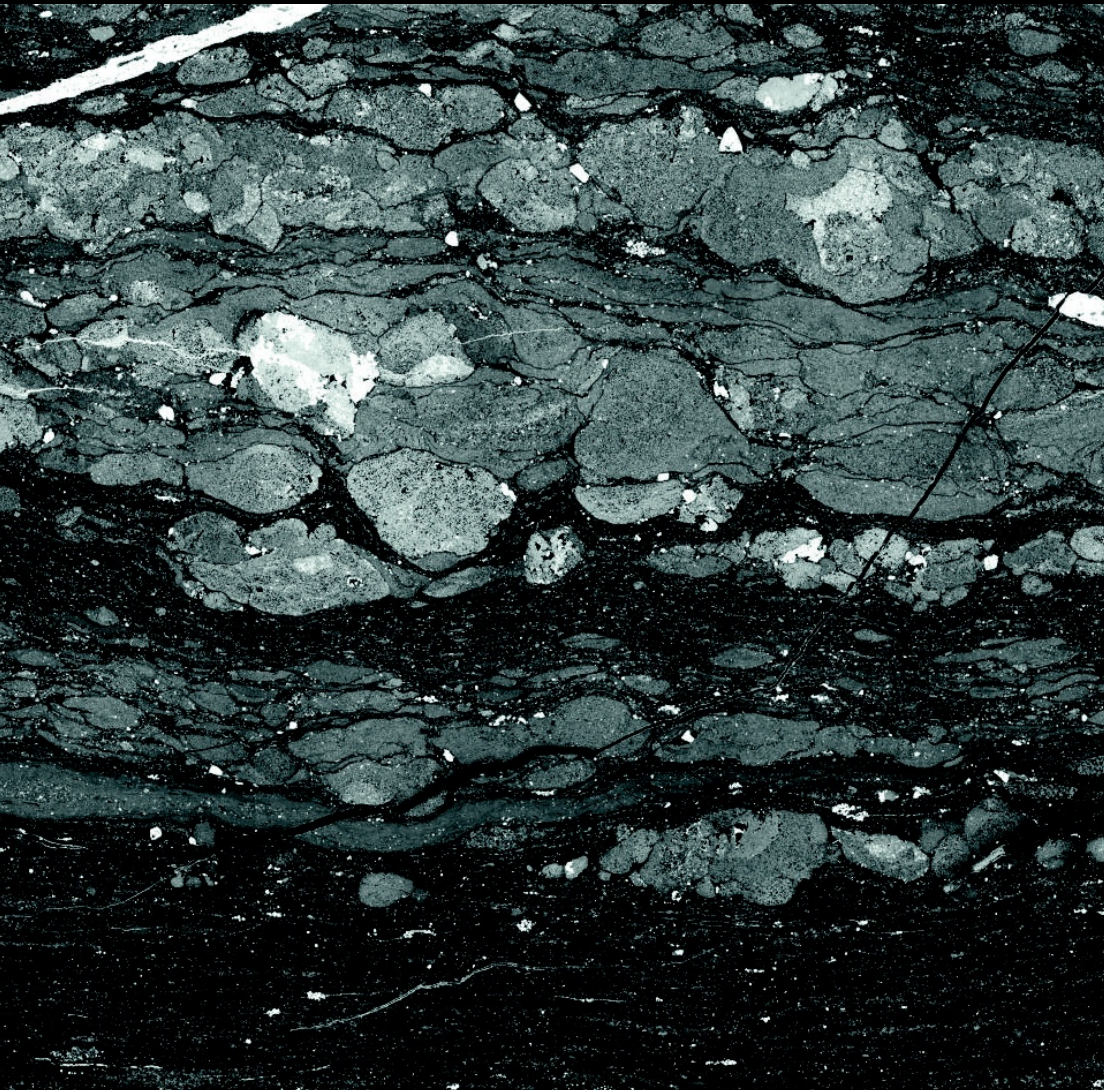
- The concentration mechanism is strongly microbially mediated (S-oxidising bacteria).



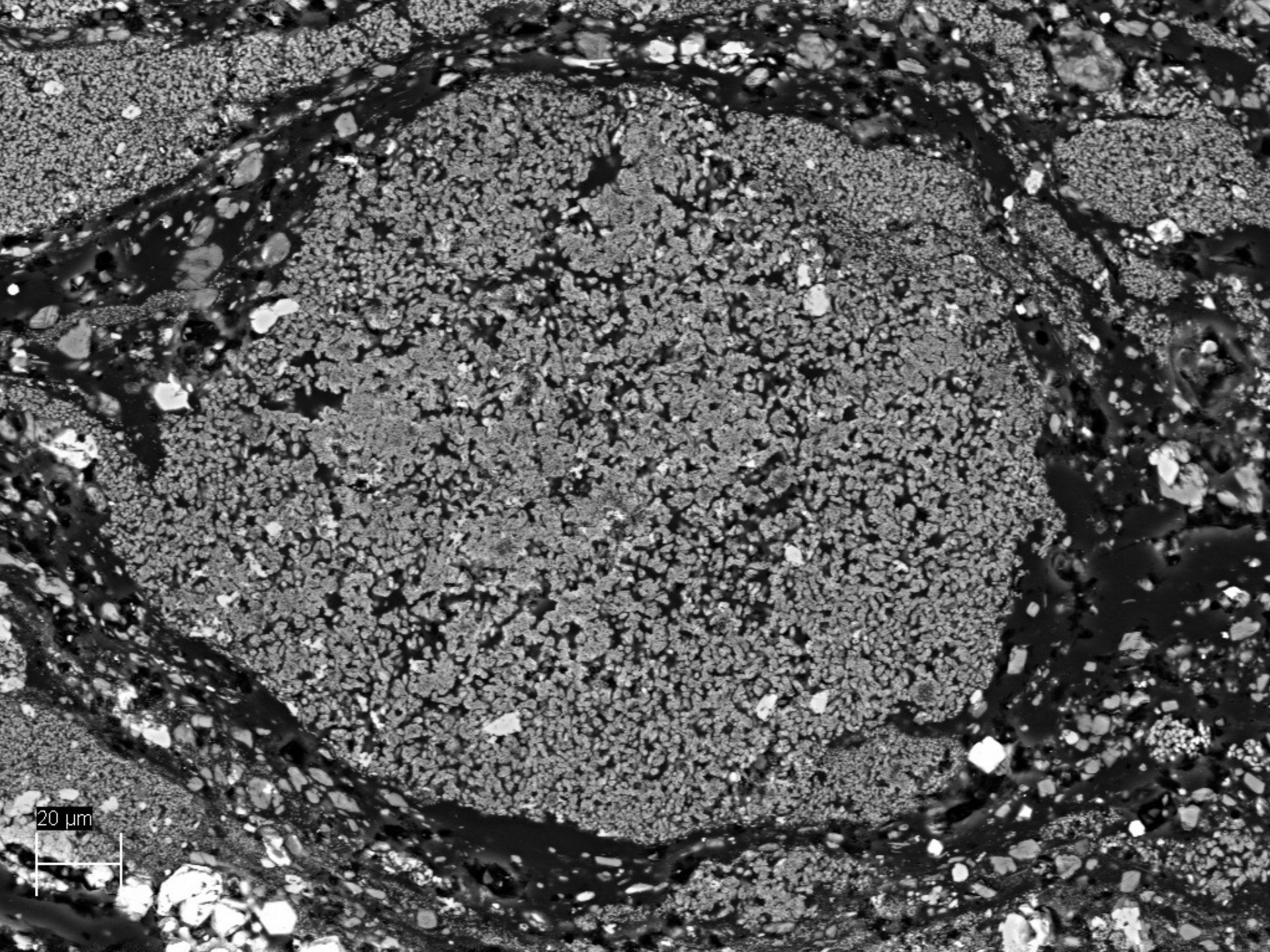
Goals

- Fine-grained comparison of ancient and modern phosphorites.
- Identify potential remains of microbial communities.
- Implications for the interpretation of other ancient phosphorites.

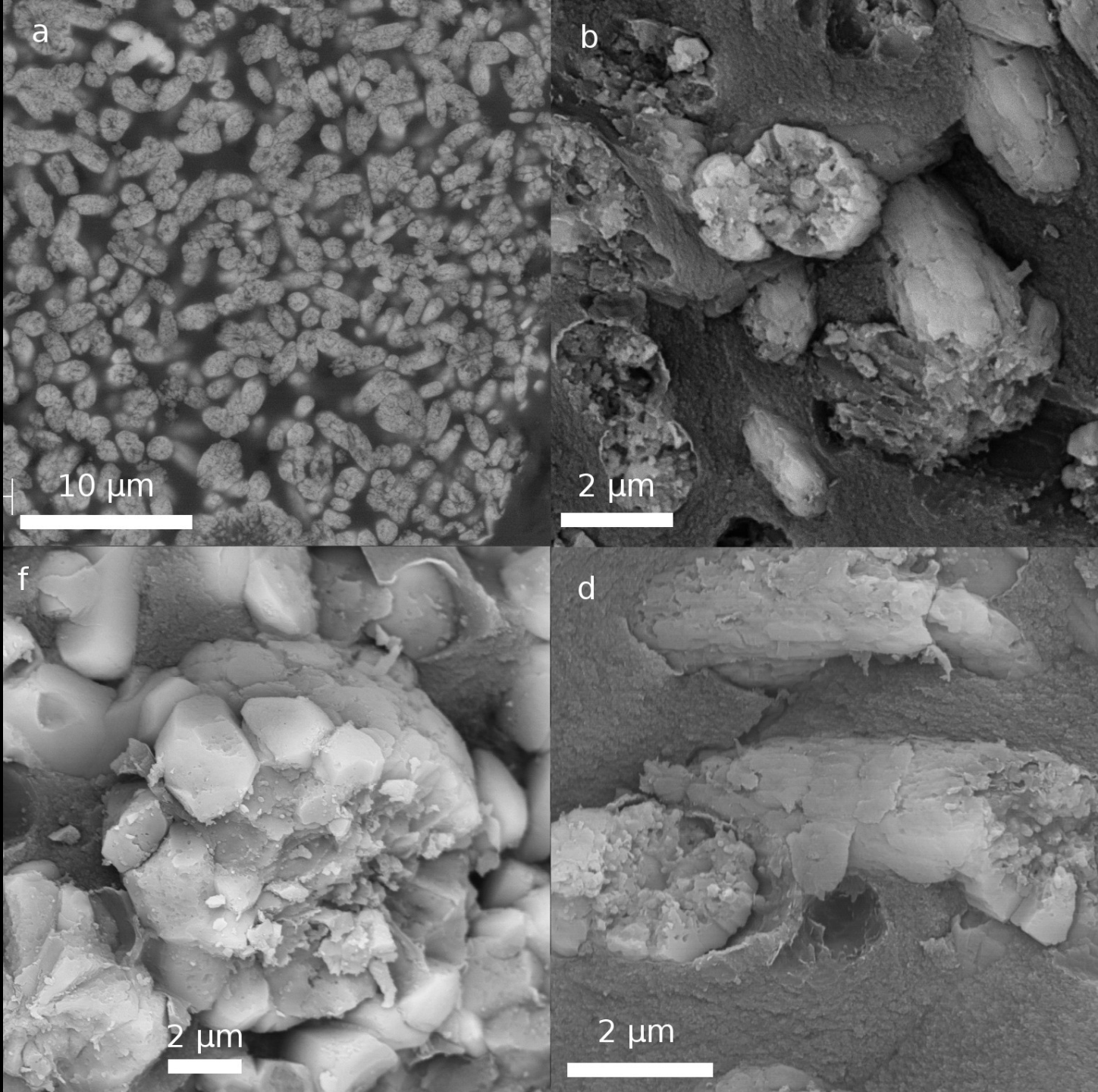
Russian Karelia, 2.0 billion yr ago...



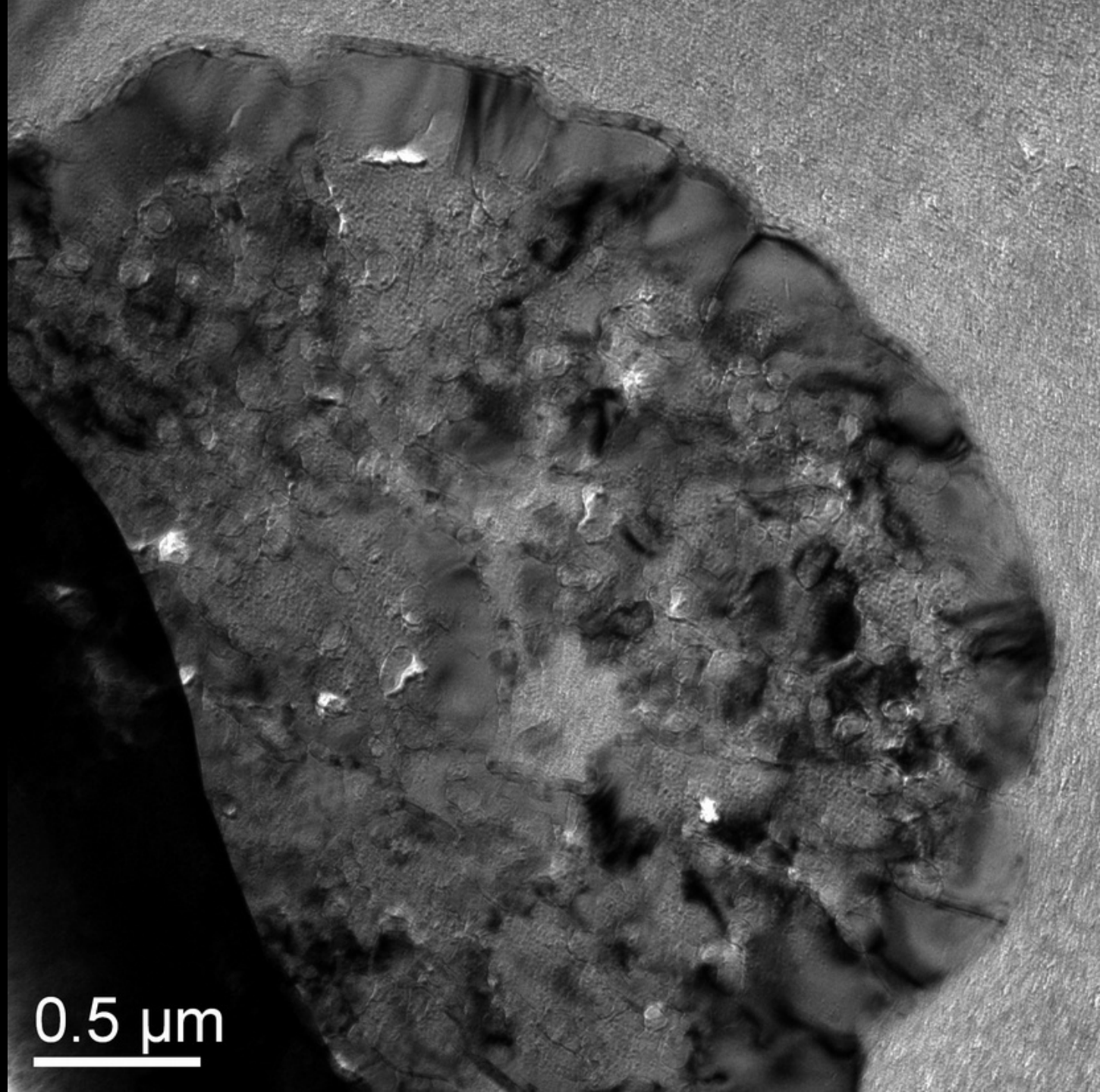
2 mm



Cylindrical microstructures

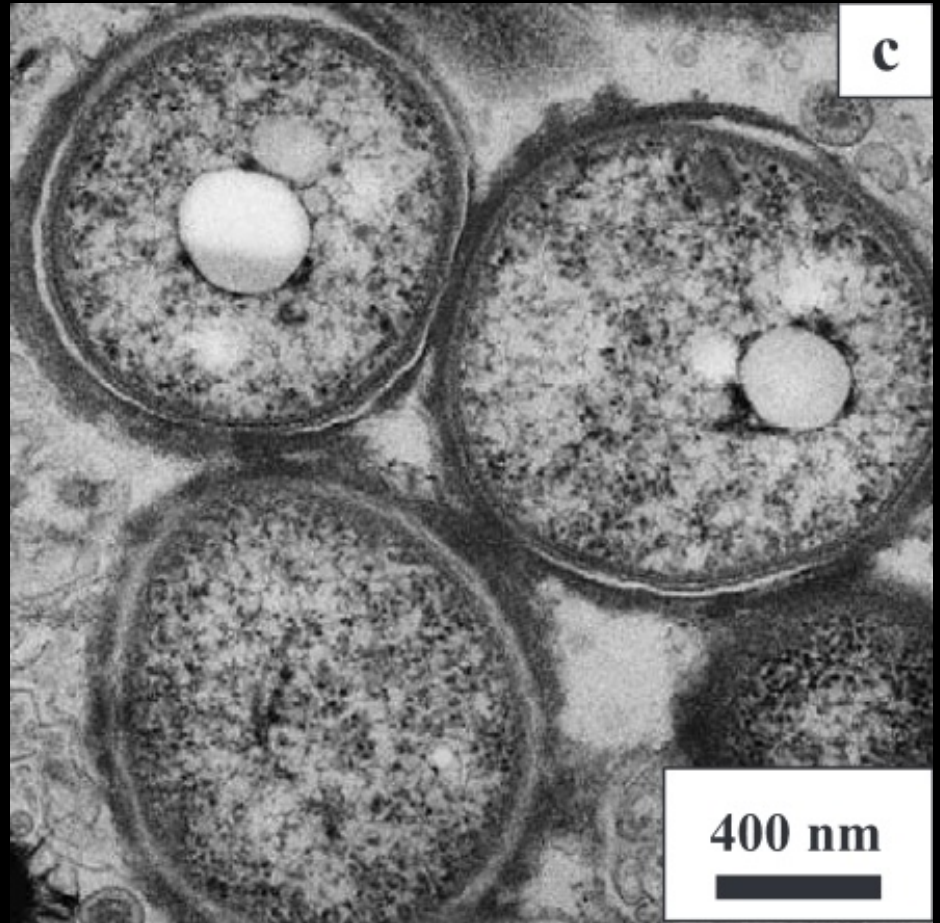


TEM - nanostructure



Fossils?

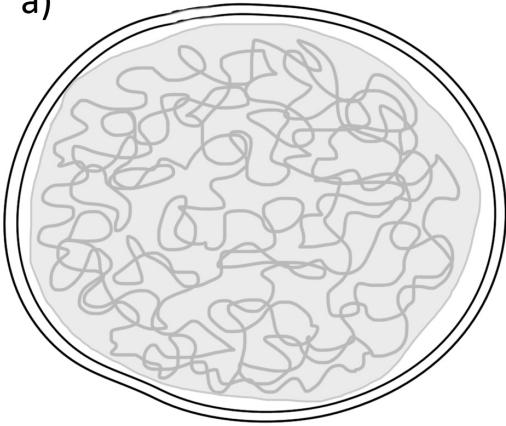
- Phosphate minerals like to precipitate on nucleation templates.
- Cell membranes may act as such.



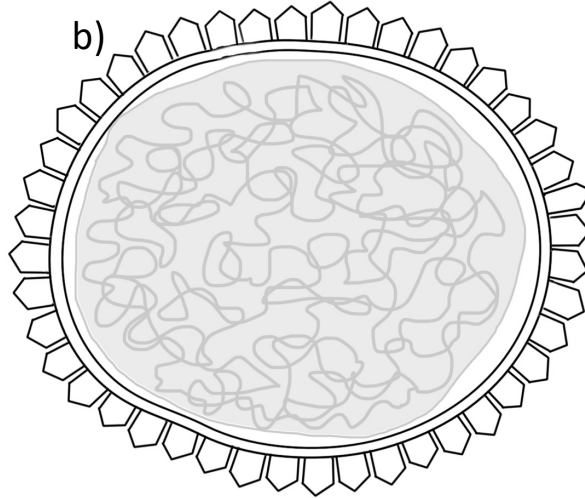
Benzerara (2004)

Fossilisation and recrystallisation

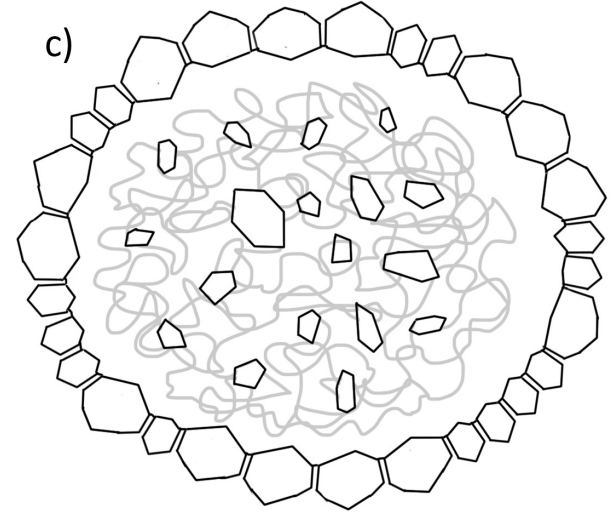
a)



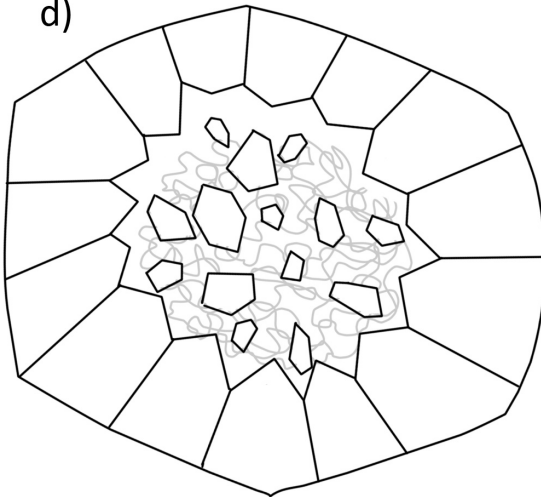
b)



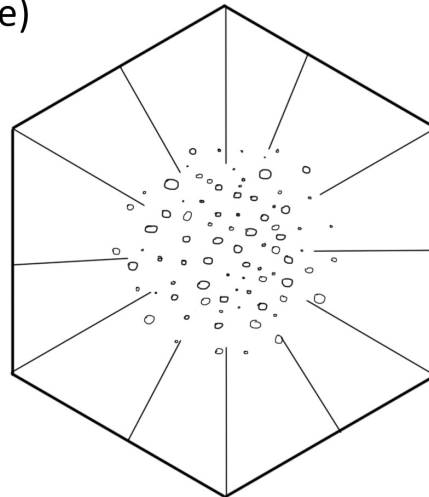
c)



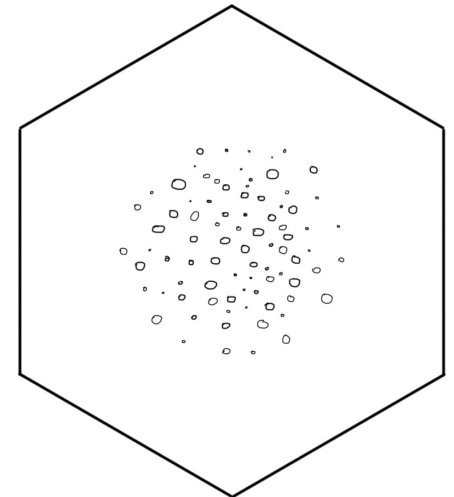
d)



e)

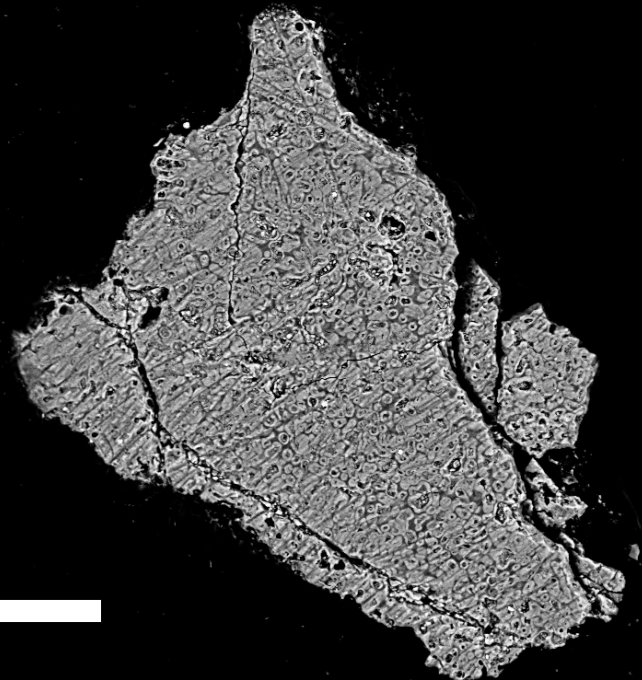
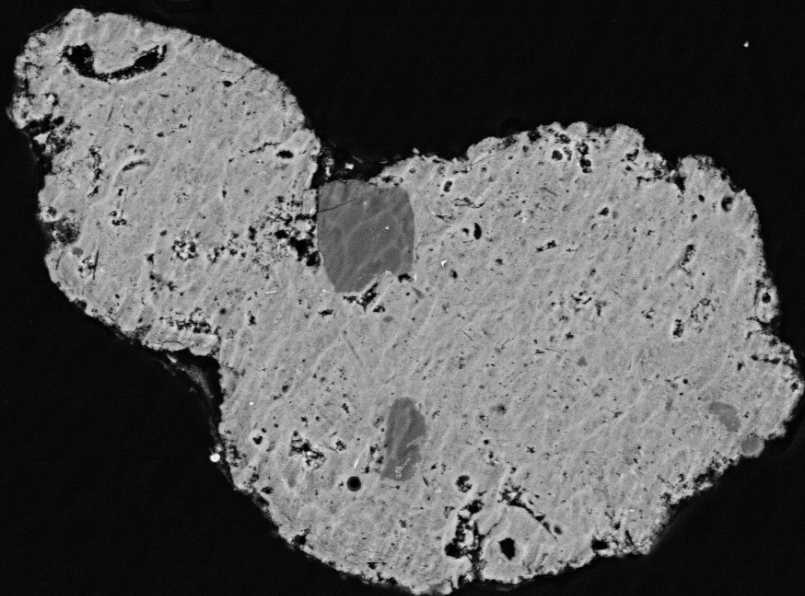
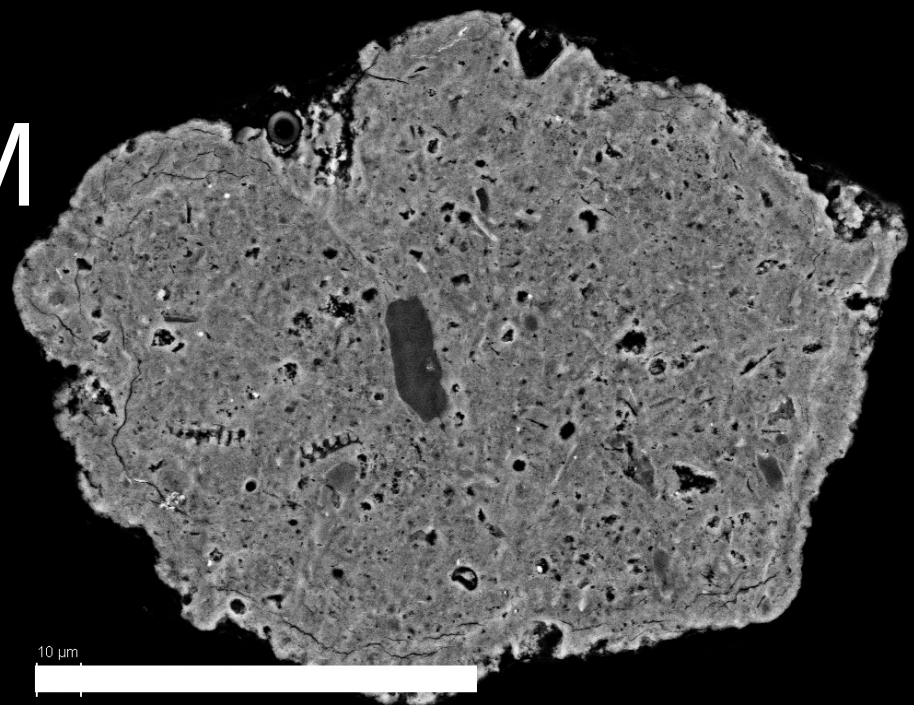
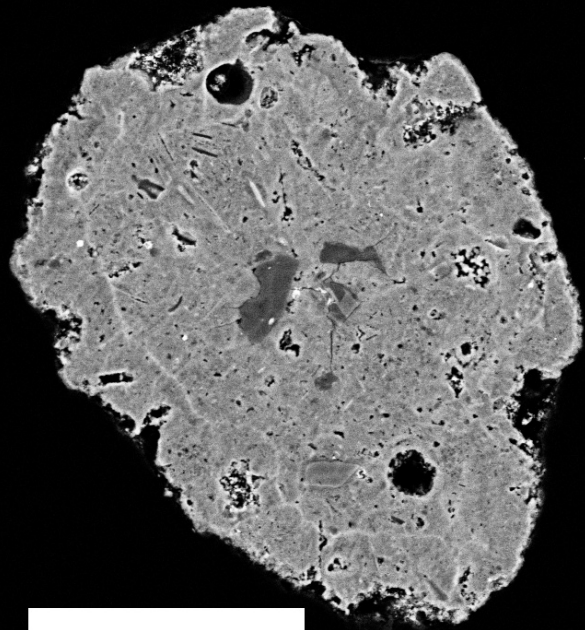


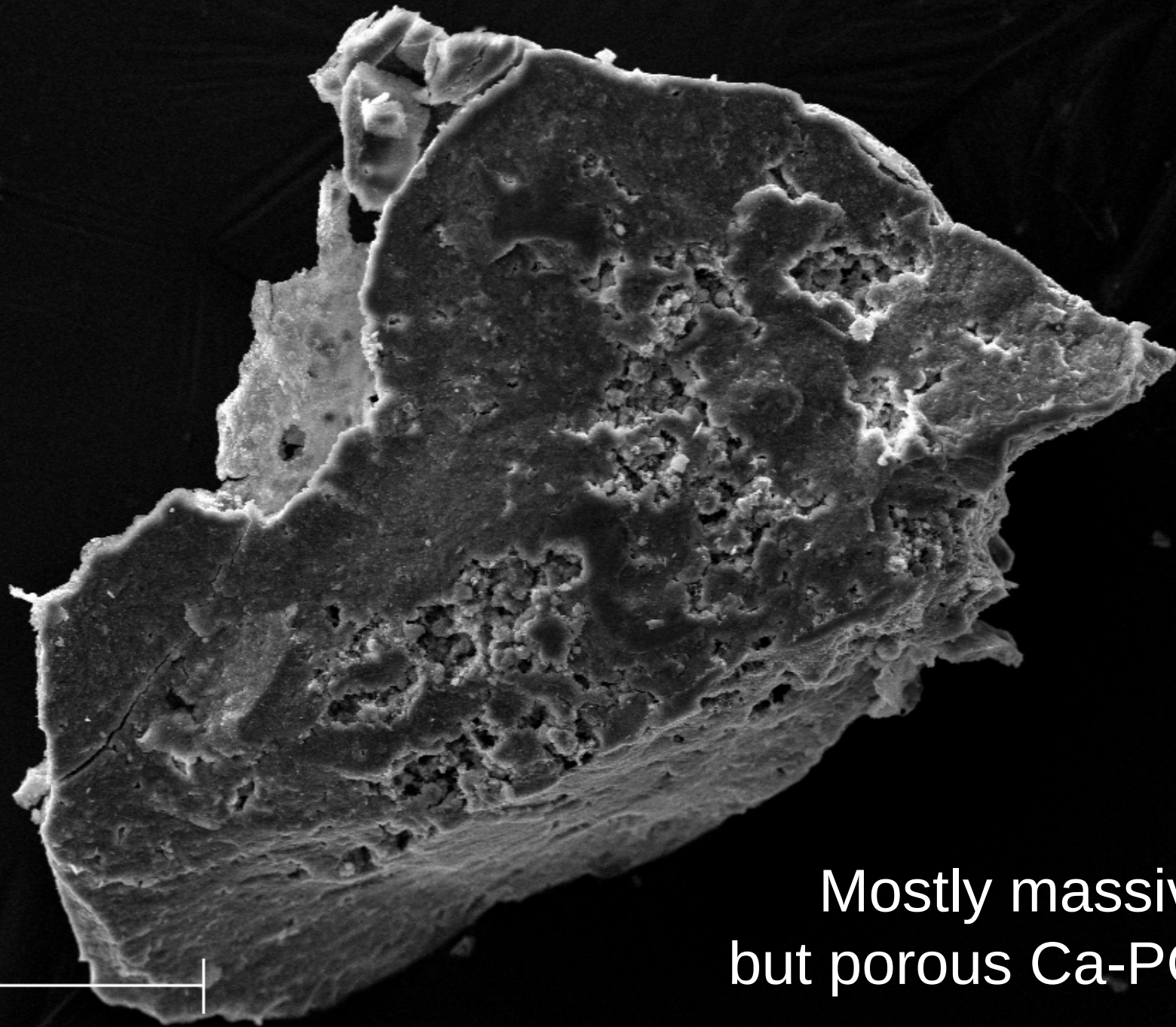
f)



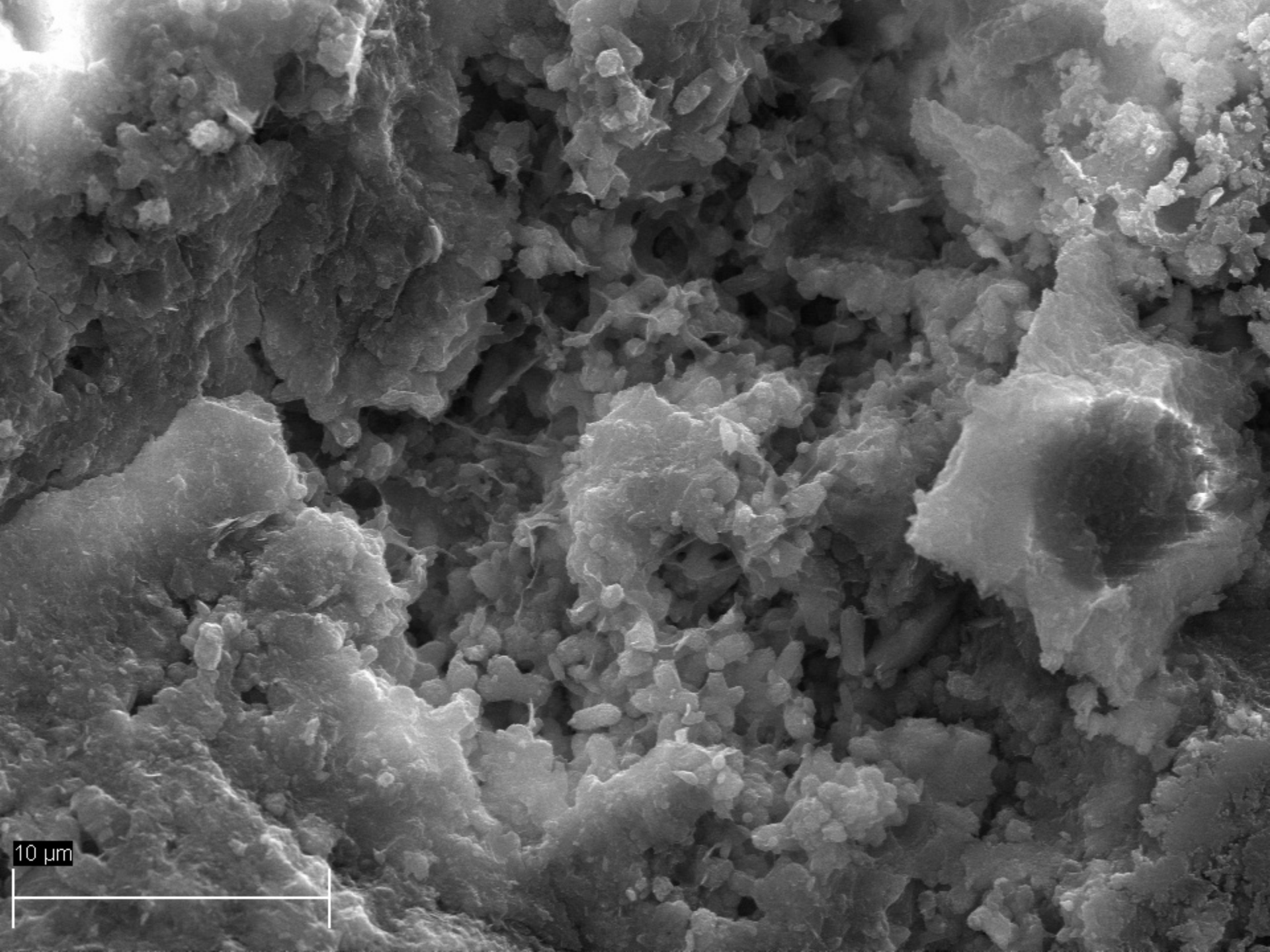


SEM





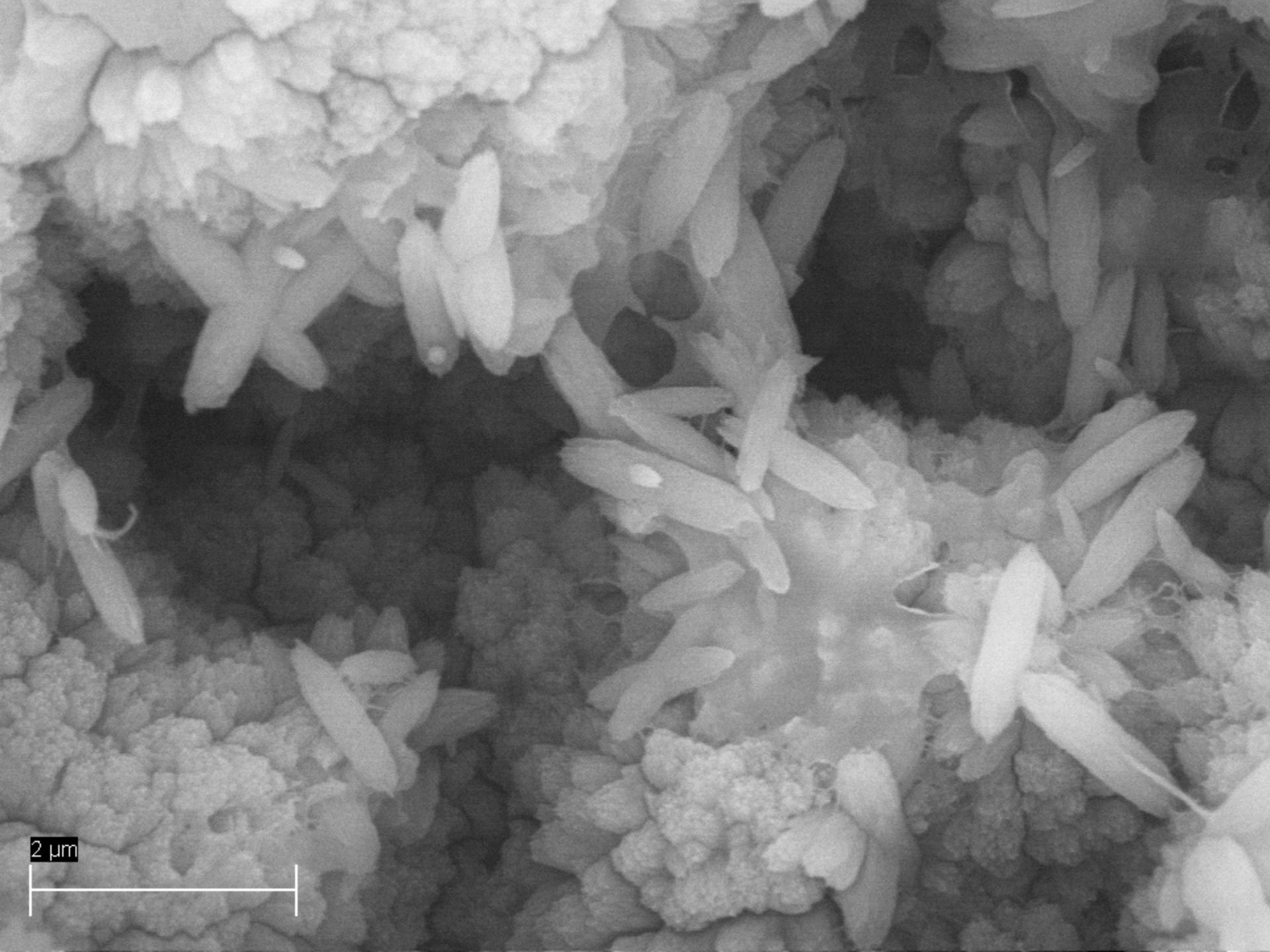
Mostly massive,
but porous Ca-PO₄



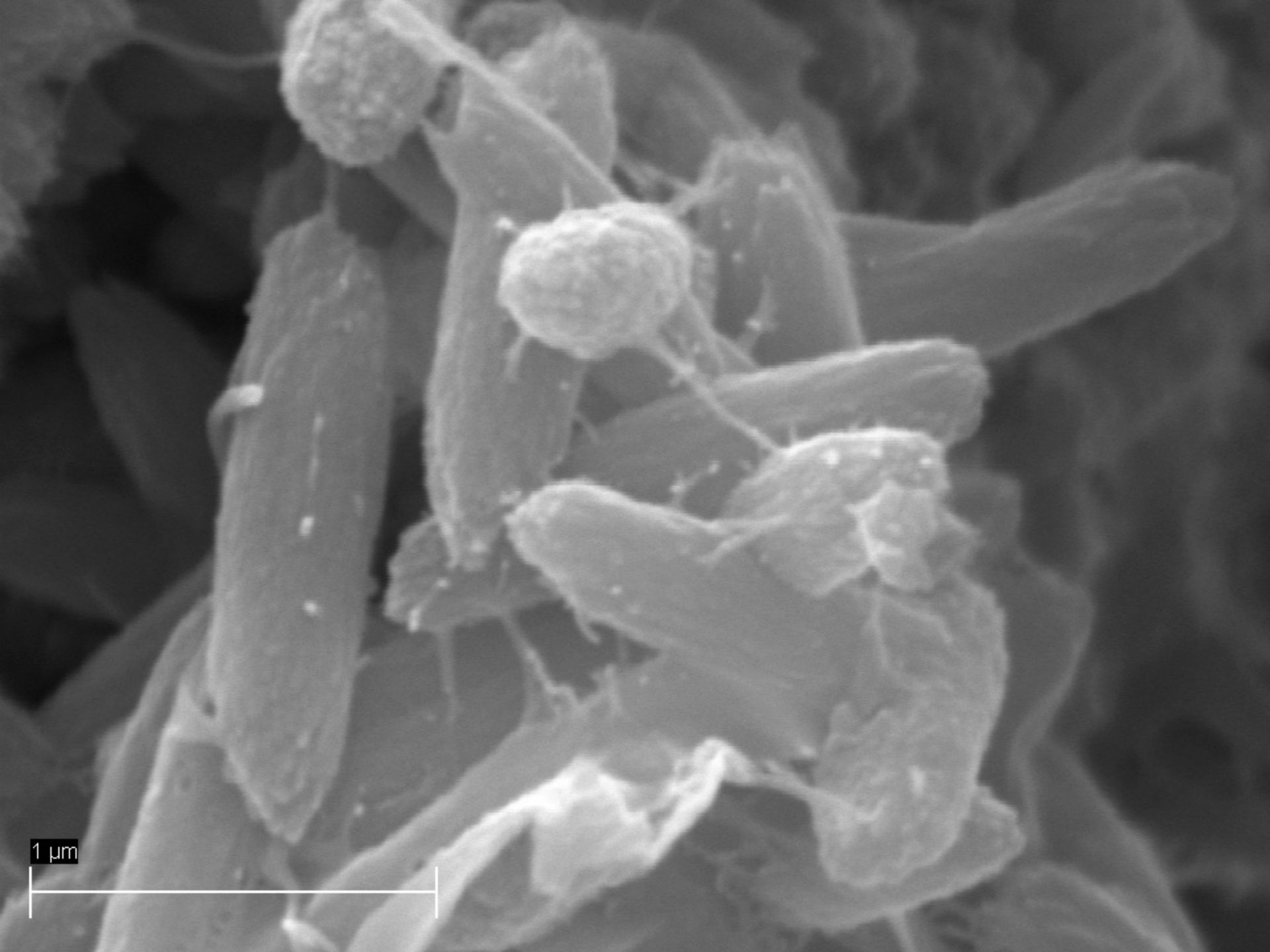
Ca-P
cylinders

2 μm

This scanning electron micrograph (SEM) shows a dense field of elongated, rod-like structures, identified as Ca-P cylinders. The cylinders vary in length and are often bundled together. The background is a rough, porous surface. A scale bar in the bottom left corner indicates a length of 2 micrometers.

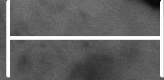


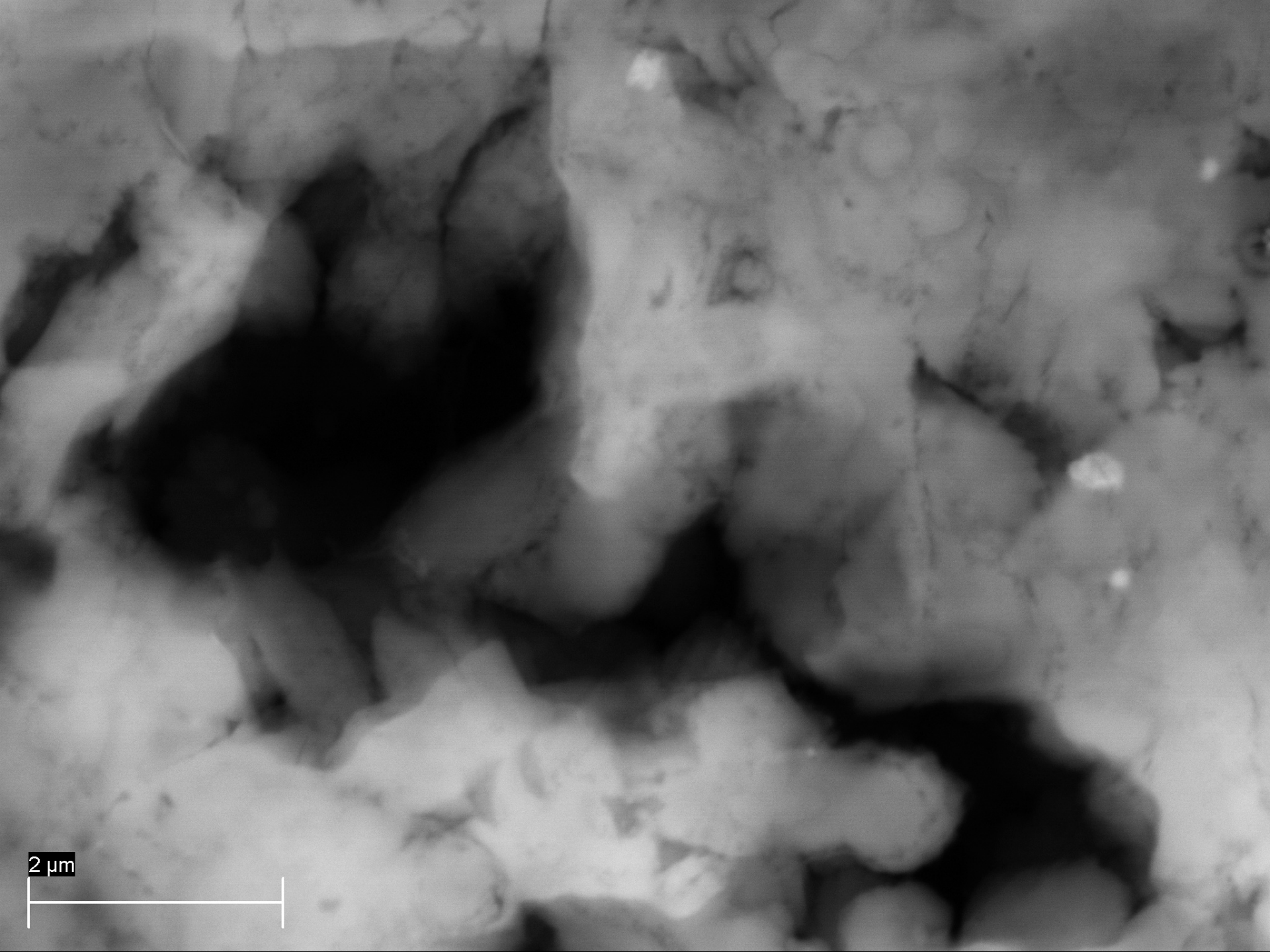
2 μm



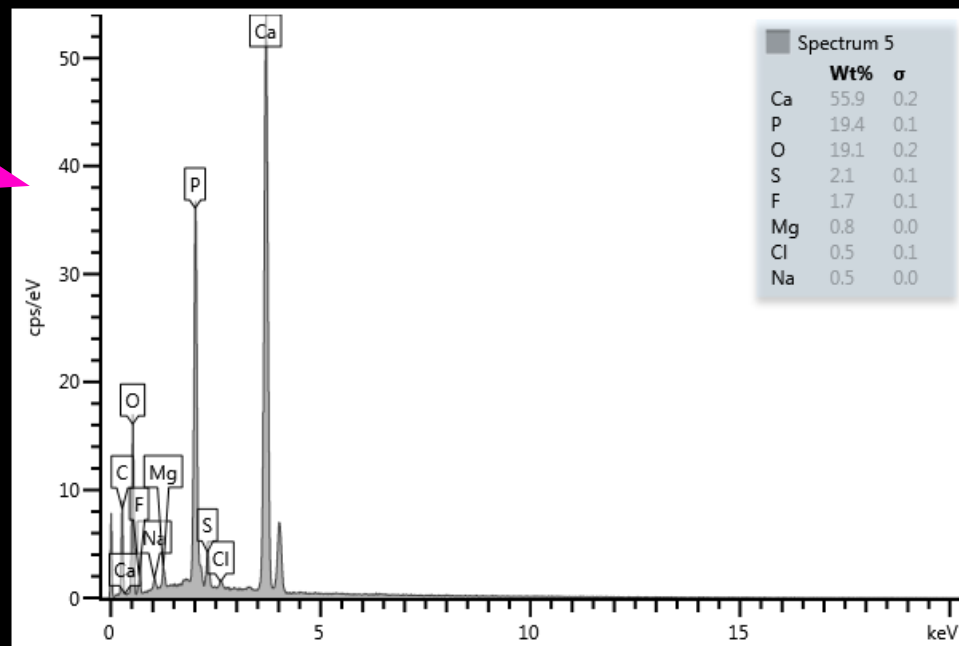
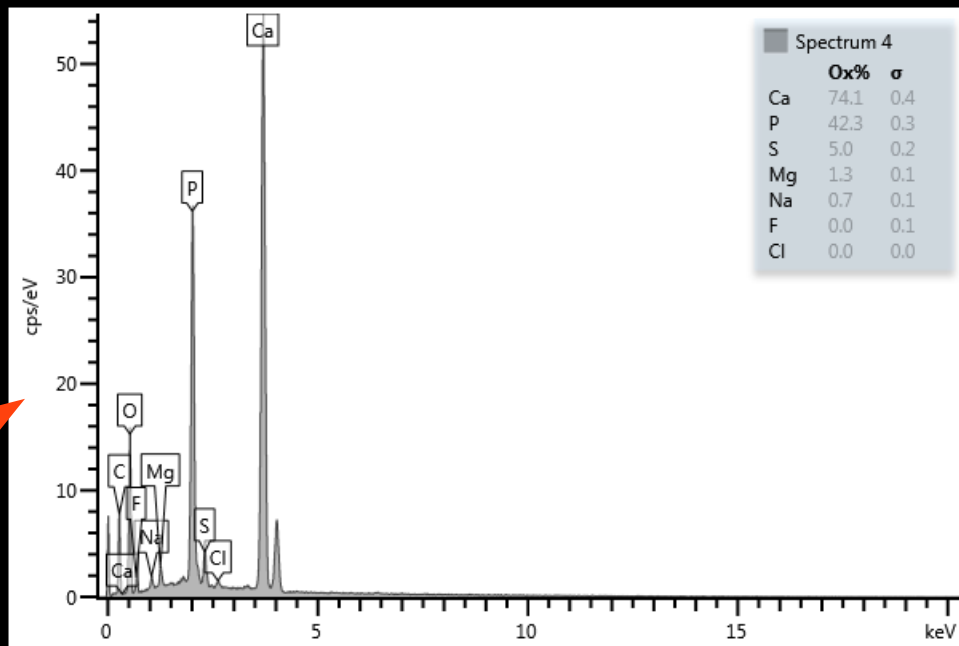
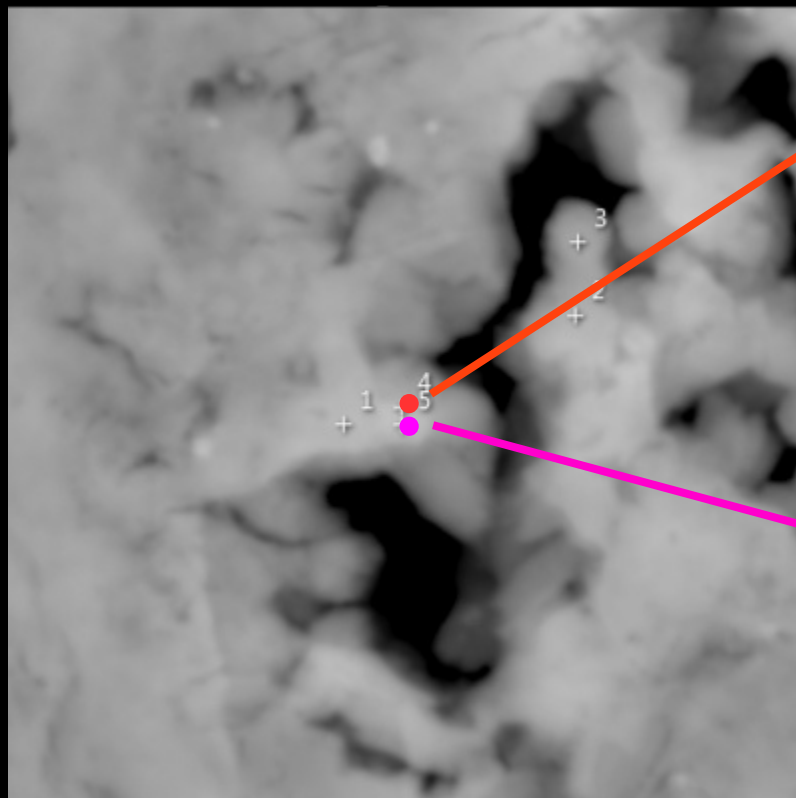
Cross-section

2 μm

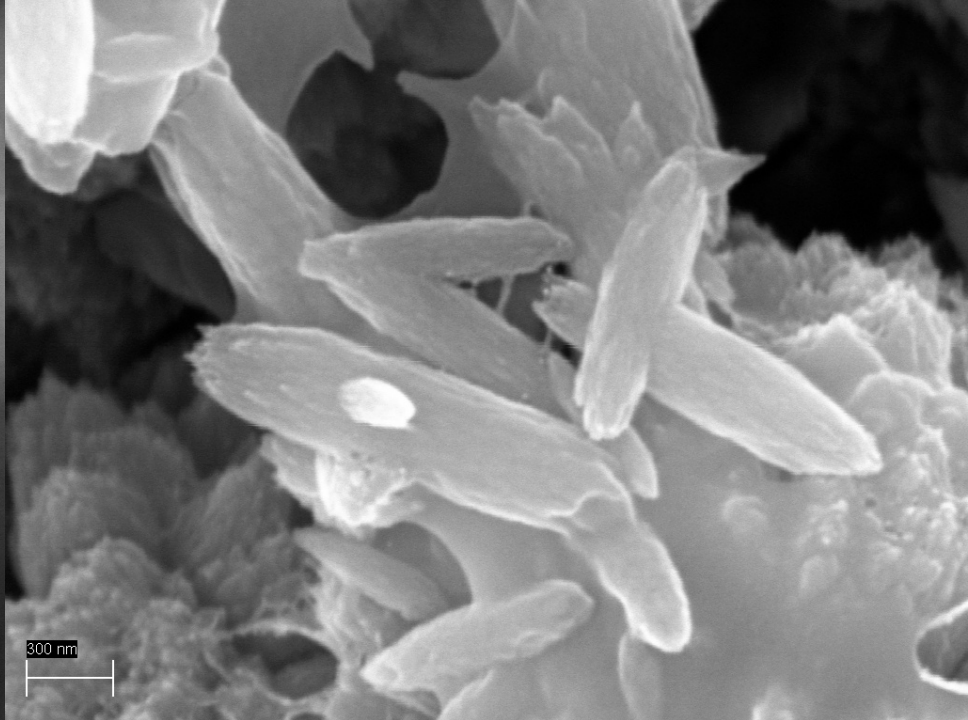
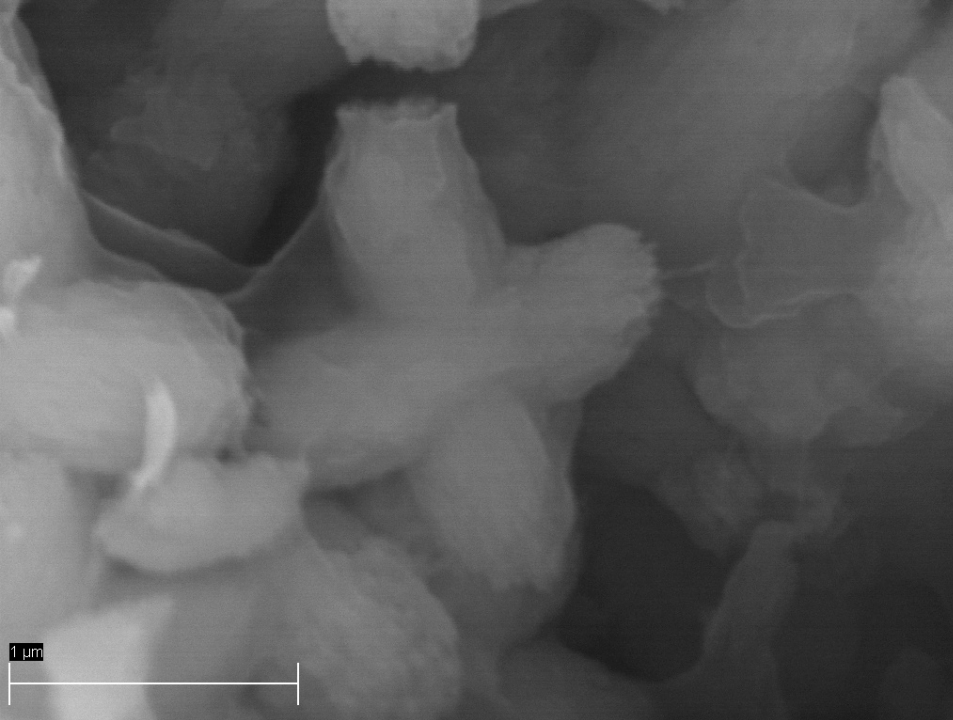
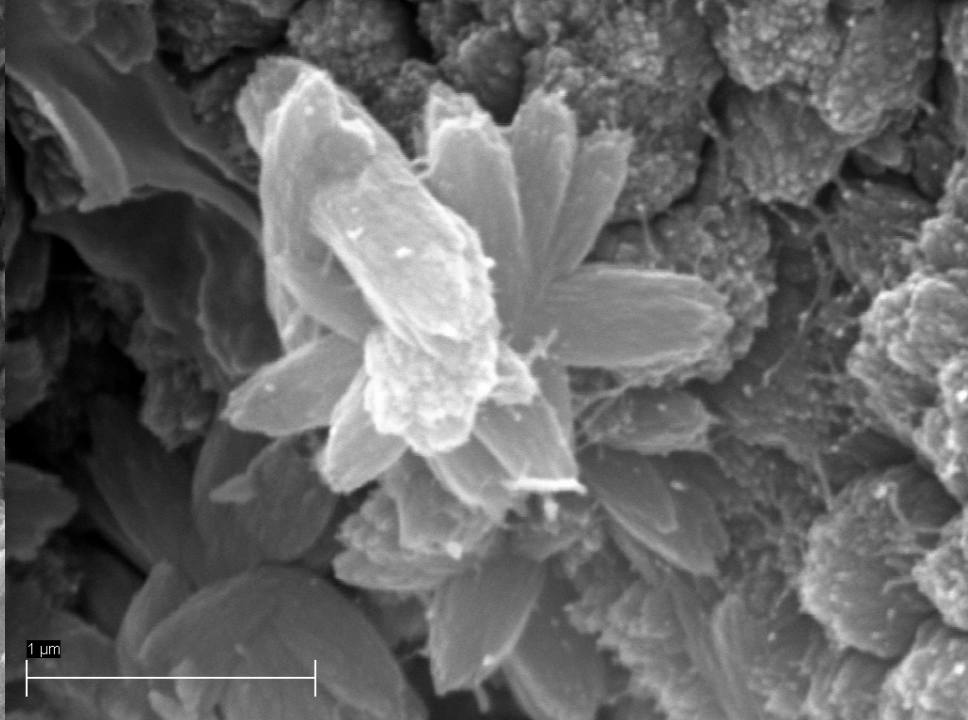
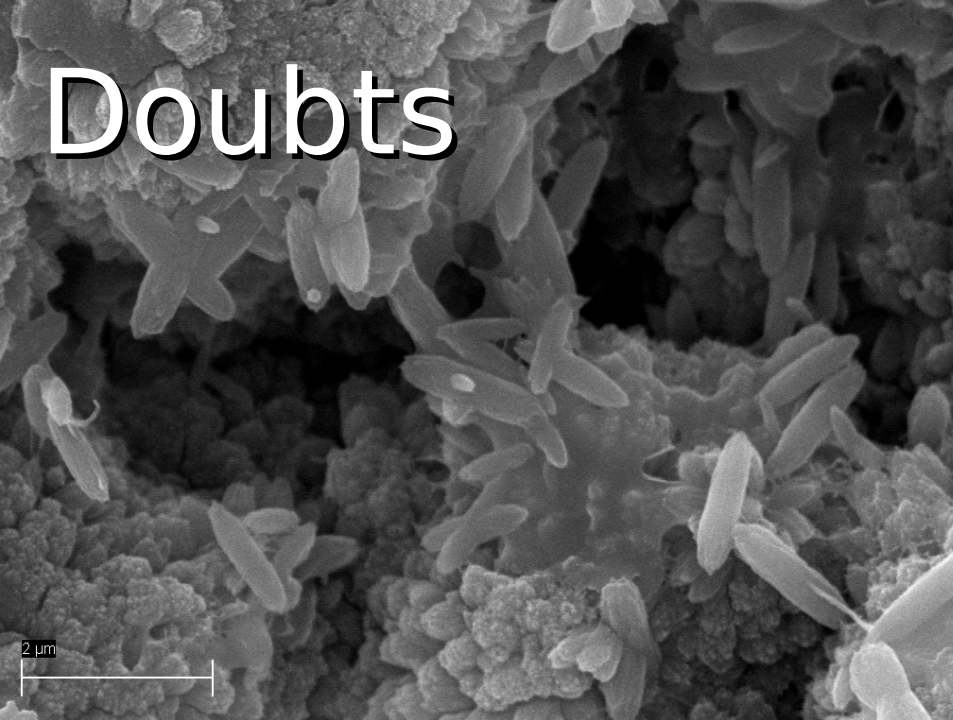




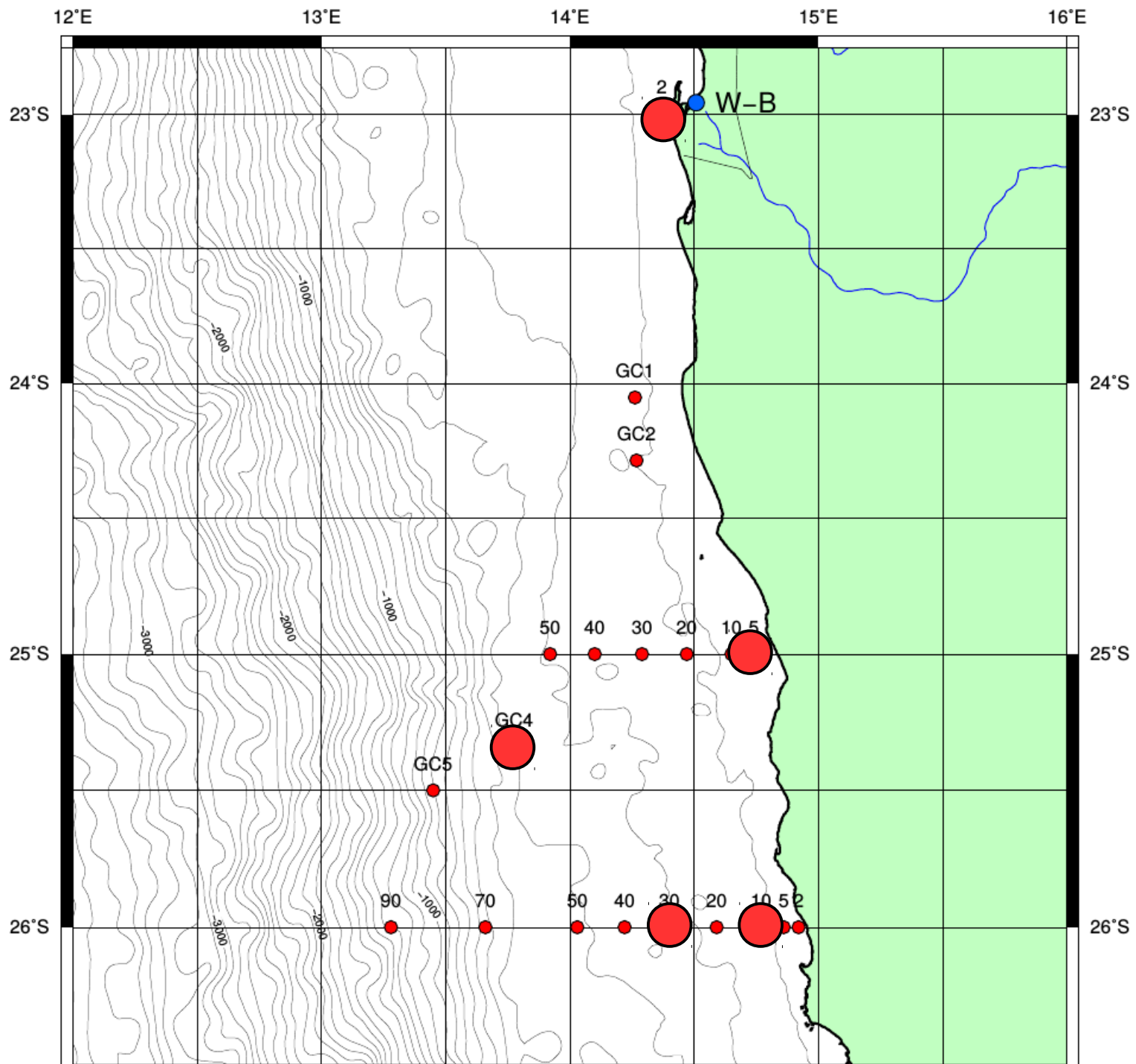
EDX



Doubts



Sampling



Sampling

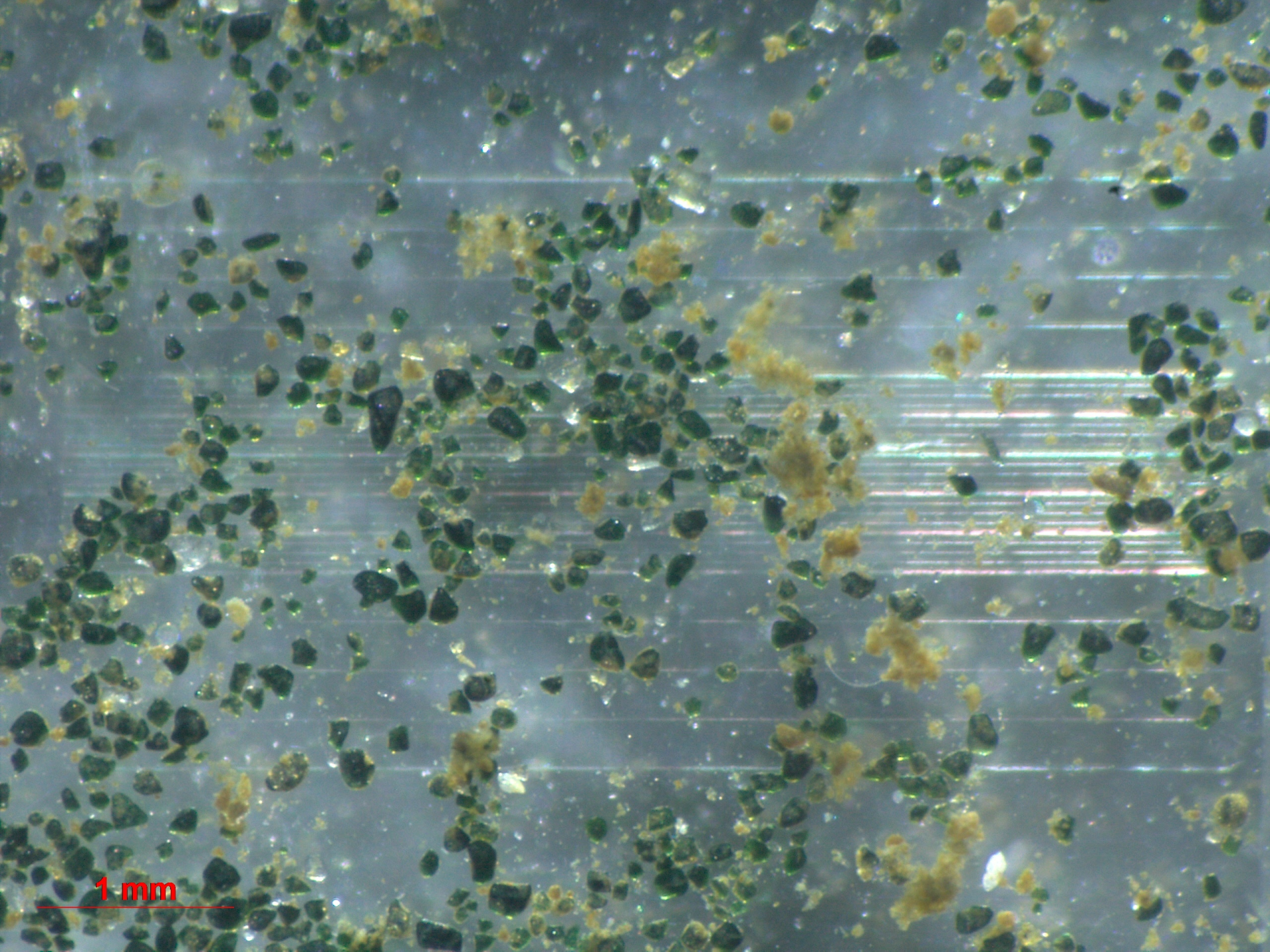
- „Diatomaceous ooze” at 23S (40 m)
- Mudbelt at 25S (47 m)
- Deeper shelf at 25.34S (301 m)
- Central shelf at 26S (198 m)
- Central shelf at 26S (116 m)



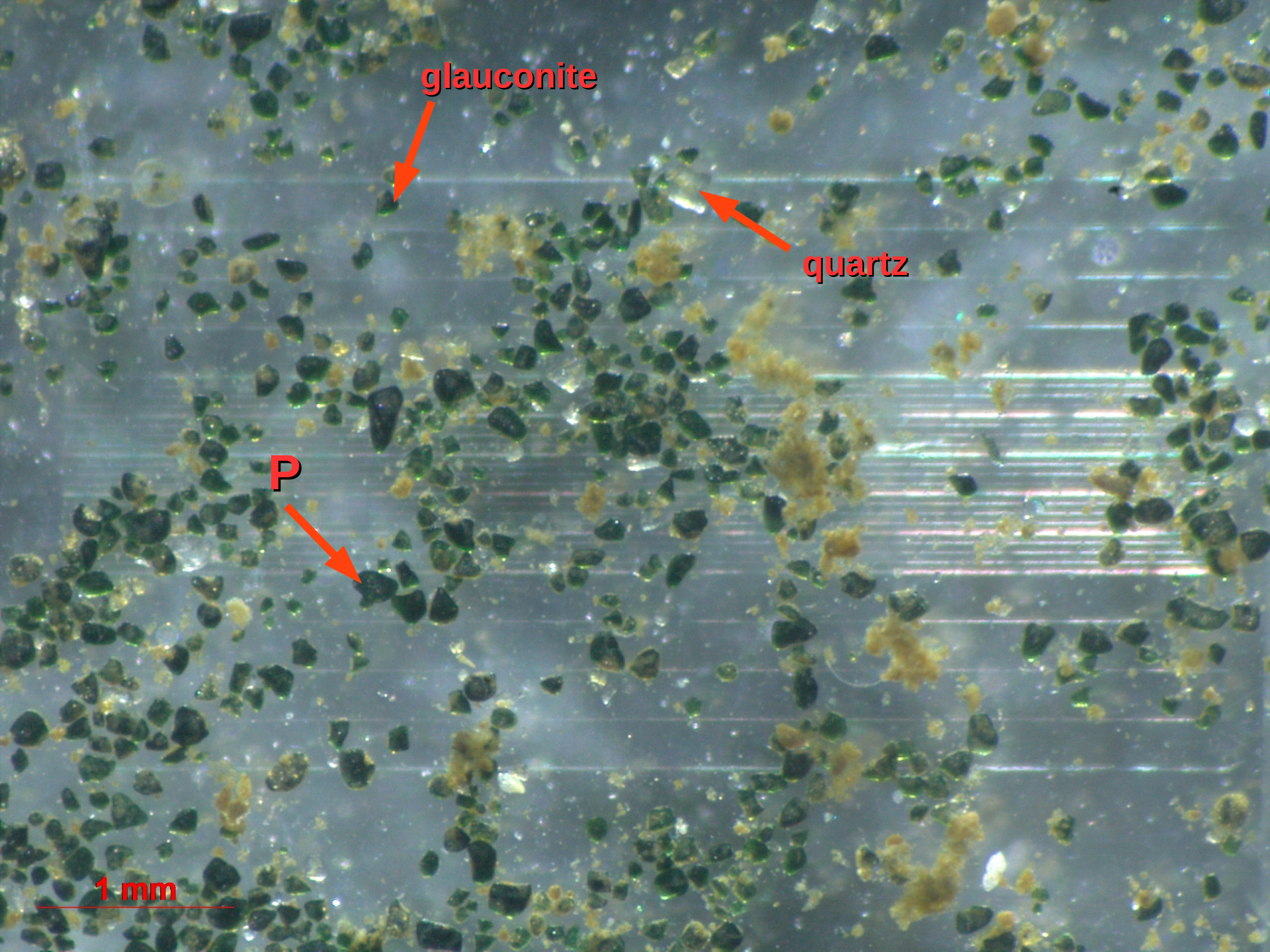
Sampling

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- Mudbelt at 25S (47 m)
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- **Central shelf at 26S (198 m)**
- Central shelf at 26S (116 m)





1 mm



glauconite

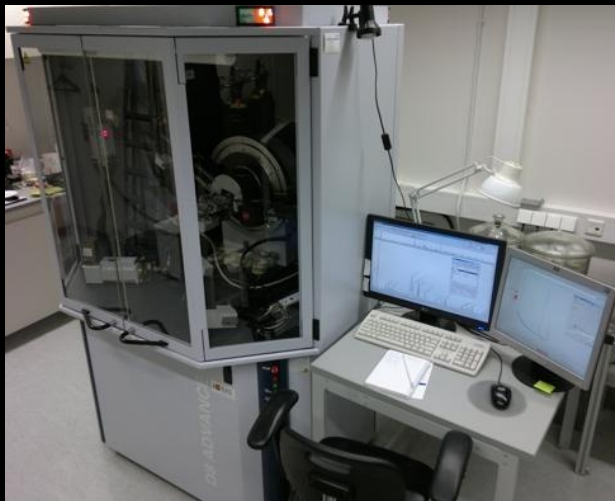
quartz

P

1 mm

Method

- Microstructure: SEM-EDX and FIB-TEM
- Geochemistry: XRD and LA-ICP-MS



Data

- High-resolution mineralogical and geochemical profiles.
- Porewater geochemistry and P speciation (Jake Bailey).

Data

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- Porewater geochemistry and P speciation (Jake Bailey).
- **Detailed micro- and nanostructure.**
- Authigenic phosphate?

Outlook

- Detailed comparison with ancient phosphorites.

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If not, what then?

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- Transformation of microstructures towards depth.

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- **Implications for the interpretation of other ancient phosphorites.**

Acknowledgements:



- NatMIRC
- RV Mirabilis crew
- UNAM Sam Nujoma Campus
- RGNO instructors and organisers

