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FLNP

Structural studies of Greek alabaster vases: data from X-ray tomography and diffraction, Raman spectroscopy

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Collaboration

> **12** partner organizations

> **25** articles in journals

> **50** conferences

- The work was carried out in collaboration with the Institute of Archeology of the Russian Academy of Sciences
- Russian Science Foundation grant No. 23-18-00196 "Comprehensive studies of the new urban necropolis of the archaic and classical time Volna 1 on the territory of the Asian Bosporus."

Excavations

- **Volna-1** is an urban soil burial ground on the Taman Peninsula
- **4.5 km** northwest of the village of Volna, Temryuk district, Krasnodar region
- mid/second quarter of the **6th** century - beginning of the **3rd** century BC
- population: mostly **Greek**

Objects and objectives

ALABASTRONS

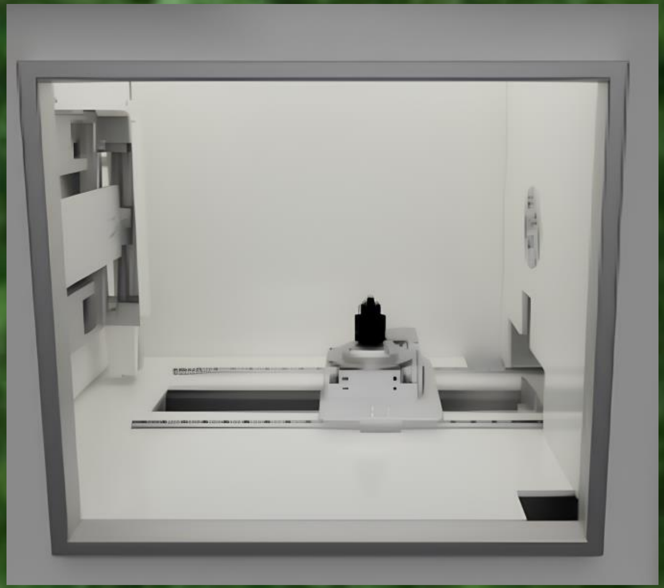
??? Alabastron (type) = Alabaster (material) ???

- Identification of Alabaster Vessel Material
- Analysis of the phase composition of alabastrons to identify possible mineral impurities
- Analysis of technological features identification of defects of the manufacture of vessels

Methods

X-Ray tomography

- Tabletop microtomography system Prodis.Compact (Moscow, Russia)
- Pixel size 64 µm
- Geometric magnification 1,2x - 10x
- Sample dimensions up to 80x60x60 mm
- tomographic reconstruction of up to 7,200 projections



X-Ray diffraction

- Specialized diffractometer Xeuss 3.0 (Xenocs SAXS, France)
- X-ray source GeniX3D (Mo-Kα edge, λ = 0.71078 Å)
- Detector Eiger 2R 500K (Dectris).
- The detector location is 0.5 m from the sample.
- Analysis by the Rietveld method using the Fullprof software package.

Raman spectroscopy

- Confotec Duo Raman spectrometer
- (SOL instruments GmbH, Augsburg, Germany)
- excitation wavelength 633 nm emitted by a He–Ne laser
- grid 1800
- confocal hole 10 µm
- lens x20.

RESULTS

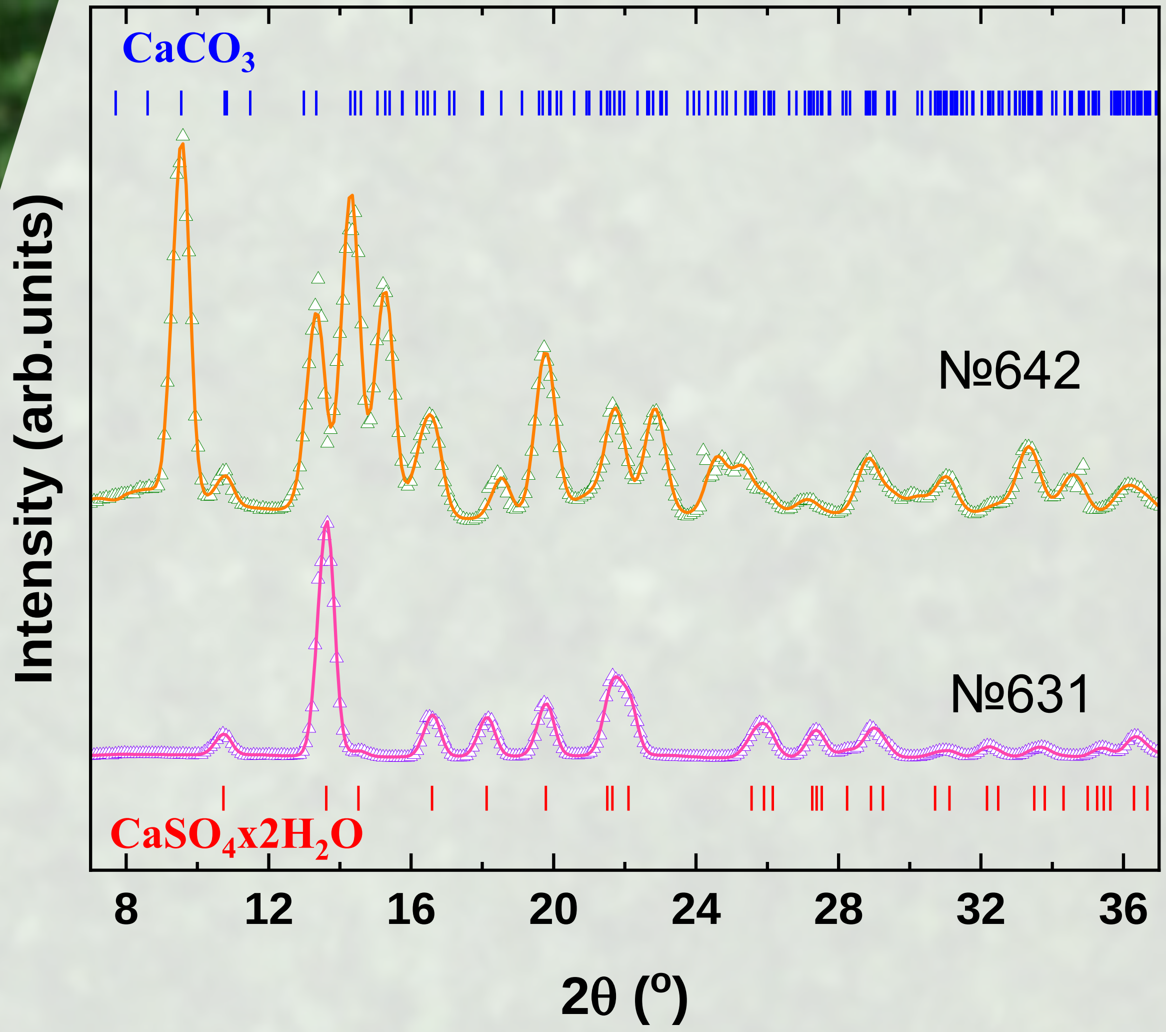
RESULTS: X-Ray diffraction

631
602

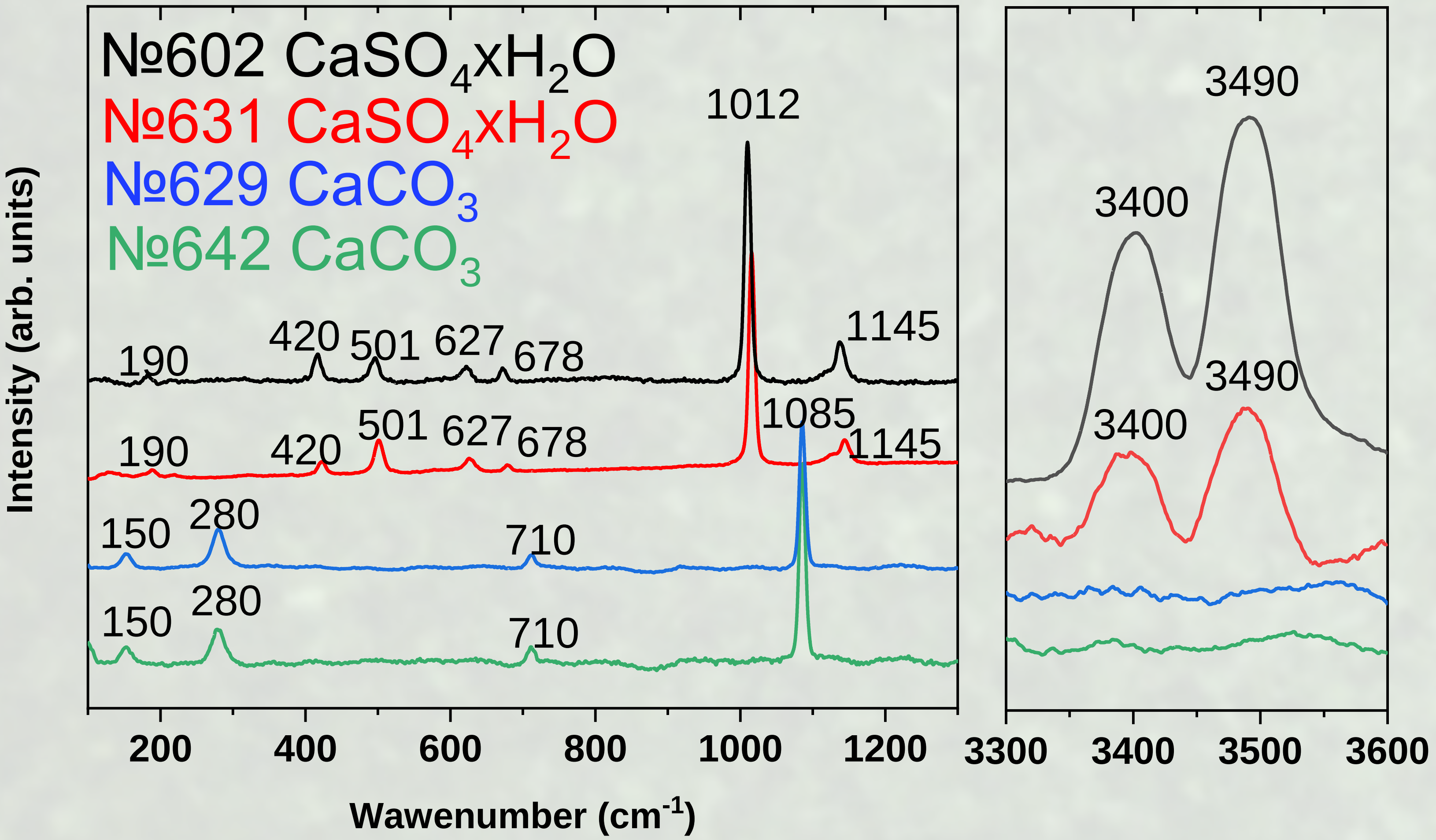
Gypsum phase $CaSO_4 \times 2H_2O$
Monoclinic model, I2/a space group
The unit cell parameters:
a= 5.7185(2) Å, b= 15.1968(3) Å,
c= 6.4753(9) Å, β=118.7(2)º
(close to the data for synthetic modern gypsum)

629
642

Calcite phase $CaCO_3$
Rhombohedral model, $R\bar{3}c$ space group
The unit cell parameters:
a=4.9390(3) Å, c=16.9716(2) Å



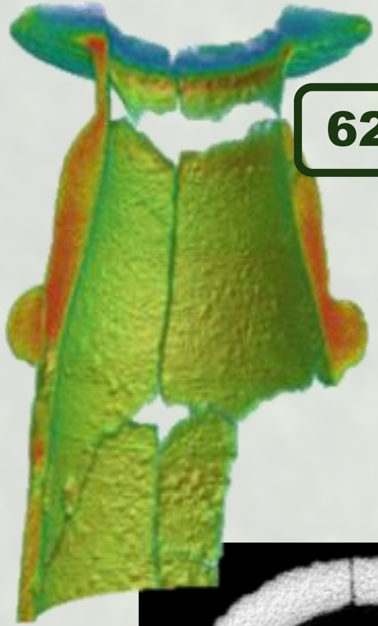
RESULTS: Raman spectroscopy

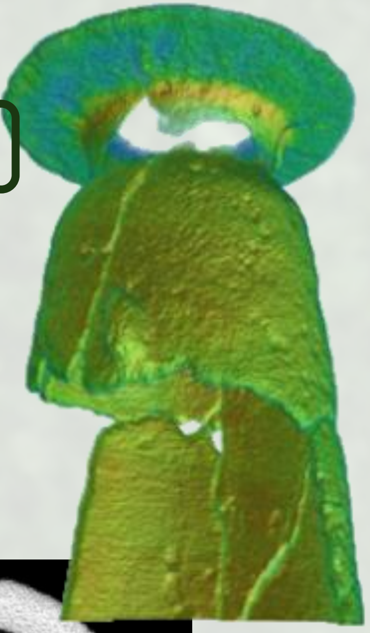


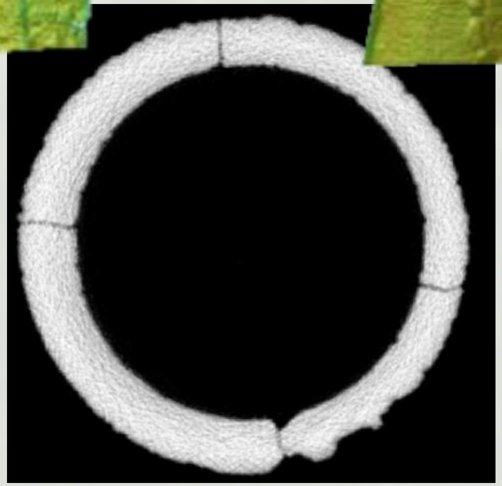
- (left) Raman spectra for the material of vases NN 602, 642, 629 and 631. The frequencies of characteristic peaks for the calcite and gypsum phases are indicated
- (right) Range of characteristic vibration frequencies of a water molecule for the studied vases NN 642, 629, 631 and 602

RESULTS: X-Ray tomography

629







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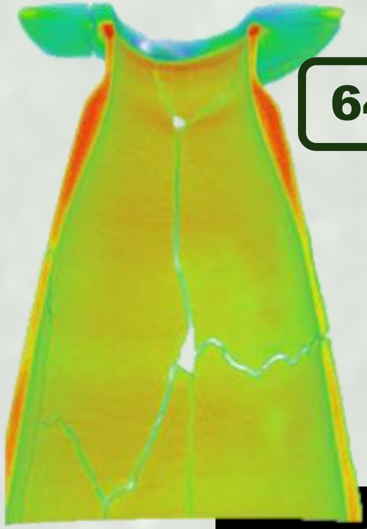
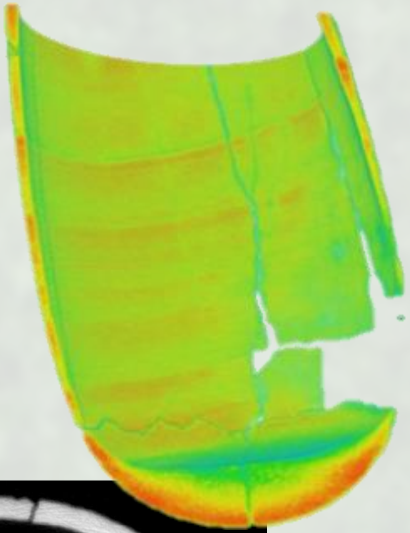
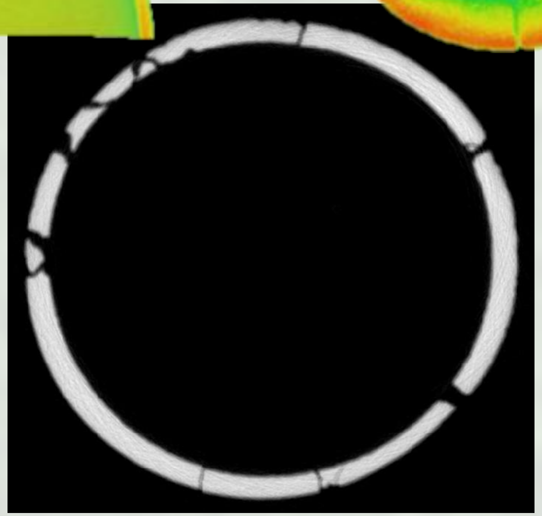
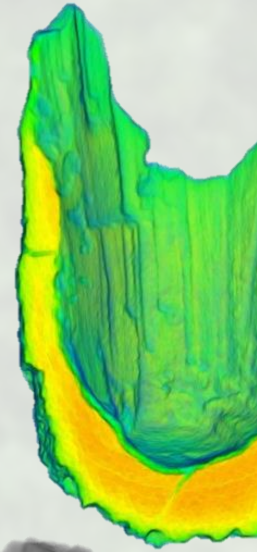
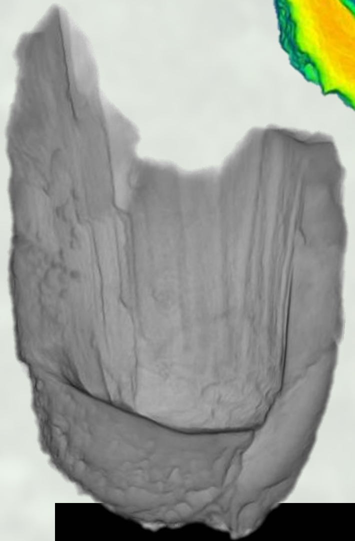


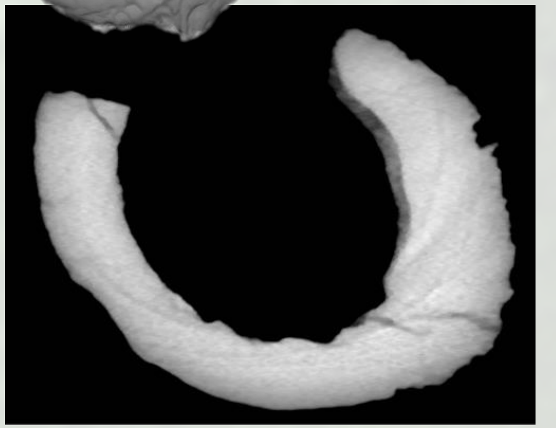




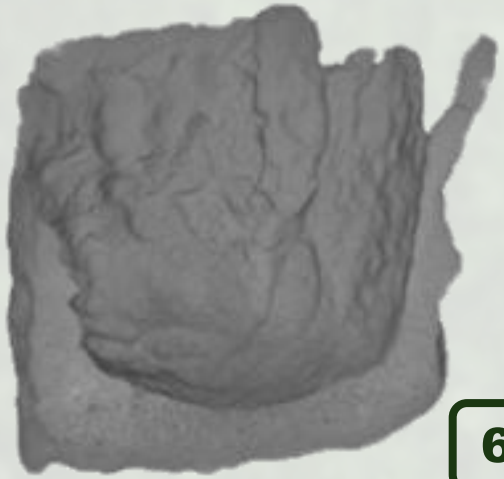
602

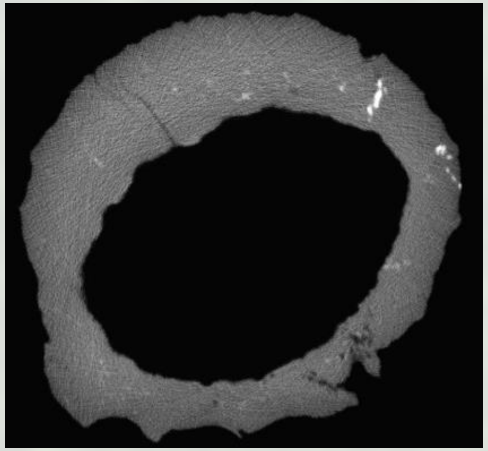




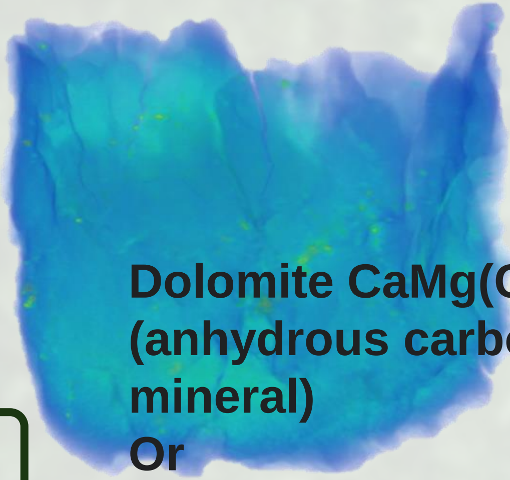


RESULTS: X-Ray tomography

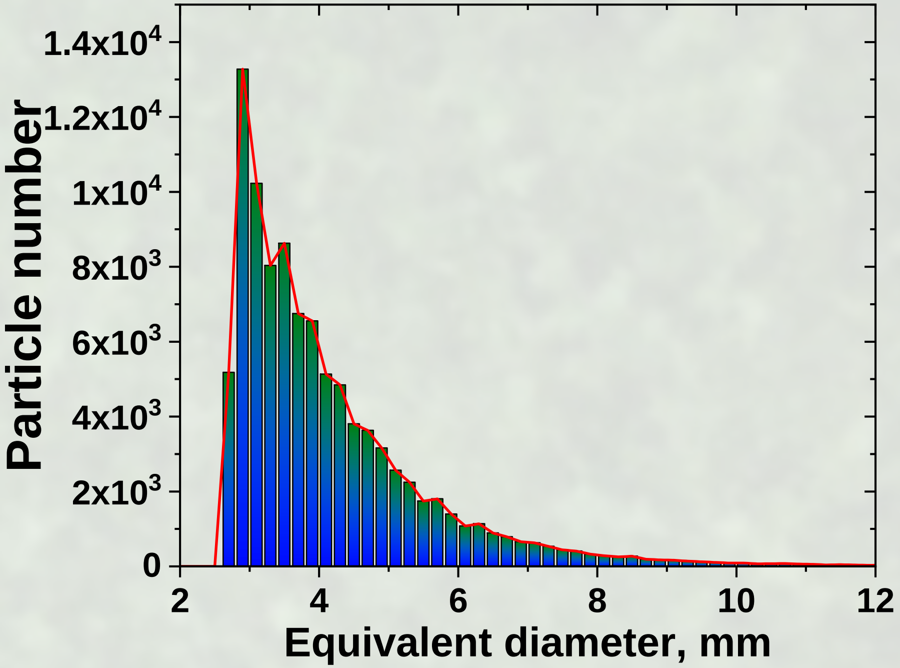


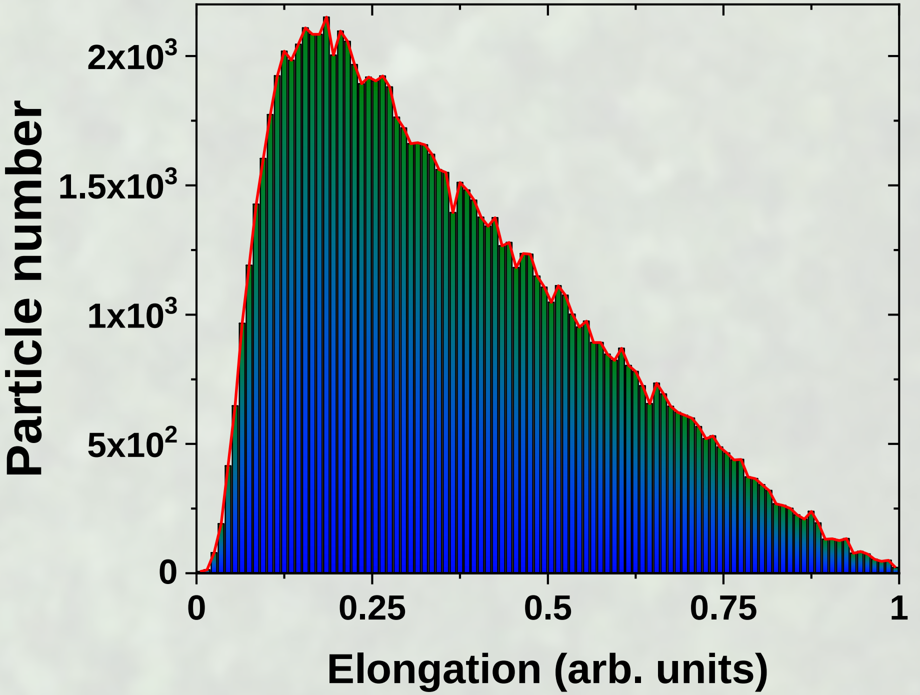


631



Dolomite $CaMg(CO_3)_2$
(anhydrous carbonate mineral)
Or
Anhydrite $CaSO_4$
(anhydrous calcium sulfate)





Conclusions

- Alabastron (type) ≠ Alabaster (material)
- Suitable testing methods:

  Raman spectroscopy,

  X-Ray diffraction,

  X-Ray tomography

- Existence of active trade routes from Greece to distant provinces
- Availability of various raw material sources

Thank you for attention!