

October 12, 2021
ICRI 2021 Fall Convention

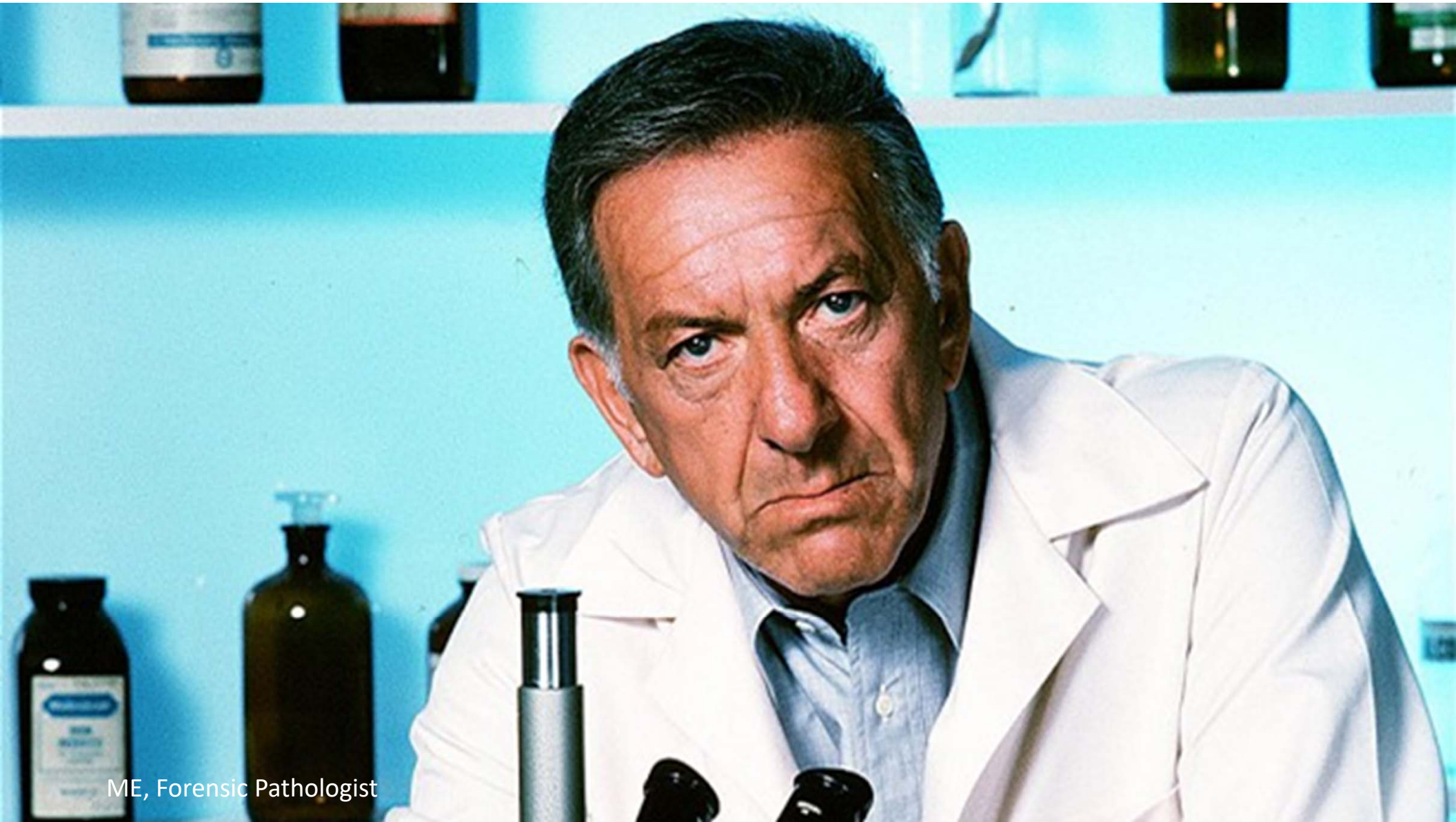
The Value of Petrographic Analysis in the Evaluation and Repair of Concrete Structures



Gerard Moulzolf, PG
Principal Petrographer/Geologist
American Engineering Testing Inc,



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ME, Forensic Pathologist

outline

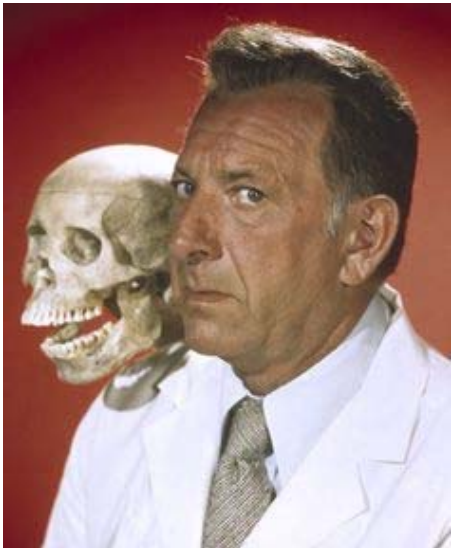
Intro to petrography

How its done

Why its done

Add chemistry

Petrographic peculiarities



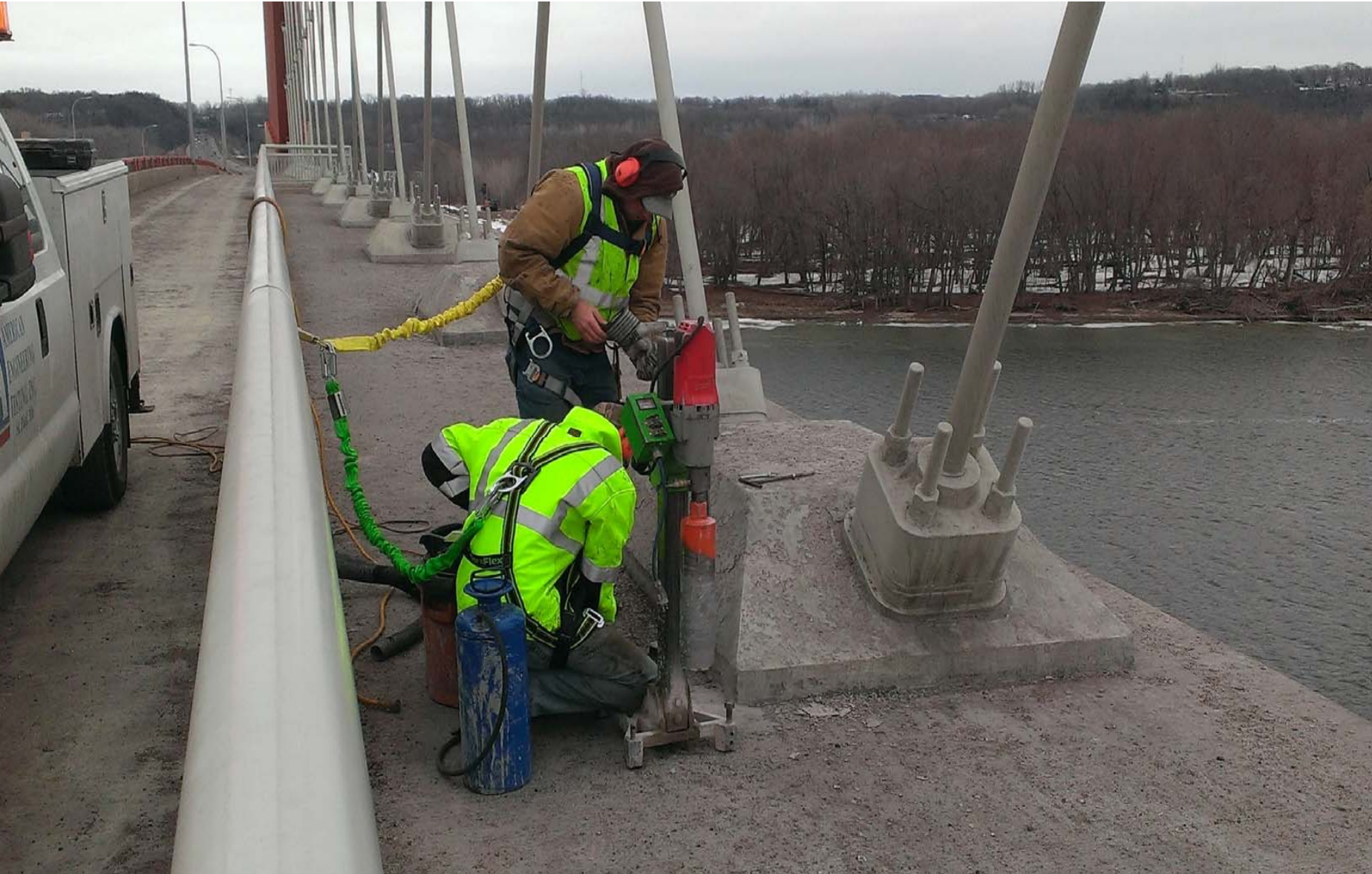
what is petrography?

Geologic term applied to the microscopic analysis of concrete, masonry, grout, stucco, plaster, and other cementitious materials.....

ASTM Committee C9 Concrete & Aggregate Sub-Committee C9.65

- **ASTM:C856**
- **ASTM:C457**
- **ASTM:C295**
- **ASTM:C1324**





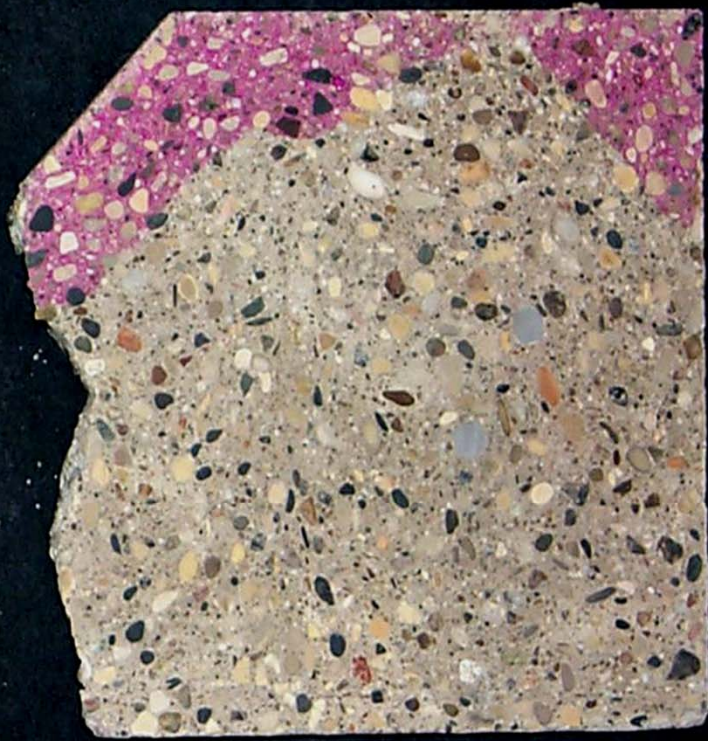
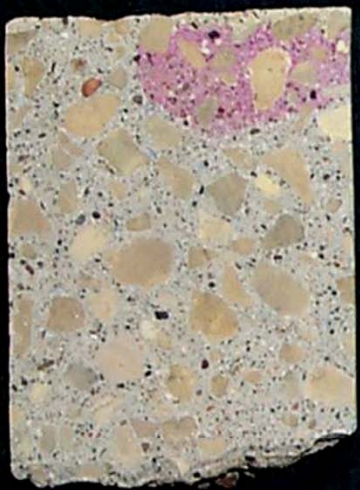






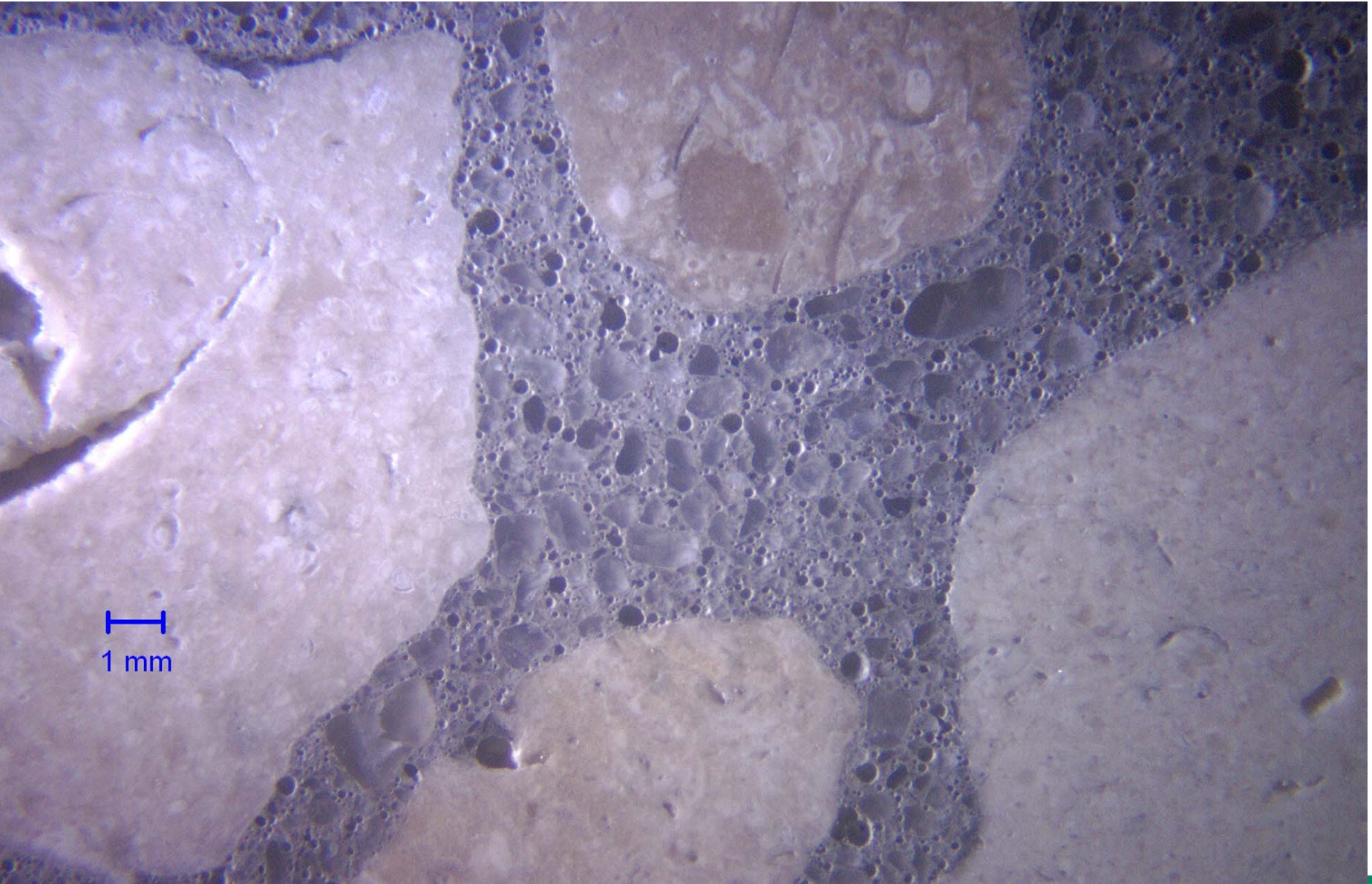
Prep Lab





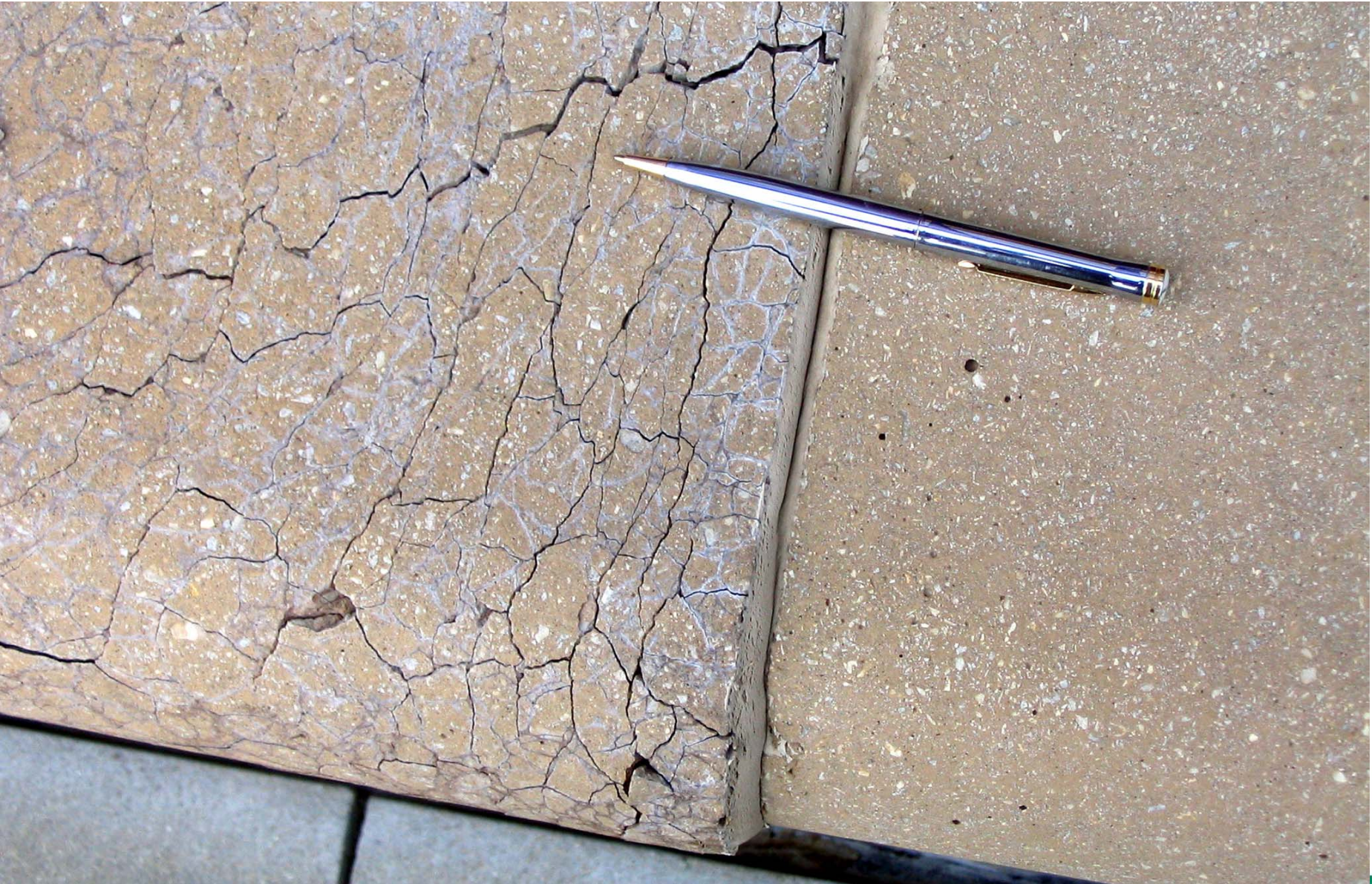




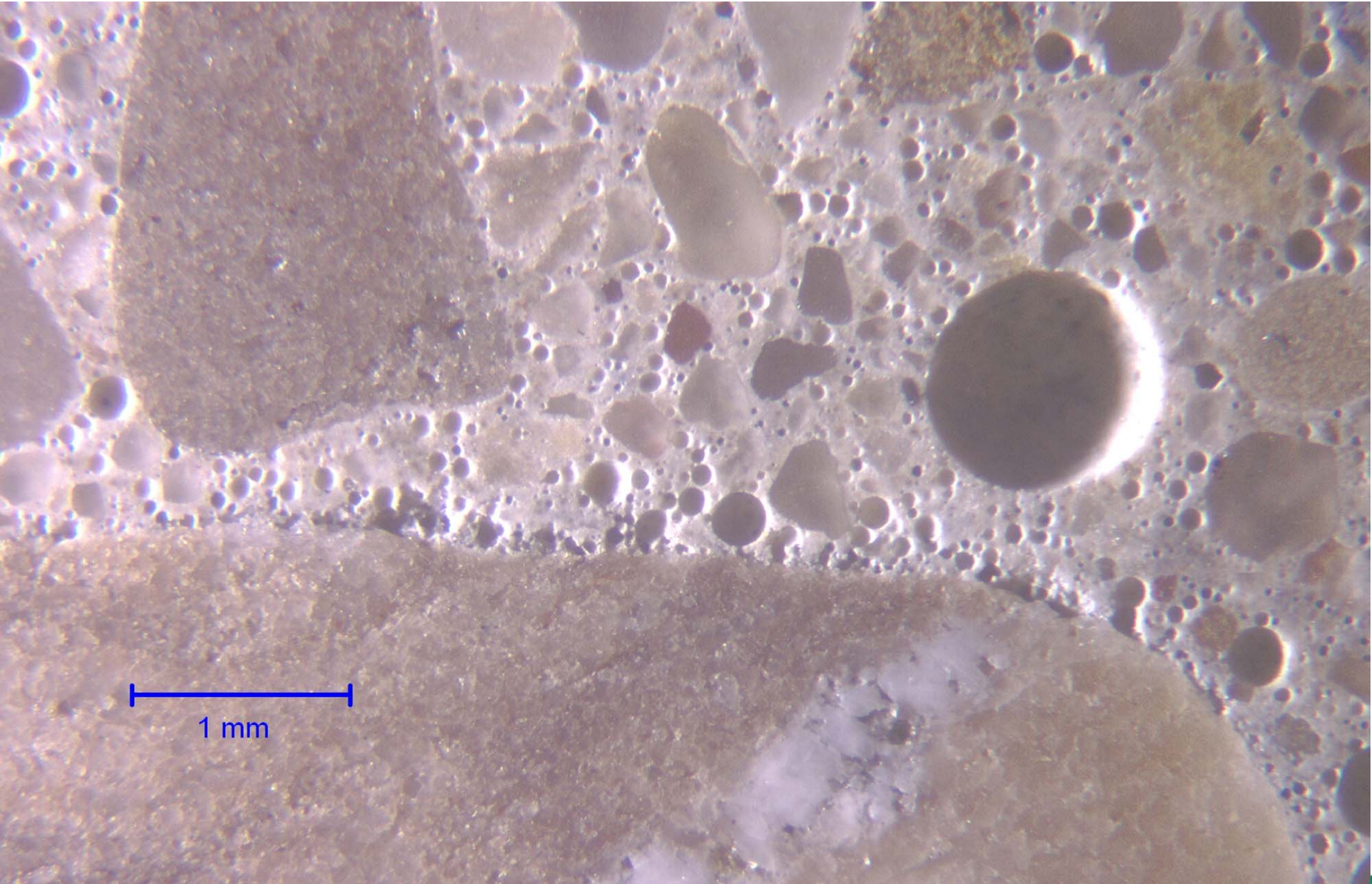


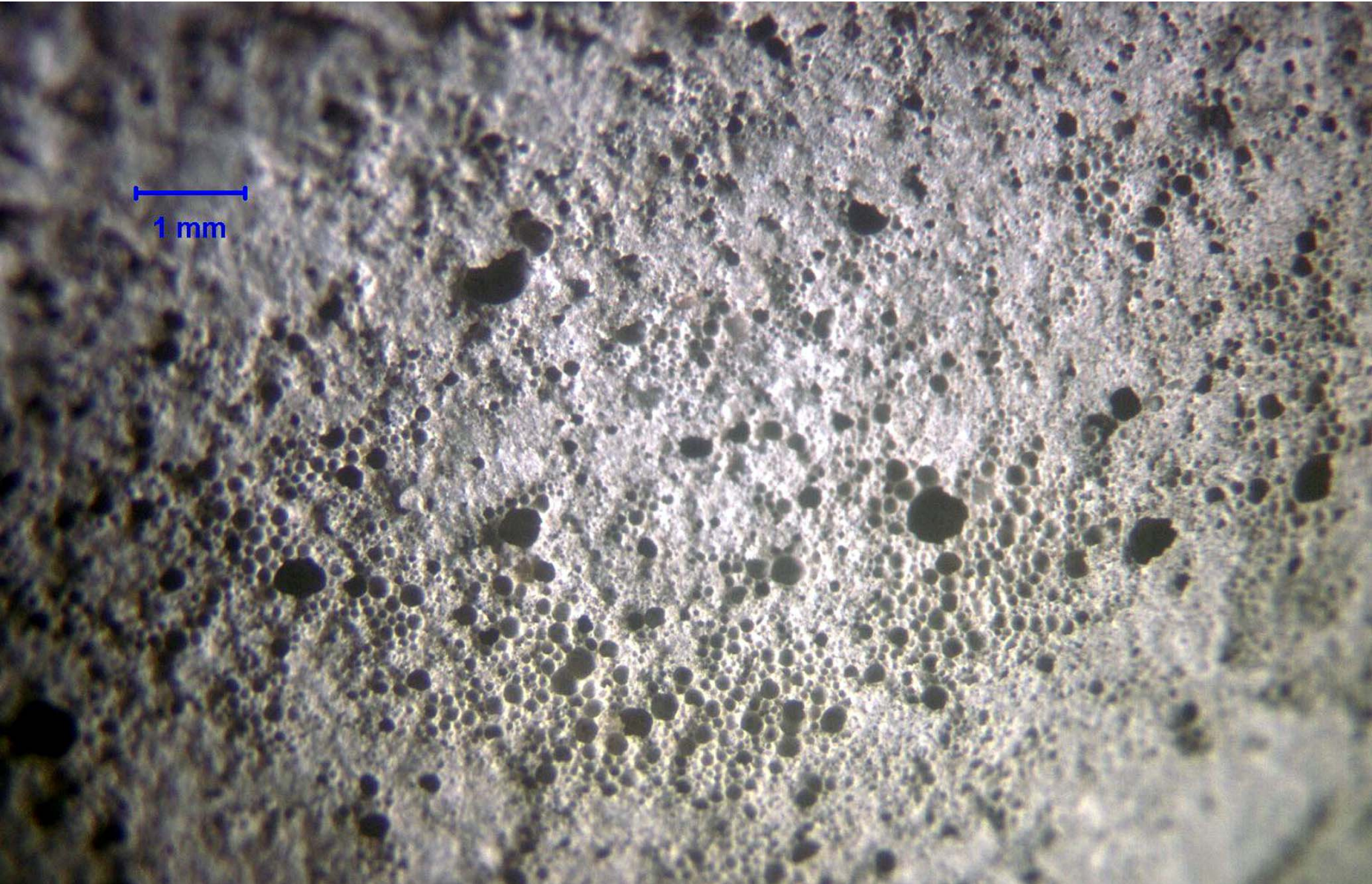
1 mm

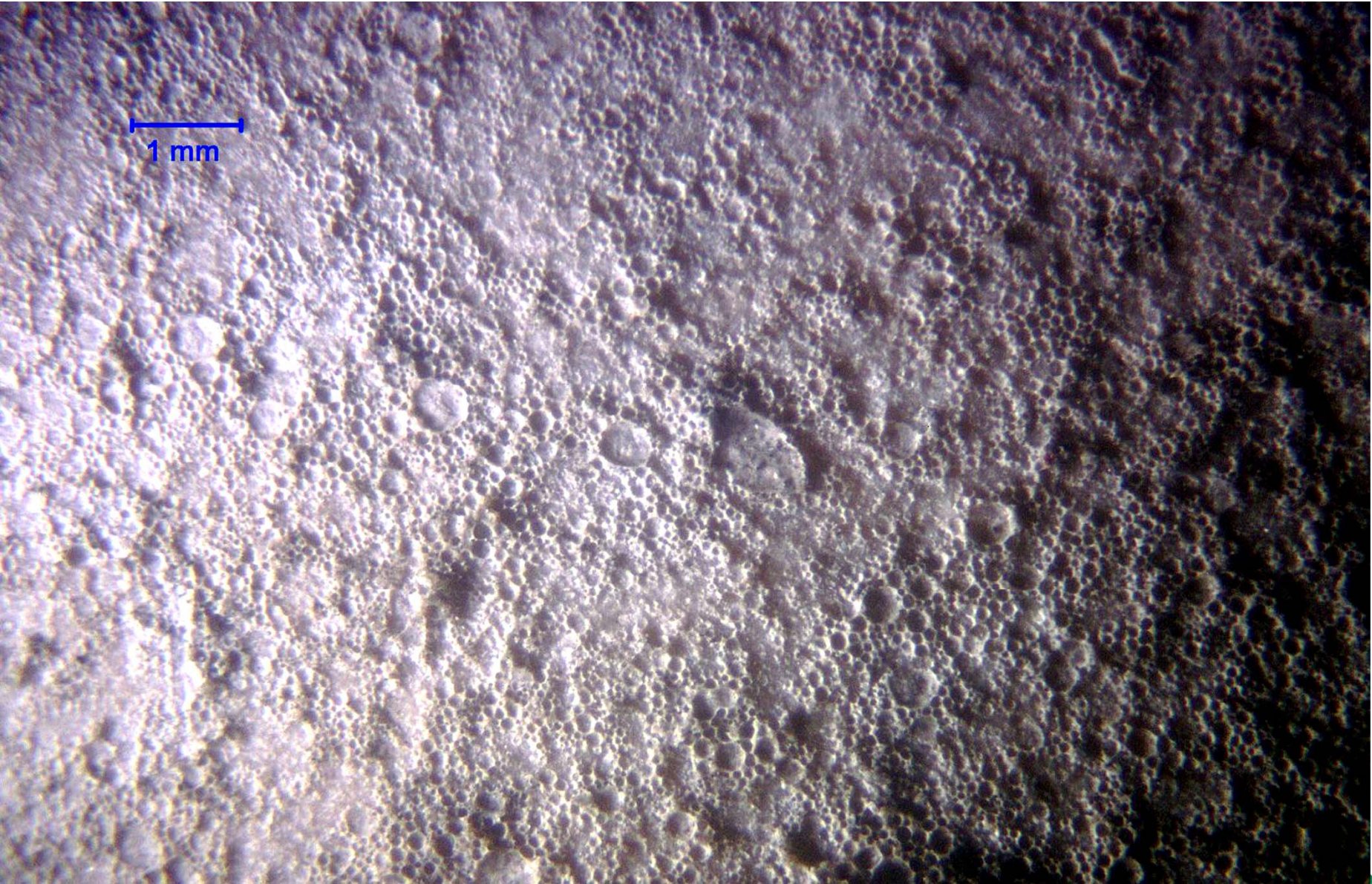


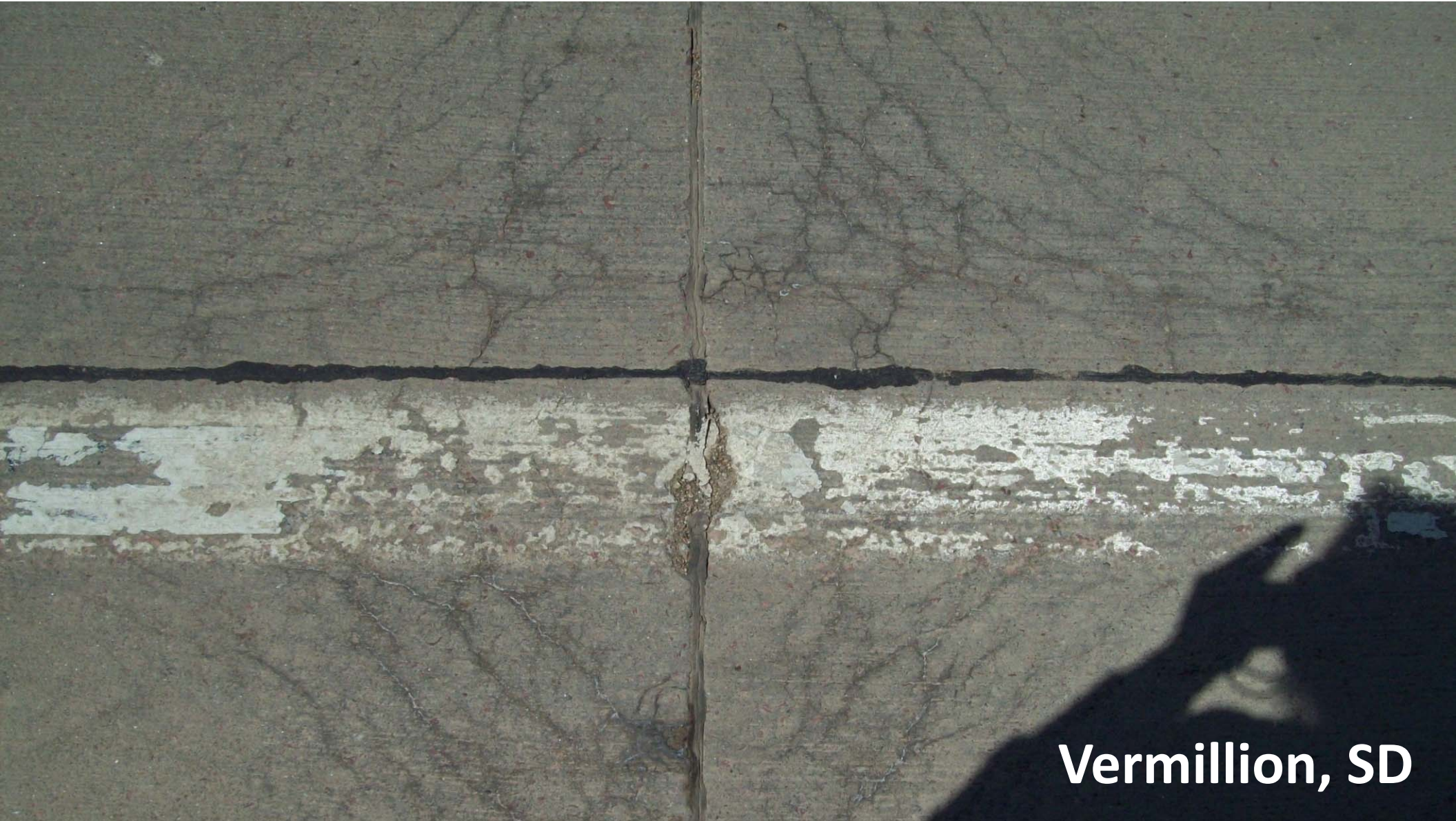




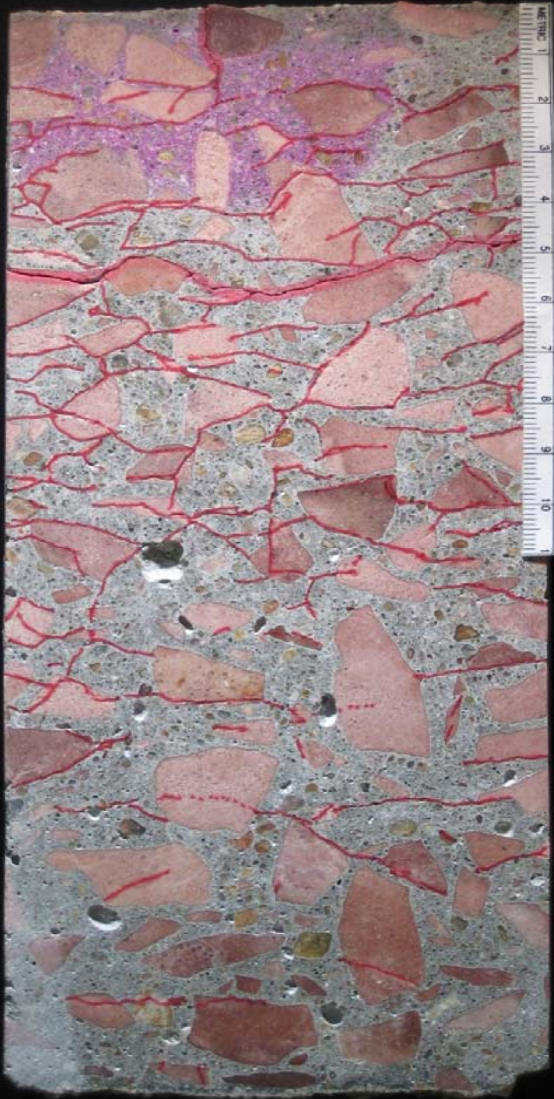




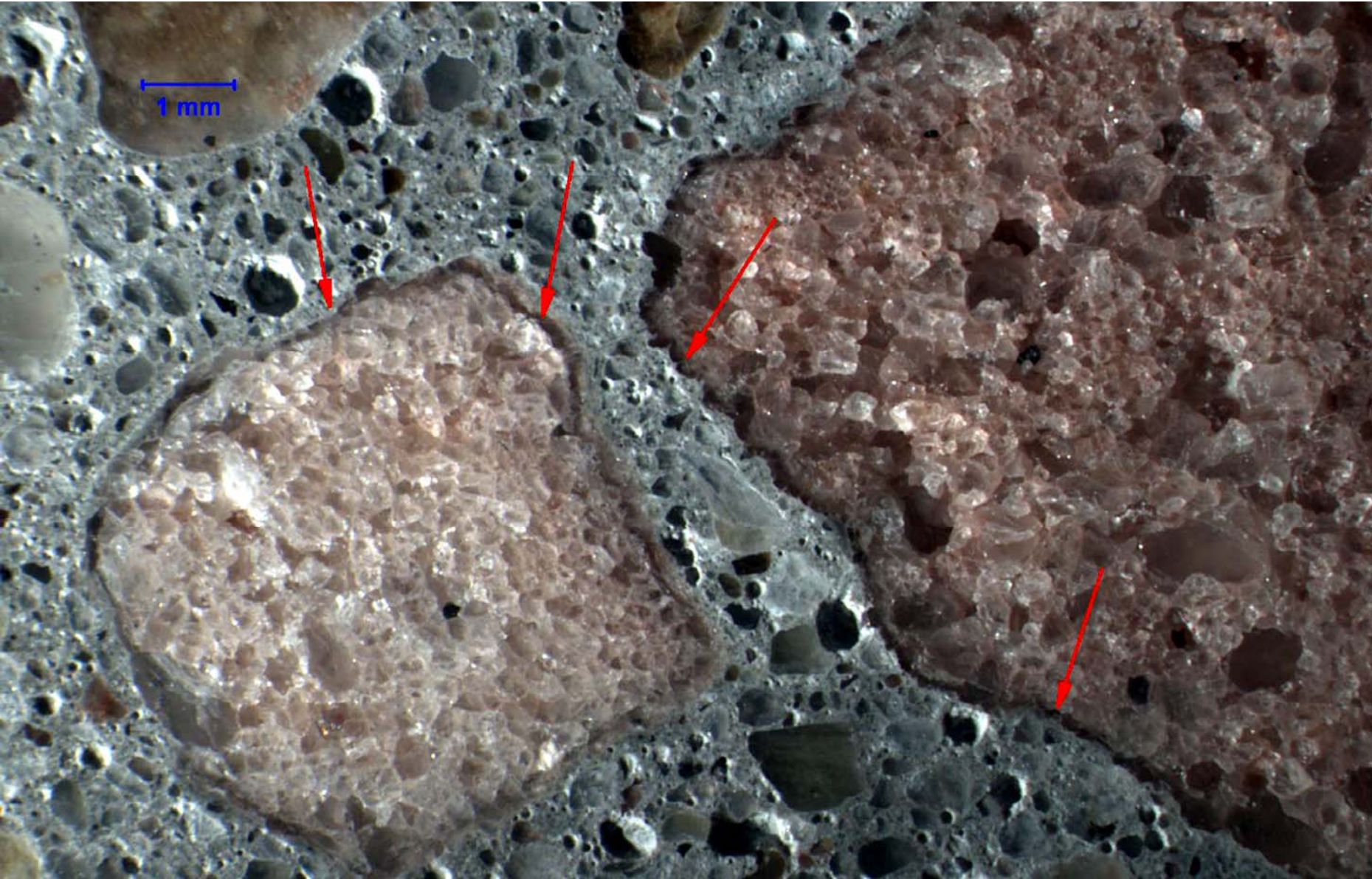


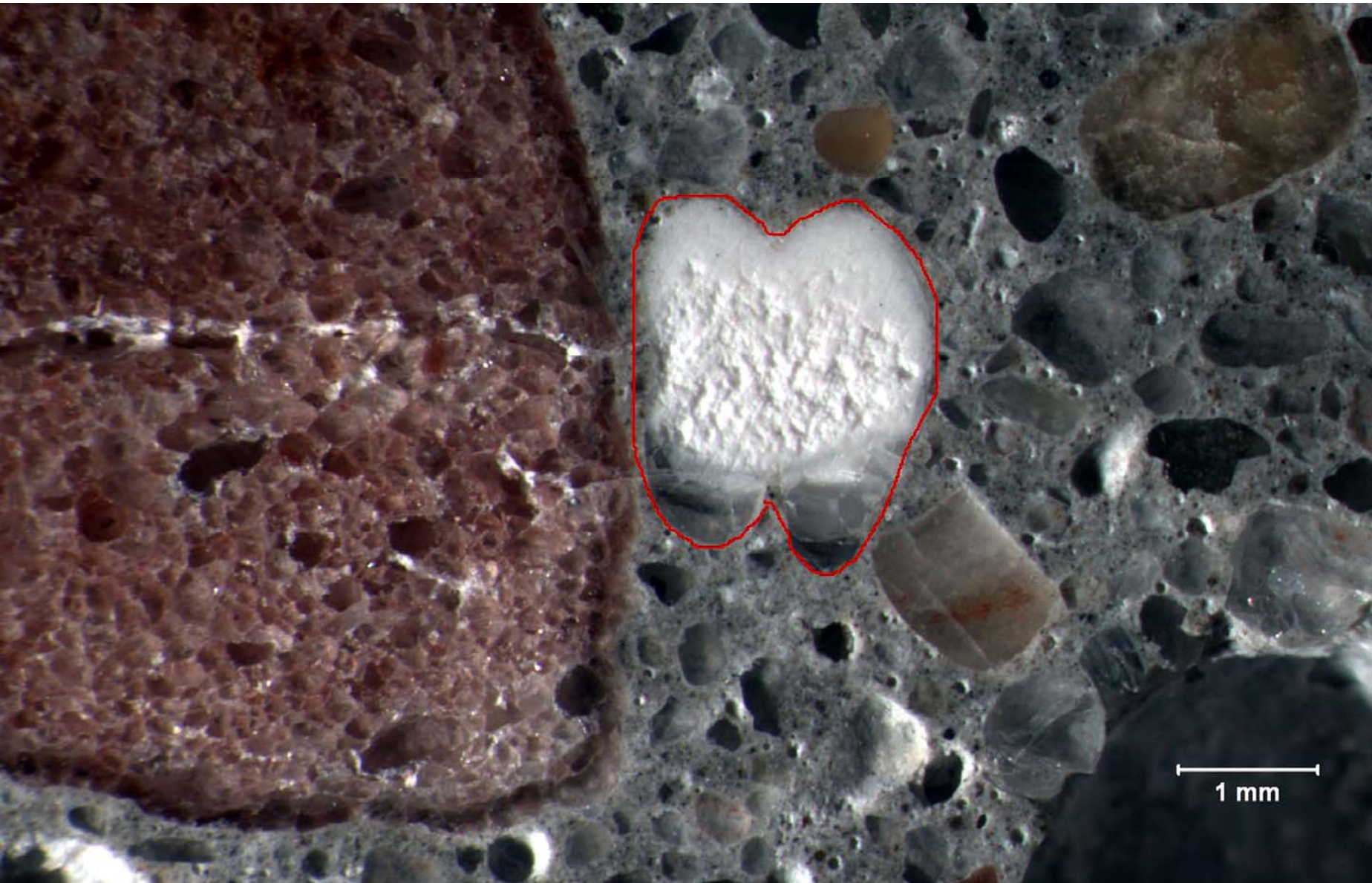


Vermillion, SD







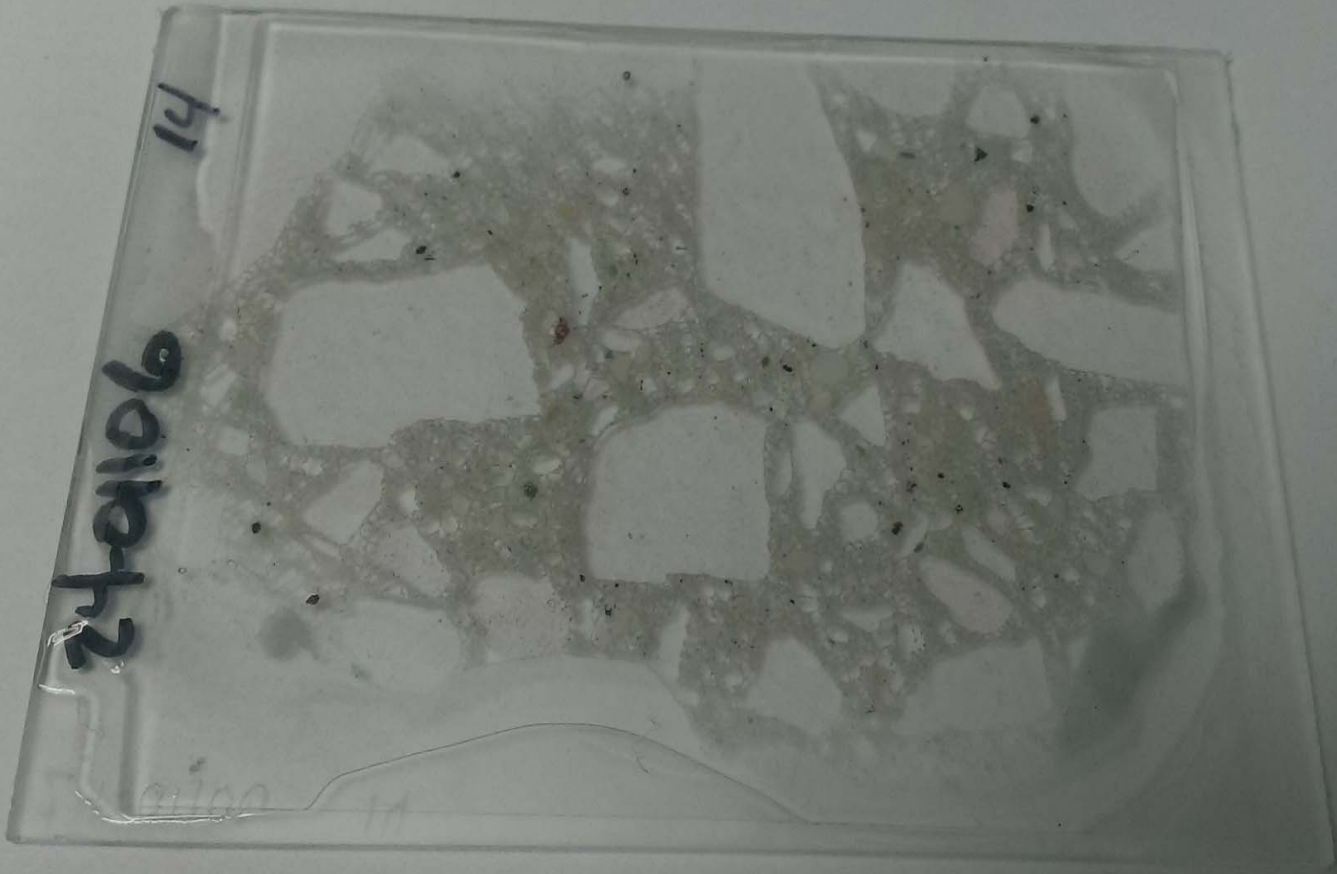


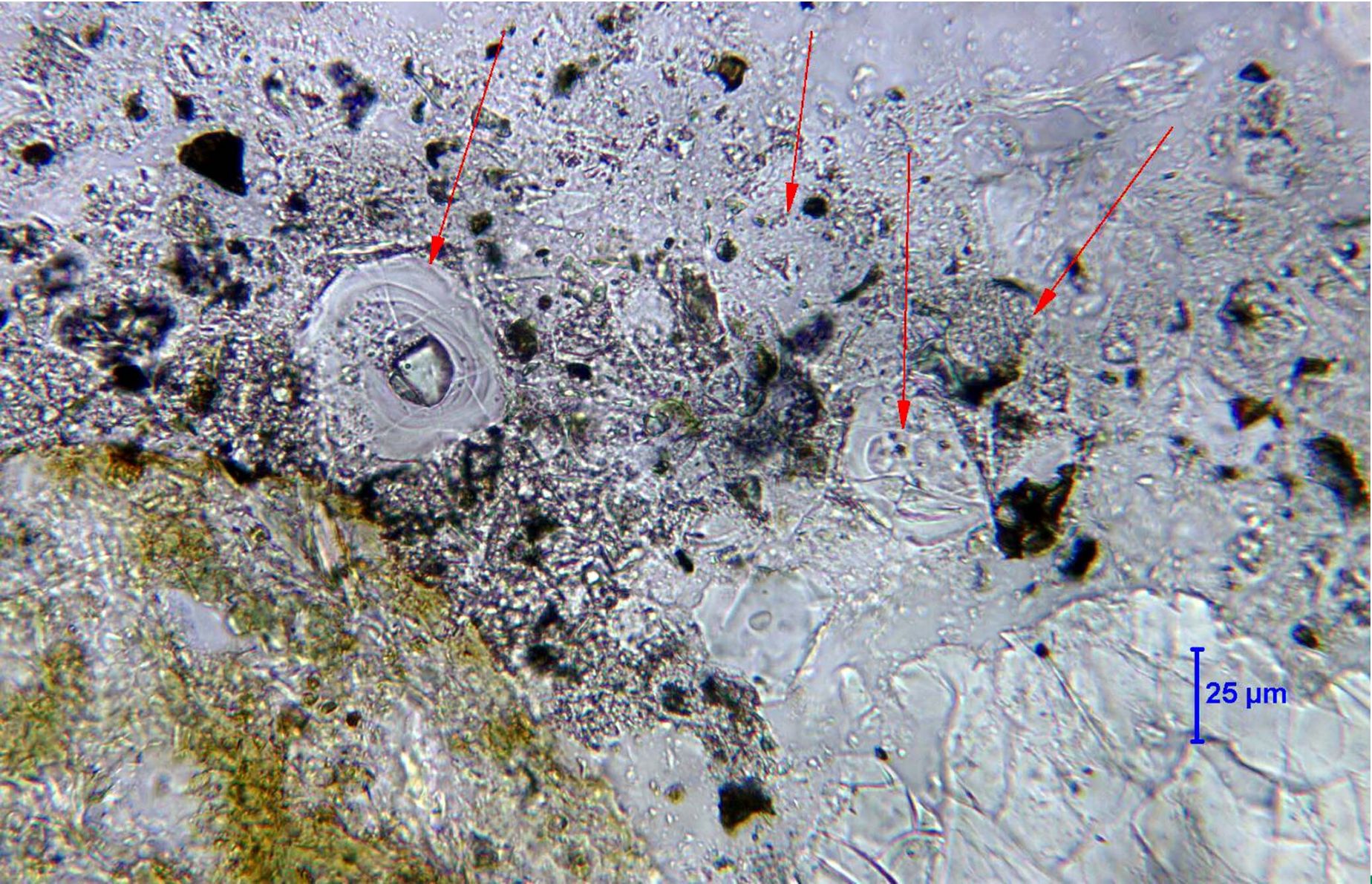


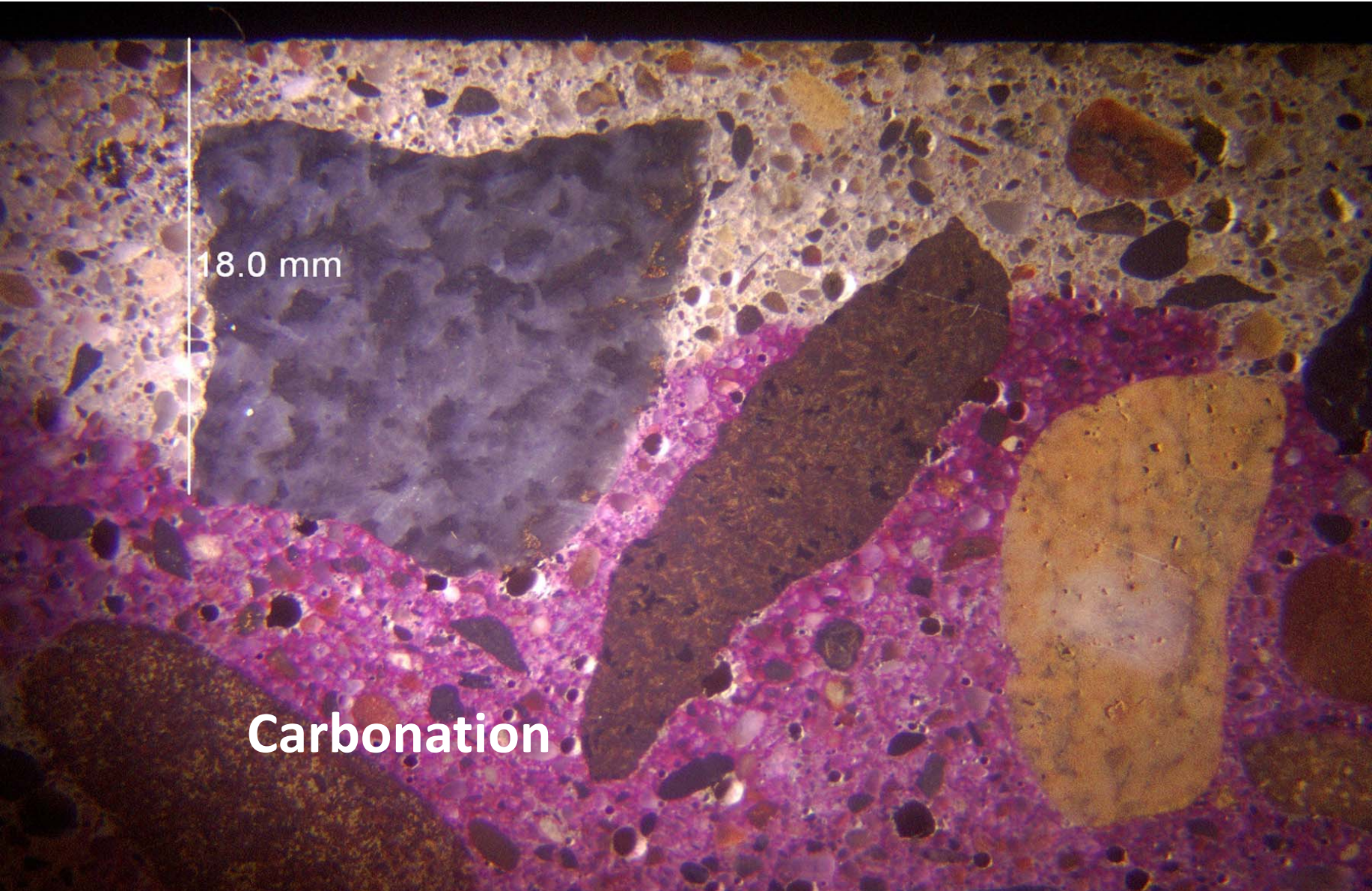


Prep Lab



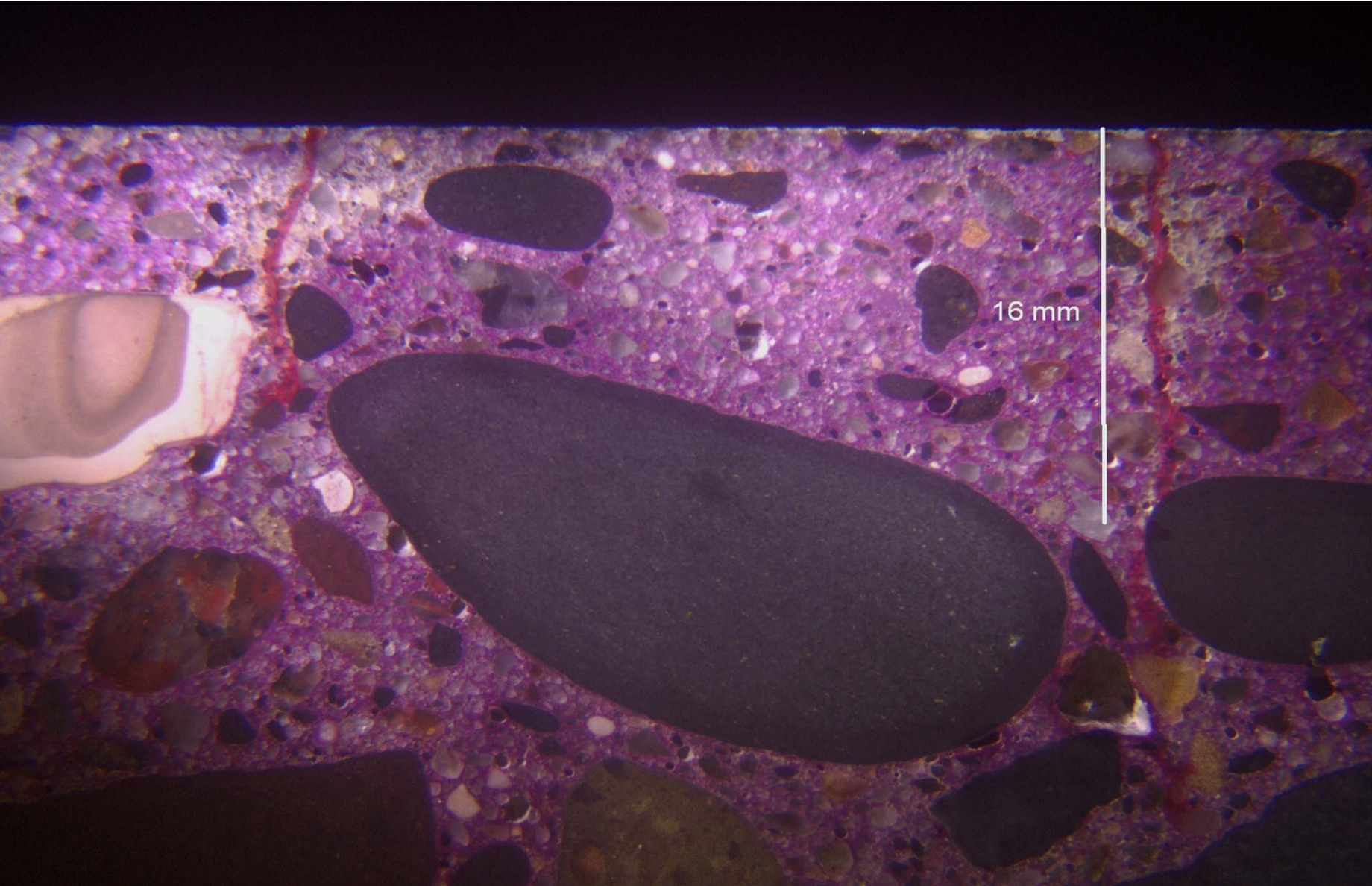


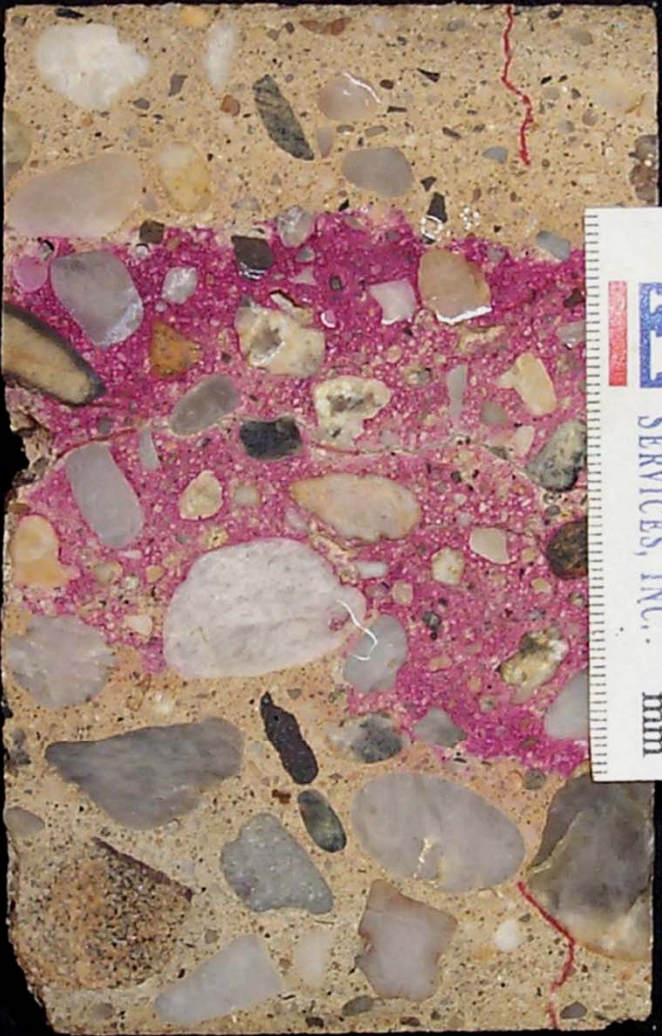




18.0 mm

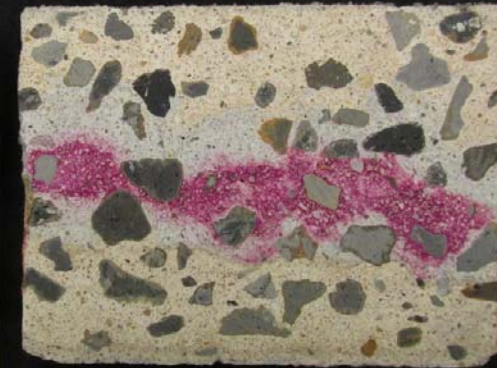
Carbonation






AMERICAN
PETROGRAPHIC
SERVICES, INC. mm





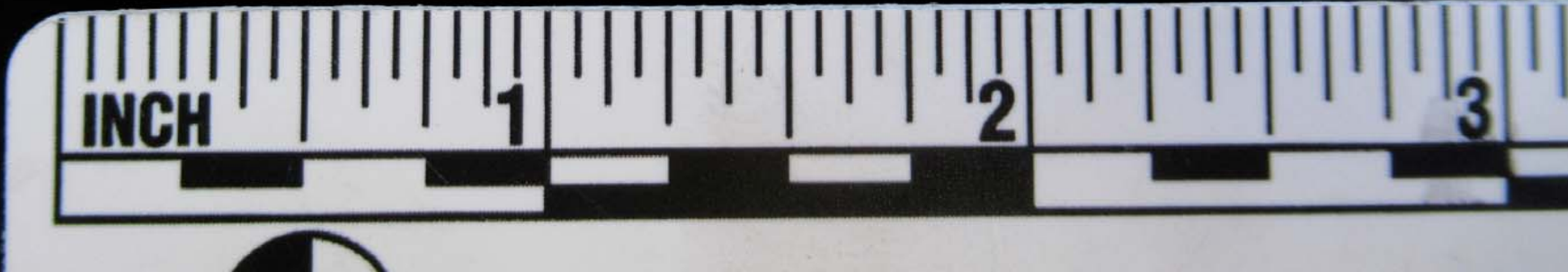
University Sports Field Risers

Surfside, FL, early 80's

N

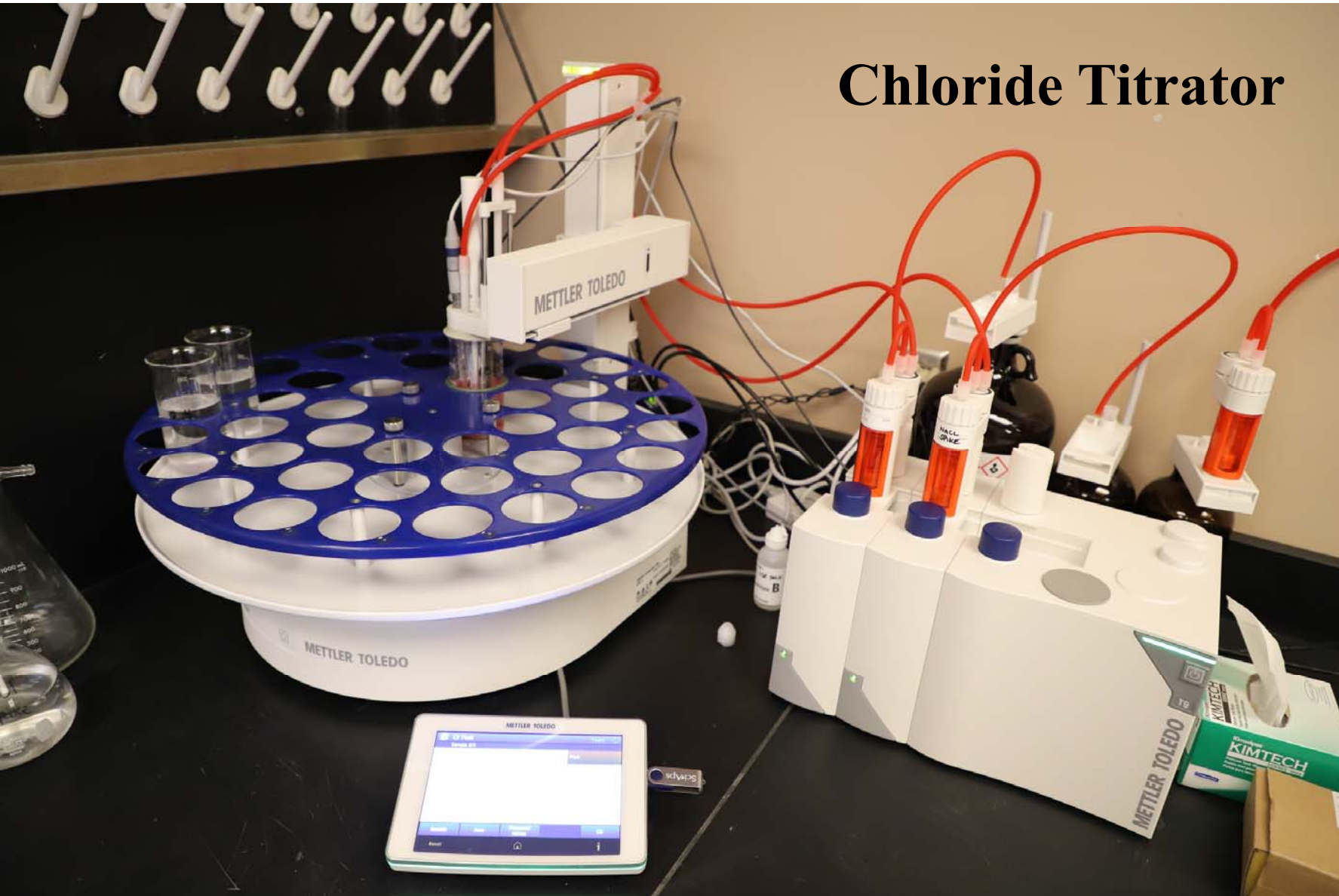
outer

inner





Chloride Titrator







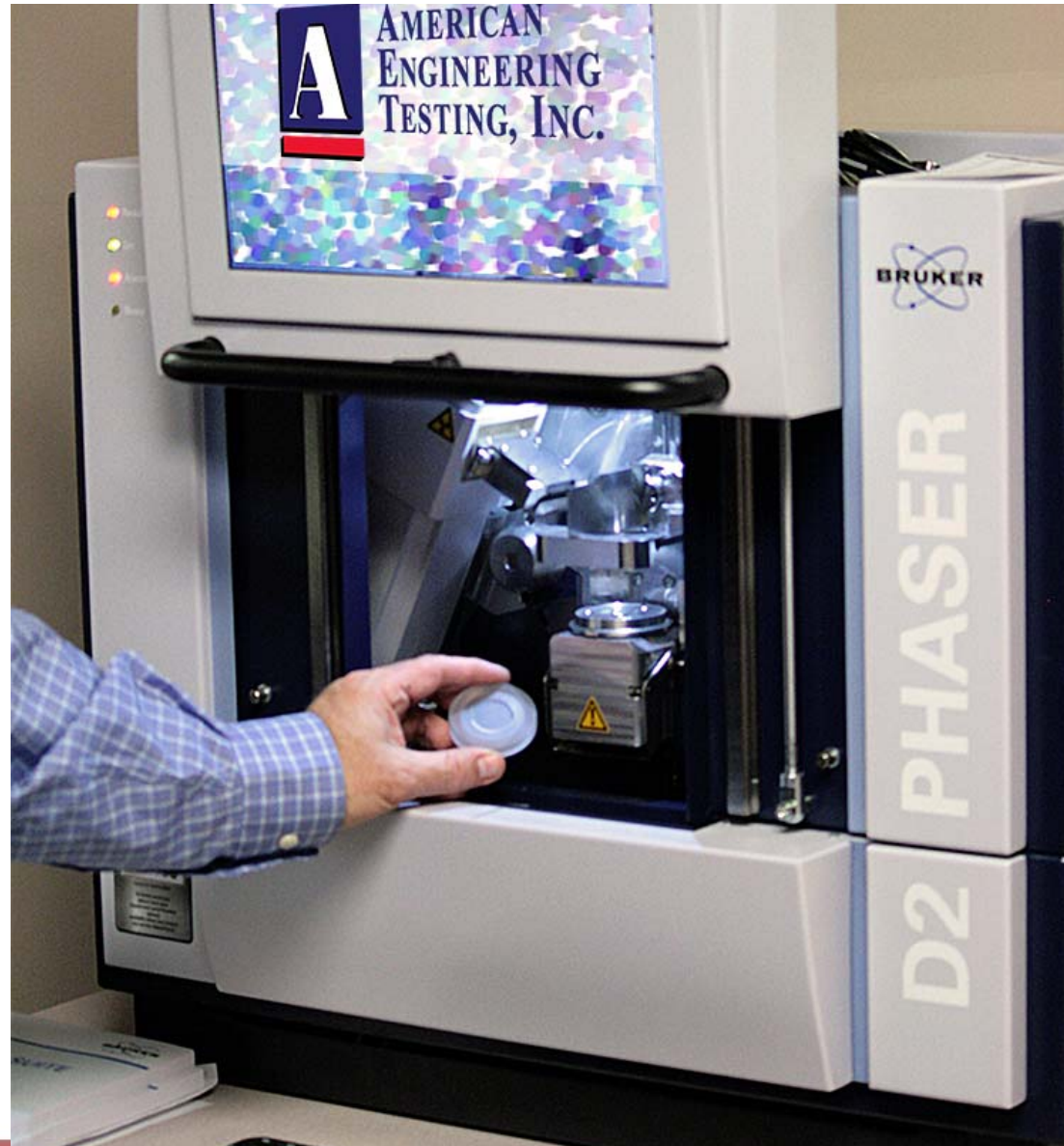
Auto Dealership, IA



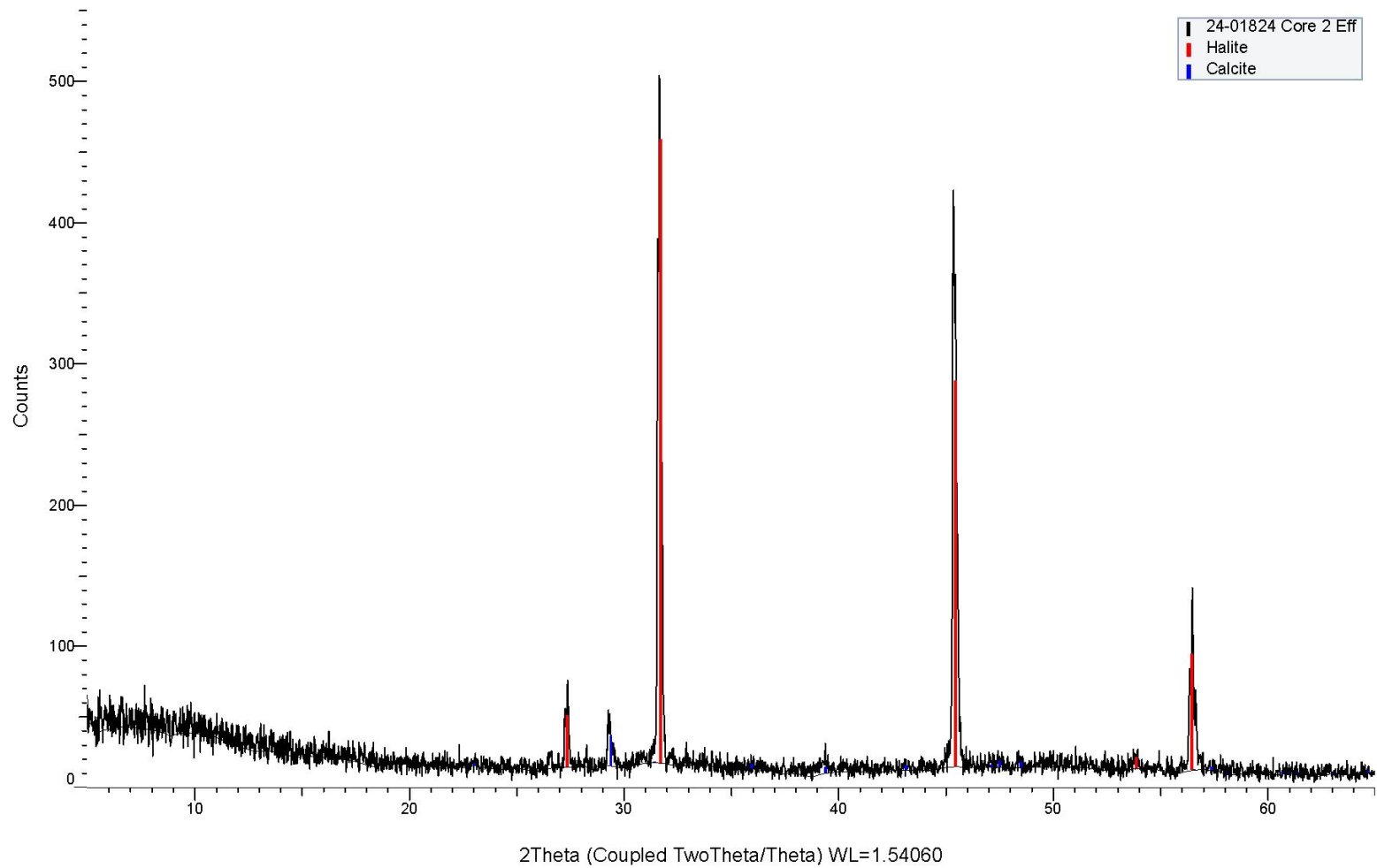


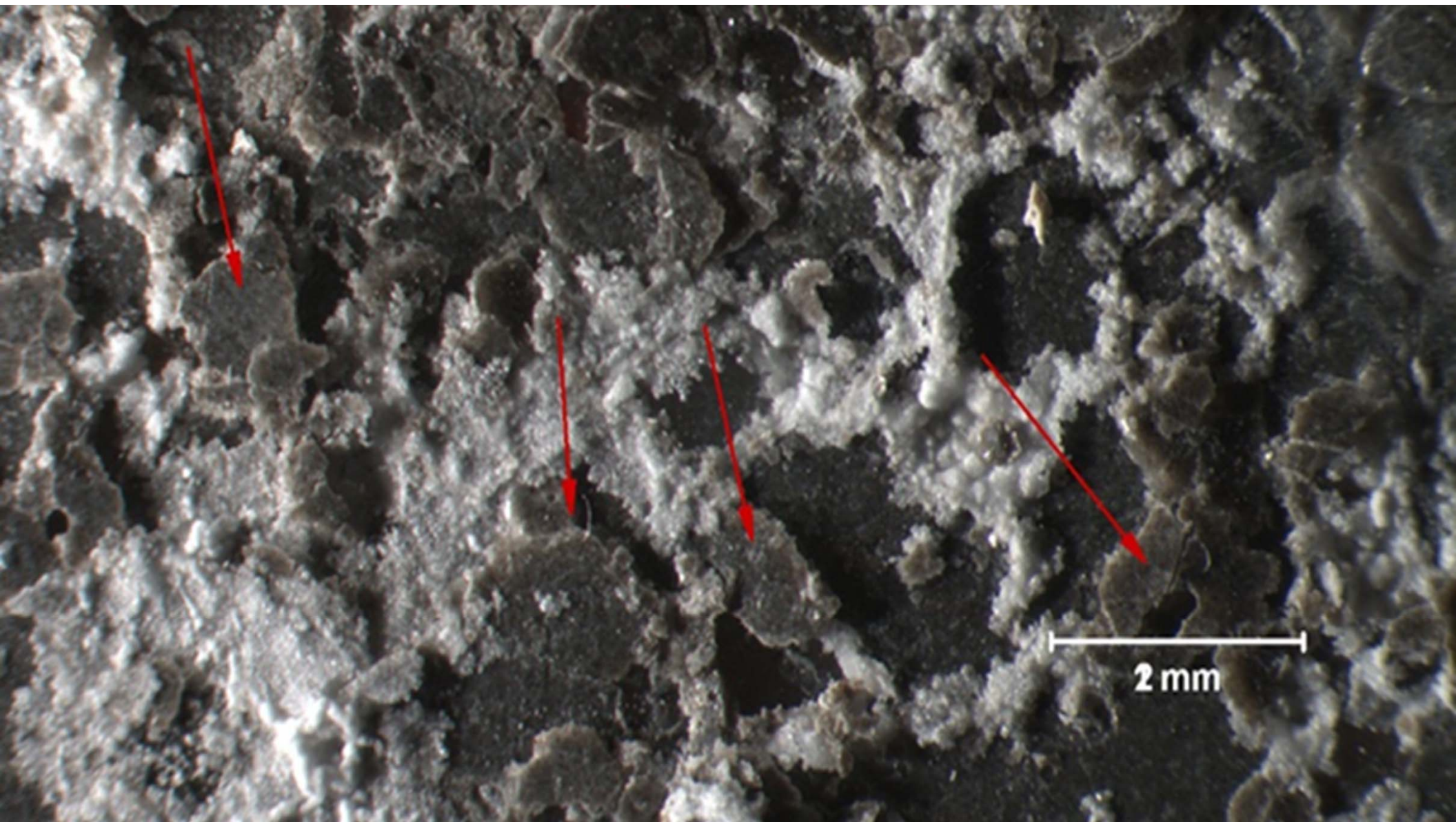
X-ray Diffraction (XRD)

qualitative, compounds



AET Project #24-01824 Core 2 Lab-Induced Efflorescence Powder X-Ray Diffraction





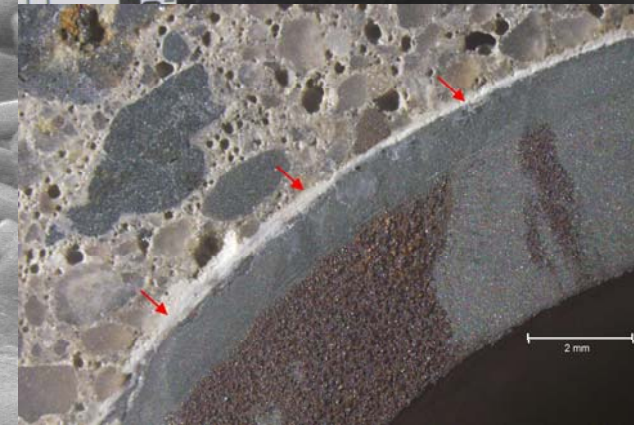
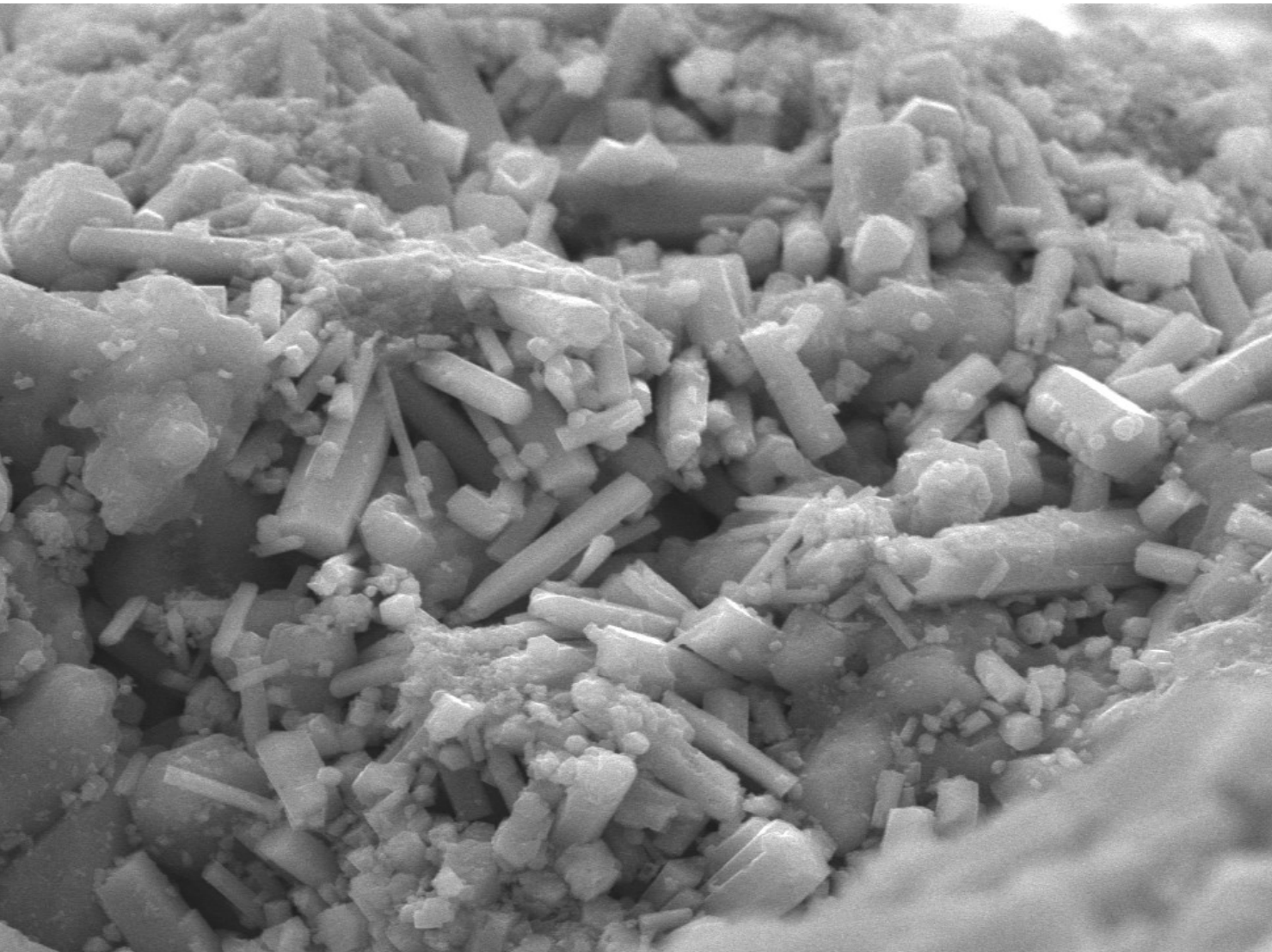
Salt Hydration Distress


Thenardite (Na_2SO_4) to Mirabilite $\bullet 10\text{H}_2\text{O}$ = 315% volume increase



Scanning Electron Microscopy with EDS

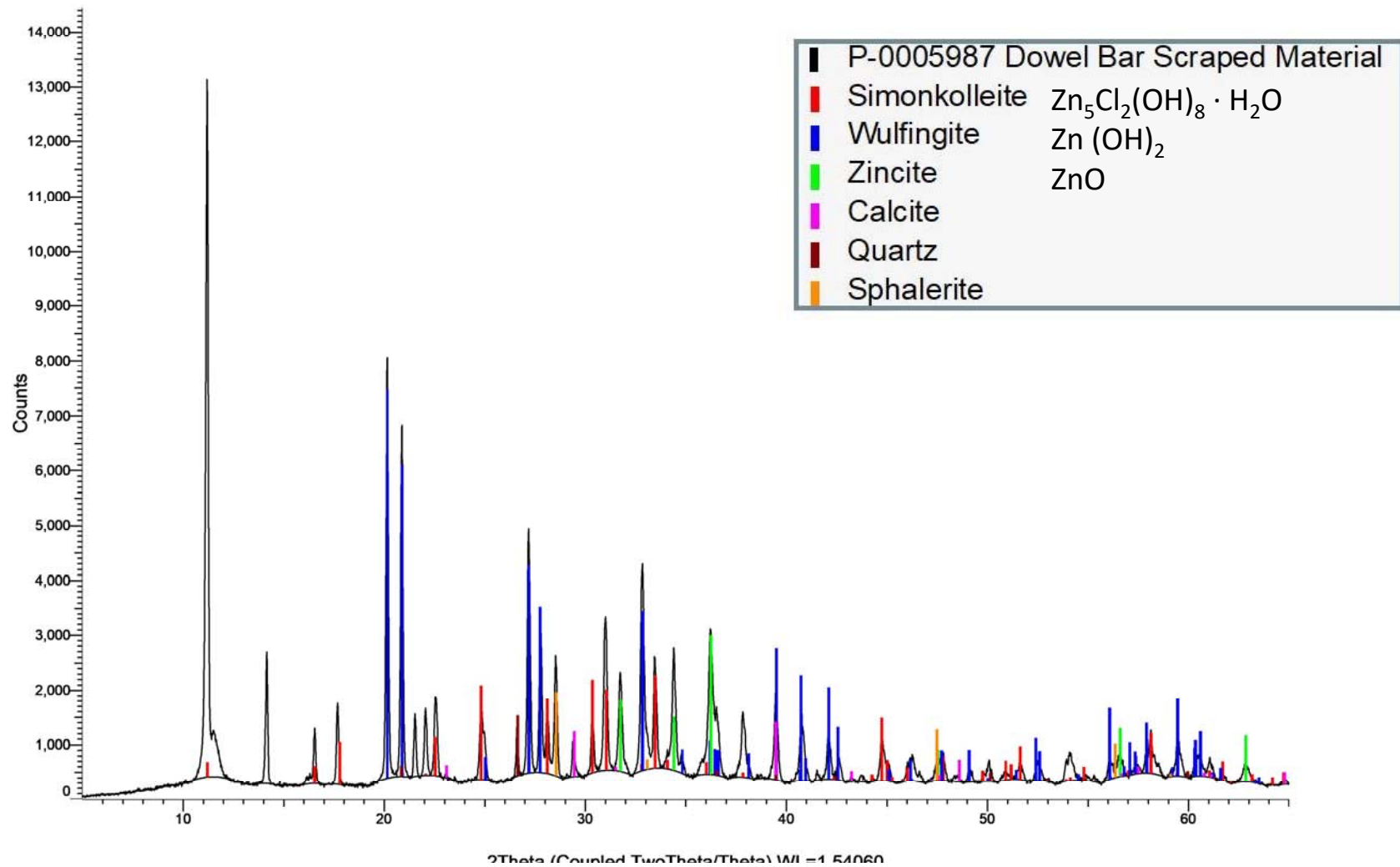




D 20.0 kV WD 10.0 mm Std.-PC 40.0 HighVac.  x3,700
D 0423 Oct. 01 2021

 5 μm

P-0005987 MNDOT Dowel Bar Scraped Material Powder X-Ray Diffraction



TGA

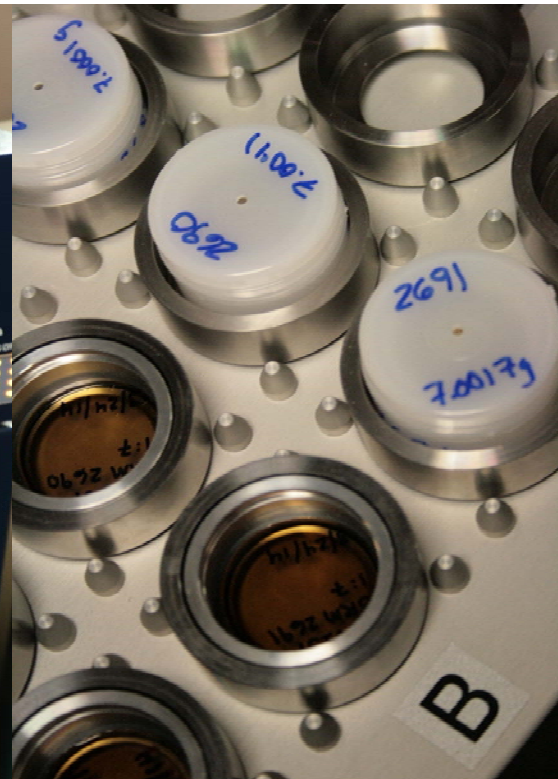
Useful for detection of various hydrous, carbonate, and sulfate phases in cementitious materials.



X-ray Fluorescence (XRF)

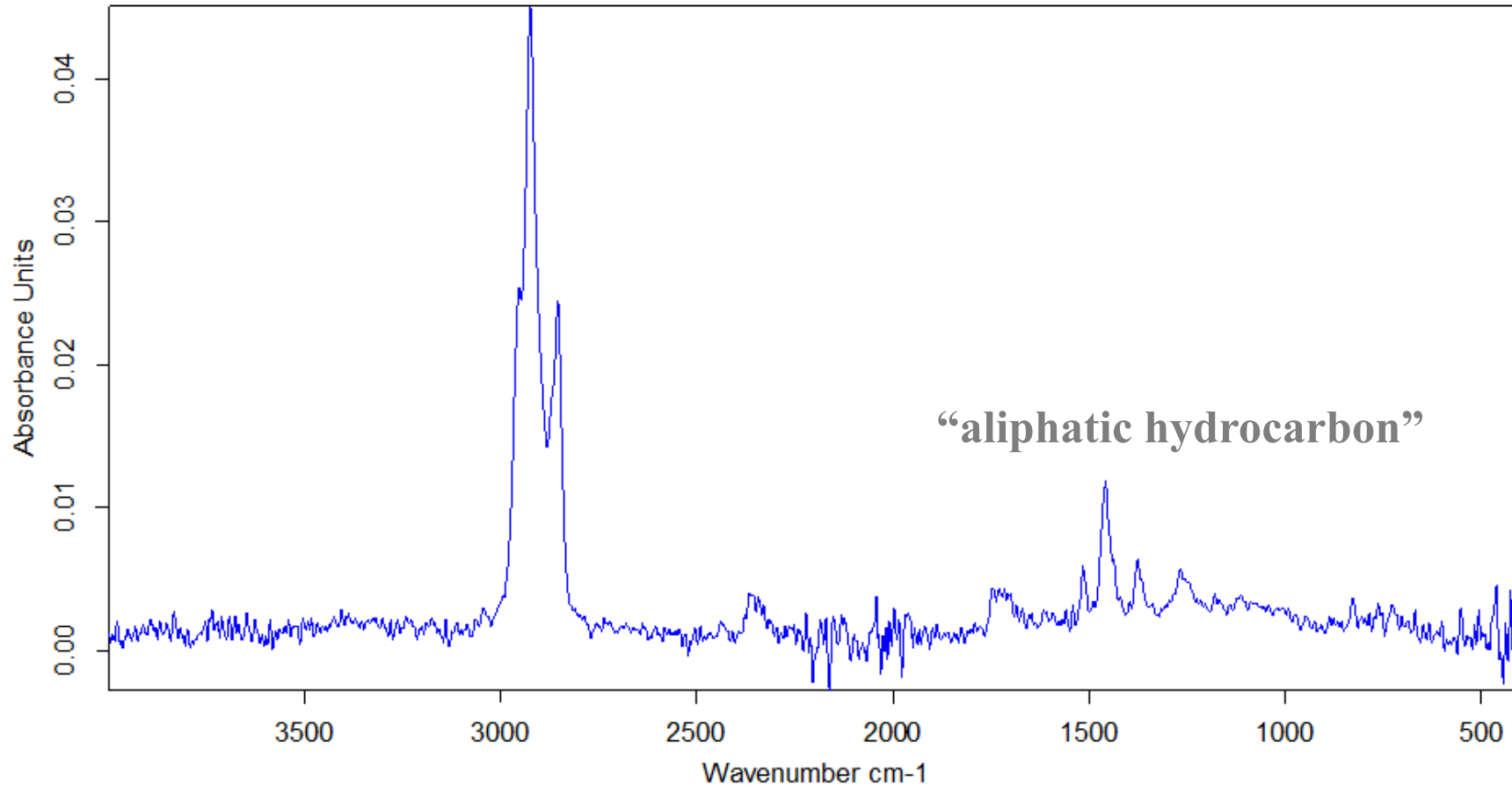


quantitative, elements



FTIR Spectroscopy





24-20506 Room 14 chloroform extract

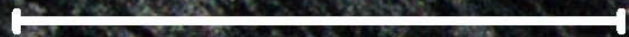
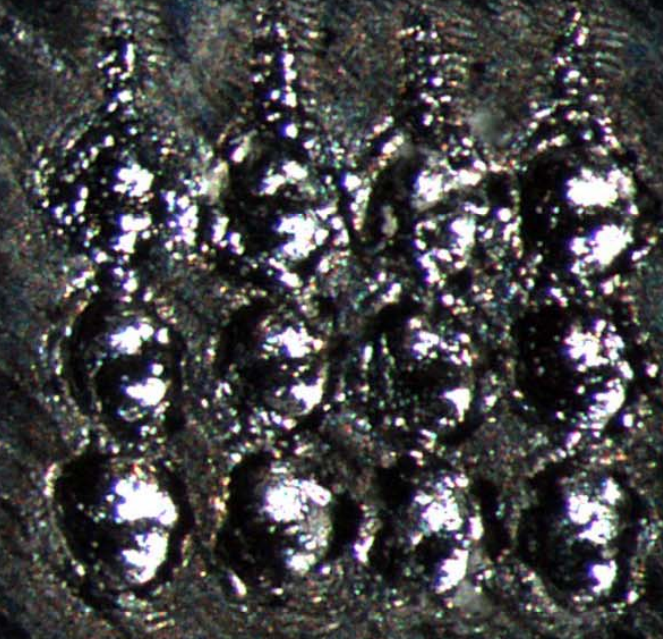
Bruker ALPHA-P ATR

3/18/2019



Laser Induced Breakdown Spectroscopy

LIBS



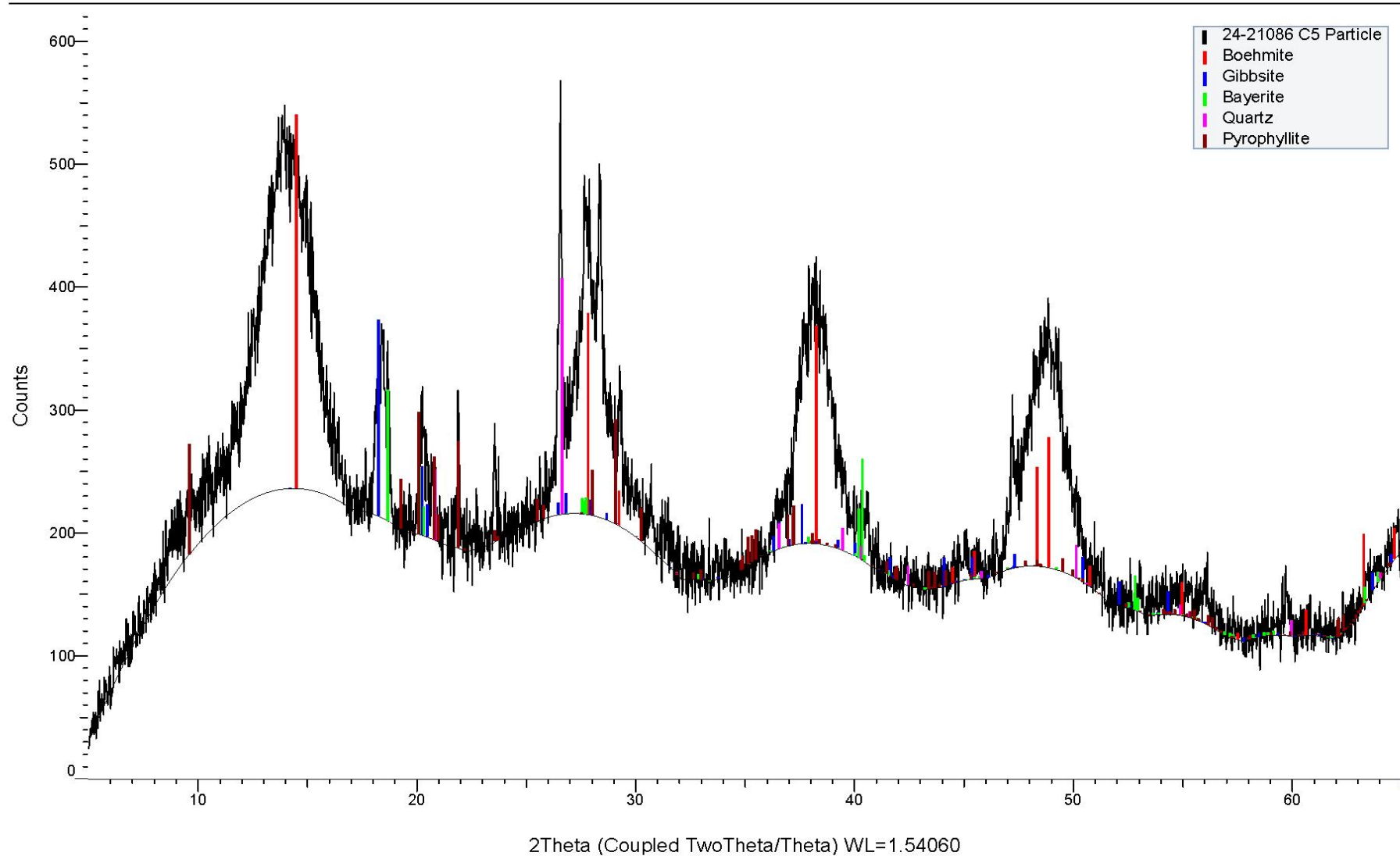
1 mm

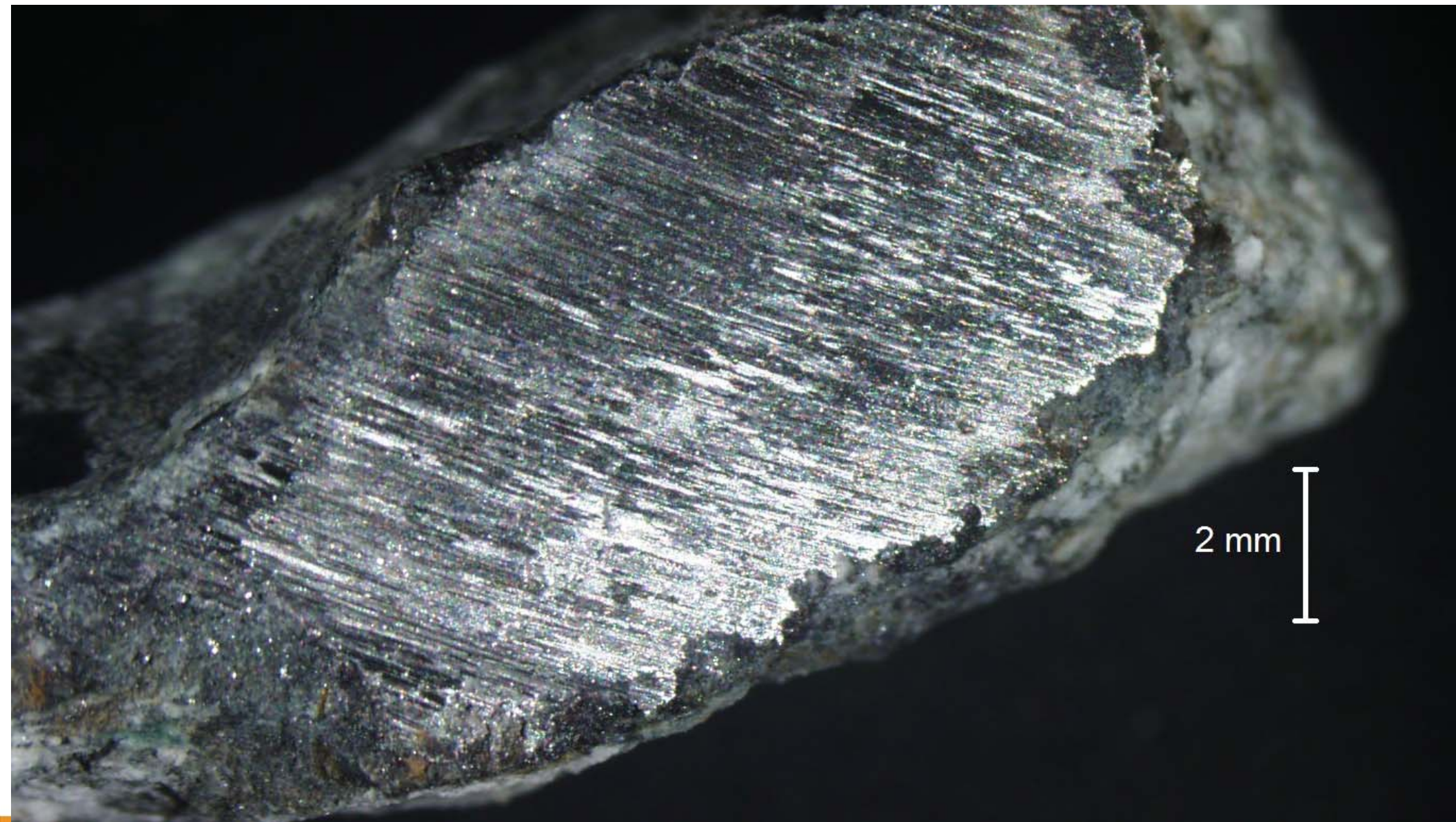
Coachella, CA





24-21086 MTGL Zenyara Estate C5 Deleterious Particle Powder X-Ray Diffraction





Z Alloy

ID



Test #439 8:53AM, Jan 27

Al-Cast
319 (97)

380 (97)
356 (95)



% +/- **319**

	%	+/-	
Magnesium Mg <small>12</small>	0.35%	0.08%	0.0-0.1%
Aluminum Al <small>13</small>	84.75%	6.10%	84.57-93.37%
Silicon Si <small>14</small>	6.30%	1.05%	5.5-6.5%
Titanium Ti <small>22</small>	0.070%	0.010%	0.0-0.25%

Questions?

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