Hueco Tanks Pictographs:

Technical Analysis in Advance of Possible Laser Cleaning

Andrew Lins, Beth Price, Ken Sutherland, Heather Brown - Philadelphia Museum of Art

Tom Tague - Bruker Optics

Andrzej Dajnowski - CSOS

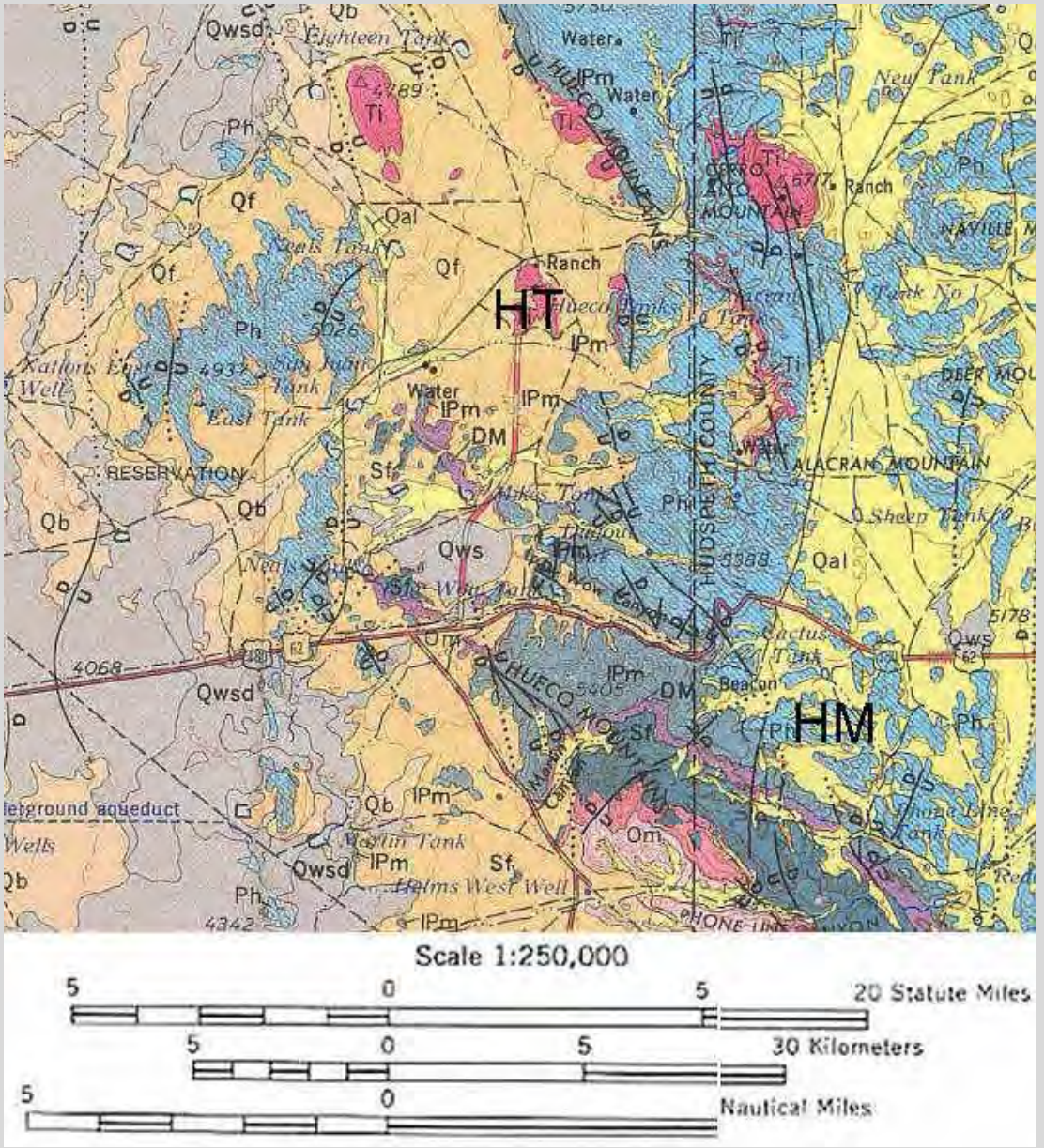
HUECO TANKS

OUTLINE

- Hueco Tanks Site Background
- Prevalence of Graffiti
- Challenges for In Situ Analysis without sampling
- Analytical Results
- Next Steps

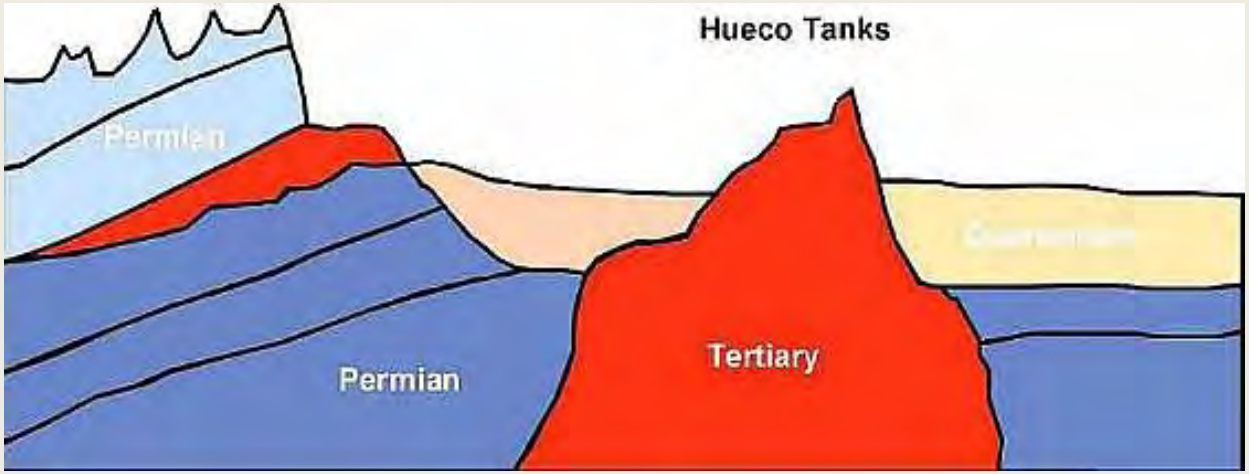
MAJOR U.S. ROCK CLIMBING SITE

Hueco Tanks Site



HUECO TANKS

A LACCOLITHIC IGNEOUS INTRUSION OF PORPHYRITIC SYENITE
COOLED UNDER A LIMESTONE CAP
C. 35 MILLION YEARS AGO



Hueco Tanks History

First Layers :	Archaic
150 – 1400/1450 AD :	Jornada Mogollon
Post 1660:	Apache and others
First Graffiti:	1849

Hueco Tanks Pictographs

Total close to 5,000; largest site for masks in US (more than 200)

Many Pictographs are from Jornada Mogollon Period, ca 100 -140/1450 AD

‘Closed’ Mask types

Dancer variants

ENHANCEMENT OF PICTOGRAPH IMAGES

Image from 5/2011

Rupestrian Cyberscan

1. Laboratory Analyses of graffiti

Graffiti – microsamples - MFTIR, Py-GCMS, SEM-EDS

2. In Situ Analyses of Pigments/media

Pictographs – no sampling – XRF, Raman, DRIFT

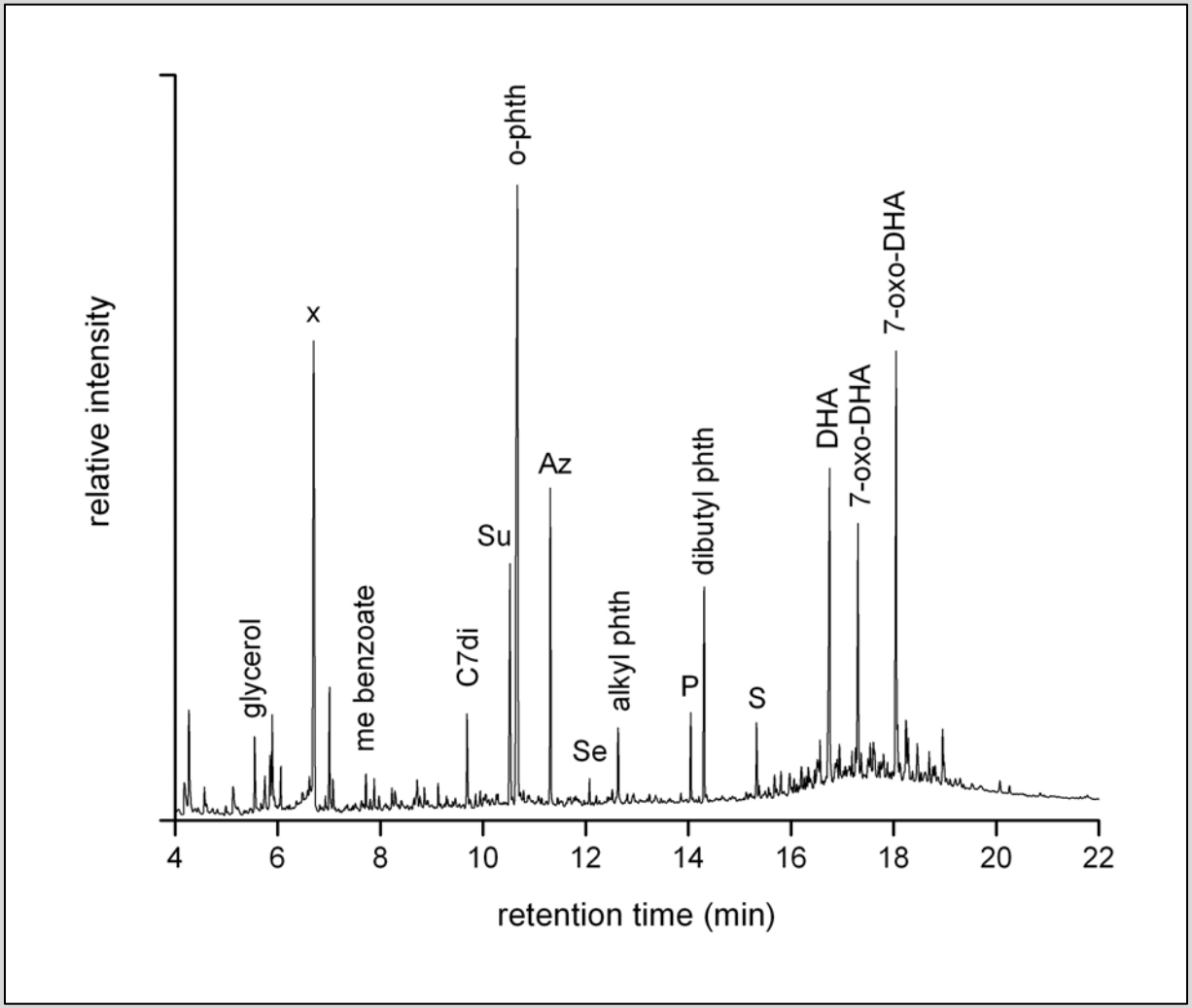
Site E01F – “HC” graffiti

Site E01F “HC”

SAMPLING GRAFFITI August 2010

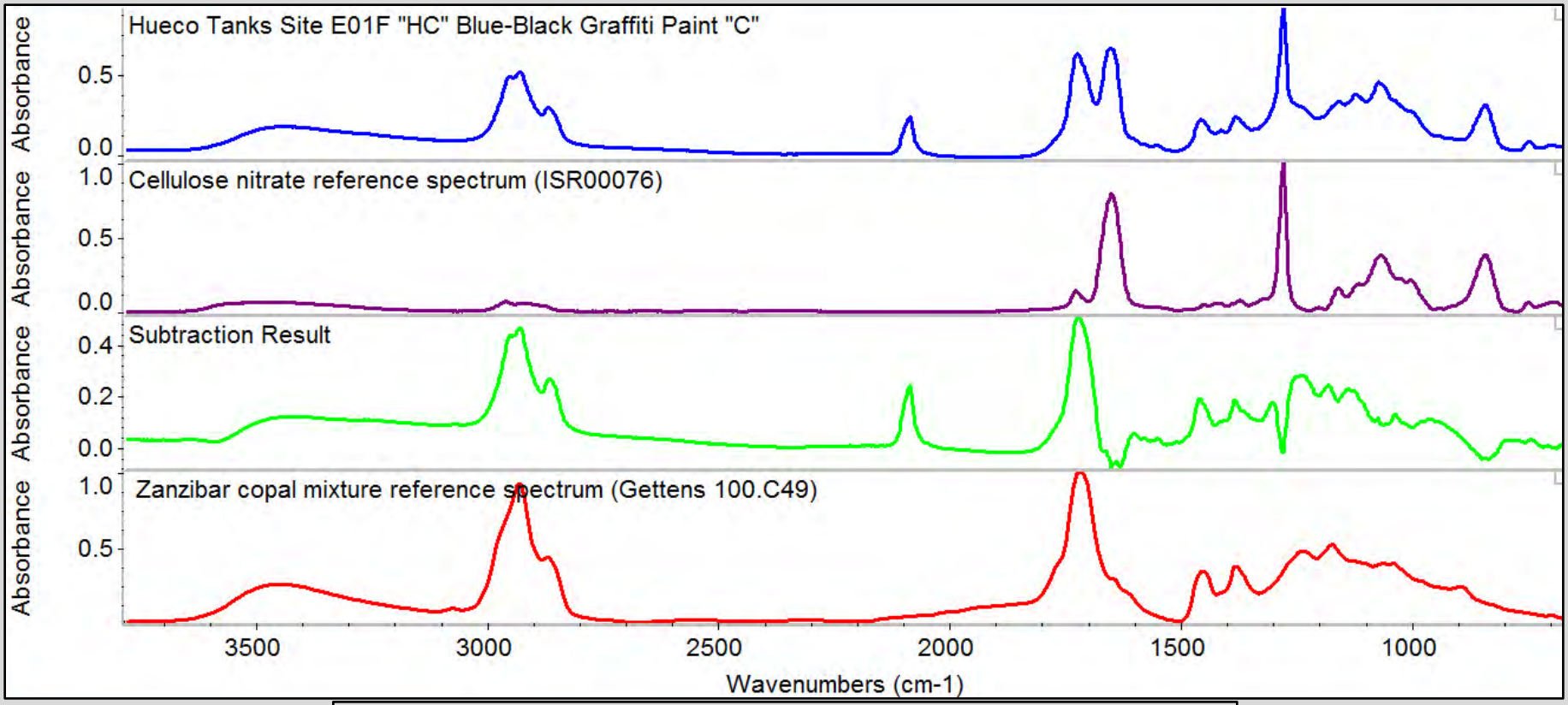
prior determination of underlying and poorly visible material

Site E01F “HC” – Media



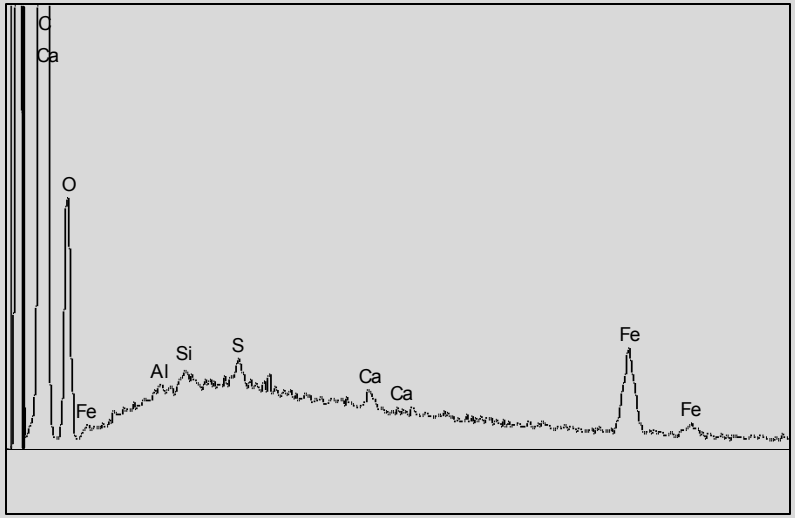
PyGCMS:: Oxidized diterpenes (DHA and 7-oxo DHA); probably Pinaceae
Dimethyl and dibutyl phthlates, P, S, Az FA's (drying oil)

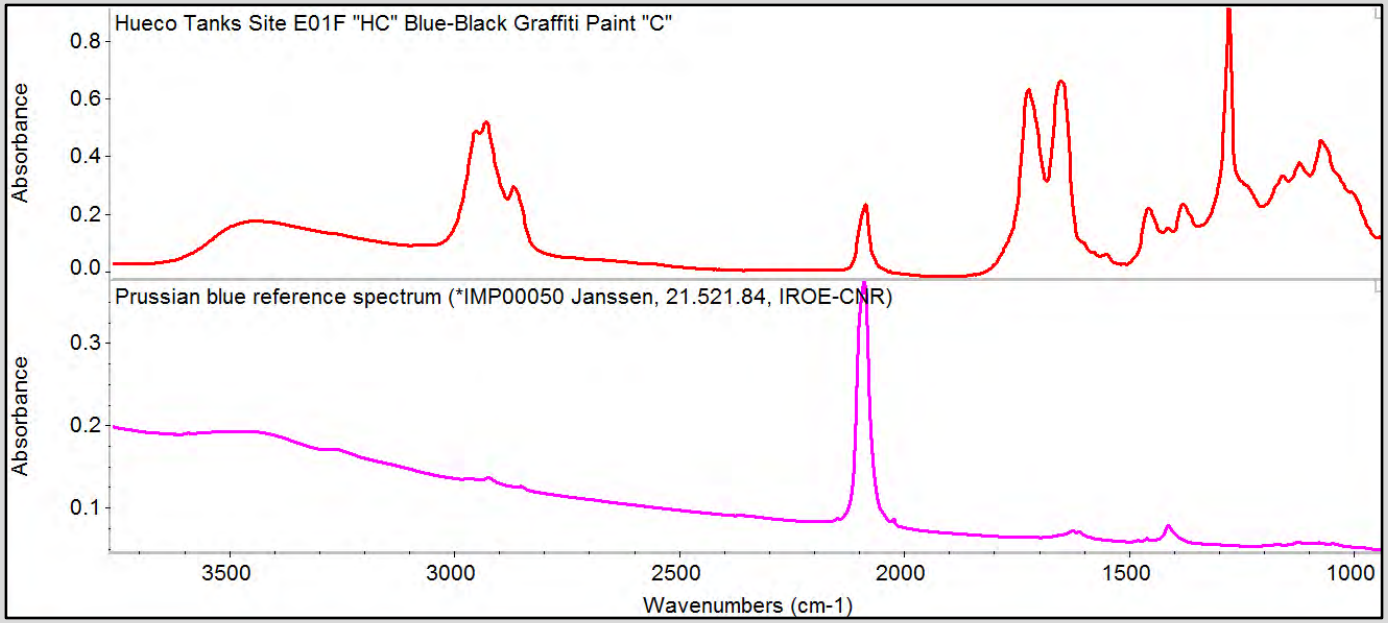
Site E01F “HC” – Media



MFTIR:
Blue-back graffiti paint (top)
CN reference spectrum (second)
Natural resin phase (third)

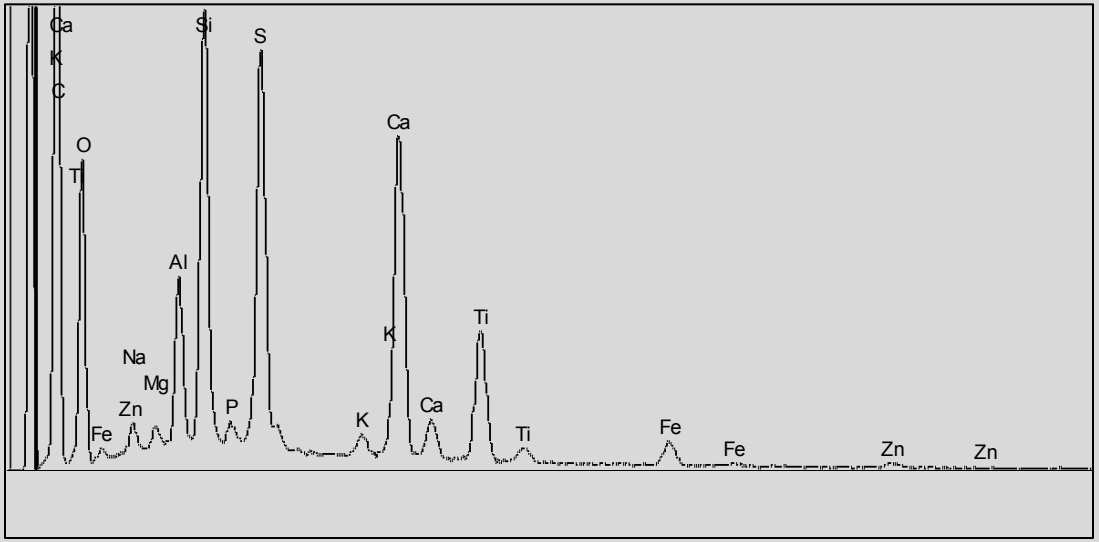
Site E01F “HC” – Pigments

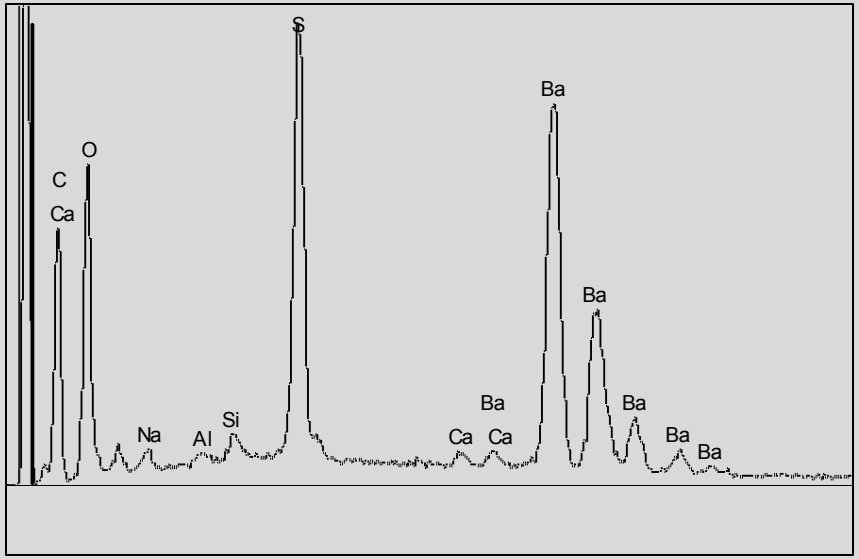




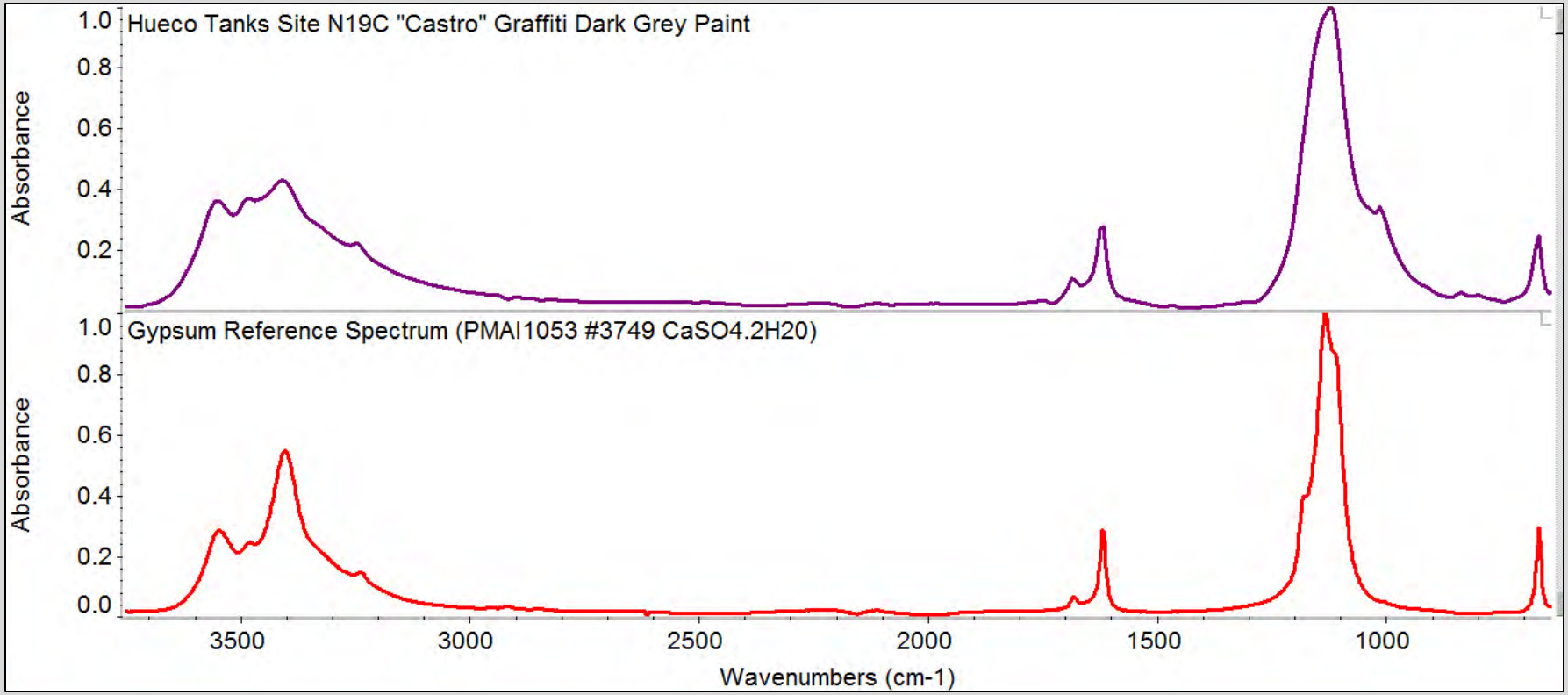
Site N19C “Castro”

Site N19C “Castro” – Fillers/Pigments

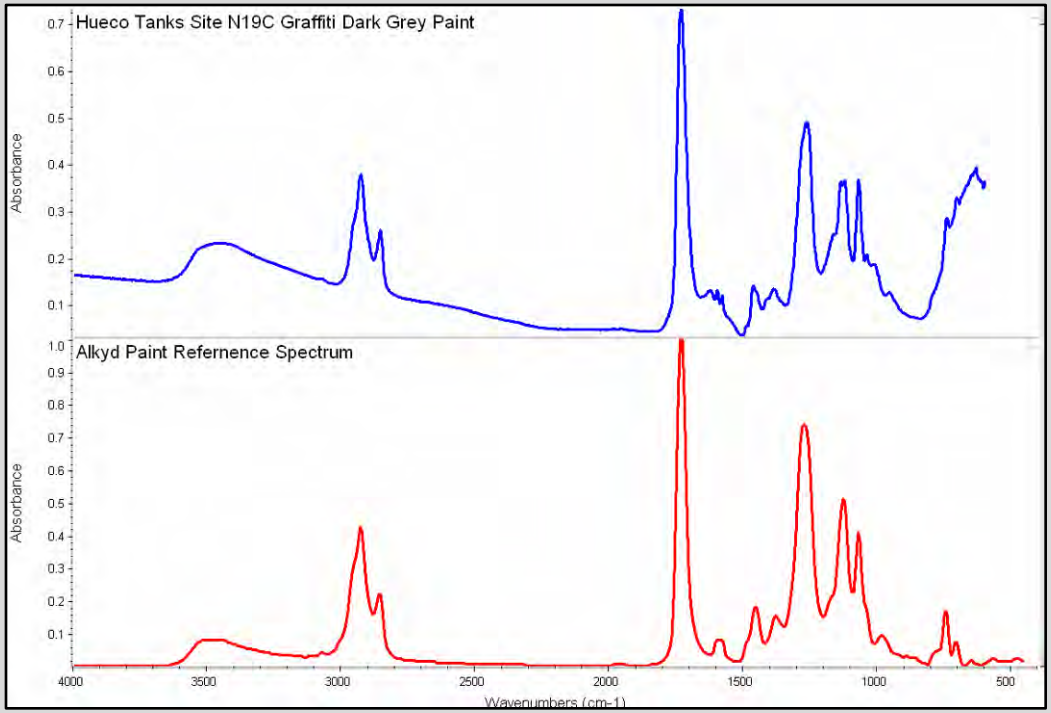


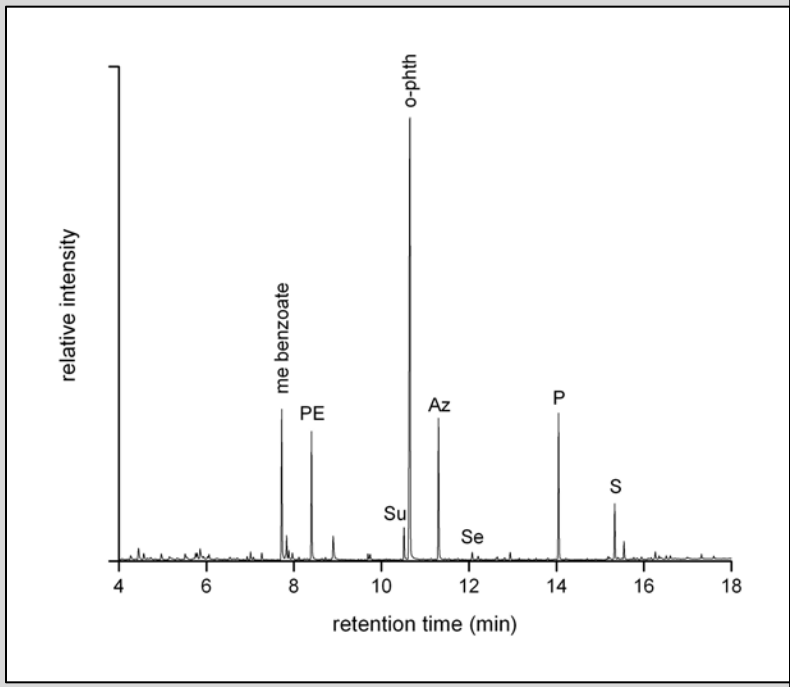


Site N19C, CASTRO: FTIR, filler - gypsum



Site N19C “Castro” – Media





MFTIR:
Grey graffiti paint from site (top)
Alkyd paint reference (bottom)

PyGCMS:
Me-benzoate
PE (≥ 1960)
Ortho phthlate
P, S, Az FAMES

In Situ Analysis of Pictographs

- No sampling allowed

In Situ Analysis Challenges

Bruker Instrumentation for on site NDT

XRF Tracer
15 KV, 23 µA: 40KV, 11.2 µA

Alpha DRIFT
Res 4cm^{-1} DTGS detector
375 – 4000 cm^{-1}

Sentinel
80mW @ sample
90 - 2175 cm^{-1}
Res 3.0 cm^{-1}

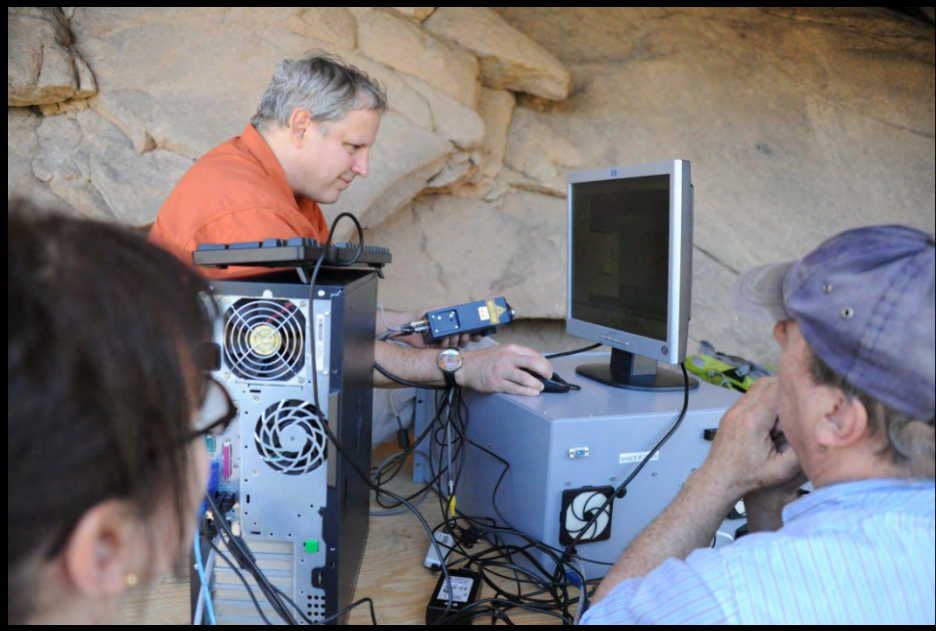
XRF Set-up

RAMAN CAMERA
USES LASER for SAMPLE LOCATION AND WHITE LIGHT FOR IMAGING

Raman set-up

Low ambient light requirement

Measurements after dusk

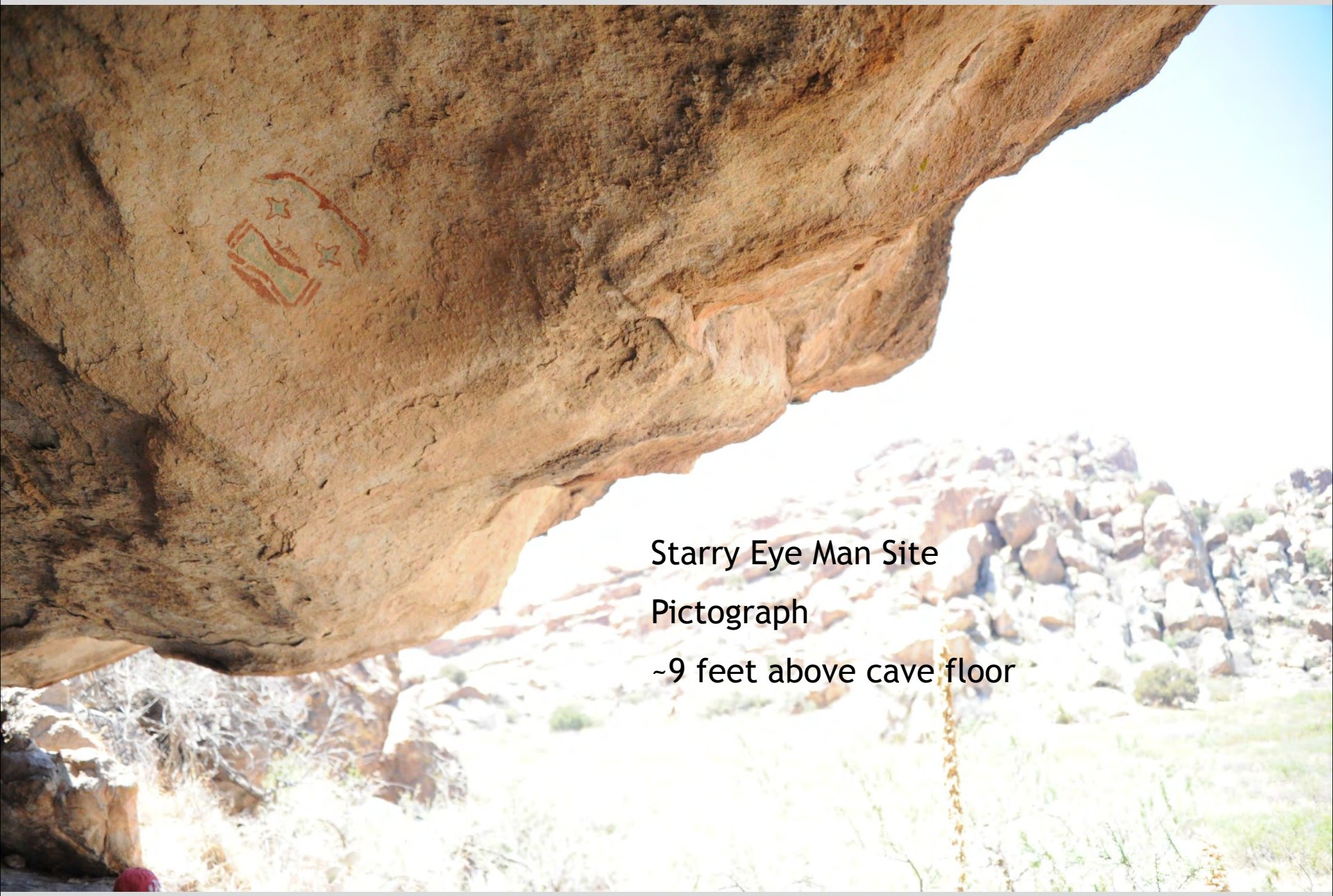


DRIFT Set-up

Spacing/Gap is 1/2” between pictograph and instrument

Pictograph
Site E10C “Starry Eyed Man”

Native American,
Jonada Mogollon
Culture
450-1400 AD

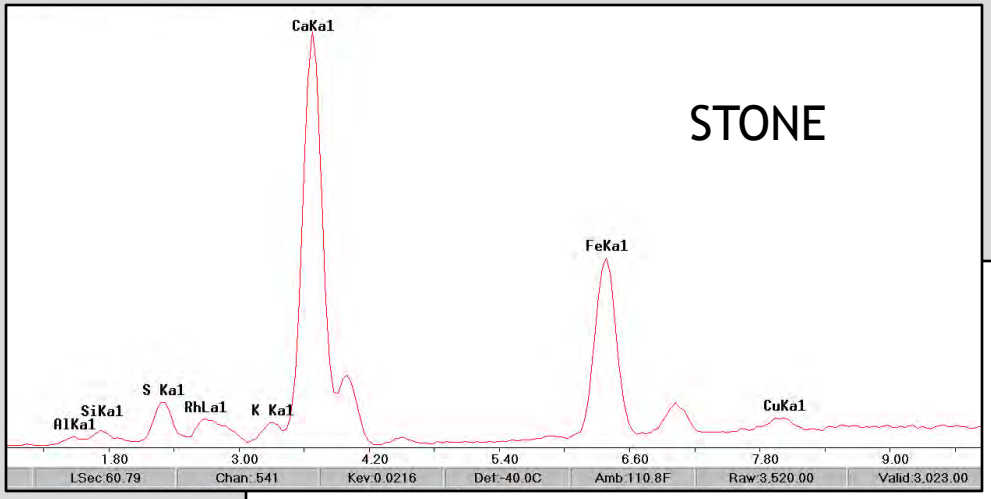


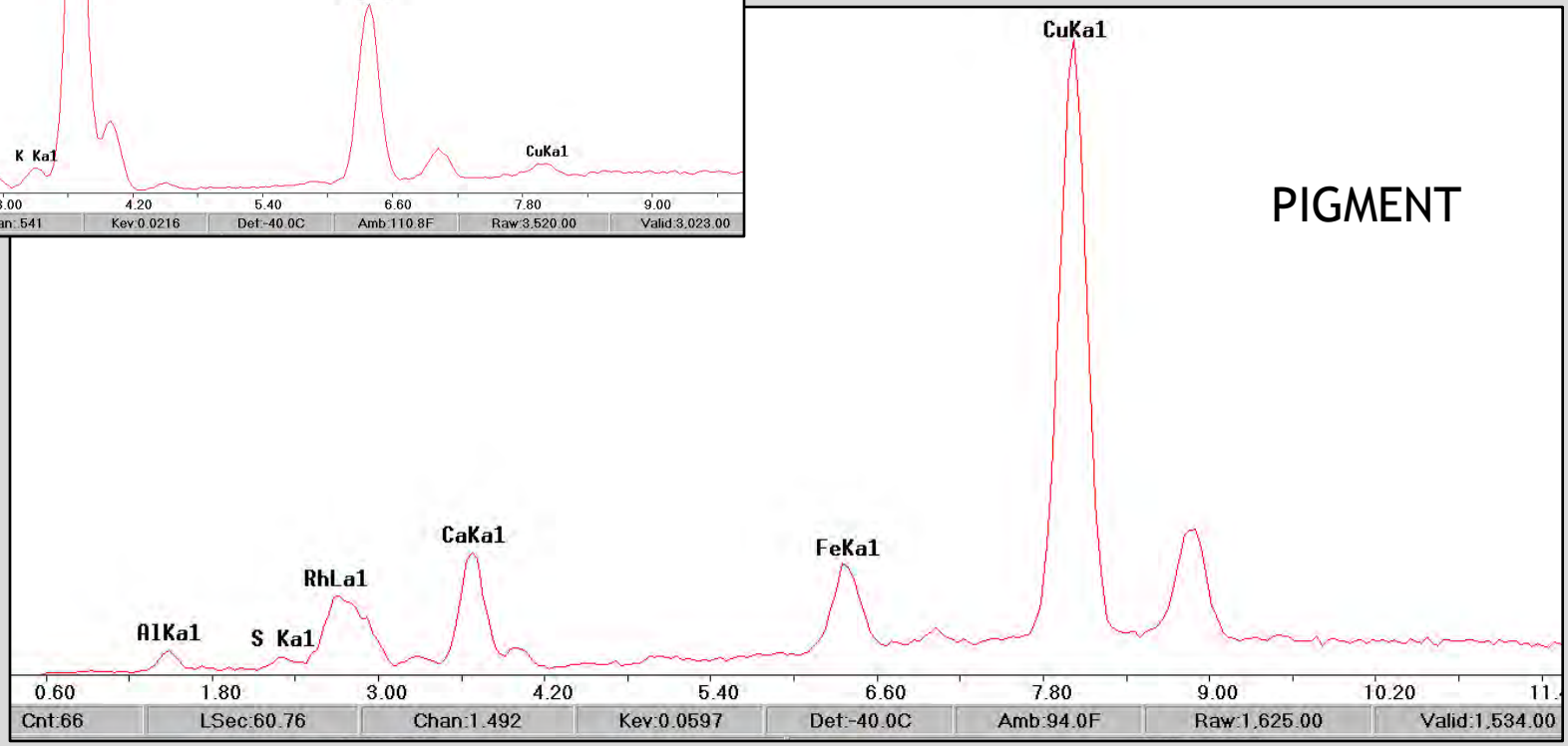
Starry Eye Man Site

Pictograph

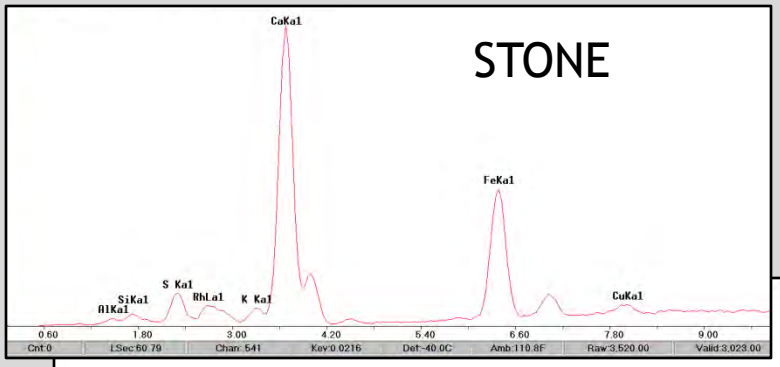
~9 feet above cave floor

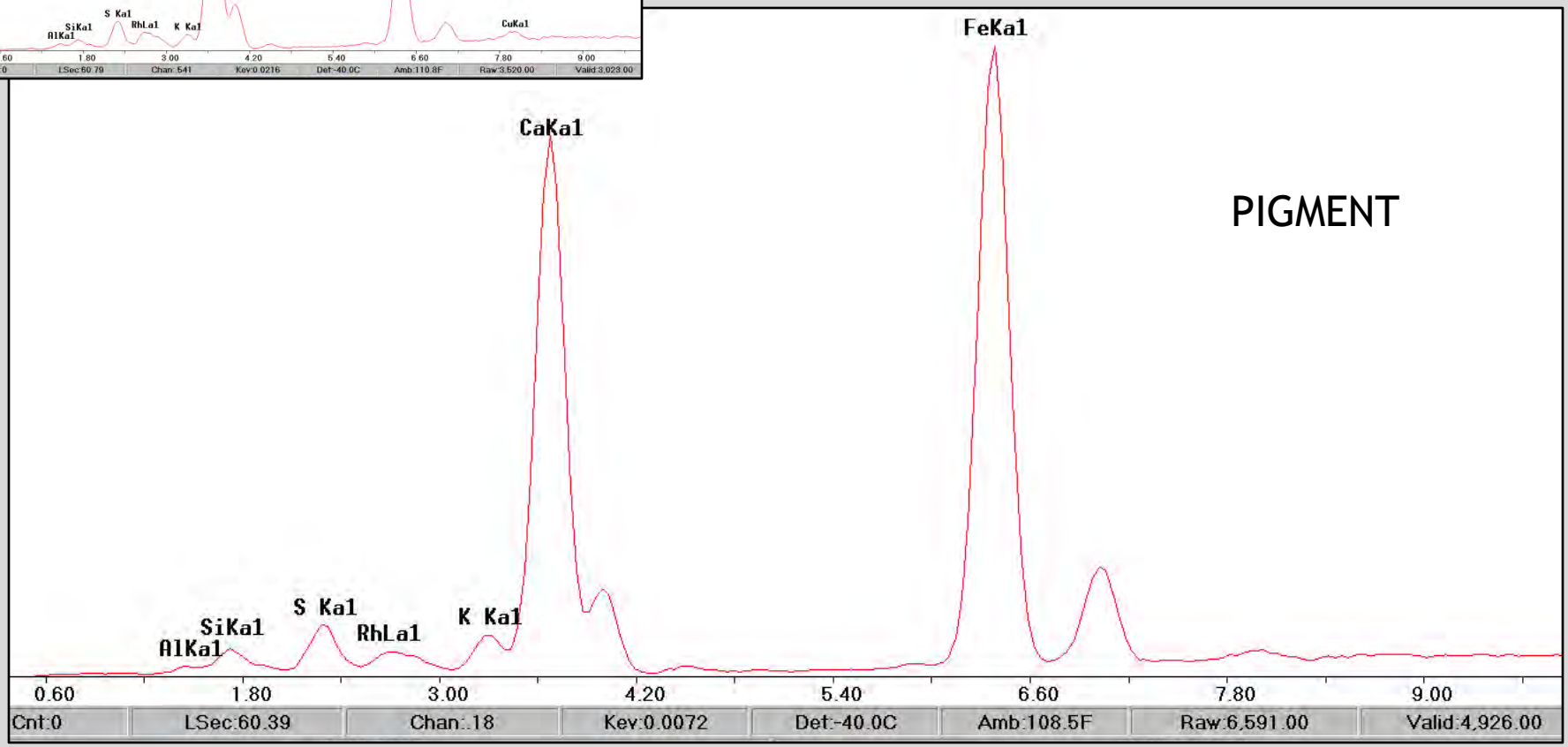
Site E10C, Starry Eye Man: Pigments – XRF - Green



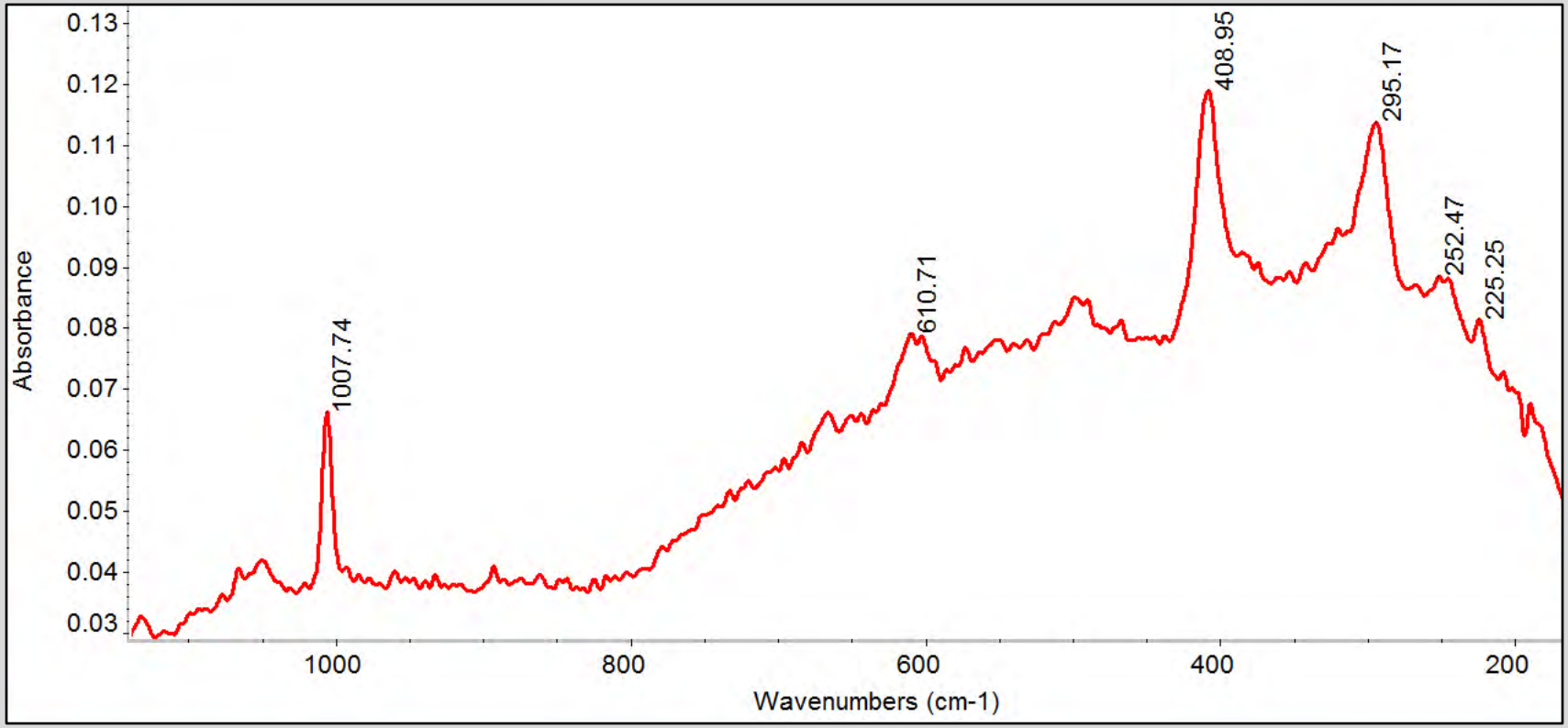


Site E10C Pigments – XRF - Red



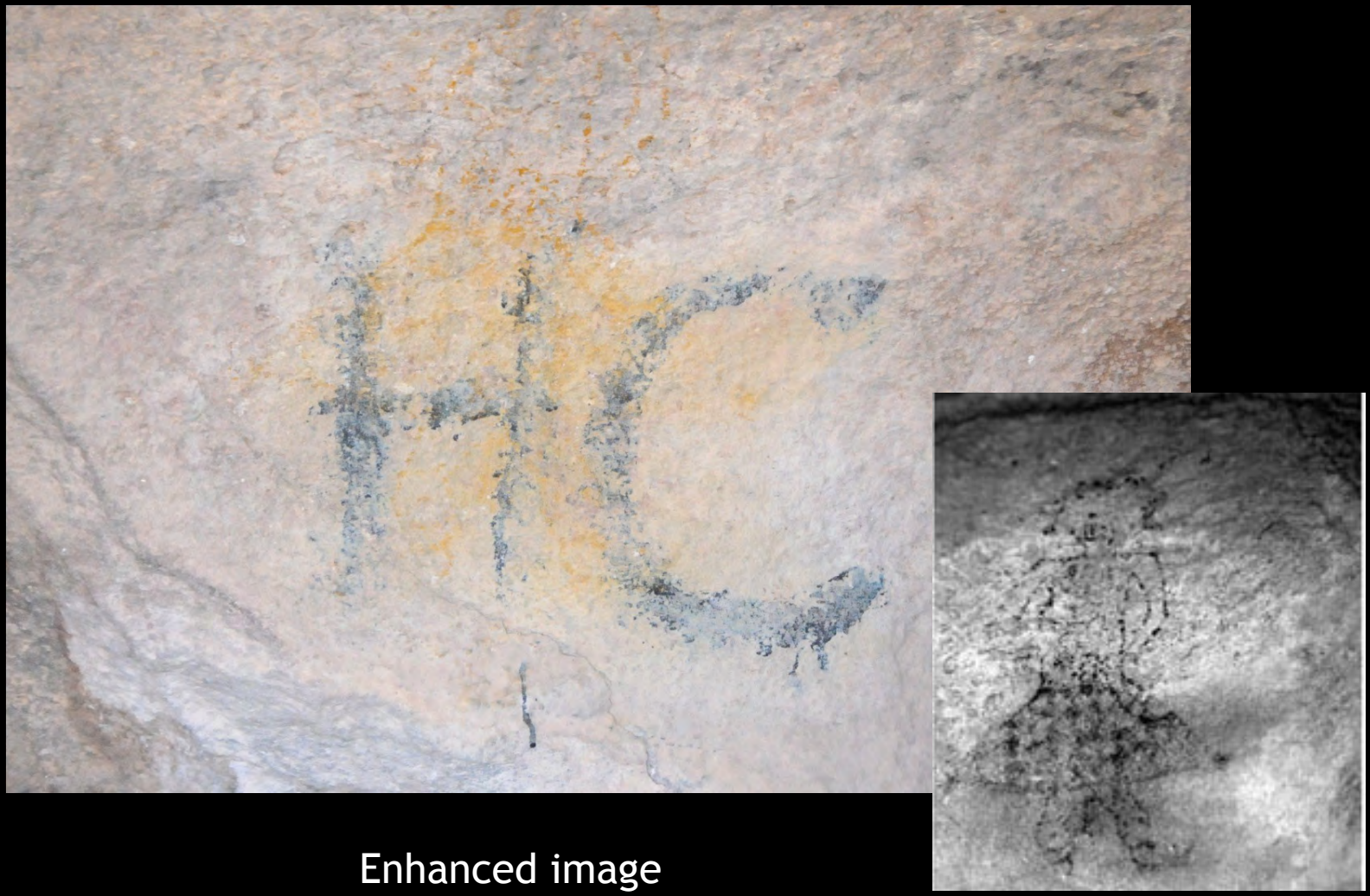


Site E10C Pigments – Raman : Hematite + Gypsum



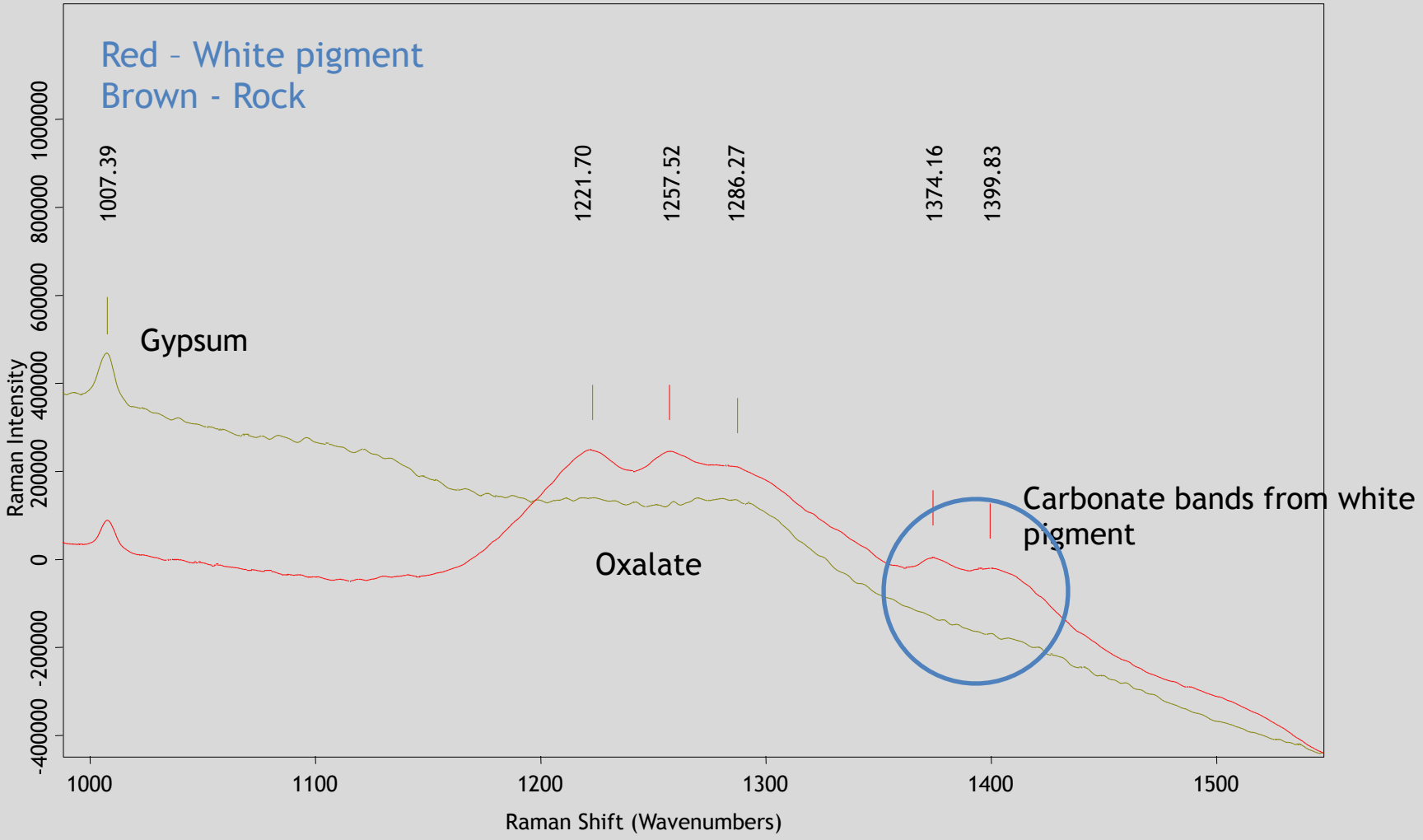
First successful in situ NDT Raman analysis for rock art
In the US

PICTOGRAPH EOIF : DANCING FIGURE

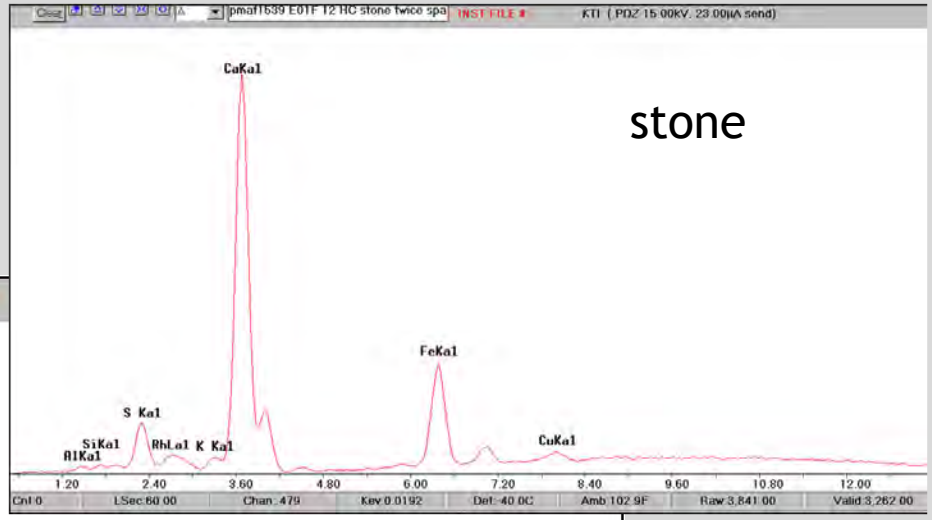


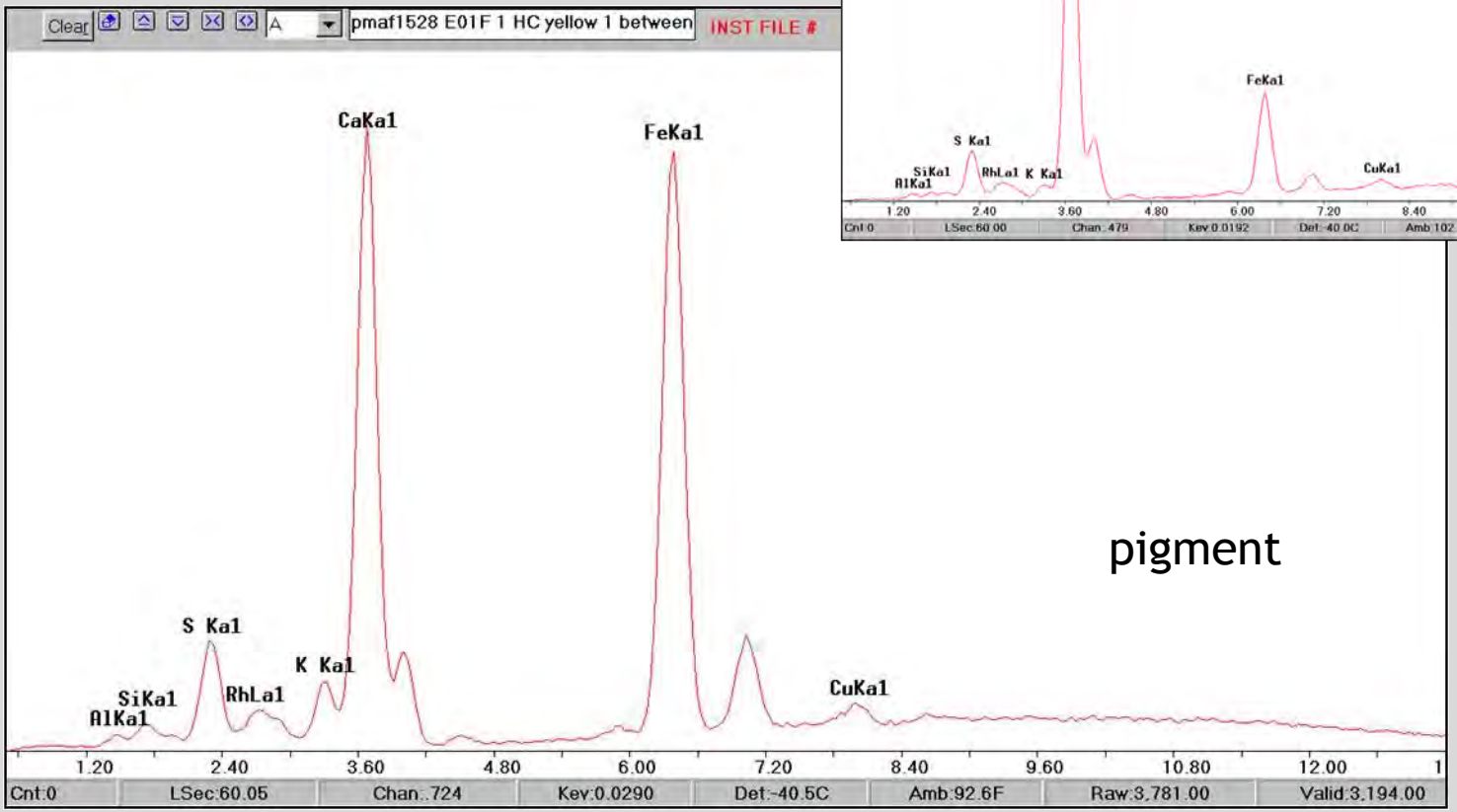
Enhanced image

WHITE PIGMENT AND ROCK SUBSTRATE E01C

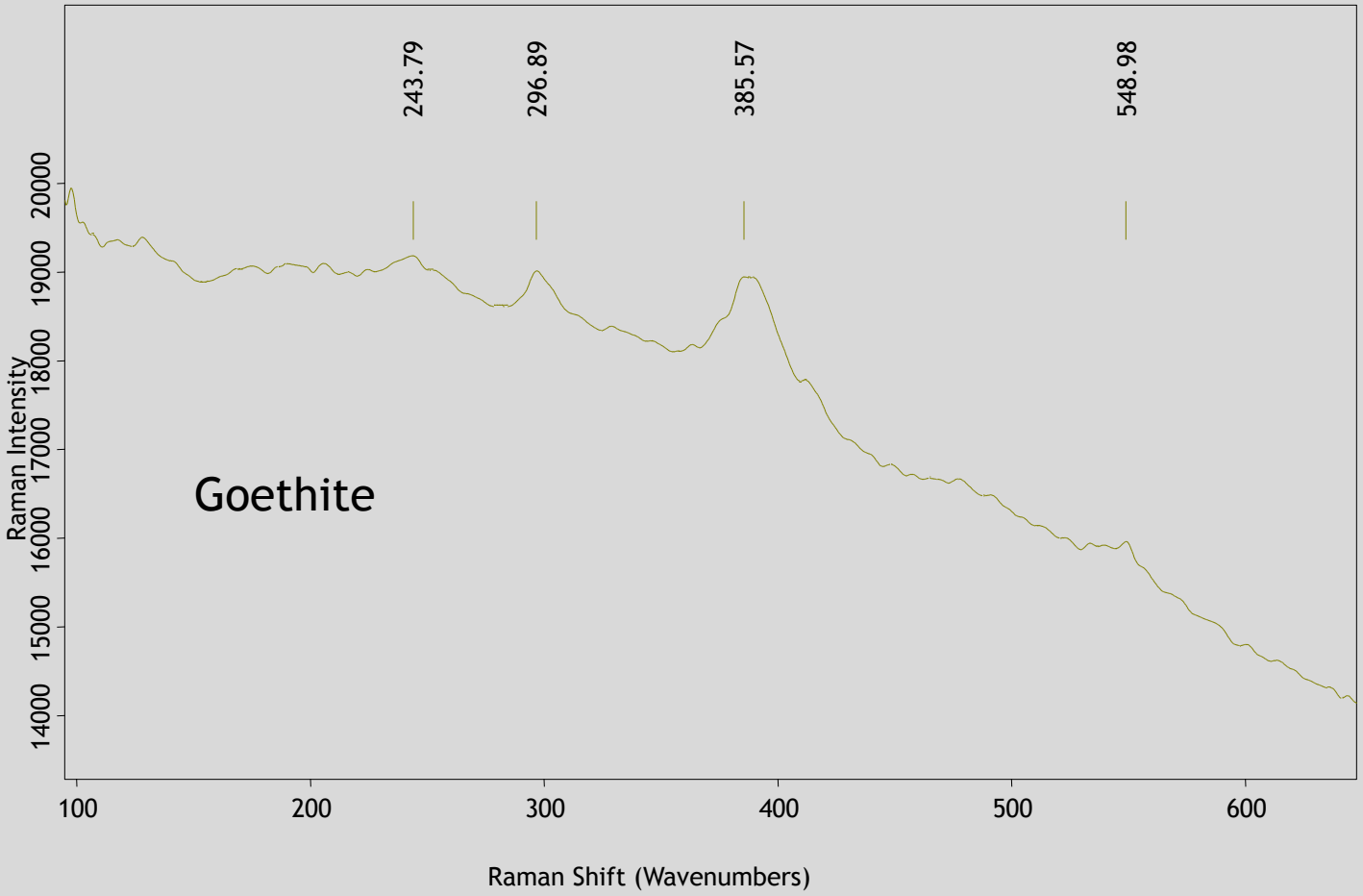


E01F, Dancing Figure; pigment vs stone XRF Data





EO1C RAMAN OF YELLOW PIGMENT FROM DANCING FIGURE



NEXT STEPS

CREATE SURROGATE SAMPLES OF ‘GRAFFITI’ OVER ‘PICTOGRAPHS’

EVALUATE DIFFERENT FLUENCES AND ABSORPTION TO OPTIMIZE CONDITIONS FOR LASER CLEANING

EXAMINE CLEANED SURROGATE SAMPLES BY SEM-EDS FOR BEAM DAMAGE OR OTHER SURFACE ALTERATION PRIOR TO FIELD TESTS

Acknowledgements

Texas Parks & Wildlife

Tim Roberts, Wanda Olszewski, Michael Strutt

Bruker

Tom Tague and Bruce Kaiser

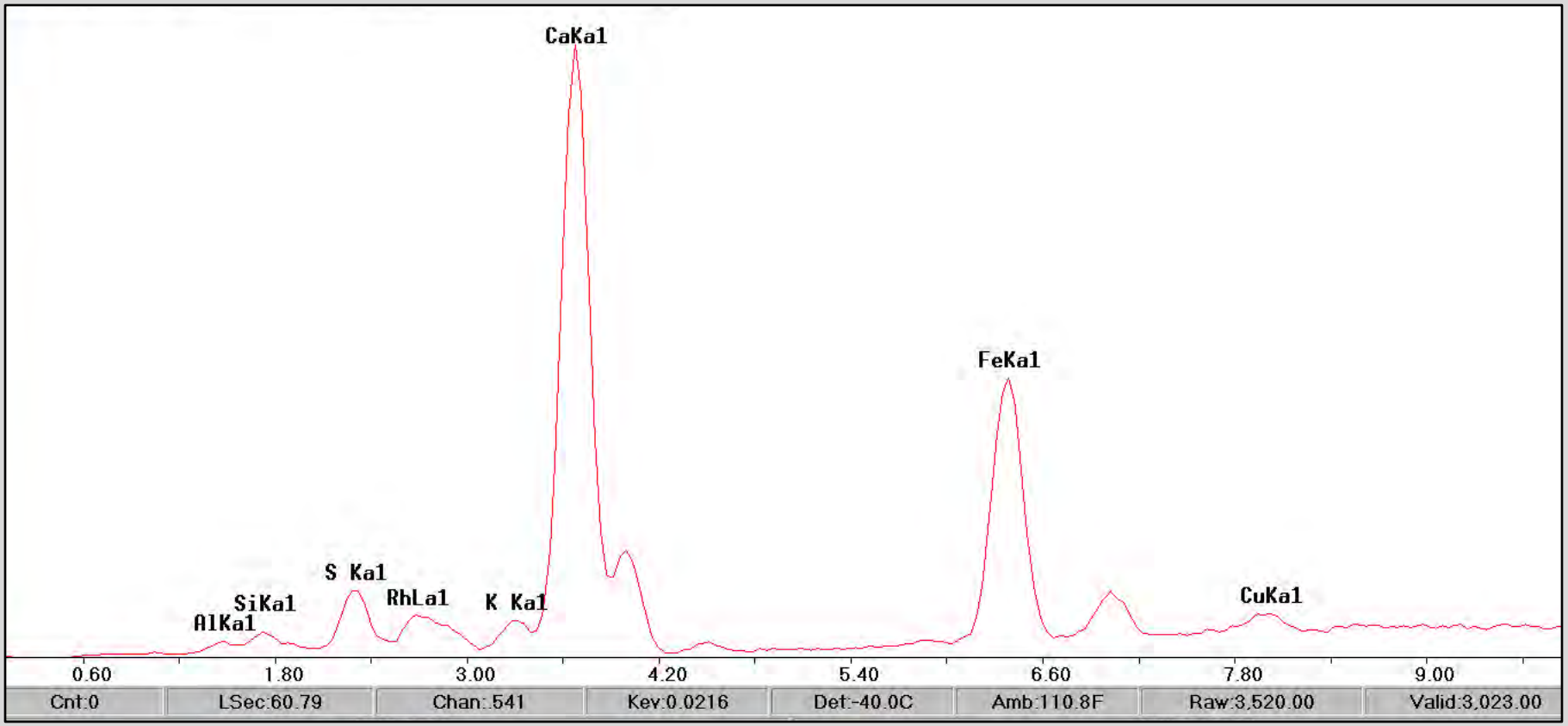
PMA

Timothy Rub, Terra Huber, Chris Wasson, with Katherine Lins

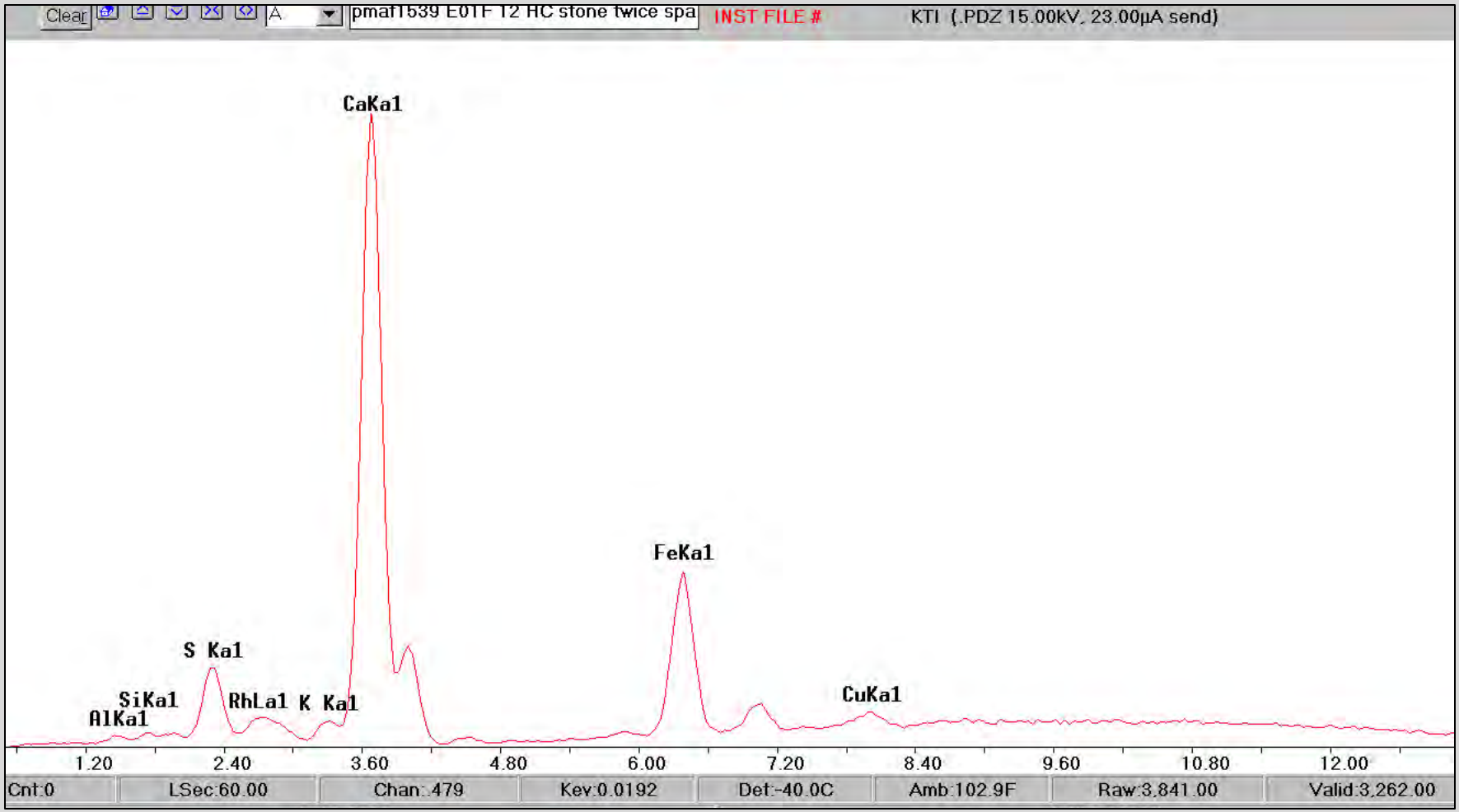
Show enhanced image E01F

Transportation Challenges

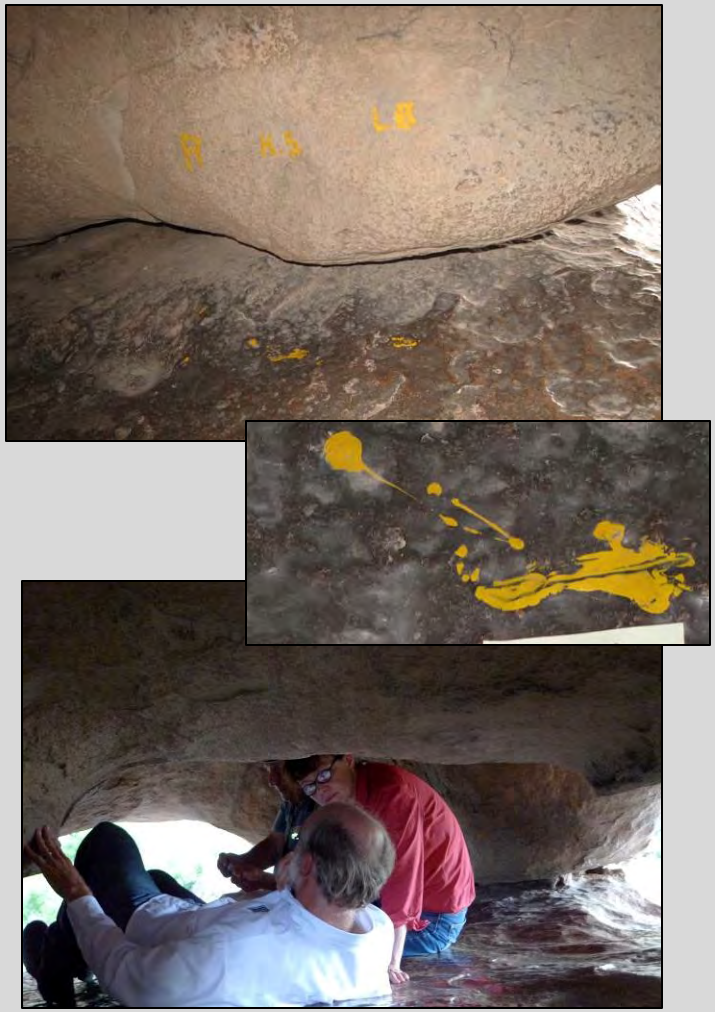
Site E10C Pigments – XRF Stone

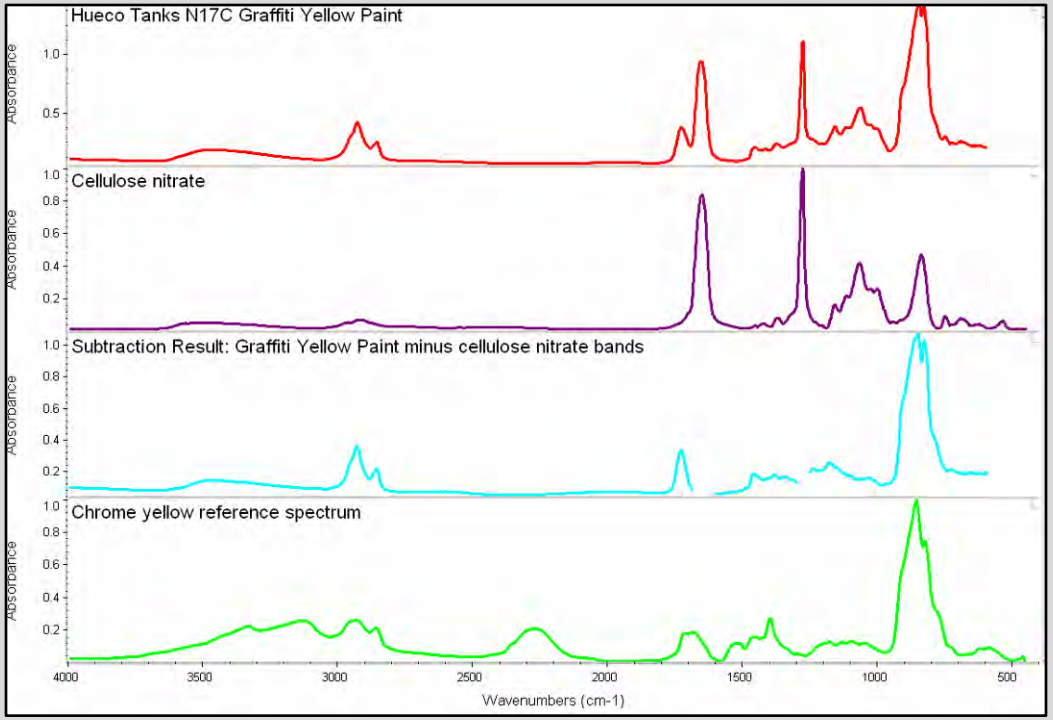


E01F Dancing Figure: XRF Results

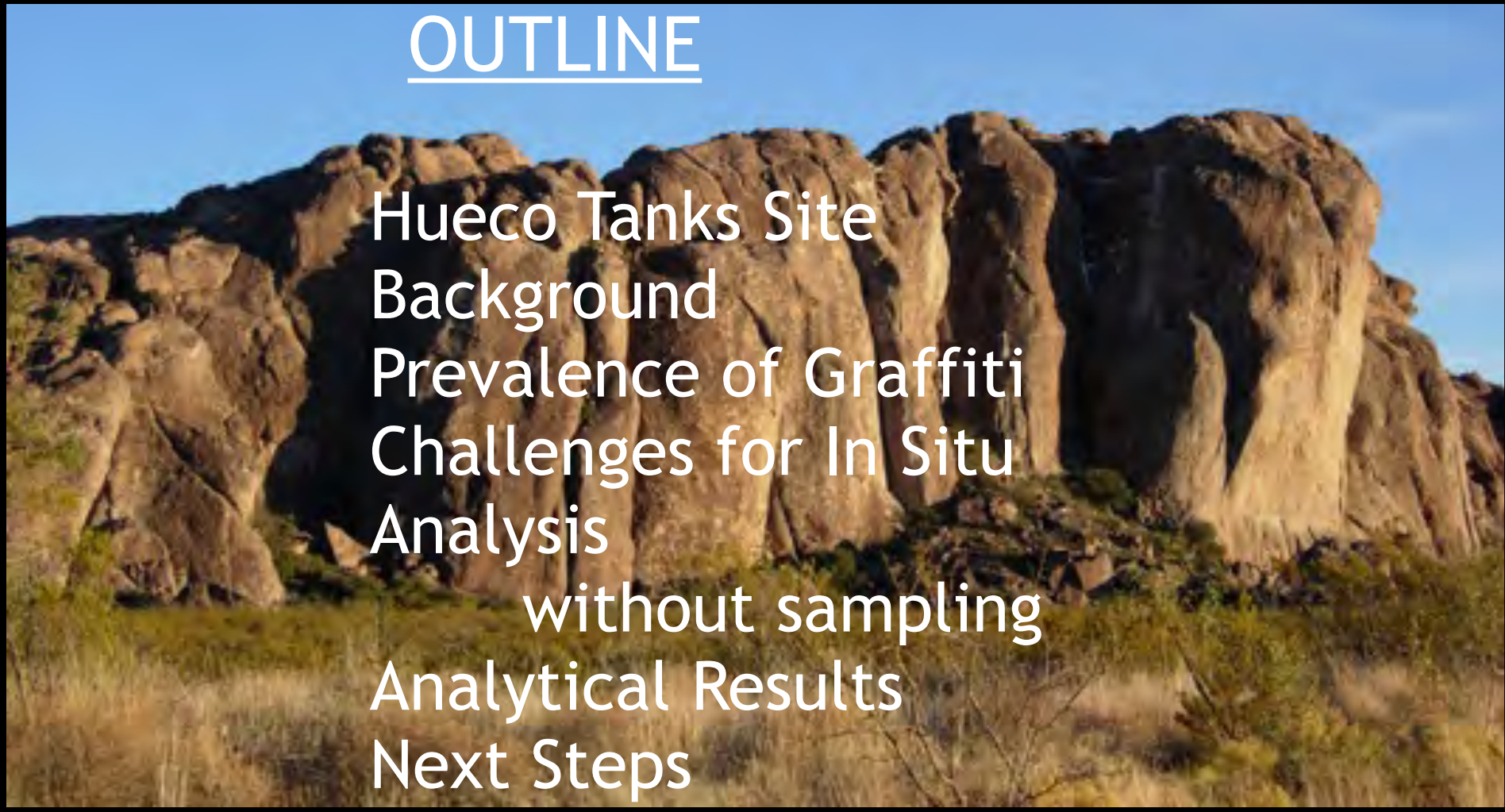


Provide Support to Outside Insitutions: Hueco Tanks, Texas Parks & Wildlife Dept





Yellow paint from site (top)
Cellulose nitrate (middle-top)
Subtraction result (middle-bottom)
Alkyd paint reference (bottom)



OUTLINE

- Hueco Tanks Site Background
- Prevalence of Graffiti
- Challenges for In Situ Analysis
  - without sampling
- Analytical Results
- Next Steps

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