

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
CSOS

Andrzej Dajnowski -



HUECO TANKS



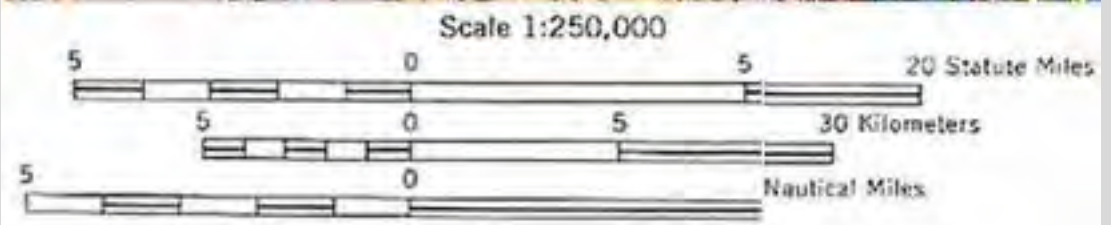
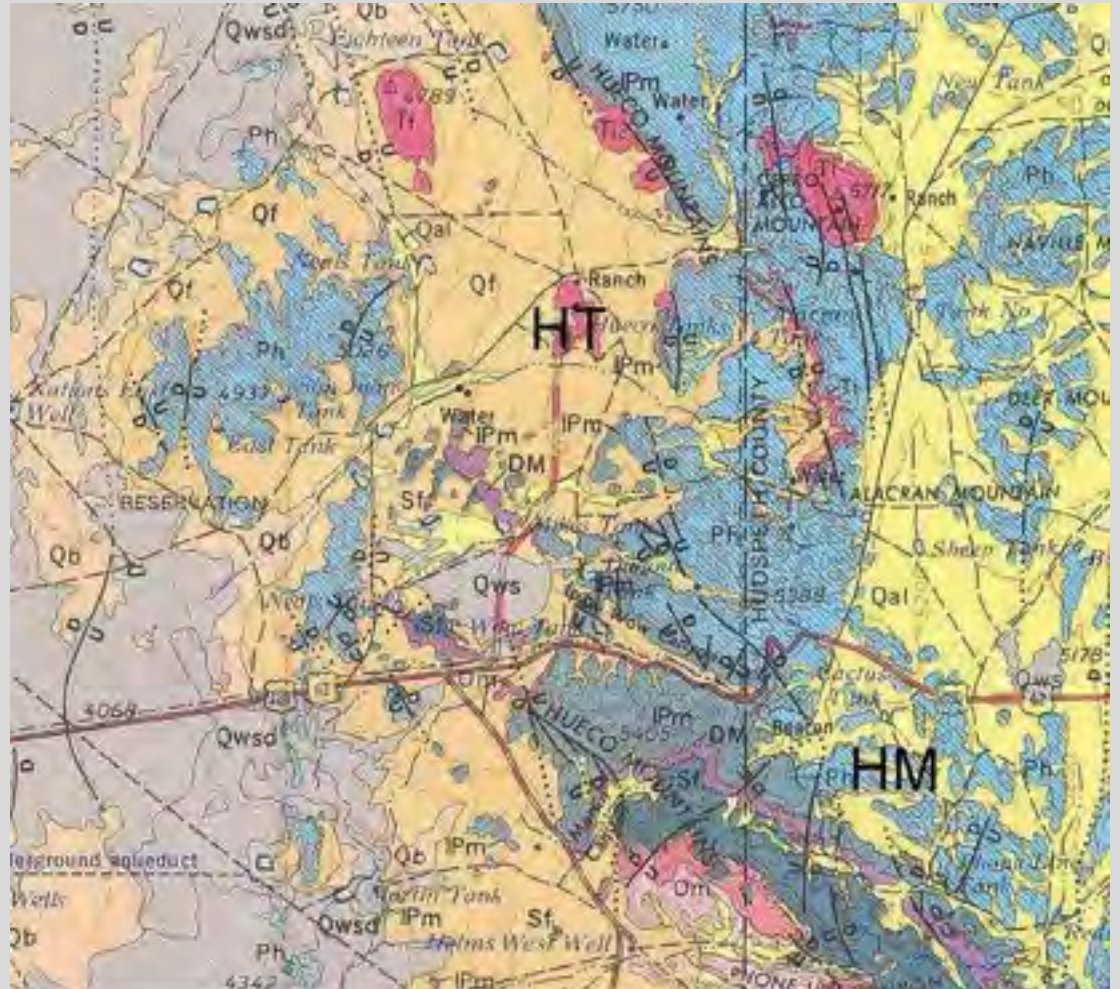
OUTLINE

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

MAJOR U.S. ROCK CLIMBING SITE

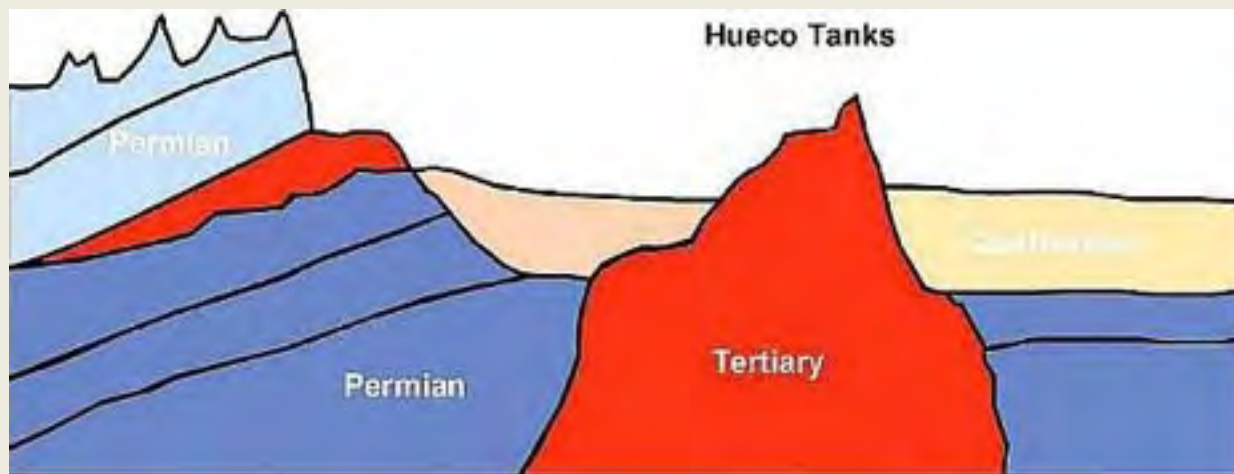


Hueco Tanks Site



HUECO TANKS

A LACCOLITHIC IGNEOUS INTRUSION OF PORPHYRYTIC 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

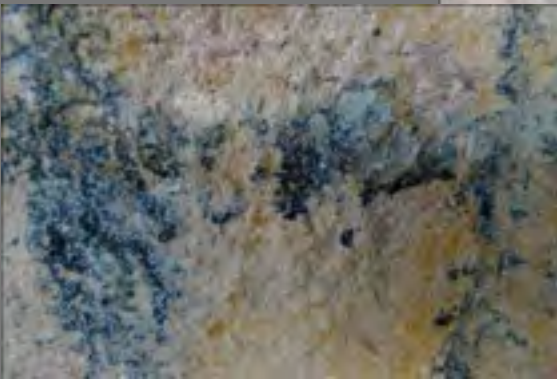
Pictographs – no sampling – XRF, Raman, DRIFT



Site E01F – “HC” graffiti



Site E01F “HC”

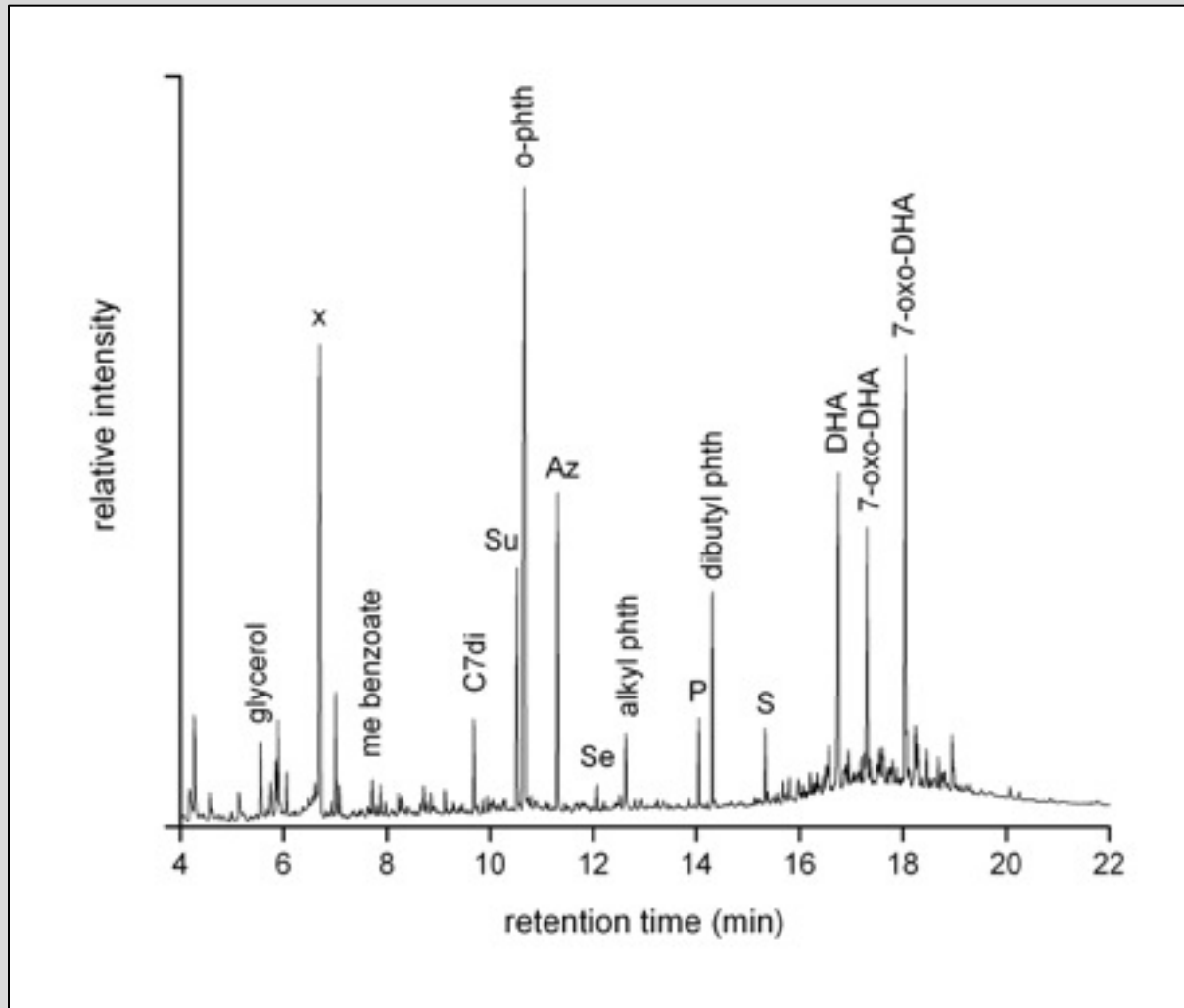


SAMPLING GRAFFITI August 2010



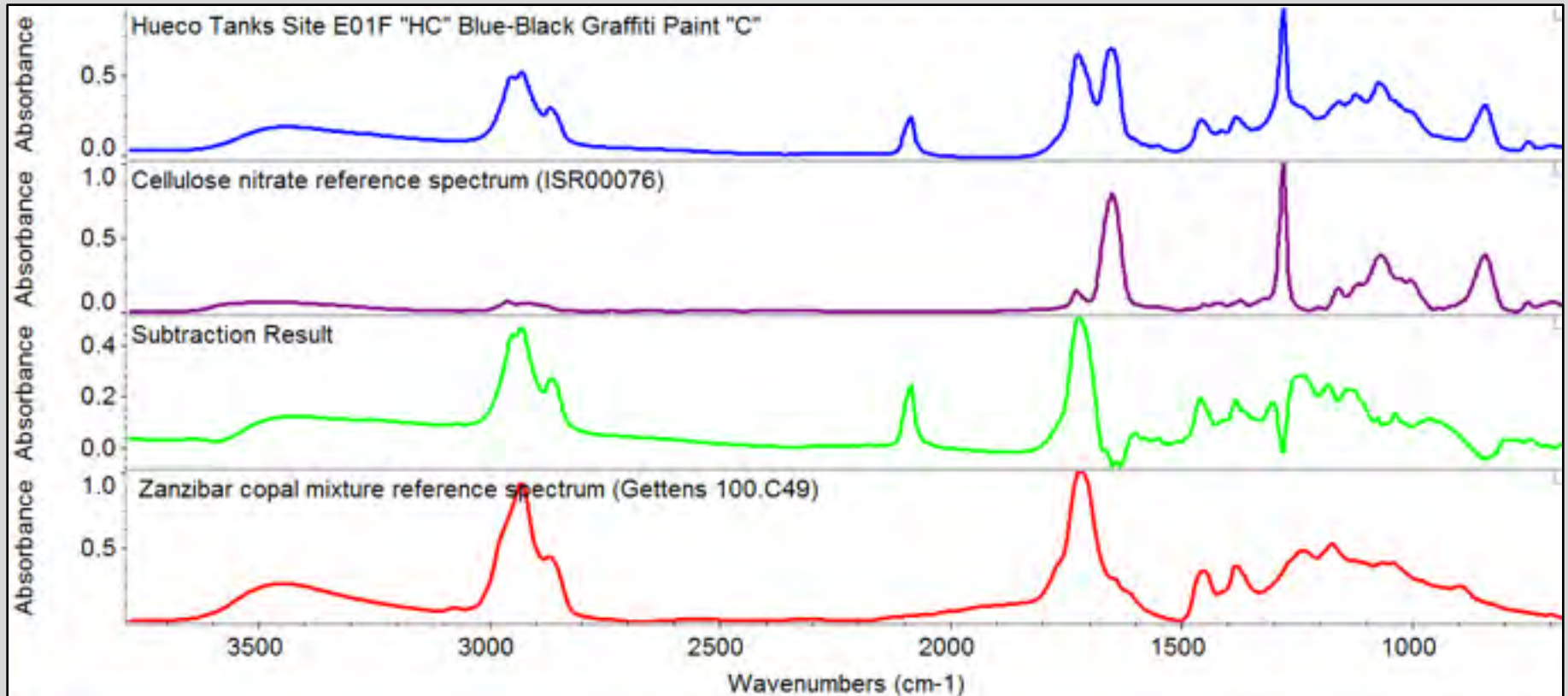
prior determination of underlying and poorly visible material

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:

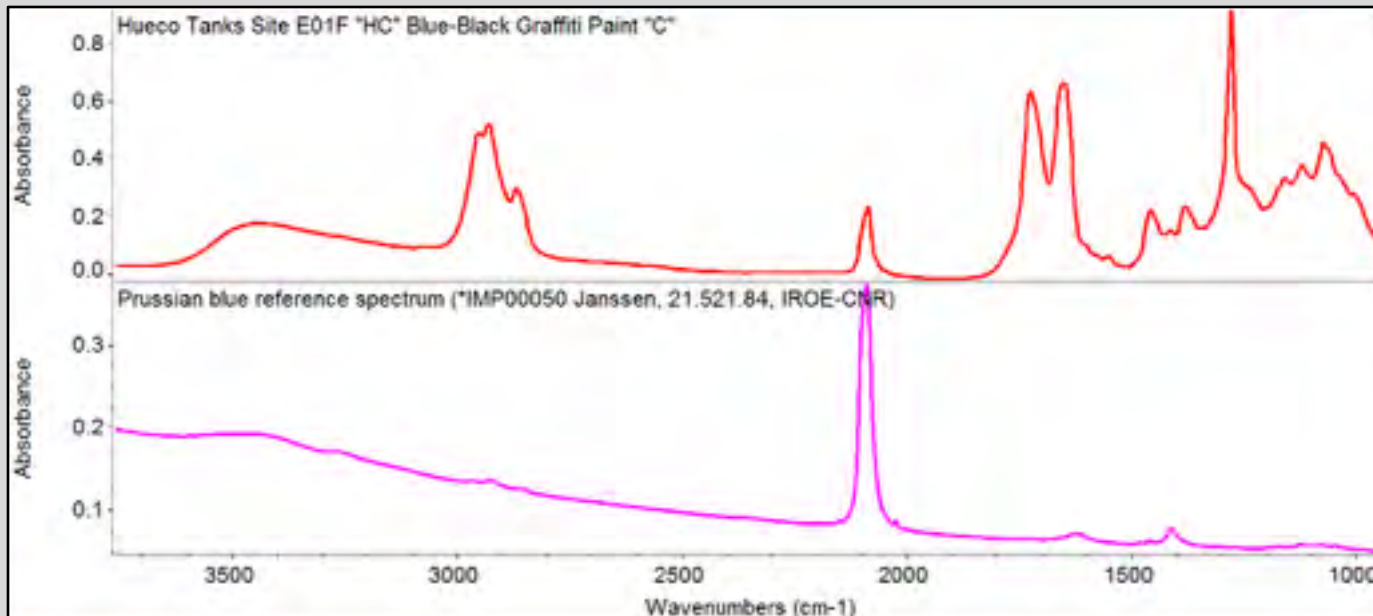
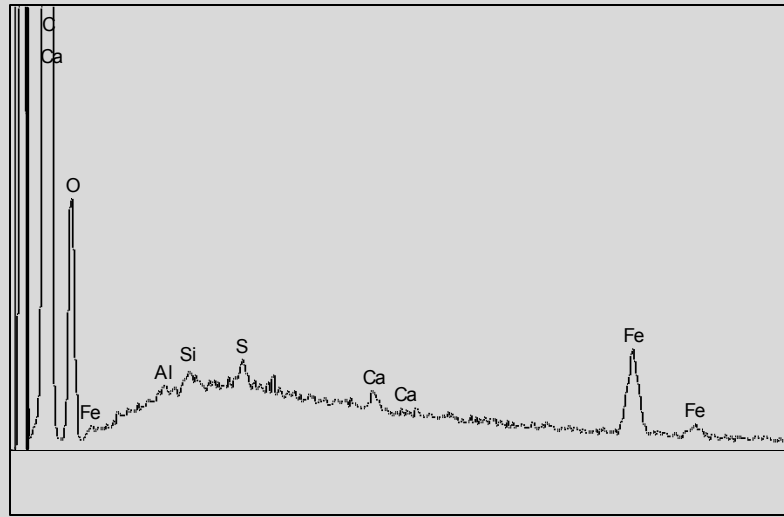
Blue-back graffiti paint (top)

CN reference spectrum (second)

Natural resin phase (third)

Natural resin reference spectrum (bottom)

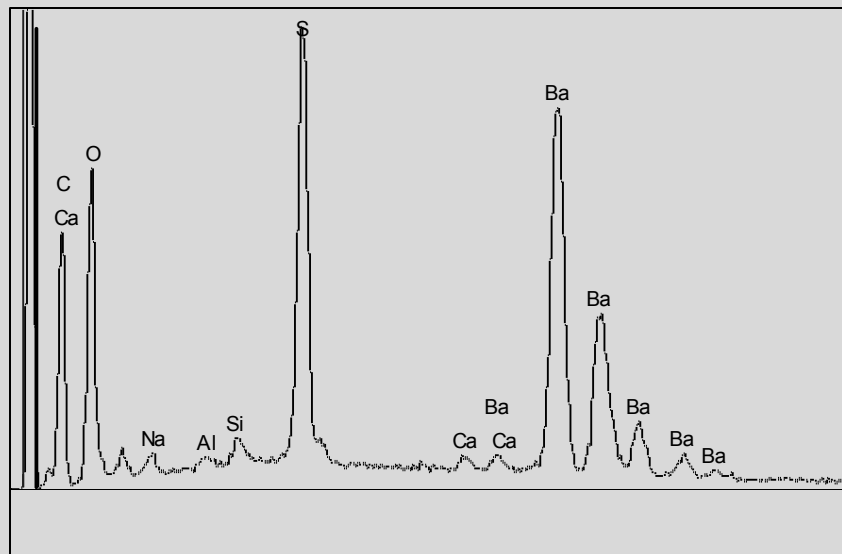
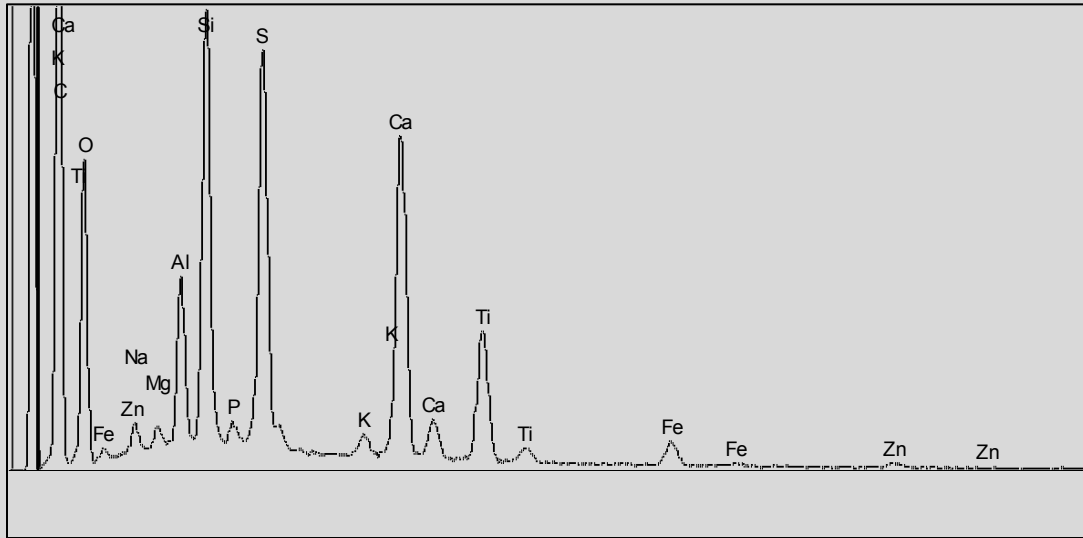
Site E01F "HC" – Pigments



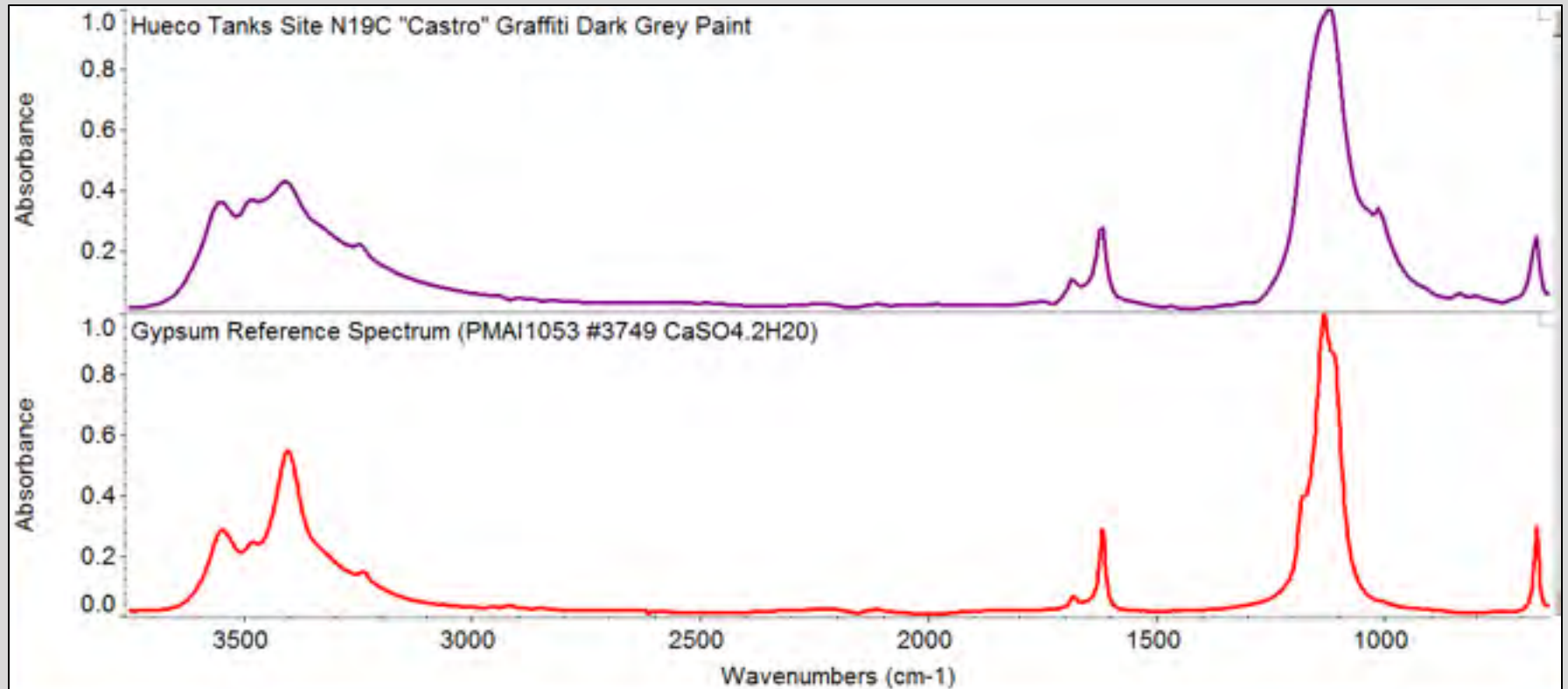
Site N19C “Castro”



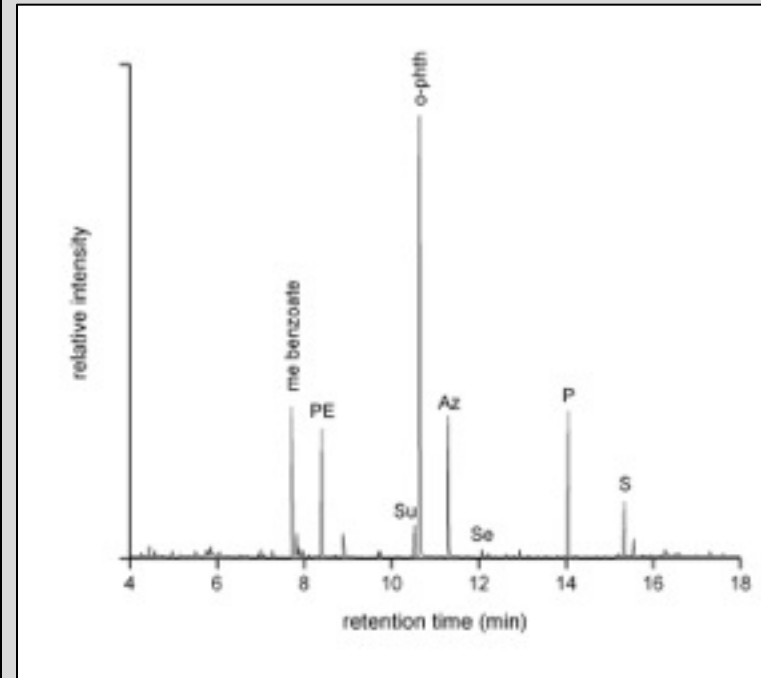
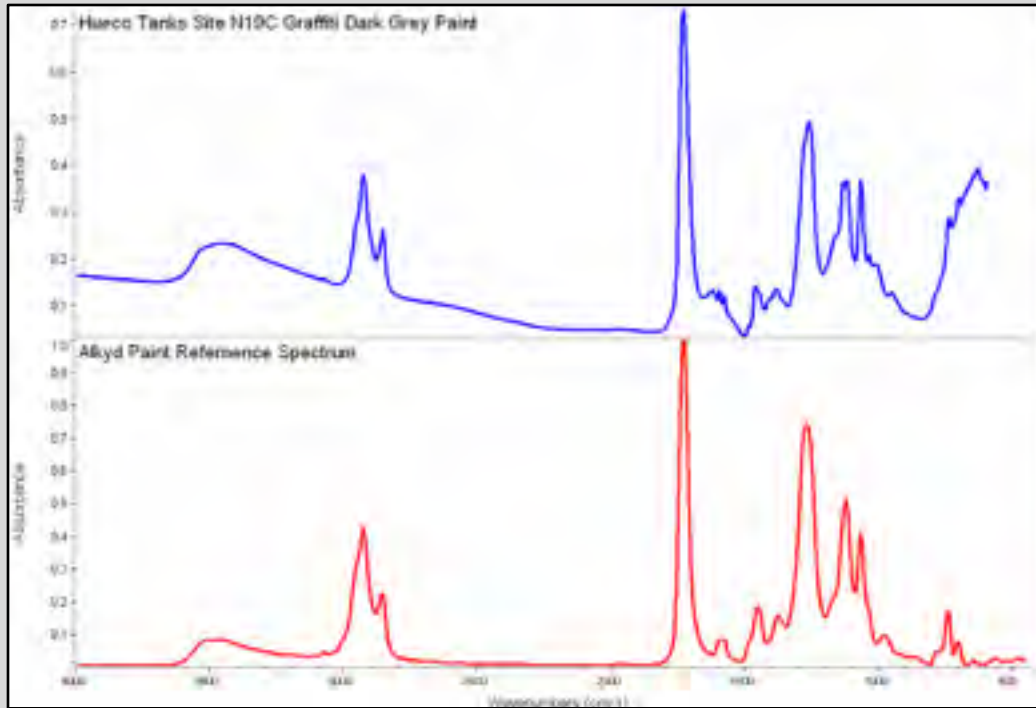
Site N19C "Castro" – Fillers/Pigments



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 μ A: 40KV, 11.2 μ A



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

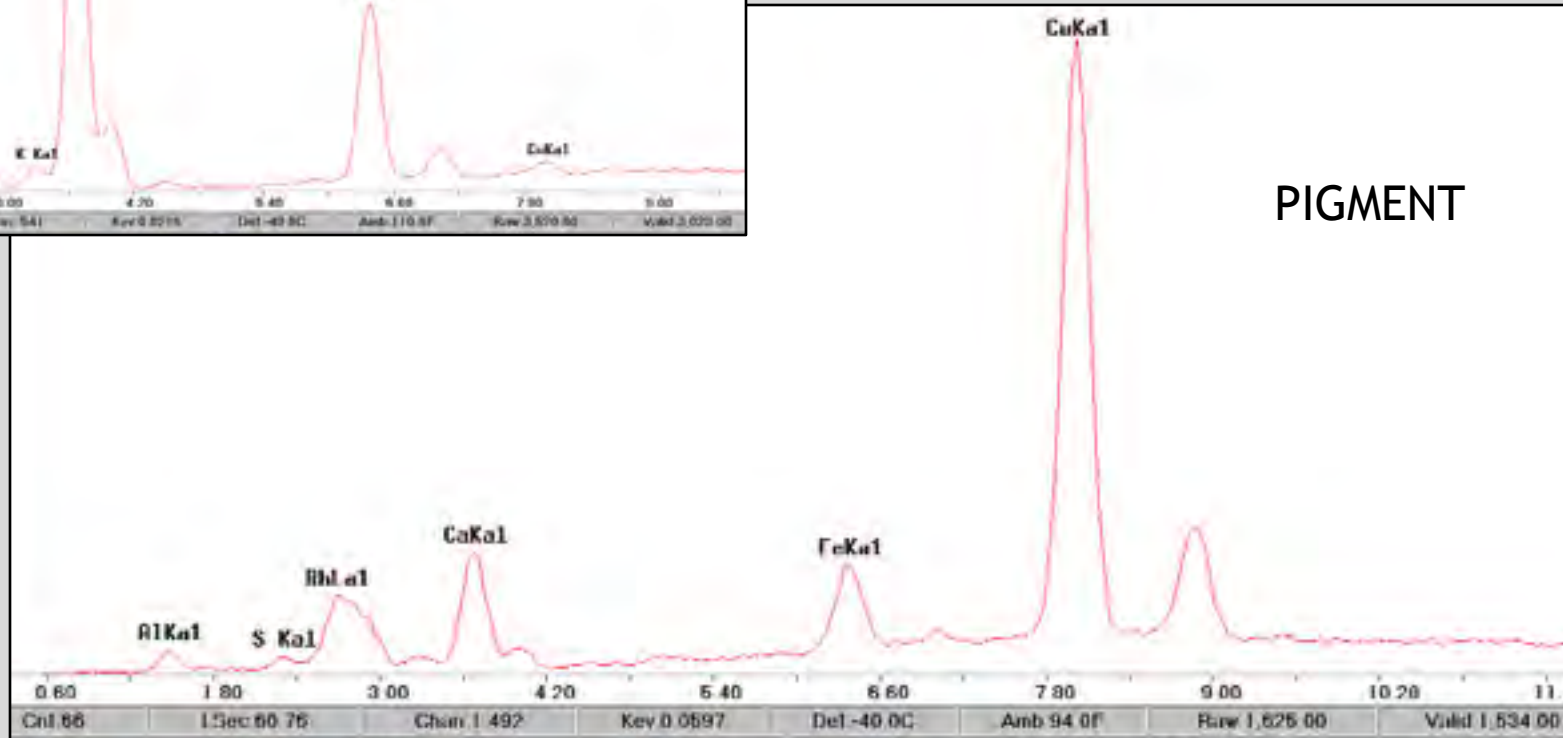
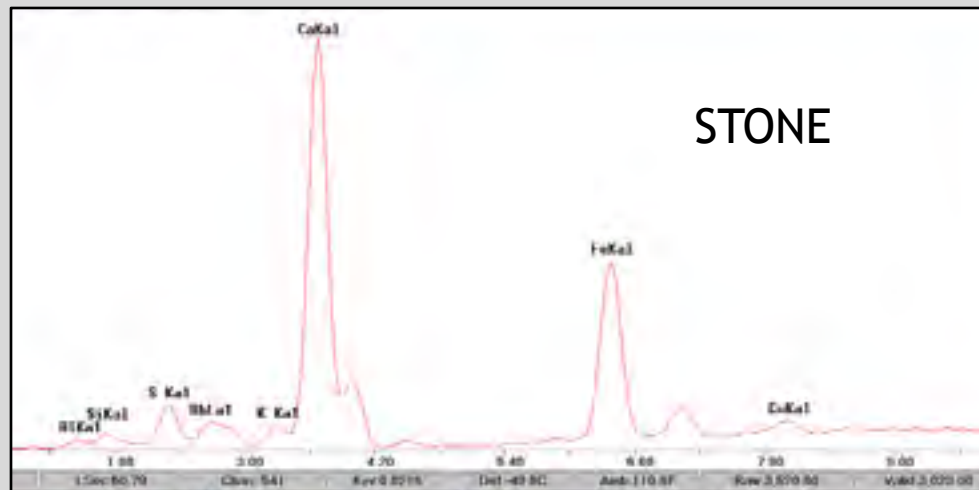


Starry Eye Man Site

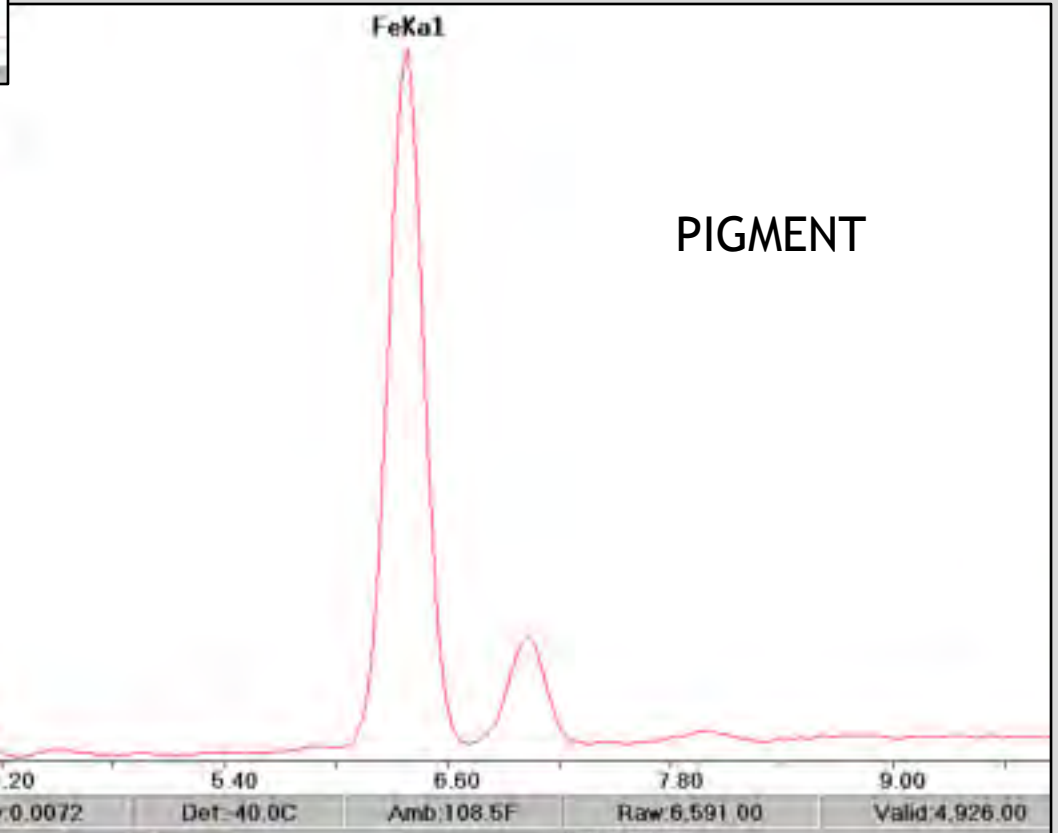
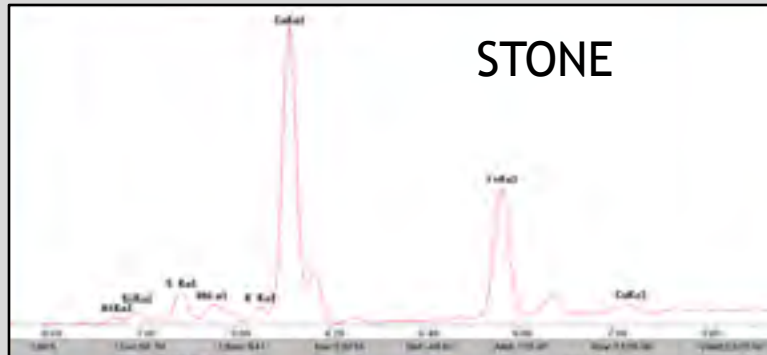
Pictograph

~9 feet above cave floor

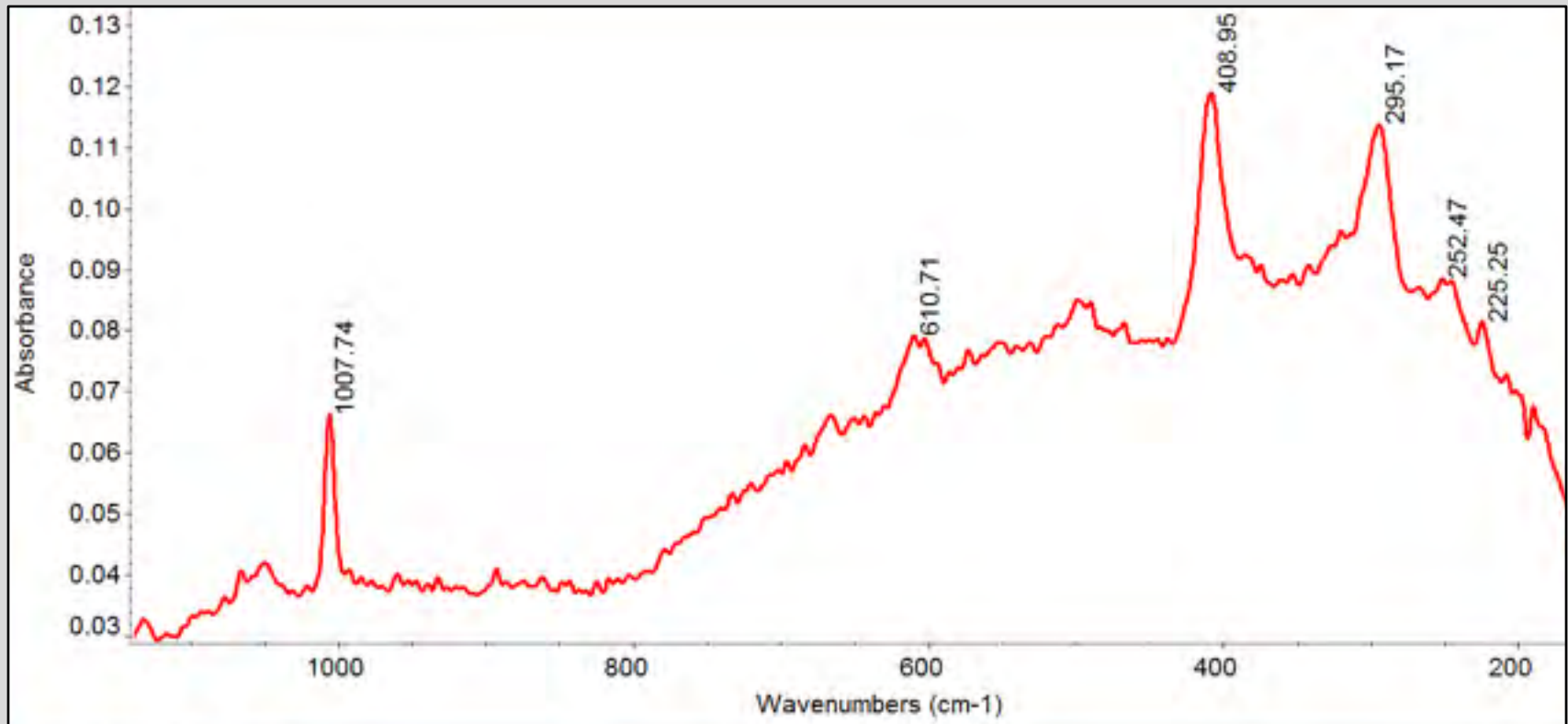
Site E10C, Starry Eye Man: Pigments – XRF - Green



Site E10C Pigments - XRF - Red



Site E10C Pigments - Raman : Hematite + Gypsum



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

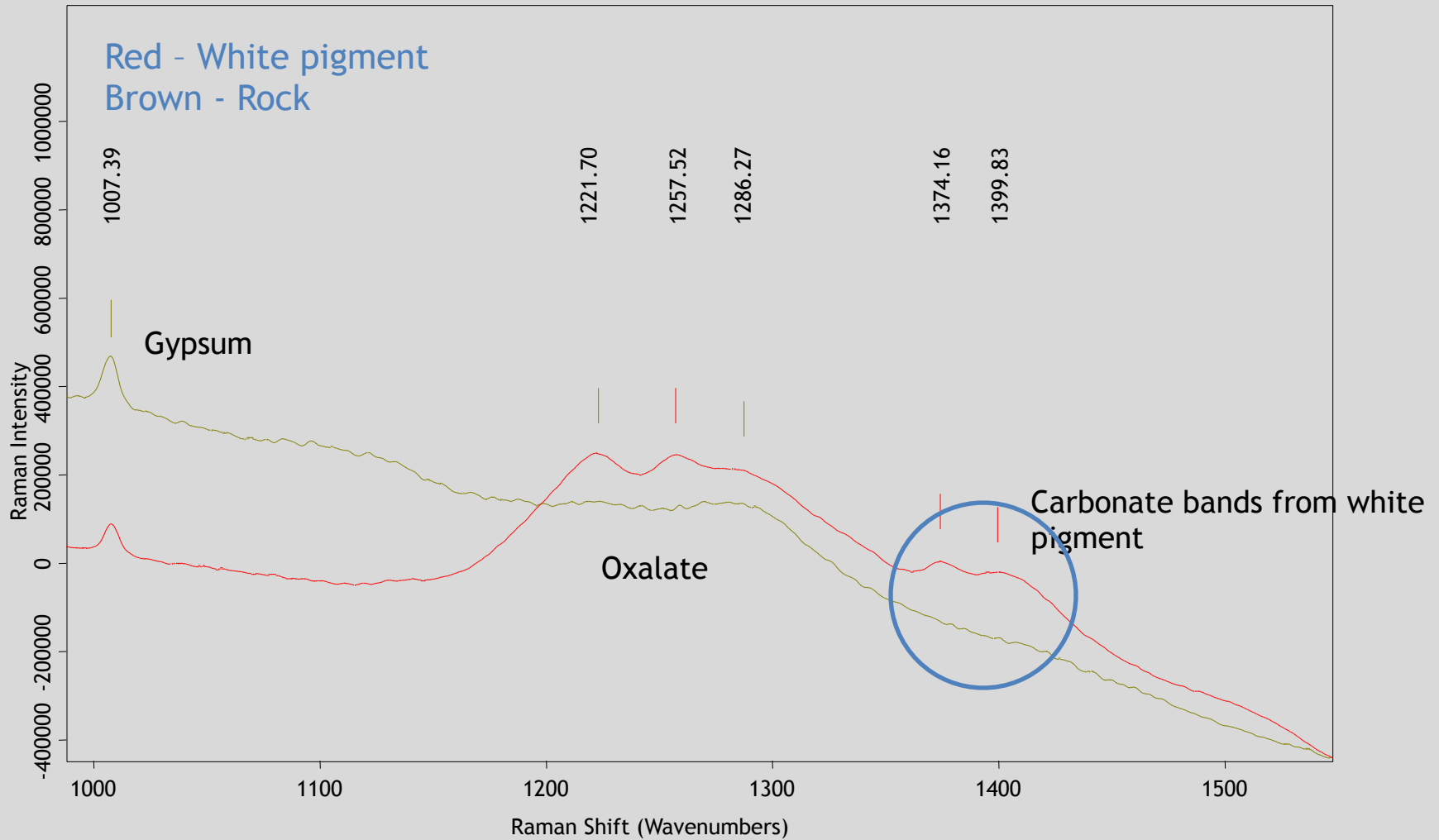
PICTOGRAPH EOIF : DANCING FIGURE



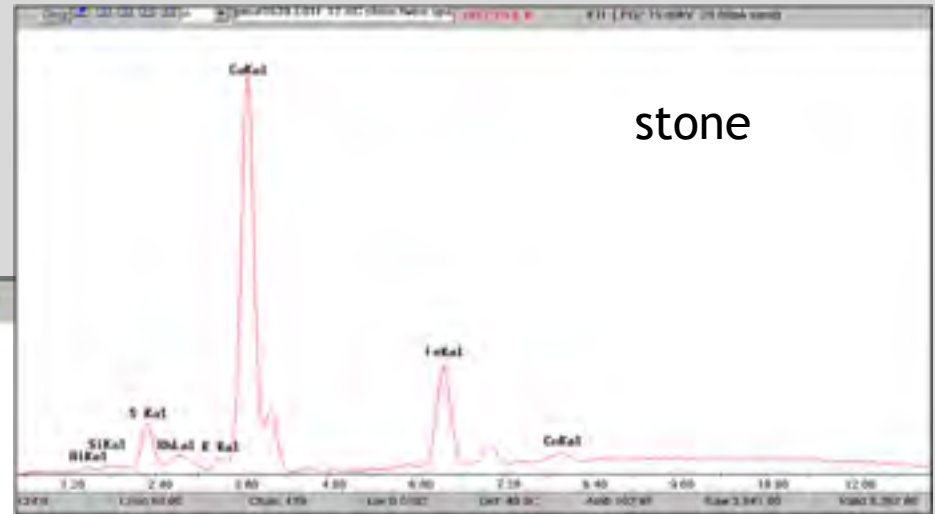
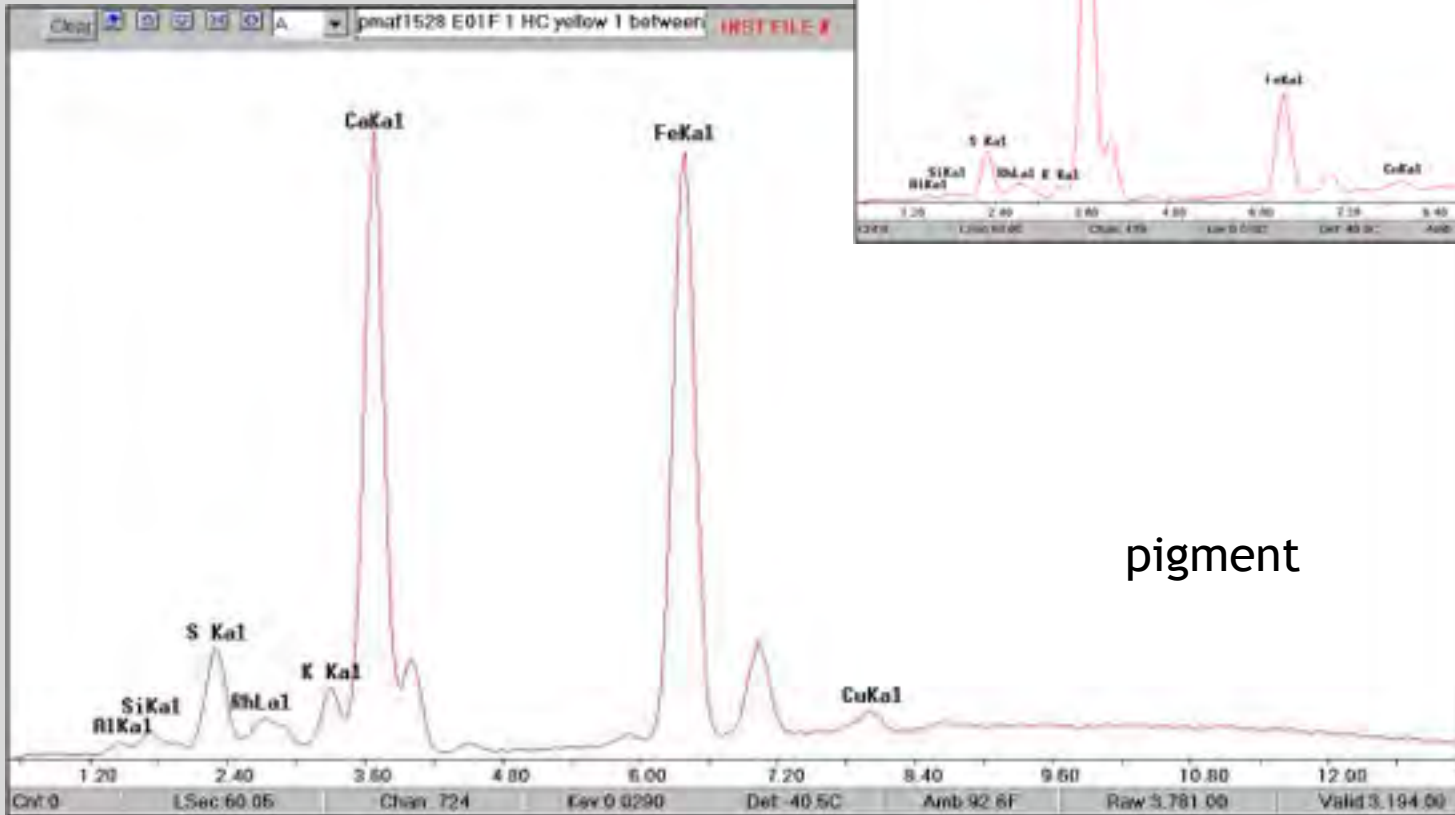
Enhanced image



WHITE PIGMENT AND ROCK SUBSTRATE E01C



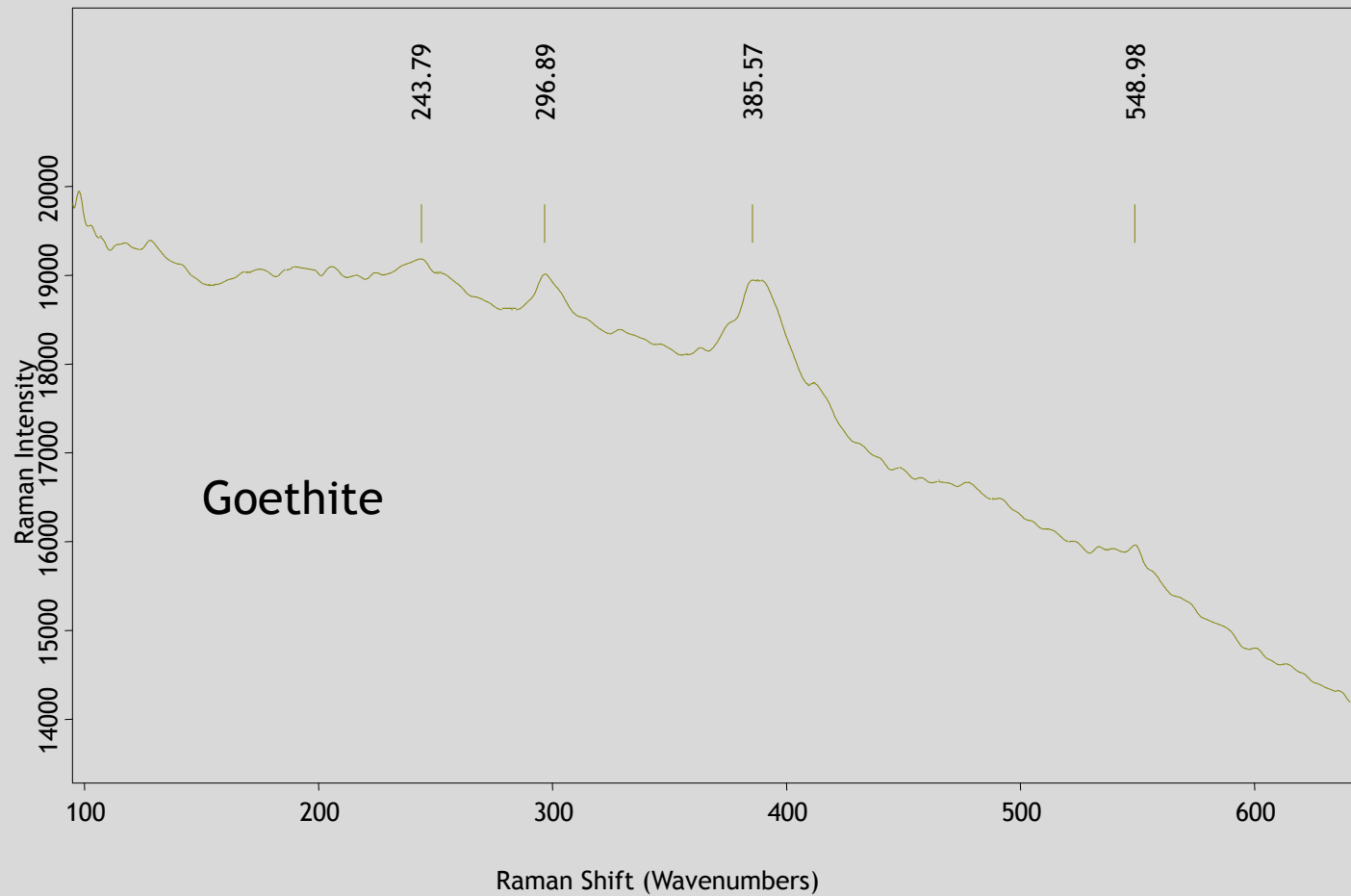
E01F, Dancing Figure;
pigment vs stone
XRF Data



stone

pigment

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

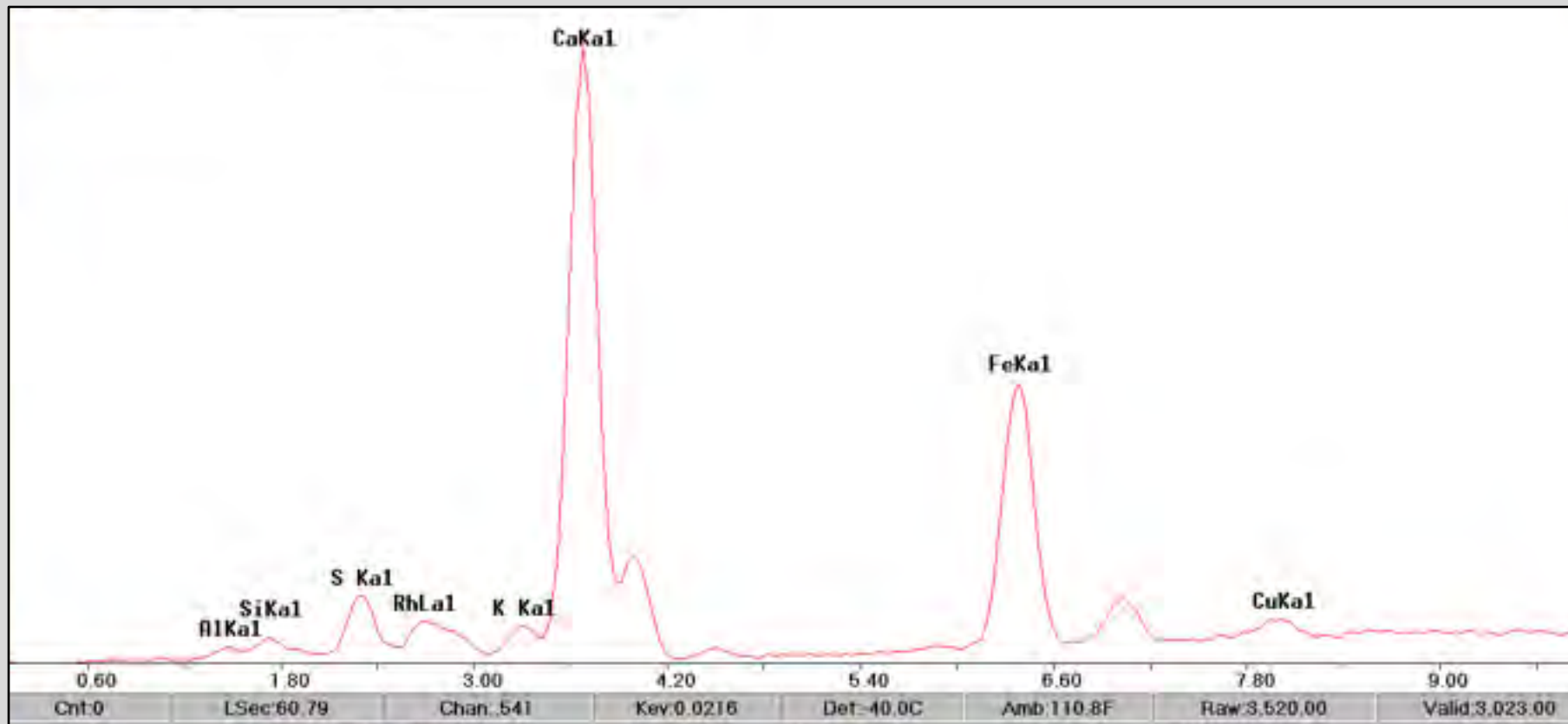
Timothy Rub, Terra Huber, Chris Wasson, with
Katherine Lins

Show enhanced image E01F

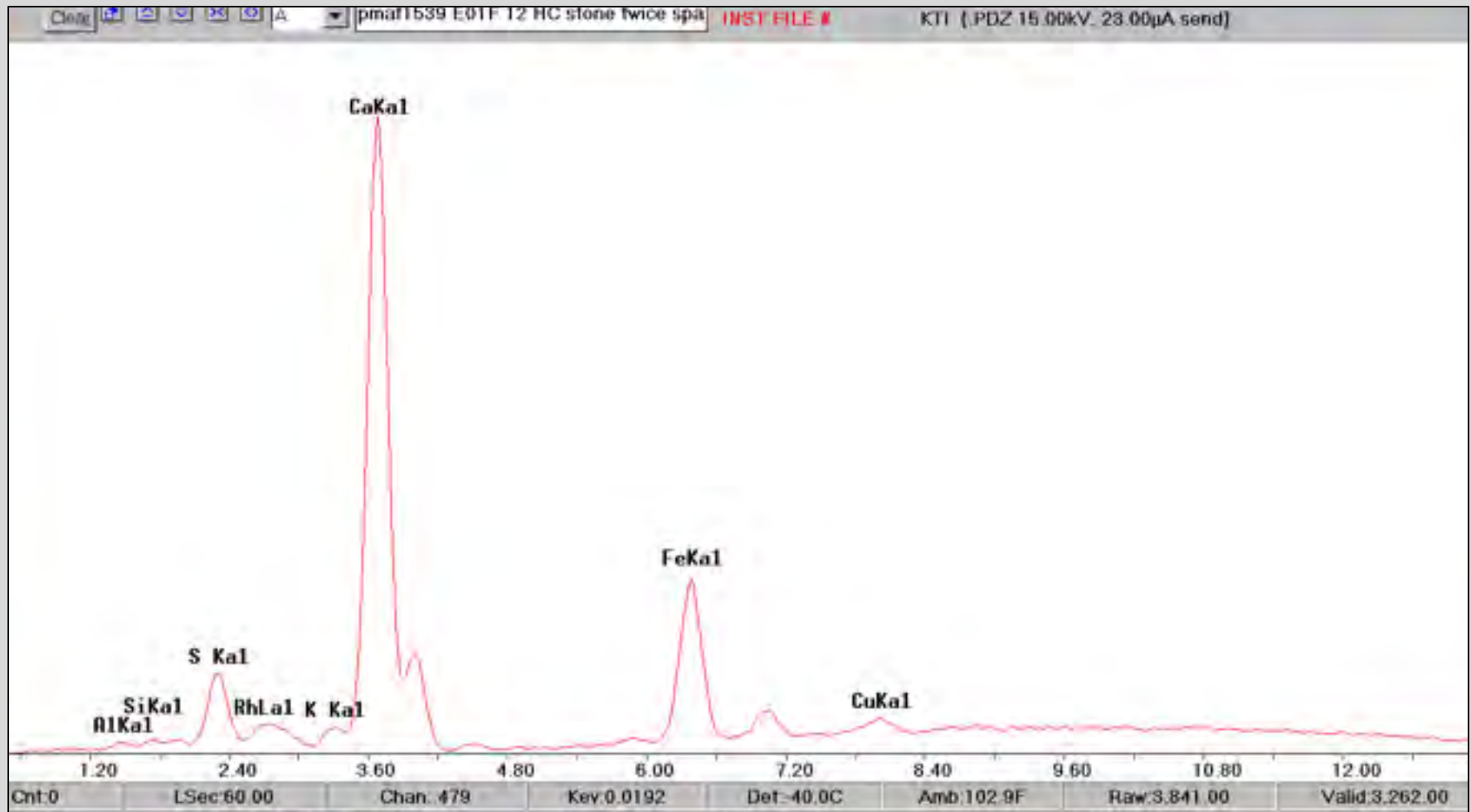
Transportation Challenges



Site E10C Pigments - XRF Stone



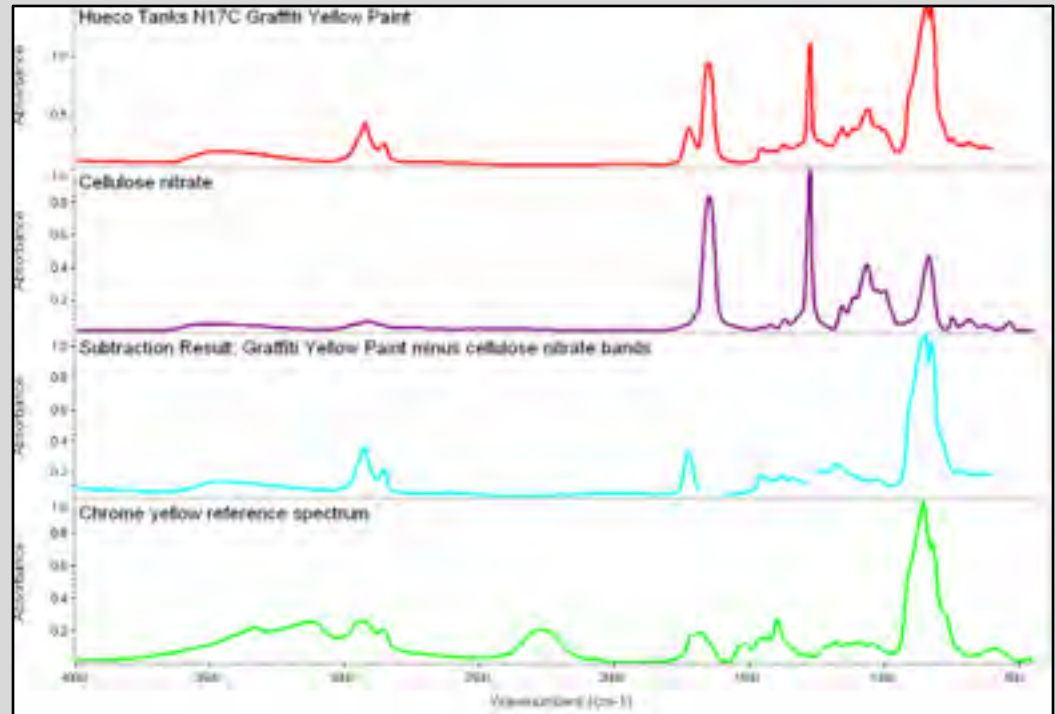
E01F Dancing Figure: XRF Results







Provide Support to Outside Institutions: 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
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