

# Compositional Analysis of Historic & Pre-Historic Pigments

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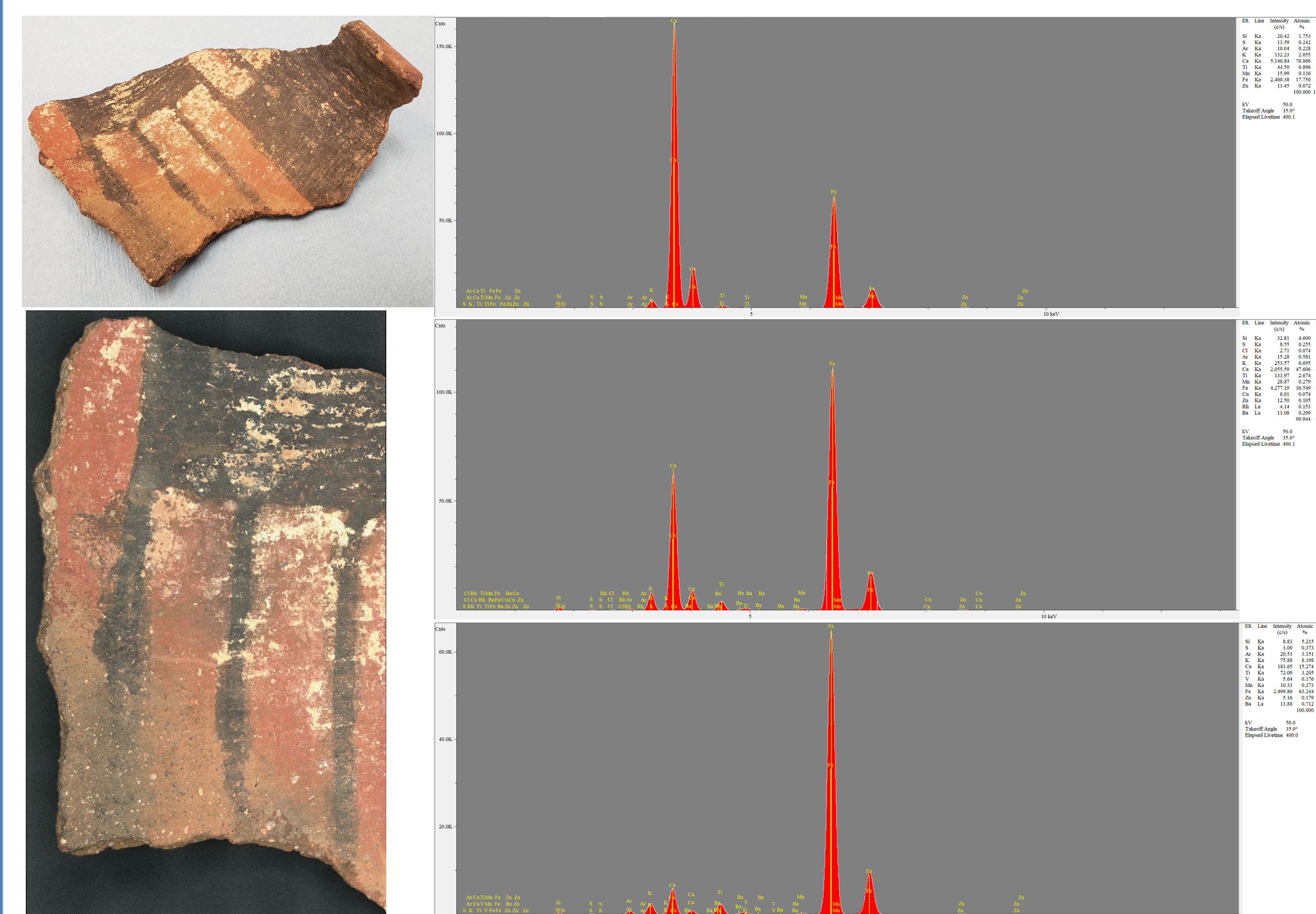


## Introduction

- X-ray Fluorescence spectroscopy (XRF) was developed as a technique for studying composition of historic and pre-historic pigments in ceramics and paintings.
- XRF techniques were applied to Native American pottery fragments from the southeastern and southwestern United States, as well as two modern paintings..
- XRF techniques were applied using an “Atlas X” X-ray fluorescence energy dispersive spectrometer by iXRF Systems.

## Glossary

- X-ray Florescence Energy Dispersive Spectroscopy: Form of spectroscopy in which characteristic X-rays re-emitted from a specimen after being bombarded by an X-ray beam are used to identify elements based on their energies.
- Sherd: Historic or pre-historic fragment of pottery
- Slip: Clay slurry applied to the outside of partially-fired pottery for various purposes.
- Temper: A hard material used to prevent shrinkage and cracking in pottery during firing or drying.



This ceramic sherd is from the southwestern US. It features a slip, temper, and two different types of pigment.

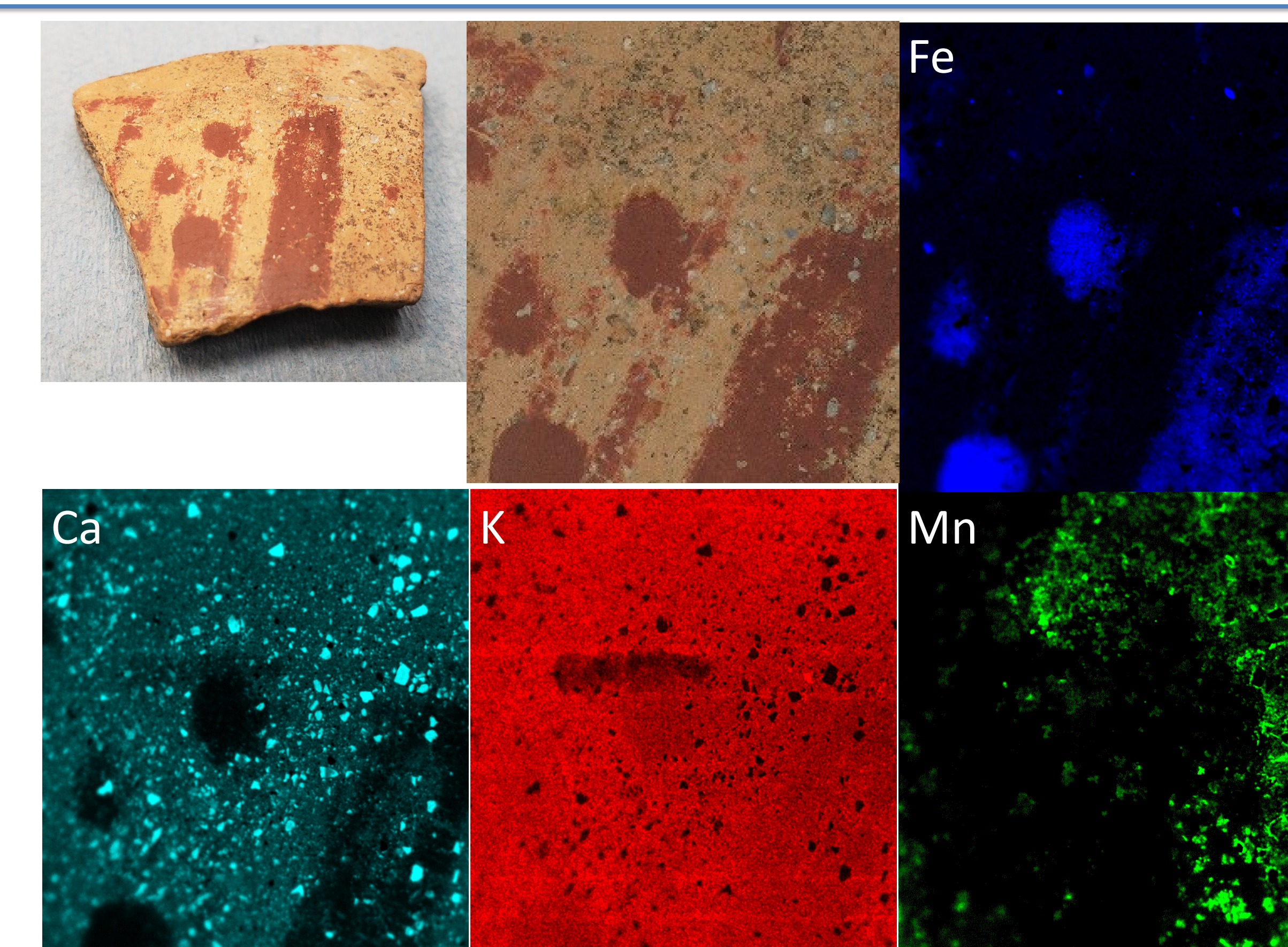
- Red Pigment: Likely red ochre, primarily iron.
- Black Pigment: Likely some carbon-based pigment, primarily calcium and iron (same as bare ceramic), but carbon cannot be detect using EDXRF spectroscopy.



This painting was made using acrylic paints by an unknown contemporary artist. It features mixed pigments and undercoating.

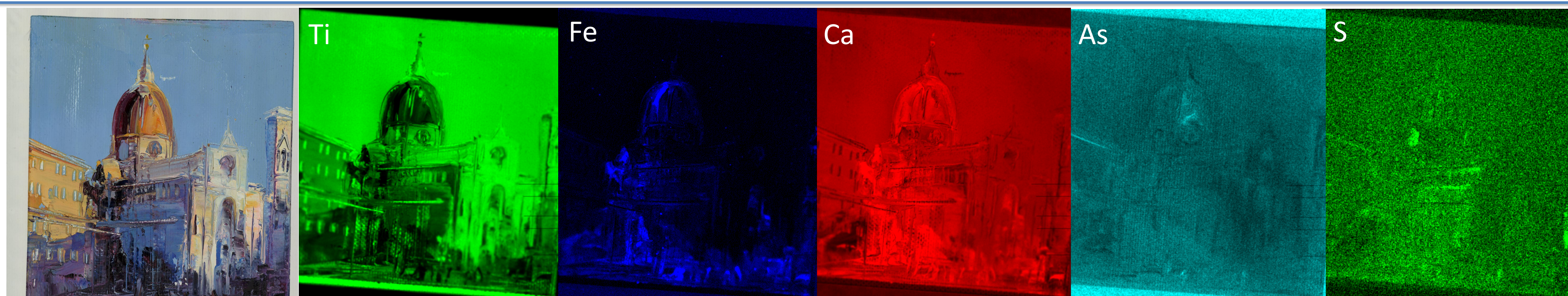
Pigment	Composition	Color
Lithopone	$BaSO_4$ and $ZnS$	White
Titanium White	$TiO_2$	White
Umber/Sienna	$Mn$ and $Fe$ Oxides	Reddish Brown/Brown

A closeup showing the use of undercoating and mixing



This ceramic sherd is from the southeastern US. It features a slip, temper, and pigmentation.

- Iron: Pigment is iron-rich, indicates the pigment is composed of red ochre.
- Calcium: Temper is calcium-rich, based on the color of the temper (white) the temper is likely crushed shells.
- Potassium: Temper contains less potassium than the clay or pigment.
- Manganese: Origin of manganese-rich regions is unknown. They appear to be dark-colored flecks on the surface.



This painting was made using oil paints by an unknown an unknown contemporary artist. It features mixed pigments, undercoating, and scraping.

Pigment	Composition	Color
Gypsum	$CaSO_4 \cdot 2H_2O$	White/Off-White
Realgar/Orpiment	$As_4S_4/As_2S_3$ (Respectively)	Red/Yellow (Respectively)
Red/Yellow Ochre	$Fe_2O_3/FeO(OH) \cdot nH_2O$ (Respectively)	Red/Yellow (Respectively)
Titanium White	$TiO_2$	White

A closeup showing the of mixing, undercoating and scraping

