Supplementary Materials

All figures and table have been referenced in the body of the main text.

Please see Materials and Methods in the body of the main text for details on the artworks, the experimental techniques, and computational approaches.

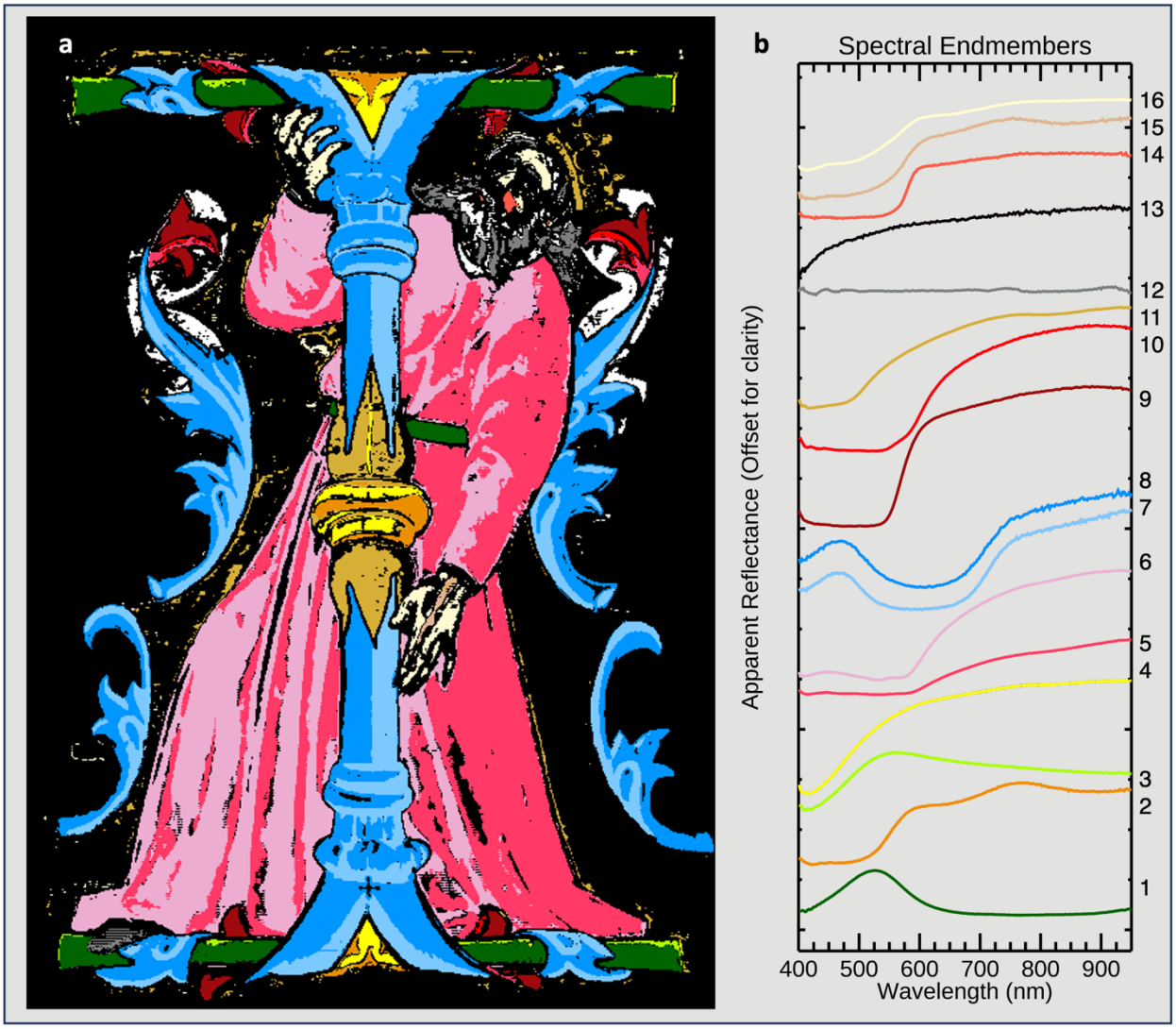


Figure S1: (a) ENVI-SHW truth material map for Initial I with David (1964.8.1226); (b) corresponding spectral endmember list.

Table S1: Spectral assignments and material class labels for endmembers in Figure S1(1964.8.1226)

Endmember	Reflectance Spectral Features (RIS, FORS)	Pigments	Material Class Label
1	R_{max} 527 nm, FWHM 120 nm, broad abs 763 nm, (abs 2217 (sh), 2270 nm)	Malachite	Malachite
2	sh 455 nm, R_{inf} 551 nm (dR/dλ 56 nm FWHM), abs ~475, 650, 880 nm, R_{max} 775 nm	Yellow ochre	Yellow-brown ochre
3	R_{max} 563 nm, R_{inf} 476 nm (dR/dλ 110 nm FWHM asym)	Lead-Tin Yellow, applied over malachite	Lead-Tin Yellow over Malachite
4	R_{inf} 472 nm (dR/dλ 134 nm FWHM asym)	Lead-tin yellow	Lead Tin Yellow
5	R_{inf} 616 nm (dR/dλ 151 nm FWHM asym) abs ~530, 573 nm	Red lake (insect)	Red Lake
6	R_{inf} 604 nm (dR/dλ 120 nm asym) abs 528, 565 nm (abs 1451 nm (w))	Red lake with lead white	Red Lake with White
7	R_{max} 470 nm, abs 600 nm (abs 1451 nm (w))	Ultramarine with lead white	Ultramarine with white
8	R_{max} 469 nm, abs 606 nm	Ultramarine	Ultramarine
9	R_{inf} 570 nm (dR/dλ 53 nm FWHM sym)	Red lead	Red Lead
10	R_{inf} (sh) 565 nm, R_{inf} 601 nm (dR/dλ max 565 nm (sh), 601 nm FHWM 87 nm asym)	Red lake applied over red lead	Red Lake over Red Lead
11	R_{inf} 513 nm (dR/dλ 104 nm FWHM asym)	Gold Leaf	Gold
12	constant or ramp 0.01 to 0.02 reflectance (abs 1449 nm)	Lead white + black	Gray
13	Fast rise in reflectance up to 460 nm and then levels out (bi-phasic)	White (inferred lead white) + ochre?	White
14	R_{inf} 581 nm (dR/dλ 35 nm FWHM sym; sh(w) 548 nm)	Vermilion	Vermilion
15	R_{max} 755 nm, abs 840 nm (dR/dλ max 436 nm, sh 509 nm, R_{inf} 576 nm FWHM 86 nm aysm)	Red ochre with some yellow ochre and white	Red flesh
16	R_{inf} 572 nm, (dR/dλ max 436 nm, sh 538 nm, max 573 nm FWHM 86 nm asym) (R_{max} 785 nm, abs 1450 nm)	Yellow ochre + red pigment (red ochre or vermilion) + lead white	Nude flesh

Abbreviations:

- dR/dλ: first derivative of reflectance with respect to wavelength
- R_{inf}: inflection point in reflectance spectrum
- R_{max}: local maximum or peak location in reflectance spectrum
- max : local maximum or peak location in derivative spectrum
- abs: absorption
- FWHM: full-width half maximum
- asym: asymmetric
- sym: symmetric
- w: weak
- sh: shoulder
- s: strong
- NT: not trained

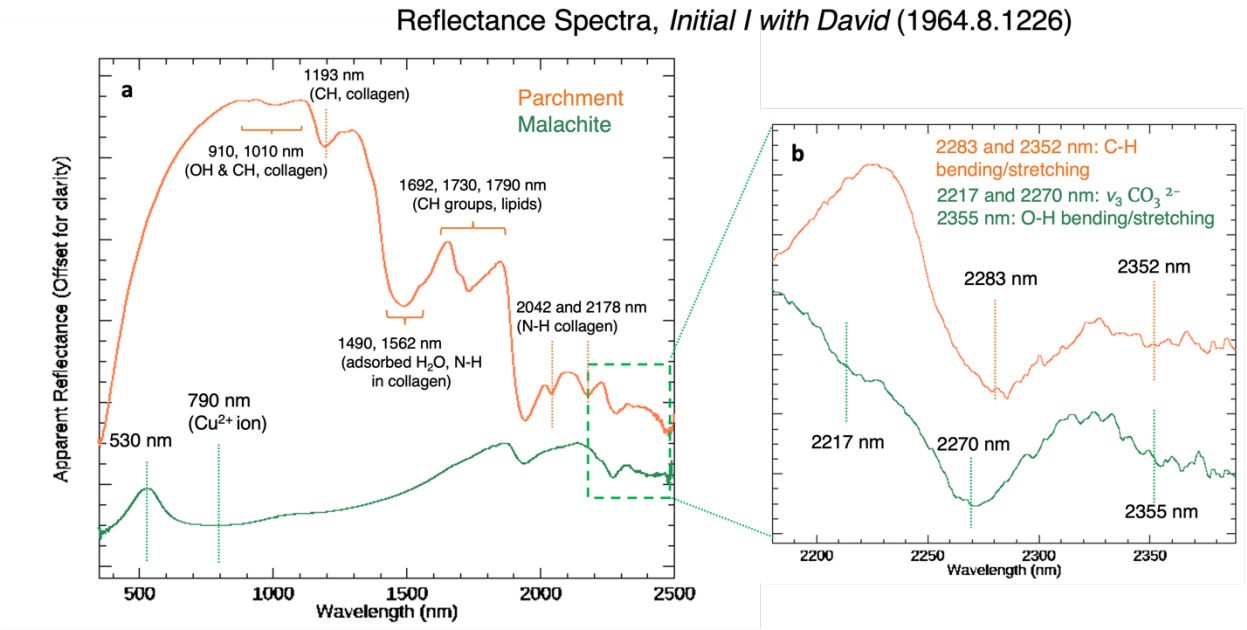


Figure S2: (a) Diffuse reflectance spectra (400-2500 nm) of parchment and m
alachite from 1964.8.1226 with labeled characteristic spectral features. (b) Close-up of important malachite featur
es in the short-wave infrared [37].

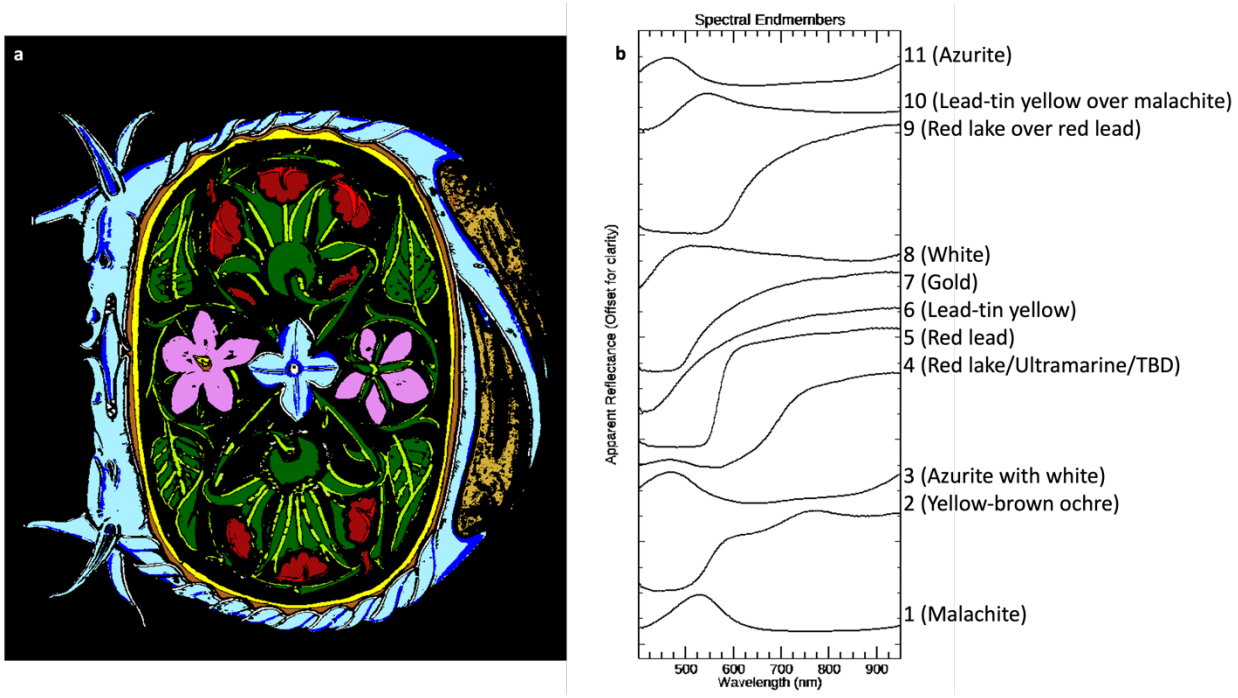


Figure S3: (a) ENVI-SHW truth material map for Initial D (1964.8.1223); (b) corresponding spectral endmember list.

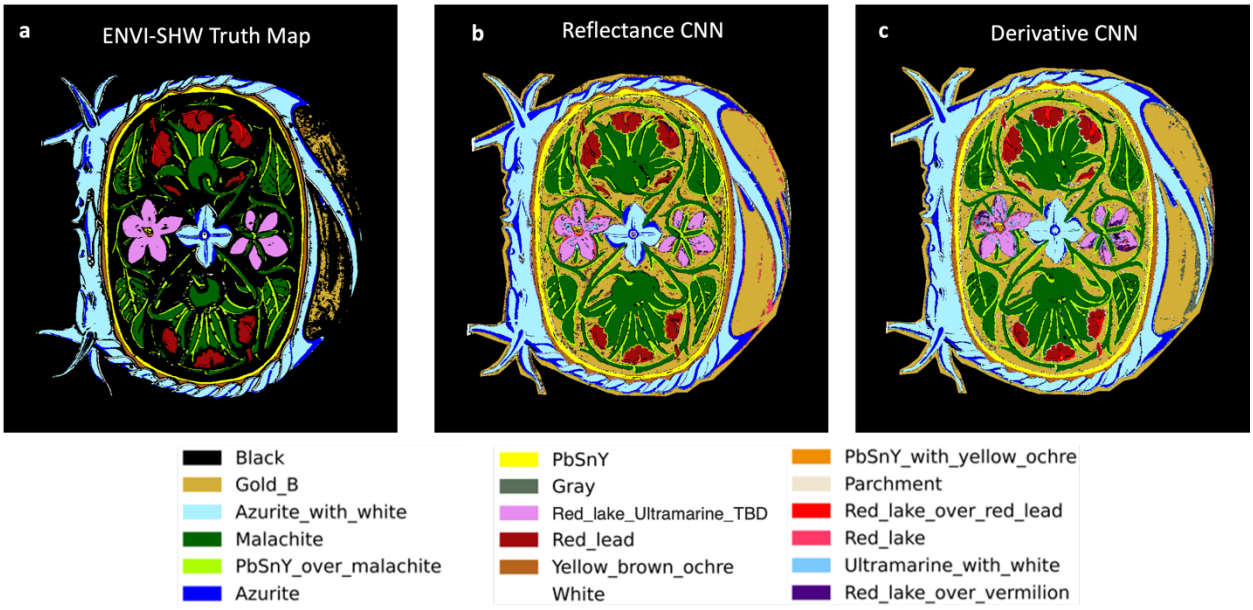


Figure S4: Classification maps for 1964.8.1223 (Initial D): (a) ENVI-SHW truth map; (b) Reflectance CNN map; (c) Derivative CNN map. Legend for colors are below maps.

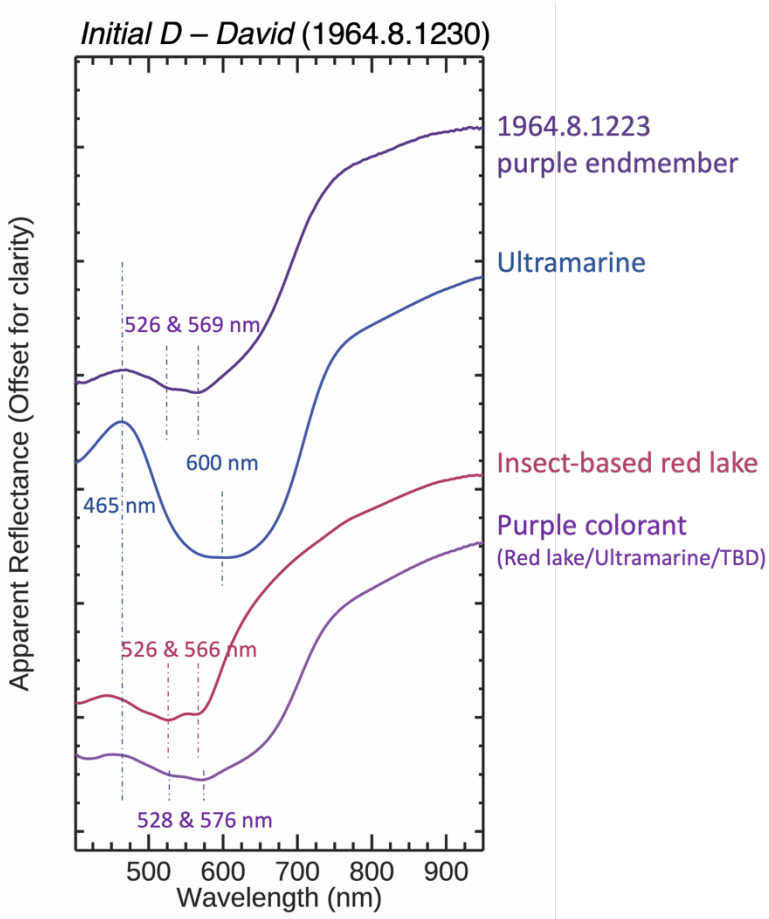


Figure S5: Diffuse reflectance spectra from training illumination Initial D - David (1964.8.1230) selected from painted are as of blue (ultramarine), pink (insect-based red lake), and purple. The purple color's spectral features s uggest it comprises ultramarine and red lake, while micrographs suggest another component. The endmember for the pu rple color identified by ENVI-SHW analysis in Initial D (1964.8.1223) is listed for comparison.

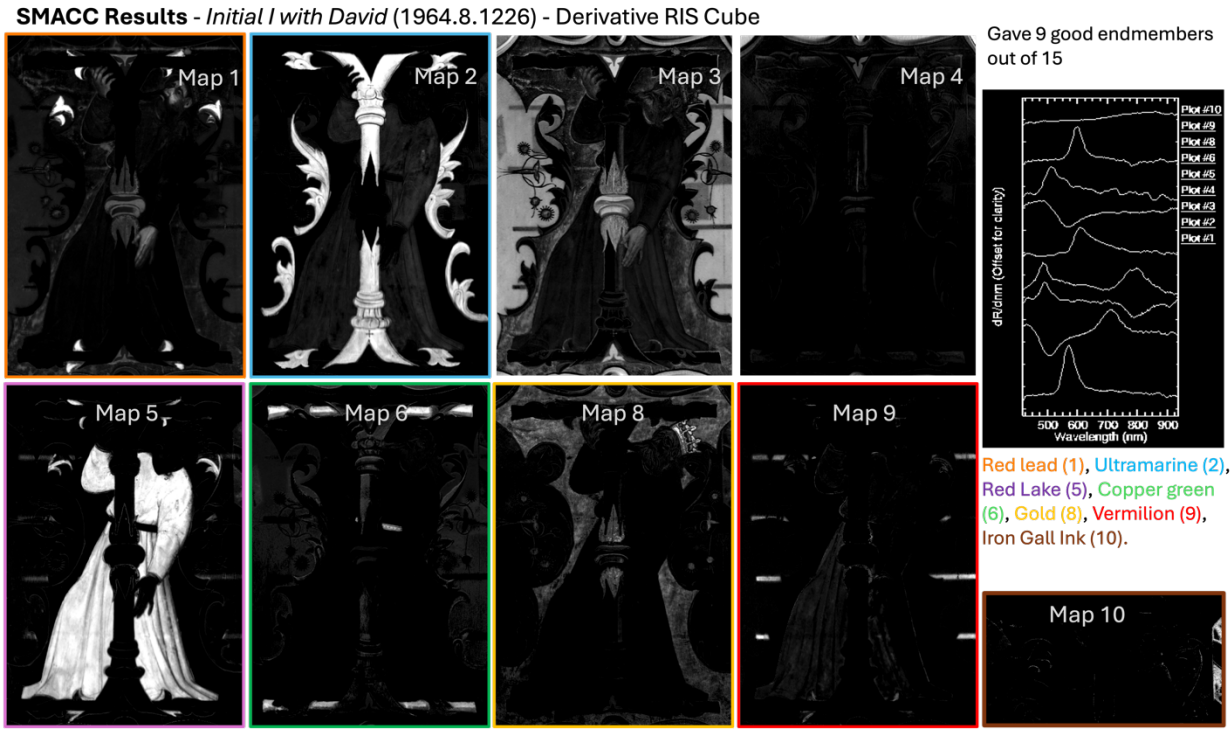


Figure S6: Sequential Maximum Angle Convex Cone (SMACC) [21] abundance images and endmember results from illumination 1964.8.1226.

Reference numbers follow main manuscript reference list.