

Supplementary materials

for Article

**New Insights into the Materials and Painting Techniques of Ancient Wall Paintings from the Roman Province of Dacia:
A Minimally Invasive Multi-Method Approach**

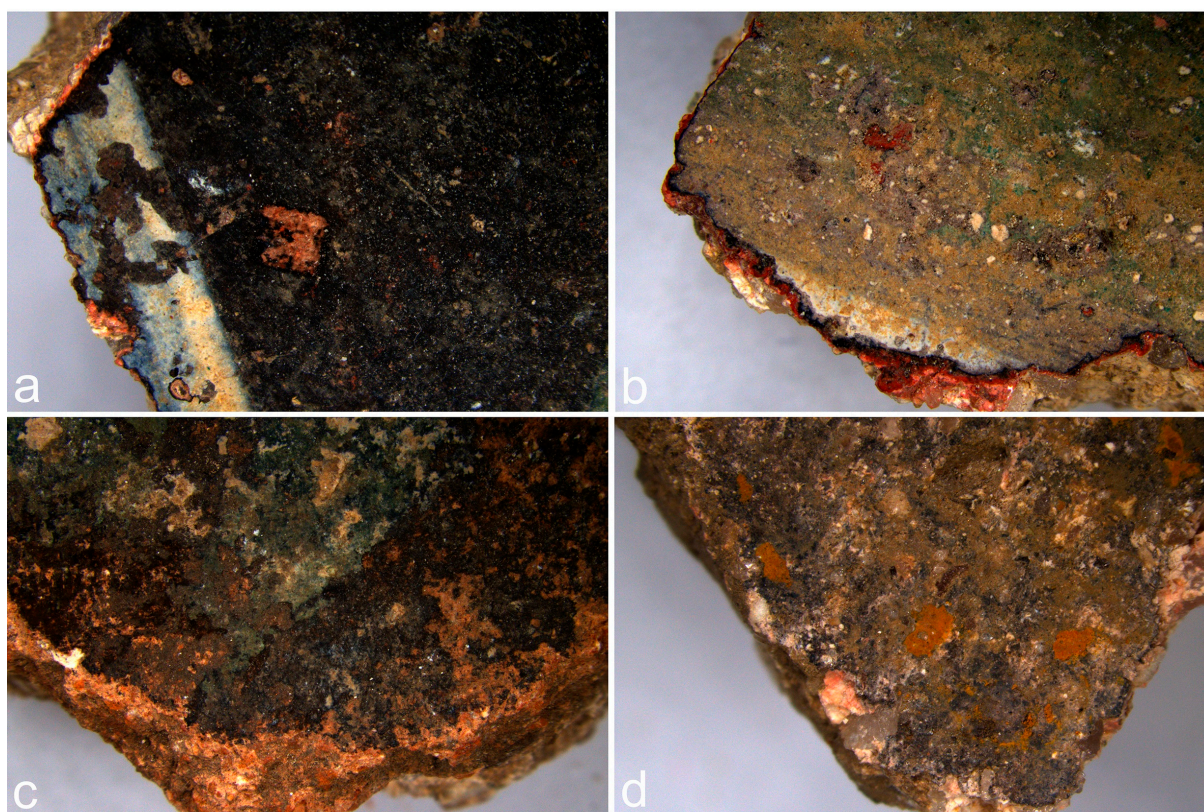


Figure S1. Optical microscopy images that highlight the existence of more complex decorative patterns (with superimposed paint layers, and/or the use of pigment mixtures: light-blue decorative paint layer applied on top of a black underground (sample S4) (**a**); light-blue decorative paint layers (in various shades) applied on top of an optical blue undercoat (sample S6) (**b**); complex polychromy, highly degraded, applied on a reddish-brown preparatory layer (sample S1) (**c**); traces of yellow ochre and other colored inclusions on top of the greyish-green underground (sample S10) (**d**).

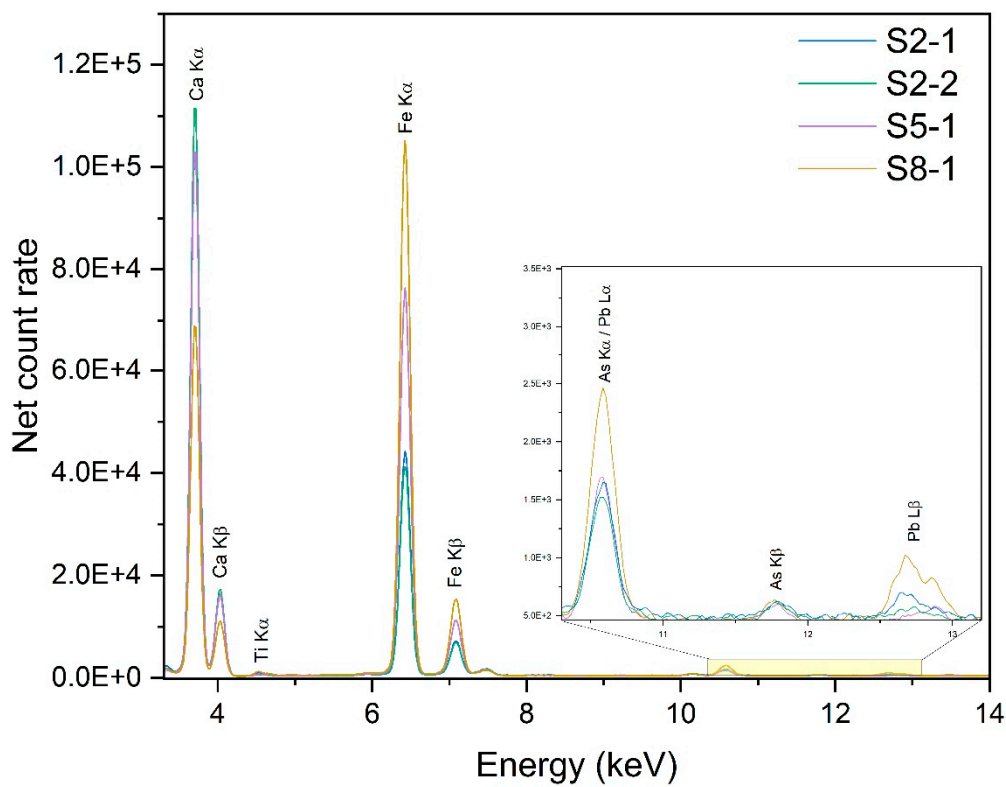


Figure S2. Comparison of XRF spectra corresponding to red areas, evidencing the K α and K β lines of As.

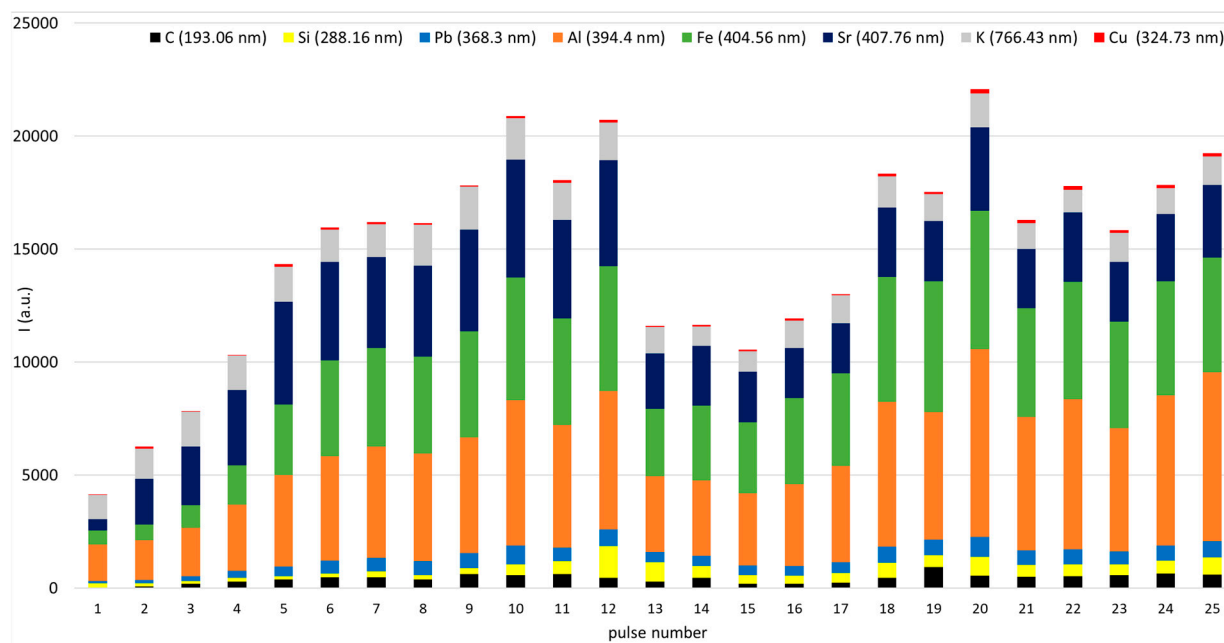


Figure S3. LIBS stratigraphic distribution on sample S6 for C, Si, Pb, Al, Fe, Sr, K and Cu.

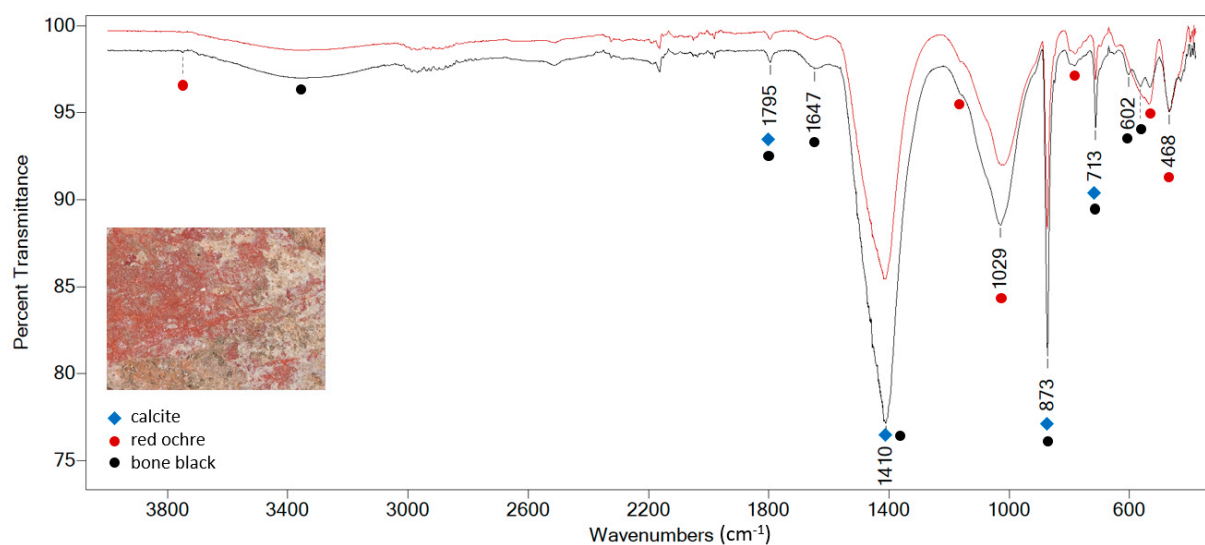


Figure S4. Comparative FTIR spectra of the top grayish paint layer (with black line) and the red paint layer underneath (with red line).

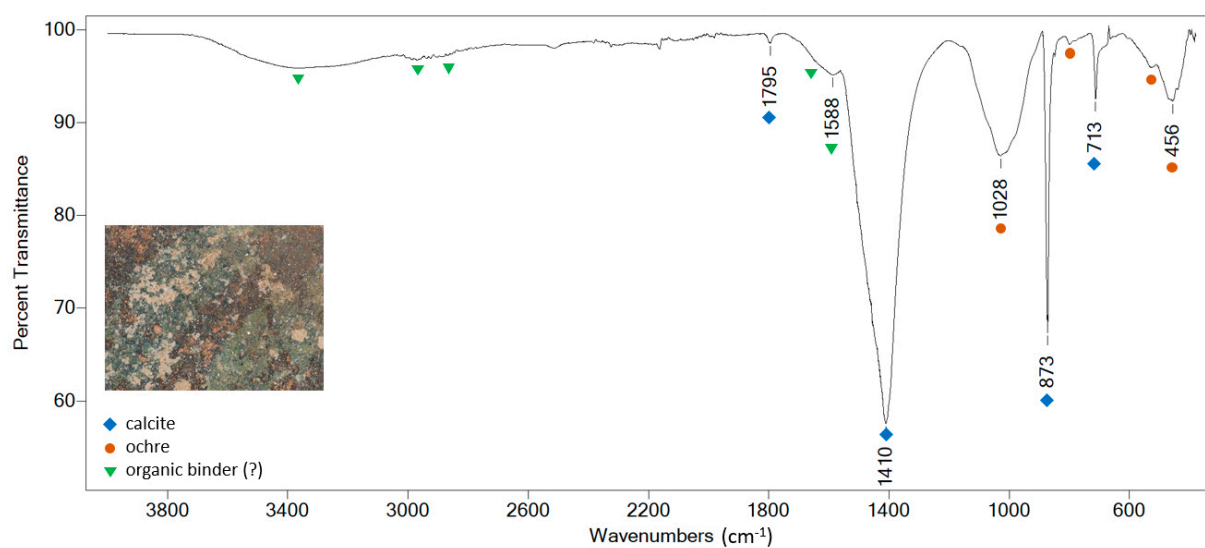


Figure S5. FTIR spectrum registered on the dark-brown paint layer on sample S1.

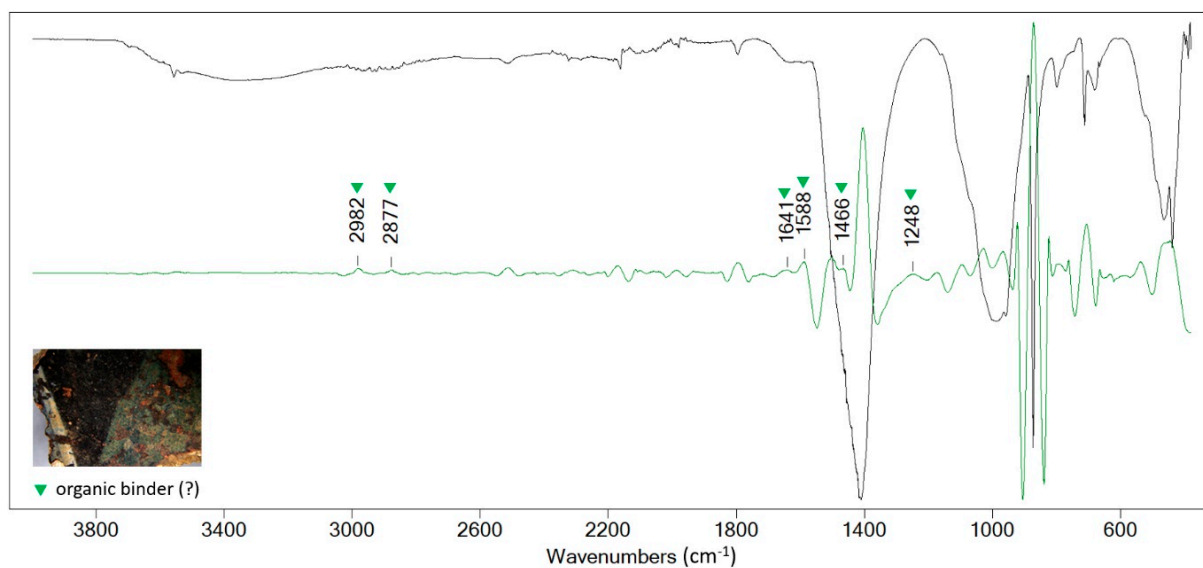


Figure S6. FTIR spectrum registered on the green painted areas on sample S4 (with black line) and the second derivative profile (with green line). The second derivative was obtained using the Savitzky–Golay method.

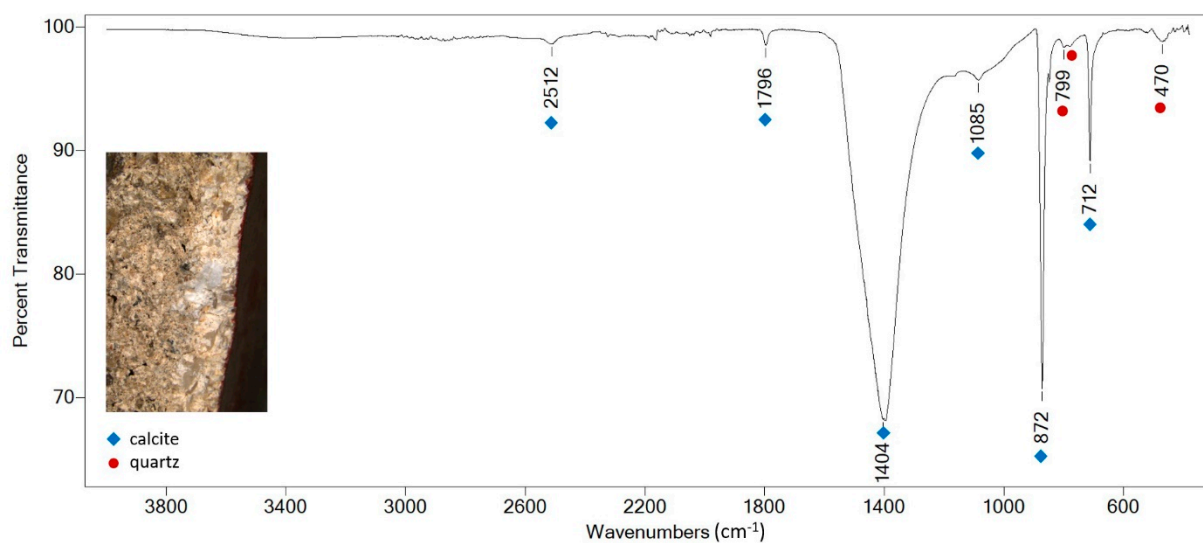


Figure S7. FTIR spectrum registered on the *intonaco* layer on sample S2.

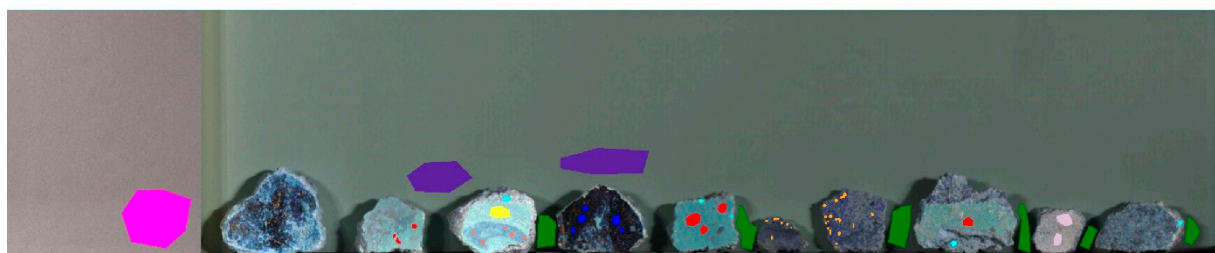


Figure S8. Spatial Region of Interest (ROI) selection.

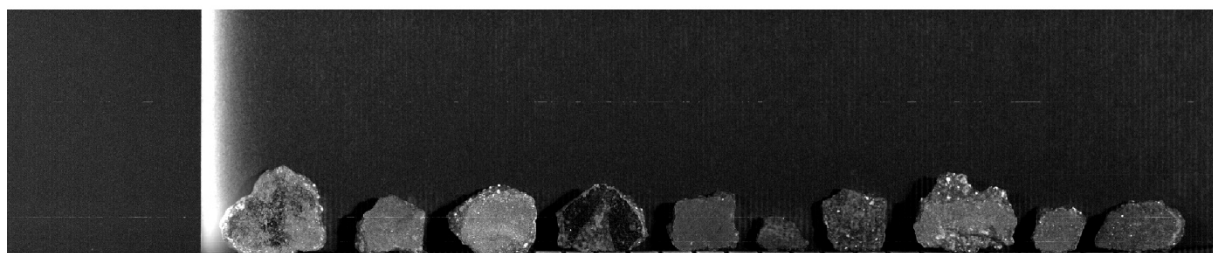


Figure S9. The root-mean-square (RMS) error image corresponding to the LSU classification.

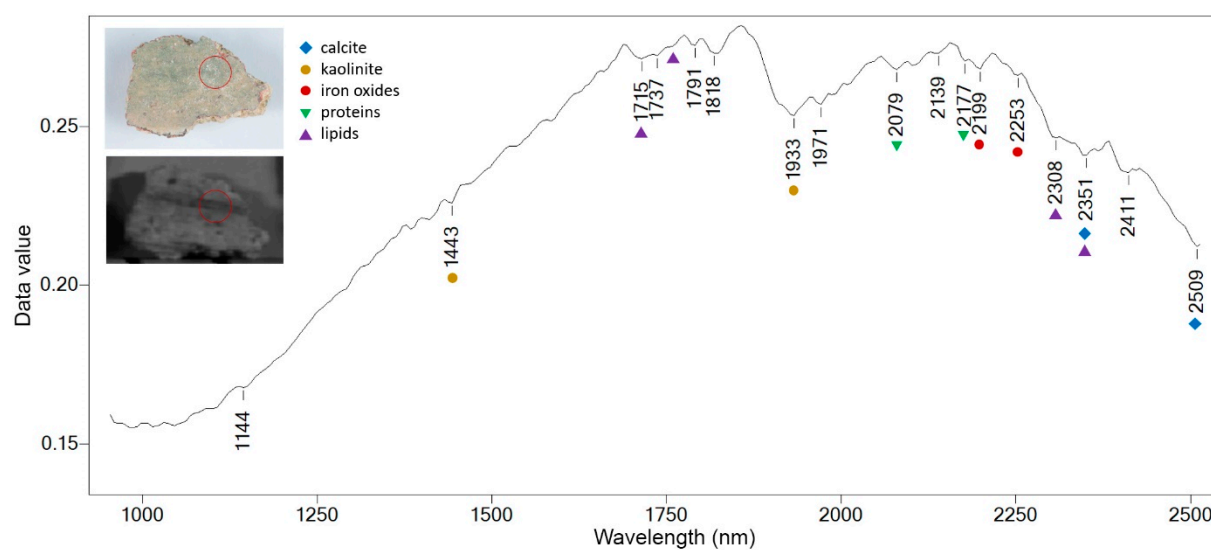
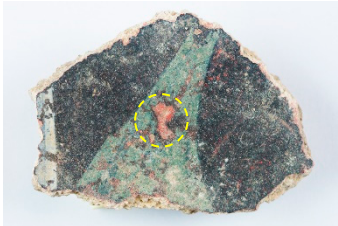
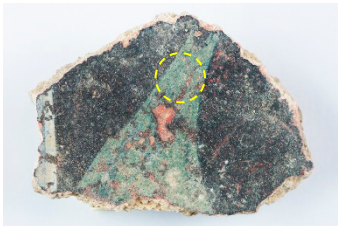
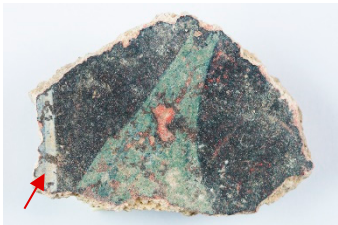
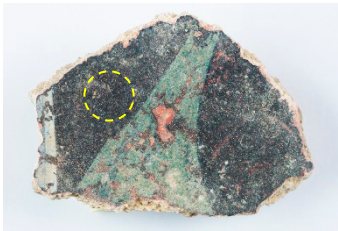



Figure S10. SWIR reflectance spectrum registered on the faded decorative band layer (observed starting with the 1600 nm band) on sample S6.

Table S1. Results of the LIBS stratigraphic analysis.

Sample	Area	Pulse	Chemical elements identified
S4	Lacuna (red paint layer) 	1	Ca, Na, K, Li, Sr, Pb
		2	Ca, Li, Al, Na, K, Sr, Mg
		3	Ca, Li, Na, K, Al, Fe, Sr, Mg
		4	Ca, Li, Fe, Na, K, Al, Sr, Mg
		5	Ca, Li, Fe, Na, K, Al, Sr, Mg, Ti, Si
		6	Ca, Li, Fe, Na, K, Sr, Al, Mg, Ti, Si
		7	Ca, Li, Fe, Na, K, Sr, Al, Mg, Ti, O, Si
		8	Ca, Li, Fe, Na, K, Sr, Al, Mg, Ti, O, Si
		9	Ca, Li, Fe, Na, K, Sr, Al, Mn, Mg, Ti, O, Si, H, C
		10	Ca, Li, Fe, Na, K, Sr, Al, Mn, Mg, O, Ti, C, Si, H
S4	Green paint layer 	1	Ca, Li, Al, Na, K, Mg, Sr, Si
		2	Ca, Li, Al, Na, K, Sr, Fe, Mg, Si
		3	Ca, Li, Na, Al, Sr, K, Fe, Mg, Si, H
		4	Ca, Li, Na, Sr, Fe, K, Al, Mg, O, H, Si, C
		5	Ca, Li, Na, Fe, Sr, K, Al, Mg, O, H, Si, C
		6	Ca, Li, Na, Fe, Sr, K, Al, Mg, O, C, H, Si
		7	Ca, Li, Na, Fe, Sr, K, Al, Mg, Ti, O, C, H, Si
		8	Ca, Li, Fe, Na, Sr, K, Al, Mg, Ti, C, O, Si, H
		9	Ca, Li, Fe, Na, Sr, K, Al, C, Mg, Ti, O, Si, H
		10	Ca, Li, Fe, Na, Sr, K, C, Al, O, Mg, Ti, Si, H
S4	Light-blue paint layer 	1	Ca, Li, Al, Sr, Mg, Na, K, Fe, Ti
		2	Ca, Li, Sr, Na, Al, Mg, K, Fe, C, Ti
		3	Ca, Li, Na, Sr, Mg, Al, Fe, K, C, Ti
		4	Ca, Li, Na, Sr, Fe, Mg, Al, K, C, Ti
		5	Ca, Li, Na, Sr, Fe, Mg, Al, K, C, Ti
		6	Ca, Li, Na, Sr, Fe, Mg, K, C, Al, Ti
		7	Ca, Li, Na, Sr, Fe, Mg, K, C, Al
		8	Ca, Li, Na, Sr, Fe, Mg, C, K, Al, O, H
		9	Ca, Li, Na, Sr, Fe, Mg, K, C, Al, O, Ti, H
		10	Ca, Li, Na, Fe, Sr, Mg, C, K, Al, O, Ti, H
		11	Ca, Li, Fe, Na, Sr, Mg, C, K, Al, Ti, O, H
		12	Ca, Li, Fe, Na, Sr, C, Mg, K, Al, Ti, O, H
		13	Ca, Li, Fe, Sr, Na, Mg, C, K, Al, O, Ti, H
		14	Ca, Li, Fe, Sr, Na, C, Mg, K, Al, O, Ti, H
		15	Ca, Li, Fe, Sr, Na, K, C, Mg, K, Al, O, Ti, H
		16	Ca, Li, Fe, Sr, Na, C, Mg, K, Al, O, Ti, H
		17	Ca, Li, Fe, Sr, Na, K, C, H, Mg, Al, O, Ti, H
		18	Ca, Li, Fe, Sr, Na, K, C, Mg, Al, O, Ti, H
		19	Ca, Fe, Sr, Na, O, K, C, Mg, O, Al, Ti, H
		20	Ca, Fe, Sr, Na, K, C, Mg, O, Al, Ti, H
		21	Ca, Li, Fe, Sr, Na, K, C, Mg, O, Al, Ti, H, Si
		22	Ca, Li, Fe, Sr, Na, C, K, Mg, O, Al, Ti, H, Si
		23	Ca, Li, Fe, Sr, Na, C, K, Mg, O, Al, Ti, H, Si
		24	Ca, Li, Fe, Sr, Na, C, K, Mg, O, Al, Ti, H, Si
		25	Ca, Li, Fe, Sr, Na, C, K, Mg, O, Al, Ti, H, Si

S4	<p>Black paint layer</p> 	1	Ca, Li, Na, C
		2	Ca, Li, Na, C, K, Sr
		3	Ca, Li, Na, C, Sr, K
		4	Ca, Li, Na, C, Sr, K, Fe
		5	Ca, Li, Na, C, Sr, K, Fe
		6	Ca, Li, Na, C, Sr, K, Fe
		7	Ca, Li, Na, Sr, C, Fe, K
		8	Ca, Li, Na, C, Sr, Fe, K, H
		9	Ca, Li, Na, Fe, Sr, C, K, H
		10	Ca, Li, Na, Fe, Sr, C, K, H
		11	Ca, Li, Na, Fe, Sr, C, K, Ti, O, H
		12	Ca, Li, Na, Fe, Sr, C, K, Ti, O, H
		13	Ca, Li, Na, Fe, Sr, C, K, Al, Ti, O, H
		14	Ca, Li, Na, Fe, Sr, C, K, Al, O, Ti, H
		15	Ca, Li, Na, Fe, Sr, C, K, Al, O, Ti, H, Si
		16	Ca, Li, Na, Fe, Sr, C, K, Al, O, Ti, H, Si
		17	Ca, Li, Na, Fe, Sr, C, K, Al, O, Ti, H, Si
		18	Ca, Li, Fe, Na, Sr, C, K, Al, O, Ti, H, Si
		19	Ca, Li, Fe, Na, Sr, C, K, Al, O, Ti, H, Si
		20	Ca, Li, Fe, Na, Sr, C, K, Al, O, Ti, H, Si
		21	Ca, Li, Fe, Na, Sr, C, K, O, Al, Ti, H, Si
		22	Ca, Li, Fe, Na, Sr, C, K, O, Al, Ti, H, Si
		23	Ca, Li, Fe, Na, Sr, C, K, O, Al, Ti, H, Si
		24	Ca, Li, Fe, Na, Sr, C, K, O, Al, Ti, H, Si
		25	Ca, Li, Fe, Na, Sr, C, K, O, Al, Ti, H, Si
S6	<p>Bluish-green paint layer</p> 	1	Ca, Li, Na, K, Sr, Mg
		2	Ca, Li, Sr, Na, Al, K, Fe, Mg
		3	Ca, Li, Sr, Na, K, Al, Fe, Mg, C
		4	Ca, Li, Sr, Na, Fe, K, Al, Mg, O, C
		5	Ca, Li, Sr, Fe, Na, K, Al, Mg, O, C, H
		6	Ca, Li, Sr, Fe, Na, K, Al, Mg, C, O, H
		7	Ca, Li, Sr, Fe, Na, K, Al, Mg, Mn, O, C, H
		8	Ca, Li, Sr, Fe, Na, K, Al, Mn, O, Mg, C, H
		9	Ca, Li, Sr, Fe, Na, K, Al, Mn, O, Mg, C, H, Si
		10	Ca, Li, Sr, Fe, Na, K, Mn, Al, C, Mg, O, H, Si
		11	Ca, Li, Sr, Fe, Na, K, Mn, Al, C, O, Mg, Si, H
		12	Ca, Li, Fe, Sr, Na, K, Mn, Al, C, O, Mg, Si, H
		13	Ca, Li, Fe, Sr, Na, K, Mn, Al, C, O, Mg, Si, H
		14	Ca, Li, Fe, Sr, Na, K, Mn, Al, O, C, Mg, Si, H
		15	Ca, Li, Fe, Sr, Na, K, Mn, Al, O, C, Mg, Si, H
		16	Ca, Li, Fe, Sr, Na, K, Mn, Al, O, C, Mg, Si, H
		17	Ca, Li, Fe, Sr, Na, K, Cr, Mn, O, Al, C, Mg, Si, H
		18	Ca, Li, Fe, Sr, Na, K, Cr, Mn, O, Al, C, Mg, Si, H
		19	Ca, Li, Fe, Sr, Na, Cr, K, Mn, O, Al, C, Mg, Si, H
		20	Ca, Li, Fe, Sr, Na, Cr, K, Mn, O, C, Al, Mg, Si, H
		21	Ca, Li, Fe, Sr, Na, Cr, K, Mn, O, C, Al, Mg, Si, H
		22	Ca, Li, Fe, Sr, Na, Cr, K, Mn, O, C, Al, Mg, Si, H
		23	Ca, Li, Fe, Sr, Na, Cr, K, Mn, O, C, Al, Mg, Si, H
		24	Fe, Sr, Na, Cr, K, Mn, O, C, Al, Mg, Si, H
		25	Ca, Li, Fe, Sr, Na, Cr, K, Mn, O, C, Al, Mg, Si, H