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Colorimetric and spectral data análisis of consolidants used for preservation of medieval plasterwork

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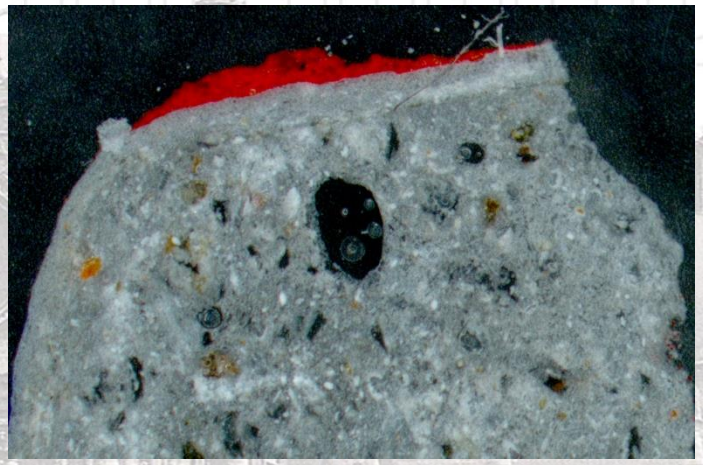
Medieval plasterwork's preservation is compromised as the lack of cohesion between polychrome sections, if not adequately treated, causes the irretrievable loss of its original appearance.

It is common to observe only scarce remains of the plasterwork's original color appearance in monuments like the Alhambra in Granada, or the Alcazar in Seville.

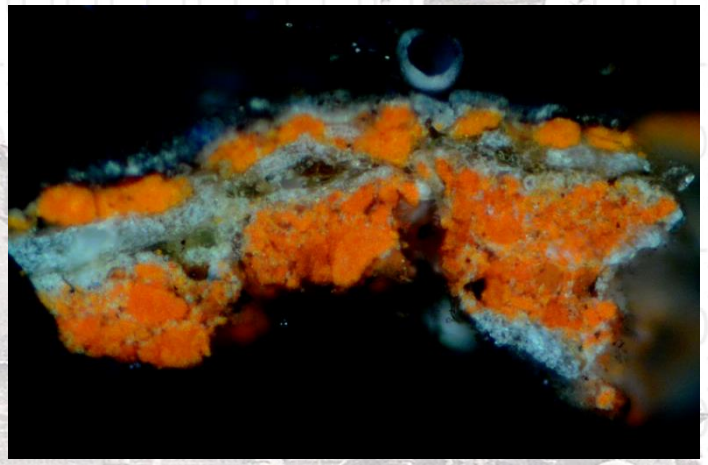
The main causes of deterioration are exposure to humidity, aggressive cleaning or subsequently applied layers of paint.

Real plasterwork samples from Patio de las Doncellas in Alcázar of Sevilla

Azurite



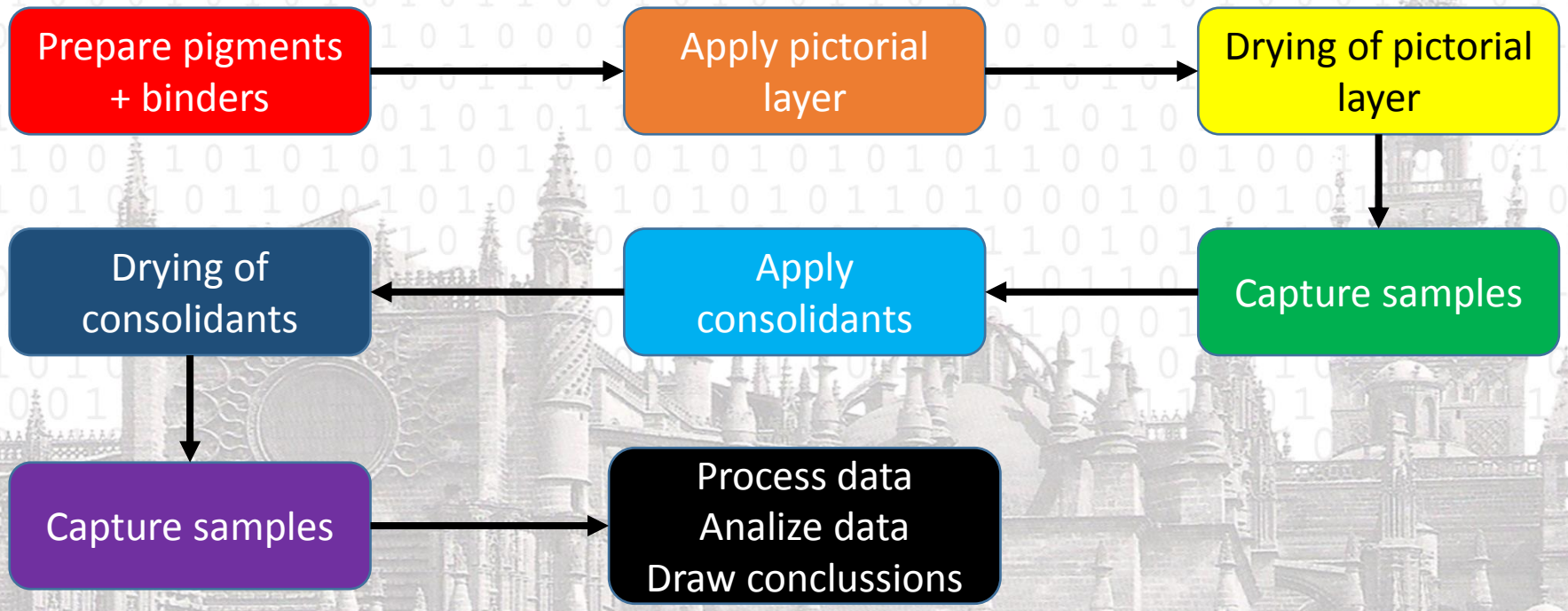
Cinnabar



Lead red

The main aim of this study is to determine the best consolidant of choice to preserve medieval plasterwork, from a colorimetric point of view.

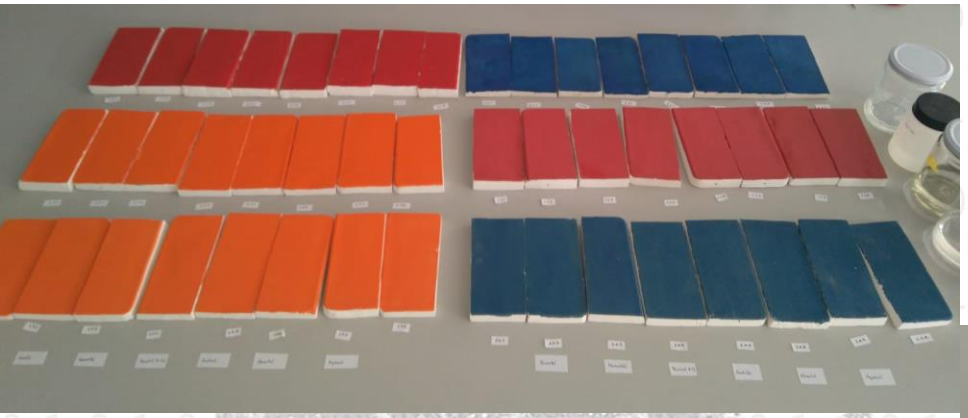
Workflow



3 pigments: natural azurite, cinnabar and lead red.

2 binders: Arabic gum and Animal glue.

6 consolidants: Bioestel, Nanoestel, Paraloid B72, Klucel, Mowital, Aquazol.

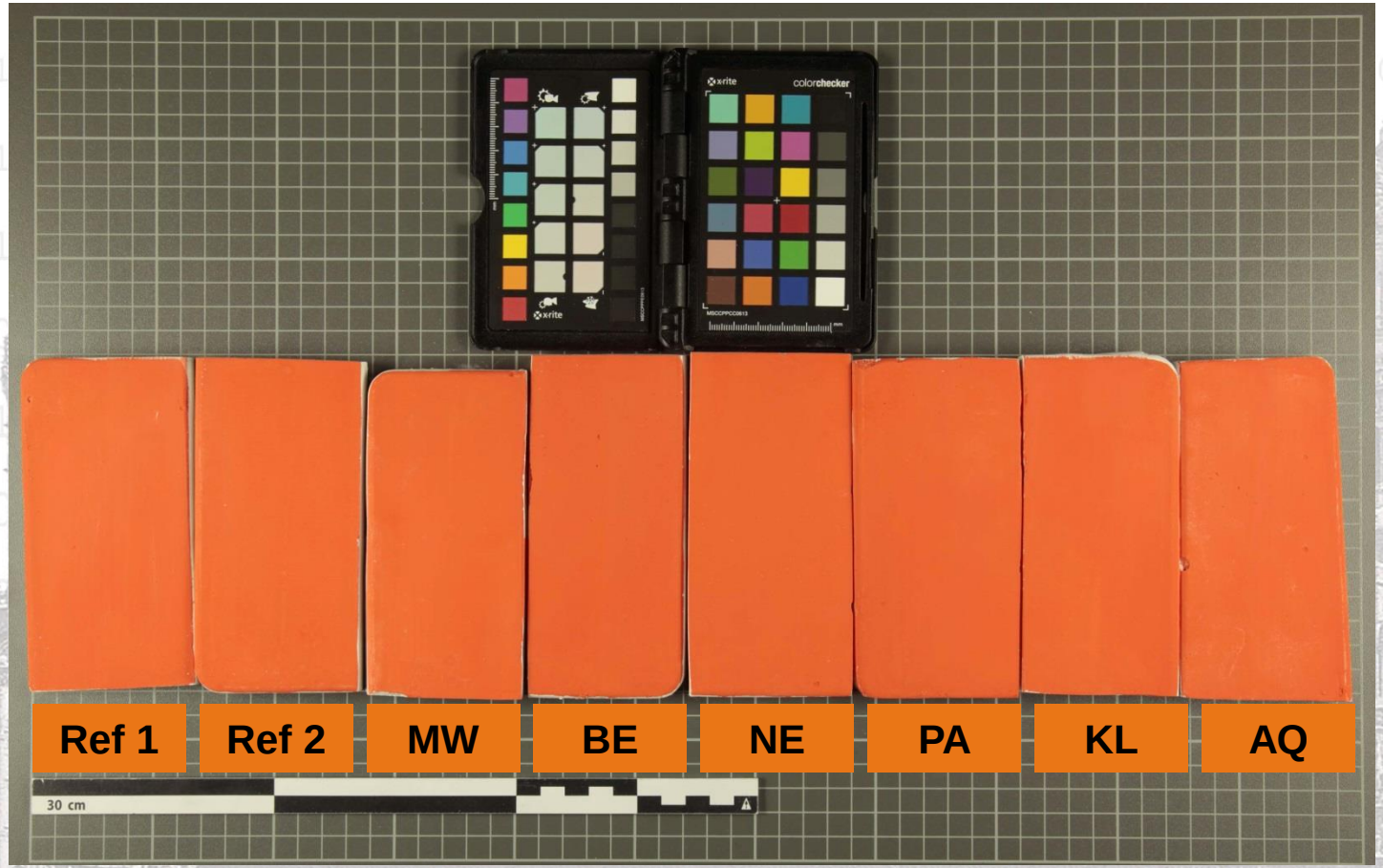


Aplication of consolidants

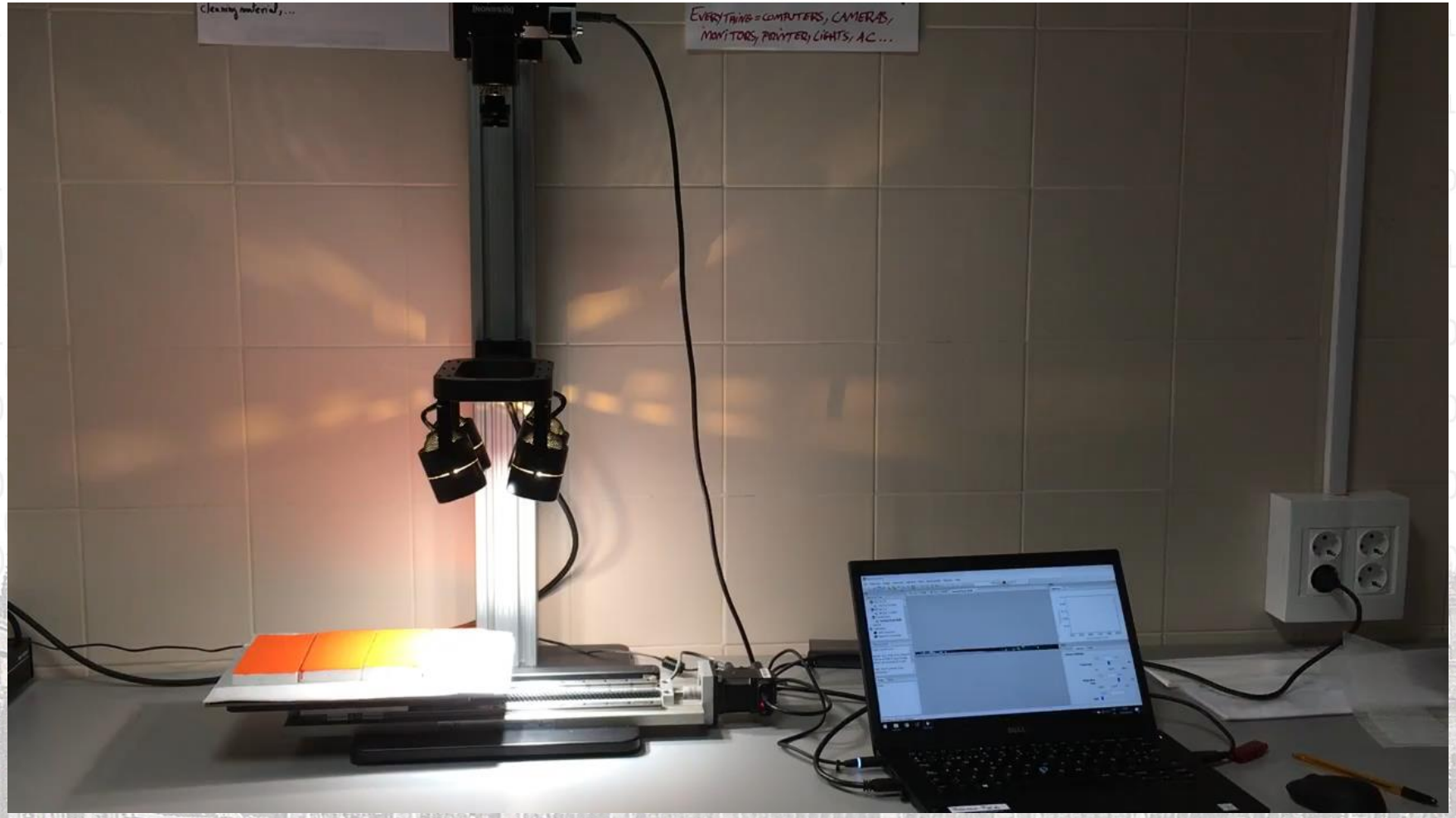
Pigment: lead red.

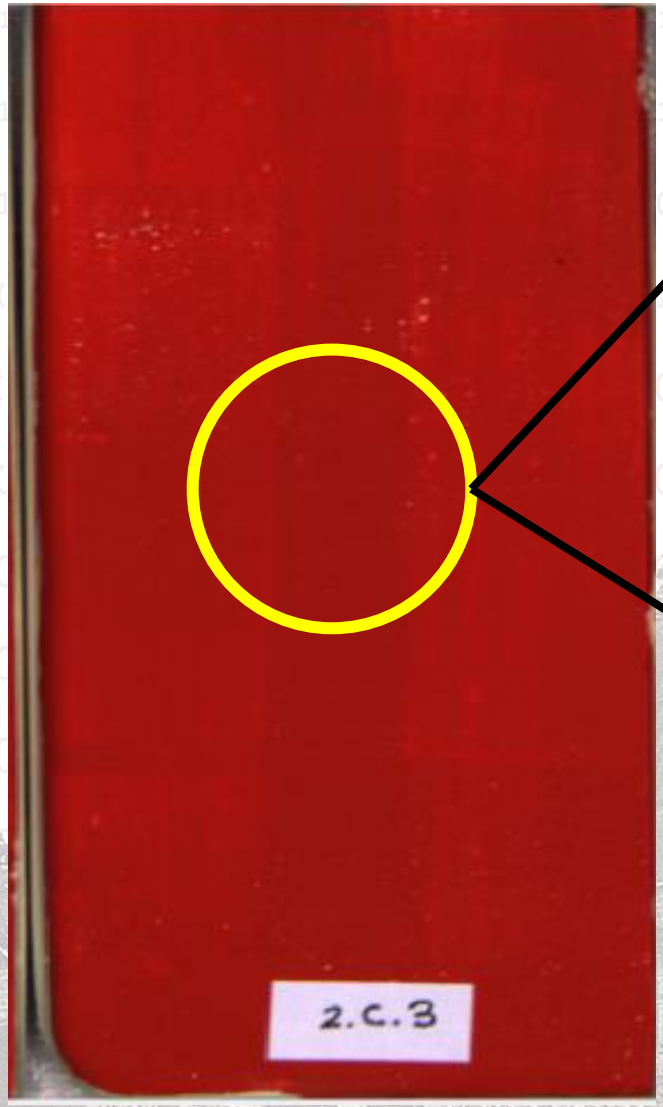
Binder: Arabic gum.

consolidants: Bioestel (BE), Nanoestel (NE), Paraloid B72 (PA), Klucel (KL), Mowital (MW), Aquazol (AQ).

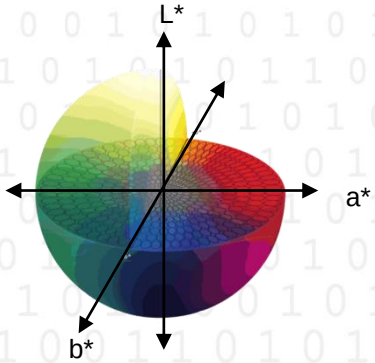


Capturing system: Hyperspectral line scanner imager (Resonon Pika L). 301 spectral bands from 400 to 1000 nm.

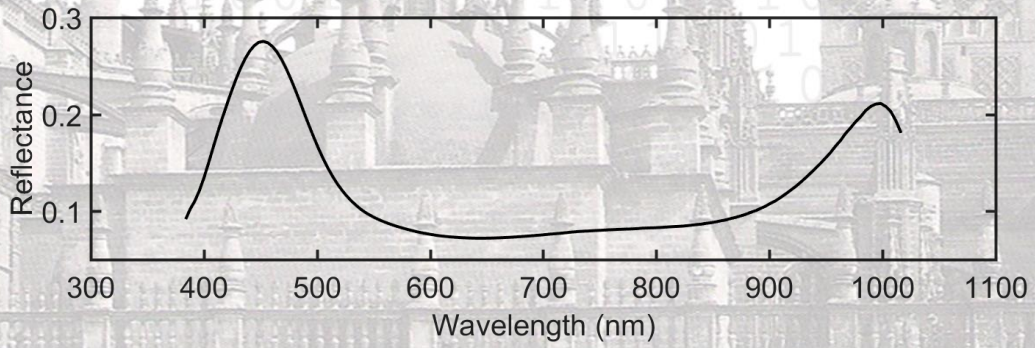




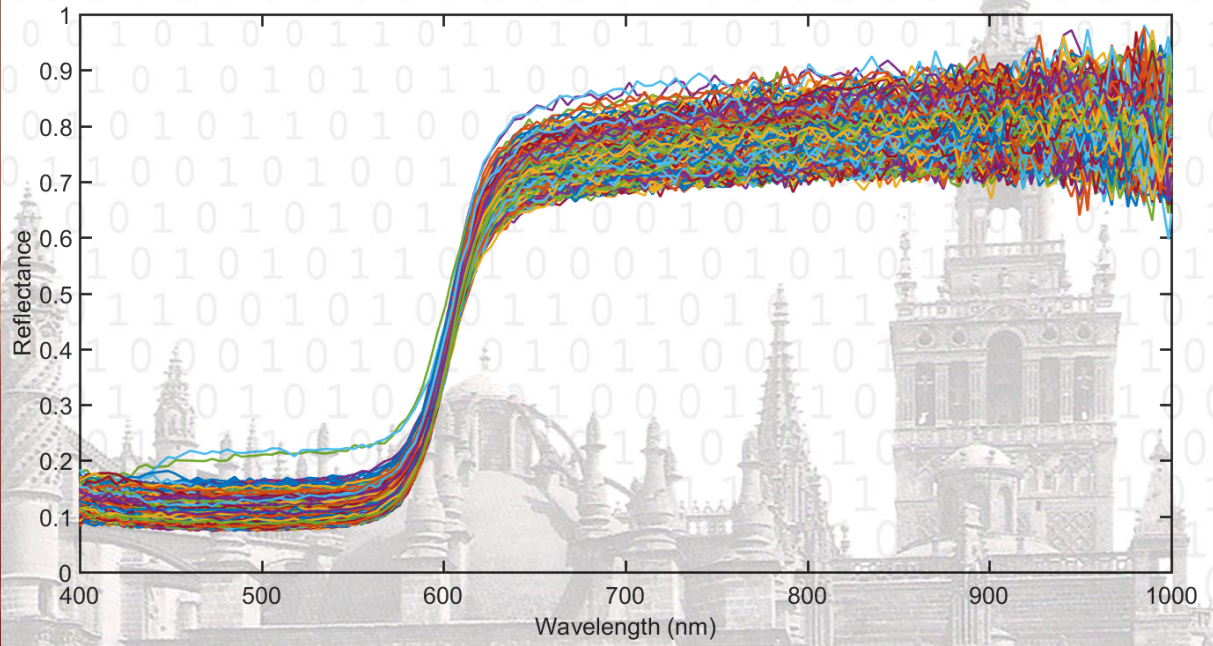
Colorimeter: average color -> RGB, L*a*b*, L*u'v', etc.



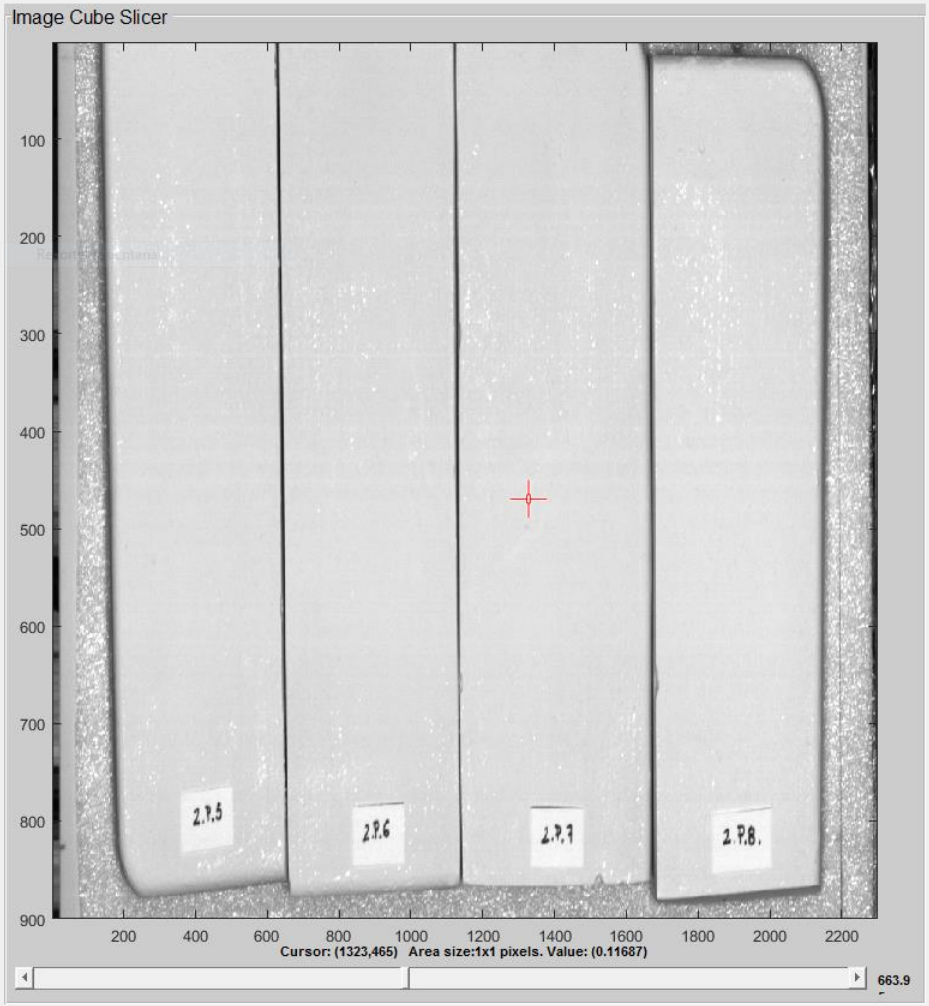
Spectrophotometer: average spectral reflectance.

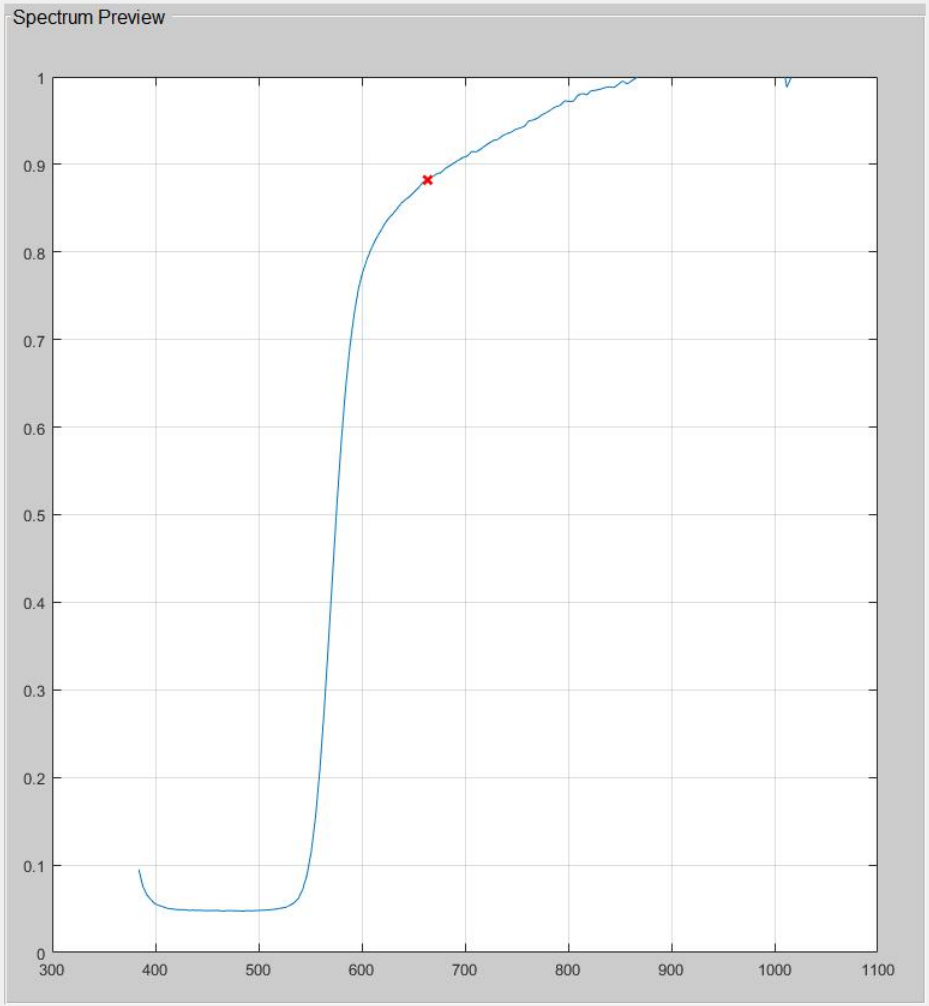


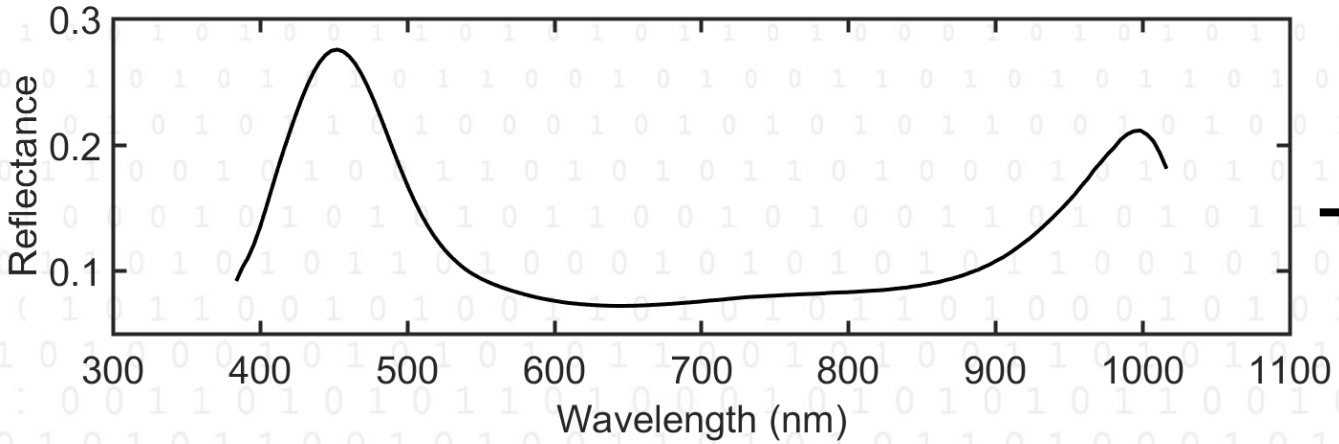
Hyperspectral imaging: spectral reflectance pixelwise

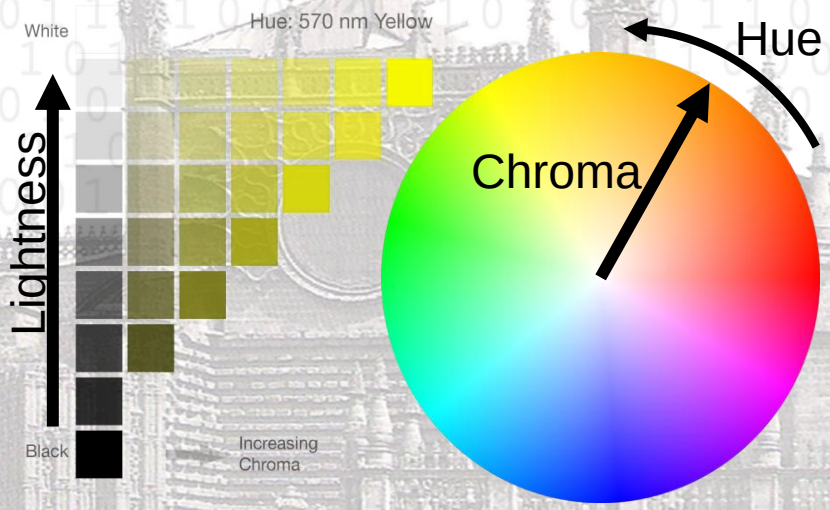


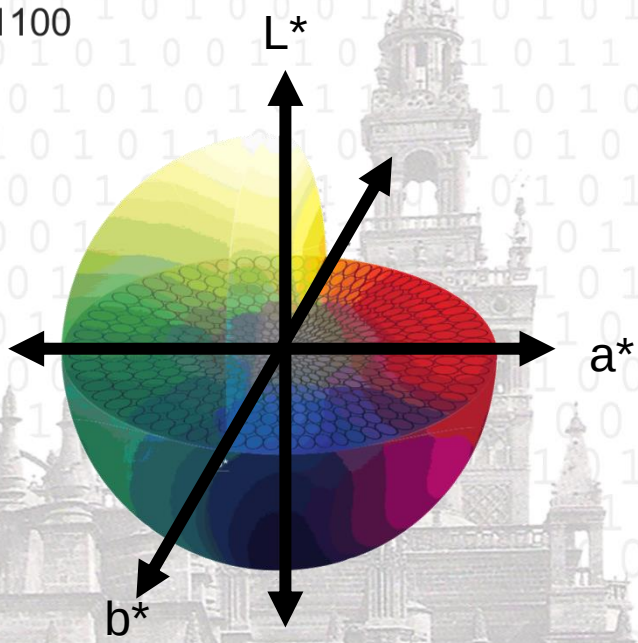
Captured images: Hyperspectral reflectance images. Full spectral reflectance pixelwise.



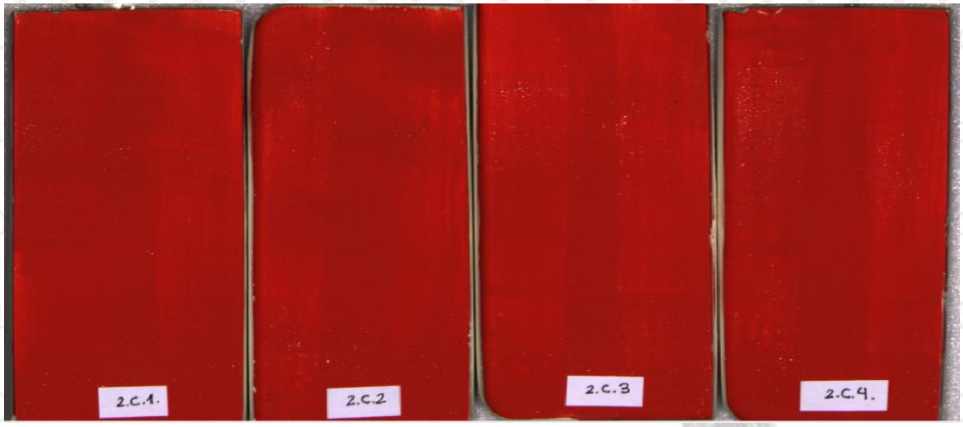



0.3
0.2
0.1
Reflectance
300
400
500
600
700
800
900
1000
1100
Wavelength (nm)


White
Hue: 570 nm Yellow
Lightness
Black
Increasing Chroma
Hue
Chroma

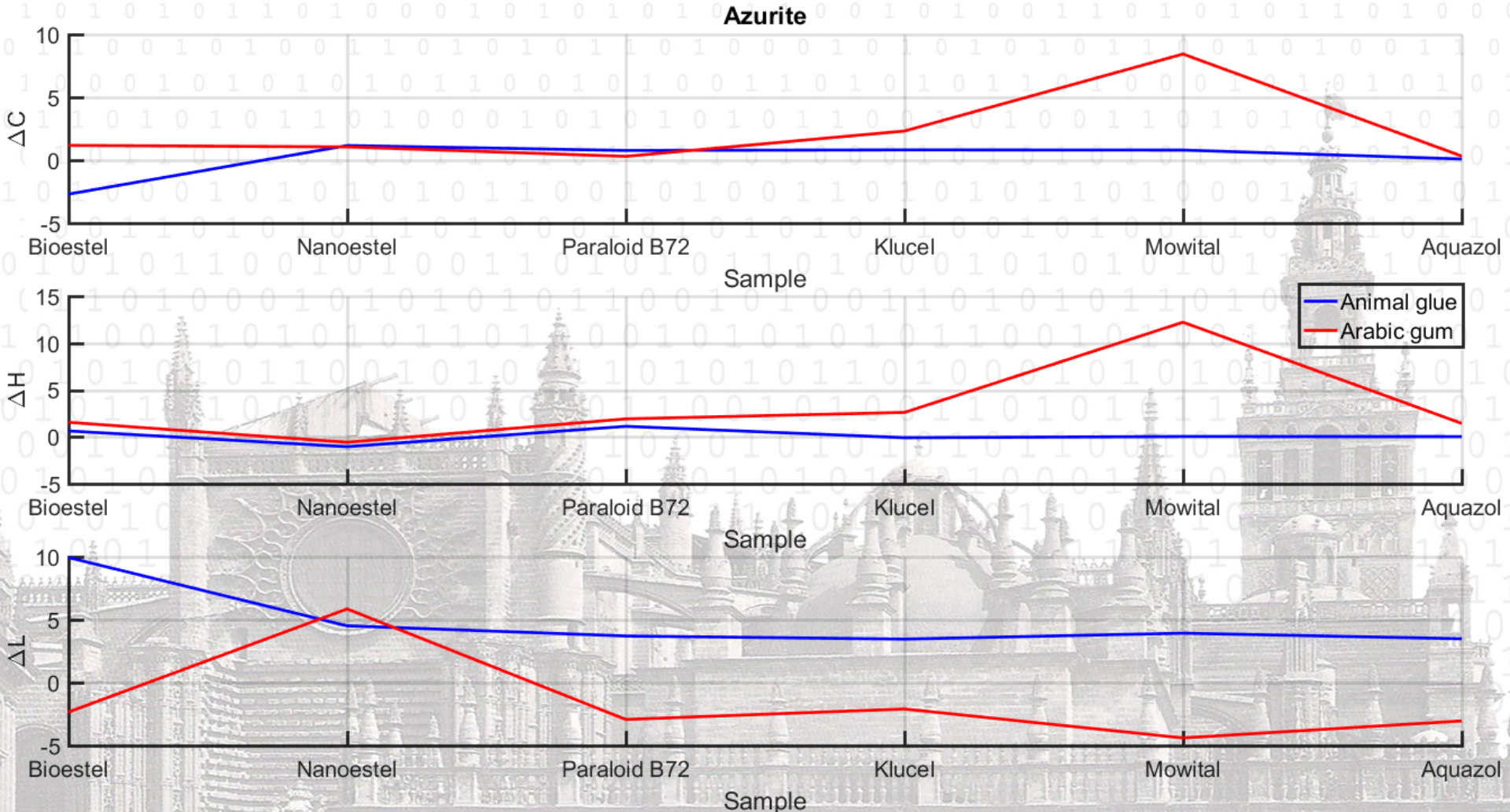

L*
a*
b*


1.A.1
1.A.2
1.A.3
1.A.4

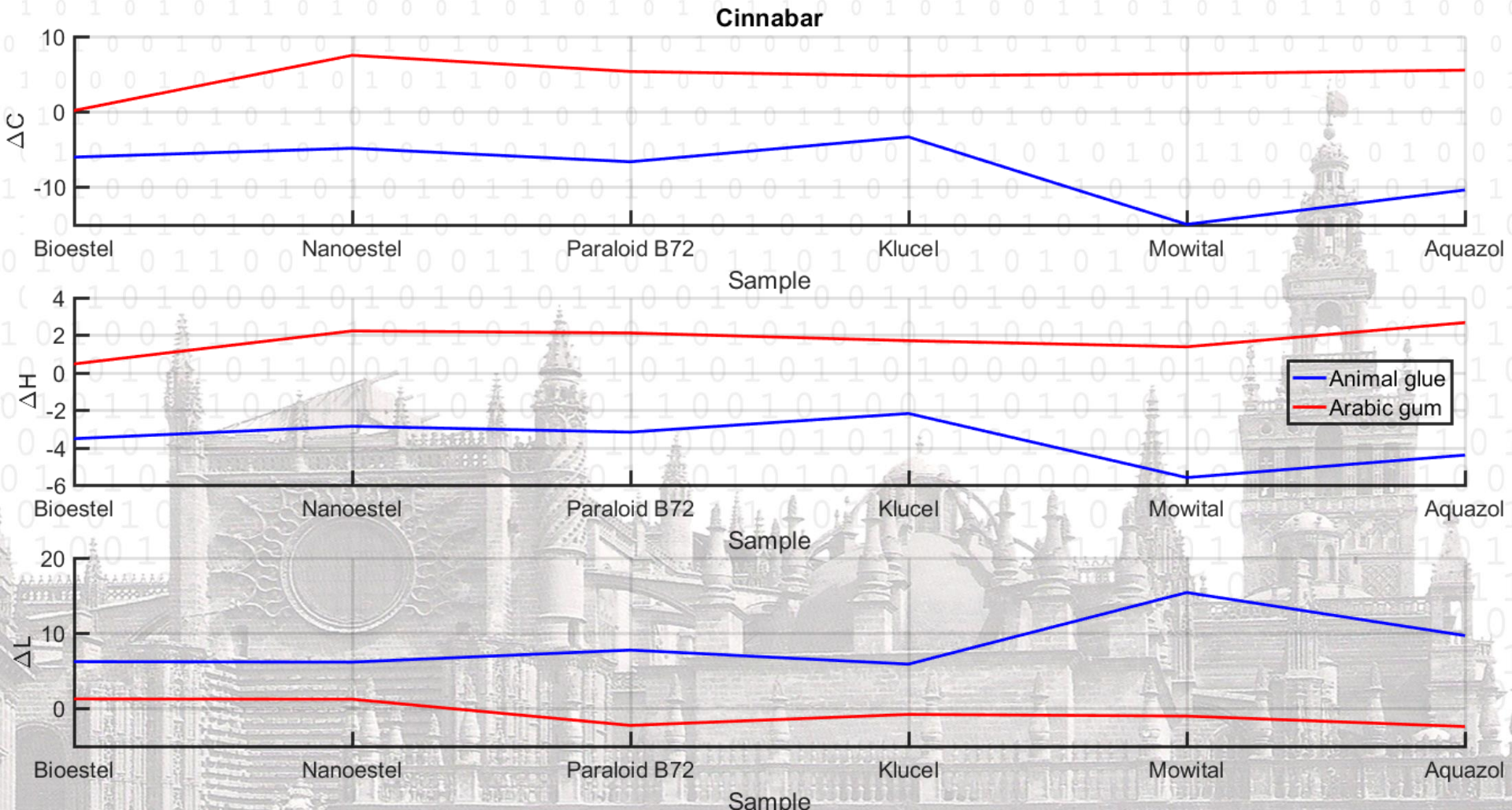

2.C.1.
2.C.2
2.C.3
2.C.4.


2.P.5
2.P.6
2.P.7
2.P.8.

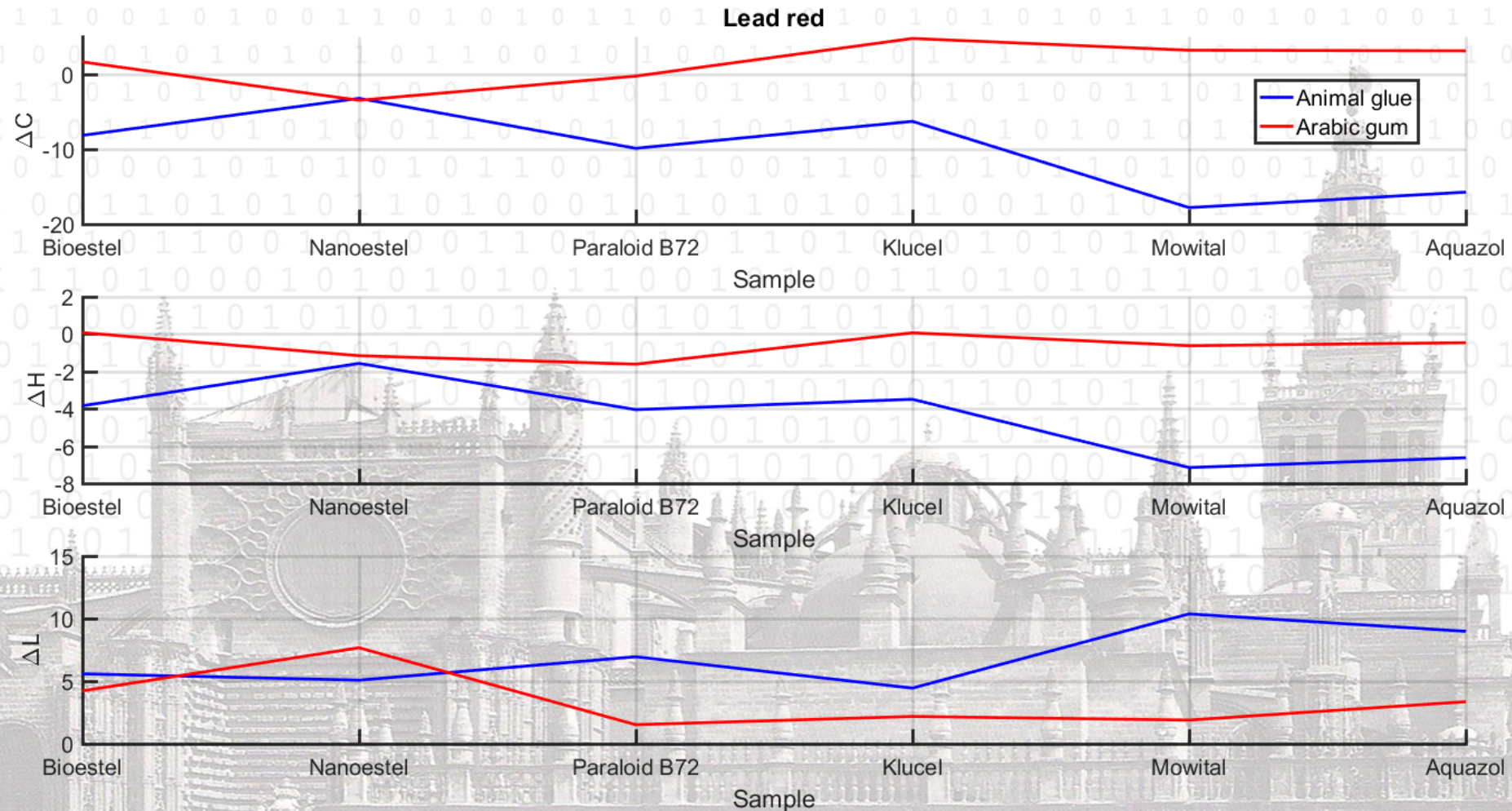
Perceptual color atributes: Arabic gum higher chroma increase and hue shift towards green and decreases lightness. Animal glue increases lightness.



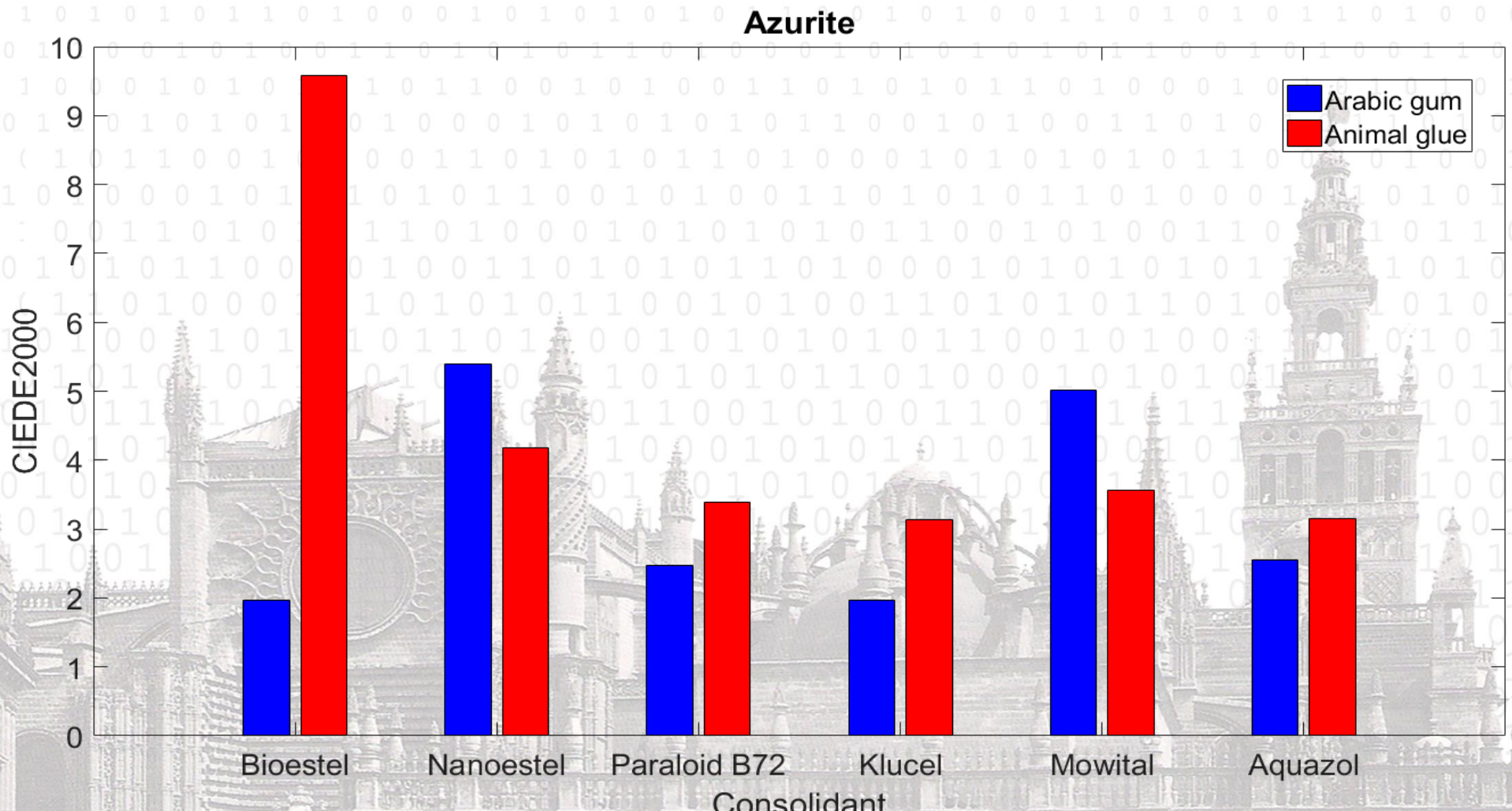
Perceptual color atributes: Arabic gum increases chroma and smaller hue shift.
Animal glue increases lightness, decreases chroma and higher hue shift in the opposite direction.



Perceptual color atributes: Arabic gum decreases lightness.
Animal glue decreases chroma, higher hue shift and lightness increase.



Color difference: across binders, Klucel preserves color best, and Mowital worst.
Arabic gum is more stable preserving color than animal glue. Best choice: Arabic gum + Bioestel



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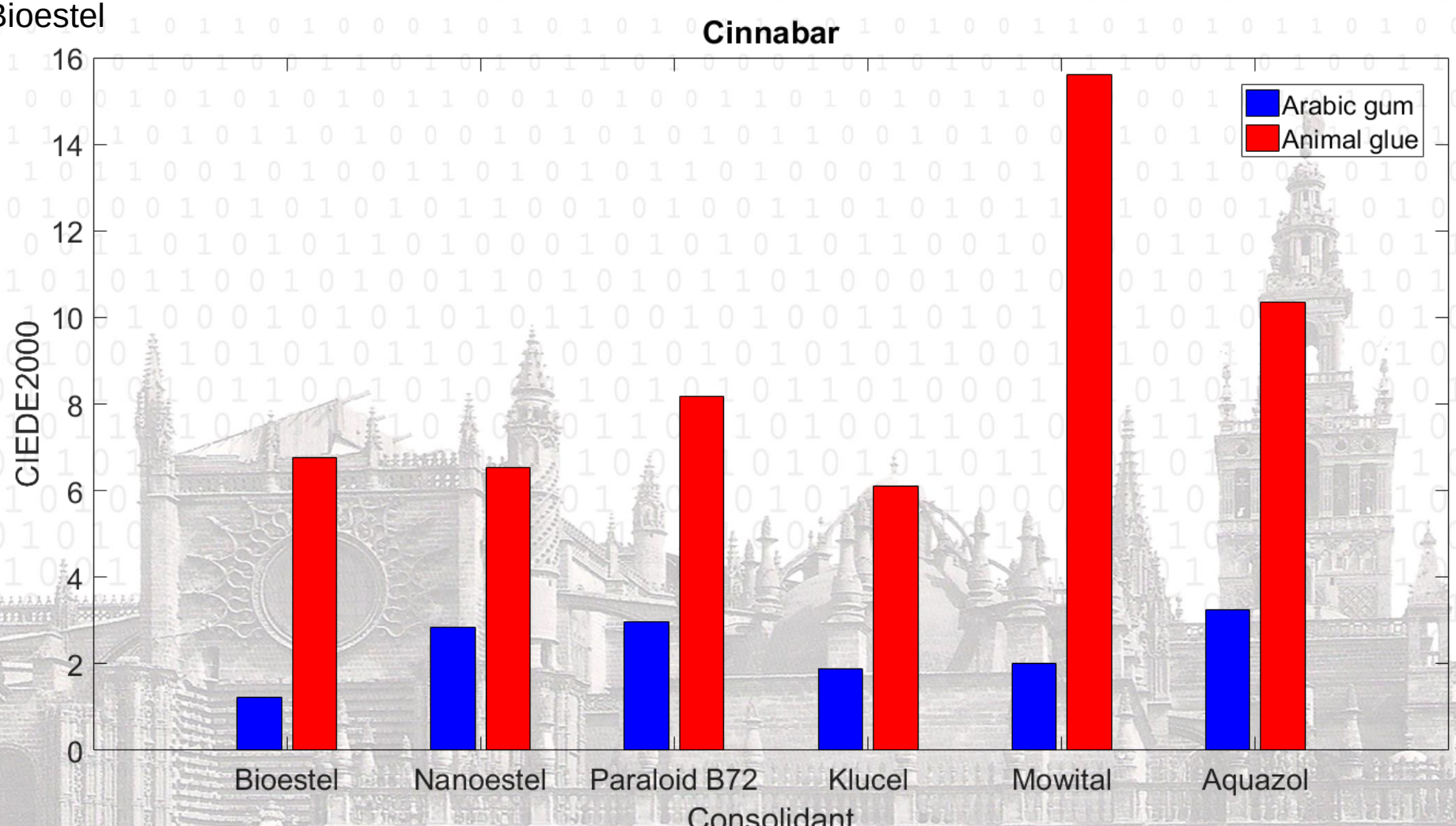

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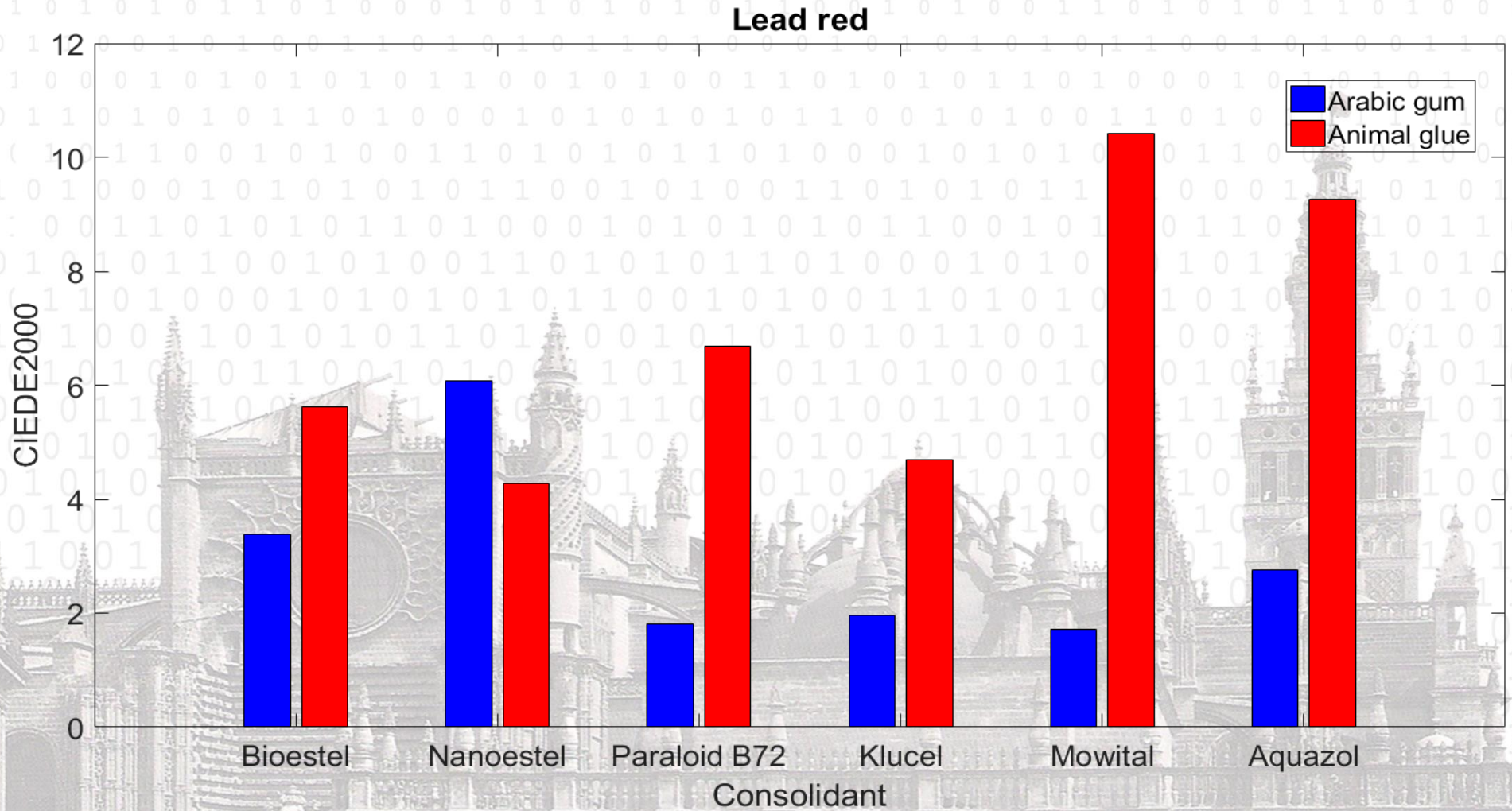
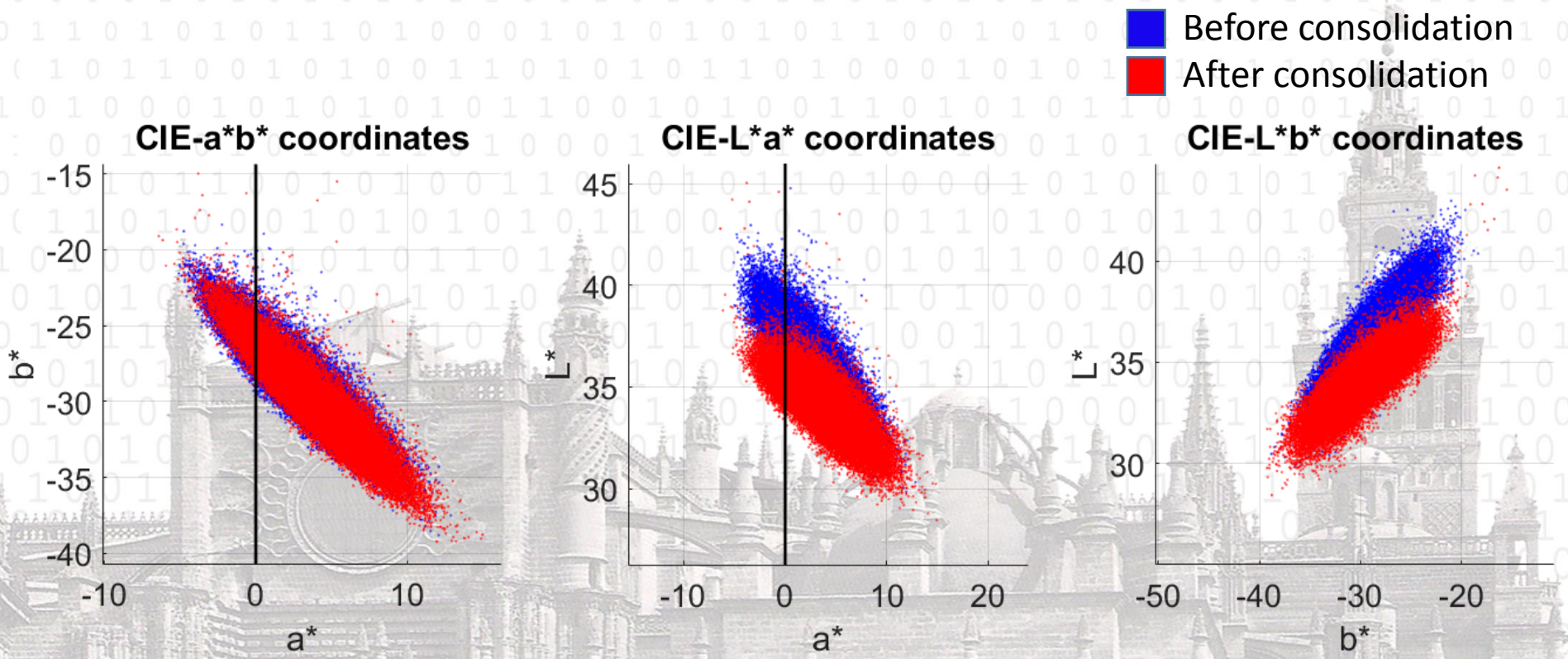
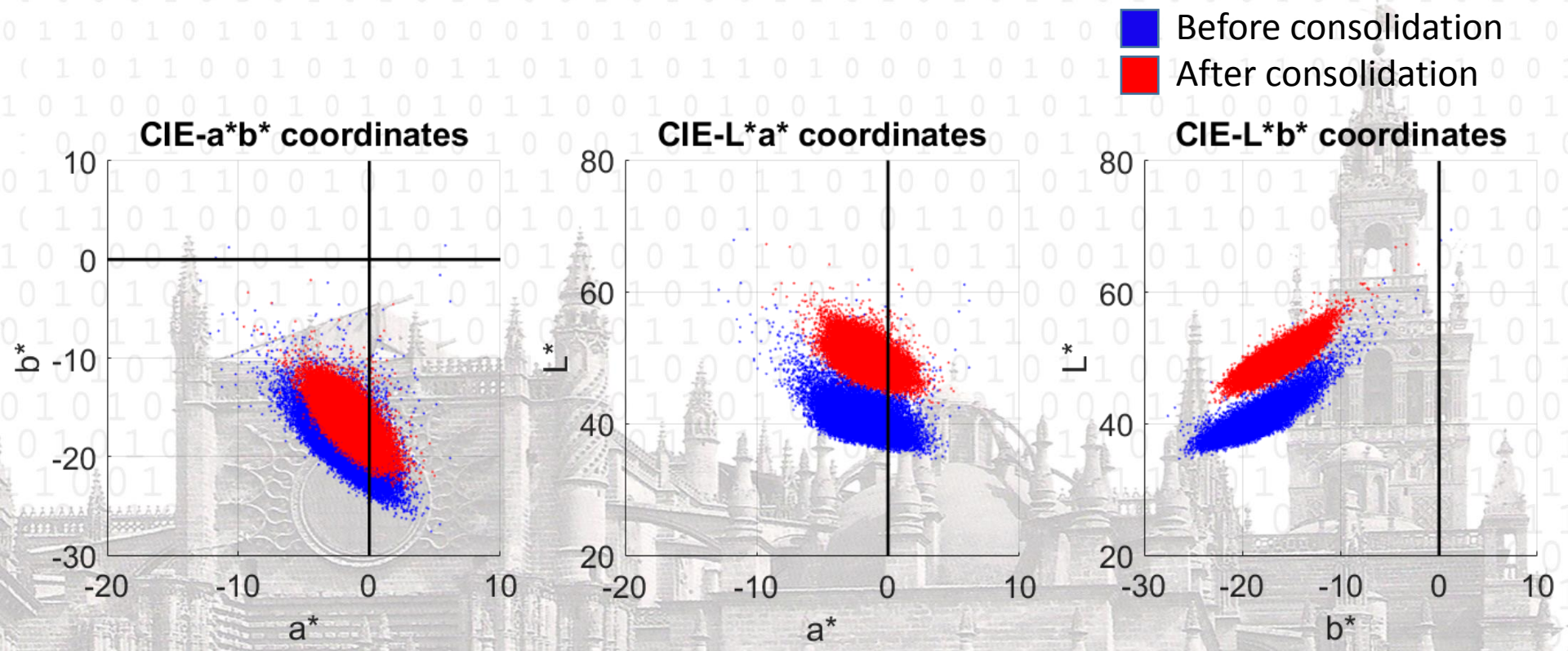


CIEL*a*b* distributions: Azurite, Arabic gum, Bioestel. Similar dispersion -> texture. Similar color (small color difference), lower lightness after consolidation is applied.



CIEL*a*b* distributions: Azurite, Animal glue, Bioestel. Similar dispersion -> texture. Different color (larger color difference), higher lightness after consolidation is applied.



Conclussion:

- The least homogeneous pigment across probes is azurite.
- The least homogeneous binder is arabic gum.
- Regarding the effect of applying the consolidant, the Klucel® is the agent that best preserves sample color across binders and pigments.
- Mowital®B60H causes the most noticeable change in color in average across pigments

Future work:

- Study the effect of aging by using an artificial aging chamber.
- Study texture parameters for different wavelengths.
- Model the aging process in order to simulate the final look of new real samples.