Materials Properties, Use and Conservation: Construction Materials and Binders

Raw materials and making techniques of Roman wallpaintings

- Literary sources;
- The creation of the “tectorium” in the making phases;
- The production techniques of the preparatory mortars and the raw materials used;
- The composition of the pigments

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The creation of Roman wall painting

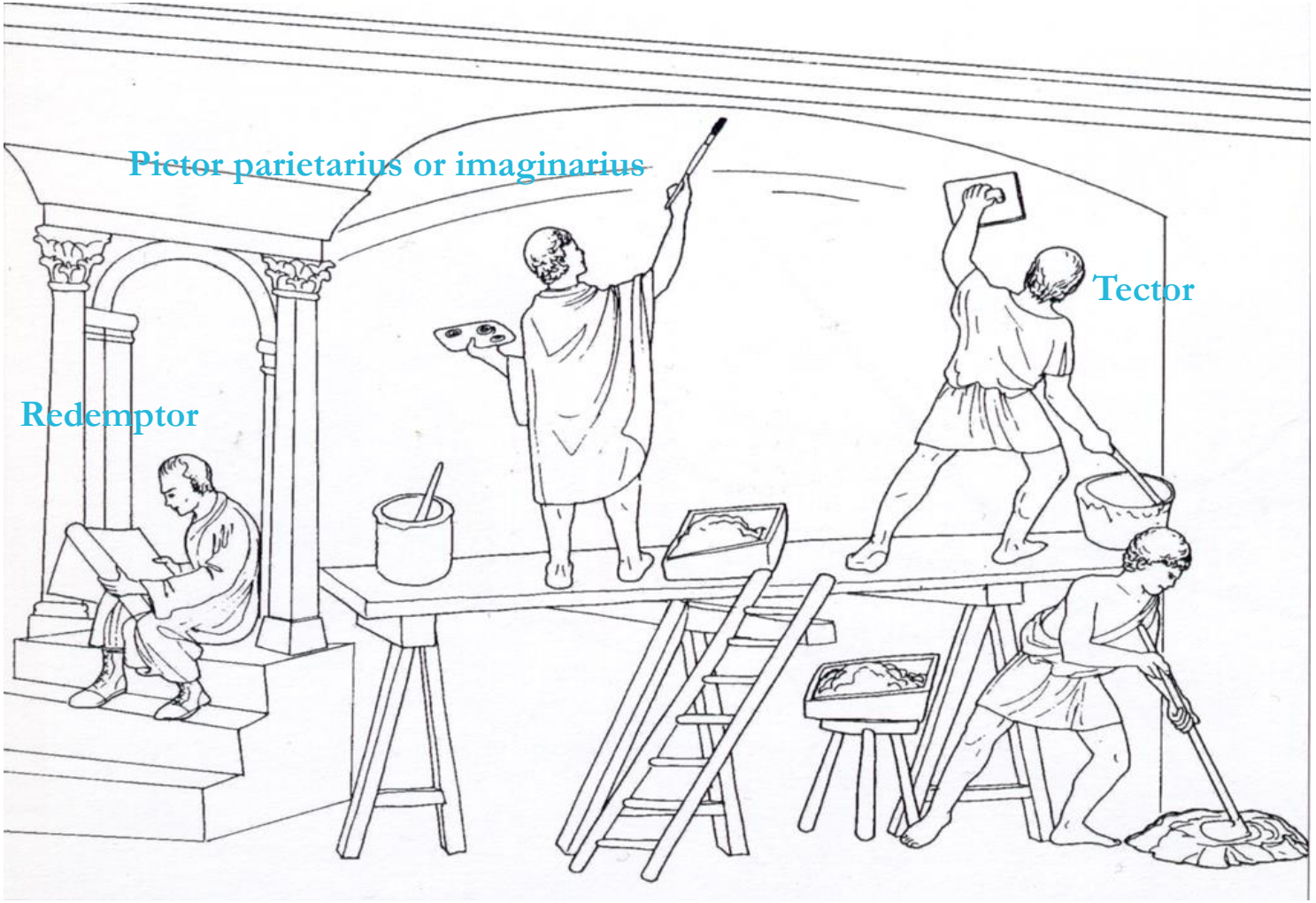
Hierarchy and organization of work

Funerary relief from Sens

2nd c. CE

The creation of Roman wall painting

Hierarchy and organization of work



Graphic reconstruction of the relief of Sens

The creation of Roman wall painting

Pompei, IX,12,9 Casa dei Pittori al lavoro, vano 12, parete E

The creation of Roman wall painting

The preparation of the *tectorium* (preparatory layers)

Aquileia – House of the Wounded Beasts

Pompei – Sarno Baths

Pompei – Sarno Baths

The ancient sources

The preparation of the *tectorium* according to Vitruvius

Coronis explicatis parietes quam asperrime trullissentur, **postea autem supra, trullissatione subarescente, deformentur directiones harenati**, uti longitudines ad regulam ad lineam, altitudines ad perpendiculum, anguli ad normam respondentes exigantur. namque sic emendata tectoriorum in picturis erit species. **subarescente, iterum et tertio inducatur. ita cum fundatior erit ex harenato directura, eo firmior erit ad vetustatem soliditas tectorii**.

Vitr. *De arch*. VII, 3, 5

Once the frames have been completed, **give the walls a very coarse layer of plaster, and then, while this plaster begins to dry, apply aligned layers of sand mortar on top,** traced with precision so that the length corresponds to the line and to the line, the height to the plumb line, the angles to the square, since in this way the surface of the covering will be free of imperfections during painting. **While this first layer begins to dry, add a second layer of mortar and sand and then a third. Thus, the deeper the application of sand mortar, the more resistant the coating will be over time.**

The ancient sources

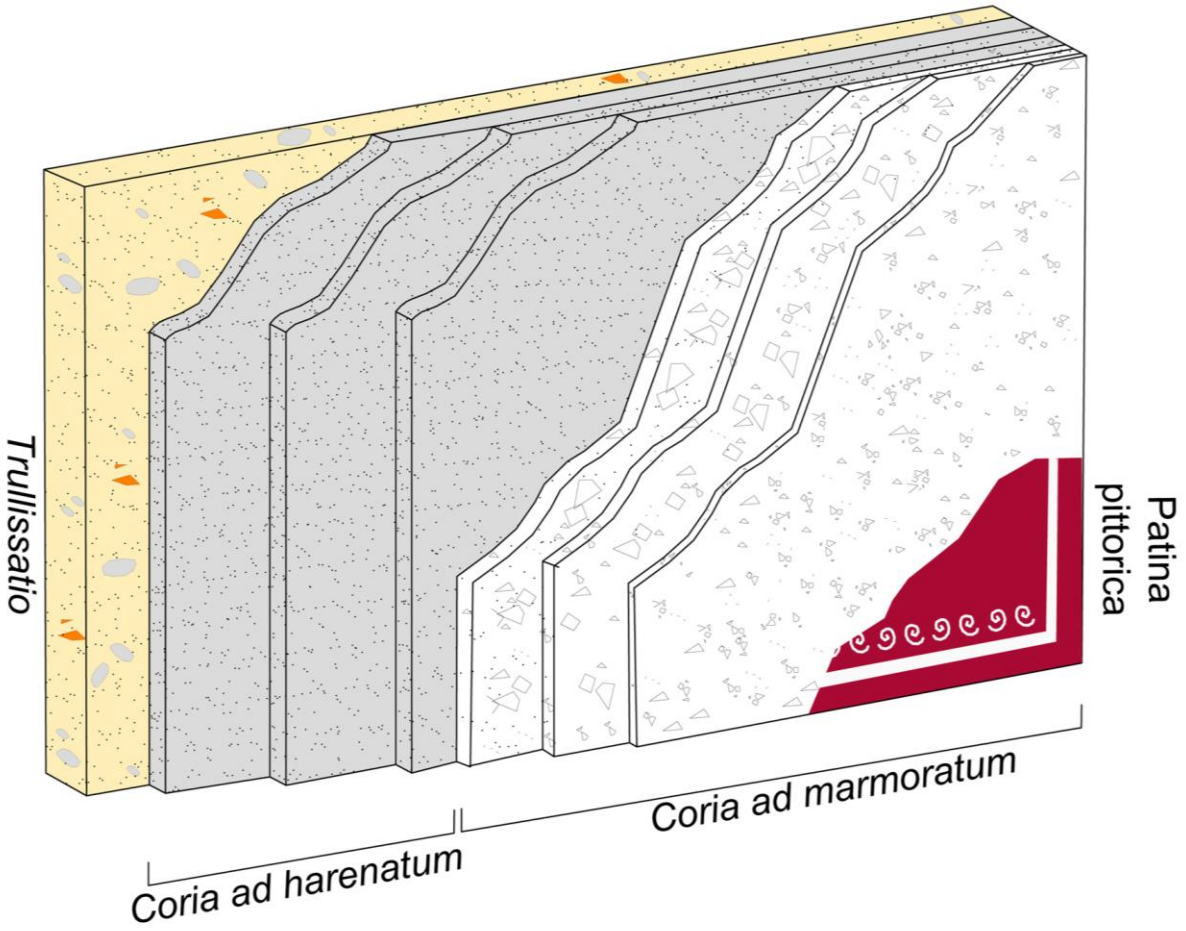
The preparation of the *tectorium* according to Vitruvius

Cum ab harena praeter trullissationem **non minus tribus coriis fuerit deformatum, tunc e marmore graneo directiones sunt subigendae**, cum ita materies temperetur uti cum subigatur non haereat ad rutrum, sed purum ferrum e mortario liberetur. **Graneo inducto et inarescente, alterum corium mediocre dirigatur. id cum subactum fuerit et bene fricatum, subtilius inducatur. ita cum tribus coriis harenae et item marmoris solidati parietes fuerint, neque rimas neque aliud vitium in se recipere poterunt.**

Vitr. *De arch*. VII, 3, 6

When **no less than three layers of sand mortar** have been applied, **in addition to the plaster, it is necessary at this point to spread layers of coarse-grained marble dust [or spatic calcite],** with the mortar mixed until, when spread, it does not stick to the trowel, but the iron tool is pulled clean out of the mortar. **Spread this layer of coarse grain and while it becomes dry, apply a second one of medium thickness, and when this has been pressed and well rubbed, spread a thinner one. In this way, strengthen with three layers of sand mortar and the same number of marble dust, the walls will not be covered with cracks or any other imperfections.**

The ancient sources



- *Trullissatio*: layer of «**rinzaffo**» at the base of the preparatory sequence with a mortar made of lime mixed with coarse sand
- *Harenatum*: 3 layers of «**arriccio**» with a mortar made of lime and fine sand
- *Politio*: 3 layers of «**intonachino**» sometimes defined as «marmorino», made of lime-based mortars mixed with marble dust or fine grained sparry calcite having a downgrading grain size distribution from the inner to the outer layer

The ancient sources

The *fresco* technique

Sed et liaculorum subactionibus fundata soliditate marmorisque candore firmo levigata, coloribus cum politionibus inductis nitidos expriment splendores. **colores autem, udo tectorio cum diligenter sunt inducti, ideo non remittunt sed sunt perpetuo permanentes,** quod calx in fornacibus excocto liquore facta raritatibus evanida, ieiunitate coacta corripit in se quae res forte contigerunt, mixtionibusque ex aliis potestatibus conlatis seminibus seu principiis una solidescendo, in quibuscumque membris est formata cum fit arida redigitur uti sui generis proprias videatur habere qualitates.

Vitr. De arch. VII, 3, 7

But once their compactness has been consolidated, by rubbing it with pasters, and smoothed with the shiny and long-lasting marble, the walls will radiate the most dazzling shine after which, together with the final finishing, the colors will be spread on them. **As for the colors, when you have had the foresight to spread them on the still damp covering, they do not come off, but remain fixed forever.** And this is because the lime, which has become porous and therefore inconsistent after its liquid component has dried in the kiln, as if forced by aridity, absorbs anything that comes into contact with it: it mixes with the constituent elements collected from other substances, forming a solid mass together with them, and, whatever the elements that constitute it, when it becomes dry it reconstitutes itself, so as to appear to possess the qualities peculiar to its nature.

The ancient sources

The *good* and the *bad* making techniques

itaque tectoria quae recte sunt facta neque vetustatibus fiunt horrida, neque cum extergentur remittunt colores, nisi si parum diligenter et in arido fuerint inducti. cum ergo ita in parietibus tectoria facta fuerint uti supra scriptum est, et firmitatem et splendorem et ad vetustatem permanentem virtutem poterunt habere. cum vero **unum corium harenae et unum minuti marmoris erit inductum, tenuitas eius minus valendo faciliter rumpitur nec splendorem poli-tionibus propter inbecillitatem crassitudinis proprium obtinebit.**

Vitr. *De arch*. VII, 3, 8

Therefore, **coatings that have been made correctly do not become rough along time nor will they allow the colors to detach when cleaned, unless they have been spread with little care and on the already dry surface**. Therefore, when the wall coverings have been made according to the procedure described above, they will be able to have not only solidity, but also a splendid appearance and an excellent quality destined to last over time. **But in the case in which only one layer of sand mortar and one of fine marble has been laid, the thinness of this coating, having less resistance, cracks easily and due to the weak thickness it will not acquire, following polishing, the necessary shine.**

The ancient sources

The *good* and the *bad* making techniques

quemadmodum enim speculum argenteum tenui lamella ductum incertas et sine viribus habet remissiones splendoris, quod autem e solida temperatura fuerit factum, recipiens in se firmis viribus politionem fulgentes in aspectu certasque considerantibus imagines reddit, **sic tectoria quae ex tenui sunt ducta materia non modo sunt rimosa, sed etiam celeriter evanescunt**, quae autem fundata harenationis et marmoris soliditate sunt crassitudine spissa, cum sunt politionibus crebris subacta, **non modo sunt nitentia, sed etiam imagines expressas aspicientibus ex eo opere remittunt.**

Vitr. De arch. VII, 3, 9

In fact, just as a silver mirror made of a thin sheet sends indistinct and weak reflections of light, while one which has been manufactured with a robust structure, being capable of withstanding vigorous polishing, reflects images which are brilliant to the eye and very distinct for those who observe, in the same way the **wall-paintings made of thin material, in addition to cracking, also fade in a short time**, while those which have a compact base, of considerable thickness, of layers of sand and marble mortar, after having been subjected to frequent polishing not only shines**.**

The ancient sources

Summing up…

✓ The "***good practices"*** to follow in order to create a brightly colored and long-lasting pictorial decoration:

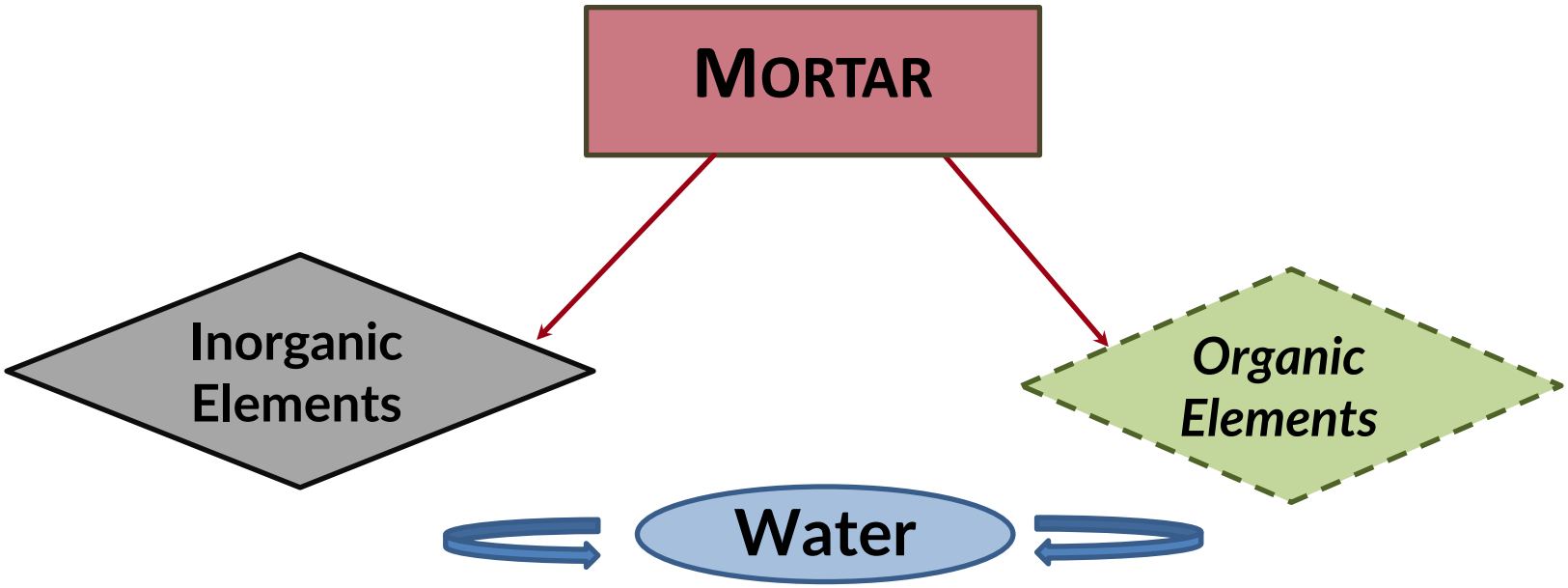
- Create a plaster in several layers, having the adequate thickness, so as to allow the pigment to bind better.
- Use marble dust (or spatic calcite) in order to give shine to the painted decoration
- Apply the pigments while wet, on the mortars support while still damp, so as to allow for better fixation and amalgamation of the color with the preparatory support.

✓ The "***bad practices"***, *as* determine the creation of a plaster poor workmanship and not very durable

- Apply a tectorium in a few layers
- Create layers of plaster of modest thickness
- Do not use marble dust (not clearly specified by the author)
- Apply the pigment with the "dry method" on a dry surface

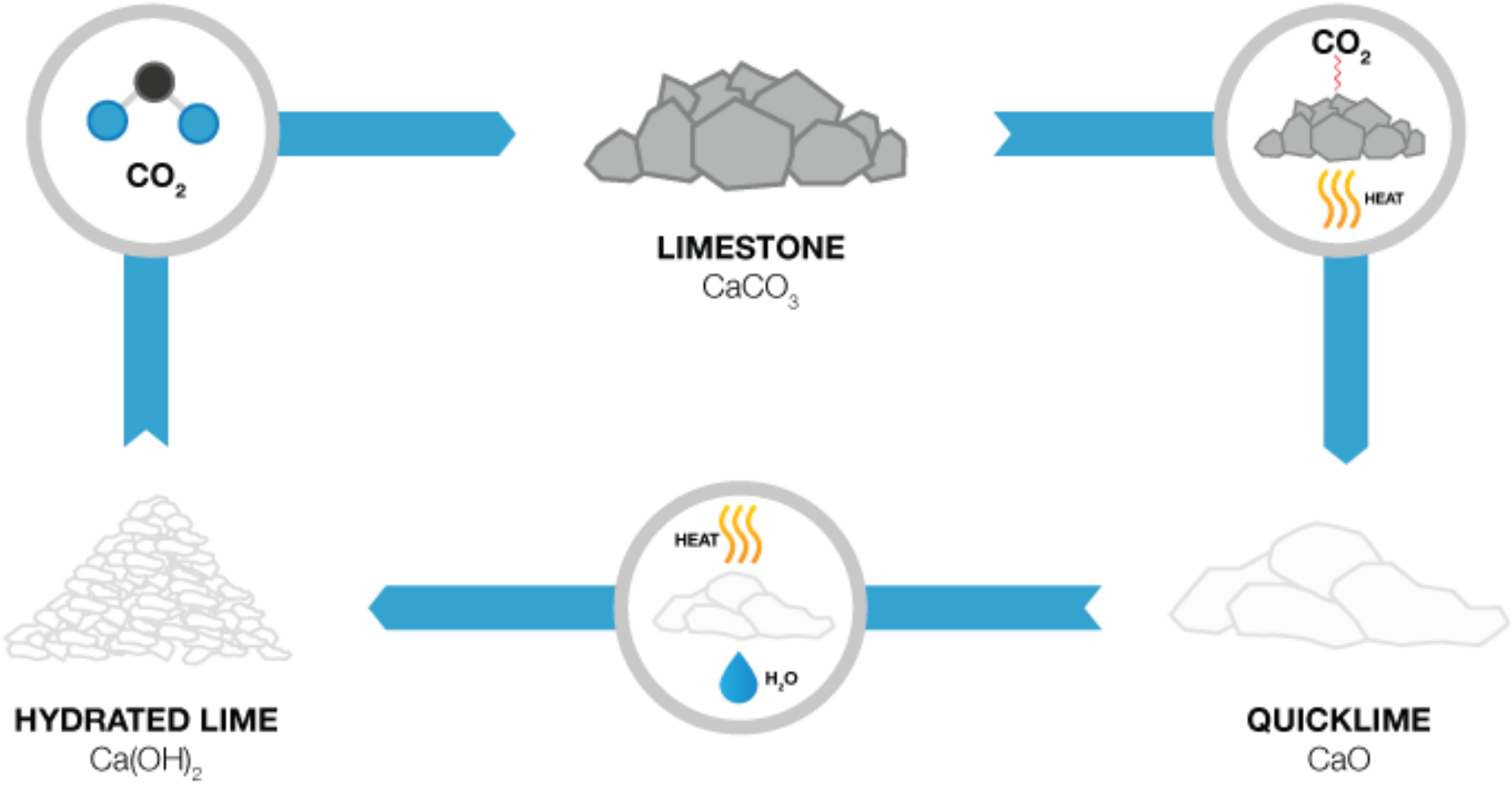
The composition of air lime-based mortars

Mortars are artificial compounds, produced by man using different materials, predominantly inorganic (but sometimes also organic), which, once mixed in water, they produce a plastic mixture capable of progressively converting through reactions chemicals, in a product with a solid consistency, with adequate mechanical resistance and adhesion to surfaces with which it comes into contact (PECCHIONI, FRATINI, CANTISANI 2008).



When in contact with air (calcium dioxide), it SOLIDIFIES over time

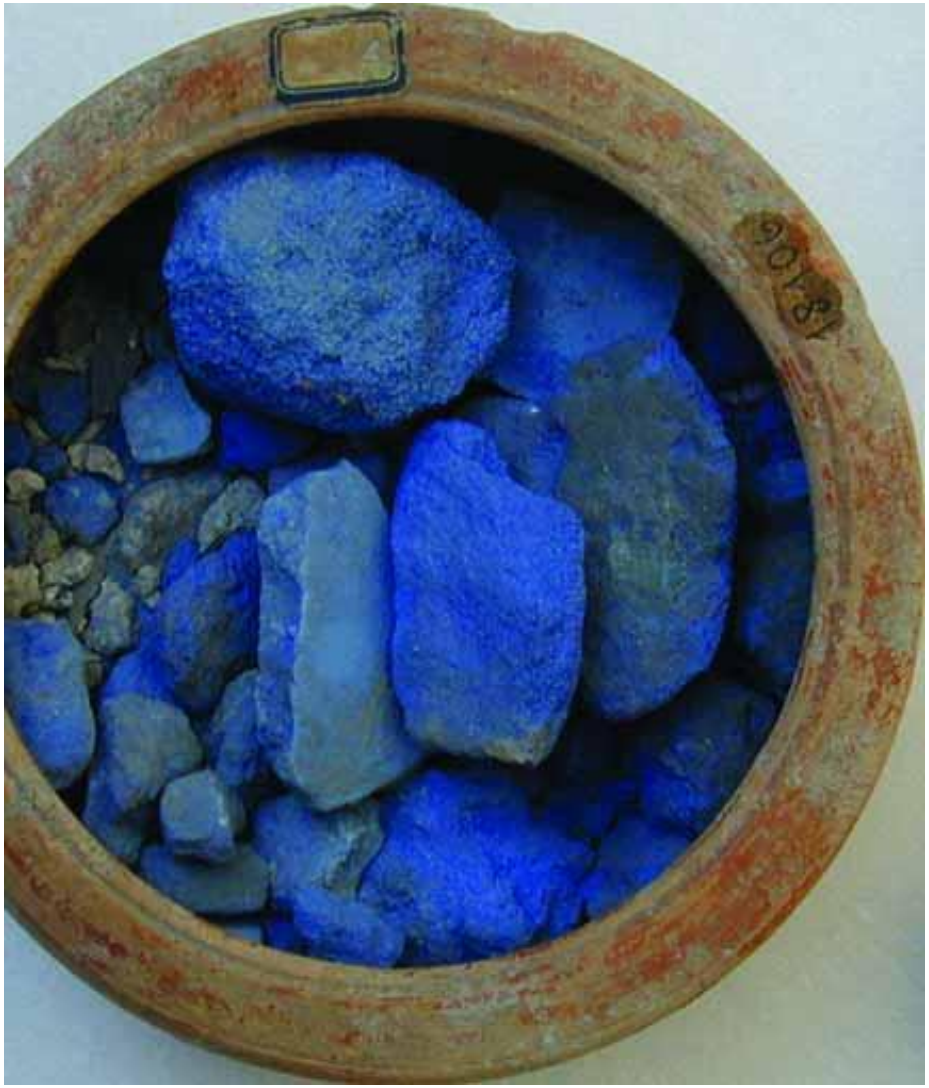
The “lime circle”



The pigments

- *Natural:*
  - Earths: (yellow, red, green ocher); clays (kaolin);
  - Minerals: Hg-based (cinnabar); to Pb-based (litharge; massicot); to As-based (Arsenolite)
  - Organic (dyes): purple-dye

- *Artificial:* pigments generally obtained by extracting metals from minerals or mixing together pigments from different sources (i.e. mineral + metal).
  - Cu-based (Egyptian blue);
  - Milk of lime or chalk
  - Smoke black or bone black (combustion)



The natural pigments and dyes

$FeO(OH)$
Goethite = yellow ochre

Fe_2O_3
Hematite = red ochre

$K(Mg,Fe)(Fe,Al)[Si_4O_{10}](OH)_2$
Celadonite = green earth (mica)

$Al_2Si_2O_5(OH)_4$
Kaolinite (clay mineral)

The mineral pigments

$Cu_2(CO_3)(OH)_2$
Malchite

PbO
Litharge (Red); Massicot (Yellow)

HgS (Mercur Sulfide = Cinnabar)

As_2O_3 = Arsenolite (arsenic oxide)

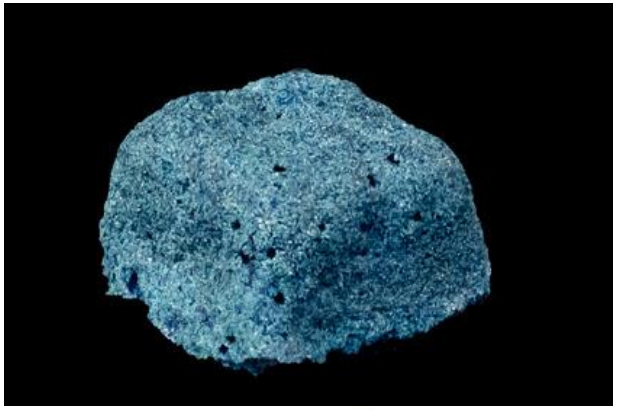
The artificial pigments

$Ca_5(OH)(PO_4)_3$
Hydroxyapatite = Bone black

C

Carbon black = nerofumo

$CaCuSi_4O_{10}$
Cuprorivaite = Egyptian Blue



$CaCO_3$ = White lime (anthropogenic calcite)

It is obtained from the fusion, at over 800 degrees, of three main elements: quartz or silica sand, calcium and copper carbonates, possibly with the addition of alkaline medium, for lowering the melting temperature *(Natron)*

The artificial pigments

Natron

Natron is a naturally occurring mixture of sodium carbonate decahydrate ($Na_2CO_3 \cdot 10H_2O$, a kind of soda ash) and around 17% sodium bicarbonate (also called baking soda, $NaHCO_3$) along with small quantities of sodium chloride and sodium sulfate.

The pigments in the ancient sources

Mentioned in ancient sources, especially give **Vitruvius** *On Architecture* (VII, 7-14)

- *ocra; sil (***yellow ochre**)
- *auripigmentum (***yellow ochre***)*
- *rubrica (***red ochre**)
- *paraetonium (***calcite**)
- *melinum (***aragonite**)
- *creta viridis (***chlorite**)
- *minium* (**cinnabar**?)
- *chrysocolla* (**malachite**?)
- *armenium* (**indigo**?)
- *indicum* (**lapis lazuli**)
- *atramentum* (**black ink**)
- *caeruleum* (**Égyptian Blue**)
- *cerussa* (**white lead**)
- *verdigris o aeruca (***green earth**)
- *sandaraca* (**realgar**)
- *purpurissimum*, ricavato dal murice (***purple-dye***)

Pliny, *Naturalis Historia*, XXXV

Difference between *colores austeri* and *colores floridi.* The latter are much higher priced and supplied by the customer

→ ***Austeri***: dark, opaque, covering colours (mainly ochres, smoke black and bone black, earths)

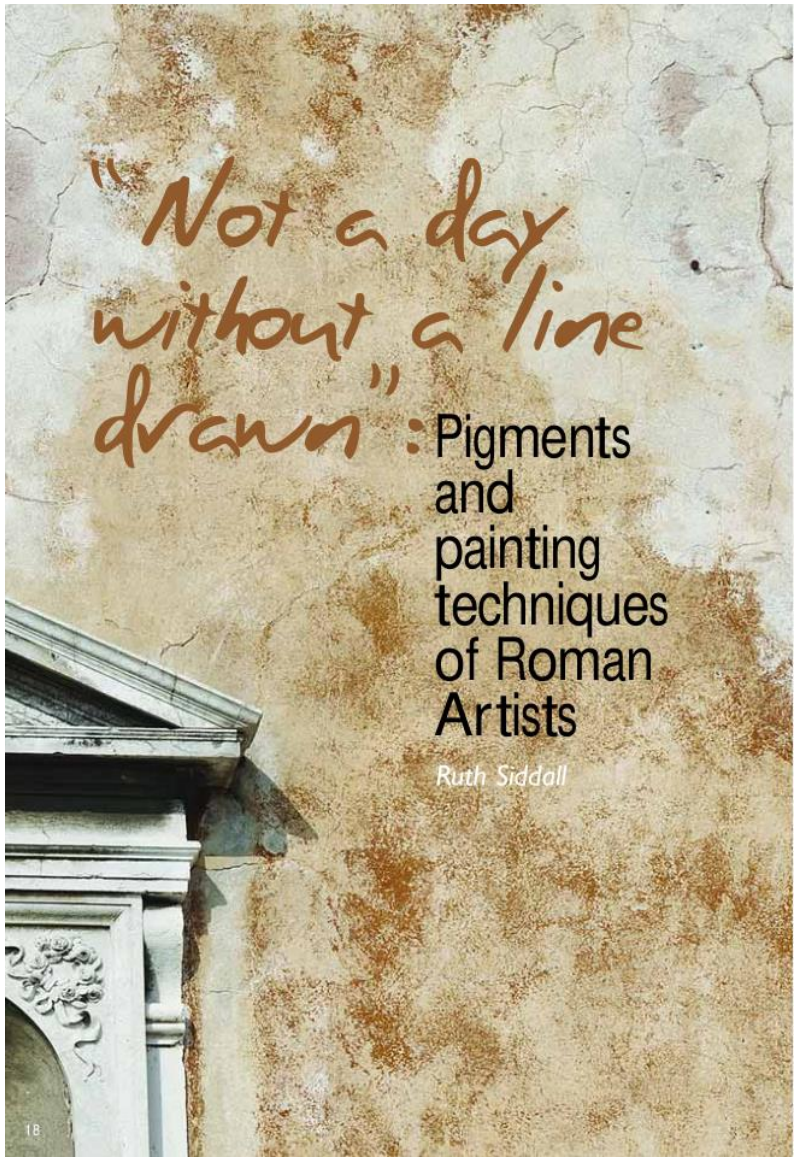
→ ***Floridi***:

- *minium (***cinnabar***?)*
- *armenio* (**indigo**)
- *caeruleum* (**Égyptian Blue**)
- *crisocolla* (**malachite?**)
- *sandaraca* (**realgar**)
- *indicum* (**lapis lazuli**)
- *purpurissimum* (**purple-dye**)

The pigments in the ancient sources

	Vitruve	Pline	Augusti	Béarat
Blanc	- *Paraetonium* - *Melinum* - *Cerussa*	- *Paraetonium* - *Melinum* - *Cerussa* - *Eretria* - *Creta anulare* - *Creta argentaria*	- *Paraetonium* - *Creta calcarea melinum, selinusia* - *Creta silicea eretria, cimolia* - *Creta argentaria diatomite*	- Calcite (chaux) - Aragonite - Craie - Dolomite - Craie annulaire - Cérusite - Diatomite
Bleu	- *Caeruleum* - *Indicum* - *Armenium* - *Indicum* fals.	- *Caeruleum* - *Indicum* - *Armenium* - *Indicum* fals.	- Azzurite - Lapis lazzuli - Indigo - Bleu égyptien	- Bleu égyptien
Jaune	- *Ocra; sil* - *Auripigmentum* - *Sil* fals.	- *Ocra; sil* - *Auripigmentum* - *Sil* fals.	- Ocre: sil attique - ocre brune - Terre d'ombre - Craie argileuse - écume d'argent (PbO) - Orpiment	- Ocre jaune - Ocre brune - Craie argileuse (marne)
Noir	- *Atramentum* (suie, charbon de bois, lie de vin brûlée)	- *Atramentum* (suie, charbon de bois, lie de vin brûlée) - 2 noirs d'origine minérale - noir d'os - *elephantinum*	- *Atramentum*	- Suie - Charbon de bois - Noir d'os
Rouge	- *Rubrica* - *Sandaraca* - *Minium* - *Sandaraca* art.	- *Rubrica* - *Sinopis* - *Ocra* art. - *Sandaraca* - *Minium* - *Sandyx* - *Syricum* - *Sandaraca* art. - *Sandaraca* fausse	- *Sinopis* - Rubrique - *Usta* - Cinabre - Réalgar - *Sandyx* ou *syricum* (minium+rubrique ou *sinopis*) - *Spuma argenti* (PbO)	- Hématite bien cris. - Hématite mal cris. - Ocre jaune chauffée - Ocre brune chauffée - Cinabre - Minium - Minium+ocre rouge -Hydroxypyromorphite + ocre rouge
Vert	- *Aeruca* - *Chrysocolla* - *Creta viridis* - *Chrysocolla* fals.	- *Aeruca* - *Chrysocolla* - *Appianum* (terre verte) - *Chrysocolla* fals.	- Terre verte - Malachite - Vert-de-gris	- Céladonite - Glauconite - Chlorite - Malachite - Vert-de-gris
Violet	- *Usta* - *Ostrum* - *Ostrum* fals.	- *Usta* - *Purpurissum*	- Pourpre foncé: diatomite teintée - Pourpre clair: dilution par la craie calcaire	- Hématite
Total	24	35	27	28

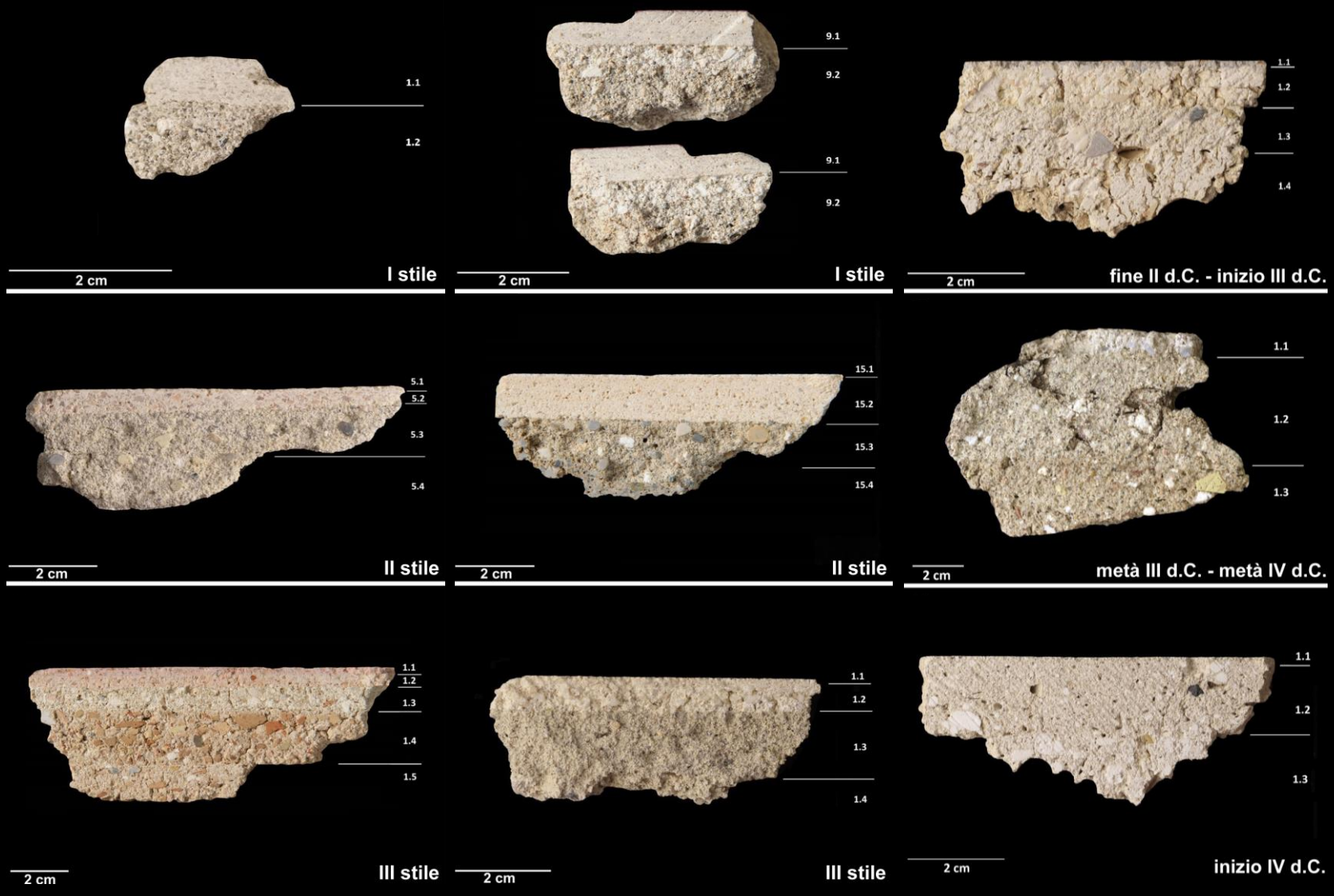
Béarat, 1997



The pigments in the ancient sources

The analytical methods

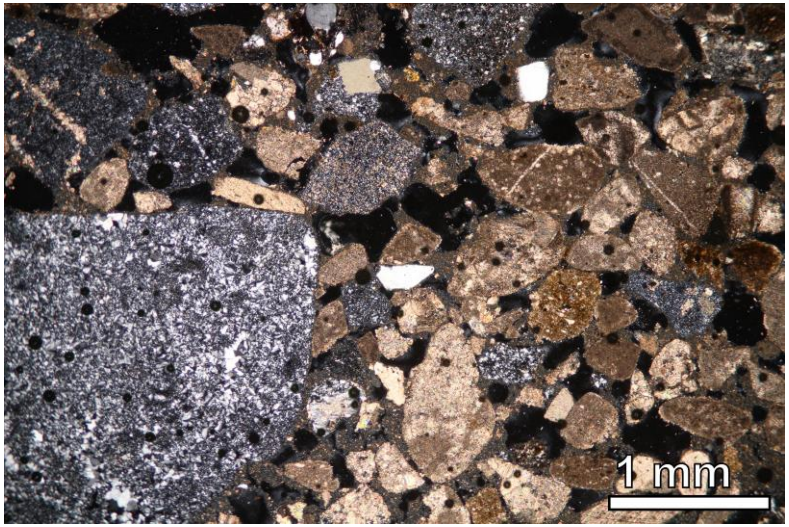
Section cutting (with diamond blade petrographic cutting machine)

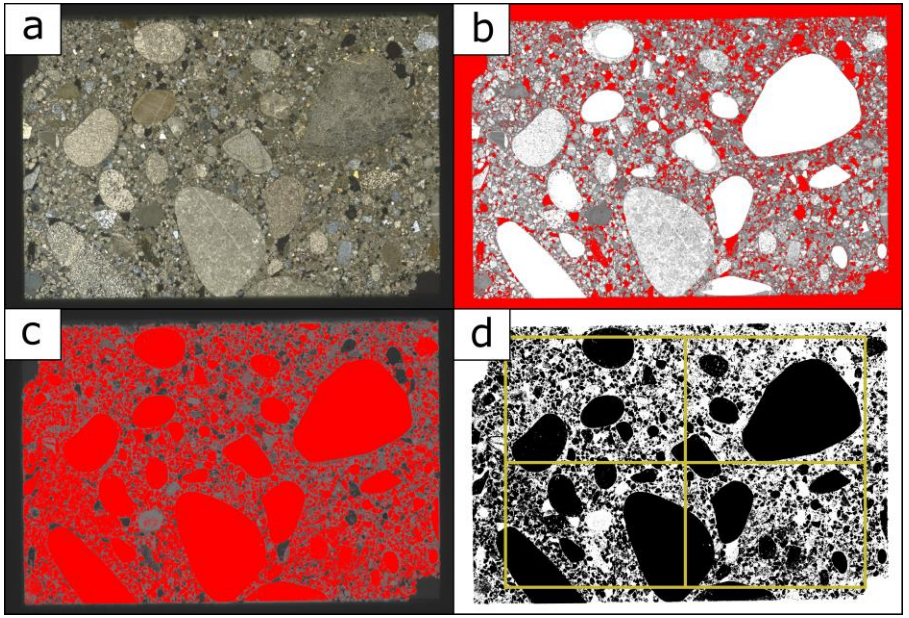


The analytical methods

REFLECTED and TRANSMITTED LIGHT optical MICROSCOPY (OM) **of thin sections (30 micron)**

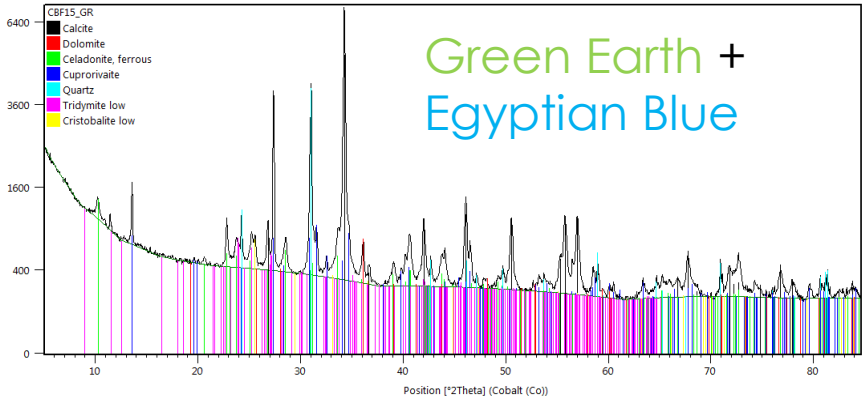
- Composition and characteristics of the binder (lime)
- Information on shape, type and grain size of the aggregate (and hypothesis of provenance)
- Distribution of the aggregate in the sample
- Mortar porosity rate
- Binder/aggregate ratio estimates
- Method of application of the patinas pictorial (plasters)

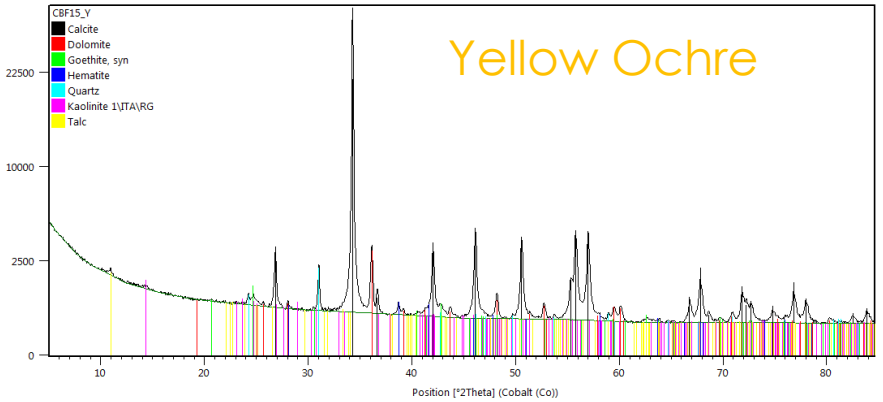




The analytical methods

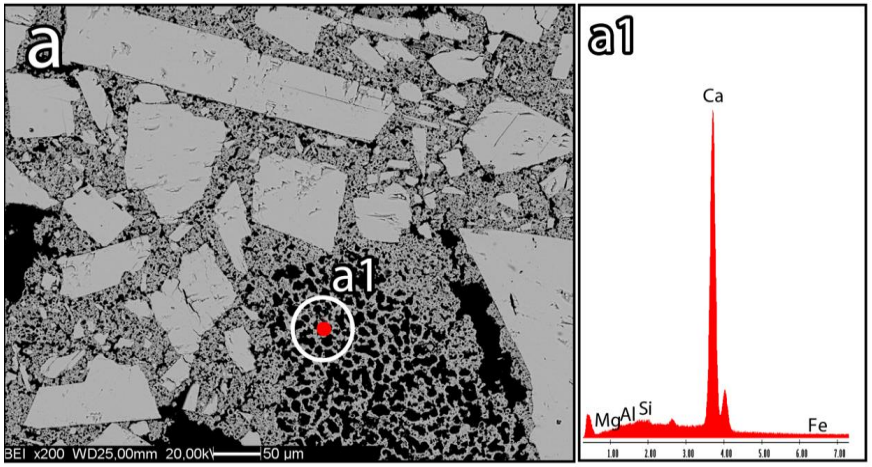
- **XRPD ANALYSIS** (X-Ray Power Diffraction Analysis)
  - Highlight the mineralogical phases of the elements present in the sample
  - **Useful for highlighting the mineralogy of pigments (ochre, cinnabar, Egyptian blue)**





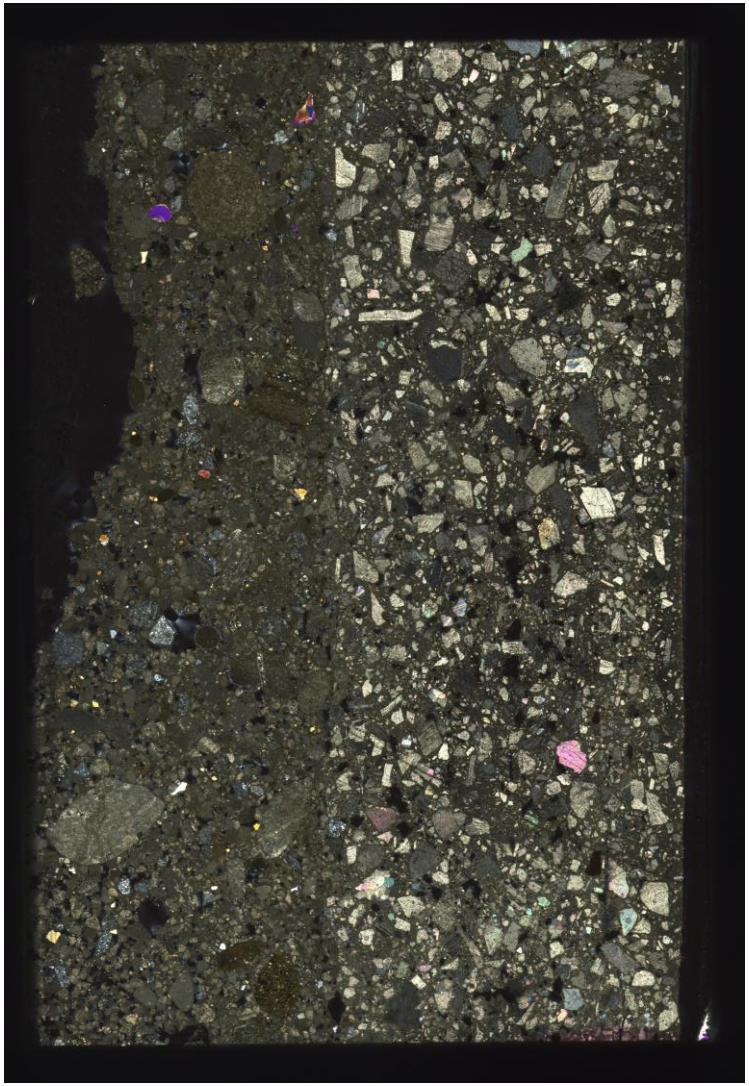
SEM (Scanning Electron Microscope) + **EDS** (Energy Dispersive X-ray Spectrometry)

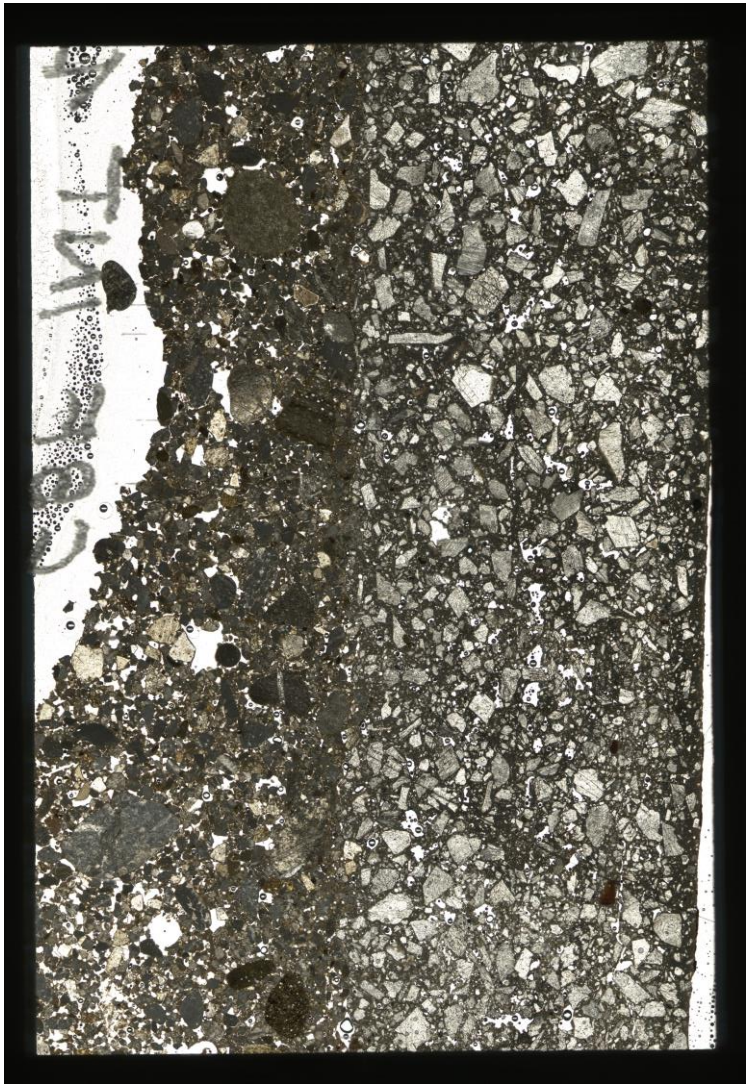
- Investigate the chemical composition of individual fractions, granules
- Identify alteration relationships chemistry (pozzolanic reaction)
- Characterization microstructural minute elements



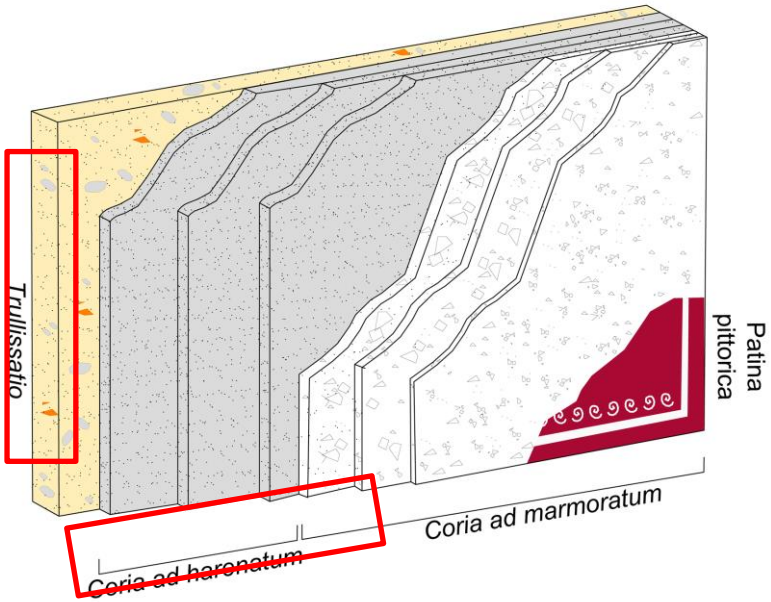
The analytical methods

REFLECTED and TRANSMITTED LIGHT OPTICAL MICROSCOPY (OM) of thin sections (30 micr.)

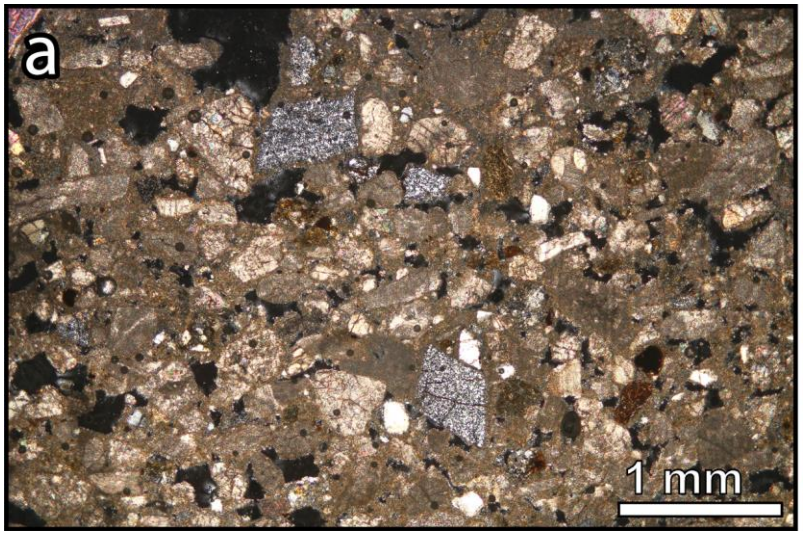


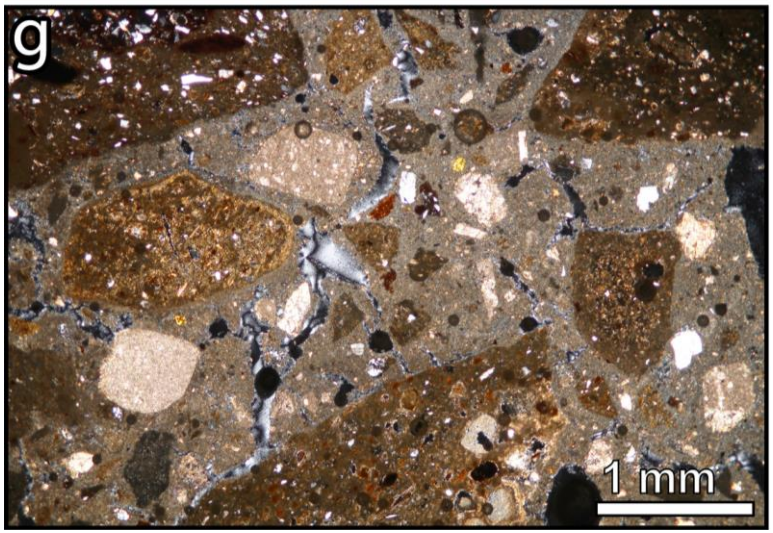


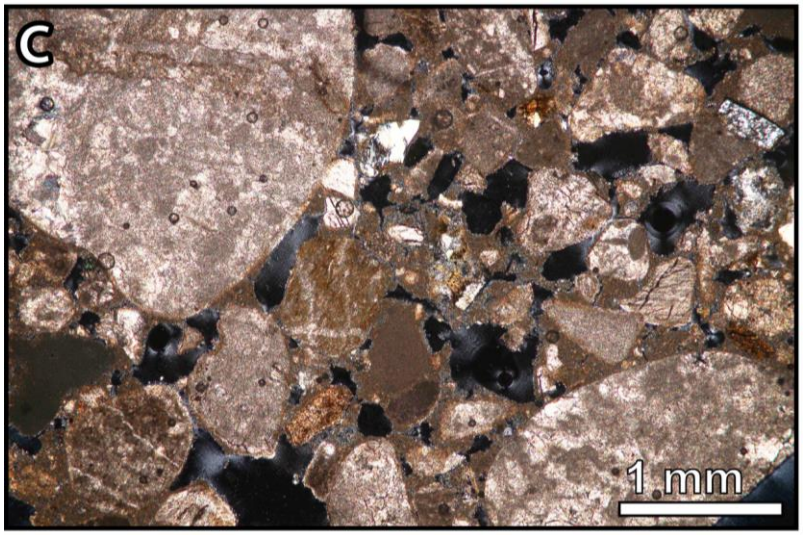
The wall-painting mortars – the archaeological data



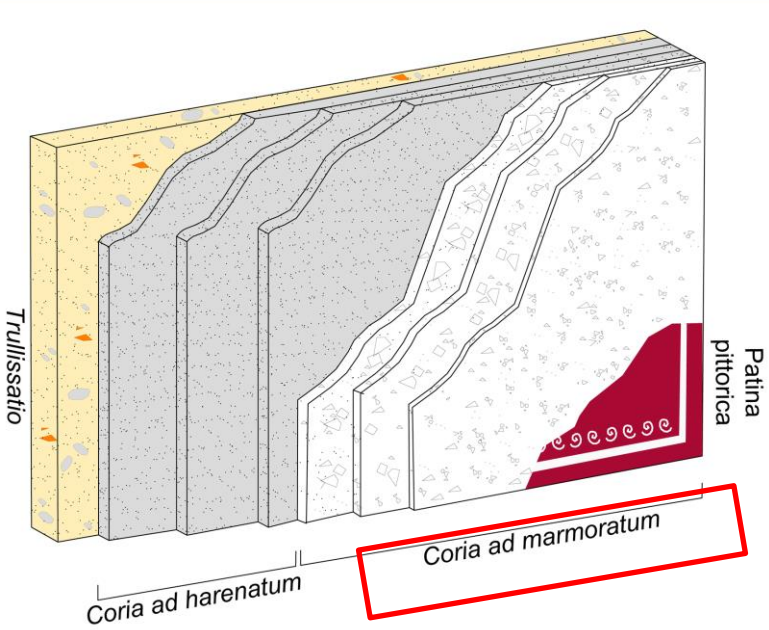
«Rinzaffo» and «arriccio»

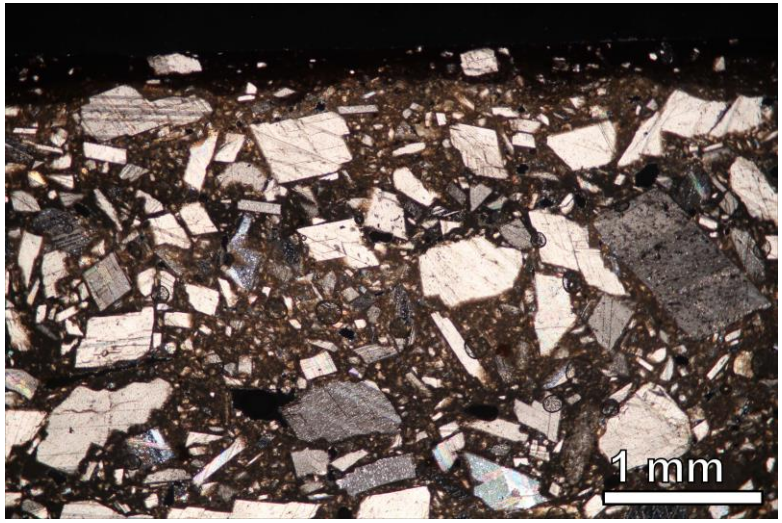




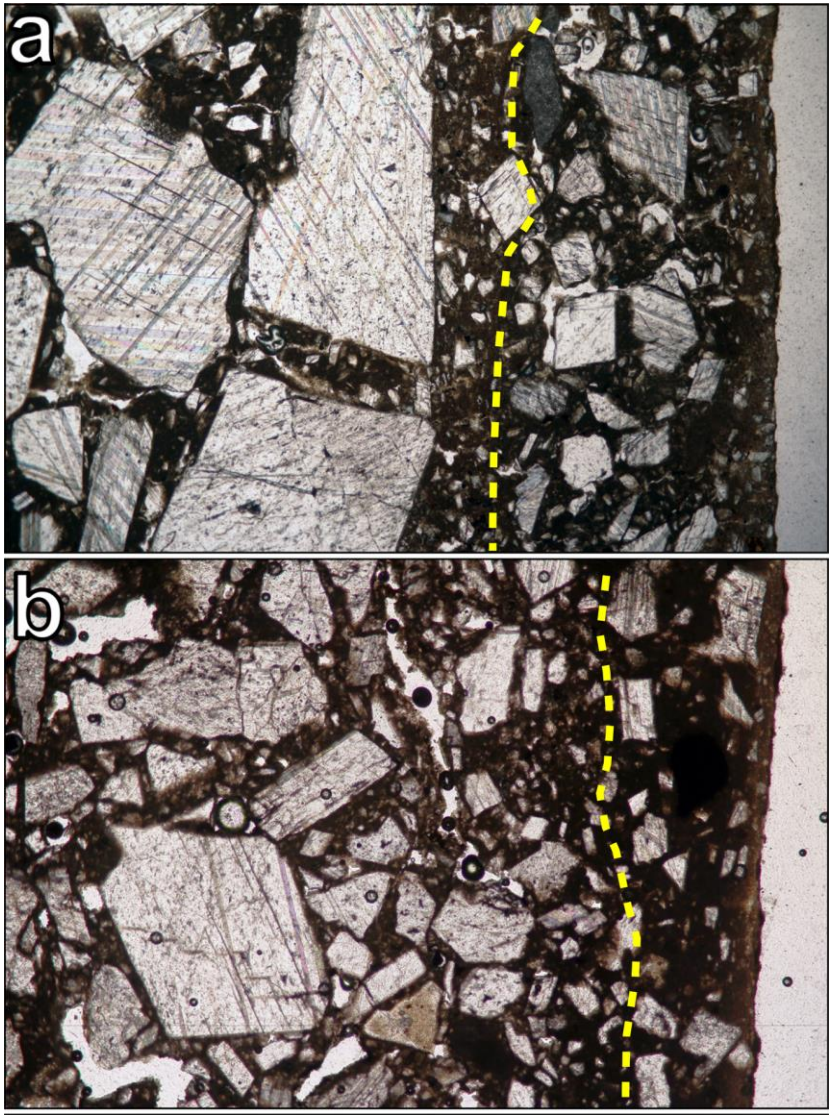


The wall-painting mortars – the archaeological data





Intonachino (Aggregate: sparry calcite > marble dust)

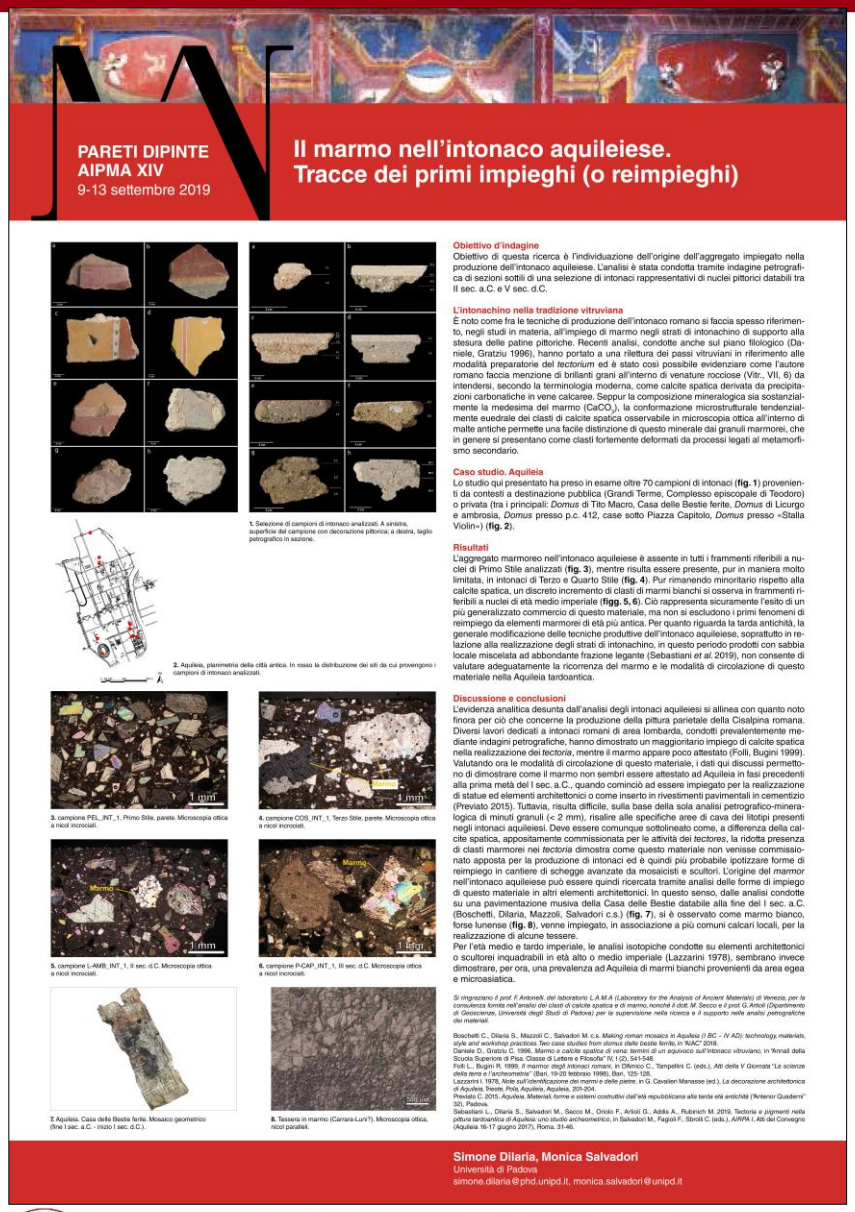


The wall-painting mortars – the archaeological data

Sparry Calcite

extremely crystalline calcite which forms in the cracks of limestone rocks due to dissolution and reprecipitation phenomena of calcium carbonate

The wall-painting mortars – the archaeological data



PARETI DIPINTE
AIPMA XIV
9-13 settembre 2019

Il marmo nell'intonaco aquileiese. Tracce dei primi impieghi (o reimpieghi)

Obiettivo d'indagine
Obiettivo di questa ricerca è l'individuazione dell'origine dell'aggregato impiegato nella produzione dell'intonaco aquileiese. L'analisi è stata condotta tramite indagine petrografica di sezioni sottili di una selezione di intonaci rappresentativi di nuclei pittorici databili tra il sec. a.C. e V sec. d.C.

L'intonachino nella tradizione vitruviana
È noto come fra le tecniche di produzione dell'intonaco romano si faccia spesso riferimento, negli studi in materia, all'impiego di marmo negli strati di intonachino di supporto alla stesura delle patine pittoriche. Recenti analisi, condotte anche sul piano filologico (Daniele, Gratziu 1996), hanno portato a una rilettura dei passi vitruviani in riferimento alle modalità preparatorie del *tectorium* ed è stato così possibile evidenziare come l'autore romano faccia menzione di brillanti grani all'interno di venature rocciose (Vitr., VII, 6) da intendersi, secondo la terminologia moderna, come calcite spatica derivata da precipitazioni carbonatiche in vene calcaree. Seppur la composizione mineralogica sia sostanzialmente la medesima del marmo ($CaCO_3$), la conformazione microstrutturale tendenzialmente euedrale dei clasti di calcite spatica osservabile in microscopia ottica all'interno di malte antiche permette una facile distinzione di questo minerale dai granuli marmorei, che in genere si presentano come clasti fortemente deformati da processi legati al metamorfismo secondario.

Caso studio. Aquileia
Lo studio qui presentato ha preso in esame oltre 70 campioni di intonaci (**fig. 1**) provenienti da contesti a destinazione pubblica (Grandi Terme, Complesso episcopale di Teodoro) o privata (tra i principali: *Domus* di Tito Macro, Casa delle Bestie ferite, *Domus* di Licurgo e ambrosia, *Domus* presso p.c. 412, case sotto Piazza Capitolo, *Domus* presso «Stalla Violin») (**fig. 2**).

1. Selezione di campioni di intonaco analizzati. A sinistra, superficie del campione con decorazione pittorica; a destra, taglio petrografico in sezione.

2. Aquileia, planimetria della città antica. In rosso la distribuzione dei siti da cui provengono i campioni di intonaco analizzati.

Risultati
L'aggregato marmoreo nell'intonaco aquileiese è assente in tutti i frammenti riferibili a nuclei di Primo Stile analizzati (**fig. 3**), mentre risulta essere presente, pur in maniera molto limitata, in intonaci di Terzo e Quarto Stile (**fig. 4**). Pur rimanendo minoritario rispetto alla calcite spatica, un discreto incremento di clasti di marmi bianchi si osserva in frammenti riferibili a nuclei di età medio imperiale (**figg. 5, 6**). Ciò rappresenta sicuramente l'esito di un più generalizzato commercio di questo materiale, ma non si escludono i primi fenomeni di reimpiego da elementi marmorei di età più antica. Per quanto riguarda la tarda antichità, la generale modificazione delle tecniche produttive dell'intonaco aquileiese, soprattutto in relazione alla realizzazione degli strati di intonachino, in questo periodo prodotti con sabbia locale miscelata ad abbondante frazione legante (Sebastiani *et al.* 2019), non consente di valutare adeguatamente la ricorrenza del marmo e le modalità di circolazione di questo materiale nella Aquileia tardoantica.

3. campione PEL_INT_1, Primo Stile, parete. Microscopia ottica a nicoli incrociati.

4. campione COS_INT_1, Terzo Stile, parete. Microscopia ottica a nicoli incrociati.

5. campione L-AMB_INT_1, II sec. d.C. Microscopia ottica a nicoli incrociati.

6. campione P-CAP_INT_1, III sec. d.C. Microscopia ottica a nicoli incrociati.

7. Aquileia. Casa delle Bestie ferite. Mosaico geometrico (fine I sec. a.C. - inizio I sec. d.C.).

8. Tessera in marmo (Carrara-Lunì?). Microscopia ottica, nicoli paralleli.

Discussione e conclusioni
L'evidenza analitica desunta dall'analisi degli intonaci aquileiesi si allinea con quanto noto finora per ciò che concerne la produzione della pittura parietale della Cisalpina romana. Diversi lavori dedicati a intonaci romani di area lombarda, condotti prevalentemente mediante indagini petrografiche, hanno dimostrato un maggioritario impiego di calcite spatica nella realizzazione dei *tectoria*, mentre il marmo appare poco attestato (Folli, Bugini 1999). Valutando ora le modalità di circolazione di questo materiale, i dati qui discussi permettono di dimostrare come il marmo non sembri essere attestato ad Aquileia in fasi precedenti alla prima metà del I sec. a.C., quando cominciò ad essere impiegato per la realizzazione di statue ed elementi architettonici o come inserto in rivestimenti pavimentali in cementizio (Previato 2015). Tuttavia, risulta difficile, sulla base della sola analisi petrografico-mineralogica di minuti granuli (< 2 mm), risalire alle specifiche aree di cava dei litotipi presenti negli intonaci aquileiesi. Deve essere comunque sottolineato come, a differenza della calcite spatica, appositamente commissionata per le attività dei *tectores*, la ridotta presenza di clasti marmorei nei *tectoria* dimostra come questo materiale non venisse commissionato apposta per la produzione di intonaci ed è quindi più probabile ipotizzare forme di reimpiego in cantiere di schegge avanzate da mosaicisti e scultori. L'origine del *marmor* nell'intonaco aquileiese può essere quindi ricercata tramite analisi delle forme di impiego di questo materiale in altri elementi architettonici. In questo senso, dalle analisi condotte su una pavimentazione musiva della Casa delle Bestie databile alla fine del I sec. a.C. (Boschetti, Dilaria, Mazzoli, Salvadori c.s.) (**fig. 7**), si è osservato come marmo bianco, forse lunense (**fig. 8**), venne impiegato, in associazione a più comuni calcari locali, per la realizzazione di alcune tessere.
Per l'età medio e tardo imperiale, le analisi isotopiche condotte su elementi architettonici o scultorei inquadrabili in età alto o medio imperiale (Lazzarini 1978), sembrano invece dimostrare, per ora, una prevalenza ad Aquileia di marmi bianchi provenienti da area egea e microasiatica.

Si ringraziano il prof. F. Antonelli, del laboratorio L.A.M.A (Laboratory for the Analysis of Ancient Materials) di Venezia, per la consulenza fornita nell'analisi dei clasti di calcite spatica e di marmo, nonché il dott. M. Secco e il prof. G. Artioli (Dipartimento di Geoscienze, Università degli Studi di Padova) per la supervisione nella ricerca e il supporto nelle analisi petrografiche dei materiali.

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Daniele D., Gratziu C. 1996. *Marmo e calcite spatica di vena: termini di un equivoco sull'intonaco vitruviano,* in "Annali della Scuola Superiore di Pisa. Classe di Lettere e Filosofia" IV, I (2), 541-548.
Folli L., Bugini R. 1999. *Il marmor degli intonaci romani,* in Olmeto C., Tampellini C. (eds.), *Atti della V Giornata "Le scienze della terra e l'archeometria"* (Bari, 19-20 febbraio 1998), Bari, 125-126.
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Previato C. 2015, *Aquileia. Materiali, forme e sistemi costruttivi dall'età repubblicana alla tarda età antichità* ("Antenor Quaderni" 32), Padova.
Sebastiani L., Dilaria S., Salvadori M., Secco M., Oriolo F., Artioli G., Addis A., Rubinich M. 2019. *Tectoria e pigmenti nella pittura tardoantica di Aquileia: uno studio archeometrico,* in Salvadori M., Fagioli F., Sibrolli C. (eds.), *AIAPA I, Atti del Convegno* (Aquileia 16-17 giugno 2017), Roma, 31-46.

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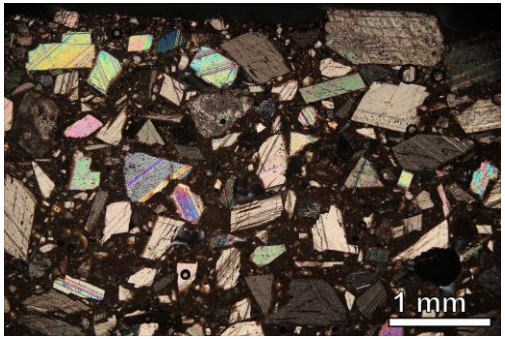
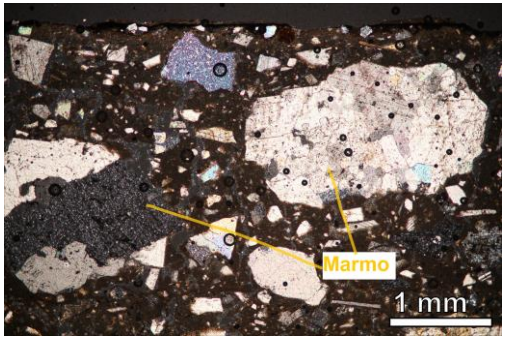
DANIELE D., GRATZIU C. 1996, *Marmo e calcite spatica di vena: termini di un equivoco sull'intonaco vitruviano,* in *Annali della Scuola Superiore di Pisa. Classe di Lettere e Filosofia*, IV, I, 2, pp. 541-548.

«Marmor non eodem genere omnibus regionibus procreatur, sed quibusdam locis glaebae ut salis micas perlucidas habentes nascuntur, quae contusae et molitae praestant operibus utilitatem. quibus autem locis eae copiae non sunt, caementa marmorea, sive assulae dicuntur, quae marmorarii ex operibus deiciunt, contunduntur et moluntur, <et cum> est subcretum in operibus utuntur.»
Vitr. *De arch.* VII, 6

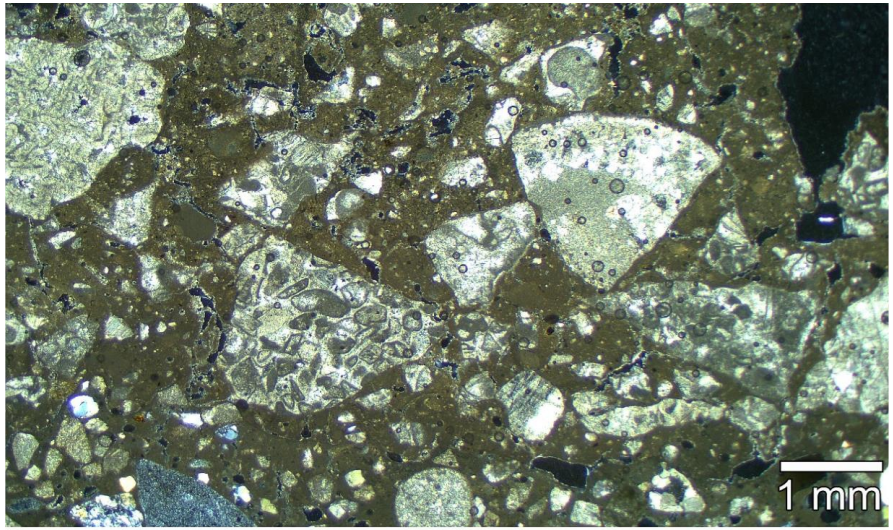




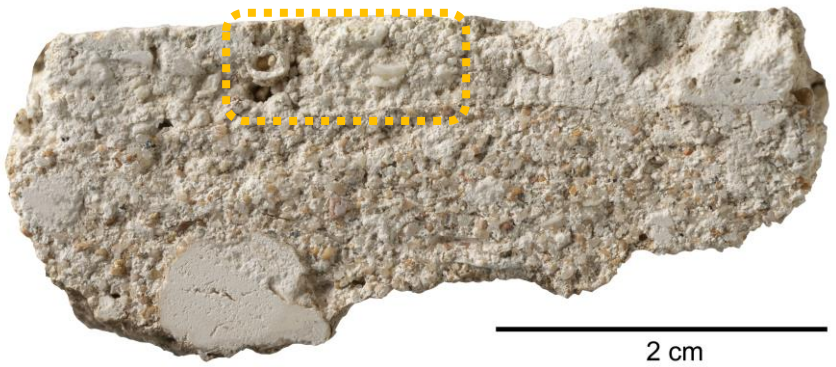
The wall-painting mortars – the archaeological data

Torre di Pordenone (I-II c. CE)

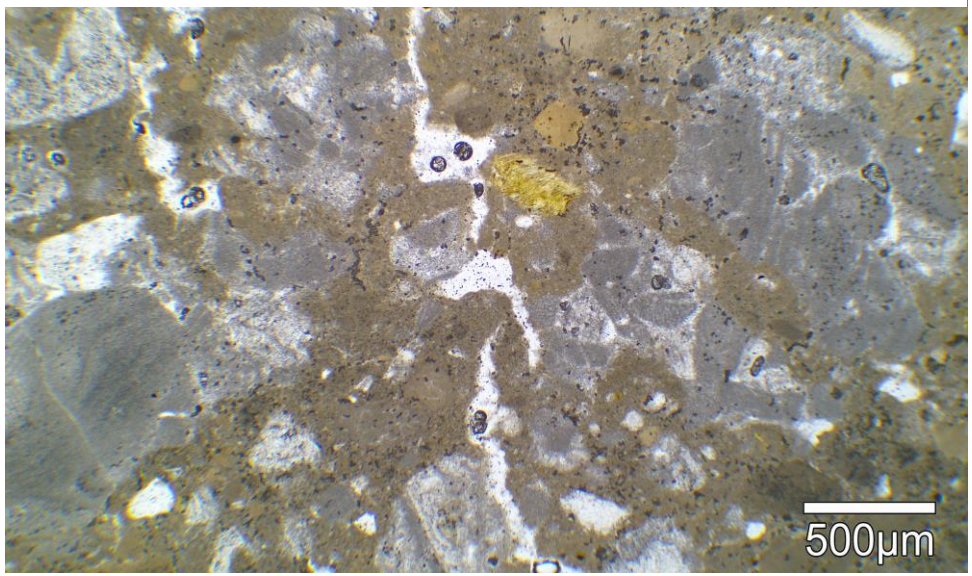
→ Fragments of limestone rocks



Bithia (Sardinia) – Roman Imperial Age

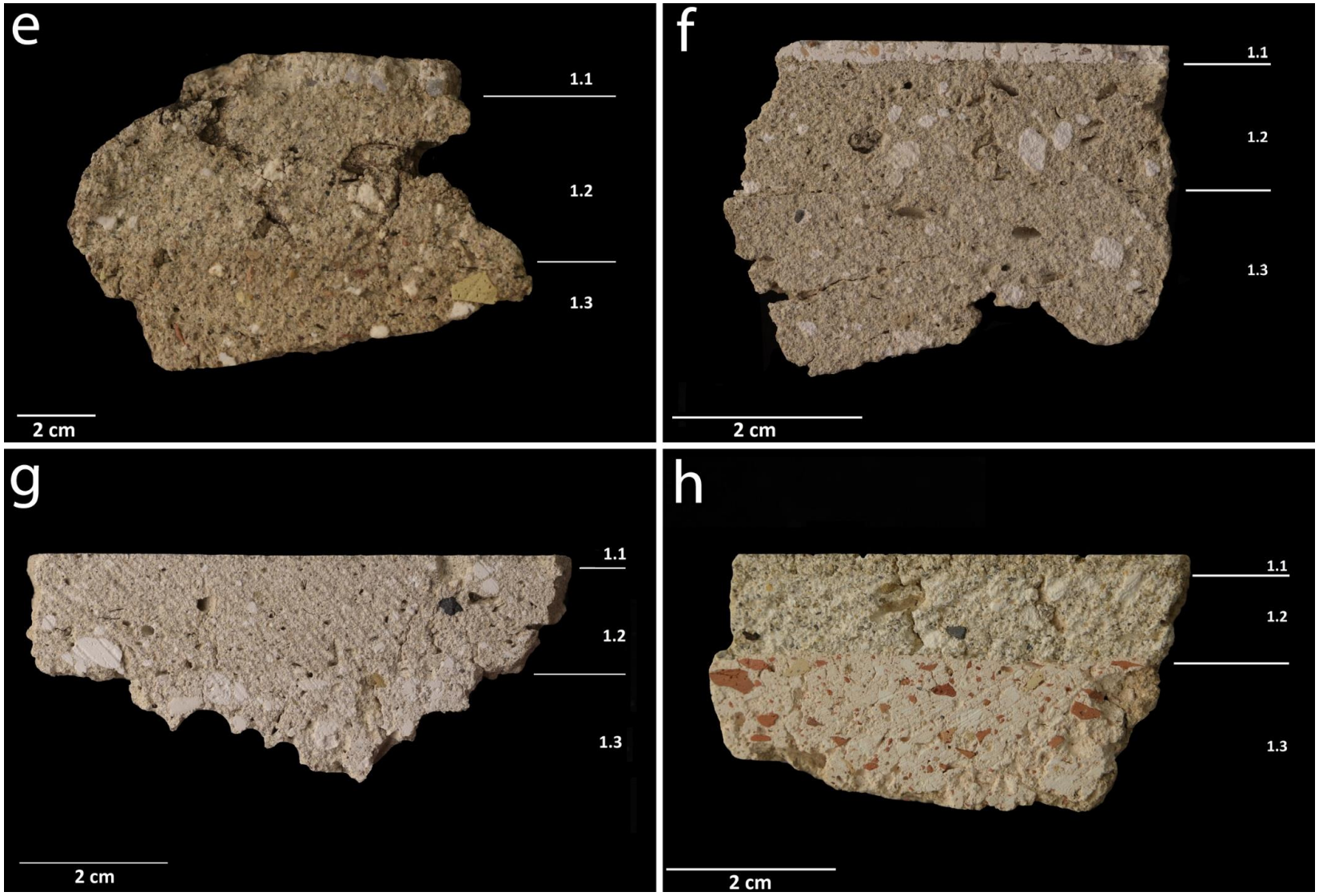


→ semi-calcined fossiliferous limestones



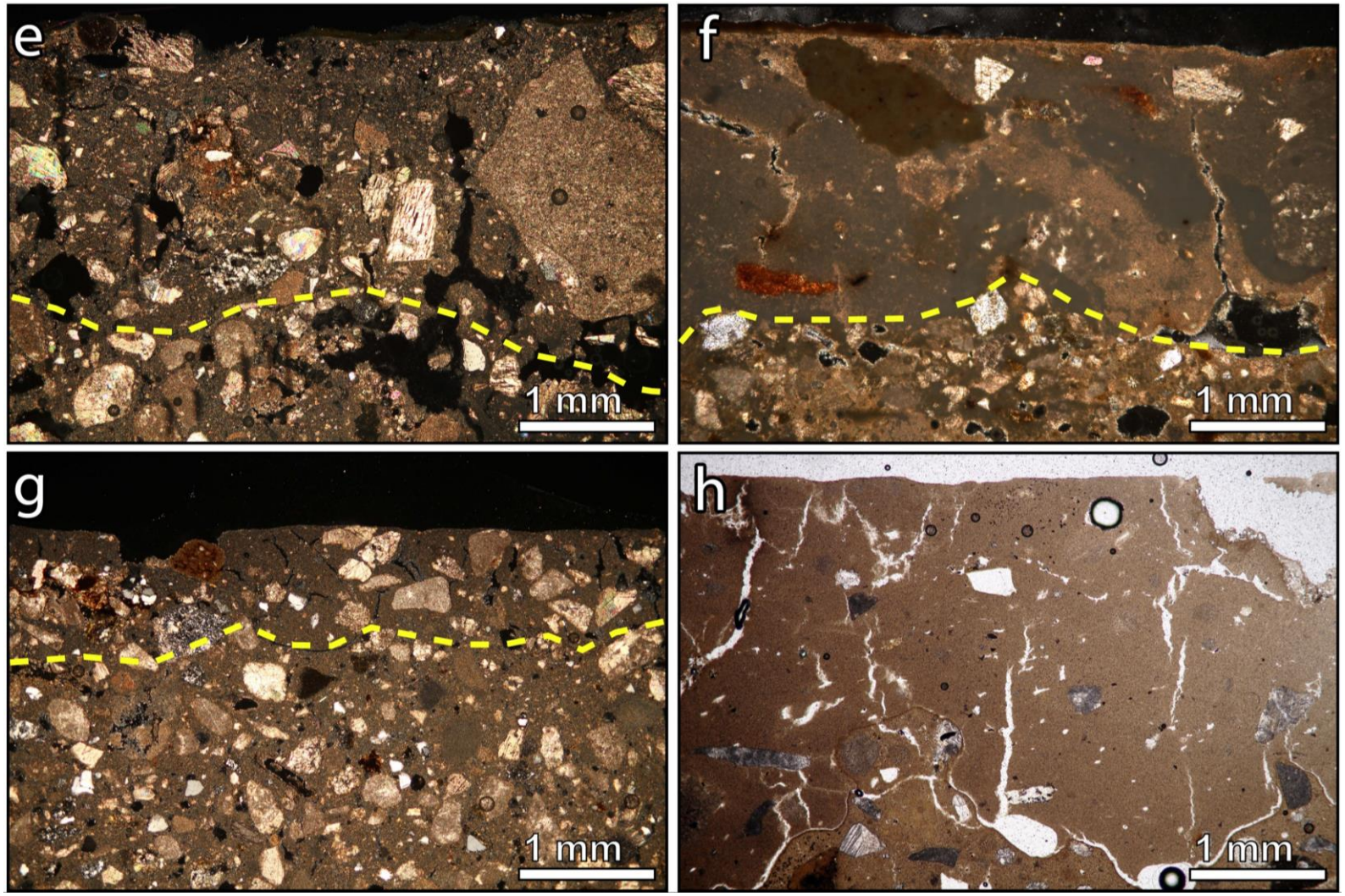
The wall-painting mortars – the archaeological data

The adoption of the «bad» techniques mentioned by the ancient sources – the thin intonachino

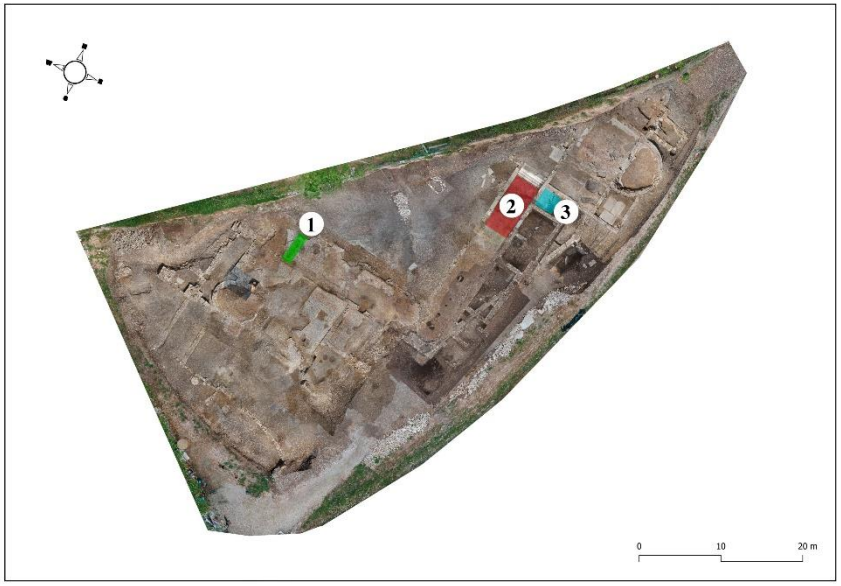


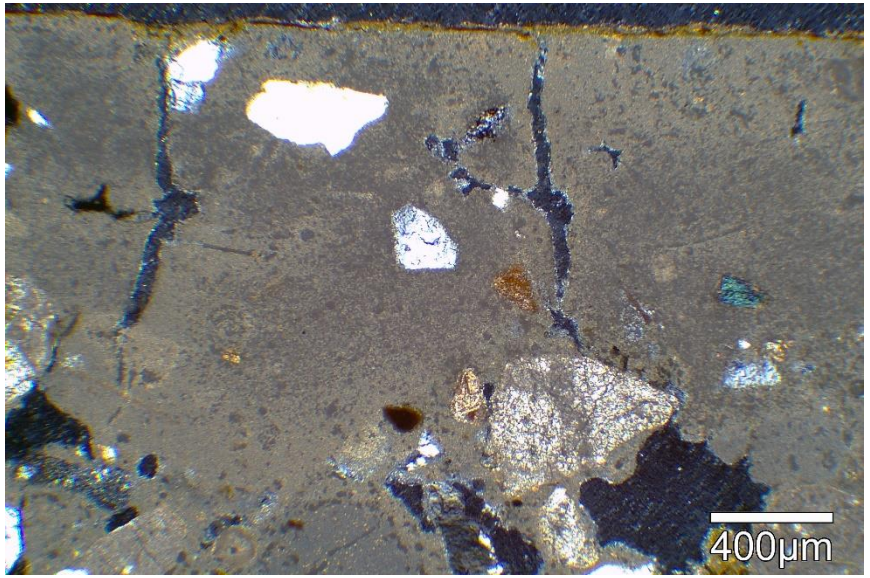
The wall-painting mortars – the archaeological data

The adoption of the «bad» techniques mentioned by the ancient sources – the thin intonachino



The wall-painting mortars – the archaeological data





Negrar (VR), Extra-urban *villa* (3rd-4th c. CE)

The wall-painting mortars – the archaeological data

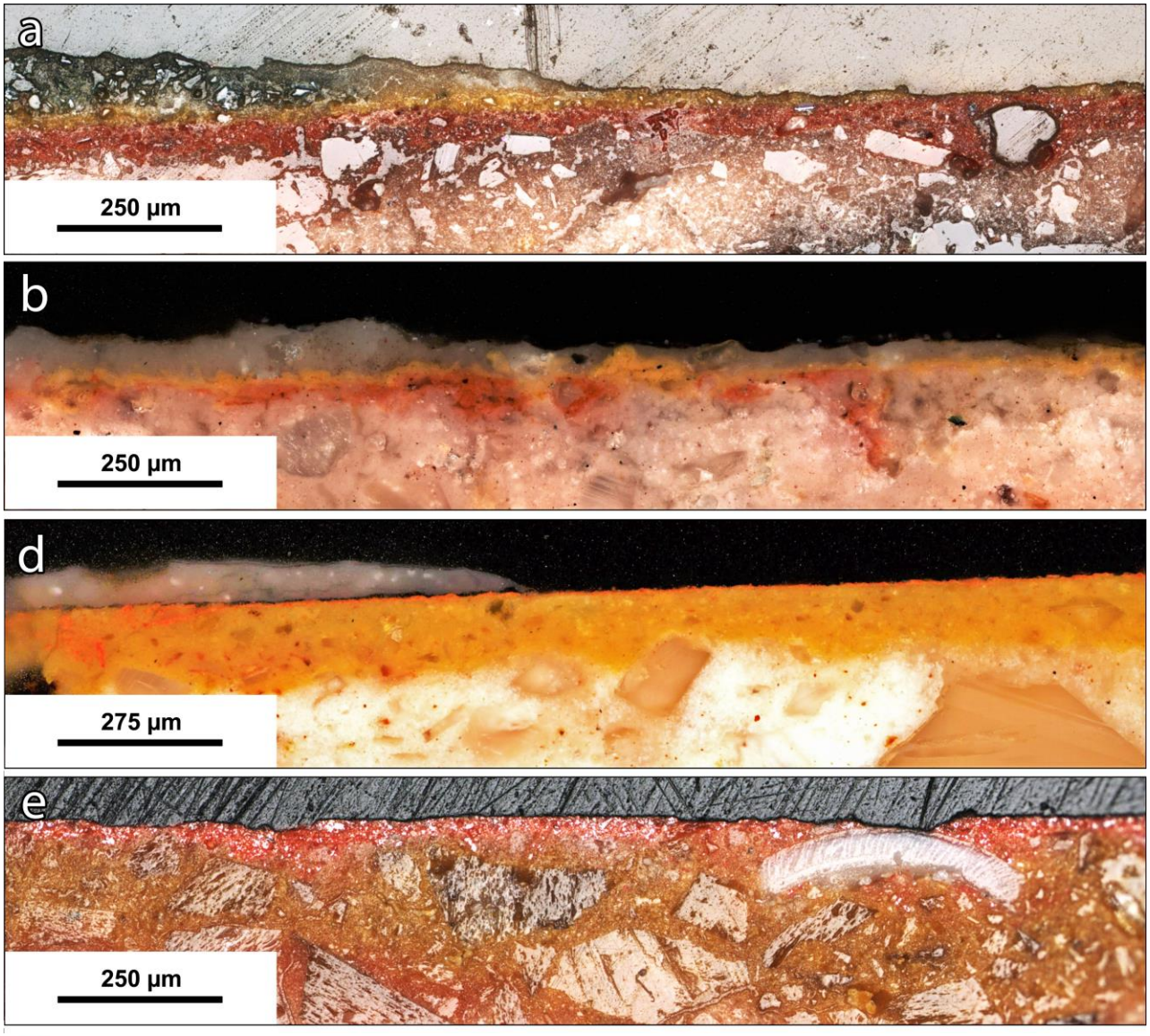
- In the creation of the plaster, we often observe a faithful adherence - in plaster layers from the late Republican or Early Imperial age - to the “good practices” mentioned by Vitruvius, with a systematic use of spathic calcite or, more rarely, fragments of marble, although, overall, the preparatory stratigraphy is simplified (maximum 2 layers) compared to the “good" practices (3 layers with decreasing aggregate grain size) referred to by the Latin treatise writer and probably used only in exceptional circumstances

- In some contexts, especially in the provincial context, we observe the use of alternative materials for the creation of the plaster, specifically selected and different from the sands used in the arriccio and rendering layers, but overall qualitatively less "effective" than the brilliant calcite spatic.

- In contexts of late antiquity there is a clear evolution in the methods of construction of the *tectorium,* which – at least in Regio coarse layers of curling and rendering

→ Loss of quality? change in knowledge? Reduced prestige attributed to late antique plaster?

The pigments – the archaeological data

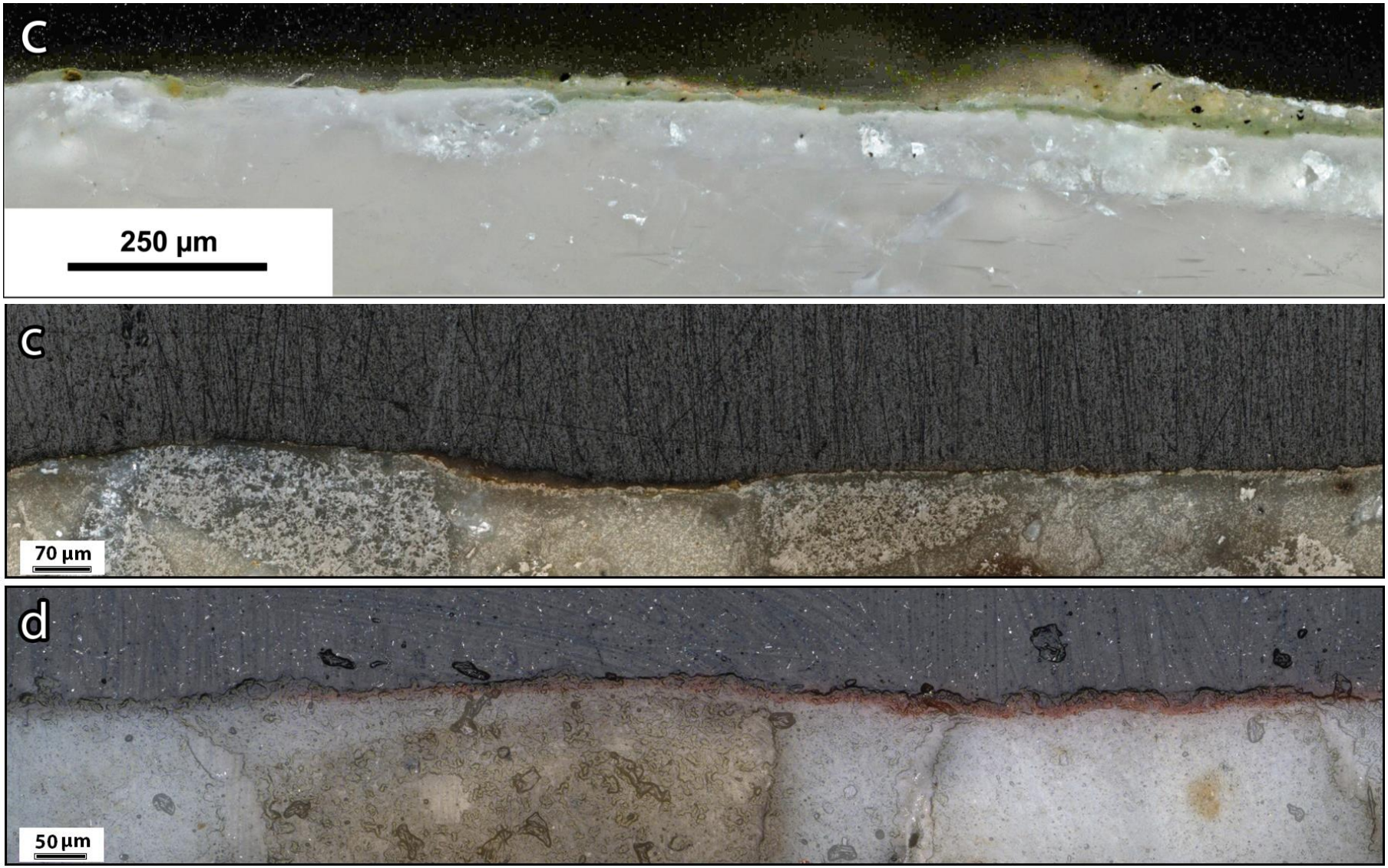


The *fresco* application method

- Gradual penetration of the pigment in the mortar underlying support
- Frequent use of two fresh under-layments red or yellow in color, aimed at igniting the chromatic tone of the painting above
- More decorations paintings hung dry.

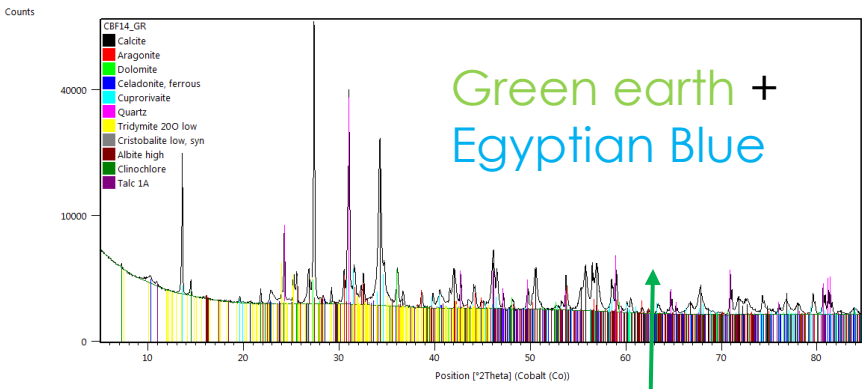
The pigments – the archaeological data

The use of techniques not recommended by the sources – dry pigment application

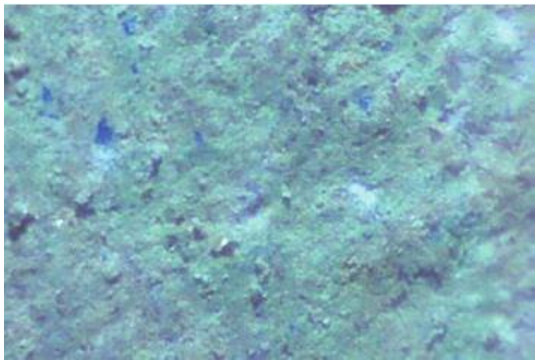


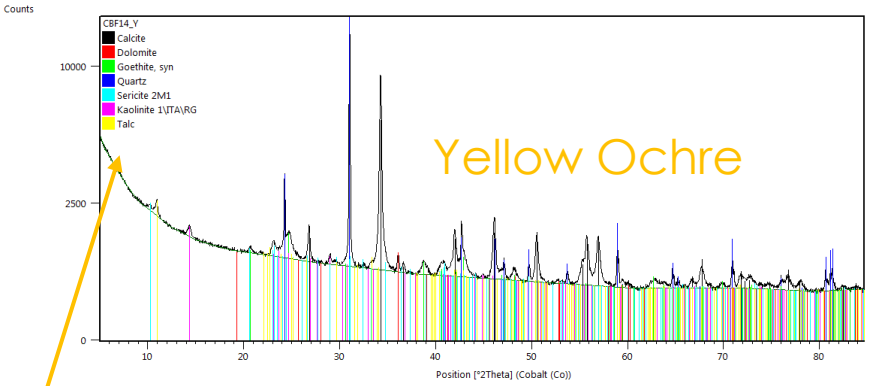
The pigments – the archaeological data

The pigments – the archaeological data

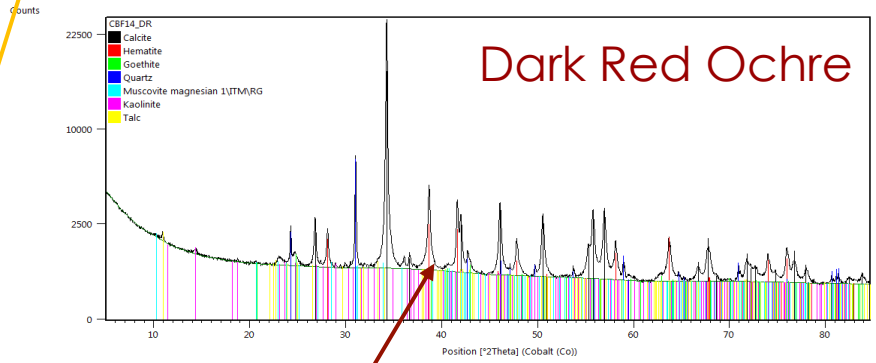


Green earth +
Egyptian Blue



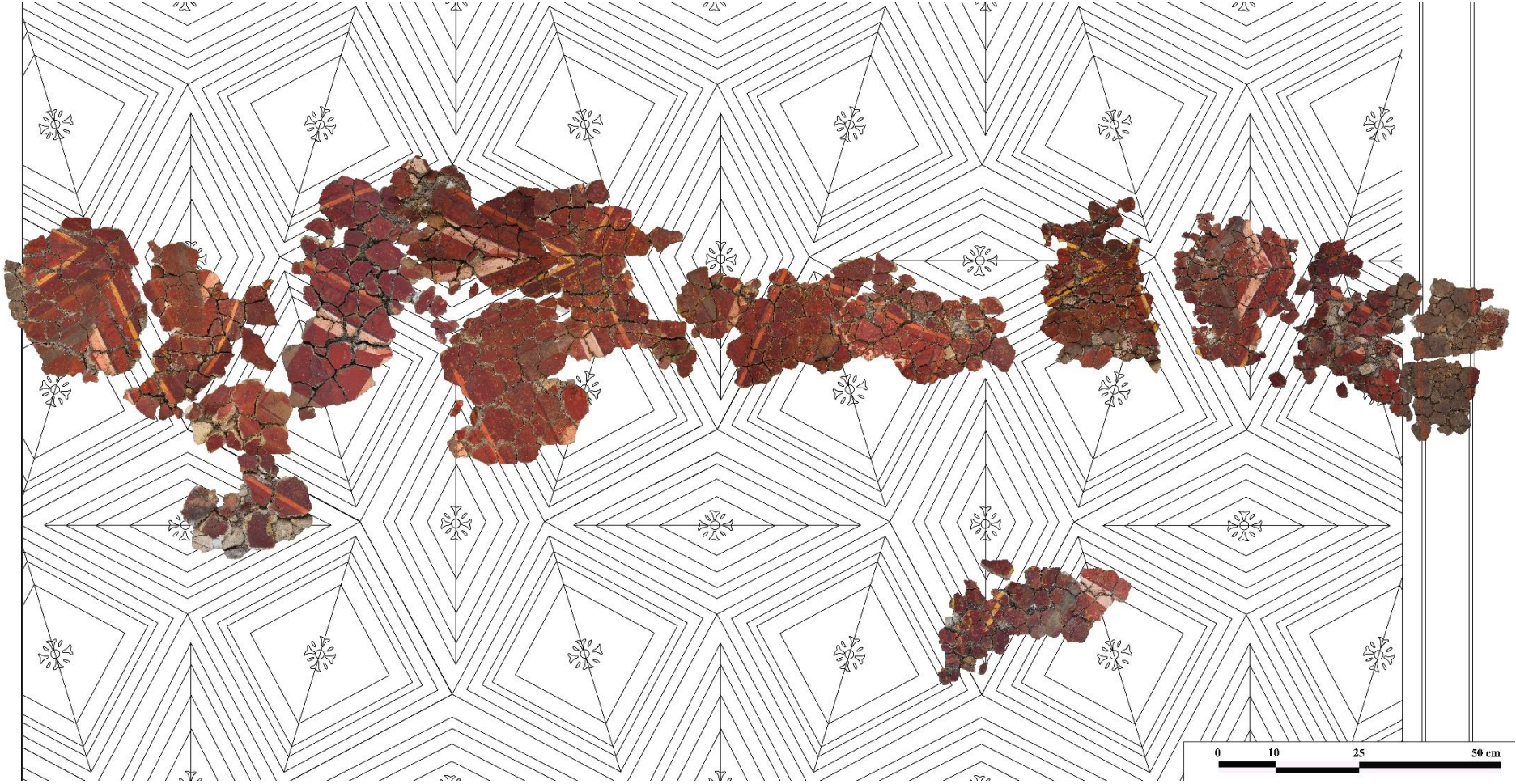


Yellow Ochre



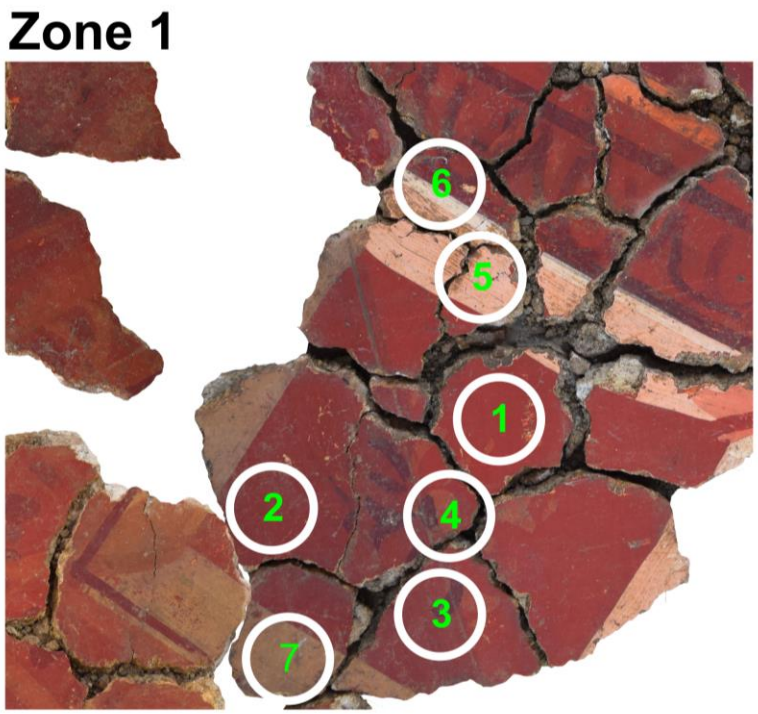
Dark Red Ochre

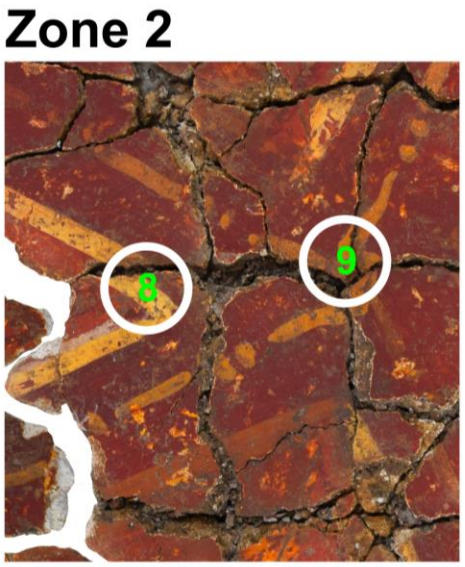
The pigments – the archaeological data



Negrar (VR), Extra-urban villa (3rd-4th c. CE) – collapsed ceiling (repeated module system)

The pigments – the archaeological data





1 ***Red*** **(R160; G56; B57)**
Hem + Gth (underpaint)

2 ***Dark Red*** **(R128; G53; B57)**
Hem + H-Ipt + C (?)

3 ***Dusky Red*** **(R104; G58; B68)**
Hem + C

4 ***Light Red*** **(R166; G96; B84)**
Hem + Cal

5 ***Pink*** **(R232; G177; B160)**
Cal + Hem

6 ***White*** **(R231; G213; B203)**
Cal

7 ***Green Gr.*** **(R129; G116; B80)**
Cpr + C + Ars (?)

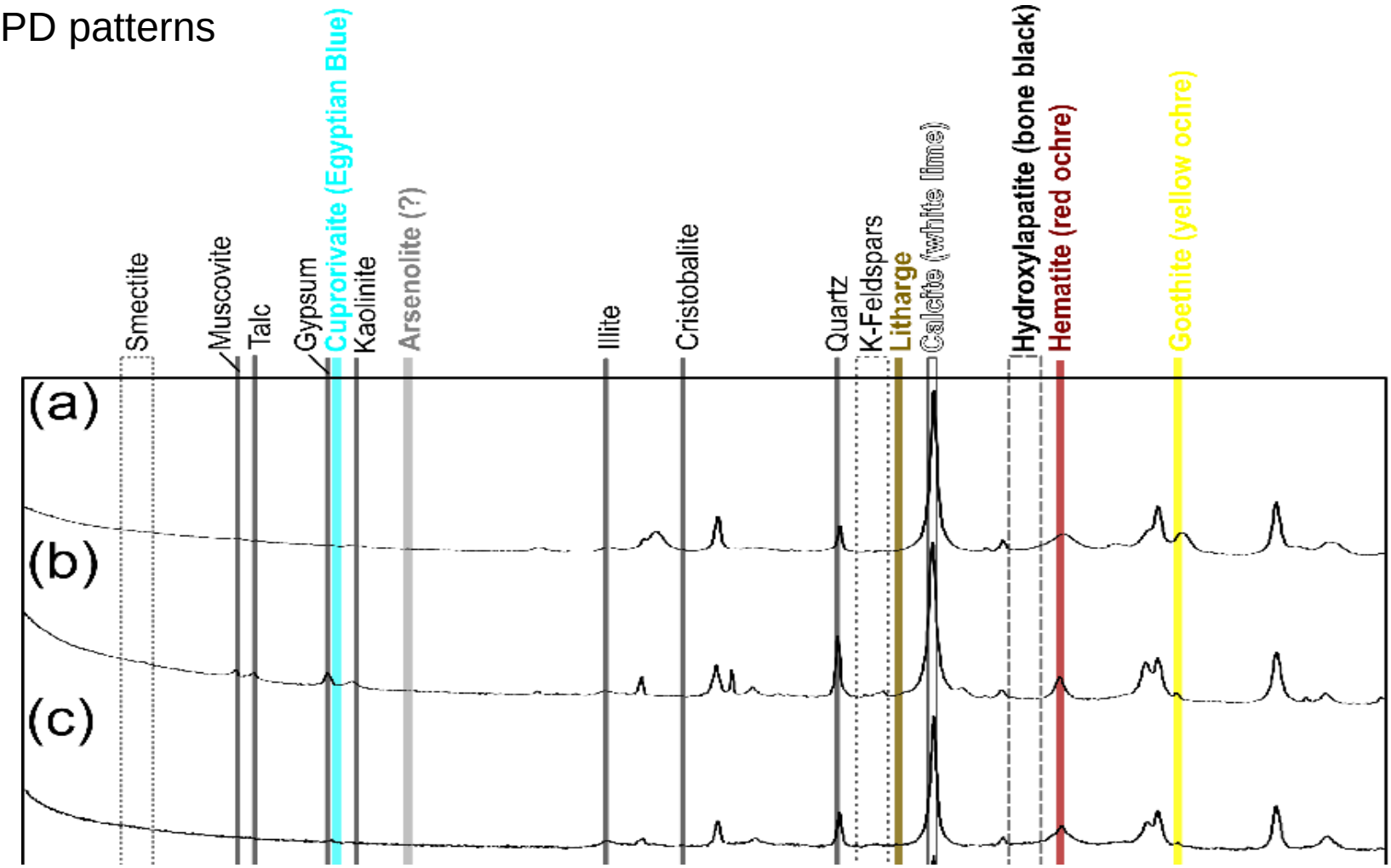
8 ***Yellow*** **(R242; G187; B86)**
Gth

9 ***Brown Yel.*** **(R195; G105; B29)**
Gth + Lit

Negrar (VR), Extra-urban villa (3rd-4th century AD) – collapsed ceiling (repeated module system)

The pigments – the archaeological data

XRPD patterns

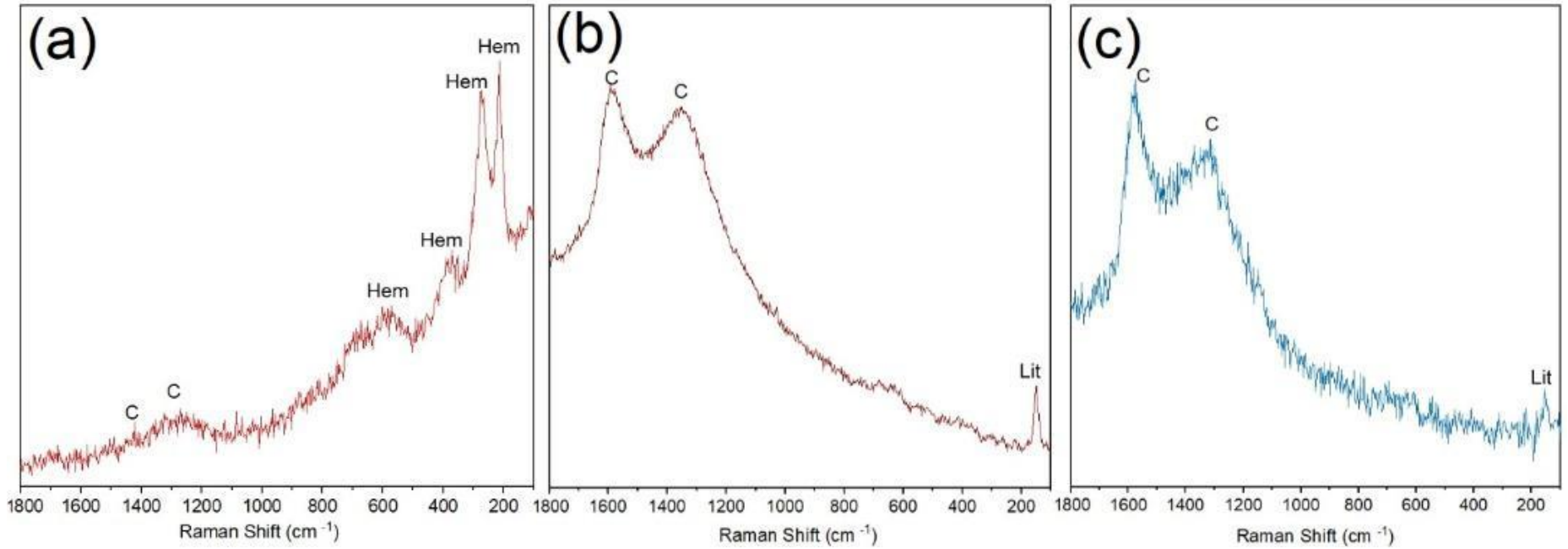


Negrar (VR), Extra-urban villa (3rd-4th c. CE) – collapsed ceiling (repeated module system)

The pigments – the archaeological data

Raman spectroscopy is a spectroscopic technique typically used to determine vibrational modes of molecules, although rotational and other low-frequency modes of systems may also be observed.

- Raman spectroscopy is commonly used in chemistry to provide a structural fingerprint by which molecules can be identified → used for determination of organic compounds in pigments

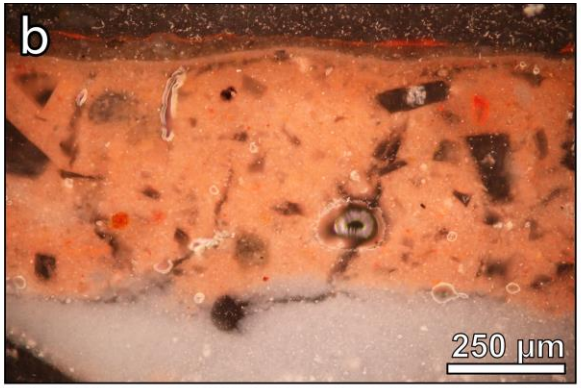


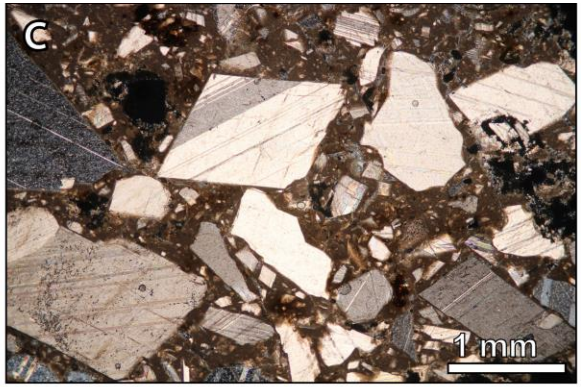
Negrar (VR), Extra-urban villa (3rd-4th century AD) – collapsed ceiling (repeated module system)

The pigments – the archaeological data

Area		Background		Over-paintings						
		Main color	shades	Palmettes (dark half)	Palmettes (light-half)	band of the lozanges	listel	band of the lozanges	listel	frame
		1	2	3	4	5	6	7	8	9
Colour		Red	Dark red	Dusky red	Light red	Pink	White	Green gr.	Yellow	Brown yel.
		R160 G56 B57	R128 G53 B57	R104 G58 B68	R166 G96 B84	R232 G177 B160	R231 G213 B203	R110 G116 B95	R242 G187 B86	R195 G105 B29
Analytical Method		XRPD	XRPD, Raman	XRPD, Raman	XRPD	XRPD	XRPD	XRPD, Raman	XRPD	XRPD
Pigment Chromophores	Hem	•	•	•	•	–	–			–
	Gth	•							•	•
	Carbon		?	•				•		
	Cpr							•		
	Ars							?		
	H-lpt		•					–		
	Cal				•	•	••			
	Lit			–				–		•

The pigments – the archaeological data





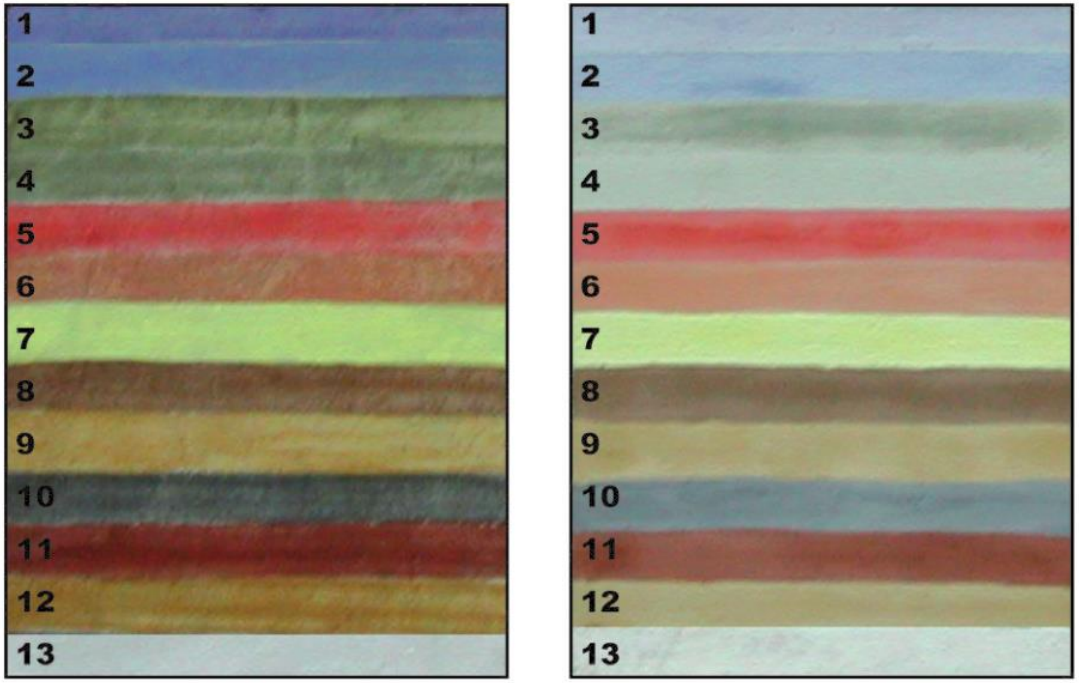
The pigments – the archaeological data

A particular technique: the «lime paint»

archaeometry

Archaeometry **54**, 4 (2012) 723–736 doi: 10.1111/j.1475-4754.2011.00647.x

FRESCO AND LIME-PAINT: AN EXPERIMENTAL STUDY AND OBJECTIVE CRITERIA FOR DISTINGUISHING BETWEEN THESE PAINTING TECHNIQUES*



FRESCO LIME-PAINT

- Smoothly colored backgrounds slightly softer
- With this technique they could tone down colors that are too bright
- it was sometimes used for background backgrounds of pictorial decorations.

Materials Properties, Use and Conservation: Construction Materials and Binders

THANK YOU FOR YOUR ATTENTION!

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