Latest analyses on Russian Byzantine frescoes from Novgorod

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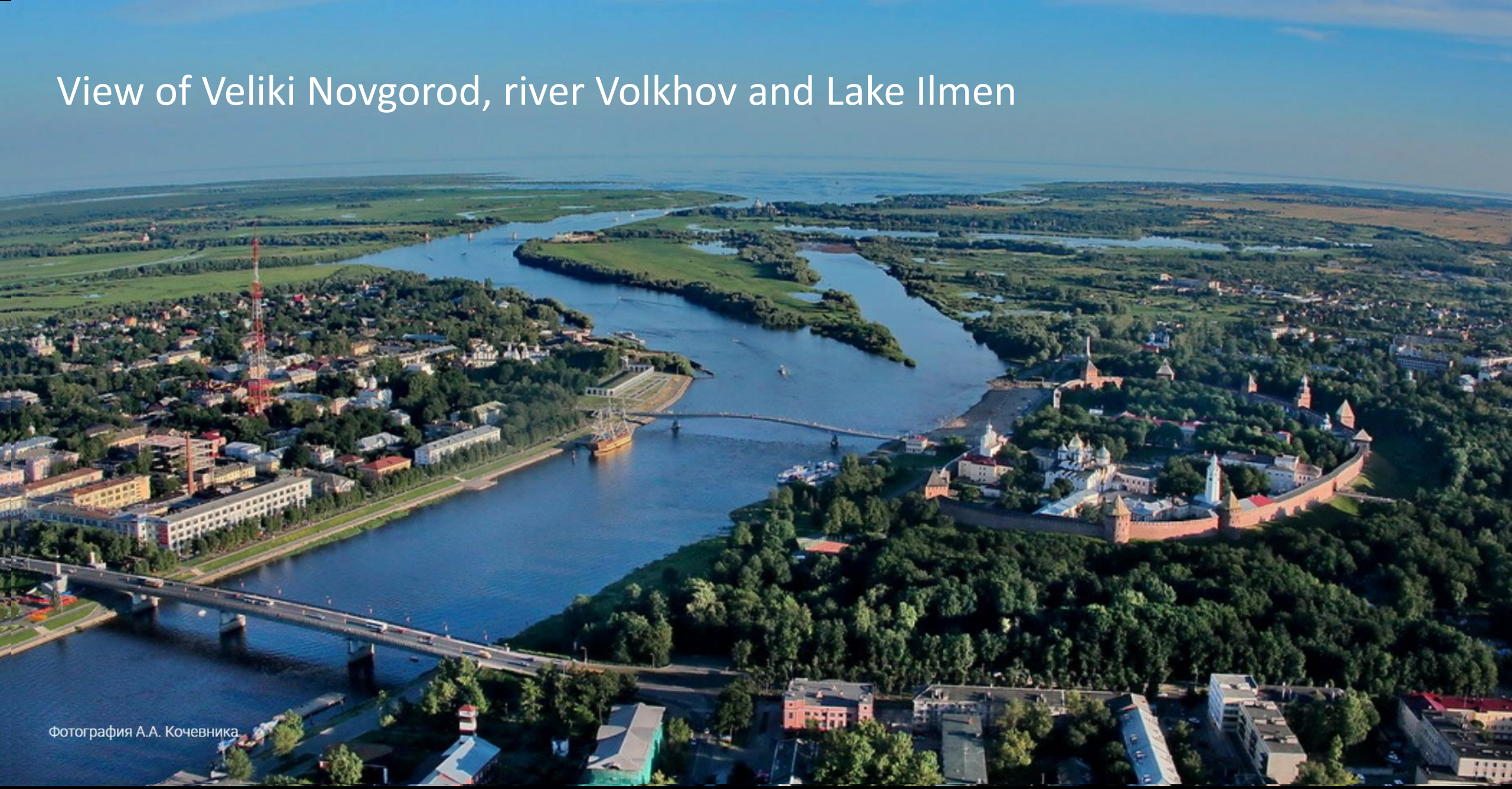
- The data we present today are part of a research project of the Laboratory of Architectural Archaeology and Interdisciplinary Study of Architectural Monuments of the Institute of Archaeology, Russian Academy of Sciences, in Moscow.
- The research was carried out within the state assignment of Ministry of Science and Higher Education of the Russian Federation (theme «Pre-Mongol frescoes in Novgorod: archaeological context and scientific research: The frescoes of the St. George Cathedral, Yuriev monastery, 2013/2020 excavations»).
- Agreement № 075-15-2021-576.

View of Veliki Novgorod, river Volkhov and Lake Ilmen



Фотография А.А. Кочевника

The well preserved Kremlin of Novgorod

The Yuriev Monastery seen from the Volkhov River

- The Cathedral of St George (Georgievskii Sobor) in the Yuriev Monastery was built in 1119

- The earliest frescoes recovered on excavation date to 1120-1130

- Inside: the walls are decorated with 19th century frescoes
- Part of the older frescoes were found in 2013 under the new floor
- The older lower level is now exposed

Some remains of the 12th century frescoes are preserved *in situ* under the latest floor

…and in the niches of the windows

- Huge amounts of early fresco fragments were recovered in the excavations of the last 9 years, carried out by the Institute of Archaeology of the Russian Academy of Sciences of Moscow
- This is only one of the deposits

- We know that the Cathedral or parts of it had been renovated in different periods

- Part of the fragments removed from the walls in the 19th century were buried in the area around the church

- One of the problems is to distinguish the fragments of different date, as they are all mixed up

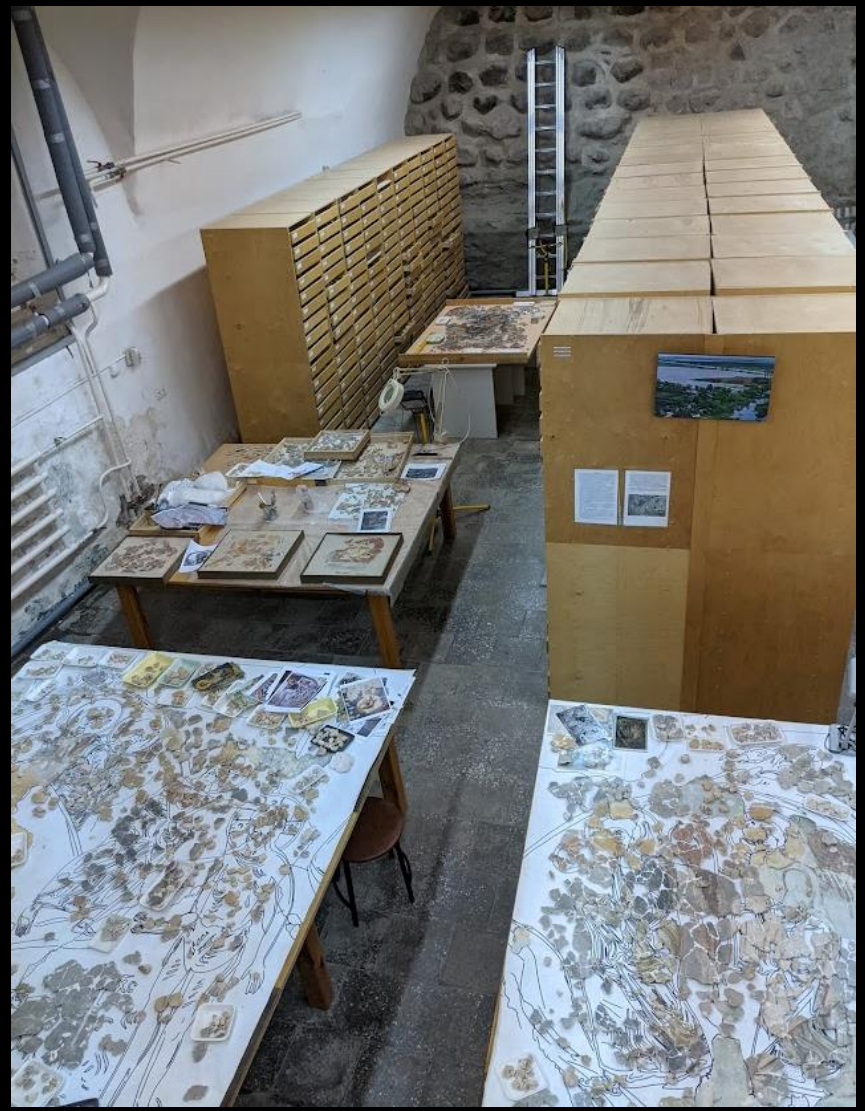
Excavation in July 2022 at Veliki Novgorod

We also carried out XRF analyses of 12th century paintings in the tower of the Cathedral…

…and of the pigment remains on the outside of the cathedral

The quality of the paintings is excellent

The frescoes will be recomposed by skillful restorers

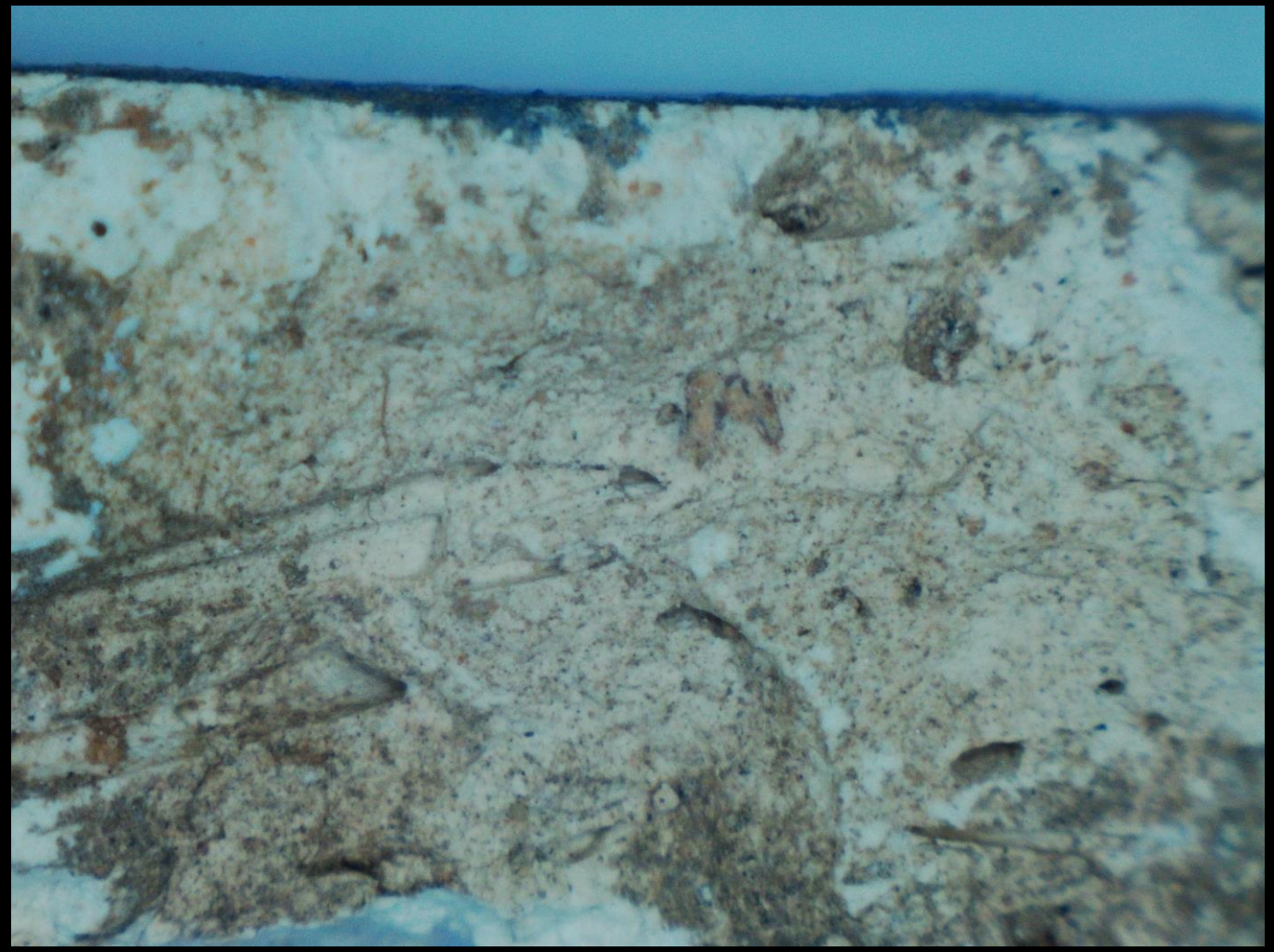


- We began in 2021 to study pigments, painting techniques, color layers, substrates, and plasters

- The methods we employ are optical microscopy (OM), X-ray Fluorescence Spectrometry (XRF) and Scanning Electron Microscope with Energy Dispersive Spectrometry (SEM-EDS)

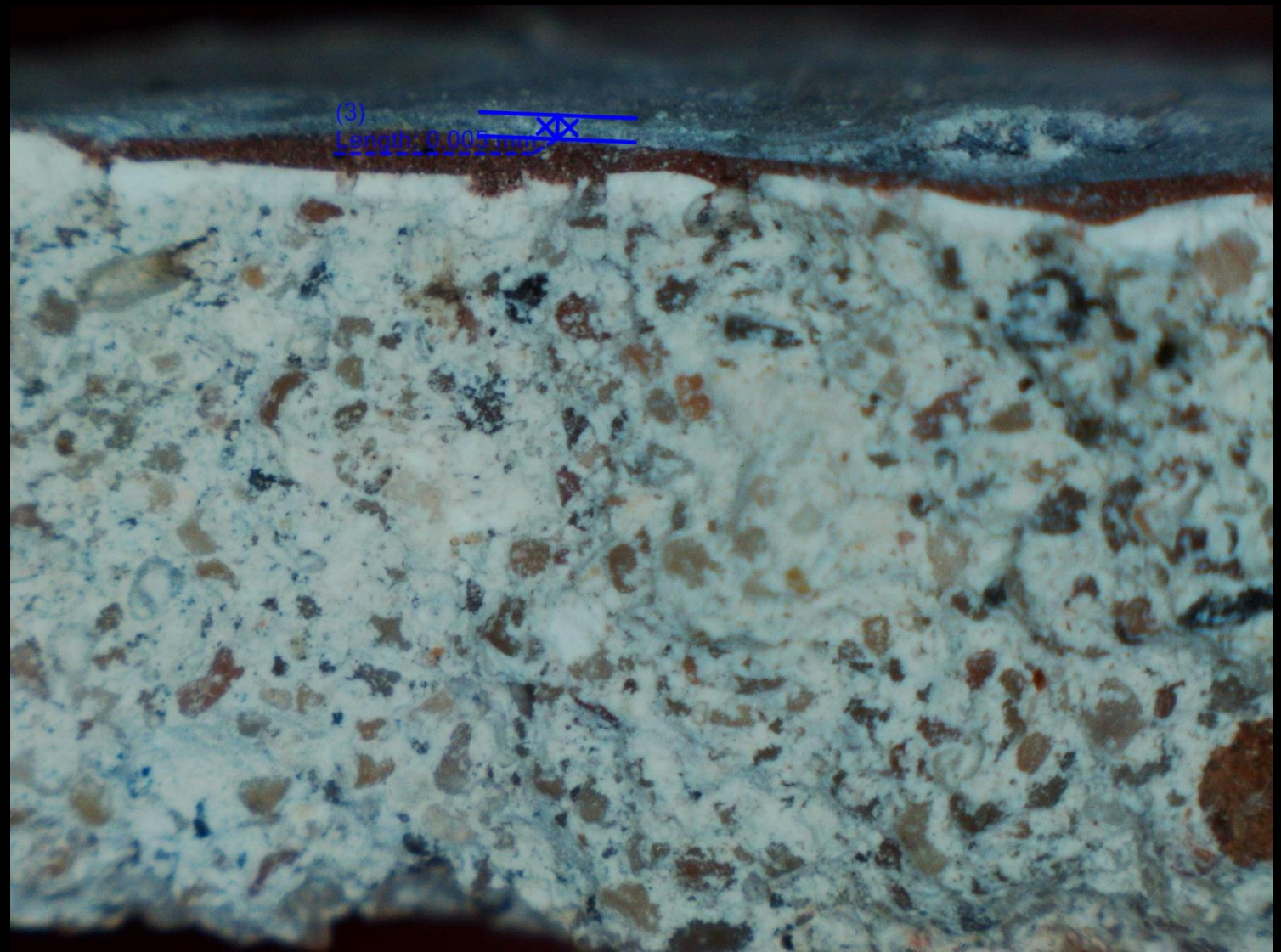
- Further analyses by XRD and Raman are planned for the near future

Optical microscopy is always the first step



- Top layer: blue pigment
- Layer of fine plaster or intonachino
- Early plaster or intonaco
- Imprints of straw and very few tiny quartz grains

Example of later fragment with blue pigment

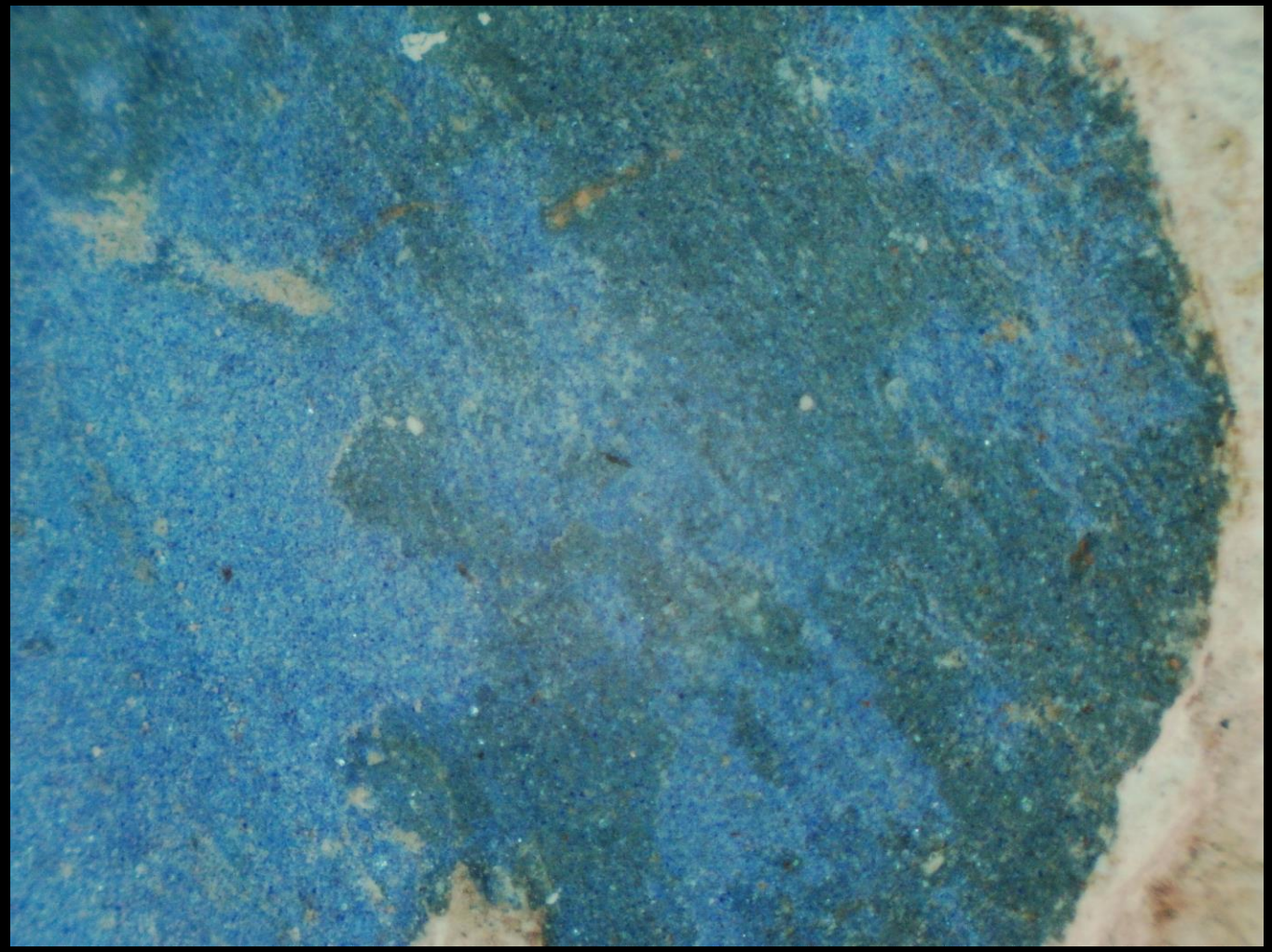


Top layer blue pigment

Red layer: ochre substrate or underpaint

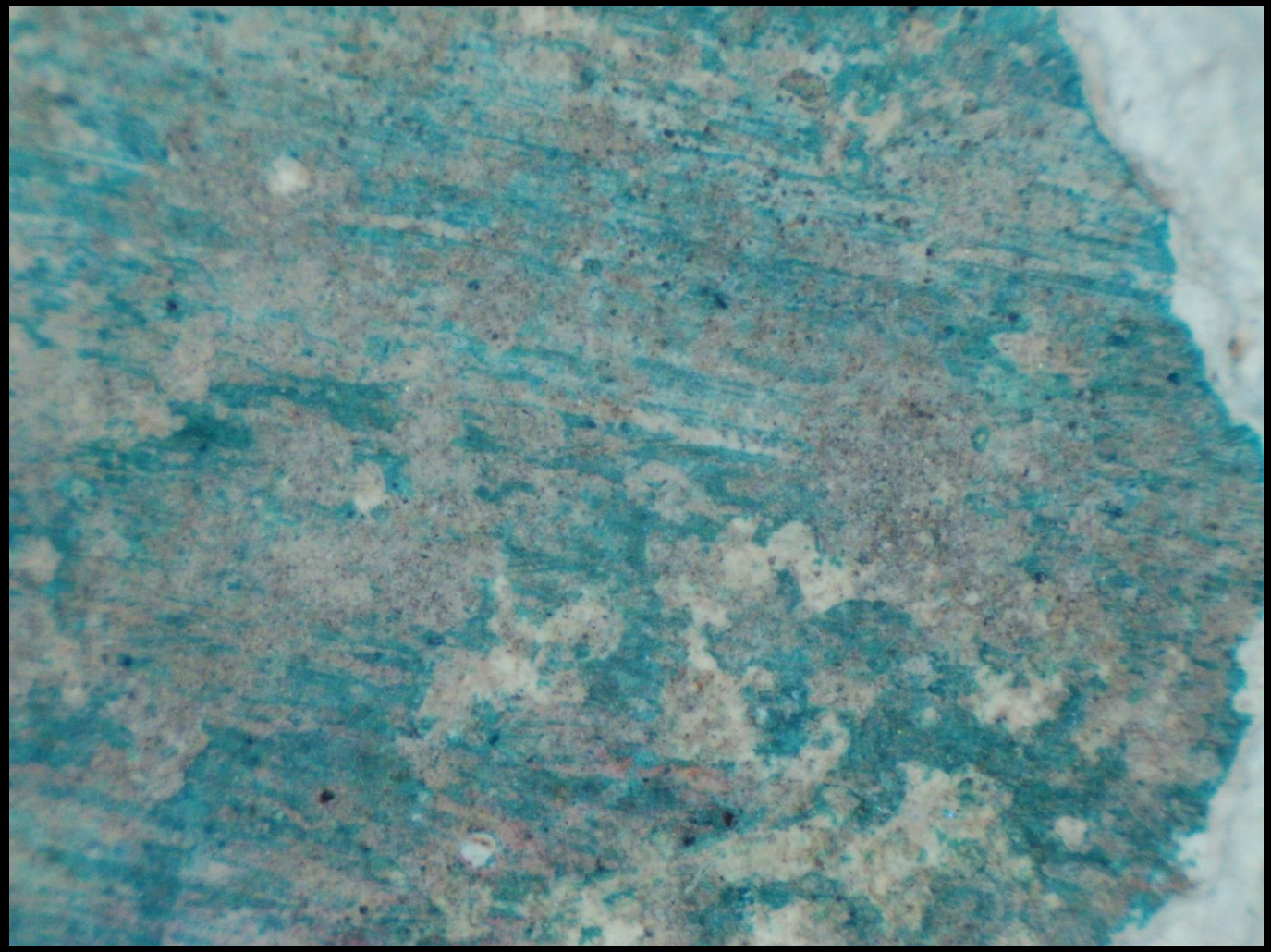
Plaster with large quarz inclusions and ground bricks (bottom right)

Some earlier fragments also have an underpaint



- Grey substrate, called *reft* in the ancient Russian texts
- SEM-EDS analyses showed that it is calcite mixed with carbon (*veneda*), the pigment is lazurite

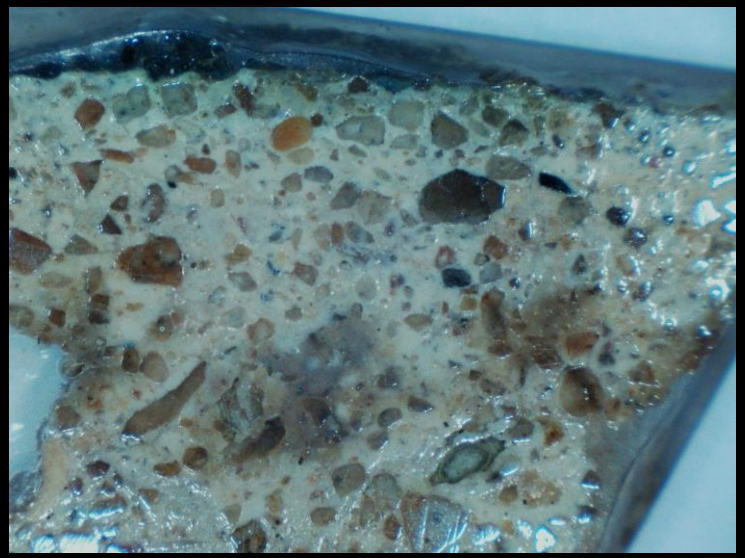
The way the pigment is applied is also indicative



- Earlier examples show carefully applied pigments, very compact and painted in one direction

- Green earth

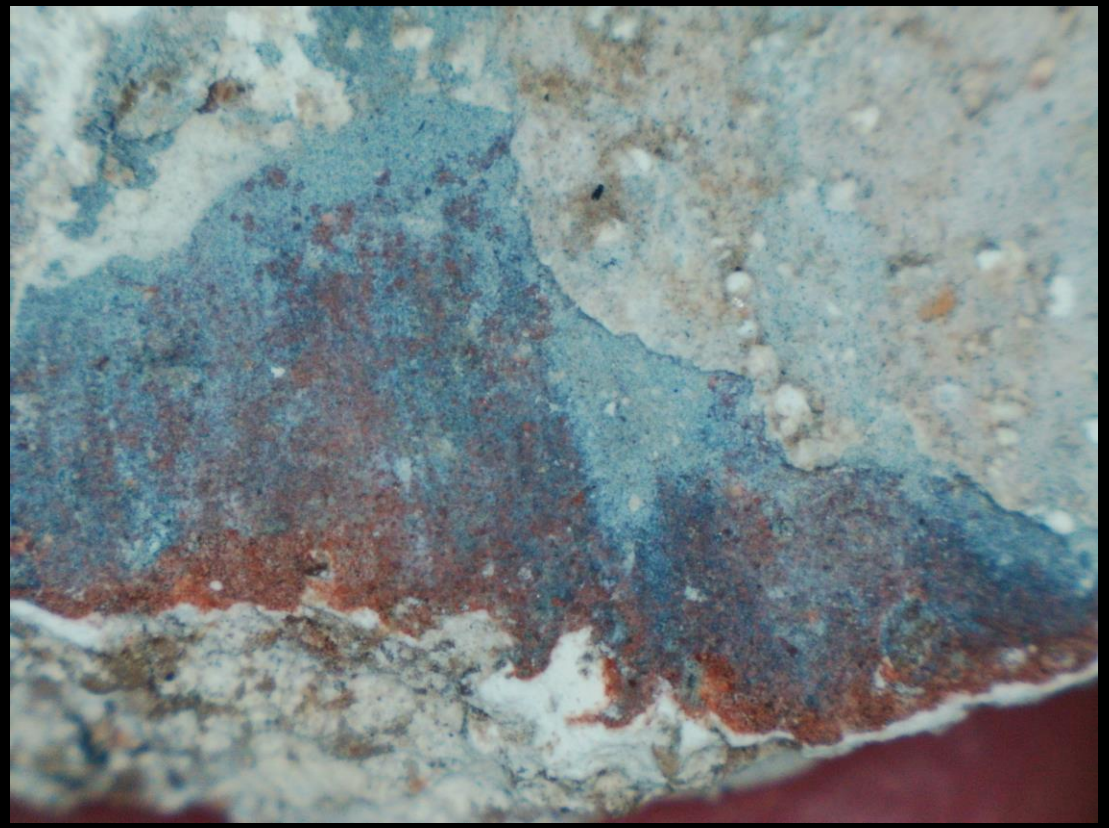
- Later examples show a less regular surface
- Larger grains of quartz are visible on the surface
- The binders are different
- Prussian blue and calcite



- Inside the intonaco we found the imprints of vegetable materials (straw. wood, hemp)
- brick fragments, sand
- The binders can also give indication on the date

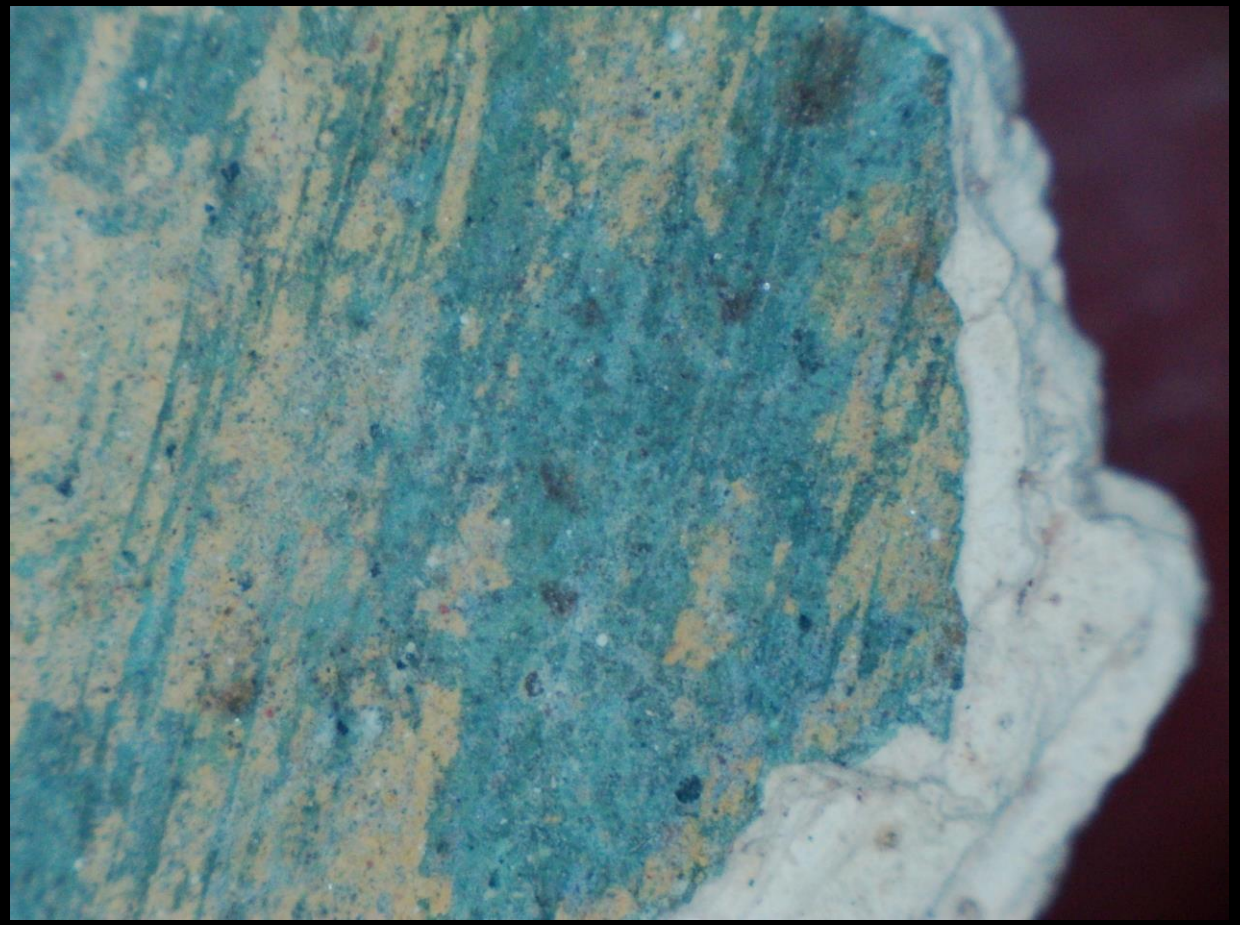
Fibres of flax were also employed in the early plaster

Later example with more layers



- The blue pigment has a different, more mixed composition and mostly a red underpaint
- This technique is known from other countries as well. The red substrate is commonly called *morellone.*
- Not found in the early period

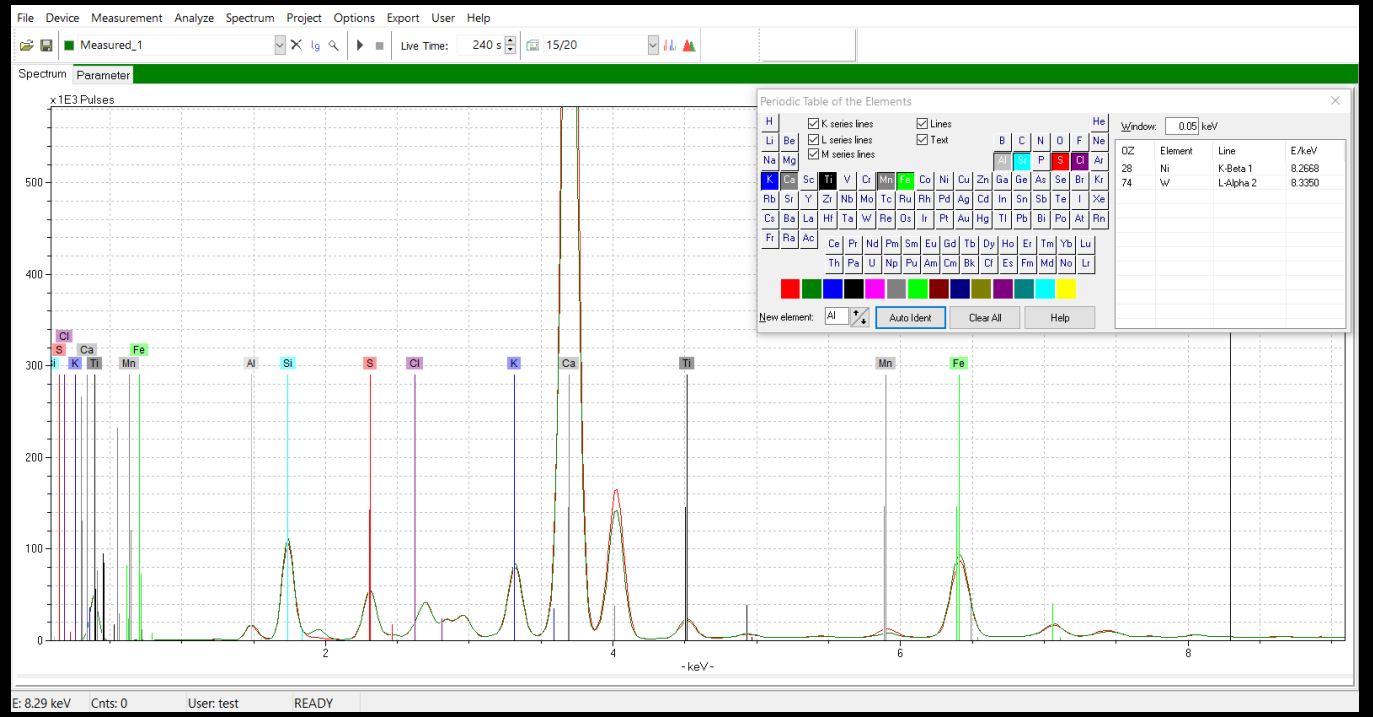
This fragment shows a yellow underpaint



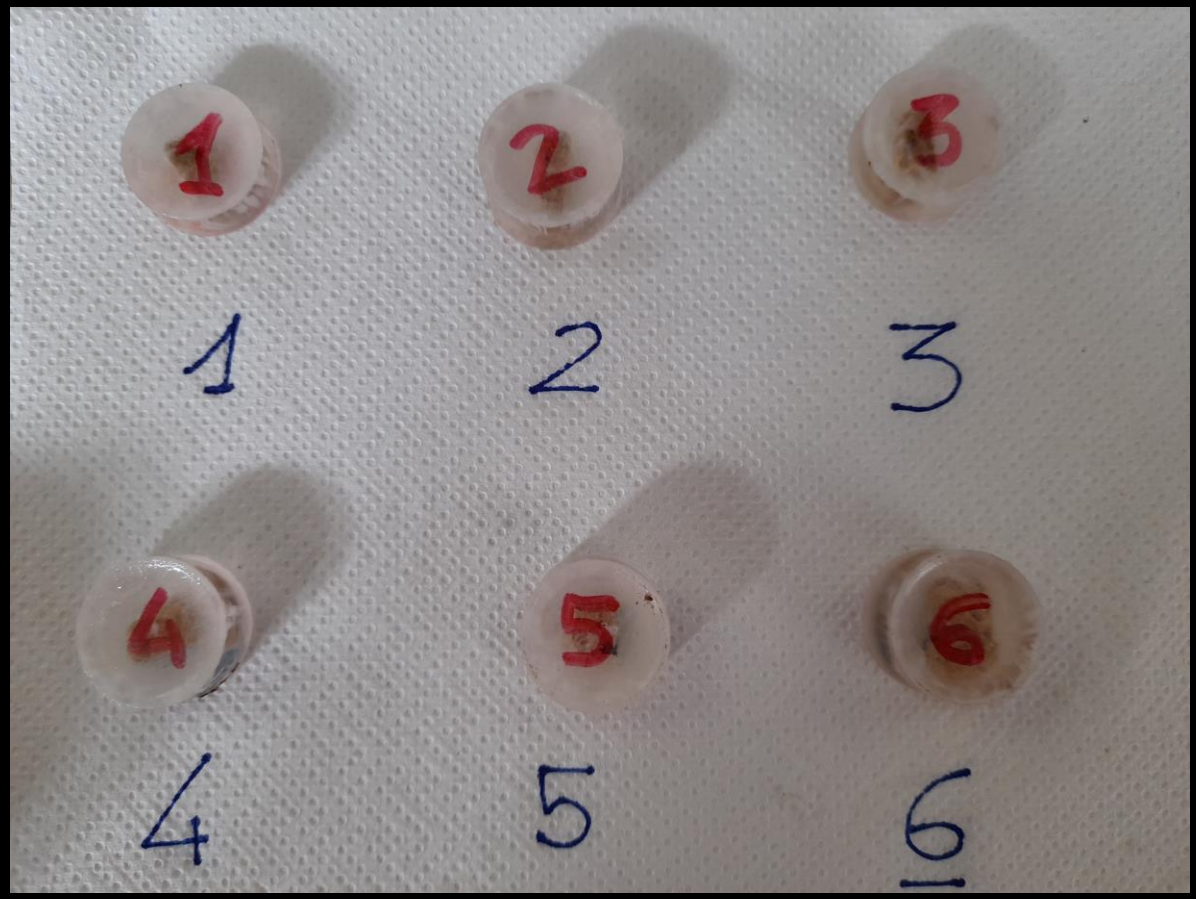
- In this case it is meant to obtain a different nuance of color

From the technique employed for the plaster and the paint this is an early example

For the first screening and the pigments in situ we use a portable XRF: example of lazurite mixed with Fe and Mn

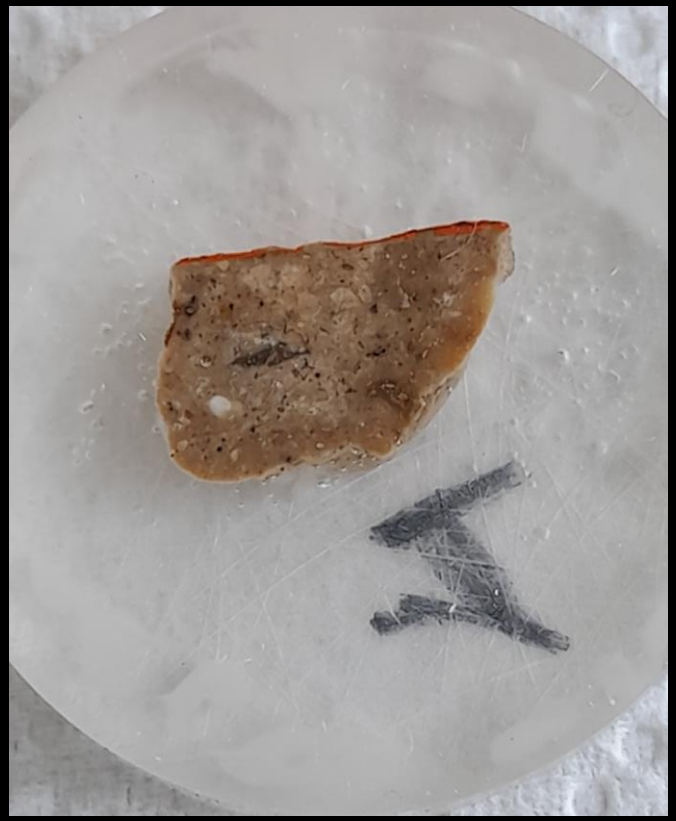


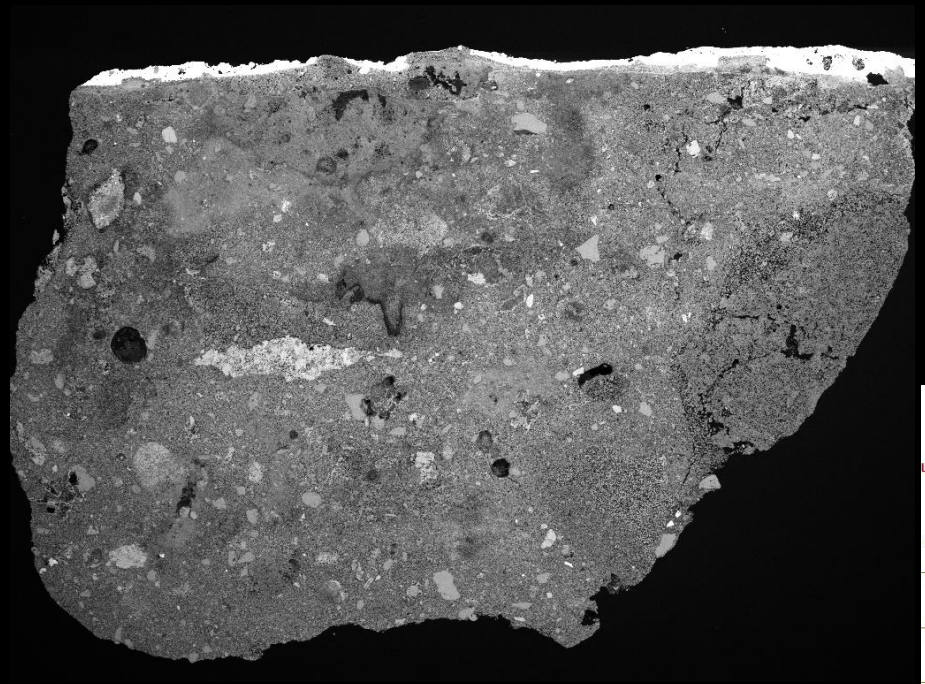
Preparation for SEM

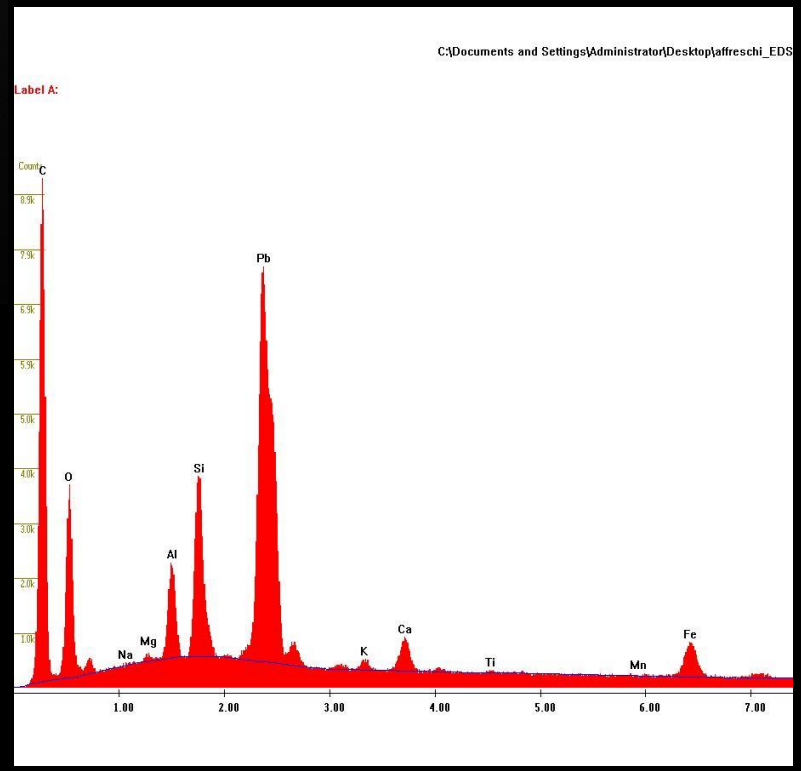


Metallization with graphite and polishing

Orange- red is minium, Pb_3O_4 + PbO







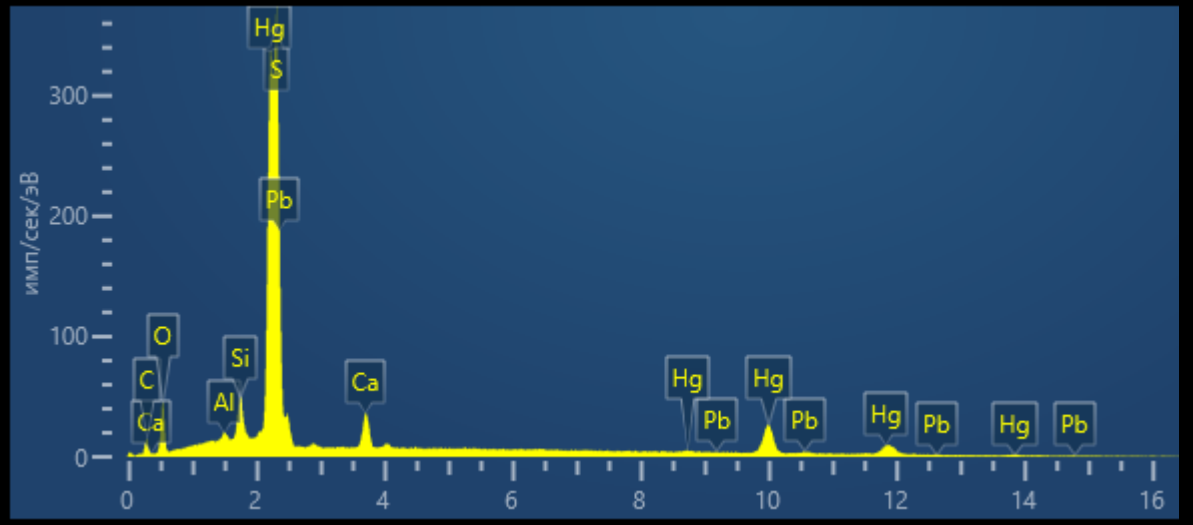
Red ochre is much more common

- We also study the efflorescence on top of the sample before mounting it in resin
- Chlorides, nitrates, sulphates etc
- Formation of gypsum

- In general we can say that in the 12th century very «classical» earth pigments were employed

- Ochres of different color: yellow, red, brown
- Green earth
- Calcium carbonate
- Lazurite etc.

We also identified cinnabar and/or cinnabar mixtures



Green pigments are mostly green earth

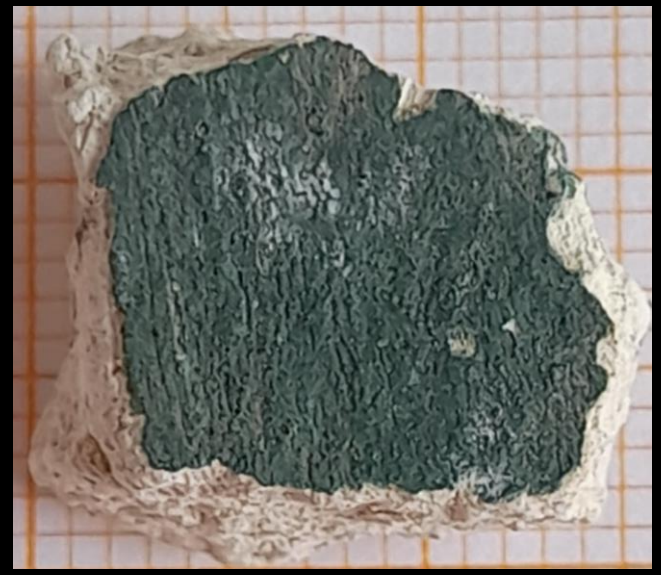
Green earth consists of powdered green stones: celadonite and glauconite i.e.

$K(Mg,Fe^{2+})Fe^{3+}(Si_4O_{10})(OH)_2$

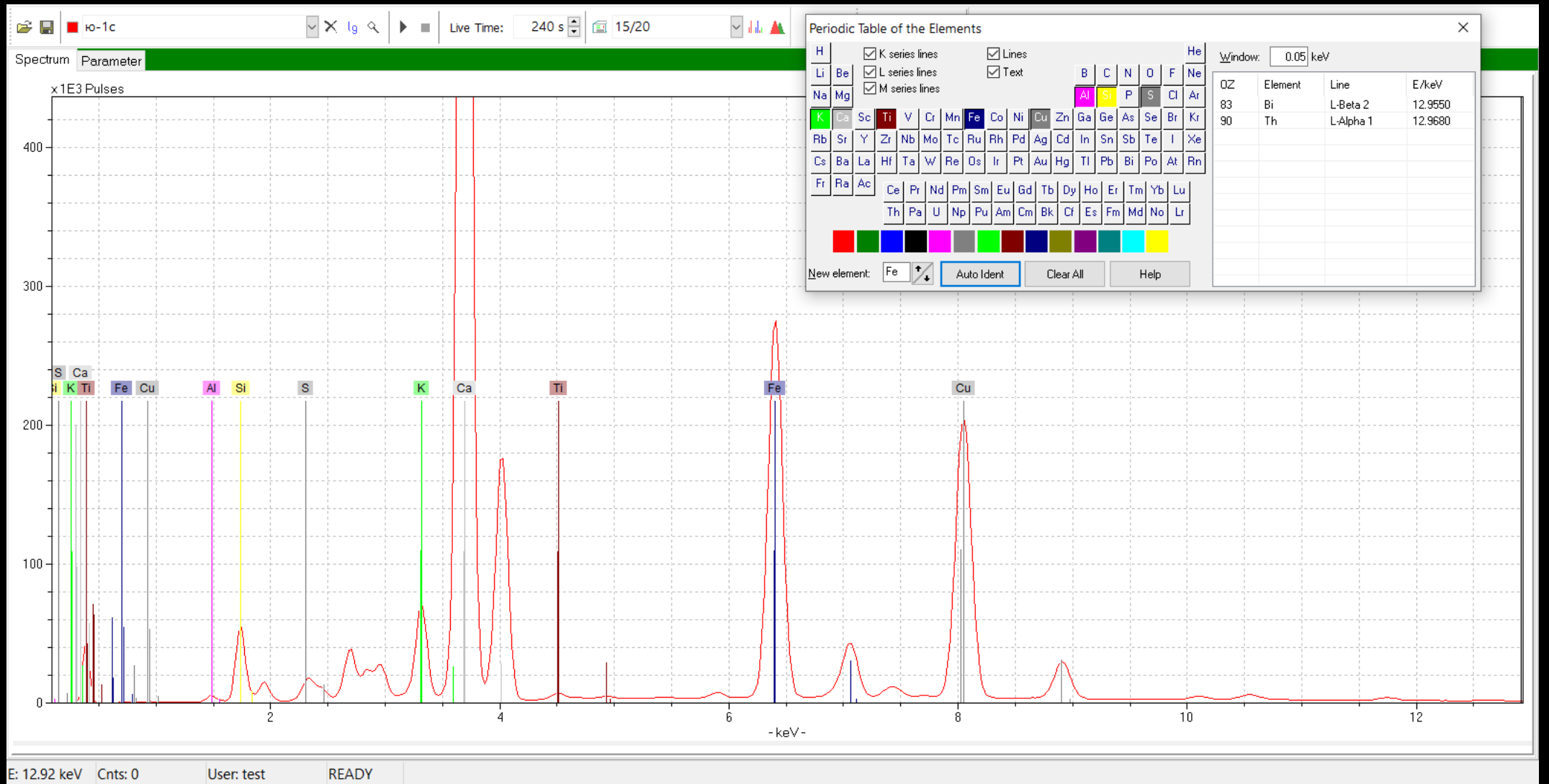
and

$(K, Na)(Fe^{3+},Al, Mg)_2(Si, Al)_4O_{10}(OH)_2$

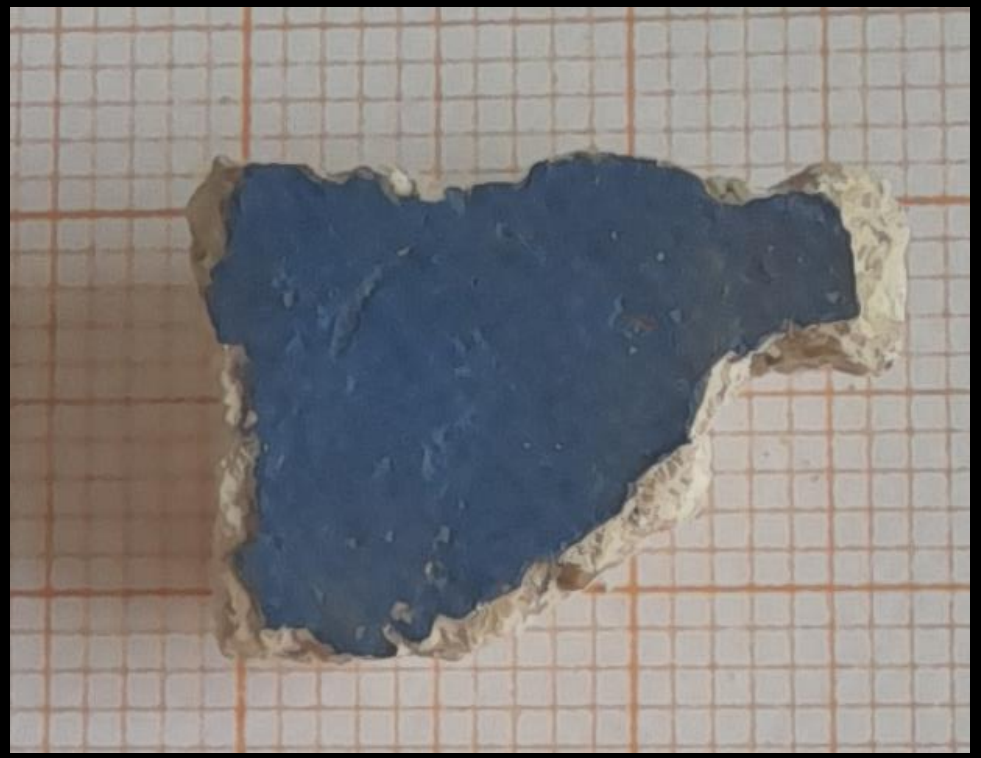
- To obtain different nuances the painters employed various mixtures
- Dark green also contains some manganese and *reft*
- For light green, green earth was mixed with white calcium carbonate

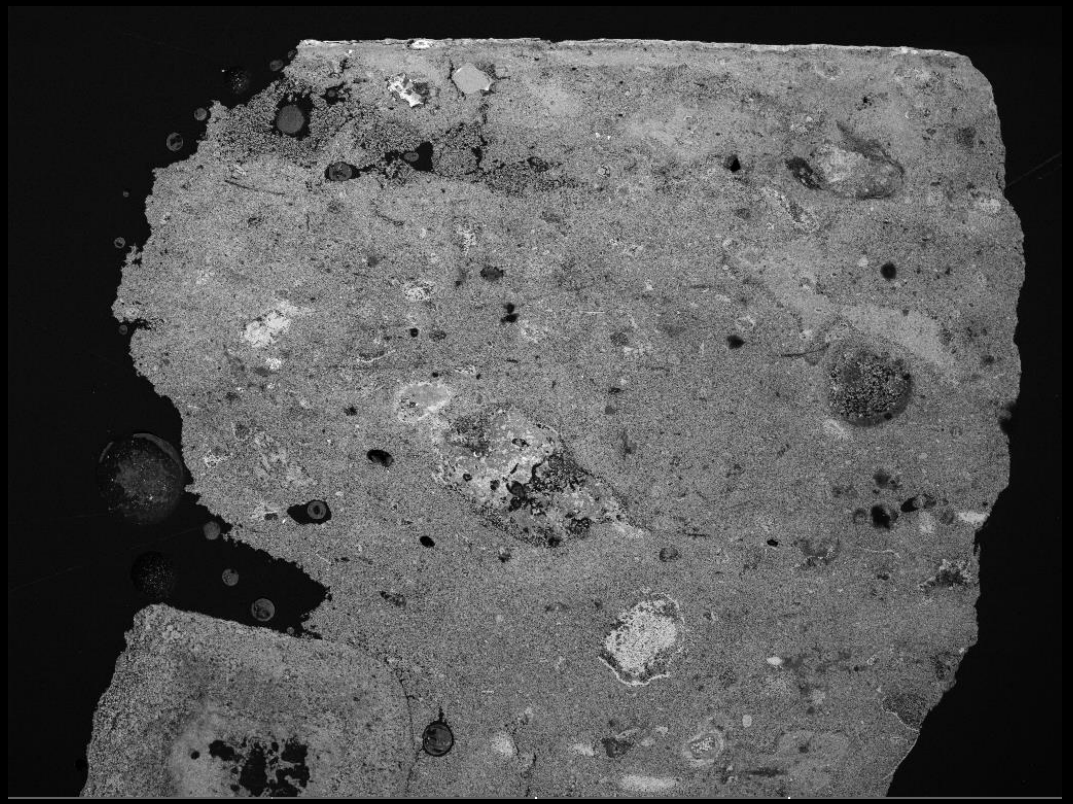


In one case we identified some copper carbonate or perhaps Egyptian green mixed with green earth



All early blue pigments consist of lazurite, i.e. lapislazuli $(Na,Ca)_8(AlSiO_4)_6(S,SO_4,Cl)$





Lazurite was the most expensive pigment in antiquity

There are very few sources of this mineral

One is in the region Badakshan in Afghanistan

But lazurite is also found in Siberia, near Lake Baikal

There are differences in composition and we plan to determine the provenance by XRD, ICP-MS, Raman

- We have hundreds of XRF and SEM measurements of pigments, both unearthed and *in situ*, from the Cathedral of St.George (1120-1130)

- For comparison we also analyzed the pigments from other churches, in particular the Church of the Annunciation on the Rurikovo Gorodišče, built in 1103, and Our Saviour on the Nereditsa Hill, built in 1198

- In this way we cover the entire century and at the end we will possibly be able to understand the evolution in technique and pigments of this period

Thank you
for your attention!