LUCA NODARI

MARTINA ZUENA

IN SITU EXTERNAL REFLECTION INFRARED SPECTROSCOPY AS CONTACTLESS TOOL TO INVESTIGATE ARTISTIC MATERIALS

Padova, 21-22 Maggio 2019

INFRARED SPECTROSCOPY & HERITAGE SCIENCE

An excellent tool to characterize functional groups in organic and inorganic materials

Painting materials, ceramic, glasses, paper, conservation materials….

Organic Materials: binders, polymers, alteration products

Inorganic Materials: binders, pigments, alteration products

INFRARED SPECTROSCOPY & HERITAGE SCIENCE: A TIMELINE

1980

Invasive and destructive; 1 mg 4000-400 cm^{-1}

2000

Micro-invasive and non-destructive; <1 mg 4000-650 cm^{-1}

2010

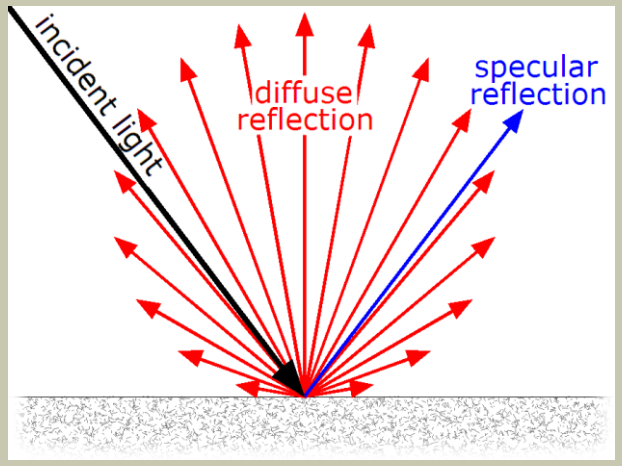
In situ, contactless; 4000-1000 cm^{-1}

2012

In situ, contactless; 7500-375 cm^{-1}

ERFTIR: FUNDAMENTALS

Detector



R_s: specular reflection

R_v: diffuse reflection

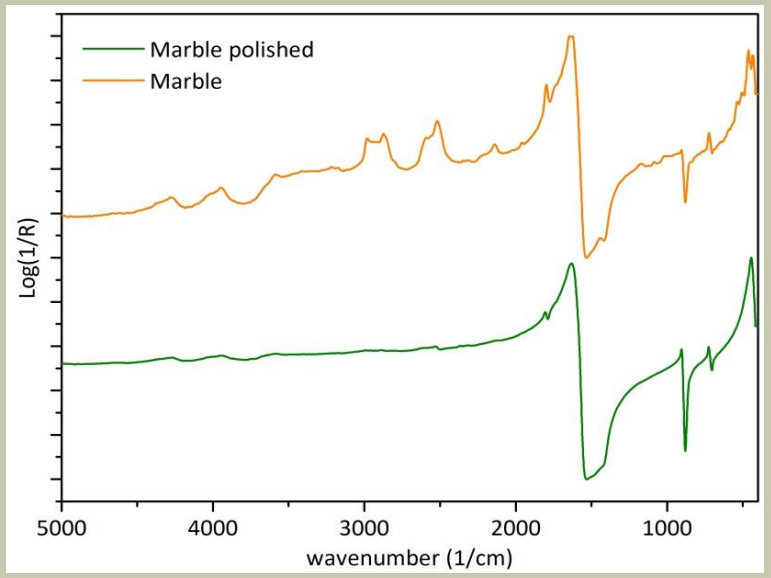
R_s ruled by Fresnel's law $$R_s = \frac{(n-1)^2+k^2}{(n+1)^2+k}$$

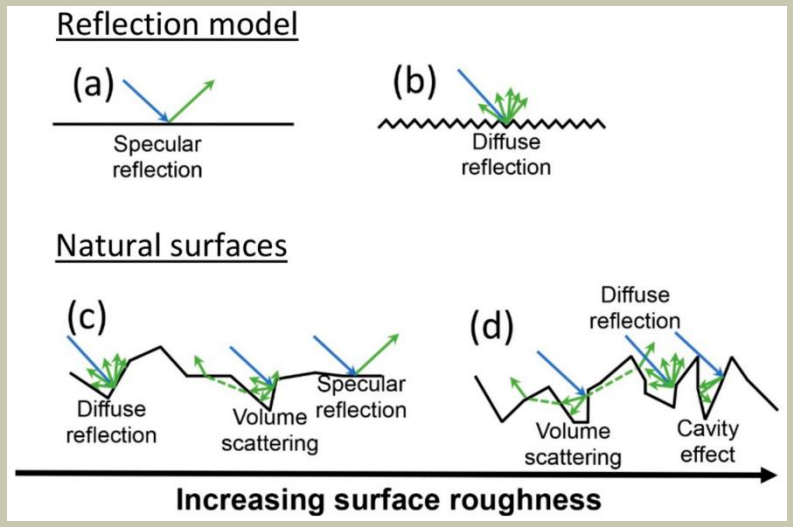
1. Derivative-like k<1, following the profile of n across the wavelength
2. Inverted band k>>1

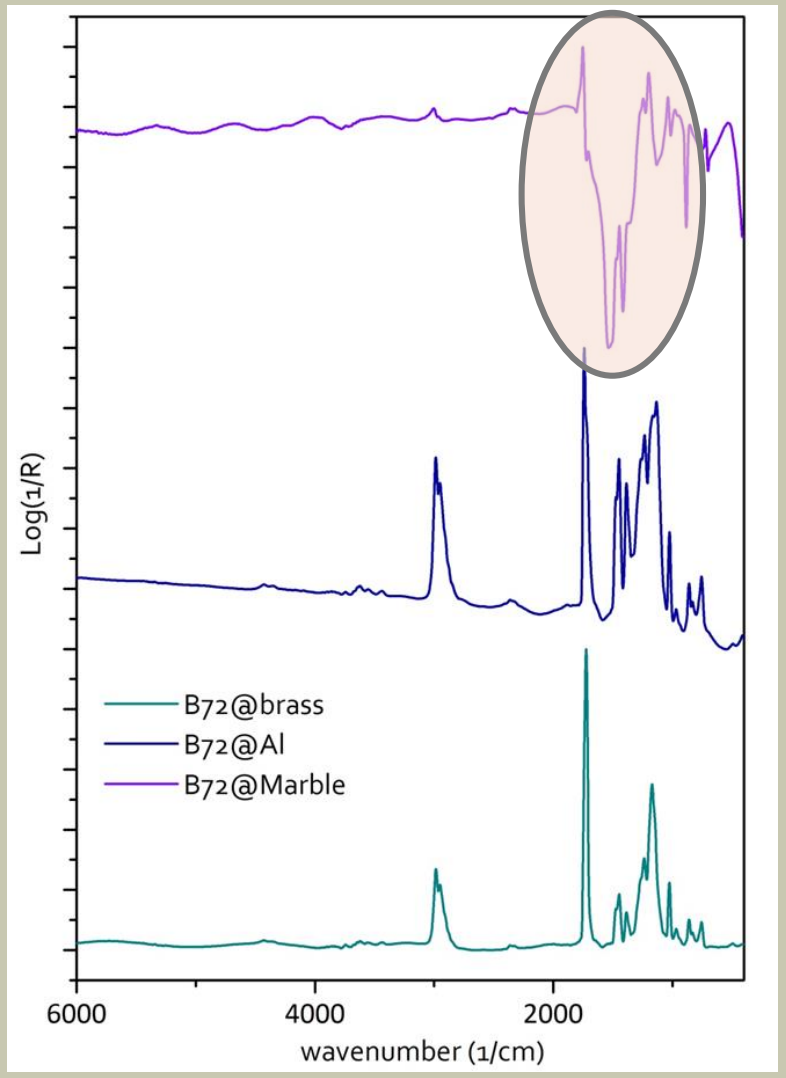
R_v originated by absorption process, spectral features close to the transmission ones, with the exception of bands intensities

Weak bands are enhanced respect to strong ones

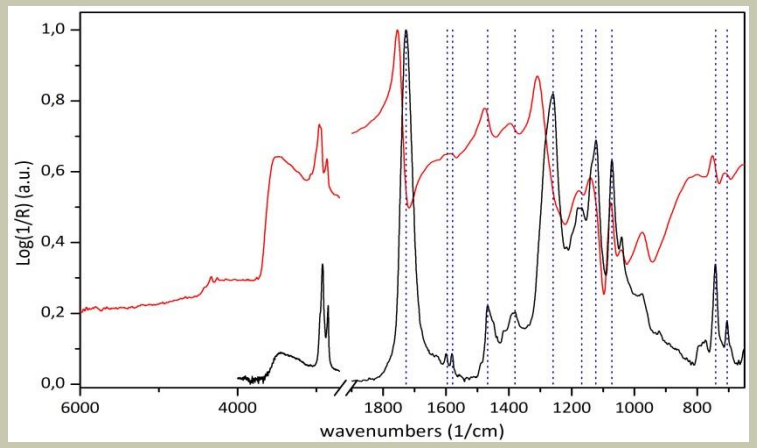
BAND DISTORTIONS:
THE INFLUENCE OF THE SUBSTRATE

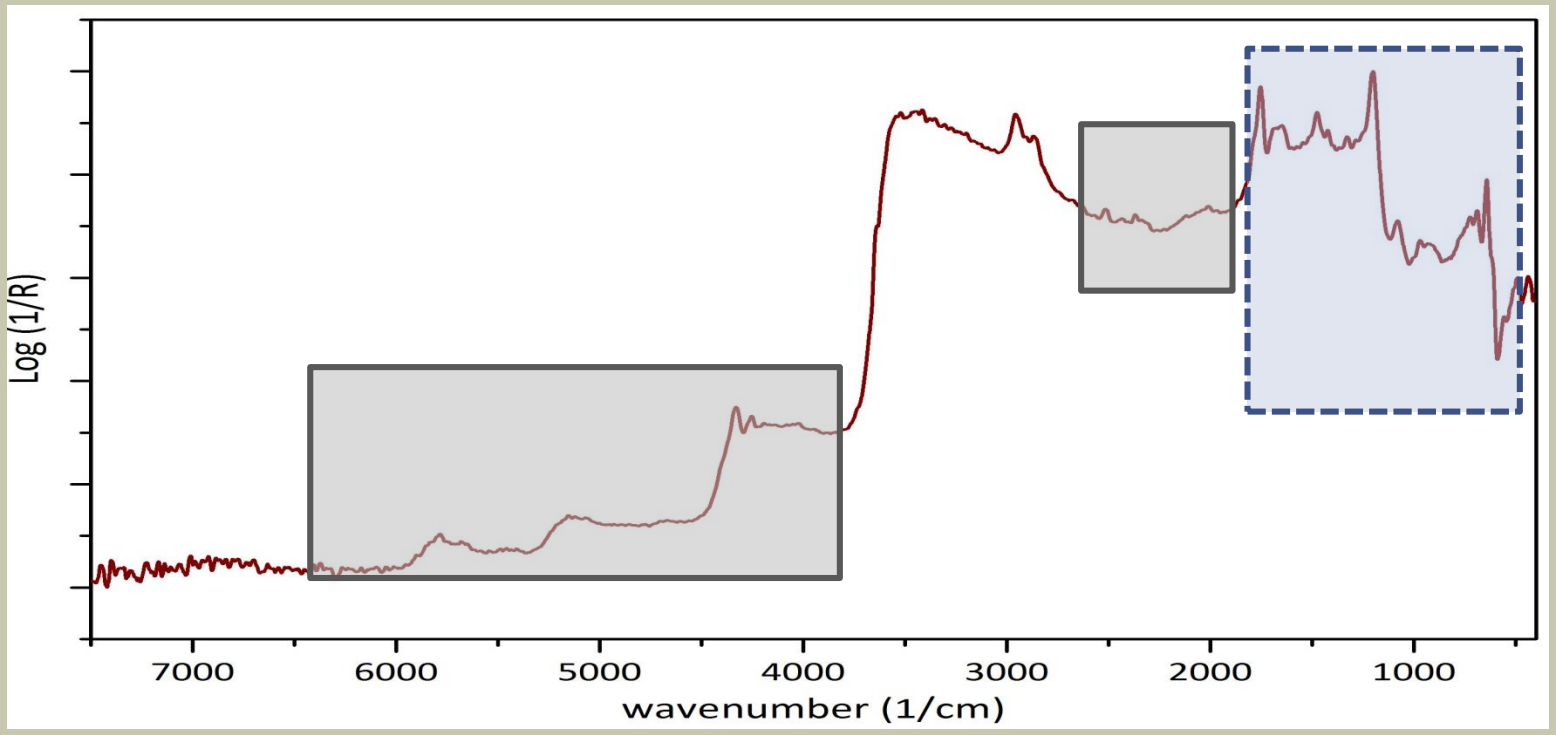






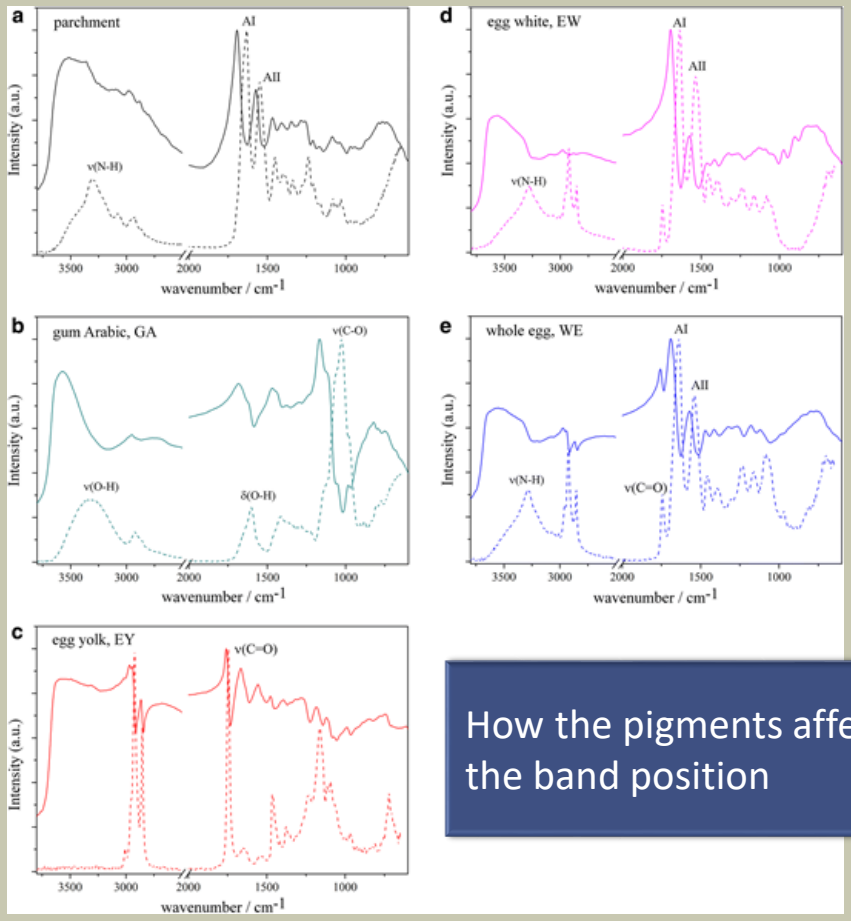
ERFTIR SPECTRA & THE SPECTRAL REGIONS



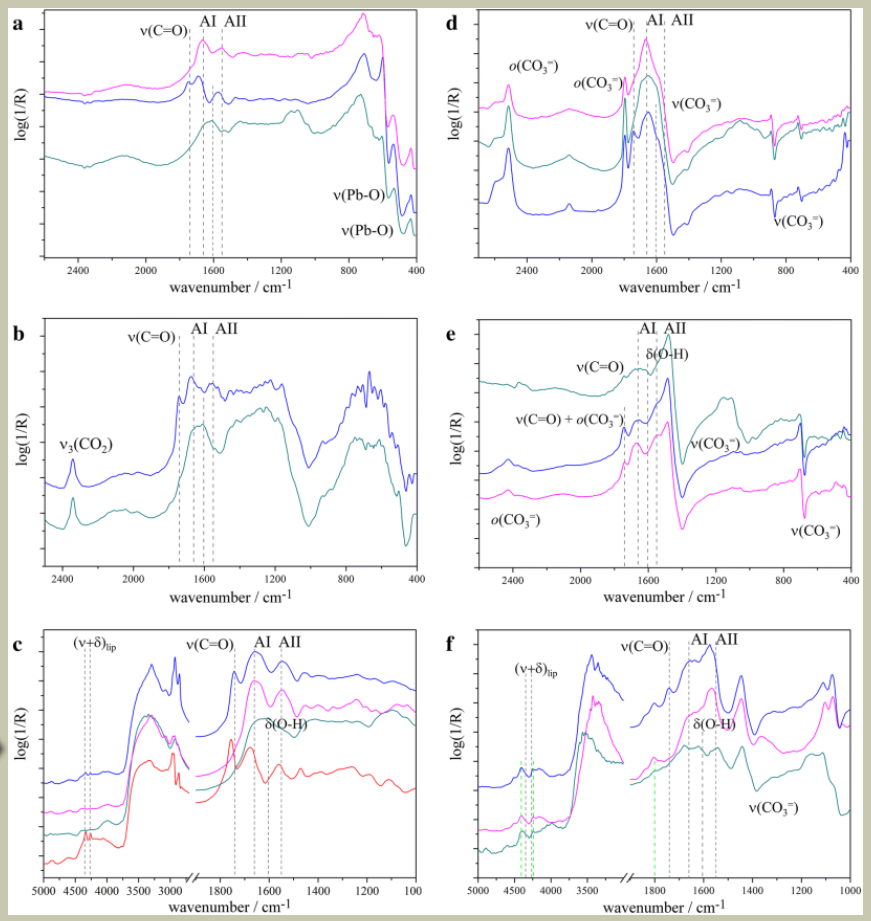


Alpha by Bruker: 7500-375 cm^{-1}: MIR+ a part of NIR

ABOUT PIGMENTS AND BINDERS



How the pigments affect the band position



Comparison between ER-FTIR and μ-ATR measurements on: a parchment; **b** gum Arabic; **c** egg yolk; **d** egg white and **e** whole egg. The main absorption region of interest is enlarged in the boxes. Dotted lines refers to the spectra collected in μ-ATR mode

Comparison between ER-FTIR spectra collected on paintouts containing various pigments bound in gum Arabic (dark cyan spectra), egg white (magenta), egg yolk (red) and whole egg (blue): **a** Pb-Sn yellow; **b** nat. ultramarine; **c** vermilion; **d** chalk; **e** lead white; **f** malachite

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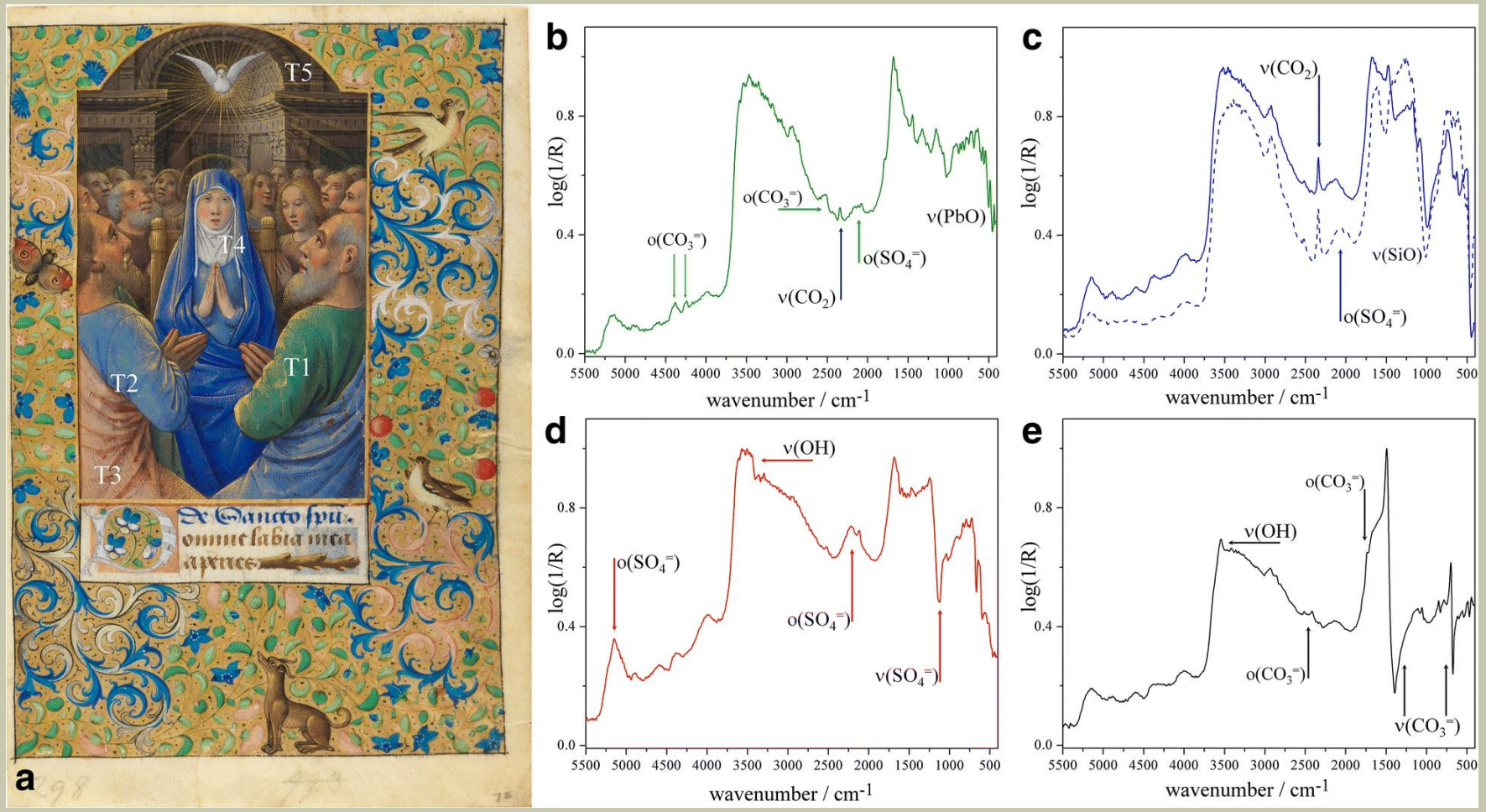

Cambridge, Fitzwilliam Museum, Marlay Cutting Fr. 5 (**a**). ER-FTIR spectra collected on the green robe (**T1**, **b**), the light blue robe (**T2**, **c**), the pink robe (**T3**, **d**) and the white wimple (**T4**, **e**). Characteristic bands for chalk, natural ultramarine, lead–tin yellow, gypsum and lead white are shown; the pigment's overtones and/or combination bands are labeled with o(functional group). The blue dashed line in **c** represent the spectrum of natural ultramarine/GA ref.

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MATERIALS AND ALTERATIONS IN MODERN PAINTINGS: MAX ERNST @ GUGGENHEIM

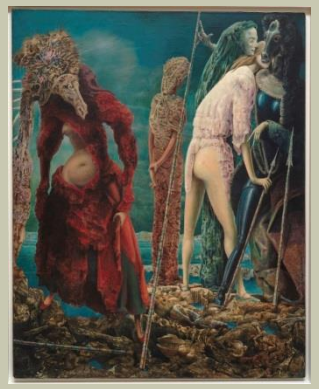
The Kiss (1927)

The Garden airplane trap (1935-36)

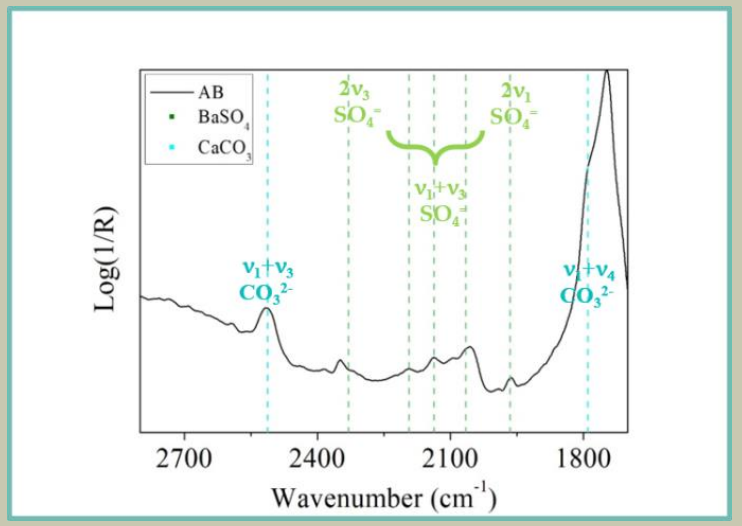
The Entire city (1937)

The Zoomorphic couple (1933)

The Attirement of the bride (1940)



The Antipope (1941-42)



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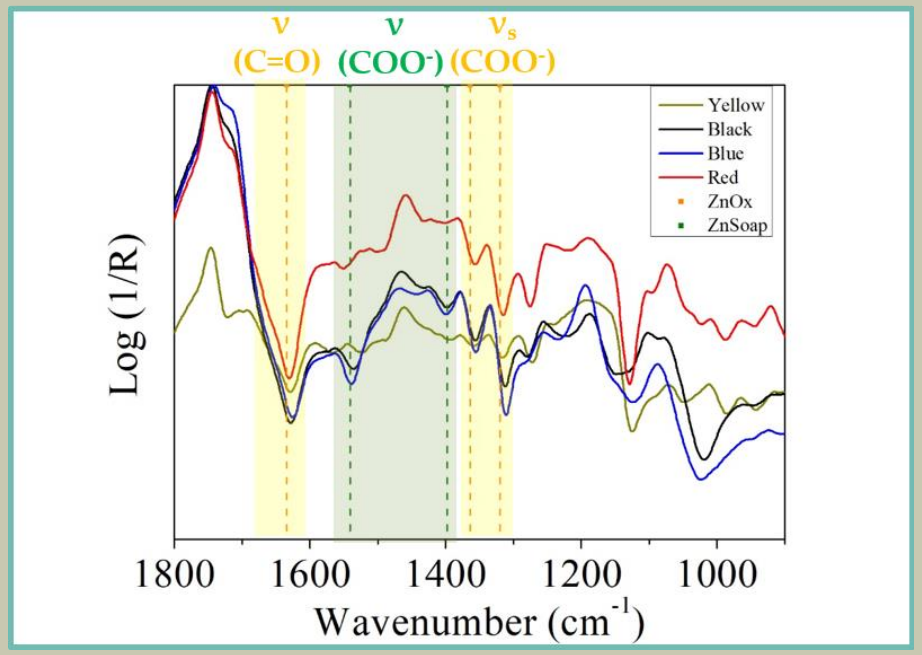
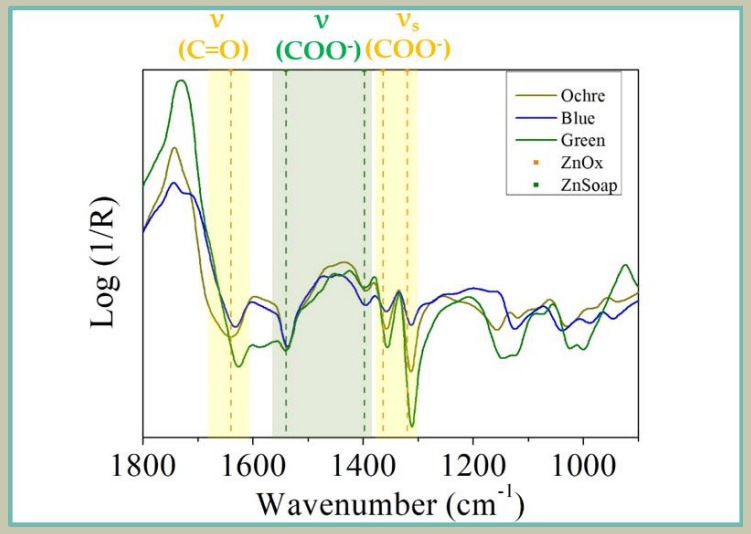
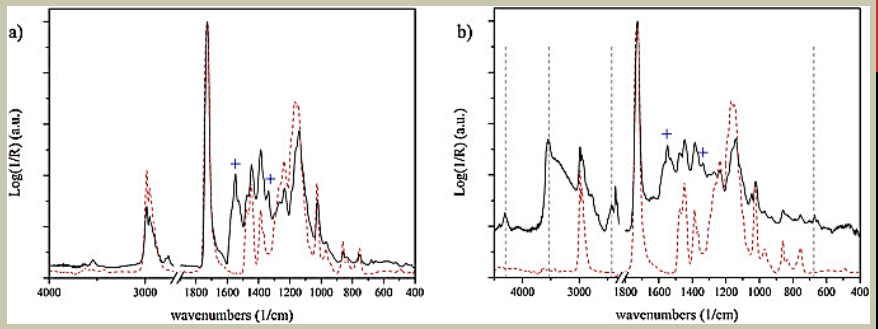




ALTERATIONS IN CONTEMPORARY ARTWORKS: FROM IN SITU MEASUREMENTS TO LAB EXPERIMENTATIONS



Why these alterations appear?
Is the room properly conditioned?
Which is the story of the oeuvre?

Stored in wood boxes

VOC!! (HAc, HForm)

L. Nodari, L. Tresin, Al.Benedetti, M.K. Tufano, P. Tomasin, J Cult Her 2019, 35:288-296

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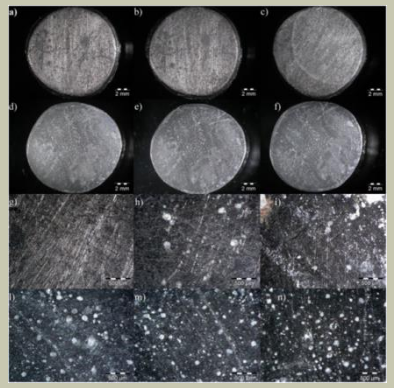

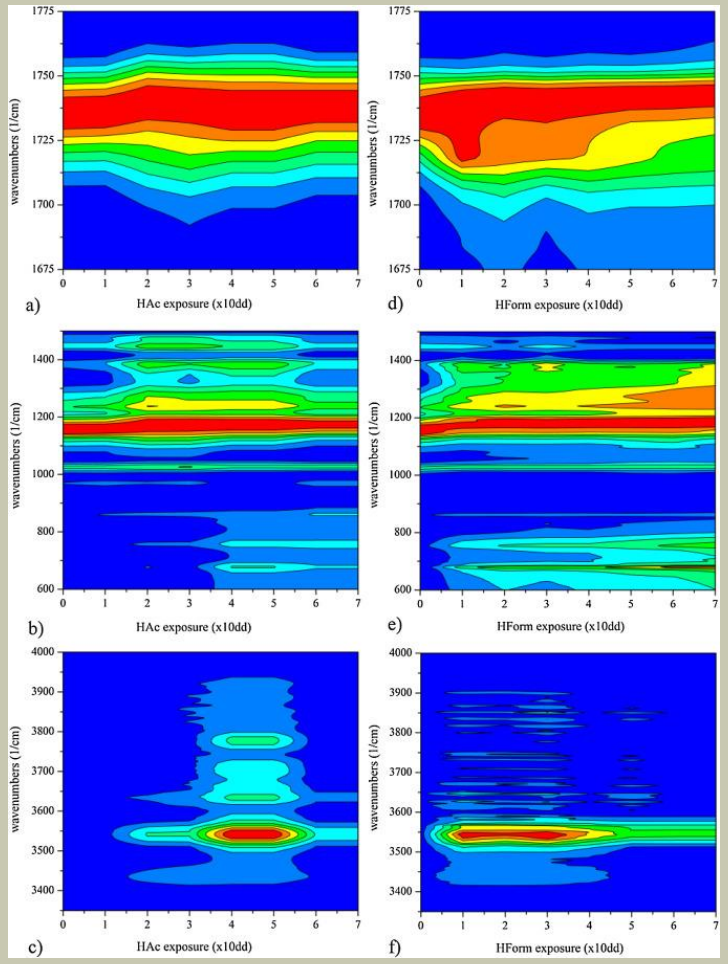

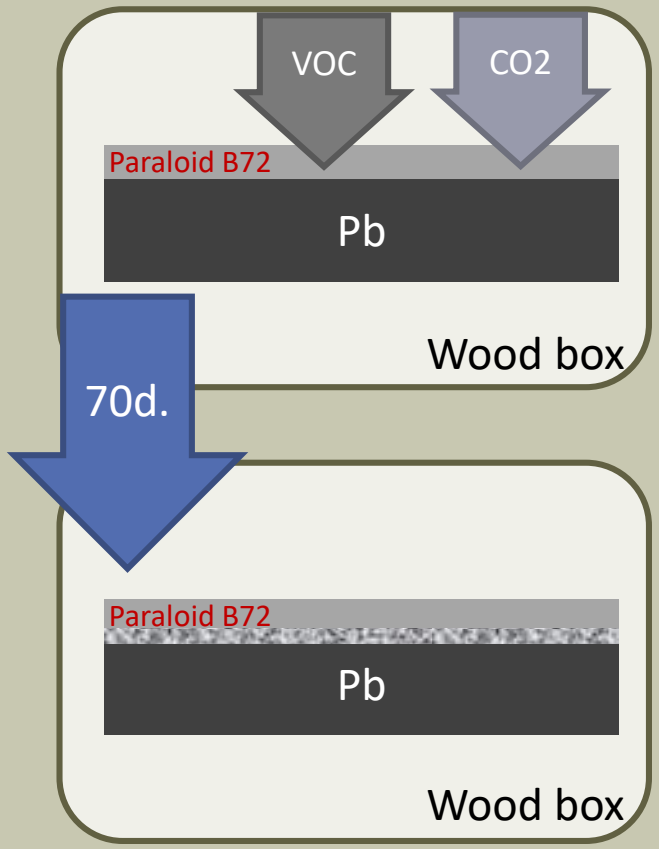

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