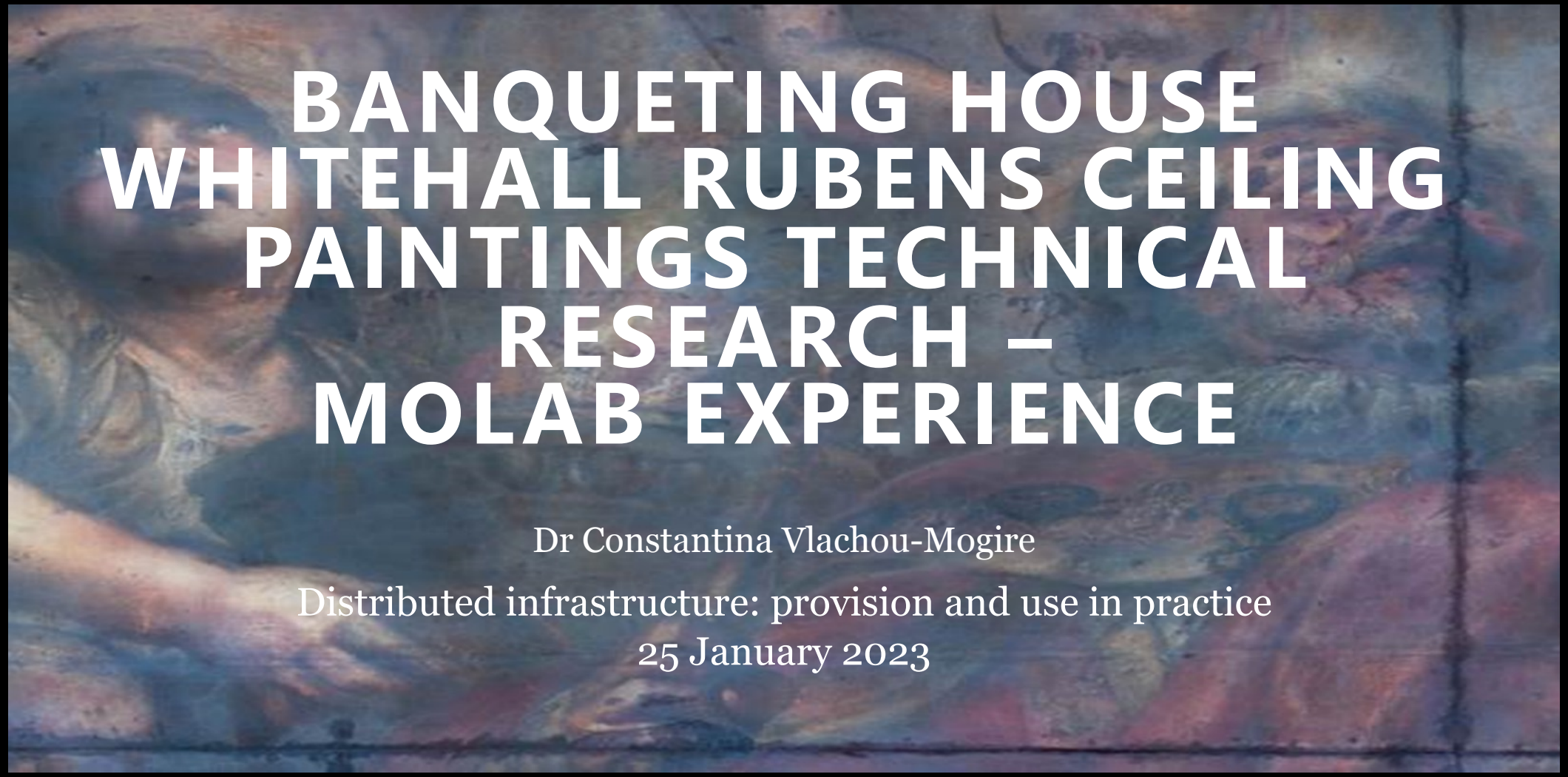
HISTORIC ROYAL PALACES



BANQUETING HOUSE WHITEHALL RUBENS CEILING PAINTINGS TECHNICAL RESEARCH – MOLAB EXPERIENCE

Dr Constantina Vlachou-Mogire

Distributed infrastructure: provision and use in practice

25 January 2023

HISTORIC ROYAL PALACES

PART ONE

INTRODUCTION

PART TWO

MOLAB ACCESS

PART THREE

RESULTS / IMPACT

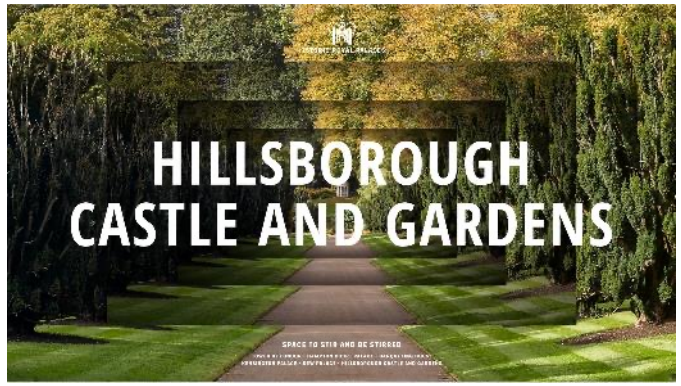
CLYDE HSI

PART ONE

INTRODUCTION

HISTORIC ROYAL PALACES

Our Cause - ‘We stir every spirit to inspire and provoke change



HISTORIC ROYAL PALACES

BANQUETING HOUSE, WHITEHALL

Designed by Inigo Jones, completed in 1622

HISTORIC ROYAL PALACES

The Apotheosis of James I

Sir Peter Paul Rubens received the commission from Charles I in 1621, painted the canvasses in Antwerp, 1630-1634, and installed in March 1636

HISTORIC ROYAL PALACES

MAROUFLAGE ON PLYWOOD BOARDS

Damage on plywood joint

HISTORIC ROYAL PALACES

1940 – evacuation of the Rubens paintings

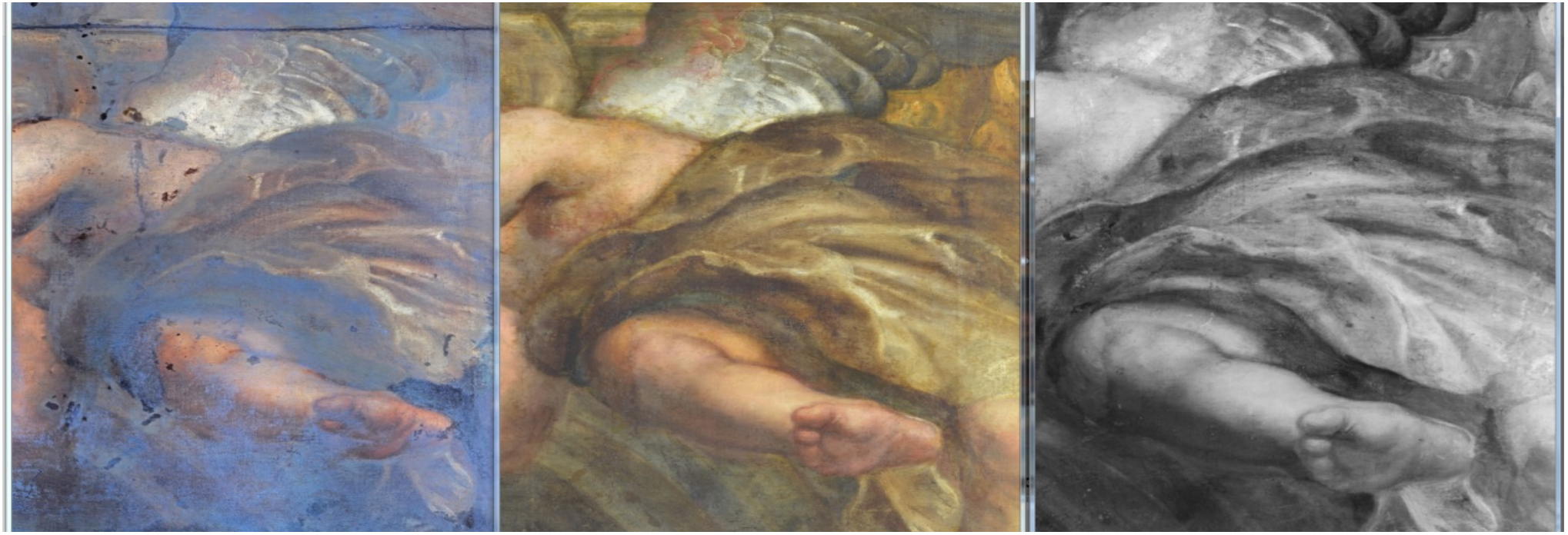
HISTORIC ROYAL PALACES

CONSERVATION 1946-52

HISTORIC ROYAL PALACES

TECHNICAL SURVEY AIMS

- Rubens technique in creating these nine paintings, and
- record evidence of previous interventions and their impact on the condition of the works today



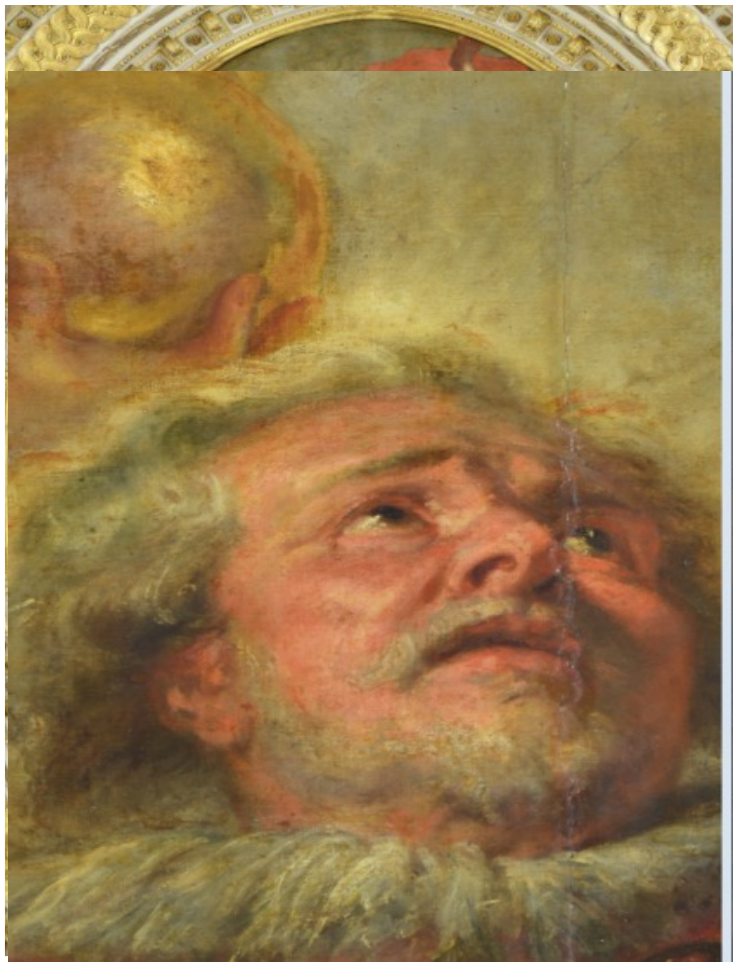
HISTORIC ROYAL PALACES

RESEARCH PLANNING

	Scaffold access	Investigations
Phase 1: Documentation	February – March 2016	Multispectral imaging
		Laser scanning – architectural drawings
		Limited sampling and non-invasive analysis
		Canvas studies
Phase 2: Material analysis	February-March 2018	Non-invasive analysis (Molab)
		Sampling

HISTORIC ROYAL PALACES

DOCUMENTATION- MULTISPECTRAL IMAGING



Visible light

Ultraviolet-induced luminescence

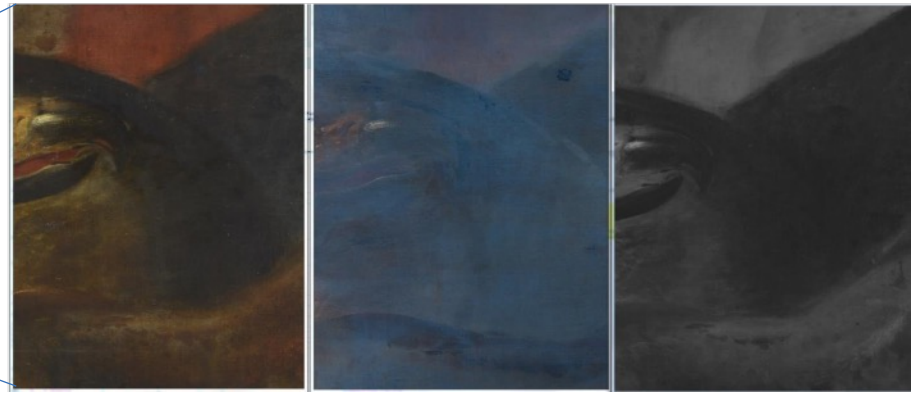
Infrared-reflected

HISTORIC ROYAL PALACES

ANALYSIS PLANNING – SAMPLING LOCATIONS

	A	B	C	D	E	F	G	H	I	J	K
1	Total samples	No	Painting	ACCESIBILITY	Sample CODE	INFORM CLEANING TRIALS	1st batch of analysis	AAR code	Samples received post AAR analysis		
2									cross section	fragment/scrapping	extract
54		11	Putti ion	no		√					
55	35	1	Apotheosis		Apotheosis_C_W9_SV1	√	20	AAR_Sample19		X (trace)	X (trace)
56	36	2	Apotheosis		Apotheosis_C_S7_SP2	√	21	AAR_Sample20	X	X	
57	37	3	Apotheosis		Apotheosis_C_T9_SP3	√	22	AAR_Sample21	X (gold coated, in tube)	X	
58	38	4	Apotheosis		Apotheosis_C_S9_SP4	√	23	AAR_Sample22	X	X	
59	39	5	Apotheosis		Apotheosis_C_S10_SP5	√?	24	AAR_Sample23	X	X (trace)	
60	40	6	Apotheosis		Apotheosis_C_U8_SP6	√?					
61	41	7	Apotheosis		Apotheosis_C_U7_SP7	√	25	AAR_Sample24	X	X	
62	42	8	Apotheosis		Apotheosis_C_S7_SP8	√	26	AAR_Sample25	X	X	
63	43	9	Apotheosis		Apotheosis_C_S8_SP9		27	AAR_Sample26	X	X	
64	44	10	Apotheosis		Apotheosis_C_V11_SP10	√	28	AAR_Sample27	X	X	
65	45	11	Apotheosis		Apotheosis_C_Q10_SP11		29	AAR_Sample28	X	X	
	46										

Apotheosis sample 1 (thick varnish)



HISTORIC ROYAL PALA

PART TWO

MOLAB ACCESS

HISTORIC
ROYAL PALACES

MOLAB ACCESS APPLICATION FORM

- Project title, Project Leader (CV information) and Team Members
- Description of the project, the artwork under investigation, type of analytical techniques requesting access and duration
- Logistic preparations (scaffolding etc) /training, risks and safety hazards
- Other access proposal to ARCHLAB or FIXLAB requested or allocated under IPERION CH related to this project or Any other EU project related to this proposal

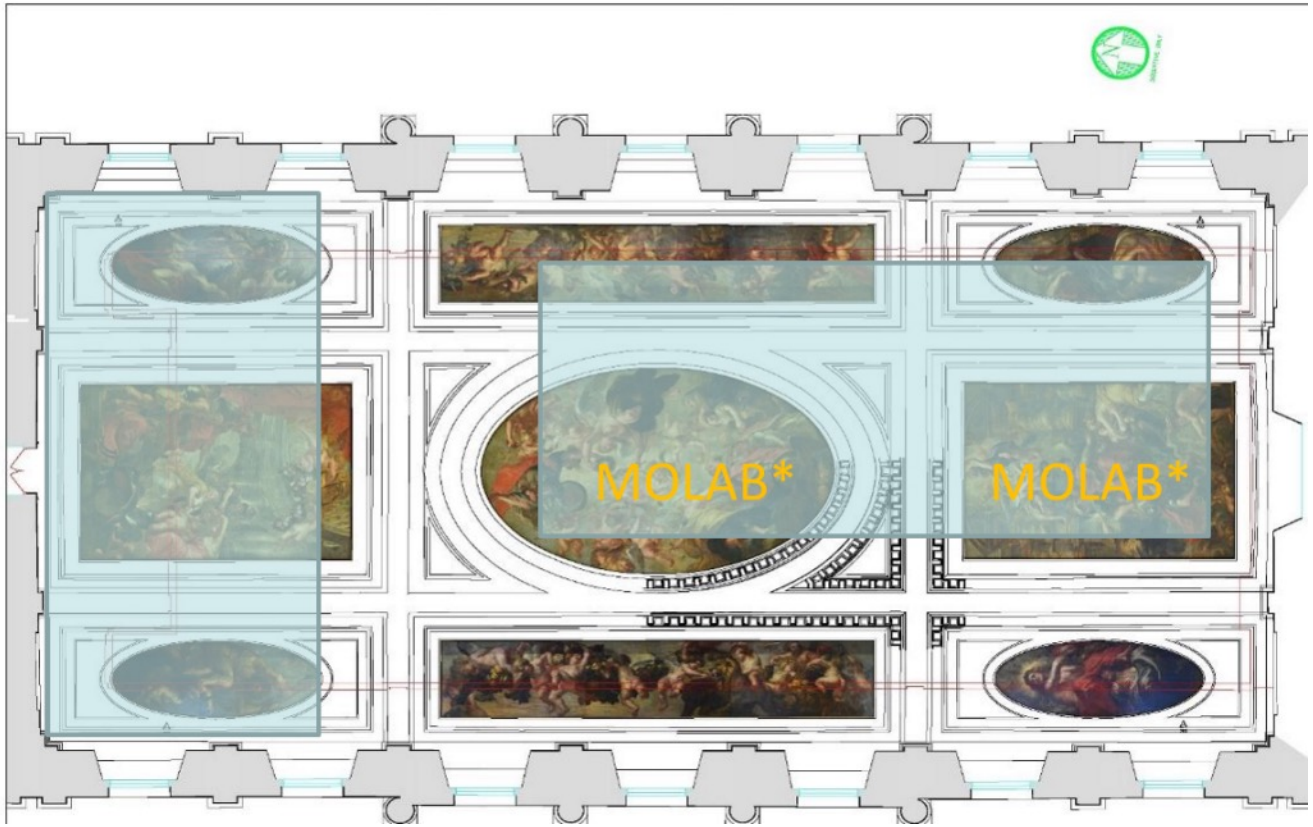
HISTORIC ROYAL PALACES

Post-access requirements

- Project Summary/User Report to be sent to the MOLAB TNA Desk no later than 2 months after MOLAB Access
- Publish the results in a renowned refereed international journal (preferably open access)
- The support by the European Community will be acknowledged by the statement *"Financial support by the Access to Research Infrastructures activity in the H2020 Programme of the EU (IPERION CH Grant Agreement n.* 654028*) is gratefully acknowledged"*.
- An electronic copy of any such paper will be sent to the MOLAB TNA Desk immediately after publication.

HISTORIC ROYAL PALACES

SCAFFOLD ACCESS AREAS: MARCH – APRIL 2018



*Supported by the Access to Research Infrastructures activity in the H2020 Programme of the EU via IPERION CH: Integrated Platform for the European Research Infrastructure ON Cultural Heritage, Grant Agreement n. 654028

MOLAB TEAMS

Team / Country	Date	Instrumentation	Team members
Molab France Centre for Research and Restoration of Museums (C2RMF) Paris	5/3/2018 – 9/3/2018	Intergraded XRD /XRF Thermography STIR	Dr Vincent Detalle Dr Elsa Bourguignon Dr Francois Mirambet Dr Kilian Laclavetine
Molab Greece Foundation for Research and Technology (FORTH) Crete	5/3/2018 – 9/3/2018	Digital Holographic Speckle Pattern Interferometry (DHSPI)	Dr Tornari Vivi, Dr Andrianakis Michalis
Molab Poland Nicolaus Copernicus University of Poland Toruń	12/3/2018-16/3/2018	Optical Coherence Tomography (OCT)	Prof Piotr Targowski Dr Magdalena Iwanicka
Molab Italy Institute of Molecular Science and Technologies of CNR (CNR-STM) Perugia	9/4/2018-13/4/2018	UV-VIS-NIR reflectance and fluorescence Alpha mid-FTIR Bruker “handheld” XRF	Dr Letizia Monico Annalisa Chieli Patricia Moretti

HEALTH AND SAFETY

HRP GENERAL RISK ASSESSMENT FORM **Form RA01**

Palace	Banqueting House Whitehall	Dept	CCC CM IM	Assessed by	Constantina Vlachou	Date	05/02/2018	
Subject	Use of HYDRA X-ray Fluorescence and X-ray Diffraction combined spectrometer at the Banqueting House for the analysis of the Rubens paintings during the scaffold period access February – April 2018					Reviews		

aragraph 44 of the Approved Code of Practice (ACOP) of IRR99.
/here a radiation employer is required to undertake a prior risk assessment, the following matters need to be considered, where they are relevant:

) the nature of the sources of ionising radiation to be used, or likely to be present, including accumulation of radon in the working environment;
YDRA is equipped with a X-ray tube of 40 kV maximum voltage, 700µA maximum intensity, and 30W maximum power. When active, a X ray beam is emitted from the ontal part of the instrument. The instrument is use for short periods of time and there is no accumulation of Radon in the working environment.

) estimated radiation dose rates to which anyone can be exposed;
ontrols have been carried out using a APVL instrument (FH40G-L10 model, SN: 031634) in the following conditions: Beam: 35kV 680µA, target material: Al
here are the results for Hydra:

oint of easurement	Dose (µSv/h)	
	10-cm distance	1-m distance
Side		0.2
Beam	75	0.75

t a 1m distance, the measured dose of X-rays is 0.75 µSv/h when directly exposed to the X-ray generator beam and 0.2 µSv/h away from the beam. These values are below ose requiring a controlled zone, so a 2-m radius safety area around the source will comply with the health and safety regulation.
he dose rate 10 cm to the aperture is 75µSv/h, with subsequent risk of significant skin dose to the fingers should a small sample be held by hand. Samples must NEVER e held by hand.

) the likelihood of contamination arising and being spread;
here is no risk of contamination

) the results of any previous personal dosimetry or area monitoring relevant to the proposed work;
ot applicable as nobody is allowed to enter the controlled zone. Therefore, no monitoring takes place.

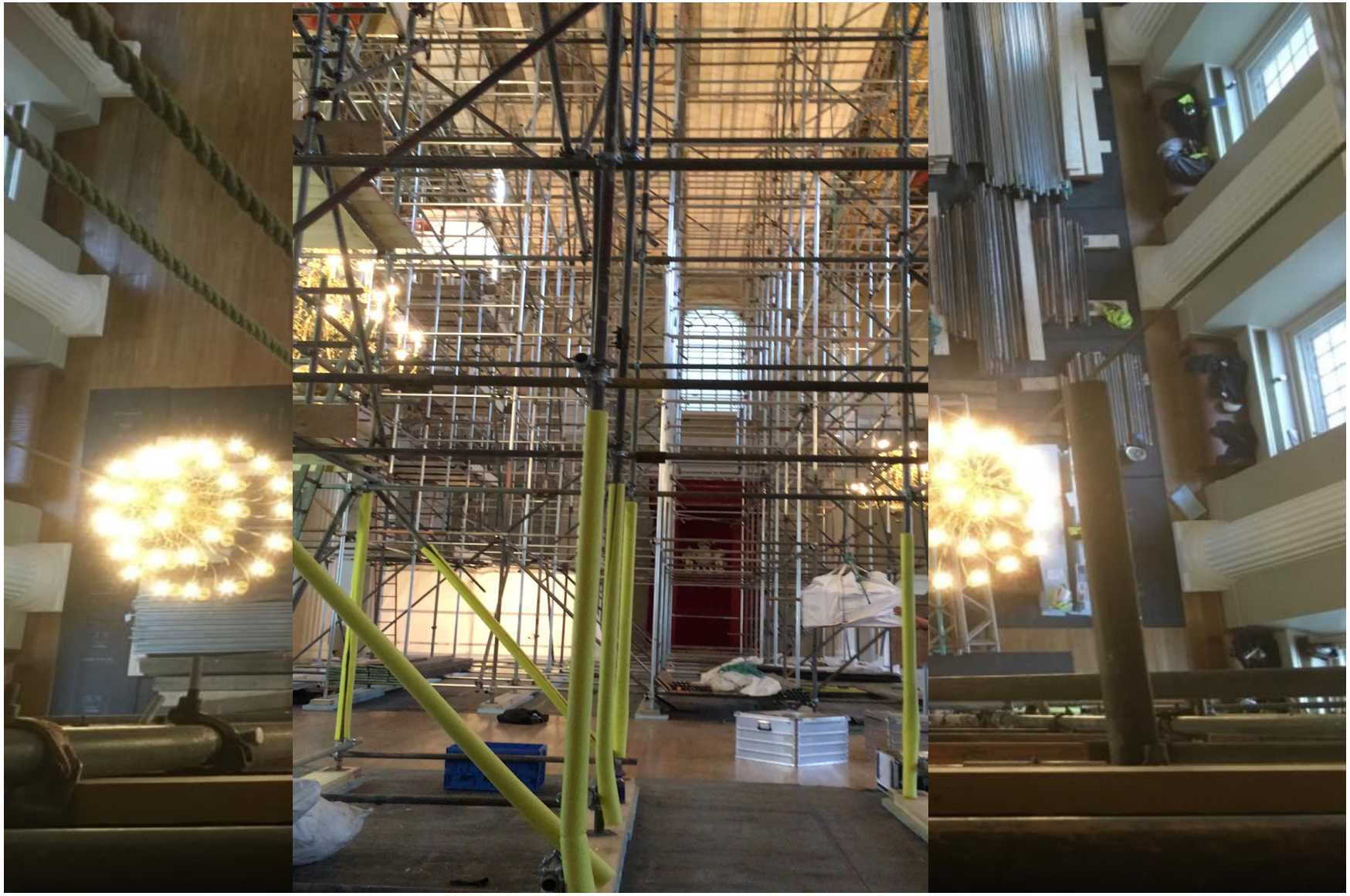
HISTORIC ROYAL PALACES

HEALTH AND SAFETY

DO NOT ENTER
X-RAY
IN PROGRESS

HISTORIC
ROYAL PALACES

CLIMBING THE SCAFFOLD

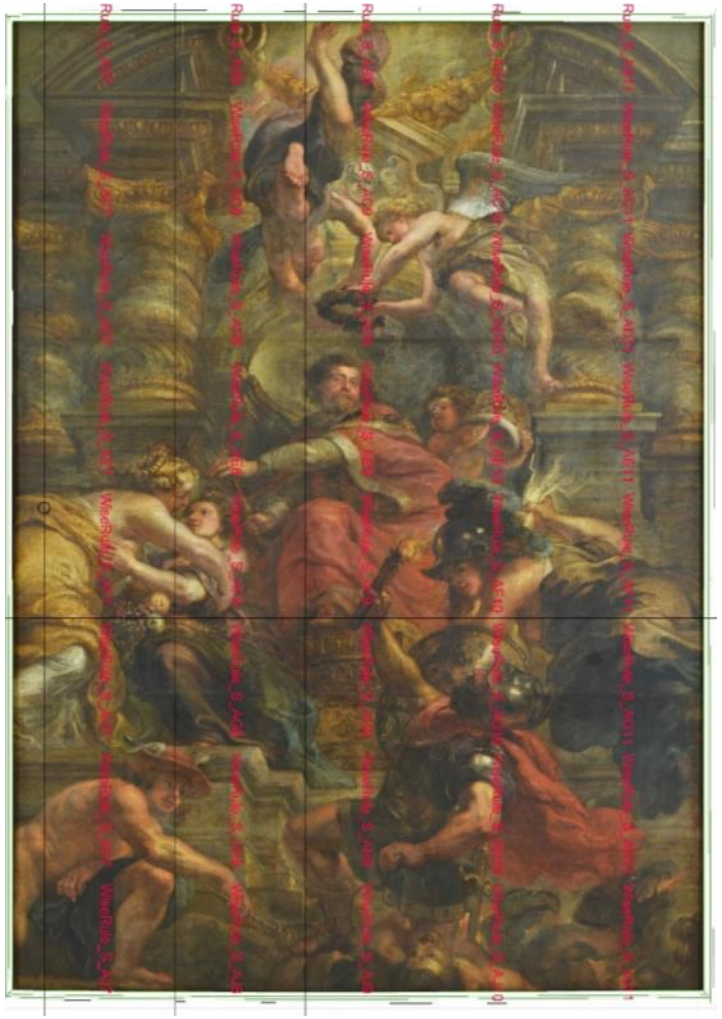


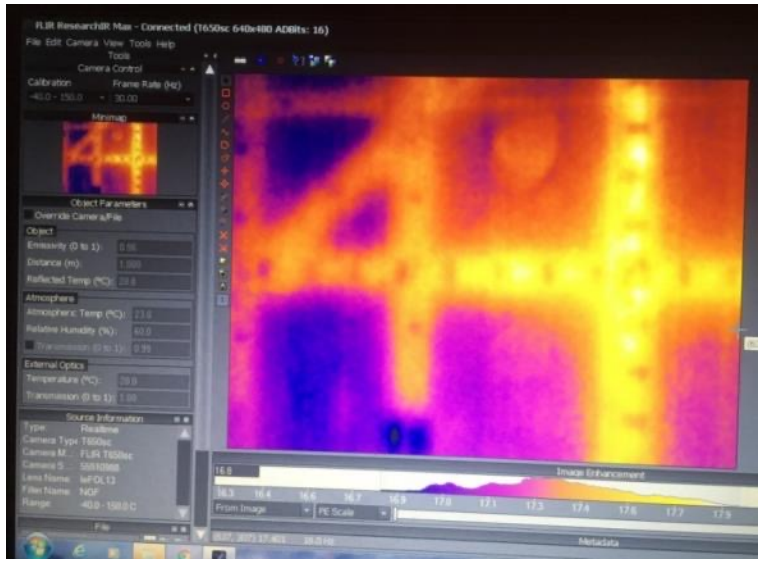
HISTORIC ROYAL PALACES

FRENCH MOLAB: INTEGRATED XRD/XRF

HISTORIC ROYAL PALACES

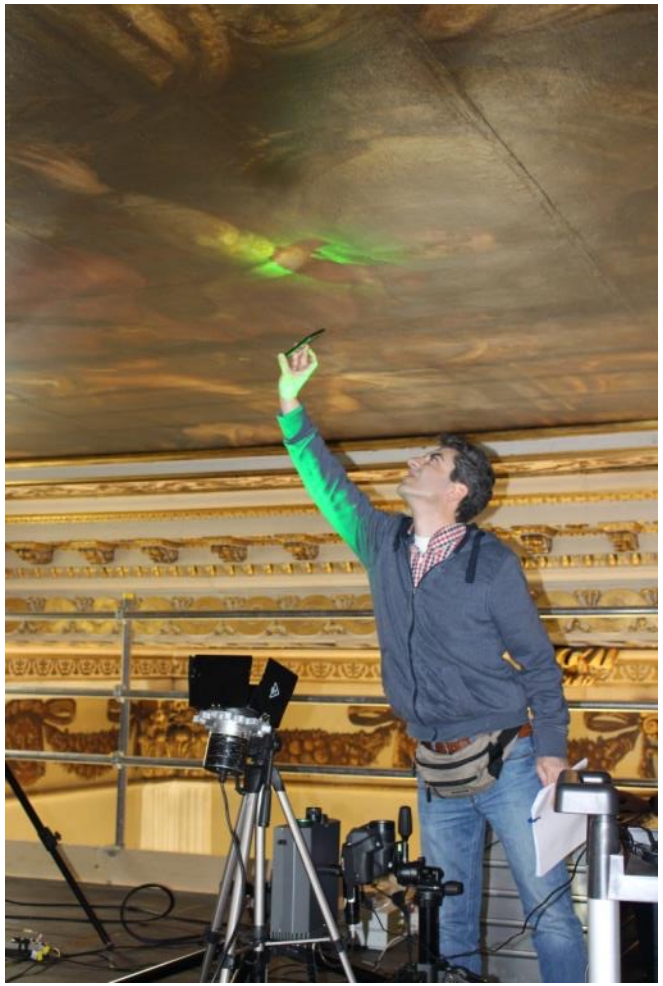
FRENCH MOLAB: THERMOGRAPHY STIR





HISTORIC ROYAL PALACES

GREEK MOLAB: DIGITAL HOLOGRAPHIC SPECKLE PATTERN INTERFEROMETRY (DHSPI)

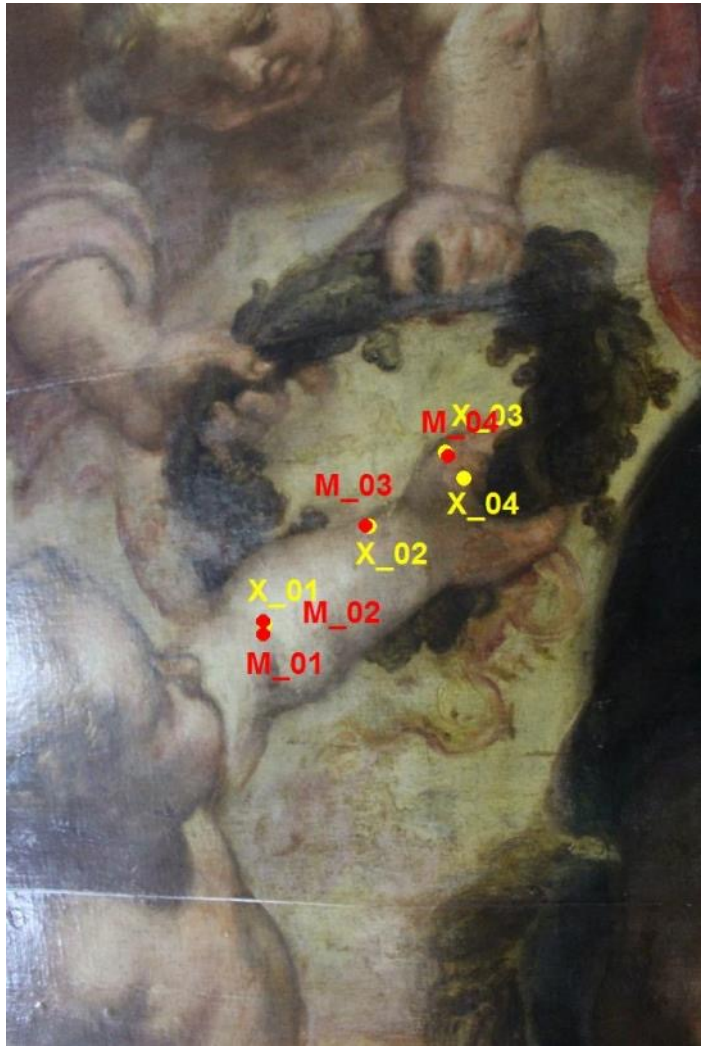


HISTORIC ROYAL PALACES

POLISH MOLAB OPTICAL COHERENCE TOMOGRAPHY (OCT)

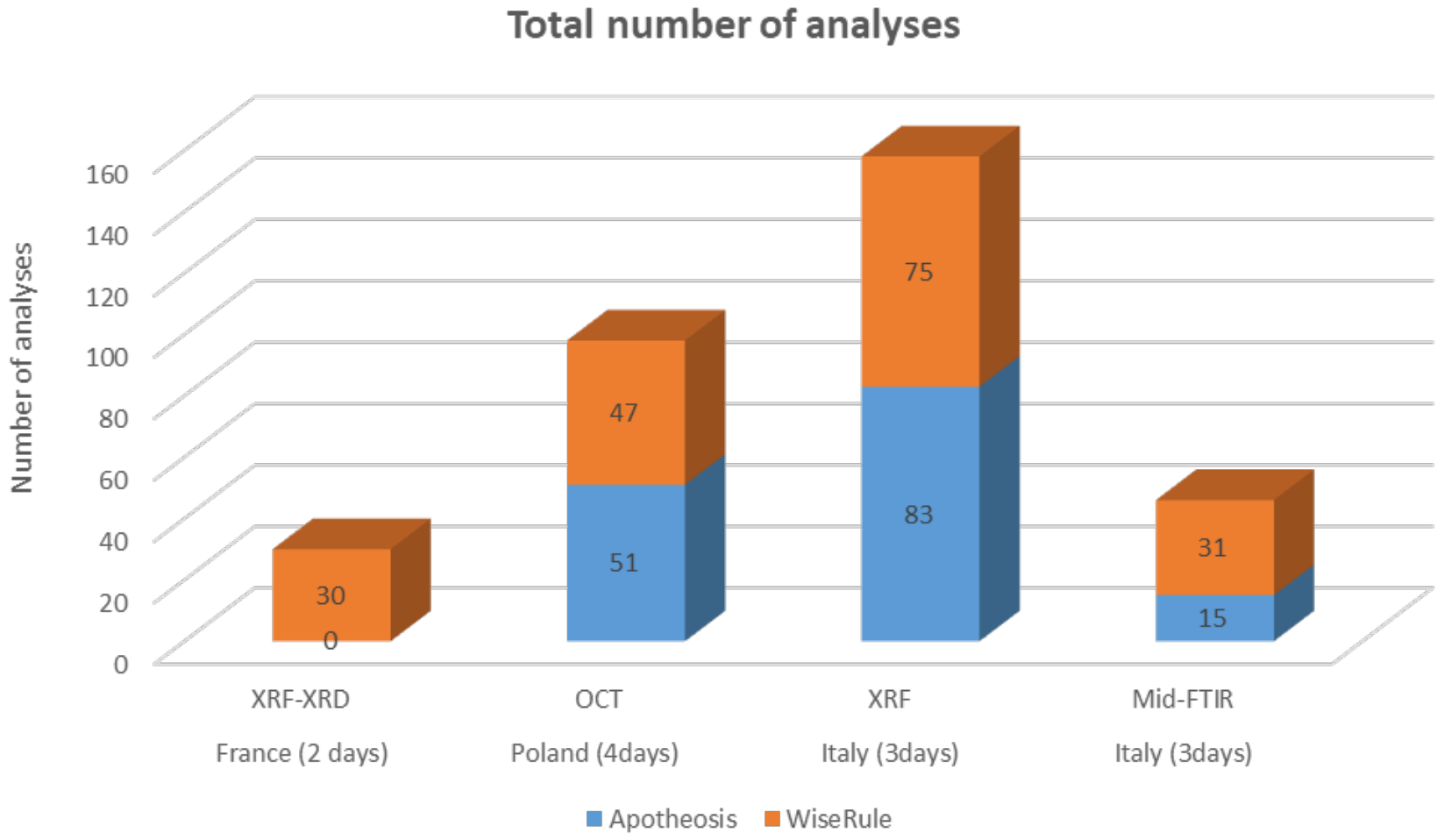
HISTORIC ROYAL PALACES

ITALIAN MOLAB
ALPHA MID-FTIR,BRUKER , PXRF



HISTORIC ROYAL PALACES

MOLAB NUMBER OF ANALYSES TOTAL 330 IN 9 DAYS



HISTORIC ROYAL PALACES

PART THREE

RESULTS / IMPACT

HISTORIC ROYAL PALACES

Rubens paint materials

White: lead white

Red: vermilion, cochineal, madder lakes, red ochre, red lead

Yellow: lead-tin yellow (type I), yellow earth, yellow lake

Blue: lapis lazuli ultramarine, azurite, smalt, indigo, verditer (blue-green)

Green: malachite 'copper resinate' glaze, verdigris

Brown : brown and red-brown earths umber, Van Dyck brown, brown lake

Black: charcoal black, carbon black, bone black

Mediums: linseed oil, walnut oil, turpentine, pine resin and occasionally egg (both white and yolk)

Apotheosis (red drapery)

Vermilion used widely on the paintings.

XRF analysis results from Apotheosis included Hg on 55 out of the 83 points of analysis.

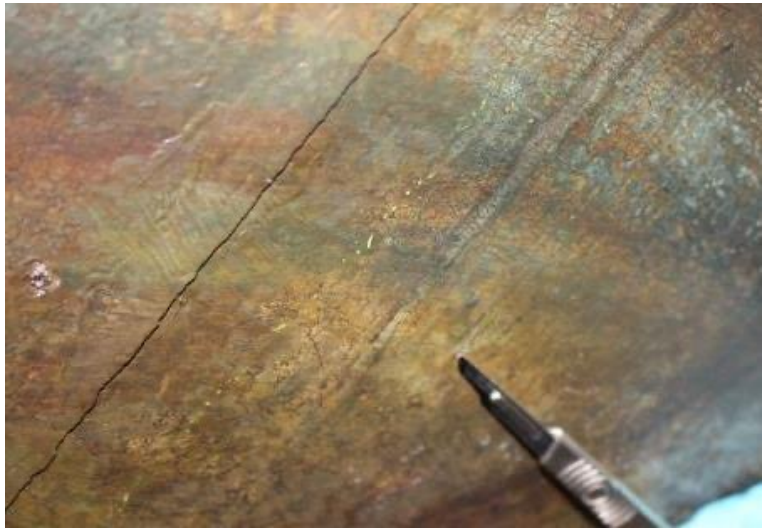
In Wise Rule Hg was traced on 42 of the 74 points of analysis

HISTORIC ROYAL PALACES

Smalt: sky

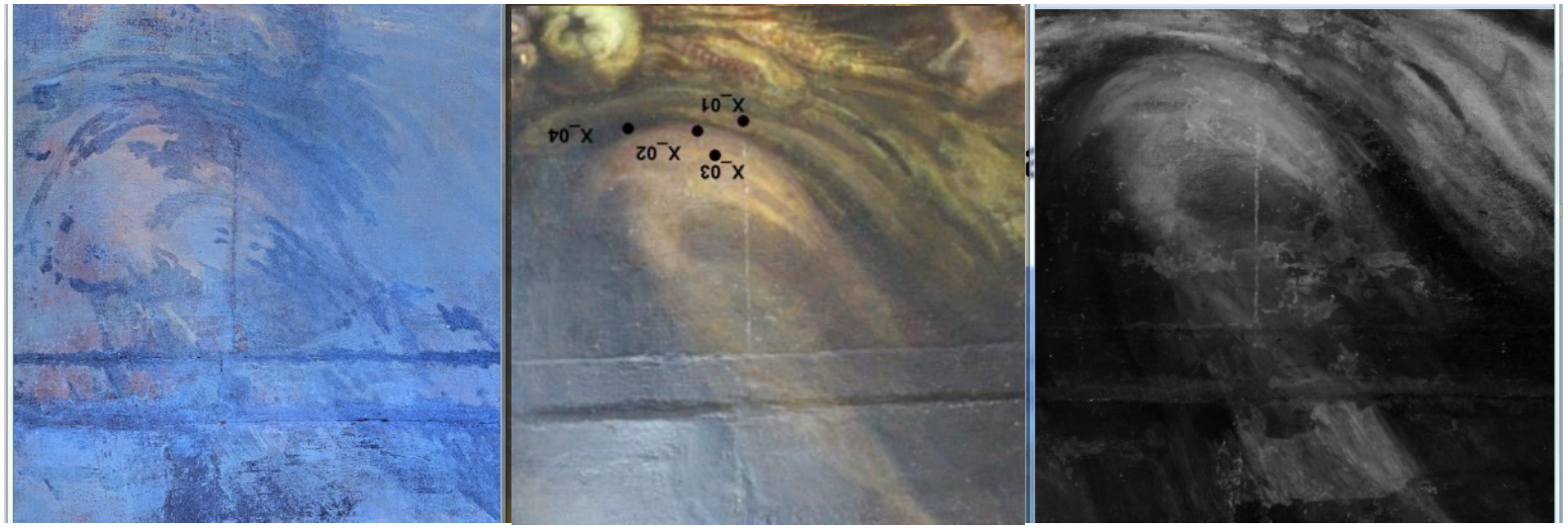
XRF results show that Co and K were detected in 12 points of analysis on Apotheosis, and 16 points of analysis on Wise Rule.

Wise rule: purple/green



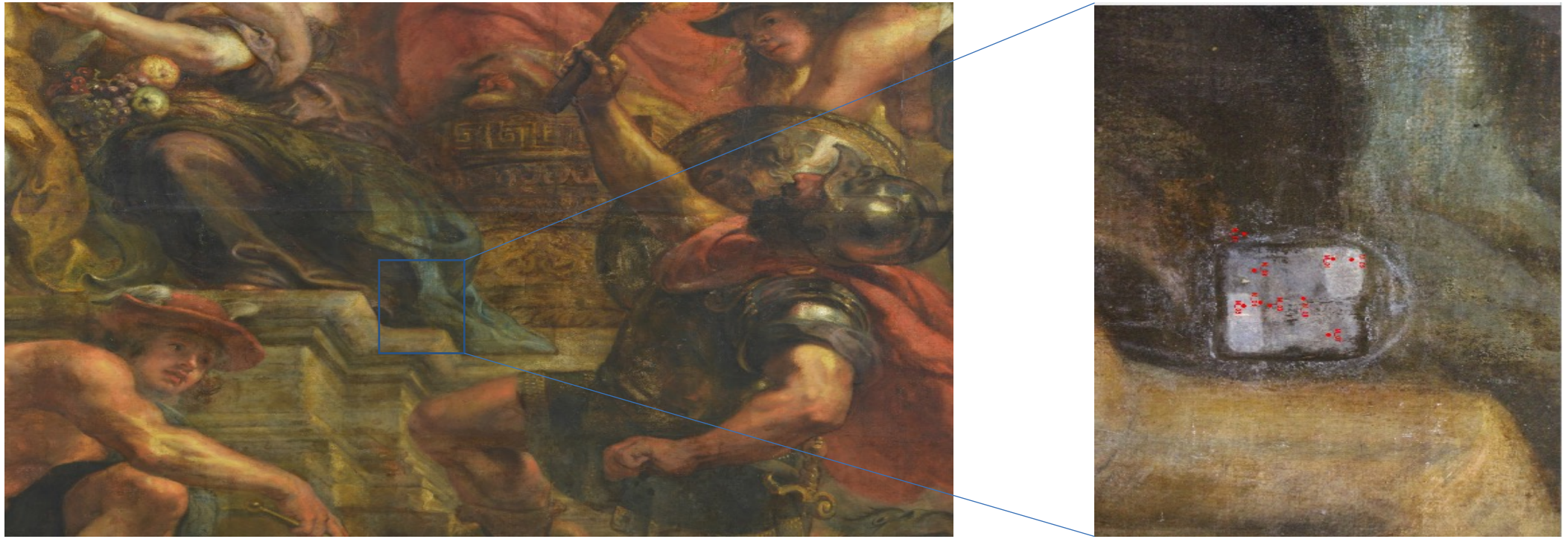
Green: Malachite (Cu) Smalt (Co and K), yellow earth (Fe).

Purple: a lighter shade of green that appears purple. Retouched area with a high Zinc content.



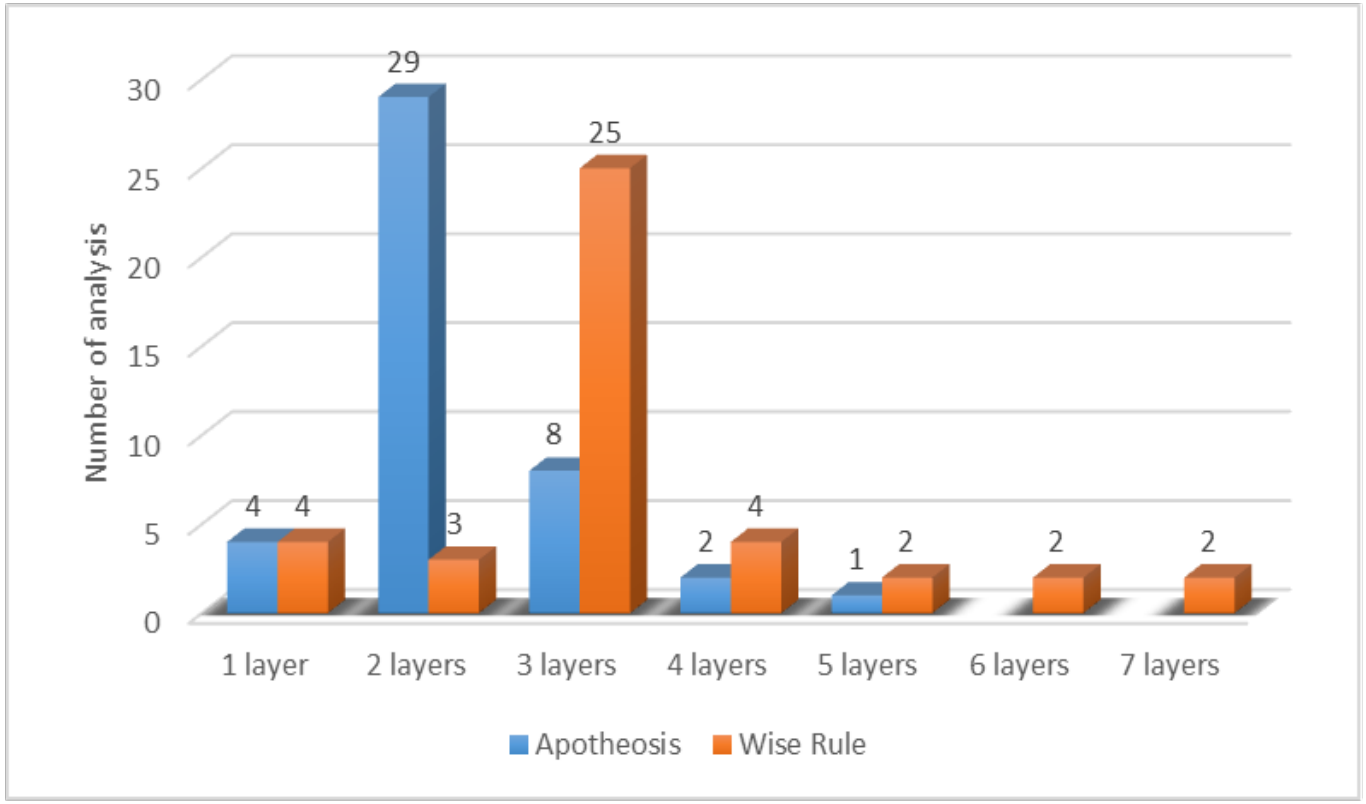
HISTORIC ROYAL PALACES

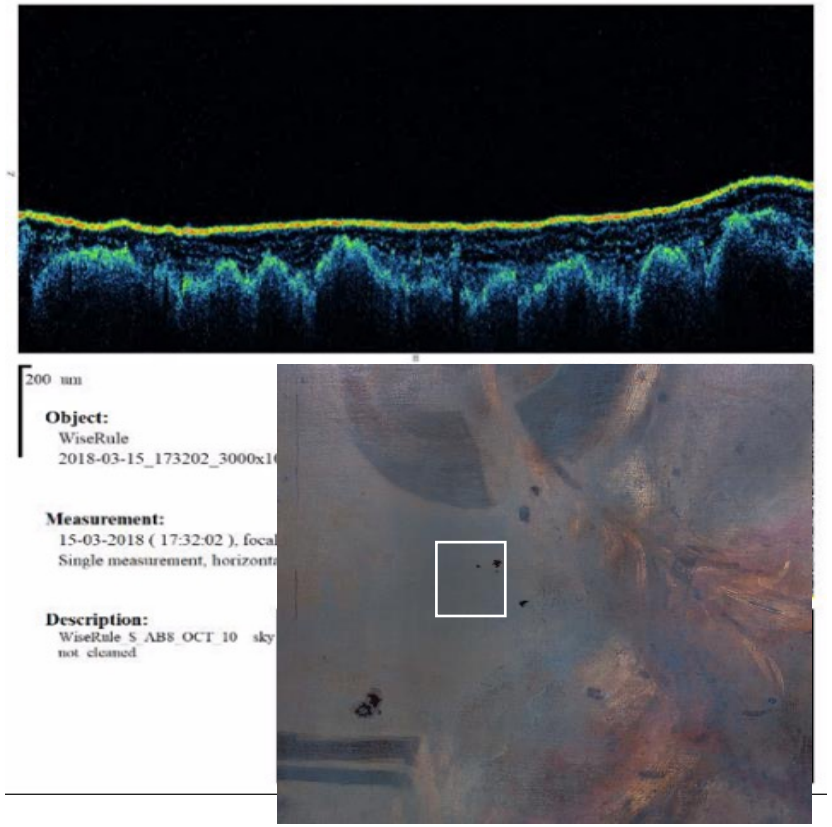
Wise rule reflection FT-IR analysis: soaps (likely of Pb) and oxalates



HISTORIC ROYAL PALACES

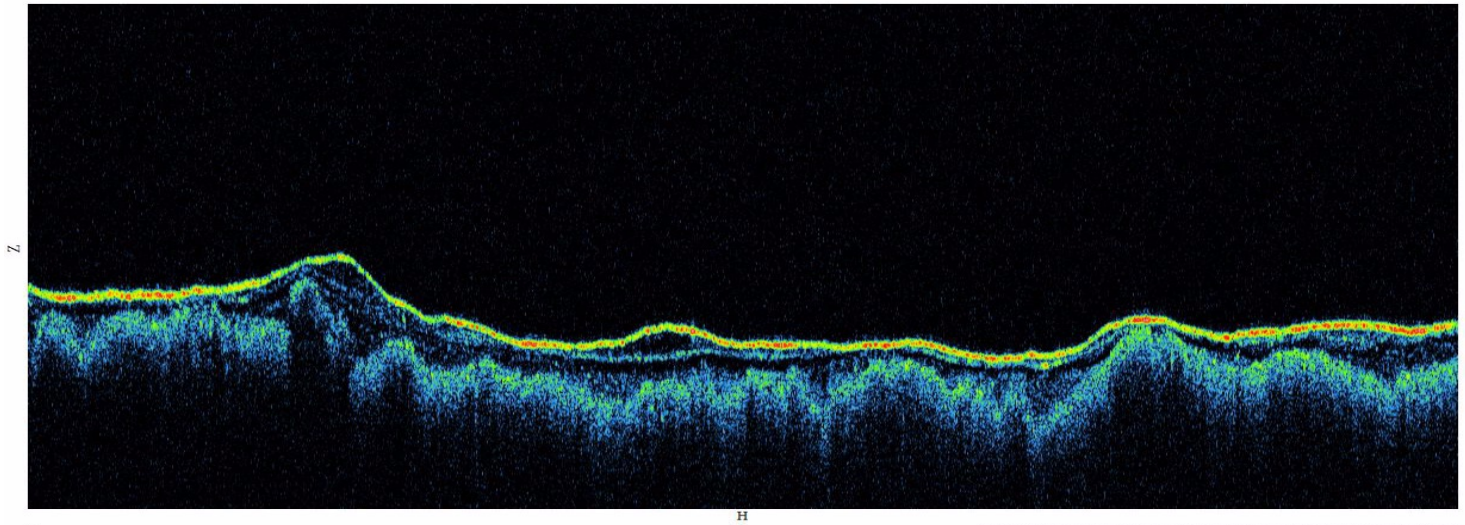
OCT analysis: number of varnish layers





HISTORIC ROYAL PALACES

OPTICAL COHERENCE TOMOGRAPHY (OCT)



200 um

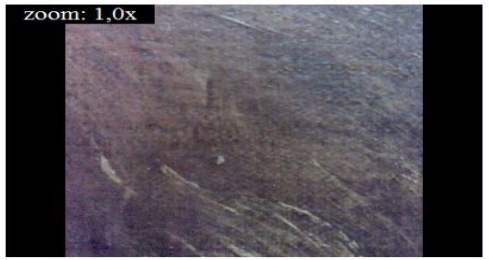
Dimension (H|V|Z) [mm]:
12,0 | 12,0 | 0,79

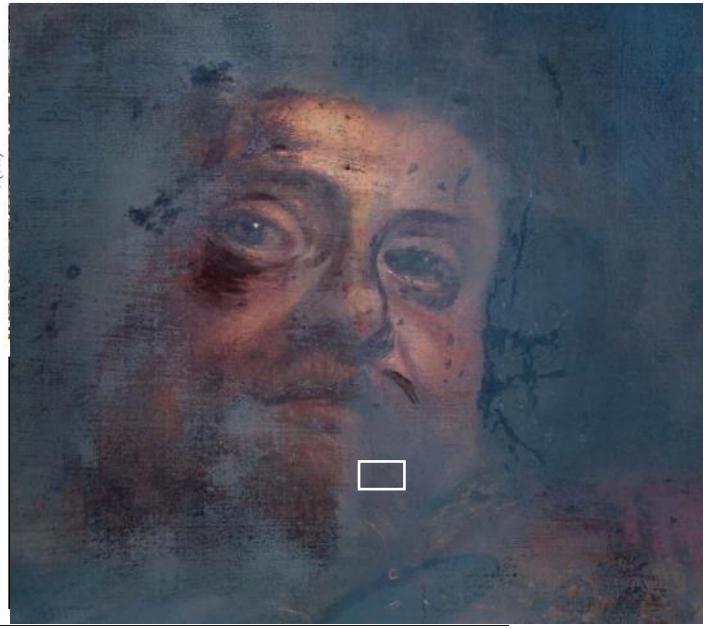
Object:
WiseRule
2018-03-15_192352_3000x100

Tomogram:
1/100

Measurement:
15-03-2018 (19:23:52), focal length: 54mm
Single measurement, horizontal

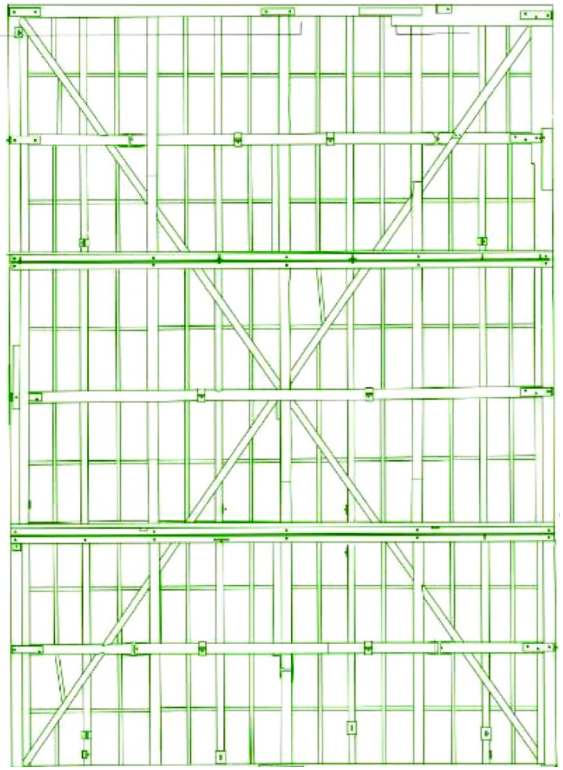
Description:
WiseRule_S_AE9_OCT_15
the King's beard, area of strong UV fluorescence

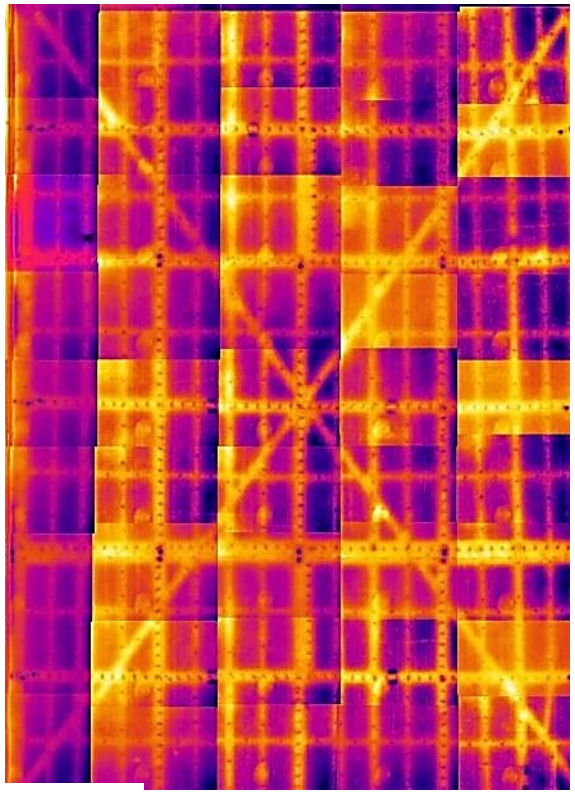




HISTORIC ROYAL PALACES

THERMOGRAPHY STIR - RESULTS



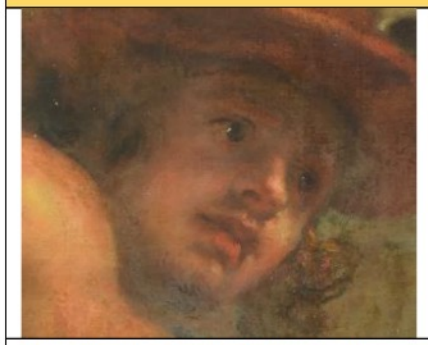


IR thermography revealed 1,600 nails under timbers holding plywood boards together

HISTORIC ROYAL PALACES

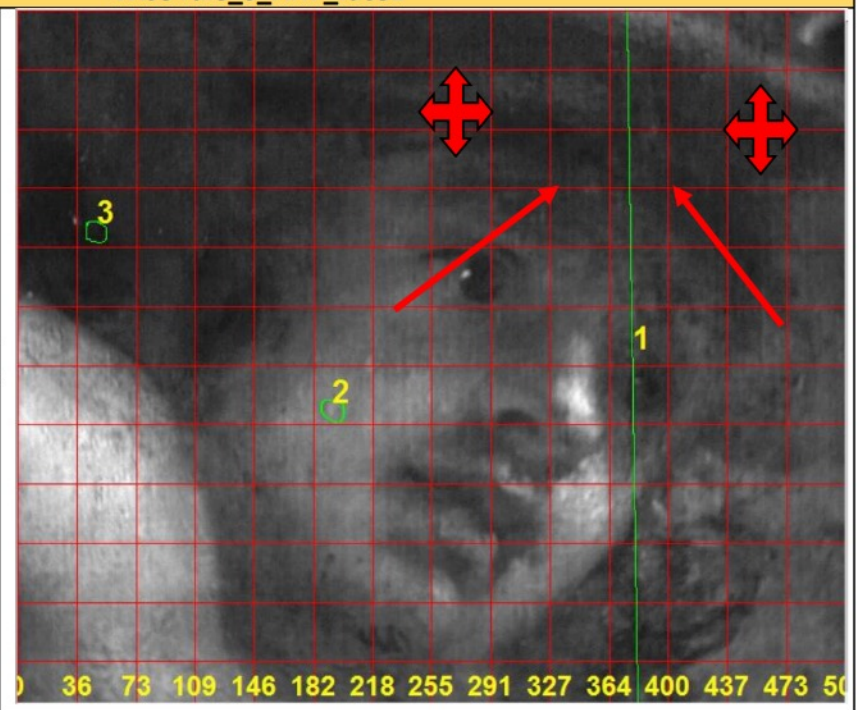
DIGITAL HOLOGRAPHIC SPECKLE PATTERN INTERFEROMETRY (DHSPI) - RESULTS

Wise rule_S_AH7_face1



Examined area (color image)

Examined area overlapped with fringe pattern



Defected areas

Defects coordinates

Defect num	Start X (mm)	Start Y (mm)	End X (mm)	End Y (mm)	Length - Area
1	374.9	1.2	381.3	425	423.8 mm
2	186.7	239.5	200.6	253.3	155.2 mm2
3	42.2	129.7	54.7	142.8	138.6 mm2

HISTORIC ROYAL PALACES

DATA COLLATION AND INTERPRETATION

RubensAnlaysisCollatedDatabase - Excel

File Home Insert Page Layout Formulas Data Review View Tell me what you want to do...

AU540

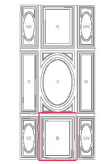
	A	B	C	D	E	F	AL	AM	AN	AO	AP	AQ	AR
1	Sample/Site of Analysis information												
2	Total No. of samples	No. per Painting	Painting	Area Code	Sample/Site of Analysis CODE	Sample/Site of Analysis description			Inorganic Analysis				
3								SEM	EDX elemental analysis			EDX mapping	Raman
526	51	17	Apotheosis	Apotheosis_C_W10	Apotheosis_C_W10_SP17		Crust formation: Lead sulfate		Pb	S, Pb	Al, K, Ca		
527	51	17	Apotheosis	Apotheosis_C_W10	Apotheosis_C_W10_SP17		UV-fluorescent, medium-rich layer mixed with particulate matter: Lead white, red lead, calcium carbonate (?), carbon		Ca	S, Pb	Al, Si		
528	51	17	Apotheosis	Apotheosis_C_W10	Apotheosis_C_W10_SP17		Thin red-brown paint layer: Lead white, red lead, calcium carbonate (?), sulfur			Al, Si, S, K, Ca, Fe, Pb	Mg, Ti		
529	51	17	Apotheosis	Apotheosis_C_W10	Apotheosis_C_W10_SP17		UV luminescent varnishes (multiple layers)						
530	51	17	Apotheosis	Apotheosis_C_W10	Apotheosis_C_W10_SP17		Particulate matter, uppermost						
531	52	18	Apotheosis	Apotheosis_C_U10	Apotheosis_C_U10_SP18	Original from the yellow drapery of Justice.		Backscattered images	Major	Minor	Trace		
532	52	18	Apotheosis	Apotheosis_C_U10	Apotheosis_C_U10_SP18		Grey ground (GU)		Pb	Ca	Al, Si		
533	52	18	Apotheosis	Apotheosis_C_U10	Apotheosis_C_U10_SP18		Pink beige paint layer (far right, bottom): Lead white, iron-containing earth pigments, lead tin yellow (type I)		Pb		Al, Si, Ca, Fe, Sn		
534	52	18	Apotheosis	Apotheosis_C_U10	Apotheosis_C_U10_SP18		Pale orange beige layer: Lead white, vermillion, lead tin yellow (type I)		Pb	Sn	Al, Si, Ca		1054 (vw), 1049 (vw), 525 (vw), 45 (vw), 379 (vw), 34 (vw), 292 (vw), 23 (vw), 255 (vw), 19 (w), 123 (s)
535	52	18	Apotheosis	Apotheosis_C_U10	Apotheosis_C_U10_SP18		Thick yellowish layer: Lead white, lead tin yellow. Possible lead soap formation, mid-left (light area in the UV image)		Pb		Al, Si, S, Cl, K, Ca		
536	52	18	Apotheosis	Apotheosis_C_U10	Apotheosis_C_U10_SP18		Crust: Lead sulfate, lead potassium sulfate		Pb	S, K	Al, Si, Ca		
537	52	18	Apotheosis	Apotheosis_C_U10	Apotheosis_C_U10_SP18		UV luminescent varnish layer						
538	52	18	Apotheosis	Apotheosis_C_U10	Apotheosis_C_U10_SP18		Partial off-white paint layer: lead white (?)		Pb		Al, Fe		
539	52	18	Apotheosis	Apotheosis_C_U10	Apotheosis_C_U10_SP18		UV luminescent varnish layers						
540	#REF!	22	Apotheosis	Apotheosis_C_V11	Apotheosis_C_V11_SV22	Varnish scapped from the green drapery of Justice, around her proper							
541	1	1	Apotheosis	Apotheosis_C_P8	Apotheosis_C_P8_X_01_pink	pink							
542	2	2	Apotheosis	Apotheosis_C_P8	Apotheosis_C_P8_X_02_pink	pink							
543	3	3	Apotheosis	Apotheosis_C_P8	Apotheosis_C_P8_X_03_pink	pink							
544	4	4	Apotheosis	Apotheosis_C_P8	Apotheosis_C_P8_X_04_pink	pink							
545	5	5	Apotheosis	Apotheosis_C_P8	Apotheosis_C_P8_X_05_flesh	flesh							
546	6	6	Apotheosis	Apotheosis_C_P8	Apotheosis_C_P8_X_06_flesh	flesh							
547	7	7	Apotheosis	Apotheosis_C_P8	Apotheosis_C_P8_X_07_flesh	flesh							
548	8	8	Apotheosis	Apotheosis_C_P8	Apotheosis_C_P8_X_08_sky	sky							
549	9	9	Apotheosis	Apotheosis_C_P8	Apotheosis_C_P8_X_09_sky	sky							
550	10	10	Apotheosis	Apotheosis_C_P8	Apotheosis_C_P8_X_10_sky	sky							

Analysis Database | table for ppt

Ready

RUBENS CEILING PAINTINGS
WISE RULE
OVERPAINTS

Key
Overpaints



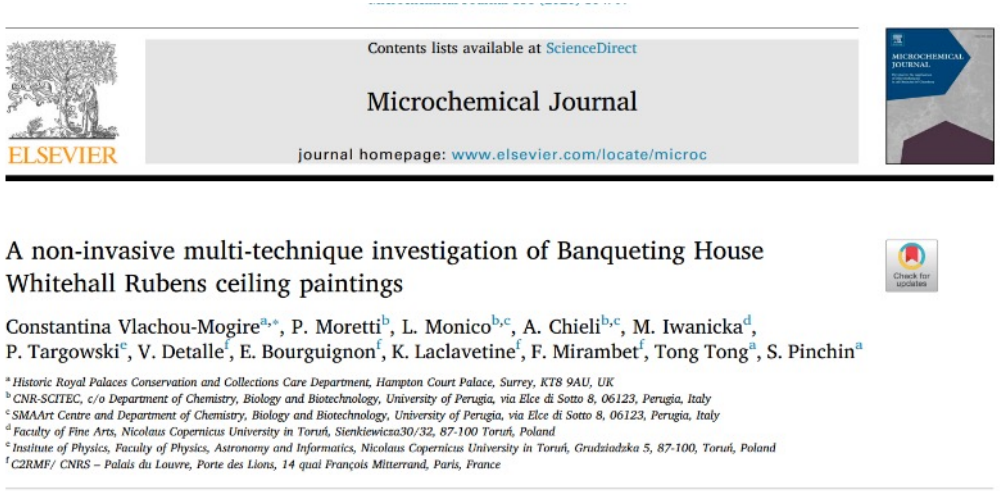
BANQUETING HOUSE
WHITEHALL

RUBENS CEILING PAINTINGS

WISE RULE

HISTORIC ROYAL PALACES

IMPACT - PUBLICATIONS



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A non-invasive multi-technique investigation of Banqueting House Whitehall Rubens ceiling paintings

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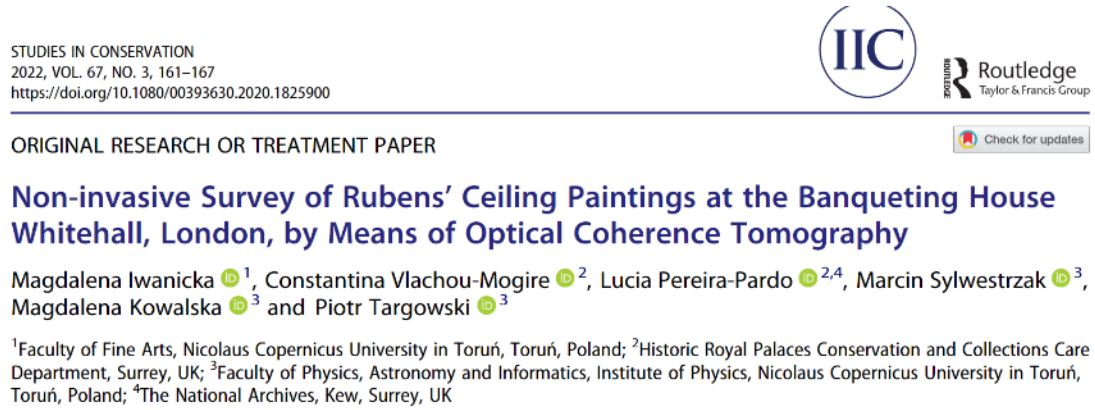

STUDIES IN CONSERVATION
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ORIGINAL RESEARCH OR TREATMENT PAPER

Non-invasive Survey of Rubens' Ceiling Paintings at the Banqueting House Whitehall, London, by Means of Optical Coherence Tomography

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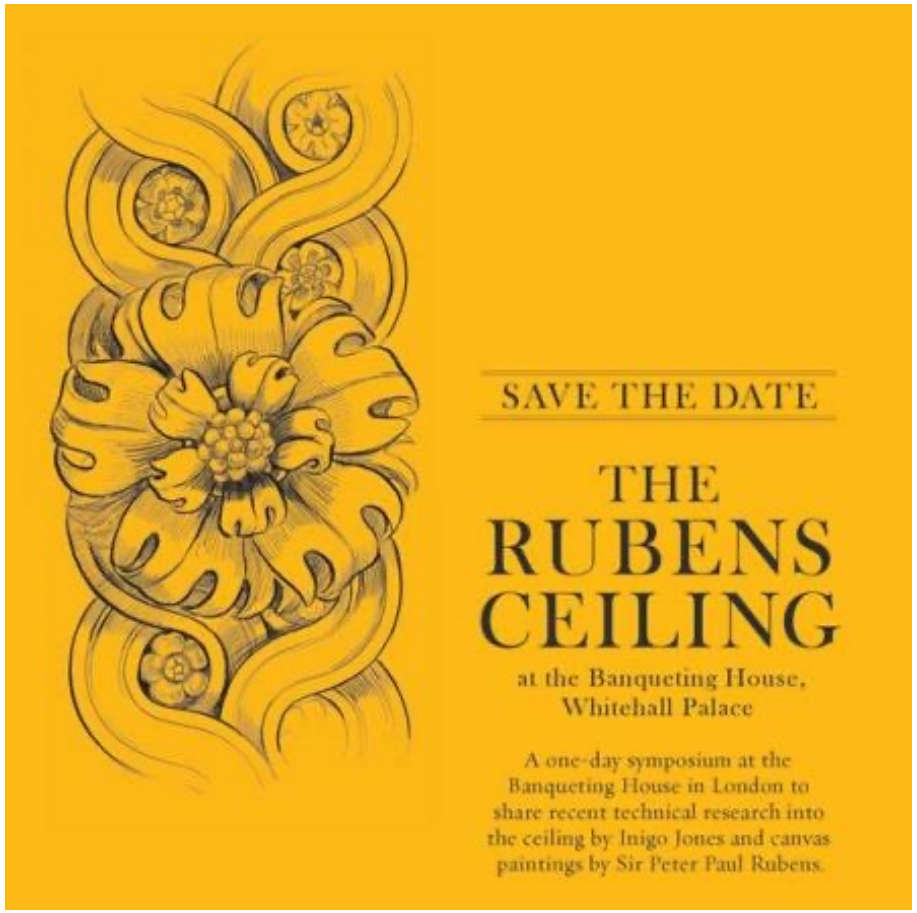
IMPACT - SYMPOSIUM



14.15–15.50	THE RUBENS PAINTINGS TECHNICAL RESEARCH Chair: Adrian Phillips
14.15	KATE FRAME 'The Rubens paintings of the Banqueting House: from painted canvasses to marouflaged structures'
14.35	DR CONSTANTINA VLACHOU 'Uncovering the Paintings' Secrets; Technical Examination and Material Analysis'
14.55	SARAH PINCHIN 'Potential Treatment Options for the Ceiling Paintings at the Banqueting House'
15.15	KATHRYN HALLETT 'Structural and Environmental Investigations'
15.35	QUESTIONS

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Monday 10 June 2019

E-RHIS SCIENTIFIC STRATEGY CASE STUDY

Example 1.3.:

Optical Coherence Tomography to Investigate Rubens Canvases at Whitehall Palace

The set of nine ceiling paintings created by Rubens and studio (1636) is one of the largest and most complex works by the master surviving in-situ. Due to many undocumented past restorations a detailed survey of the state of preservation was needed. Thickness and structure of varnishes were resolved; delaminations as well as retouchings from former restoration campaigns were detected. Different build-up of varnish layers due to past selective cleaning treatments was found in many places and linked do discolourations of the surface. Optical coherence tomography (OCT) is a non-invasive method of structural imaging, providing virtual cross-sections of the build-up of sub-surface layers. It substitutes microscopic analysis of samples thus enabling structural examination of the heritage object in unlimited number of areas.

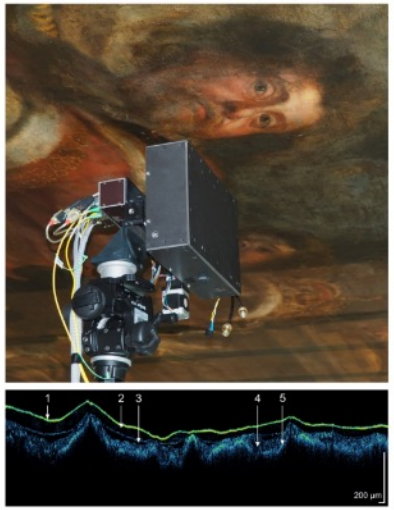

Figure: OCT examination of The Apotheosis of King James I, P. P. Rubens, Whitehall Palace, London with the instrument facing up (top, photo P. Targowski) and the resultant cross-sectional image (bottom).

In the OCT cross-section: 1 - surface of the painting; 2, 3 - two varnish layers; 4 - glazes; 5 - surface of an opaque paint layer.

Constantina Vlachou Mogire et al. "A non-invasive multi-technique investigation of Banqueting House Whitehall Rubens ceiling paintings". In: *Microchemical Journal* (2020), p. 104797

MOLAB access: RUBENS TCR BHW (project leader: Dr Constantina Vlachou-Mogire, Historic Royal Palaces Conservation and Collections Care Department, Hampton Court Palace, Surrey KT8 9AU, UK)

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THANK YOU!

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