# Insight with Synchrotron Light

## into Nabataean Painting Materials: A micro-spectroscopic study

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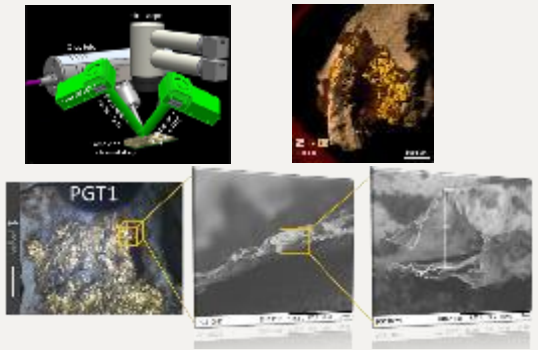
# Conservation of Historical Wall Painting

Case study: Nabataean gilded wall paintings and stucco at Petra

## Conservation

### Painting Technology

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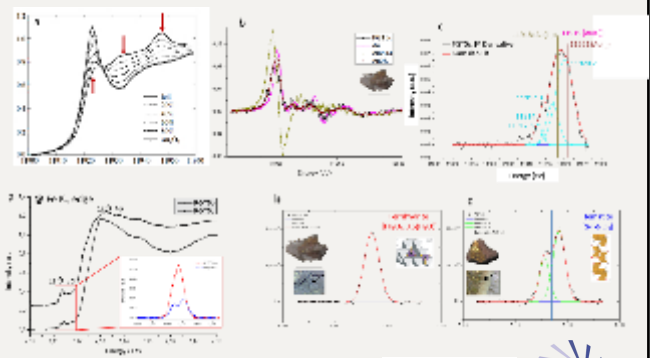
### Condition Assessment



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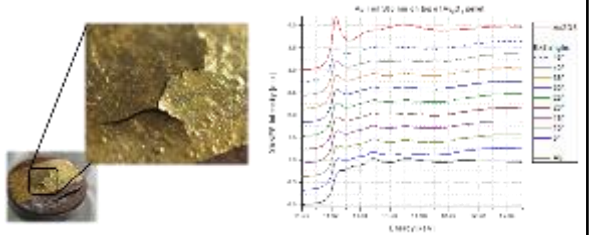
### Development of Compatible Conservation Material



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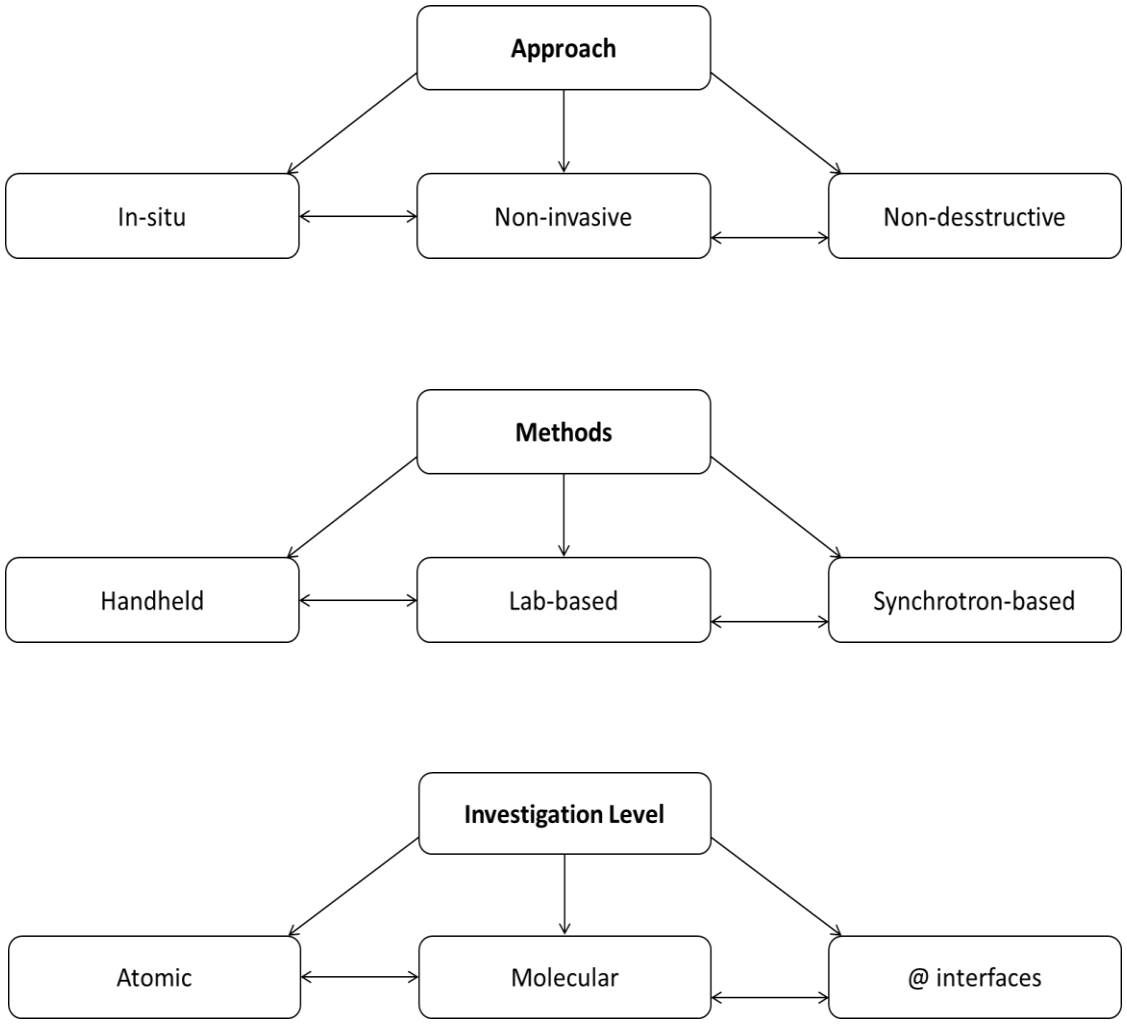
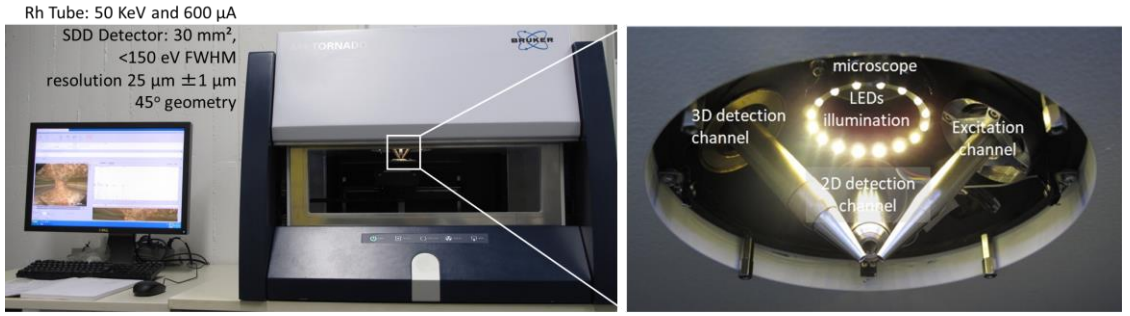
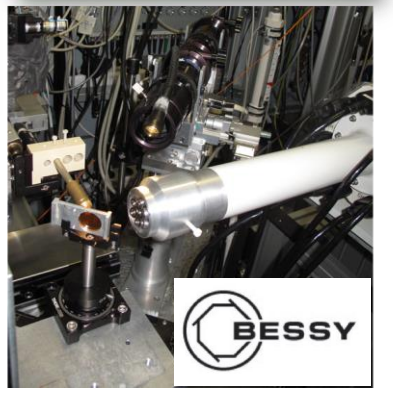
# Analytical Approach, Methodology, and Techniques






Mo Tube: 50 KeV and 600 µA
SDD Detector: < 145 eV
Resolution 12,9 ± 0,7 µm
45° geometry

# Presented Highlights

- **Chemical Speciation using SR 2D-µXANES (Painting technology // Chemical-induced alteration)**

*Example from Temple of Winged Lions*

- **Chemical Speciation using 3D-µXRF and SR 2D-µXANES (Painting technology // Thermal-induced alteration)**

*Example from Temple of Winged Lions*

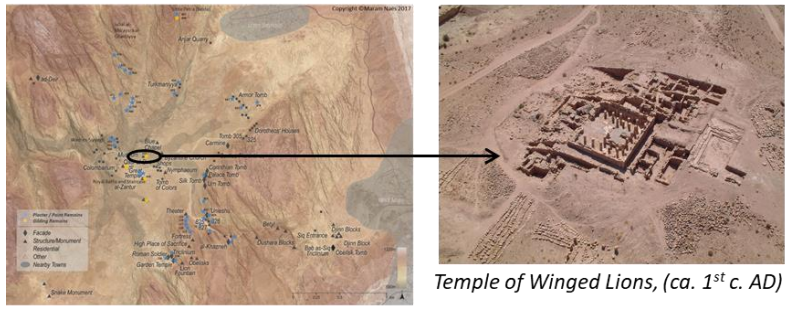
- **Identification of Organic Components using Lab and SR 2D-µFTIR (Painting Technology // Deterioration products)**

*Example from Temple of Winged Lions*

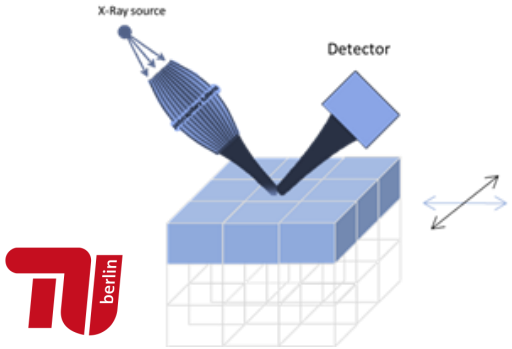
- **Identification of Organic Components using SR 2D-µFTIR (Painting Technology // Deterioration products)**

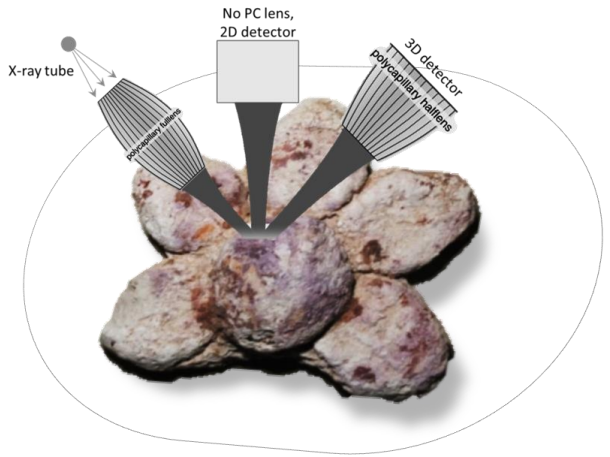
*Example from Temple of Winged Lions*

# Elemental Composition using 2D- and 3D-µXRF (Painting Technology)



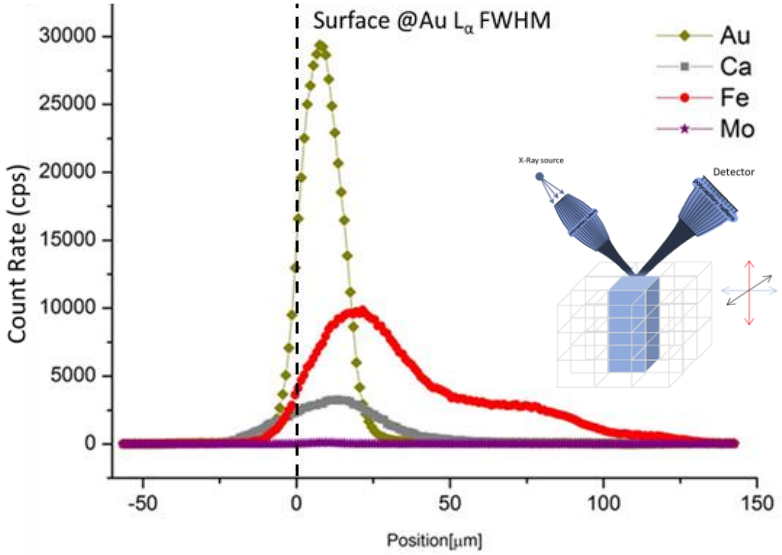
*Temple of Winged Lions, (ca. 1st c. AD)*



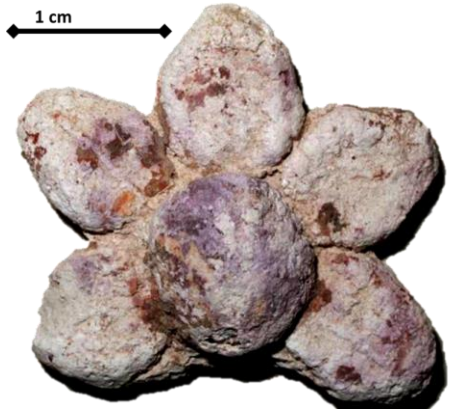



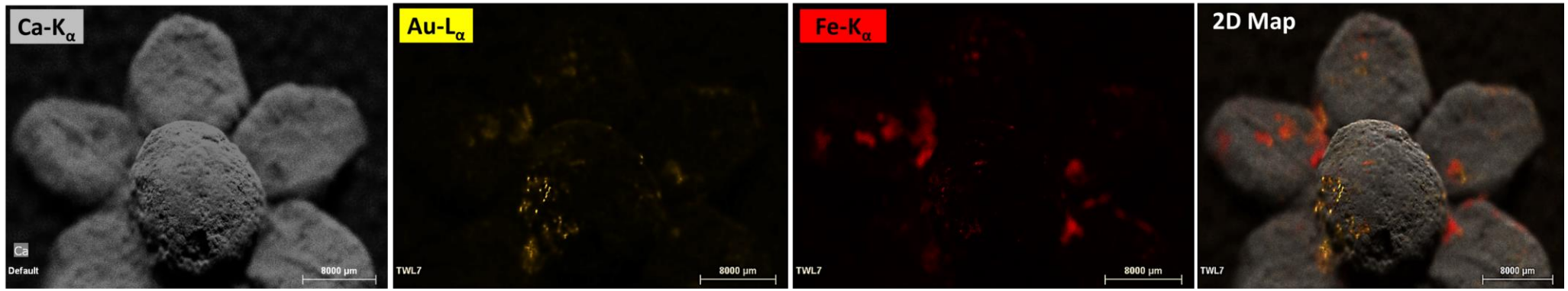

- Au, Fe, and Ca-S matrix
- Highly disrupted gold layer
- Iron in conjunction with gold

## 3D-µXRF depth profile



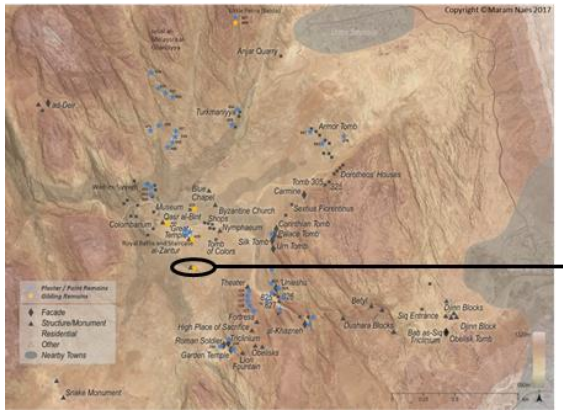

## 2D-µXRF elemental maps




3D-µXRF: Dwelling time 10 s/step, step size 4 µm, 60 steps, ca. 30 min. aquisition time
2D-µXRF: Dwelling time 10 s/step, step size 25 µm, 2.5 x 2.5cm$^2$

# Identification of Organic Components (Painting Technology // Deterioration products)



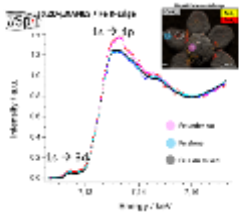
*Ez-Zantur IV painted Villa, Room 1, (ca. 1st c. AD)*

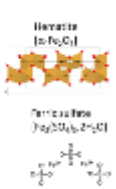

# Summary

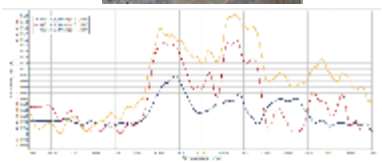
Nabataean gilded and painted surfaces at Petra

## Conservation

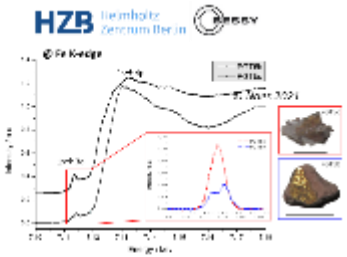
### Painting Technology

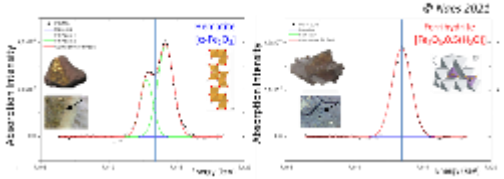


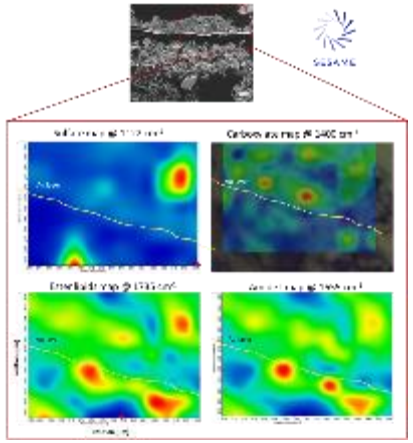




### Condition Assessment







# Outlook

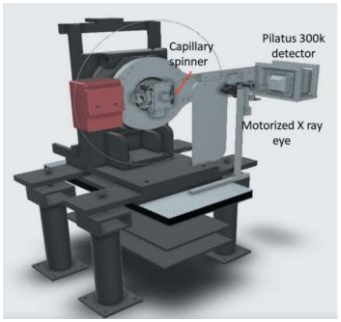
## D02-EMIRA

SESAME

*Synchrotron Radiation News, 2017, 30:4, 8-10*

## I09-MS

SESAME

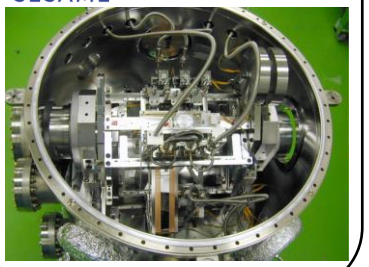



Abdellatief *et al*. 2022, *J. Synch. Rad.* 29

## HESEB

Helmholtz-SESAME Soft X-Ray Beamline for SESAME

SESAME



W. Eberhardt, 15.12.2020. HESEB colloquium *https://www.hzdr.de/db/Cms?pOid=62086*

## D08-XAFS/XRF

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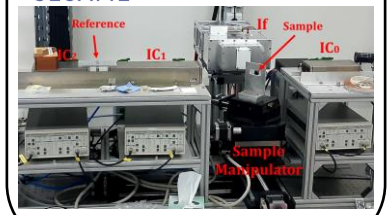


*https://www.sesame.org.jo/beamlines/xafs-xrf*

# Acknowledgement

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IAEA International Atomic Energy Agency
Atoms for Peace

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Petra Development & Tourism Region Authority

DFG Deutsche Forschungsgemeinschaft
German Research Foundation

SESAME

متحف بترا
The Petra Museum

مُتحف الأردن
THE JORDAN MUSEUM

Petra Painting Conservation Project (PPCP)
*(DFG Project Number 285789434)*

HZB Helmholtz Zentrum Berlin

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***Thank you for your attention***