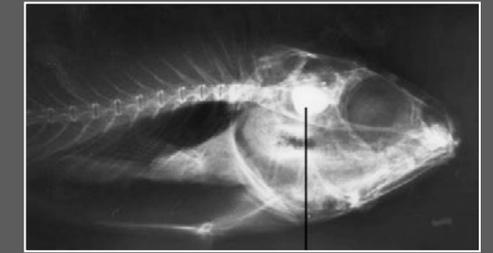
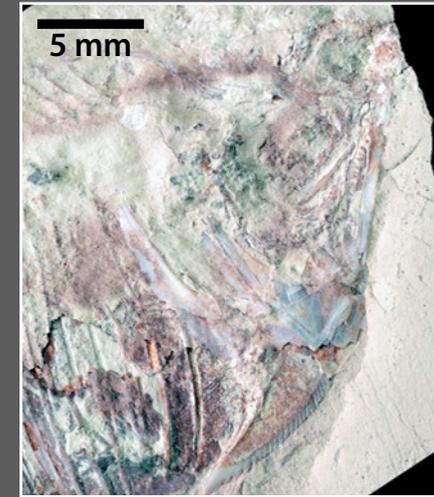


# IPANEMA European ancient material synchrotron research platform

Loïc Bertrand

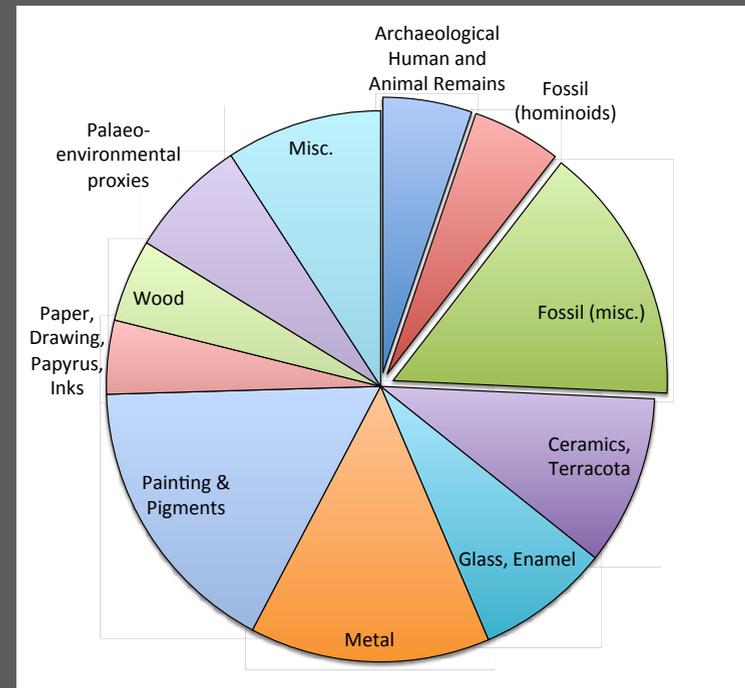


the only platform dedicated to ancient materials research at a large-scale facility



<http://nmita.geology.uiowa.edu>

in the context of the rapid growth of the use of synchrotron methods for ancient materials: 50% of the 800+ publications are less than 5 year old!

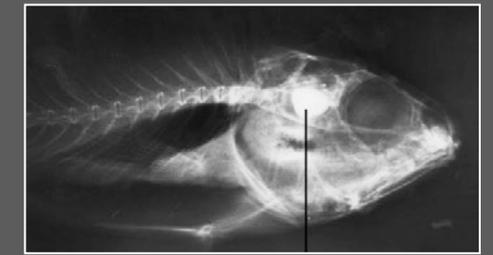
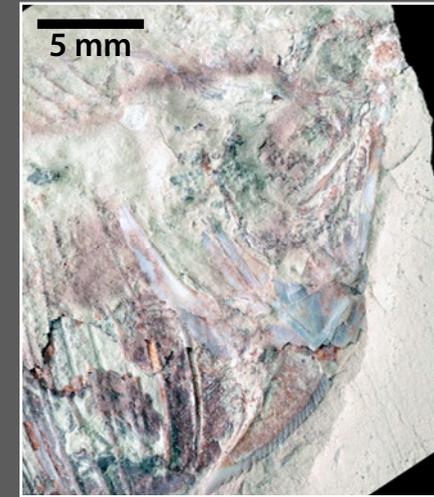


# IPANEMA European ancient material synchrotron research platform

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the only platform  
dedicated to ancient materials  
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<http://nmita.geology.uiowa.edu>



at Synchrotron SOLEIL,  
Saclay, France (start: 2008)



new premises open in Sept.  
2013 (laboratories, offices)



PUMA beamline optimised  
for ancient materials studies



## European and international consultation

**3 × 4 working groups** (100+ scientists)

### **numerous discussions**

over the past 10 years: meetings, 4 conferences and satellite workshops, round table discussions, 5 international training schools...

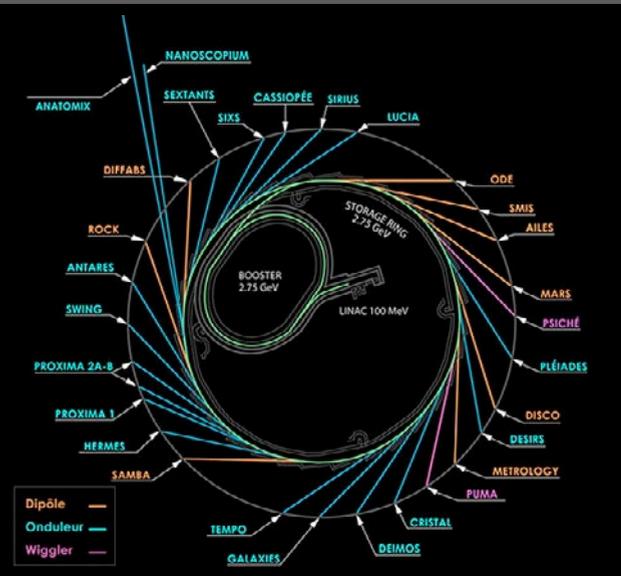


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**direct feedback from projects and users**

**198** synchrotron projects submitted since 2008 (54% accepted) on **15** SOLEIL beamlines work at several other synchrotron facilities





## European and international consultation

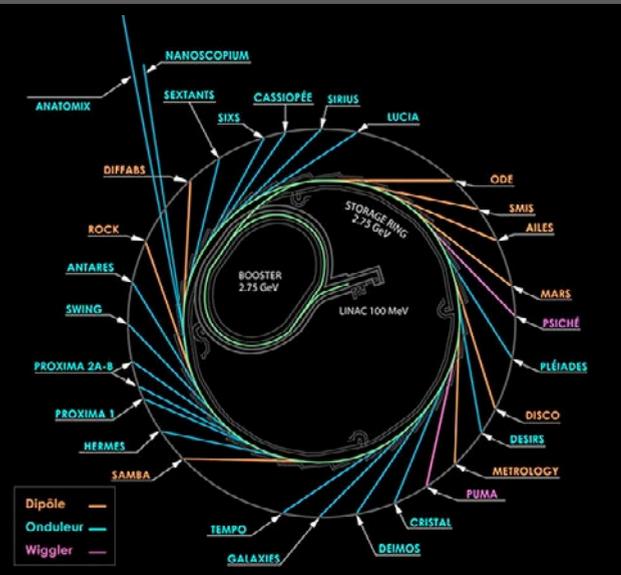
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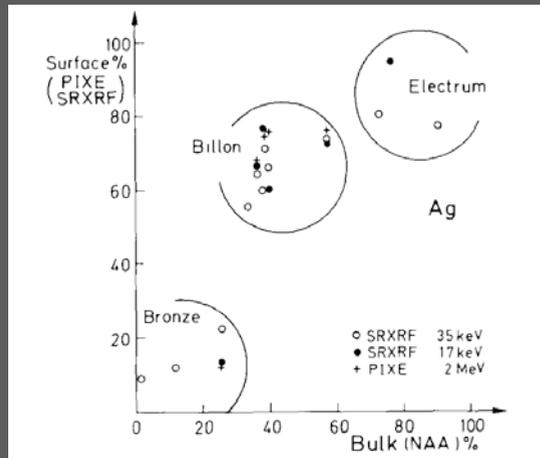
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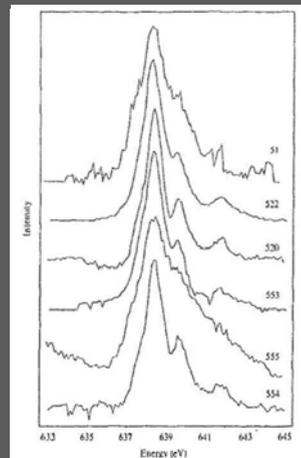


**partners**

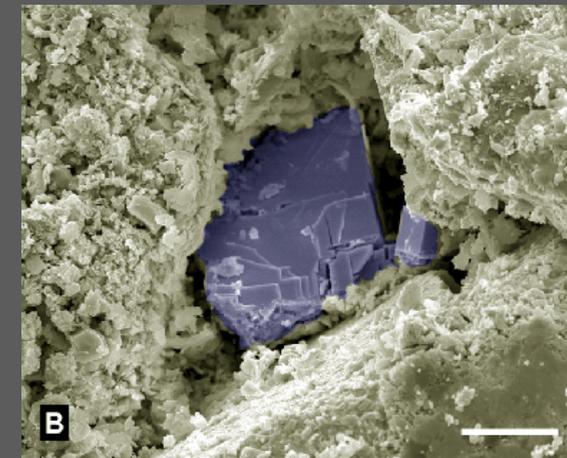




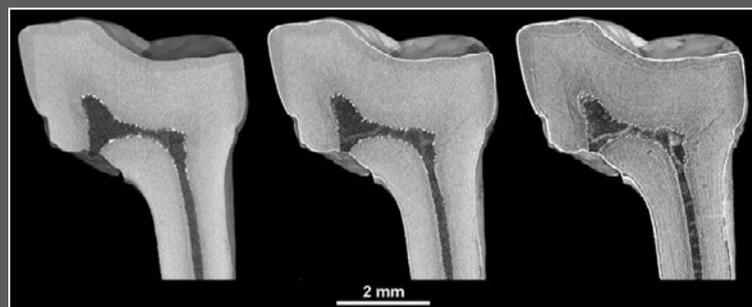
**1989** P. Chevallier (LURE) *et al.* show that synchrotron XRF discriminates ancient Gaulish coins



**1995** P. Schofield (London NHM) *et al.* study the color of ancient glasses by performing Fe and Mn X-ray speciation



**1999** Ph. Walter (C2RMF) *et al.* demonstrate that Egyptians mastered lead chemistry to synthesise cosmetics



**2006** P. Tafforeau (ESRF) *et al.* demonstrate the power of phase-contrast  $\mu$ CT to image fossils



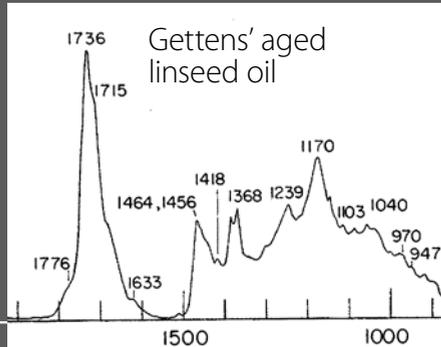
**2008** J. Dik (TU Delft) *et al.* are able to visualise a hidden Van Gogh painting by scanning of an entire painting



**2010** J.-P. Échard (Musée de la Musique) *et al.* identify the process used by A. Stradivari to finish his musical instruments



cello from Jaques Boquay, bef. 1715

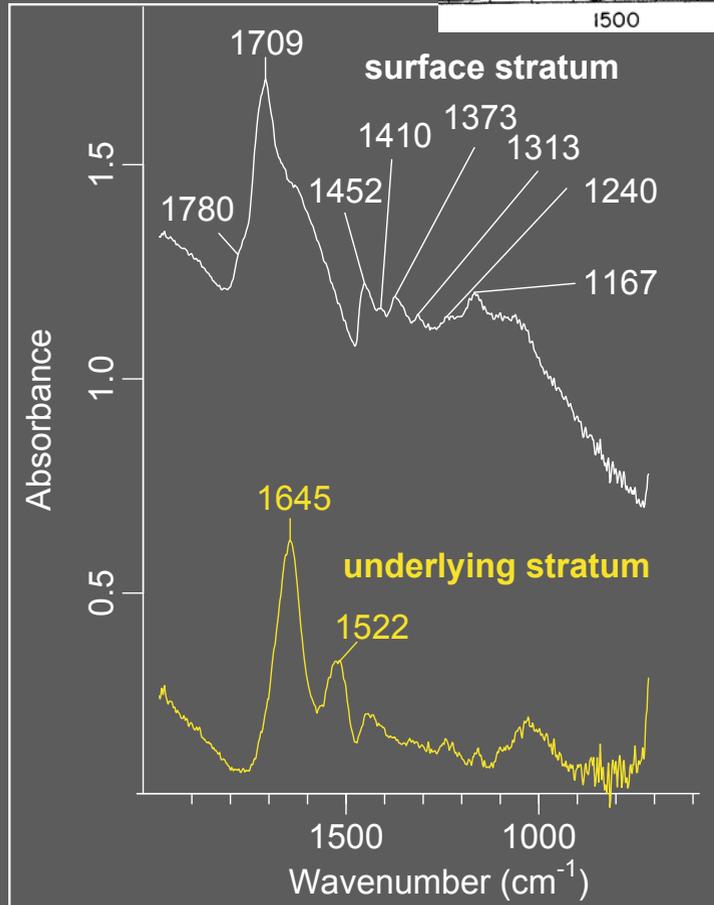


Meilunas et al., 1990

## ancient materials are...

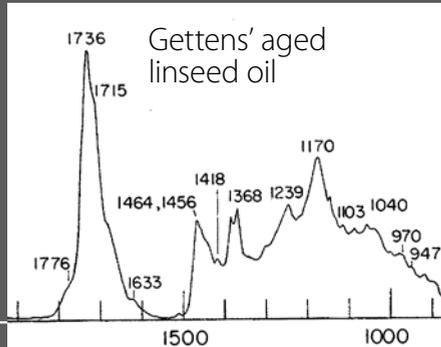
- essential for **Humanities and environmental research**
- interesting for their **long-term evolution**
- but also for their **out-of-equilibrium properties**
- **heterogenous** at all scales

SR infrared spectroscopy, 10x10  $\mu\text{m}^2$





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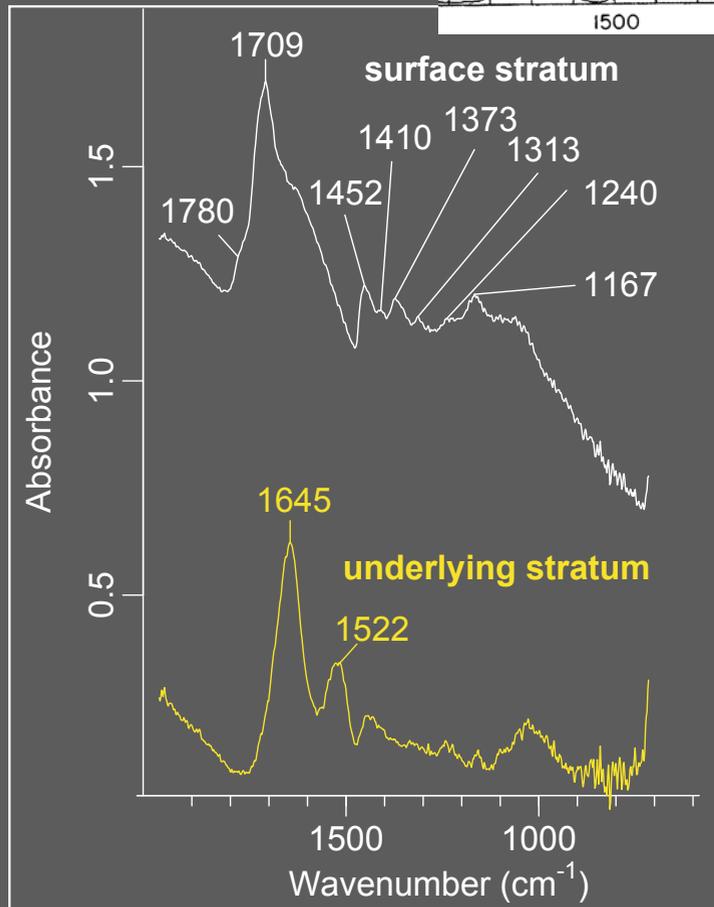
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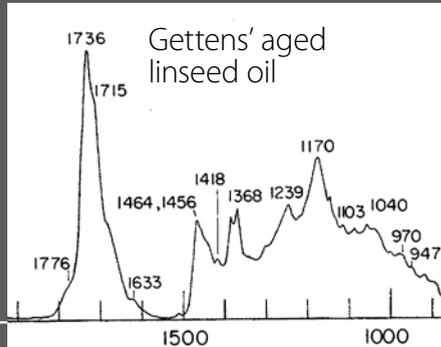
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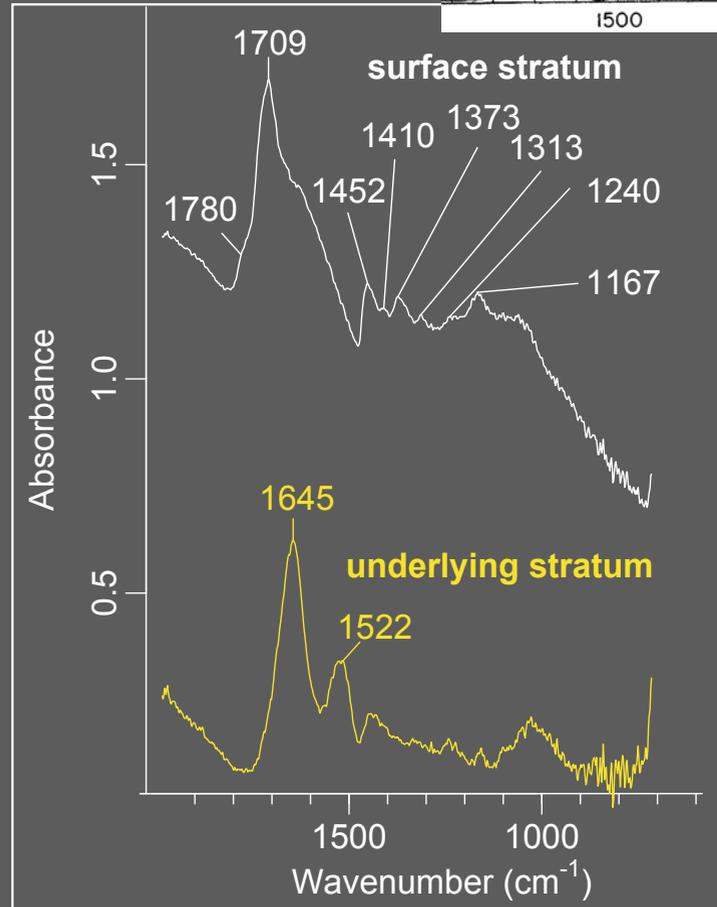


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## ... an analytical challenge

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## ... leading to organisational tours de force

- bridging distinct cultures around objects
- erratic lines of funding
- not a gimmick to advertise physics facilities

**clarifying research targets**

**work on corpuses and collections  
rather than individual objects**



"Zinc white" paints (ZnO)



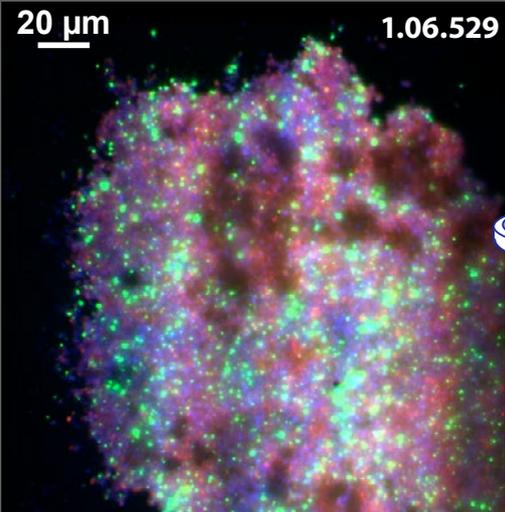
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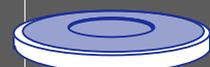
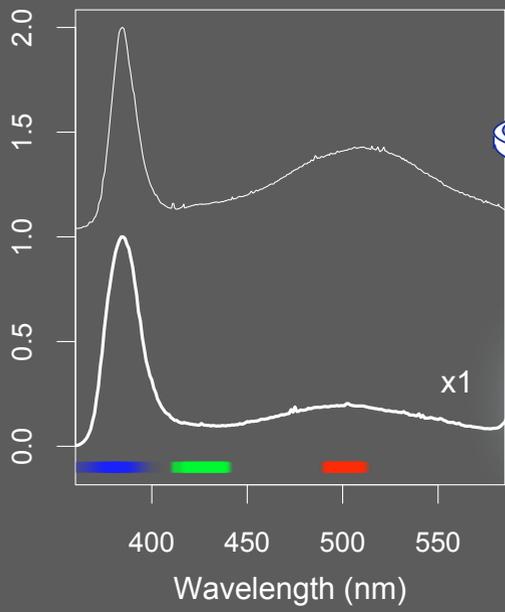
from day-to-day questions to fundamental ancient materials research

corrosion of archaeological metals, diffusion of consolidants, imaging of fossil microfauna, built environment, rock art, preventive conservation...

high-resolution luminescence signature of heritage materials, radiation damage mechanisms



40× obj.  
pps: 320 nm



40× obj.  
(20 μm)<sup>2</sup>



optical fibre  
6 mm<sup>2</sup>

$\lambda_{exc} = 275 \text{ nm}$



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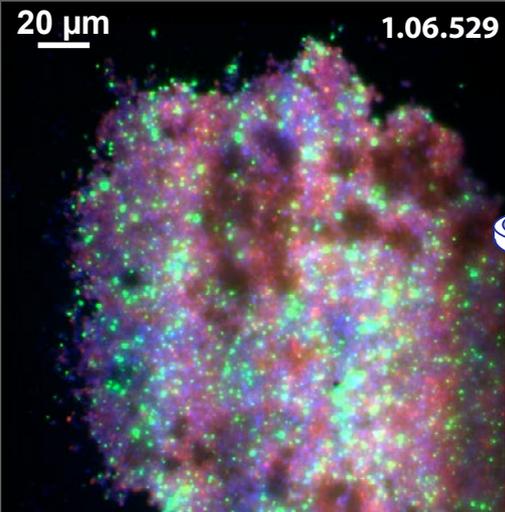
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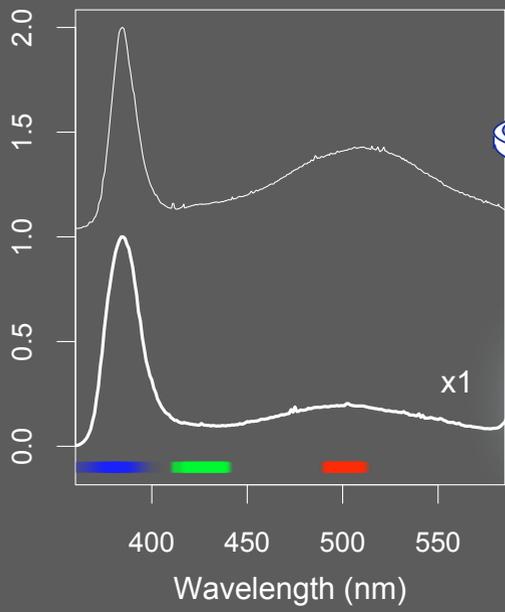


enhanced user support

sample preparation, data processing  
 presentation of instrumental capabilities  
 stability, calibration



40× obj.  
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optical fibre  
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## **developing novel methodologies**

a step beyond mere use of existing methods

## **experiment preparation**

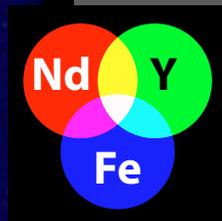
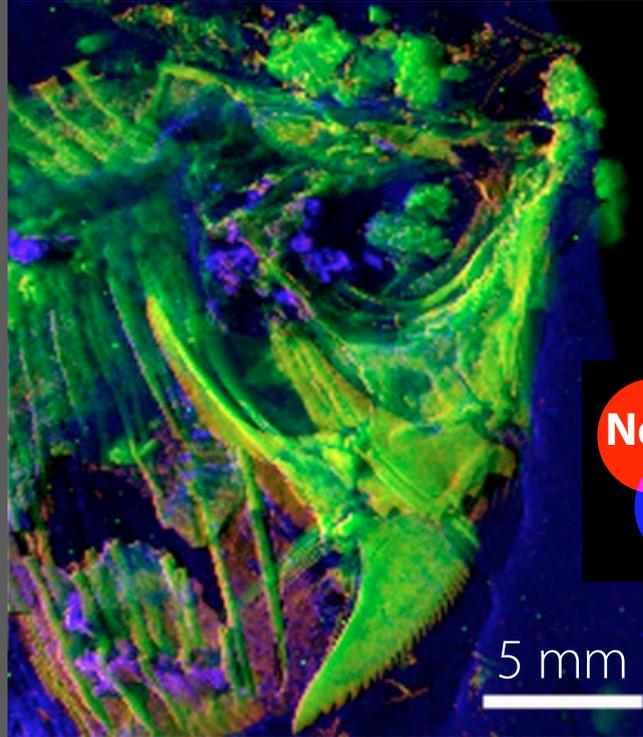
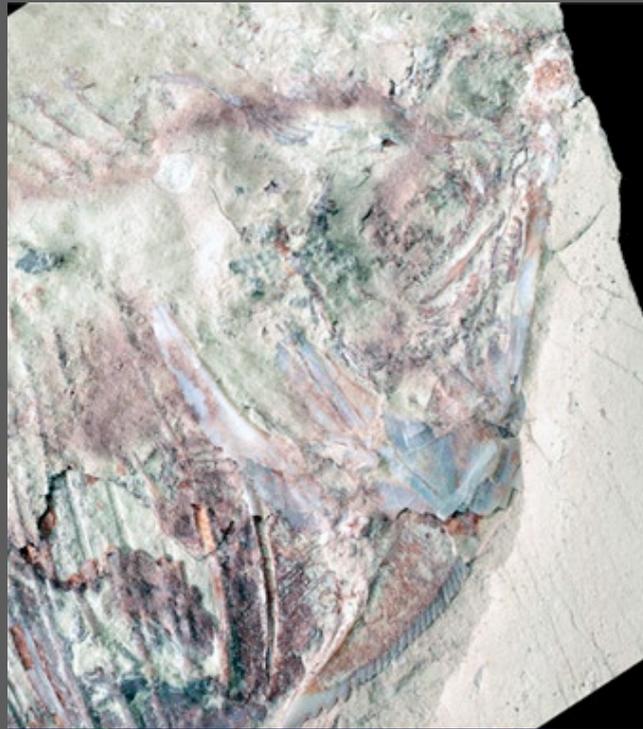
optimal sample preparation

## **data processing, mining and archival**

improved processing software

image statistical analysis

Exceptionally preserved  
Cretaceous flat fossils (100 Ma)



## developing novel methodologies

a step beyond mere use of existing methods

### experiment preparation

optimal sample preparation

### data processing, mining and archival

improved processing software

image statistical analysis

### new or improved instruments

developing dynamics (spatial, spectral) in imaging

UV luminescence imaging

X-ray scanning and 3D imaging

more quantitiveness

connecting existing instruments

# towards a **better coordinated European and international environment** for ancient material characterisation?

## **improved service to users**

practical know-how is central!

focus on medium-term projects

strict proposal evaluation based on ancient materials criteria

dedicated methodological research



large-scale facilities



mobile platforms



data repositories



museums



sites



archives

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## **join involved infrastructures**

connecting large-scale facilities: synchrotron, neutron, dating, laser...  
interface with lab and portable instruments  
joint instrumental development  
heritage data curation  
dissemination in the museum or at the site



large-scale facilities



mobile platforms



data repositories



museums



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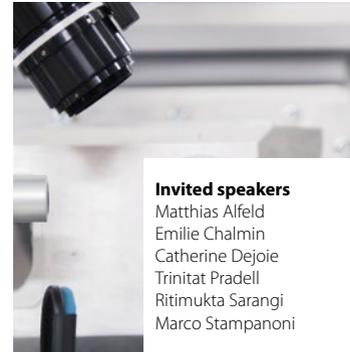
thank you for  
your attention!



9–12 sept. 2014 Musée du Louvre, Paris

## Synchrotron radiation and neutrons in art and archaeology Conference

Conférence Rayonnement synchrotron  
et neutrons pour l'art et l'archéologie



### Invited speakers

Matthias Alfeld  
Emilie Chalmin  
Catherine Dejoie  
Trinitat Pradell  
Ritumukta Sarangi  
Marco Stampanoni

### International scientific committee

Annemie Adriaens  
Loïc Bertrand  
Joris Dik  
Koen Janssens  
Apurva Metha  
Jennifer Mass  
Martin Radtke  
Ina Reiche  
Jean Susini  
Josefina Pérez-Arategui  
Robert van Langh



### Public session Wednesday September 10, afternoon Louvre auditorium

*Session publique*  
10 septembre  
après-midi  
Auditorium du Louvre  
Uwe Bergmann  
Robert van Langh  
Philippe Sciau



[www.sr2a-2014.org](http://www.sr2a-2014.org)

deadline for abstract submission: April 15

organised by C2RMF, CRCC, IPANEMA, LAMS, LAPA, LRMH, The Louvre Museum,  
MNHN Prehistory department and PATRIMA.

with the financial support of



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Deadline for abstract submission: **April 15**  
Deadline for early registration: **June 15**