



New Developments On FAME In Environmental, Geochemical & Earth Sciences



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TERRE
UNIVERS
ENVIRONNEMENT

ENVironnemEnt@SOLEIL: ENVIES 2014

Synchrotron SOLEIL, Saint-Aubin, France - 13 et 14 mai 2014

for XAS measurement

natural C^{ion} → **detection limit**

small differences → **high resolution**

for the samples

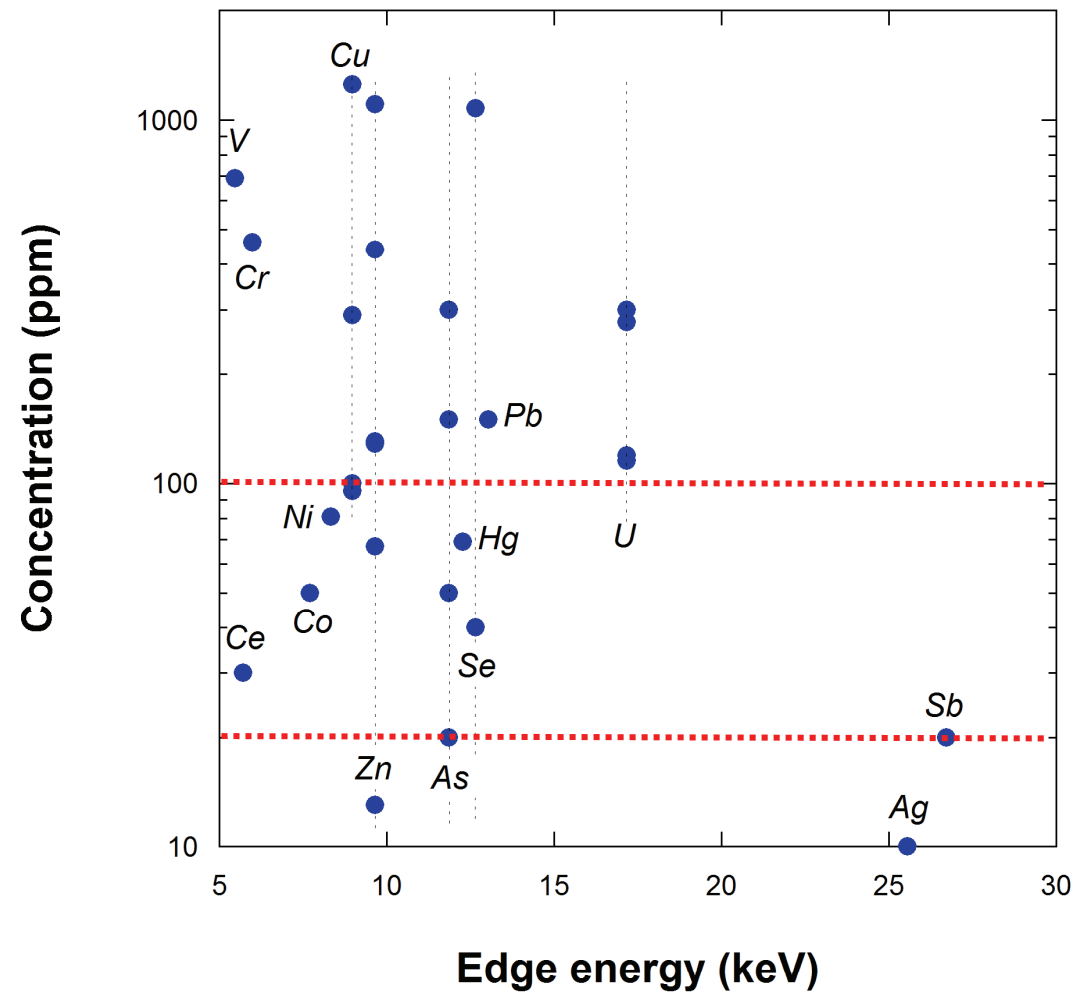
radiation damages → **low T**

inhomogeneous samples → **beam stability**

FAME performances



Concentration
limit for speciation
measurement:
~20-100ppm



from Hazemann et al., "High Resolution Spectroscopy on an X-ray Absorption Beamline", *Journal of Synchrotron Radiation* **16** (2009) 283-292

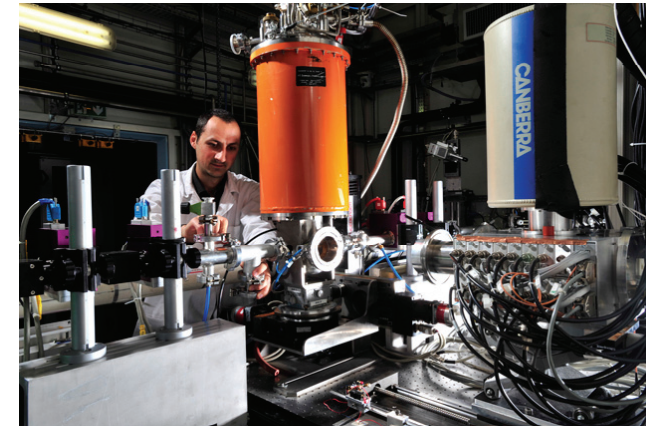
New development: CAS



Solid-State Detector

Energy resolution: 200-300 eV

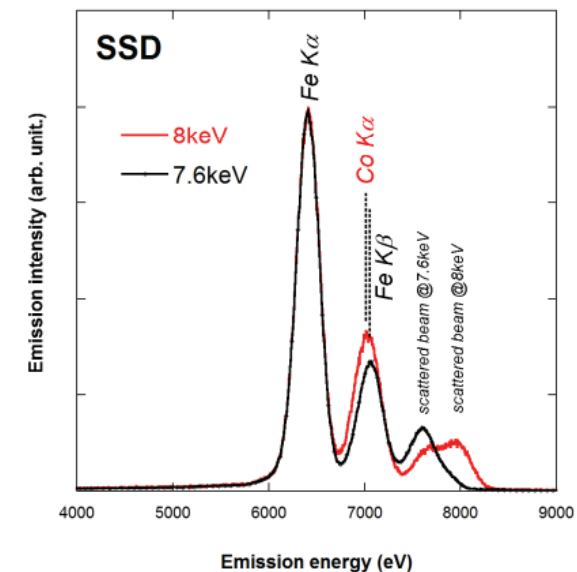
Counting rate limit → total amount of absorbers (matrix + elt. of interest)



Crystal analyzer spectrometer

Energy resolution: 1-3 eV

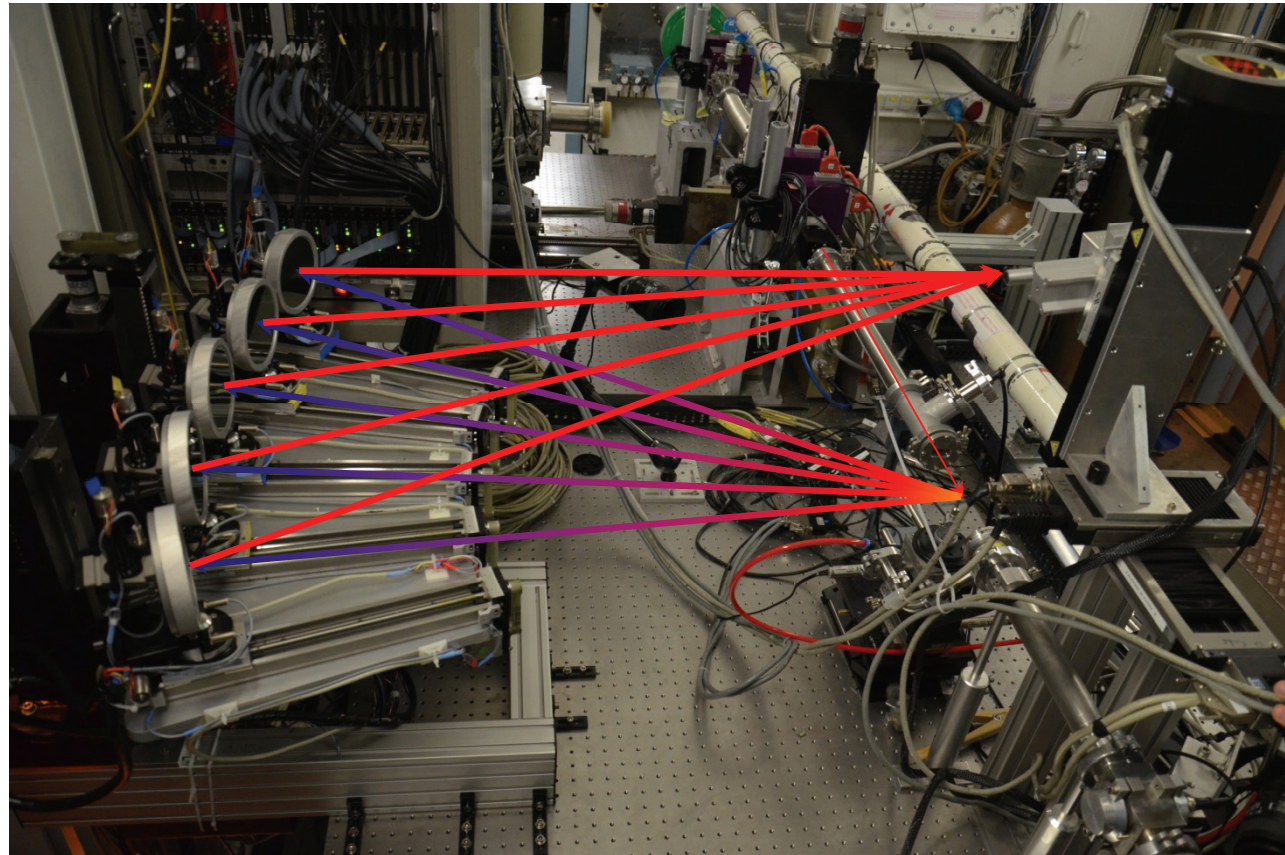
Counting rate limit → amount of elt. of interest



Hazemann et al., *Journal of Synchrotron Radiation* **16** (2009) 283-292

Llorens et al., *Review of Scientific Instruments* **83** (2012) 063104

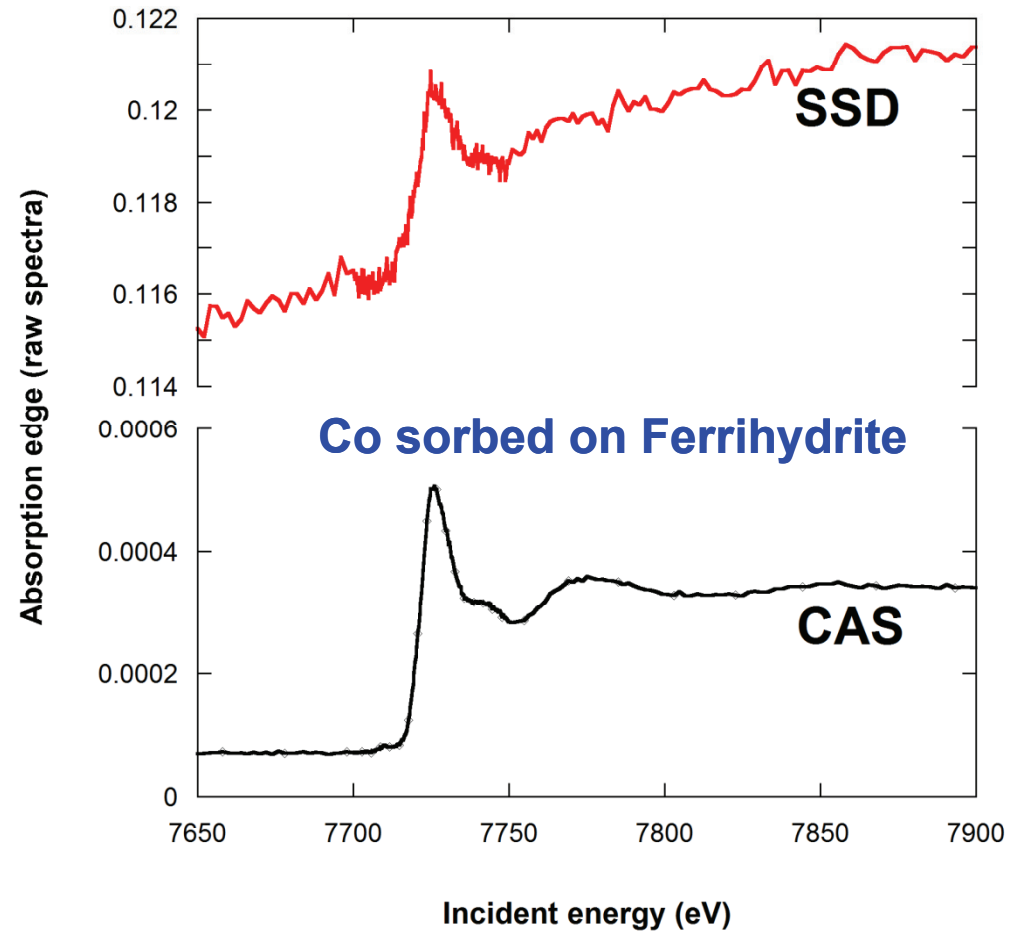
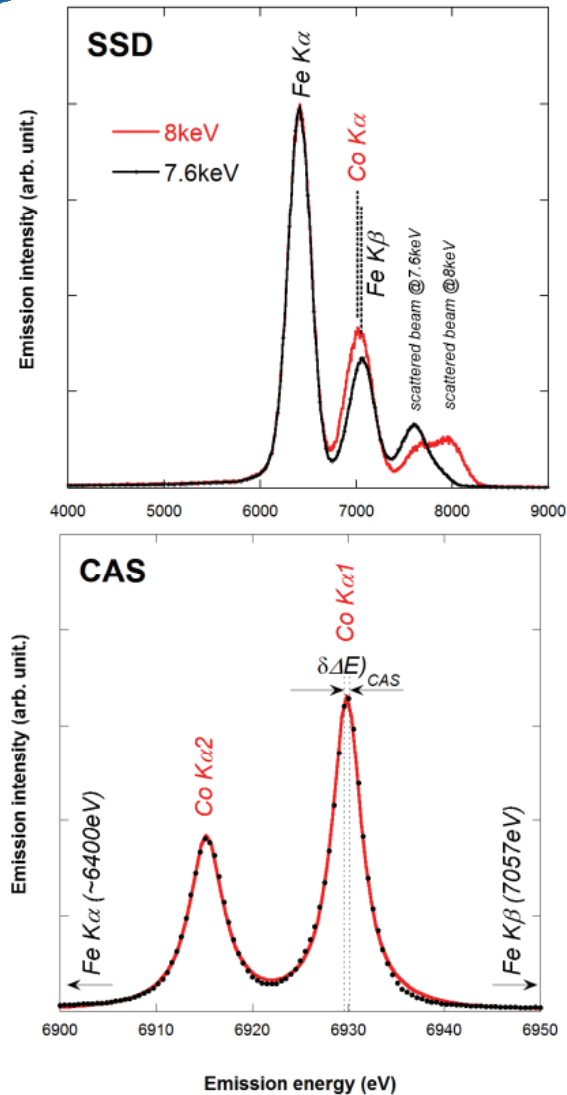
New development: CAS



Hazemann et al., *Journal of Synchrotron Radiation* **16** (2009) 283-292

Llorens et al., *Review of Scientific Instruments* **83** (2012) 063104

High selectivity



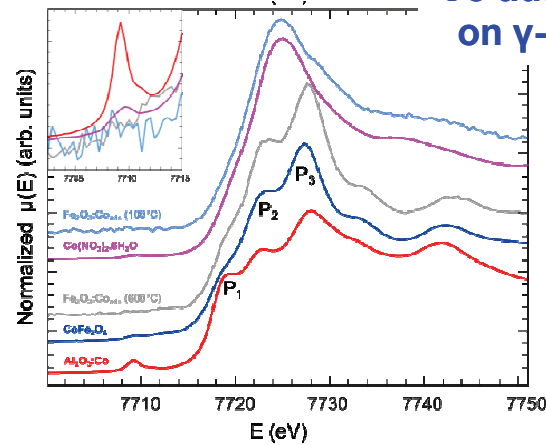
Collaboration FAME, R. Collins (Australia) & J. Rose (CEREGE)



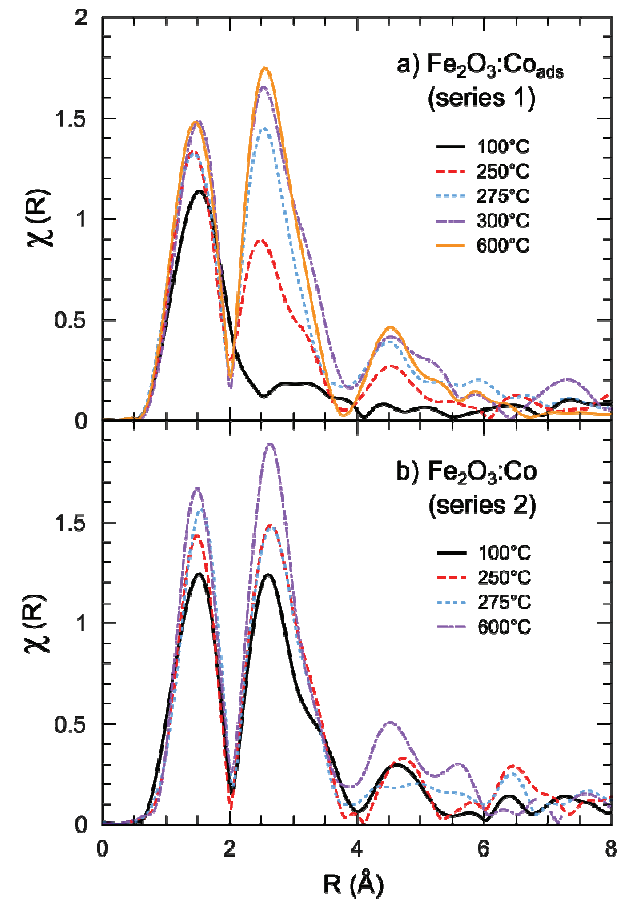
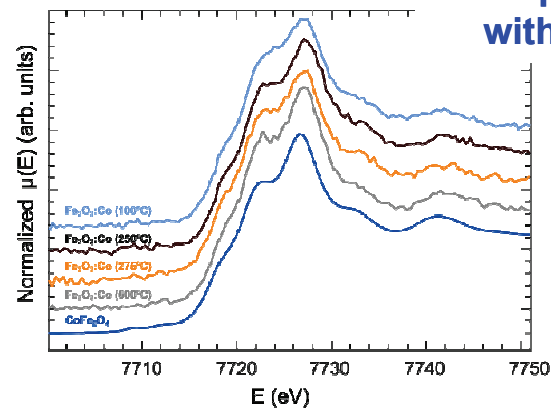
High selectivity



Co adsorbed
on $\gamma\text{-Fe}_2\text{O}_3$



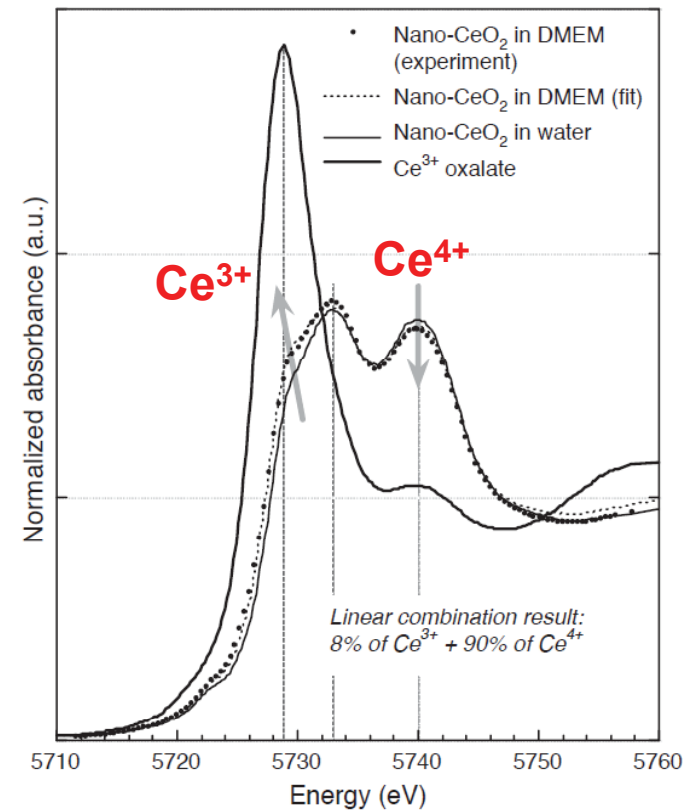
Co coprecipitated
with $\gamma\text{-Fe}_2\text{O}_3$



High resolution



Toxicity
↕
Subtle differences
in total speciation



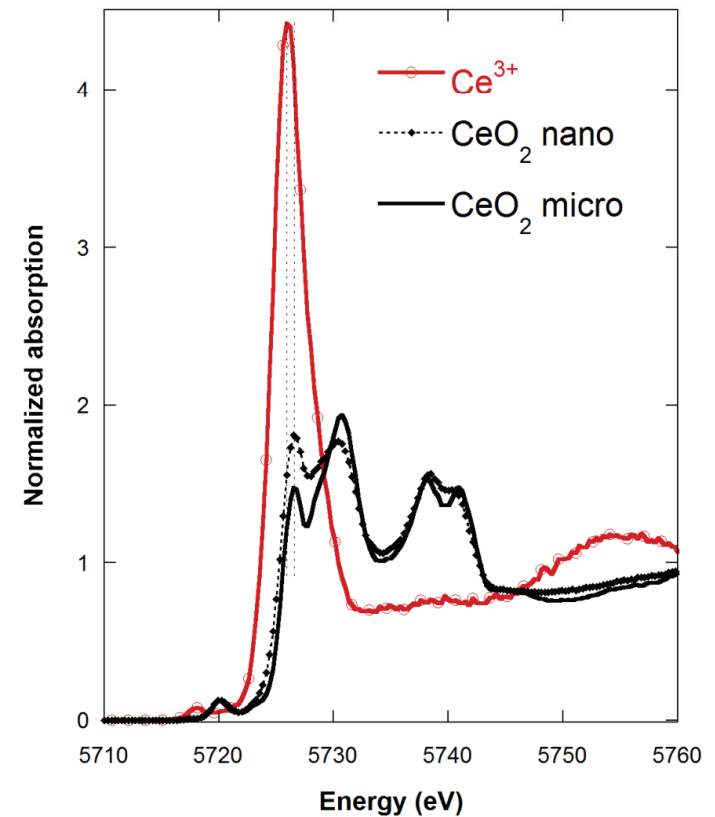
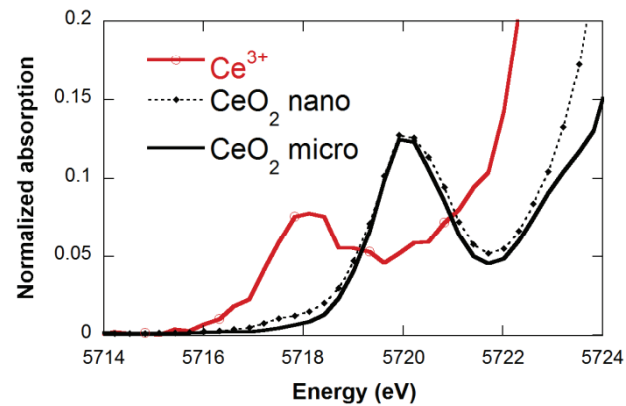
Auffan et al., "DNA damage generated by redox processes occurring at the surface of cerium dioxide nanoparticles", *Nanotoxicology* **3** (2009) 161-171



High resolution



- **HERFD-XANES on CeO₂**
 - well-marked features
 - ≠ main peak positions (~0.5eV)
 - pre-edge peaks



Collaboration FAME & M. Tella, M. Auffan, J. Rose, A. Masion (CEREGE)



Conclusion



Structural tool for speciation determination

of diluted element
with an high resolution

2 beamlines in 2016

FAME → 20 ppm (total absorption measurement)

FAME-UHD → 1 ppm (high resolution measurement)

Beamtime for users: x2

Acknowledgments



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<http://www.esrf.fr/> → beamline BM30b