News from CAMECA

François Horréard,
Product manager

AMETEK (15 000 employees worldwide)

Electromechanical Group

Electronic Instruments Group

CAMECA SCIENCE & METROLOGY SOLUTIONS

SIMS / EPMA / APT

nu

ICP-MS / GD-MS / TIMS / IRMS

EDAX

EBSD / EDS / WDS / Micro-XRF

SPECTRO

ICP-OES / ED-OES / XRF

VISION RESEARCH

High Speed Digital Cameras

AMPTEK

X-Ray and Gamma-Ray Detectors, Digital Pulse Processors XRF

AMETEK MATERIALS ANALYSIS DIVISION

AMT (Advanced Measurement Technologies)

ORTEC

solartron analytical

SUNPOWER

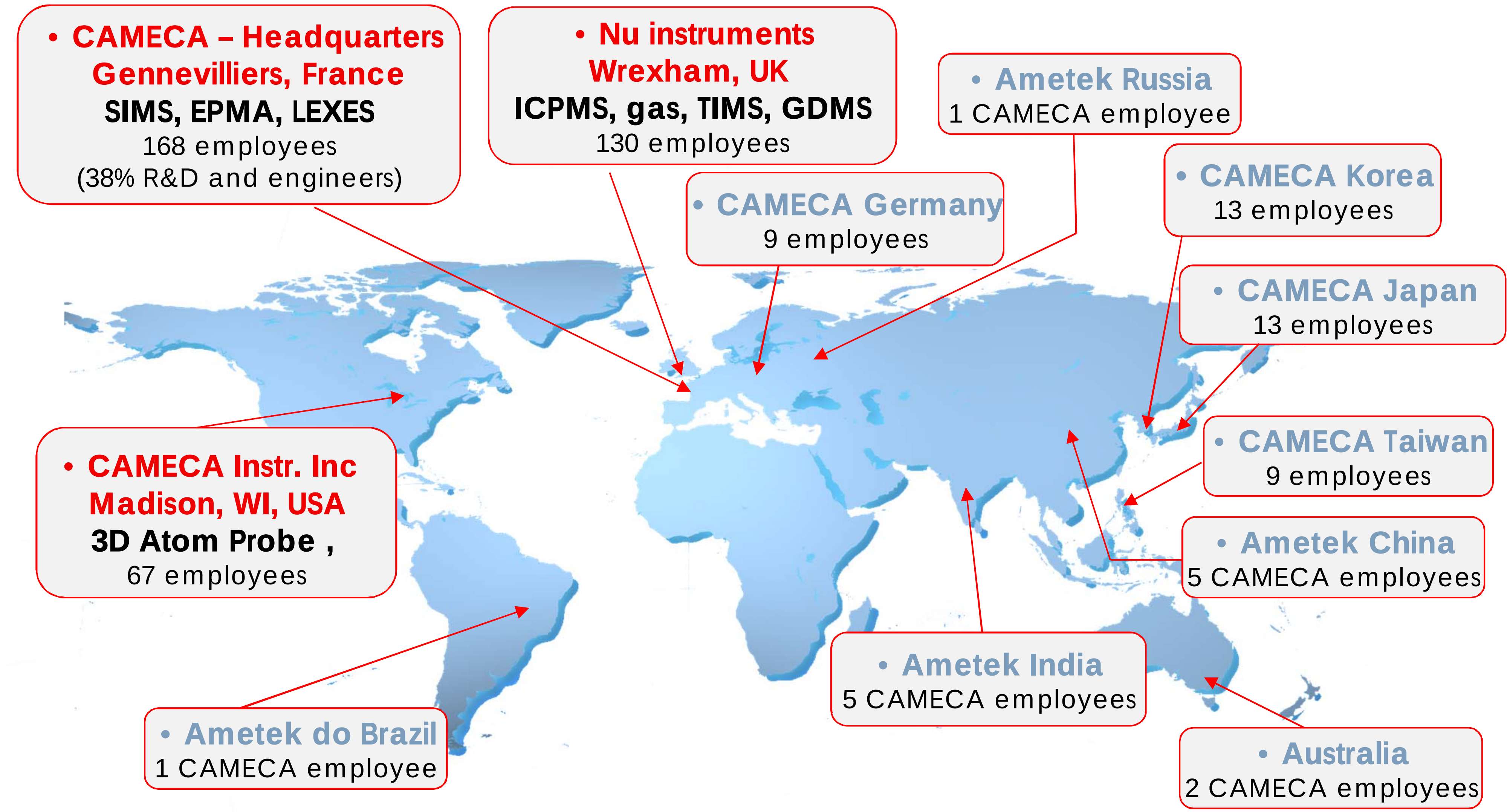
Princeton Applied Research

Radiation detectors

Stirling engines, Cryocoolers

EIS (Electrical Impedence Spectroscopy)

CAMECA worldwide organization



- R&D and industrial center
- Sales and Service

Agents in other areas

Three development & manufacturing sites

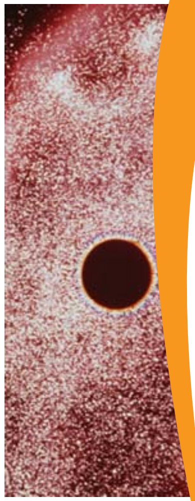
CAMECA Headquarters,
Gennevilliers, France
SIMS, EPMA, LEXES

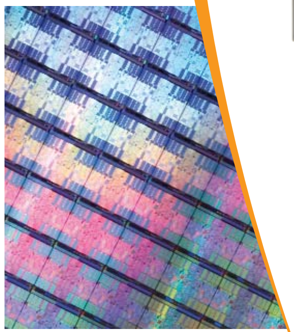
CAMECA Nu Instruments, Wrexham, UK
ICP-MS, TIMS, GD-MS, Gas MS

Atom Probe Technology Center,
Madison, WI, USA

World Leader in Elemental & Isotopic Microanalysis

CAMECA®
SCIENCE & METROLOGY SOLUTIONS





EPMA

Electron Probe MicroAnalysis

Electrons in / X rays out

SXFive, SXFiveFE

EX-300

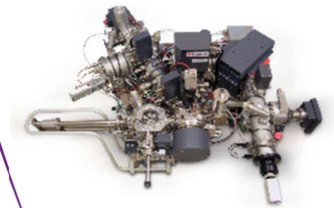
SIMS

Secondary Ion Mass Spectrometry

Ions in / ions out

IMS 1300-HR³, KLEORA

IMS 7f-Auto, 7f-GEO



NanoSIMS 50L

IMS Wf, SC Ultra

SIMS 4550

APT

Atom Probe Tomography

E field / ions out

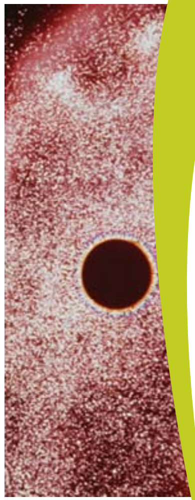
LEAP® 5000

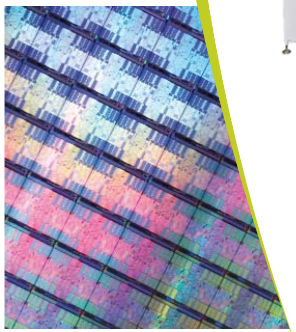
EIKOS™

www.cameca.com France, Brazil, China, Germany, India, Japan, Korea, Russia, Taiwan, UK, USA.

AMETEK®
MATERIALS ANALYSIS DIVISION

Innovator in Elemental & Isotopic Mass Spectrometry





ICP-MS

Inductively Coupled Plasma Mass Spectrometry

Liquid/Solid (Laser) in (Plasma source)/ions out

PLASMA 1700

PLASMA 3

ATTOM ES

SIRMS

Stable Isotope Ratio Mass Spectrometry

Gas in (Electron source)/ions out

PANORAMA

PERSPECTIVE

HORIZON

Noble Gas

Noble Gas Mass Spectrometry

Gas in (Electron source)/ions out

NOBLESSE HR

TIMS

Thermal Ionization Mass Spectr.

Solid in (Thermal source)/ions out

TIMS

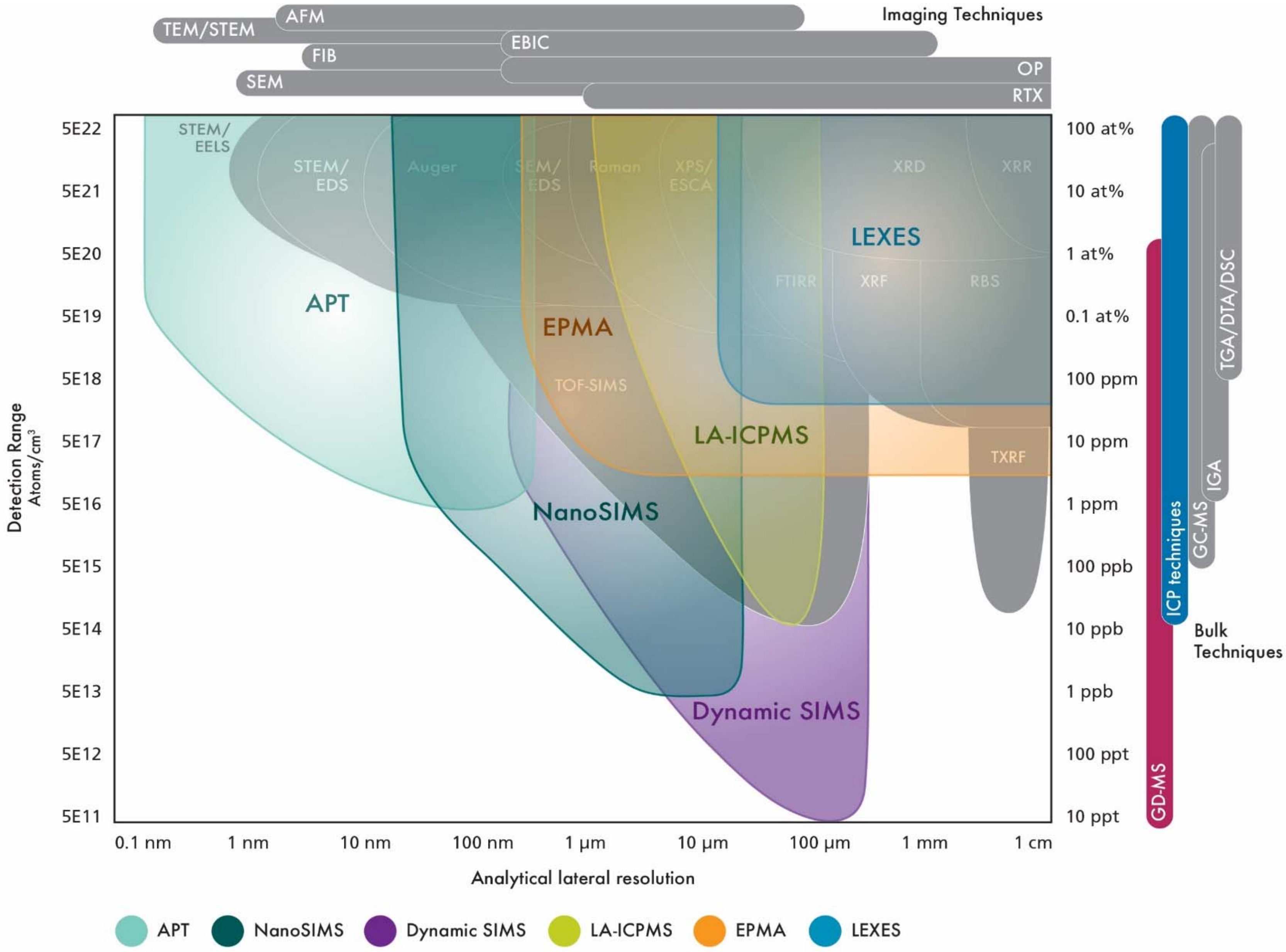
GDMS

Glow Discharge Mass Spectr.

Solid in (Glow discharge source)/ions out

ASTRUM

Microanalysis & bulk elemental analysis



3D atom probe

The LEAP 5000

- **Optimal performance**
  - UV Laser
  - Up to 80% detector efficiency
  - MHz pulse frequency
  - Microtip specimen handling

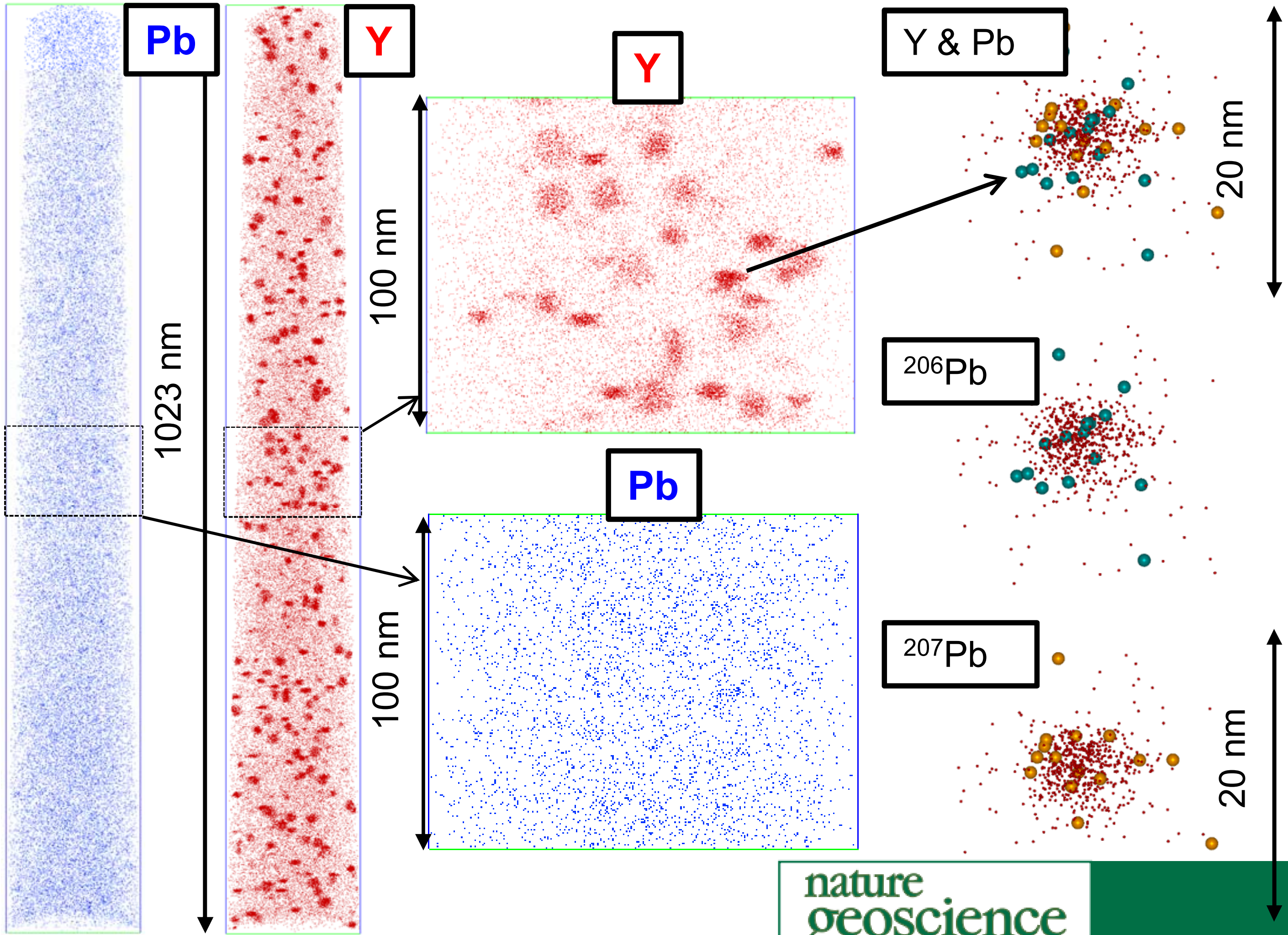
- Most diverse Applications Space, including **Geosciences**

The New EIKOS™ ATOM PROBE TOMOGRAPHY

- New hardware designs
  - Pre-aligned electrode
  - Simplified Specimen Stage
  - Simplified Cryo System
  - Simplified Green Laser option

- Outstanding performance at **lowest Cost of Ownership**

APT of 4.4 Ga Zircon, 2014



- Analysis of the oldest known piece of the earth by Dr. John Valley has helped to drive interest in atom probe analysis of natural geological materials
- This work demonstrated the feasibility of isotopic analysis and aging of nanodomains in zircon

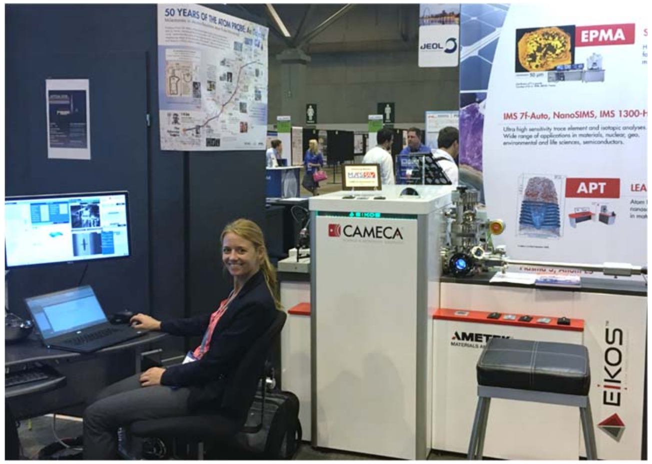
nature geoscience
LETTERS
PUBLISHED ONLINE: 23 FEBRUARY 2014 | DOI: 10.1038/NGEO2075

Hadean age for a post-magma-ocean zircon confirmed by atom-probe tomography

John W. Valley[1*], Aaron J. Cavosie[1,2], Takayuki Ushikubo[1], David A. Reinhard[3], Daniel F. Lawrence[3], David J. Larson[3], Peter H. Clifton[3], Thomas F. Kelly[3], Simon A. Wilde[4], Desmond E. Moser[5] and Michael J. Spicuzza[1]

What you will NOT see today: 3D atom probes

The New EIKOS™ ATOM PROBE TOMOGRAPHY in live demonstration at M&M conference, 6-10 Aug. 2017, St Louis, MI, USA



The new sapphire

Collision/Reaction cell Multi-collector ICP-MS

From the Plasma 3 MC ICPMS…

Why add a Collision/Reaction cell ?

The **Argon ICP ion source** produces a significant beam of **Ar+ ions** (~10's µA) along with **polyatomic molecules** such as ArH, Ar2+ and ArO+

- These can **interfere** directly with the atomic ions of the same nominal mass for example **K, Fe**
- Polyatomic interferences are currently dealt with using the **high resolution** capabilities of MC-ICP mass spectrometers but with some **limitations (transmission)**
- Analysis of elements such as **Ca** is difficult on current multi-collectors due to the presence of the **large argon beam**
- The ion current from Ar+ ions also affects the **abundance sensitivity** of higher mass ions

Benefits of Collision/Reaction cell ?

Hydrogen Collision gas

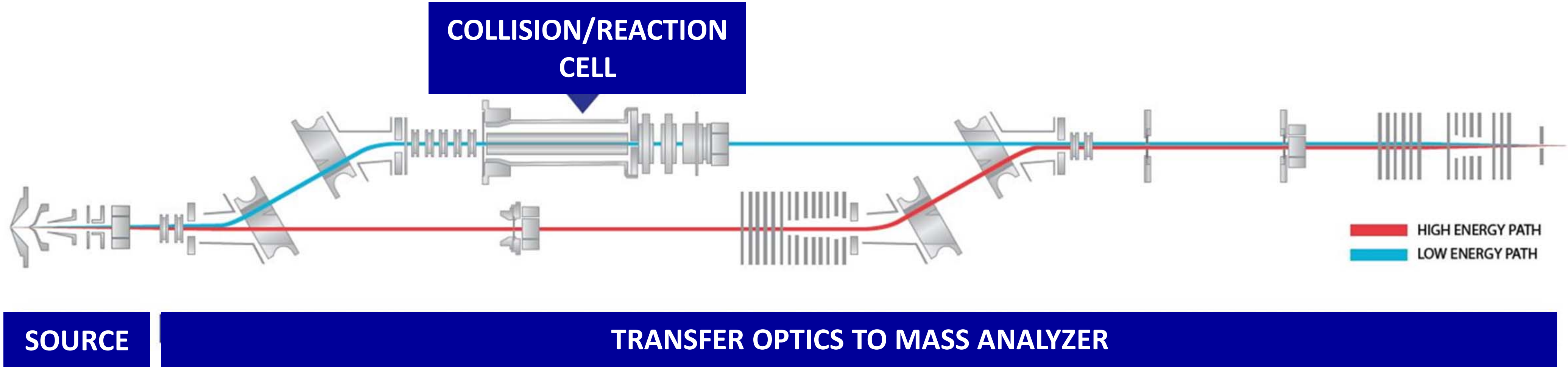
- Argon ions undergo a charge exchange with hydrogen
  - $Ar^+ + H_2 \rightarrow Ar + H_2^+$
  - $ArH^+ + H_2 \rightarrow Ar + H_3^+$
  - $ArO^+ + H_2 \rightarrow Ar + H_2O^+$

- This can **reduce** the Argon ion signal by > **9 orders of magnitude** while other analytes are unaffected.

Oxygen or **Ammonia** Collision gas

- **Interferences can be shifted in mass**
  - $M^+ + O_2 \rightarrow MO^+ + O$
  - $M^+ + NH_3 \rightarrow MNH_3^+$

The technical solution: a dual path

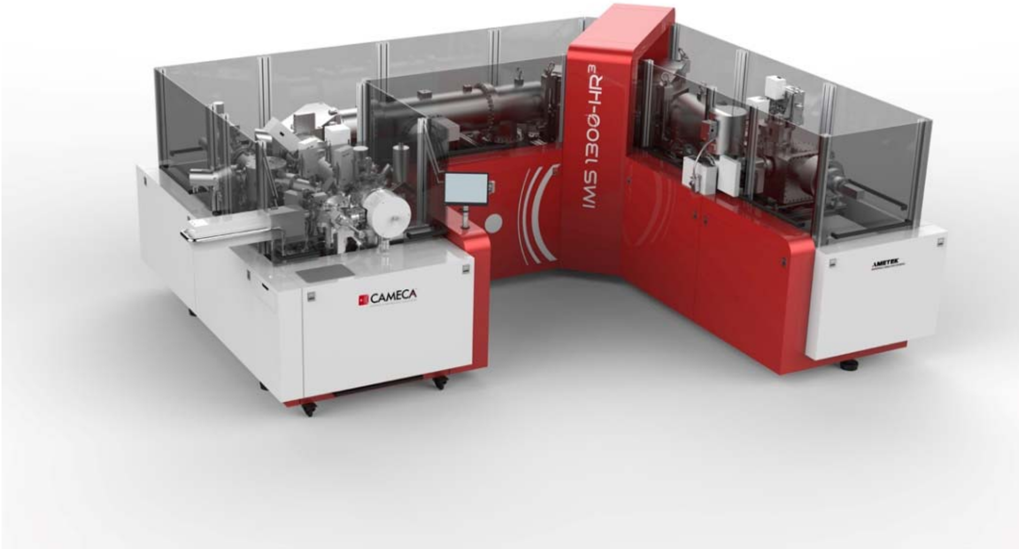


- Dual path does not require cell gas to be stopped
- High energy beam does not pass through RF multipoles and behaves exactly as the Plasma 3

Summary

- **Low Energy Path with Collision/Reaction cell for interference removal**
- **High energy Path for classical Multi-Collector performance**
- **Up to 4 independently controlled reaction gas inlets**
- **Shipment of the first instrument to Harvard in Q3 2017** (K and Ca isotopes for cosmo-chemistry applications).

Mid-2016: Introducing the IMS 1300-HR^3



IMS 1300-HR^3

High **R**eproducibility

High Spatial **R**esolution

High Mass **R**esolution

- High brightness RF-plasma oxygen ion source
- Automated sample loading system
- Motorized sample height (Z) adjustment
- UV-light microscope
- Low noise 1 E12 Ω resistor Faraday cup preamplifier boards
- Pfeiffer turbo-molecular pumps
- Updated Electronics & Software

Mid-2017: testing the IMS 1300-HR3 before shipment in Sept. to JAEA

Preparing the opening of a showroom at CAMECA

Finishing the installation of an EPMA SX Five FE, an IMS 7f-Auto and a NanoSIMS 50L.

- The NS50L will be operated from a separate control room.
- THERMO water chiller (water-water) and ERKOM air compressor (8bars) in the same room.

CAMECA SCIENCE & METROLOGY SOLUTIONS

CAMECA Organization & new personnel

Jean-Charles Chen,
CAMECA BU manager

Jean-Charles Chen,
Acting VP Sales & Service

Patrick McCarthy, Global OPEX Director
+ **acting Global Service Manager**

R&D and Product Marketing
Dr. Michel Schuhmacher
(Dr. Laurent Roussel)

SIMS Sales,
academic
Philippe Saliot

Subsidiaries
(sales & service)

Claude Guignes,
Services Operation

Dr. Etienne Wortham,
Service Business

Mathias Carrachioli,
FSE manager France

Dr. Wolfgang Berneike,
Country manager, Cameca Ger.

Dr. Ulrich Erkhe,
Service manager, Cameca Ger.

CAMECA Organization & new personnel

R&D and Product Marketing
Dr. Michel Schuhmacher
(Dr. Laurent Roussel)

R&D

- François Hillion: adjunct R&D mgr
  & NanoSIMS project leader
- **Dr. Nicolas Saquet, ion sources**

Product Marketing

Dr. Dave Larson manages the technical product mgrs:

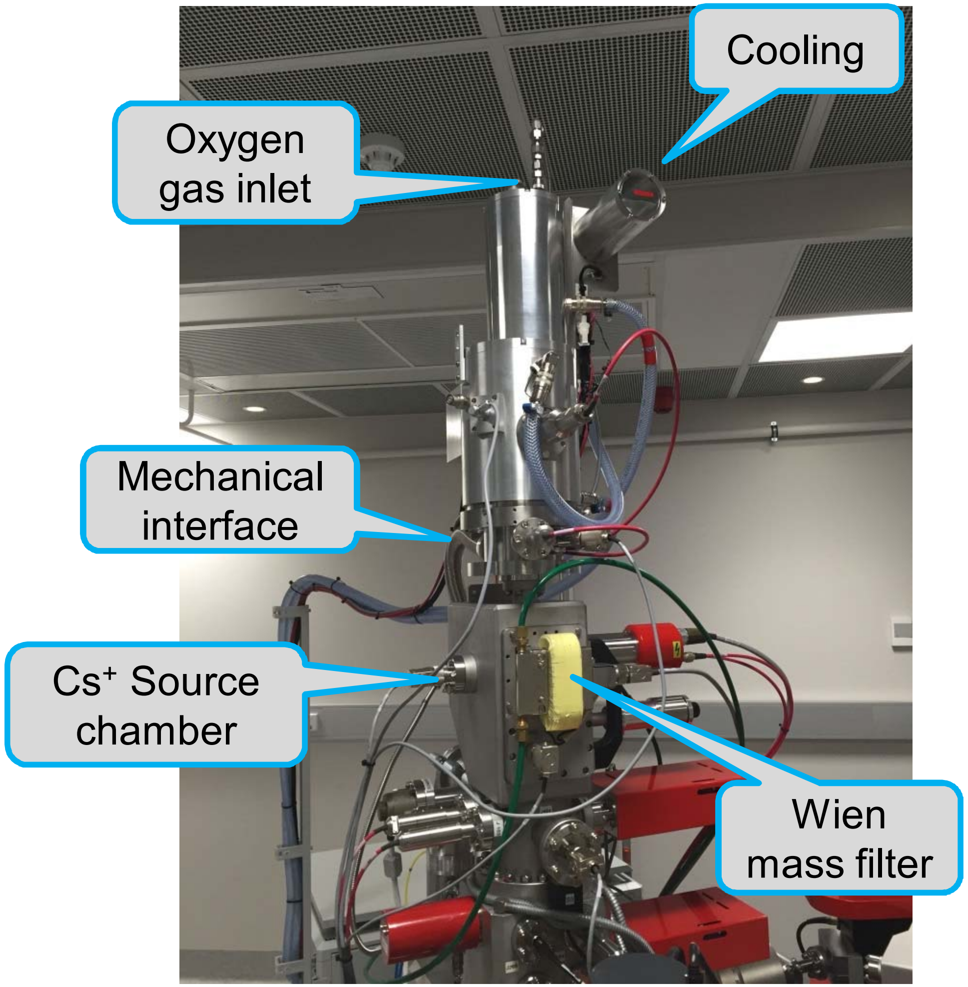
- Dr. Paula Peres: IMS 7f, IMS 1300
- Dr. Olivier Dulac: LEXES, IMS Wf & SCU
- Dr. Anne-Sophie Robbes: SX 5 EPMA
- Dr. Rob Ulfig: EIKOS APT
- **Dr. David Reinhardt: LEAP APT**
- François Horréard: NanoSIMS

Each PM manages the corresponding App. Lab

➔ CAMECA searching (again) for a NS50 application lab manager !

A new RF-plasma O^- primary ion source

NS50L equiped with RF plasma



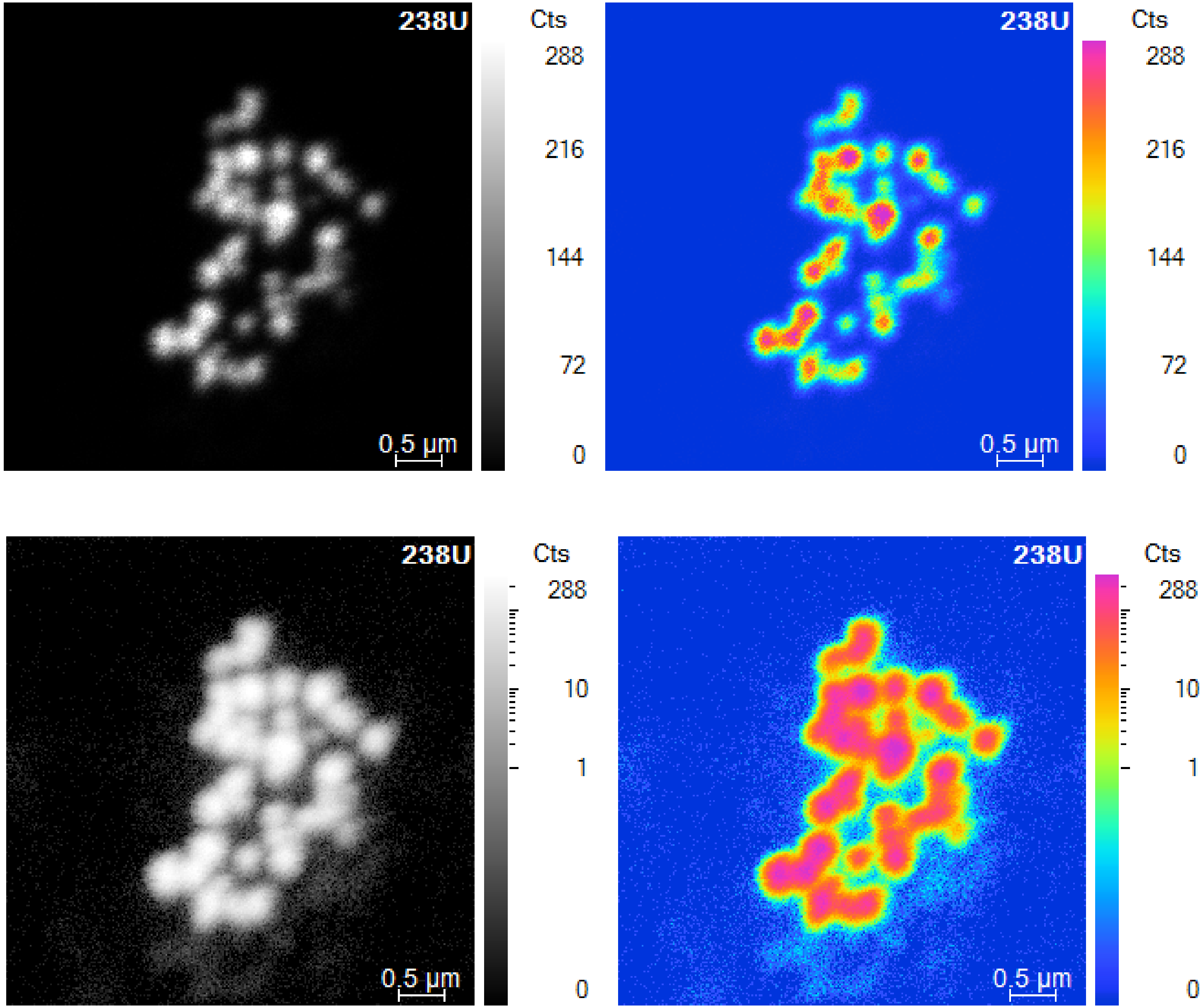
RF plasma O- primary ion source

Rack for electronics & cooler

Similar performance between the new RF-plasma ion source in O^- mode and the CAMECA microbeam Cs^+ ion source.

Photos by courtesy of Pr. M. Kilburn, UWA, Perth, Australia.

U Particles with RF plasma O- ion source

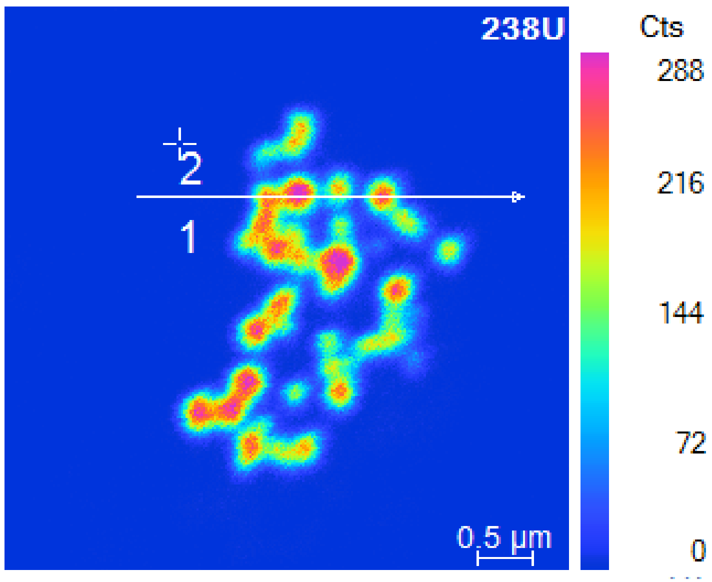


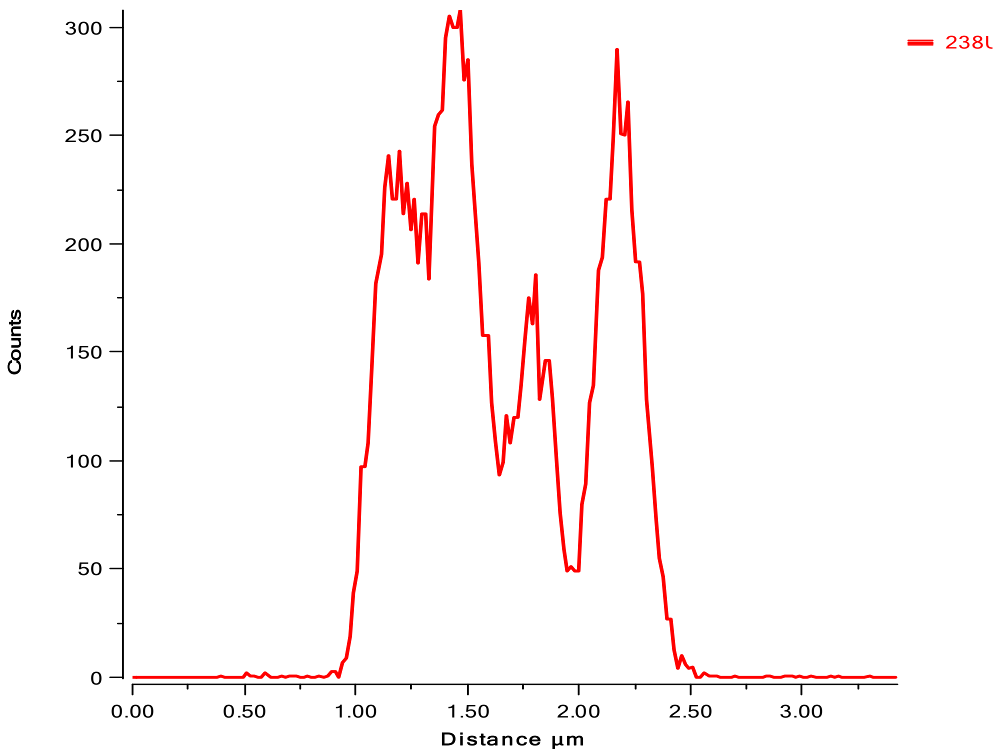
Linear scale

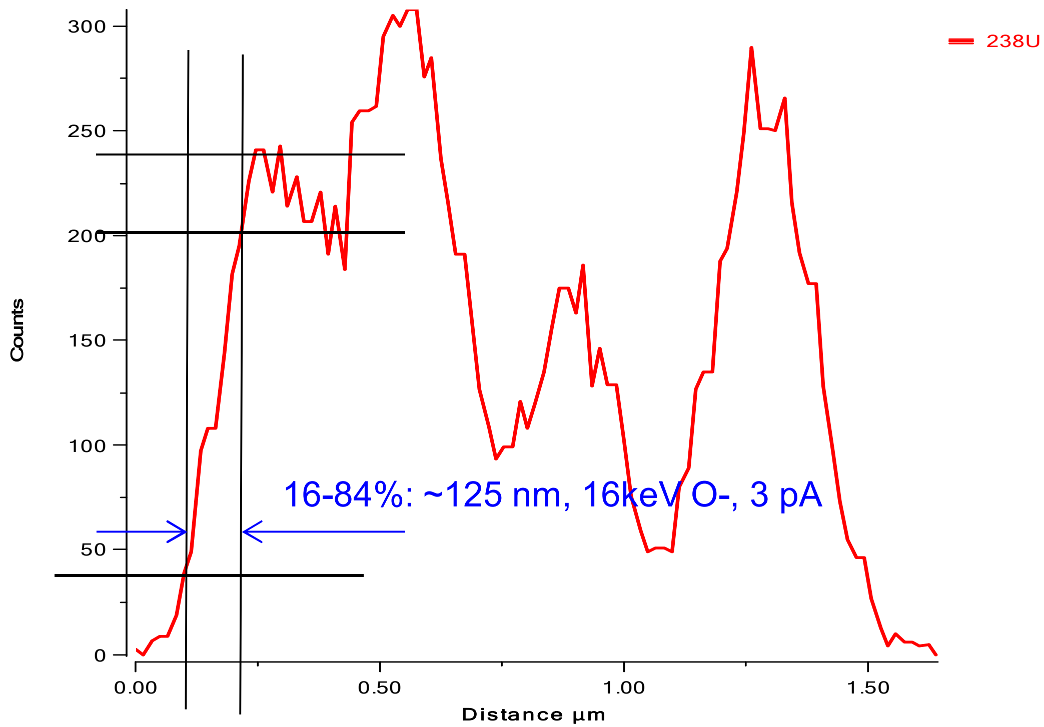
LOG scale

Elements	Field of View, µm	Nb pixels	Dwell, ms/pix/cycle	Cycles	Total acq time	Primary beam current (pA)
250.577	5 x 5	256 x 256	4	1	4m 41s	3

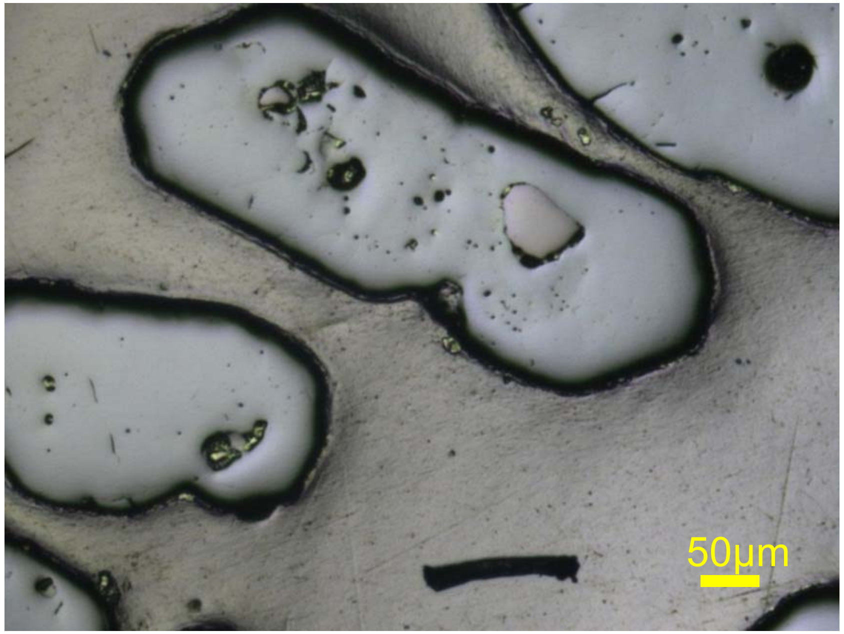
U Particles with RF plasma O- ion source







Improved in-situ optical microscope & LED illumination



Zircon grains, 700 µm FOV

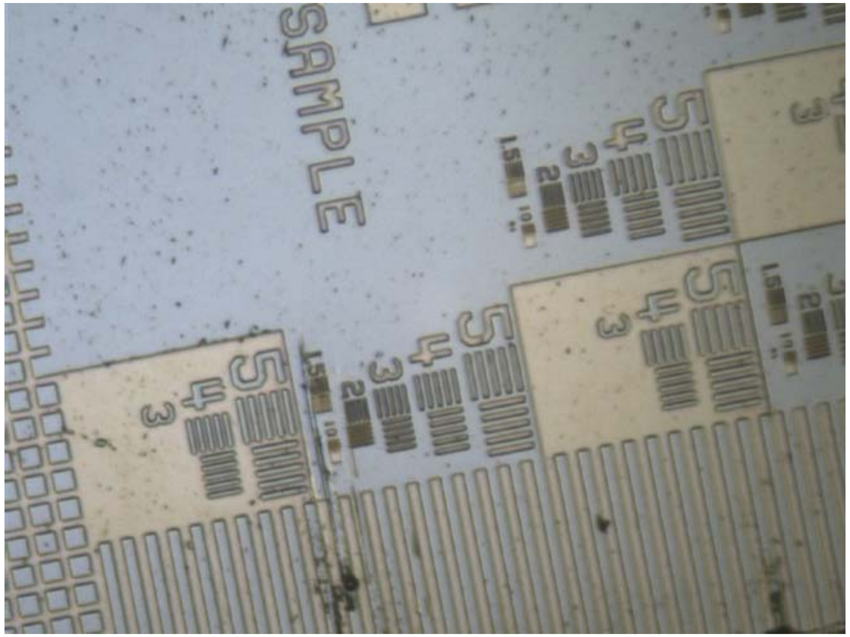
2052 x 2456 pixel digital camera

Fixed 700µm FOV

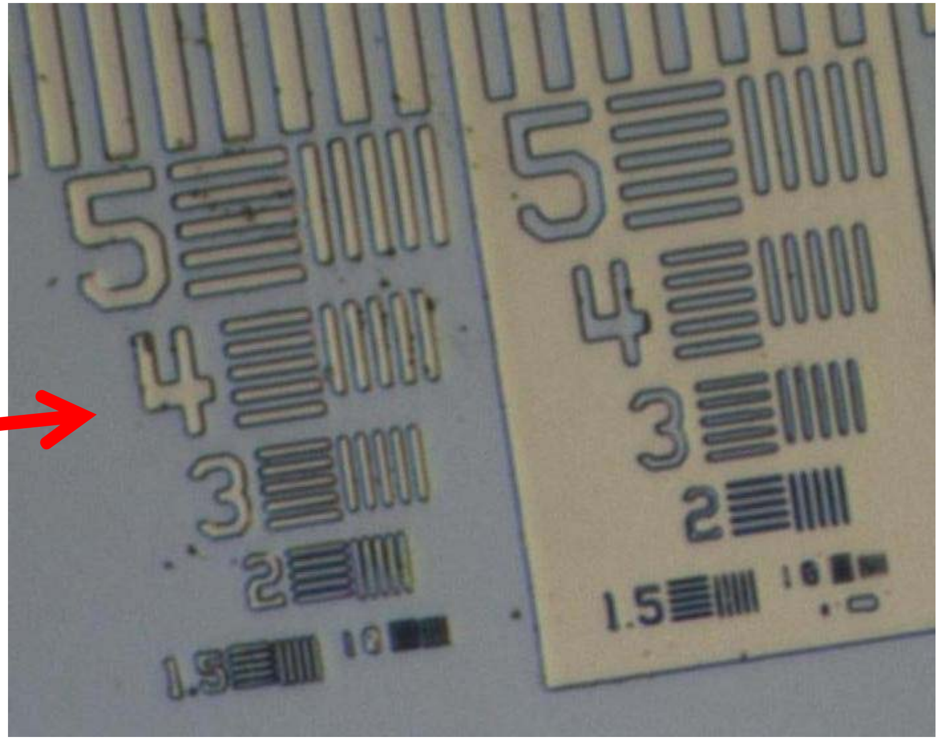
Digital zoom: no mechanical shift when zooming.

Homogeneous white LED illumination over the FOV.

1.5 µm lateral resolution

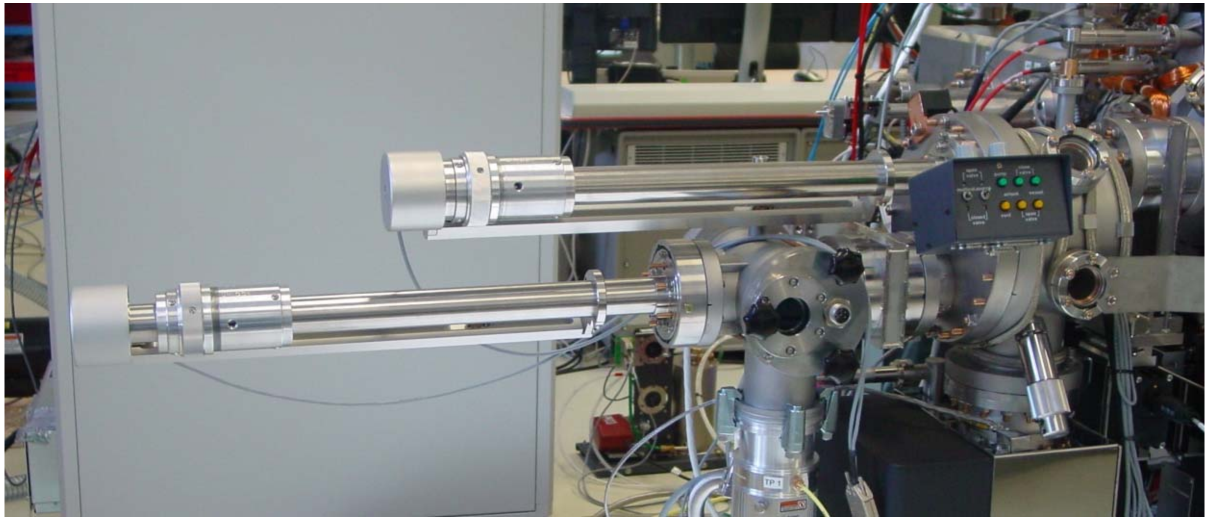


700 µm FOV



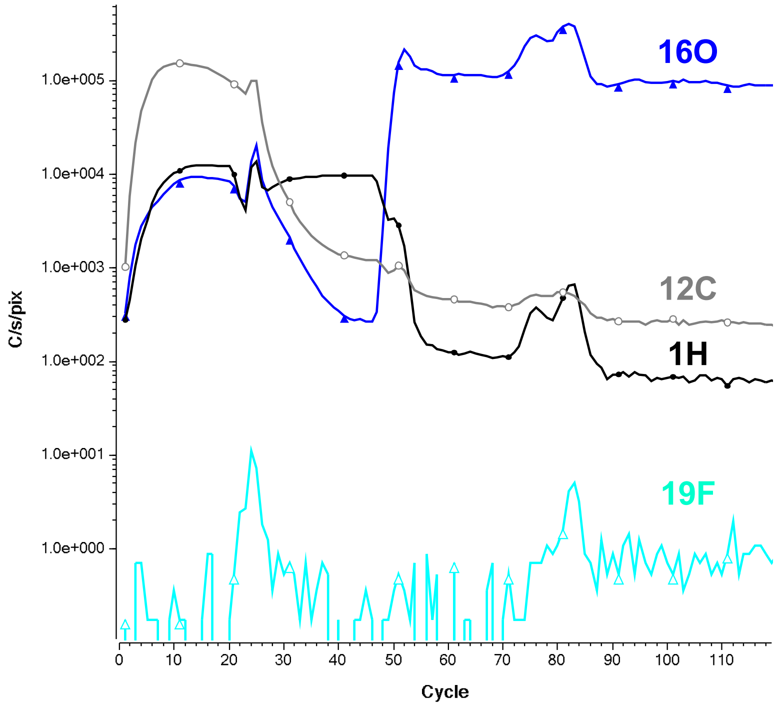
Digital zoom

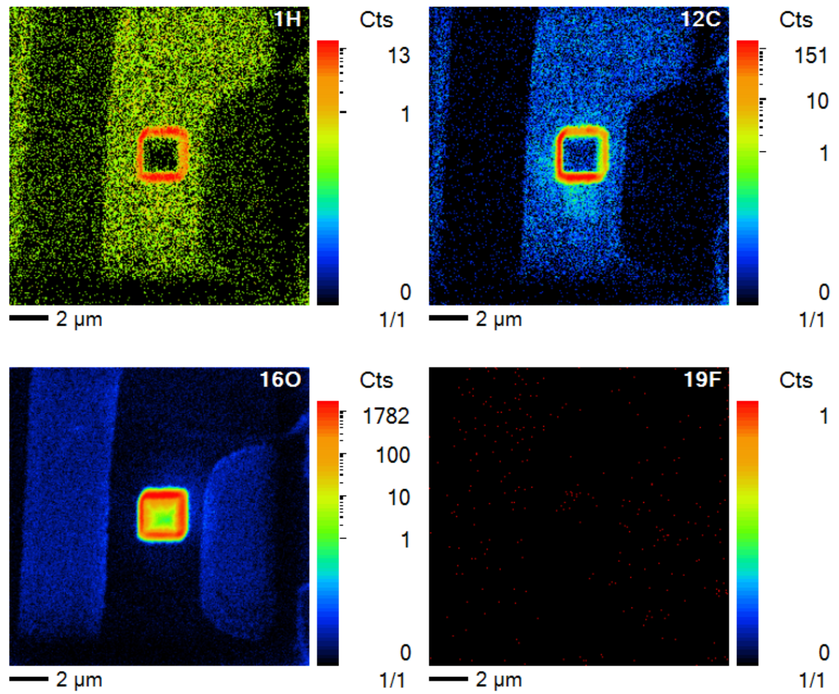
Magnetic transfer rods



NanoSIMS control software:
the current version is V 4.4

2 x 2 µm direct profiles





2 x 2 µm crater after depth profile

- **The NanoSIMS permits depth profiling from a few µm² areas with unique sensitivity**
- **For µm-size structures with high aspect ratio, direct profiles can be faster than profile reconstruction from ROIs**
- **Sample drift can become a limitation**

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Alternated Drift correction

To be tested hopefully for SIMS XXI…

Alternated drift correction for **very small direct depth profiles** or image stacks **without contrast :**

- Recording **image #1 of a small detail** present in the largest FoV accessible, before starting acquisition (SEM, TIC, SIMS),
- **Start** image stack or direct depth profile acquisition,
- After a preset cycle nb, automated **pause**, de-zoom, zoom on the small detail, record and save the **image #2**,
- **Compare** images i and i+1, apply **drift correction**, correct beam position with electrostatic **deflection**,
- **Restart** image stack or profile,

Etc…

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WinImage II: version 4.4

- **Switch to Windows (7 & 10) 64 bits**: better handling of large image stacks
- Copy-Paste of images:
  - in **EMF** (vectorial format keeping texts sharp)
  - Without border (for mosaics)
  - With 0, 1 or 2 lines of infos below the images
- Import of **external images** (SEM, TEM, optical, …) , streching, rotation, scaling and matching **SIMS-External or External -SIMS.**
- **Superimposition of 3D images in RGB** (red green blue)
- **Image filtering** (= smoothing: Gaussian, Median, Box)
- Display of profiles from multiple ROIs and line-scans from multiple cycles: ergonomy, saveable symbols & colors, flexibility
- **Reduction of stacks**: pixel summing, cycle summing, cycle suppressions
- **Cycle automatic scan** allowing 3D movies recording
- Caliper: distance measurement on images
- Corrections of many former Pbs

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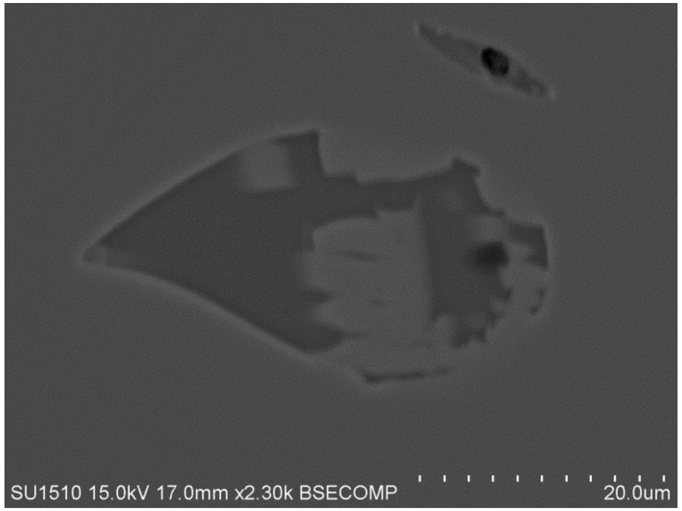
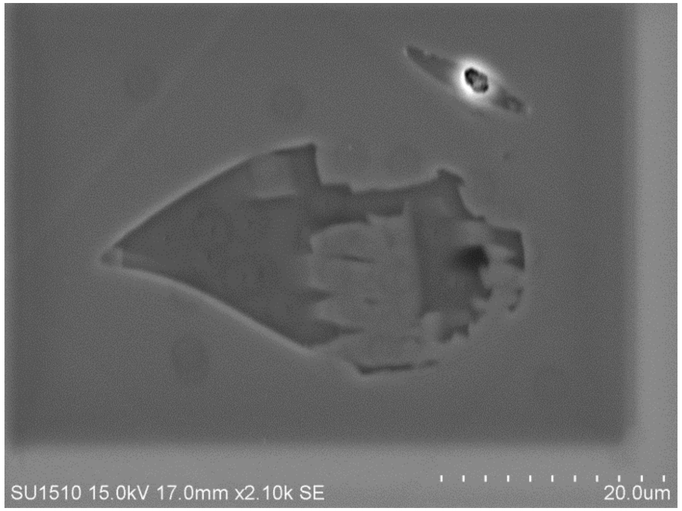
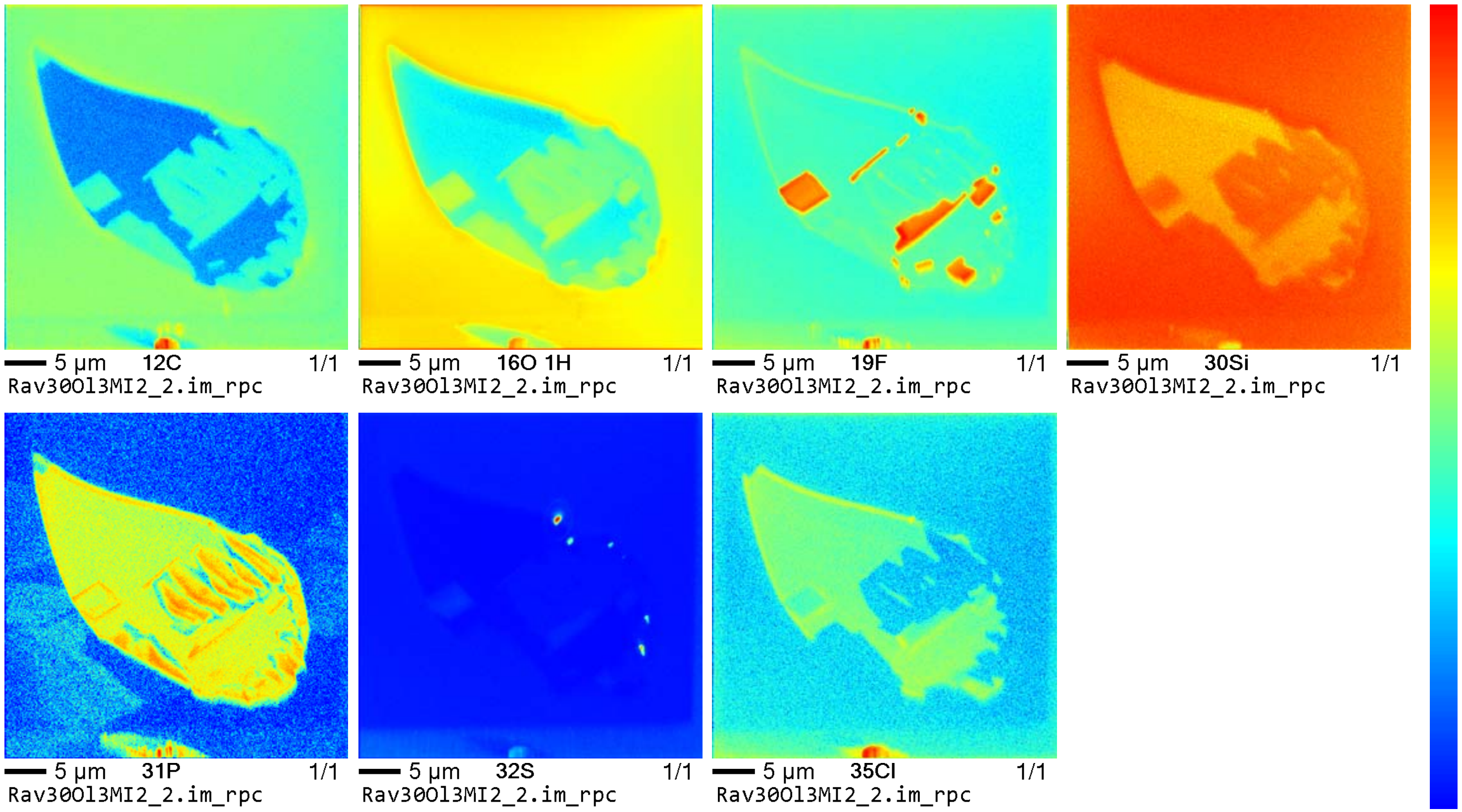
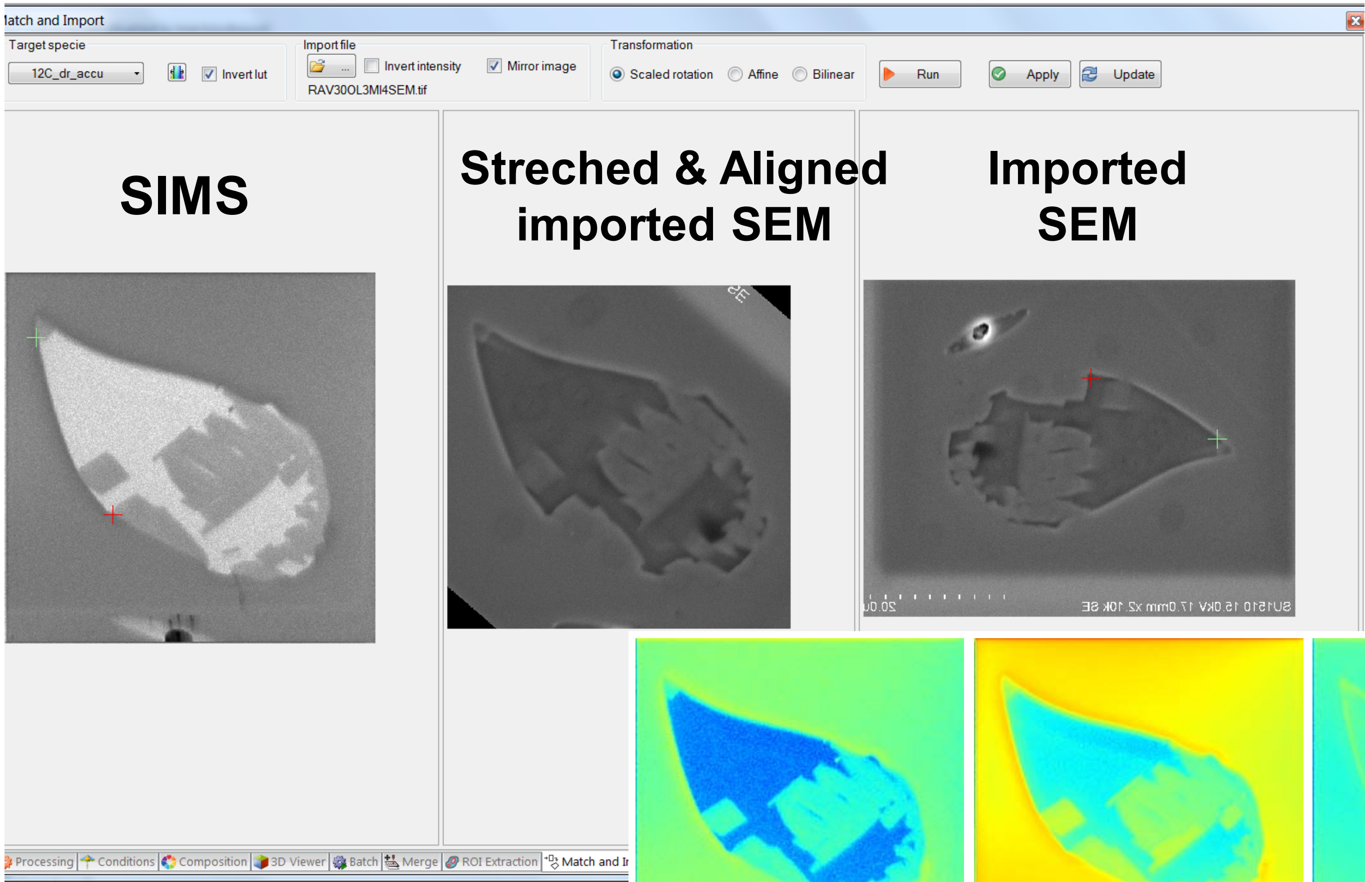
Import external images (BSE, SEM, ….)

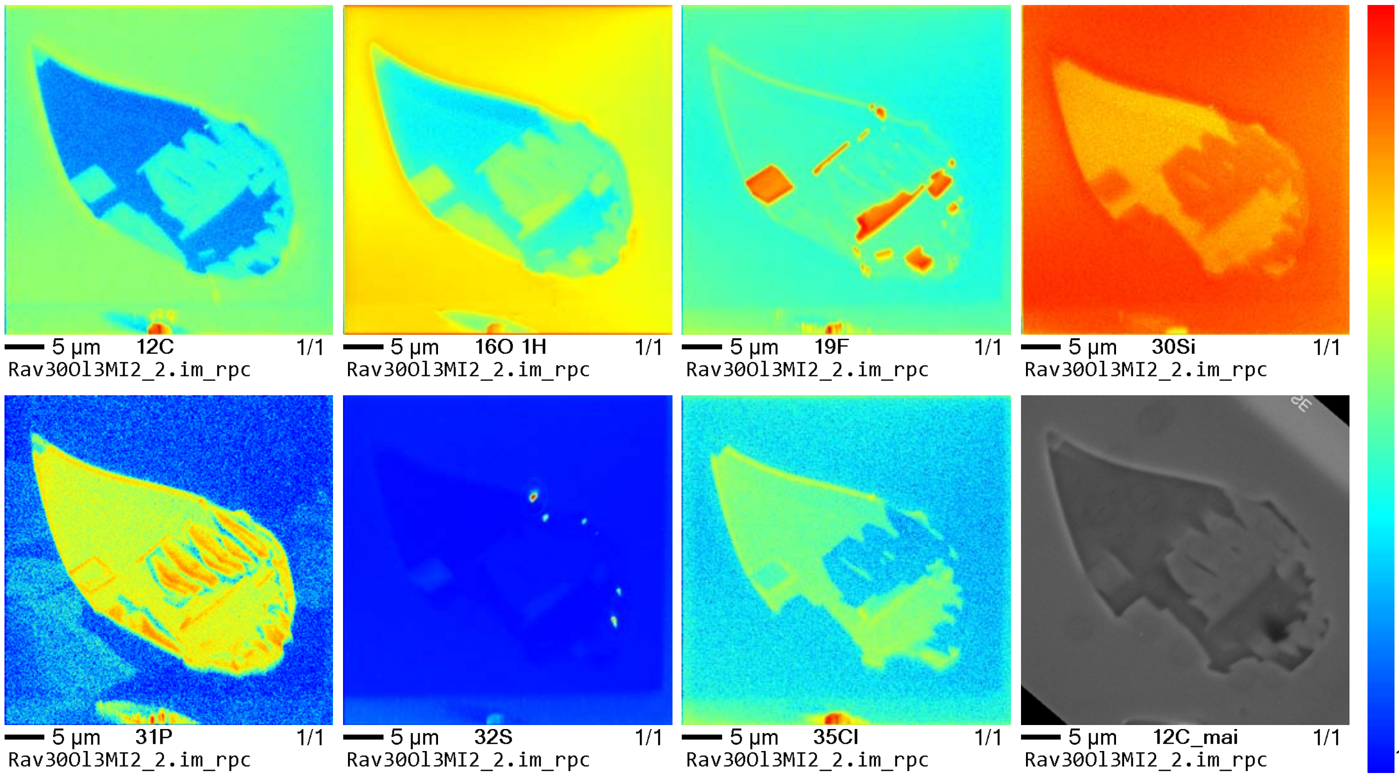






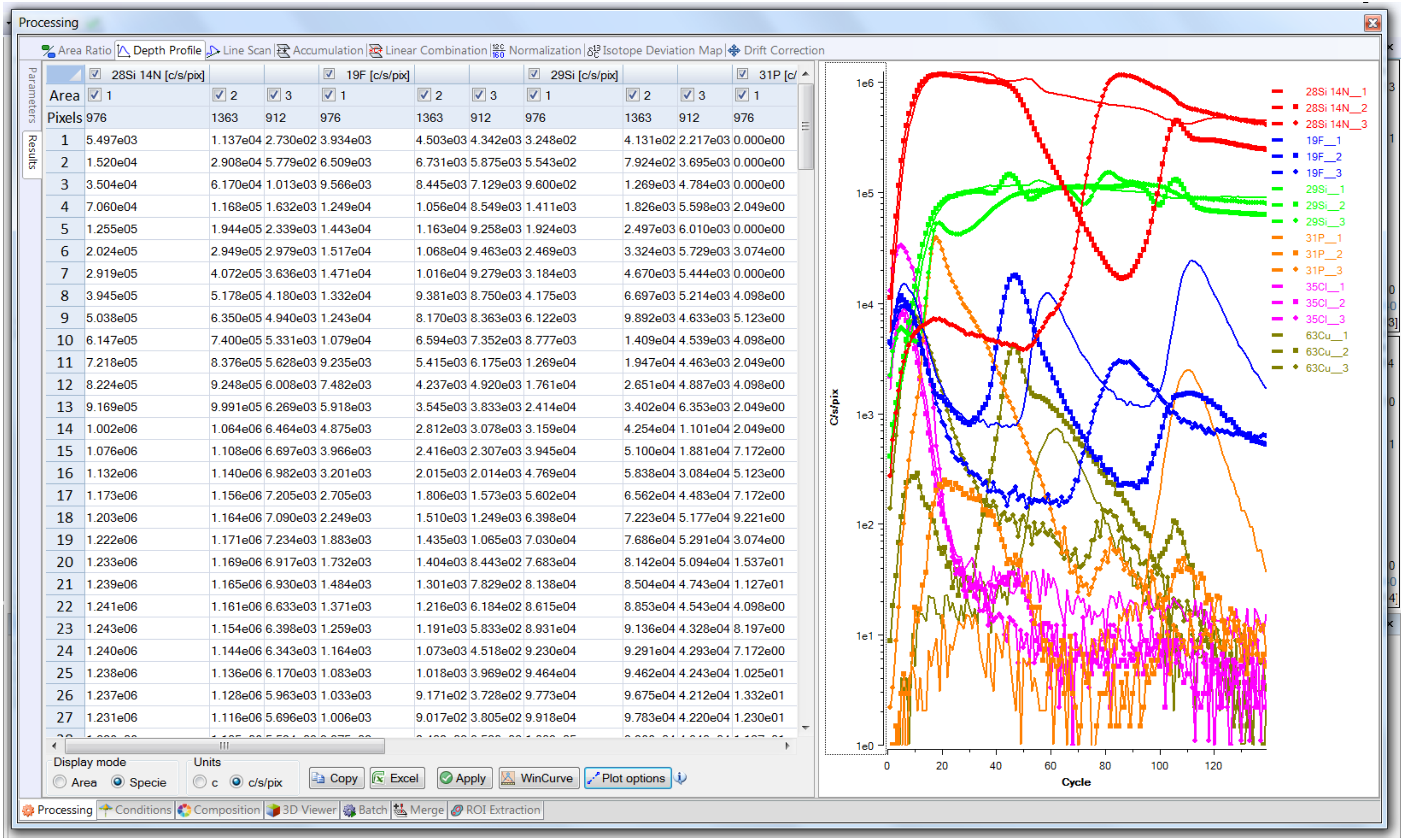
Automated strech and superimposition of external image (2, 3 or 4 alignment points)





Images by courtesy of Motoo Ito, JAMSTEC

WinImage II, Multi ROI Depth Profiles



	28Si 14N [c/s/pix]			19F [c/s/pix]			29Si [c/s/pix]			31P [c/
Area	1	2	3	1	2	3	1	2	3	1
Pixels	976	1363	912	976	1363	912	976	1363	912	976
1	5.497e03	1.137e04	2.730e02	3.934e03	4.503e03	4.342e03	3.248e02	4.131e02	2.217e03	0.000e00
2	1.520e04	2.908e04	5.779e02	6.509e03	6.731e03	5.875e03	5.543e02	7.924e02	3.695e03	0.000e00
3	3.504e04	6.170e04	1.013e03	9.566e03	8.445e03	7.129e03	9.600e02	1.269e03	4.784e03	0.000e00
4	7.060e04	1.168e05	1.632e03	1.249e04	1.056e04	8.549e03	1.411e03	1.826e03	5.598e03	2.049e00
5	1.255e05	1.944e05	2.339e03	1.443e04	1.163e04	9.258e03	1.924e03	2.497e03	6.010e03	0.000e00
6	2.024e05	2.949e05	2.979e03	1.517e04	1.068e04	9.463e03	2.469e03	3.324e03	5.729e03	3.074e00
7	2.919e05	4.072e05	3.636e03	1.471e04	1.016e04	9.279e03	3.184e03	4.670e03	5.444e03	0.000e00
8	3.945e05	5.178e05	4.180e03	1.332e04	9.381e03	8.750e03	4.175e03	6.697e03	5.214e03	4.098e00
9	5.038e05	6.350e05	4.940e03	1.243e04	8.170e03	8.363e03	6.122e03	9.892e03	4.633e03	5.123e00
10	6.147e05	7.400e05	5.331e03	1.079e04	6.594e03	7.352e03	8.777e03	1.409e04	4.539e03	4.098e00
11	7.218e05	8.376e05	5.628e03	9.235e03	5.415e03	6.175e03	1.269e04	1.947e04	4.463e03	2.049e00
12	8.224e05	9.248e05	6.008e03	7.482e03	4.237e03	4.920e03	1.761e04	2.651e04	4.887e03	4.098e00
13	9.169e05	9.991e05	6.269e03	5.918e03	3.545e03	3.833e03	2.414e04	3.402e04	6.353e03	2.049e00
14	1.002e06	1.064e06	6.464e03	4.875e03	2.812e03	3.078e03	3.159e04	4.254e04	1.101e04	2.049e00
15	1.076e06	1.108e06	6.697e03	3.966e03	2.416e03	2.307e03	3.945e04	5.100e04	1.881e04	7.172e00
16	1.132e06	1.140e06	6.982e03	3.201e03	2.015e03	2.014e03	4.769e04	5.838e04	3.084e04	5.123e00
17	1.173e06	1.156e06	7.205e03	2.705e03	1.806e03	1.573e03	5.602e04	6.562e04	4.483e04	7.172e00
18	1.203e06	1.164e06	7.090e03	2.249e03	1.510e03	1.249e03	6.398e04	7.223e04	5.177e04	9.221e00
19	1.222e06	1.171e06	7.234e03	1.883e03	1.435e03	1.065e03	7.030e04	7.686e04	5.291e04	3.074e00
20	1.233e06	1.169e06	6.917e03	1.732e03	1.404e03	8.443e02	7.683e04	8.142e04	5.094e04	1.537e01
21	1.239e06	1.165e06	6.930e03	1.484e03	1.301e03	7.829e02	8.138e04	8.504e04	4.743e04	1.127e01
22	1.241e06	1.161e06	6.633e03	1.371e03	1.216e03	6.184e02	8.615e04	8.853e04	4.543e04	4.098e00
23	1.243e06	1.154e06	6.398e03	1.259e03	1.191e03	5.833e02	8.931e04	9.136e04	4.328e04	8.197e00
24	1.240e06	1.144e06	6.343e03	1.164e03	1.073e03	4.518e02	9.230e04	9.291e04	4.293e04	7.172e00
25	1.238e06	1.136e06	6.170e03	1.083e03	1.018e03	3.969e02	9.464e04	9.462e04	4.243e04	1.025e01
26	1.237e06	1.128e06	5.963e03	1.033e03	9.171e02	3.728e02	9.773e04	9.675e04	4.212e04	1.332e01
27	1.231e06	1.116e06	5.696e03	1.006e03	9.017e02	3.805e02	9.918e04	9.783e04	4.220e04	1.230e01

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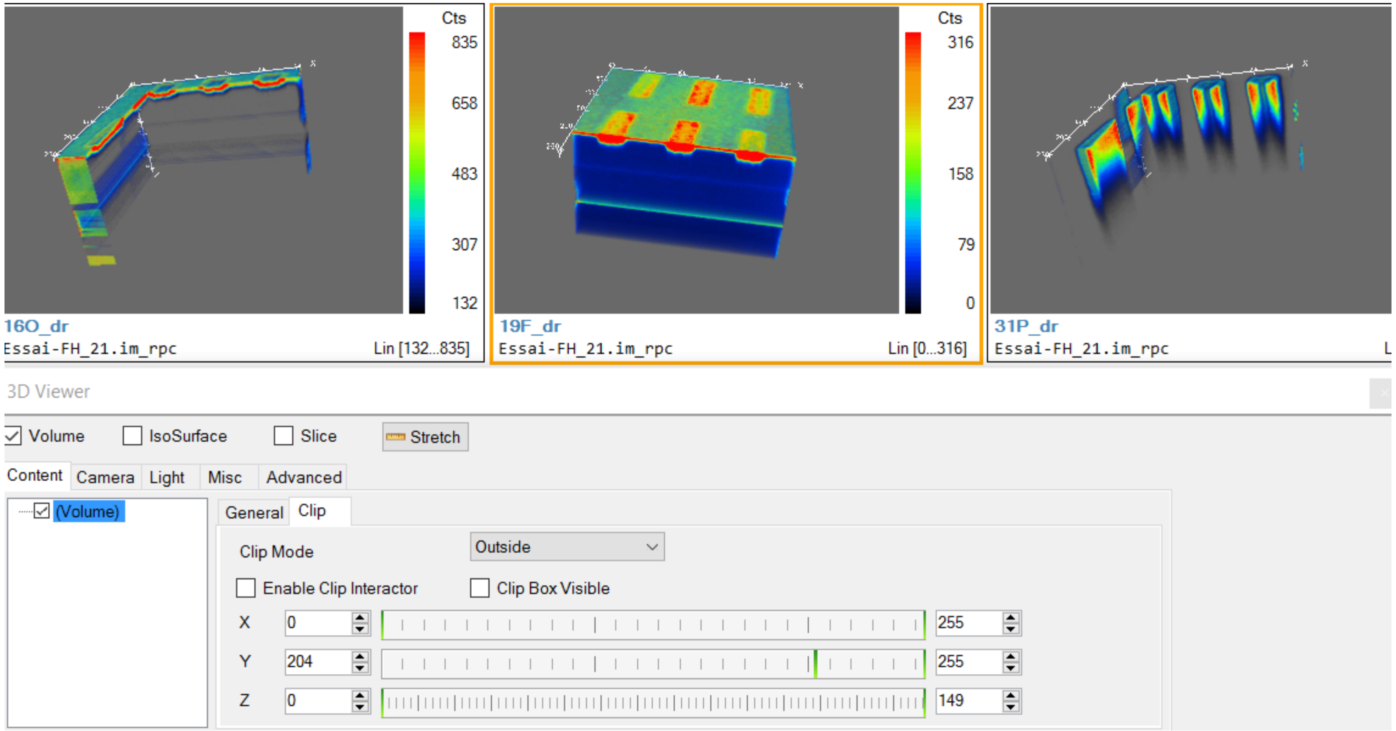
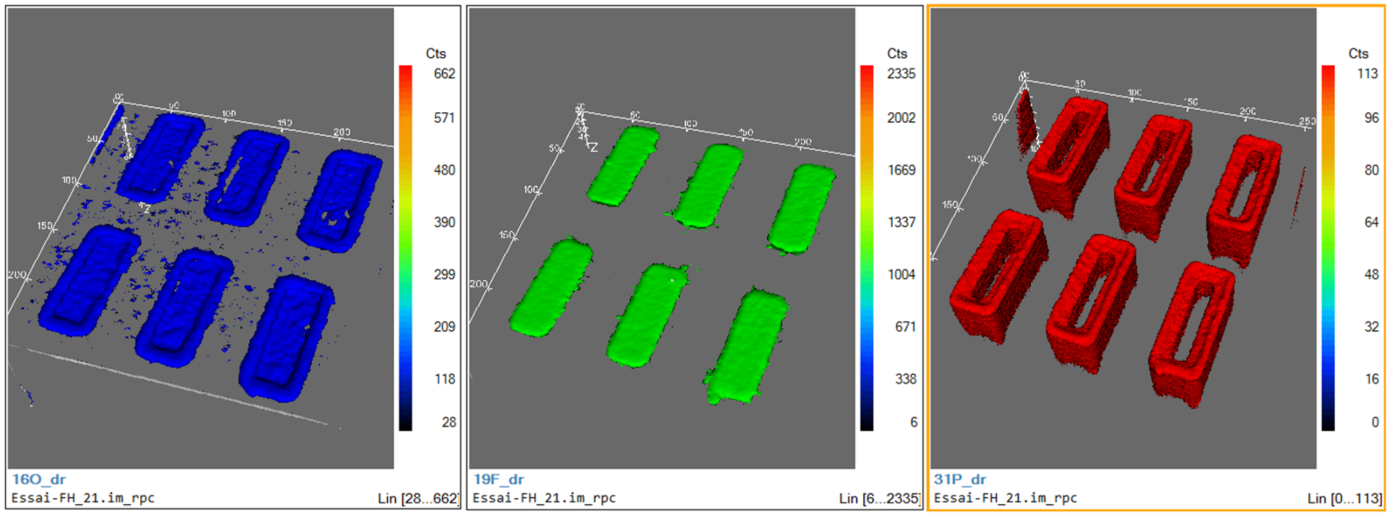
3D display

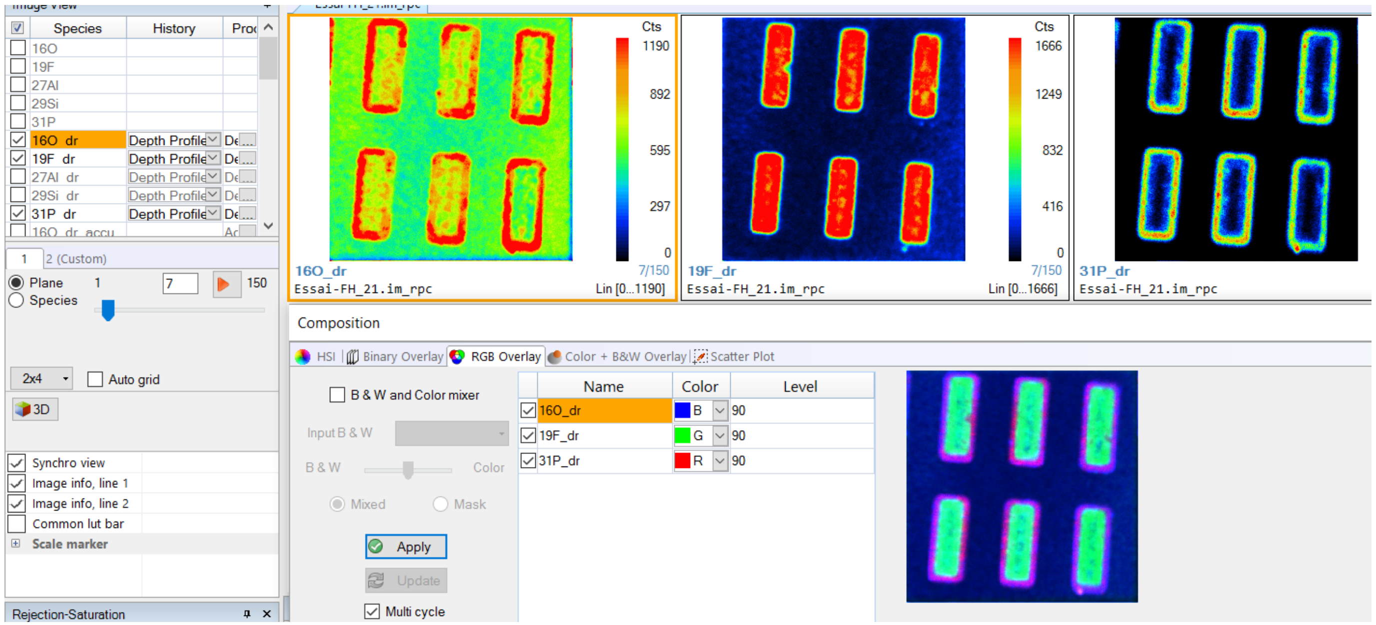
volume

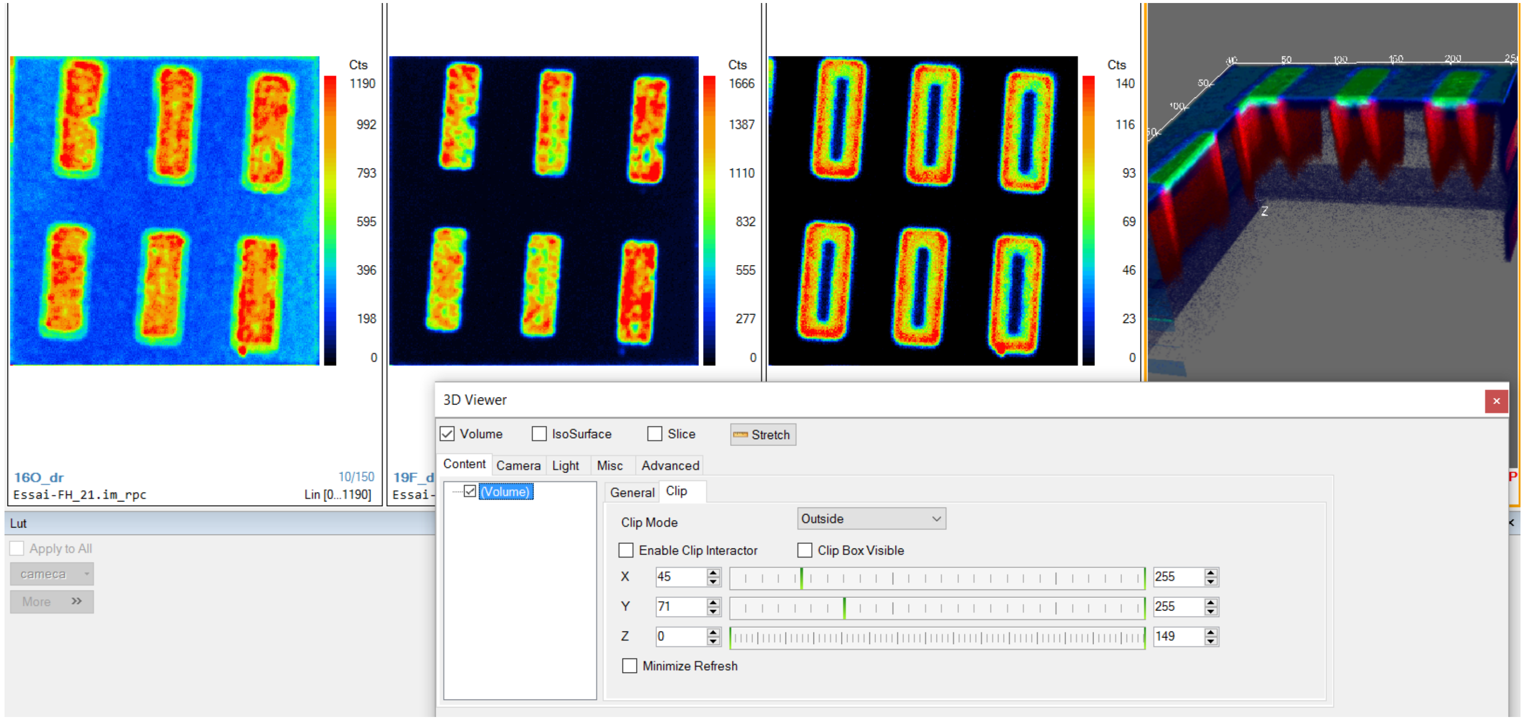


isosurface



3D view in RGB superimposition





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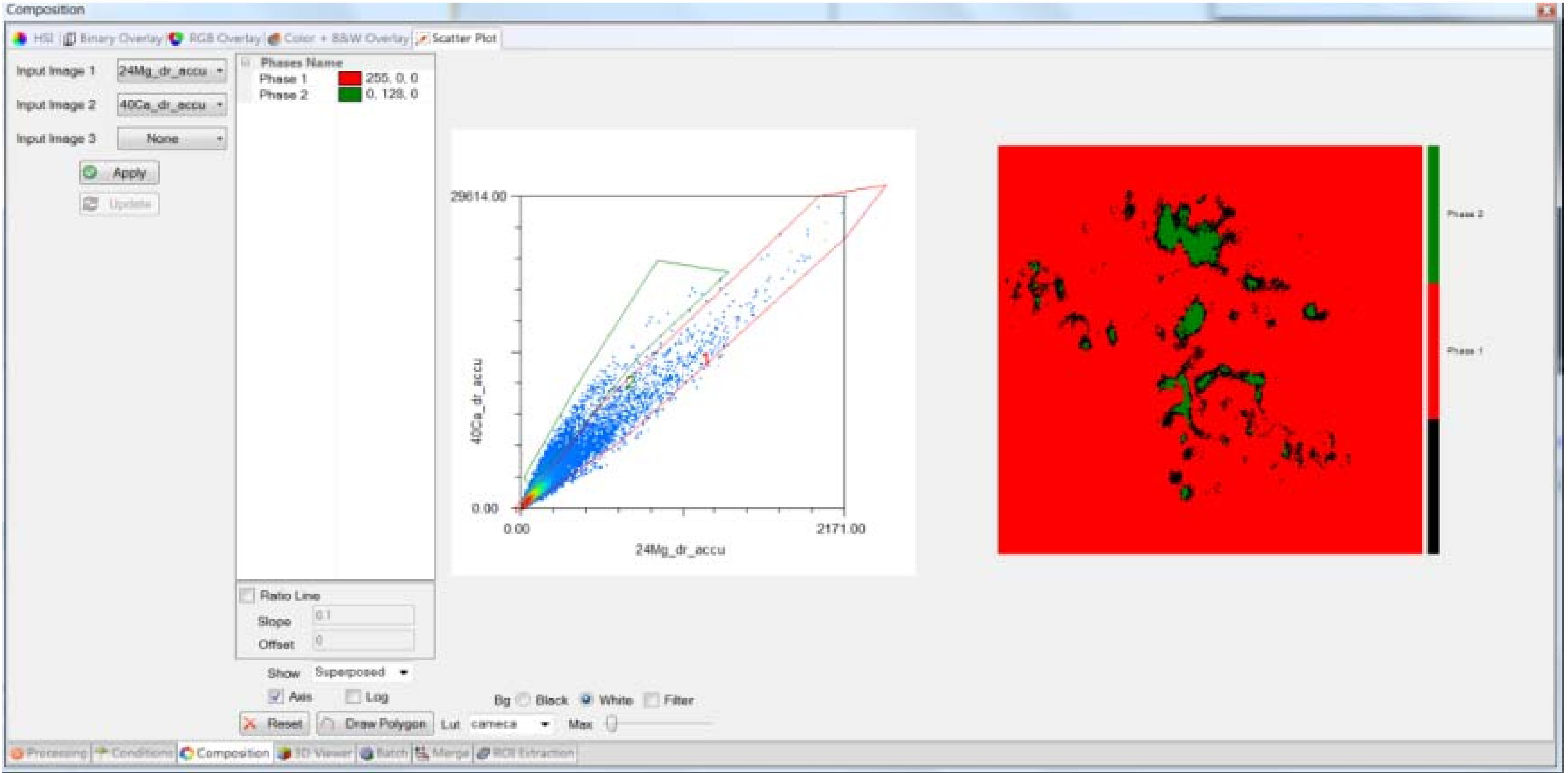
WinImage II, Scatter Plot



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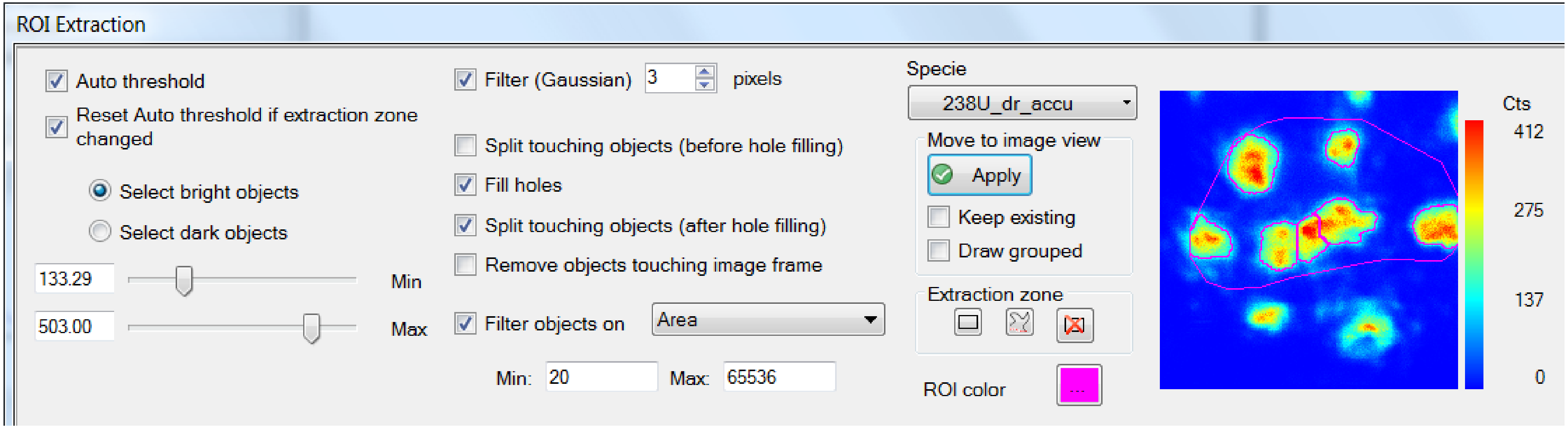
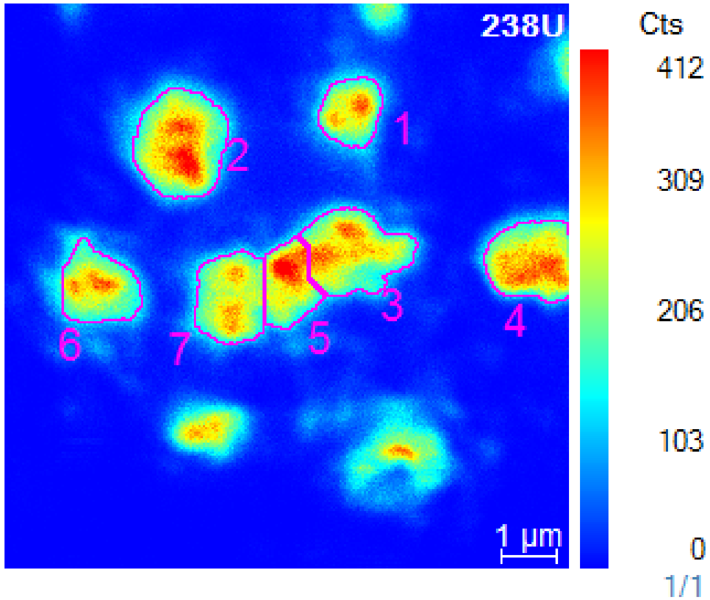
WinImage II, Automated ROI definition





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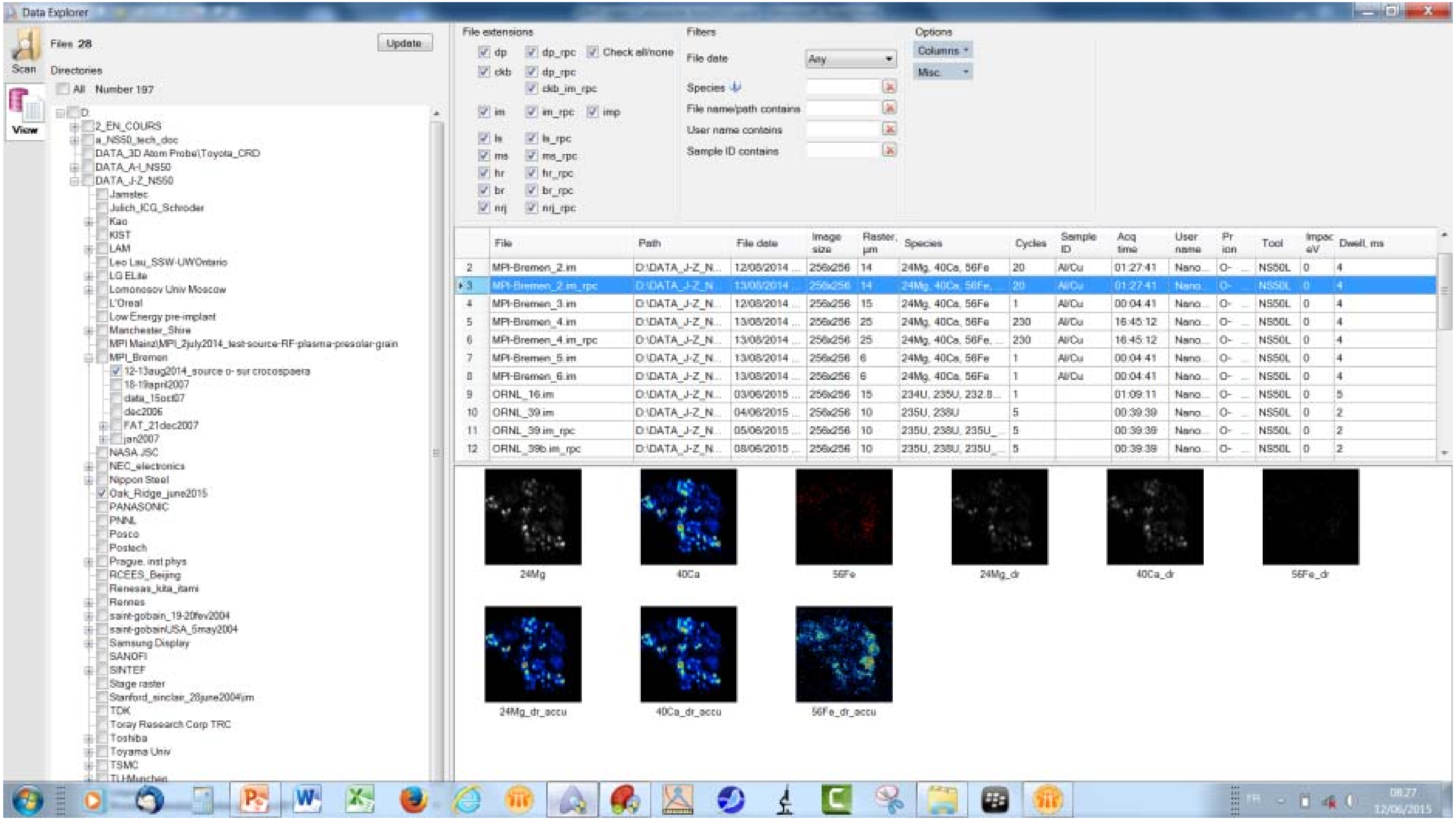
WinImage II, file manager



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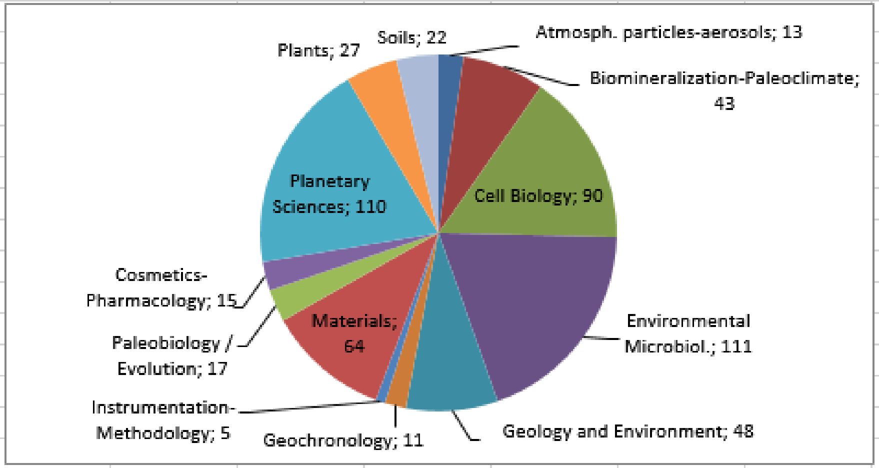

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325	SCI	2007	us	GEO	33,6	Extracellular proteins limit the dispersal of biogenic nanoparticles. John W. Moreau, P. K. Weber, M.C.Martin, B.Gilbert, I.D.Hutcheon, J.F.Banfield. SCIENCE, Vol. 316, 15
326		2007		geo	4,3	Chemical imaging with NanoSIMS: A window into deep-Earth geochemical processes. J. Badro, F. Ryerson, P.K. Weber, A. Ricolleau, S.J. Fallon, I.D. Hutcheon, F. Albarè
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328		2005		GEO	1,2	The application of HRTEM techniques and NanoSIMS to chemically and isotopically characterize Geobacter sulfurreducens surfaces. Fayek, M., S. Utsunomiya, S. M. Pf
329		2005		GEO		Study of the mechanism of diatom cell division by means of 29Si isotope tracing. J-N. Audinot, C. Guignard, H-N. Migeon, L. Hoffmann. SIMS XV proceedings, 2005.
330	cop	2002	de	GEO	3,7	EMP and SIMS studies on Mn/Ca and Fe/Ca systematics in benthic foraminifera from the Peruvian OMZ: a contribution to the identification of potential redox proxies
331		3000		GEOCHRON		**Geochronology** 11
332	els	2017	it, sa, us, d	EOCHRO	3,5	The effect of crystal-plastic deformation on isotope and trace element distribution in zircon: Combined BSE, CL, EBSD, FEG-EMPA and NanoSIMS study. Elizaveta Kovale
333	els	2017	tw, jp, cn	EOCHRO	2,7	The Triassic reworking of the Yunkai massif (South China): EMP monazite and U-Pb zircon geochronologic evidence. Cheng-Hong Chen, Yung-Hsin Liu, Chi-Yu Lee, Yuji
334	els	2015	cn	EOCHRO	5,7	Diagenetic xenotime dating to constrain the initial depositional time of the Yan-Liao Rift.Yan-Bin Zhang, Qiu-Li Li, Zhong-Wu Lan, Fu-Yuan Wu, Xian-Hua Li, Jin-Hui Ya
335	ELS	2014	jp	EOCHRO	7,4	New chronological constraints for Cryogenian to Cambrian rocks in the Three Gorges, Weng'an and Chengjiang areas, South China. Yoshihiro Okada, Yusuke Sawaki, T
336		2014	jp	EOCHRO	2,7	Ion microprobe U–Pb dating and Sr isotope measurement of a protoconodont. Yuji Sano, Kosaku Toyoshima, Akizumi Ishida, Kotaro Shirai, Naoto Takahata, Tomohiko
337		2014		GEOCHRO	1,7	Dating thin zircon rims by NanoSIMS: the Fengtien nephrite (Taiwan) is the youngest jade on Earth. Tzen-Fu Yui, Tadashi Usuki, Chun-Yen Chen, Akizumi Ishida, Yuji Sa
338	RSC	2012	cn	EOCHRO	3,2	Precise micrometre-sized Pb-Pb and U-Pb dating with NanoSIMS. Wei Yang, Yang-Ting Lin, Jian-Chao Zhang, Jia-Long Hao, Wen-Jie Shen and Sen Hu. J. Anal. At. Spectro
339	ELS	2008	jp	EOCHRO	7,4	Ion microprobe U–Pb dating of zircon with a 15 micrometer spatial resolution using NanoSIMS. Naoto Takahata, Yukiyasu Tsutsumi, Yuji Sano. Gondwana Research 14
340	els	2008	jp, cn	EOCHRO	7,4	Internal structures and U–Pb ages of zircons from a tuff layer in the Meishucunian formation, Yunnan Province, South China. Yusuke Sawaki, Manabu Nishizawa, Take
341	GSJ	2006	jp	EOCHRO	0,8	Ion microprobe U-Pb dating of monazite with about five micrometer spatial resolution. Yuji Sano,Naoto Takahata, Yukiyasu Tsutsumi and Tomoharu Miyamoto. Geoch
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343		3000		INSTRUM		**Instrumentation-Methodology** 5
344	acs	2016	fr	NSTRUM	5,7	A New Radio Frequency Plasma Oxygen Primary Ion Source on Nano Secondary Ion Mass Spectrometry for Improved Lateral Resolution and Detection of Electropositive
345	els	2016	fr	NSTRUM	5,9	Estimation of nitrogen-to-carbon ratios of organics and carbon materials at the submicrometer scale . Julien Alleon, Sylvain Bernard *, Laurent Remusat, Francois Rob
346	avs	2016	us	NSTRUM	1,9	Quantifying element incorporation in multispecies biofilms using nanoscale secondary ion mass spectrometry image analysis . Ryan S. Renslow, Stephen R. Lindema
347	els	2015	fr	NSTRUM	2	Hydrogen isotopic fractionation in secondary ion mass spectrometryusing polyatomic ions. Noémie Bardin, Jean Duprat, Georges Slodzian, Ting-Di Wu, Donia Baklouti

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Thank you for your attention !

We have in the room today:

Dr. Wolfgang Berneike, General manager CAMECA Germany

Dr. Ulrich Erkhe, Service manager, CAMECA Germany

Mr. Patrick Mc Carthy, Global OPEX Director & acting Global Service Manager

Dr. Etienne Wortham, Service Business

Mr. François Hillion, NanoSIMS project leader

Mr. François Horréard, NanoSIMS product manager