Cryogenic SIMS

for Cosmochemistry and Biology

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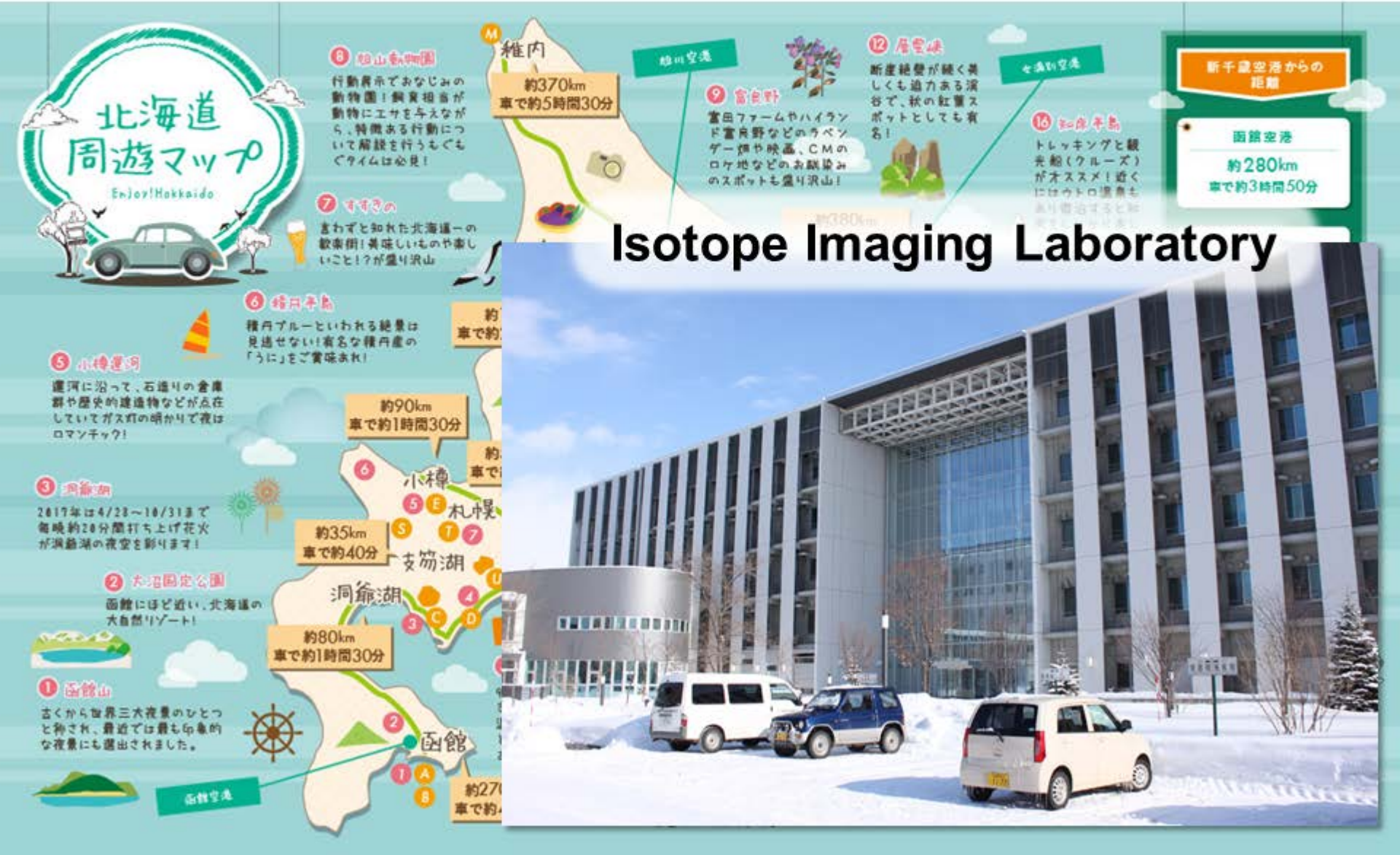
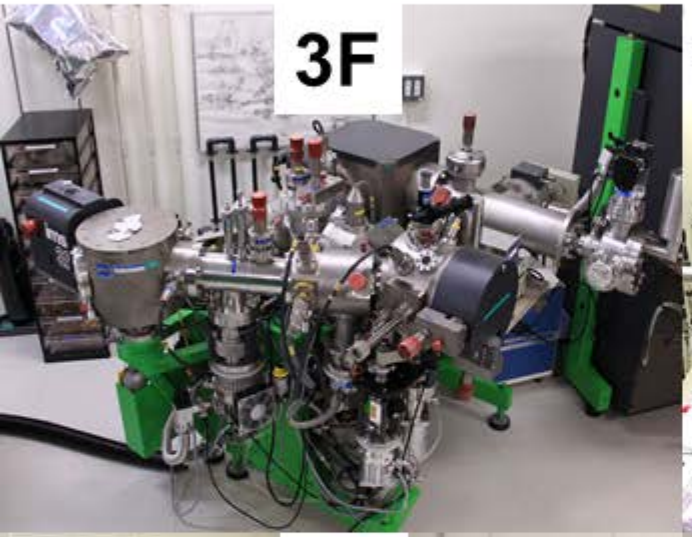
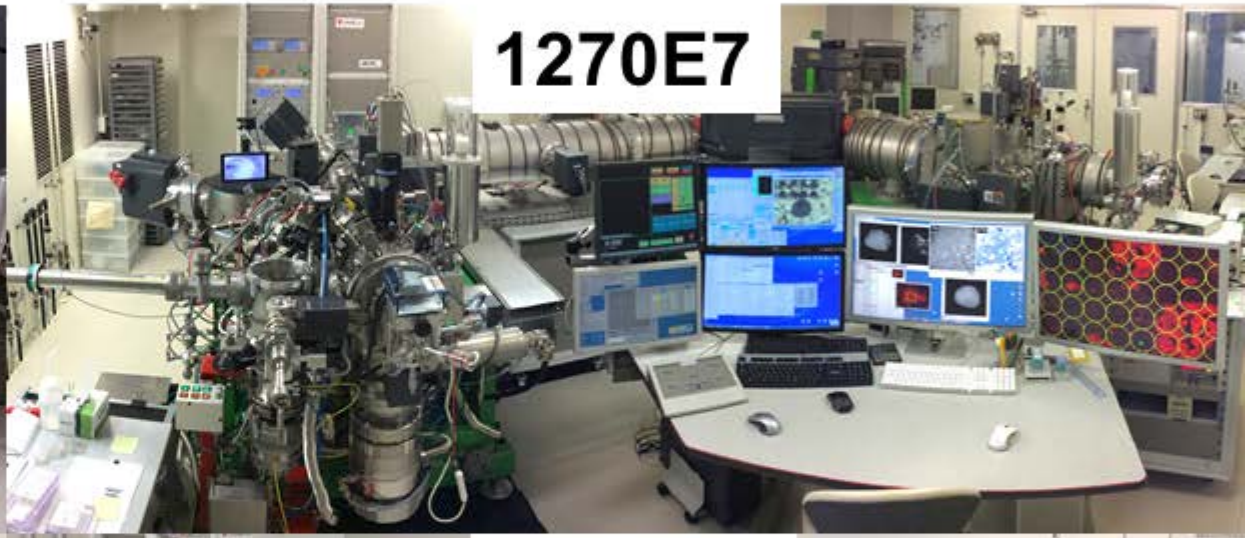
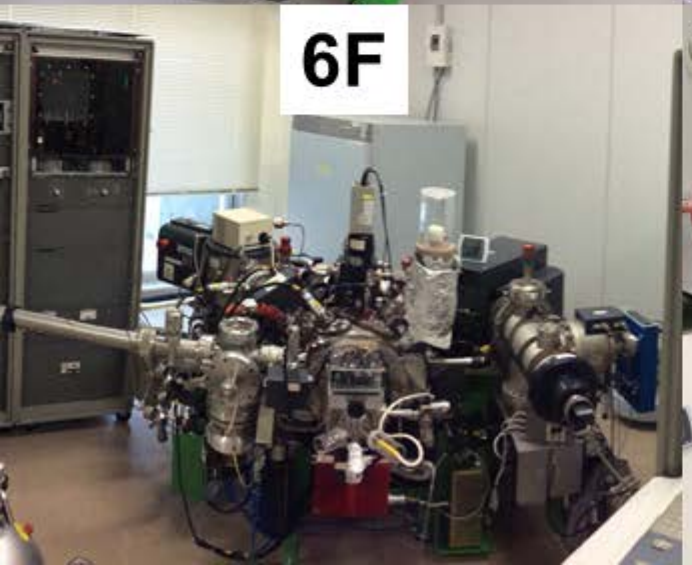
Hokkaido

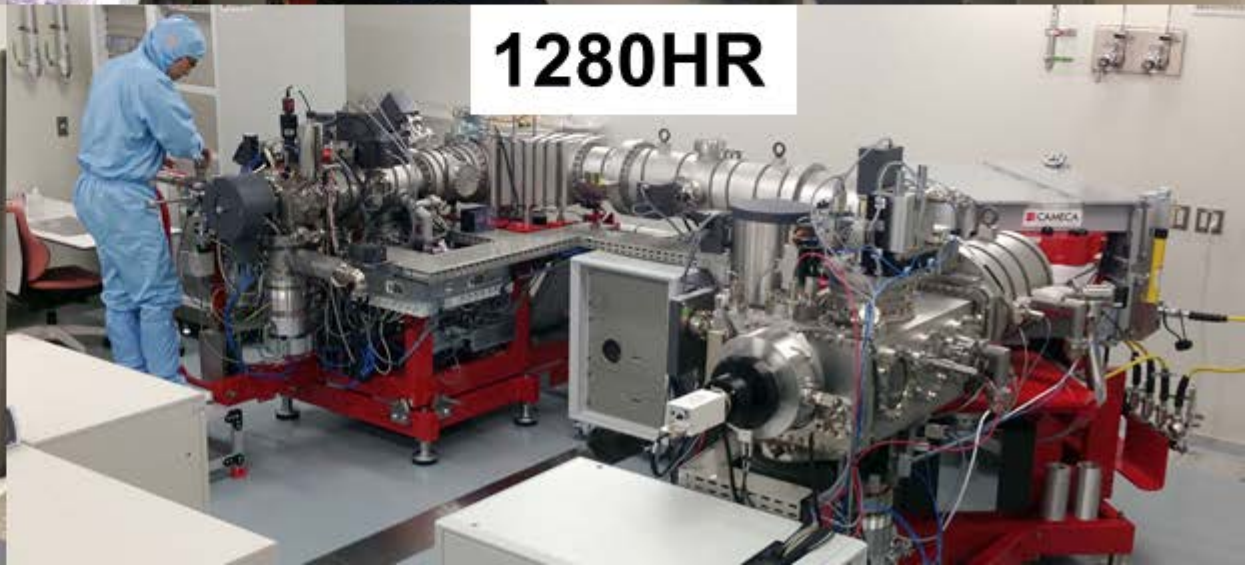

北海道
周遊マップ
Enjoy!Hokkaido
旭山動物園
行動展示でおなじみの動物園！飼育担当が動物にエサを与えながら、特徴ある行動について解説を行うもぐもぐタイムは必見！
すすきの
言わずと知れた北海道一の歓楽街！美味しいものや楽しいこと！？が盛り沢山
積丹半島
積丹ブルーといわれる絶景は見逃せない！有名な積丹産の「うに」をご賞味あれ！
小樽運河
運河に沿って、石造りの倉庫群や歴史的建造物などが点在していてガス灯の明かりで夜はロマンチック！
洞爺湖
2017年は4/28～10/31まで毎晩約20分間打ち上げ花火が洞爺湖の夜空を彩ります！
大沼国定公園
函館にほど近い、北海道の大自然リゾート！
函館山
古くから世界三大夜景のひとつと称され、最近では最も印象的な夜景にも選出されました。
函館空港
維内
約370km
車で約5時間30分
旭川空港
富良野
富田ファームやハイラント富良野などのラベンダー畑や映画、CMのロケ地などのお馴染みのスポットも盛り沢山！
層雲峡
断崖絶壁が続く美しくも迫力ある渓谷で、秋の紅葉スポットとしても有名！
女満別空港
知床半島
トレッキングと観光船（クルーズ）がオススメ！近くにはウトロ温泉も
新千歳空港からの距離
函館空港
約280km
車で約3時間50分
約90km
車で約1時間30分
約35km
車で約40分
約80km
車で約1時間30分
小樽
札幌
支笏湖
洞爺湖
函館
Isotope Imaging Laboratory

SIMS in IIL



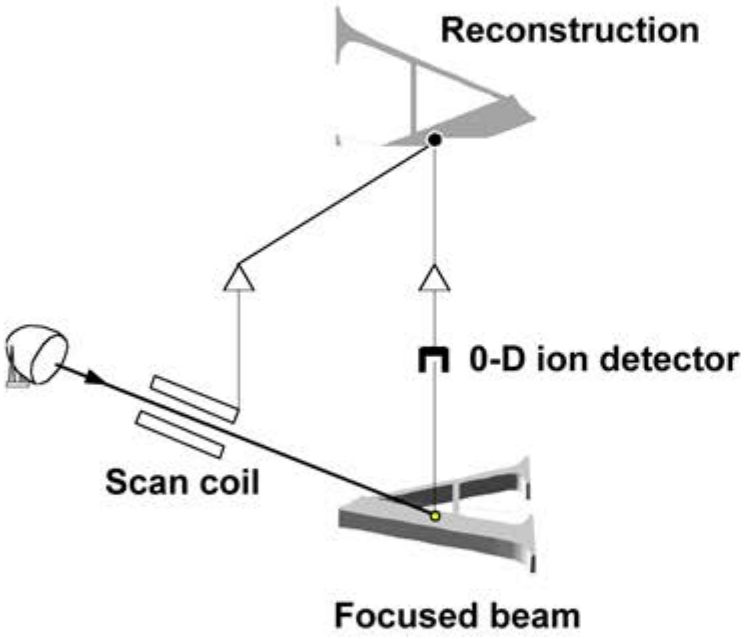




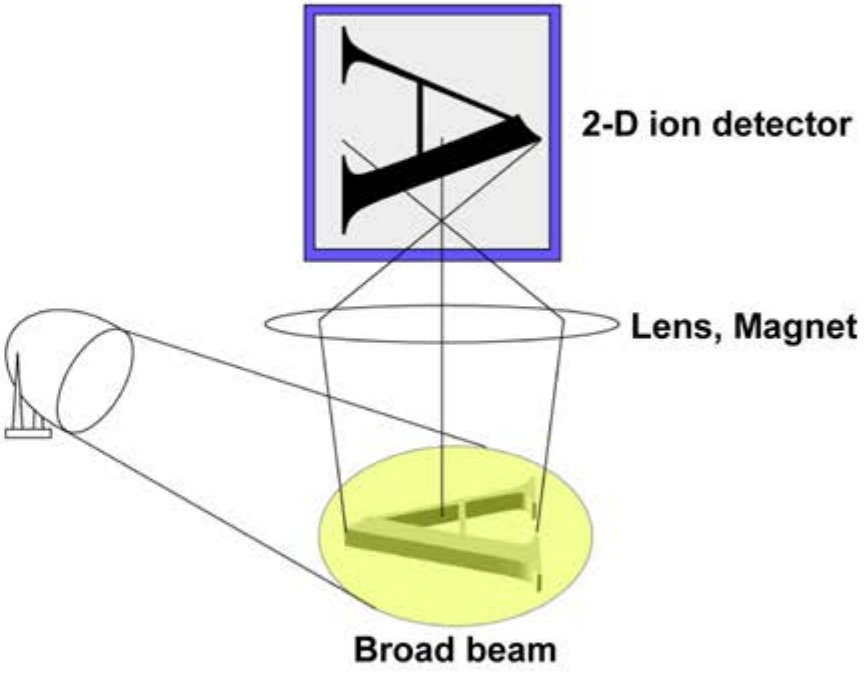


Isotope Imaging

Scanning



Stigmatic



Probe size

Microbeam < 1 μm

NanoSIMS < 50 nm

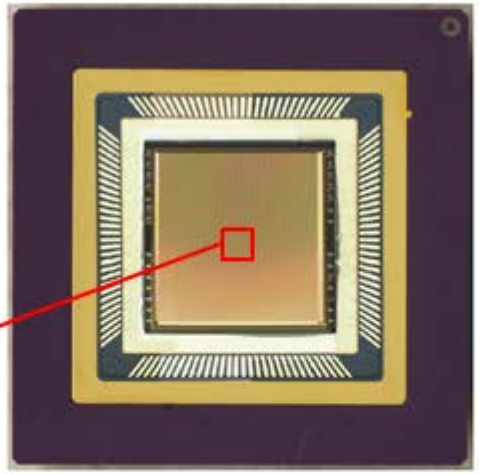
FIB-SIMS < 10 nm

Ion optics

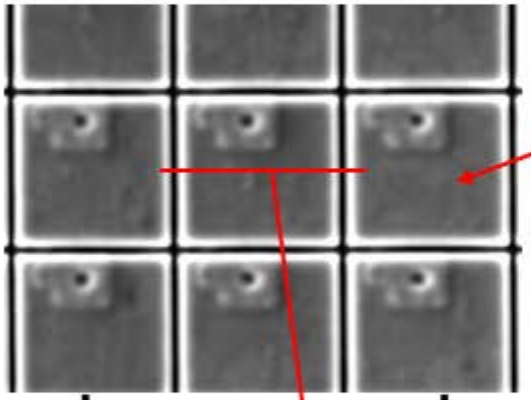
- High intensity
- High precision
- Wide area

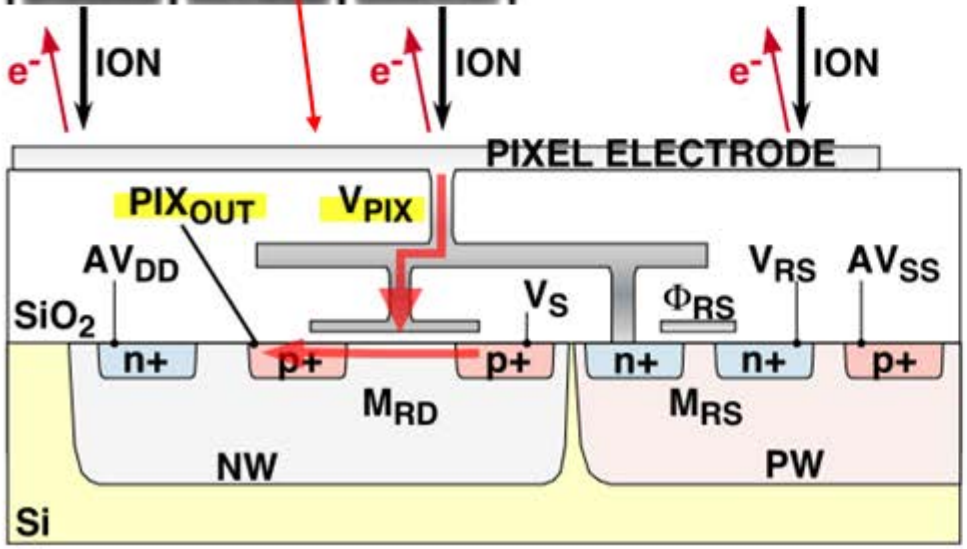
Isotope Imaging

SCAPS

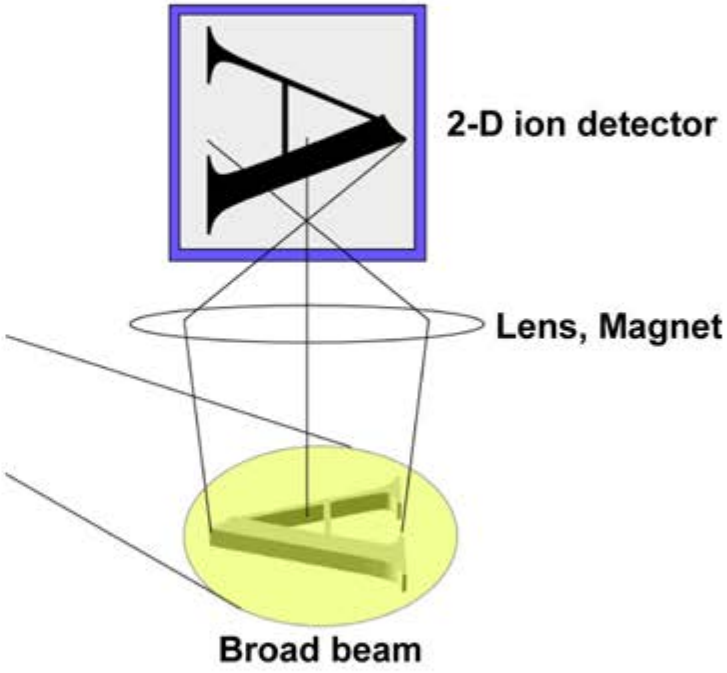


600x600 pixel





Stigmatic

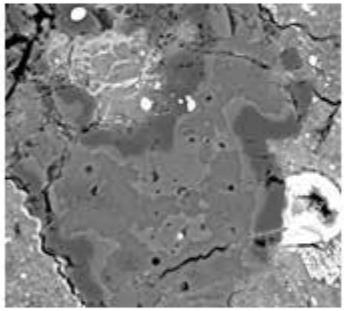


Ion optics

- High intensity
- High precision
- Wide area

Isotopograph

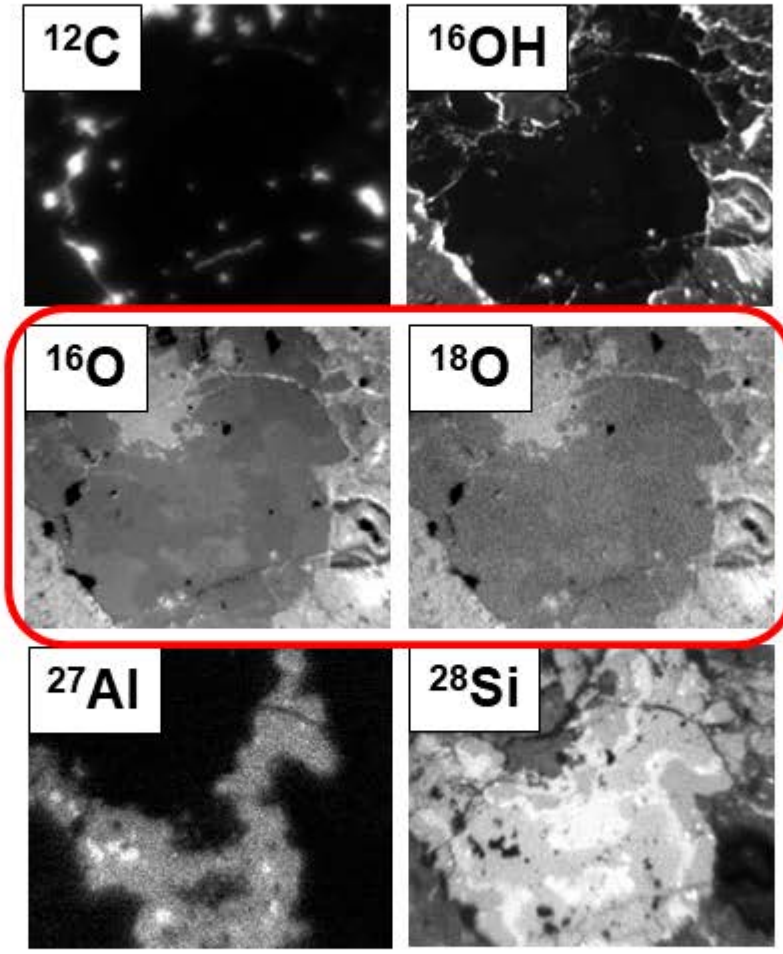
SEM, TEM…



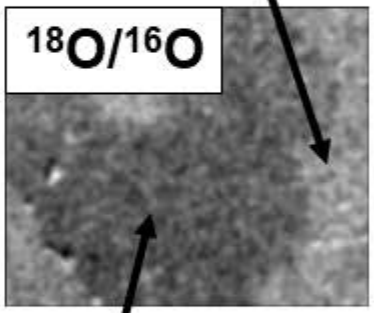
10μm

Si, O, C…

Mass Separate



16O : 99.762
18O : 0.200



16O : 99.767
18O : 0.192

Element

Isotope

Ratio

(2007~present)

平成19年度

文部科学省：先端研究施設共用促進事業

「安定同位元素イメージング技術による産業イノベーション」により

利用課題を募集します。

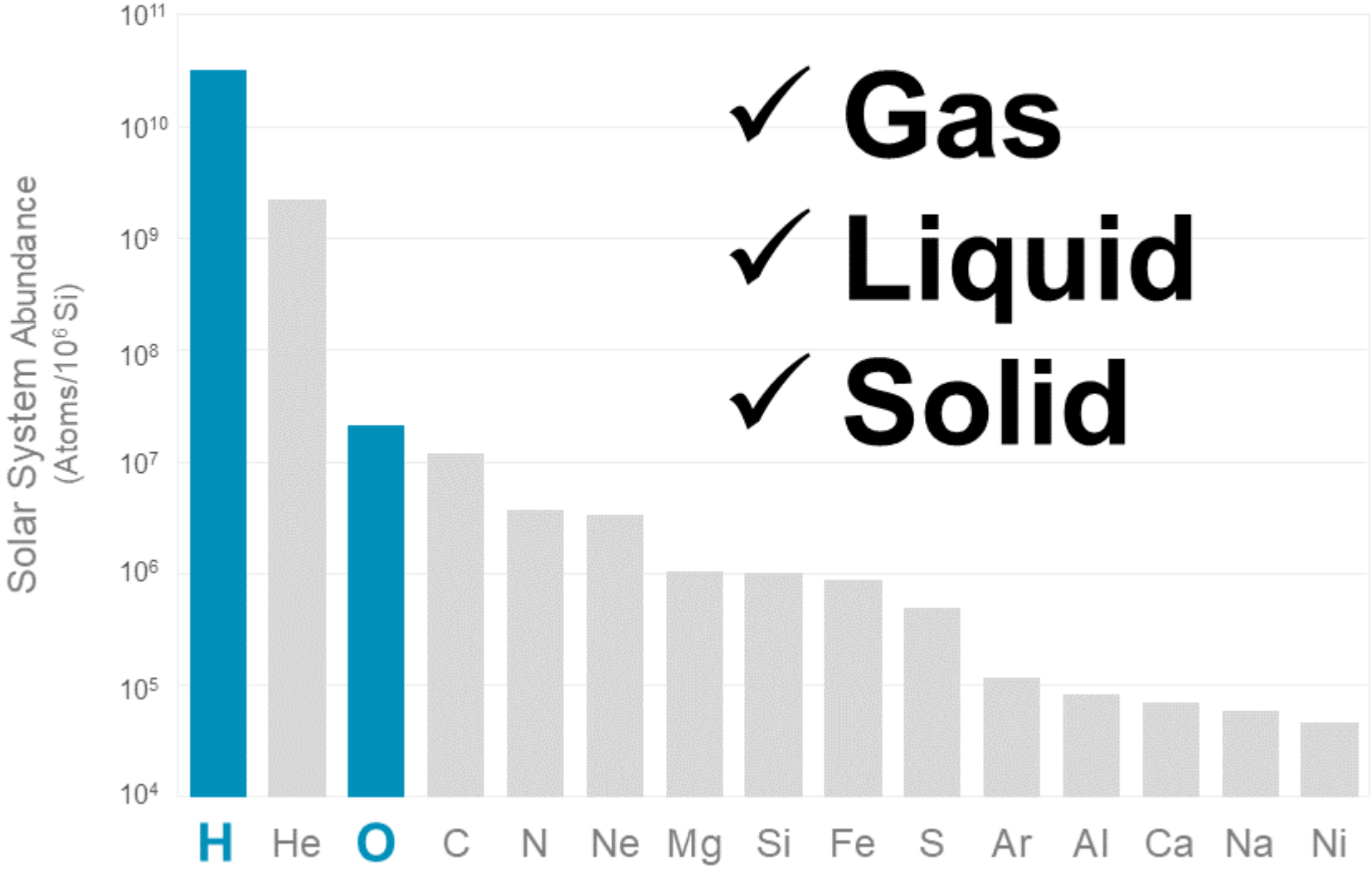
技術課題の解決に、是非お役立て下さい。

北海道大学　創成科学共同研究機構

同位体顕微鏡システム

Isotope Imaging Laboratory

H_2O



(Data from Lodders, 2010)

Moon water

NATURE GEOSCIENCE DOI: 10.1038/NGEO1050

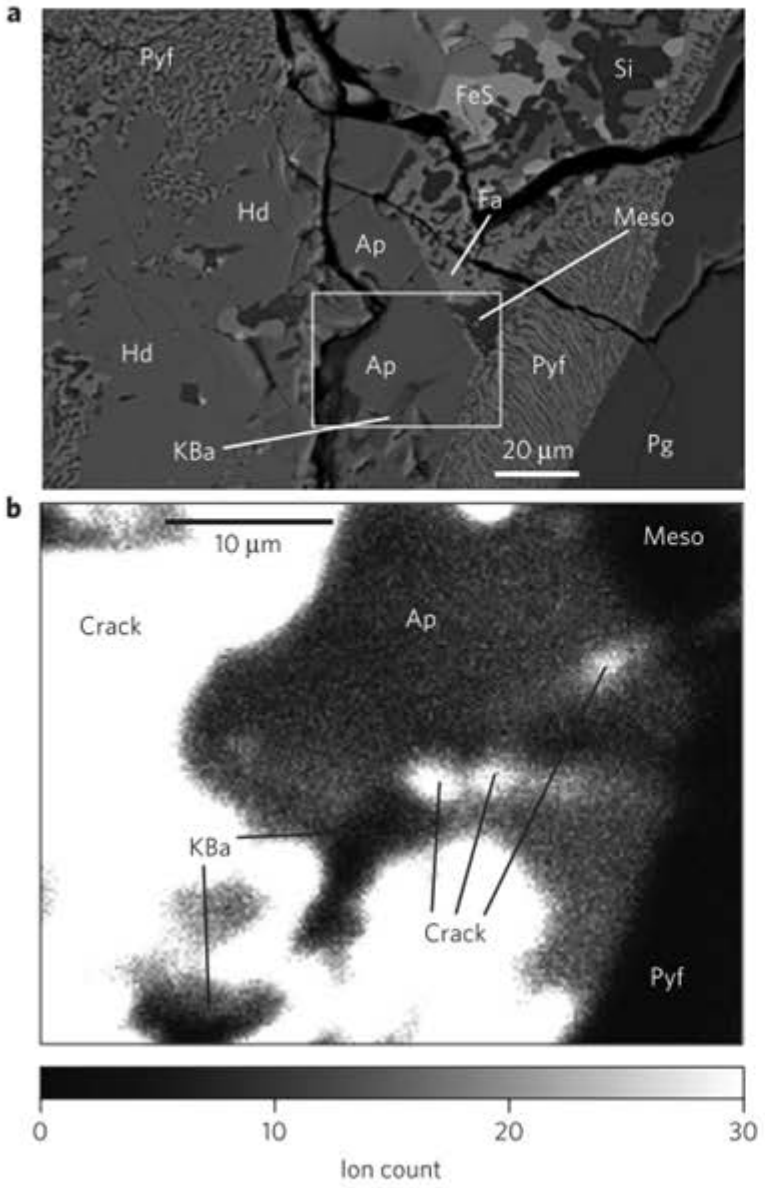


Figure 1 | Backscatter electron image and SCAPS ^{1}H image of apatite grain 5 of 10044,12. a, Backscatter electron image. Apatite (Ap) is

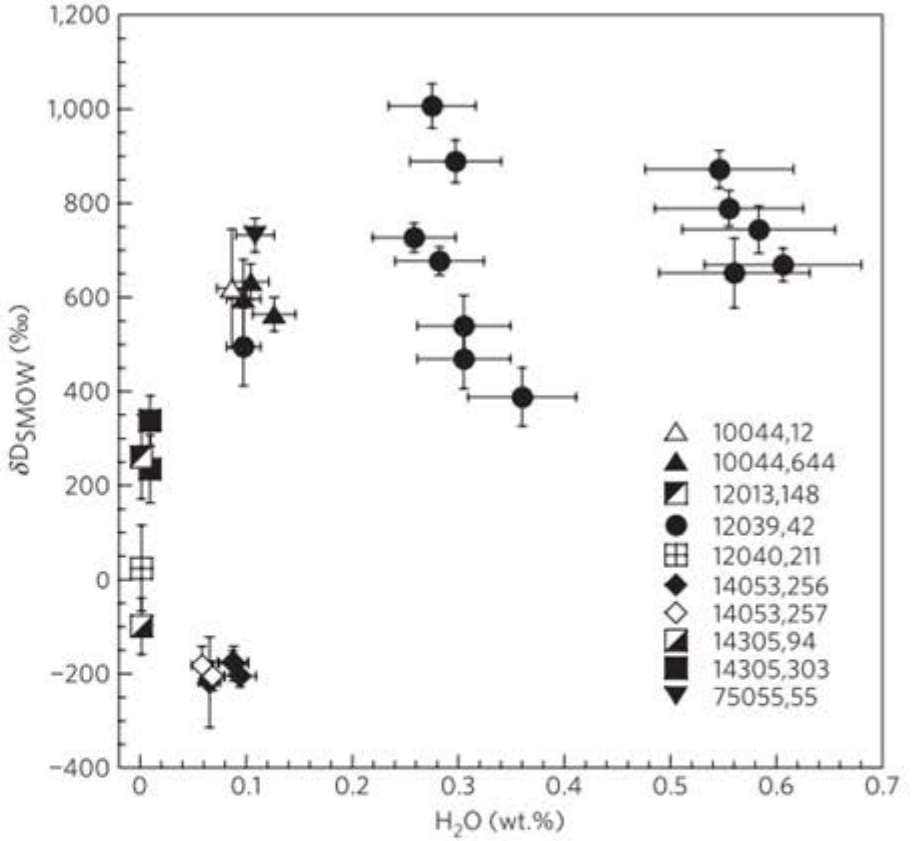
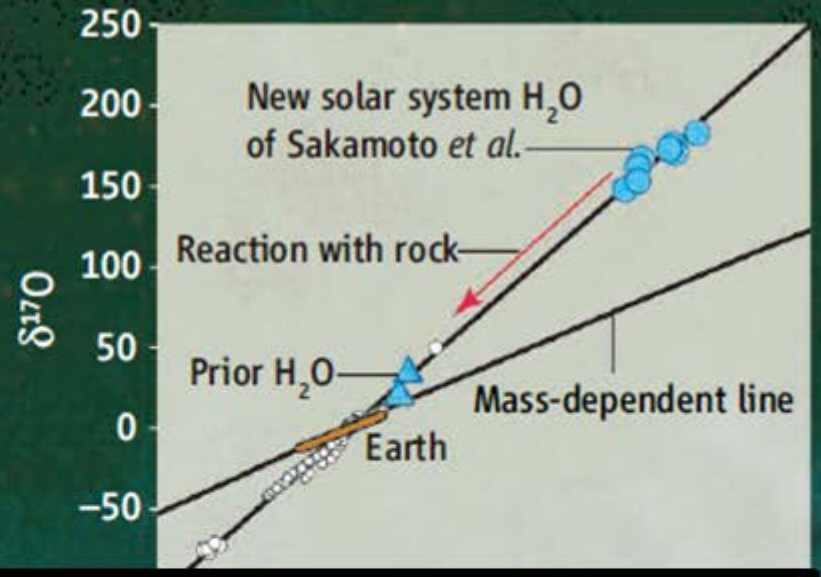


Figure 2 | δD(‰) versus H_2O (wt.%) of lunar apatite measured in this study. Three apatite grains are essentially dry (12040,211; 12013,148; 14305,94), and two of these have δD that are difficult to distinguish from terrestrial water. The error bars are 2σ.

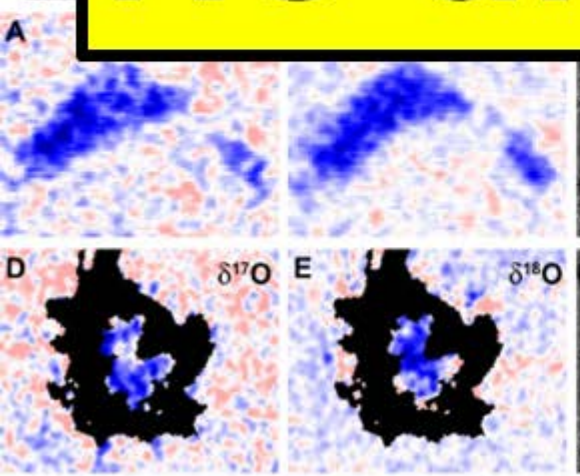
Information). Microscale variability of δD values in the hydrous mineral amphibole from mantle xenoliths[18] and the Montserrat volcano[19] shows that intragrain and intergrain hydrogen isotopic heterogeneity can be preserved during volcanic processes on Earth. If process-related effects on t ruled out, then the range

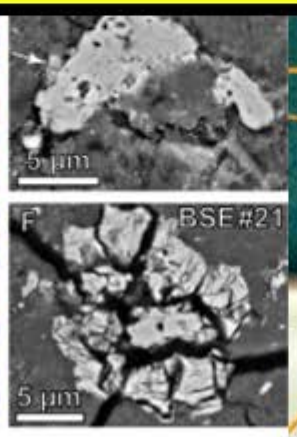
Greenwood *et al.*, 2011

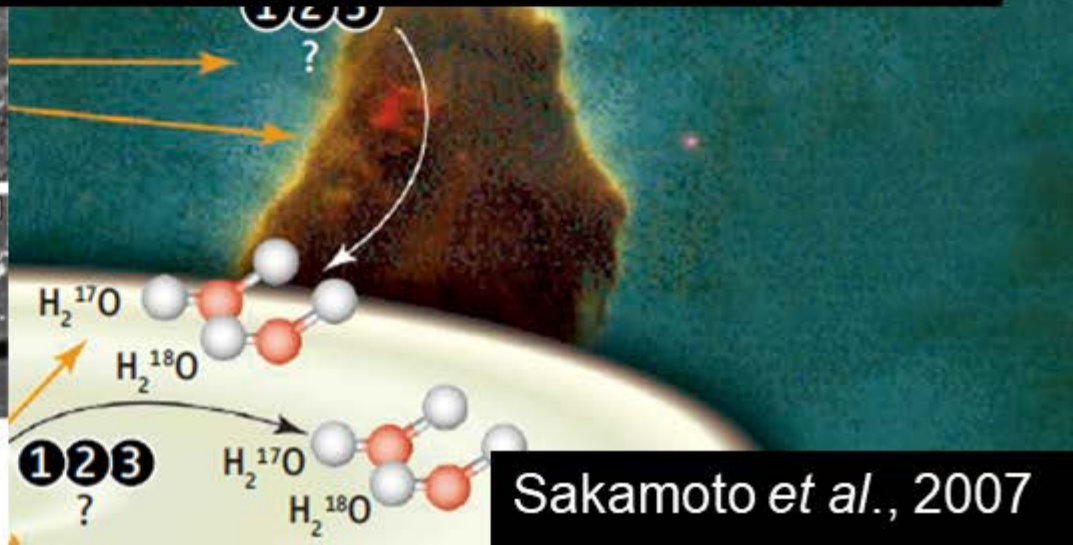
Primordial water



No direct evidence



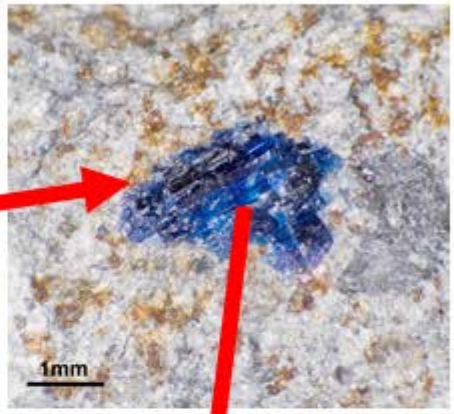


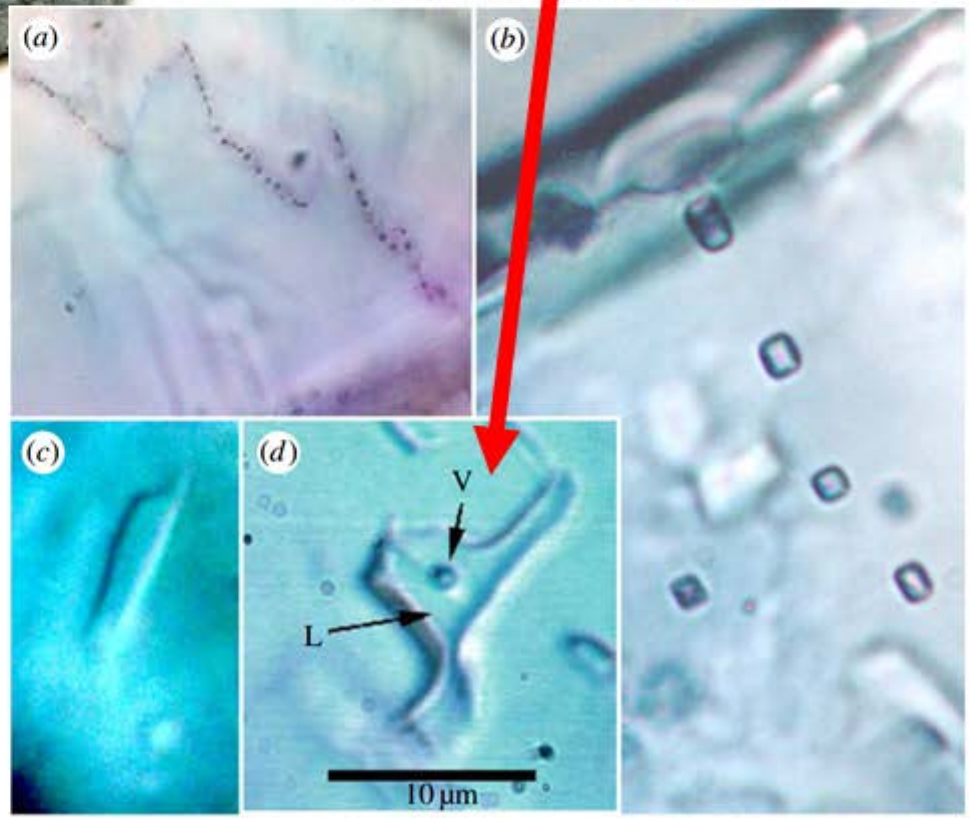


Sakamoto *et al.*, 2007

Zag Meteorite

Halite crystal (4.3Ga)

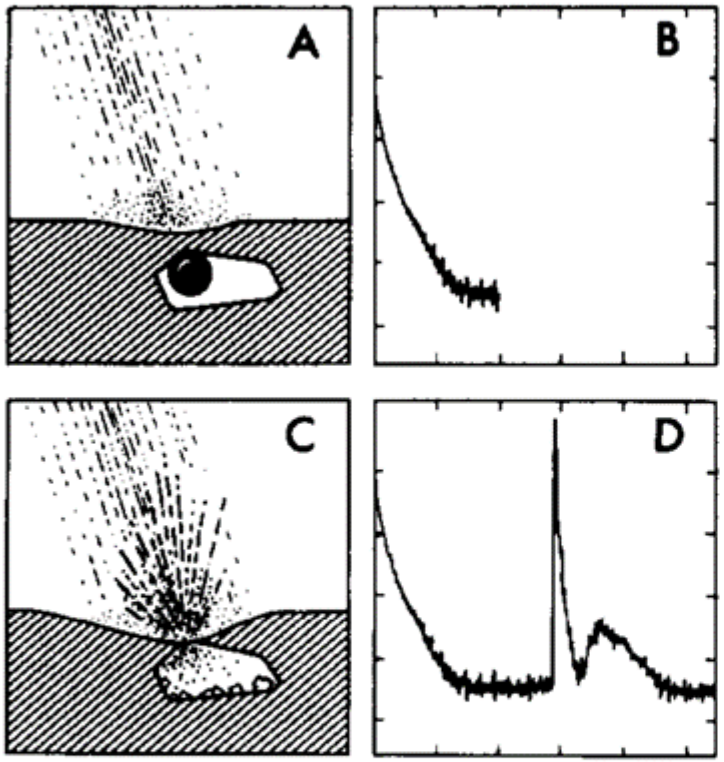




Fluid inclusion

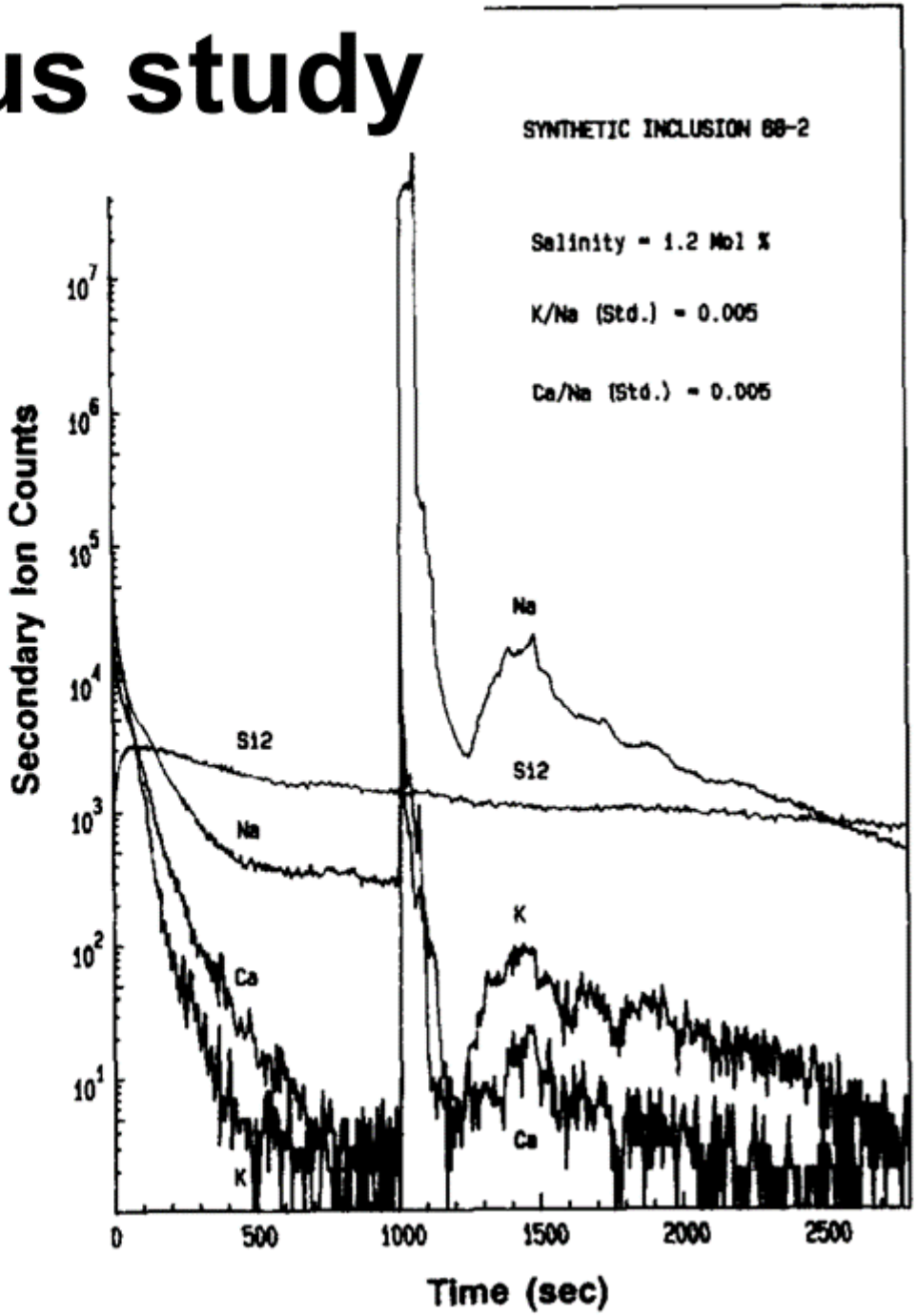
Zolensky 1982, 2017

Previous study

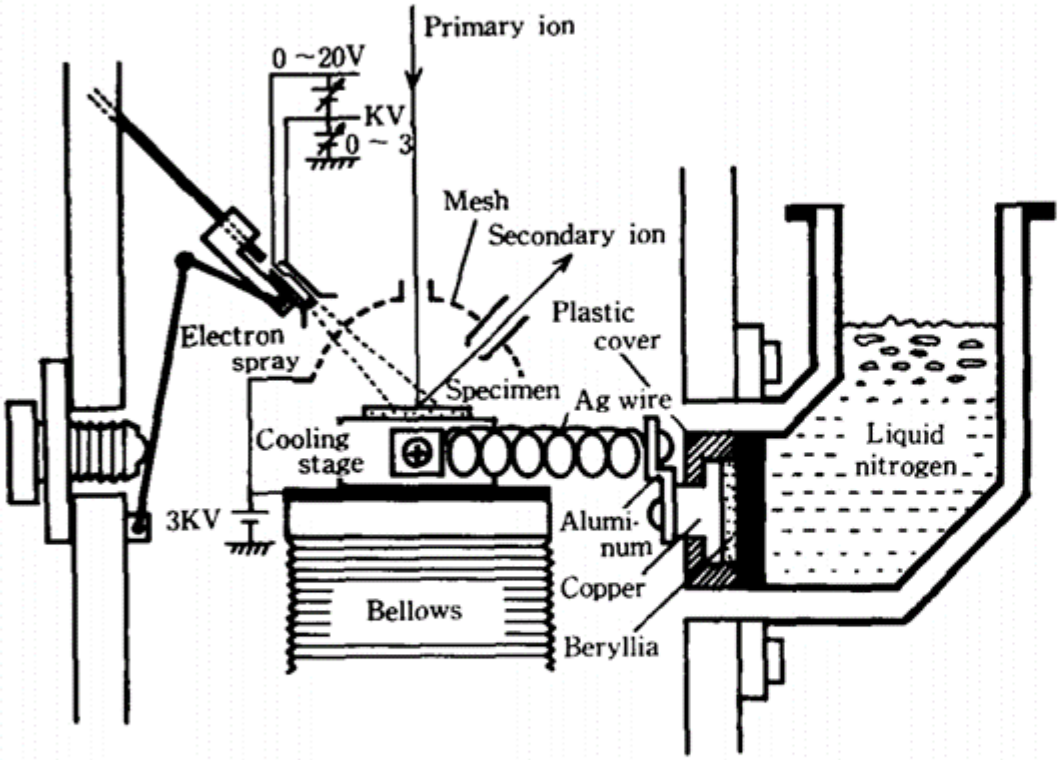


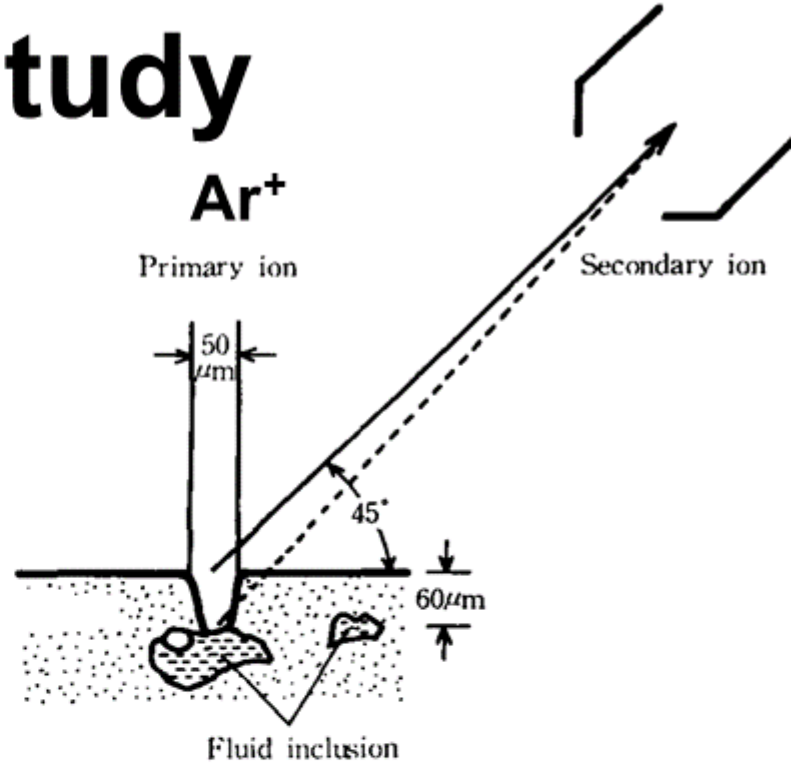
CAMECA ims-4F
Room temperature
Elemental analysis

Diamond et al., 1990

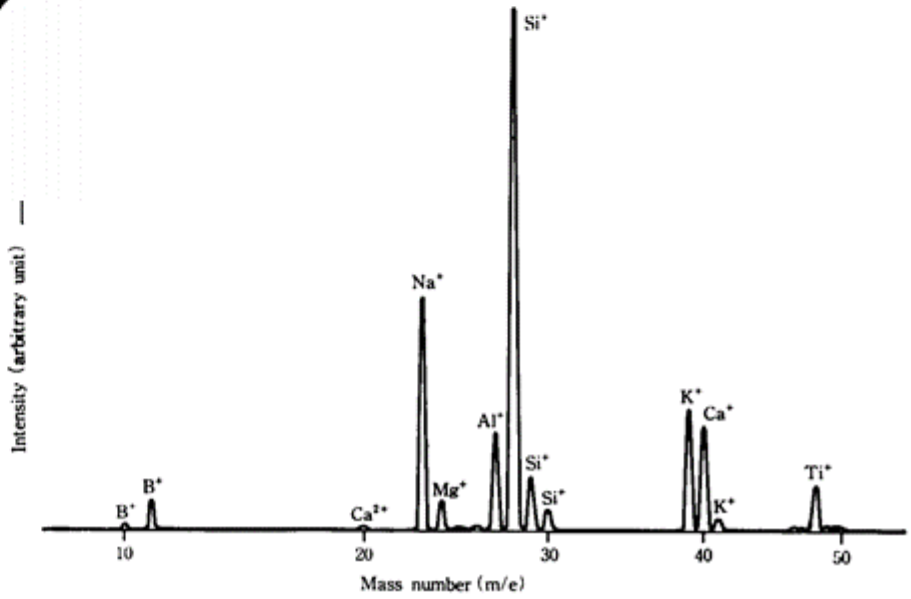


Previous study



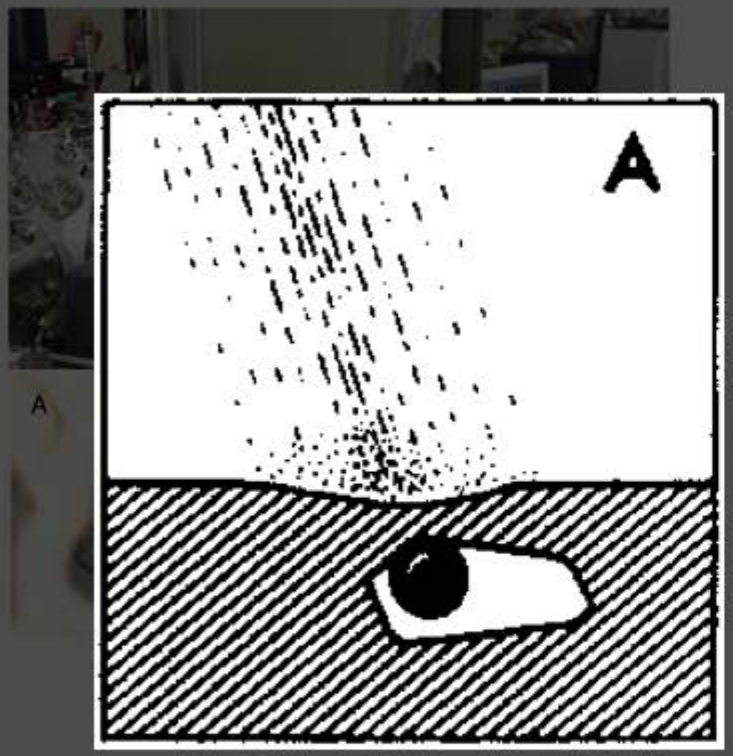


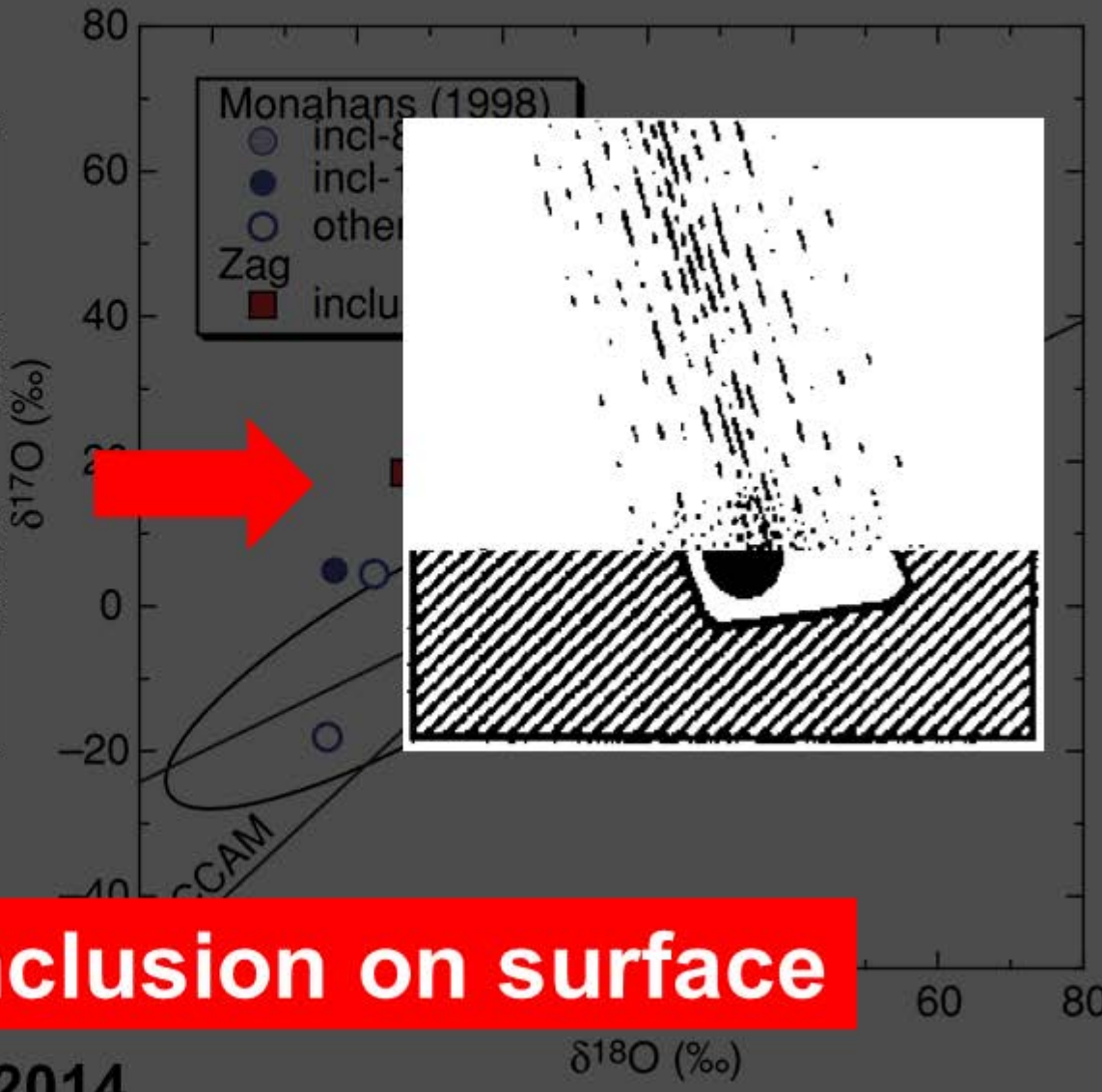
Hitachi IMA-I
Cold-sample-stage
Elemental analysis



Sato et al., 1978

Previous study





CAMECA ims-1270

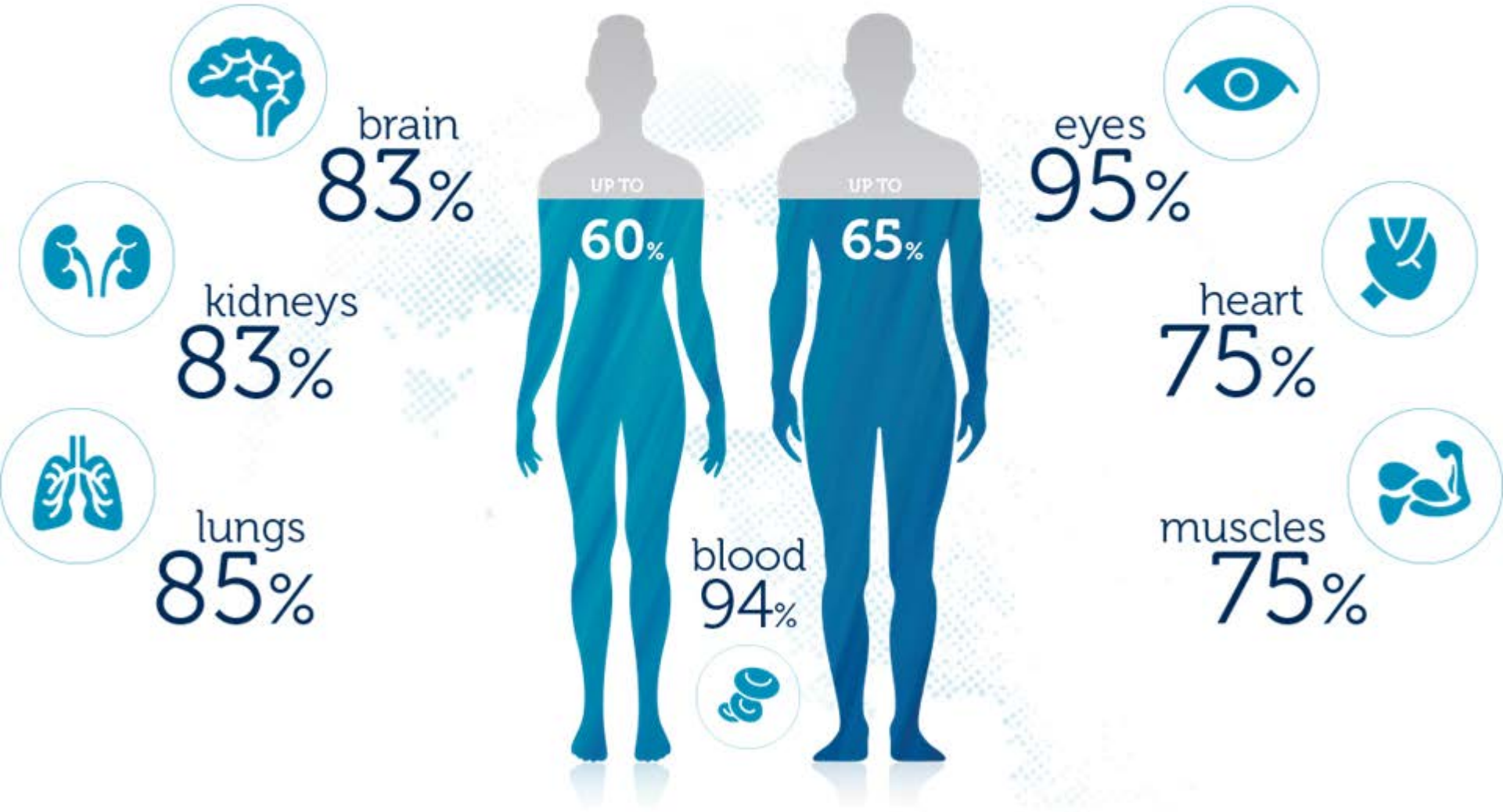
Cold-sample-stage

Isotop

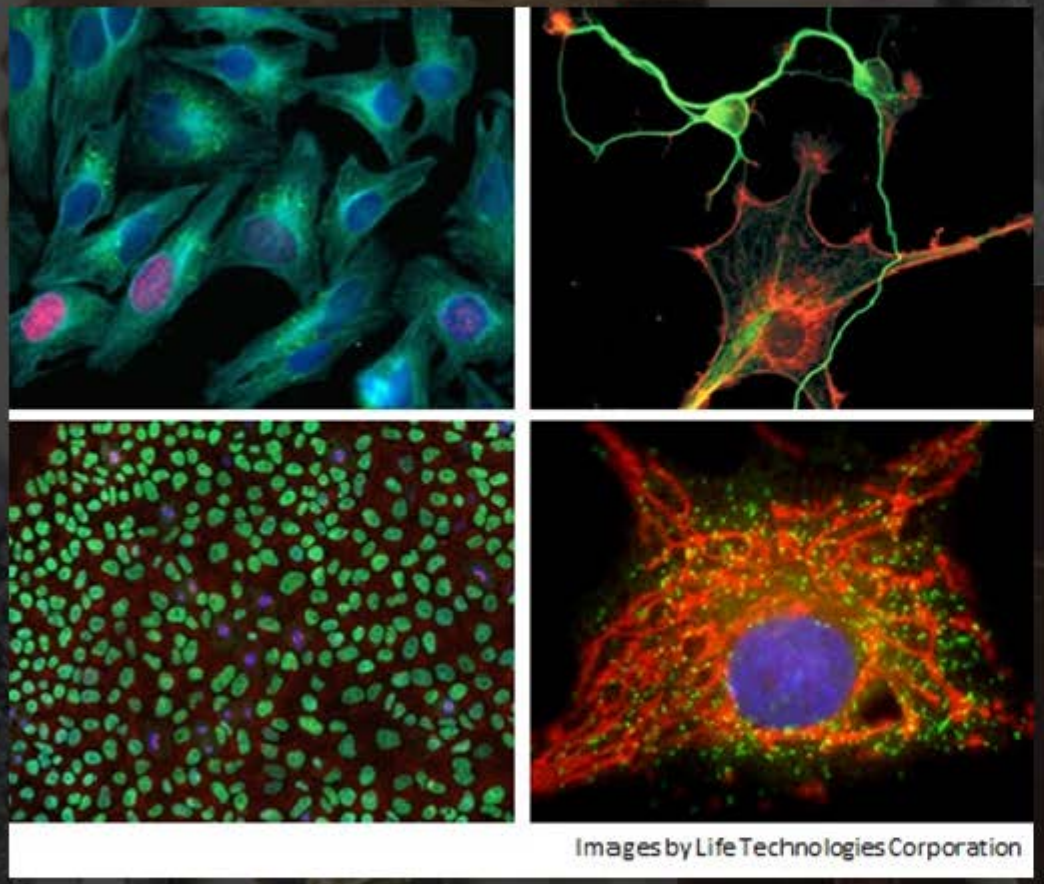
Expose inclusion on surface

Yurimoto et al., 2014

H_2O


brain
83%
kidneys
83%
lungs
85%
UP TO
60%
UP TO
65%
blood
94%
eyes
95%
heart
75%
muscles
75%

Protein, RNA, DNA...



Small molecule

D_2O

$^{13}CO_2$

$^{15}NH_3$

^{13}C-amino acid

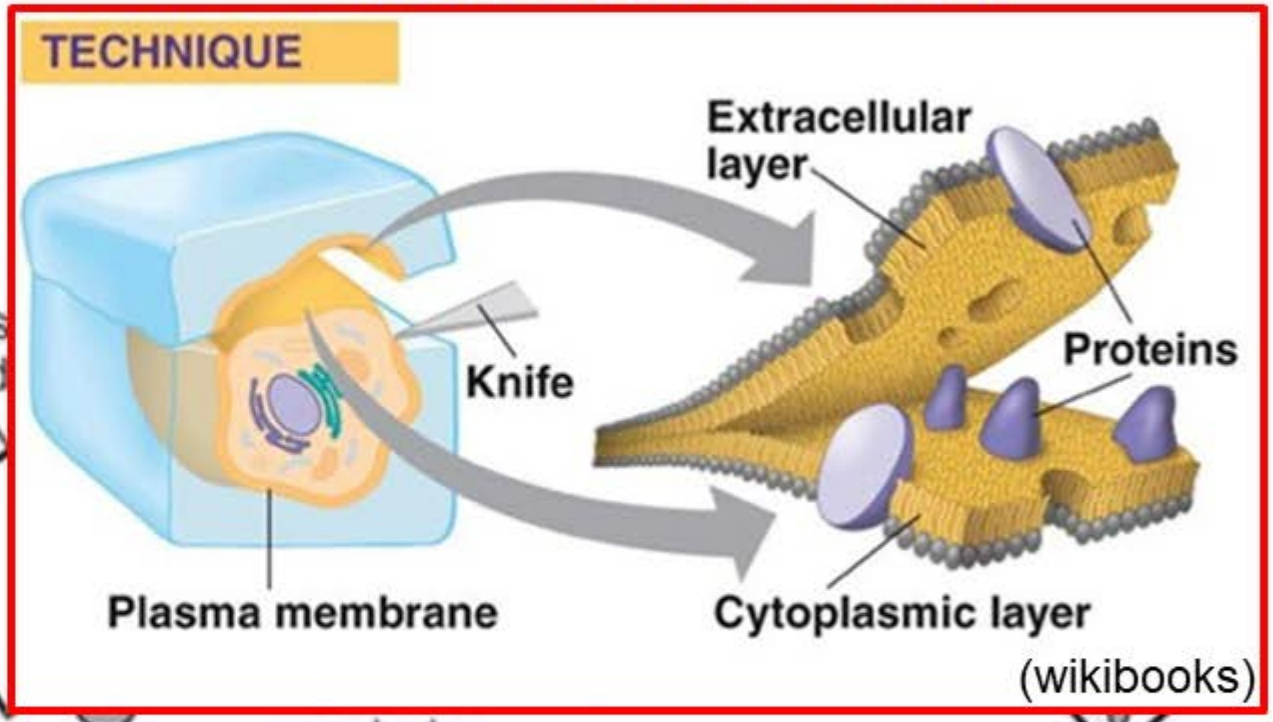
^{13}C-glucose

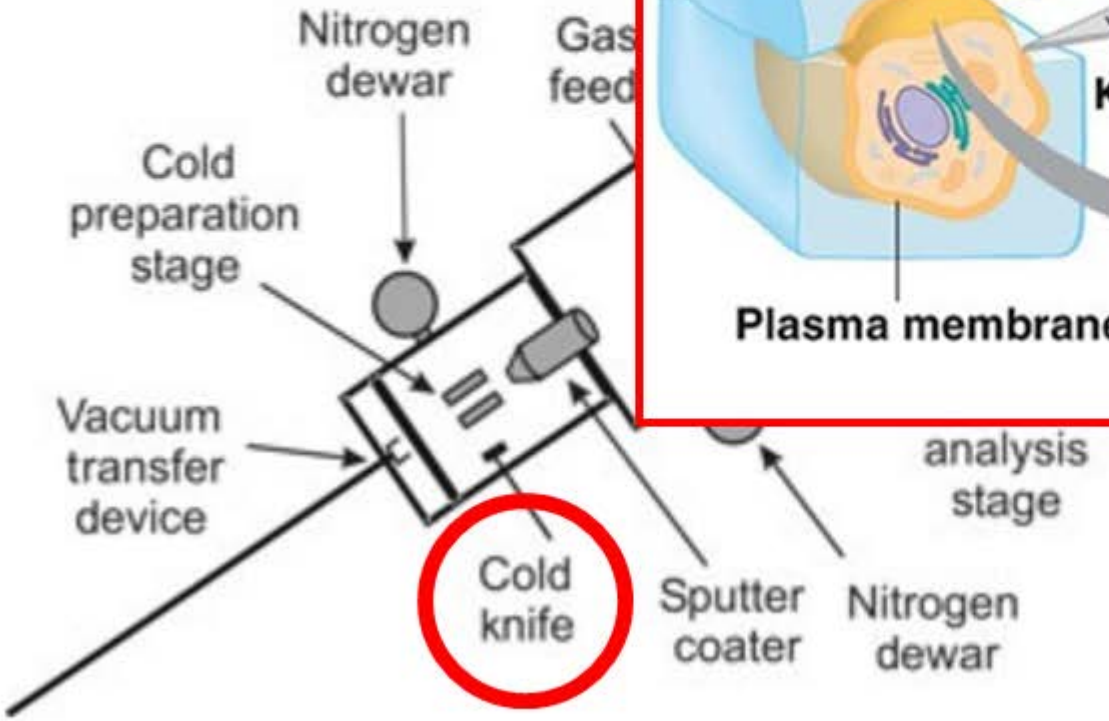
:

Water soluble

Previous study

freeze fracture method





(Dickinson et al., 2007)

Dérue et al., 2006; Dickinson et al., 2007

Freeze fracture

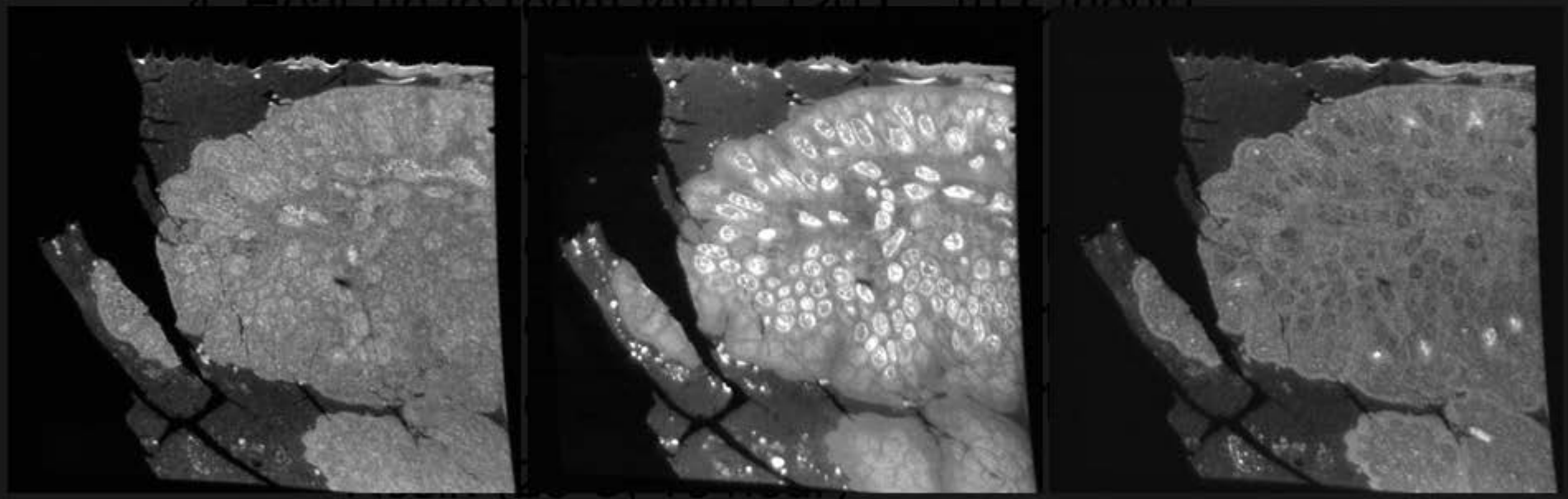
Cryostat

Independent sample preparation

- ✓ High pressure freezing
- ✓ cryo-FIB
- ✓ cryo-ultramicrotome
- ✓ cryostat
- ✓ freeze fracture
- :

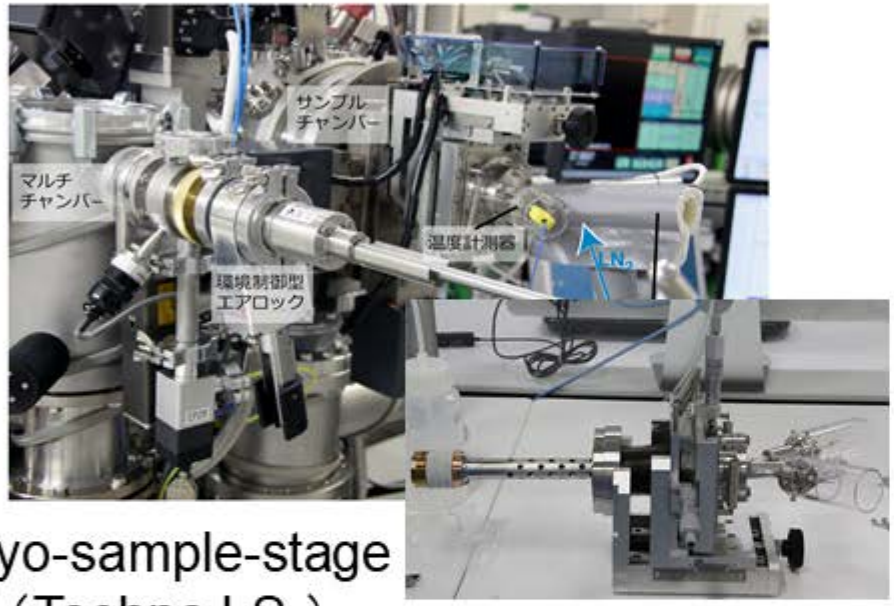
Conventional method

1. Cut (5 x 0.6mm)
2. High pressure freezing
3. Freeze-substitution (methanol, -90°C, 90 hour)
4. Heat up to room temp. (-20°C, 10°C/hour)
7. Polimeriza
8. Sectioning

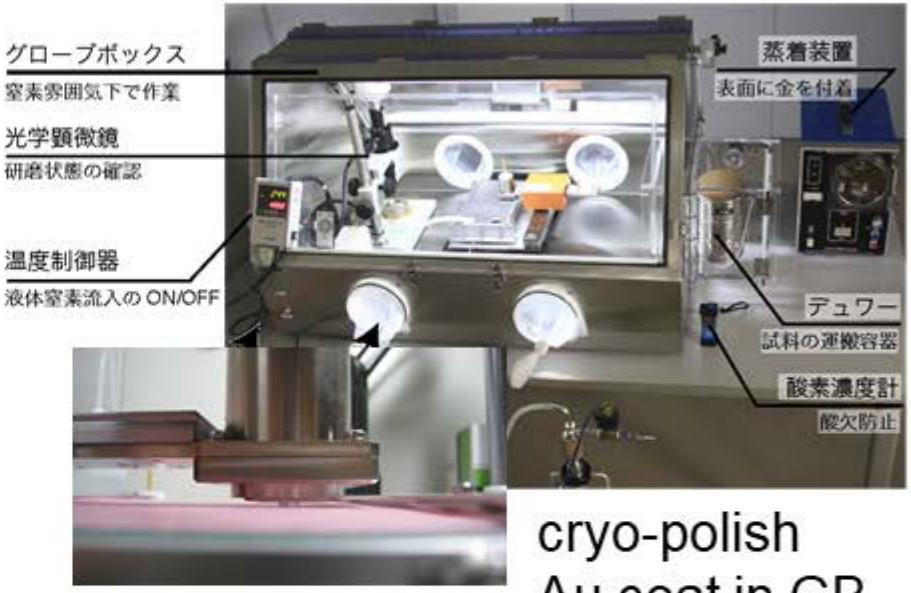


How different?

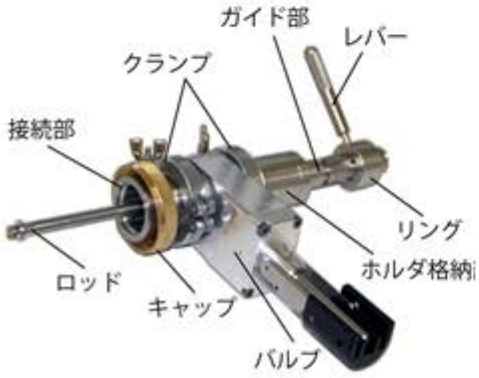
Elements of Cryo-SIMS



cryo-sample-stage
（Techno I.S.）



cryo-polish
Au coat in GB



cryo-loadlock

cryo-transfer vessel

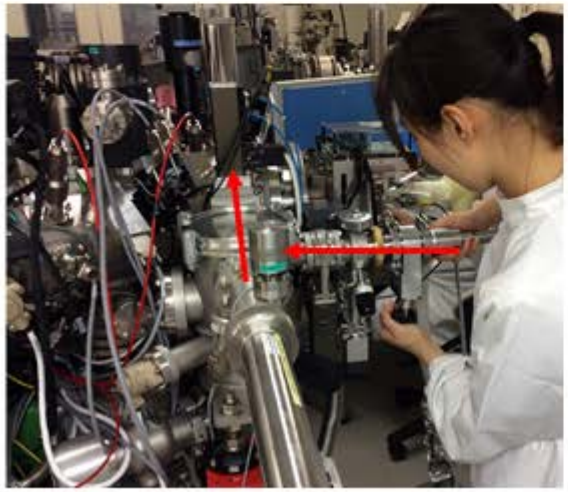
cryo-holder

Workflow

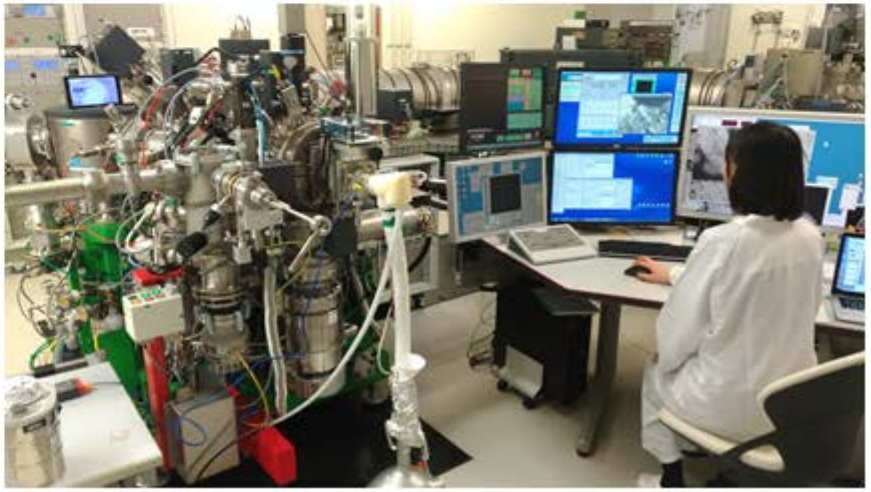
Au coated sample
in cryo-holder

Transfer

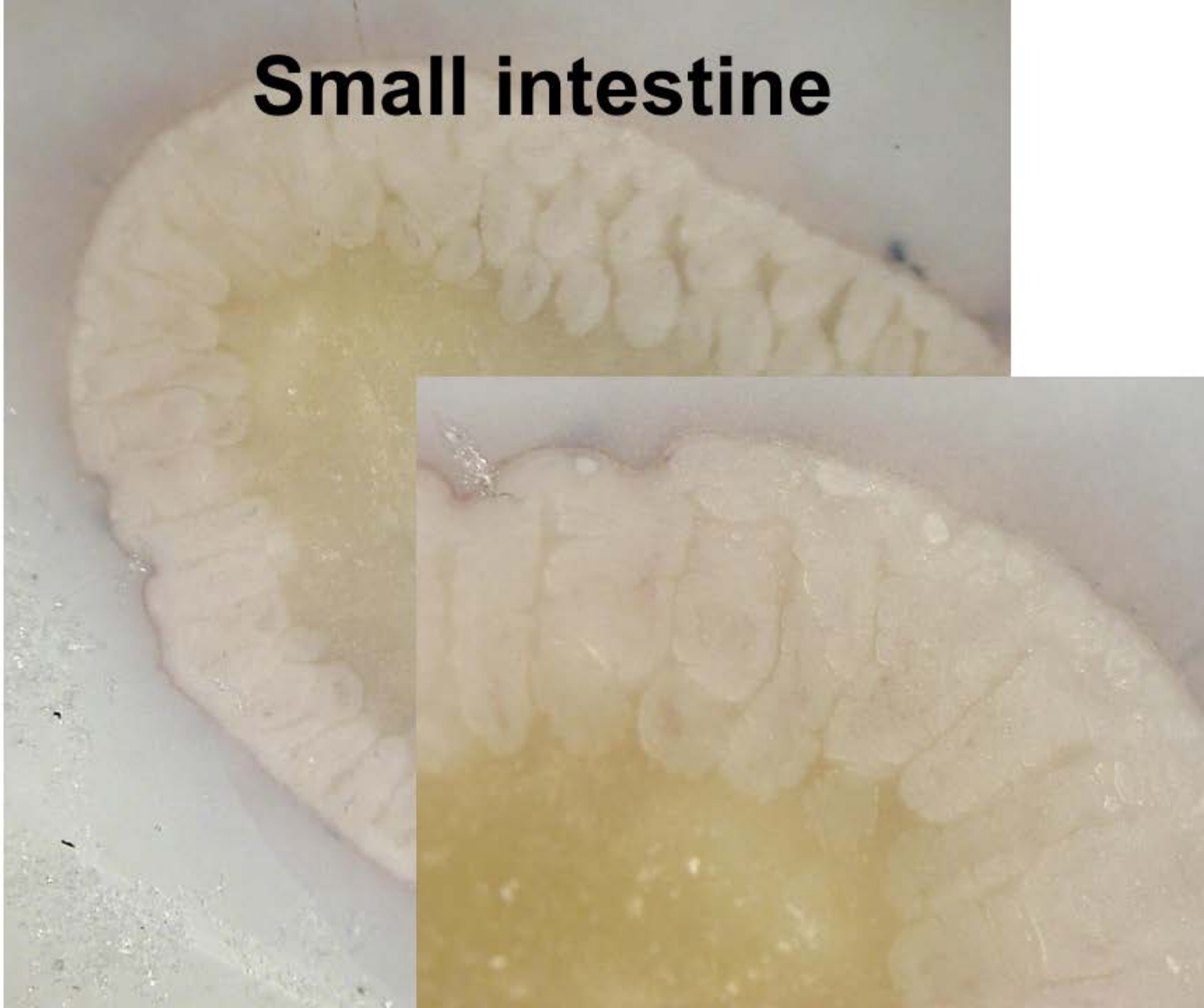
Pick up



Set to cryo-sample-stage

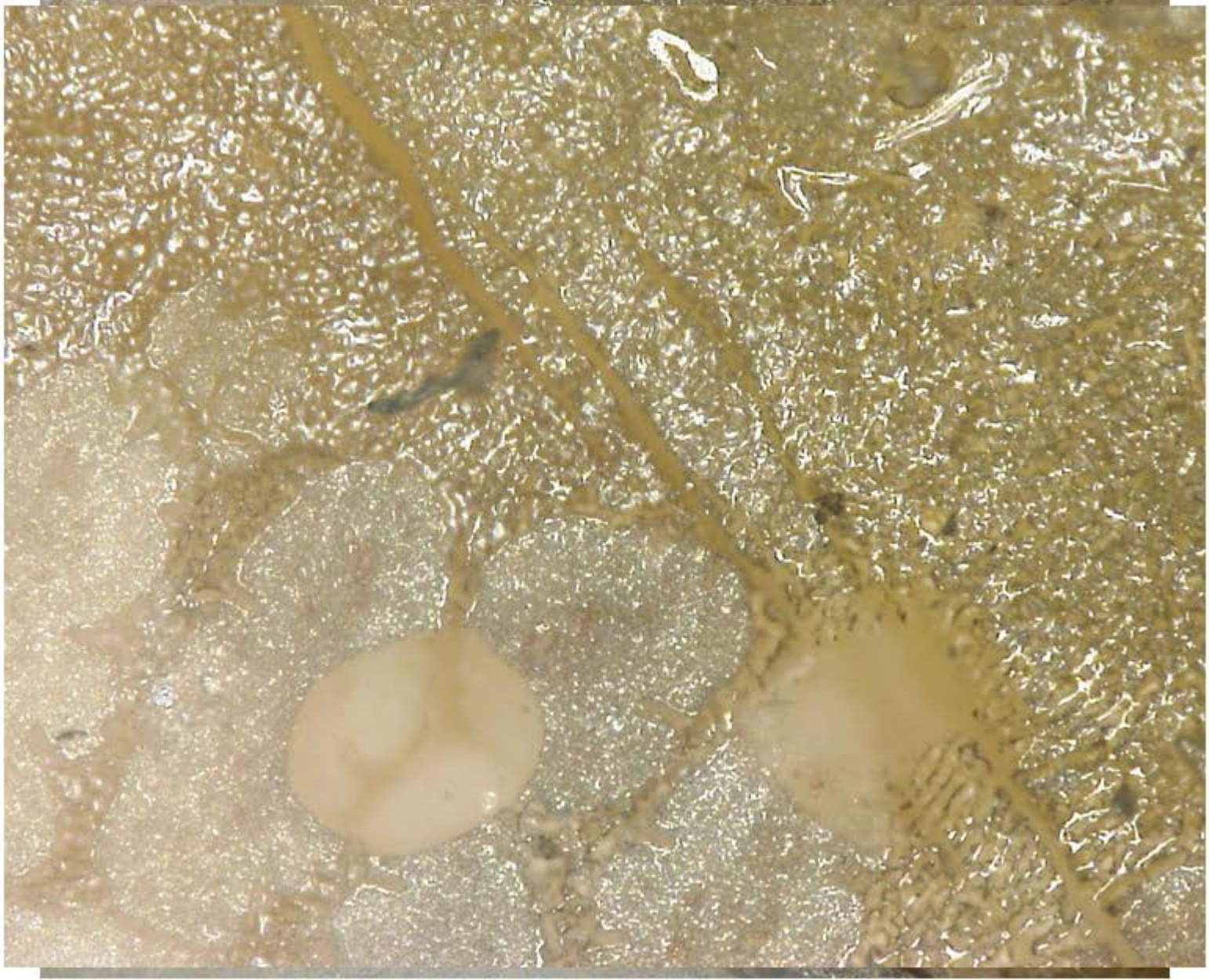


Analysis


Small intestine

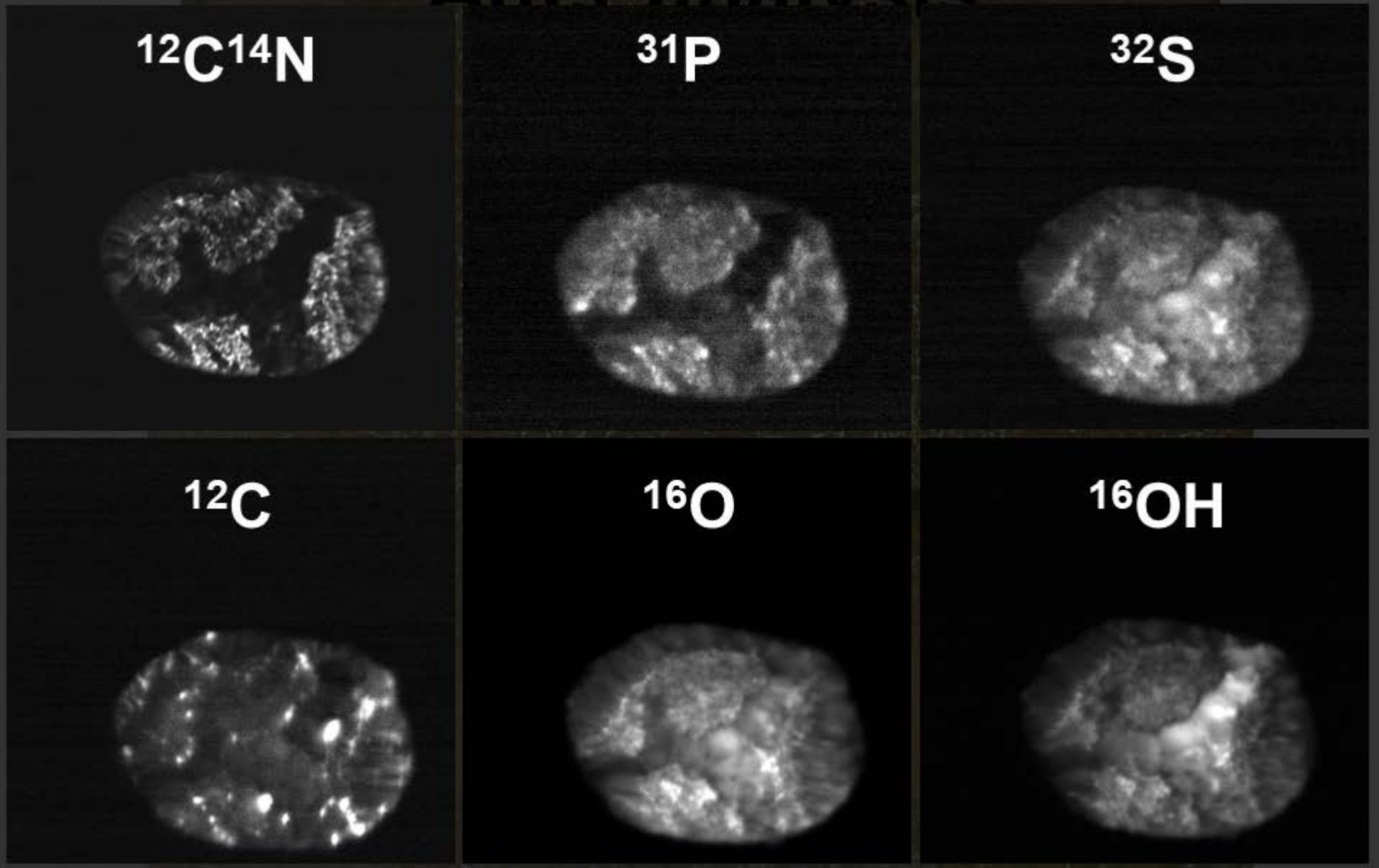

After Au coat

After analysis



Cryo

After analysis



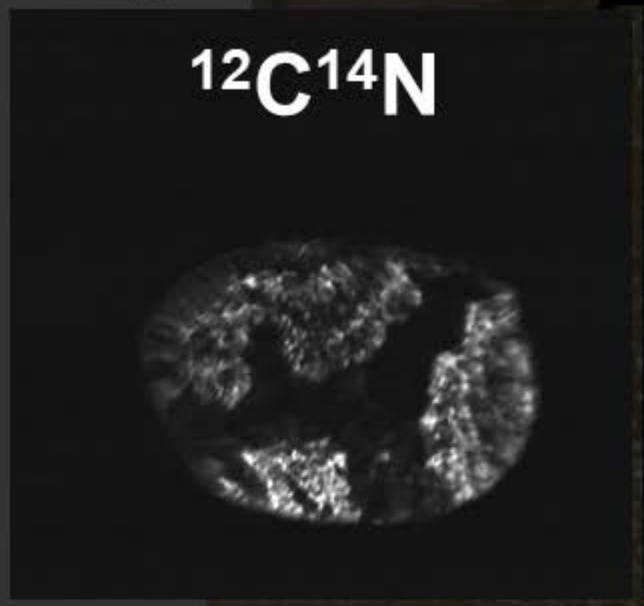
Cryo

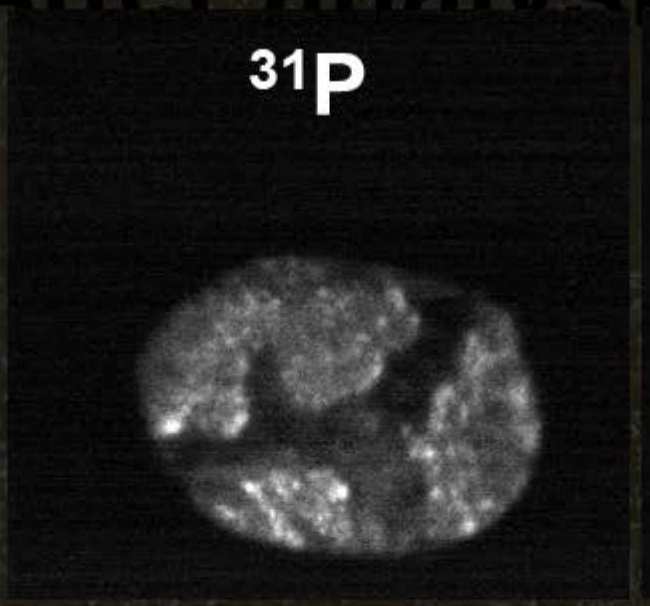
After analysis

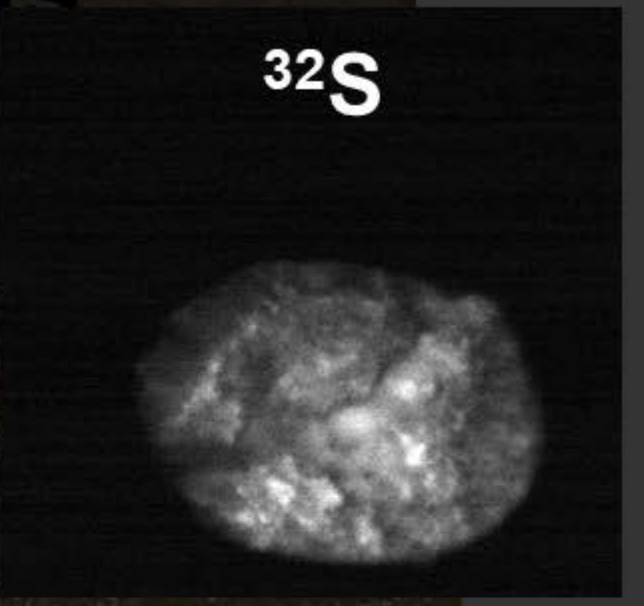
$^{12}C^{14}N$

^{31}P

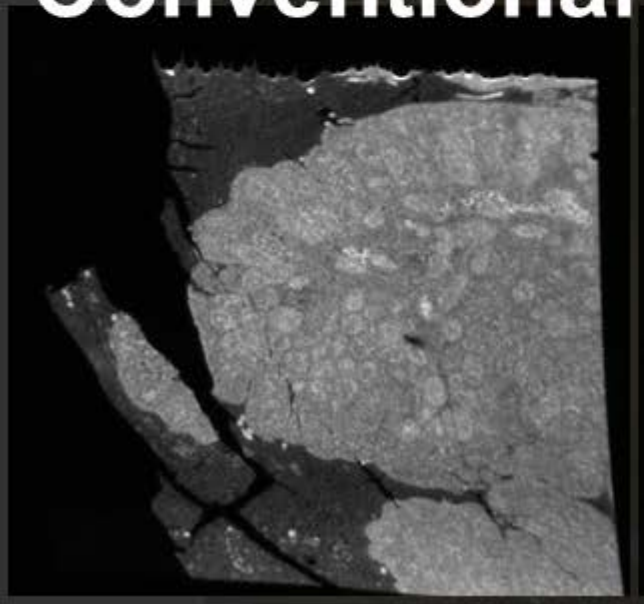
^{32}S

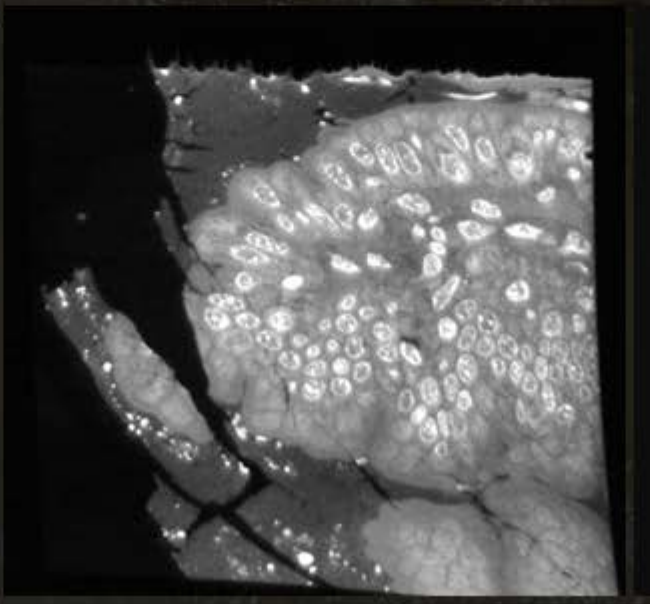


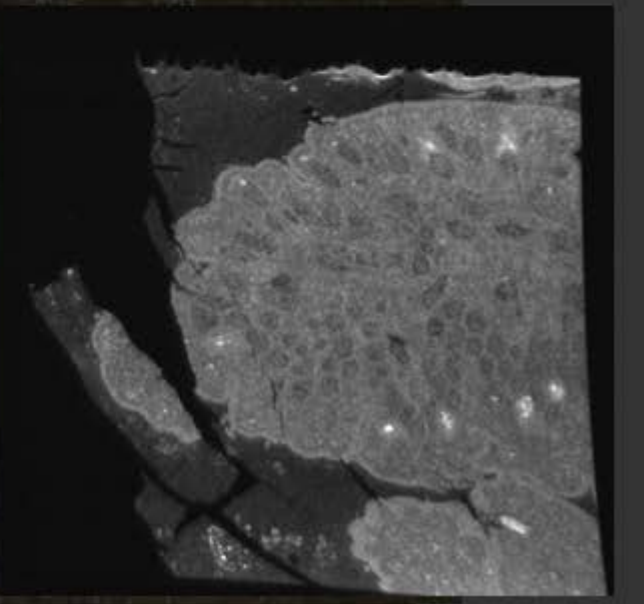




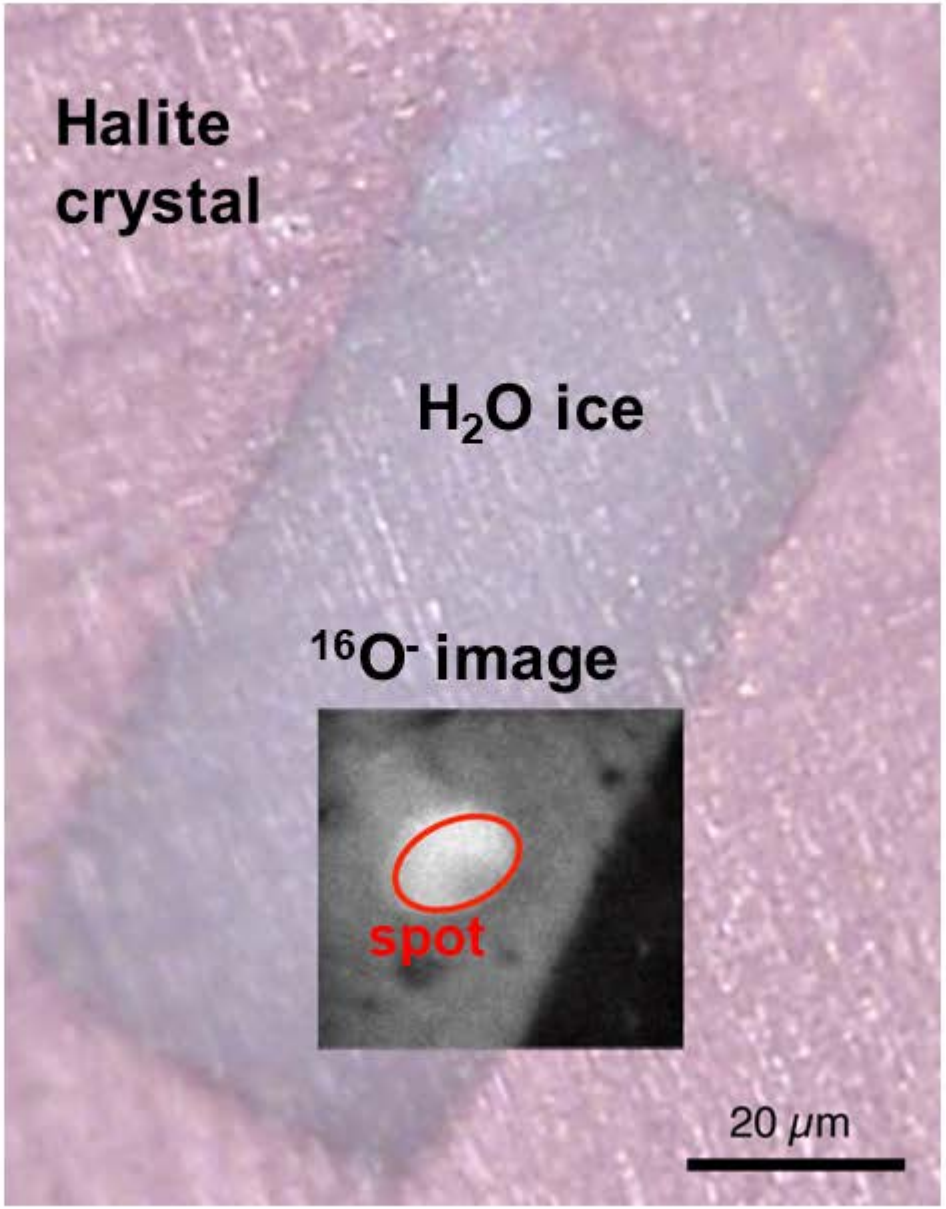
Conventional



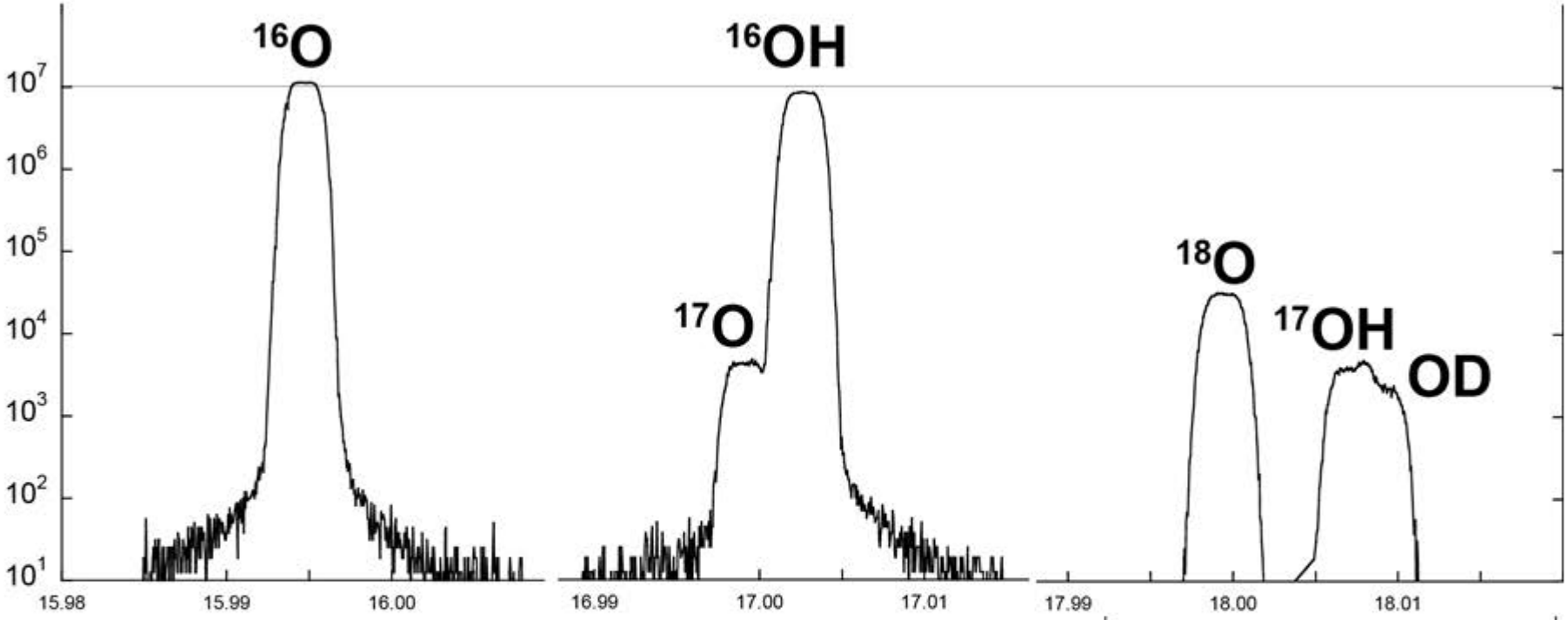


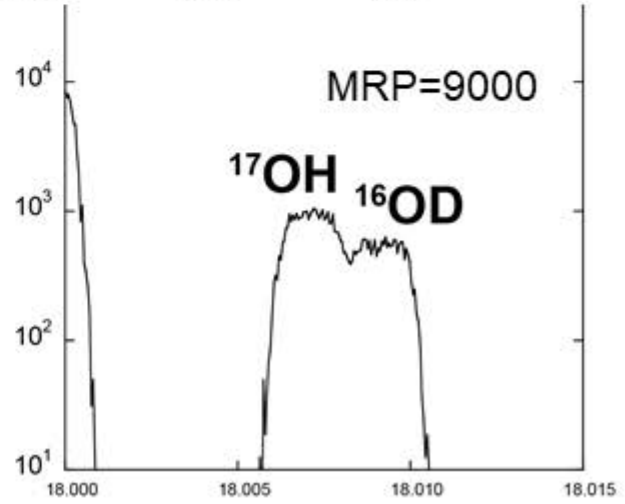


Isotope Image of ice



Mass spectrum of ice





^{16}O / ^{16}OH

O-isotope analysis of ice