Radiation & Radioactive Materials Research

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Materials Deformation

Dr. Pamela Burnley
Department of Geoscience
Phone: (702) 895-5460
Email: pamela.burnley@unlv.edu

Expertise:

High Pressure Rock Deformation

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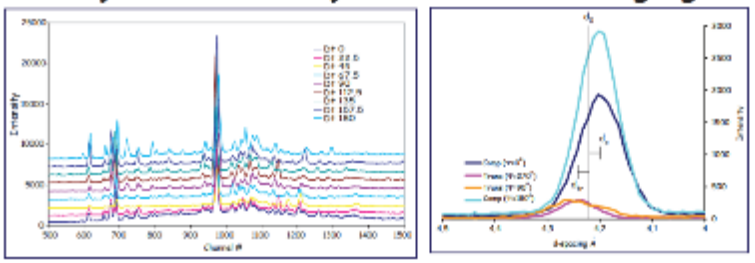
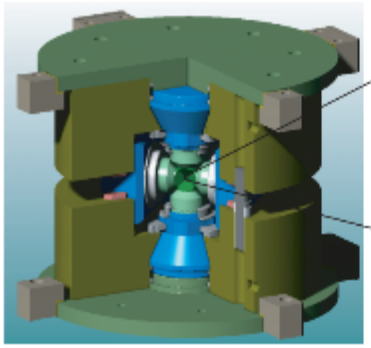
High Pressure studies of Deformation and the Acoustoelastic effect

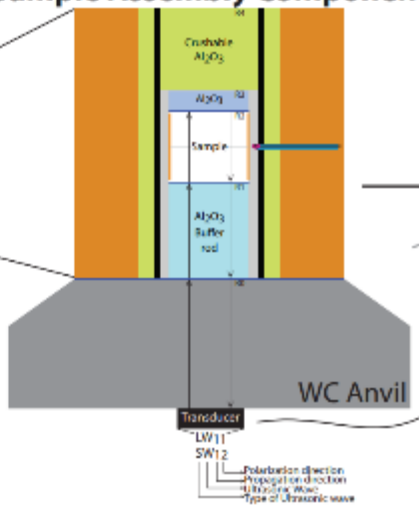
Synchrotron X-ray diffraction and imaging

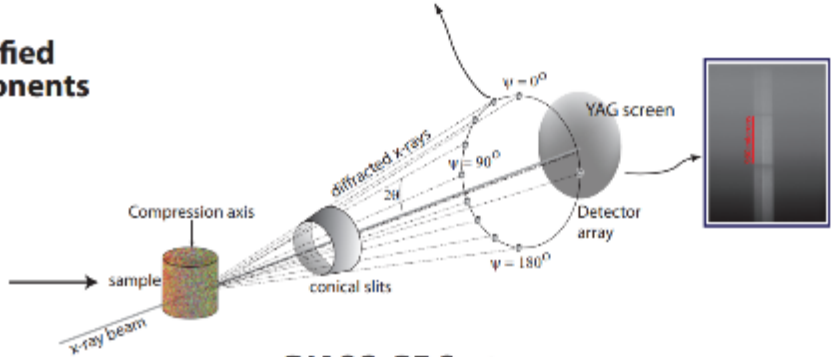


D-DIA module

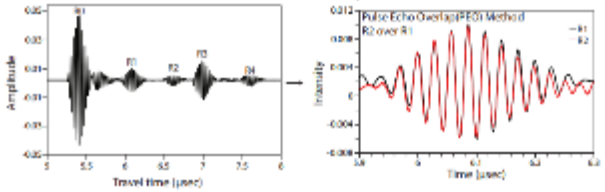


Ultrasonic D-DIA Modified Sample Assembly Components



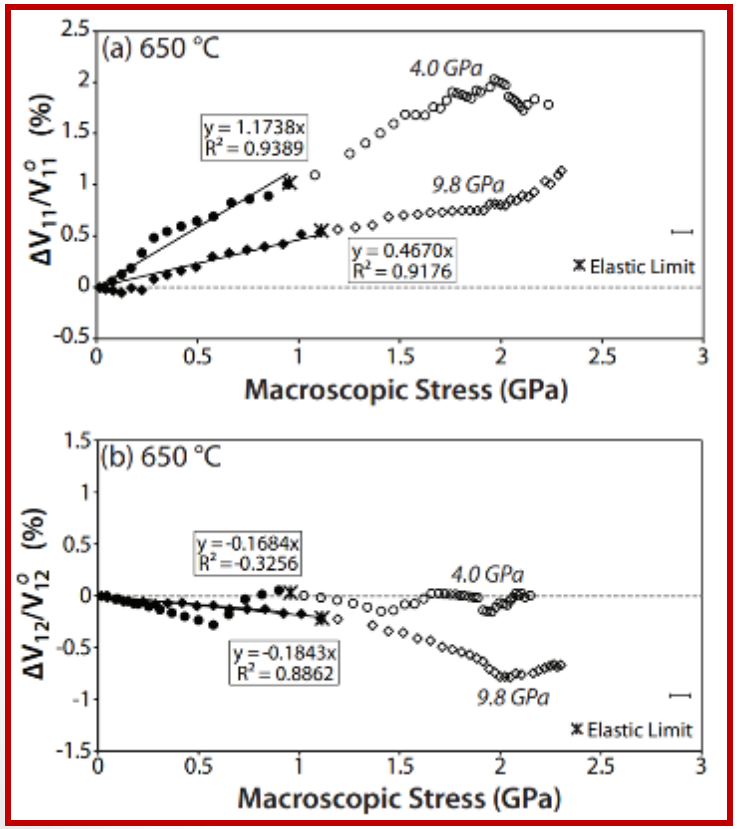


DIASCoPE System



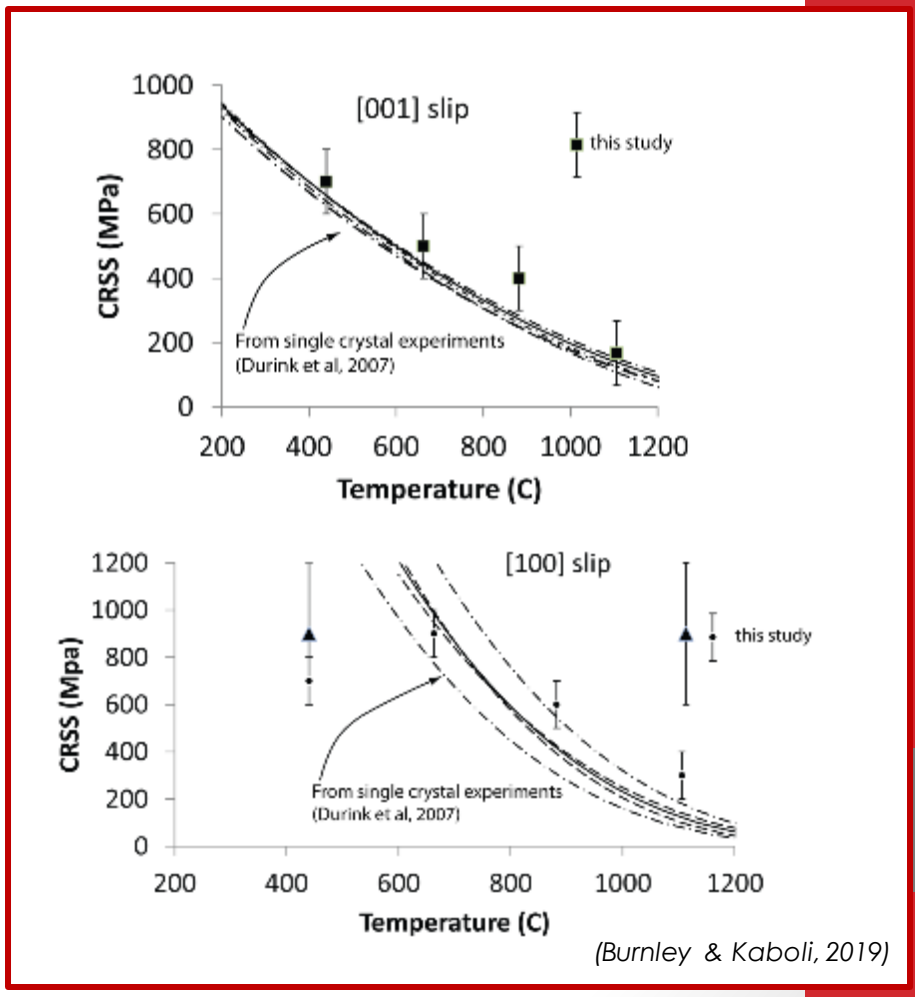
High Pressure studies of Deformation and the Acoustoelastic effect

Compression- and shear-wave velocities are a function of compressive stress



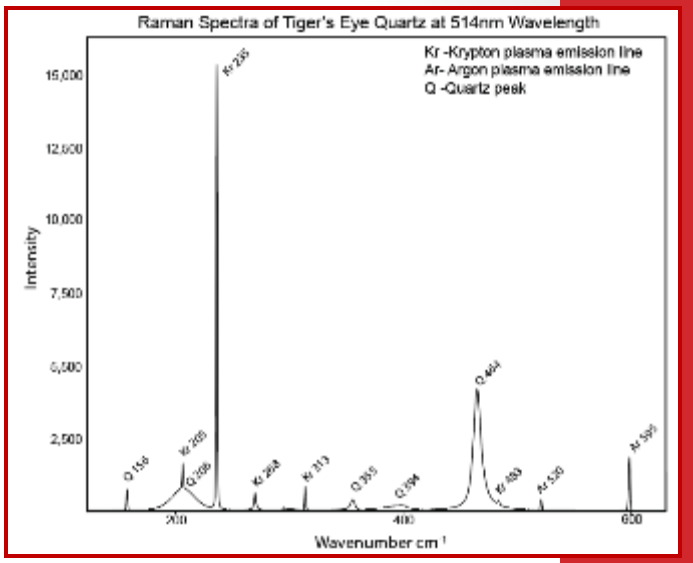
(Traylor, Whitaker & Burnley, in prep)

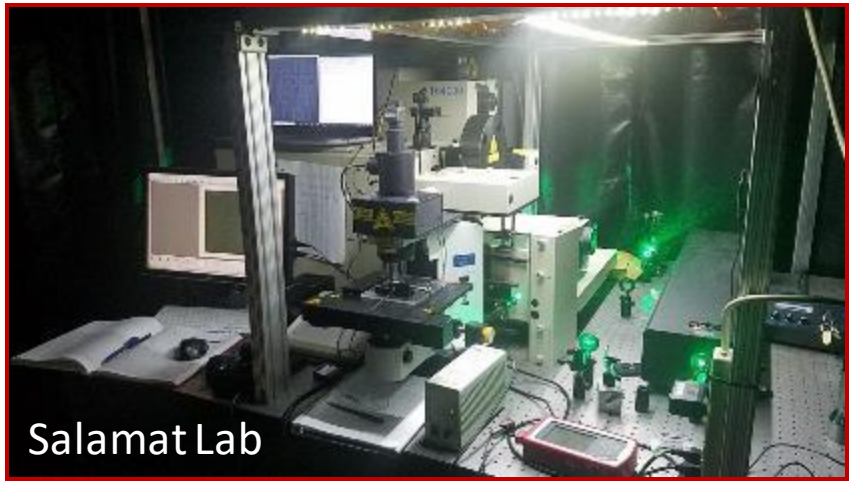
Details of multiple slip systems derived from a single multi step experiment

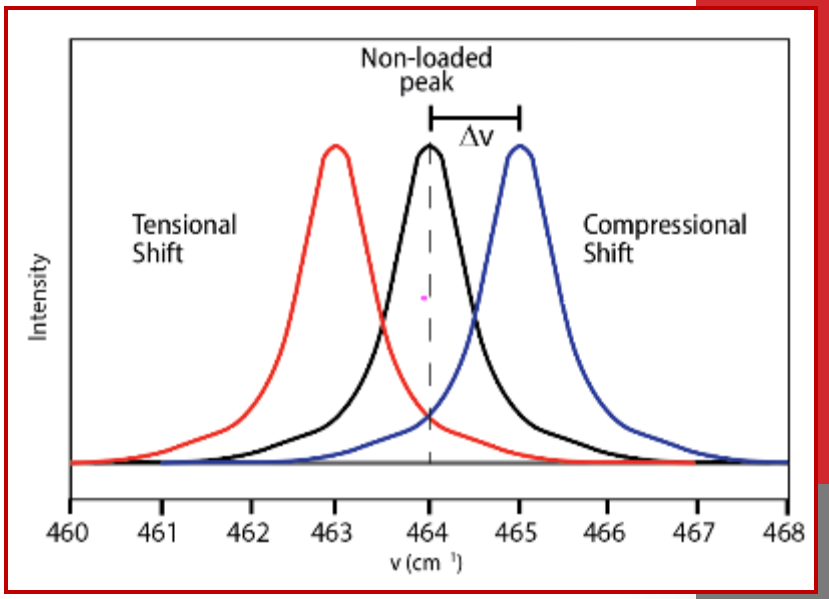


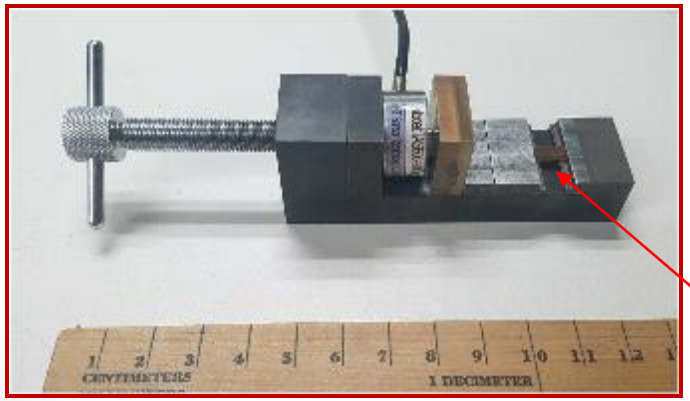
(Burnley & Kaboli, 2019)

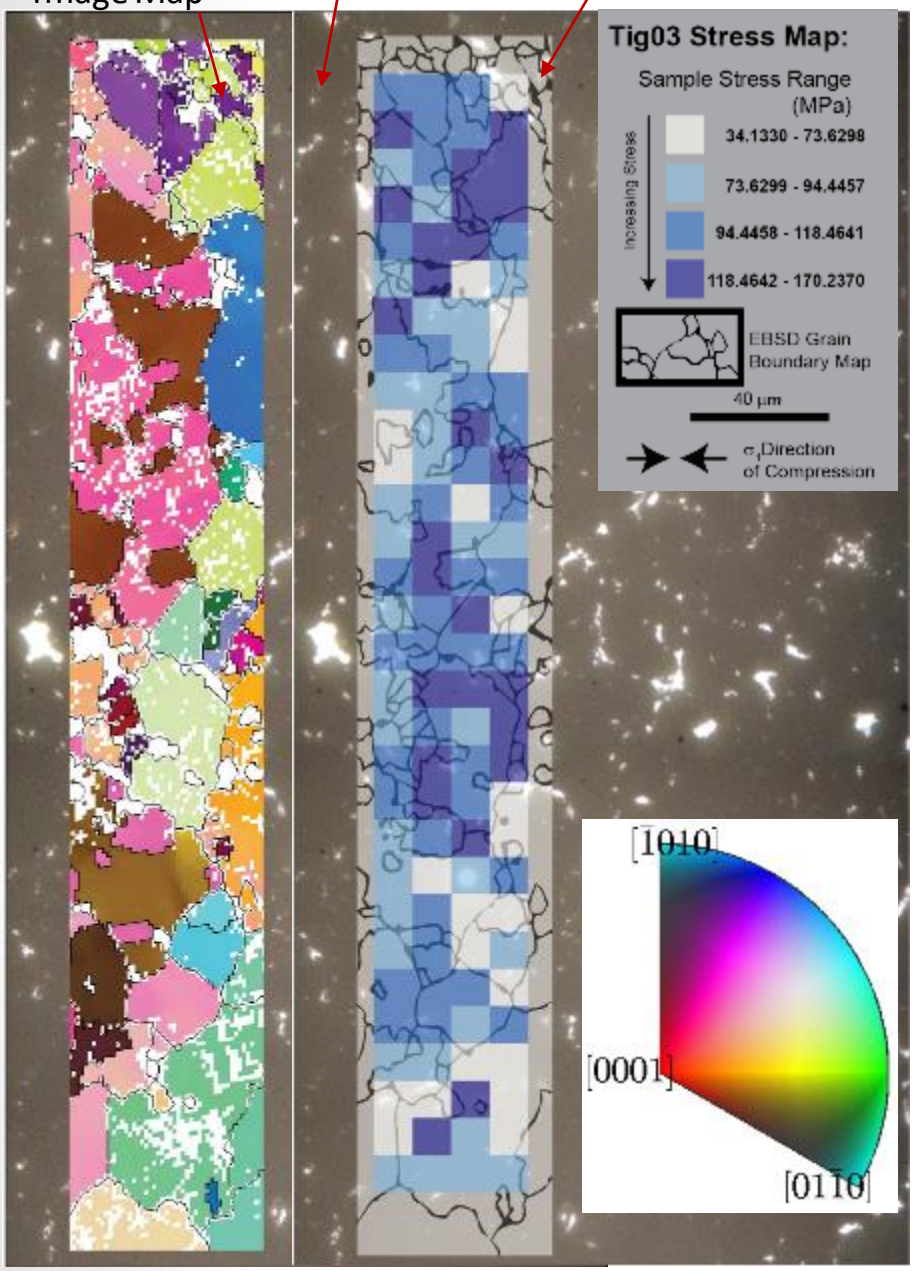
Raman spectroscopic measurements of stress distribution

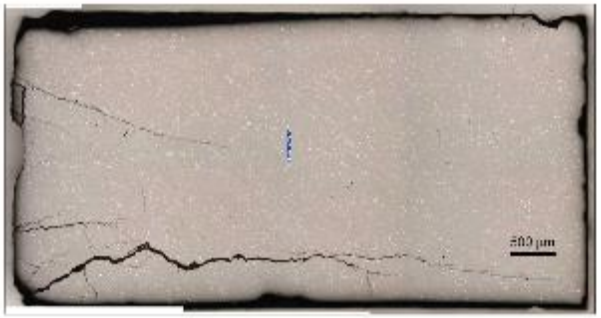




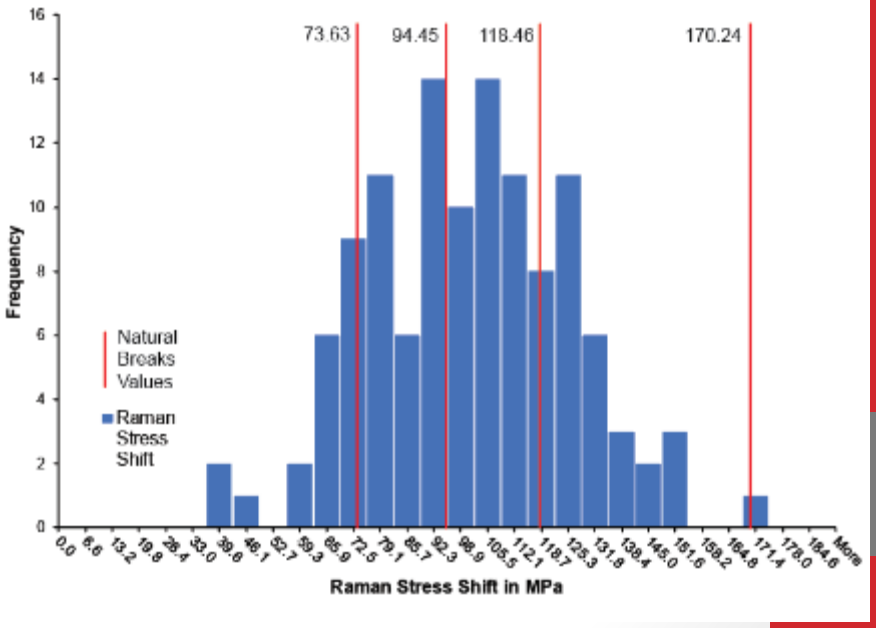




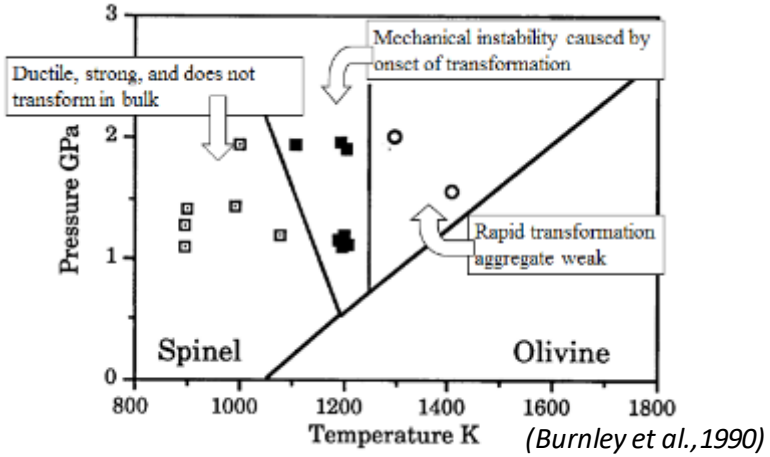




- Peak shifts converted to sample stress using single crystal measurements

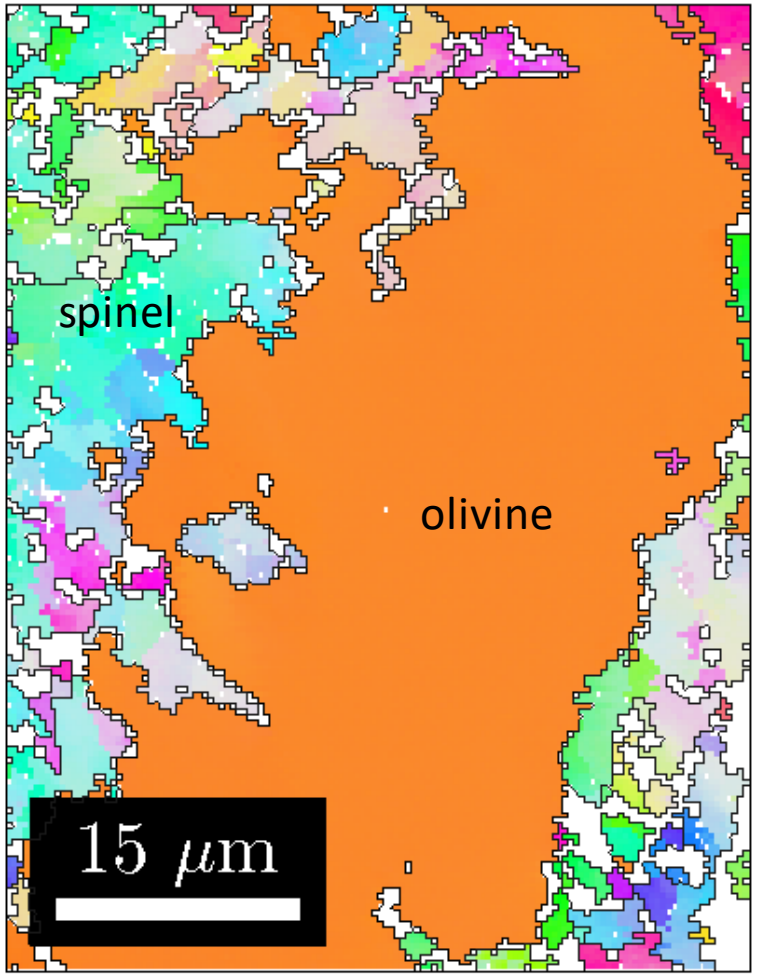


Interaction of Phase Transformation and Deformation



(Burnley et al.,1990)

- Growth of spinel in metastable olivine creates mechanical instability
- New microstructural analysis clarifies nature of instability



Electron Backscatter Diffraction Orientation Image Map

(Burnley et al., in prep)

Radioactive Materials and Radiation

Dr. Pamela Burnley
Department of Geoscience
Phone: (702) 895-5460
Email: pamela.burnley@unlv.edu

Expertise:

Gamma ray background radiation

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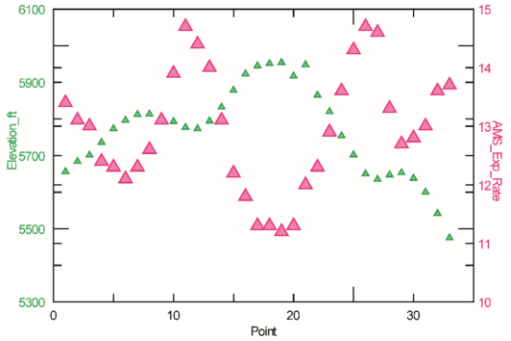
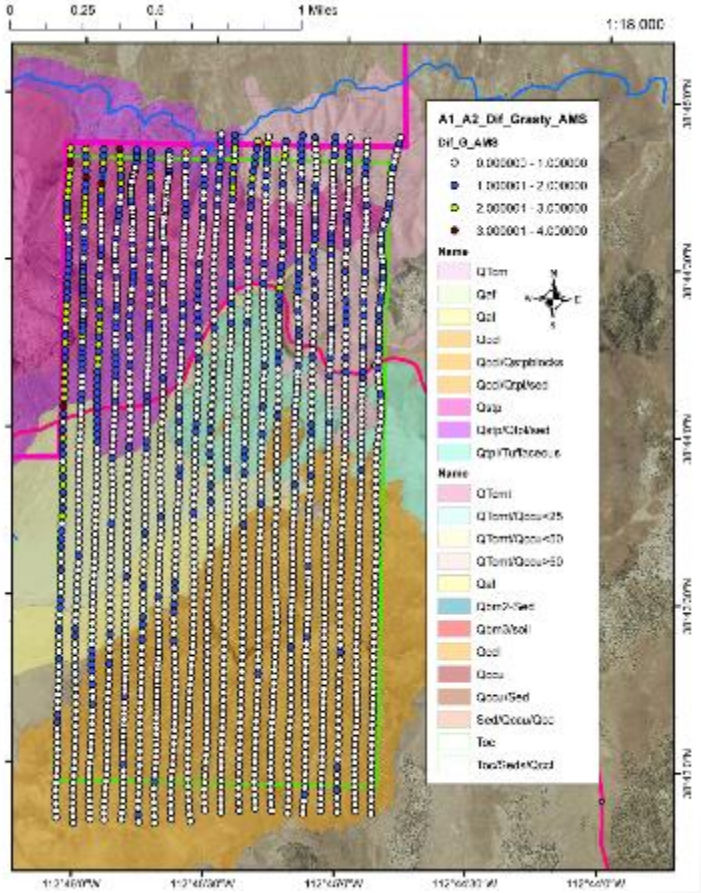
γ-ray Background Radiation



- Predictive model based on legacy NURE data & geologic map units
- Most points within 1μR/hr
- Largest deviations associated with steep topography
- Led to D. Haber's PhD research on topographic corrections

Difference between AMS flight data and predictive model

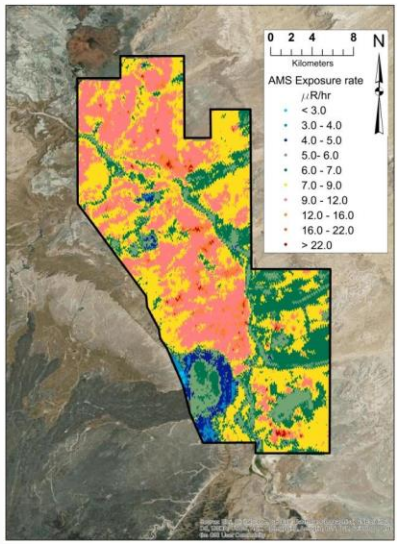


SDRD

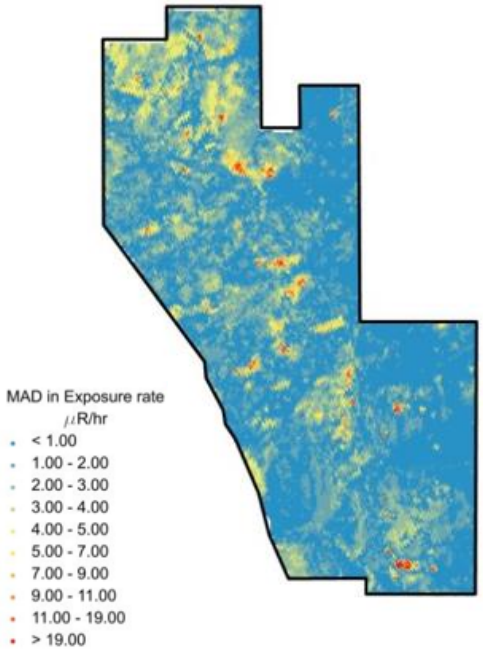
γ-ray Background Radiation

AMS flight data

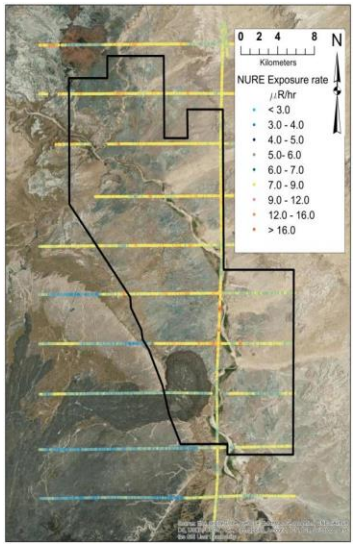
Cameron, AZ



Difference between AMS data and model



Model based on ASTER data, NURE survey & geologic map



(Adcock et al. 2019)

Highlights Uranium mines

Radiochemistry

Paul M. Forster
Department of Chemistry and Biochemistry
Radiochemistry

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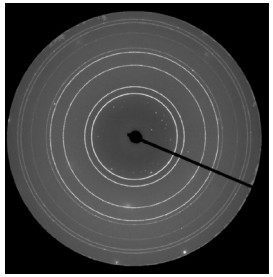
Expertise:

-Structure determination (X-ray and neutron diffraction, total scattering)



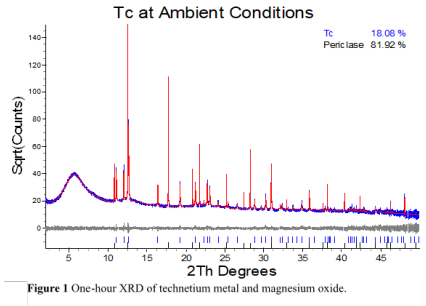
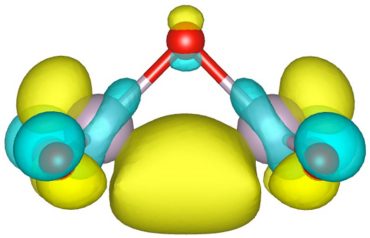
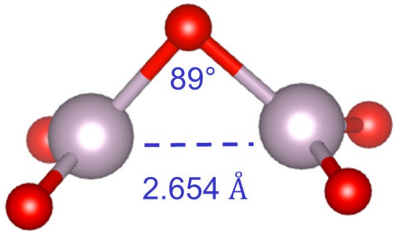


Figure 1 One-hour XRD of technetium metal and magnesium oxide.

-Structure-property relationships, integrated simulation

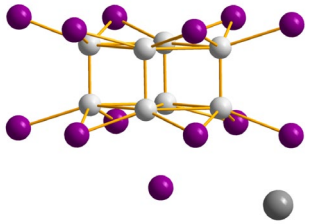


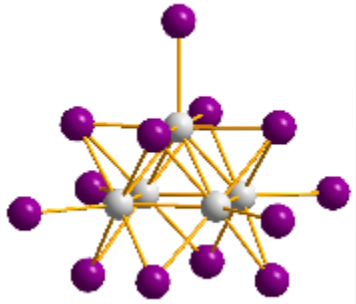


Probable identification of a gas phase technetium oxide molecule

-Hydro/solvothermal synthesis

Technetium iodide compounds prepared solvothermally





Paul M. Forster
Department of Chemistry and Biochemistry
Radiochemistry

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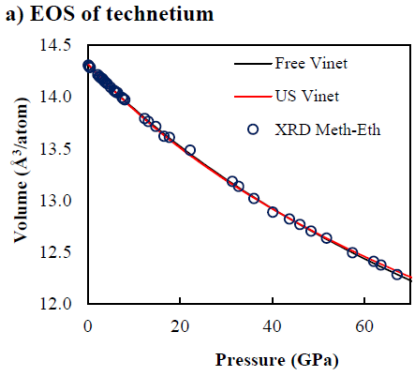
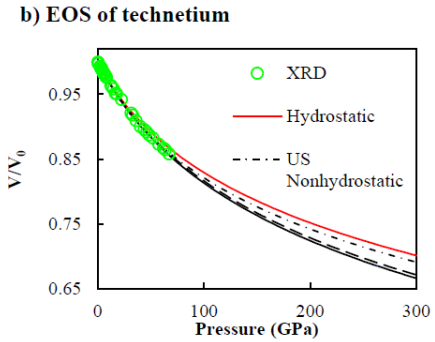
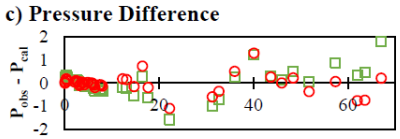
Relevant projects:

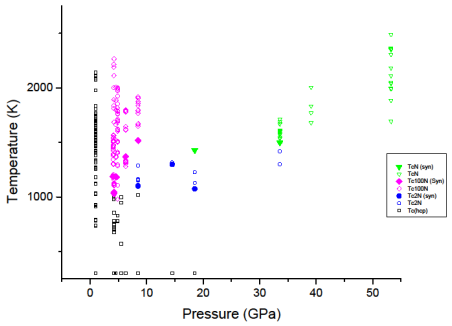
First diffraction-based equation of state for elemental Tc

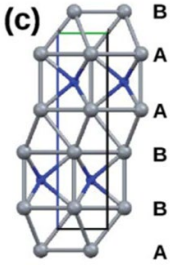


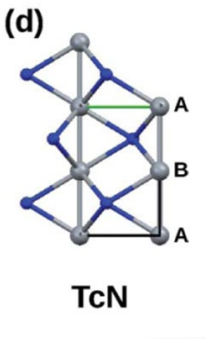




Discovery of new binary Tc nitrides







Paul M. Forster
Department of Chemistry and Biochemistry
Radiochemistry

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Art Gelis

Director, Radiochemistry Program

Actinide Separations and Recovery

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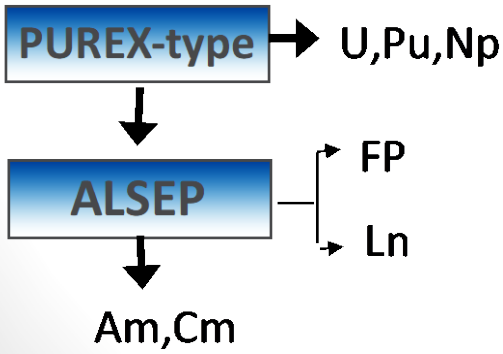
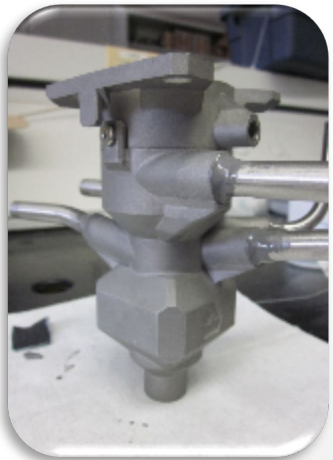
Design and Testing of Advanced Separation Processes using Additive Manufacturing

- **Liquid-Liquid Extraction and Separation of Plutonium, Uranium, Minor Actinides, Lanthanides and Fission Products**
- **Twenty-seven 3D-printed acrylic centrifugal contactors (CC), fabricated at Argonne National Lab are available at UNLV**
- **Contactors can be 3D-printed in stainless steel or any alloy**
- **Solvent extraction separations can be tailored to a specific goal**
- **Example: Actinide Lanthanide SEParation process - ALSEP, designed and tested for DOE-NE**



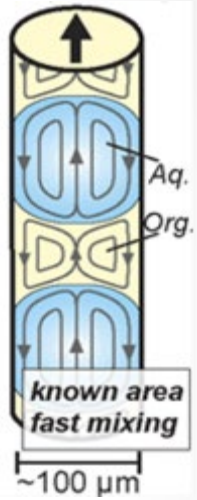
10+1 acrylic CC

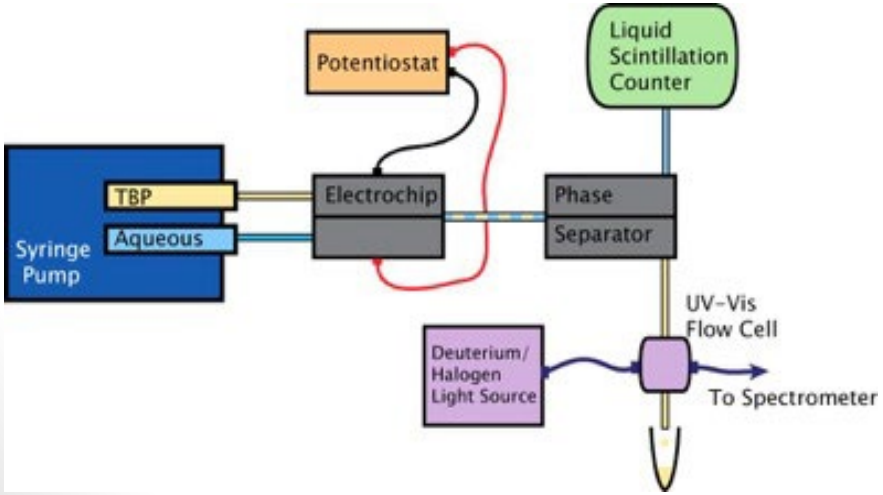
Steel CC

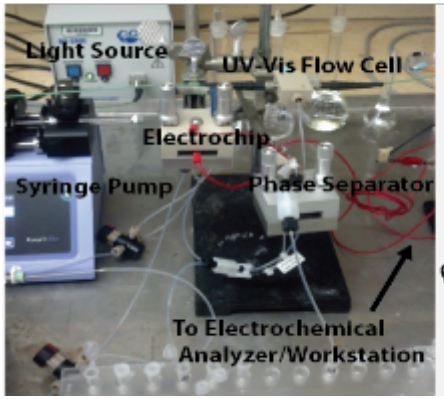


Microfluidic Systems for Rapid Radionuclide Separation and Detection

- **Microfluidic device to combine aqueous and organic phases, rapidly mix, then separate phases, following by analysis**
- **Selective Extraction of radionuclides on a very small scale**
- **Can be implemented either as a bench-top setup or as a portable detector**
- **Potential applications: rapid Pu separation and detection from Uranium and FP for safeguards; ”dirty bomb” analysis**







Strategic Materials Analysis and Recovery – David Hatchett and Ken Czerwinski

Dissolution of UF_6 into IL at 0 hours, 24 hours, 30 days, and the recovery of UF_6 salt.

Expertise:

- Actinide, Lanthanide, and Li materials recovery from Ionic Liquids (Ils).
- Electrochemical, Spectrocopic, and thermal analysis of Radioactive materials.
- Radiochemistry and Analytical Chemistry.

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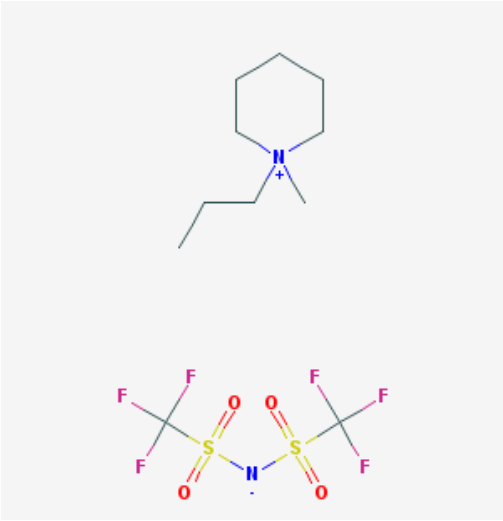
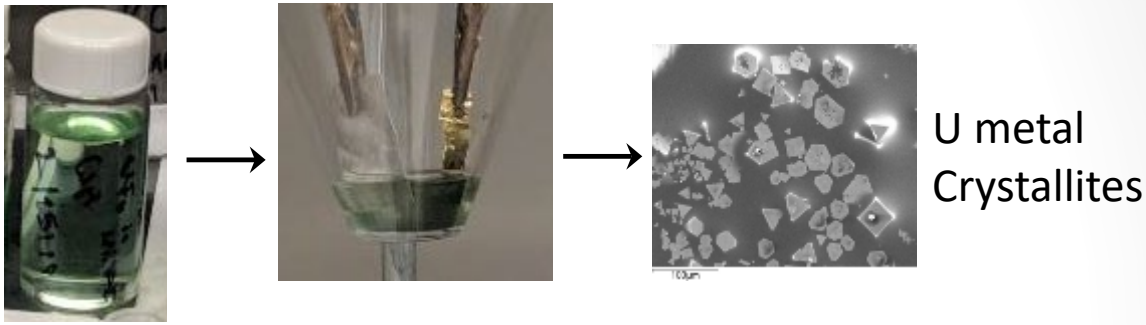
Strategic Materials Analysis and Recovery – David Hatchett and Ken Czerwinski



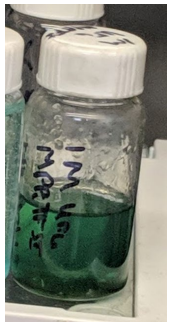
1-methyl-1-propyl piperidinium bis(trifluoromethylsulfonyl)imide [MPPi][TFSI]

Electrochemistry

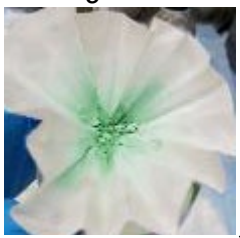


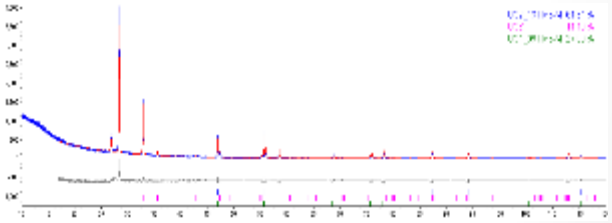
U metal Crystallites

Low Concentration 0.1 M



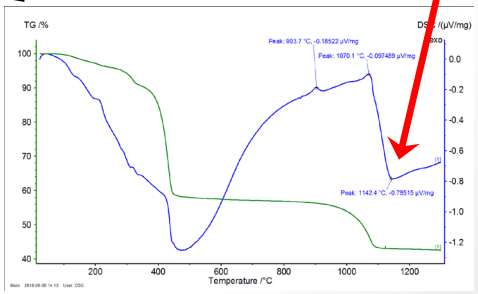
UF_6 salt





Air

U metal



$$UF_6 + 2\ TFSI^- \rightarrow UF_6^{2-} + 2\ TFSI\cdot$$

$[MPPi]_2[UF_6]$

UF_6 salt

High Concentration 0.95 M

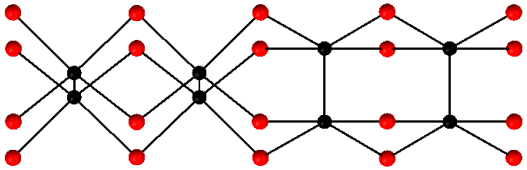
Paths to U recovery from UF_6 dissolved in IL

Technetium and Uranium Chemistry

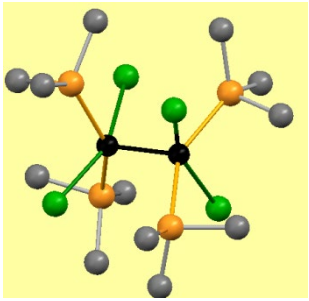
Frederic Poineau, PhD
Radiochemistry

→ Synthetic and coordination chemistry

Technetium binary and ternary halide compounds
Compounds with multiple metal-metal bonds



$TcCl_2$: a unique structure-type



$Tc_2Cl_4(PMe_3)_4$

→ Chemistry relevant to remediation and fuel cycle applications

Separation, vitrification, and waste forms (alloys)

Demonstration of the separation of
uranium from technetium for fuel cycle application

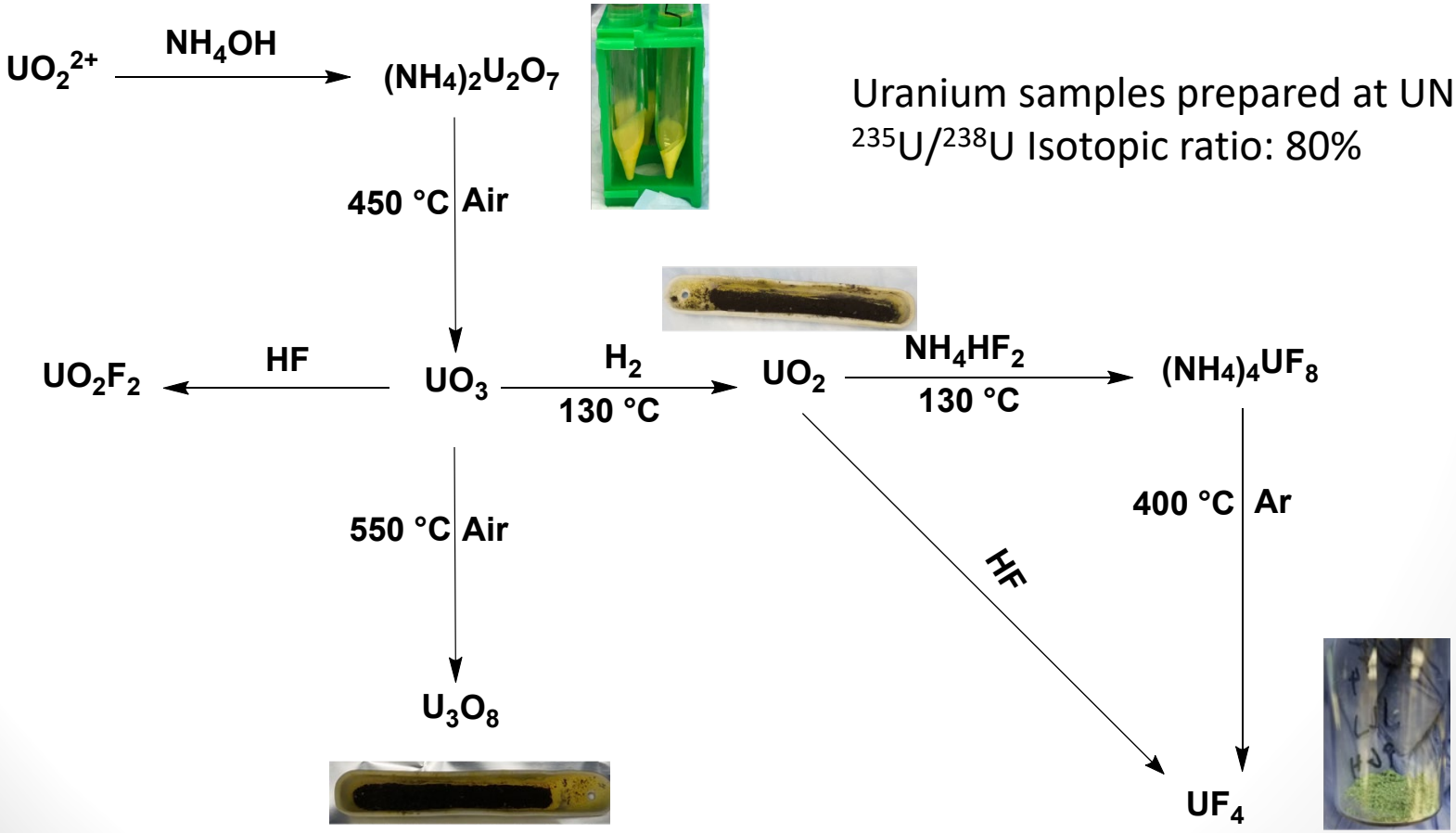
Preparation of U-Tc alloys by arc melting

Frederic Poineau, PhD
Radiochemistry

→ Collaborative work relevant to nuclear forensics

Analysis of Uranium Isotopic Ratios by Thermal Ionization Mass Spectrometry (TIMS)

- Uranium compounds found throughout the fuel cycle (UO_2, U_3O_8, UF_4) prepared at UNLV
- $^{235}U/^{238}U$ isotopic ratio measurements using TIMS at LANL



Uranium samples prepared at UNLV
$^{235}U/^{238}U$ Isotopic ratio: 80%