

## Quantitative elemental analysis of solutions or solids following dissolution

### Major to sub-part per million levels

#### Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES)

- Simultaneous, multielement analysis for more than 70 elements

### Minor to sub-part per billion levels

#### Inductively Coupled Plasma-Mass Spectrometry (ICP-MS)

- Quantitative or rapid semiquantitative analysis for up to 72 elements
- Isotope ratio measurements (for tracer experiments, high accuracy isotope dilution calibration, etc)

### Minor to part per trillion levels

#### Inductively Coupled Plasma-Dynamic Reaction Cell- or Sector Field-Mass Spectrometry (ICP-DRC-MS, ICP-SF-MS)

- Minimum measurable concentration typically contamination limited
- Accurately measure low concentrations of P, S, As, Se, Fe, Cr, etc, that are difficult for ICP-MS using conventional quadrupole MS.

## Direct, quantitative elemental analysis of solids (selected locations or maps)

### Major to sub-part per million

#### Laser Ablation-Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS)

- Spot analysis - 2 to 400  $\mu\text{m}$  in diameter
- Homogenized 193 nm laser beam for precisely controlled ablation
- Video microscope viewing of sample
- Selectable analysis locations as lines, spots
- Spatially resolved elemental mapping

### State of the art instrumentation

ICP-OES: PerkinElmer Optima 3000DV, Optima 4300DV, Optima 5300V, Optima 8300DV

ICP-MS: PerkinElmer ELAN 6000

ICP-DRC-MS: Perkin Elmer ELAN 6100 DRC<sup>plus</sup>

ICP-SF-MS: ThermoFinnigan Element 2 Sector Field Mass Spectrometer

#### Sample introduction systems for:

Solutions (0.5-1 mL/min)

Solutions (20-100  $\mu\text{L}/\text{min}$ )

Direct solid sample analysis :

New Wave Research UP-193HE Excimer Laser Ablation System with Beam Homogenizing Optics

#### Sample preparation:

Hot plate, Paar bomb, Savillex PFA vessels  
Milestone Ethos TC closed PFA vessel  
microwave digestion with P, T control  
Class 10 laminar flow exhausting hood

## Elemental chemical analysis of virtually any type of sample

### Recent samples/projects include:

Minor, trace , ultratrace elements in:

sediments  
rocks  
apatite  
dust in ice cores  
plants  
human brain tissue  
ceramics  
alloys  
quartz  
superconductors  
thin films  
propylene glycol  
bones  
shells  
artery plaque  
zeolites  
carbon nanotubes  
cells  
metalloproteins

Lake/river water from Columbus, Panama, Taiwan, Antarctica

Chronology of trace elements in corals

Potentially toxic trace elements in raw materials, consumer products

Develop method to monitor fish migration in Lake Erie based on trace elements in ear bones (otoliths)

We specialize in unique measurement problems, technique development and collaborative research in addition to more routine elemental chemical analysis.

## TERL Clientele

Faculty, staff and students from more than 25 departments in 10 colleges are TERL clients or collaborators. The TERL also serves clients outside of the University at commercial rates. Clients include some of the largest and some of the smallest companies in Ohio.

## Educational Opportunities

TERL staff teach short courses on elemental chemical analysis that cover the fundamental concepts and practical knowledge to use ICP-OES and ICP-MS. The short courses are also useful for those who use elemental chemical analysis data.

TERL facilities and staff are also available for use in other classes. Both undergraduate and graduate students can carry out measurements.

TERL personnel also collaborate with other researchers at OSU, other Universities and companies on a variety of projects.

## Superb Facilities

The TERL is located in the renovated Mendenhall Laboratory. Instrument laboratories have HEPA filtered air and precisely controlled temperature for highly reproducible, accurate measurements. Facilities for chemical and physical sample preparation include a class 10 laminar flow exhausting hood and workbench, solid sample surface preparation and apparatus to dissolve virtually any material for analysis.

## TERL Staff/Contact Information

**Dr. John Olesik, 292-6954**

**TERL Director, olesik.2@osu.edu**

John has an international reputation for research in the areas of analytical chemistry, plasma spectrochemistry, optical spectroscopy and mass spectrometry. Winner of the 2001 Lester Strock Award from the Society of Applied Spectroscopy and the American Chemical Society Spectrochemical Analysis Award in 2009. He serves as Director and ICP expert.

**Anthony Lutton, 292-1987**

**Research Associate, lutton.7@osu.edu**

Inductively Coupled Plasma Spectrometry

Anthony is a B.S. Chemist (Ohio State, 2003) who is responsible for sample preparation, ICP-OES and ICP-MS measurements in the TERL. He has extensive experience making accurate measurements in complex samples and at concentrations down to parts per trillion.

**Fang Liu**

**Graduate Research Assistant**

Fang is a Chemistry graduate student who is investigating approaches to overcome spectral overlaps in ICP-MS as well as new sample introduction systems for ICP-OES and ICP-MS.

**Shi Jiao**

**Graduate Research Assistant**

Shi is a Chemistry graduate student who is investigating matrix effects in ICP-MS in order to improve analysis accuracy.

Trace  
Element  
Research  
Laboratory



The TERL has state of the art elemental chemical analysis capabilities and superb expertise using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) and Mass Spectrometry (ICP-MS). We can analyze virtually any type of sample to solve unique and routine problems or answer research questions.

Solution detection limits

(part per billion, ng/mL)  
< 1 < 0.1 < 0.01 < 0.001 ppb

Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac															

Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	Nb	Lw

We can provide complete sample analysis, collaborate on projects, teach how to use the measurement techniques and/or provide access to superb instruments.

Contact us for solutions to your elemental chemical analysis needs.

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