

Overview of beryllium sampling and analysis techniques

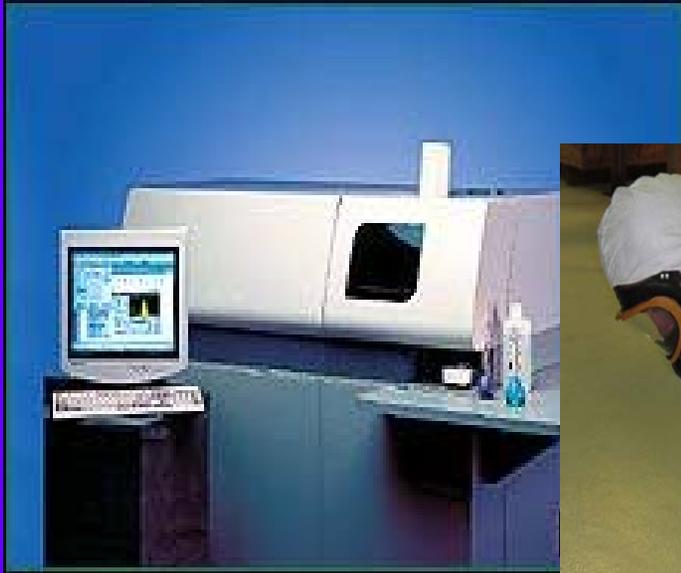
An Industrial Hygienist's View of Beryllium Analysis

Kathryn Creek, MS, CIH
ACS National Meeting
March 31, 2004

Background

- ❖ Beryllium exposure causes Chronic Beryllium Disease, a chronic debilitating lung disease
- ❖ The DOE *Chronic Beryllium Disease Prevention Program Rule, 10 CFR Part 850*, requires beryllium surface and air monitoring to determine health risk and the effectiveness of mechanisms used to minimize or eliminate that risk.
- ❖ Current analytical techniques involve substantial delays and costs.

Current gold standard-ICP





Beryllium Particulates and Their Detection

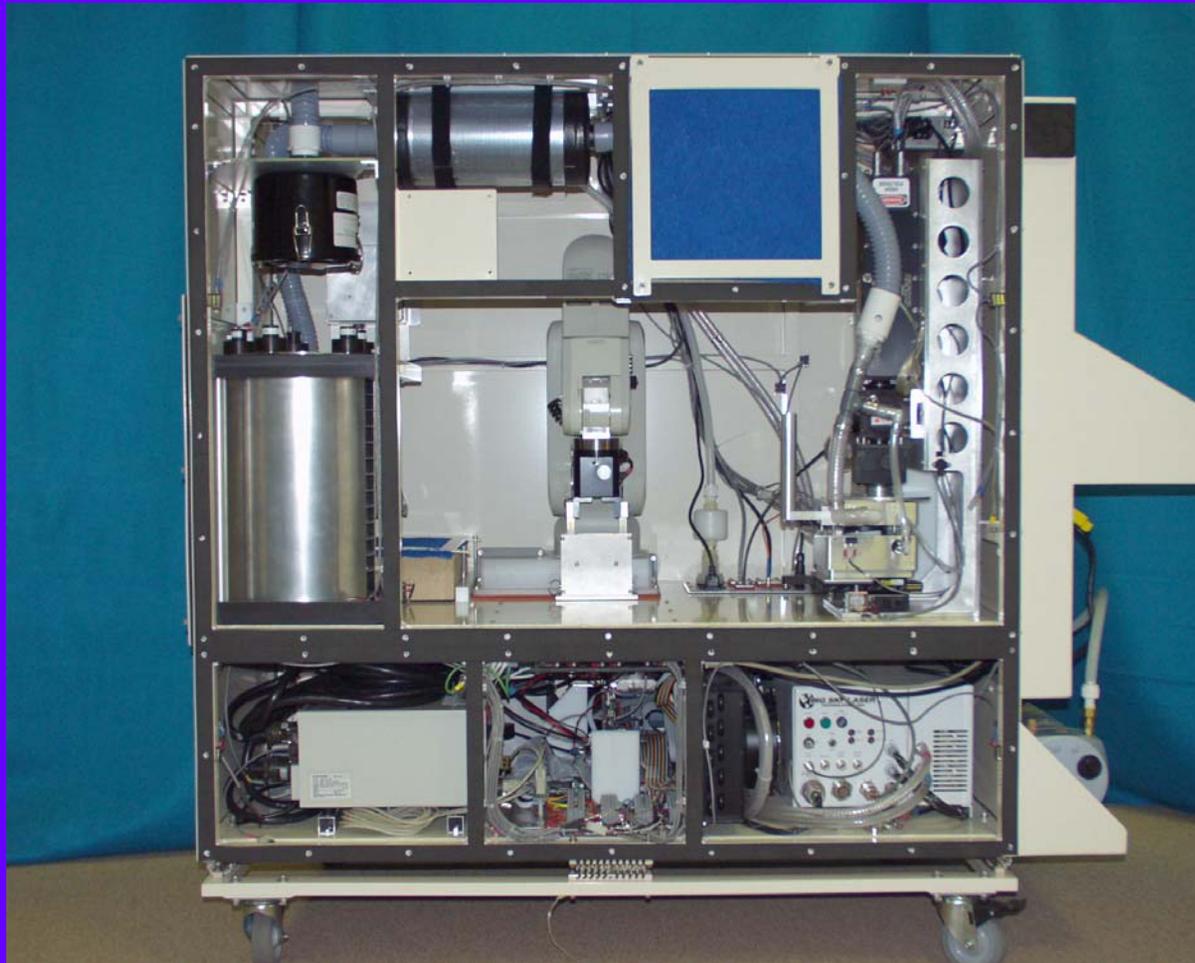
February 13 & 14, 2002 • Eldorado Hotel in Santa Fe



- ❖ Symposium hosted by Network of Senior Scientists and Engineers (NSSE) and LANL
- ❖ Beryllium Advanced Technology Assessment Team (BeATAT) formed as a result of information learned at symposium
- ❖ Team charged with coming up with specifications for instruments or methods, standard protocols for method testing, plan for validation of instruments, communication, funding resource list, priority research list

Objectives of beryllium real-time monitoring

- ❖ Improved worker and public protection
 - ◆ Basis for engineering/administrative controls/PPE
 - ◆ Timely feedback to workers
- ❖ Improved productivity
 - ◆ Movement of Materials
 - ◆ Personnel efficiency
 - ◆ Reduced analytical laboratory costs
- ❖ Characterize contamination migration
- ❖ Evaluate legacy areas

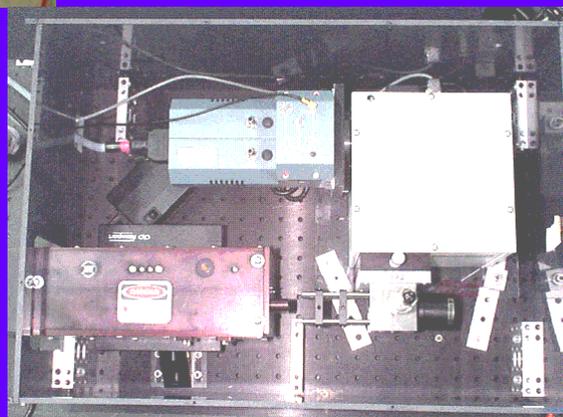


Laser Induced Breakdown Spectroscopy

AEROSOL-FOCUSING LASER-INDUCED-BREAKDOWN SPECTROSCOPY



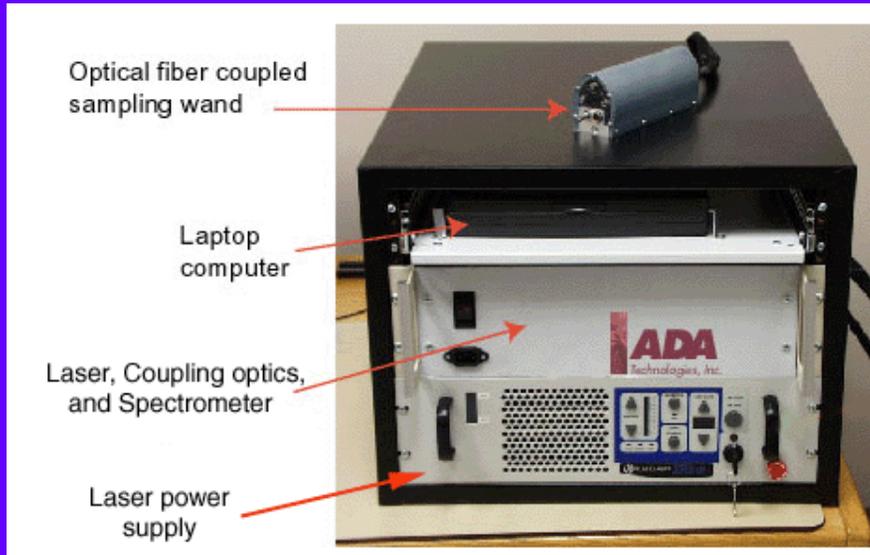
Portable unit enables in-situ measurement of the elemental composition of airborne particulate matter in near-real time.



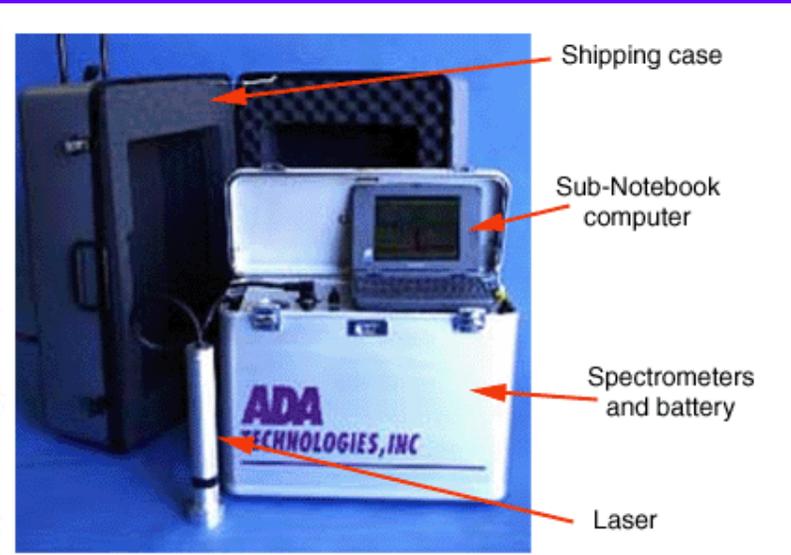
Instrument has a capability for the simultaneous, multi-element analysis of airborne particles.

ADA's LIBS Instruments

LIBS Instrument for D&D



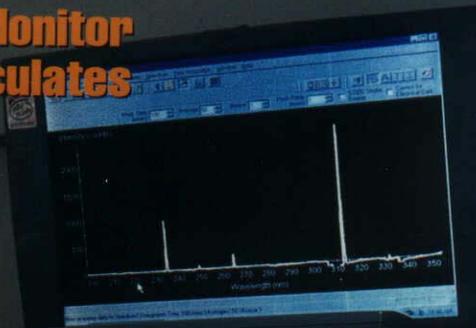
Field portable multi-metals in soils



2000 R&D 100 Entry

Los Alamos Monitor for Air Particulates (LA-MAP)

Yixiang Duan



- Continuous, real-time
air-particulate
monitoring*
- Identifies hazardous
elements; instantly
protects workers*
- Highly sensitive,
portable, lightweight*
- Effective inside or
outdoors*



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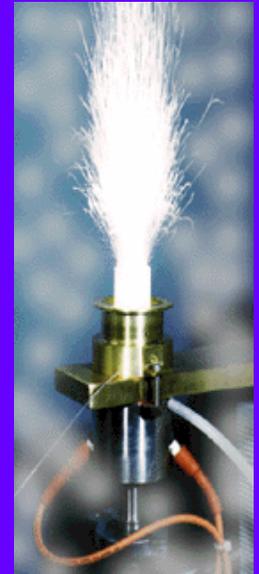
Los Alamos
NATIONAL LABORATORY



Amzil BAM System



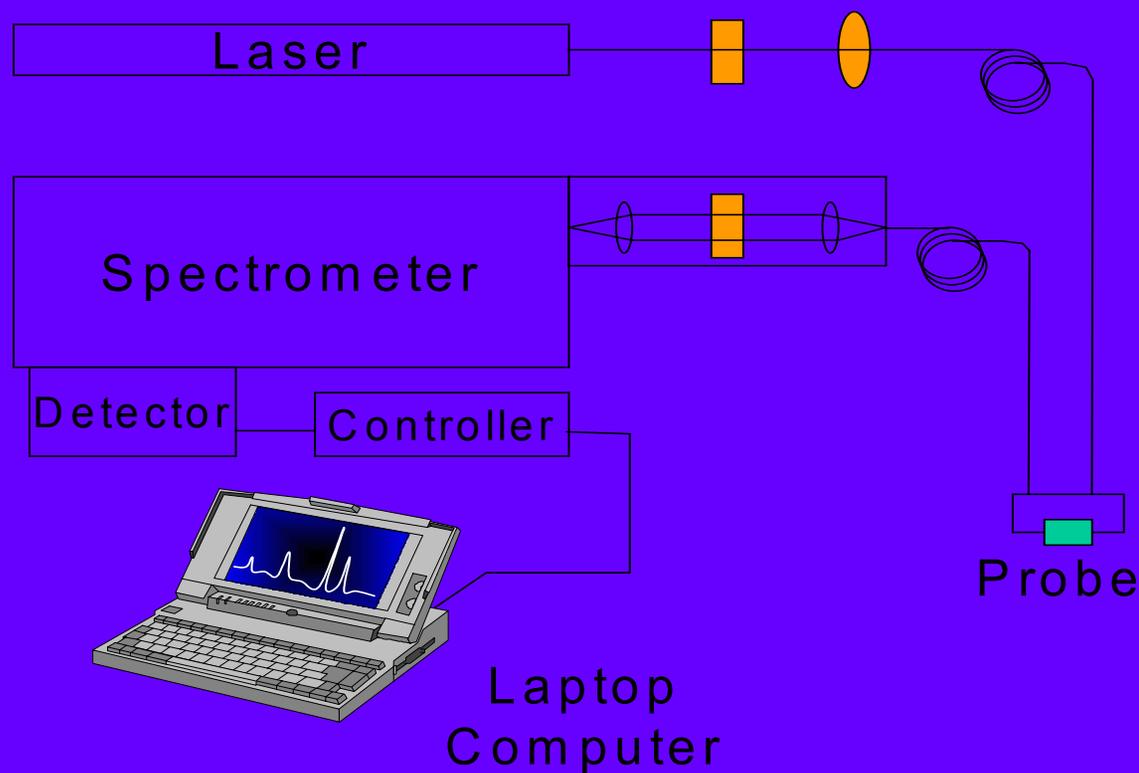
- High Sensitivity
- High Sampling Rate
- Complete Particulate Volatilization
- Air Cooled
- Operates on Electricity & Air
- Robust Cart Mounted Package
- Completely Automatic
- Simple Touch Screen Interface
- Full Gear Operation



Surface-Enhanced Raman Scattering

SERS

Raman Instrumental Setup



Adsorptive Stripping Voltammetry Analysis of Beryllium in Dusts and Air Samples





Colorimetric



Fluorometric



Status of non-lab analysis/detection techniques

❖ Fifteen instruments/methods

- Technology development-5

- Prototype – 5

- Out of business – 1

- Commercial instruments -4

 - ◆ One only qualitative, one never tested with beryllium, two over \$300k and very large

❖ One method in process of being validated

WHAT ARE WE LOOKING FOR?

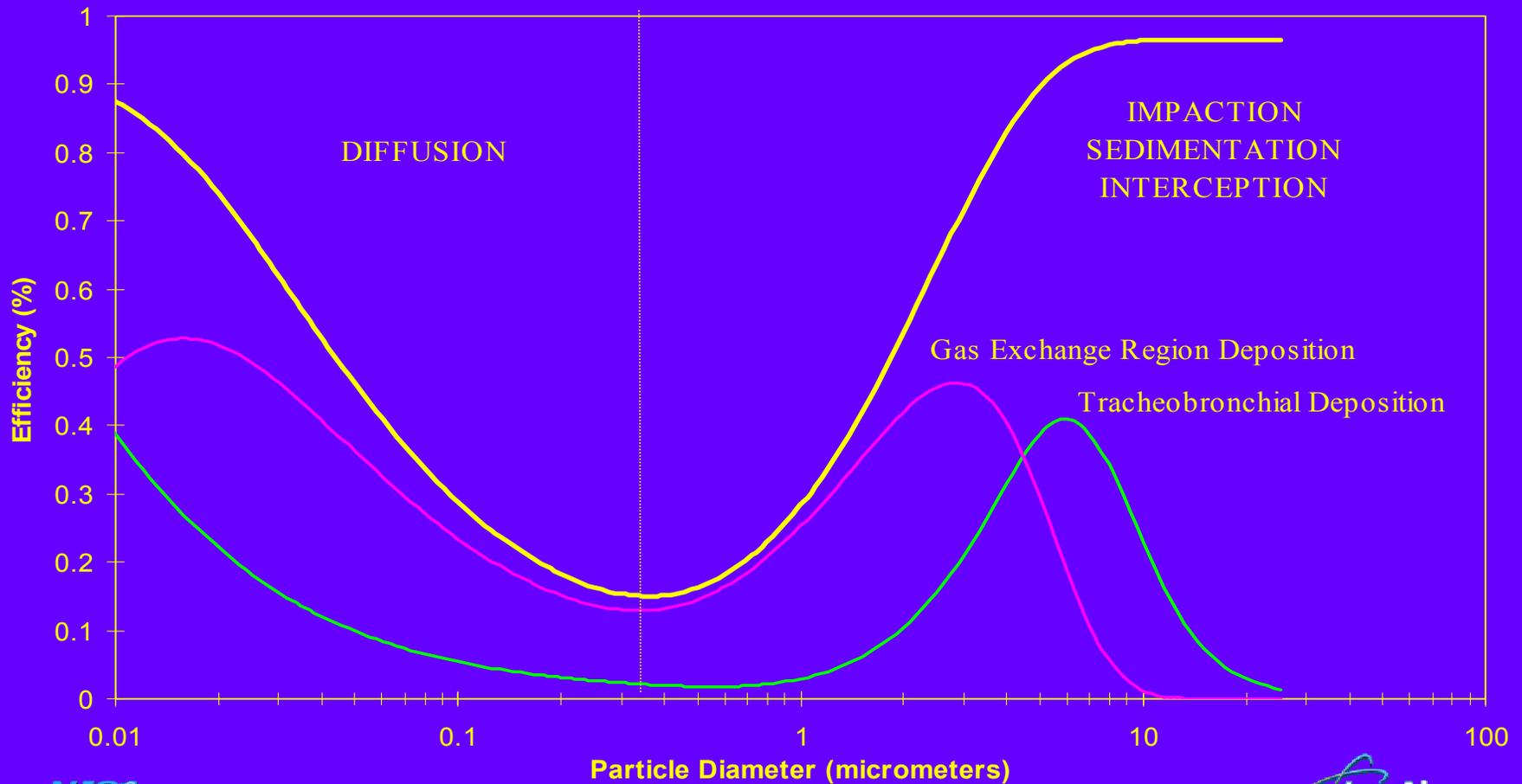
Let's talk about exposure risk.

Comparison of locations by deposited Be particle number and average Be mass concentration

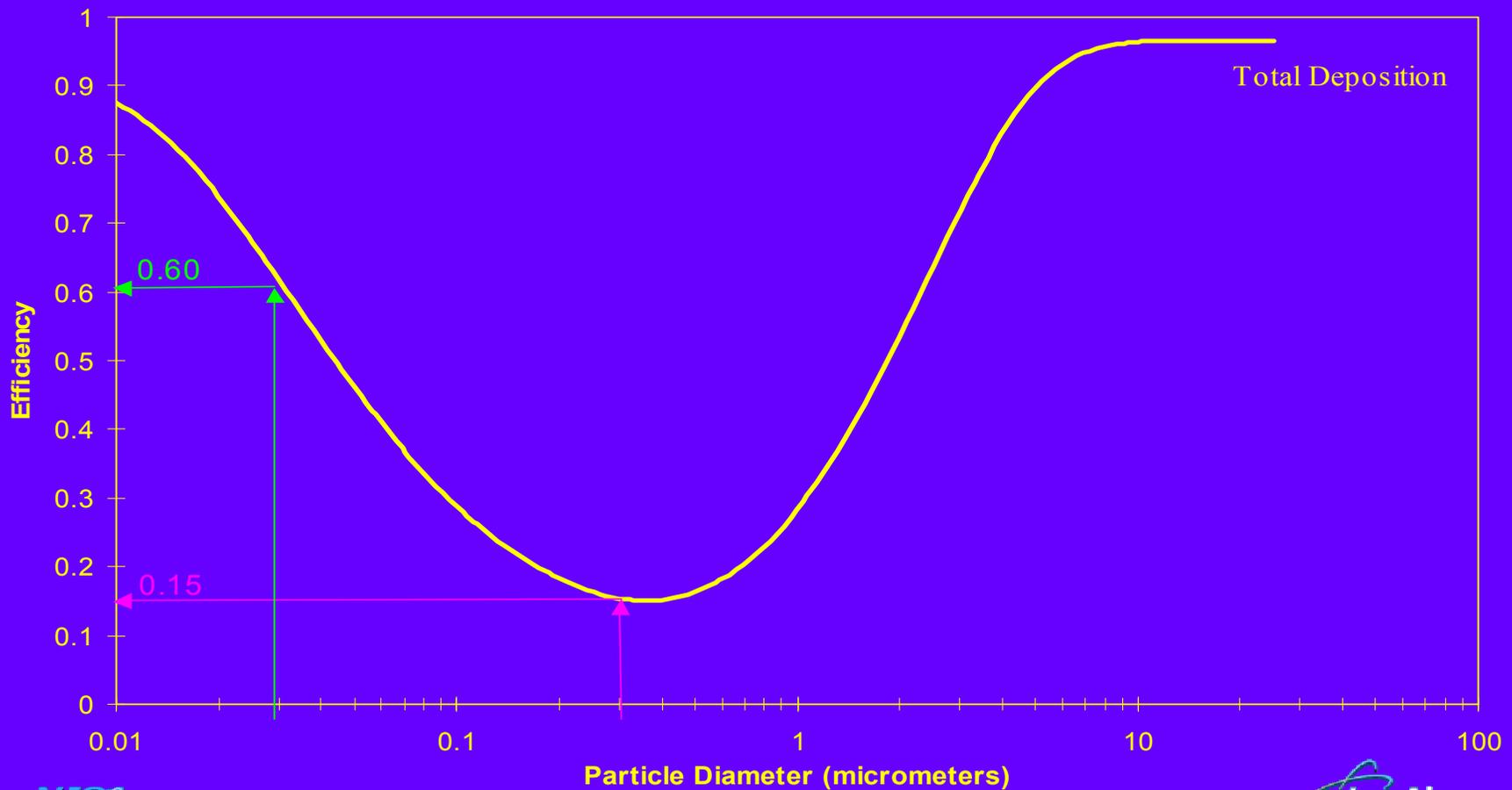
	Deposited Be Particles / cc	Average Be Mass ug / m ³
Oxide furnace area	9900	0.015
Fluoride furnace area (Average)	9700	0.25
Cast shop	3700	0.036
Hydrolysis / filling area	1800	0.19
Wet plant (Processing Facility)	1400	0.058
Reduction furnace area	300	0.059
Bulk pickle in strip mill	200	0.075
Ball mill (Processing Facility)	100	0.074
Beryl ore mine	9	0.24
Ore crusher	5	0.077
Milling operation	3	0.004
Administration and shipping	1	0.001

Michael McCawley, et al.

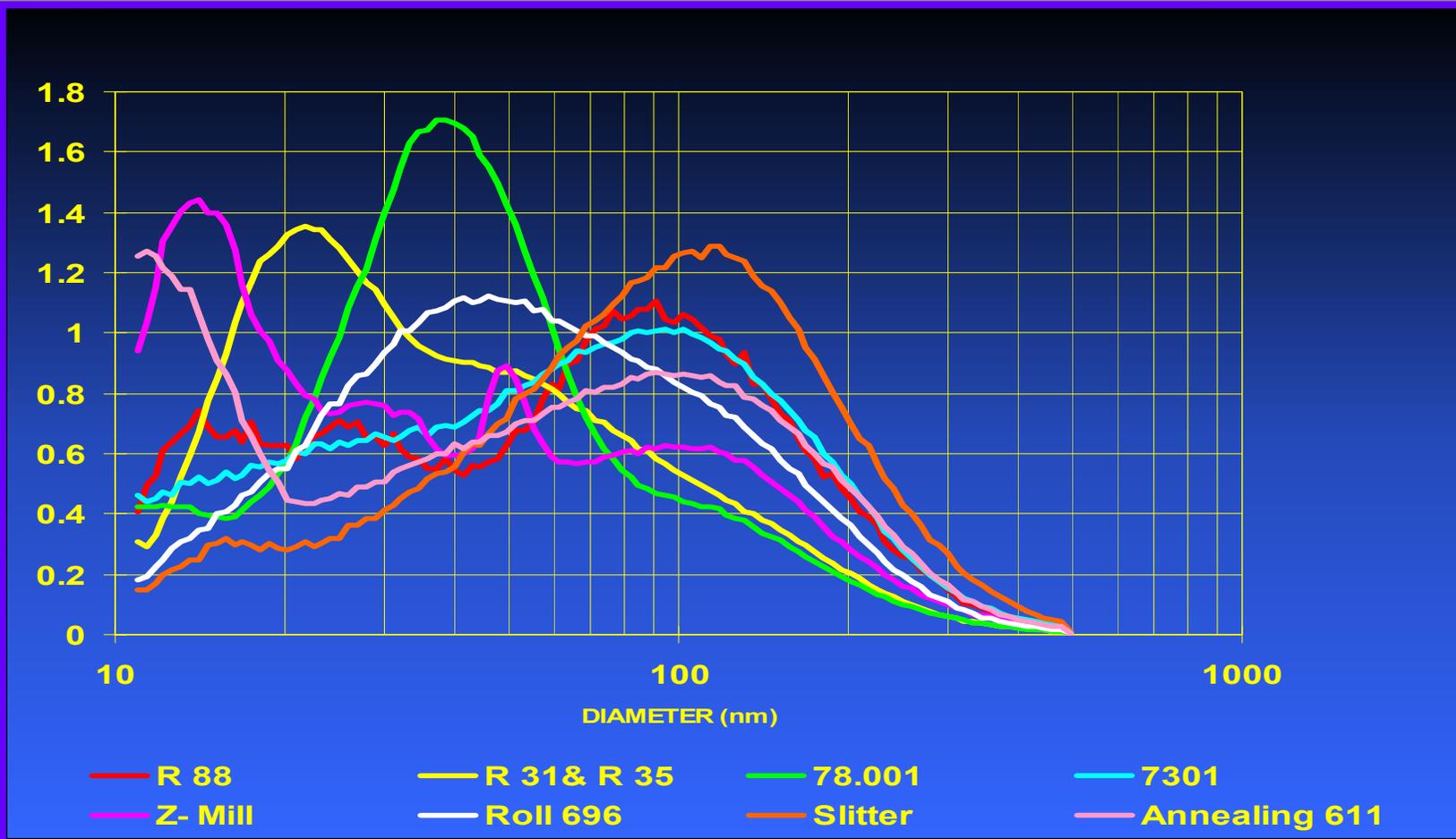
Lung Deposition Curve



Dose is particle size dependent



Particle size data by operation



Preliminary conclusions on beryllium health

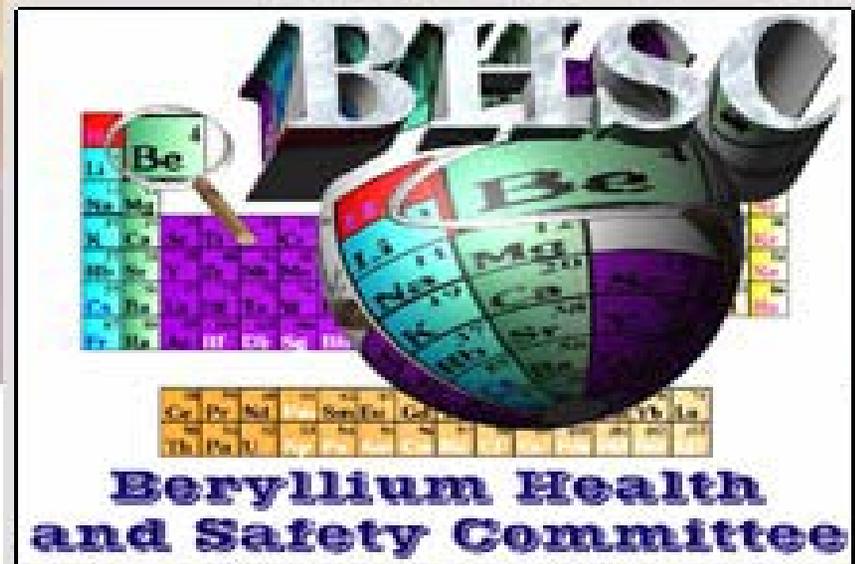
- ❖ Dose response relationships for beryllium sensitization and beryllium disease have not previously been clearly established
- ❖ Risk may be particle size dependent
- ❖ Skin contamination may be a route of sensitization
- ❖ Particle number may be the correct metric for air exposures

In search of the perfect method

- ❖ Real-time
- ❖ Low detection limit (<10ng)
- ❖ Ability to speciate
- ❖ Non-destructive
- ❖ Measures number or surface area of airborne particles
- ❖ Small (can hang device on a person)
- ❖ Inexpensive
- ❖ Rugged
- ❖ Validated in laboratory and workplace setting and proven to assess exposure risk

Beryllium

Health and Safety Committee



- ❖ **MISSION:** To promote the safe use of beryllium and prevent chronic beryllium disease and other adverse health effects in the workplace that will be accomplished by identifying and promoting:
 - Best work practices
 - Needed research
 - Technical standards and measures
- ❖ Developed a research priority list
- ❖ In process of developing an ASTM standard on beryllium sampling and analysis

<http://www.sandia.gov/BHSC/index.htm>

BH&SC Membership/Leadership

- ❖ DOE Complex
- ❖ OSHA
- ❖ NIOSH
- ❖ Private sector
- ❖ DOD and subcontractors
- ❖ AWE
- ❖ Academia
- ❖ UK, Canada, US primarily
- ❖ Chair, Kathryn Creek
creek@lanl.gov
- ❖ Analytical Subcommittee
Chair, Mike Brisson,
mike.brisson@srs.gov

Conclusion

- ❖ Research needs to be continued to
 - reduce cost and time
 - allow for increase in sample throughput,
 - provide workplace risk determination for surface and airborne exposure
- ❖ A sampling and analysis method needs to be developed to meet our current needs