Libby Asbestos Site
Libby, Montana

U.S. Environmental Protection Agency
Region 8, ATSDR, PHS,
US DOT-Volpe
November 14, 2002

Two General Types of Asbestos

Serpentine asbestos (chrysotile) Most commonly used. Snake like structure.

Amphibole asbestos (hundreds of fiber types) Few commercial uses. Straight, spear like structure. Most literature considers more toxic.

ASBESTOS HEALTH EFFECTS

- ***Asbestosis*** -Scarring of the lung tissue. Severity ranges from mild impairment to disabling and eventually fatal.
- ***Malignant mesothelioma***-Fatal cancer of the lung pleural (outside lining). Virtually all cases attributable to asbestos exposure.
- ***Lung cancer*** Asbestos exposure increases risk of all lung cancer, especially when combined with smoking.
- **Latency** -The time between exposure to asbestos and the onset of disease typically 10 to 40 years.

Site Background

Background Information

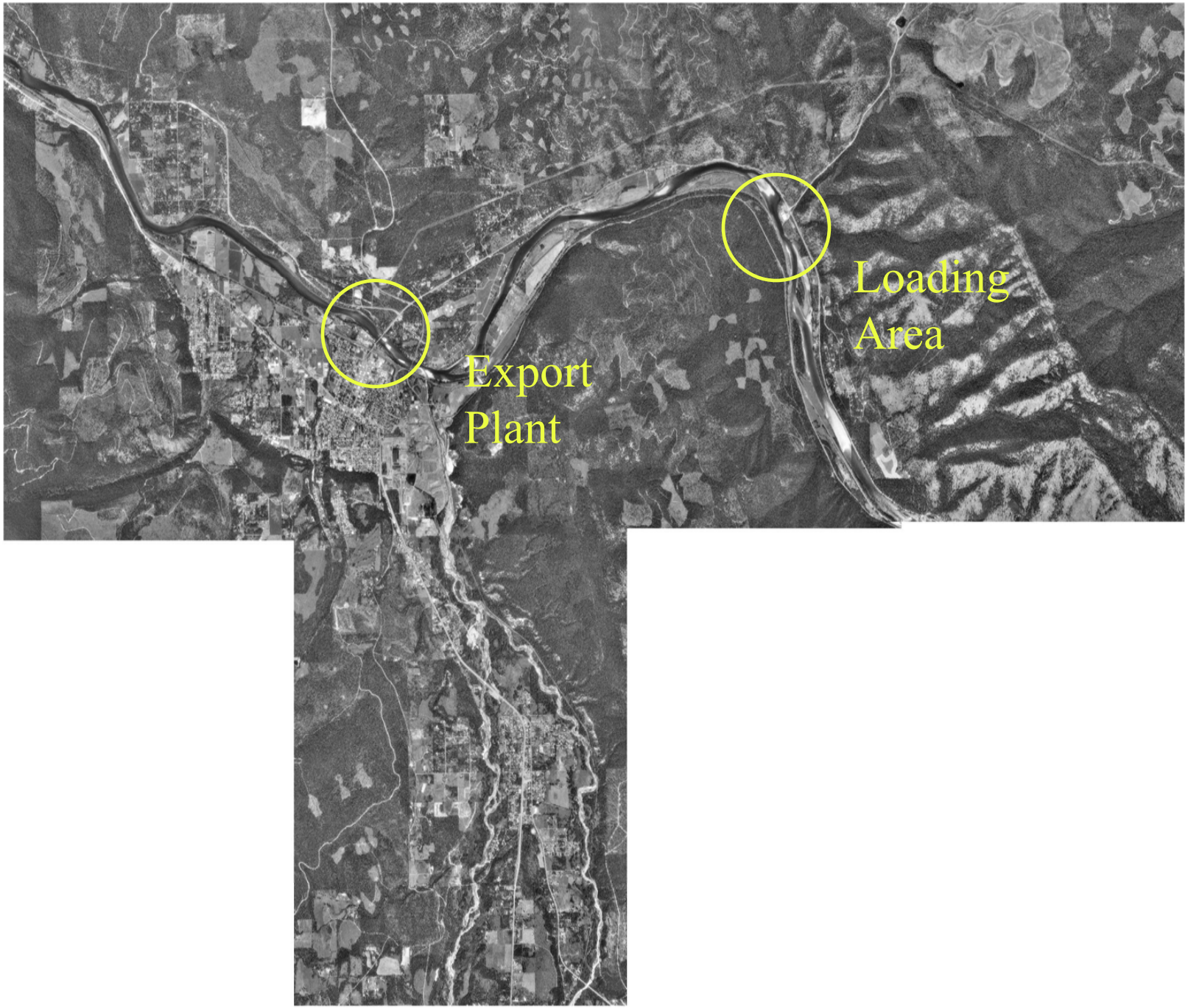
- Demographics
  - Area population = 10,000 (city 2600)
  - Area homes = 2000 (400 city homes)

- Mine operated from 1920's-1990
  - 150-200 workers employed at a time
  - Approximately 2000 total employees
  - Grace purchased in 1963, closed 1991


CANADA
Libby
WASH.
Kalispell
Spokane
90
MONTANA
Great Falls
Missoula
Helena
Butte
OREGON
IDAHO
15

Historical Background

- Produced 80% of world's vermiculite
- Asbestos in all vermiculite ore mined
- Appears to have resulted in widespread airborne contamination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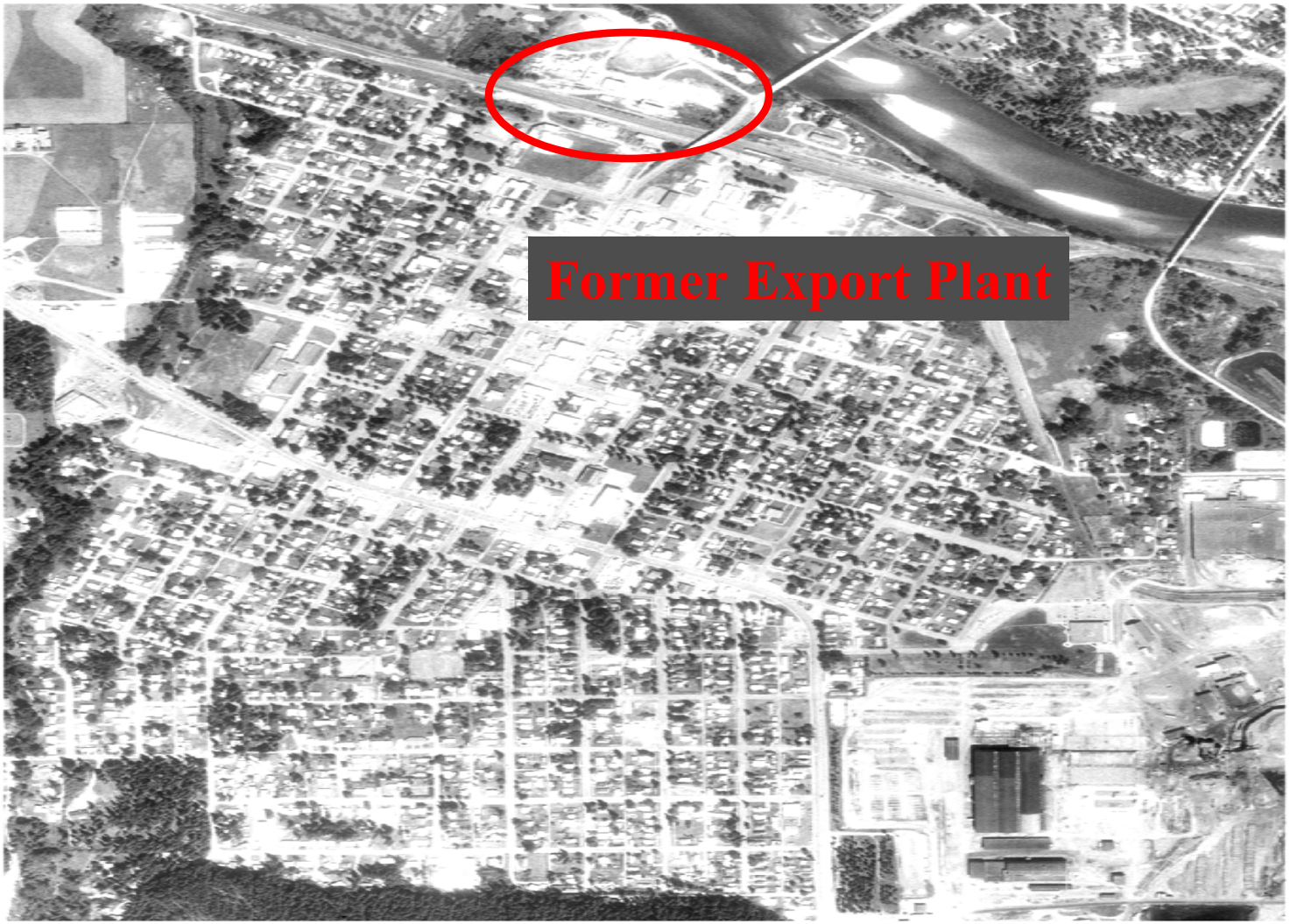
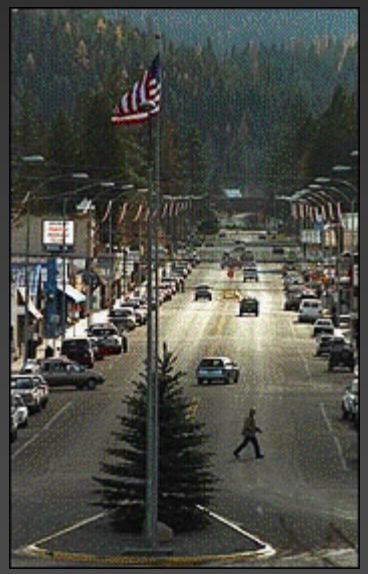

Former Export Plant

Mill reportedly emitted up to 5000 lbs./day of asbestos to the atmosphere

seattle P-I.com Special Reports



By ANDREW SCHNEIDER
SEATTLE POST-INTELLIGENCER SENIOR NATIONAL CORRESPONDENT

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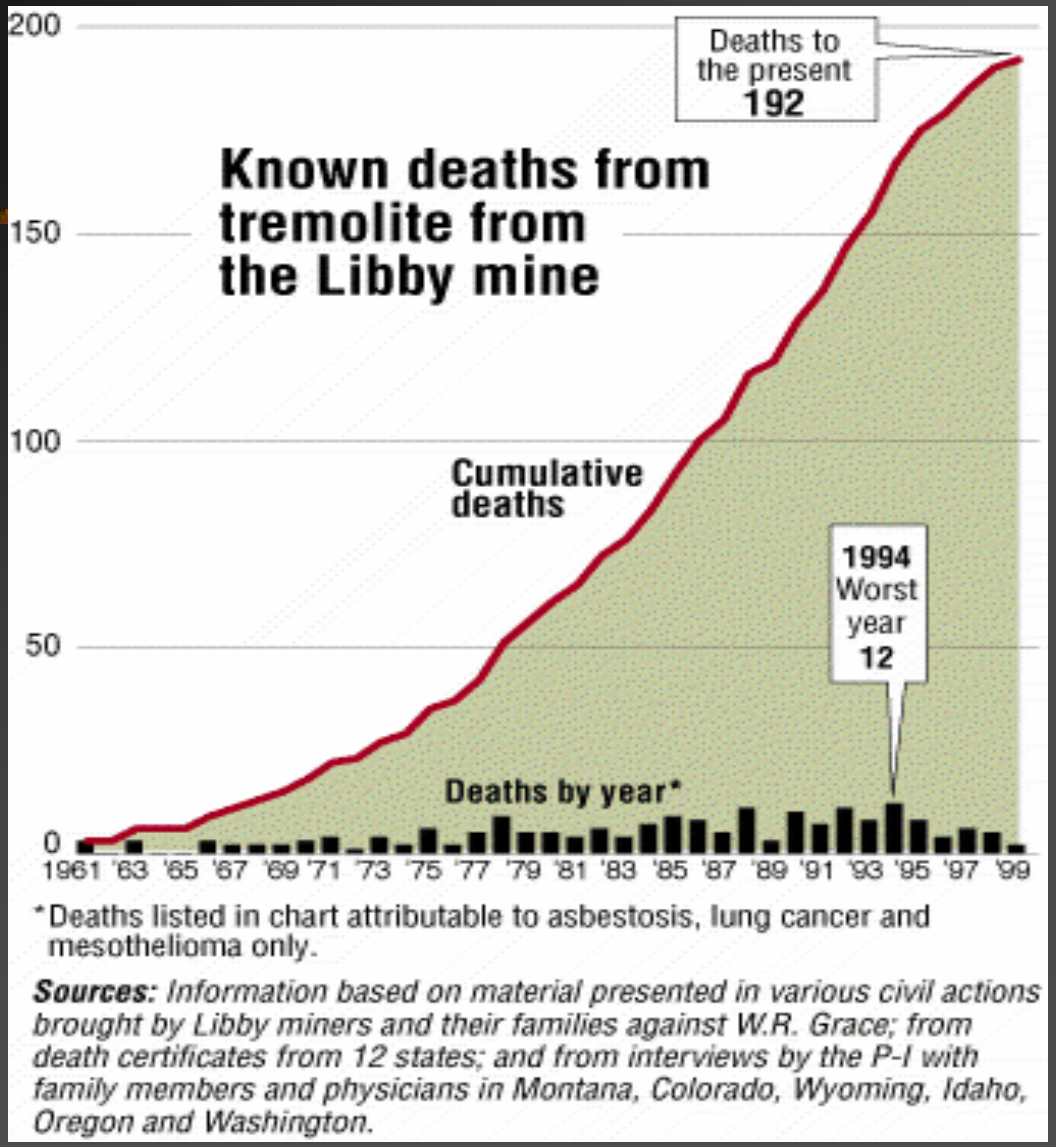
Uncivil Action: A town left to die

Tiny Libby, Mont., depended for years on the jobs at a vermiculite mine. But the mine is closed now, and a P-I investigation shows the town is paying a tragic price for those jobs. Hundreds of former miners, their wives and children, and other townspeople have either died or been diagnosed with fatal illness from asbestos the mine released into the air. No one stepped in to stop the dying. Now the town wonders when it will end, and if the town's children are still at risk.

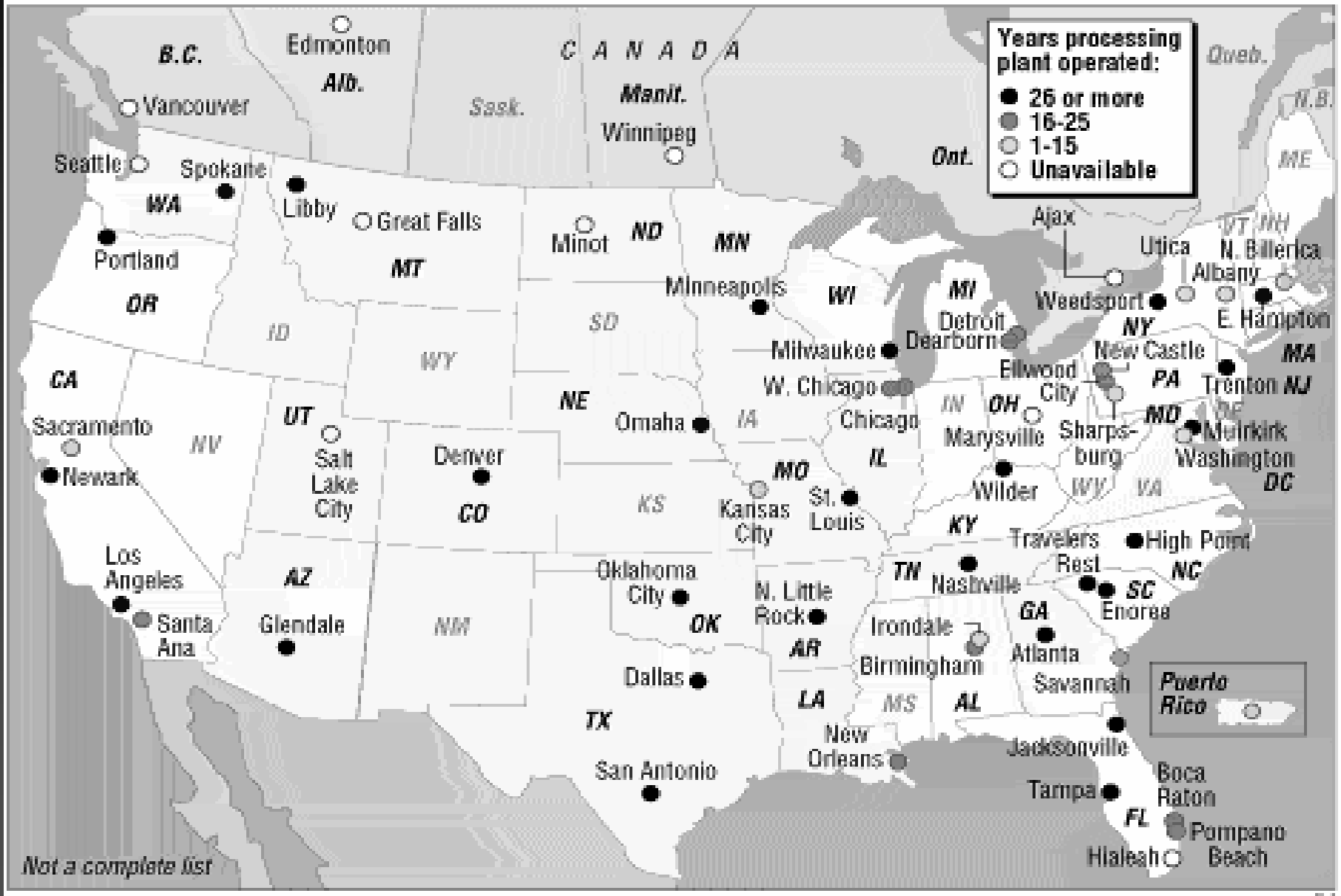
"I want the people of Libby to know that we take very seriously these threats to their health and we are going to bring to bear the resources of EPA to solve the problem and prevent further harm," Yellowtail said.



Source: SEATTLE P-I

Plants that processed asbestos-tainted ore

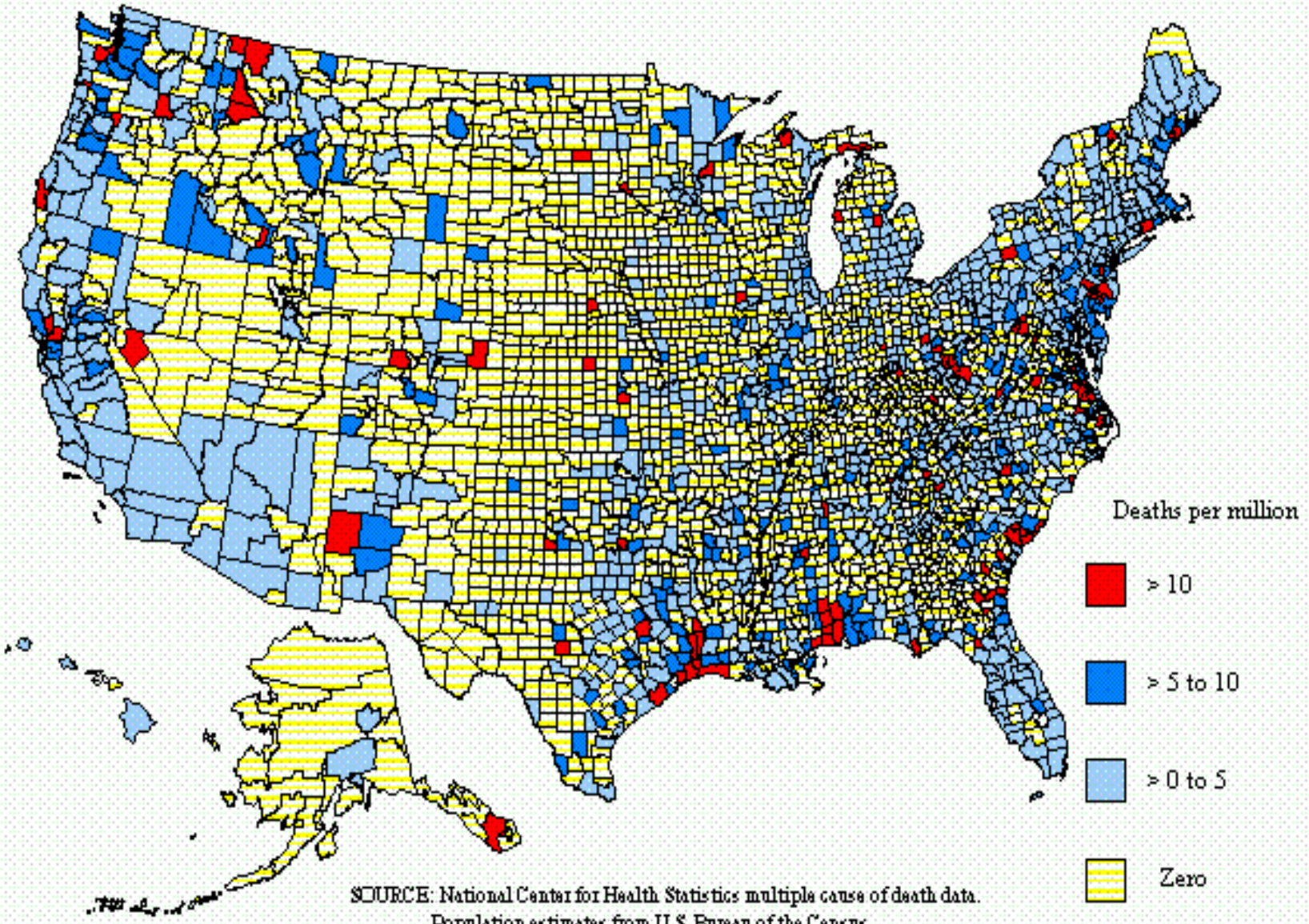
Millions of tons of the same asbestos-tainted vermiculite ore that sickened and killed hundreds in Libby, Mont., was shipped to plants in cities across the United States and Canada. The mine operated from 1924 to 1990. Some of the plants were owned or licensed by the mine's owners, the Zonolite Co., and after 1963, the W.R. Grace Co. Other plants were operated by firms that bought the ore. The ore was used in potting soil, insulation and other construction materials.



P-1

Figure 1-5. Asbestosis: Age-adjusted mortality rates by county,

U.S. residents age 15 and over, 1983-1992



SOURCE: National Center for Health Statistics multiple cause of death data.
Population estimates from U.S. Bureau of the Census.

EPA Mobilization

- EPA/PHS mobilized an emergency response team to Libby to November 22, 1999
- Team conducted preliminary sampling activities, began interviewing area physicians
- Determined the need for **medical** and **environmental** investigations

Medical Investigations

Medical Investigations

- Funded by EPA, led by PHS and ATSDR
- Three pronged approach:
  - Morbidity/Mortality study (ATSDR)
  - Develop formal epidemiological case series (PHS/ATSDR)
  - Conduct medical screening (ATSDR)

Medical Screening Scope

- >7500 individuals screened
- World's largest single point asbestos screening
- Basic screening consisted of:
  - 3 view chest x-ray
  - Basic spirometry
  - Extensive exposure questionnaire
- Some follow up:
  - Cat Scans
  - Box PFTs

Medical Investigations

- Regional physicians reporting hundreds of related deaths, many more sick (>1000)
- Standardized Mortality Study indicates rate of Asbestosis 40-60 times expected, Mesothelioma >1000 times expected
- Results of Medical Screening shows 18-30% with lung abnormalities. 12-24% among non-miners
- Emphasis on pleural disease

Sampling Investigations

Environmental Investigations

- **Address three areas:**
  - Mine/processing areas
  - Ambient conditions
  - Residential & public settings (indoor/outdoor)
- **Libby Investigation Team Includes:**
  - EPA: Region 8, ERT-Edison, N.J.
  - USGS
  - NIOSH
  - DOT-Volpe

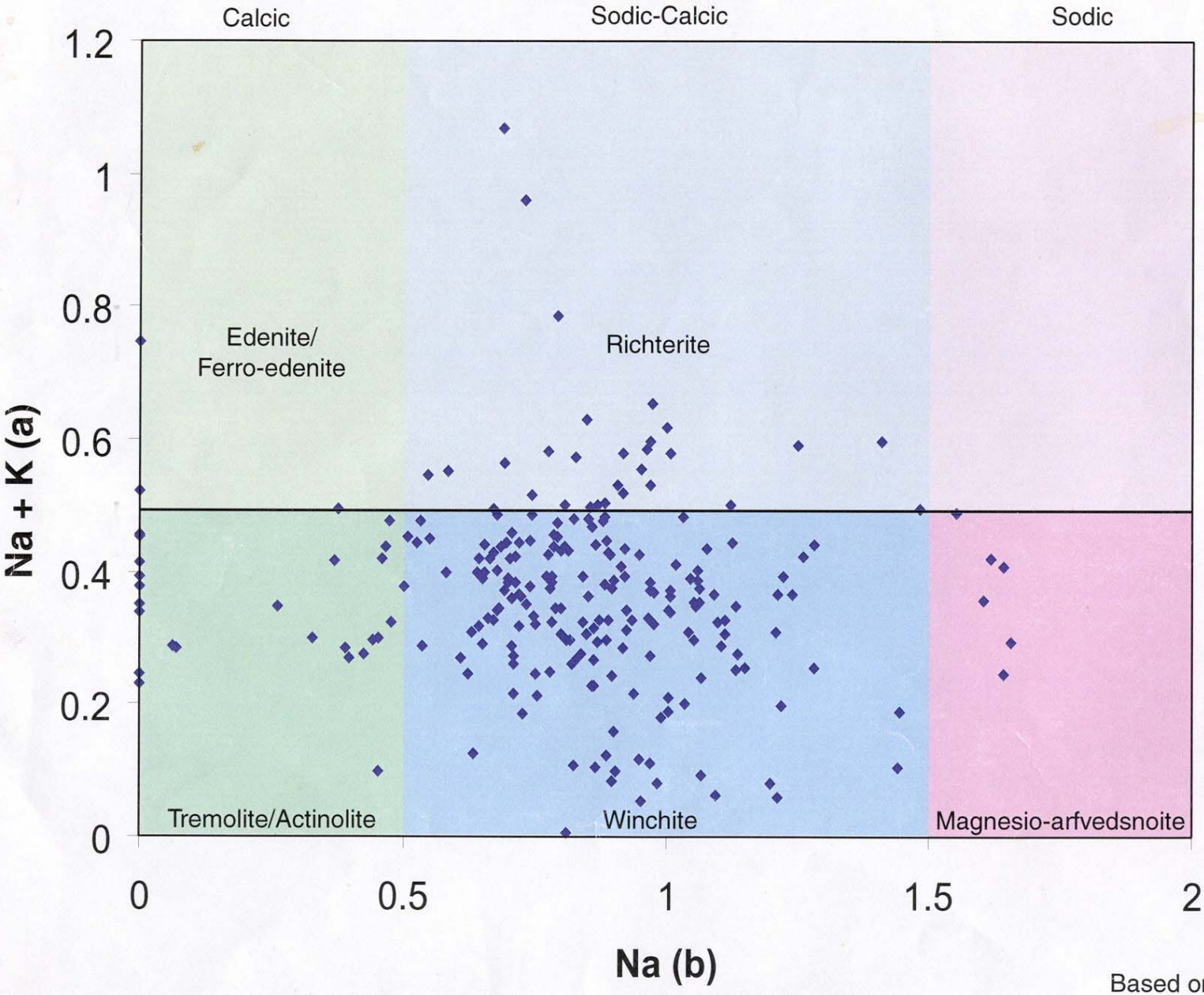
Environmental Investigations Activities

- **Phase I Assessment** – Nature and Extent
  - More than 25,000 samples from all media
  - Survey of more than 6000 participating residents
- **Phase II Assessment- Exposure Assessment**
  - Actual exposure scenarios:
    - Attics
    - Living areas
    - Yards
    - Gardens

What Do We Know About Libby Asbestos?

- Made up mostly of 4 amphibole fibers- tremolite, actinolite, richterite, and winchite
- 10-25% of the fibers are >10um in length, depending on the media
- Fiber diameter is normally between 0.1 and 1.0 um (avg. around 0.6um)
- It also contains long (up to 120 um) cleavage fragments and transition fibers

Libby Amphibole Probe Data

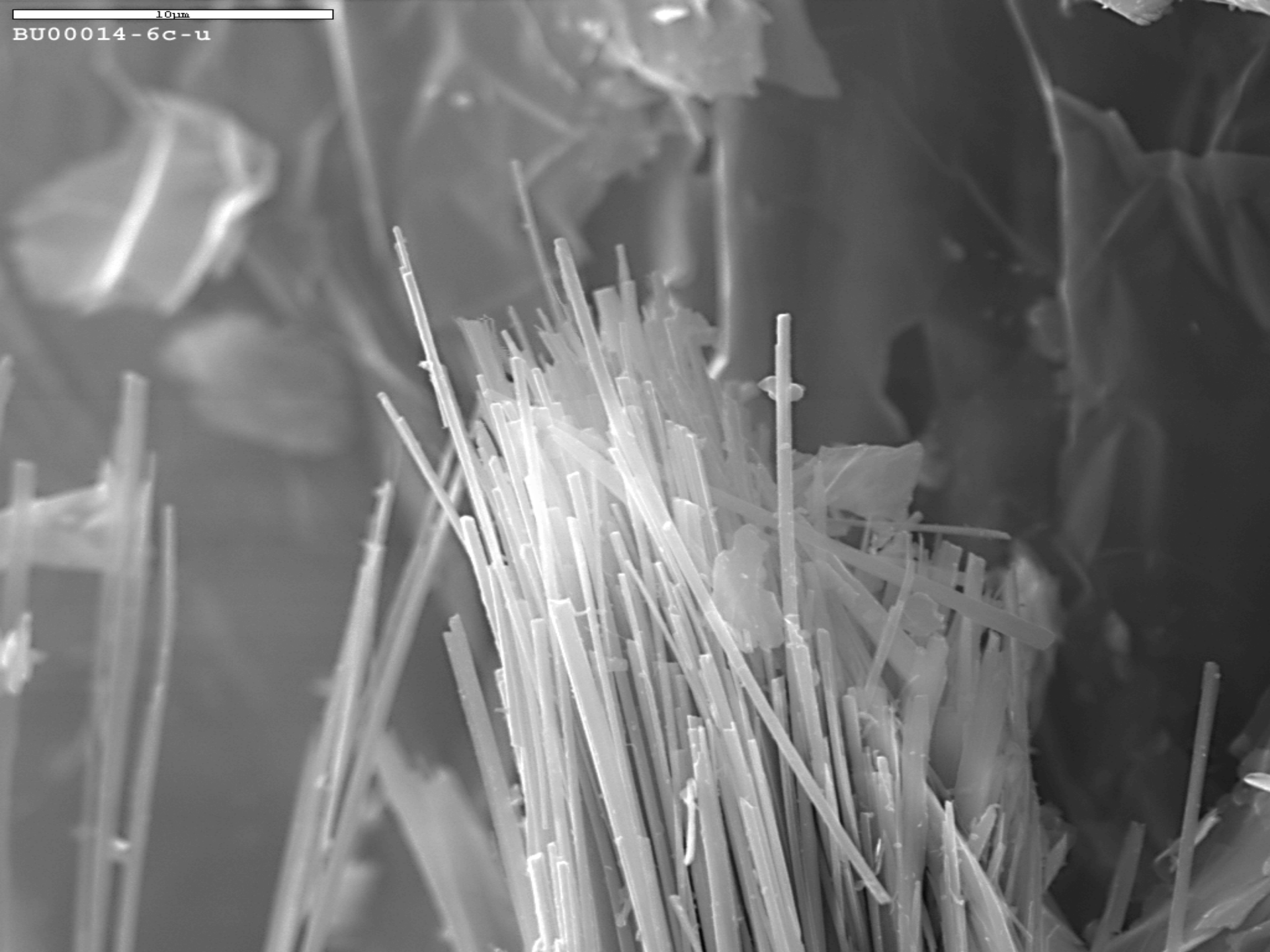


Samples

10A2
12A2
14A1
16A
17A2
19A1
21A1
25A
26A

Based on Leake 97


5 µm
BU00014-03-u


10µm
BU00014-6c-u

Have There Been Recent Exposures in Libby?

- **YES:**
  - **Two Former Processing**: areas contained asbestos up to 35% by PLM-Areas in public use, Exposure scenario testing indicated significant entrainment/risk
  - **Mine**: entirety covered with asbestos, up to 100%
  - **Mine Road**: contaminated-generates elevated levels with traffic
  - **Schools/Parks**: mine tailings used at school tracks and city parks
  - **Homes:** >40% have amphibole asbestos in yard or indoor dust
  - **Zonolite Insulation** 11% of residents report "frequent" contact, >40% report "occasional" contact

What Factors May Make Libby Asbestos Exposures Unique?

- Documented, widespread asbestos related disease (sensitized population)
- Multiple exposure pathways
- Terrain and meteorology
- Other aggravating respiratory conditions
  - Non-attainment area for particulates
  - High percentage of smokers

Removal Updates

What Are We Doing to Reduce Exposure?

- Several clean-ups underway:
  - Processing Areas
  - Mine Road
  - Three Schools
  - Residential Properties
- Public cautions about contact with Zonolite products, removal started this summer

Cleanup Description

- Former Processing or Disposal Areas
  - Classic “Dig and Hauls”
  - Zonolite Mine Being Used for Disposal
  - Contaminated Equipment, Buildings, and/or Debris Either Cleaned or Disposed of if Needed

Cleanup Description

- Residential
  - Bulk Soil/Source Removal First
  - Vermiculite Insulation Removal Second
  - Interior Cleaning Last
  - Clearance Using AHERA “Like” Protocol

Residential Priorities

- Worst First
  - Multiple Sources With High Levels (e.g. yard >1% and >5,000f/cm2 and Zonolite present)
  - Single Source With High Levels (e.g. yard>1%, dust >10,000 f/cm2)
  - “Leaking” or “Disturbed” Zonolite Insulation
  - Zonolite Present but Intact, No other sources

Typical Interior Removal Methods

- Remove ZAI via Remote Vacuum Truck (Attic, Wall Space)
- HEPA Vacuum Attic
- Seal Wall Space
- HEPA Vacuum/ Wet-Wipe Living Space
- Clear Via Aggressive Air Sampling-TEM Analysis (Long Term Follow-up)

Archeological Investigation

Excavation at Screening Plant

Loading at Screening Plant


KOMATSU

Decon Station

Disposal Area

Science Projects

What Questions Remain to Be Answered?

- How do we quantify the risks of these fibers?
- How should we measure them?
- What are the risks in homes? Yards? Gardens? Roads?
- What risks are associated with Zonolite Insulation?
- What are others doing?

What Are We Doing to Get The Answers?

- Update Risk Assessment Methodology
- IRIS Update
- Conduct comparison study of old/new analytical methods (PE Study)
- Residential Sampling (Phase II)
- Animal Studies? Human Lung Burdens?

*These EPA studies are being coordinated with NIOSH, NIST, PHS, ATSDR, USGS

What Are Others Doing?

- NIOSH is Updating Libby Cohort, Evaluating Zonolite/Vermiculite Risks to Workers
- ATSDR/PHS Conducting More Medical Screening, Doing a Libby Case Series, Evaluating Screening Techniques
- ATSDR Doing Medical Screening at Libby Sisters
- University of Montana has a Sizable NIH Grant
  - Rat Study
  - Biomarker Evaluation
  - Sputum/Lung Tissue Evaluation

Next Steps/Issues

How Much More Work In Libby?

- Site Listed on NPL October 2002
- Long Term Needs at the Mine/Drainage Unknown
- Contaminant Screening Study Via an RI Enlarged to Cover All of Libby Valley (>3000 properties)
- Approximately 900 Properties Appear to Need some Form of Clean-up

What About Placing Libby on the NPL?

- Allows Area Wide Evaluation, More Detailed Risk Assessment, More Methodical Approach
- Priority Given to “In Town” Properties Over Mine Drainage
- Transition From “Removal” to “Remedial” Must Not Slow Down Pace of Clean Ups

Issues Raised By Libby

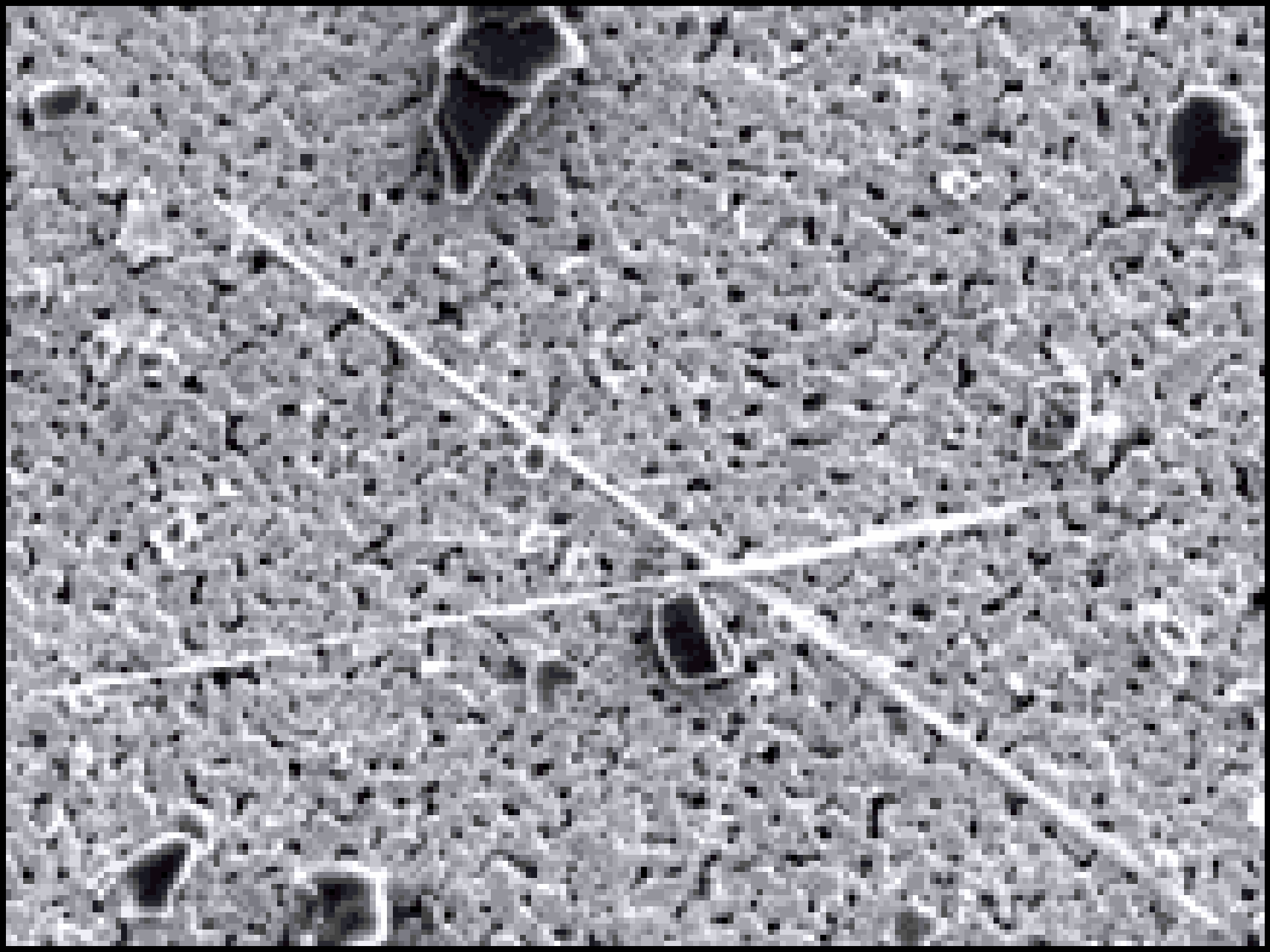
- What is safe? What is not? Who pays?
- Should we cleanup inside homes on a broad scale using Superfund?
- W.R. Grace Bankruptcy
- Libby citizens demanding complete cleanup of their homes, now
- Intense National Interest
  - Congressional
  - National Media Coverage
  - Private Litigation

Conclusions

- Asbestos clean-up in Libby is occurring on a "worst first" basis
- Analytical and risk assessment method reviews must be completed before risk assessment is finalized to ensure good science
- These method updates may have implications far beyond Libby and Superfund
- **We will continue to work with PHS and ATSDR to provide long-term health screening, health research, and health care to Libby residents**

Conclusions

- Decisions on how to handle Zonolite Insulation may have broad impacts on EPA policy and budget
- The evaluation of these issues will be highly scrutinized by affected individuals, private attorneys, national media, Congress, and other Federal Agencies
- To Date, Data From ATSDR Medical Investigations are the Backbone of EPA's Risk/ Clean Up Decisions



ASBESTOS SAMPLING & ANALYSIS

Collection

Preparation

Analysis

Instruments

Methods and Counting Rules

Instruments

- Transmission Electron Microscope (TEM)
- Scanning Electron Microscope (SEM)
- Polarized Light Microscope (PLM)
- Phase Contrast Microscope (PCM)
- Infrared Spectroscopy (IR)
- X-Ray Diffraction (XRD)

Sample Collection, Preparation, and Analysis

- Soil
- Bulk
- Air
- Dust

Collection of Soil Samples

- Collection No Different Than for Other Contaminants
- Typically Heterogeneous, Depends on Nature of Contaminant Source
- Take Appropriate Respiratory Protection
- Percent Asbestos by Weight

Soil Sample Preparation

- Need to Know Purpose of Samples Up Front
- Pick Out Large Bundles/Chunks For Weighing, Usually Under a Stereo-Microscope
- Homogenize Sample
- Regardless of the Instrument to be Used Grinding Will Give the Most Accurate and Consistent Sample Data, But…

More Soil Preparation

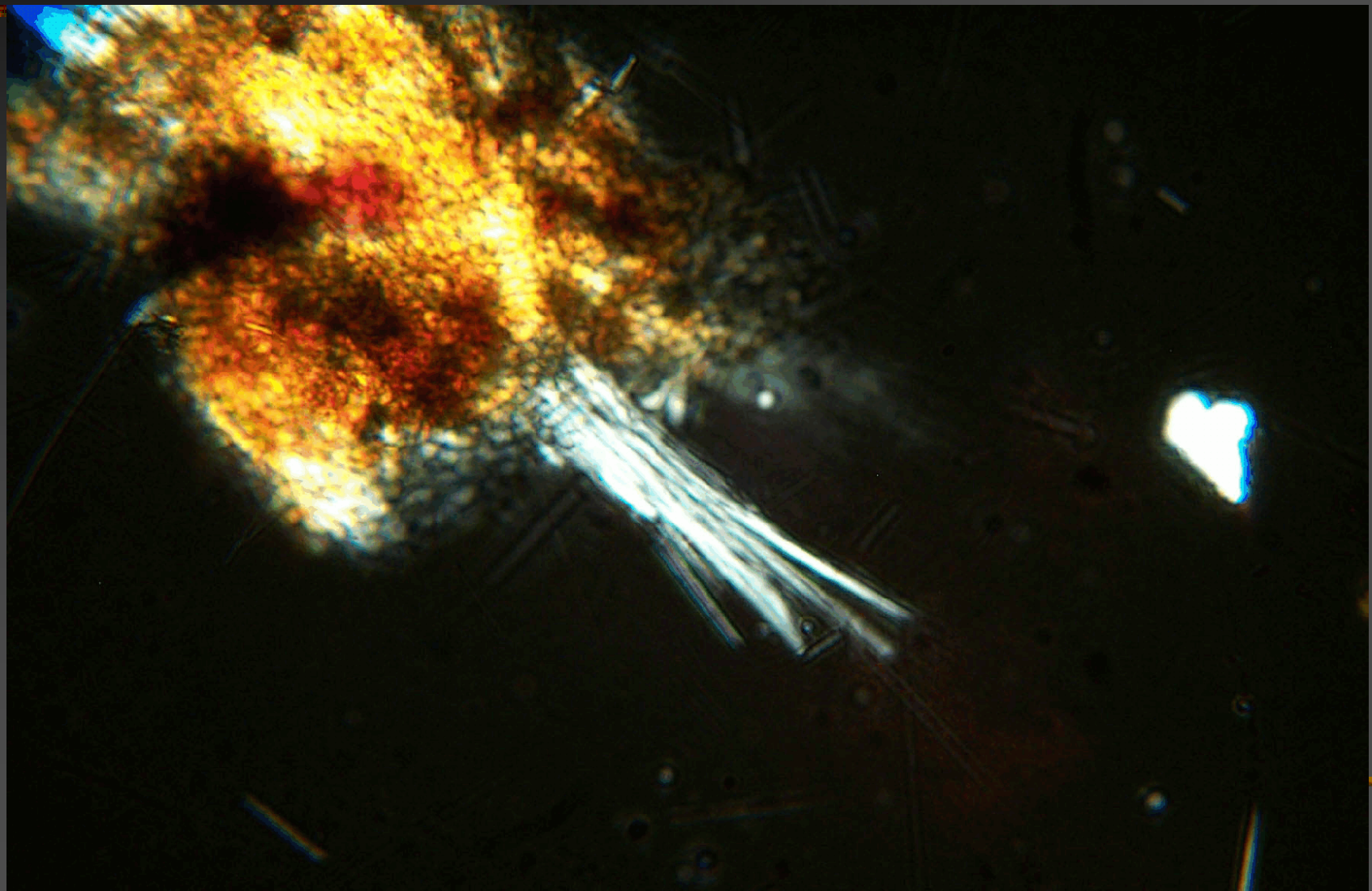
- Grinding Will Compromise Morphological Information
- Grinding May Alter Mineral Habit (e.g. Bundles vs. Free Fibers)
- Grinding May Create Cleavage Fragments
- Therefore, Qualitative Morphological Assessment Should be Done Separate From Quantitative Analysis

Soil Sample Analysis

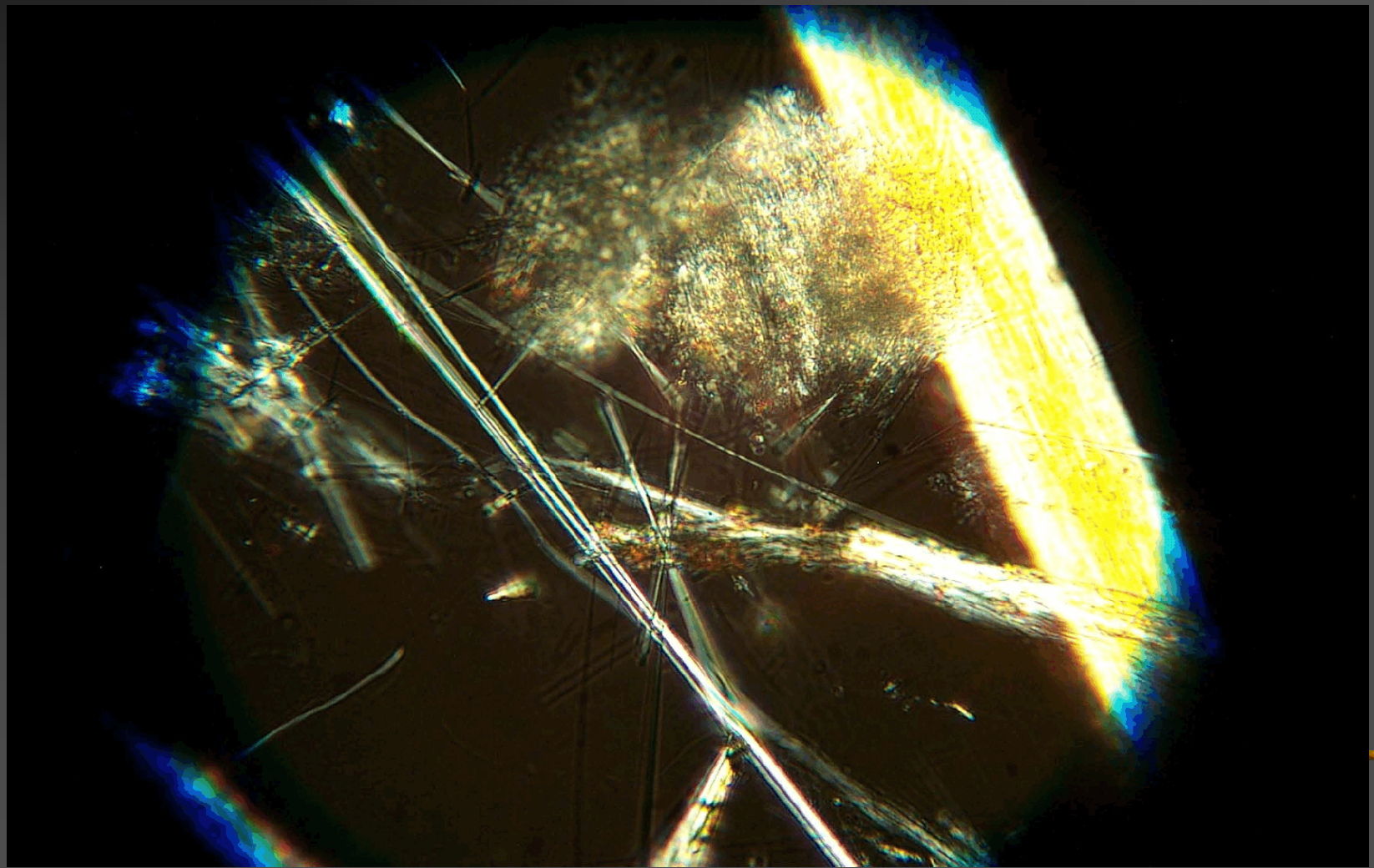
- Look At Summary Sheet
- Need Some Morphology?
  - SEM, TEM, maybe PLM
- Need Mineralogy?
  - SEM/TEM with EDS; maybe PLM; IR; XRD
- Just Need Total?
  - PLM, IR, XRD-Grind the Hell Out of Sample

PLM Microscope

PLM Photo of Tremolite



PLM of Amosite and Human Hair



Soil Sample Analysis-Random Notes

- To Date, SEM Strictly Qualitative, But Best to Determine Fiber Size Distribution. Quantitative Method Under Development
- PLM, Though Touted as Quantitative, is Highly Subjective and Depends Completely on Quality of Analyst. Still Cheap and Useful
- Solid TEM Solid Methods Are Expensive, Require Monster Sample Prep, and are Most Frustrated by Heterogeneity

Collection of Bulk Samples

- Building Materials/Insulation
- Material is Usually Homogeneous
- Grab Samples Usually Used
- May Involve Cutting of Discrete Section
- Percent Asbestos by Weight

Preparation/Analysis of Bulk Samples

- Analogous to Soil Samples

Air Sample Collection

- All Involve a Pump Pulling Air Across a Filter, With the Prepared Filter Going Under the Instrument (f/cc)
- Three Basic Types
  - Stationary
    - Passive, Active
  - Personnel
  - AHERA Clearance (see Part 763)

More Air Sample Collection

- The More Air Pulled Through, the Lower the Detection Level
- However, Depending on Site Conditions (e.g. dust) Large Sample Volumes May Produce Unreadable Samples
- Normal Ambient Conditions 4000L Collected at <12 /min is Practical Maximum
- Under Site Work Conditions, or Dusty Environments 1200 L is Usual Maximum, Sometimes 80 L is Maximum

More Air Sample Collection

- Sampling in Wet and/or Windy Conditions Not Advisable
- Pump Flow Rates Should Not Exceed 12-15 L/min

Air Sample Preparation

- A Small Sliver of Cassette Filter is Cut and Then Viewed for Opacity
- If Opacity Low (<10-25%) Then Sample is Sent for Direct Preparation
- If Opacity is High (>10-25%) Then Sample is Sent for Indirect Preparation

Direct Preparation

- The Sample Sliver is Etched
- Sealed in Silicon
- Mounted on a Specimen Grid
- Put Into the Microscope

Indirect Preparation

- A Portion (typically ¼) of the Original is Cut Out, Dissolved or Ashed
- This Portion of Sample is Suspended in Liquid and Then Re-filtered
- Then the Direct Preparation Procedures Followed

About Air Sample Cassettes

- Only a Tiny Portion (typically 1/3700) of the Sample Viewed Under the Microscope
- Distribution of Fibers on Cassette is Not Uniform, Thought to be Either Poisson or Negative-Binomial Distribution
- Thus Typical Analyses Are Inherently Subject to Great Statistical Variation

Indirect Pros and Cons

- Pros
  - Allows information to be garnered from otherwise unreadable samples
  - Generates nearly uniform distribution of fibers on filters
- Cons
  - Involves large dilution of sample
  - Likely looses some material in sample prep
  - Possibly alters morphology and mineral habit

Air Sample Analysis

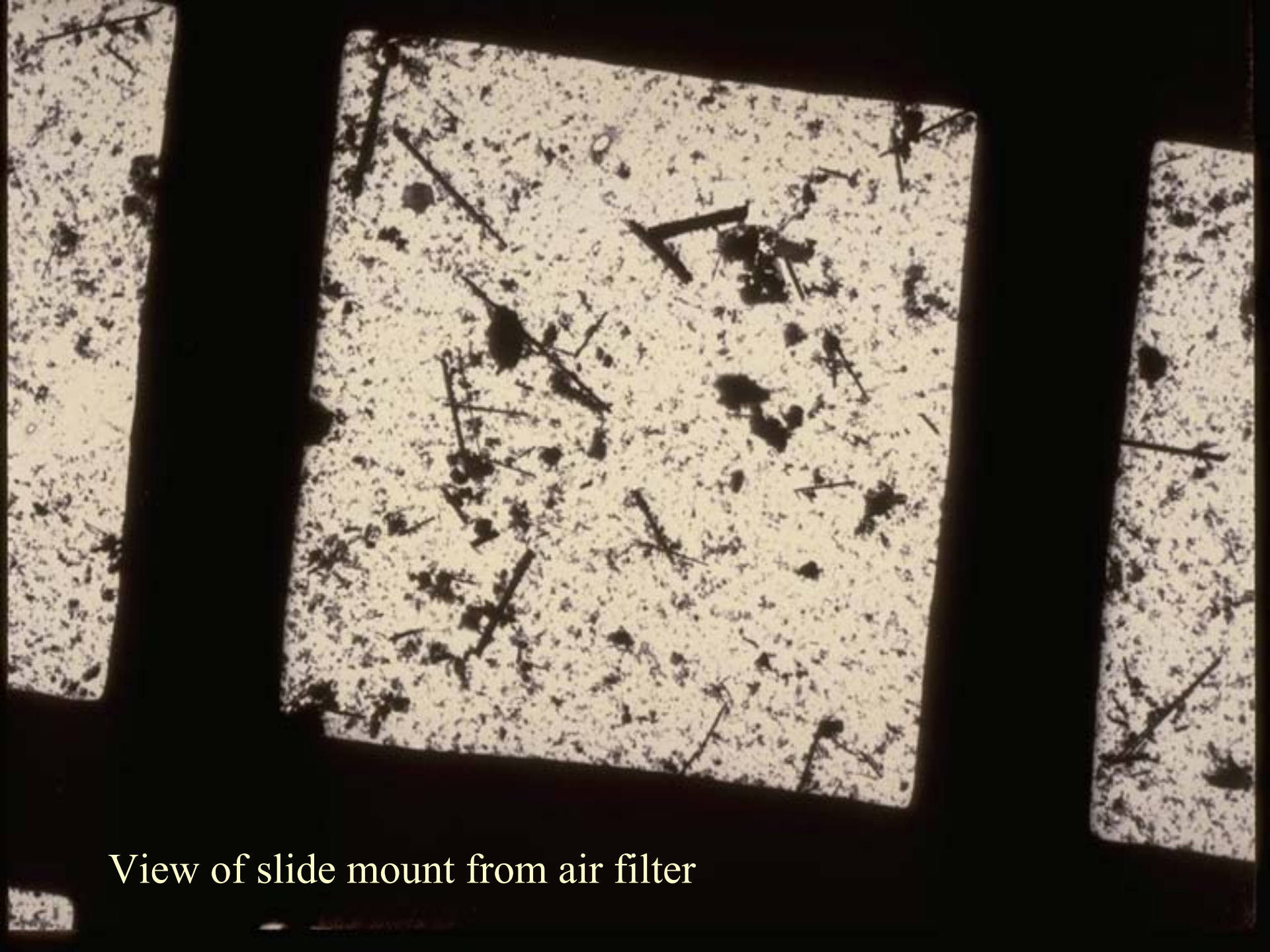
- PCM
  - NIOSH 7400
- TEM
  - NIOSH 7402
  - ISO 10-312
  - Yamate
  - AHERA

PCM Analysis

- Normally 250-400x
- Can’t Distinguish Between Cat Hair and Asbestos
- Near Useless in Environmental/ Residential Settings
- Provides No Mineralogy
- Required by OSHA for Health And Safety
- Can Resolve only Fibers >5um long/ >0.25 um wide

TEM Analysis

- Normally 400-20,000x (can be 100,000x +)
- Can Get Definitive Morphology/Mineralogy
- The More Grids Counted, the Lower the Detection Level
- Different Methods Have Different “Counting Rules.” Thus the Same Specimen, In the Same Microscope, Could Give Different Results Depending on the Method
- Look at Second Summary Sheet



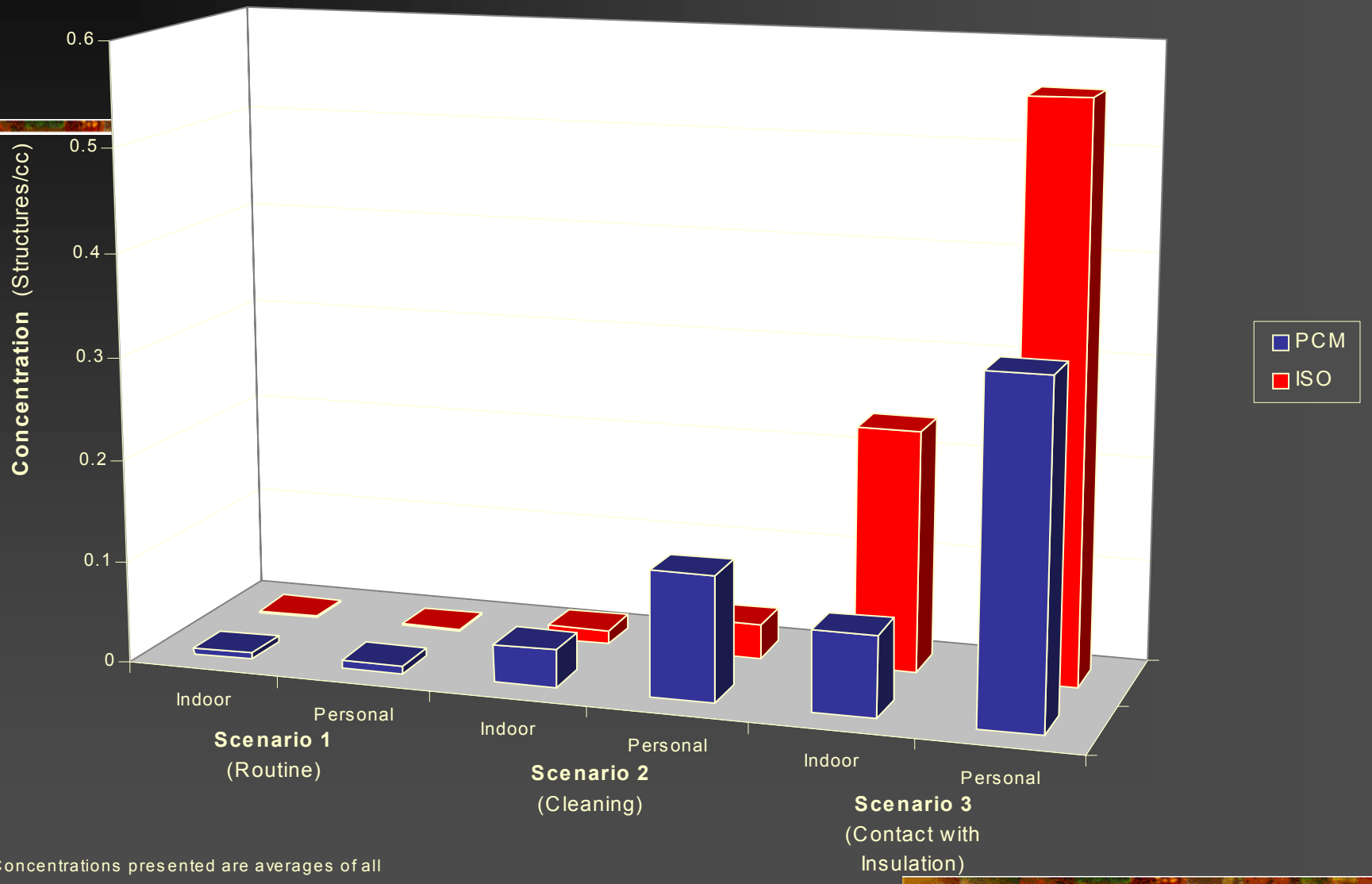
View of slide mount from air filter

More Air Samples

- The Selection of How Air Samples are Collected (e.g.- Stationary vs. Personnel), Prepared, and Analyzed (e.g. PCM vs. TEM; or NIOSH 7402 vs. ISO 10-312) Will Have a Profound Effect on the Resulting Data
- The OSC Should Be Cognizant of All These Factors Before Making Risk Decisions

- DRAFT -

Asbestos Concentration

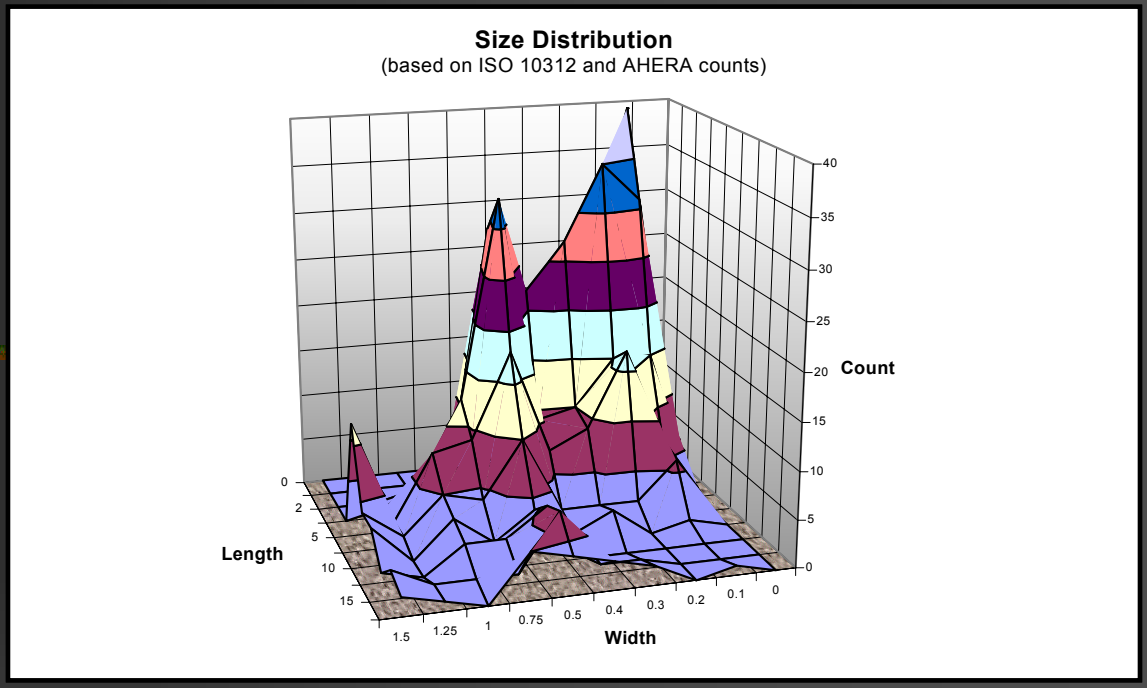


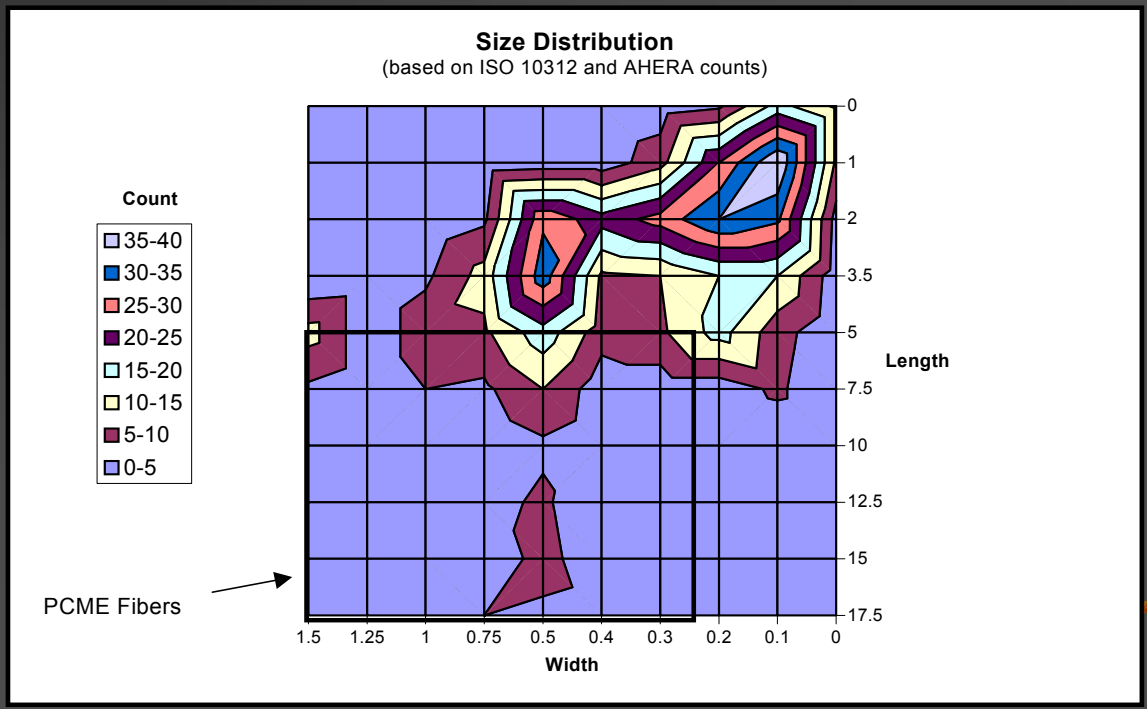
Note: Concentrations presented are averages of all non-zero values that were above the detection limit.

Fiber size distributions

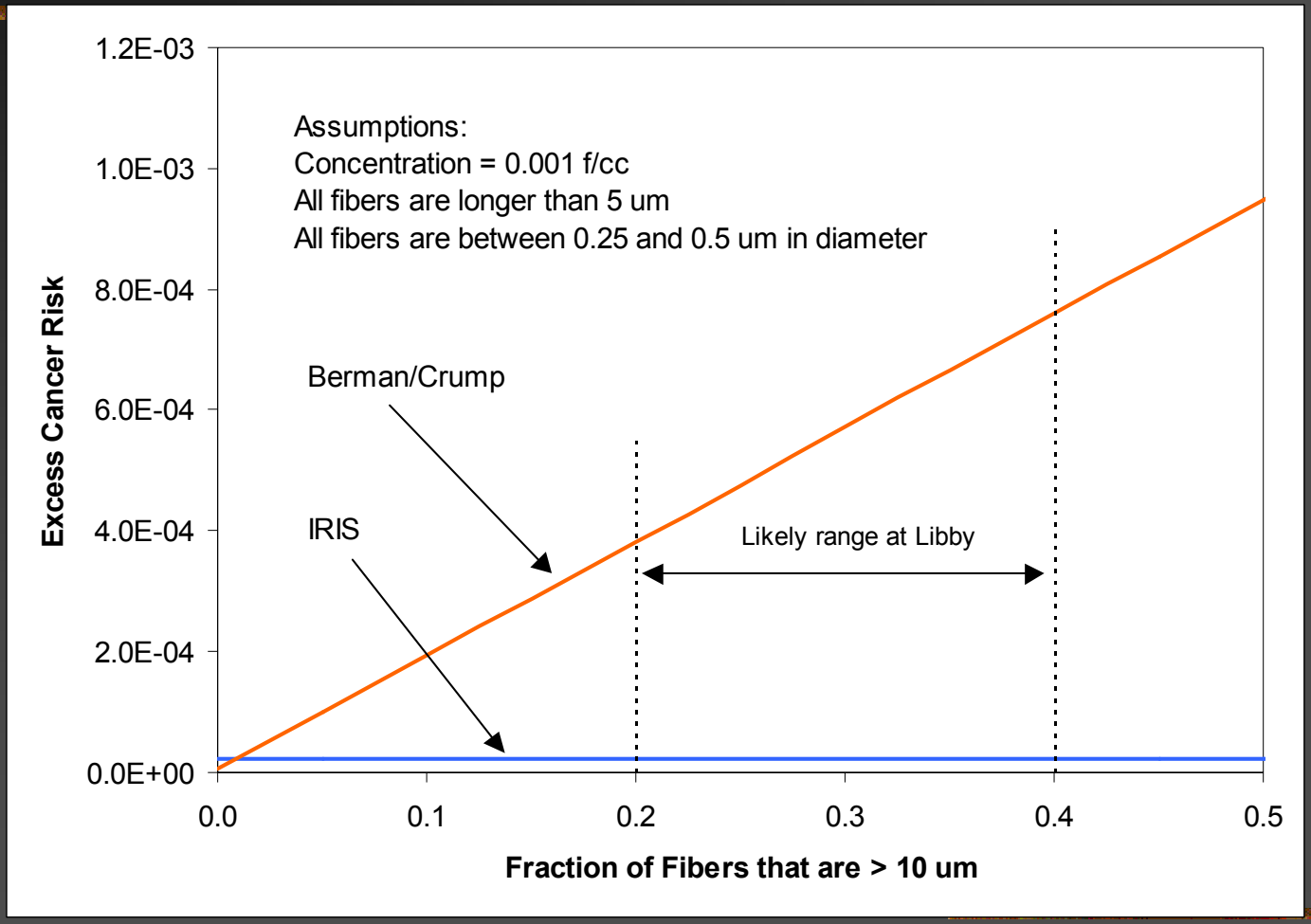
Analysis of fiber size Distribution Indicates that only 30% Fall within the regulated range.

EPA risk assessments Use only regulated (or PCME) fibers to calculate risks.





Why Risk Assessment Methodology Makes a Difference



Dust Sample Collection

- Wipe Samples
- Microvac On to an Air Filter
- Gives Indication of Surface Loading
- Fibers/cm2 of Surface Sampled

Dust Sample Preparation/Analysis

- Dust Samples Are Near Universally Handled Liked “Indirect” Air Samples
- Should Be Thought of As Quasi-Quantitative
- Good Indicators of Relative Loading (both on and off-site), But Are Not Easily Translated Into Risk or Quantitative Risk Assessments
- Good Before/After Tests

Other Random Asbestos S&A Issues

- Cleavage Fragments vs. Born Fibers vs. Transition Fibers
- OSHA “Regulated” Fibers vs. the Universe of Amphibole Fibers vs. Asbestos as a Hazardous Substance
- Fibers <5 um in Length