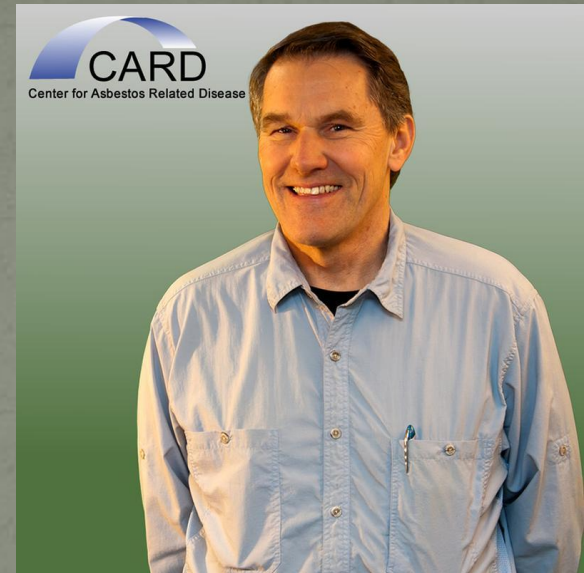


# Lessons from Libby, Montana: Mining, Asbestos, & Public Health



Presented by  
The Center for Asbestos Related Disease

Dr. Brad Black, Medical Director  
Michelle Boltz, FNP-C



Our mission is “to provide long-term screening, health monitoring, disease diagnosis, specialized asbestos healthcare and counseling to all people impacted by Libby amphibole asbestos. In addition, CARD provides outreach, advocacy, disease prevention and research to benefit all people impacted by asbestos.”



Libby High School



Noorvik, Alaska Indian Health Service  
National Health Service Corps 2006-2010



# Historical Knowledge of Diseases Caused By Asbestos

- 1907- **First Case of asbestosis (England)**
- 1918- American & Canadian Insurance companies refuse to cover asbestos workers due to increased incidence of disease
- 1930- Edward Merewether confirms that **inhalation of asbestos dust can cause a fatal disease.**
- 1931- UK begins regulating asbestos exposure
- 1964: Selikoff, Churg, and Hammond demonstrate that insulation contract workers face a health hazard resulting from asbestos exposure.
- 1971- **OSHA Act, US officially regulates asbestos exposure**

# Historically Held Asbestos Assumptions

- All regulated asbestos forms are equal
  - (i.e. toxicity of chrysotile = amphiboles)
- Other mineral forms are non-toxic or not important
- Only long fibers ( $>5$   $\mu\text{m}$ ) and thin fibers ( $>3:1$  aspect ratio) are toxic
- Only concentrations of asbestos  $>1\%$  in materials pose a substantial risk.

# Historically Held Asbestos Assumptions (cont.)

- Need high dose & long workplace exposures to get disease.
- Significant non-cancer disease does not occur in non-workers.
- Pleural changes do not equal significant disease.
- If you protect against the risk of cancer then you will also protect against the risk of non-cancer disease.









# Different Fibers = Different Health Results

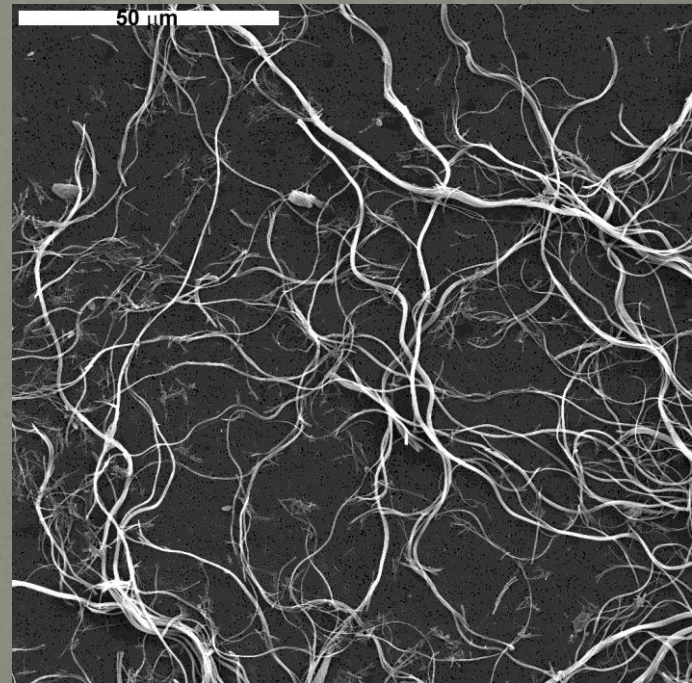
## Amphibole Asbestos



**Estimated ½ life: Decades**

Dx Manifestation from 10-40  
years from exposure

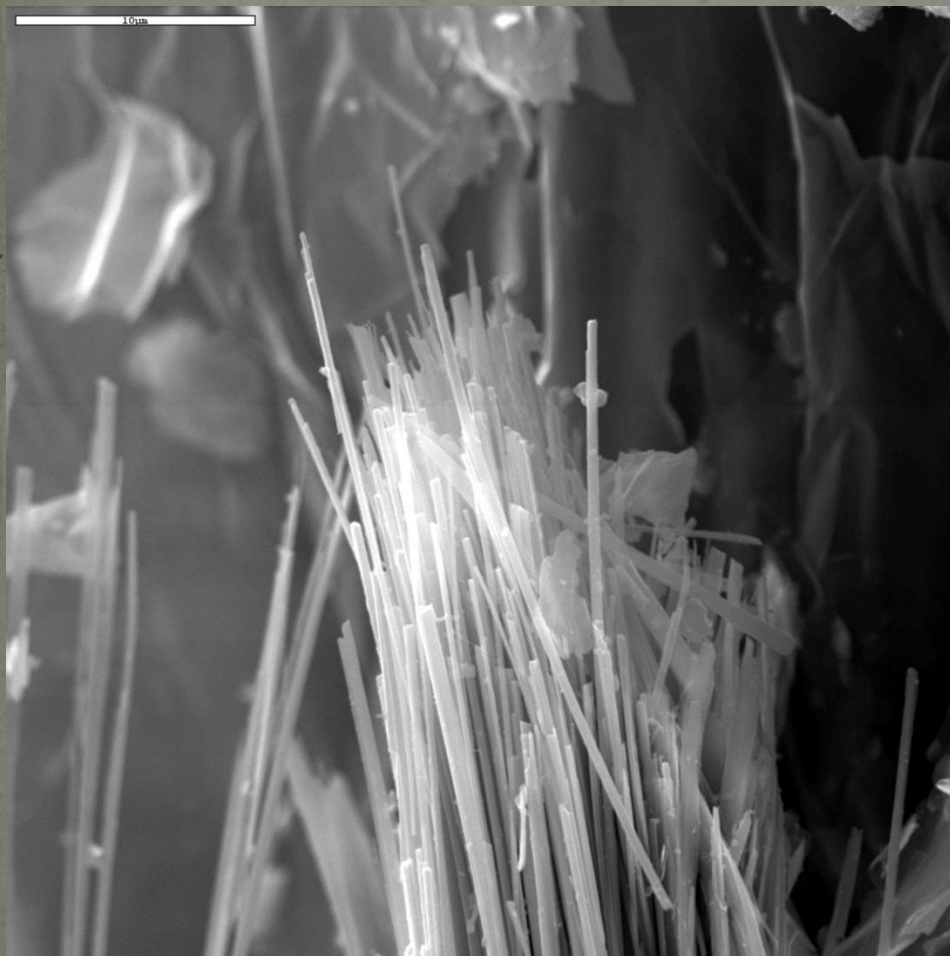
## Chrysotile Asbestos



**Estimated ½ life: 2-3 Months**

Dx Manifestation by 20 years from  
exposure

# Libby Amphibole Asbestos



- Winchite 84%
- Richterite 10%
- Tremolite 5%



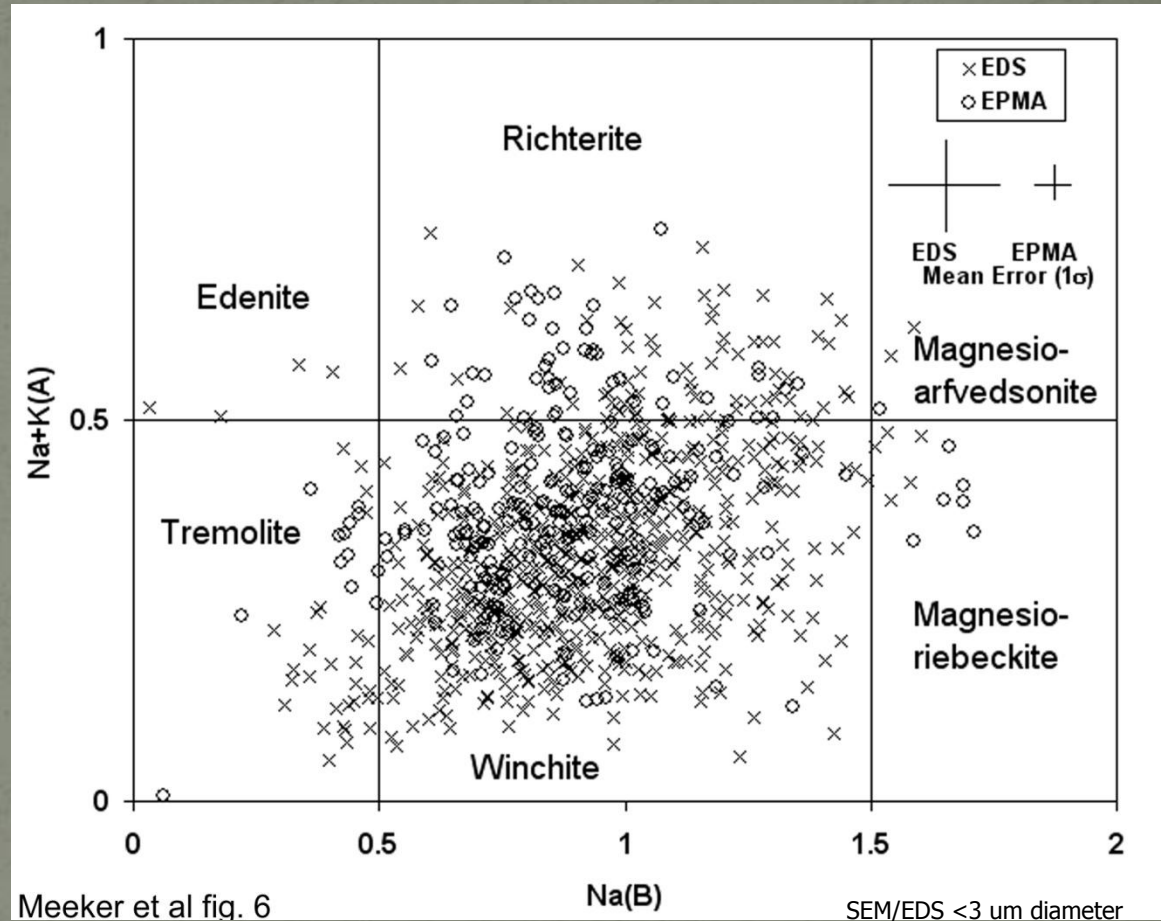
# Libby Amphibole Composition

Winchite 85%

Richterite 10%

Tremolite 5 %

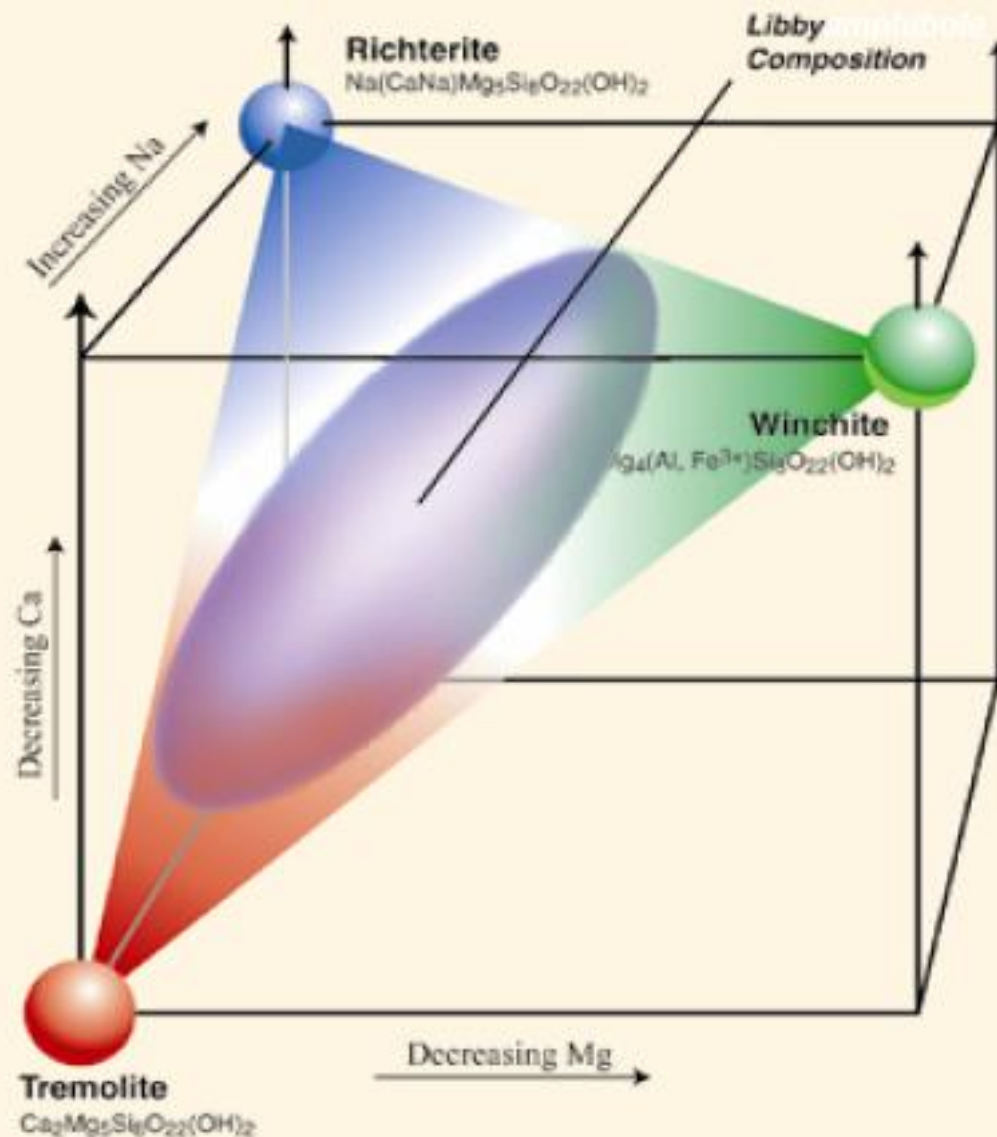
Based on the classification criteria of Leake et al, 1997



Meeker et al, 2003, The composition and morphology of amphiboles from the Rainy Creek complex, near Libby, Montana. American Mineralogist V88, In Press.

# Libby, Montana Amphibole Chemistry

(April, 2001)

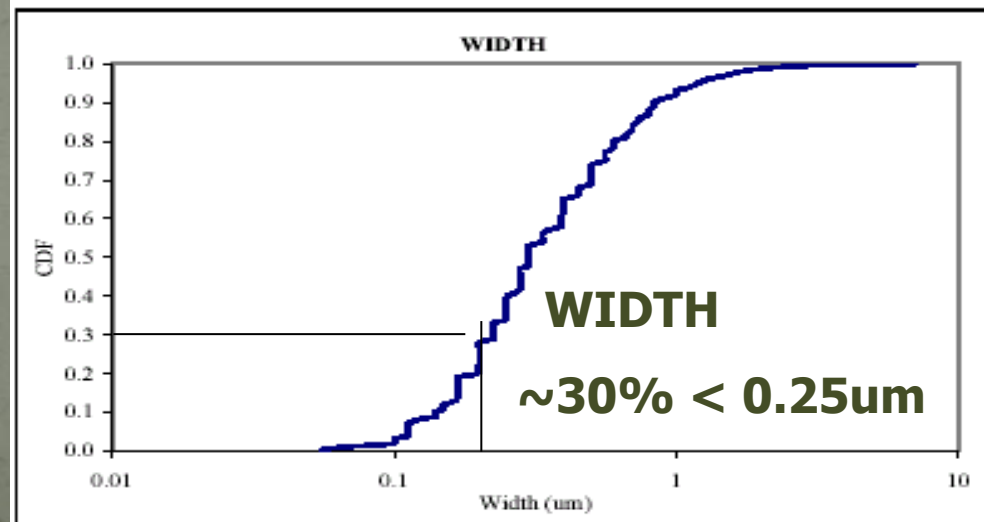
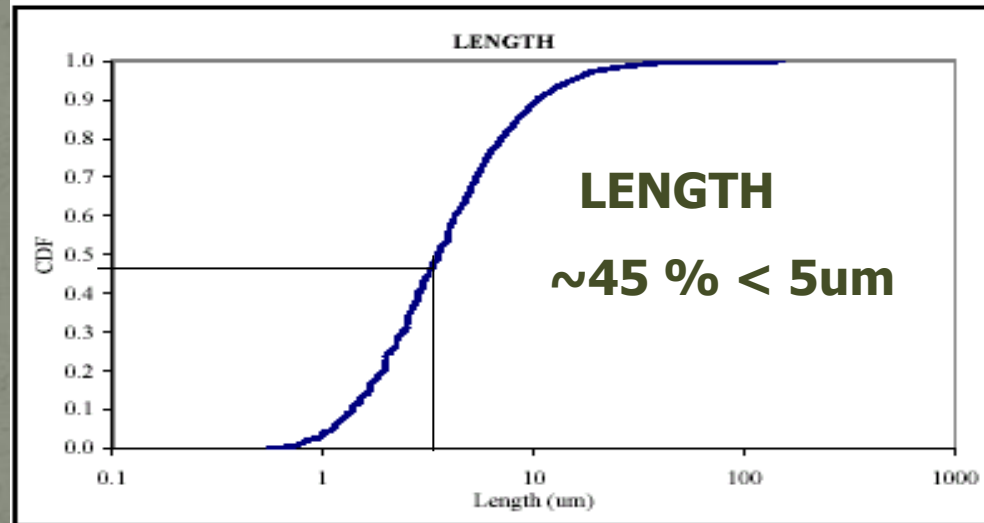


DRAFT

# Fiber Size Distributions

- Only about 50% of the fibers fall within the regulated range.
- EPA risk assessments use only regulated (or PCME) fibers to calculate risks.

Libby Amphibole (LA) Structure Distributions Based on ISO 10312



Based on LA Structures by ISO 10312 (N=6247)

8/3/03

# Historical Epidemiology Studies

- Exposure Data
  - Historical data (chrysotile mostly studied)
  - Lack of personal samples (estimated exposure by job)
  - Phase contrast measurements (PCM) miss fibers  $< 0.3 \mu\text{m}$ .
    - $< 50\%$  of fibers may be counted depending on fiber type & process.
  - Fiber morphologic information lacking
    - Fiber dimensions critical to toxicity
- Response / Health Effect data
  - varies with exposure, latency, & health endpoints evaluated.

# Risk Assessments

Many “Risk Assessments” include only the risk of developing a cancerous (malignant) disease, such as lung cancer or mesothelioma.

For the first time, the EPA is developing a toxicity value for non-cancerous (benign) asbestos related disease. This is being done because of the high burden of morbidity (illness) and mortality (death) that is associated with non-cancerous asbestos disease, such as asbestosis and pleural disease.



# Toxicity Value for Libby Amphibole



Expected Release 2013

Draft Libby Amphibole  
RfC= 0.00001 f/cc

**Current OSHA permissible level of all  
asbestos types: 0.1 f/cc**

# Disease Caused by Asbestos

Exposure

+

Time

=

Risk

■ Exposure to asbestos is not an automatic death sentence. Many factors determine health effects and how severe they will be.

**Factors include:** How many fibers entered the body • How long the exposure • If the material was inhaled or consumed in food or drink.

Fibers enter the body through the nose and mouth by inhalation or from drinking.

**Esophagus**

Cancer can develop from swallowing asbestos fibers

**Heart**

Blood flow to the lungs can be impaired and cause the heart to enlarge or fail.

**Pleural membrane**

When scar tissue forms in the pleural membrane, the tissue is unable to expand and contract. Breathing can become painful or impossible.

**Larynx**

**Right lung**

**Left lung**

**Bronchia**

**Bronchia**

**Alveoli**

**Alveoli**

**Diaphragm**

**Abdomen**

**Stomach**

**Intestines**

Swallowed asbestos fibers build up and may cause cancer

Asbestos fibers in the alveoli can cause cancer and prevent exchange of oxygen and carbon dioxide between the lungs and red blood cells.

**Blood vessels**

**Alveoli**

**Asbestos fibers**

Exposure

+

Amount

=

Damage

# Asbestos Related Disease

## CANCER

Lung Cancers  
(Interstitial)

Mesothelioma  
(Pleural)

Colon  
Rectum  
Larynx/Pharynx  
Stomach  
Esophagus  
Ovary

## Non-Cancer (Fibrosis)

Pleural

Interstitial

Pleural  
Thickening

Asbestosis

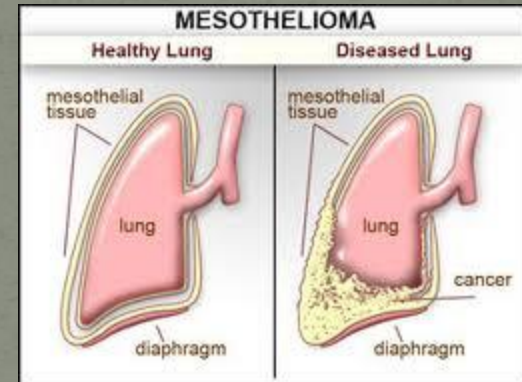
Pleural  
Plaques

# Asbestos Related Lung Cancers



## Lung Cancers

Also caused by smoking and other carcinogens



## Mesothelioma

Occurs in the lining of the lungs and abdomen

Libby Observed 3/~2500

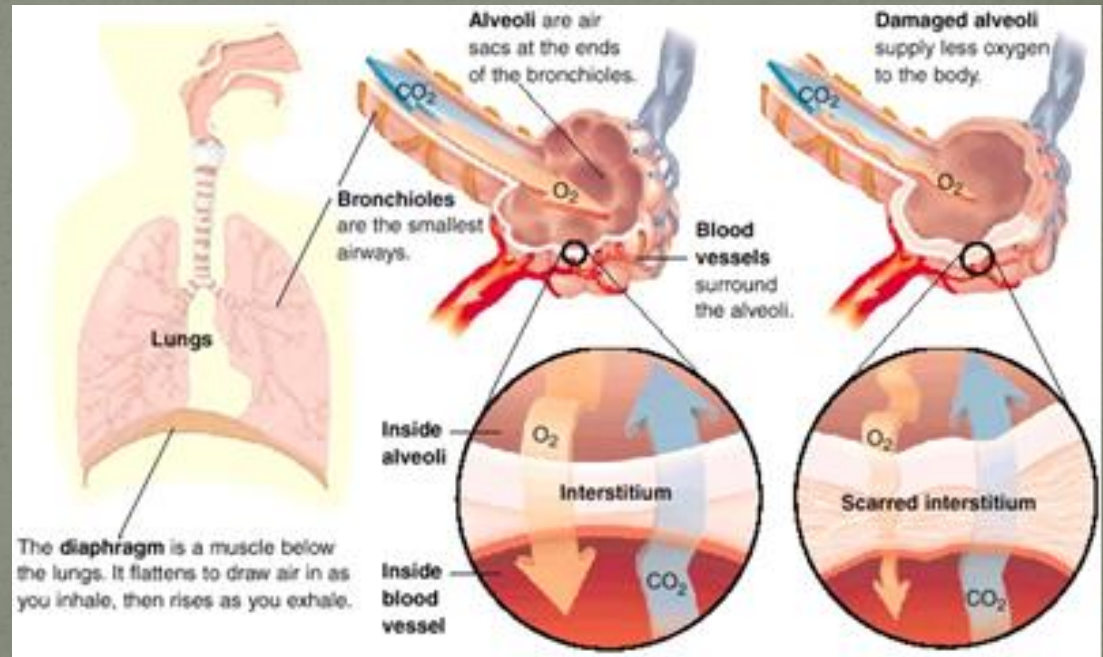
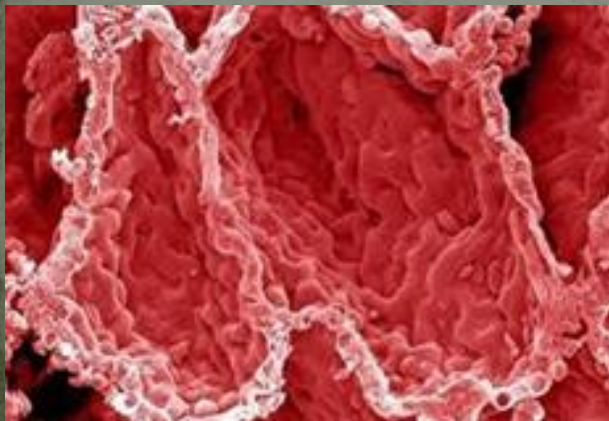
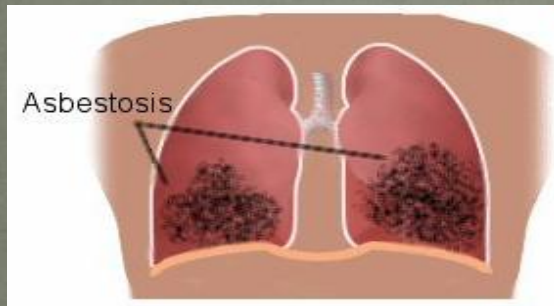
Expected: typically est. <10/million

**More people in the United States die from lung cancer than any other type of cancer.**

# Asbestosis: Interstitial Fibrosis

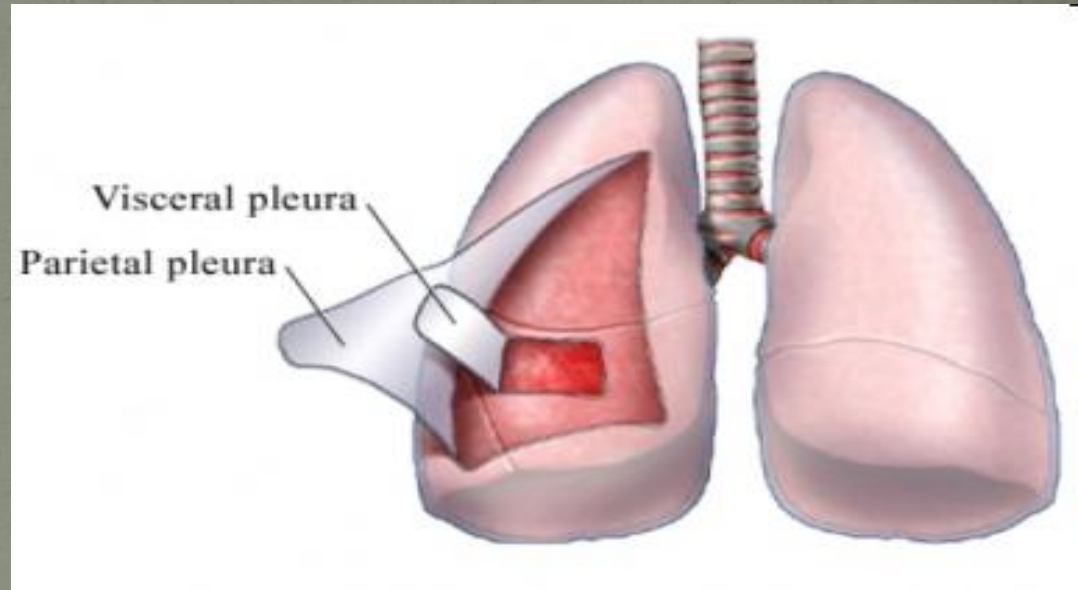
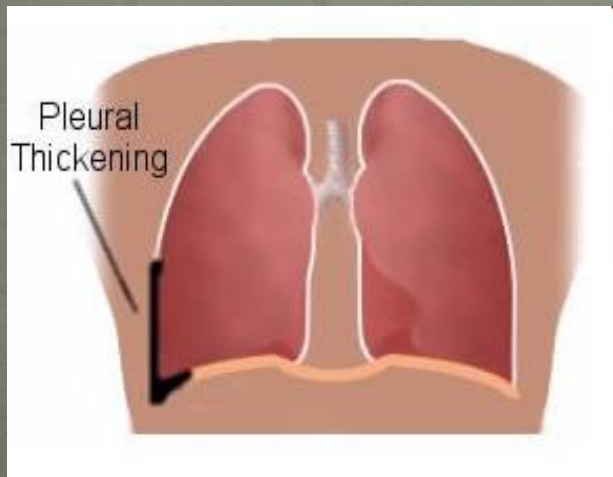
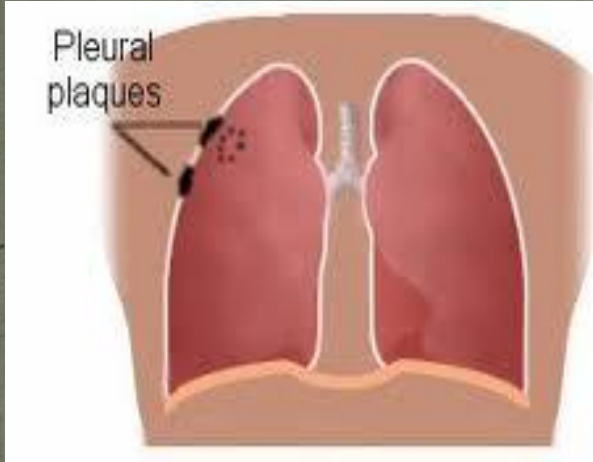
(Scarring on the inside of the lungs)

More Common with Chrysotile asbestos



# Asbestos Related Pleural Disease

(Scarring in the outside lining of the lungs)



# “Beauty Mark”

(ATS) reports a significant reduction in lung function attributable to both circumscribed and diffuse pleural fibrosis, even in the absence of radiological evidence of interstitial fibrosis (asbestosis).

## Pleural Plaques: Not Just a Marker of Exposure

[Occup Environ Med](#). 2012 Mar 1. [Epub ahead of print]

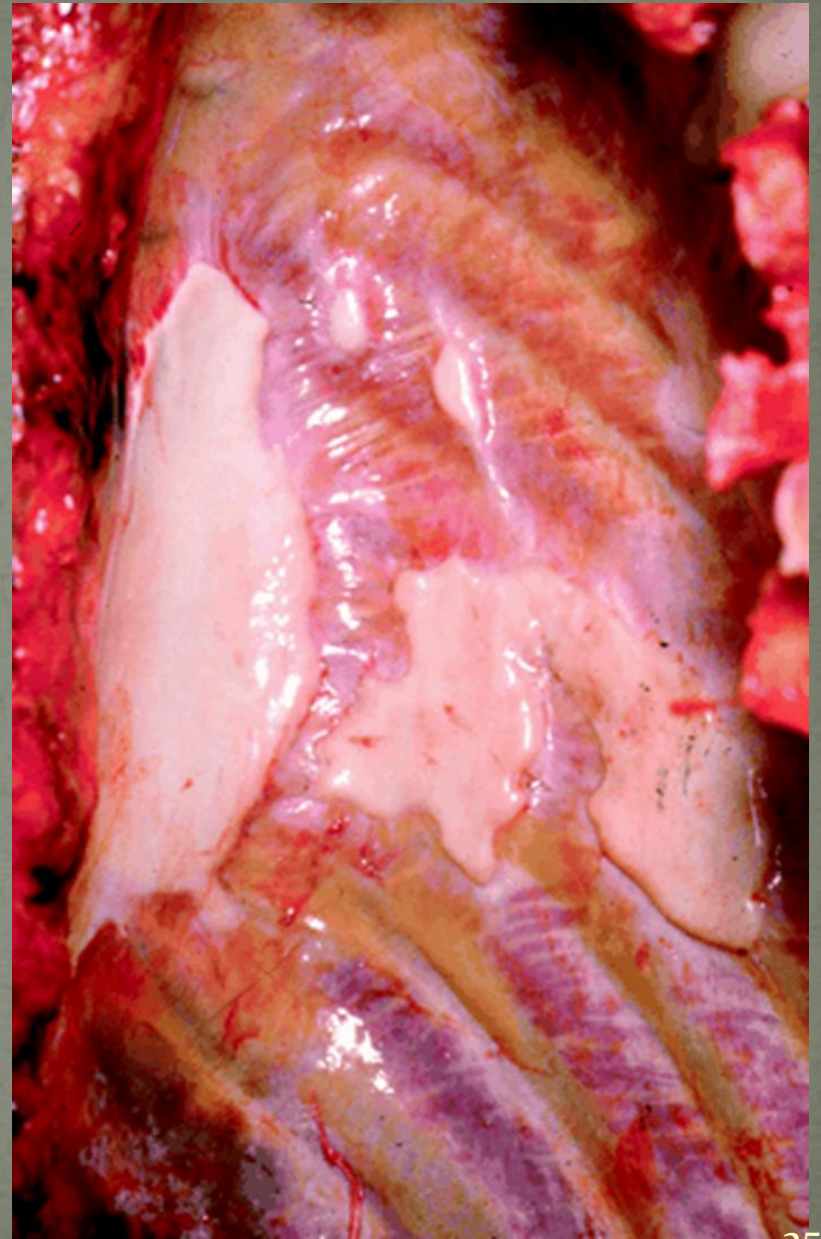
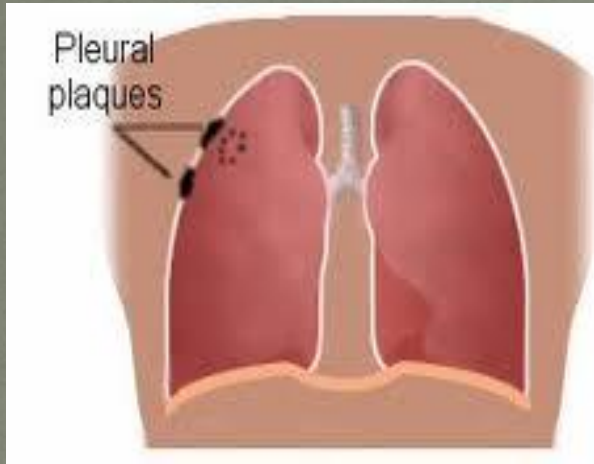
**Associations between radiographic findings and spirometry in a community exposed to Libby amphibole.**

[Larson TC](#), [Lewin M](#), [Gottschall EB](#), [Antao VC](#), [Kapil V](#), [Rose CS](#).

Division of Health Studies, Agency for Toxic Substance and Disease Registry, Atlanta, Georgia, USA.

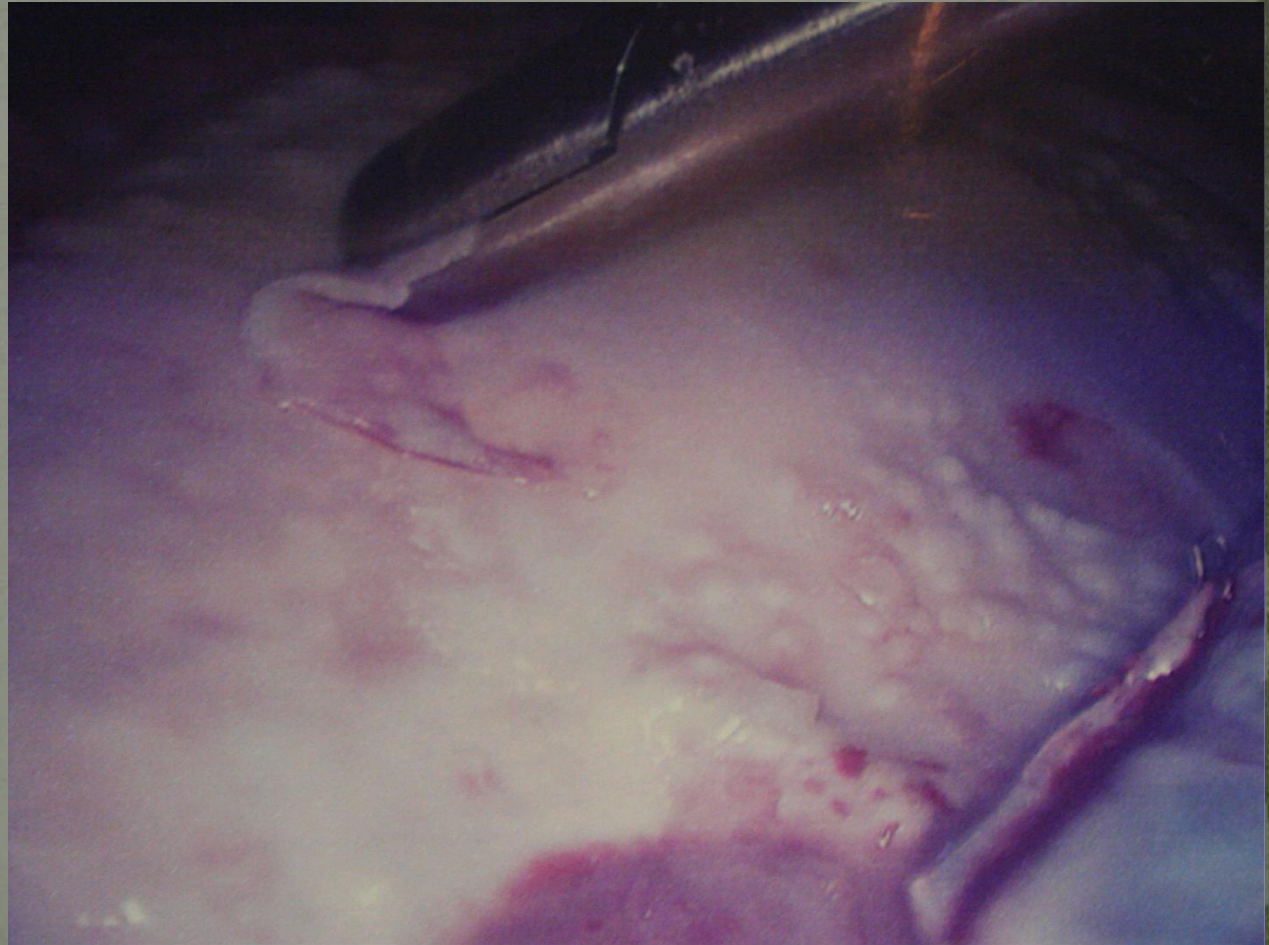
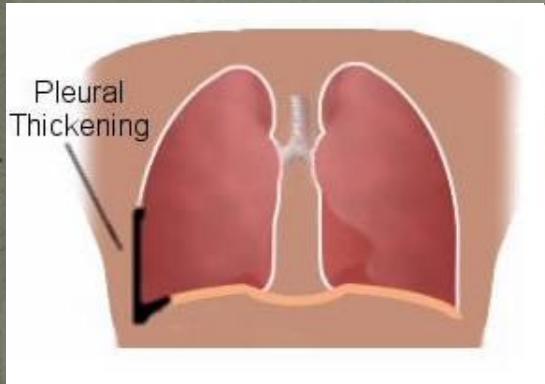


# Pleural Plaque

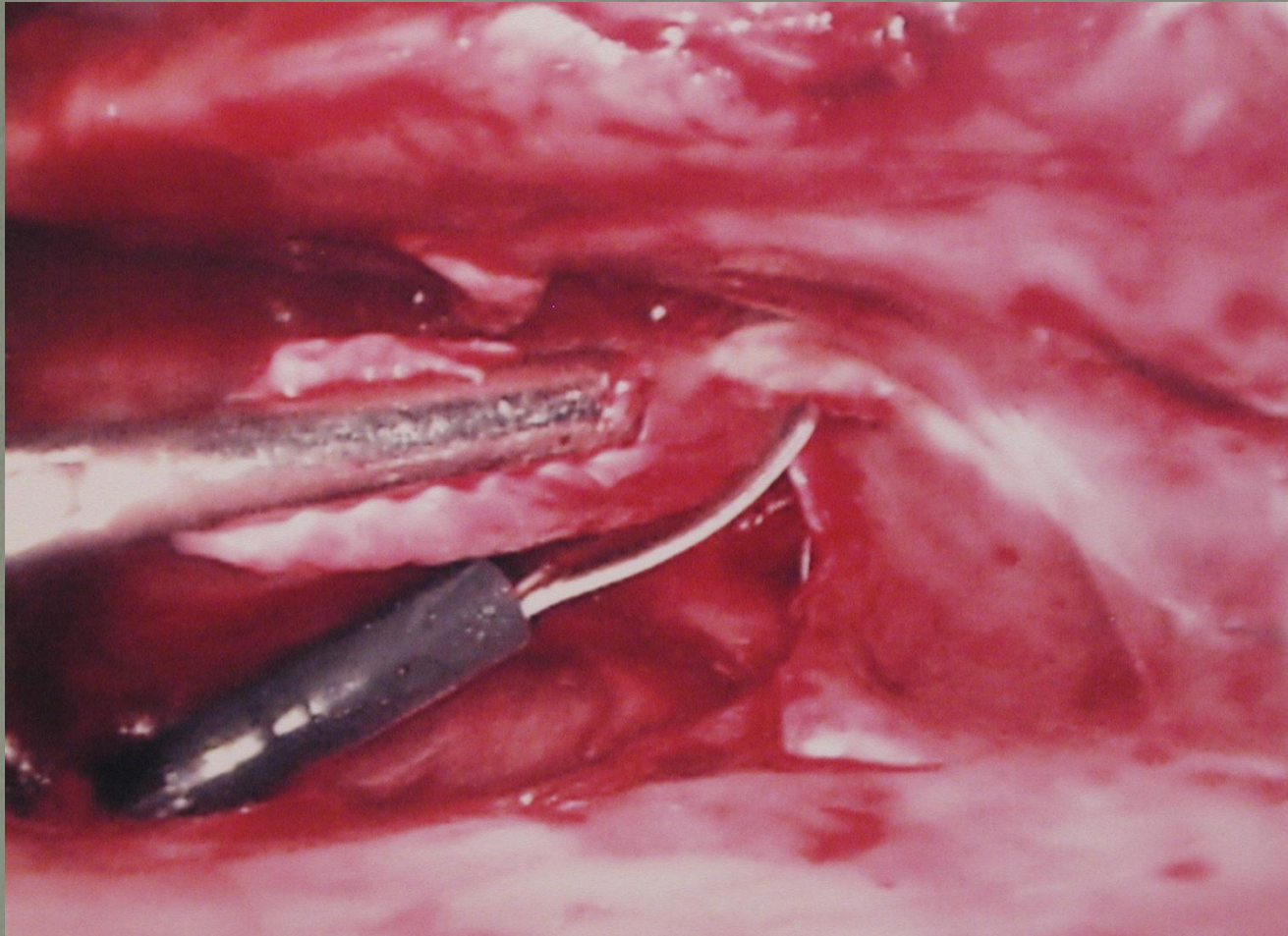


# Pleural Thickening

More Common with Amphibole Asbestos



# CHEST PAIN



[Pain Med](#). 2011 Sep;12(9):1303-8. doi: 10.1111/j.1526-4637.2011.01209.x. Epub 2011 Aug 11.

A retrospective study of chest pain in benign asbestos pleural disease.

[Allen RK](#), [Cramond T](#), [Lennon D](#), [Waterhouse M](#).

# Autoimmune Induction?

*We found increasing risk estimates for Systemic Autoimmune Disease with increasing numbers of reported asbestos exposure pathways ( $p < 0.001$ ).*

Ex) systemic lupus erythematosus, scleroderma, or rheumatoid arthritis (RA).

# American Thoracic Society (ATS) GUIDELINES FOR DIAGNOSIS of ARD

- Evidence of plausible causation
  - ***Occupational or Environmental History of Asbestos Exposure w/ Latency***
- Evidence of structural change on imaging (often non-specific)
- Exclusion of alternative diagnosis
- Functional assessment is not required for diagnosis but is part of a complete evaluation

# Recognizing Asbestos Related Disease (ARD)

X-rays are not clinically sensitive enough to use as a diagnostic tool

CT or “CAT Scans” are the gold-standard for identifying radiographic changes of ARD

1544192534 DEPARTMENT OF HEALTH AND HUMAN SERVICES PUBLIC HEALTH SERVICE OMB No. 0920-0020

DATE OF RADIOGRAPH: MONTH YEAR  
 WORKER'S Social Security Number  
 ROENTGENOGRAPHIC INTERPRETATION TYPE OF READING: A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z  
 FACILITY IDENTIFICATION

1. FILM QUALITY: Overexposed (dark), Underexposed (light), Poor contrast, Poor processing, Artifacts, Improper position, Underdefinition, Mottle, Other (please specify)

2A. ANY PARENCHYMAL ABNORMALITIES CONSISTENT WITH PNEUMOCOSES? YES NO  
 2B. SMALL OPACITIES: PRIMARY, SECONDARY, UPPER, MIDDLE, LOWER, A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z  
 2C. LARGE OPACITIES: A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z

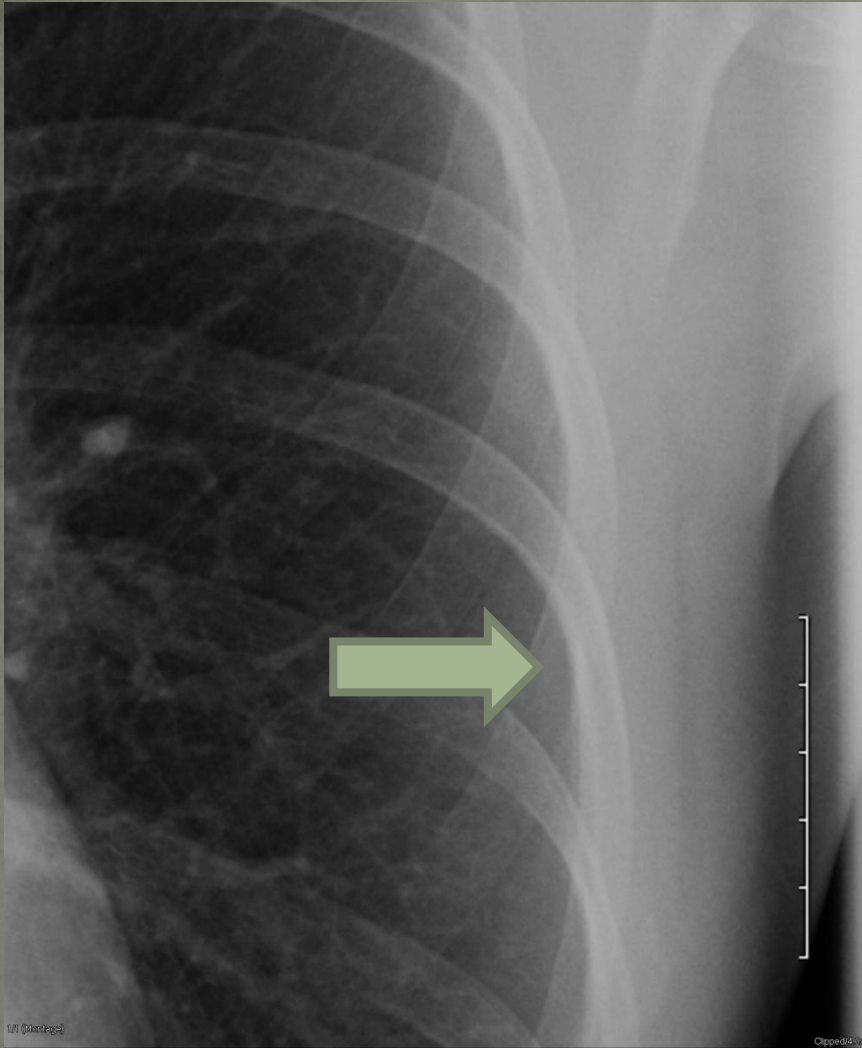
3A. ANY PLEURAL ABNORMALITIES CONSISTENT WITH PNEUMOCOSES? YES NO  
 3B. PLEURAL PLAQUES: Chest wall, In profile, Front on, Diaphragm, Other sites, Calcification, Roster chest wall, combined for in profile and front on, 1/4 to 1/2 of lateral chest wall = 1, 1/4 to 1/2 of lateral chest wall = 2, > 1/2 of lateral chest wall = 3, Films (in profile only) (One minimum width required): 2 to 5 mm = a, 5 to 10 mm = b, > 10 mm = c

3C. COSTOPHRENIC ANGLE OBLITERATION: YES NO  
 3D. DIFFUSE PLEURAL THICKENING: Chest wall, In profile, Front on, Calcification, Roster chest wall, combined for in profile and front on, 1/4 to 1/2 of lateral chest wall = 1, 1/4 to 1/2 of lateral chest wall = 2, > 1/2 of lateral chest wall = 3, Films (in profile only) (One minimum width required): 2 to 5 mm = a, 5 to 10 mm = b, > 10 mm = c

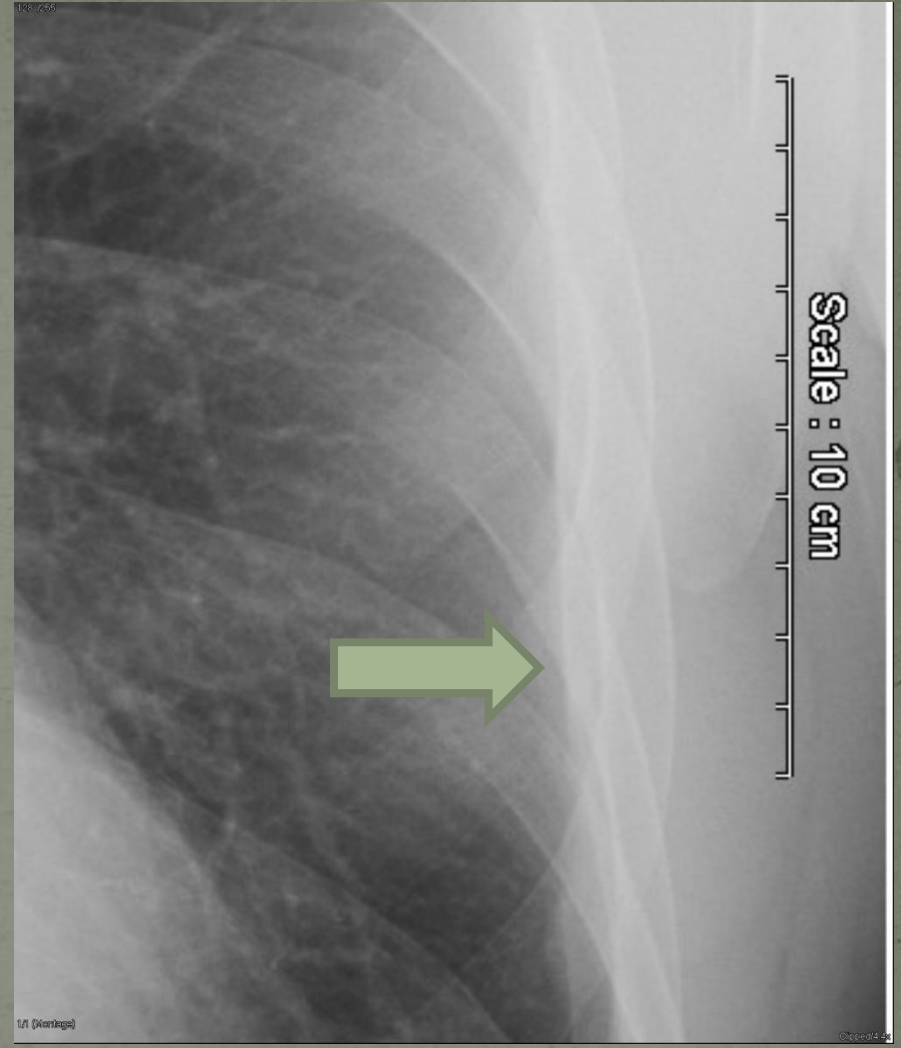
4A. ANY OTHER ABNORMALITIES? YES NO  
 4B. OTHER SYMBOLS (OBLIGATORY): A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z  
 4C. Should worker see personal physician because of findings in section 4? YES NO  
 FILM READER'S DATE OF READING

B-reading Standard Methodology:

- Research
- Academic
- Epidemiological purposes

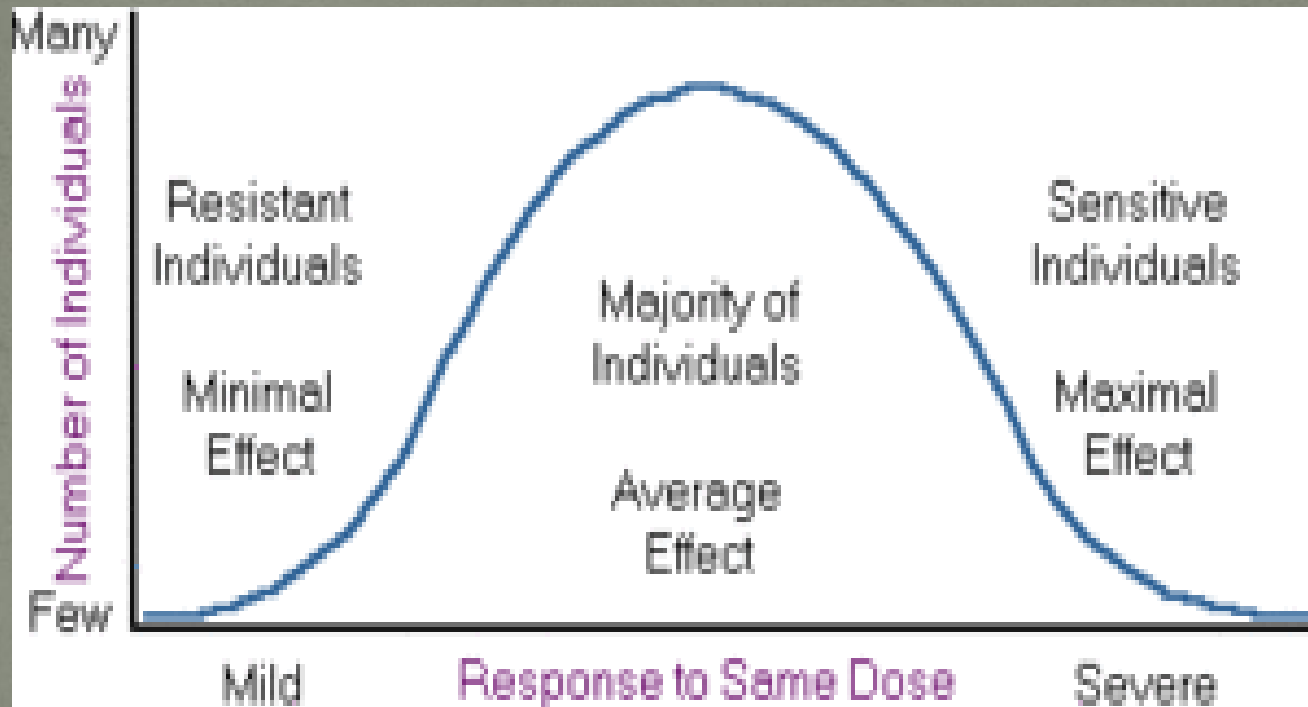


Normal Chest X-ray



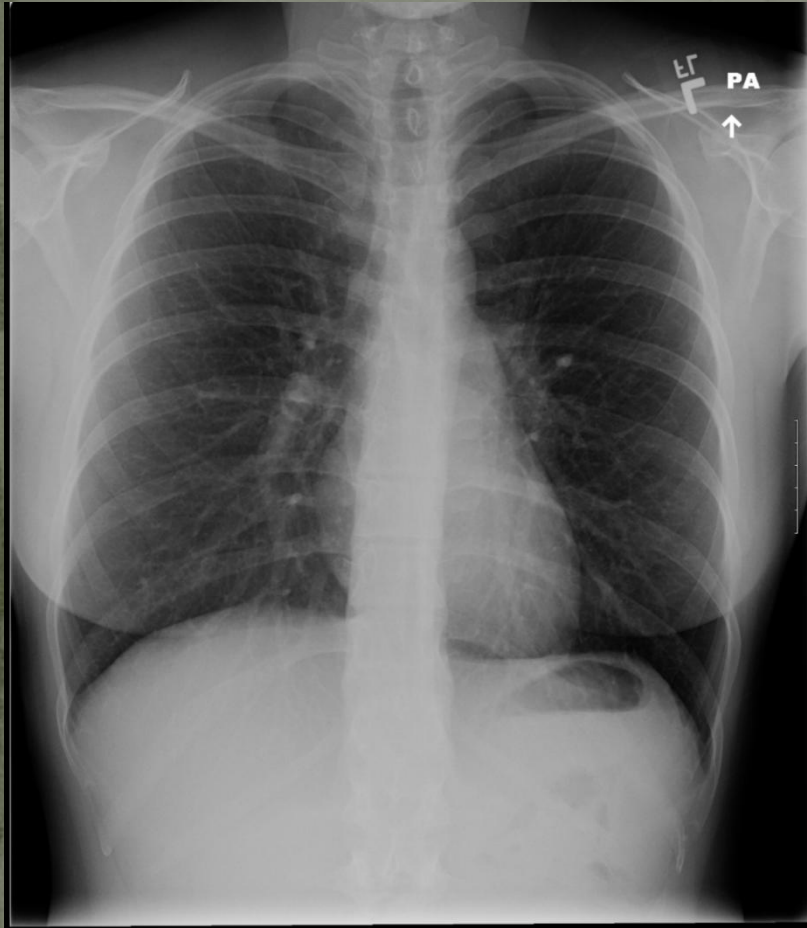
Pleural Thickening

# Health Effects of Non-Malignant ARD





# Low-Dose Environmental Exposure



(Left) Normal (Right) Patient lived in Troy near the rail road tracks until he was 19 yo, when he permanently left the area. Patient is 35 yo in x-ray.

# Rapid Progression

Patient raised in Libby, worked as a butcher. Liked to fish on the river near the vermiculite processing plant. Moved out of Libby in his 30's. Very active, ran 14 miles per day.

<u>2004/ 51yo</u>	<u>2006/ 53yo</u>	<u>3/2008/ 55yo</u>	<u>10/2008</u>
FVC 4.89 114%	3.12 68%	1.68 40%	1.03 25%
FEV 3.61 104%	2.79 76%	1.11 33%	1.00 30%
	Ratio 112%	Ratio 86%	
DLCO 109%	DLCO 85%	Unable	

# 1/16/2010– 57 yo, Deceased

## Following complications from asbestosis.

### Larry “Lar” Lavon Hill

Survived by his wife,  
Son and daughter,  
Twin grand-daughters,  
Grandson & Granddaughter,  
Parents,  
Brothers & Sisters





Libby

Kootenai River

Zonolite Mountain

Rainy Creek

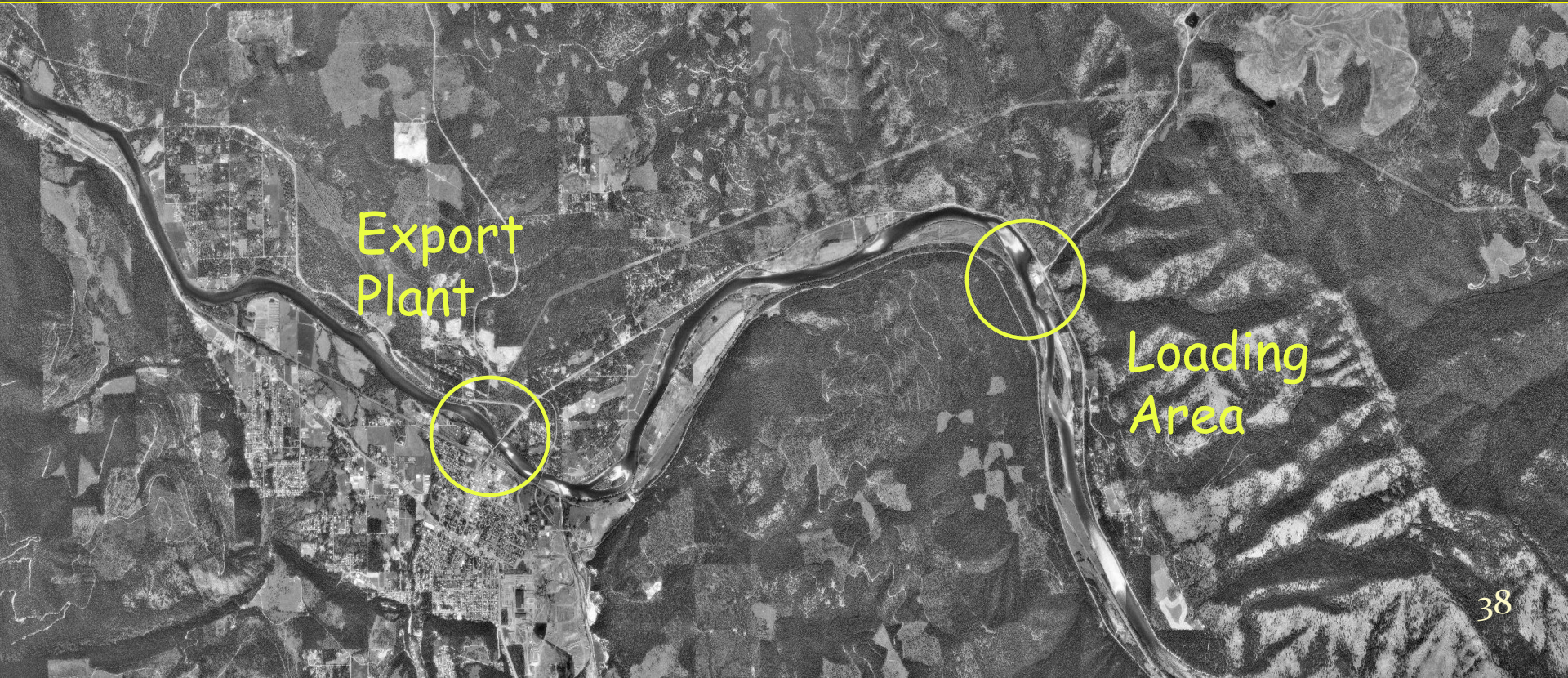


Note the dust from the dry mill. The mine site was located 6 miles from the town of Libby.



# The Community

- Brought home in work clothes
- Personal use - insulation in homes, garden soil treatment, driveways
- School playgrounds, athletic fields, tracks, ice skating rinks
- Children playing in export plant piles





**Libby Export Plant  
circa 1950**





# Libby Declared 1<sup>st</sup> Public Health Emergency by EPA 2009

<http://www.youtube.com/watch?v=5yA1utQyCno>



## Screening Program Outcomes

Year I 6/2011- 6/2012  
Year II 7/2012- 2/2013 (Quarter 1-3)

### Year One

672 new patients

110 re-screening

**782 Total screenings**

520 patients chose CT

355 (68% of 520) diagnosed w/ARD

**45% Total diagnosed with ARD**

### Year Two (Quarter 1-3)

638 new patients

165 re-screening

**803 Total screenings**

618 patients chose CT

395 (64% of 618) diagnosed

**49% Total diagnosed**



## Screening Program Outcomes, Year I 6/2011- 6/2012

### Who are the people being diagnosed?

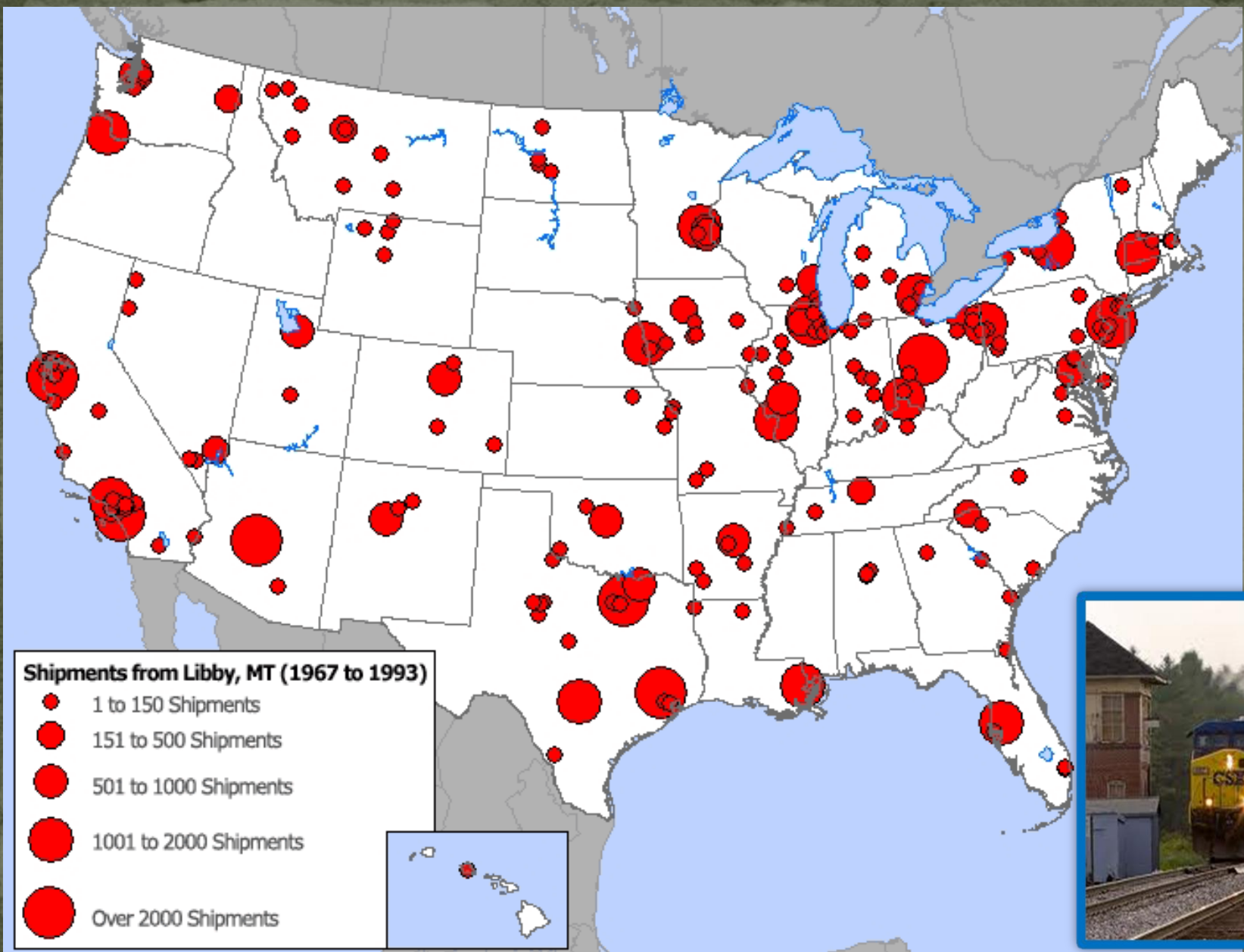
<35 yo	7% (56 patients)
35-49	18.5% (144)
50-64	48.5% (379)
65+	26% (203)

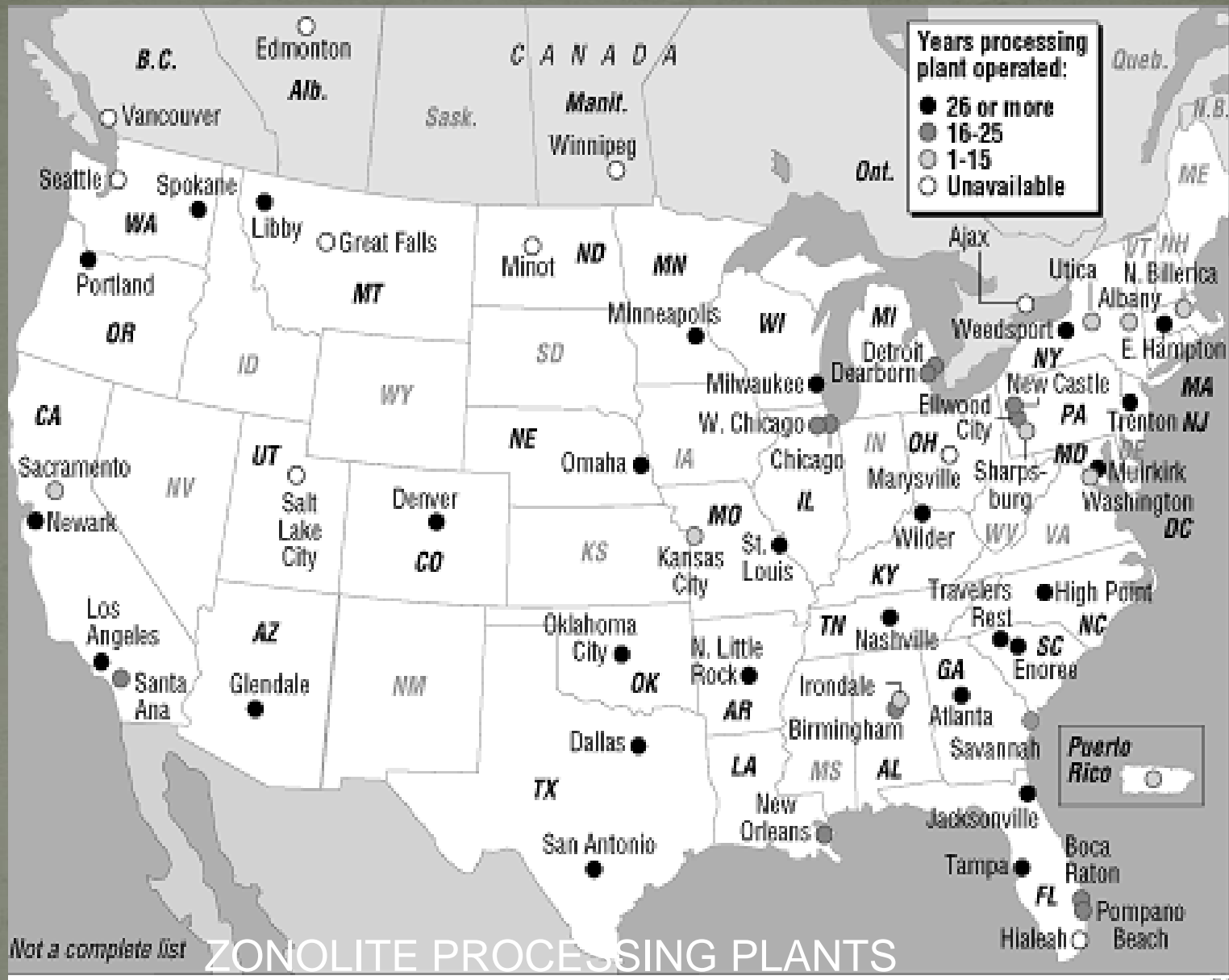
75% within Lincoln County

25% outside of Lincoln County

# Libby Amphibole Asbestos *Not Just a Libby Risk*







P-1



EPA estimates  
vermiculite insulation is  
present in 30 million  
homes across the USA



These attractive Johns-Manville  
Asbestos Sidewall Shingles are  
applied right over old siding—  
*never need paint to preserve them!*





**WHEN THE FIRE ALARM WENT OFF,  
IT TOOK TWO HOURS TO EVACUATE  
NEW YORK'S WORLD TRADE CENTRE.**

The bigger the building, the more important fire-proofing becomes

That's why today's buildings have asbestos-cement walls and even floors containing asbestos.

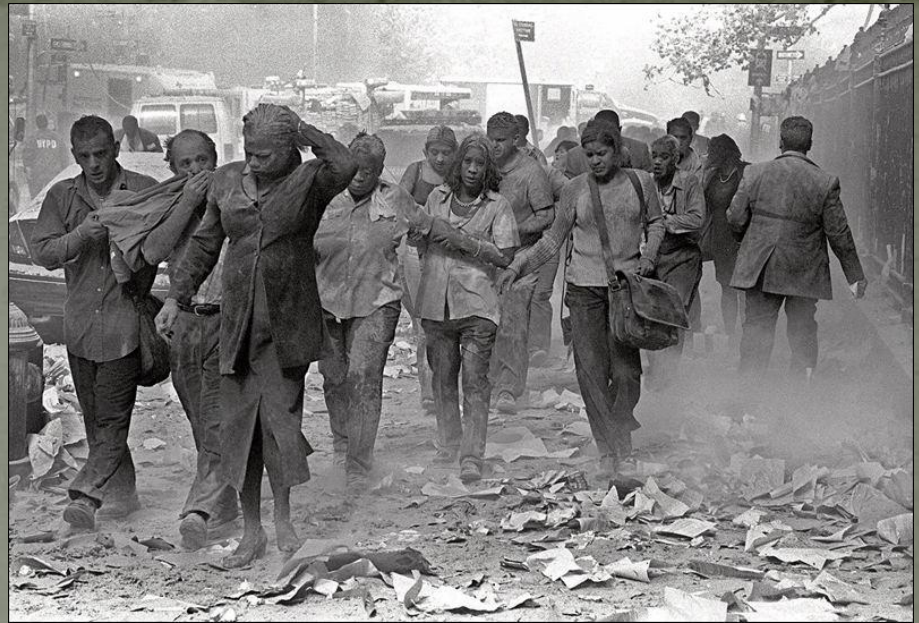
Asbestos contains fire, cannot burn and holds up after metal and glass have melted down, giving vital time for people to escape.

You'll also find asbestos sealing plumbing joints, insulating heating pipes, electric motors and emergency generators.

Asbestos. We couldn't live the way we do without it

**ASBESTOS**

**When life depends on it, you use asbestos.**

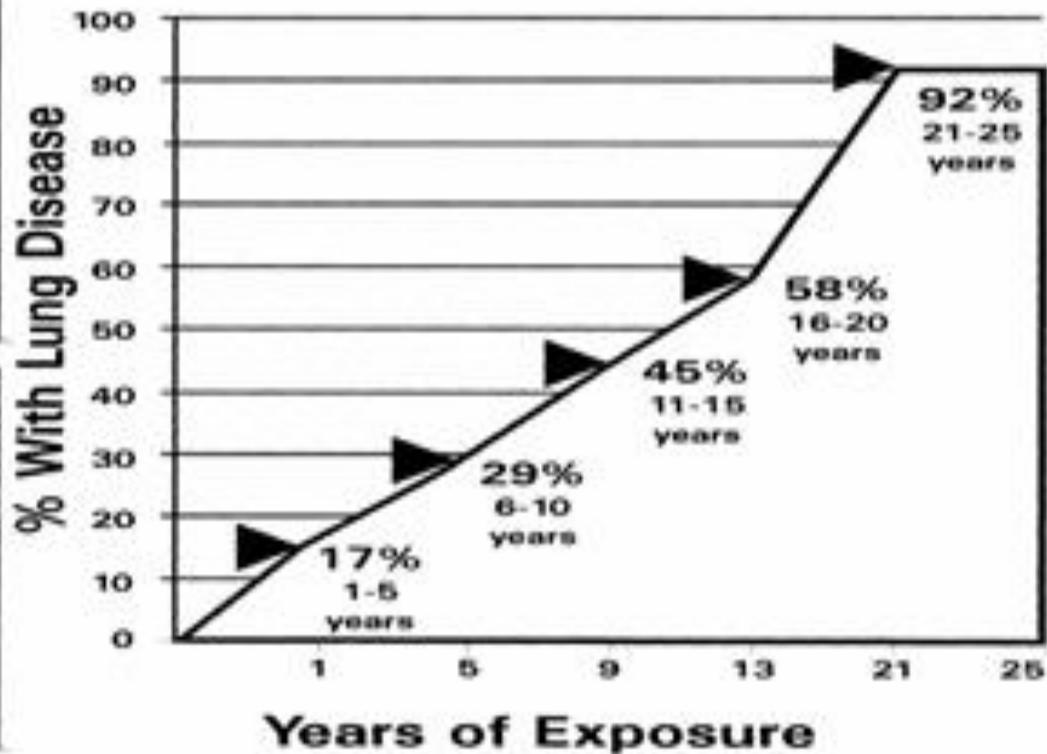




# Personal info and perspective

- Pediatric Practice, 1977
- Practice Partner – Richard Irons, MD
- Recognition of asbestos related disease due to occupational exposure
- Proposal to WR Grace, 1978

## Workers with Disease - 1969



Per Exh. 130.4 Grace Headquarters In-house Study

CASO  
0-250

# Dr. Irons' proposal on a voyage to Cambridge

- Retrospective study of mortality and illness involving past and present employees and family members.
- Prospective study to follow all present employees “to the grave”
- Expand the current employee monitoring
- Physician follow-up
- WR Grace to finance

## Internal memo/ Dec, 1978

“...Irons sees himself as the Selikoff of the tremolite world and Libby Hospital as the Mt. Sinai of the west.”

# Internal memo/ April, 1979

- ....As you can conclude from his memo, Irons is “turning the screw”.
- ....We either play the game his way or he is going to blow the whistle.

# Libby in 1980's

- NIOSH study of Zonolite workers but no further action taken.
- EPA awareness of the potential public health problems associated with Zonolite insulation but no further action taken.

# Marysville, Ohio

- Dr. Jim Lockey recognized health effects in the Scott's Co. employees associated with their use of Libby vermiculite ore. He convinced the company to cease using the Libby vermiculite ore.
- He was unsuccessful in convincing WR Grace officials that their vermiculite ore was hazardous.
- (1984) Dr. Lockey published the results of these findings and also published a second article pointing out the potential for significant public health problems associated with the Libby product.

# WR Grace closes Libby Vermiculite Mine, 1991

- With the loss of a major business client and the increasing demand on Grace to place a warning label on their products, the future profitability of their asbestos- contaminated vermiculite ore/products was in serious question.



# Poor assumption

- With the extensive amount of attention in the 1980's to the WR Grace asbestos tainted vermiculite hazards, including the scrutiny of the EPA, any current or future health concerns would have been solved.

# 1990s Observations

- Dr. Alan Whitehouse, Spokane pulmonologist, identified patients with ARD whose only exposure to LA was environmental.
- Suspicion is raised that there is a larger public health problem.
- Previous WRG memos surfaced for public availability.

# November, 1999

## Seattle P-I Articles

- Widespread asbestos exposure in Libby area
- Asbestos related lung disease as a result of environmental exposure
- Transport of asbestos contaminated ore to multiple export plants around North America

# Initial Response to Articles (Personal)

- Disbelief/denial
- Public health failure?
- Consultation with Alan Whitehouse, MD
- Acceptance of the potential scope of the asbestos exposure

# Initial Community response

- Strong denial by many residents, many of whom had not had family members or friends impacted by ARD
- Loyalty to WR GRACE
- Anger directed to community members who voiced their health concerns and criticism of WR Grace
- Fear of adverse effects to local economy

# Motivation for assuming community leadership role

- Public health credibility
- Need for community repair
- “Receiving and carrying torch” – Richard Irons, MD
- Fill the void in advocacy for our community members with adverse health effects

# The Emergency Response

- EPA, Region VIII with DHHS, Region VIII
- Environmental and health assessment
- Emergency clean-up plan
- Preparation for health screening to determine extent of significant asbestos exposure
- ATSDR response

# Lessons from Libby

- Asbestos Disease is often un-noticed in the community until generations of residents have been exposed.
  - Illness from “benign” asbestos disease causes more morbidity and mortality than cancerous asbestos disease.
- 
- Effective oversight and investigation by agencies requires public concern and engagement to protect public health.
  - Community and greater public involvement can initiate environmental remediation, disease recognition and management, and hopefully prevention of further exposures.



# Ambler Similarities (Health Effects)

- 2007 ATSDR Health Consultation of Kobuk river residents indicates ~18% Chest x-ray abnormality on B-read
- 2000/2001 ATSDR Screening of Libby residents indicated ~ 18% Chest x-ray abnormality on B-read
- In both communities initial assessment of death certificates and diagnoses in medical charts show little to no ARD.

\*\* B-reading was conducted in both locations on a sample of community members that include both occupational and environmental exposures.

B-reads in both locations require clinical correlation for diagnosis, as abnormalities may represent findings that are not asbestos related. CT scans are the gold-standard method of determining if abnormalities are asbestos related or not.

# Historical Fiber Characterization of the Ambler Region

- Historical mining documents document that 36.5 tons of tremolite asbestos was mined in 1945 from “asbestos mountain”, as well as 1 ton of chrysotile slip fiber. (p6)
- “The main production from Dahl Creek deposit was tremolite asbestos.” (p15)

# Ambler Fiber Sampling

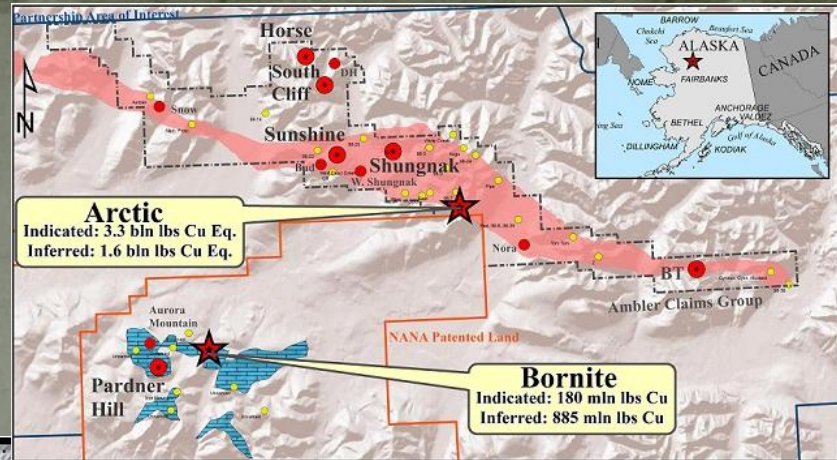
- 2007 ATSDR Health Consultation Sampling:
  - “The sampling plan was not intended to determine the safety associated with digging and construction activities...including sewer and water upgrades...”
  - Air samples were largely overloaded with dust preventing analysis on many samples

# 2007 ATSDR Ambler Soil Sampling

- “All samples showed chrysotile asbestos...indicating the presence of numerous short fibers and very long fibers.” (p.7)
- “Ambler soil data indicate widespread asbestos contamination of chrysotile asbestos containing many long thin fibers.”

# 2007 ATSDR Recommendations

- “Pedestrians are exposed to asbestos and dust levels of health concern.” (p2)
- “No gravel from the pit should be used on roads.” (p2)
- “All access to the gravel pit that supplies road gravel should be closed.” (p2)
- “The gravel from the Ambler gravel pit at the end of the airport road should not be used for road gravel or in any manner that leaves it exposed to the air.” (p.15)



**Upper Kobuk Mineral Project**

- ★ Major Deposit
- Historical Resources Estimate
- Mineralized Drill Intercept
- Prospect

Legend for sequences:  
█ Ambler Sequence  
█ Bornite Sequence

**NOVA COPPER**

**AMBLER MINING DISTRICT**  
String of Pearls & Bornite Deposit  
Alaska

PROJECTION: UTM Zone 4 NAD83  
 SCALE: 1:100,000  
 FIGURE: 1

