

# ACCEPTING THE CHALLENGE

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Each of us, simply by going to work each day, may face hazards that threaten our health and safety. Risking one's life or health should never be considered merely part of the job.

Many in Labor, Industry, and Government have voiced the desire to take mine worker safety and health to the next level...

but how do we undertake this important goal?

# Today's Presentation

- Describe a process for *moving to the next level...*
- Provide background information on mining and mining safety and health in the US
- Provide examples from the NIOSH research program

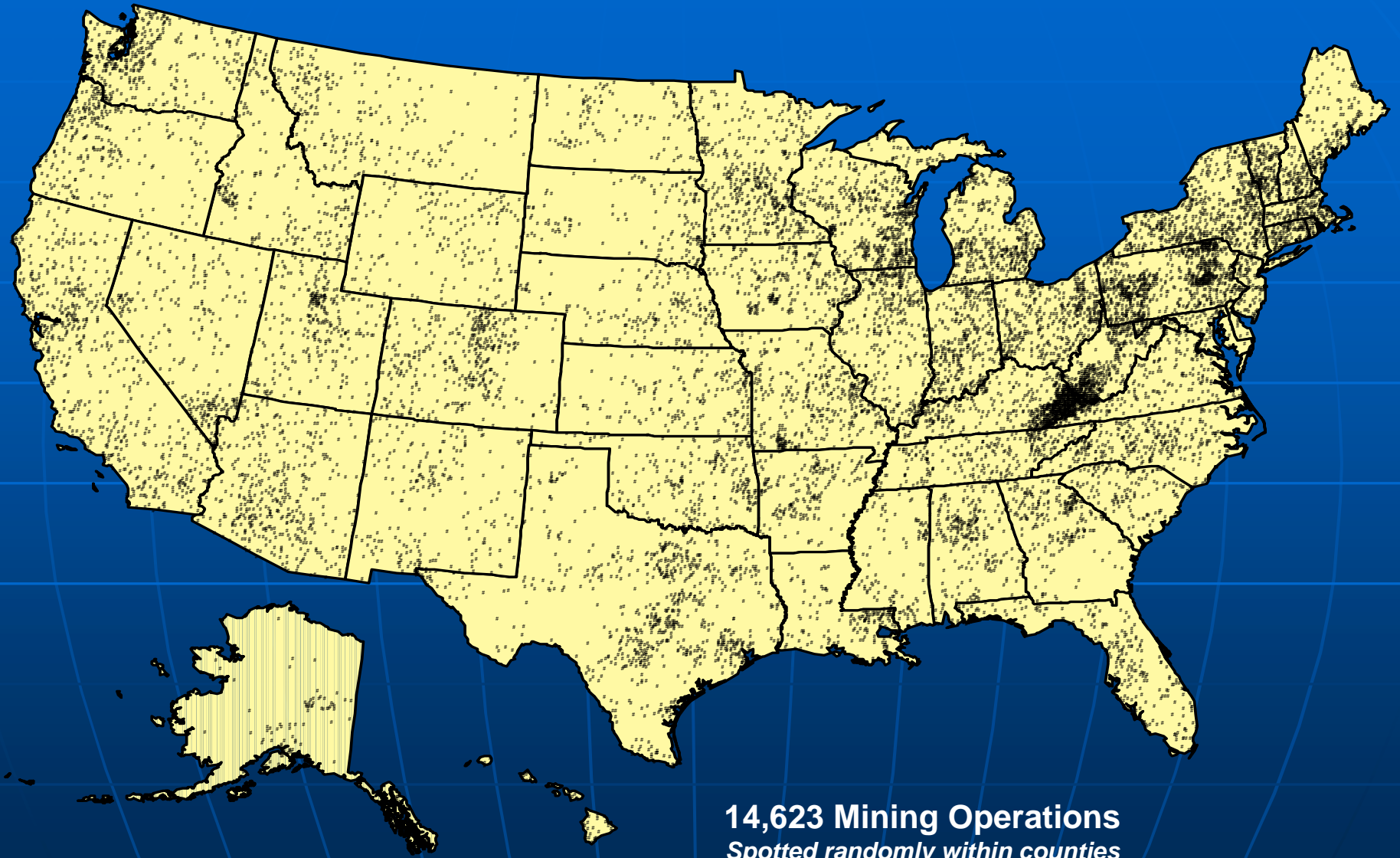
# A Process...

- Characterize the present and identify sentinel events...
- Examine underlying causes...
- Propose general interventions and identify barriers to their application...
- Develop and execute a focused research and development program...and then introduce the interventions...
- Evaluate intervention effectiveness...

# Characterization

- Industry
- Fatalities, injuries, and illnesses
- Sentinel events

# Mining Operations, 2001

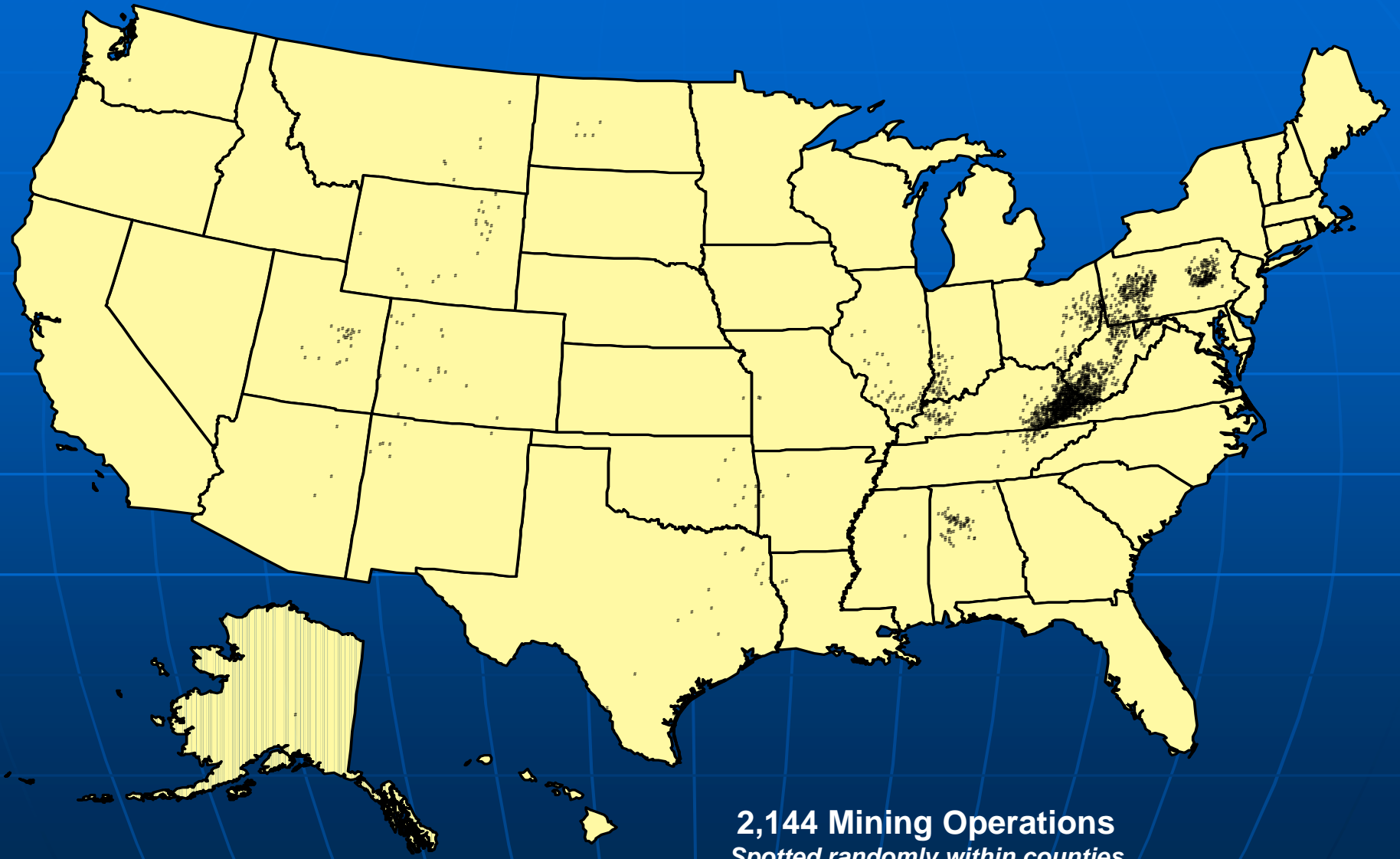


**14,623 Mining Operations**  
*Spotted randomly within counties*

Not shown: Puerto Rico, 106 mines;  
U.S. Virgin Islands, 4 mines

**Data source: MSHA**

# Coal Mining Operations, 2001

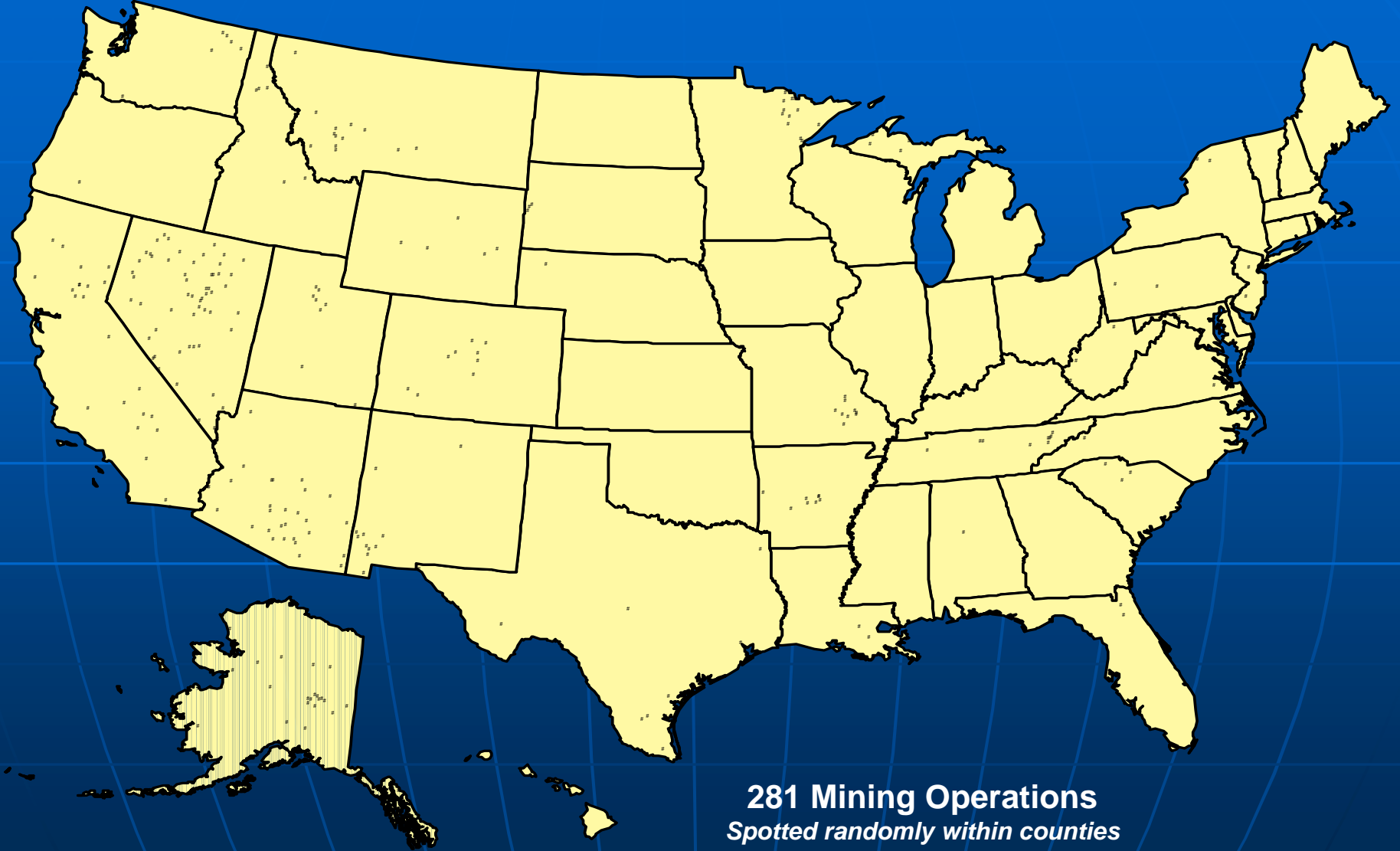


**2,144 Mining Operations**  
*Spotted randomly within counties*

**Data source: MSHA**



# Metal Mining Operations, 2001

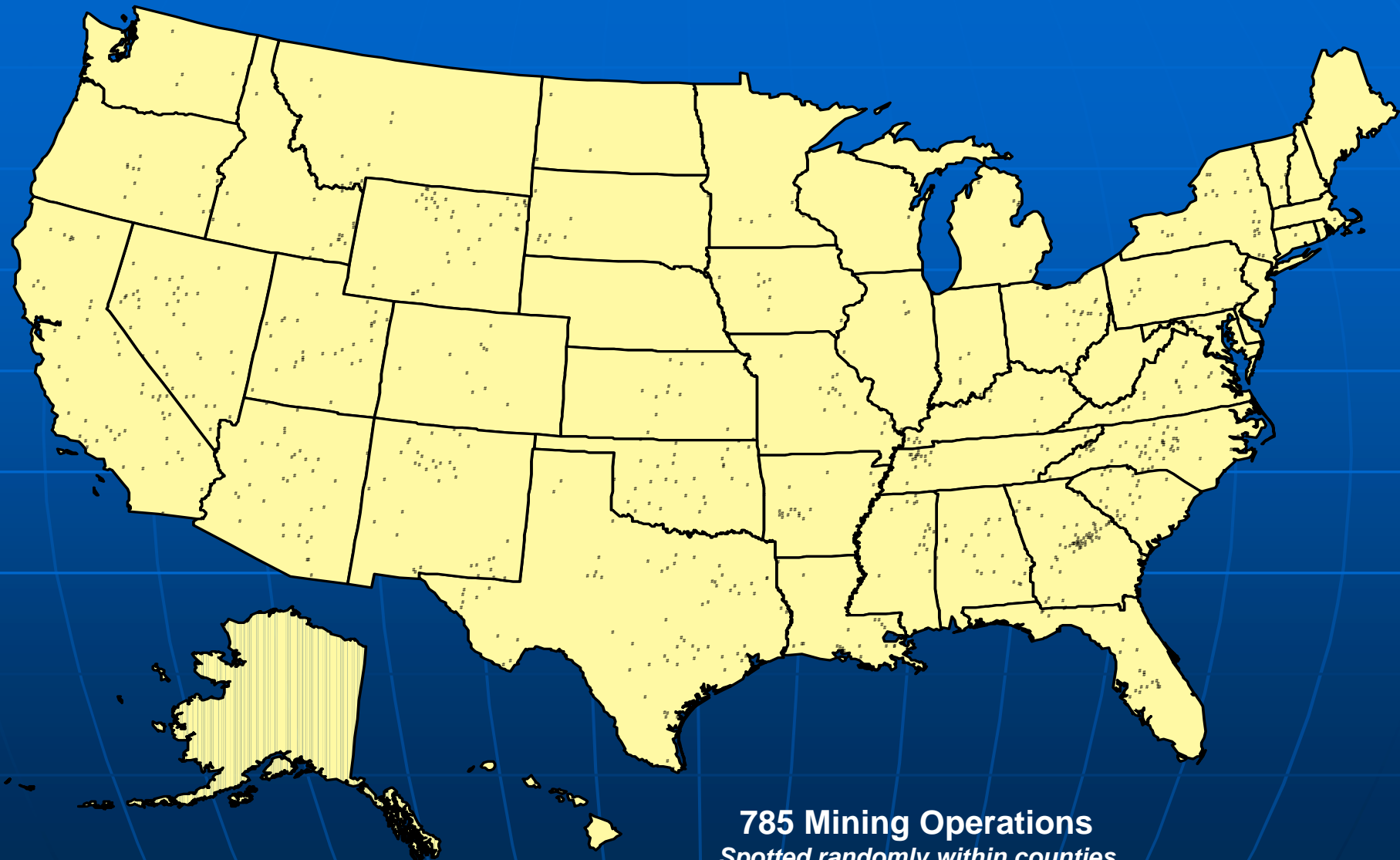


**281 Mining Operations**  
*Spotted randomly within counties*

Not shown: U.S. Virgin Islands, 1 mine

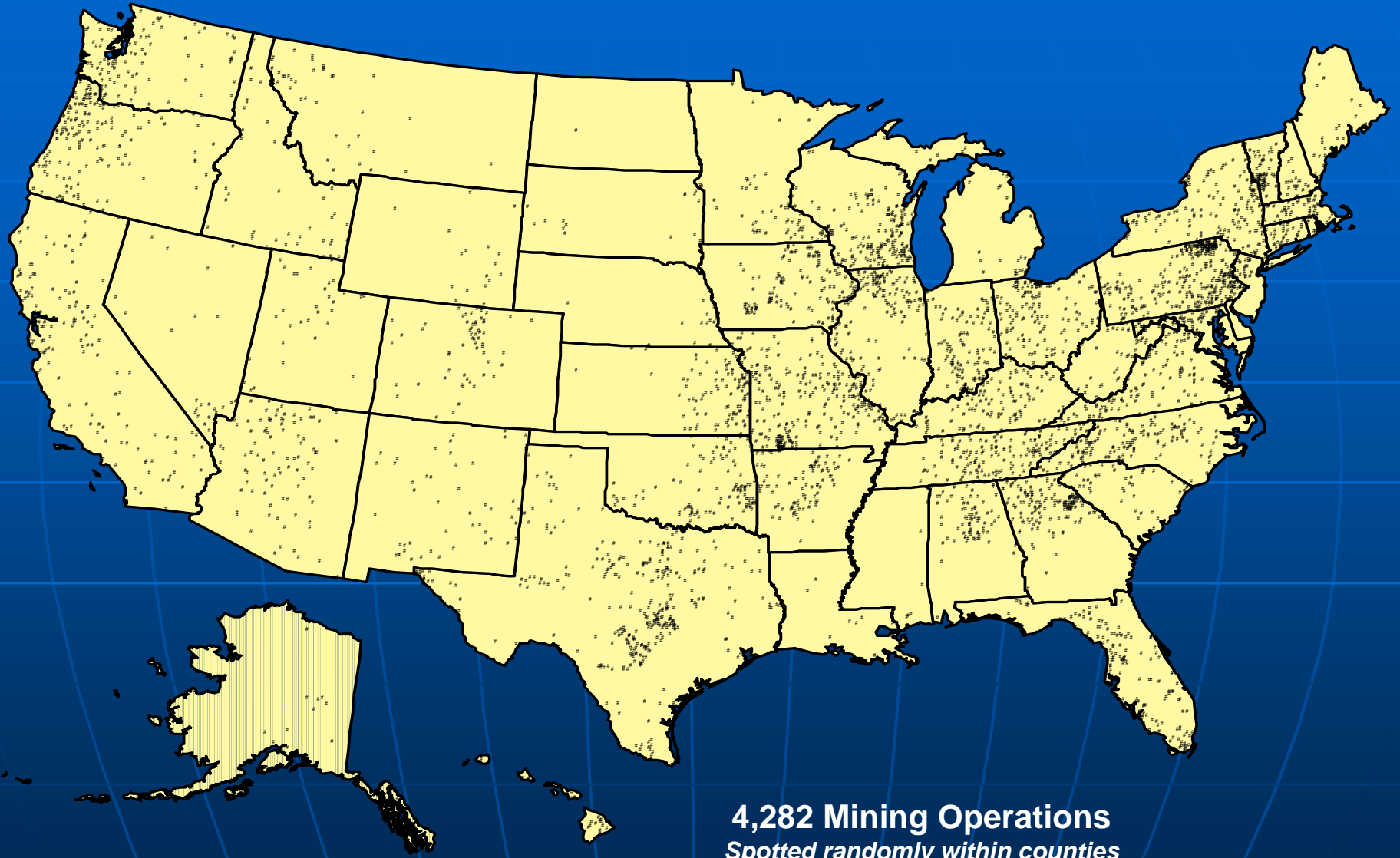
**Data source: MSHA**

# Nonmetal Mining Operations, 2001



Data source: MSHA

# Stone Mining Operations, 2001

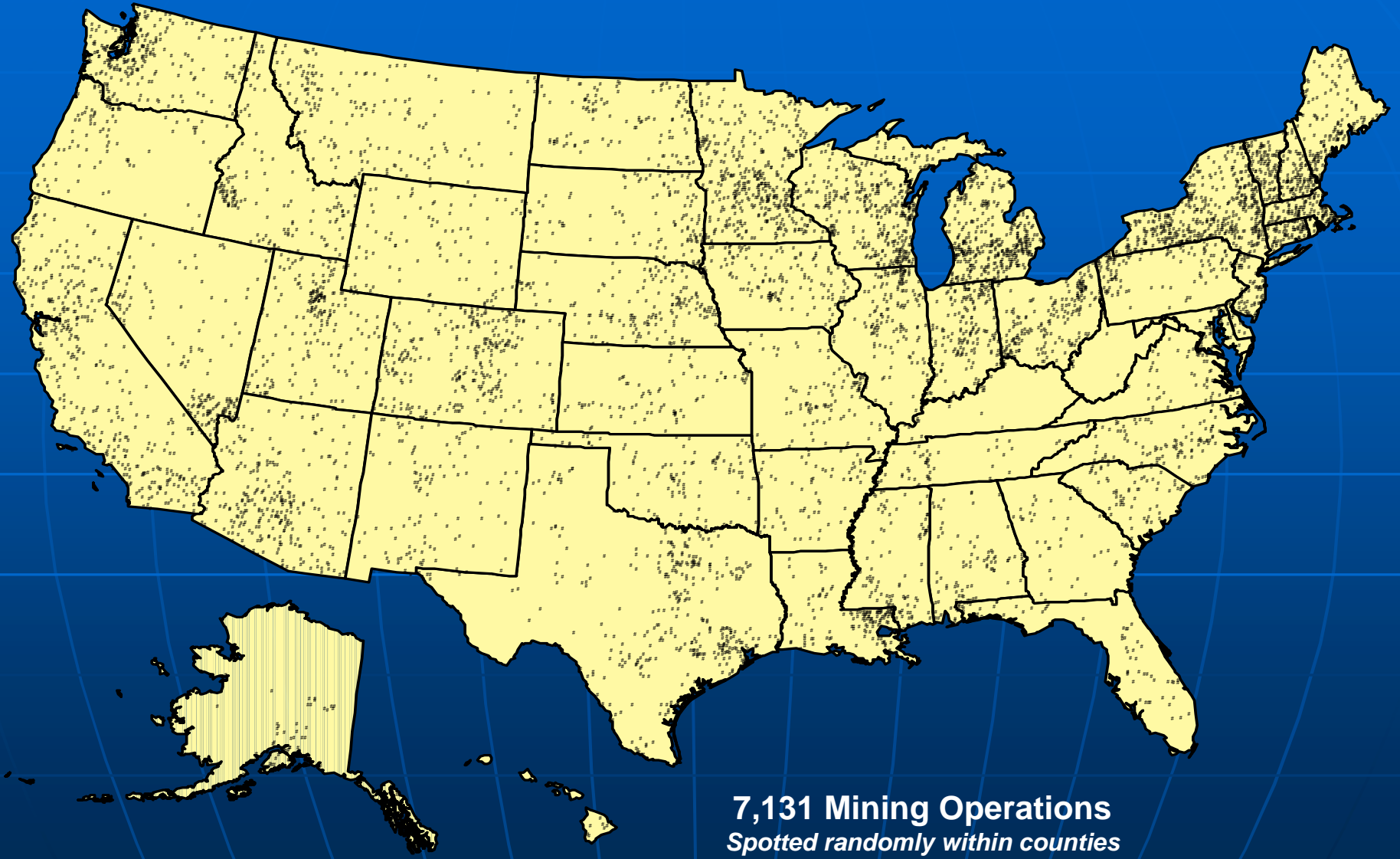


**4,282 Mining Operations**  
*Spotted randomly within counties*

Not shown: Puerto Rico, 61 mines;  
U.S. Virgin Islands, 3 mines

**Data source: MSHA**

# Sand & Gravel Mining Operations, 2001

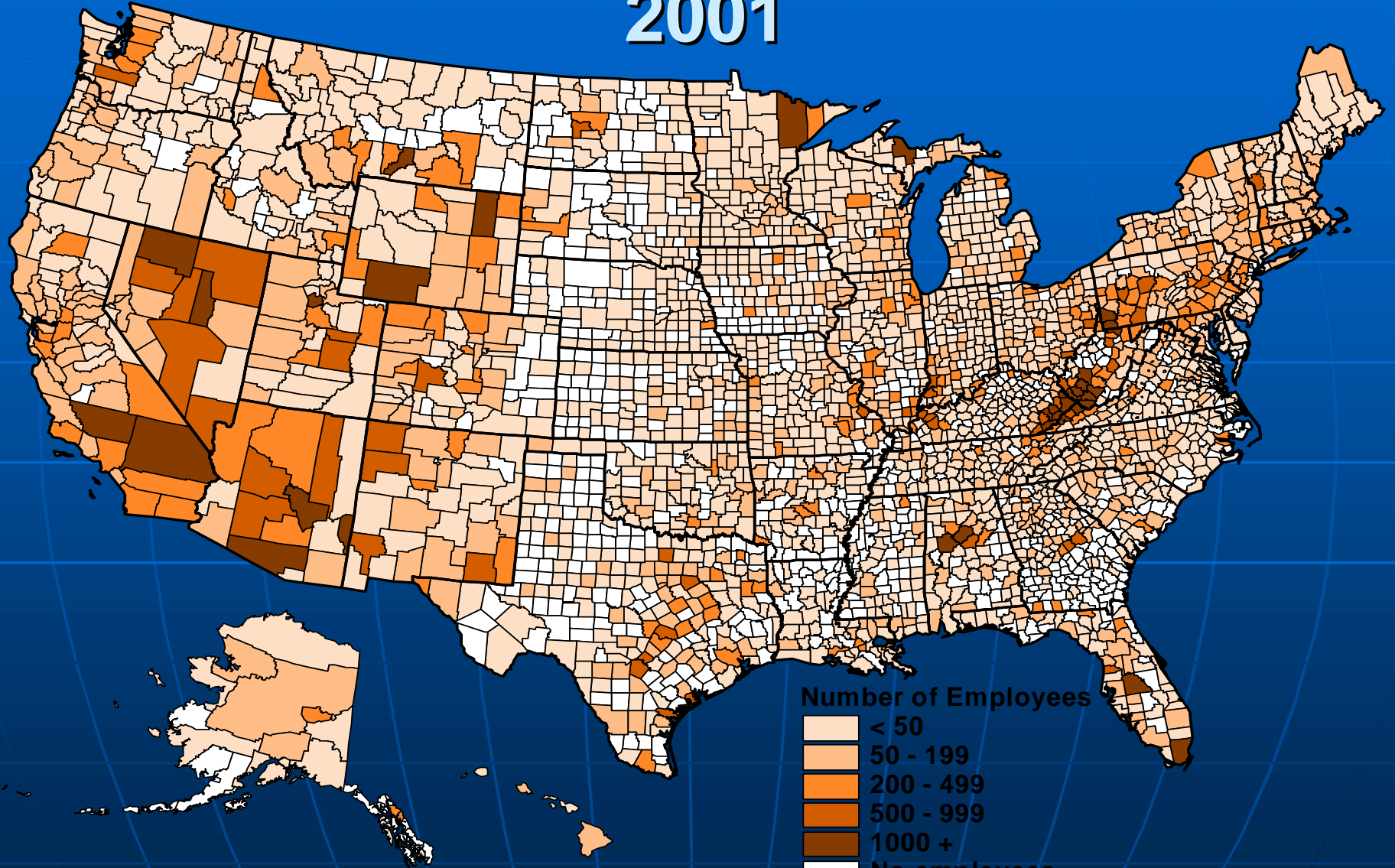


**7,131 Mining Operations**  
*Spotted randomly within counties*

Not shown: Puerto Rico, 45 mines

**Data source: MSHA**

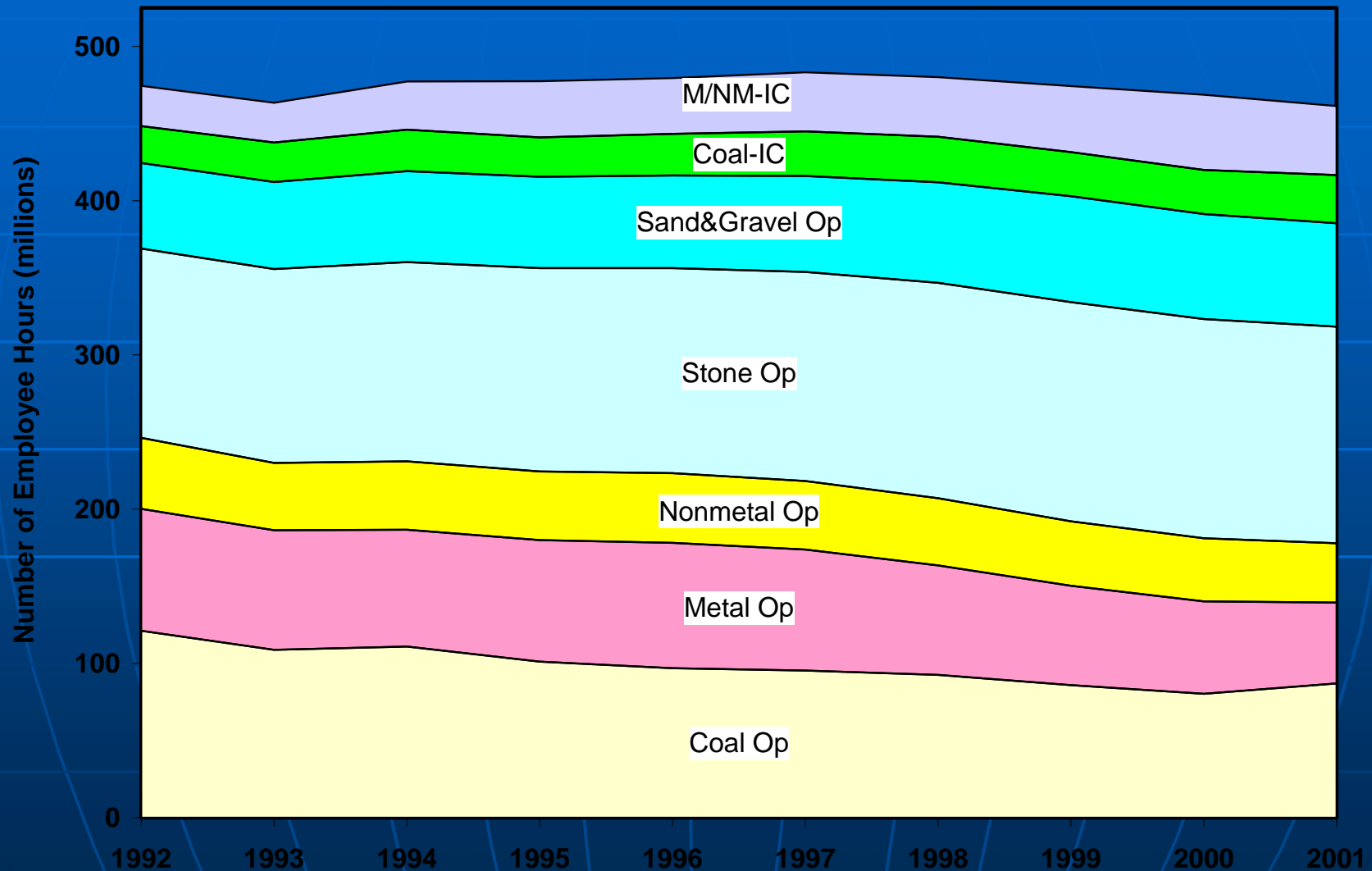
# Mine Operator Employees 2001



Data source: MSHA

233,112 Employees (excludes office workers)

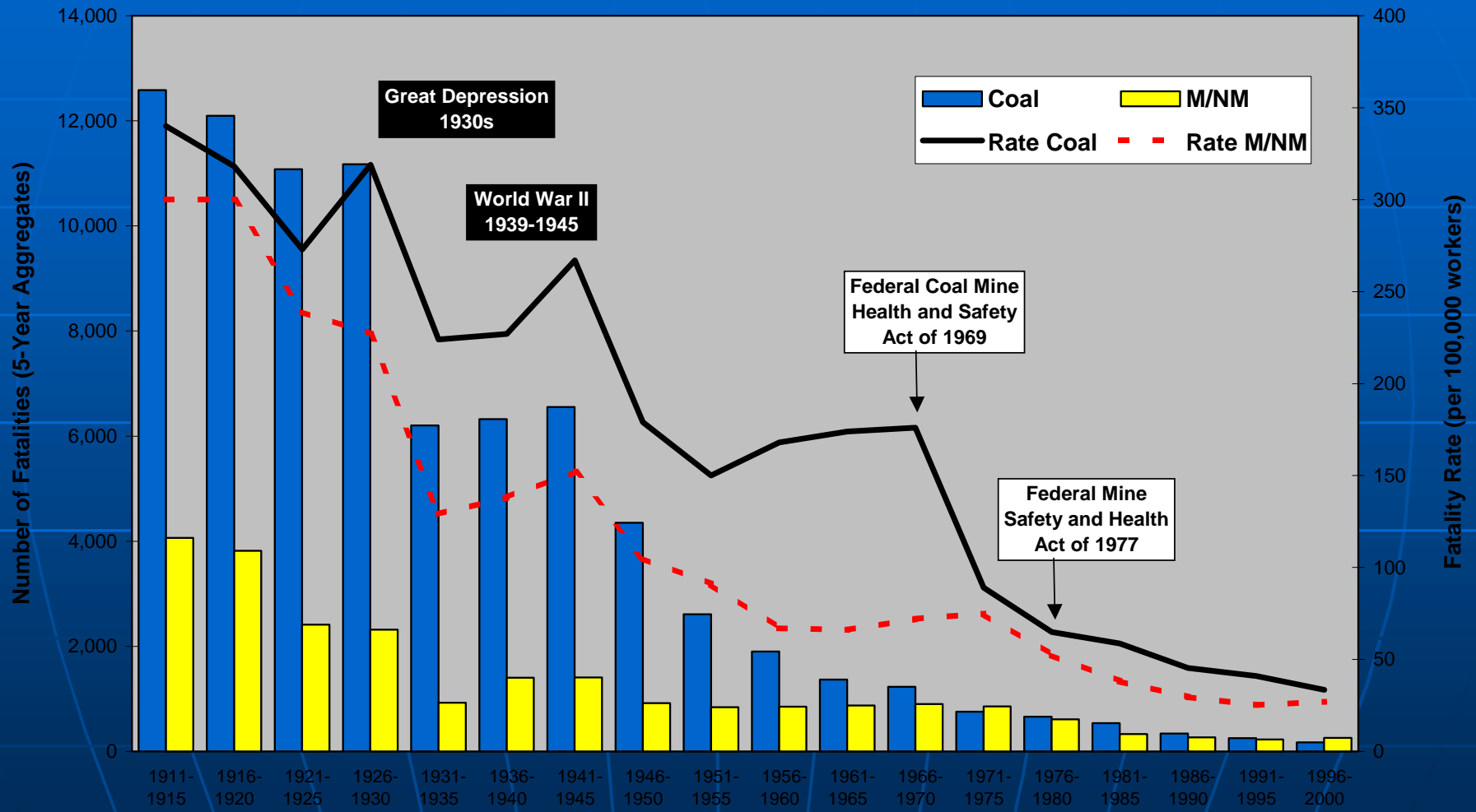
# Number of Surface Employee Hours Reported by Employer Type and Commodity, 1992-2001 (Excludes Office Workers)



# U.S. Mine Production Value (\$billion)

	1995	1996	1997	1998	1999	2000	2001
Coal	19.5	19.7	19.8	19.7	18.3	18.0	19.6
Metals	14.0	13.0	13.1	11.1	9.8	10.1	8.6
Industrial Minerals	24.6	25.8	27.4	28.5	29.3	29.1	29.7

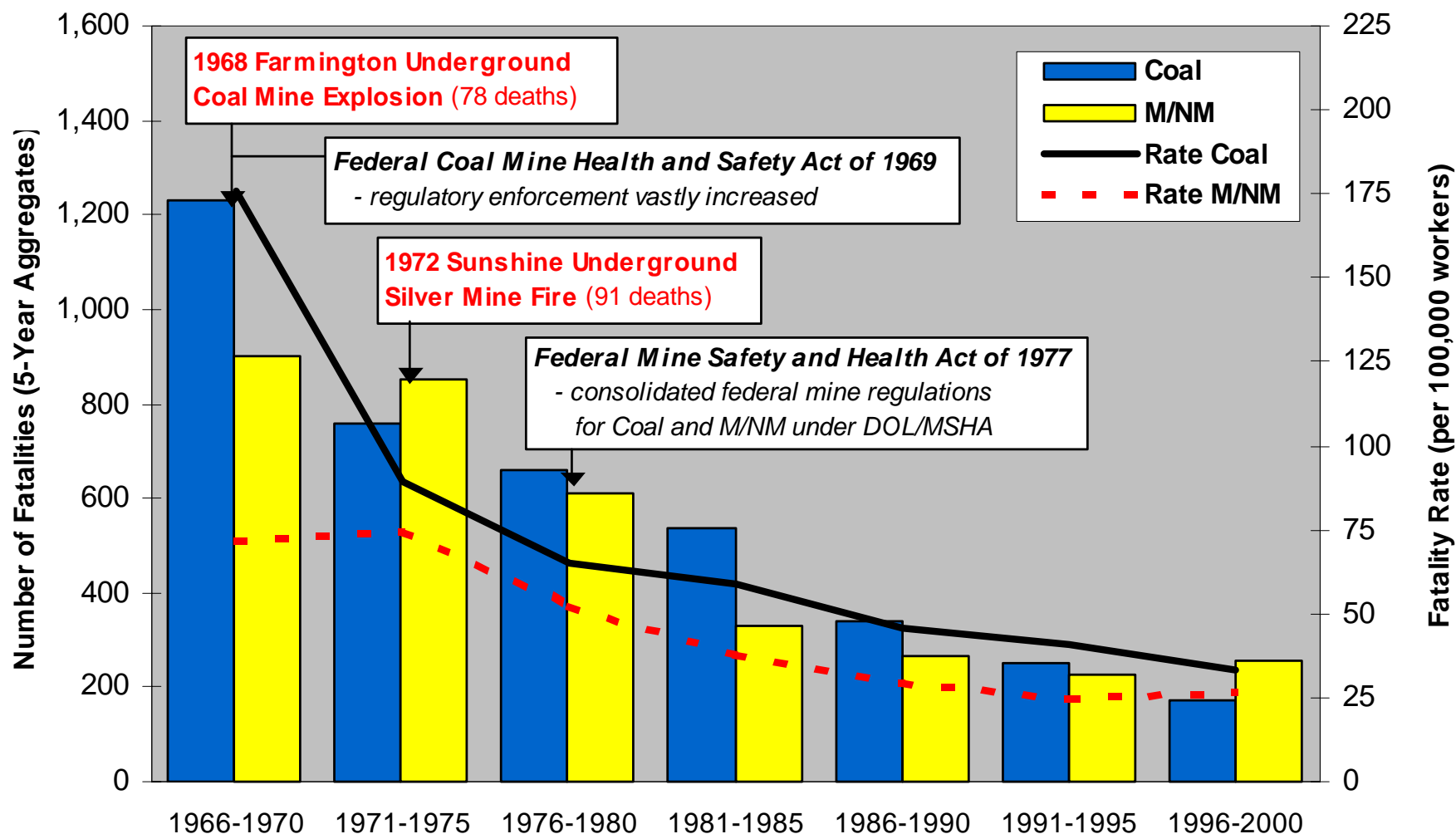
# Number of Fatalities (5-year aggregates) and Average Fatality Rates by Mining Sector (Coal versus Metal/Nonmetal), 1911-2000



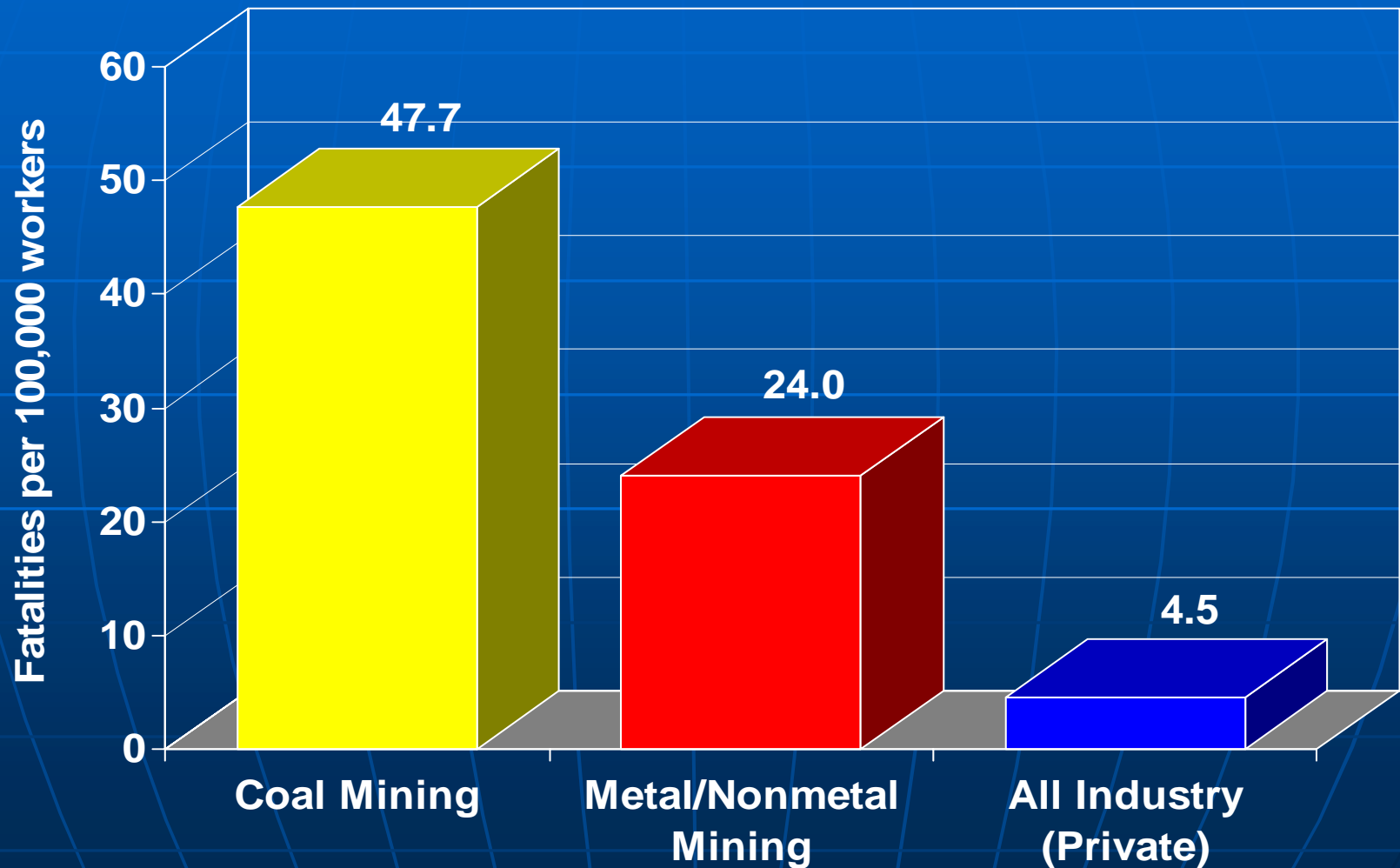
Data source: Bureau of Mines; MSHA



# Number of Fatalities (5-year aggregates) and Average Fatality Rates by Mining Sector (Coal versus Metal/Nonmetal), 1966-2000

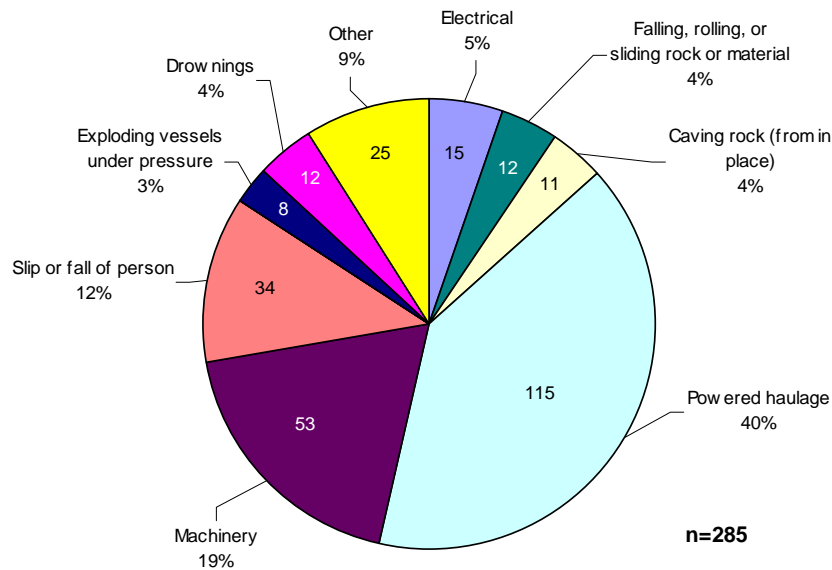


# Fatality Rate in Coal Mining, Metal/Nonmetal Mining, and All Industry (Private), 2001

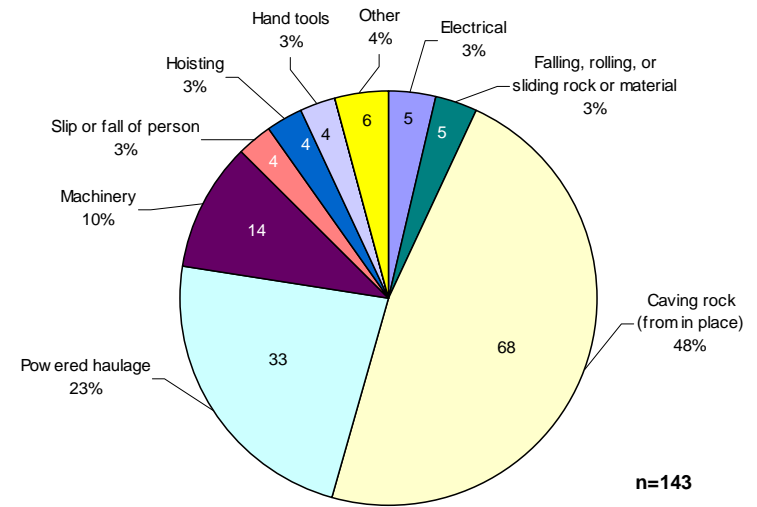


Data source: BLS

# Number and Distribution of Mining Fatalities Within Work Location by Type of Incident, 1996-2000

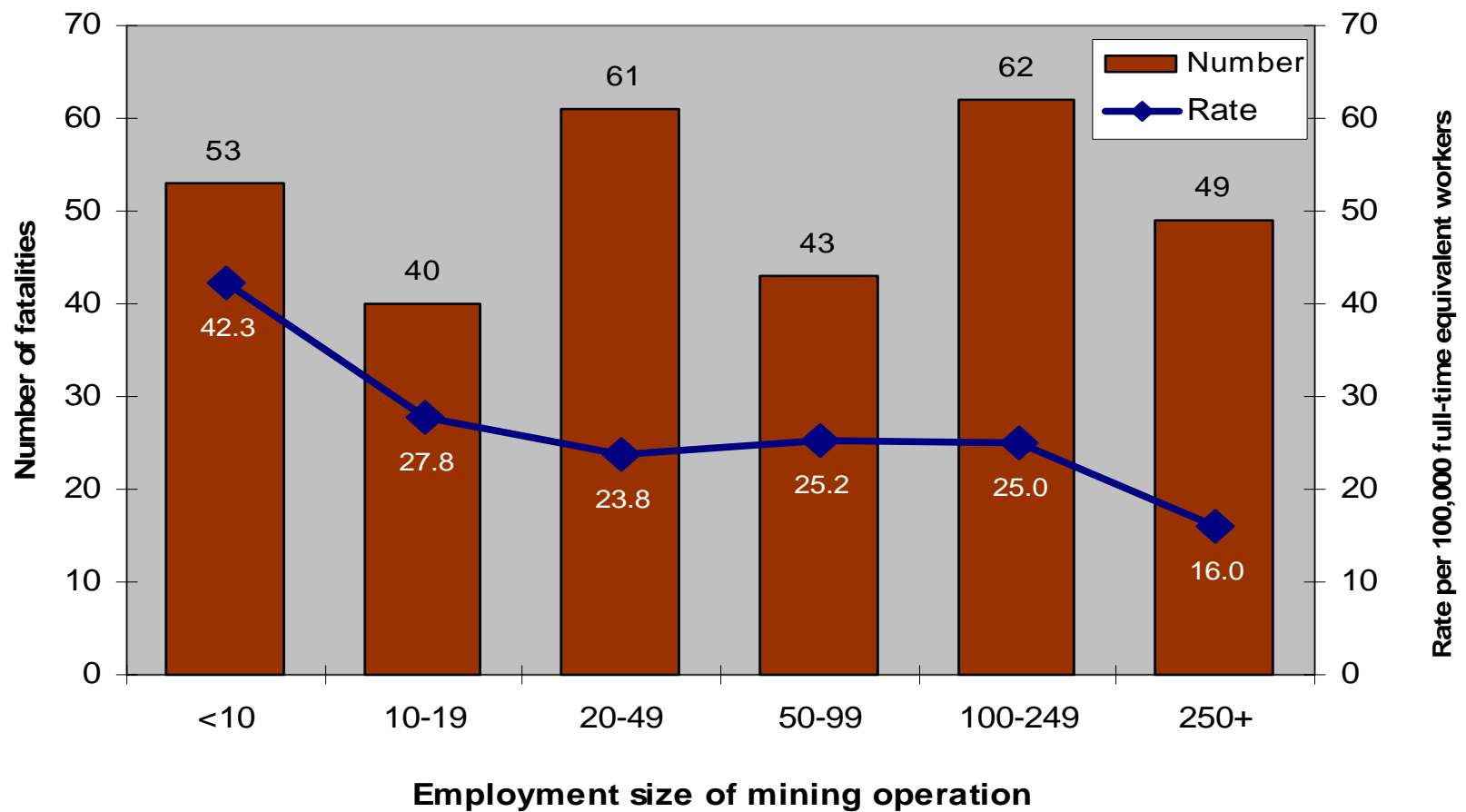


Surface Work Locations

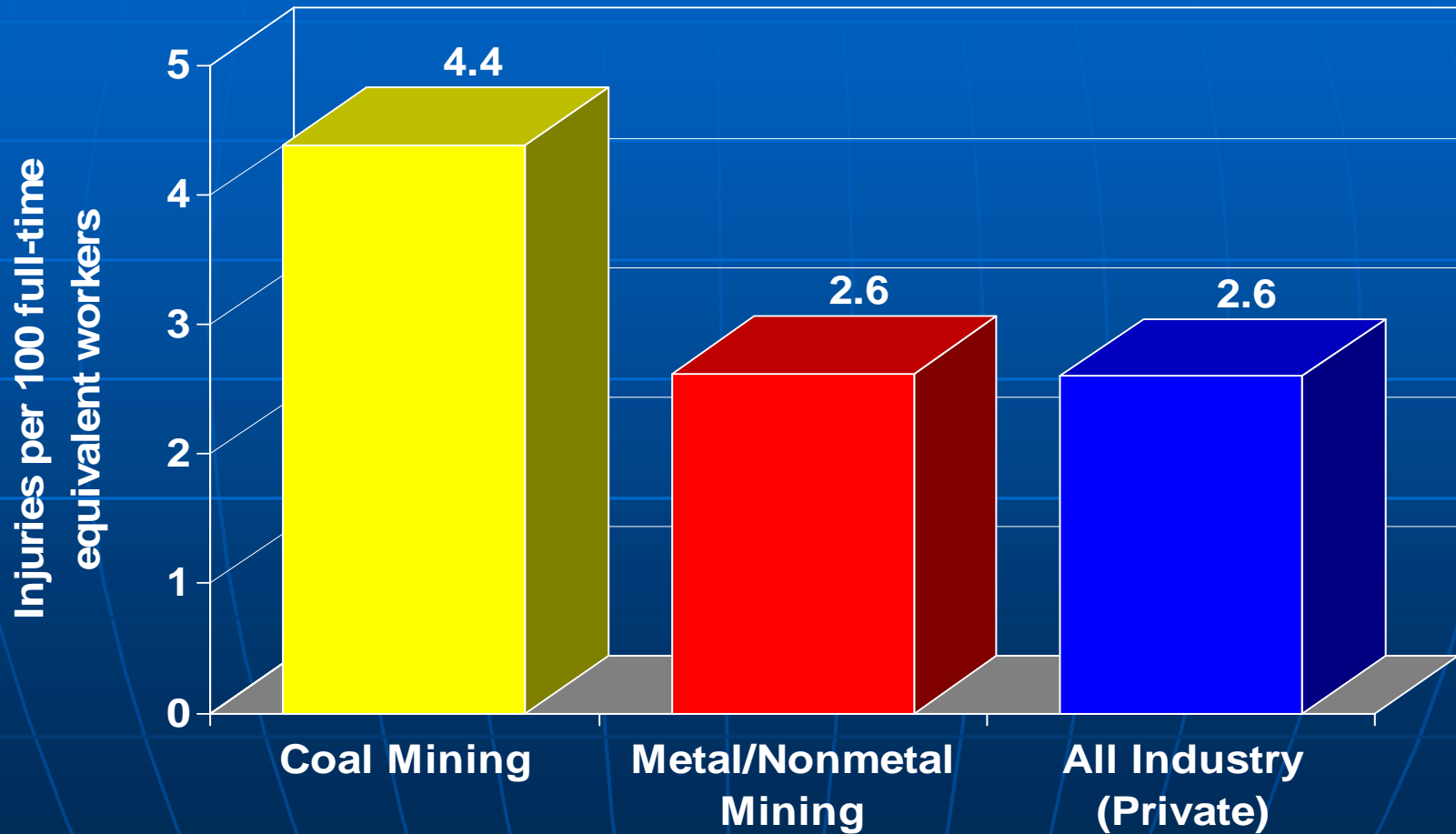


Underground Work Locations

# Number and Rate of Fatalities by Employment Size of Mining Operation, 1997-2001

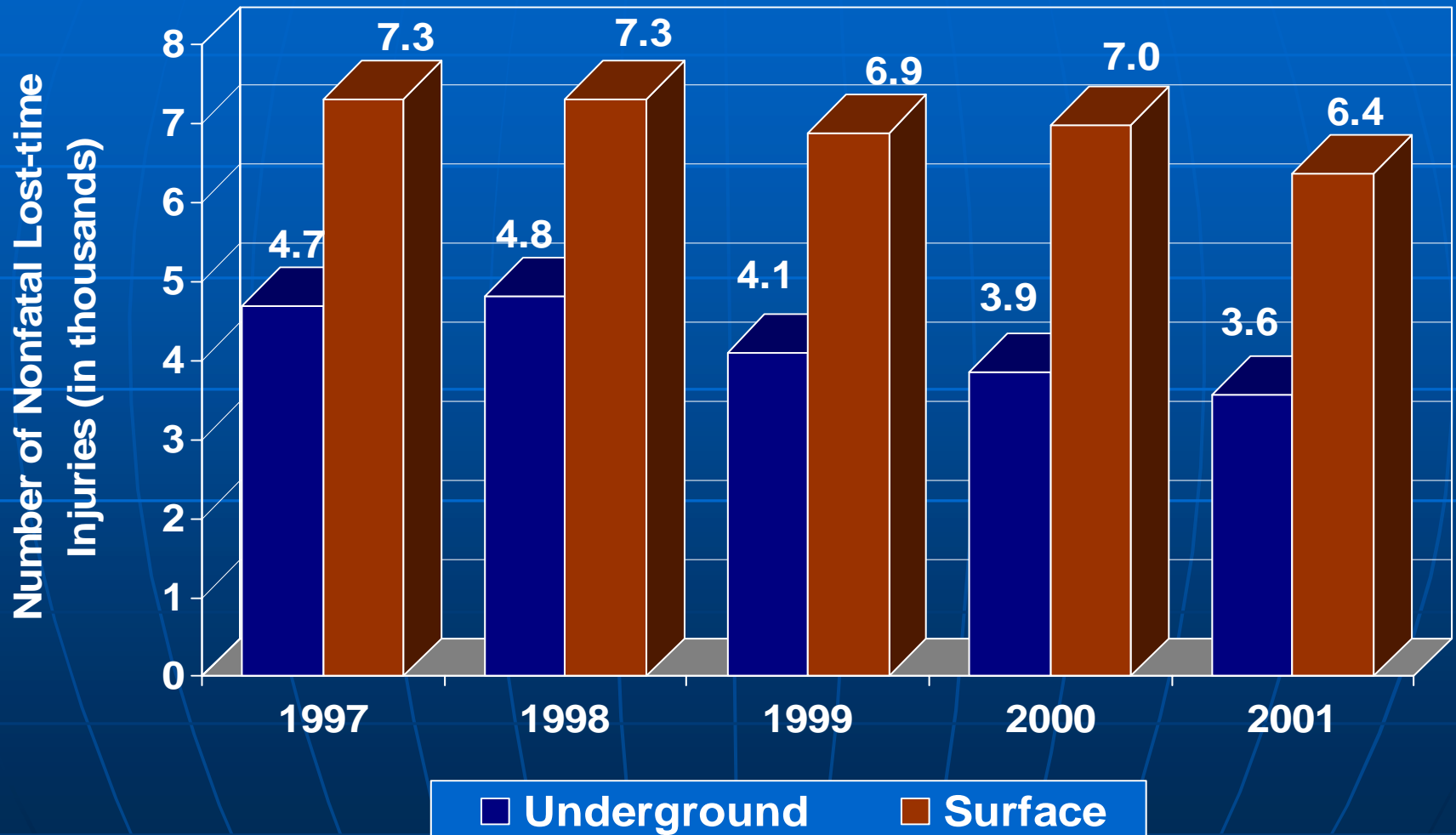


# Nonfatal Lost-time Injury Rate in Coal Mining, Metal/Nonmetal Mining, and All Industry (Private), 2001



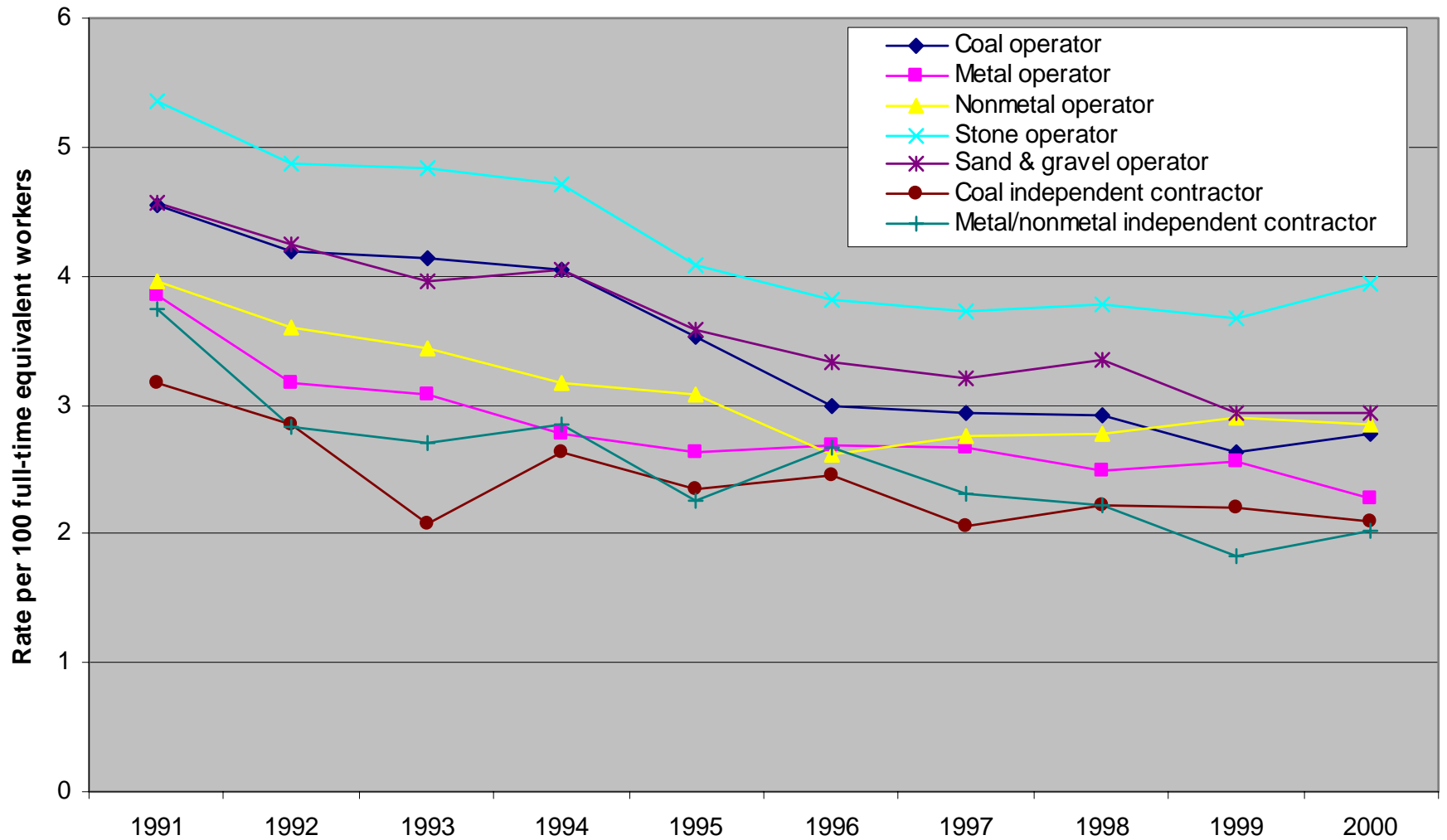
Data sources: MSHA; BLS

# Number of Nonfatal Lost-time Injuries by Work Location, 1997-2001

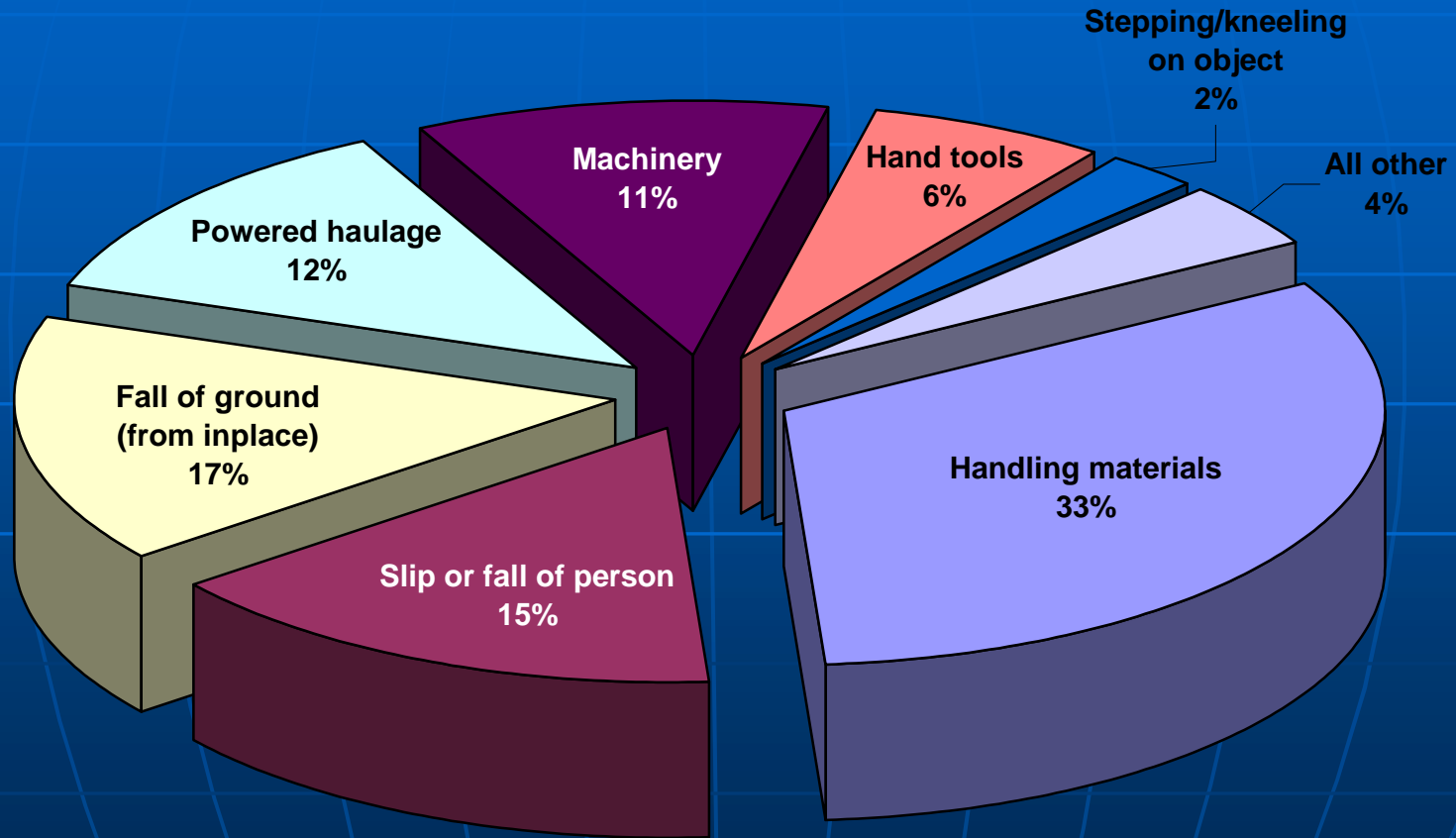


Data source: MSHA

# Average Annual Rate of Lost-Workday Cases for Surface Mining Operations by Type of Employer and Commodity, 1991-2000

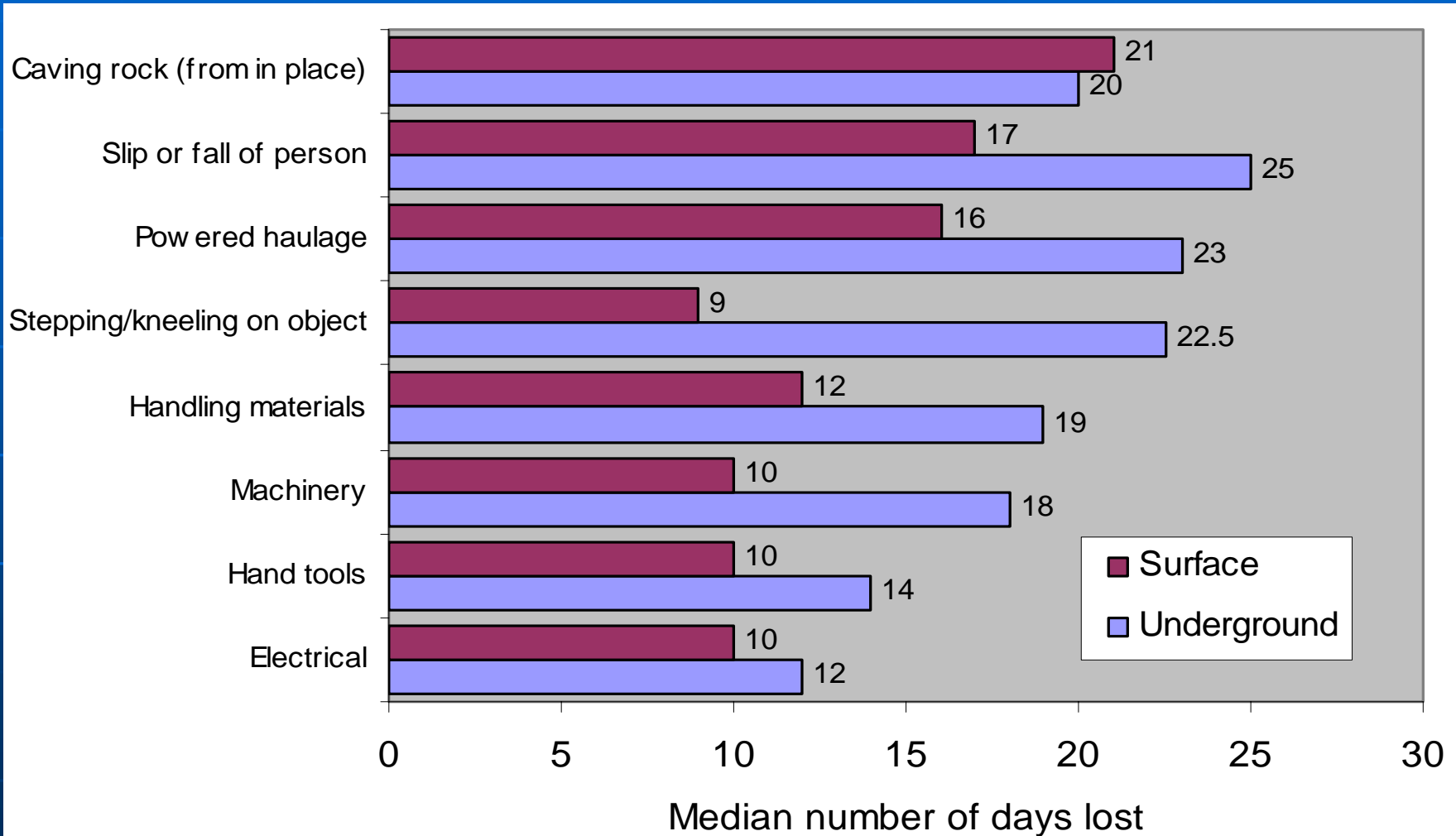


# Distribution of Lost-time Injuries by Accident Class Underground Mining, 1997-2001 (n=21,028)

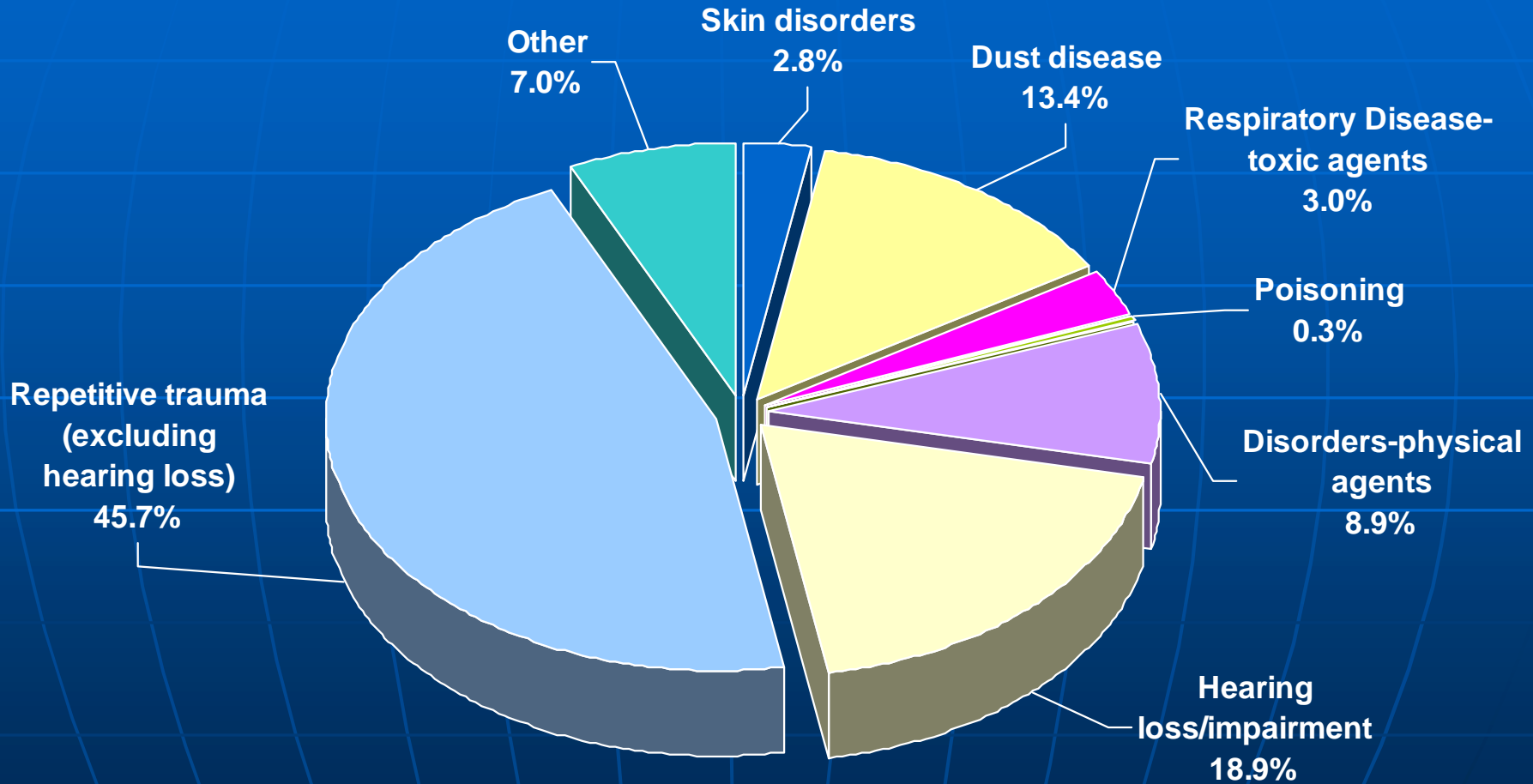




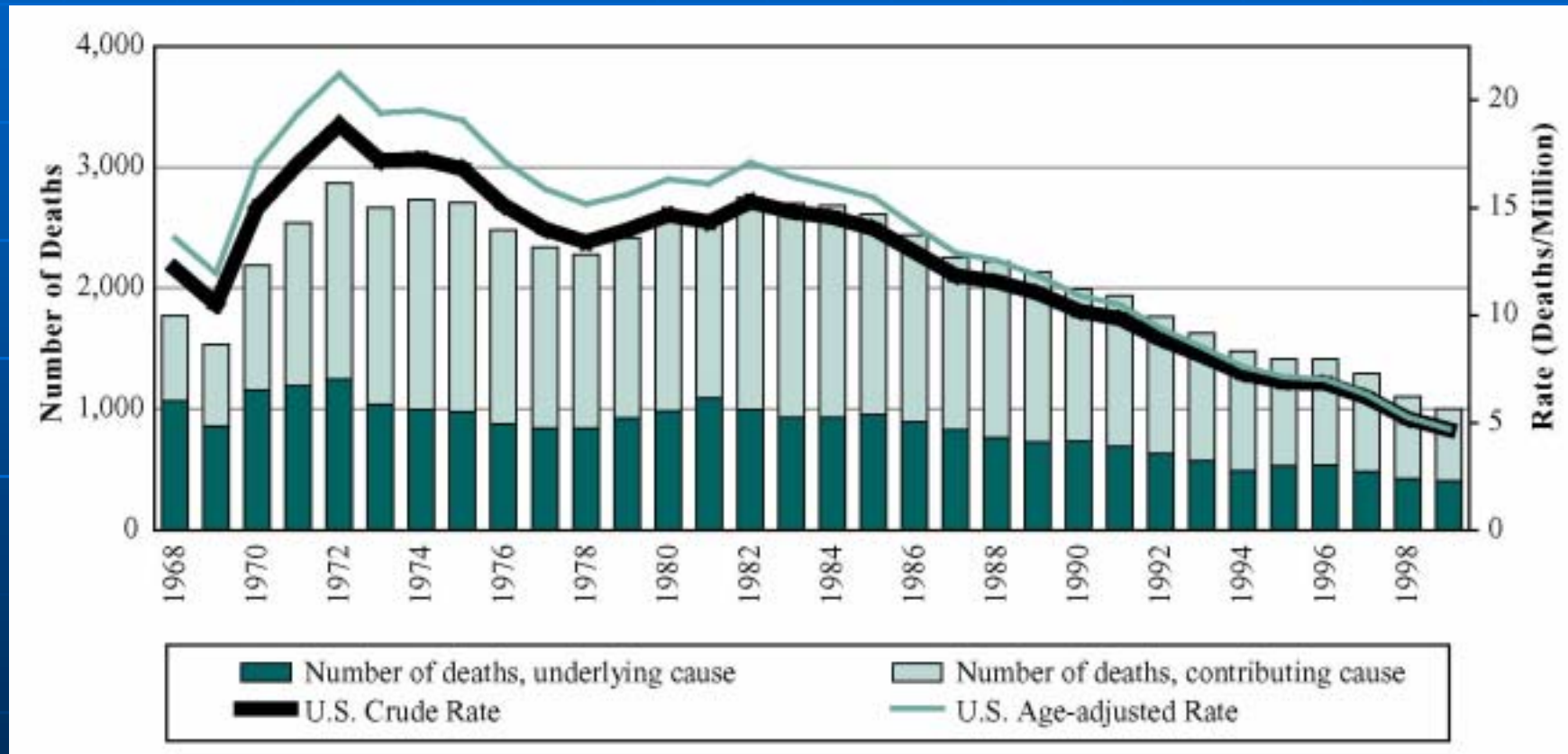
## Median Number of Days Lost for Lost-Workday Cases by Work Location and for Selected Types of Incidents, 1996-2000



# Distribution of Illnesses (Percent) Reported to MSHA in 2001

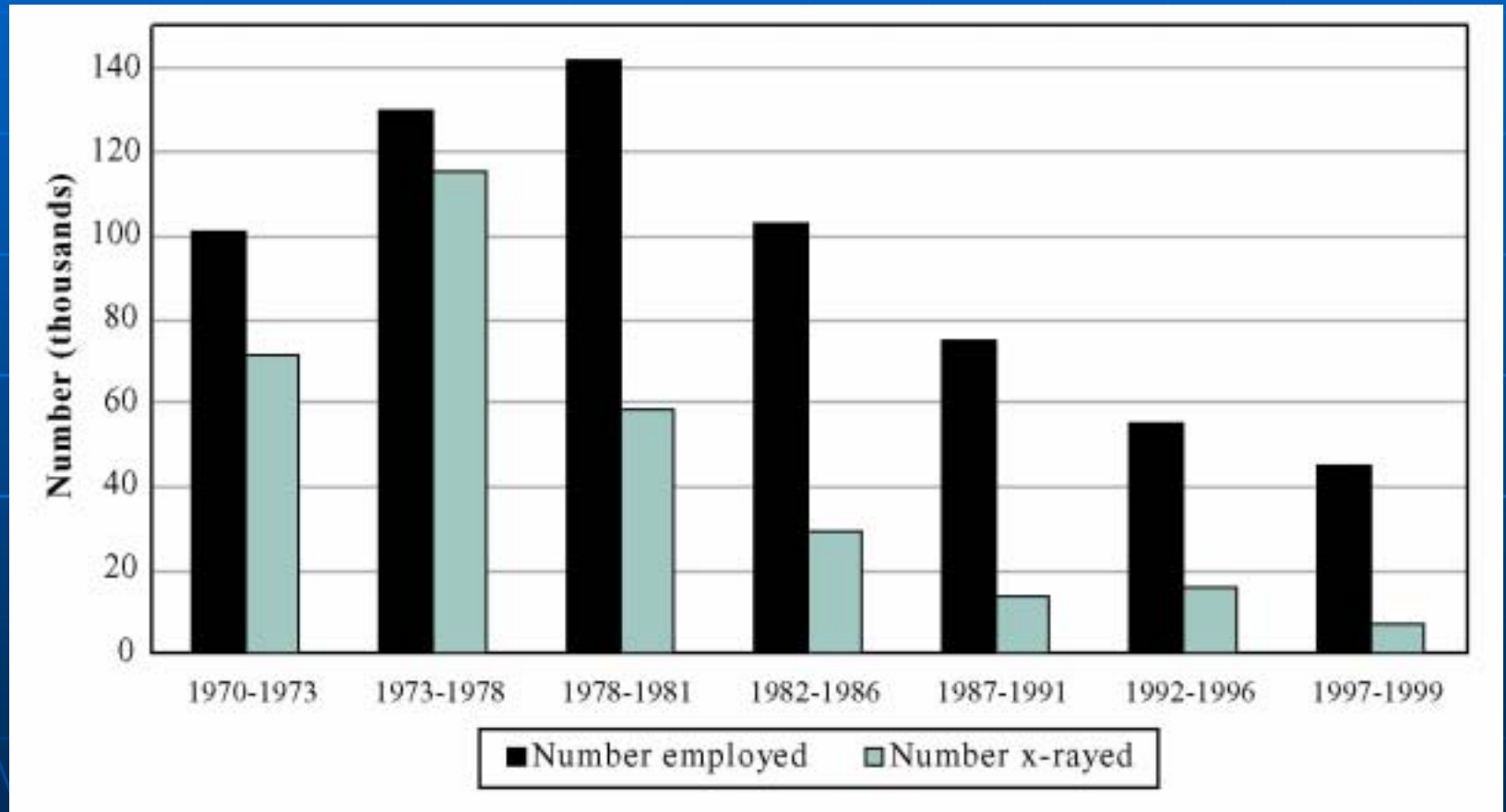


# Coal Workers' Pneumoconiosis: Number of Deaths, Crude and Age-adjusted Mortality Rates, U.S. Residents Age 15 and Over, 1968-1999.



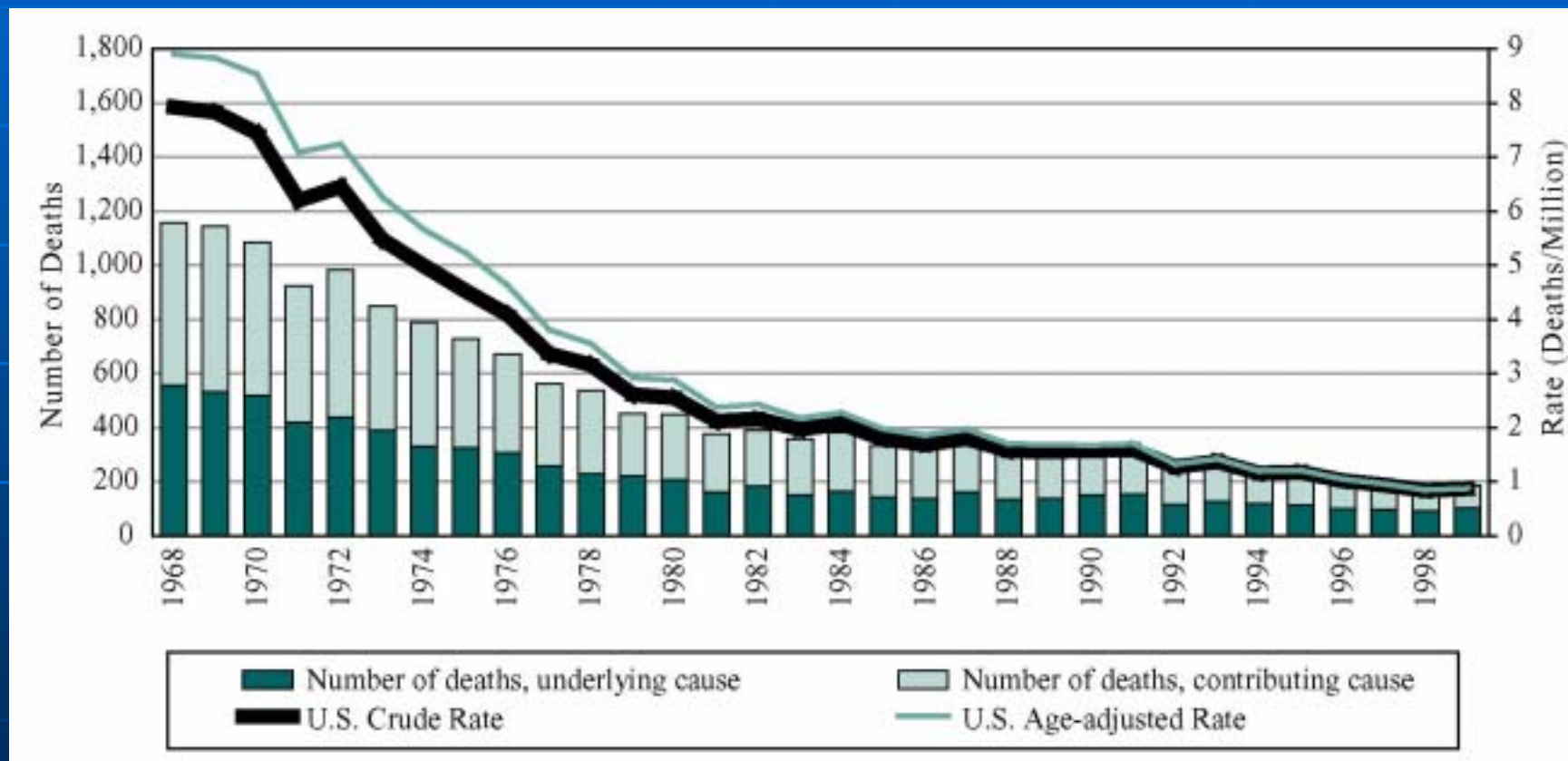
Source: Work-related Lung Disease Surveillance Report, 2002 (NIOSH)

# Coal Workers X-ray Surveillance Program: Estimated Number of Actively Employed Underground Coal Miners and Number Examined, 1970-1999



Source: Work-related Lung Disease Surveillance Report, 2002 (NIOSH)

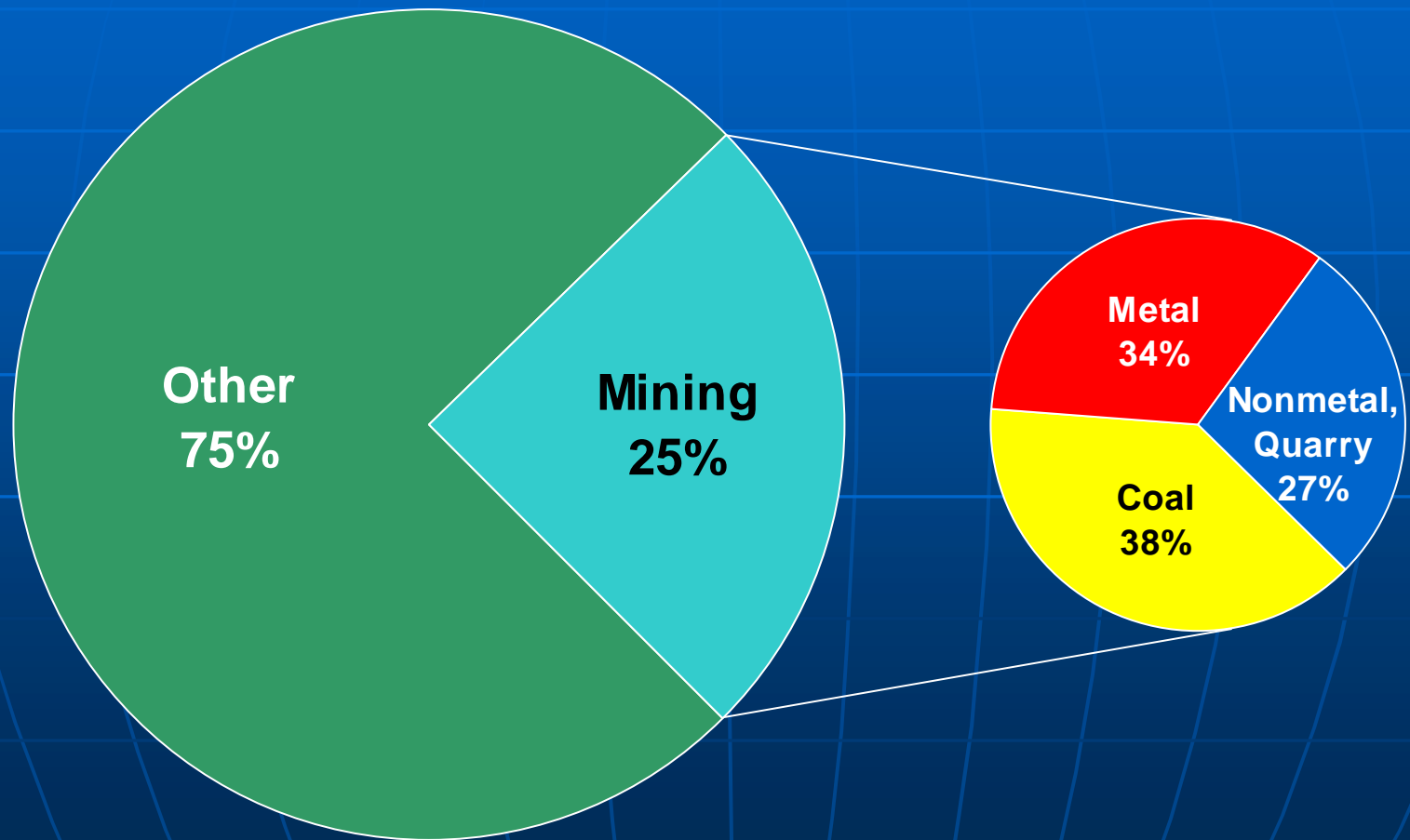
# Silicosis: Number of Deaths, Crude and Age-adjusted Mortality Rates, U.S. Residents Age 15 and Over, 1968-1999



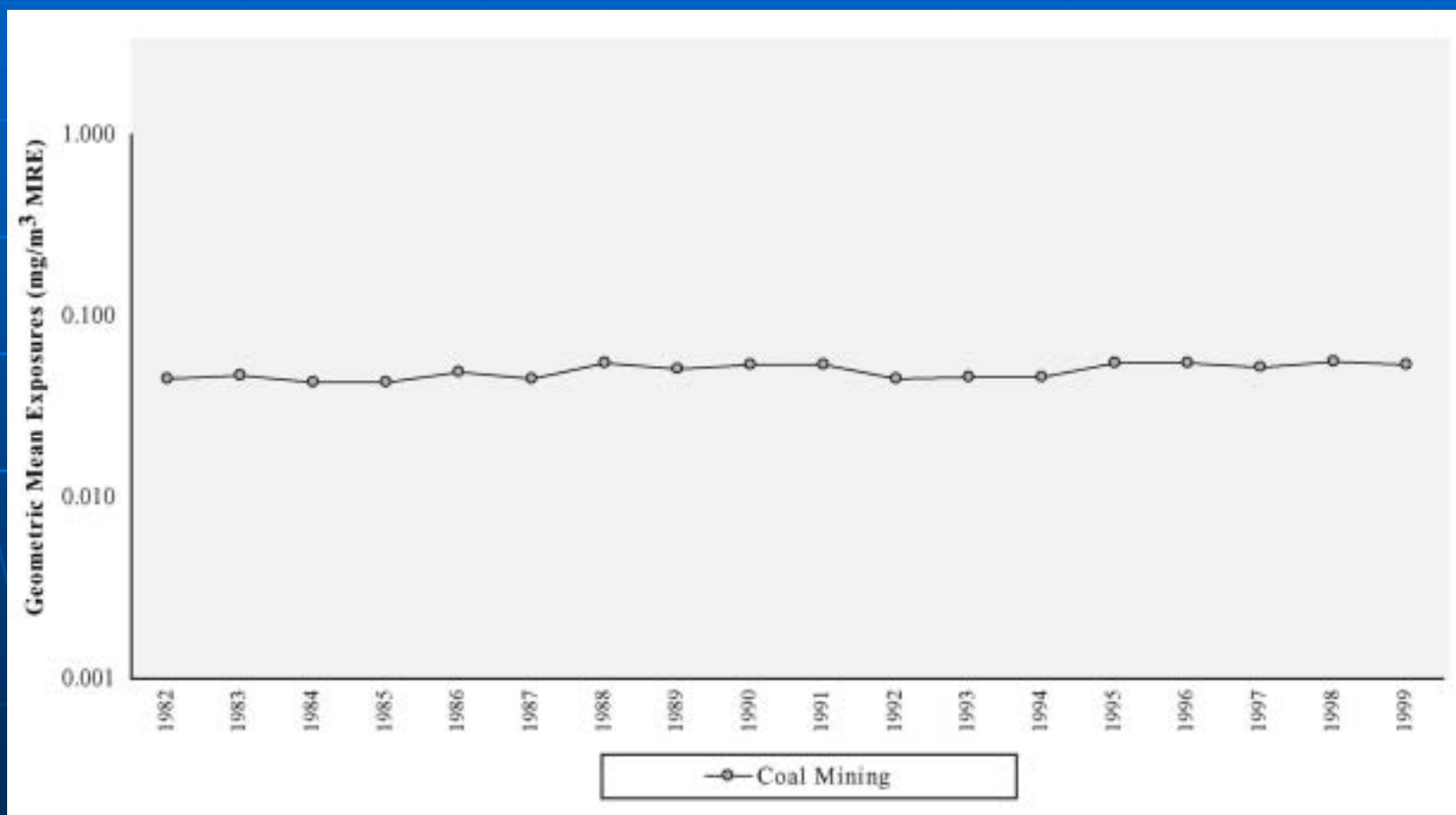
Source: Work-related Lung Disease Surveillance Report, 2002 (NIOSH)

# Silicosis: Most Frequently Recorded Industries on Death Certificate, 1996-1999

## U.S. Residents Age 15 and Over

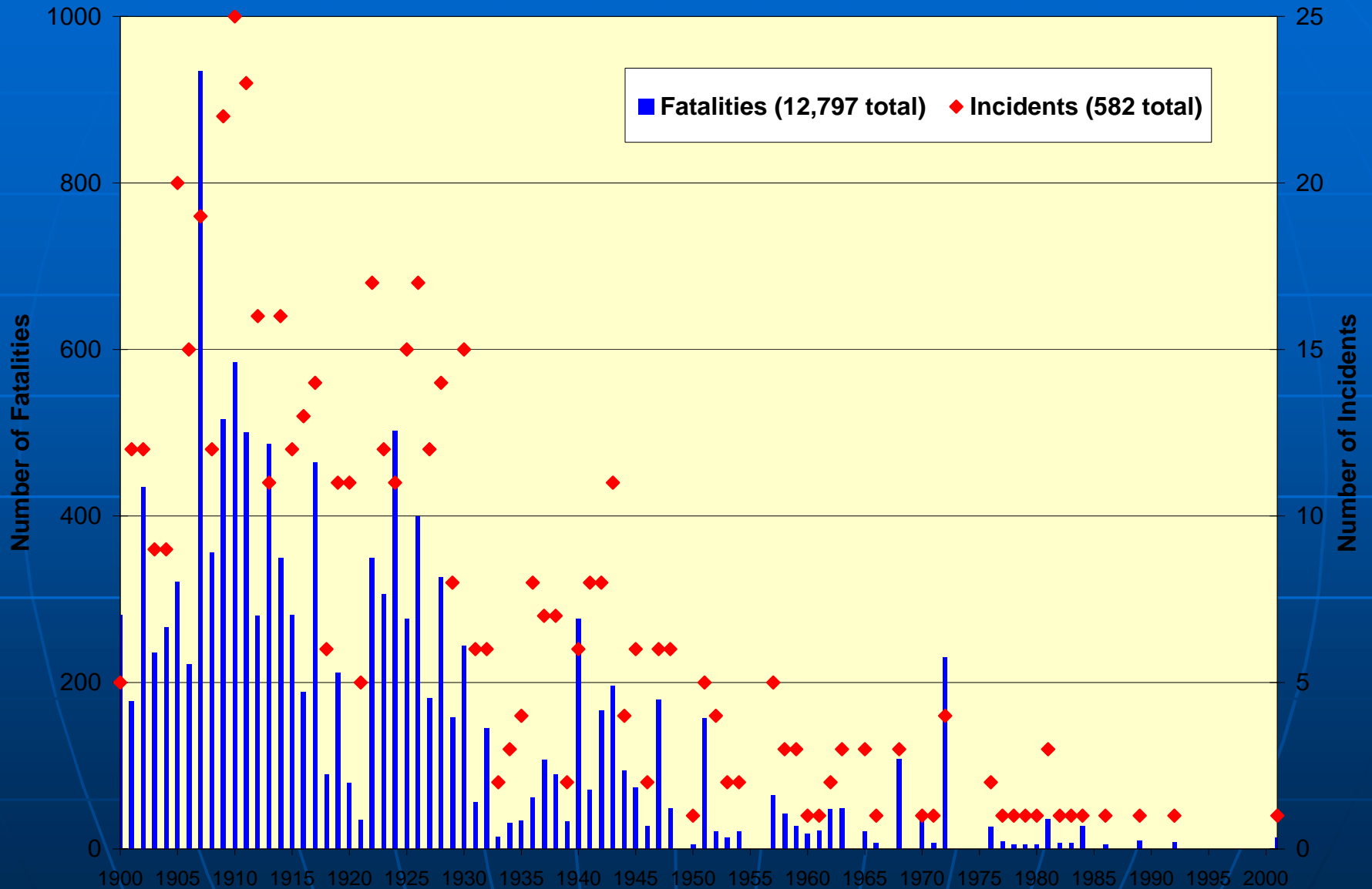


# Respirable Quartz: Geometric Mean Exposures in Coal Mining, MSHA Inspector and Mine Operator Samples, 1982-1999



Source: Work-related Lung Disease Surveillance Report, 2002 (NIOSH)

# All Mining Disaster\* Incidents and Fatalities, 1900-2001



Data source: MSHA

\* A mine disaster is an incident with 5 or more fatalities



# Health Challenges, Present and Future

- Noise
- Dust
  - Coal
  - Silica
- Diesel Particulate Matter
- Other possibly toxic substances

# Safety Challenges, Present and Future

## ■ Fatalities

- Ground Control
- Powered Haulage

## ■ Injuries

- Materials Handling
- Slips and Falls
- Musculoskeletal Disorders

# Emerging Health & Safety Concerns

- Work Organization
  - Stress, Cardiovascular Disease, and Depression,
- Mining under more adverse conditions
  - Potential for increased hazards
- New mining technologies
  - Safer systems
  - Possible new safety or health hazards

# Emerging Health & Safety Concerns

## ■ Aging Workforce

- Increased likelihood of injuries or accidents
- Different training requirements
- Possibility of increased accidents from a large influx of inexperienced workers

# Research Program

- Based on Surveillance Data, Stakeholder Needs, and Risk Analysis/ Loss Control
- Most projects funded from an external peer-review of proposals
- Program is balanced between long and short term projects, basic and applied research , and among mining types and commodities

# PROJECT EXAMPLES

- To illustrate
  - New challenges
  - New approaches
  - The successful ...
  - Lessons learned



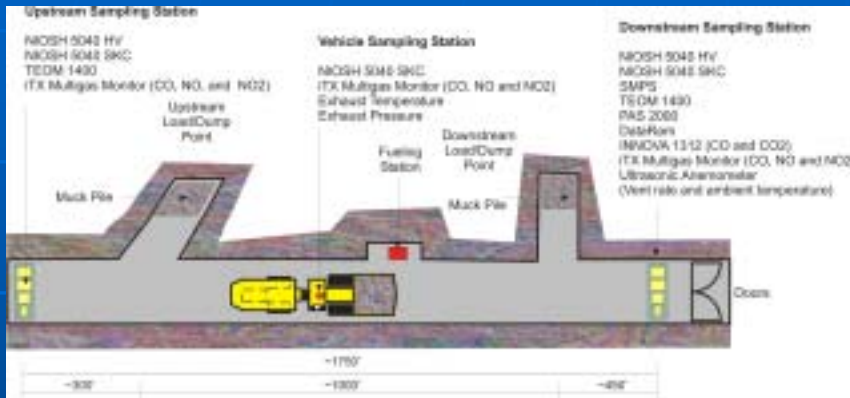


# DIESEL RESEARCH



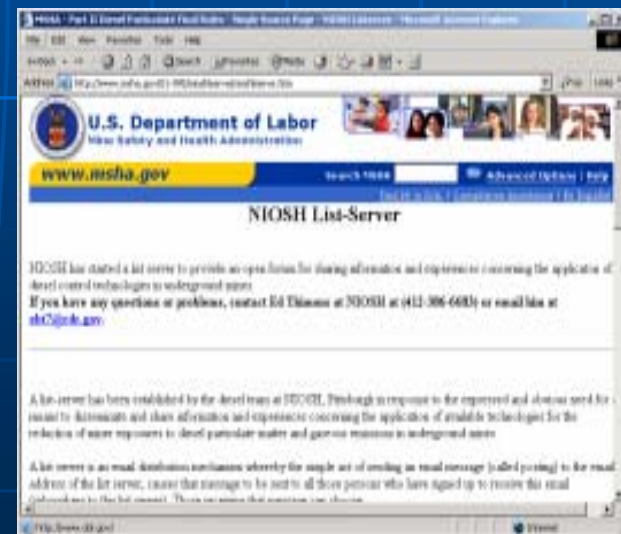
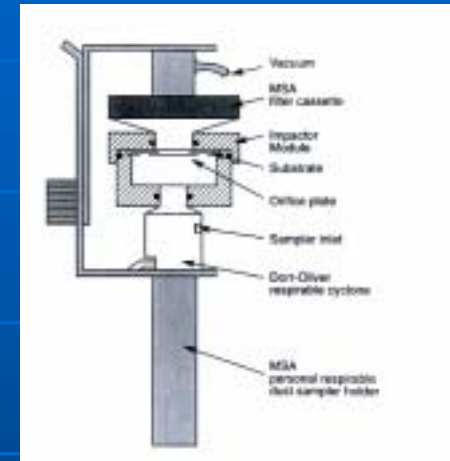
- 5040 Interference Study
- Personal Dosimeter
- Control Technology
- Particle Size Distribution

# Stillwater Study-Isolated Zone





# Other Examples – DPM





# FULL SCALE LONGWALL GALLERY

- ✓ Seam Height
- ✓ Cutting Direction
  - External Spray Configuration
  - Face Air Velocity
  - Water Quantity at the Shearer
  - Drum Water Spray Pressure
  - External Water Spray Pressure



# DUST ENTRAINMENT TUNNEL

- ✓ Dust Concentration
  - Total and Respirable
  - Average of 3 Impactors
- ✓ Size Distribution
  - Stage Mass
  - Mass Median Diameter

# Real-time Dust Monitoring



- Contrast of present dust plan verification with the possibility of near-real-time control
- Worker Empowerment to Improve H&S



# Clothes Cleaning Booth





# RETROFIT CAB FILTRATION STUDIES



- Focus on improving existing cabs
- Cab protection factors of 10:1 achieved on old equipment with positive cab pressure

# Improved Collector Inlet Hood



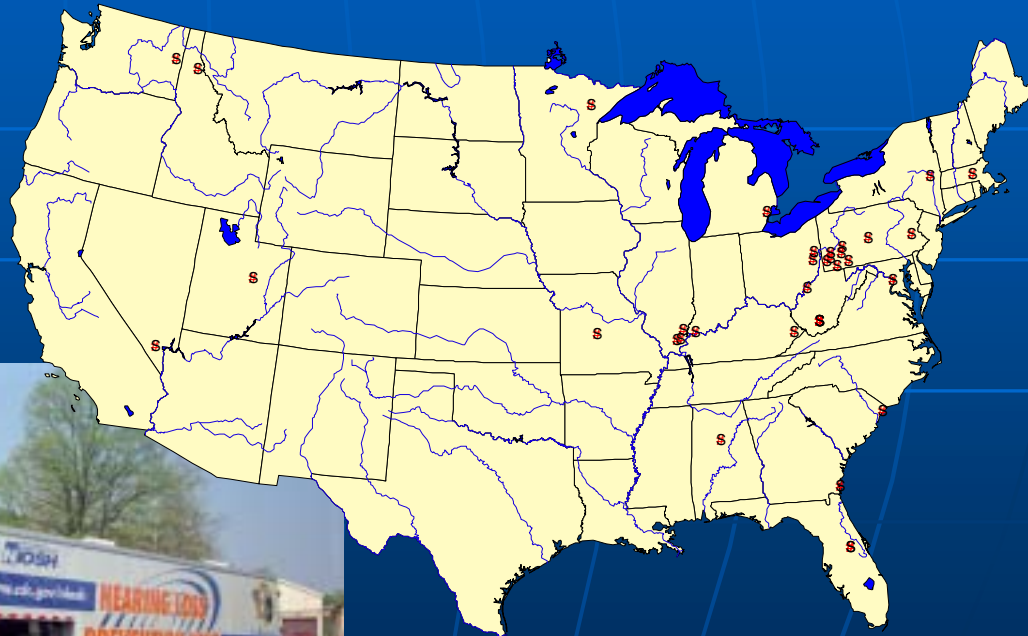


# Evaluation and Development of Noise Controls



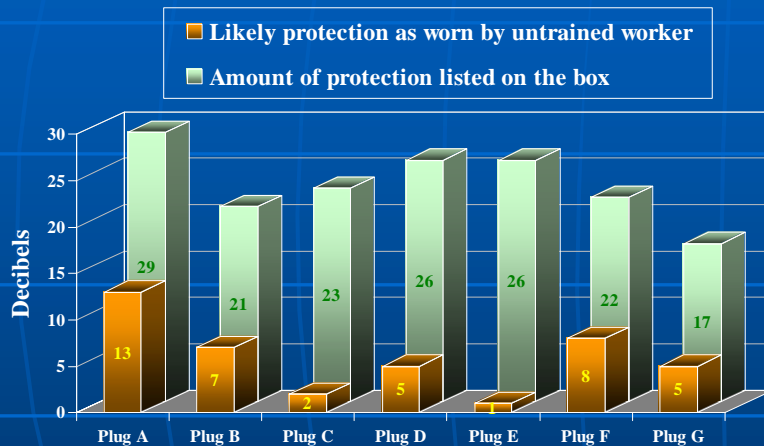
# Interventions and outreach with the Hearing Loss Prevention Unit

- Traveled to 38 sites nationwide
- Performed 3958 test series on 2924 workers, 1676 miners





# Training Interventions (HLP)



## Putting in soft foam earplugs

To get the best protection from your soft foam earplugs, remember to **roll**, **pull**, and **hold** when putting them in. Use clean hands to keep from getting dirt and germs into your ears!



**1. Roll** the earplugs up into a small, thin "snake" with your fingers. You can use one or both hands.



**2. Pull** the top of your ear up and back with your opposite hand to straighten out your ear canal. The rolled-up earplug should slide right in.



**3. Hold** the earplug in with your finger—as far as it will go. Count to 20 or 30 out loud while waiting for the plug to expand and fill the ear canal. Your voice will sound muffled when the plug has made a good seal.

**Check the fit** when you're all done. The entire foam body of the earplug should be within the ear canal. Try cupping your hands tightly over your ears. If sounds are much more muffled with your hands in place, the earplug may not be sealing properly. Take them out and try again.



U.S. Department of Health and Human Services  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health  
[www.cdc.gov/niosh](http://www.cdc.gov/niosh) • 1-800-35-NIOSH

# *Musculoskeletal Disorders* *(MSDs)*

Back injuries

Miners knee

Carpal tunnel

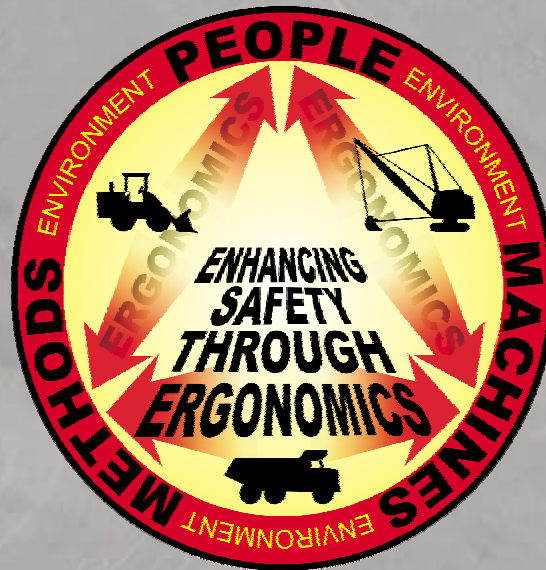
Tendonitis

Bursitis



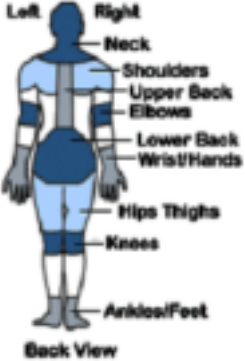
# Partnering for Successful Ergonomics

## A Study of Musculoskeletal Disorders in Mining



# The Bridger Process

- Mine management commitment
- Forming an Ergonomics Committee
- Committee training
- Workforce training
- Reporting and suggestions from workforce

1. Comments/suggestions:		Risk Factor Report Card
<hr/> <hr/> <hr/>		
2. Check all risk factors that apply:		3. Mark areas affected with an X
<input type="checkbox"/> Poor Posture	<input type="checkbox"/> Forceful Gripping	
<input type="checkbox"/> Repetitive Work	<input type="checkbox"/> Heavy Lifting/Carrying	
<input type="checkbox"/> Vibrating Tools	<input type="checkbox"/> Bouncing/Jarring	
Other risk factors: _____		
4. Name: _____		
5. Work area: _____		



# NIOSH Interventions

## Prill Truck



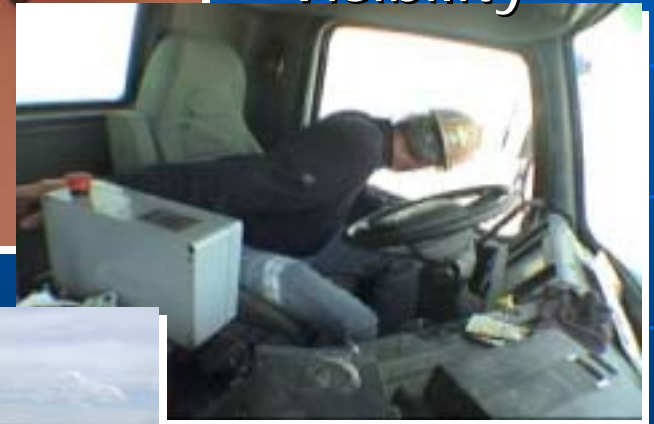
Ladders



Operator  
Visibility



Steps and Hand  
Holds



# Blasting H&S Issues



# MATERIAL FLAMMABILITY

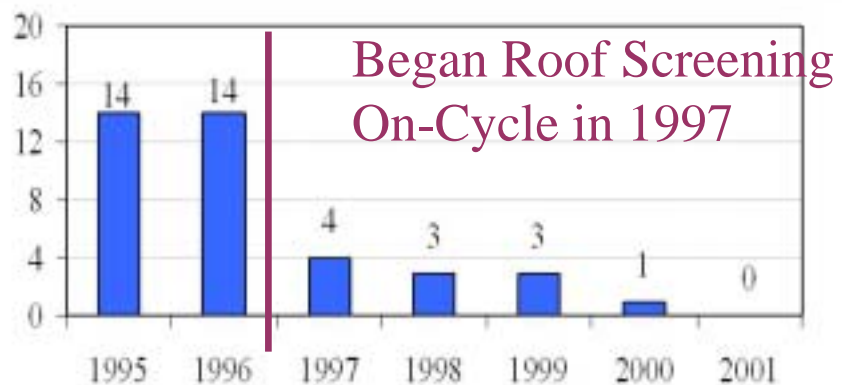






## NIOSH Personal Bolter Screen

### Roof Skin Injuries at a Coal Mine in northern Maryland



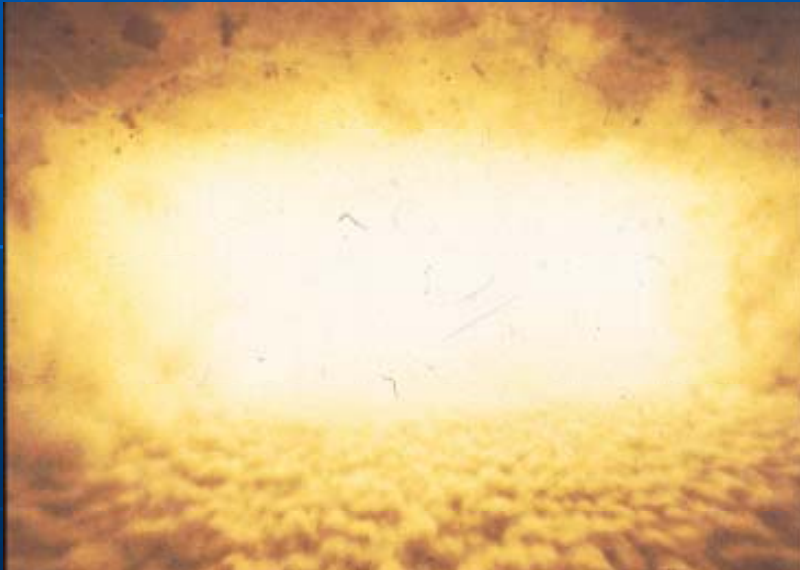


# Lake Lynn Experimental Mine



# EXPLOSIONS:

- Prevention and suppression of gas and dust explosions



# EXPLOSIONS:

- Determine the effectiveness of seal designs and develop alternative test methods





# LLEM Explosion Research

Joint study with MSHA to use LLEM post-explosion observations to improve methodology for explosion accident investigations



Post-explosion floor dust sampling to determine extent of combustion and to measure contributions of volatiles & fixed carbon to the burning



Optical probes for measuring dust dispersion throughout the mine cross-section during explosion

# Frictional Ignition Research

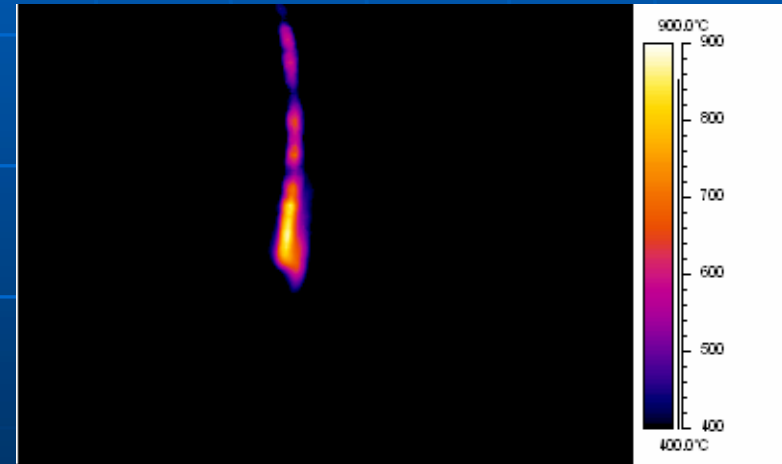
- Presence of heavier hydrocarbons enhances ignitability of methane (Willow Creek, UT)



Miner bit cutting into sandstone block



Frictional hot streak, which can ignite methane



Infrared false color image of hot streak temperature

# Mine Rescue and Response

- Realistic Training Simulations



- Evaluate Technologies



# Remote Construction of Seals for Mine Fire Control and Abatement





# Large Opening Mine Ventilation





# Electrical Safety

<b>Specifications:</b>	<b>HVP Systems</b>
Voltage:	33 kVrms (2 - 33 kVrms, 1000V available for other voltages.)
Display:	Modular LCD Display with impact resistant, anti-glare window
Test System:	40 foot Panel (Standard Panel) optional components include: Cassi/Gauss system for water tightness 207' 40 foot Panel (11.8' 200'). It is recommended that the Monitor Panel be installed in an appropriate environment
Protections:	Detected and passed for the "ground fault"
Communications:	RS-485, 10' (Modem)
Alarm Messages:	(via message for each warning light and each alarm light, startup message and the correct message (3 messages total)
Location/Display:	33 kVrms protection
Alarm Signals:	4 Submarine Signals for the 33 kVrms Alarm
Relays:	4 One Column (200, double throw relay for each warning light and each alarm light)
Warning Lights:	2 Yellow Lights
Alarm Lights:	2 Red Lights
Terminal Blocks:	40 Terminal Switch (each spring loaded terminals that are intended in vibration and loosening)
Configuration:	Fully configured with all option when shipped. Configuration can be changed and/or all options can be added if needed
Specifications subject to change without notice	

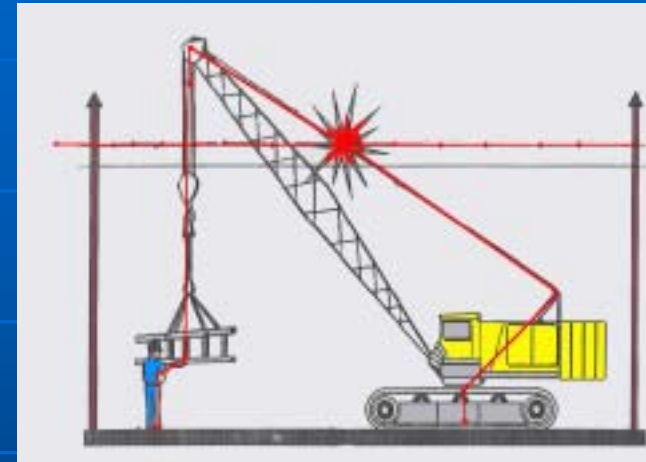
**GENERAL ARRANGEMENT**

This need to protect personnel and equipment from contact with electrical lines is vital. High voltage proximity alarms have successfully provided a method of protection for over four decades. Their record is outstanding. To date, there has never been a death or injury on any vehicle that has had a high voltage proximity alarm installed.

HVP Systems has built upon this reputation by offering a range of devices that provide the most comprehensive protection available. HVP Systems is continuing to develop additional products that save lives and protect equipment.

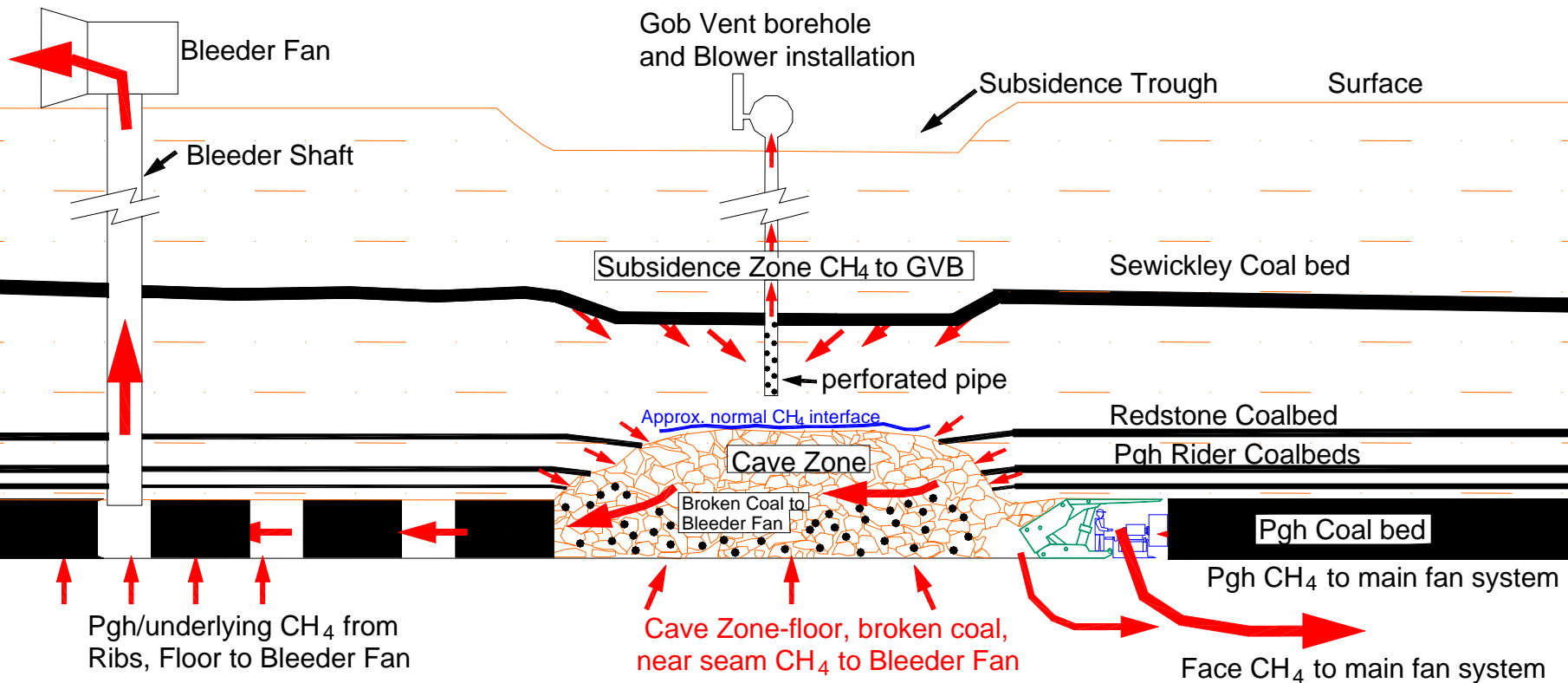
Safety is our business!

**HVP Systems**  
PHD 403  
5224 West State Road 46  
Sandwich, FL 32773  
tel. 407.688.2800  
fax. 407.526.5866  
[info@hvp-systems.com](mailto:info@hvp-systems.com)



# Longwall Ventilation

## Conceptual Pgh Coalbed Methane (CH<sub>4</sub>) Sources and Destinations



# Training Different Generations in the Workplace



**VETERANS**



**BOOMERS**



**XERS**



**NEXTERS**

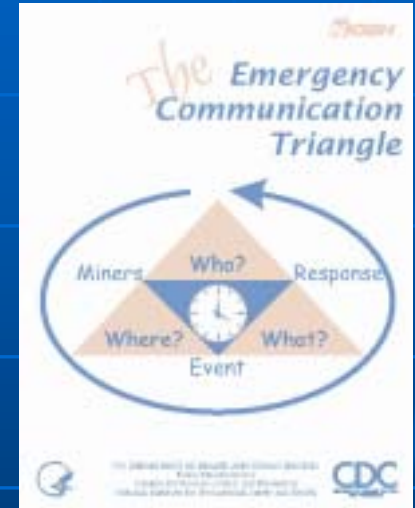
Source: Ron Zemke (2001)

# Training... achieving behavioral outcomes

## ■ Quecreek Inundation Example

- Emergency Communications Training

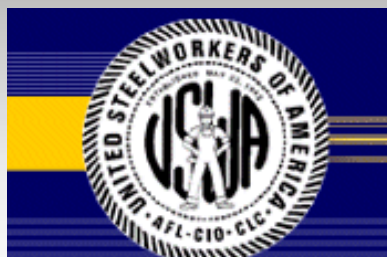
- MERITS



# Stakeholder Input and Partnerships

- ... move quickly to practical solutions to important health and safety problems, working with them, rather than against them.
  - Shared vision over the problem and the solution
  - Synergies over shared expertise
  - Access to sites and equipment
  - Tripartite support





NATIONAL STONE, SAND & GRAVEL ASSOCIATION



Natural building blocks for quality of life

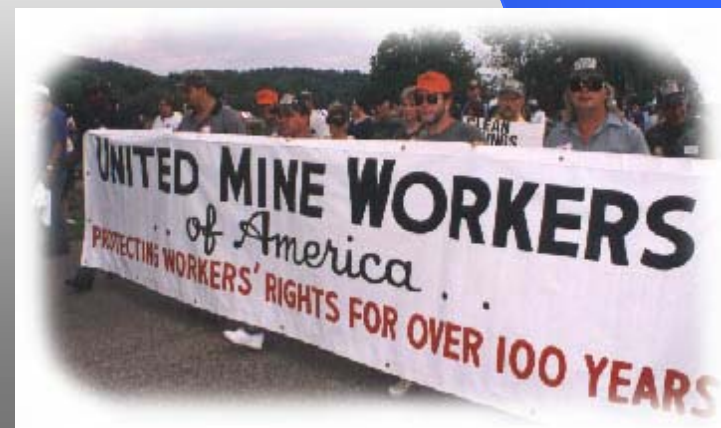


Mine Safety and Health Administration



STILLWATER MINING COMPANY

MORTON SALT

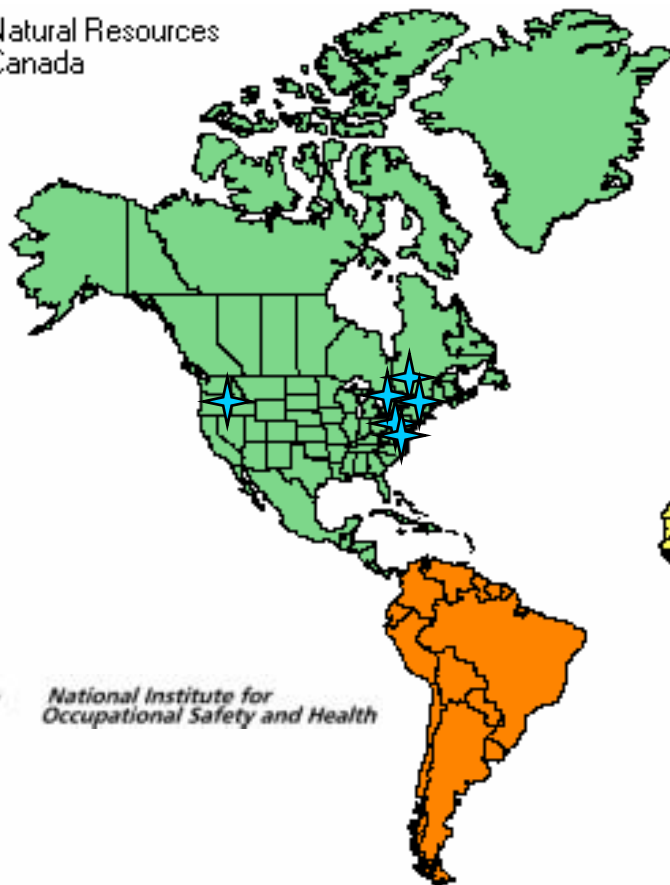




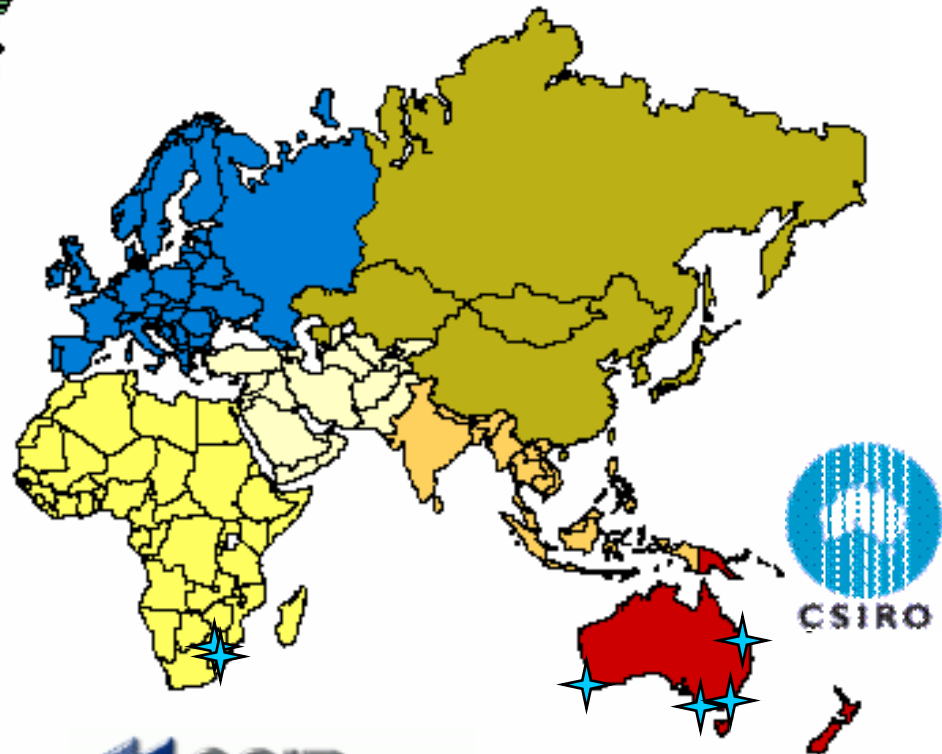
# global mining research alliance



Natural Resources  
Canada



National Institute for  
Occupational Safety and Health



CSIRO



CSIR  
Miningtek

# Summary Questions

- What are the surveillance data telling us?
  - The plateau and the need to change approaches...
  - The decline and the need to continue with the successful interventions...
  - The incline, and the need to act decisively...
  - The sentinels... our wake up call



# Summary Questions

- Are the underlying causes of the problem being addressed, or only the symptoms?
- What is working, what is not, how do you know, and what are you going to do about it?

# Summary Questions

- Have we defined the barriers to the desired outcomes, and developed a plan to address them?
- If our plan is fully successful, will the desired outcome be achieved?

# Conclusions

- The complexities revealed in the surveillance data clearly show progress, but also the increasingly challenging task of achieving further health and safety improvements.
- The successful methods of making progress in the past may not alone guarantee future successes.

# Conclusions

- Advances in science and technology will offer new insights into problems and solutions.
- Multi-disciplinary efforts will be more important and systems-based approaches will be necessary.
- Partnerships will be required and will become more global in nature.

# Conclusions

- The challenges to economic, safe, and environmentally responsible mining are ever increasing, as are society's expectations for improved health and safety in the mines...
- The resourcefulness and commitment of the mining stakeholders has never been greater...
- The prospect of taking health and safety to the next level is bright!



# Improving Mineworker Health and Safety through Research and Prevention

