

Burns &
McDonnell
SINCE 1898

and



A Presentation to U.S. Office Of Management and Budget

December 14, 2009

**Specific Use of Coal Fly Ash in the Stabilization
of Underground Mines
in the Kansas City Area**

Burns & McDonnell
Founded 1898

History of USC

- **Small company started in 1994 to solve underground mine stabilization for Briarcliff Development.**
- **Has since performed stabilization services for third parties to backfill and stabilize underground limestone mines.**

Use of Flyash as Recyclable Material

- **The first step for \$200 million of commercial and residential development over 80 acre limestone mine in Kansas City.**
- **Backfill of City streets and State and Federal Highways located above limestone mines to prevent collapse.**

Long Track Record of Successful Backfilling

- **Backfilling has been in process for more than 15 years, with support by many parties:**
 - Missouri DNR
 - Kansas Dep't. of Health and Environment
 - U.S. EPA Region 7
 - City of Kansas City, Missouri
 - Unified Government of Wyandotte County and Kansas City, Kansas
 - MoDOT (Missouri Department of Transportation)

Coal Flyash in Mine Stabilization

- **Mine Stabilization**
 - The Material is Well Suited to Purpose
 - Suited to Specific KC Mine Geology and Hydrogeology
- **Flyash as a Recyclable Material**
 - Comparable Materials Likely Not Feasible
- **Impact of Regulations**
 - Could Disrupt Mine Stabilization Projects

Mine Stabilization

- **Typical Underground Mines in KC**
 - **Limestone Rock**
 - **14-Foot High Room-and-Pillar Mines**
 - **200 feet Below Ground Surface**
- **This Project: Over 90 Acres**
- **Principal Stability Issue: Strong Limestone Versus Weak Shale**

Mine Stabilization



**Briarcliff Mine Entry
(Active Mining 1952 – 1969)**

Mine Stabilization

Mine Rooms and Pillars

505

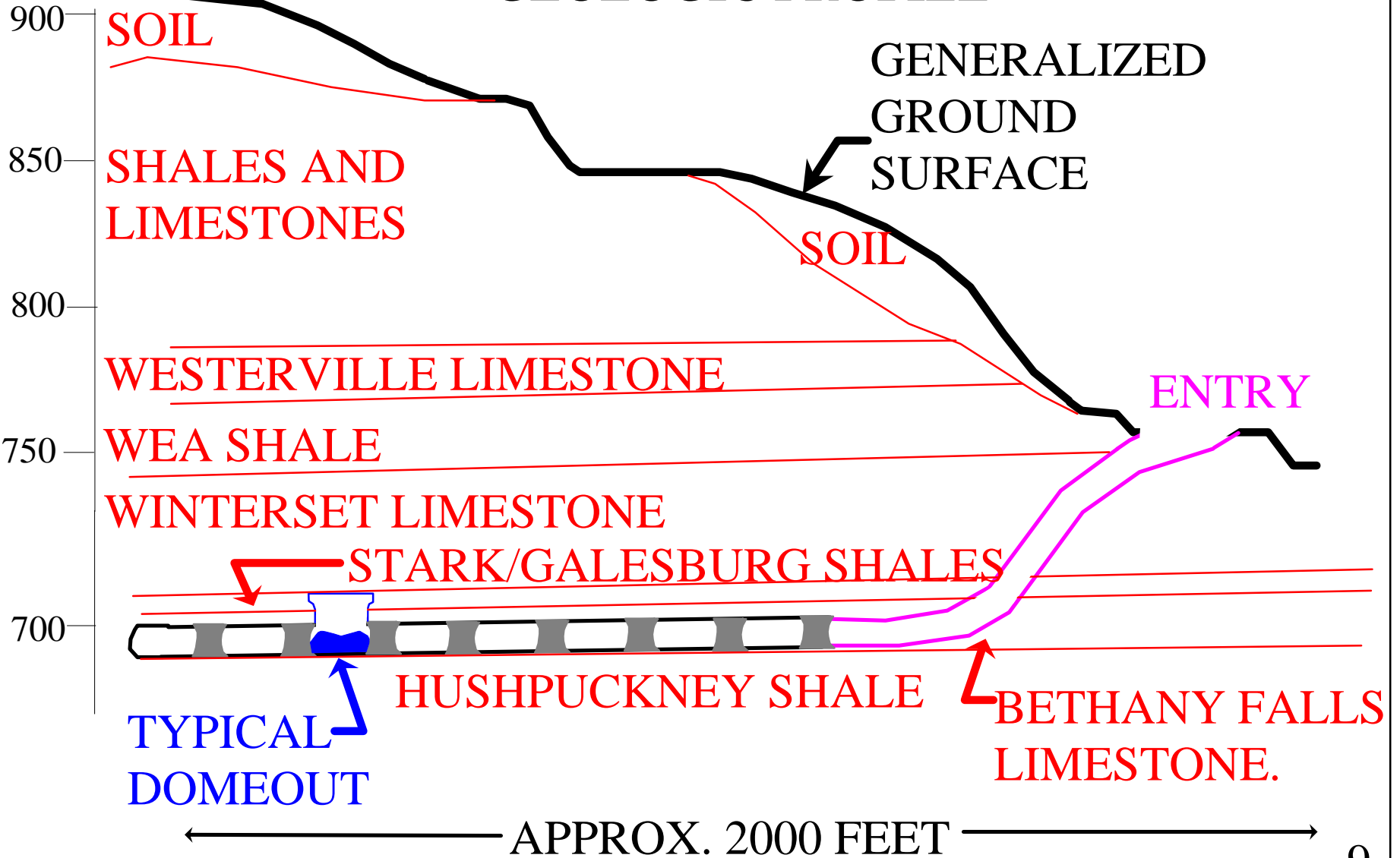
Dry Floor

NORTH

SOUTH

Elevation
in Feet

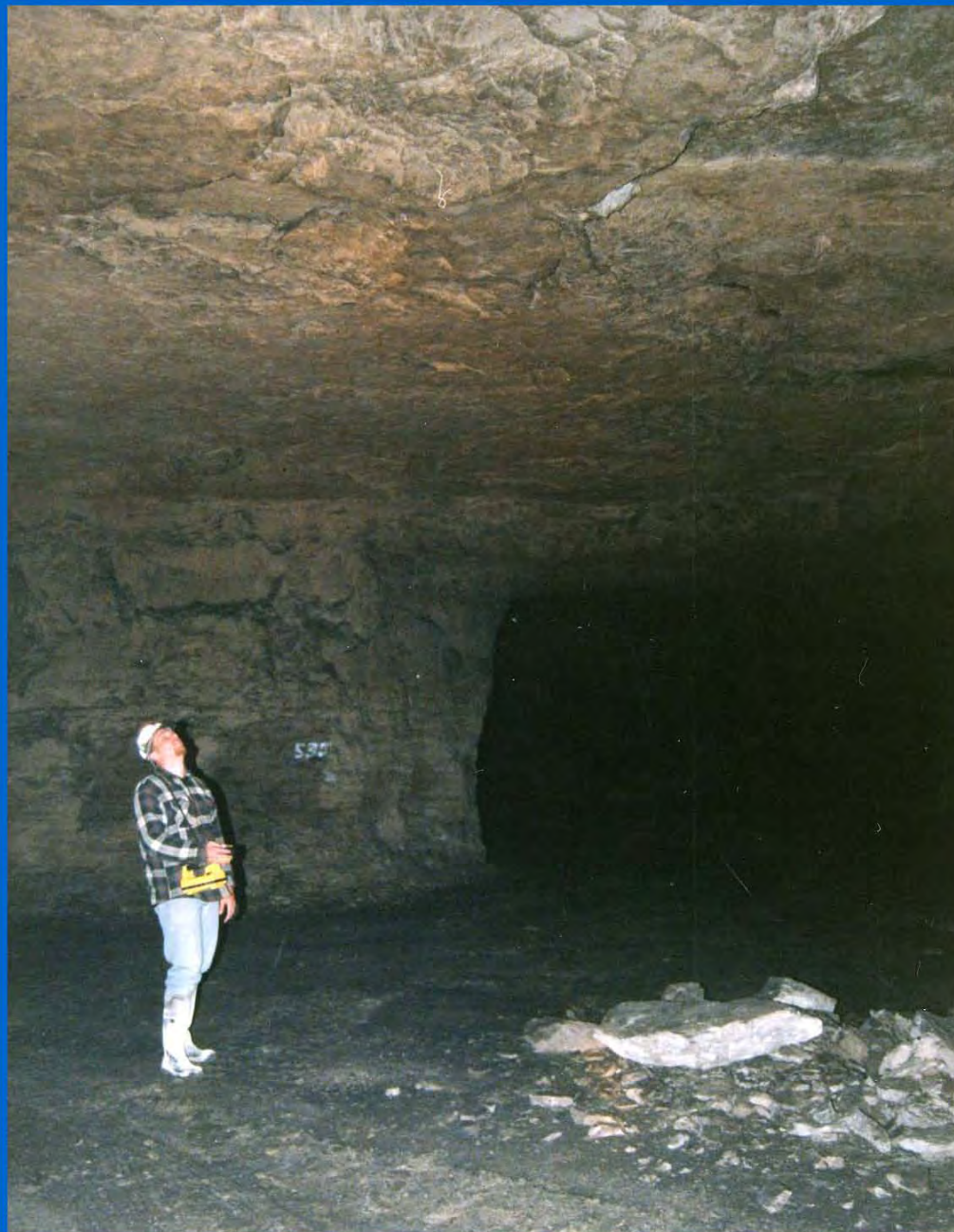
TYPICAL KANSAS CITY LIMESTONE MINE GEOLOGIC PROFILE



Typical Roof Defect (“Pothole”): Shaley Zone in Limestone Roof



Later: Chunks Down

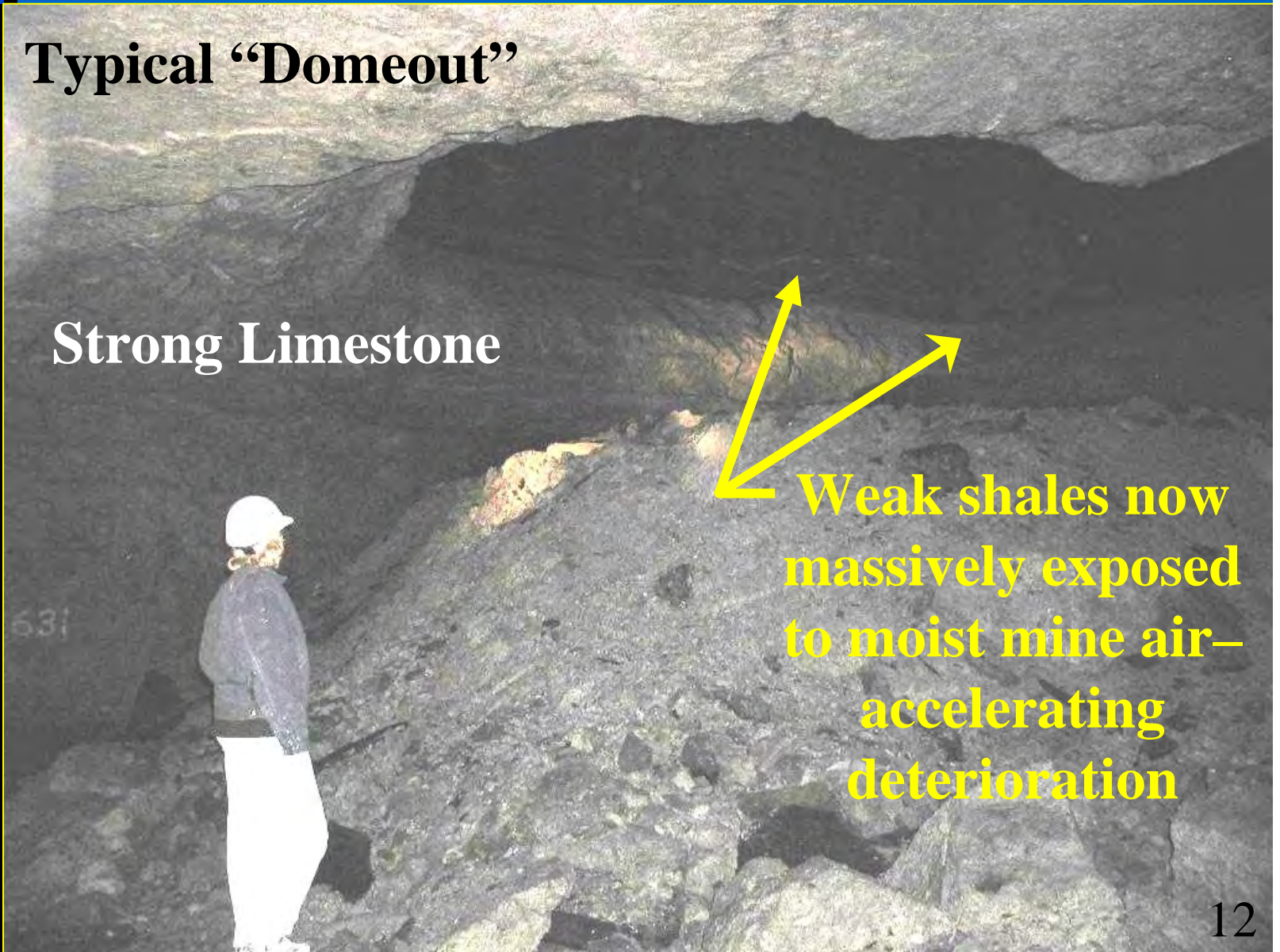


Later Again: Roof Falls

Typical “Domeout”

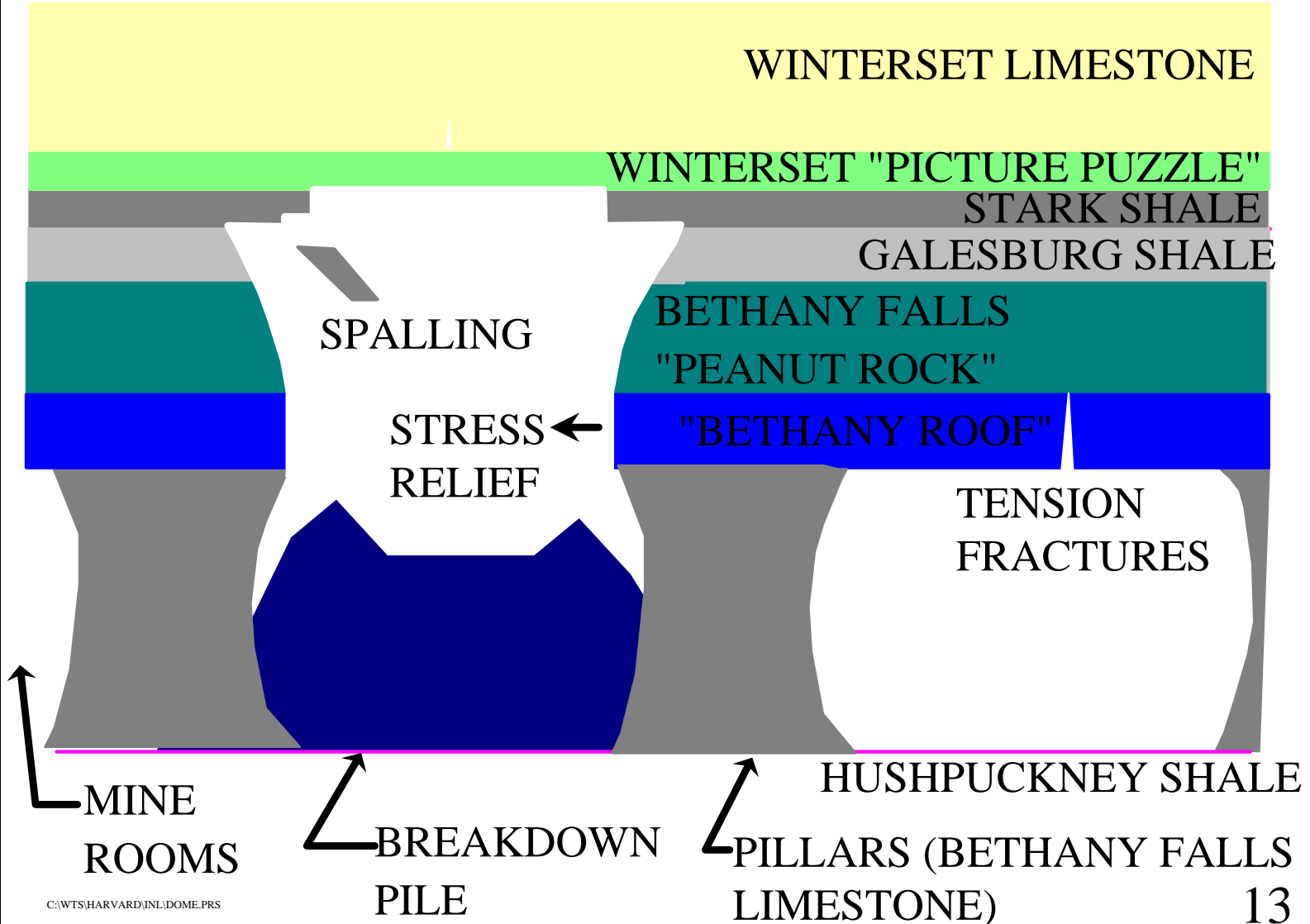
Strong Limestone

Weak shales now
massively exposed
to moist mine air—
accelerating
deterioration



Weak Shales now Exposed in Domeout

FORMATION OF DOMEOUT

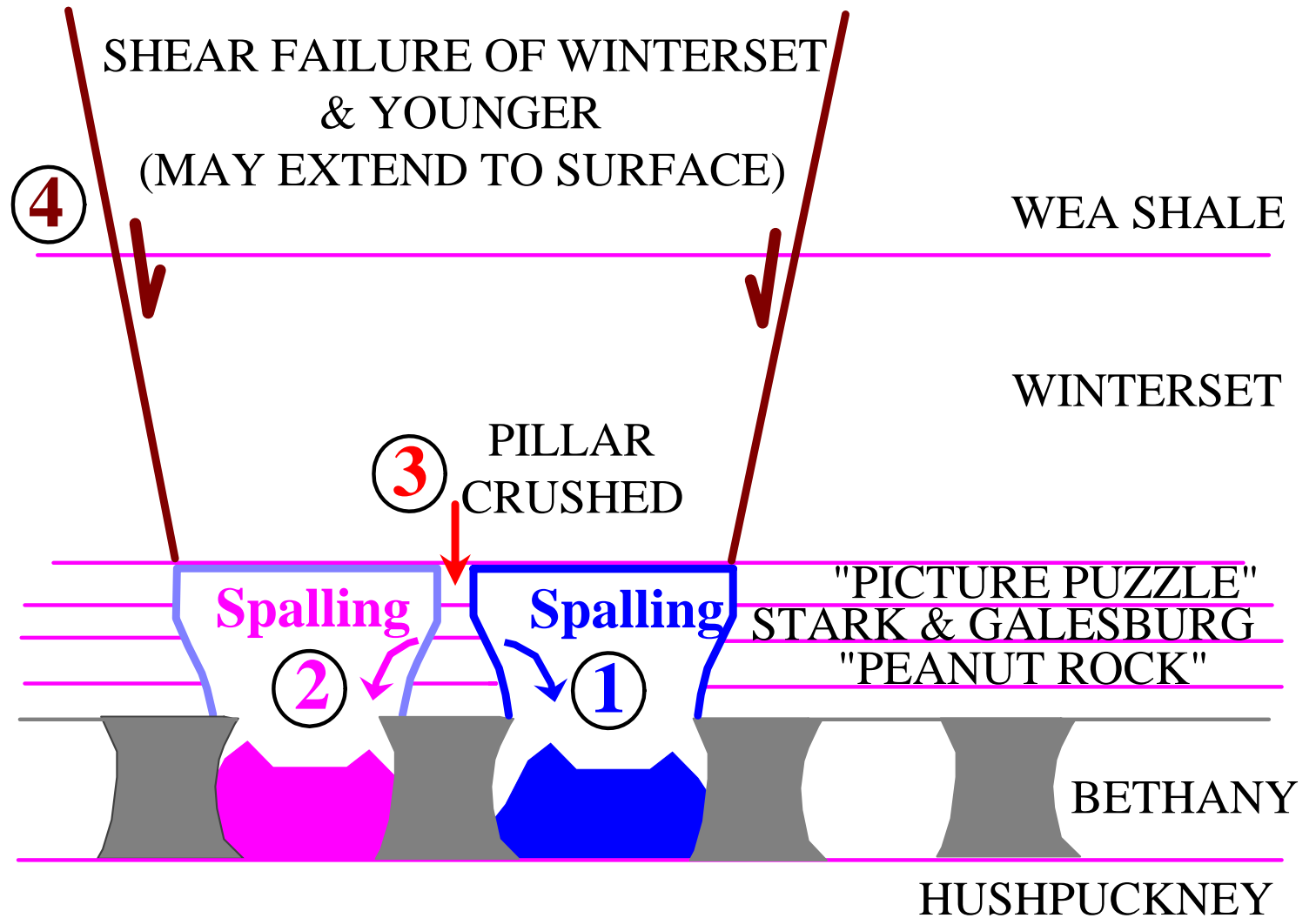


Multiple-Room Domeout with Surrounded Internal Pillar

Shale Slabs Spall Off;
Pillar Size Diminishes



Progression of Collapse to Surface



Morning temblor makes appearance in KCK



JEFF ROBERSON/The Kansas City Star

The effects of Thursday's minor earthquake in Kansas City, Kan., could be seen in the parking lot of the Indian Springs Medical Building. Don Denney walked near the crevice as he talked on a cellular phone following the morning temblor.

Mild quake strong enough to cause damage

Rare event leads to dozens of phone calls

By MARK WIEBE
The Kansas City Star

An earthquake briefly shook parts of Kansas City, Kan., at 9:18 a.m. Thursday, jangling some nerves, damaging one structure, forcing the evacuation of several buildings, but injuring no one.

By California standards, it was a small earthquake. But in this area, where earthquakes are rare, the tremor triggered dozens of phone calls to police, news agencies and Wyandotte County's Unified Government.

It was, after all, the first earthquake in many years that caused noticeable tremors in the Kansas City area, according to Don Steeples, a geophysics professor at the University of Kansas.

Thursday's quake might not have been felt outside of Kansas City, Kan. Dispatchers at the Johnson County Emergency Communications Center and the Kansas City Police Department communications unit didn't receive any reports of tremors.

Steeples said area residents had little reason to worry about earthquakes.

"We don't know what's going to happen," Steeples said. "But statistically, I have a great deal of confidence that there are going to be a hundred times more earthquakes in Los An-

geles than in Kansas City over thousands of years."

Steeples said a 1961 earthquake felt here measured nearly 4.0 in magnitude. Its epicenter was about 20 miles northeast of Kansas City, Mo.

More recently, seismographs recorded two earthquakes near Kansas City International Airport in the mid-1980s, he said, but no one felt those.

In addition, the U.S. Geological Survey in Golden, Colo., notes that in 1968, an earthquake centered in southern Illinois registered a magnitude 5.3 and was felt in this area.

See QUAKE, A-8

Mine Stabilization

Rapid Mine Collapse, KCK: Kansas City Star 1998

Mine Stabilization

**Surface Subsidence Over Rapid
Mine Collapse, Kansas City,
Kansas, 1998**



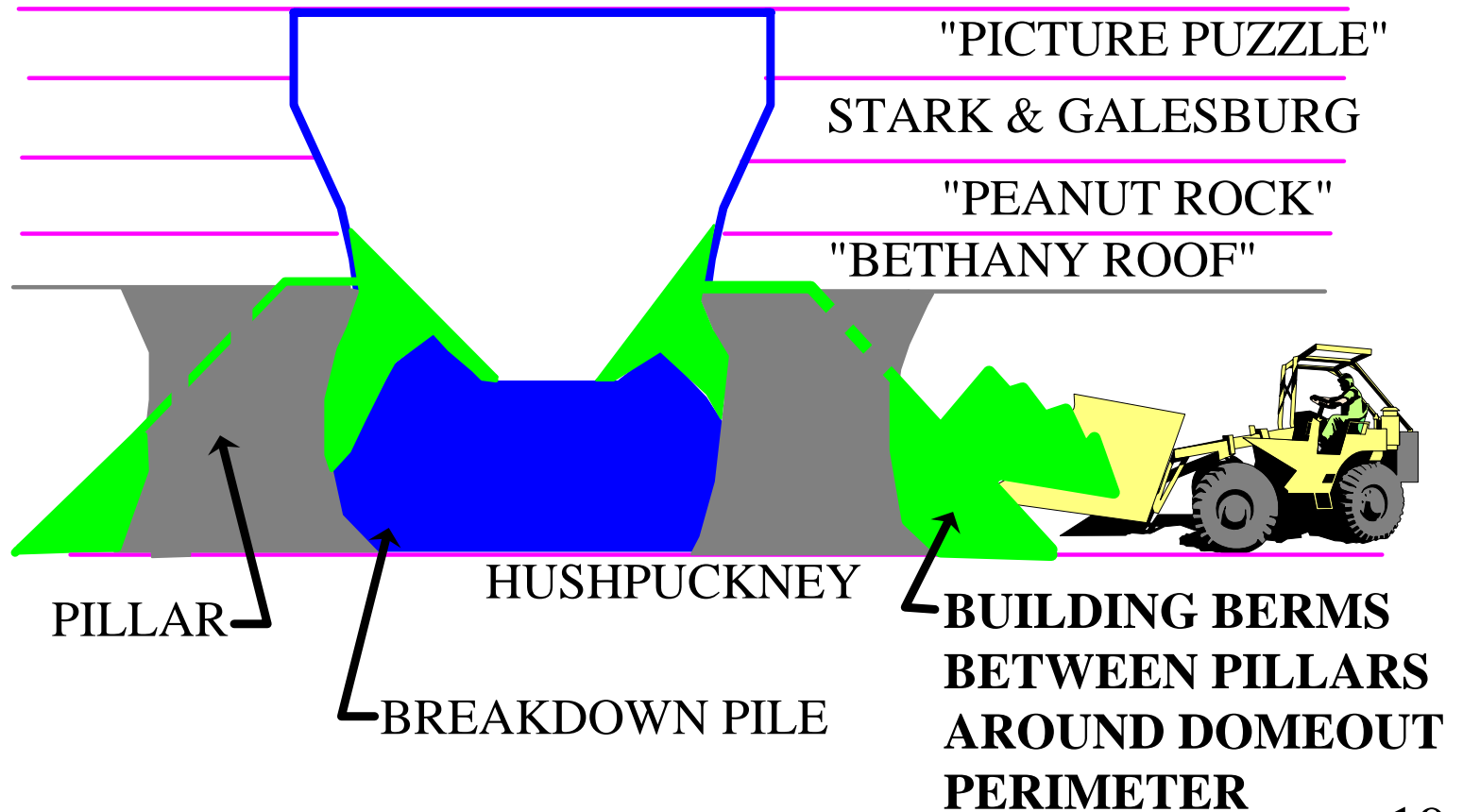
Mine Stabilization

- **Solution:**
 - **Protect the Pillars**
 - **Pillars Are Already Doing Their Job**
 - **Self-Cementing Flyash Encases the Pillars**
 - **Strong Enough to Prevent Chunks from Falling Out**
 - **Immerses Them to Isolate Them from Humid Mine Air**

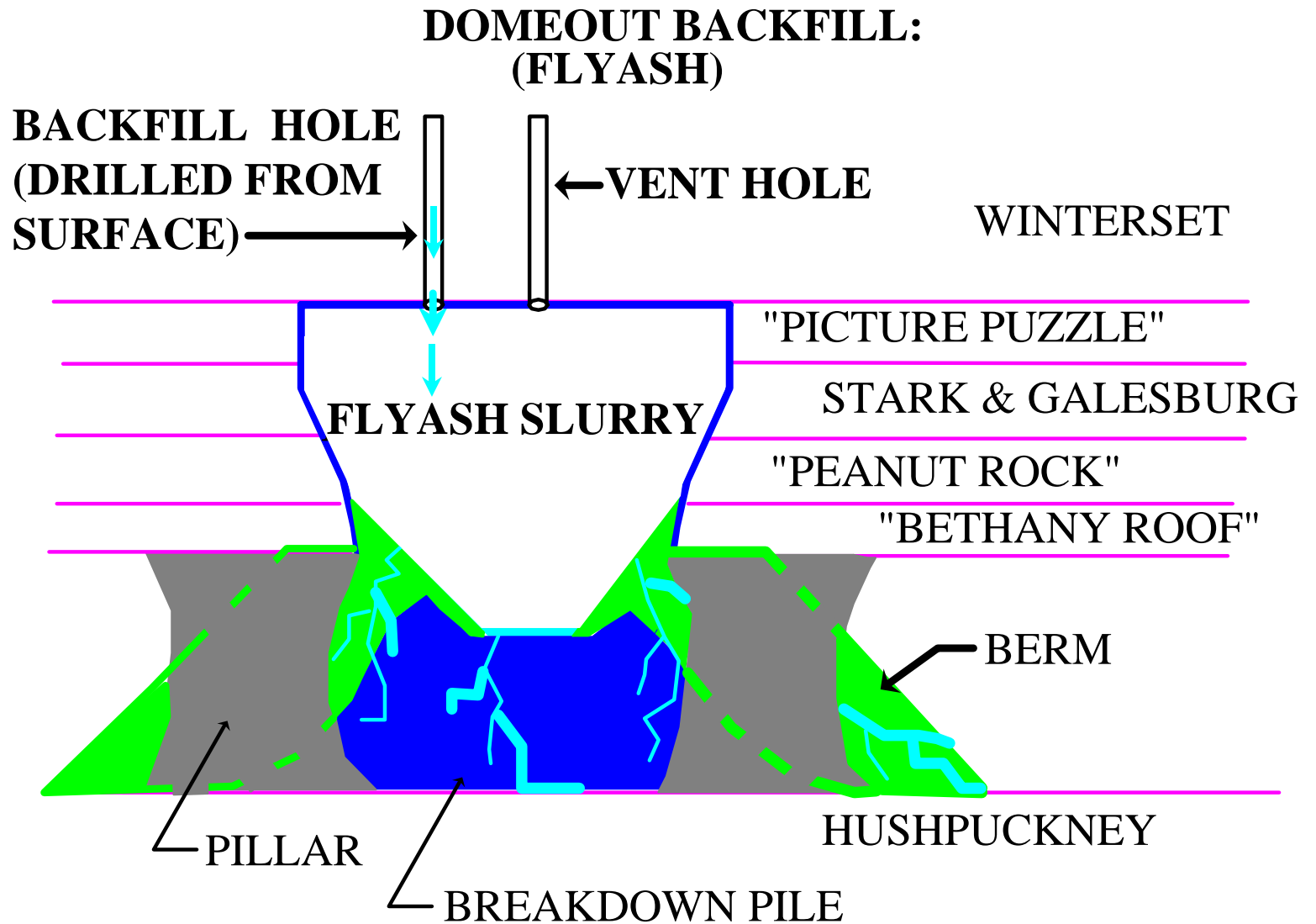
Mine Stabilization

DOMEOUT BACKFILL: BERM

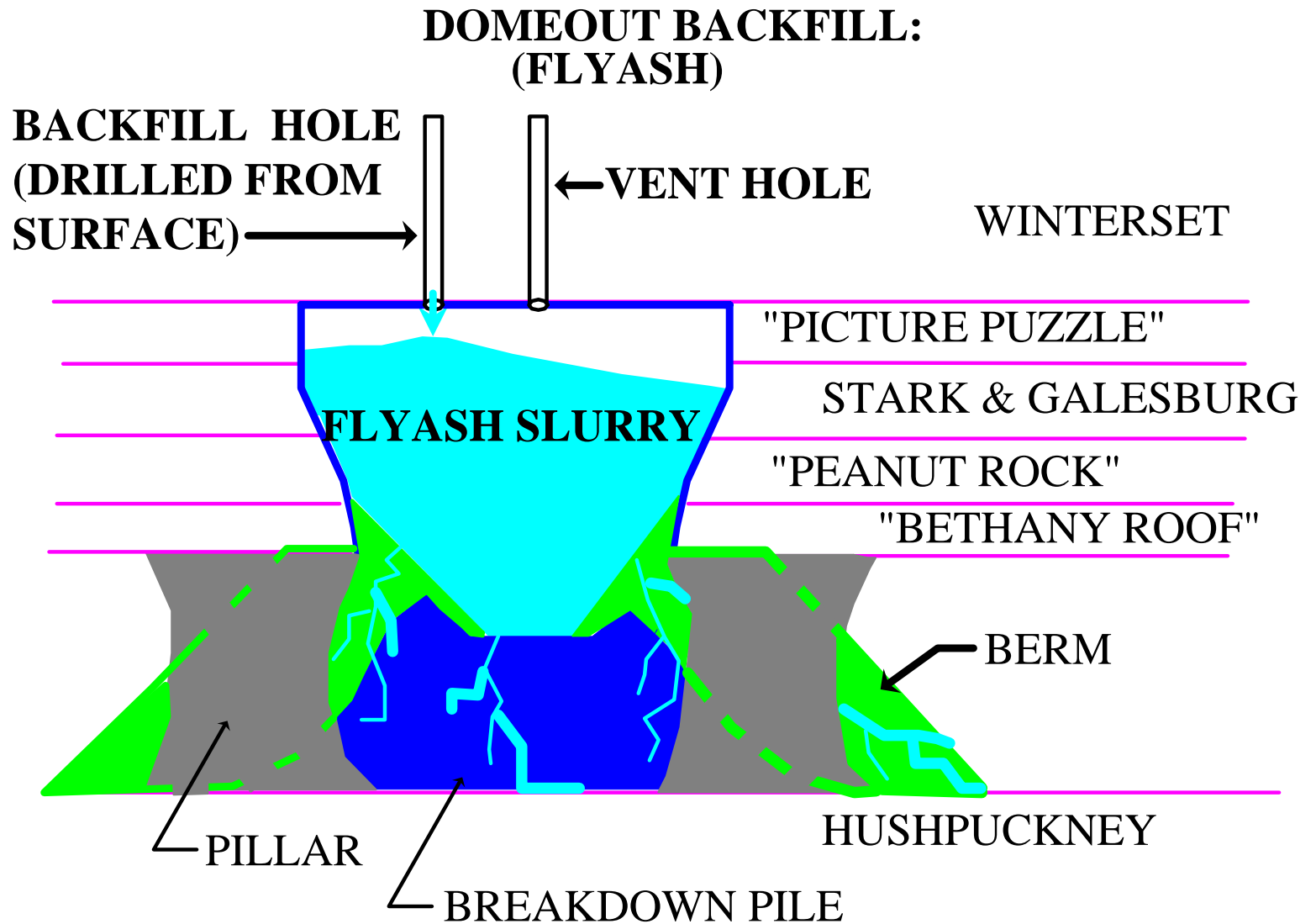
WINTERSET



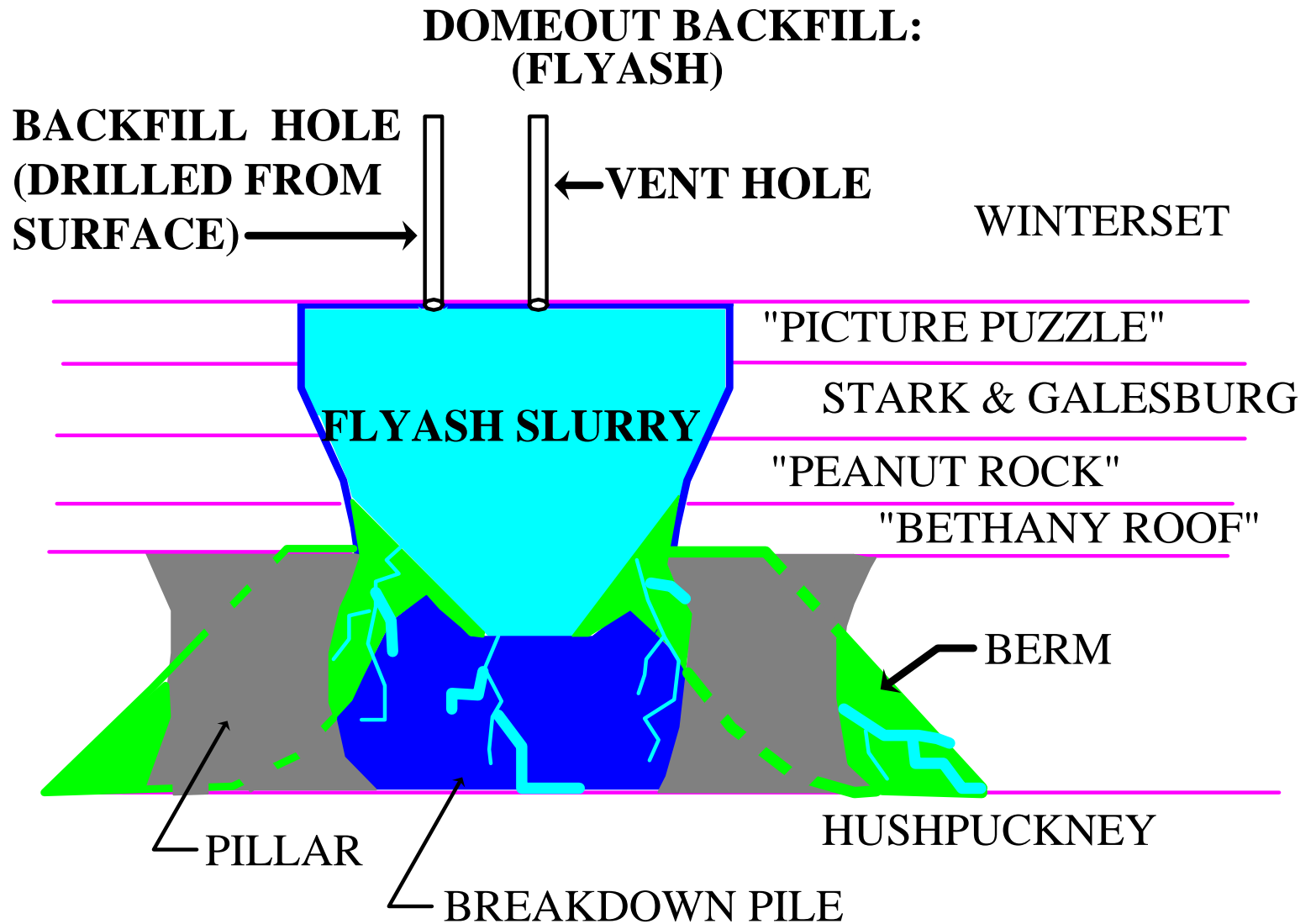
Mine Stabilization



Mine Stabilization

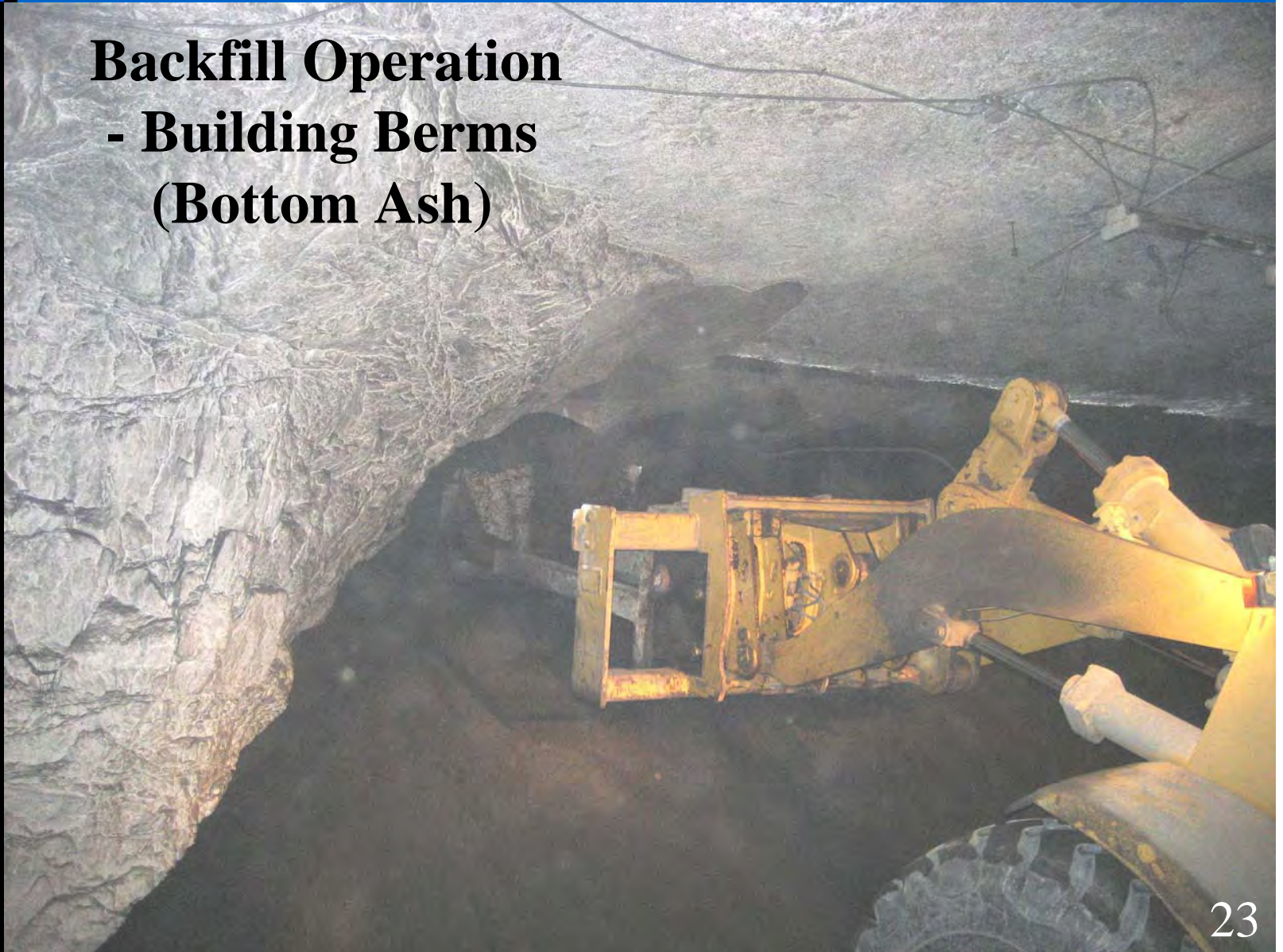


Mine Stabilization



Mine Stabilization

Backfill Operation - Building Berms (Bottom Ash)



Mine Stabilization

Backfill Operation – Drilling Holes



Mine Stabilization

Backfill Operation – View Up Borehole



Mine Stabilization

Backfill Operation - Placing Flyash



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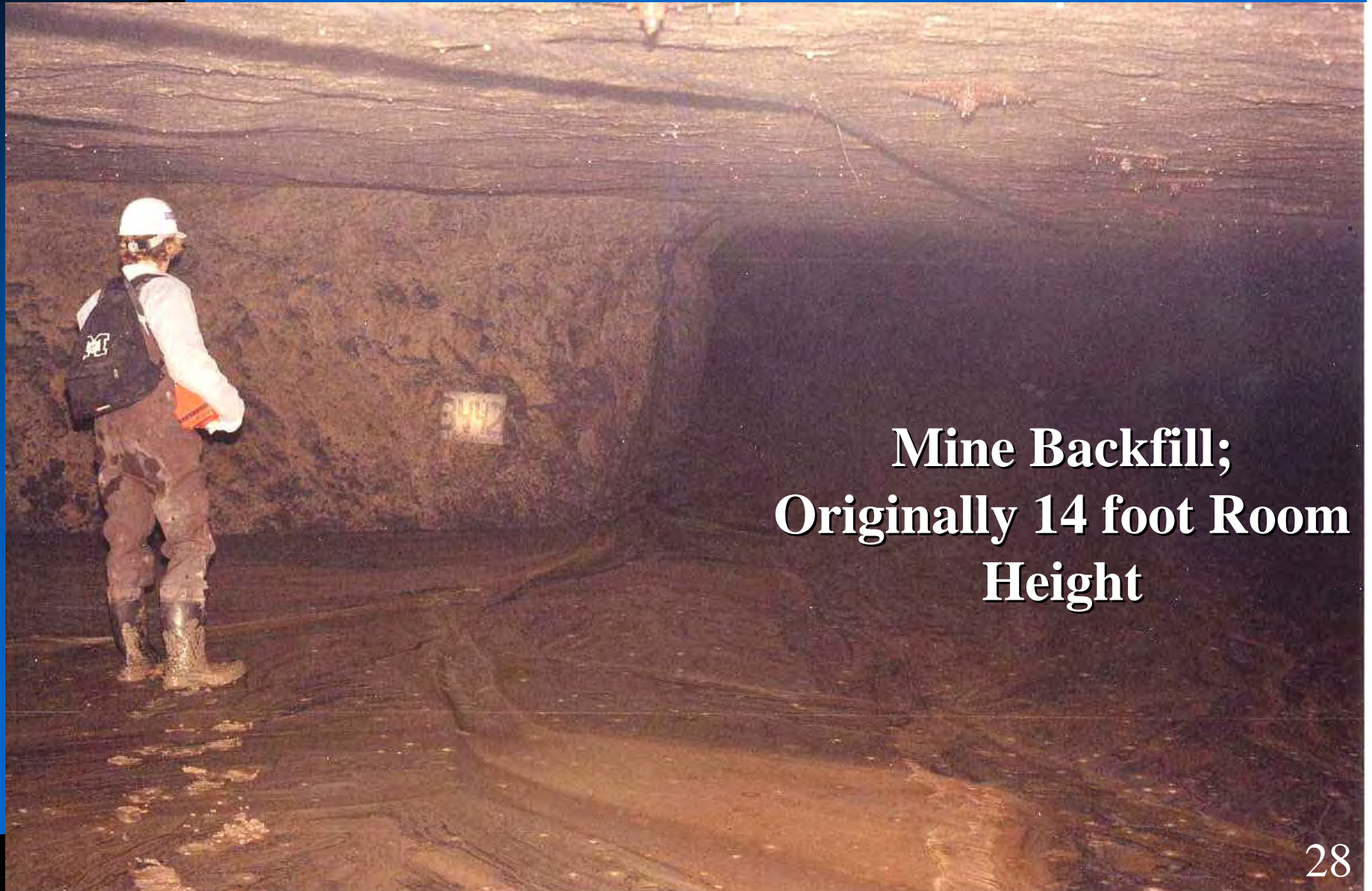
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Mine Stabilization



**Backfill
Operation -
Flyash Slurry
Flow, 200 feet
below ground**

Mine Stabilization

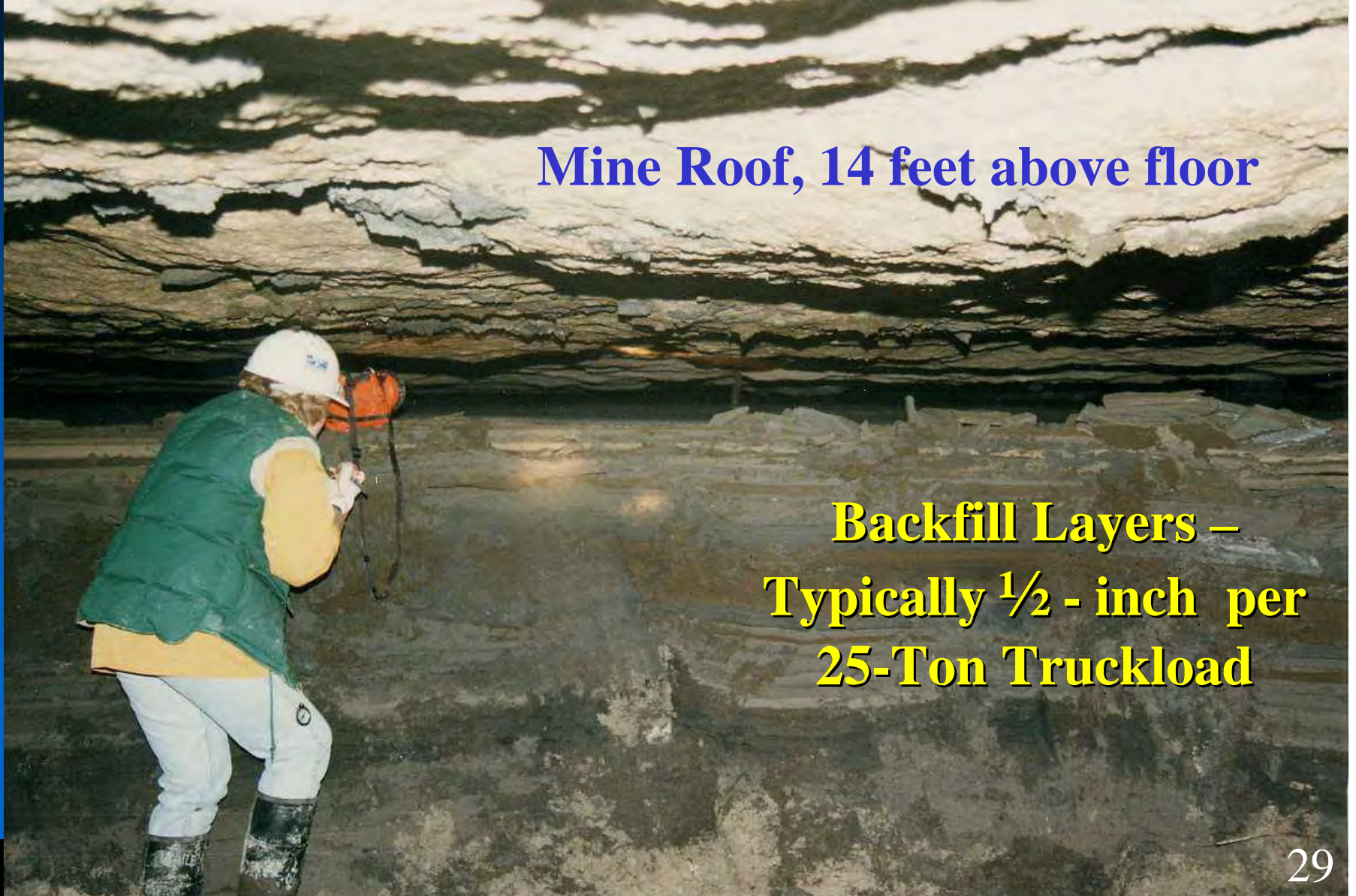


**Mine Backfill;
Originally 14 foot Room
Height**

Mine Stabilization: Cutaway View

Mine Roof, 14 feet above floor

**Backfill Layers –
Typically $\frac{1}{2}$ - inch per
25-Ton Truckload**



Another Cutaway View in Breakdown Pile in Domeout



Development Above the Mine



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Development Above the Mine



Without Mine Stabilization:

- **Ground Above Mines =**
 - **Wasteland**
 - **Infrastructure at Risk**
 - US Hwy 169
 - Briarcliff Pkwy & Mulberry Drive
 - I-435
 - Holliday Drive
 - 59th Street
- **Pozzolonic (self-cementing) Coal Flyash Slurry Fills the Void**

Recyclable Material

- **Beneficial Use**
 - **Used as “Substitute” for Other Commercially Available Products**
 - **Cement Grout: Low Flow and Extreme pH**
 - **Sand: Poor Flow Characteristics**
 - **Mud: No Strength to Preserve Pillars**
 - **Mine Worker Safety is Improved by Use of Flyash (Can be placed from aboveground)**

Recyclable Material

Comparison of Mine and Landfill: Physical Environment

MINE

- No Weathering or Erosion Potential
- Direct Contact Pathway Eliminated
- No Potential Blowing Dust, Eliminates Inhalation Pathway
- Negligible Groundwater Impact Potential

LANDFILL

- Potential Erosion
- Potential Direct Contact Pathway
- Blowing Dust and Inhalation Exposures Possible
- Negligible (But Higher) Groundwater Impact Potential

Recyclable Material

- **Ash Characteristics (Kansas City Project)**
 - **Fine Grained Particulates: Intrinsically Low Permeability**
 - **Pozzolonic Reaction: Self-Cementing Material – Lowers Permeability Even More**
 - **No Significant Leaching via TCLP Testing (Acid Leaching); Results from Over a Decade**
- **Acid Leached Metals Levels are Lower Than Some Natural Bedrock Groundwaters in KC**

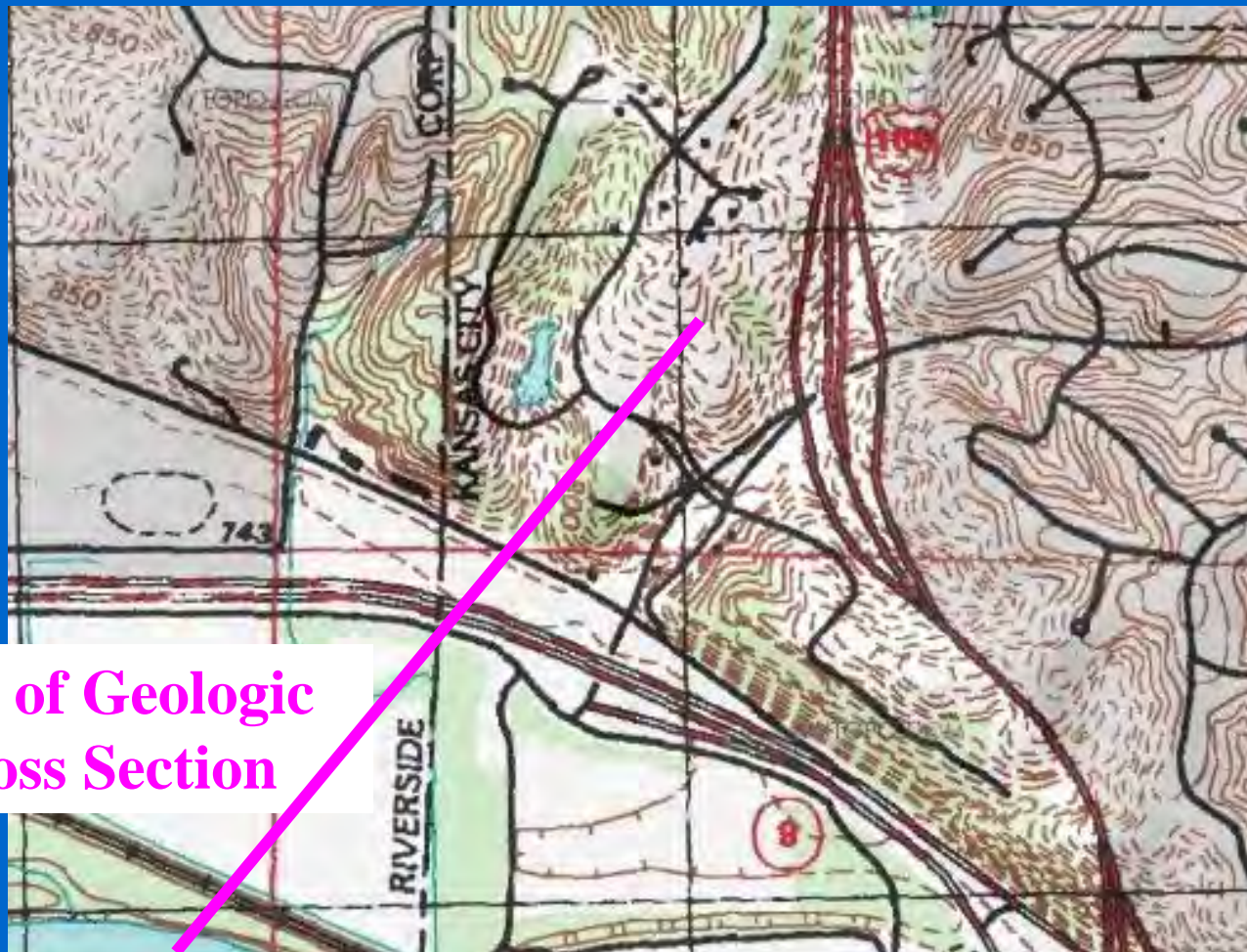
Recyclable Material

Example: Metals in Stark Shale Formation (Mine Roof Zone) Natural Groundwater in the KC Region

- **Lead: up to 82 ppb (Public Health Goal 0)
(Action Level 15 ppb)**
- **Cadmium: up to 71 ppb (MCL 5)**
- **Chromium: up to 23 ppb (MCL 100)**
- **Zinc: up to 4,700 ppb (MCL 5,000)**

Recyclable Material

Comparison of Mine and Landfill: Hydrogeological Conditions



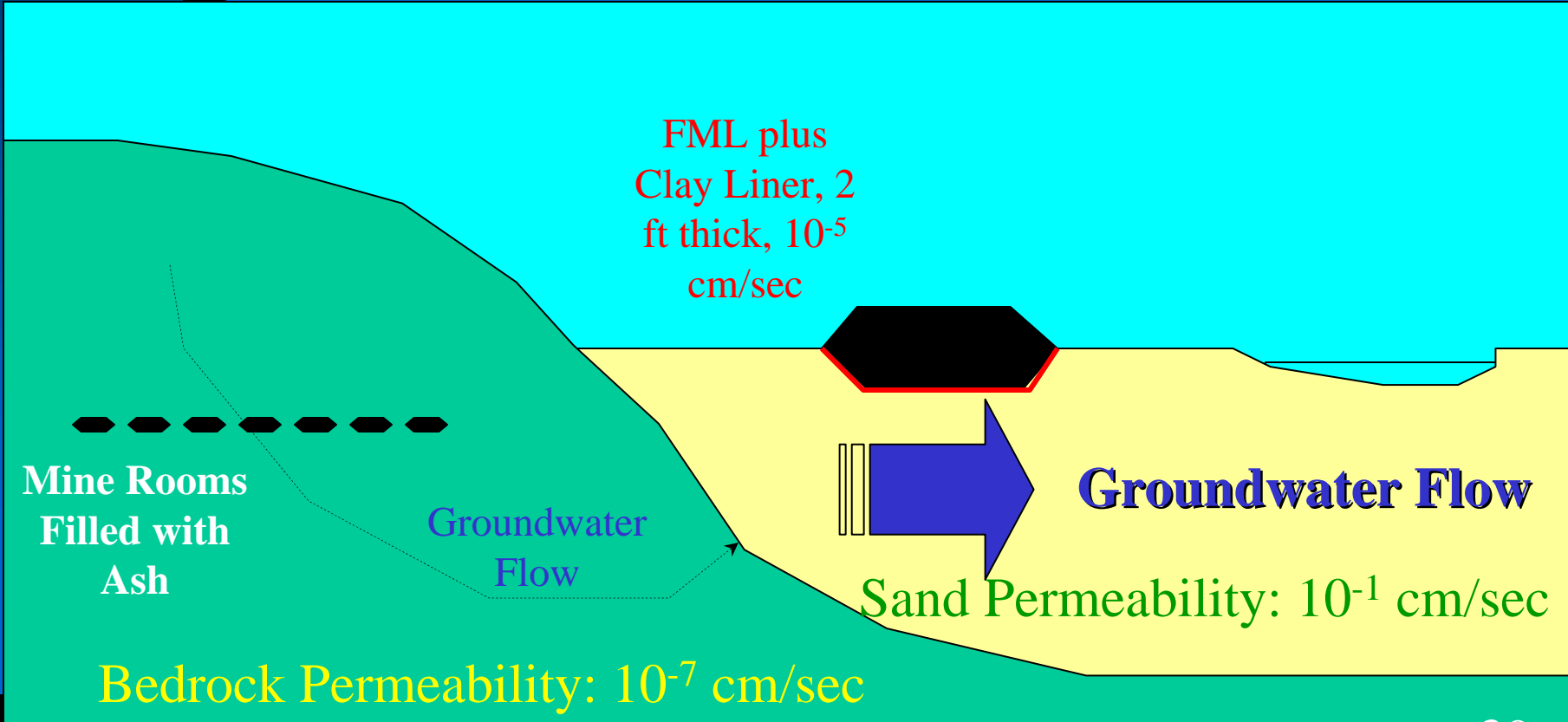
Line of Geologic
Cross Section

Recyclable Material

Comparison of Mine and Landfill:

Typical KC Mine

Typical Flyash Landfill



Current Regulations

- **(1993) EPA Regulatory Determination on CCBs**
 - **Subtitle C is inappropriate, based on:**
 - **Limited risks posed by CCBs**
 - **Adequate State and Federal regulatory programs**
 - **Evaluation needs to be on a site-specific basis**
 - **Exempts wastes from regulation as hazardous wastes under RCRA Subtitle C**

<<http://www.epa.gov/epawaste/nonhaz/industrial/special/mineral/080993.pdf>>

Current Regulations

- **(2000) EPA Regulatory Determinations**
 - **Environmental harm not associated with beneficial use**
 - **CCBs do not warrant regulation as hazardous waste**
 - **Some uses require hydrogeologic evaluation**

<<http://www.epa.gov/epawaste/conservation/rrr/imr/ccps/resources.htm>>

Current Regulations

- **(2000) EPA Regulatory Determinations, cont'd.**
 - **Concluded No Additional Regulations Warranted**
 - **Stated Barriers on Beneficial Use Should be Avoided**
 - **Conserves natural resources**
 - **Reduces disposal costs**
 - **Agency Supported Increase in Beneficial Use**

EPA Rulemaking – Alternatives being Considered

- **Reclassify CCBs as Hazardous Waste;
or**
- **Require Subtitle D regulation at a
minimum; or**
- **Hybrid**

- **May allow exemptions for some
beneficial reuse – possible deference to
states**

Consequences of Regulating Ash as Hazardous Waste

- **Specific beneficial uses may become technically or economically infeasible.**
- **Raw mineral material use would likely increase significantly.**
- **Utility rates would increase:**
 - **Waste Volume Increase = Less Airspace**
 - **Landfill siting / capacity difficulties**
- **Industry collaboration would diminish.**
- **Broad, overarching rules would limit flexibility for site-specific beneficial uses.**

Consequences of Regulating Ash as Hazardous Waste

- **Some Coal Combustion Byproduct Usage Projects Truly Constitute a Beneficial Use**
- **Not merely cheap waste disposal.**

Use of Flyash as Recyclable Material

- **Return ground above mines back to more productive use, and make safe for the general public.**
- **Section 409 in the Surface Mining Control & Reclamation Act of 1977 declares that voids resulting from mining operations constitute a hazard to the public health or safety, and surface impacts of any underground mining operation may degrade the environment.**
- **New regulations should therefore allow flexibility to allow safe stabilization with CCB's.**

Use of Flyash as Recyclable Material

- **Our activity is regulated in Missouri under the State's Underground Injection Control program.**
 - **Permit requires groundwater monitoring to ensure the material is not adversely affecting groundwater.**
 - **More than 10 years' of monitoring data confirms that no releases are occurring.**

Impact to Small Business

- **Not Negligible**
- **Safe use of CCB's is the foundation of our business.**



and



Discussion