



Underground Limestone Mines - Case Histories of Sustainable Industrial, Research, and Commercial Use


David Newman, Ph.D., P.E., *President*

Appalachian Mining & Engineering, Inc.
Lexington, Kentucky

History of Underground Limestone Mines in the United States

- Limestone and various sulfide ores have been mined underground since the early 1800's






Advantages of Underground Limestone Mines

- Large space > 90,000 m²
- Can be secured with limited access
- Generally stable back, pillars, and floor
- Fireproof
- Climate controlled environment
- Well ventilated – generally no noxious gases



Examples of Post Mining Uses of Underground Limestone Mines

- Civil defense or storm shelter
- Warehouse – storage facility (Subtropolis - Kansas City)
- Underground office complex
 - Secure data storage and recovery center
- Mushroom farming (Creekside Mushrooms – 27MM Kg/yr)
- Research facility (USBM/NIOSH)



Case Histories of Sustainable Use of Abandoned Limestone Mines

Case History No. 1

- Highbridge Springs Bottled Water and Kentucky Underground Storage
 - ❖ Active underground mining stopped by water inflow from a sinkhole
 - ❖ Two businesses developed from an abandoned underground quarry purchased at a property tax auction

Aerial View of the Facility



History of Highbridge Springs – Kentucky Underground Storage

- Prior Uses of the Quarry
 - Civil Defense Shelter
 - Bulk Cheese Storage
 - Storage of Cars, Boats, Recreational Vehicles



Current Use of the Underground Mine

Highbridge Springs Water

- Built in the “wet” side of the quarry
- Dam constructed to impound 25MM l of water
- Initially produced distilled water
- Developed reverse osmosis bottled water plant

Kentucky Underground Storage

- Storage of cars, boats, RVs
- Developed climate controlled section for record storage
- Storage of business, government, Univ. of KY rare book collection



Underground Data Storage – Data Recovery Centers

- Abandoned limestone mines are well suited to data storage – data recovery
- Highest and best use of an abandoned mine
- Transition from bulk storage to sophisticated data storage and recovery
- Clients include:
 - Government
 - Banks, Brokerage house, Financial institutions
 - Hospitals
 - Multi-national corporations
 - IT corporations

Data Storage – Data Recovery Centers

Completely, Self -
Sufficient, Autonomous
Underground Operation

- Large space 7.6m-8.5m high, +/- 93K m²
- Stable back, pillars, and floor
- Limited and secure access, available 24hrs.
- Minimal surface exposure/visibility
- Unaffected by weather
- Redundant power supply
- Some close to metropolitan cities/transportation





Underground Data Storage – Data Recovery Centers

- Case History – Iron Mountain
 - Located in a mine north of Pittsburgh, Pa.
 - Currently housing paper records and tape in a 158K m²
 - Mine has transformed into a data storage and recovery center with an underground community of 2,700 employees
 - Redundant power
 - Fire department
 - Potable water from mine pool & treatment plant
 - Ventilation to cool servers and electronics
- Goal is to create multiple centers funded as a real estate investment trust (REIT)

Underground Research Laboratory

- ❖ U.S. Bureau of Mines created an experimental mine in 1911 to conduct field scale experiments.
- ❖ Objective was to determine the role of coal dust in mine explosions. CH_4 thought to be the sole source of mine explosions
- ❖ Abandoned Pittsburgh seam mine in Bruceton, Pa. selected as it is on the USBM campus.
- ❖ Not popular with surrounding commercial and residential area.



USBM Lake Lynn Experimental Mine

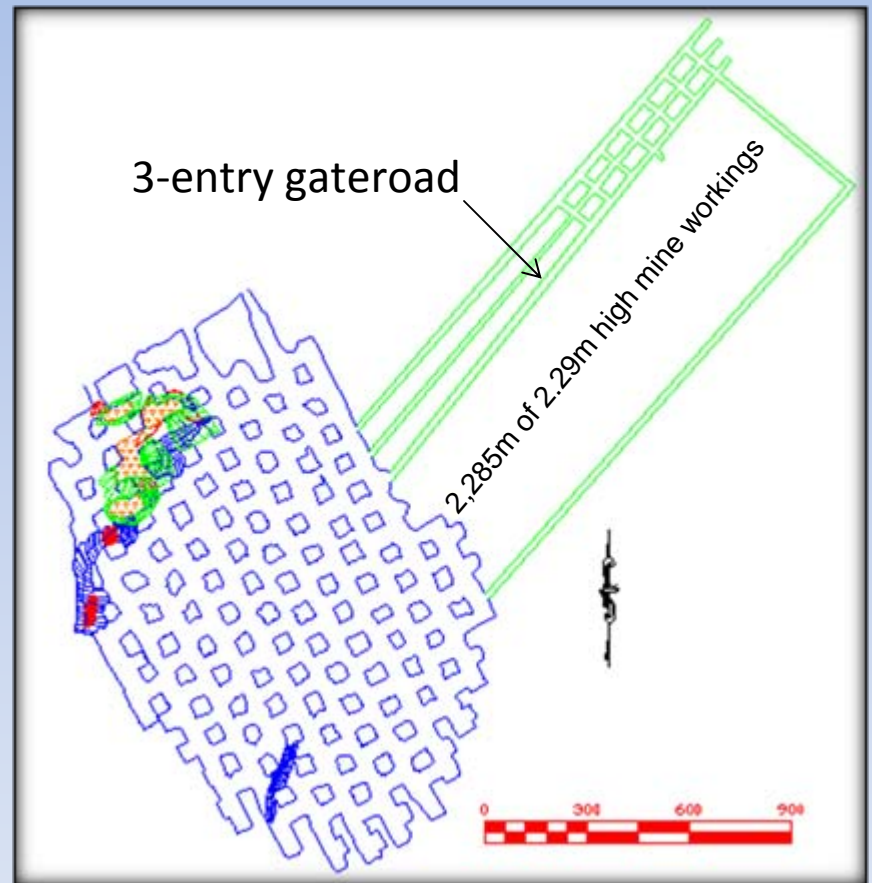
In 1979 USBM identified an abandoned limestone mine on a 162-ha tract in rural West Virginia.

- Existing mine abandoned due to sinkhole and roof conditions in isolated section
- USBM desired a field laboratory for mine explosion and mine fire research
- USBM desired an underground laboratory where geometry of longwall and room-and-pillar mines would be duplicated



USBM Lake Lynn Laboratory

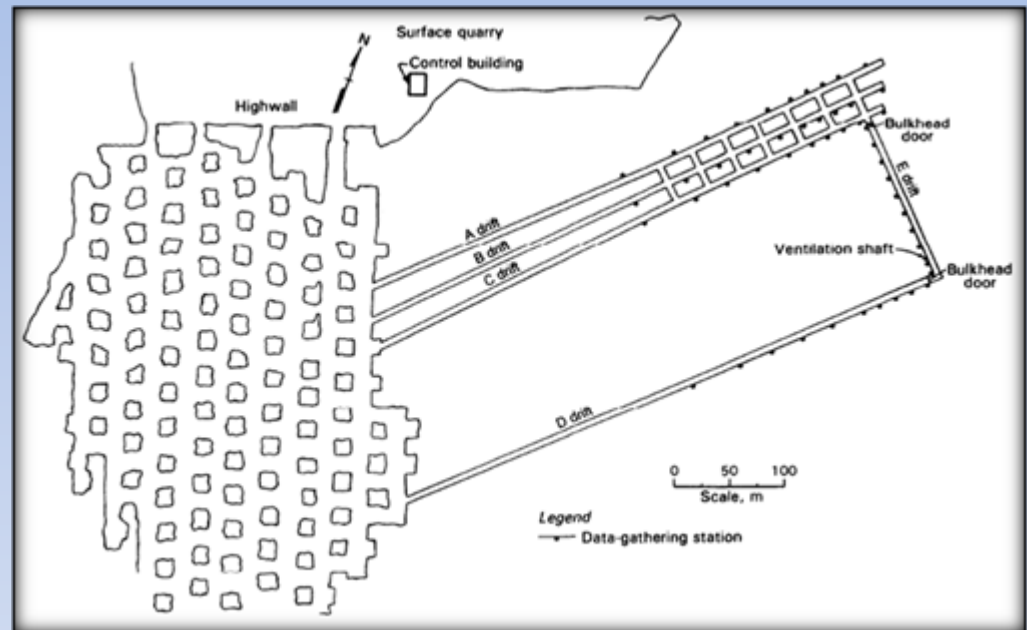
- ❖ New area of the LLEM driven to NE of existing mine workings
- ❖ Existing mine workings provide a “muffler zone” where the vibration, air-blast, dust, and smoke associated with an explosion is dissipated.
- ❖ Non flammable mine
- ❖ No substitute for full scale testing of explosions and fires



USBM Lake Lynn Laboratory

❖ By 1982 the laboratory was completed

- 40,250 km of data & video cables embedded in the walls
- Full scale CH₄ and dust explosion
- In 2006 full scale mine seal testing done in response to Sago accident
- Bulkhead testing in isolated heading that was pressurized with water



Case History - Conclusions

- An abandoned limestone mine can be used for multiple applications
 - Warehousing, truck depot, and bulk storage
 - Highly secure document and data storage
 - Data recovery centers developed for multiple clients
 - Mushroom farming
 - Bottled water or manufacturing plants
- Once ground conditions are stabilized
 - Low maintenance costs
 - Secure, climate controlled environment

Underground Limestone Mines

Have the Potential to be More Valuable in a Post Mining Use
Than During Mining

