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EXPLORE

The Depths of Our Experience

Underground Coal Mining & Western Canada

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Topics

- World coal importance
- UG mining considerations
- Why mine UG
- Western Canada mining
- UG mechanized mining methods
- Questions

Background

- Fortunate to travel the world and to be of service to others in providing energy / agricultural solutions
- Major solution to world poverty is providing these answers to all
- We all need to be responsible for best practices and much is yet to be learned.

World Wide Coal is Important

- ~ 8 billion tonnes (Bt) produced per year
- 40% electrical generation
- 30% primary energy needs
- ~ 1 Bt for steel production
  - 70% of steel production uses coal
- China ~3.5 Bt ~93% from UG
- India ~600 Mt ~75% by Surface
- ~ 60 % world production by UG

2013 Canada Coal Production

- 69 million tonnes (Mt)
  - ~98% surface mined
- BC 31Mt
  - $4.6B revenue (58% of BC mineral production)
  - ~99% surface (1 UG mine in BC - Quinsam)
- Several UG projects in BC & AB are being studied

UG Mining Considerations

- Geologic conditions
- Mine design/method
- Ground control
- Environmental/regulatory
- Safety
- Market climate
- Skilled people

Geologic Conditions

- Structure/setting – faulting, folding, continuity, dip/strike, seam(s) thickness, depth, etc.
- Roof, floor, interburden, and overburden make-up
- Methane/water considerations
- Geotechnical parameters
- Characterization of resources

The Mine Design/Operation Challenge

- Resource to recoverable base
- Design/operate mine for the conditions
  - Multiple methodology
- Development proper infrastructure/support systems for the UG mine
- Economic viability balance with market and natural ever changing conditions

Challenges of Western Canada UG Mining

- Geologic complexity
- Steep coal seam dips
- Thin seams
- Thick coal
- Multiple seams
  - Combination of steep / thin / thick
- Coal friability and strength
- Limitation on mining history

Challenges of Western Canada UG Mining

Multiple Methodology

Transition from surface to underground to maximize resource recovery.

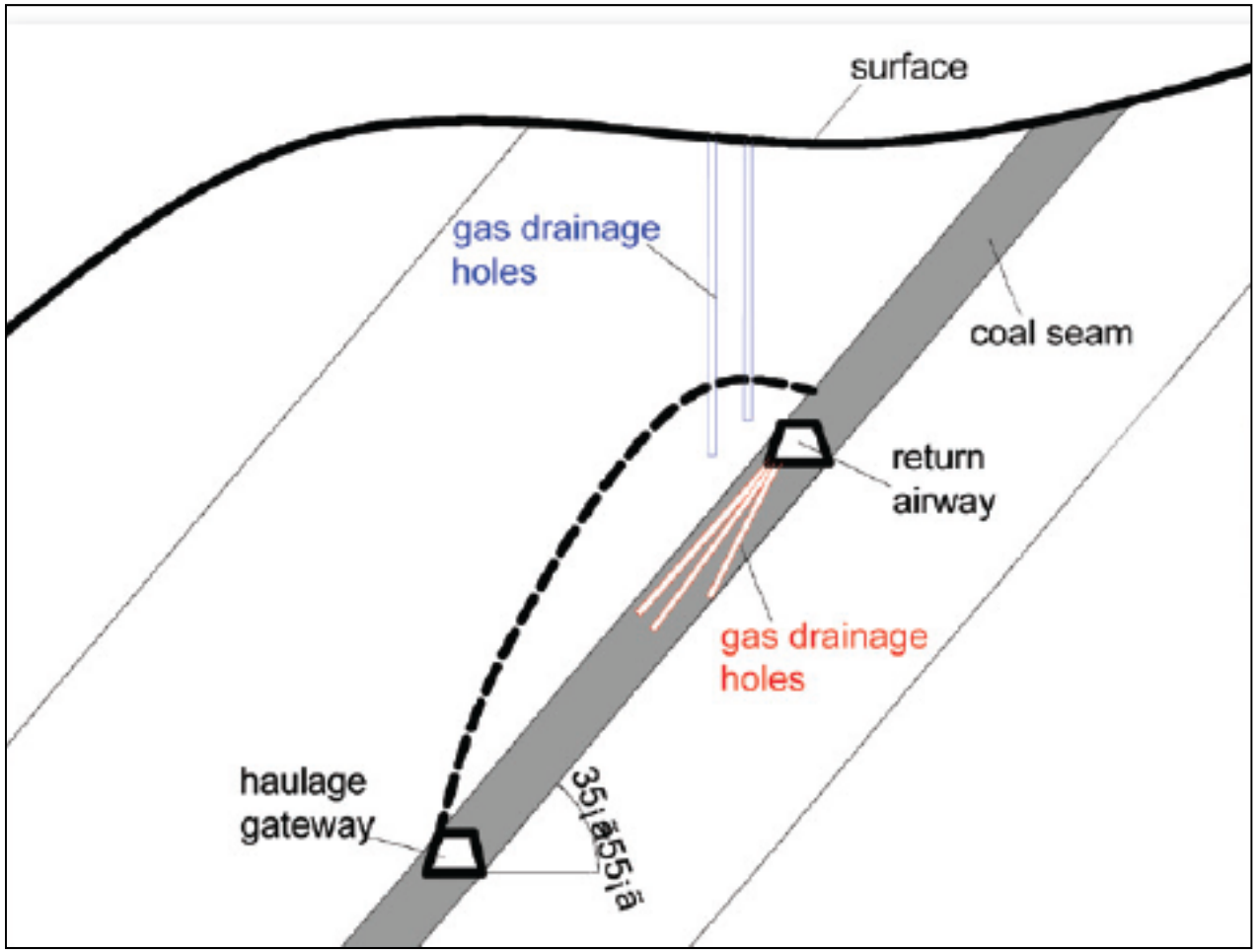
Surface Mining Highwall

Highwall Prep for UG Entrance

Mines Surface to UG

- Grande Cache Alberta (room & pillar)
- San Juan USA (longwall)
- Bridger USA (longwall)
- 20-Mile USA (longwall)

Longwall on Steeply Dipping Seams



UG Mechanized Mining Methods

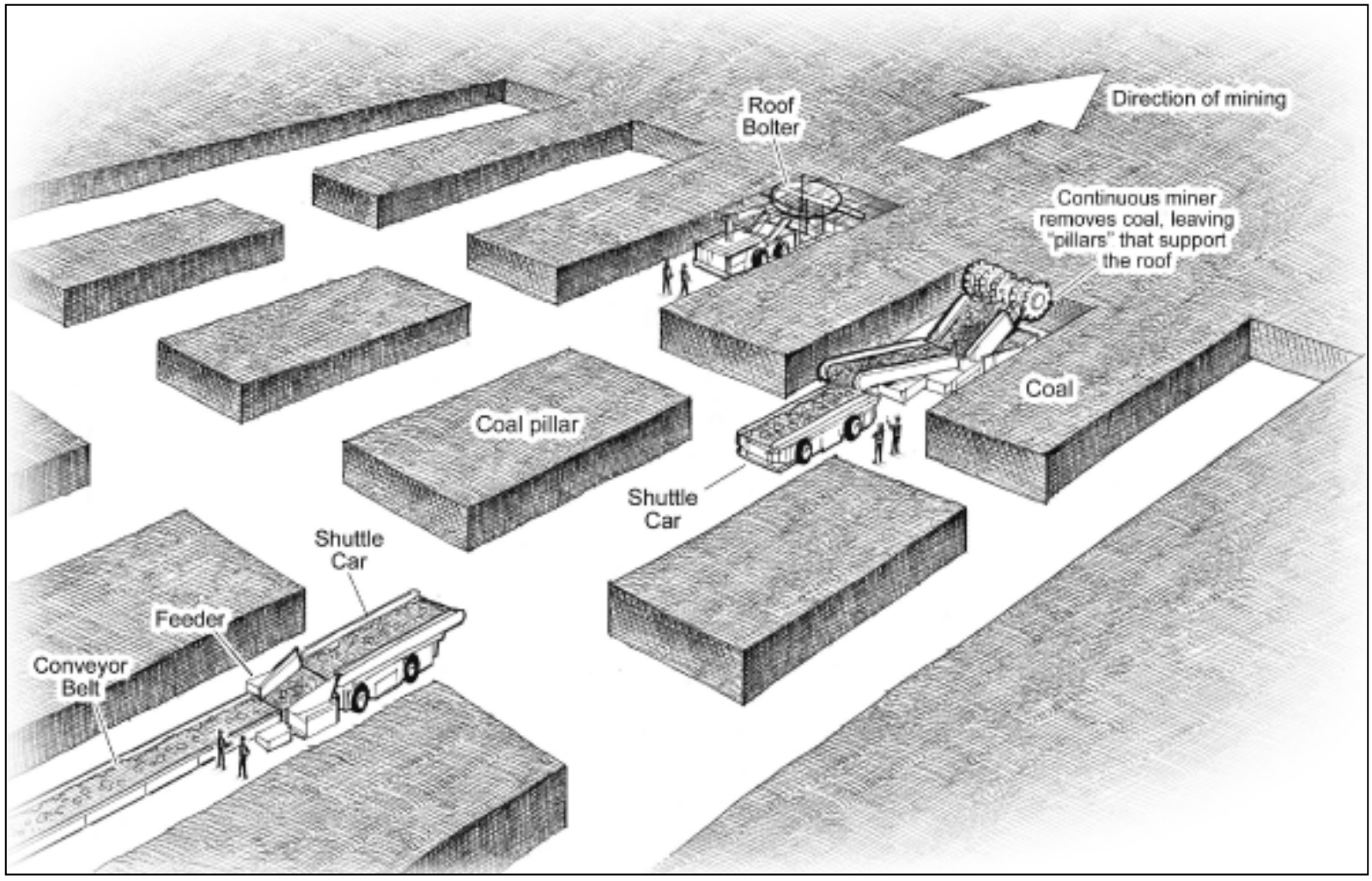
- Highwall mining
- Room and pillar work
  - First mining
  - Retreat or depillar mining
- Longwall mining

Highwall Mining

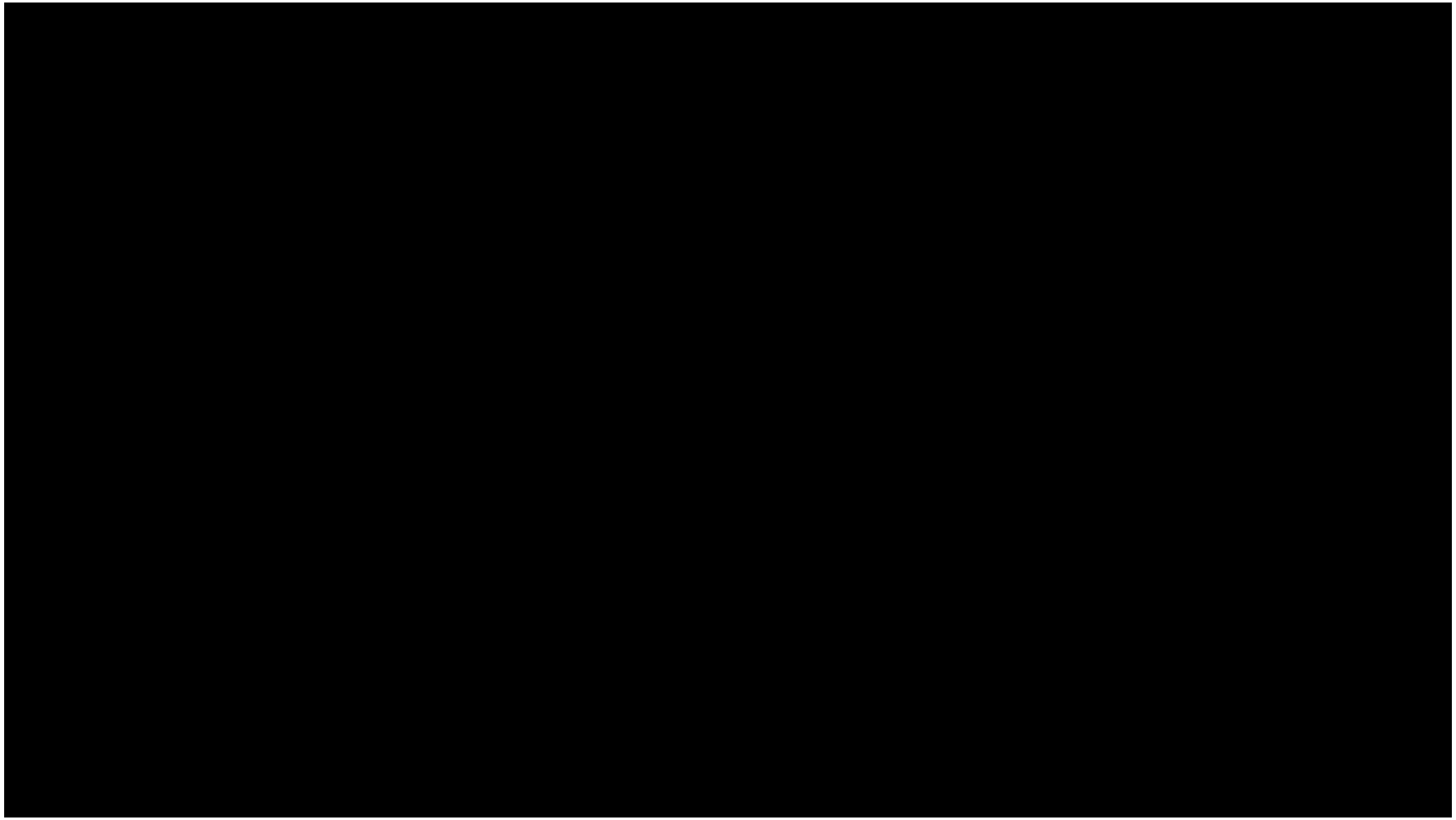
Room and Pillar

- Primary production or development for longwall
- CM equipment - limit ~16 degrees dip
- ~0.8 to 5 meter thickness
- Variable size mineable reserve blocks
- 3-10 times less productive than longwall
- Alternate road header limited to ~20 degree

Room & Pillar General Layout



Room and Pillar Mining

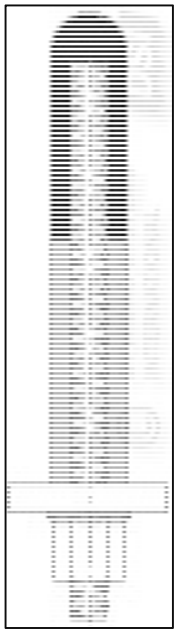


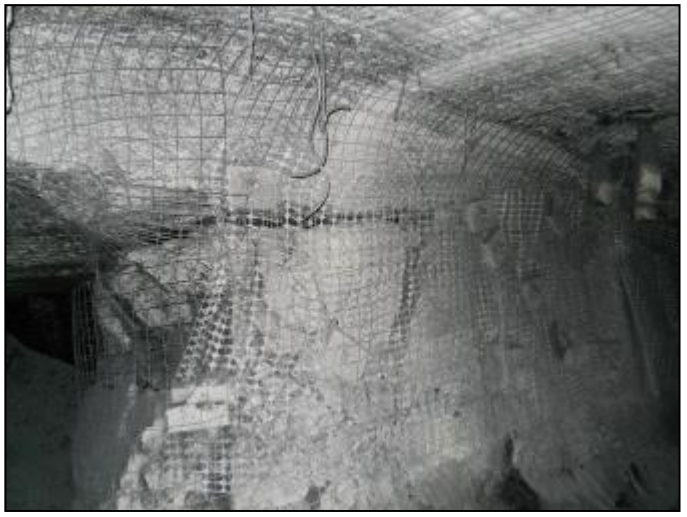
Continuous Miner

Electric Shuttle Car/Diesel Ram Car

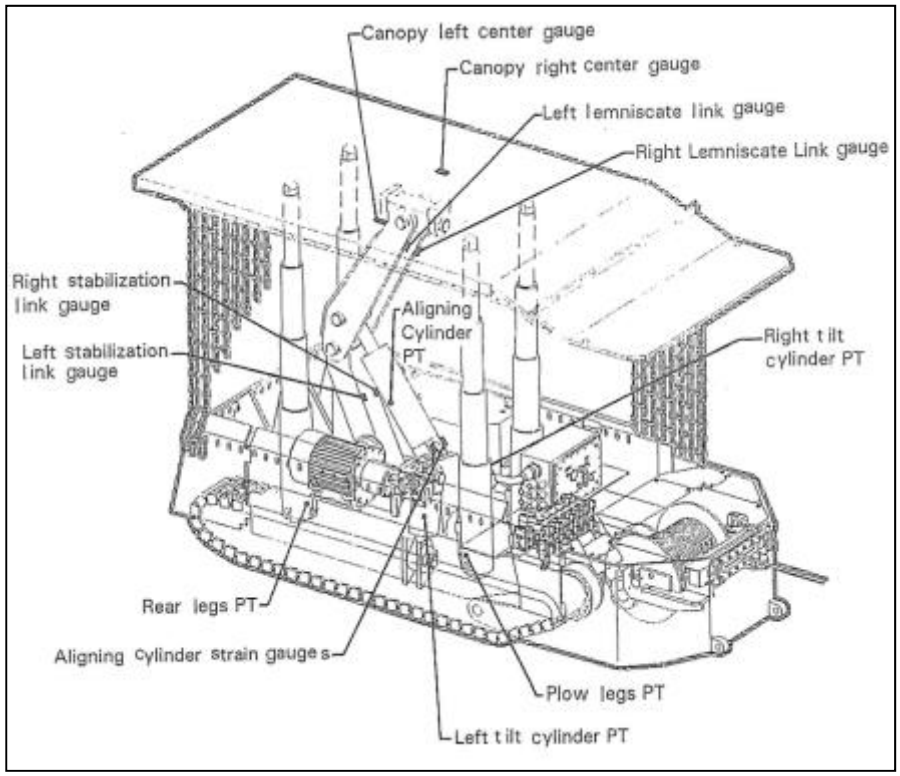
Feeder Breaker

Roof Bolter & Support

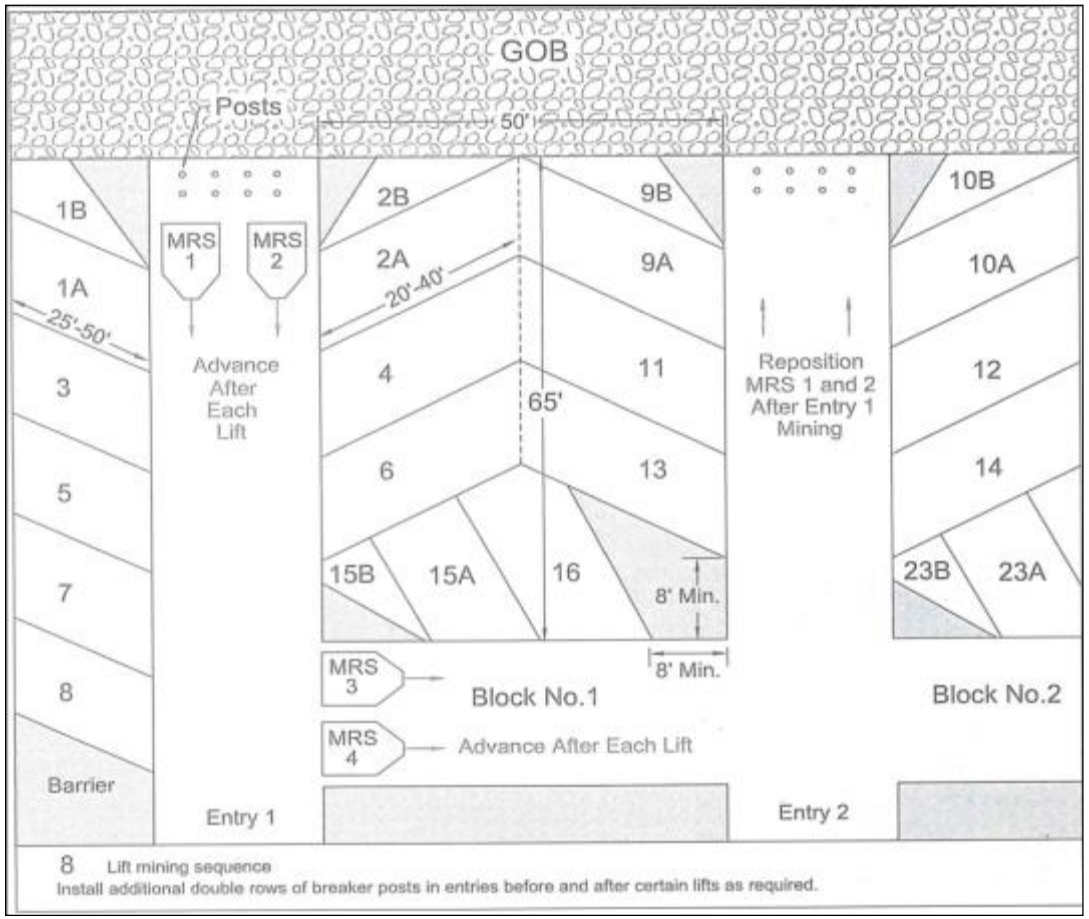




Mobile Roof Support (MRS) - Depillaring



Pillar Recovery Sequence

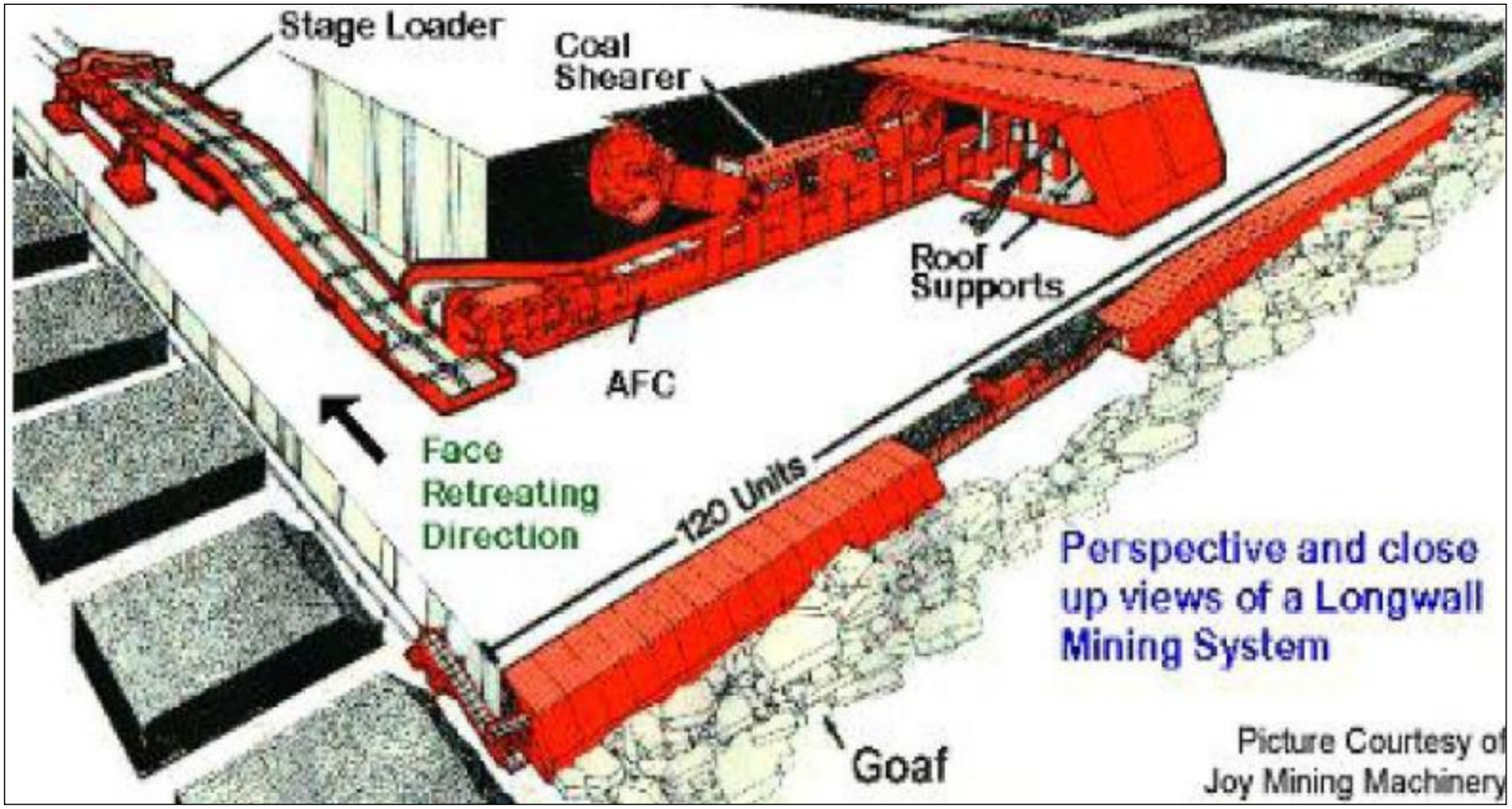


Roadheader w/ Extensible Belt

Longwall Mining

- Significantly more capital intensive to room and pillar (3-12 times)
- Mining range (0.8 m – 25m)
- Limit of ~55 degrees
- Higher recovery and productivity, lower operating cost and manpower requirement reduced over room and pillar
- More specific design application

Longwall Mining General Layout



Longwall (Shearer) System in Thick/Flat Seam

Longwall Plow System in Thin Seam

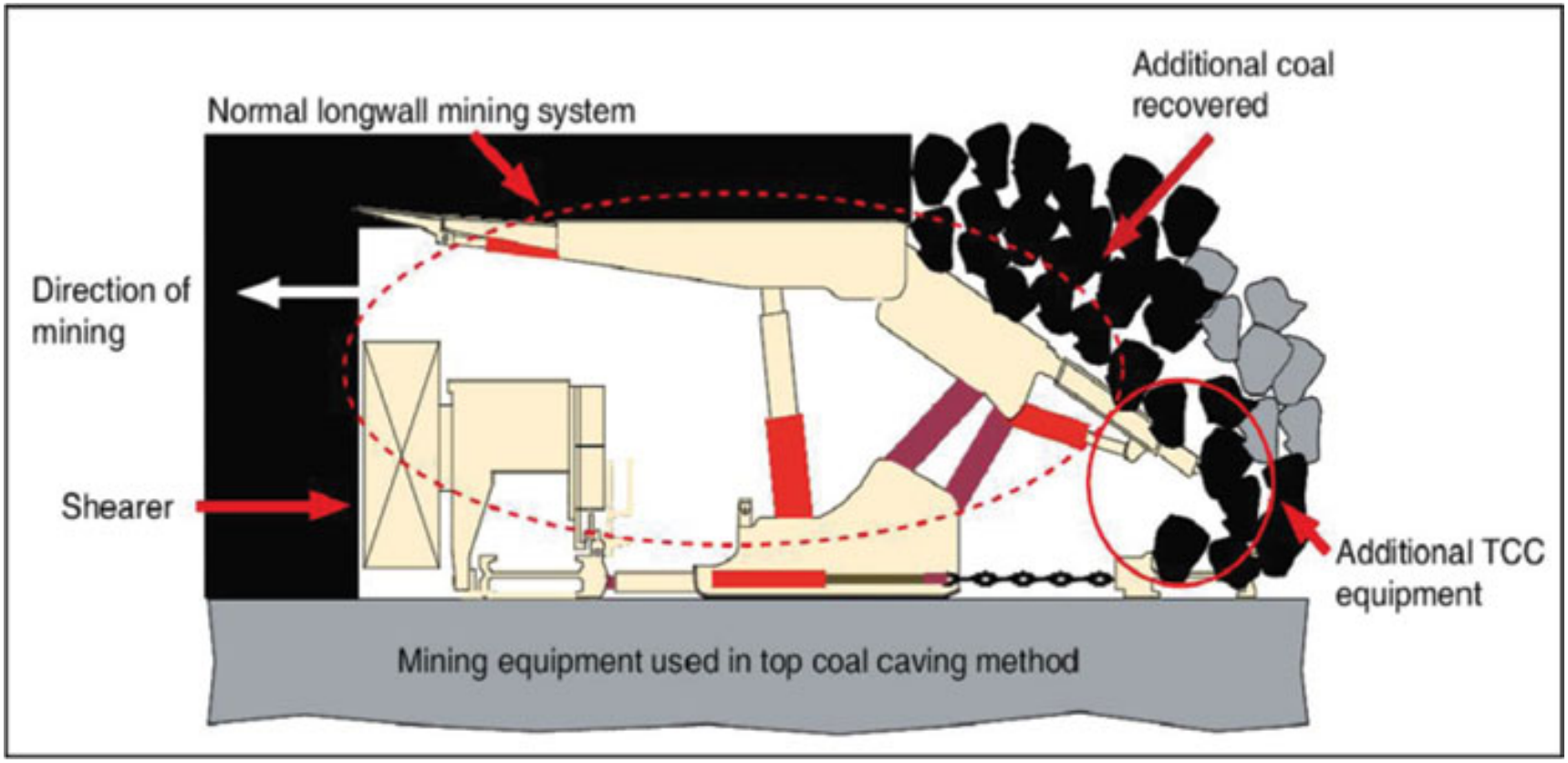
Shields (Roof Support Thick & Thin)

Longwall Mining

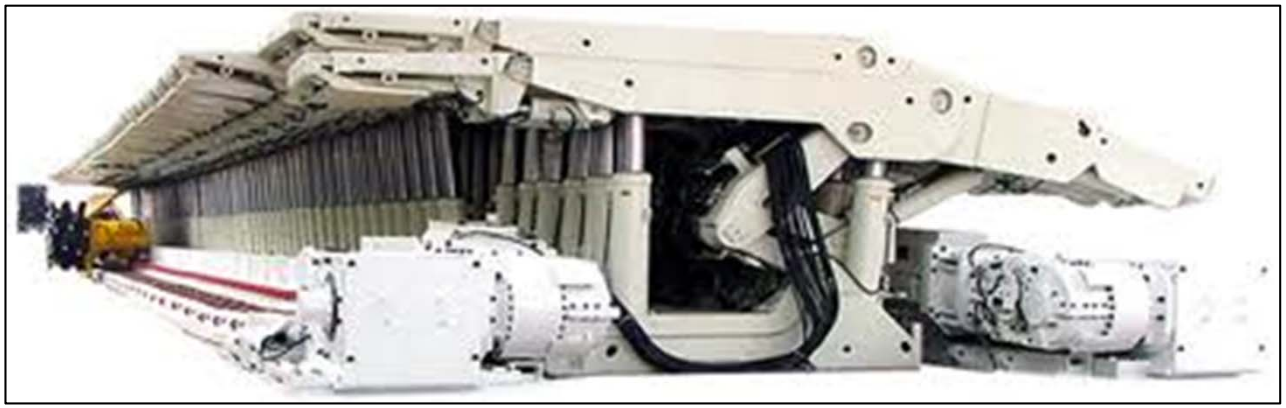
Longwall Mining (Courtesy of HDI Mining)

Automated Plow System

Longwall Top Caving



Longwall Top Caving Equipment



Longwall Top Caving

Challenges of Steep Seam Mining

Challenges of Thin & Steep

Monorail Haulage

Future Western Canada UG Mining

Requirements:

- Market Demand
- Application
- Education

Thank You!

QUESTIONS?

- Feel free to contact me at:

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