



Conference Workshop

From top coal caving longwalls to hydro mining

Wednesday 24th October 2012: 9.00am

Allison Golsby MAusIMM(CP), RPEQ, MEngSc(Min Man), MMinEng(Geomech), GDipMVent
Chief Executive Officer

GPO Box 358
Brisbane Qld 4001

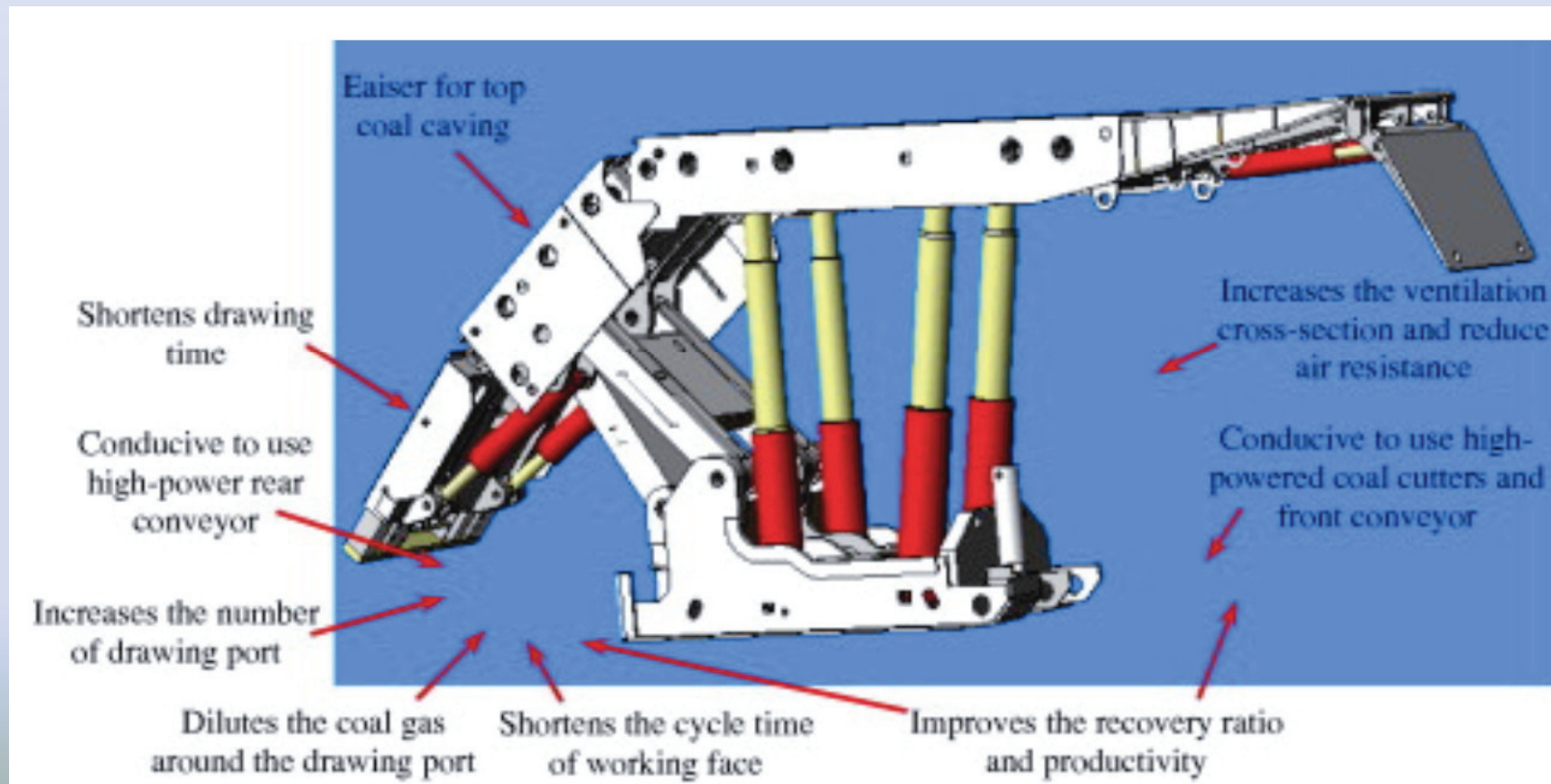


allison@golsby.org
M +61 409 008 942

www.consultmine.com.au
ABN: 65155280292

Workshop Outline

- Background
- Brainstorm with workshop delegates
- Possible answers
- Posit solutions



Schedule



ABN: 65155280292

8.30 am Morning coffee and registration

9.00 am Workshop

Introduction

Background

What is Top Coal Caving

10.30am Morning Tea

11.00am Workshop

Is top coal caving the answer?

How does it work

Are there other mining methods?

Is new technology available?

12.30 pm Lunch

1.30pm Workshop

Can you block cave coal?

Longwall ploughs vs Longwall shearers?

Could a Longwall be developed that could cut 9m?

What are the limits of super chocks?

Are tunnel boring machines viable for coal mining?

3.00 pm Afternoon Tea

3.30pm Workshop

What is hydro mining?

Is hydro mining safe?

Could hydro mining harvest all the coal from a 9m seam? If so, how wide would The cut be; for what distance and at what depth?

5.00 pm Finish

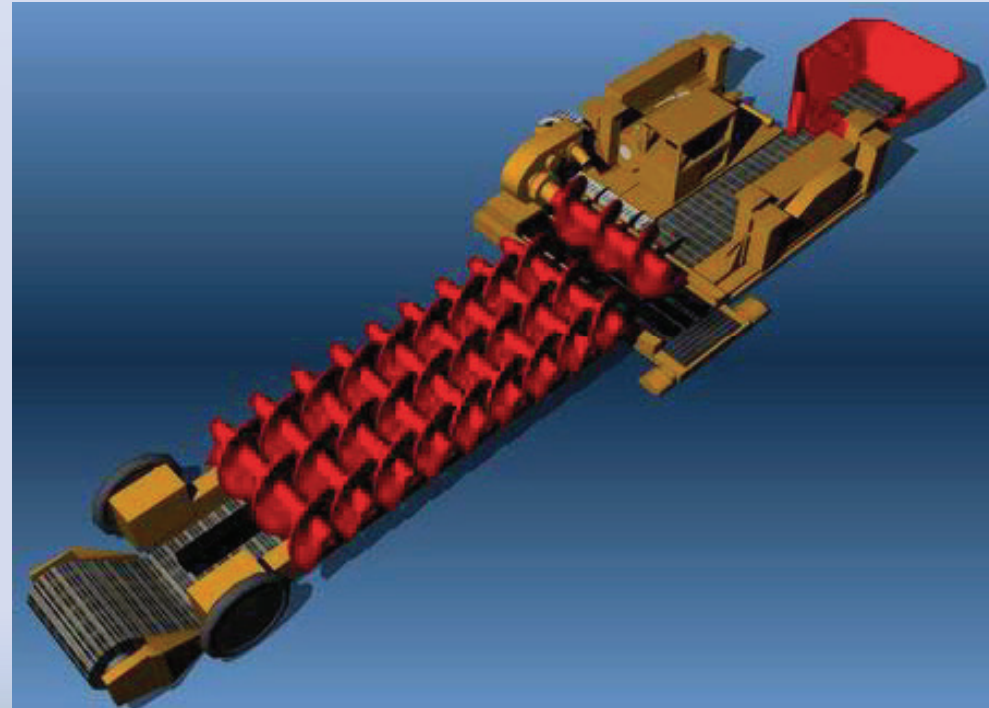
Workshop Summary

- What is top coal caving?
- Is top coal caving the answer?
- How does top coal caving work?
- Are there other mining methods?
- Is new technology available?
- Can you block cave coal? If not, why not?
- Longwall ploughs vs Longwall shearers?



Workshop Summary (cont)

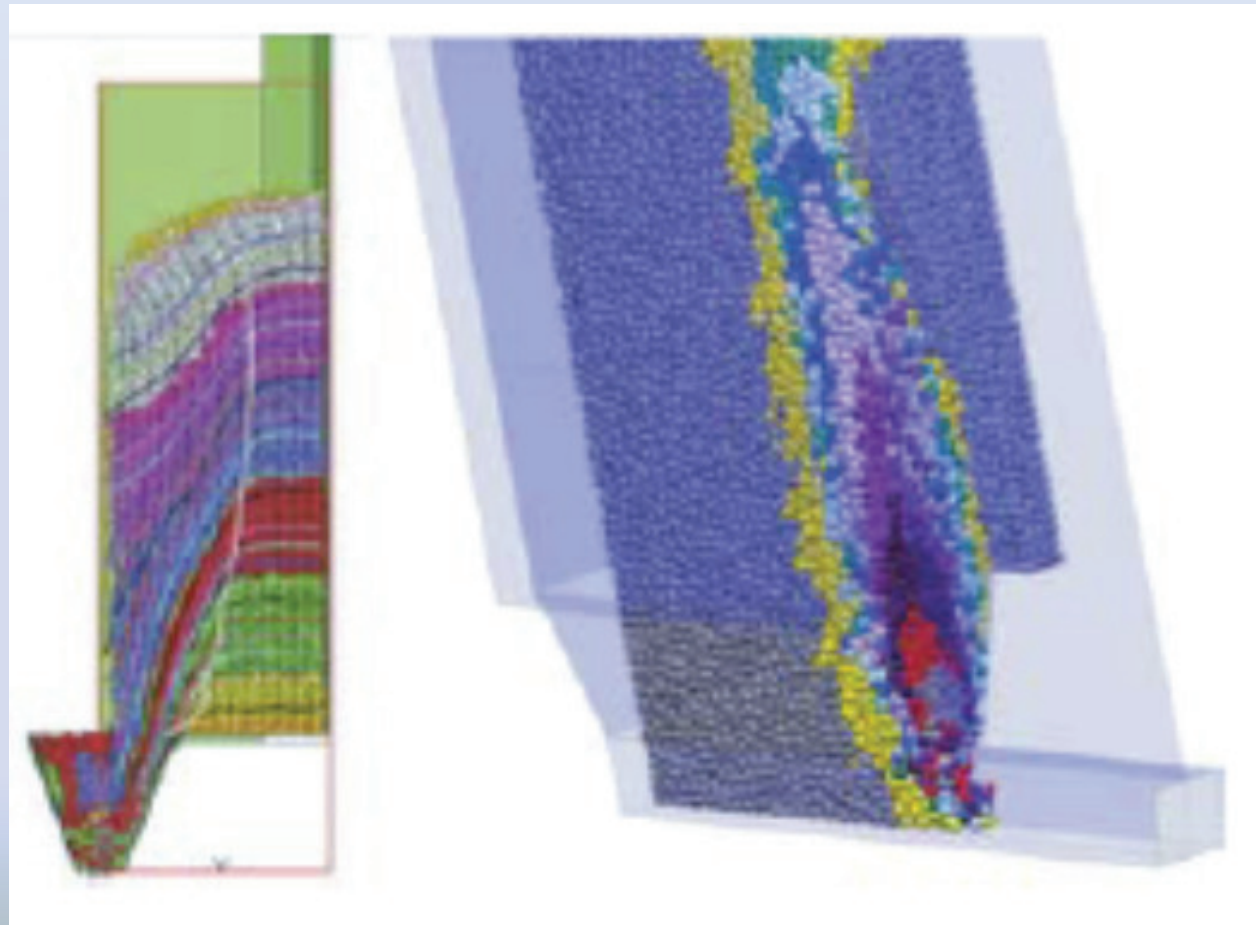
- Could a Longwall be developed that could cut 9m?
- What are the limits of super chocks?
- Are tunnel boring machines viable for coal mining?
- What is hydro mining?
- Is hydro mining safe?
- Could hydro mining harvest all the coal from a 9m seam? If so, how wide would The cut be; for what distance and at what depth?



Background

- Thick seam mining

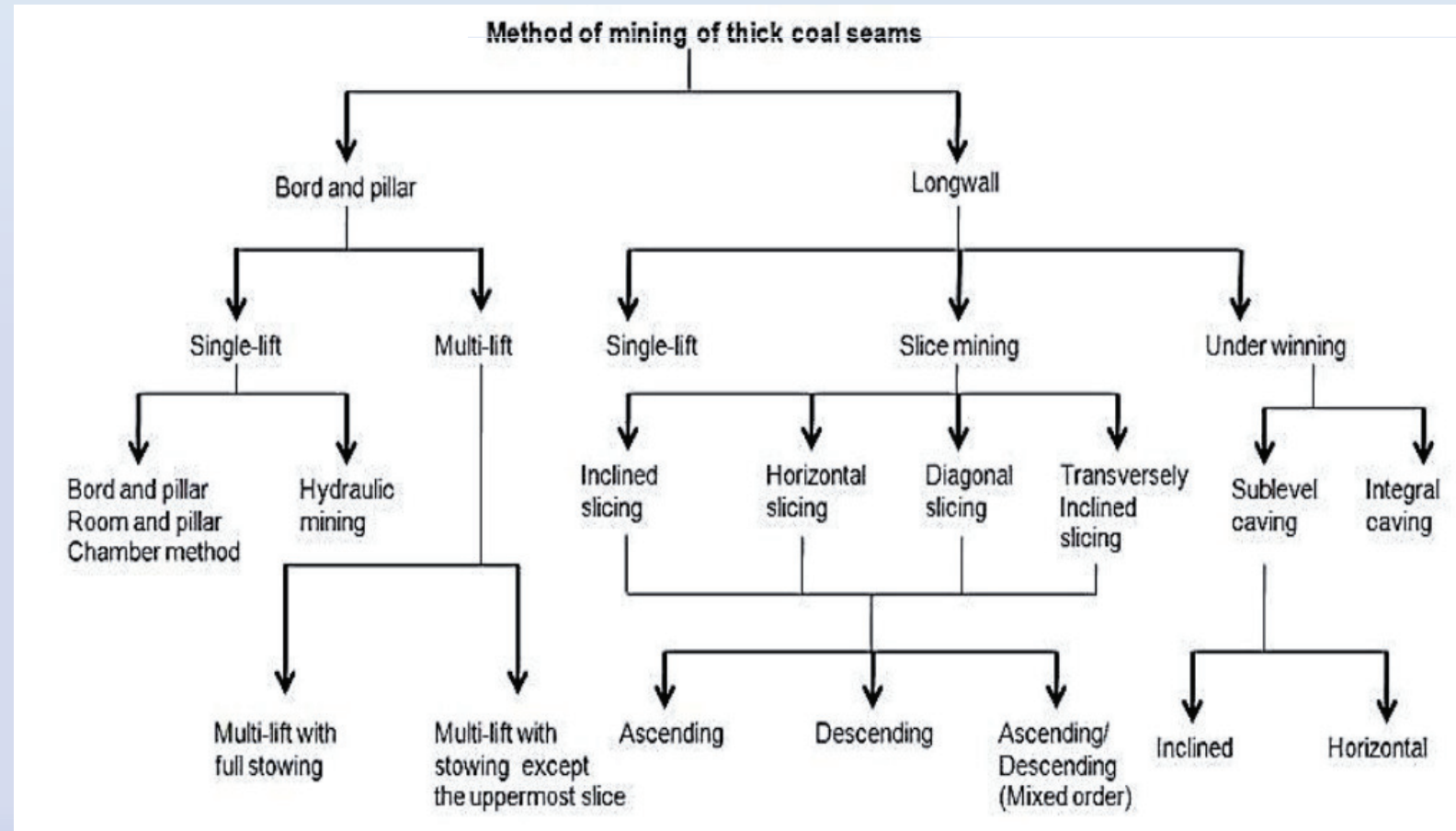
- More than 4.8m
- Strata control
- Premature pillar failure
- Spontaneous combustion
- Heavier supports required
- Subsidence
- Higher capital
- Easier to plan
- More dilution
- Higher extraction ratio
- Higher gas make



Background

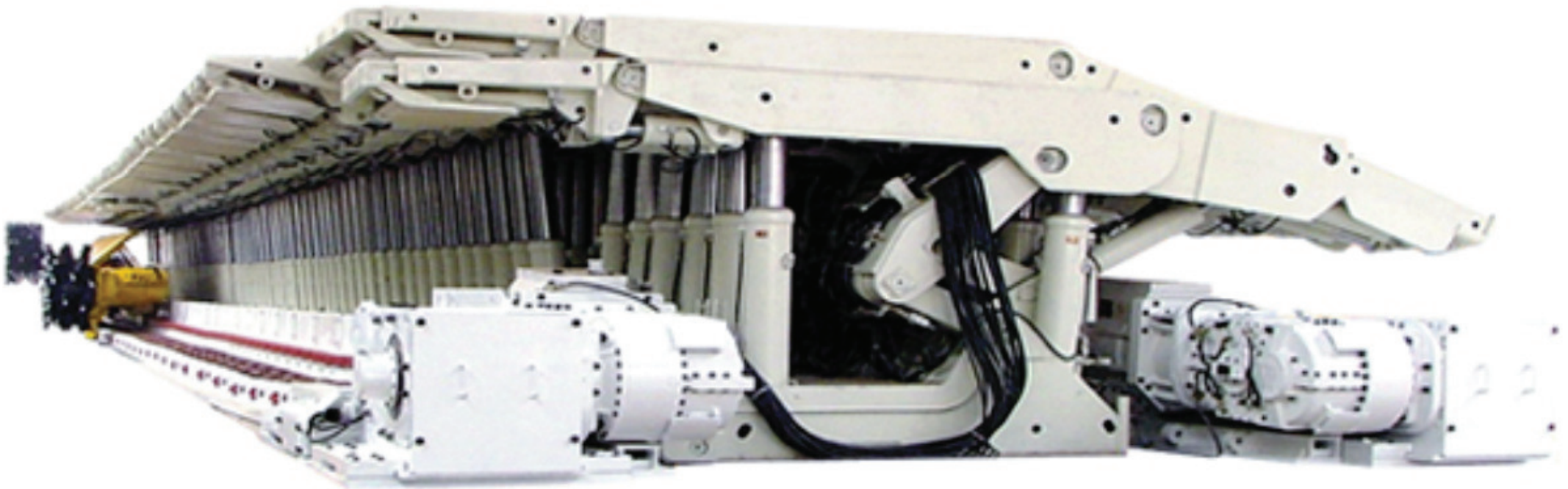
- Methods

- Hydraulic
- Caving
- Multi slice
- High face
- Longwall
- Velenje
- Auger
- Tunnel Borer
- Road header



What is top coal caving?

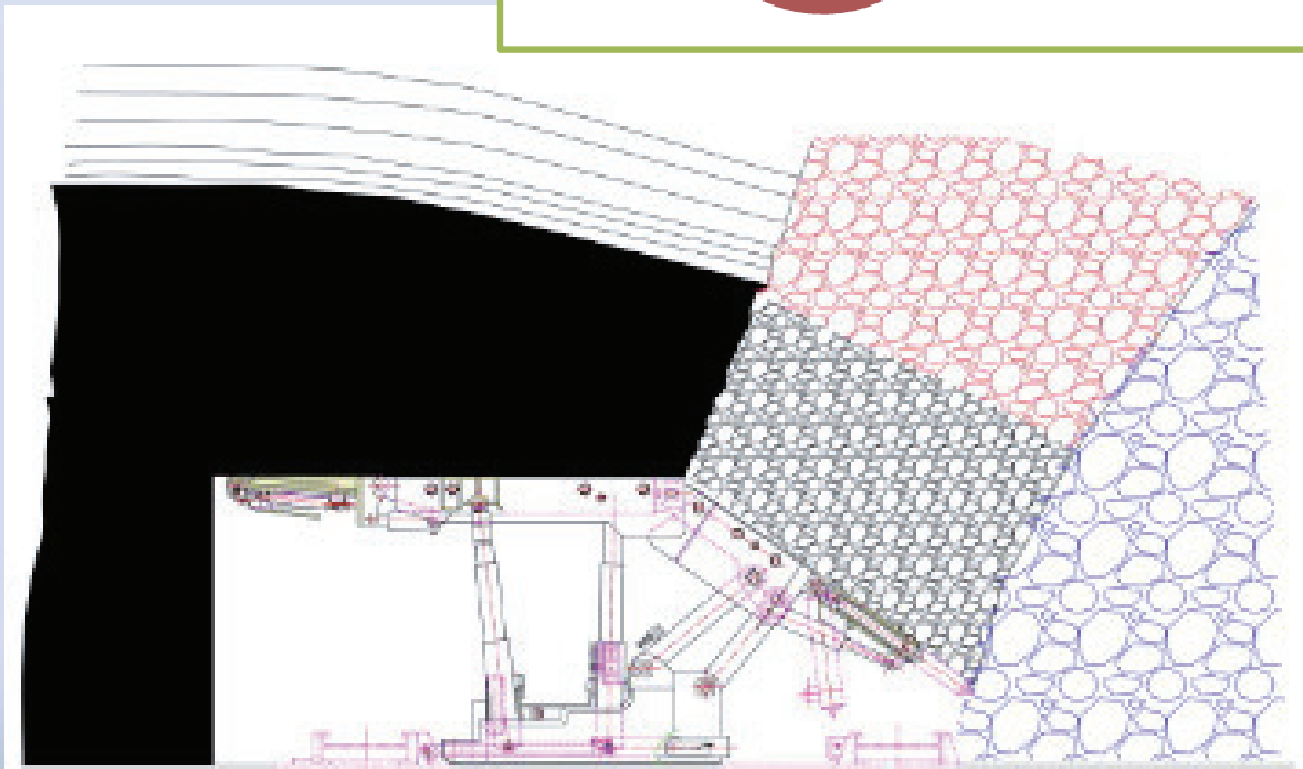
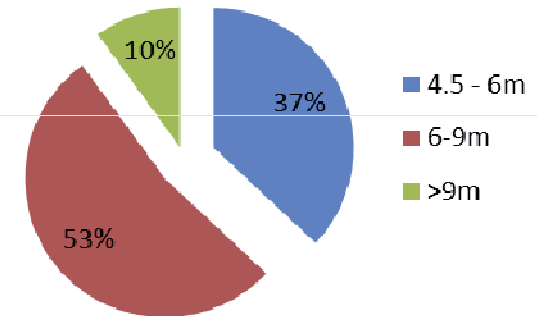
- Longwall shearer
- Extracts higher than normal LW
- Upper part of the seam is caved



What is top coal caving?

- 85-90% recovery
- 6.4Bt estimated Australian reserves suitable for LTCC (UNSW/CSIRO)
- Blasting may be used
- Caving by gravity
- LW at foot of seam
- Two AFCs
- Suits high fluidity coal with good fragmentation

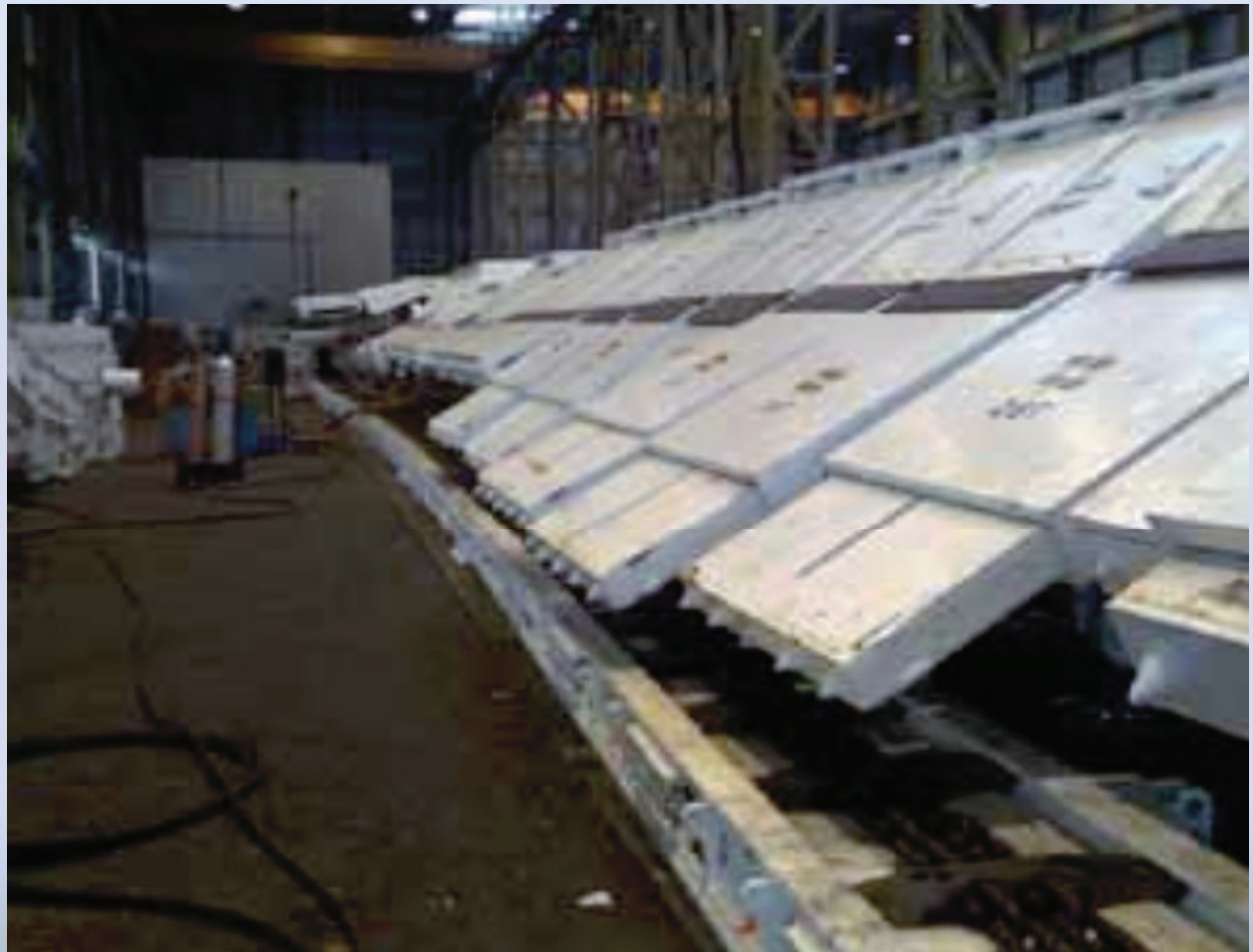
Australian Seam Thickness Measured Resource



Is top coal caving the answer?

- Benefits

- Recovery
- Lower face extraction height
- Increased face stability
- Easier development
- Reduced risk of goaf spontaneous combustion
- Higher resource recovery compared to cost of development



Is top coal caving the answer?

- Risks

- Spontaneous Combustion
- Dilution
- Conditioning – hydro fracturing or blasting
- Gas make
- Fire risk
- Subsidence
- Dust
- Convergence of gate roads



Is top coal caving the answer?

- Geotechnical risk
 - Waste angle of repose
 - Top coal max radius
 - Top coal caving angles
 - Yield angles
 - Wall friction energy
 - Wall stress

- Equipment selection

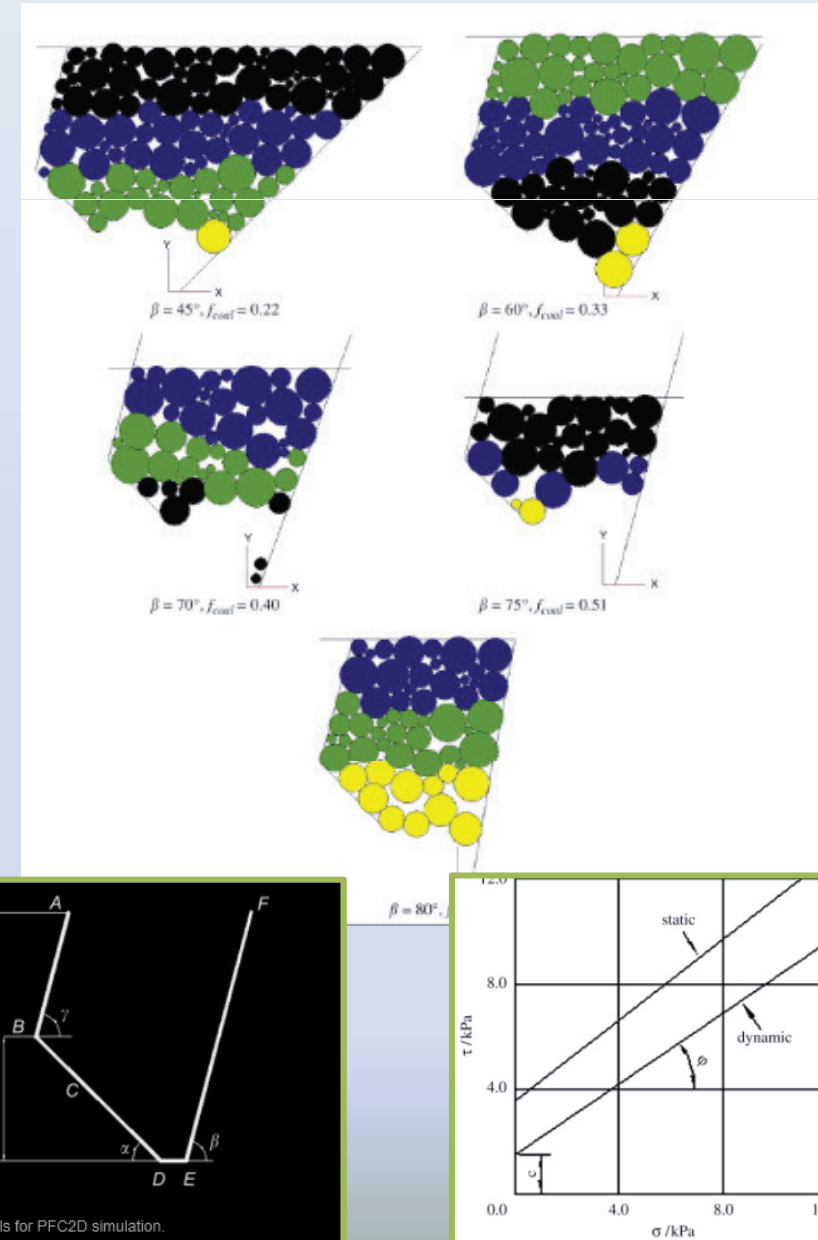
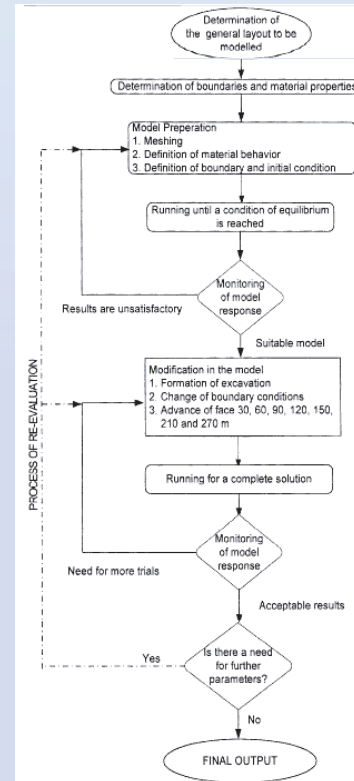


Fig. 4. Models for PFC2D simulation.

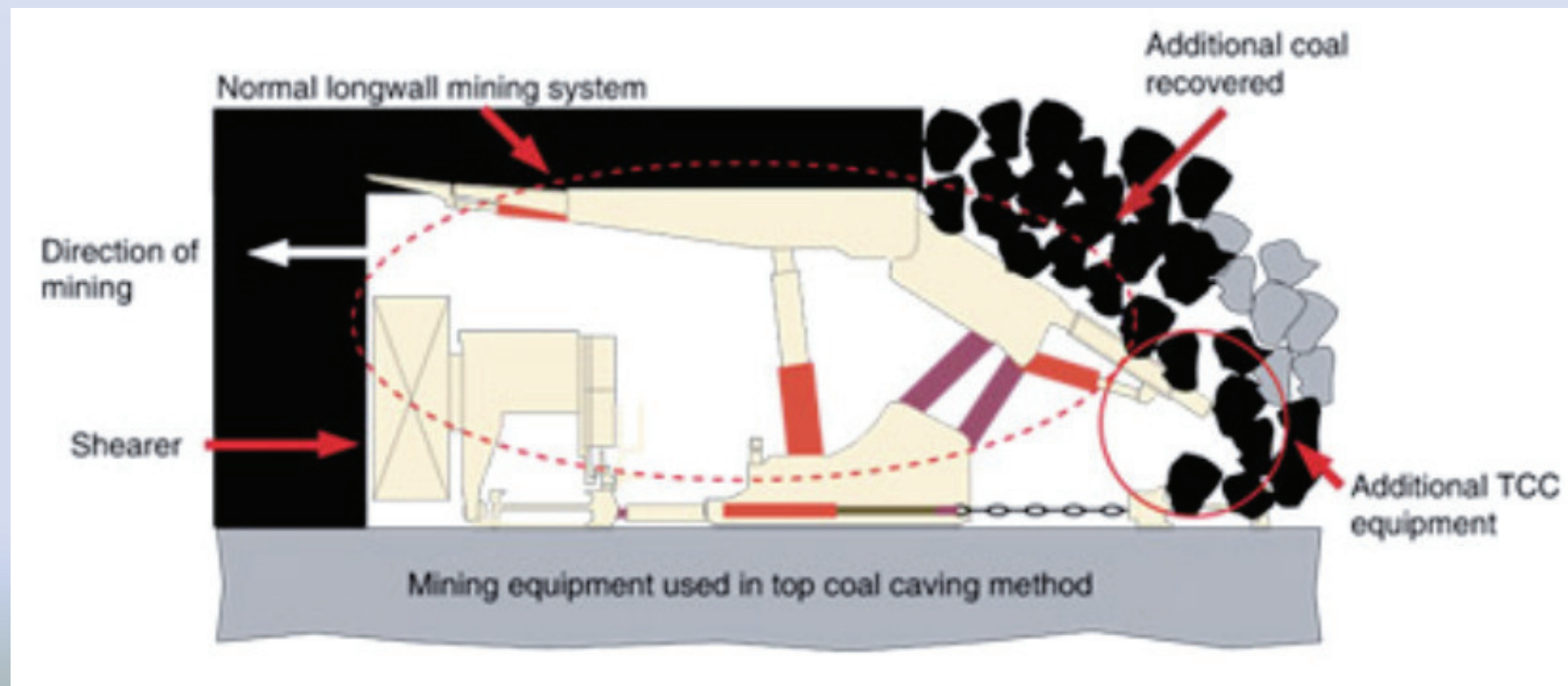
How does top coal caving work?

- Case study – Austar
- Acknowledge the assistance of:
 - Austar website
 - Ellton Longwall website
 - China National Coal Mining equipment website
 - China Overseas Development co website
 - Kurt Ekanayake – Austar commissioning and now Principle Mining Engineer AMC



How does top coal caving work?

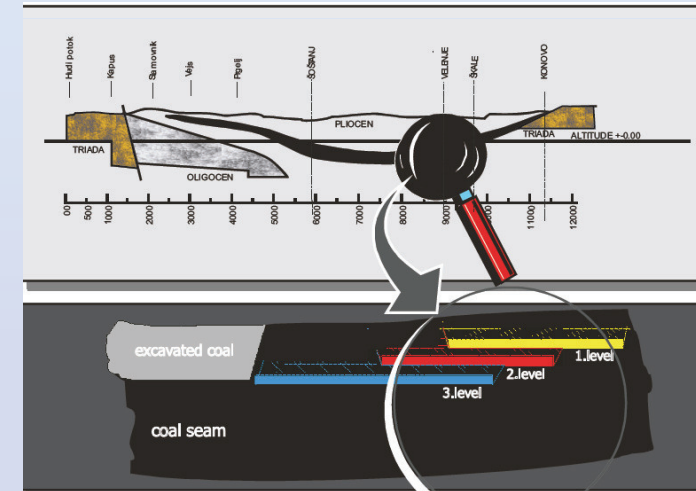
- Case study - Austar
- Soutirage



Are there other mining methods?

- Velenje method

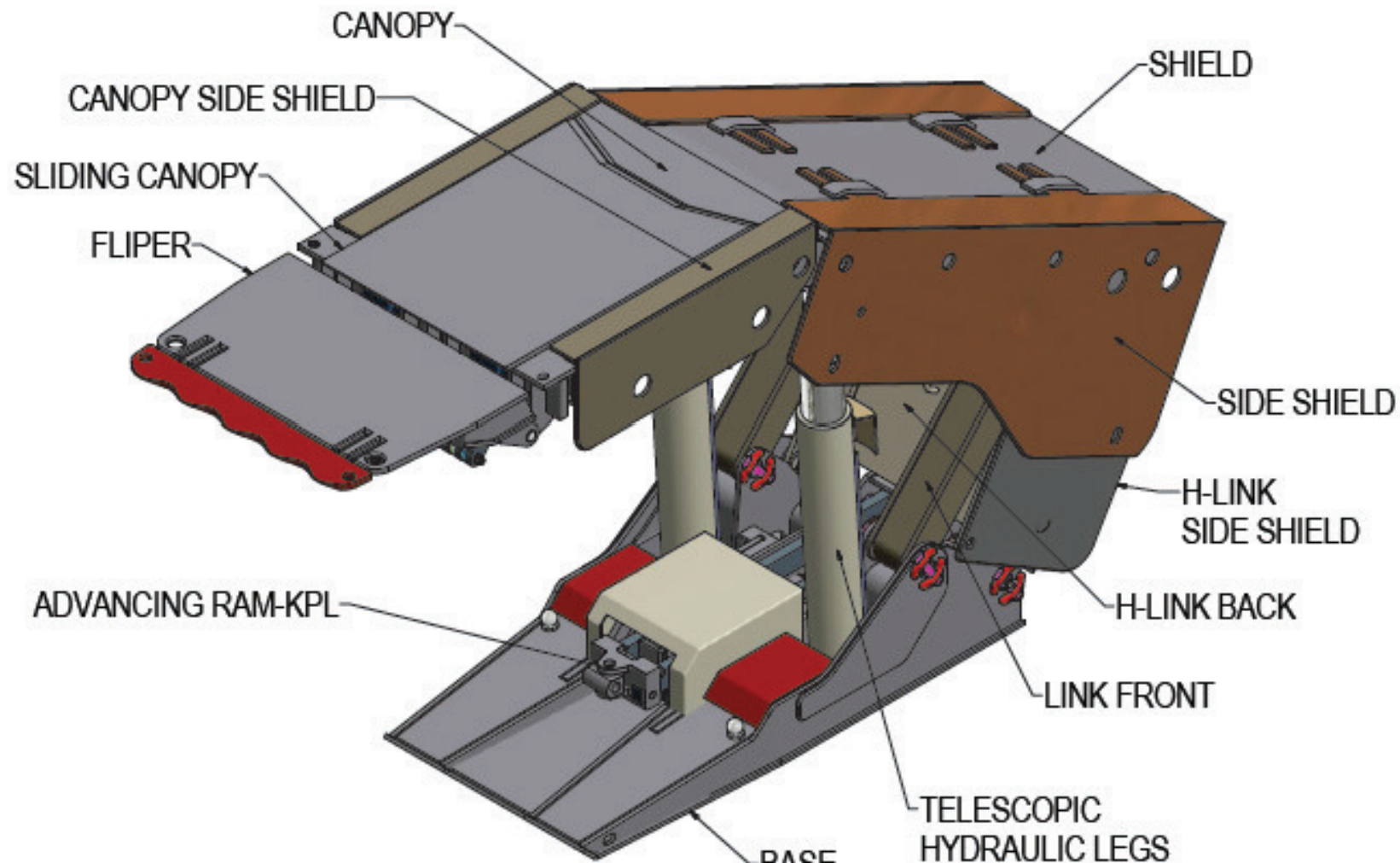
- Face 5-17m high
- Face length 200m
- Face advance 9m/day



Are there other mining methods?

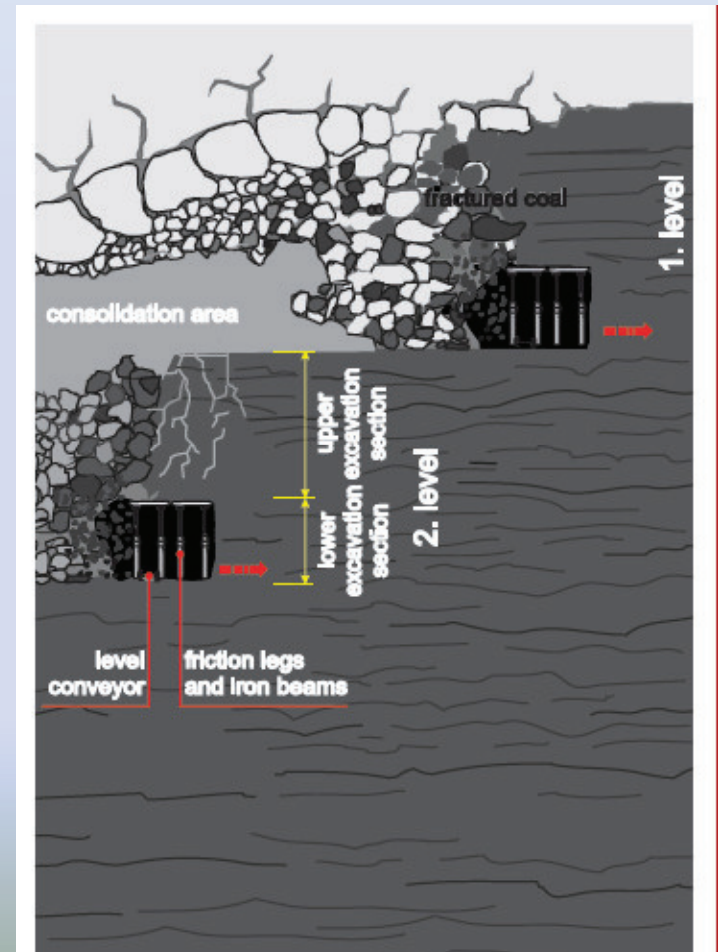
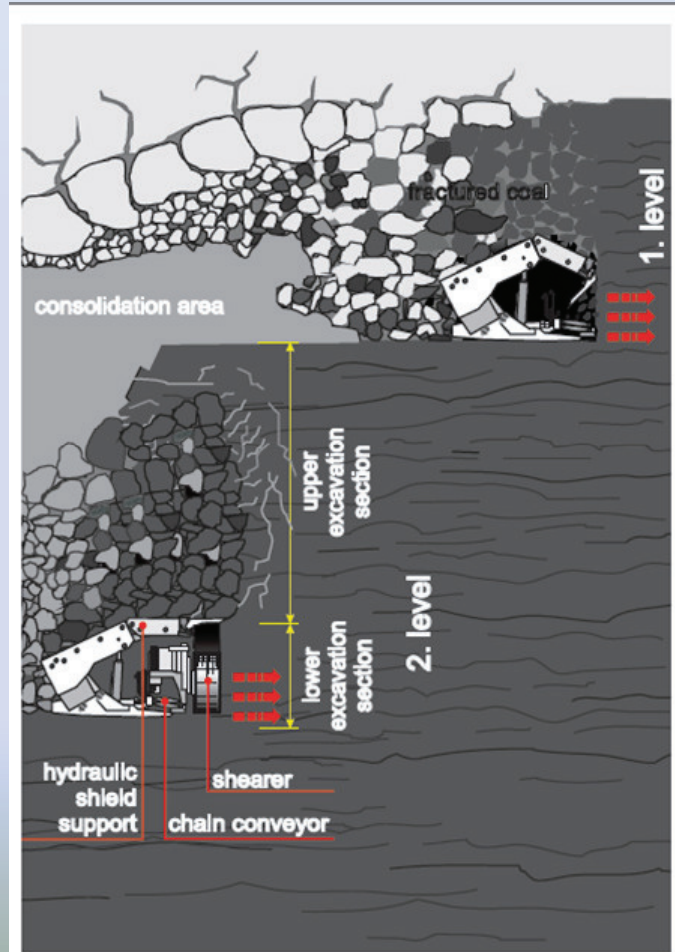
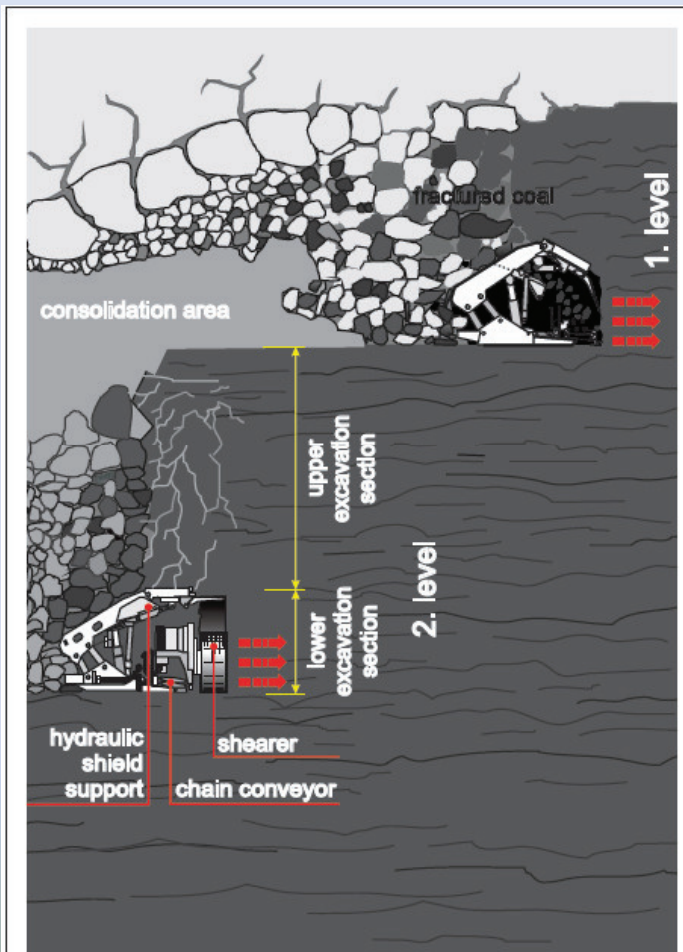
- Velenje Longwall

<http://www.rlv.si/en/files/default/ANG%20BROSURA%20VOM.pdf>



Are there other mining methods?

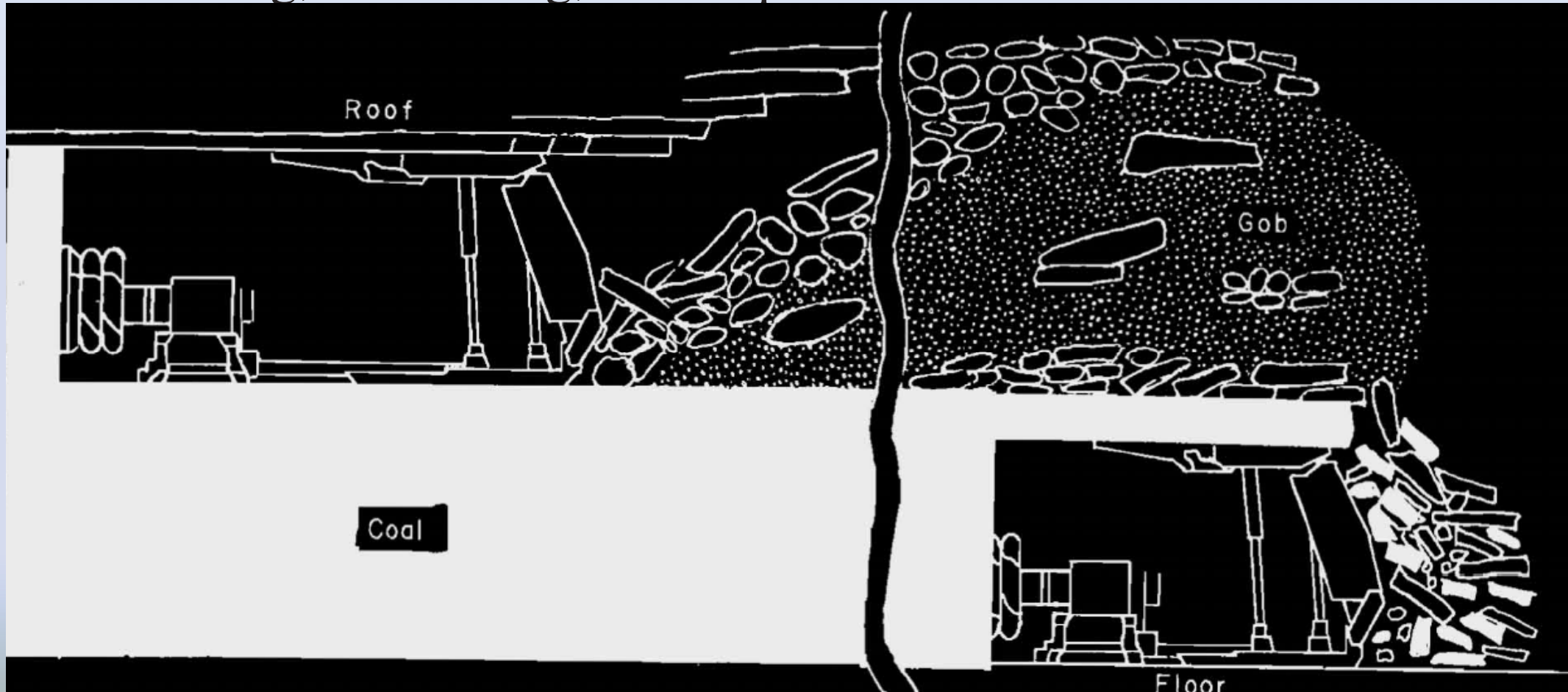
- Velenje Longwall



Are there other mining methods?

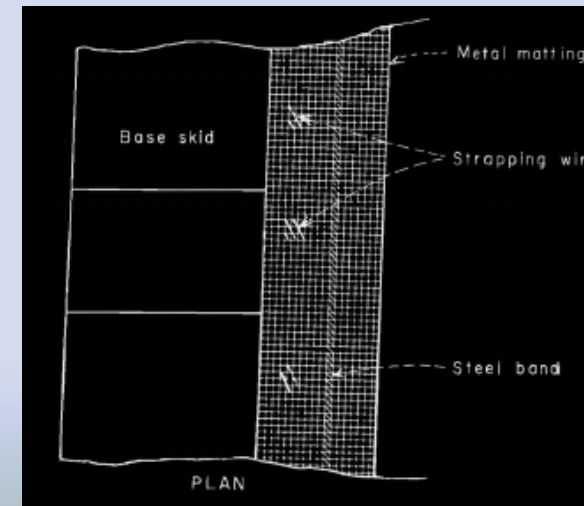
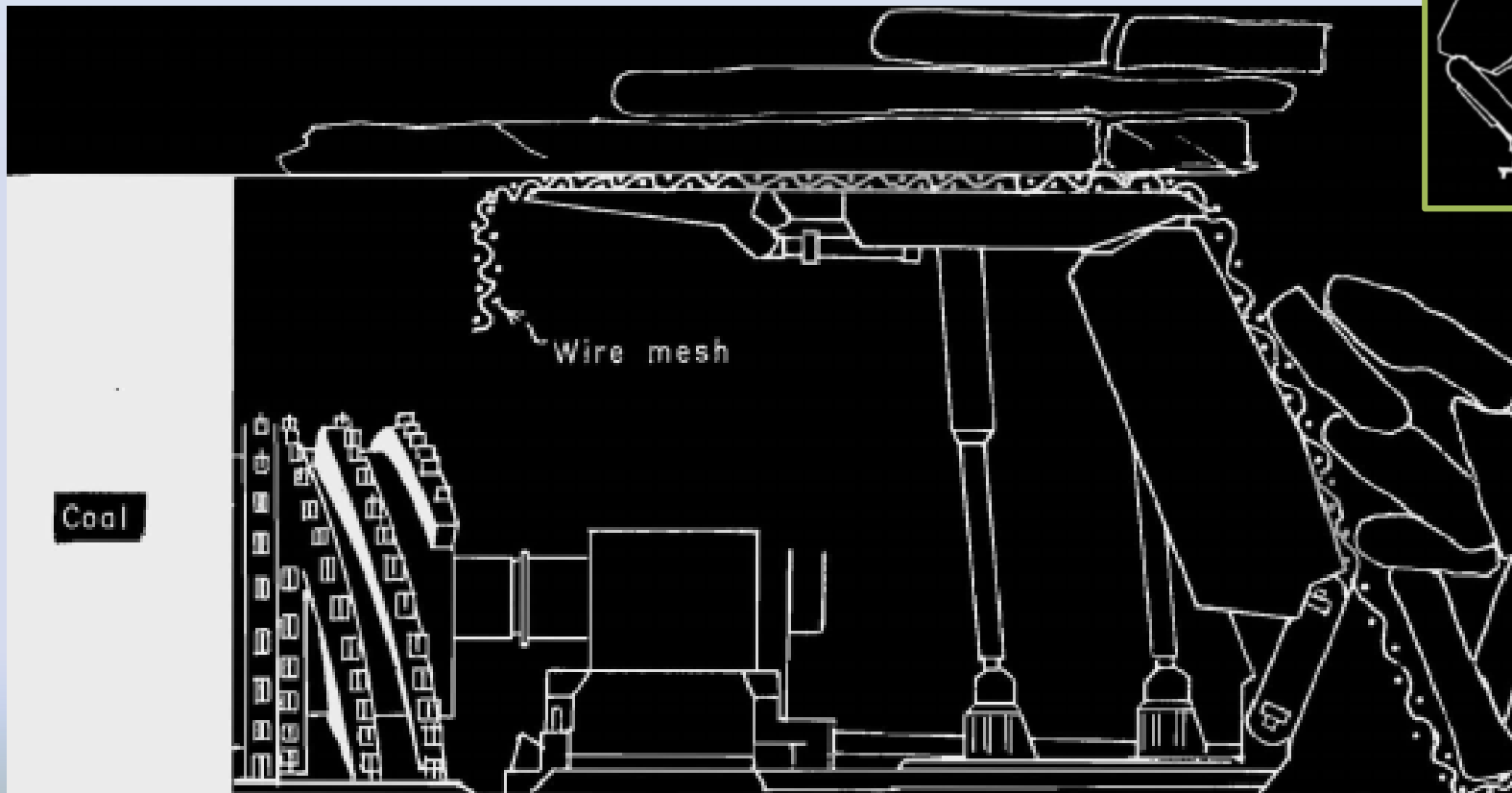
- Multislice Longwall

- Ascending, descending, non sequential



Are there other mining methods?

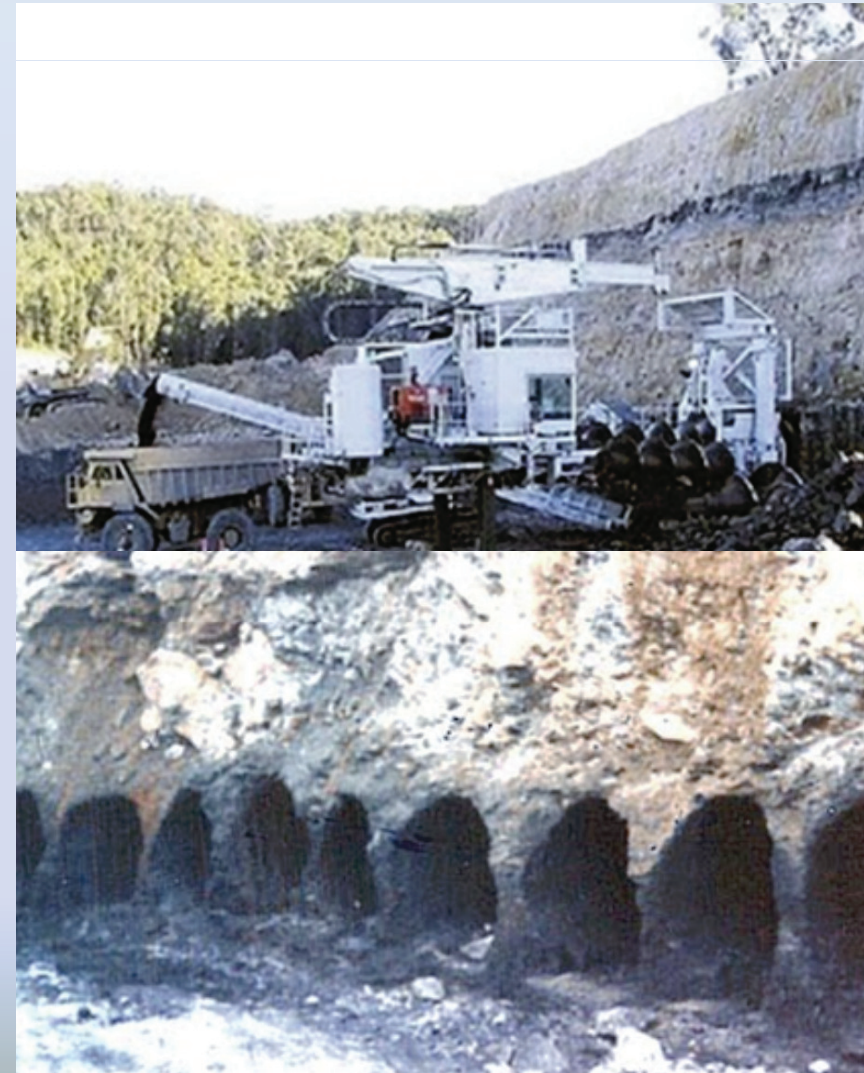
- Multislice Longwall
 - Horizon maintenance



Are there other mining methods?

- Auger Mining

- High wall mining
- Punch mining
- Depth of cut – rig force
- Hard to steer
- Utilise coal between open cut and underground



Mine planning and panel layout

➤ Plan

- Capital
- Seam thickness
- Coal recovery
- Same roof and floor conditions as normal LW
- Gassy – non simultaneous multislice
- Sealing and spon com
- Ventilation

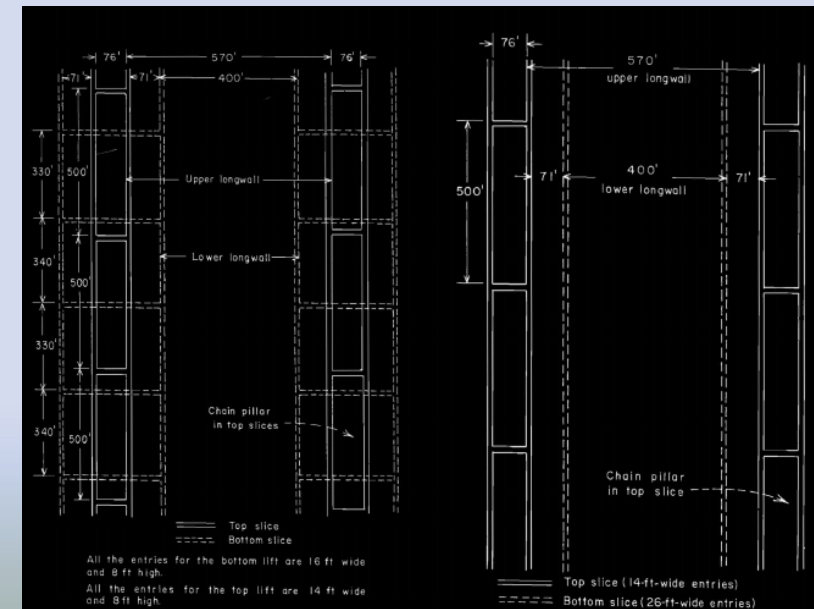
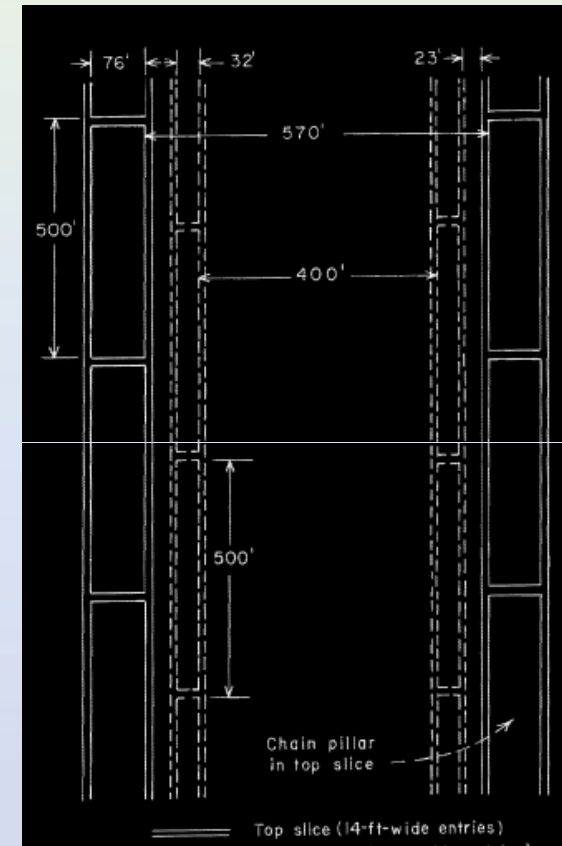


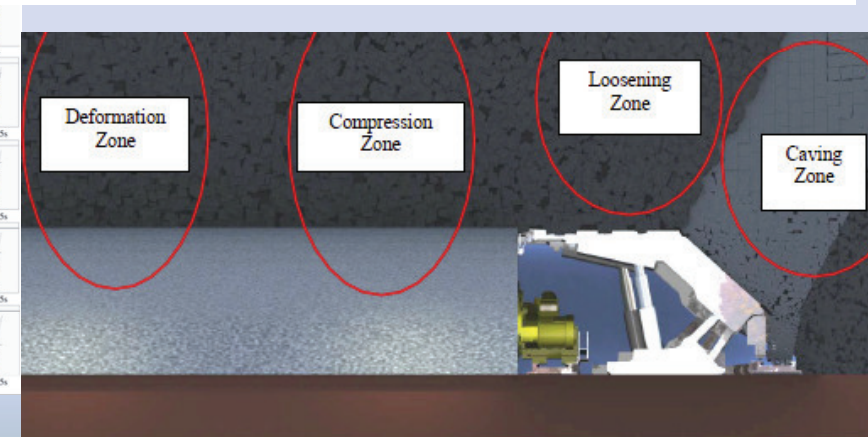
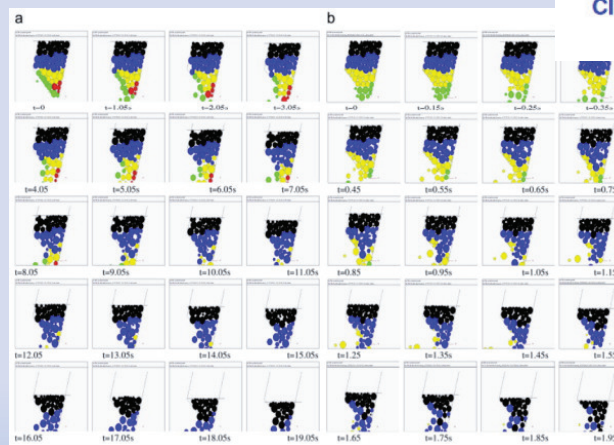
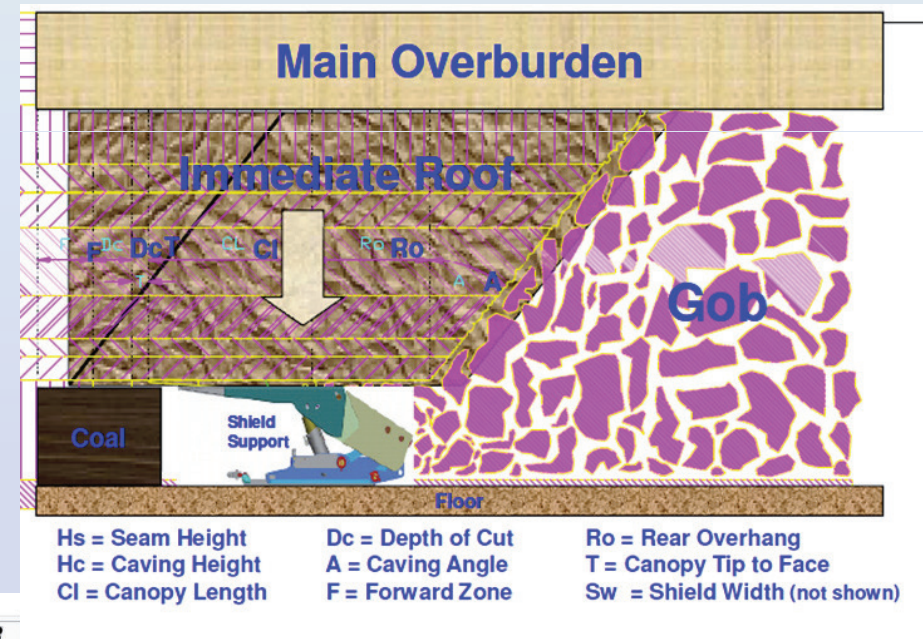
FIGURE 8. - Longwall panel layout with upper entries

FIGURE 9. - Longwall panel layout with double entries

Is new technology available?

- Predictive tools

- Fragmentation
- Waste slope angle
- Flow analysis
- Coal arch behaviour
- Coal breakage angle
- Particle size
- Hard to model



Is new technology available?

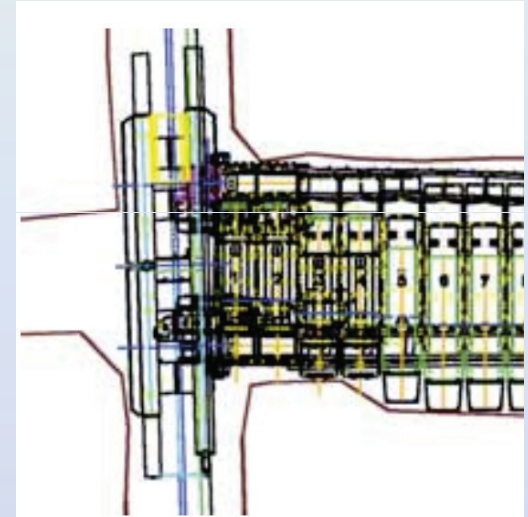
- Multi slice
LW support
- Specialist
support



Self advancing hydraulic supports to keep roadways open

Is new technology available?

- Main gate support to the rear BSL –
Case study Austar



A schematic plan view of the main gate end shows



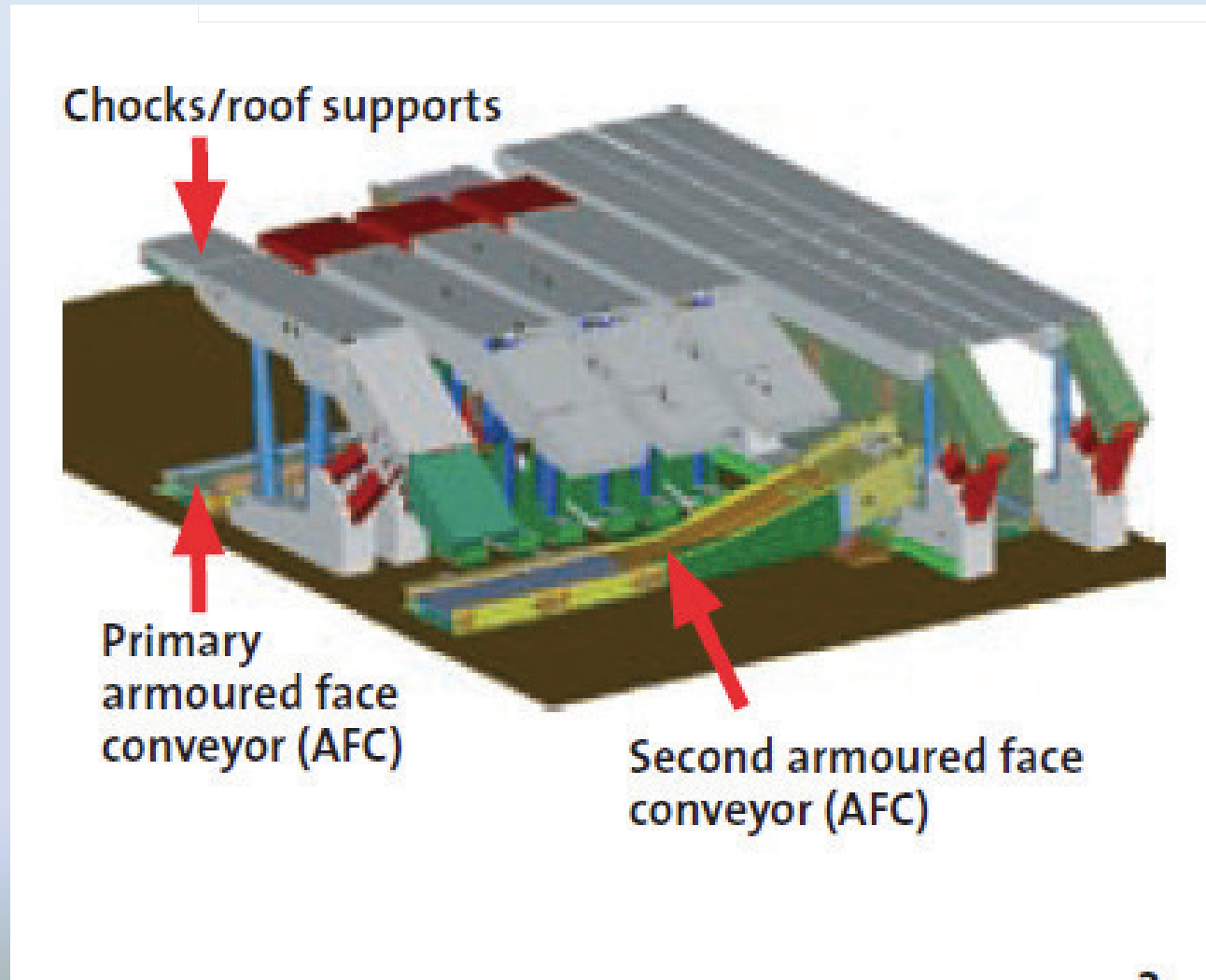
Is new technology available?

- Commissioning
- Caving – Case study Austar



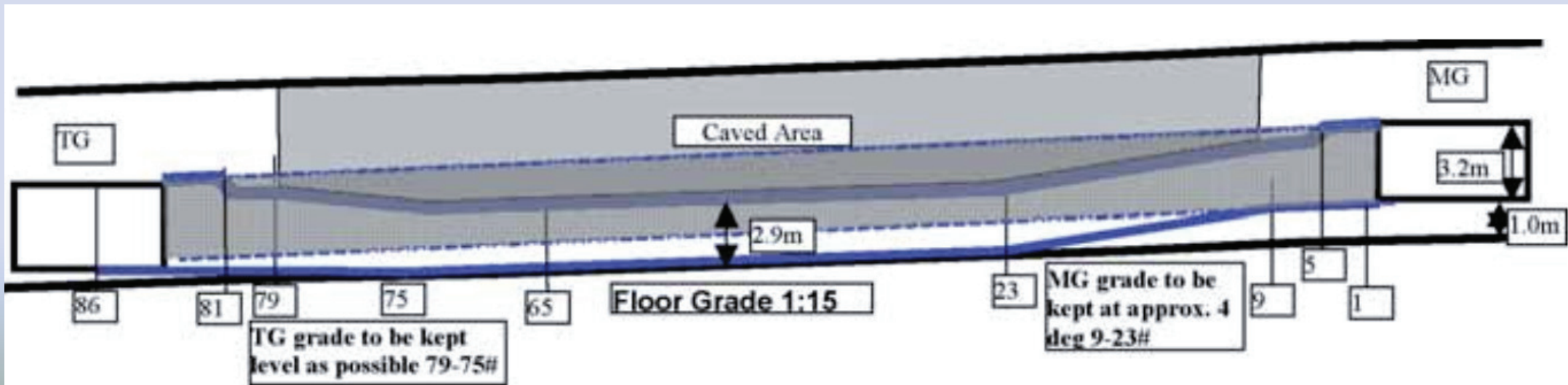
Is new technology available?

- Moving forward -
Case study Austar
- Recovery sequence
- Roof support
- Anticipated increased stress and floor heave



Is new technology available?

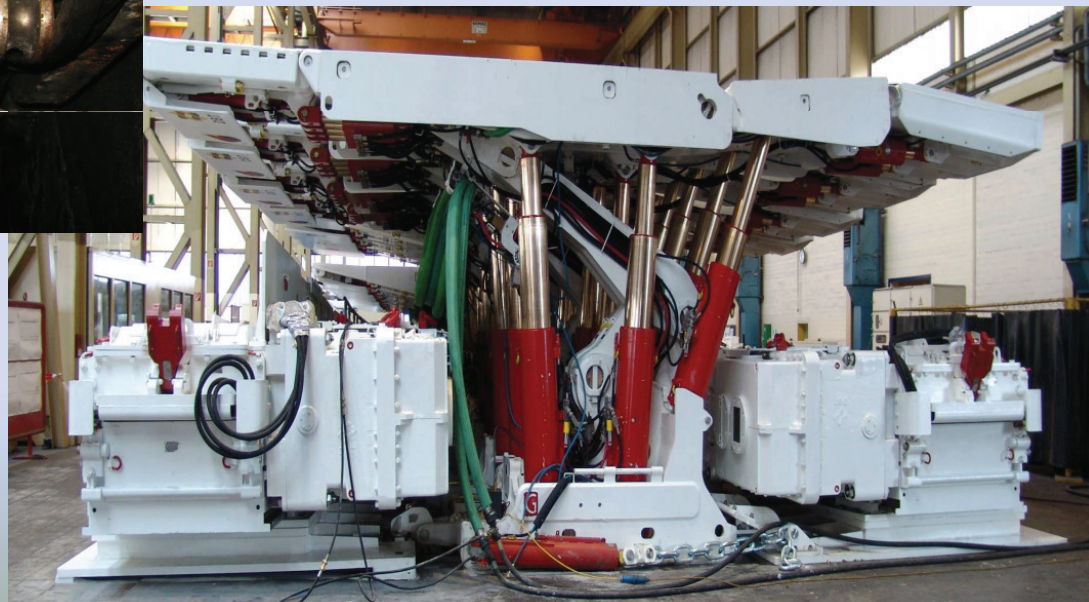
- Moving forward - Case study Austar
- Increased roadway size
- Increased valve functions to supports
- Maintenance engineering
- Ventilation – gas/heat
- Automation



cross-section of the longwall face demonstrates the importance of horizon control.

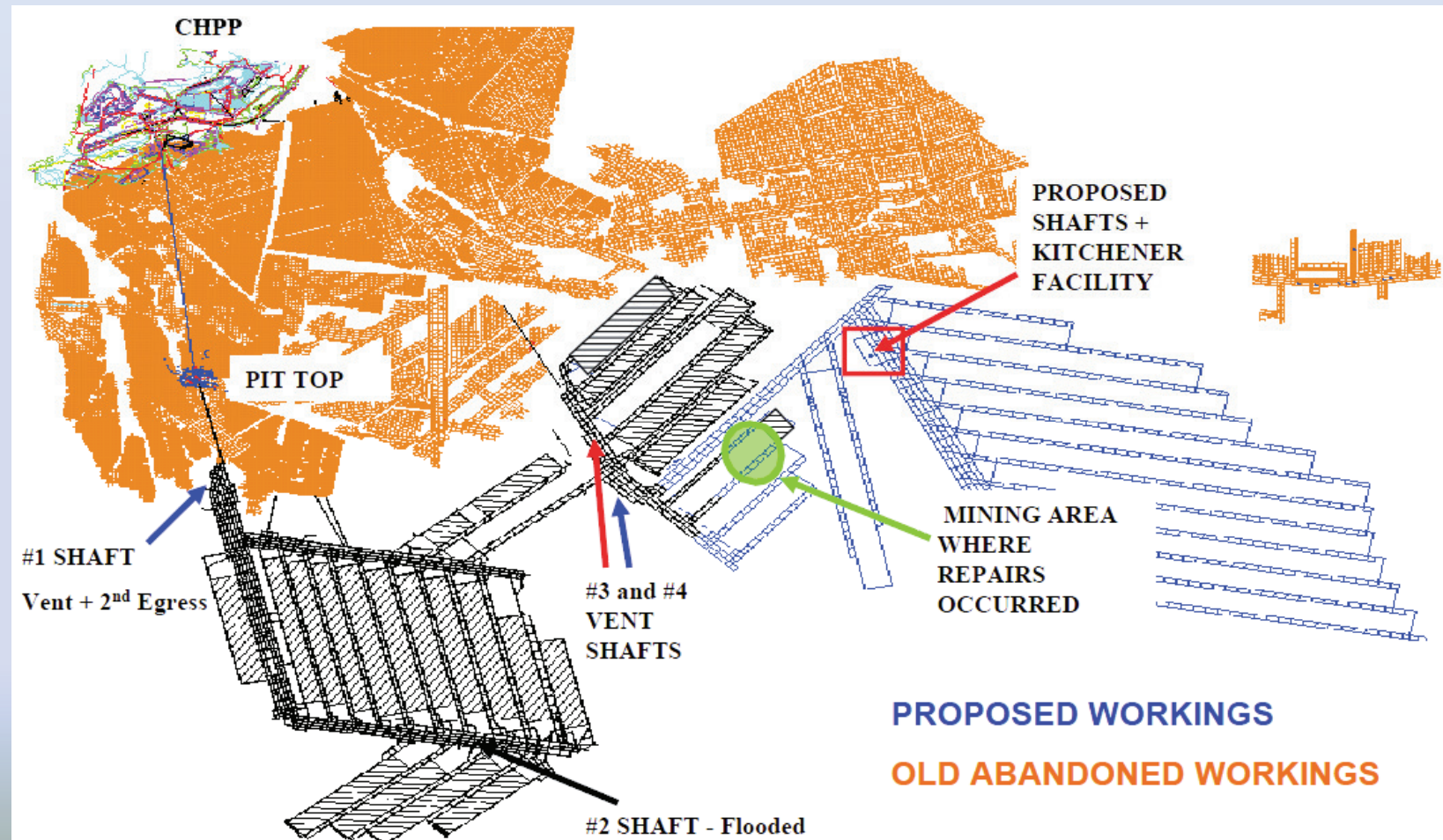
Is new technology available?

- Moving forward - Case study Austar
- Continuous improvement



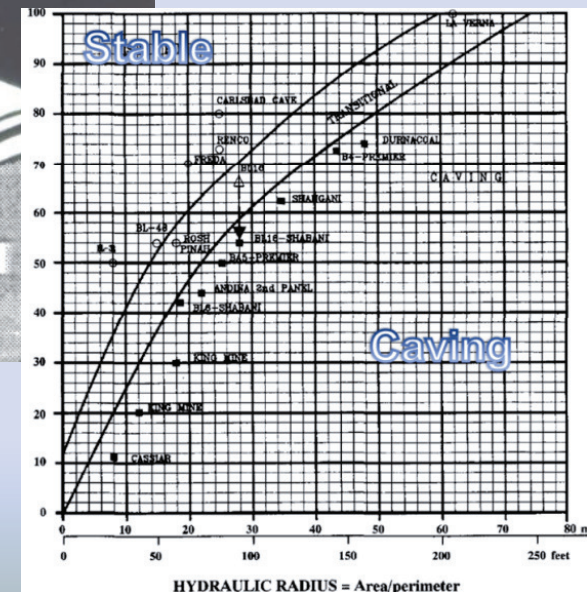
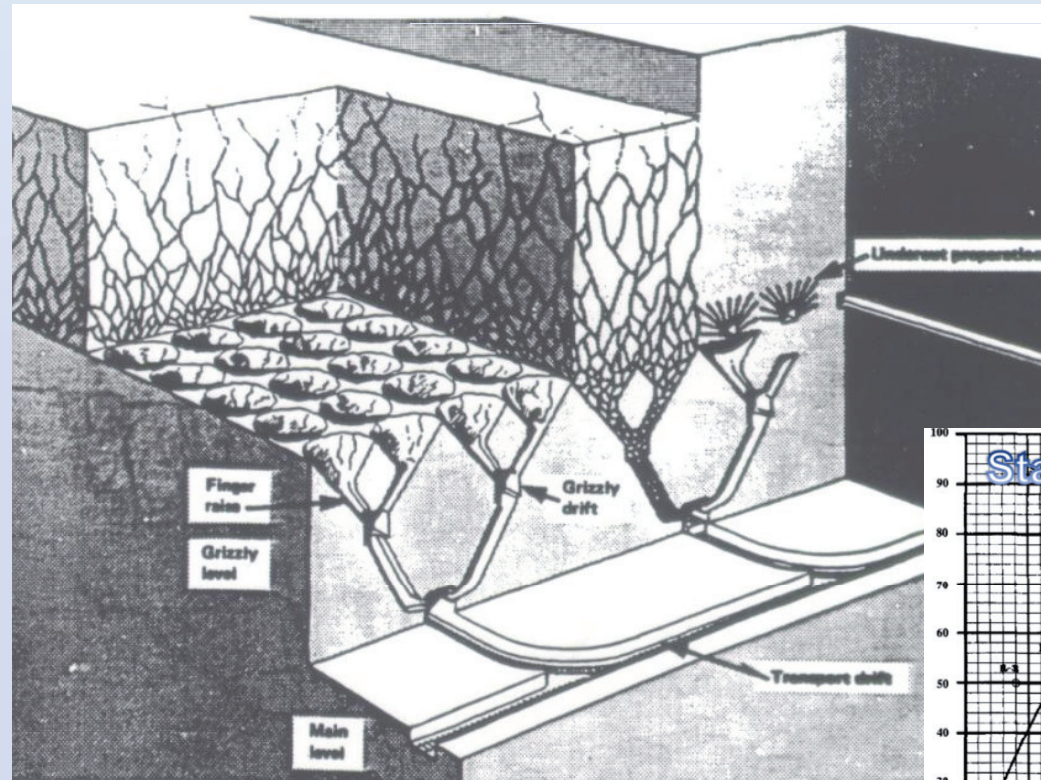
Is new technology available?

➤ Ventilation



Can you block cave coal? If not, why not?

- Vertical seams
- Used in Europe
- Not sticky coal
- Geotechnical issues
- Broad seams
- Low capital cost
- Recover all of the seam
- Using an extraction level



Longwall ploughs vs Longwall shearers?

- Mainly used in Europe
- Height of plough is the working height of the seam
- Mounted on the front of the AFC
- Picks act like chisels
- Small web



Longwall ploughs vs Longwall shearers?

- Less moving parts
- Cheap
- Low dust make
- Keeps exposed roof area small
- Cutting height is limited
- Cutting stone is limited
- High cutting height – machine is less stable
- Exposed chain haulage – safety
- Grading only with AFC



Photo Courtesy of Australian Mining Monthly

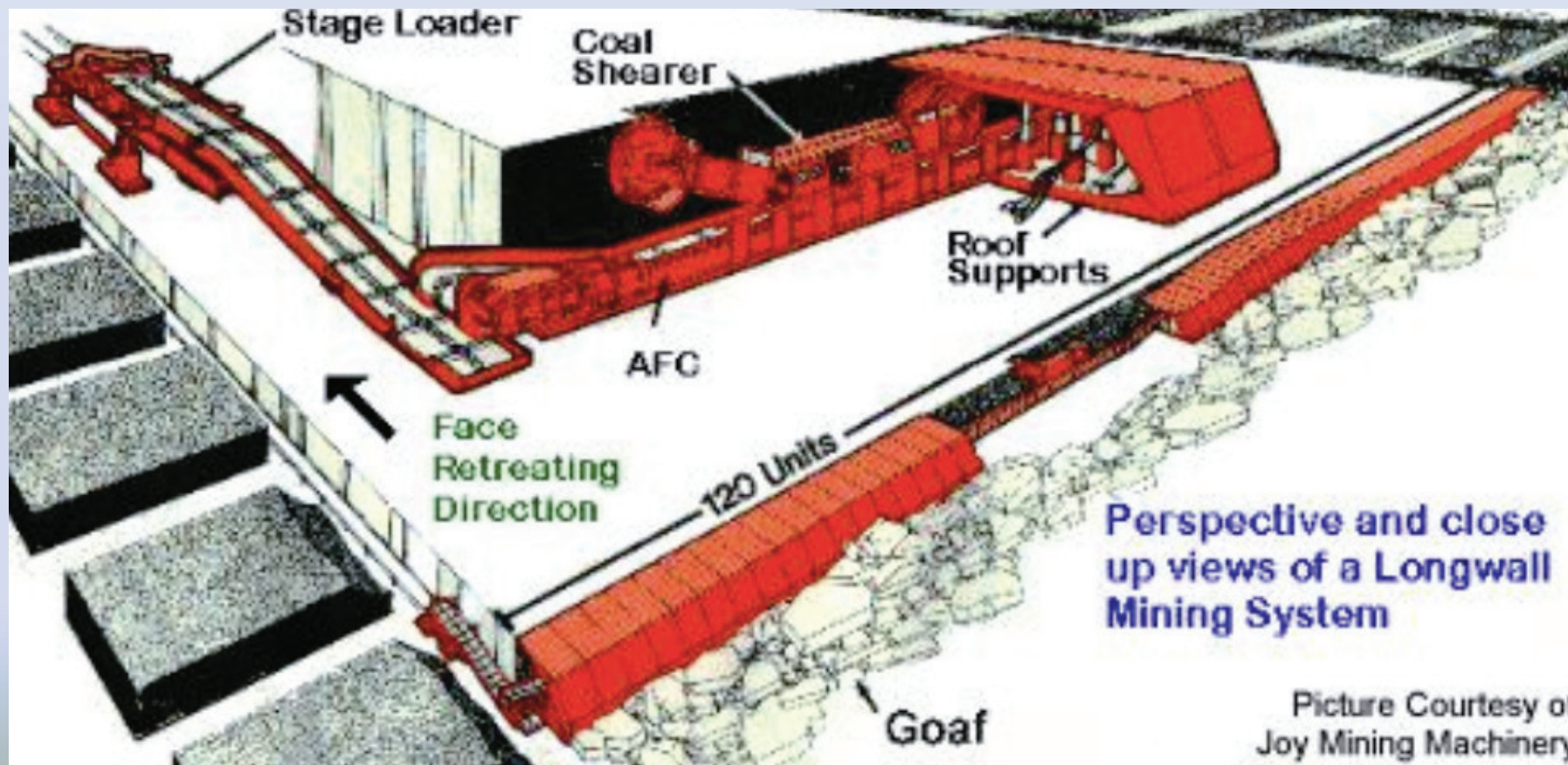
Longwall ploughs vs Longwall shearers?

- Shearer commonly used in Australia
- Shearer cuts a wider web
- Shearer flexible cutting height
- Shearer easier to change grade
- Shearer needs to sit above coal flow
- Shearer can be automated
- Plough can cut a thinner seam



Could a Longwall be developed that could cut 9m?

- High face longwall mining



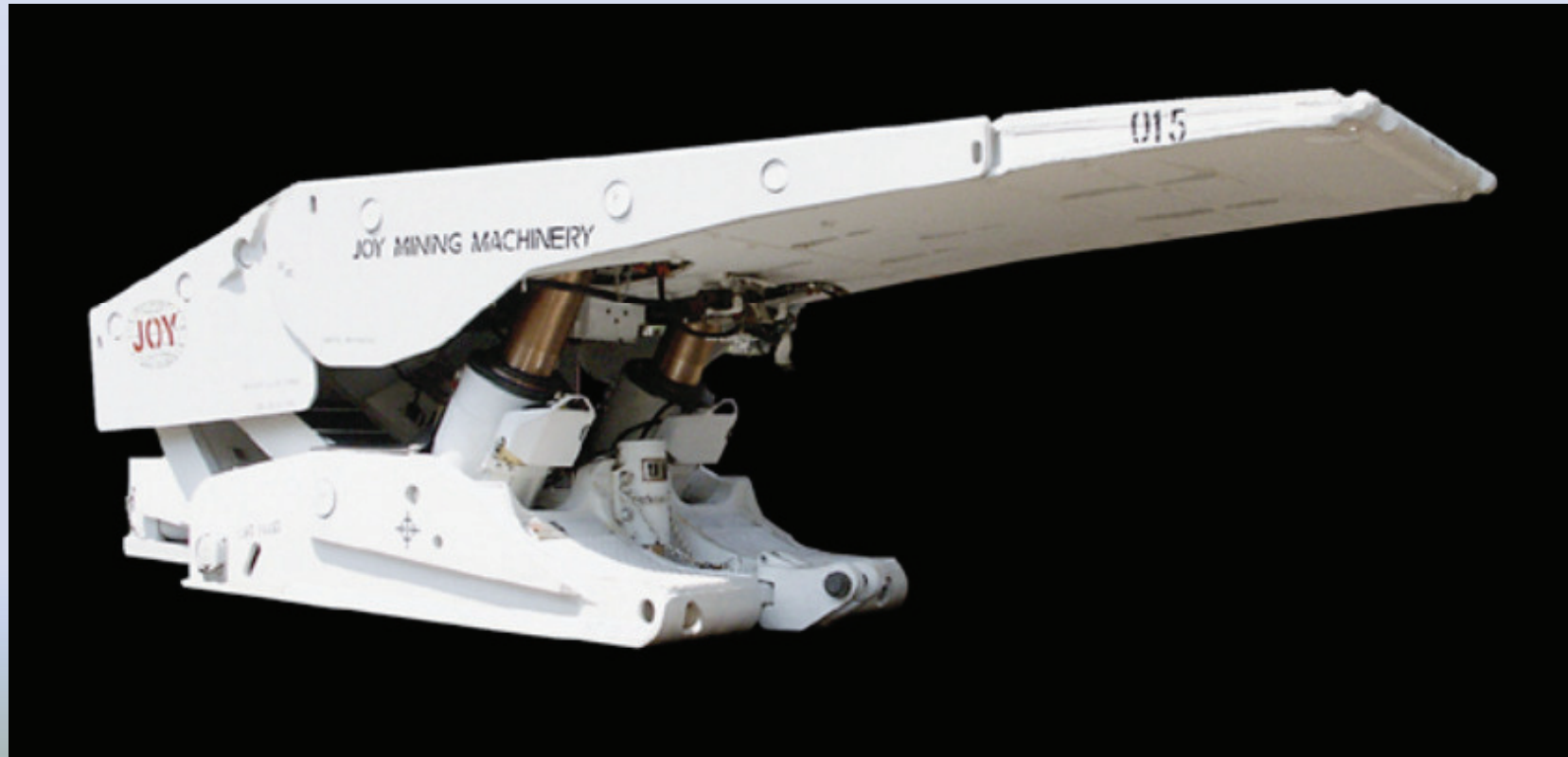
Could a Longwall be developed that could cut 9m?

- Larger coal slabs
- Higher production
- Currently cuts 6 to 7 m
- Into the future – 10m?
- Can LTCC to 17 m
- Ground stability
- Need strong floor and roof
- Harder to manage cavities



What are the limits of super chocks?

- Higher cost
- Good control
- Size and weight
- Reaction time
- Ergonomics
- Gas drainage
- Web width



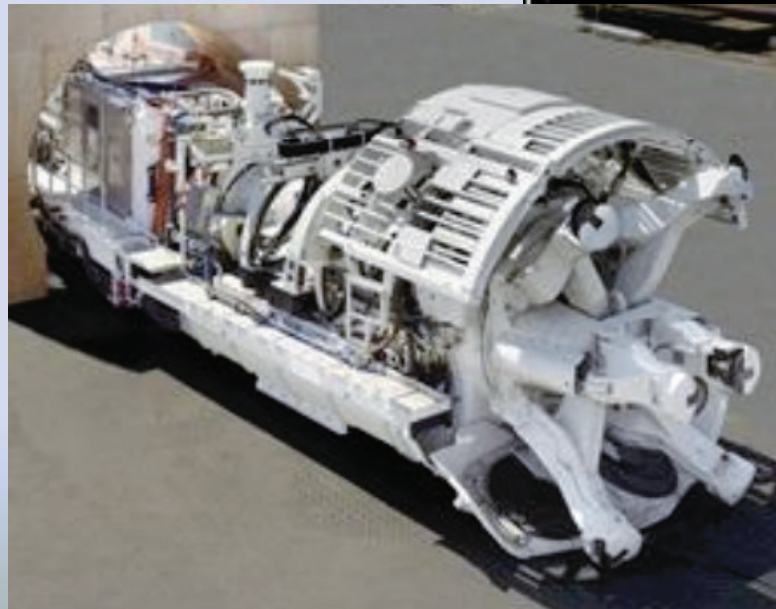
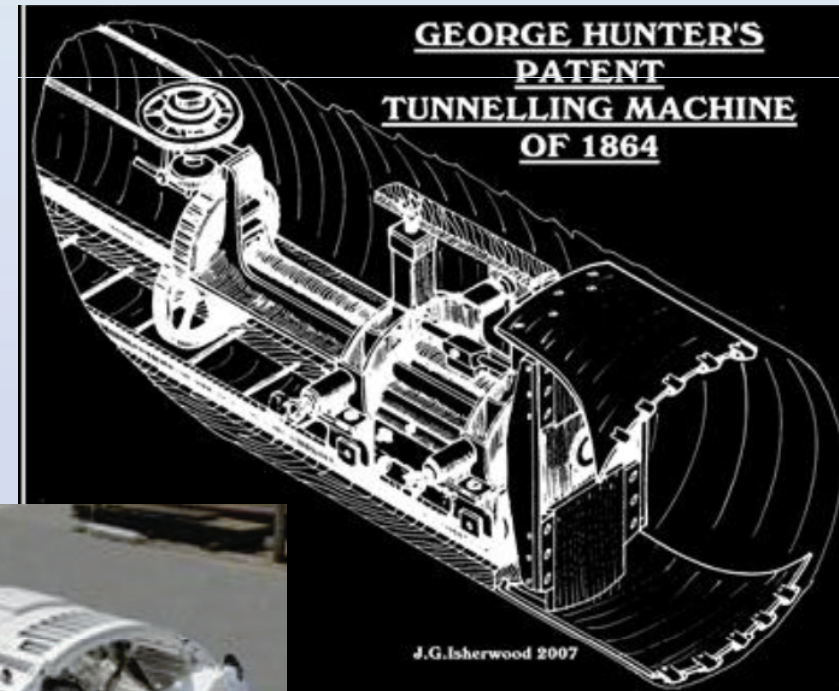
What are the limits of super chocks?

- Pressure requirements
- Transporting the chock
- LW system depends on good support design
- Convergence management
- Setting pressures – stiffness vs yield/reset
- Misalignment /gaps between chocks
- Load distribution



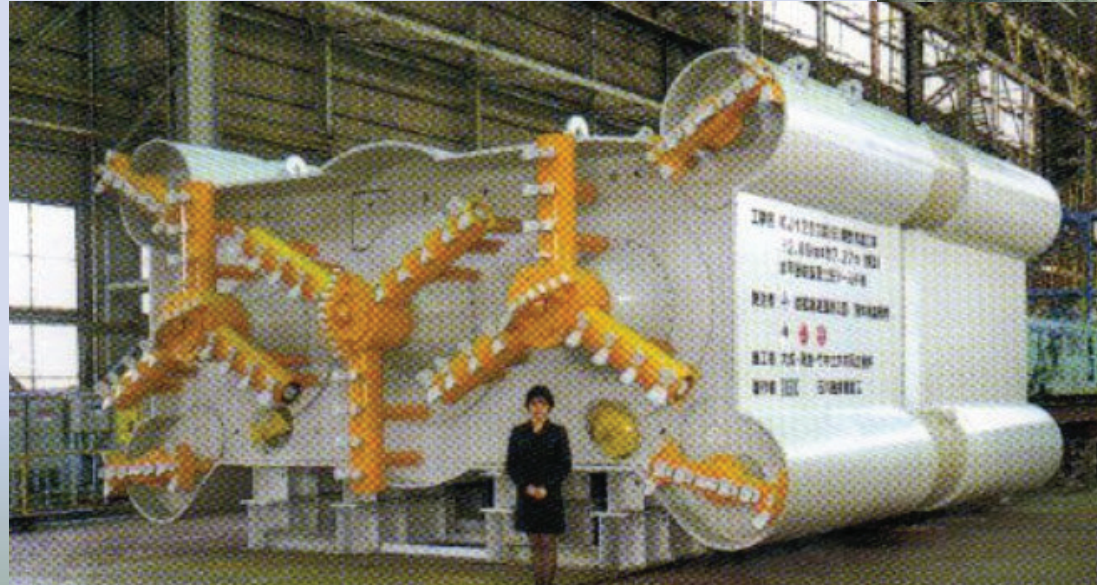
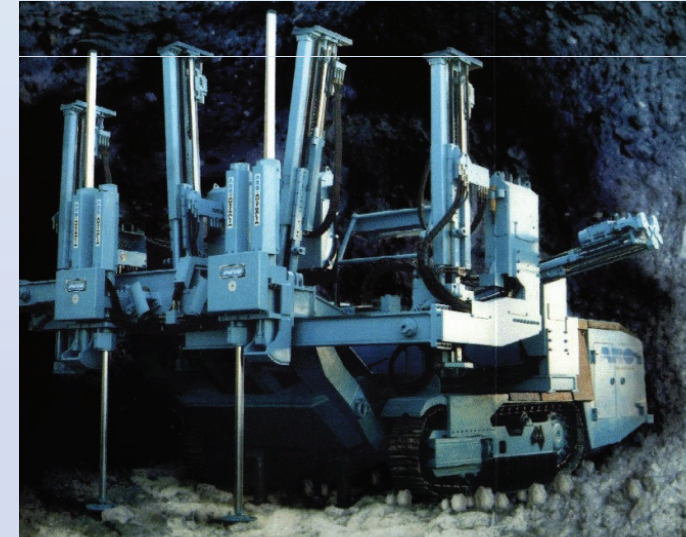
Are tunnel boring machines viable for coal mining?

- History of TBMs in coal
- Can be slow to advance
- Hard to remove cuttings
- Circular profile



Are tunnel boring machines viable for coal mining?

- TBMs
- IHI Mojura TBM
- Rapid roadway development
- Can partition the roadway for ventilation
- 6 to 8 m cut
- Strata support



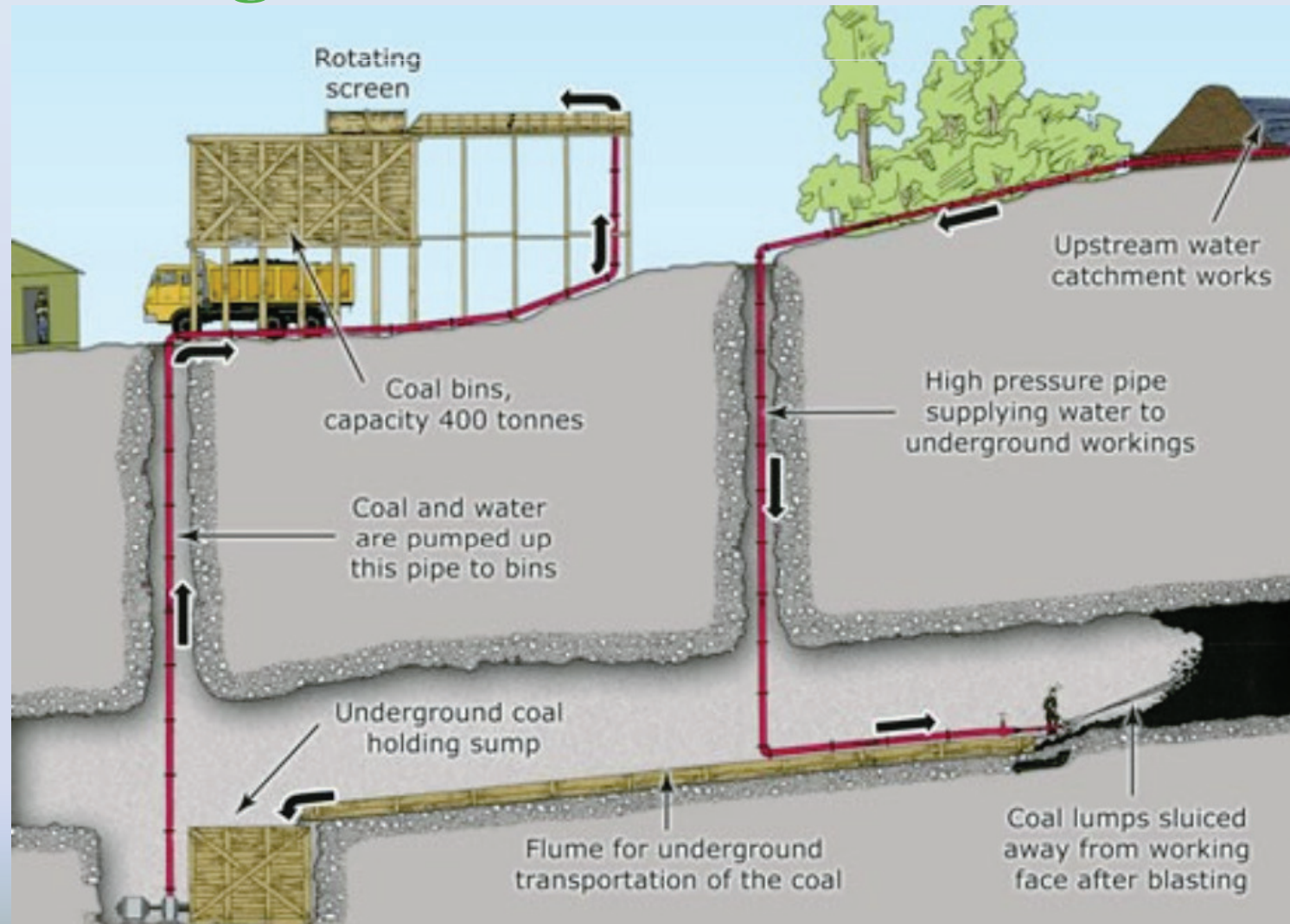
Are tunnel boring machines viable for coal mining?

- Road header
- Flexible opening configurations
- No damage to surrounding rock –drill and blast
- Tracks, truck or inside shield mounts



What is hydro mining?

- Water jets used to break up coal and transport it
- Can remove whole coal seam
- Gas management
- Ventilation
- Higher recovery of coal



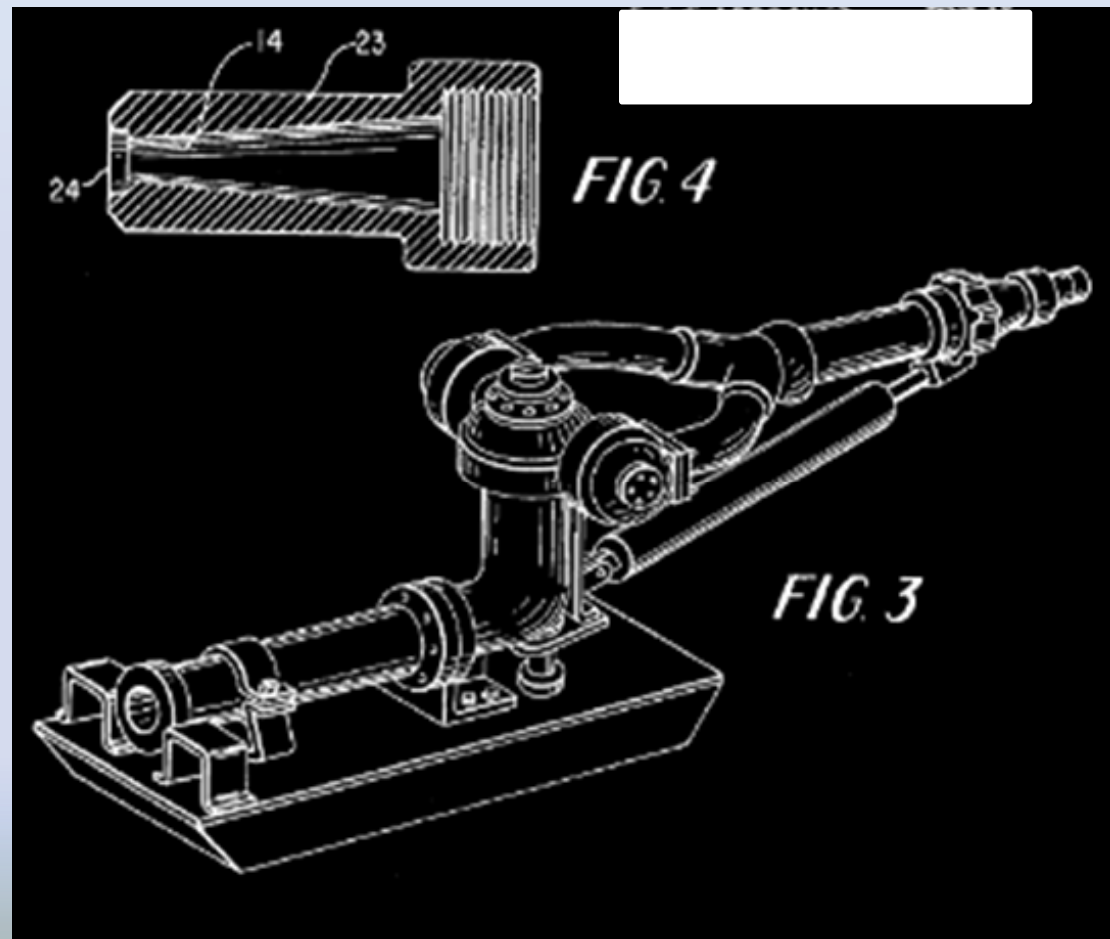
What is hydro mining?

- Coal carried along flumes
- Smaller coal product
- Mine up dip
- Water use
- Uncontrolled fall of material
- Dilution
- Operator removed from extraction area



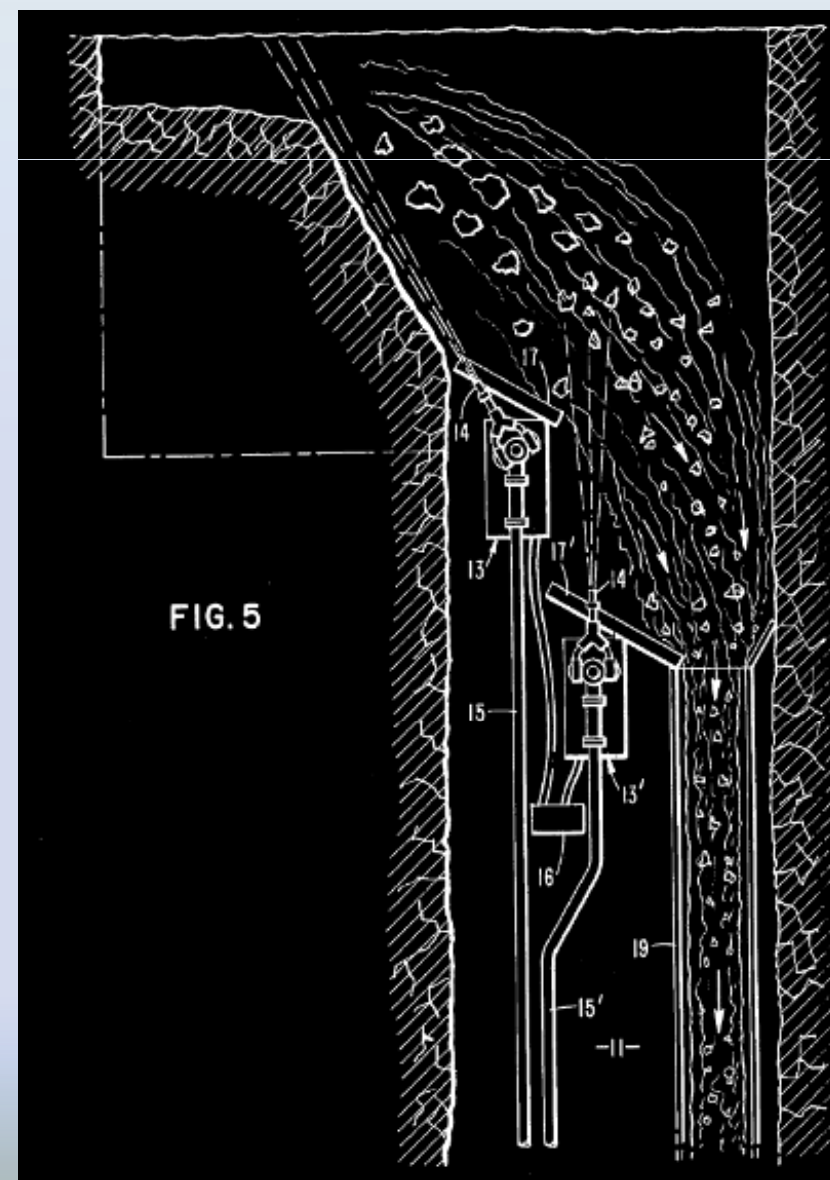
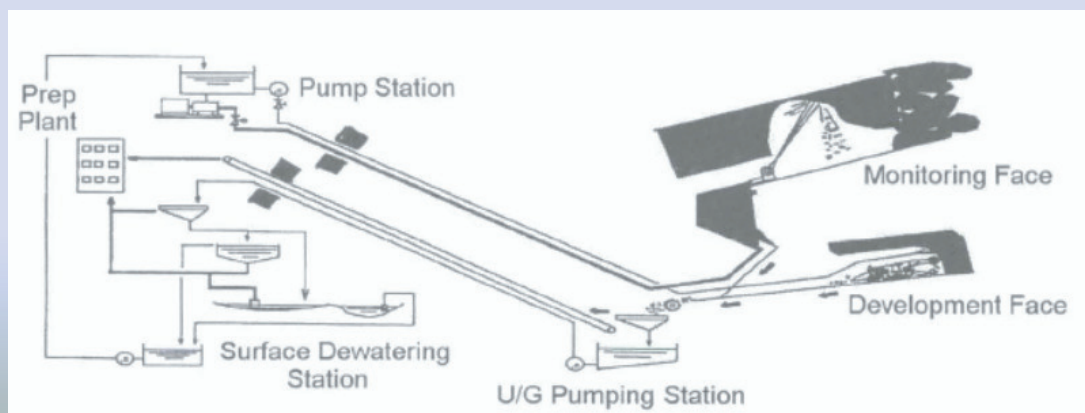
Is hydro mining safe?

- safety
 - Particle splatter – shield required for operator
 - Hard to manoeuvre equipment
 - Particle size
 - Dust
 - Spark and gas ignition
 - Poor ventilation control
 - High pressure water
 - Equipment damage from pillar failure



Could hydro mining harvest all the coal from a 9m seam?

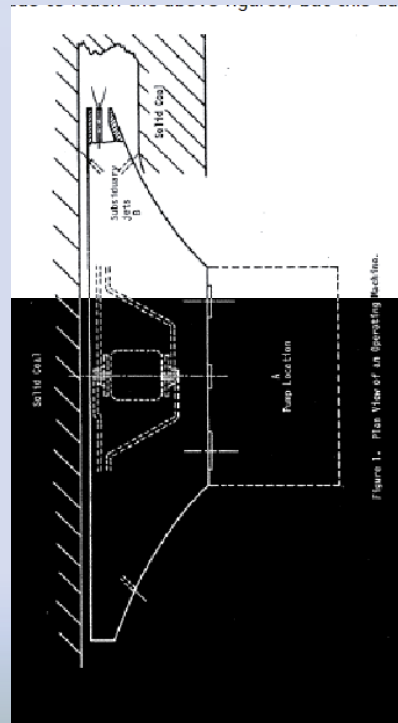
- 4 to 12 degree dip
- Entry to panel at lowest point
- Up to 15 m
- Hard roof and floor
- Operator experience
- Recovery over 75%



Could hydro mining harvest all the coal from a 9m seam?

➤ Extraction and height depends on:

- Coal hardness
- Roof weight
- Cleat direction
- Cutting distance
- Pump flow
- Pump output pressure
- Future



If so, how wide would the cut be; for what distance and at what depth?

- Strongman 2 – 25 to 15 m to improve cutting rates
- Pump flow
- Pump output pressure
- Increased depth of cover improves cutting distances
- Coal properties





Conference Workshop

From top coal caving longwalls to hydro mining

Wednesday 24th October 2012: 9.00 am

Thank you.

Any Questions?

Allison Golsby MAusIMM(CP), RPEQ, MEngSc(Min Man), MMinEng(Geomech), GDipMVent

Chief Executive Officer

GPO Box 358
Brisbane Qld 4001

allison@golsby.org
M +61 409 008 942



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