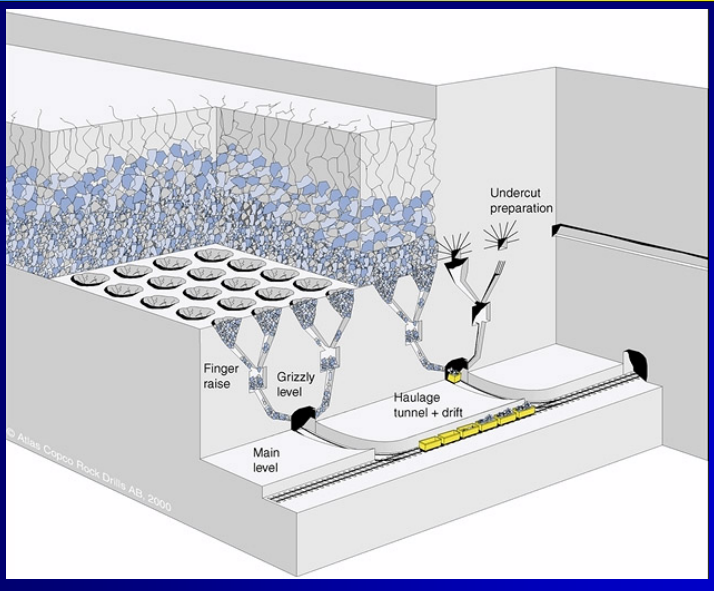
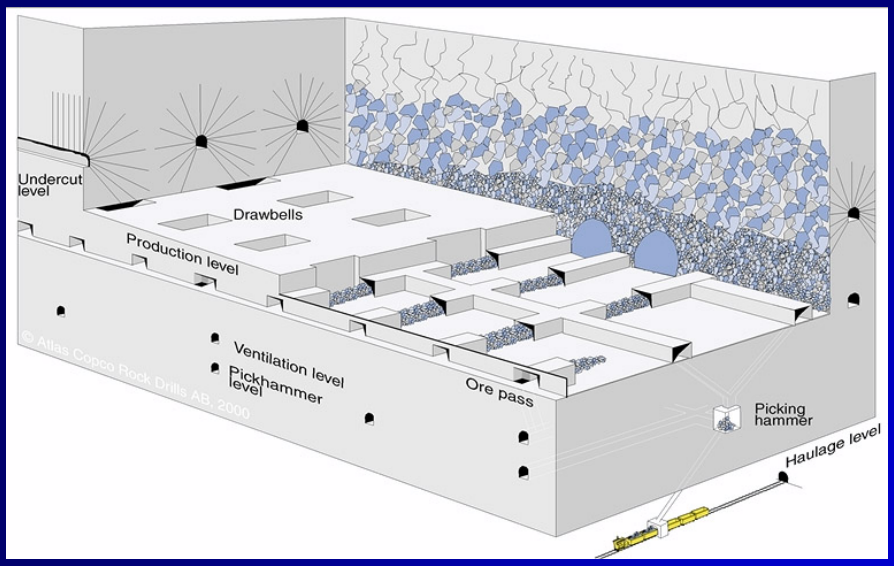
Block Caving



Block Caving

Block Caving



Classification of Mining Methods

Mining Methods

Unsupported Methods

- Essentially self-supporting
- No major artificial support (backfill)

- Room & Pillar Mining
- Stope & Pillar Mining
- Shrinkage Stoping
- Sublevel Stoping

Supported Methods

- Require substantial amount of artificial support (backfill)

- Cut and Fill Stoping

Caving Methods

- Exploitation workings designed to collapse
- Induced, controlled, massive caving of deposit

- Longwall Mining
- Sublevel Caving
- **Block Caving**

Basic Facts

- Caving Method
- Overlying rock caves into the void
- Overall mining progresses downwards
- Used in near-vertical or massive deposits
- Cheapest underground mining method

Conditions

- Ore strength: weak to moderate or even fairly strong (cavable!), not sticky, not readily oxidised
- Rock strength: weak to moderate, distinct boundary between ore and rock
- Deposit shape: massive or thick tabular, fairly regular
- Deposit dip: fairly steep (> 60°) to vertical, flatter for massive deposits
- Deposit size: very large extent, great thickness (> 30 m)

Conditions

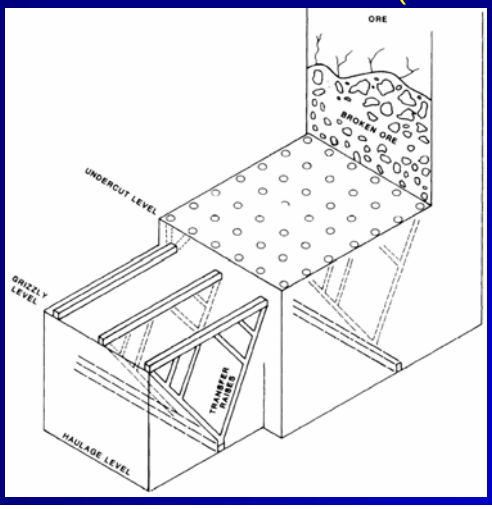
- Ore grade: low (ideal for disseminated ore)
- Ore uniformity: fairly uniform and homogeneous (no sorting possible)
- Depth: moderate (600...1200 m, overburden stress greater than rock strength)

Development

- Extensive and expensive development
- Horizontal development on the haulage level (drifts, crosscuts)
- Ore drawing facilities (chutes, draw points, trenches)
- Finger raises, bells
- Development of the undercut level

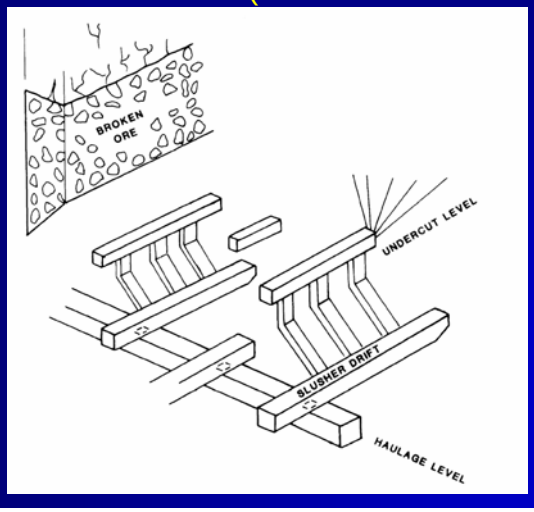
Variation: Full Gravity System/Grizzly System

- Consists of haulage level, transfer raises, grizzly level, finger raises and undercut level (for small rocks)



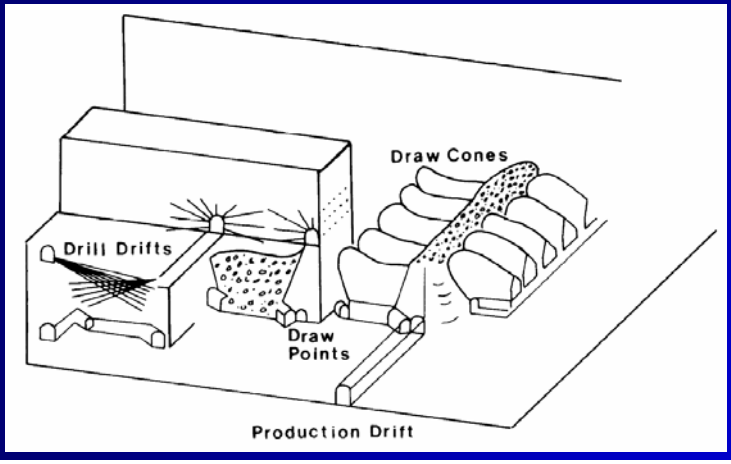
Variation: Slusher Drift System

- Consists of haulage level, slusher drifts, finger raises and undercut level (for medium size rocks)



Variation: LHD System

- Consists of haulage level, transfer raises, production level, draw point entries, draw cones and undercut level (for larger rocks)



Stoping Operations

- Drilling:

Initiation of caving by longhole blasting on the undercut level

Hole sizes about 51...76 mm

- Blasting:

Drill holes are charged with ANFO or slurries

Charging with bulk material using pneumatic loaders or pumps

Stoping Operations

- Ground control:

Extensive support can be necessary in development openings (rock bolts, shotcrete, steel sets or arches, cable, mesh)

- Drawing of ore:

Drawing of ore must be closely controlled (“draw control”) to avoid excessive dilution

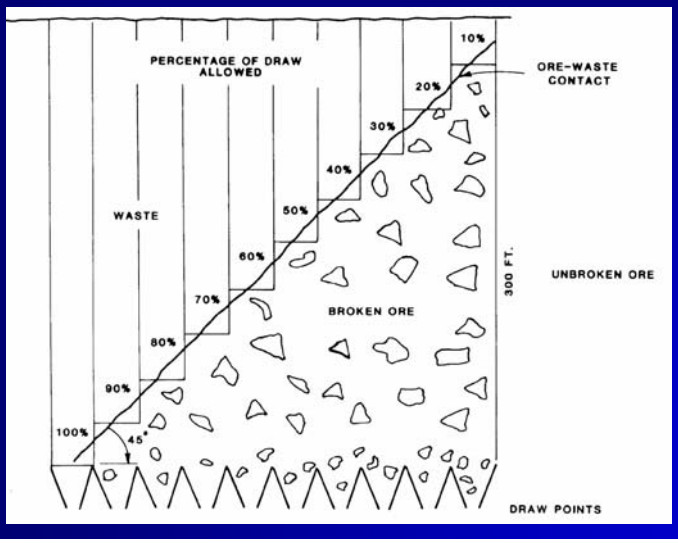
Ore flows to the haulage level because of gravity, sometimes aided by slushers

Ore is taken from the draw points using LHDs

Ore is hauled to the shaft using LHDs, trucks, trains or conveyor belts

Stoping Operations

Draw control section



Equipment

- Drilling: Drill rig, Longhole drill rig
- Loading: LHD, slusher
- Haulage: LHD, trucks, trains, conveyor belts

Dangers

- Hang-ups and uncontrolled caving can cause dangerous air blasts!
- Example: Accident at Northparkes mine, Australia, 1999

- Sudden collapse of huge amount of ore causing air blast

- 4 miners were killed when their pick up was crushed by the air blast

- Production was stopped for 2 months

Advantages

+ Fairly high productivity (14...45 t per employee-shift)
+ Low mining cost (relative cost 10 %)
+ Very high production rate, large-scale method
+ High recovery (90...125 %)
+ Production entirely by caving without drilling and blasting
+ Suitable for gravity-flow or fully mechanised materials handling; repetitive standardised operations
+ Good health and safety conditions

Disadvantages

- Moderate dilution (10...20 %)
- Caving and subsidence destroy surface
- Draw control critical to success
- Very high development cost
- Substantial maintenance of production openings
- Rigid and inflexible method
- Risk of hang-ups and air blasts
- Possibility of spontaneous combustion in ore or rock

Example

El Teniente mine, Chile:

Large copper porphyry ore body

Largest underground mine of the world

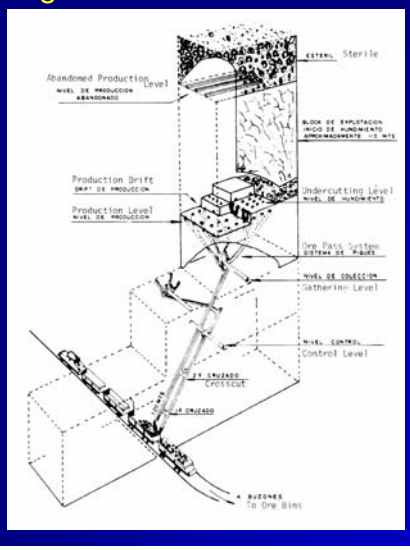
Use of full gravity system (secondary ore) and LHD system (primary ore)

Production rate about 100,000 t/d with 1.16 % Cu

Productivity about 60 t Cu per worker-year

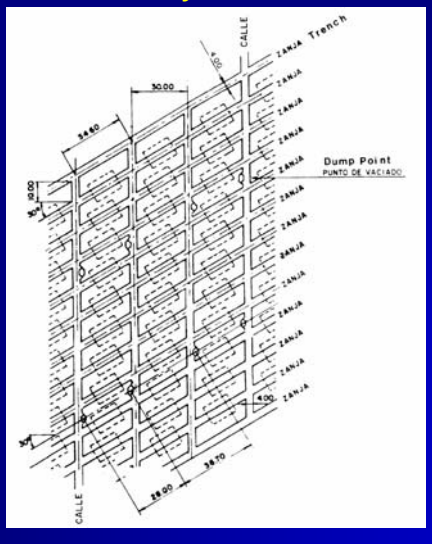
Example

Caving block at El Teniente mine



Example

Production level layout at El Teniente mine



Conclusion

Cheap and widely used method for underground mining