

Introduction to Underground Mining

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Key concepts, methods, and considerations for extracting mineral resources below the earth's surface.

1. What Is Underground Mining?

Aspect	Description
Definition	Extraction of ore deposits located beneath the ground surface, using tunnels, shafts, and chambers.
Purpose	Access high-grade or deep-lying ore bodies that are uneconomical to mine by open-pit methods.
Typical Products	Coal, gold, copper, zinc, nickel, diamonds, rare earth elements, and many other metals and minerals.
Depth Range	Usually >100m (330ft) below ground; can exceed several kilometers for deep-level operations.

2. Advantages & Disadvantages

Advantages	Disadvantages
- Lower surface disturbance & smaller land footprint. - Ability to target high-grade zones & better ore recovery. - Reduced overburden removal & less waste rock. - Can operate in rugged terrain where open-pit is impossible.	- Higher capital cost for development (shafts, ventilation, safety systems). - Increased safety hazards (rock falls, gas, fire). - Complex logistics for personnel, equipment, and ore transport. - Greater energy consumption for ventilation and dewatering.

3. Main Underground Mining Methods

Method	Typical Use	Key Features

Introduction to Underground Mining

Room and Pillar	Flat-lying, tabular deposits (e.g., coal, potash).	• Large “rooms” mined, leaving pillars for support. • Pillars may be partially or fully reclaimed (retreat mining).
Longwall Mining	Thick, continuous coal seams.	• Mechanized shearer cuts a long wall; hydraulic roof supports advance with the face. • High productivity, high recovery (>80%).
Cut and Fill	Irregular ore bodies, steep dips.	• Ore is removed in slices; each slice is back-filled with waste rock or cemented paste to provide support.
Block Caving	Massive, low-grade ore bodies at depth.	• Induced fracturing and caving of a large block; broken ore flows by gravity to drawpoints.
Sublevel Stoping	Medium-to-high-grade, steeply dipping ore.	• Drilling from sublevels, blasting creates a “stop” (hanging wall) that is removed.
Shrinkage Stoping	High-grade, steep ore bodies.	• Broken ore is left in the stope to provide temporary support; later removed.
Raise-boring & Drilling	Access creation, ventilation shafts.	• Large-diameter holes bored upward from a lower level, then reamed to size.

Selection depends on ore geometry, depth, rock mechanics, safety, and economics.

4. Key Components of an Underground Mine

1. Access Infrastructure

- **Shafts** (vertical) – personnel, ore hoisting, ventilation, services.
- **Declines/Slopes** (inclined) – vehicle access, often cheaper for shallow deposits.
- **Ventilation shafts** – supply fresh air, exhaust contaminated air.

2. Ground Support Systems

- Rock bolts, cable bolts, shotcrete, steel sets, concrete lining.
- Designed to control deformation and prevent collapses.

3. Material Handling

Introduction to Underground Mining

- **Hoists & skips