

Introduction to Surface Mining

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Key concepts, processes, and environmental considerations

1. What Is Surface Mining?

Aspect	Description
Definition	Extraction of mineral deposits that are located near the earth’s surface, using equipment that removes overlying soil and rock (the <i>overburden</i>).
Typical Minerals	Coal, copper, gold, iron ore, bauxite, phosphates, limestone, sand & gravel.
Contrast with Underground Mining	Surface mining removes the entire overburden; underground mining accesses ore through shafts/tunnels while leaving most overburden in place.

2. Major Types of Surface Mining

Method	Ideal Ore Characteristics	Typical Equipment	Process Overview
Open-Pit (Open-Cast) Mining	Large, relatively shallow ore bodies; stable rock walls.	Draglines, electric shovels, haul trucks, benchers.	- Sequential removal of overburden in benches. - Ore is blasted, loaded, and hauled to processing plant.
Strip Mining	Flat-lying, extensive coal seams or sedimentary deposits.	Bucket-wheel excavators, draglines, conveyors.	- Overburden is stripped in long strips; ore is exposed and removed. - Overburden may be backfilled after extraction.
Mountaintop Removal (MTR)	Coal seams in hilly terrain.	Bulldozers, explosives, high-capacity trucks.	Summit is blasted and removed; overburden is placed in adjacent valleys (valley fills).

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Dredging	Underwater mineral deposits (sand, gravel, tin, gold).	Dredge pumps, suction pipes, floating barges.	• Sediment is suctioned from the water column, screened, and pumped ashore.
Placer Mining (often considered surface)	Loose, high-grade gravels containing gold, gemstones.	Excavators, sluice boxes, trommels.	• Material is excavated, washed, and heavy minerals are separated by gravity.

3. General Sequence of Operations

1. Exploration & Feasibility

- Geological mapping, drilling, sampling, resource modeling.
- Economic analysis (market price, extraction cost, infrastructure).

2. Mine Planning & Design

- **Pit Design** – slope angles, bench height, haul road layout.
- **Schedule** – sequencing of blocks, equipment allocation.
- **Environmental Baseline** – water, flora/fauna, community impact.

3. Overburden Removal

- *Bulk removal* using draglines, shovels, or bulldozers.
- Overburden is either stored on-site (for later reclamation) or used for backfilling.

4. Ore Extraction

- Drilling & blasting (if rock).
- Loading and hauling to processing plant or directly to stockpiles.

5. Processing

- Crushing, grinding, concentration (flotation, magnetic separation, etc.).
- Tailings are stored in engineered ponds.

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6. Reclamation & Closure

- Recontouring land to stable slopes.
 - Re?vegetation, water?quality monitoring, post?closure land?use planning.
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4. Equipment Overview

Category	Typical Machines	Primary Function
Excavation	Draglines, bucket?wheel excavators, electric shovels	Remove overburden & load ore