

## Mining & Mineral Resources

BR: Stuff made from minerals?

- Almost everything you see

Mineral: a naturally occurring, usually inorganic, solid that has a characteristic chemical composition, an orderly internal structure, & a characteristic set of physical properties.

- Made of atoms of a single element

or of compounds [2 or more atoms]

"Native Element"

- Atoms are arranged in regular or repeating geometric patterns

Ex.  
Gold,  
Silver,  
Copper

- Physical properties are determined by arrangement of atoms & the strength of the chemical bond between the atoms

• Metallic Mineral: mineral that exhibits metallic luster; usually a ↑ density; tends to be efficient conductor of heat & electricity

Ex: Gold, Silver, Copper

• Nonmetallic Mineral: shiny or dull; ↓ density, & tends to not be a conductor of heat or electricity; good insulators; may not allow light to pass

Ex:

Mineral consumption in US [thousands of US]

Iron Ore ~ 45

Aluminum ~ 6

Salt ~ 32

Copper ~ 2.5

Phosphate ~ 24

Lead ~ 1.5

Clays ~ 21

Zinc

Ore Minerals: minerals that are valuable & economical to extract

[Gangue Minerals - no commercial value, but are extracted & ore minerals]

Formation: minerals that form are dependent on the environment

- Metals form when magma cools & hardens

- Hydrothermal Solutions: hot, subsurface waters that contain dissolved minerals; flow through cracks in rocks & dissolve other minerals, they then fill fractures to form ore deposits known as veins

- Evaporites: water flowing over land dissolves salts, when the water evaporates these are the salts left behind; form in arid [hot] regions  
↳ halite [rock salt] & gypsum

## - Mineral Resources & Their Uses

- Alloys: combination of 2 or more metals; often combine the most desirable properties of each metal
- Nonmetals are among the most widely used minerals in the world
  - ↳ Gemstones: nonmetallic minerals prized for beauty, rarity, or durability
  - Ex: Diamond, ruby, sapphire, emerald, aquamarine, topaz, & tourmaline

### RSx Uses:

- Aluminum
- Copper
- Gold
- Iron
- Lead
- Silicon
- Silver
- Sulfur
- Titanium
- Zinc

### Matching [Element to Ore]:

- Aluminum
- Beryllium
- Chromium
- Copper
- Iron
- Lead
- Manganese
- Mercury
- Molybdenum
- Nickel
- Silver
- Tin
- Titanium
- Uranium
- Zinc

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# Mineral Exploration & Mining

## Types:

### • Subsurface Mining:

- 50m or more below surface

- Ex. Coal & Salt

┌───┐ "Room & Pillar Mining"  
└───┘  
└───┘ "Longwall Mining"

- Solution Mining [Potash, Salt & Sulfur]

→ Most economical

→ Hot water injected to dissolve ore & then air pumped to surface.

### • Surface Mining:

- Close to earth's surface

- Ex. Coal, Copper, & Gold

┌───┐ "Open Pit Mining"

• Downward, layer by layer

- "Quarrying" ← AKA

- Granite & Marble

- Clay, Gypsum, & Talc

- Produce aggregates

↳ sand, gravel, & crushed rock

## ° Placer Mining

- When rock weathers & disintegrates, minerals in the rock are released; minerals are concentrated by wind & water into surface deposits [Placer deposits]
- Concentration typically in stream beds & bends in rivers
- Dredging excavates sediments of gold, diamonds, & other heavy minerals

- Smelting: crushed ore is melted @ ↑ temps in furnaces to separate impurities from molten metal

- Flux bonds impurities & separates them from molten metal
- Molten metal falls to the bottom & is recovered
- Flux & impurities form "slag" layer on top of molten minerals

## ° Environmental impacts

Air & Noise Pollution

Water contamination

Displacement of wildlife

Erosion

Soil Degradation

Subsidence [Sinking]

Mine Fires

### - Mining Regulations

- Regulated by federal & state laws

- Must comply with:

  - Clean Water Act

  - Safe Drinking Water Act

  - Clean Air Act

  - Endangered Species Act

- Reclamation: process of returning land to its original or better condition after mining is complete

  - Based on Surface Mining Control & Reclamation Act of 1977 [SMCRA]

## Metals & Minerals

### Ferrous Metals:

- Iron containing metals
  - Most important = iron ore (basis of steel industry)
  - Most valuable types of iron ore
    - Hematite ( $\text{Fe}_2\text{O}_3$ )
    - Magnetite ( $\text{Fe}_3\text{O}_4$ )
    - Limonite ( $2\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ )
    - Siderite ( $\text{FeCO}_3$ )
  - Low grade ores are called taconite, 40% or less of metallic ore
  - High grade ores are 60% or more of metallic ore
  - Benefaction = separating ore from rock
  - Smelting = removing impurities from concentrate
  - Ferroalloys are ferrous metals combined with iron to give steel certain properties
    - Chromium, Manganese, Molybdenum, Nickel, Tungsten, Vanadium

### Non-Ferrous Metals

- Include copper, aluminum, lead, zinc, tin, mercury
- Copper = red in color; ductile (hammered), malleable, non-corrosive
  - Uses: tools, weapons, kitchen utensils, coins, screens, piping
  - Copper + Tin = Bronze
  - Copper + Zinc = Brass
- Aluminum = most common metals due to availability, light weight, heat reflectivity, corrosive resistance, & electrical conductivity
  - 1/7 of Earth's core
  - Most common form = bauxite ore (Arkansas, Alabama, Georgia)
- Lead = found mostly west of Mississippi River (Missouri, Idaho, Colorado, Utah)
  - Uses: batteries, metal building construction
  - Used for heavy weight, softness, corrosive resistance, & malleability
  - Most of the lead used in the US is imported
- Zinc = most commonly used in galvanized steel to make it rust resistant
  - Uses: brass (30% zinc), car parts, kitchen utensils, vacuum cleaners, washing machines
- Tin = combined with copper to make bronze
  - Occurs naturally in granite rocks
  - Domestic suppliers = Alaska, Colorado, Texas
- Mercury = only metal stable at liquid temperatures
  - Small deposits through California & Nevada
  - Found in limestone & volcanic rock