

LECTURE 7: Metallurgy

Furnace processes, mechanical processes, wet processes.

Furnace processes: manipulation of heat and atmosphere to free metals.

- Preliminary roasting to remove sulphur, carbonic acid, to break up ore body, to allow access to gasses.
- Oxidation or reduction of remaining impurities.
- Cupellation: use of heat and blast of air to consume, dross, or absorb impurities.
- Liquation: use of differential melting points.

Mechanical processes: crushing, grinding, washing of ore.. Esp. for gold and silver in quartz.

Wet process: amalgamation of gold with mercury.

Major metals gold, silver, tin, lead, copper, iron. Minor metals: mercury, antimony. Zinc known as compound.

Metallic mercury distilled from cinnabar

Copper: Break & roast ore, drives off sulphur & oxidizes sulphides.

Smelt w flux of limestone, charcoal fuel => slag & cuprous sulphide matte.

Partial oxidation with air => copper & SO₂.

Iron: Carbonate ores need reduction furnace.

Crush & roast ore; carbonate => oxide ($\text{FeCO}_3 \Rightarrow \text{FeO} + \text{CO}_2$).

Reduction furnace: heat + C w/o O₂: $\text{Fe}_2\text{O}_3 + \text{C} \Rightarrow 2\text{Fe} + \text{CO}_2 + \text{CO}$.

Limestone flux + gangue = slag

“Bloom” of iron, hammered at 1100C

Elba, Populonia

Cast iron requires 1450 C.

Bronze = copper + 8-12% tin

Brass = copper + 10-30% zinc (Copper + ZnCO₃, calamine)

Called *orichalcum* (“mountain copper” or “gold copper”). Roman invention.