Roasting

In the case of carbonates and sulfides, a process called "roasting" drives out the unwanted carbon or sulfur, leaving an oxide, which can be directly reduced. Roasting is usually carried out in an oxidizing environment. A few practical examples:

- Malachite, a common ore of copper, is primarily copper carbonate hydroxide
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- $Cu_2(CO_3)(OH)_2 = 2CuO + CO_2 + H_2O$
- This mineral undergoes thermal decomposition to 2CuO, CO_2, and H_2Oin several stages between 250 °C and 350 °C. The carbon dioxide and water are expelled into the atmosphere, leaving copper(II) oxide which can be directly reduced to copper.

- The roasting process is generally undertaken in combination with reverberatory furnaces. In the roaster, the copper concentrate is partially oxidised to produce "calcine" and sulfur dioxide gas. The stoichiometry of the reaction which occurs is:

  - $2\ CuFeS_2 + 3\ O_2 \rightarrow 2\ FeO + 2\ CuS + 2\ SO_2$
  - Roasting generally leaves more sulfur in the calcined product (15% in the case of the roaster at Mount Isa Mines) than a sinter plant leaves in the sintered product (about 7% in the case of the Electrolytic Refining and Smelting smelter).

  - As of 2005, roasting is no longer common in copper concentrate treatment, because its combination with reverberatory furnaces is not energy efficient and the SO_2 concentration in the roaster off gas is too dilute for cost-effective capture.

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- Galena, the most common mineral of lead, is primarily lead sulfide (PbS). The sulfide is oxidized to a sulfite ($PbSO_3$) which thermally decomposes into lead oxide and sulfur dioxide gas. (PbO and SO_2) The sulfur dioxide is expelled (like the carbon dioxide in the previous example), and the lead oxide is reduced as below.