Ore deposit environments

- **Magmatic**
  - **Cumulate deposits – fractional crystallization processes can concentrate metals (Cr, Fe, Pt)**
  - **Pegmatites – late staged crystallization forms pegmatites and many residual elements are concentrated (Li, Ce, Be, Sn, and U)**
- **Hydrothermal**
  - **Magmatic fluid - directly associated with magma**
  - **Porphyries - Hot water heated by pluton**
  - **Skarn – hot water associated with contact metamorphisms**
  - **Exhalatives – hot water flowing to surface**
  - **Epigenetic – hot water not directly associated with pluton**

Water-rock interactions

- To concentrate a material, water must:
  - Transport the ions
  - A ‘trap’ must cause precipitation in a spatially constrained manner
- Trace metals which do not go into igneous minerals easily get very concentrated in the last bit of melt
- Leaching can preferentially remove materials, enriching what is left or having the leachate precipitate something further away

Metal Sulfide Mineral Solubility

- Problem 1: Transport of Zn to 'trap':

$$ZnS + 2\,H^{+} + 0.5\,O_2 = Zn^{2+} + S^{2-} + H_2O$$

$$\log K = -9.57 = \log \frac{[Zn^{2+}]\, f_{S^{2-}}\, [H_2O]}{[H^{+}]^2\, f_{O2}^{0.5}\, [ZnS]}$$

Need to determine the redox state the Zn^{2+} would have been at equilibrium with…

What other minerals are in the deposit that might indicate that? → define approximate f_{O2} and f_{S2-} values and compute Zn^{2+} conc. → Pretty low Zn^{2+}