

Crystallization of Minerals

- Minerals must be crystalline – part of the definition
- Crystalline=having an ordered internal structure
- Internal order may or may not lead to perfect external crystal shape
- Shapes of crystals
- euhedral=perfect external shape, flat faces controlled by internal structure
- anhedral=irregular, no crystal faces visible
- subhedral=in between
- Amorphous=noncrystalline, lacks ordered internal structure

Where and how do crystals grow?

- Minerals grow gradually from liquids like magmas and aqueous solutions
- From magmas in **igneous rocks**
- From water between grains in **sediments and sedimentary rocks**
- From saline water in basins where **evaporation** is significant
- By gradual replacement of other minerals in **metamorphic rocks**

Size of Crystals is controlled by:

- Temperature - at hi T atoms are very mobile
- Time
- Abundance of constituent elements
- Presence or absence of a **flux** (a substance that speeds up crystallization, reaction, or melting)
- magma or water vapor can act as a flux

Pegmatites have the largest crystals

- Pegmatites are extremely coarse-grained igneous rocks
- Some single crystals are up to 50 feet long!
- They form from the last liquid in a granite pluton
- rich in water and other volatiles (which act as flux)
- composed mainly of quartz, feldspar and micas
- rich in **excluded** elements like B, Be, Li, U, Sn
- may contain well-formed, unusual minerals like tourmaline, beryl, spodumene and topaz

Pegmatite examples – Black Hills, California, New England

Mistakes or Defects in Crystals

- Crystalline substances have an ordered internal structure
- Real crystals have some mistakes or defects in their internal structures
- Rapidly formed crystals have the most defects
- Some defects can be annealed out by heating the substance to a temperature below its melting point and holding it there for a while

Types of Defects in Crystals (see handout)

- Schottky defect *
- Impurity defect (interstitial) *
- Screw dislocation **
- Frenkel defect (misplaced ion) *
- Edge dislocation (extra layer) **
- Multiple defects

* point defects

** line defects

Twinning

- When two or more crystals of the same mineral share common atoms, typically along planes

- Twinned crystals must be symmetrically related
- Simple twins - only 2 members or parts
- Complex twins - more than 2 members or parts
- Contact twins - share only one plane of atoms
- Penetration twins - members share a volume
- Polysynthetic twins - complex twins with parallel planes of shared atoms
- Cyclic twins - complex twins with non-parallel planes of shared atoms

Twinning (see handout for examples)