Mineral Properties in Hand Specimen

Luster

- Metallic
- Sub-metallic
- Non-metallic
- Vitreous
- Adamantine
- Resinous
- Greasy
- Silky
- Pearly
- Dull
- And many others

Adamantine (to sparkle and appear brilliant like diamond)

Diaphaneity (ability to transmit light)
- Transparent
- Translucent
- Opaque

**Color**

- **Chromophores**
  - Elements that give minerals color
  - Mainly transition metals (Fe, Ti, Cr, Mn, etc.)
- **Idiochromatic (“self”-coloring)**
  - Major or "necessary" elements determine color
  - More likely to be useful for identification
- **Allochromatic ("other"-coloring)**
  - Minor or trace elements determine color
  - Ruby red is from trace Cr in corundum (Al₂O₃)
  - Sapphire blue is from trace Fe and Ti in Al₂O₃

Staurolite is idiochromatic

- Fe gives staurolite its brown color
- Staurolite formula is Fe₂Al₉Si₄O₂₅(OH)
Rhodochrosite is idiochromatic

- Mn gives rhodochrosite its cherry red color
  - Rhodochrosite formula is MnCO$_3$

Aquamarine is allochromatic

- Trace Fe gives aquamarine its blue color
  - Aquamarine is Beryl, formula Be$_2$Al$_2$Si$_6$O$_{18}$

Structural defects may give quartz color

- Radiation damage causes purple (amethyst) or smoky color

Streak is a useful diagnostic property

- Color of fine powder on streak plate is more reliable than hand-specimen color
- Mineral must be softer than the streak plate (H~6.5)
- Streak is especially useful for dark, metallic minerals

Play of Colors

- Opalescence - white light is separated into many colors (opal and moonstone)
- Chatoyancy and asterism - scattering effects
Crystal Shape

- Special named shapes
  - cube       Pyrite
  - dodecahedron Garnet
  - octahedron Magnetite

- General Shapes
  - prismatic
  - platy
  - blocky
  - tabular
  - bladed

Crystal Habit (in aggregates)

- massive
- granular
- radiating
- acicular
- fibrous
- asbestiform
- colloform or globular
- botryoidal (bubble-like)

Cleavage

- Shiny, smooth, planar breakage
- Between weakly bonded planes in mineral structure
- Sometimes hard to tell from growth faces (which commonly have imperfections, not as smooth)
- By quality
  - perfect
  - good
  - fair
- By shape or number and angle between them
  - cubic
  - rhombohedral
  - octahedral
  - prismatic
Cleavage Examples

Minerals without Cleavage have irregular Fractures

Quartz growth forms

Conchoidal fracture in quartz

**Hardness (relative)**

Mohs Hardness Scale

- talc \( H = 1 \)
- gypsum \( H = 2 \)
  - fingernail \( H = 2.5 \)
- calcite \( H = 3 \)
  - penny \( H = 3.5 \)
- fluorite \( H = 4 \)
- apatite \( H = 5 \)
  - knife, glass \( H = 5.5 \)
- feldspar \( H = 6 \)
  - file, streak plate \( H = 6.5 \)
- quartz  
  - H=7
- topaz  
  - H=8
- corundum  
  - H=9
- diamond  
  - H=10

Density (and Specific Gravity)

- Density ($\rho$) is in grams/cubic centimeter (g/cc)
- Specific Gravity (G) is mass mineral / mass water at 1 atm and 4°C (~1; therefore, $\rho$ and G values are similar; G is unitless)
- Determined by weight in water vs. weight in air

Density (or Specific Gravity)

- Relative density (or "heft") is useful for identifying some minerals
- most minerals range from G=2 to G=8
- average G non-metallic minerals ~2.7  (quartz)
- average G metallic minerals ~5  (pyrite)
- Barite (BaSO$_4$) with G=4.5 feels heavier than most other light colored, translucent minerals (of the same size)
- Galena (PbS) with G=7.6 feels heavier than most other metallic minerals (of the same size)

Other Useful Properties
• A few minerals are magnetic (attract a magnet) Magnetite \((Fe_3O_4)\) and Pyrrhotite \((Fe_{1-x}S)\)

• Some carbonate minerals effervesce (fizz) in dilute (5%) HCl: Calcite, Rhodochrosite, Aragonite; others, especially Dolomite, do not

• Fluorescence, phosphorescence, thermoluminescence or radioactivity are diagnostic for a few minerals

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

Twins have re-entrant angles, which single crystals do not!!

Twinning (see slide-show and handout for examples)