Mineral Properties

Hand sample description

How do we characterize minerals?

1) Color and streak
2) Luster
3) Hardness
4) Fracture and tenacity
5) Crystal form and system
6) Crystal shape and habit
7) Cleavage and parting
8) Twinning
9) Specific gravity/ density
10) Electrical properties, magnetism, radioactivity

Crystal Habit

The general *shapes* of crystals (i.e. cubic)

Habit is controlled by environment; therefore, it is not a fixed property and varies with locality unlike *form* that connotes a specific arrangement of atoms

l1

Because crystals have a direct relationship to the internal structure it follows that the faces have a definite relationship to each other.

Nicolaus Steno first spotted this relationship in 1669, and Steno's law states that:

"The angles between equivalent faces of crystals of the same substance, measured at the same temperature, are constant"

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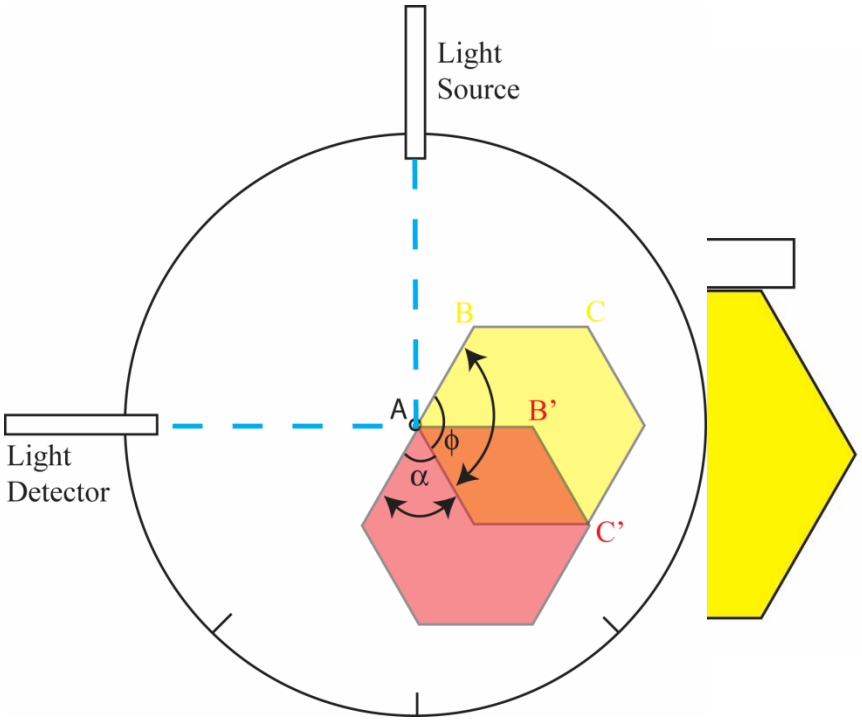
l1 This is the law of Constancy of Interfacial Angles

It is also important to note that this law has no bearing to the relative sizes of the faces...
localuser, 7/31/2006

Measuring interfacial angles

At the beginning of the 19th Century optical apparatus and the reflection goniometer came into use.

At the most basic level it is possible using a contact goniometer.



The crystal is mounted so that a crystal face reflects light.

The crystal is rotated about an external facial angle (α) until light is once more reflected into the detector.

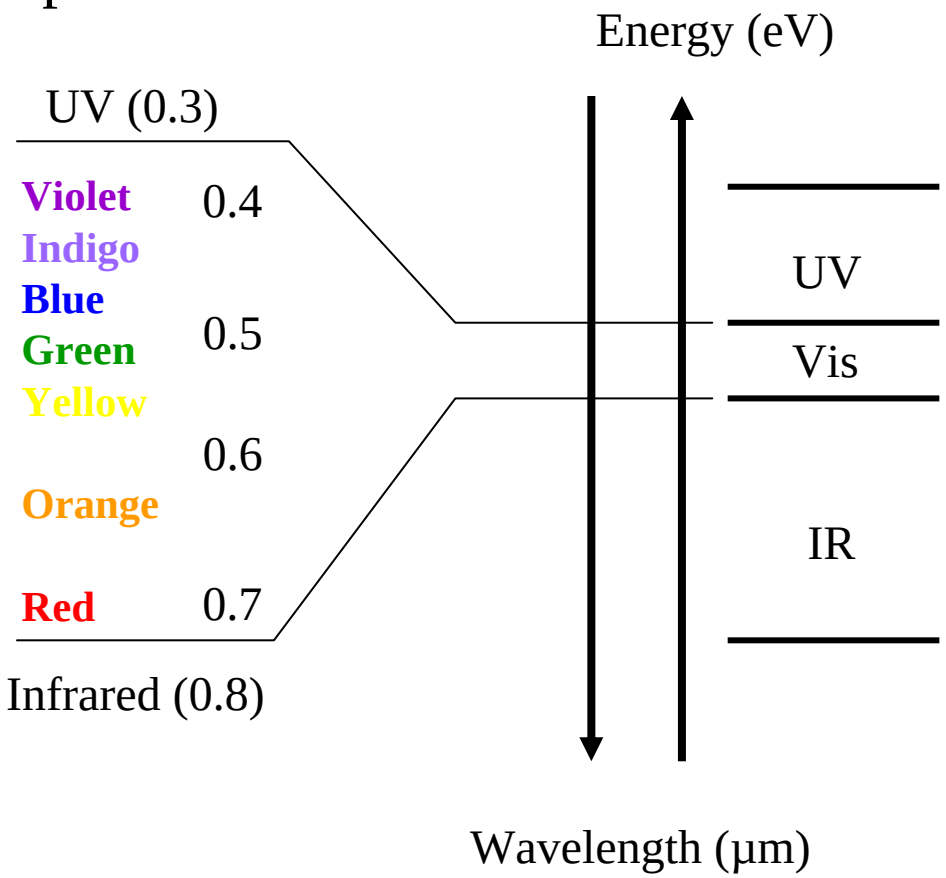
The interfacial angle (φ) can be measured since: α + φ = 180°.

Color

Perhaps the most “obvious” of properties.

White light, or visible light, is the combination of wave-lengths detectable to the human eye.

A minerals color is a function of energy absorption.



Streak

Despite the distinctive color of some minerals it is often observed that the powder form of a mineral has a different unique color.

This is the streak, and can be identified either by powdering a sample or drawing the specimen over a streak plate (a piece of unglazed porcelain).

Luster – the description of a minerals ability to reflect light.

Descriptive mineralogy uses terms such as:

1. (sub-) Metallic
2. (sub-) Adamantine (brilliance)
3. (sub-) Vitreous (look
4. Resinous (dried glue
5. Pearly (iridescent)
6. Greasy, waxy….
7. Silky
8. Dull and Earthy

Cleavage, parting, and Fracture

Descriptions of how a mineral "breaks"

The cleavage of a mineral is its tendency to break parallel to certain planes.

- Eminent
- Perfect
- Distinct or Good
- Imperfect
- Difficult

The properties of cleavage, parting and fracture are all related to the *tenacity* or tensile strength of a mineral – also related to the *toughness*

Whether a mineral is brittle, ductile, elastic, etc. is a direct reflection on the elements composing a mineral and the types of bonds that hold a mineral together

1. Conchoidal
2. Sub-conchoidal
3. Even
4. Uneven (rough)

5. Hackley (rough jagged)
6. Splintery (elongate, sharp, acicular)
7. Earthy

Hardness: A minerals resistance to abrasion

Typically measured on Moh's hardness scale (H).

1. Talc ← rubs off into flakes on skin
2. Gypsum ← fingernail
3. Calcite ← copper coin or knife blade
4. Fluorite ← knife blade
5. Apatite ← knife blade with pressure applied
6. Feldspar ← usually will scratch glass
7. Quartz ← scratches window glass
8. Topaz ← hard to distinguish from #7H minerals or one another unless Diamond or Corundum are themselves available
9. Corundum ←
10. Diamond ←

Twinning

Symmetrical intergrowth of 2 or more crystals of the same mineral – twin planes can be related to one another by symmetry operations: mirror planes, an axis of rotation, or or an axis of roto-inversion

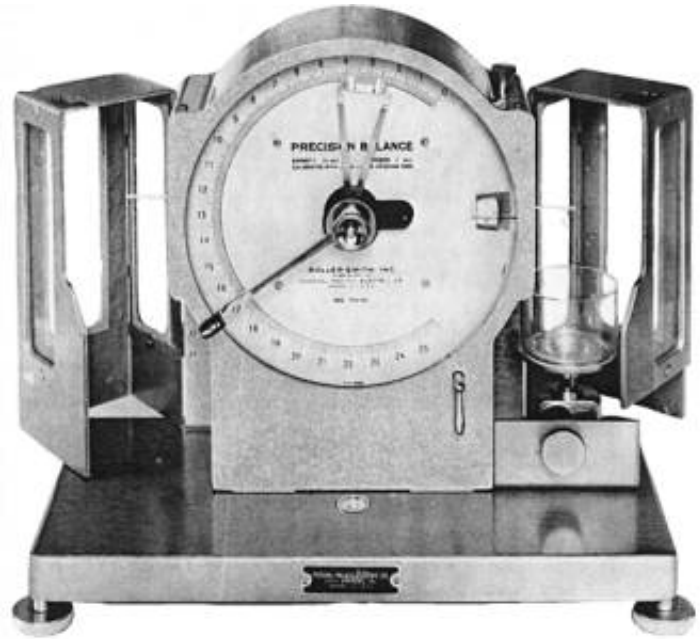
Basal cleavage - 1 direction, breaks into sheets
Prismatic cleavage - 2 directions @ 90°, rectangular prisms
- 2 directions not @ 90°, parallelograms
Cubic cleavage - 3 directions @ 90°, cubes
Rhombohedral cleavage - 3 directions not @ 90°
Octahedral cleavage - 4 directions
Dodecahedral cleavage - 6 directions

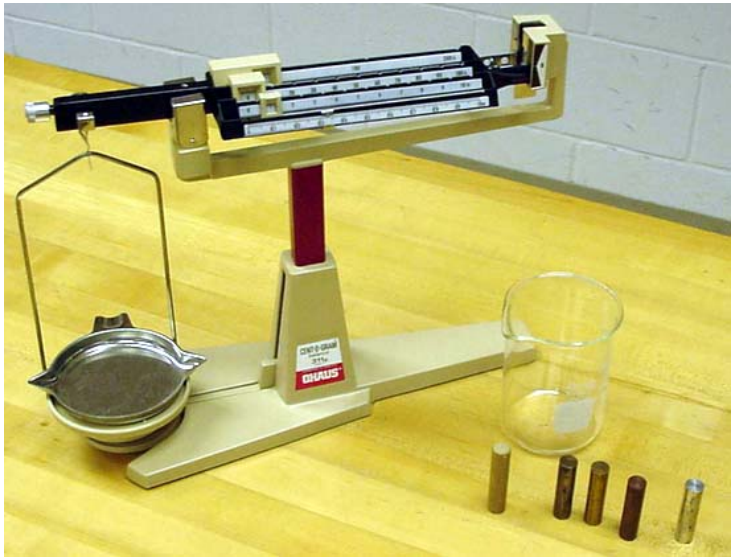
Specific Gravity (Density)

Density = Mass/Volume, and is measured in units of mass per distance^3.

The measurement of mass is fairly simple, but the measurement of volume is not.

The simplest methodology utilises Archimedes' principle and makes use of hydrometers, Jolly, beam or Berman balances, or the pycnometer.





In the simplest of terms the specific gravity of a substance is:

$$S.G = \text{Wt. in air}/[(\text{Wt. in air}) - (\text{Wt. in water})]$$

Meanwhile, a pycnometer provides great accuracy via calculation:

$$S.G = \frac{(\text{Wt. of } Pyc_0) - (\text{Wt. of } Pyc_{sample})}{(\text{Wt. of } Pyc_{(sample + H2O)}) + (\text{Wt. of } Pyc_0) - (\text{Wt. of } Pyc_{sample}) - (\text{Wt. of } Pyc_{H2O})}$$