# GY111 Introductory Geology

Laboratory 1: Minerals

# Definition of a Mineral

- Naturally occurring (can't be man-made)
- Inorganic (can't be composed of living or once-living material)
- Crystalline (has an ordered internal structure)
- Solid (can't be liquid or gas)
- Definite composition (you can use a chemical formula to express the composition – $SiO_2$)

# Polymorphs

- A polymorph refers to two or more minerals that have the same chemical formula but are in fact different minerals because their internal structure is different
- Examples:
  - $CaCO_3$: Aragonite and Calcite
  - $Al_2SiO_5$: Kyanite and Andalusite

# Physical Properties of Minerals

- Color
- Streak: color of finely powdered mineral
- Specific Gravity: ratio of weight of mineral divided by the weight of an equal volume of water
- Luster: the way that a fresh, un-weathered mineral surface reflects light
  - Metallic- like a metal
  - Non-Metallic
    - Vitreous – glassy
    - Adamantine- very intense, similar to a Diamond
    - Resinous
    - Waxy
    - Pearly
    - Greasy
    - Silky
    - Earthy- dull, like dirt or soil

# Physical Properties cont.

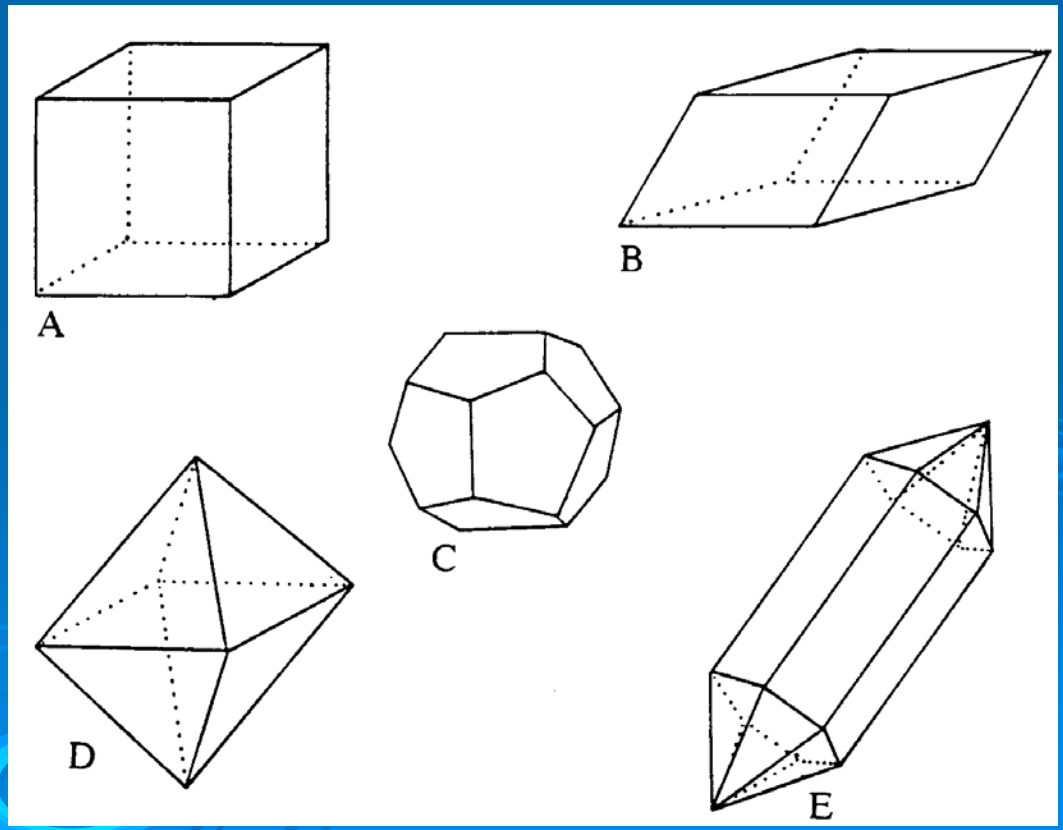
- Hardness: resistance to scratching
  - Moh's Hardness Scale (Know this for exams!)

**Table 1.2.** Mohs' scale of hardness for minerals and other common substances.

| Hardness | Mineral | Other materials |
|---|---|---|
| 1 | Talc | |
| 2 | Gypsum | 2.5 Fingernail |
| 3 | Calcite | 3.5 Copper Penny |
| 4 | Fluorite | |
| 5 | Apatite | 5.0-5.5 Steel, |
| 6 | Orthoclase Feldspar | 6 Glass |
| 7 | Quartz | |
| 8 | Topaz | |
| 9 | Corundum | |
| 10 | Diamond | |

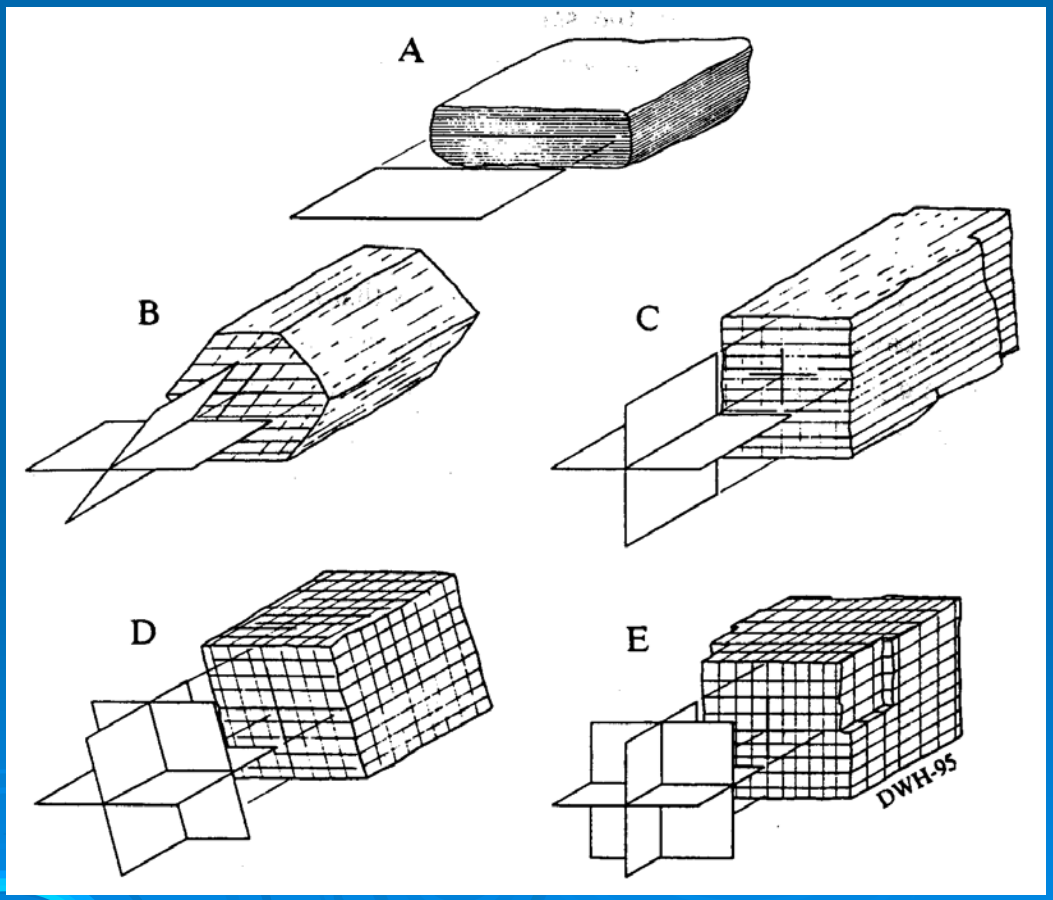
# Physical Properties cont.

- Crystal Form: characteristic shape that a crystal will form when allowed to grow unimpeded
  - A: Cubic
  - B: Rhombohedral
  - C: Dodecahedral
  - D: Octohedral
  - E: Prismatic



# Physical Properties cont.

- Fracture & Cleavage:
  - Cleavage- tendency to break along smooth planes
  - Fracture- breakage along irregular surfaces
- Concoidal Fracture: fracture of glass
- Examples
  - A: 1 direction (mica)
  - B: 2 directions not at 90 degrees (amphibole)
  - C: 2 directions at 90 degrees
  - D: 3 directions not at 90 degrees (calcite)
  - E: 3 directions at 90 degrees (halite)



# Physical Properties cont.

- Miscellaneous Properties:
  - Optical
    - Double Refraction: calcite
  - Taste
    - Halite (NaCl): table salt
    - Sylvite (KCl): bitter taste
  - Reaction with HCl acid
    - Calcite will effervesce  “bubble”
  - Magnetism
    - Magnetite: attracts iron metal; magnetic

# Economic Uses

- Know the economic uses for future exams!

**Table 1.5.** Economic uses of some minerals

| Mineral | Economic Use |
|---|---|
| bauxite | aluminum ore |
| calcite | Portland cement, chalk, antacids |
| dolomite | vitamins, antacid, garden lime |
| chalcopyrite | copper ore |
| galena | lead ore |
| garnet | gemstones, jewelry, sand paper |
| gypsum | sheetrock, plaster, cosmetics |
| graphite | lubricants, pencil lead |
| halite | table salt |
| olivine | jewelry (mineral peridot) |
| diamond | abrasives, girl's best friends |
| sulfur | pharmaceuticals, asphalt, plastics |
| fluorite | dental applications, steel flux |
| kaolinite | clay, pottery, tile, Kaopectate, cosmetics |
| hematite | iron ore |
| limonite | iron ore |
| magnetite | iron ore |
| quartz | electronic applications |
| sphalerite | zinc ore |
| talc | lubricant, talcum powder |

# Chemical Groups

- Know which group a given mineral falls into for exams!
- Groups
  - Elements (Au)
  - Oxides ($Fe_2O_3$)
  - Silicates ($KAlSi_3O_8$)
  - Carbonates ($CaCO_3$)
  - Sulfates ($CaSO_4$)
  - Sulfides ($FeS_2$)
  - Halides (NaCl)
  - Phosphate ($Ca_5(F,Cl)(PO_4)_3$
- Mineral Formula Table

# Laboratory Exercise #1

- Use the version from my website: Lab 1 (http://www.usouthal.edu/geography/allison/GY111/LabProblemSet1_Minerals.pdf)
- Print out or access reference materials from my website links:
  - Mineral Chemical Groups and Formulae (http://www.usouthal.edu/geography/allison/GY111/MineralFormulaTable.pdf)
  - Periodic Table of the Elements (http://www.ch.cam.ac.uk/magnus/PeriodicTable.html)

# Example Economic Problem

- Suppose you inherited 100,000 of Pyrite ($FeS_2$) ore from a relative. How much is it worth given a market price of $33/ton of iron?
  - Molecular Wt. of FeS2 = 1 x 55.845g/mole (Fe) + 2 x 32.065g/mole (S) = 119.975 g/mole
  - Tons of Fe = tons mined x (At. Wt. Fe)/(Mol. wt. FeS2) = 100,000 tons x (55.845)/(119.975) = 46,547 tons
  - $$$ = 46,547 tons x $33/ton = $ 1,536,051