

# 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 –  $\text{SiO}_2$ )

# 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:
  - $\text{CaCO}_3$ : Aragonite and Calcite
  - $\text{Al}_2\text{SiO}_5$ : 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!)

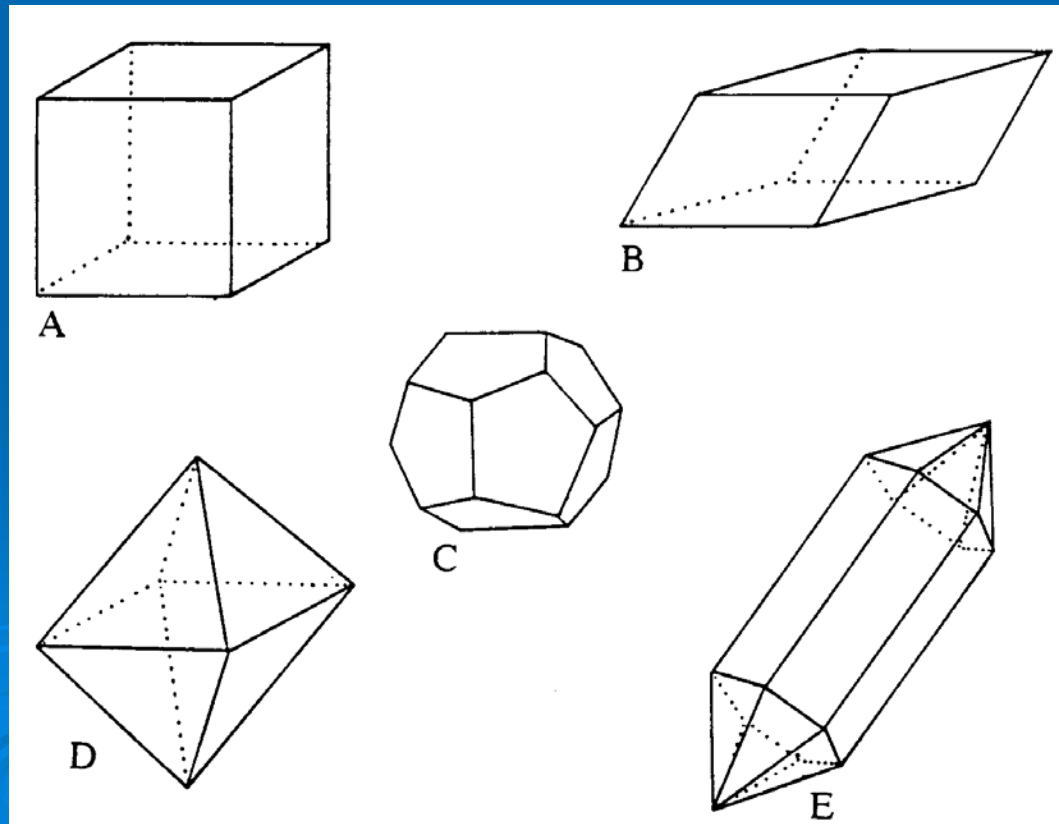
**Table 1.2.** Mohs' scale of hardness for minerals and other common substances.

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.

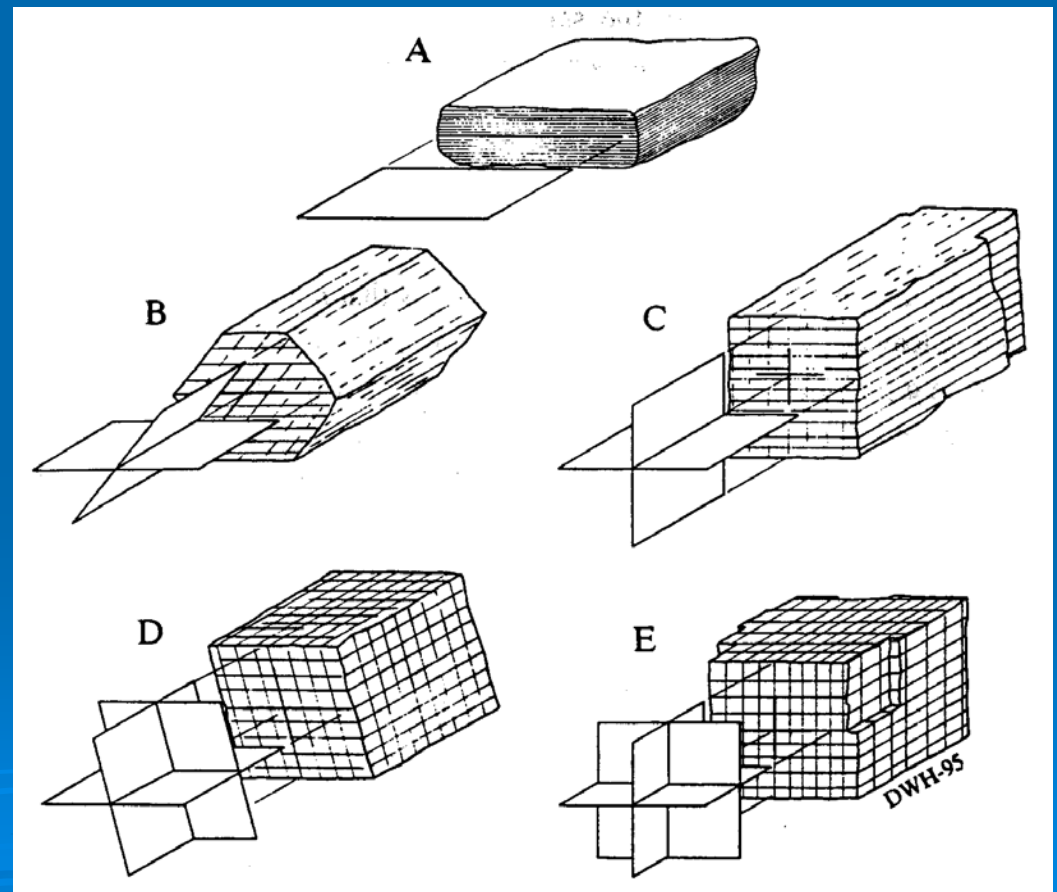
➤ Crystal Form:  
characteristic shape that  
a crystal will form when  
allowed to grow  
unimpeded

- 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
- Conchoidal Fracture: fracture of glass
- Examples
  - A: 1 direction (mica)
  - B: 2 directions not at 90 degrees (amphibole)
  - C: 2 directions at 90 degrees (pyroxene, feldspar)
  - D: 3 directions not at 90 degrees (calcite)
  - E: 3 directions at 90 degrees (halite, galena)



# 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
chalcopryrite	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 ( $\text{Fe}_2\text{O}_3$ )
  - Silicates ( $\text{KAlSi}_3\text{O}_8$ )
  - Carbonates ( $\text{CaCO}_3$ )
  - Sulfates ( $\text{CaSO}_4$ )
  - Sulfides ( $\text{FeS}_2$ )
  - Halides (NaCl)
  - Phosphate ( $\text{Ca}_5(\text{F,Cl})(\text{PO}_4)_3$ )
- Mineral Formula Table

# Laboratory Exercise #1

- Use the version from my website: Lab 1 ([http://www.usouthal.edu/geography/allison/GY111/LabProblemSet1\\_Minerals.pdf](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 ([www.periodictable.com](http://www.periodictable.com))

# Example Economic Problem

- Suppose you inherited 100,000 tons of Pyrite ( $\text{FeS}_2$ ) ore from a relative. How much is it worth given a market price of \$33/ton of iron?
  - Molecular Wt. of  $\text{FeS}_2$  =  $1 \times 55.845 \text{ g/mole (Fe)} + 2 \times 32.065 \text{ g/mole (S)} = 119.975 \text{ g/mole}$
  - Tons of Fe = tons mined  $\times$  (At. Wt. Fe)/(Mol. wt.  $\text{FeS}_2$ ) =  $100,000 \text{ tons} \times (55.845)/(119.975) = 46,547 \text{ tons}$
  - \$\$\$ =  $46,547 \text{ tons} \times \$33/\text{ton} = \$ 1,536,051$