Minerals: Building Blocks of Rocks Chapter 1

WHAT IS A MINERAL?

- Do we need Minerals? What for?
- Name something made from Minerals
- How to go from Elements to Minerals to Rocks?
- Can we live without Minerals?

Minerals are building blocks of rocks

A. **Mineral Definition**
   1. **Natural** not man made
   2. **Inorganic** not a living thing
   3. **Solid** like a rock
   4. **Crystalline structure** (internal order of atoms)
   5. **Definite chemical composition**

B. Mineraloid is a mineral that lacks a crystalline structure

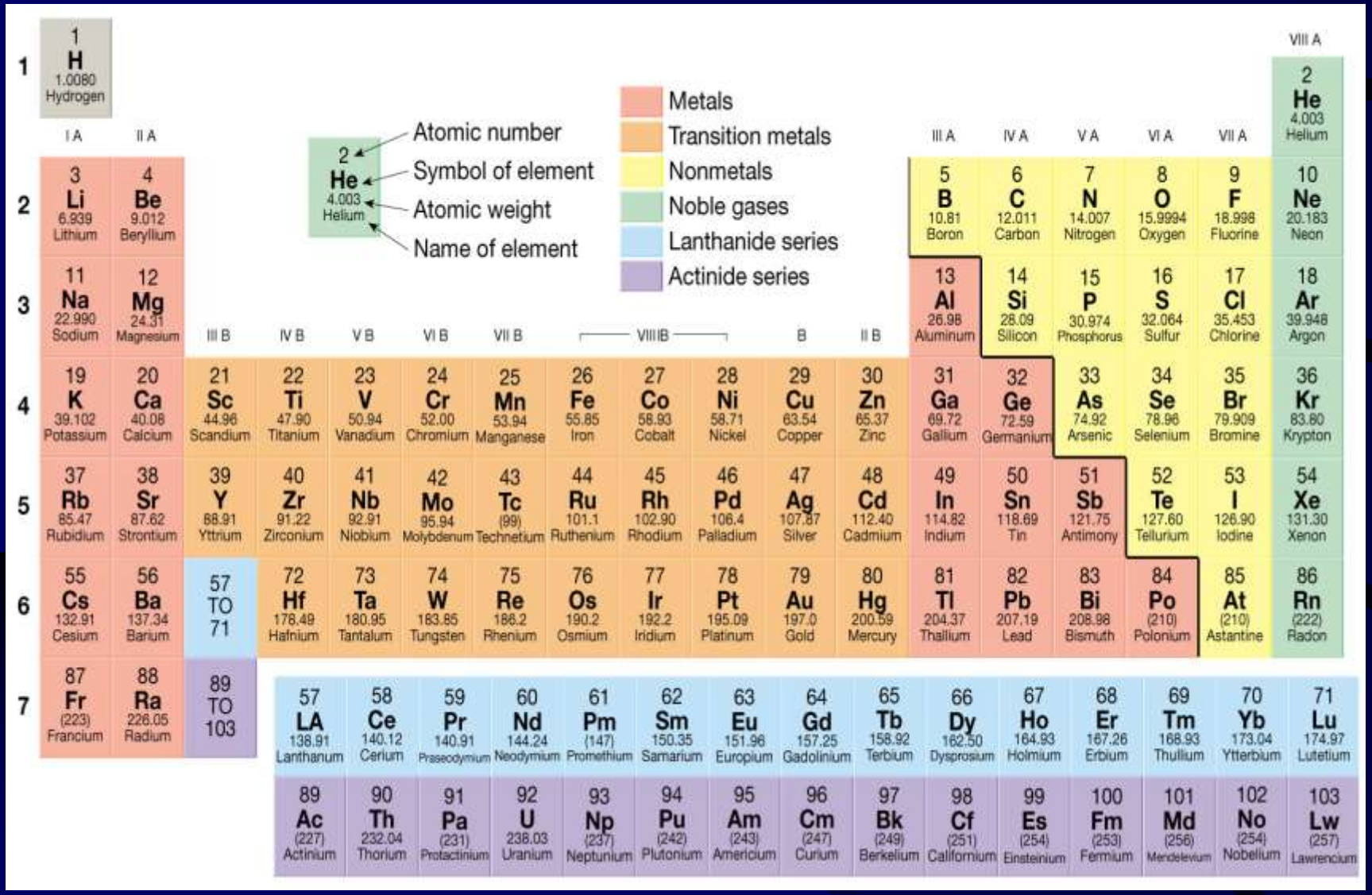
C. Rocks are aggregates of minerals

Minerals are Made of Chemical Elements (Atoms)

A. Elements
   1. Basic building blocks of minerals
   2. Over 100 are known

B. Atoms
   1. Smallest particles of matter
   2. Have all the characteristics of an element

Periodic table of the Elements

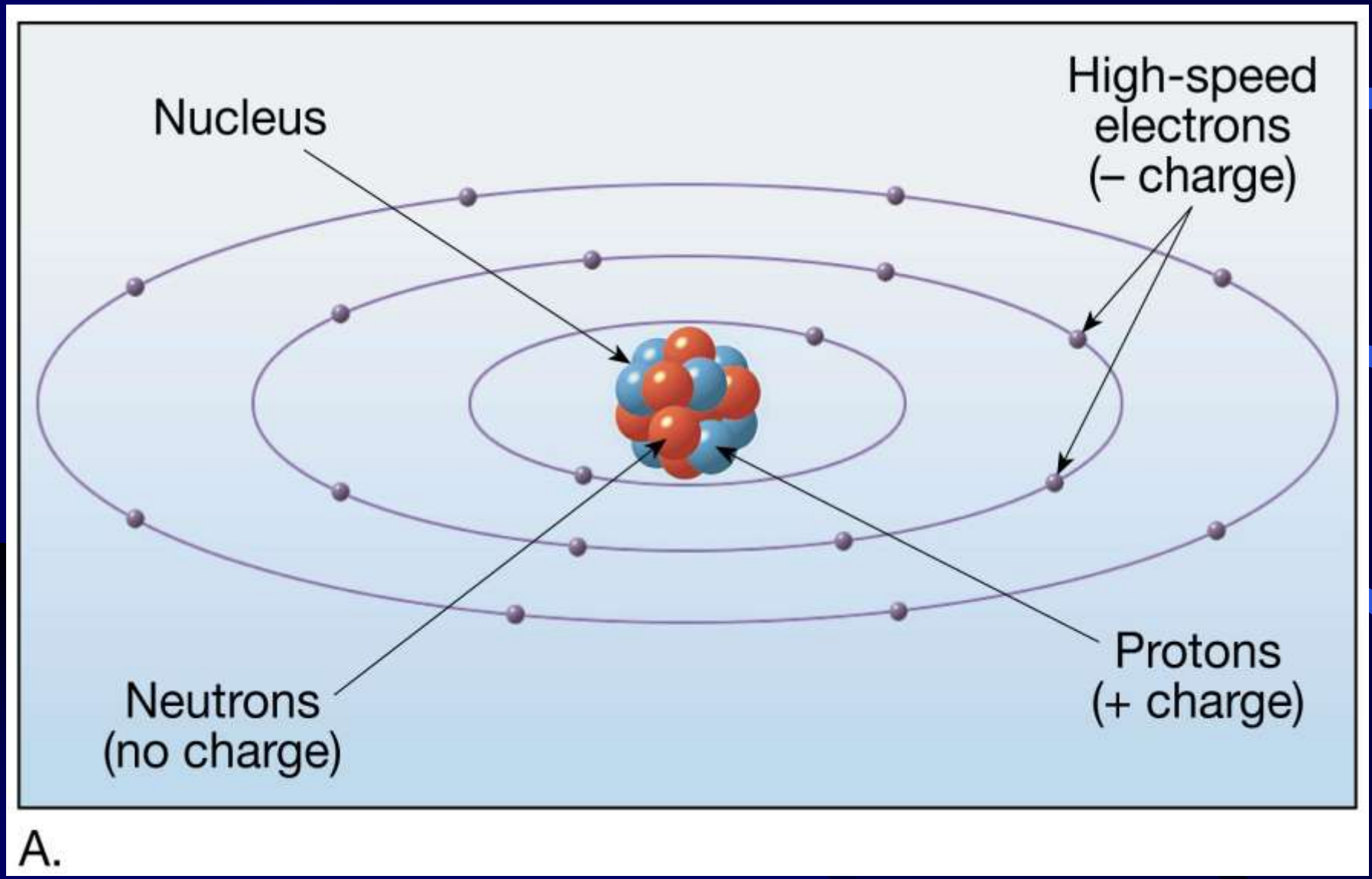


Atomic Structure

A. Nucleus – central part of an atom that contains
   1. Protons – positive electrical charges
   2. Neutrons – neutral electrical charges

B. Energy levels, or shells
   1. Surround nucleus
   2. Contain electrons – negative electrical charges

Simplified view of the atom



How atoms are constructed

C. Atomic Number is the number of protons in an atom's nucleus = Charge of the Atom

D. Bonding of atoms

1. Forms a compound with two or more elements.
2. Ions are atoms that gain or lose electrons.

- Ions Atoms that have gained (Anion) or lost (Cation) one or more electrons

How atoms are constructed

- Isotopes
  - Have different mass numbers – the sum of the neutrons plus protons (atomic weight)
  - Many isotopes are radioactive and emit energy and particles

Minerals

A. Physical properties of minerals

1. Crystal form – the internal structure of a mineral defined by its atomic arrangement.
2. Luster – how a mineral sample reflects light

   Metallic or Nonmetallic
3. Color – simply the color of a sample. Many mineral varieties appear as different colors.
4. Streak – the color of a mineral's powder
5. Hardness – the resistance of a mineral to be scratched by another mineral Scale of 1 - 10

TABLE 2.2 **Mohs Scale of Hardness**

Relative Scale		Mineral	Hardness of Some Common Objects
Hardest	10	Diamond	
	9	Corundum	
	8	Topaz	
	7	Quartz	
	6	Potassium Feldspar	
	5	Apatite	5.5 Glass, Pocketknife
	4	Fluorite	
	3	Calcite	3 Copper Penny
	2	Gypsum	2.5 Fingernail
Softest	1	Talc	

What are the two minerals your fingernail can scratch?

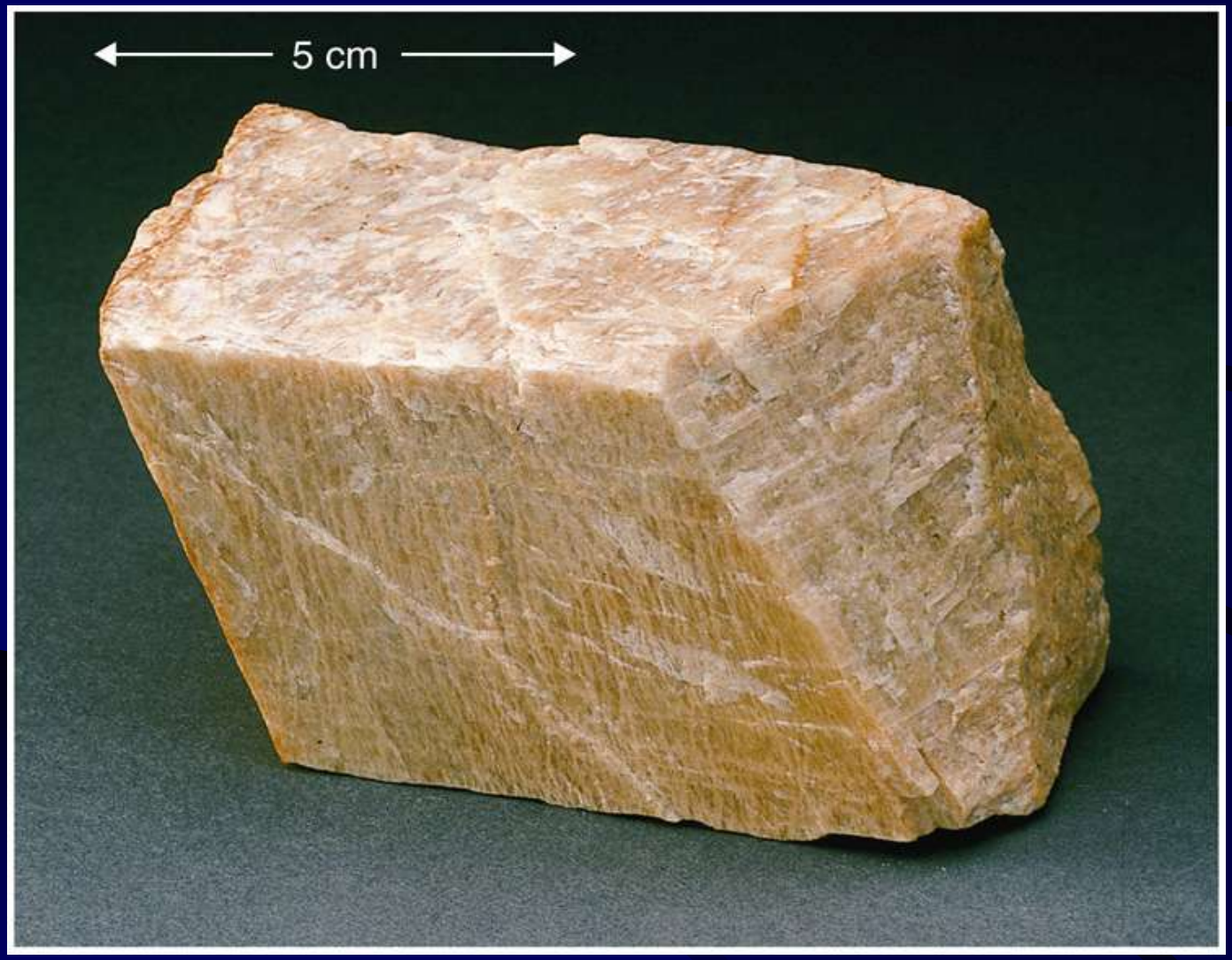
1. Calcite and Gypsum

2. Gypsum and Talc

3. Talc and Calcite

What is the luster displayed by this mineral ?

Potassium feldspar



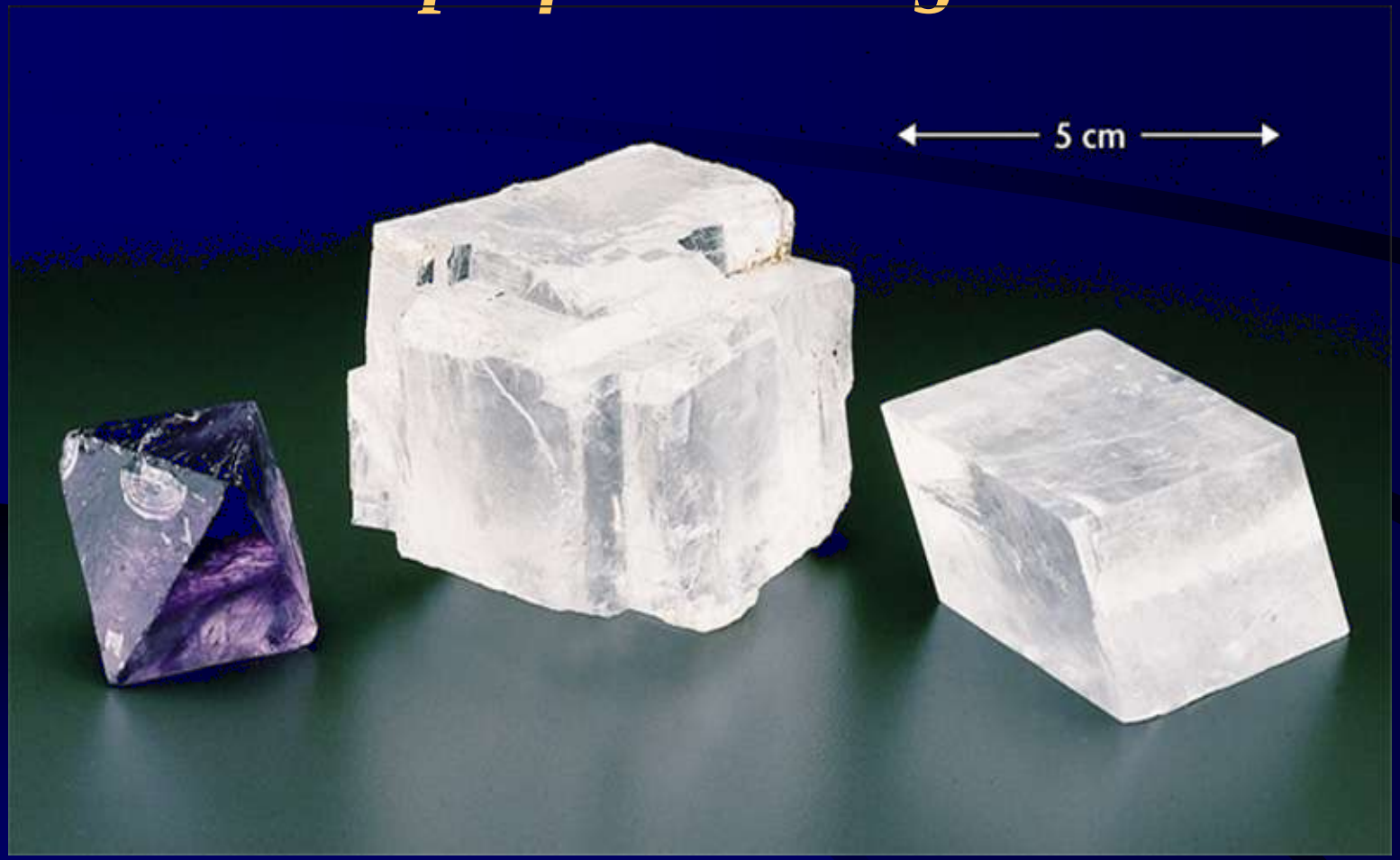
Minerals

- Physical properties of minerals
  6. Cleavage – tendency of a mineral to break along smooth faces or surfaces
  7. Fracture – tendency of a mineral to break along rough, uneven faces or surfaces
  8. Specific gravity – unit-less measure comparing density of 1 cc of mineral to 1 cc of water

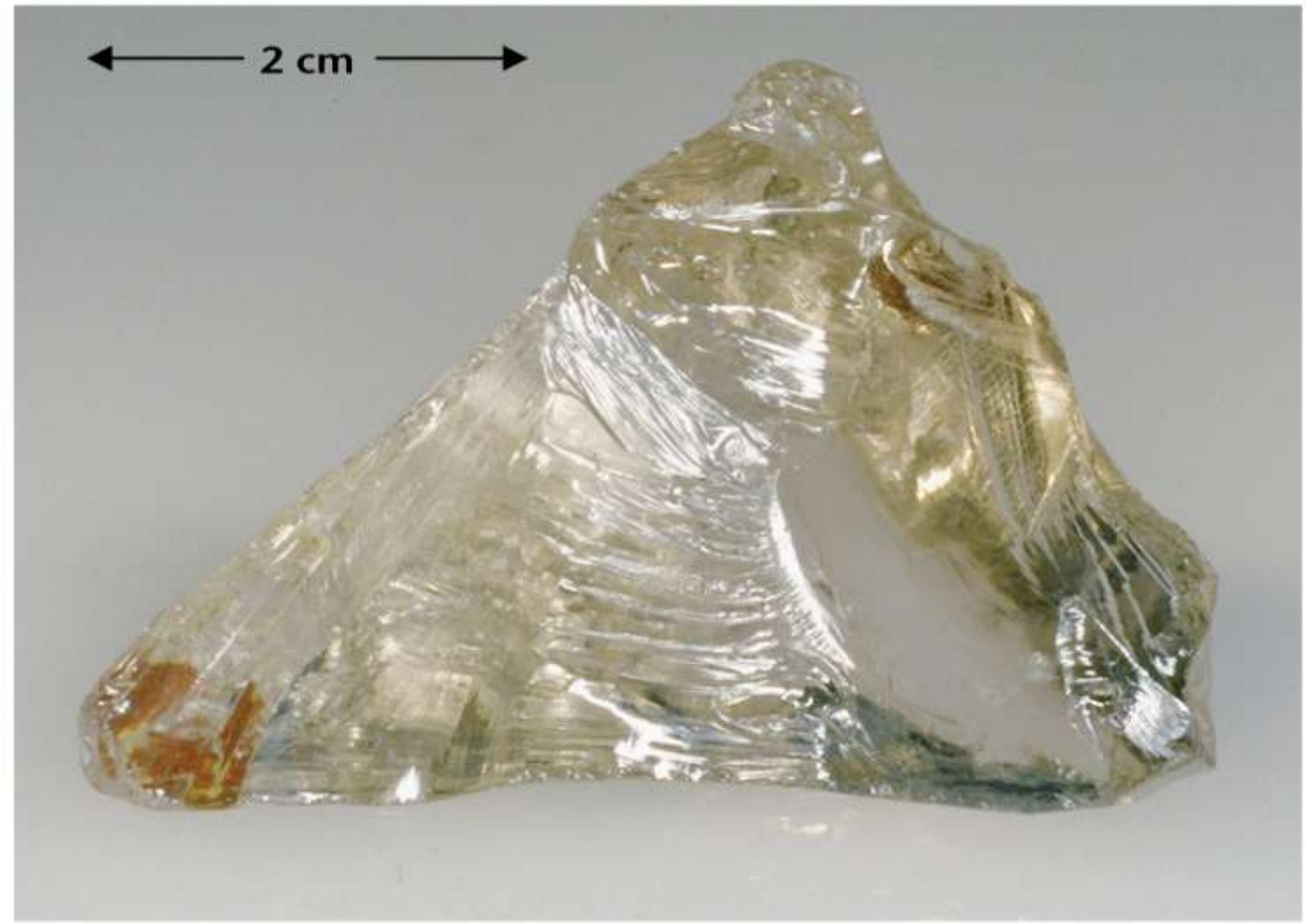
Does this quartz crystal exhibit crystal form or cleavage faces, why?

A.

Fluorite (left), Halite (center), and Calcite (right): do they show a perfect cleavage?



Quartz with a conchoidal fracture
Does this mineral have cleavage?



Mineral Identification

- 9. Other properties
  - a. Taste
  - b. Smell
  - c. Elasticity
  - d. Malleability
  - e. Feel
  - f. Magnetism
  - g. Double refraction
  - h. Reaction to hydrochloric acid
  - i. Radioactivity

B. A few dozen minerals are called the Rock Forming Minerals:

Are common minerals found in all igneous rocks

1. The eight elements that compose most rock-forming minerals are
   - a. oxygen (O),
   - b. silicon (Si),
   - c, aluminum (Al),
   - d. iron (Fe),
   - e. calcium (Ca),
   - f. sodium (Na),
   - g. potassium (K),
   - h. magnesium (Mg)

Table 2.3 Relative abundance of the most common elements in the continental crust

Element	Approximate Percentage by Weight
Oxygen (O)	46.6
Silicon (Si)	27.7
Aluminum (Al)	8.1
Iron (Fe)	5.0
Calcium (Ca)	3.6
Sodium (Na)	2.8
Potassium (K)	2.6
Magnesium (Mg)	2.1
All others	1.5
Total	100

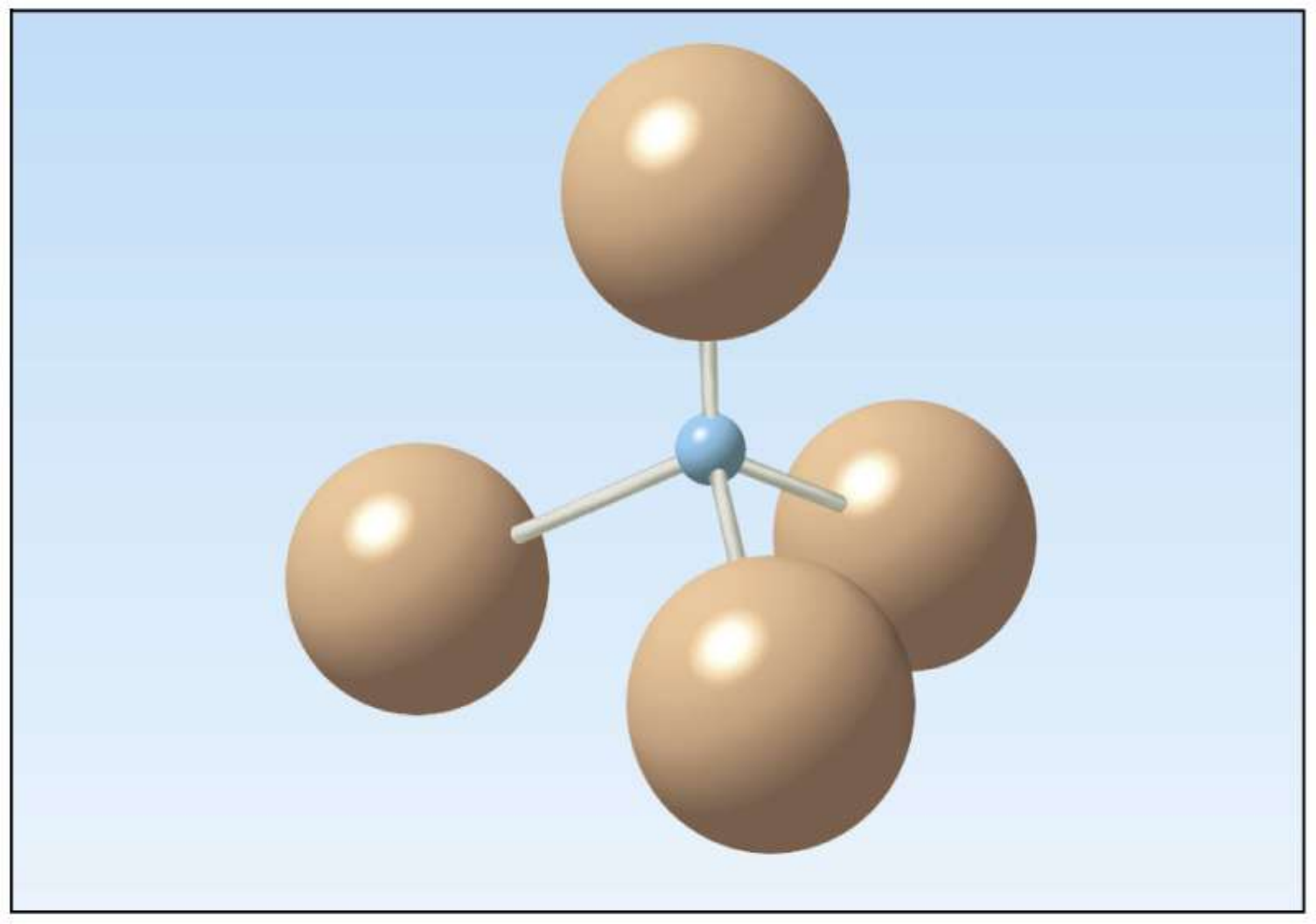
Source: Data from Brian Mason.

C. Mineral Groups

1. Rock-forming silicates
   a. Are the most common mineral group
   b. Contain the silicon-oxygen tetrahedron
      1. Four oxygen atoms surrounding a much smaller silicon atom
      2. Combines with other atoms to form the various silicate structures

Form from a magma or lava (molten rock)

The silicate $(SiO_4)^{-4}$ molecule



❖Non Silicate Mineral Group

- Major groups
  - Oxides – minerals composed of oxygen and some other elements except sulfur, silicon, or carbon. (Hematite, Limonite)
  - Sulfides – minerals composed of sulfur and some other elements except oxygen, silicon or carbon. (Galena, Pyrite)
  - Sulfates – minerals composed of sulfur and 4 oxygen atoms and some other elements except silicon or carbon. (Gypsum)

Hematite – Oxide Mineral

Galena – Sulfide Mineral

Sulfur – Native Mineral

Fluorite – Halide Mineral

❖Non Silicate mineral groups

- Major groups
  - Halides – minerals composed of combinations of cholrine, bromine, or fluorine with some other elements except oxygen, carbon, sulfur, or silicon. (Halite, Fluorite)
  - Carbonates – minerals composed of carbon and oxygen and some other elements except sulfur or silicon. (Calcite, Dolomite)
  - “Native” elements – minerals composed of a single element (Sulfur, Graphite)

Native Copper

b. Carbonates
   1. A major rock-forming group
   2. Found in the rocks limestone and marble

c. Halite and gypsum are found in sedimentary rocks

d. Many have economic value

Some common non-silicate minerals

Calcite

Halite

Gypsum

Diamonds

- Are made of pure carbon like graphite minerals
- Form at High pressure, high temperature deep underground unlike graphite
- Only 20% of diamonds traded are used in jewelry, the rest goes to industry

Mining Minerals

1. What are minerals used for?
2. How can we found them?
3. What Earth Scientists look for minerals?
4. What are the steps for mineral exploration?
5. Are we going to run out of mineral resources?

Minerals

D. Mineral resources

1. Reserves are already identified deposits
2. Ores are useful metallic minerals that can be mined at a profit
3. Economic factors may change and influence a resource

Steps for Mineral Exploration

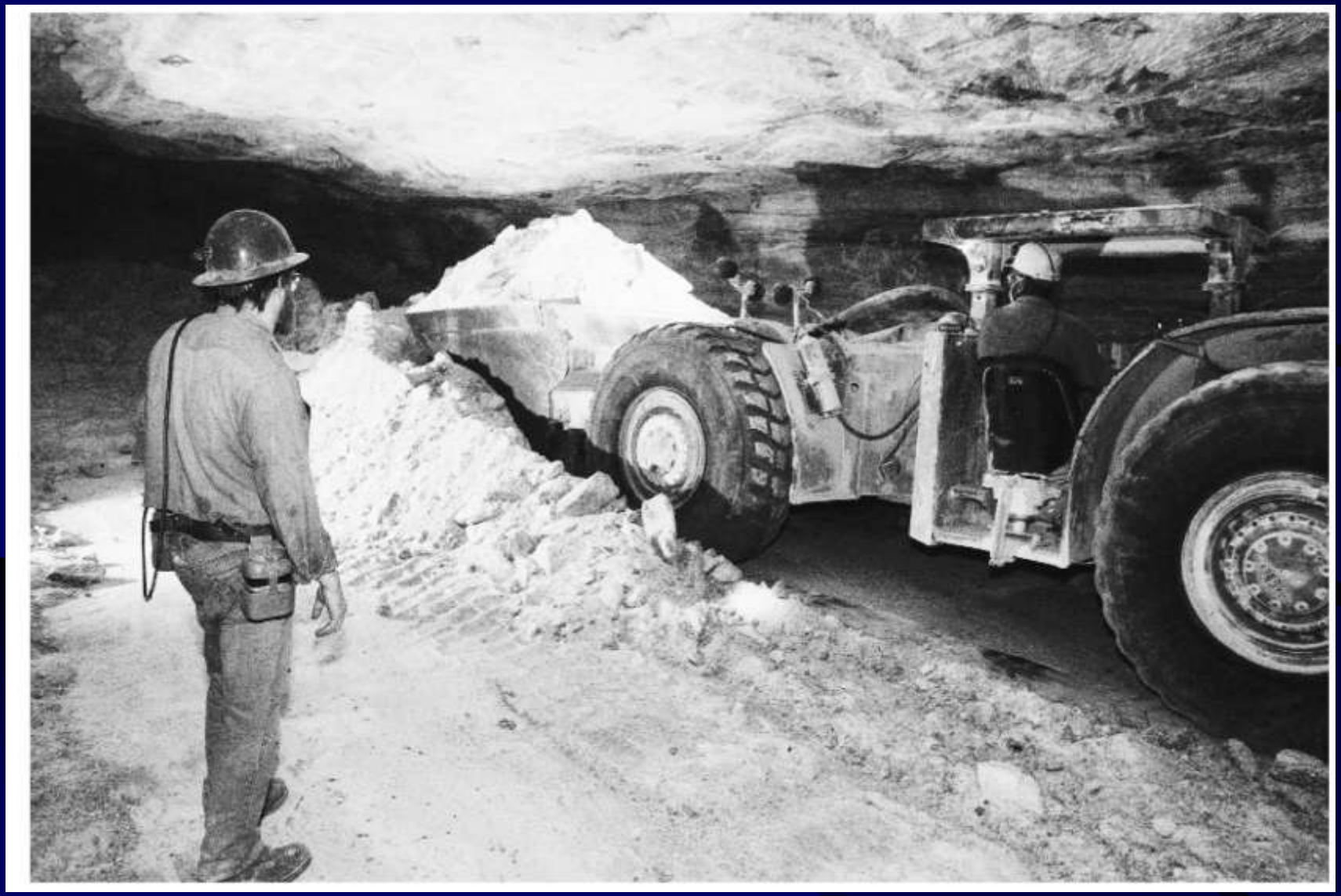
- **Exploration Stage:**

1. Identify target on a Geological map
2. Collect rock samples for analysis
3. Use core drilling to confirm the presence of deposit underground

- **Feasibility Study:**

1. Evaluate the reserves of economic mineral found
2. Plan for the exploitation of the resource found

An underground halite (salt) mine



The Bingham copper mine in Utah