IRON

Is a mineral that we use in a lot of stuff, it can be found in forms like

1. **HEMATITE (Fe_2O_3)**
    - **color ->** black – silver-gray – brown – reddish-brown – red
    - **hardness -> 5-6 on the mohs scale**
    - **luster ->** strong metallic
    - **transparency -> opaque**
    - **magneticity ->** not magnetic, and isn't attracted to common magnet
    - **origin**
        i. alteration in igneous, metamorphic, and sedimentary rocks
        ii. crystallization during the differentiation of a magma
        iii. precipitation from hydrothermal fluids moving through a rock mass
        iv. contact metamorphism when magma reacts with adjacent rocks

    - **usage**
        i. gem materials
        ii. healing stones
        iii. stopping x-rays because of its density
        iv. creating polishing compounds

2. **MAGNETITE (Fe_3O_4)**
    - **Color ->** black
    - **Magneticity ->** attracted to common magnet
    - **Transparency ->** opaque
    - **Luster ->** submetallic to metallic
    - **Hardness ->** 5-6.5 on the mohs scale
    - **Facts**
        i. It is often found in isometric crystals
        ii. The most strongly magnetic material found in nature
    - **Usage**
        i. Most important ore of iron
        ii. Heavy media separation
        iii. Studies of earth magnetic field

3. **Pyrite (FeS_2)**
    - **Color ->** brass-yellow
    - **luster ->** bright metallic luster
    - **origin**
        i. high and low temperature in small quantities in igneous, metamorphic, and sedimentary rocks world wide
    - **specific gravity ->** high
    - **facts**
        i. the most common sulfide mineral (iron sulfide)
        ii. has a famous nickname "fool's gold" because of its gold color, metallic luster, and high specific gravity
        iii. forms stuff with gold
        iv. some deposits of pyrite contain enough gold to warrant mining

Copper

A mineral that we use in stuff because of its conductivity

1. **Chalcopyrite ($CuFeS_2$)**
   - **Color ->** brass yellow
   - **Specific gravity ->** high
   - **Luster ->** metallic
   - **Facts**
     i. The most important ore for copper for thousands of years
     ii. It was also named "fool's gold" because of its similarity to gold

2. **Malachite ($Cu_2(CO_3)(OH)_2$)**
   - **Color ->** green
   - **Hardness ->** 3.5 – 4 on mohs scale
   - **Usage**
     i. Gemstone
     ii. Sculptural material
     iii. Jewelry
   - **Facts**
     i. One of the first ores to produce copper
     ii. Sold at high prices than copper or its ores
     iii. Produces effervescence when in contact with cold dilute hydrochloric acid

Commented [SD1]: Bubbles in the acid

MINERAL RESOURCES IN THE OCEAN

iron-manganese nodule

- **Color ->** dark
- **grain size ->** very fine-grained
- **facts**
  - it harms the ocean floor as extracting it takes sediments and the minerals out of the ocean floor and it also doesn't have specified rules as it is in an open area

NOTE

- the oldest continental bedrock is **4 billion years old**
- only a tiny fraction of rocks in a continent are **ores**
- most rocks do not contain economically valuable minerals, these include rocks such as sandstone, shale, limestone, granite, basalt, schist, and gneiss
- sedimentary rocks represent the big areas that have the same color
- sedimentary rocks cover the rocks deeper in earth's crust (**layered horizontally)**

Orogenic belts

Are areas where collisions between earth's lithospheric plates have resulted in great uplift of the land surface, these uplifts form stuff like mountains

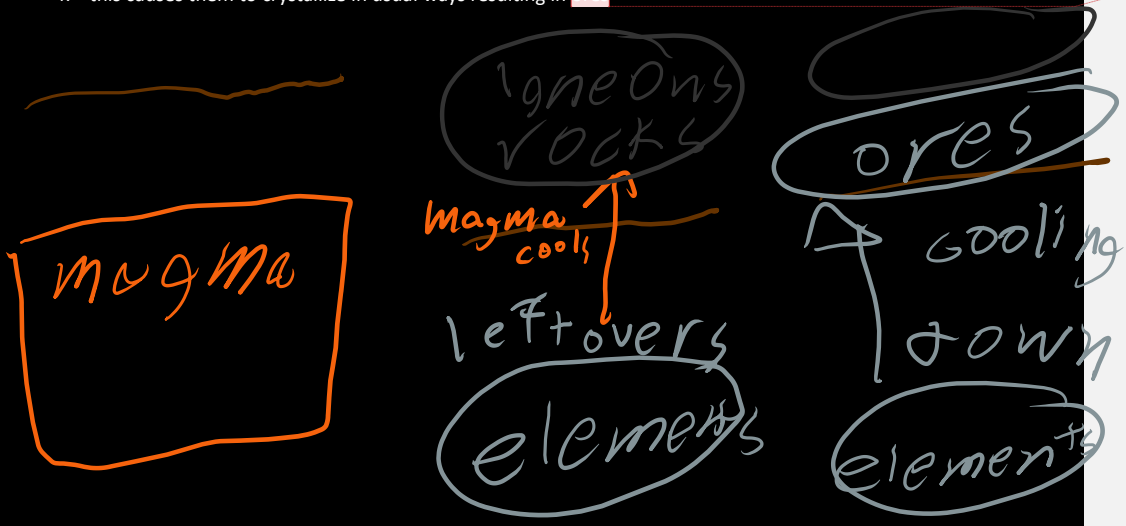
Commented [SD2]: Mountains are worn down from their original heights. In some of those areas, igneous activity has led to deposition of various ores

Hypothermal activity

Are one of the most important processes that form ores, here are the steps

1. magma contains many valuable chemical elements in small quantities
2. they become concentrated in water-rich juices, which are left over after the magma crystallized into igneous rocks
3. these elements work their way upwards towards the surface, they cool down in the process
4. this causes them to crystallize in usual ways resulting in ores

Commented [SD3]: Ex: copper, zinc, tin, lead, mercury, gold, silver, platinum, and so on.
Come from hydrothermal ore deposits.



Ores of iron:

Come from special sedimentary rocks and they were deposited in the oceans far back in geologic times

Ores of aluminum (bauxites):

Are formed when rocks that contain aluminum are weathered at earth's surface in warm and humid climates

Finding minerals

1. Every ore has a guide rock associated with it, search for guide rocks
2. Look for folds/fractures/faults in the guide rocks
3. Look for unusual colors on the guide rocks, or analyze unusual samples from the guide rocks
4. Record all info on a map

Geochemistry

is studying the distribution and amounts of chemical elements in minerals/rocks/ores/soils/water/atmosphere, and their circulation overtime in nature, this might also include vegetation and water that absorbed said elements
geochemists cannot tell how far below the surface a mineral is

Geophysics

Is studying the physical properties of earth, or applying physical measurements on the geologic problems

- In oil explorations, a special technique called **"seismic-wave reflection"** is used, where
    - a small explosion causes a vibration
    - Striking the ground with a steel plate causes a vibration
    - this vibration travels through the crust, which then is reflected back to the surface, the vibration is recorded on an instrument called a **geophone,** this vibration can help geophysicists
        - accurately determine if the subsurface is folded or faulted, and it can also reveal where oil, gas, or mineral deposits may build up
        - measure the local strength of earth's gravity field
        - measure the density of the rocks below earth's surface
- **magnetometer** is used to detect changes in earth's magnetic field, rocks that contain many iron bearing minerals affect the local magnetic field

MINING

Has two types

Surface mining

- **open-pit mining:** is a type of surface mining that works if the ore body is very large and near the surface, the process begins by removing the upper soil and then remove the rocks above the ore body
    - **ore and waste in the pit** are drilled, blasted, and loaded into huge trucks which then transport them to crushers or waste-piles, the crushed ore then is transported to facilities for storage and refining
- **dimension stone quarries:** are special types of open-pit mines, where large blocks of (granite, marble, limestone, sandstone) are removed intact, quarrying is used when the desired product is large blocks of the rock itself
- **strip mines** : are when deposits in the form of thin but widespread sheet-like layers near the surface, strip mines are used in stuff like oil shale

surface mines disturb the land in many ways as

- overburden are removed with the vegetations untop, which removes eco-systems
- dissolved chemicals from some rocks/minerals are exposed at the surface during mining, which pollutes water

Underground mining

- is when the resources lie deep underground or when the ore body has irregular geometry
- large **rooms** are formed when the ore is removed, modern techniques include
    - **back filling tunnels** to recover ore pillars, which helps prevent cave-ins and guards against environmental problems like acid-mine drainage

Commented [SD4]: **ores** are denser than common rocks in earth's crust, as the gravity field over most ores is a bit stronger than other rocks, which is then measured by an instrument called **gravimeter** that helps determine if there are ores under or not

Commented [SD5]: here, the **ore body** is called a **spoil**

Commented [SD6]: **overburdens** are rocks that lie over mineral deposits