

## DATA SHEET DS1

### CHARACTERISTICS OF COMMON ORE MINERALS

*Abbreviations: H = Hardness, SG = Specific Gravity*

*\*\* Suggested for Activities*

#### Native Metals:

Distinct metallic luster. Rather soft, malleable, ductile and sectile. All conduct heat and electricity, have metallic luster, hackly fracture, low melting points. SG proportional to the atomic weight, since they are relatively "pure" substances", although substitutions are common in some cases. The colors of the native metals are an indication of the wavelength of light which they absorb, for example, gold absorbs the yellow part of the visible light spectrum, and silver the white part. Most are rather inert, or in other words, not especially reactive with other elements.

Gold: **Au** H=2.5-3 SG=19.3 Yellow metallic luster. Most contains some silver. Crystals rare, and sometimes dendritic.

Silver: **Ag** H=2.5-3 SG=10.5 Bright silver metallic luster. Irregular masses, plates, scales or wires. Often tarnished brown or gray-black.

**\*\*Copper:** **Cu** H=2.5-3 SG=8.9 Distinct copper metallic luster, but often tarnished to a dark color. Crystals include octahedrons, cubes, dodecahedrons, or dendrites.

Platinum: **Pt** H=4-4.5 SG=21.45 Steel-gray color with bright luster when polished. Magnetic when it contains impurities of iron.

Bismuth: **Bi** H=2-2.5 SG=9.8 Silver-white metallic luster sometimes with a reddish tinge. Laminated texture. Perfect cleavage. Sectile.

#### Sulfides:

Most ore minerals are sulfide minerals. Generally opaque. Most have distinct colors and streaks.

**\*\*Chalcocite:** **Cu<sub>2</sub>S** H=2.5 –3. Metallic lead-gray luster but usually tarnished to dull black. Gray black streak.

**\*\*Galena:** **PbS** H=2.5. SG=7.4-7.6 Bright metallic. Lead gray color and streak. CUBIC, perfect cubic cleavage.

**\*\*Sphalerite:** **ZnS** H=3.5-4. SG=3.9-4.1 Luster nonmetallic, resinous, or submetallic. Commonly Yellow-brown. Perfect cleavage in 6 directions.

**\*\*Chalcopyrite:** **CuFeS<sub>2</sub>** H=3.5-4 SG=4.1-4.3 Metallic luster, brass yellow color often tarnished to bronze, or iridescent. Streak greenish black. Brittle. Softer than steel. Becomes magnetic on heating.

**\*\*Pyrite:** **FeS<sub>2</sub>** H=6-6.5 SG=5.02 Metallic luster. Brass color, sometimes tarnished darker. CUBIC crystals. Streak greenish or brownish black. Striations on cubes, or pyritohedron.

**\*\*Pyrrhotite:** **FeS** H=4 SG=4.58-4.65 Metallic luster. Brownish bronze color. Streak black. Moderately Magnetic. Becomes strongly magnetic on heating. Usually massive, not crystalline.

**\*\*Arsenopyrite:** **FeAsS** H=5.5-6 SG=6.07 Metallic luster. Color gunmetal gray. Streak black. Garlic odor on glancing with hammer, or heating. Wedge shaped crystals common, twinned. Massive. Characteristic green oxide Scorodite, or yellow oxide.

**\*\*Molybdenite:** **MoS<sub>2</sub>** H=1-1.5 SG=4.62-4.73 Metallic luster. Flexible but not elastic. Greasy feel. Color lead gray with blue tone. Streak gray black. Soft like graphite.

Nickeline: **NiAs** H=5-5.5 SG=7.78 Metallic luster. Pinkish bronze color. Alters to green stain like, oxide mineral (annabergite). Brown-black streak. Conchoidal fracture.

**\*\*Stibnite:**  $\text{Sb}_2\text{S}_3$  H=2 SG=4.52-4.62 Metallic luster. Color and streak lead gray to black. Perfect cleavage in one direction, with striations. Massive form most common. Bright yellow and red oxides common.

### **Sulfosalts:**

Referred to as 'double sulfides'. Typically less abundant than regular sulfides.

**Tetrahedrite:**  $\text{Cu}_{12}\text{Sb}_4\text{S}_{13}$  H=3-4.5 SG=4.6-5.1 Luster metallic to submetallic. Color gray-black to black. Streak black to brown. Tetrahedral crystals or massive. Brittle. Solid solution with Tennantite ( $\text{Cu}_{12}\text{As}_4\text{S}_{13}$ ). Can contain high silver (Freibergite).

**Jamesonite:**  $\text{Pb}_4\text{FeSb}_6\text{S}_{14}$  H=2-3 SG=5.63 Luster metallic. Color and Streak steel gray to gray black. Characteristic feathery, fibrous, acicular crystals. Lacks good cleavage.

### **Sulfates:**

**Barite:**  $\text{BaSO}_4$  H=2.5-3.5 SG=4.48 Colorless, white, yellow, green or black. Vitreous luster. White streak. Unusually heavy for a nonmetallic mineral. Perfect prismatic cleavage. Sometimes fluorescent under UV light.

**Gypsum:**  $\text{CaSO}_4 \times 2\text{H}_2\text{O}$  H=2 SG=2.32 Vitreous to massive texture, or sometimes fibrous. Colorless to gray, white, yellow, red, or brown from various impurities.

### **Oxides:**

**Cassiterite:**  $\text{SnO}_2$  H=6-7 SG=6.8-7.1 (high for nonmetallic mineral). Luster submetallic to dull. Color brown or black, rare yellowish. Streak white. Translucent to transparent. Crystals=prisms, some elbow shapes.

**\*\*Magnetite:**  $\text{Fe}_3\text{O}_4$  H=6 SG=5.18 Luster metallic, submet. Color black. Streak black. Highly magnetic. Octahedral crystals and partings.

**\*\*Chromite:**  $\text{FeCr}_2\text{O}_4$  H=5.5 SG=4.6 Luster metallic to submetallic. Color black to brownish black. Streak dark brown. Some subtranslucent. Crystals rare (octahedral and small). Typically massive or small globules in Peridotite or Serpentinite (Olivine-bearing 'UM' rocks).

**\*\*Specular Hematite:**  $\text{Fe}_2\text{O}_3$  H=5.5-6.5 SG=5.3 Shiny silver metallic luster. Red streak. Becomes magnetic when heated.

**Ilmenite:**  $\text{FeTiO}_3$  H=5-6 SG=4.5-5 Black to dark brown rhombohedral crystals. Submetallic luster, to semi-opaque. Weakly magnetic, and becomes strongly magnetic with heating.

### **Hydroxides:**

**Azurite:**  $\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$  H=3.5-4.0 SG=3.83 Blue color. Sub-translucent to vitreous to dull luster. Often occurs as stain. Pale blue streak. Secondary copper mineral.

**\*\*Malachite:**  $\text{Cu}_2(\text{CO}_3)(\text{OH})_2$  H=3.5-4.0 SG=4.0 Green color. Often occurs as stain, or can be massive, or banded. Light green streak.

### Tungstates:

\*\*Scheelite:  $\text{CaWO}_4$  H=4.5-5 SG=5.9-6.1 (unusually high for nonmetallic mineral). Luster vitreous to adamantine. Color white, yellow, green, brown, pale orange brown. FLUORESCENT in Short Wave UV light (due to Mo impurities). Looks like calcite. Associated with carbonate or calcareous host rocks

### Halides:

\*\*Fluorite:  $\text{CaF}_2$  H=4 SG=3.8 Luster vitreous. Color any; blue-green, purple common. Transparent to translucent. Cubic crystals and Octahedral cleavage. Some massive, banded.

## CHARACTERISTICS OF COMMON GANGUE MINERALS

### Silicates:

Quartz:  $\text{SiO}_2$  H=7 SG=2.65 Vitreous luster. Clear translucent and many colors. Crystals hexagonal. Many different forms and textures. Extremely common mineral.

\*\*Pyroxene:  $(\text{Ca, Na})(\text{Mg, Fe, Al, Ti})(\text{Si, Al})_2\text{O}_6$  H=5.6 SG=3.2-3.5 Dark green to black. Subvitreous, to sub translucent luster. Almost square crystals. Two good cleavages at nearly right angles. Gray green streak.

\*\*Hornblende:  $(\text{Ca, Na})_{2-3}(\text{Mg, Fe, Al})_5(\text{Al, Si})_8\text{O}_{22}(\text{OH})_2$  H=5-6 SG=3.0-3.4 Dark green to black. Perfect prismatic cleavage (diamond shape cross section) with one angle of 120 degrees.

Olivine:  $(\text{Mg, Fe})_2\text{SiO}_4$  H=6.5-7.0 SG=3.3-4.2 Olive green to yellow. Transparent to translucent, vitreous luster. Usually occurs in granular masses. Noticeably heavy.

### Carbonates:

\*\*Calcite:  $\text{CaCO}_3$  H=3 SG=2.7 Semi-hard. Many colors including clear, white, pink, green, or yellow. Perfect rhombohedral cleavage (three angles less than 90 degrees). White streak. Strongly effervescent reaction with HCl.

\*\*Dolomite:  $\text{CaMg}(\text{CO}_3)_2$  H=3.5-4.0 SG=2.85 Semi-hard, and like calcite, many colors and rhombohedral cleavage. Weakly effervescent with HCl, but more reactive when powdered.

# COMPOSITIONS OF COMMON ROCKS

## Plutonic Igneous:

- \*\*Diorite: Composition: albite + hornblende + access. min.'s.
- \*\*Gabbro: Composition: calcic plagioclase + olivine + pyroxene + access. min.'s.
- \*\*Granite: Composition: quartz + potassium feldspar + plagioclase + biotite + access. min.'s.
- \*\*Peridotite: Composition: olivine + pyroxene + access. min.'s (chromite, etc..).
- \*\*Pyroxenite: Composition: pyroxene + olivine +/- amphibole +/- sulfides +/- garnet + access. min.'s.

## Volcanic:

- \*\*Basalt: Composition: calcic plagioclase + pyroxene +/- hornblende + access. min.'s
- \*\*Rhyolite: Composition: quartz + potassium feldspar + biotite + albite +/- glass + access. min.'s.

## Metamorphic:

- \*\*Greenstone: Composition: same as basalt or gabbro. Weak foliation (planar fabric).
- \*\*Schist: Composition: usually mica and quartz and/or numerous other possible minerals. Strong foliation caused by alignment of micas.

## Metasomatic:

- \*\*Skarn: Composition: highly variable, can contain pyroxene, garnet, amphibole, sulfides, calcite, magnetite, epidote, scheelite, tremolite, and/or numerous other possible minerals.

## Sedimentary:

- \*\*Sandstone: Composition: fine- to coarse grains of quartz and/or feldspar and variable impurities.
- \*\*Limestone: Composition: calcite and/or dolomite with impurities such as quartz and clay minerals. May contain fossils.
- \*\*Shale: Composition: very fine-grained clay minerals, quartz and minor access. min.'s
- \*\*Conglomerate: Composition: highly variable. Very coarse grained. Contains clasts (typically rounded) of quartz pebbles, shale, or other rock types (ie, gravel) in a matrix of sand, silt or other material.