## A SHORT LIST OF BUTTE MINERALS

A listing of minerals identified at Butte, Montana, probably numbers close to one hundred. At Montana Resources' Continental Pit, the number of minerals we are concerned with is actually small. Some of the common minerals found in the Continental pit are:

1) Pyrite – $Fe_2$ - metallic, pale yellow, brassy color – as granular aggregates or crystals – brittle, hardness = 6.0-6.5 – gangue (waste): also known as "fool's gold".

2) Chalcopyrite – $CuFeS_2$ – metallic, buttery-golden yellow with a greenish cast, and will tarnish to an iridescent blue – as granular aggregates, rarely as crystals – brittle, hardness=3.5-4.0 – ore of copper – 34.6% copper when pure: may contain small amounts of silver.

3) Chalcocite – $Cu_2S$ – metallic to earthy, dark gray to black – as granular aggregates replacing pyrite, or sooty coatings on pyrite or chalcopyrite grains (this form is secondary, that is, deposited by cold surface water leaching down through the ore), massive, and very rarely as crystals (primary) – soft, brittle to sectile, hardness=2.5-3.0-ore of copper – 79.9% copper when pure, may contain small to significant amounts of silver.

4) Molybdenite – $MoS_2$ – metallic, dark gray, silvery with a slight purplish cast - as granular aggregates, flakes, slickensides, and occasionally, flat crystals – soft, brittle, hardness=1.0-1.5 – ore of molybdenum – 59.9% molybdenum when pure.

5) Native Copper – Cu – metallic, red-copper – forms dendritic (tree-like) masses, plates, leaf-like forms, and rarely, shiny, diamond or cube-shaped crystals – soft, malleabel: hardness=2.5-3.0 – greater than 97% pure copper, this material is actually difficult to treat in a milling circuit, and is not easily recovered. It is unusual at Butte, but is a primary ore in Michigan.

6) Quartz – $SiO_2$ – glassy to resinous, white to dark gray – as granular aggregates, vein fillings, and good crystals in vugs (pockets) – hard, brittle – hardness = 7.0 – gangue, but is useful as flux during smelting – accompanying all of the above minerals.

7) Tennantite – $Cu_{12}As_4S_{13}$ – gray-dark gray metallic – "gray copper" – forms granular aggregates, and rarely, three-sided pyramids (tetrahedrons) – hardness = 3.0 – 4.5 – copper ore, containing 51.6% copper, but is generally minor in the Continental Pit occurring as rare fillings in main Stage veins. Enargite – $Cu_3AsS_4$ – gray metallic – forms granular aggregates with or without elongate faces (indicating perfect cleavage in one direction) or bladed to prismatic crystals. Prismatic crystals were common at Butte (underground) and are very distictive due to a diamond-shaped, flat termination (pinacoid) on the top of the crystals. Hardness = 3.0 – copper ore containing 48.41% copper. This mineral is minor in the Continental Pit and occurs in the same veins as tennantite, often intermixed, and they are difficult to tell apart.

8) Malachite (green) and Azurite (blue) – copper carbonates created by the action of air, acid, and water on copper sulfides.