Lab 1 Mineral Utility Lab notes

The physical world is made up of a vast number of different minerals. Later on in the course, we will learn about some of the more common rock-forming ones. In this lab, however, we will discuss some of the ones you have probably already heard about because we mine them, e.g. gold, silver, and even salt or “halite”. These and most other minerals have to be extracted from “ore” before we can use them. Nonmetallic resources generally are not called ores, but are classified as industrial rocks and minerals. However they still have economic significance.

Ore is any naturally occurring material from which a mineral or minerals can be extracted profitably. An ore body is a mineral deposit or part of a mineral deposit, consisting of ore. Ore bodies can range in size from a few tons to more than a billion tons.

There are four major methods for collecting minerals or their ore. **Open-pits:** are used for deposits within 100m or the surface. Iron, malachite and azurite (copper), and galena (lead) are common open-pit ore minerals. Open-pits are less selective than subsurface methods, removing massive amounts of rock for a small ore turnover. An example of this is the Bingham Mine near Salt Lake City, Utah which removes 225,000 metric tons of rock a day, 20% of which is ore.

**Quarries:** Sand, gravel and other industrial or building rocks such as limestone, granite and marble are taken from quarries. Rocks like granite and marble are used as decorative rocks on the outside of buildings, or even as countertops. One shell square in downtown New Orleans is completely composed of travertine limestone.
**Dredging:** A special type of open pit mining used when the inflow of water is too high to be pumped out economically, and ore is sufficiently unconsolidated to be dug without blasting. Dredging employs chain buckets and draglines to scrape up surface deposits covered with water. Removing mineral rich sand from a stream bed is an example of dredging.

**Subsurface mining:** is used when a deposit is so deep that surface mining is impractical. Miners dig a deep vertical shaft, blast tunnels and rooms, and transport the ore to the surface. Compared to surface mining, proportionally more underground mining is done in developing countries where labor costs are relatively lower.

Extremely deep ore deposits are not mineable at a profit by any method.

**Processing**

Minerals usually need to be processed before they can be used. **Beneficiation** is the physical act of removing a mineral from its ore. Quarried rocks may simply need crushing, grinding, and sizing before use. Metal ores require much more work to remove impurities. Smelting and other chemical processes are used to free a metallic element from the oxygen, sulfur, or other elements with which it is combined in an ore.

Galena’s chemical compound is PbS (lead sulfide), the chemical separation of galena creates lead (Pb) and sulfur (S).

On the following page is an example of the total process of mineral extraction, here specifically copper.

**Environmental Concerns**

There are many environmental concerns with respect to mining activities from the initial exploration for ore to full blown extraction.

An initial concern is cosmetics, as seen in the photo of the copper mine near silver city an open pit mine is a major undertaking, and not necessarily aesthetically pleasing. Mining removes habitat with the total area used by the mine including roads to transport rock and ore through the surrounding countryside. While this may seem like a major loss, and it is for the local area, the total land use of mines in the U.S. is only 0.26% of the land area.

**Tailings** are the waste material remaining after ore has been pulverized and concentrated for processing. Tailings contain the leftovers which can include toxic chemicals such as sulfides. As chemicals such as sulfides mix with ground waters they create sulfuric acid, a major component of acid rain. Sulfuric acid also works to release even more toxic chemicals from the tailings into the environment. **Leaching** is the removal of chemicals by the movement of water. This is a concern today because in the past precautions were not taken to prevent the leaching of chemicals from tailings piles, and these chemicals and kill an ecosystem. Today the Environmental Protection Agency (EPA) regulates the creation and maintenance of tailings piles or ponds and requires that they be lined with plastic or impermeable clays to prevent the leaching of chemicals into the environment.
FIGURE 10.2. The principal stages of the copper mining and smelting process.
What kind of ore collection process is shown in this picture?

What collection method might be used to obtain sand for cement mixing?

Describe and discuss environmental disturbances created by a mine.

Name five parts of an automobile that are derived from minerals.
Part II. Mineral Exploration.

Materials: “Ore” Box (wooden block), straw, pipe cleaner, plastic cup.

Introduction: The purpose of this lab is to simulate the creation of a two dimensional ore map, and to calculate the cost of ore exploration versus profit created from an ore body. When a mining company decides to explore a possible location for a mineral ore there are a series of procedures they follow. The first is to explore the area. This is done by taking sample cores around the area of the potential mine location. This is usually done in a grid pattern so that the company can get a good idea of the size of the ore body. Depending on funding, the size, and the purity of the ore body, the grid used may be in meters, or even miles. Once the approximate size of the ore body is known the company can calculate an approximate value for the ore body. With this “value” they can then calculate whether or not it will be profitable to mine the ore body.

Directions:

The attached page has a one inch grid on it; you will use this to create your “ore map”. There are 81 possible drill spots on the map. Your company has allotted $350,000 to the exploration of the possible Gorman Gold ore body. One core hole costs $17,500. With your budget you have the potential to drill 20 holes.

Take the straw and stick it into one of the holes in the top of the ore box. If the straw does not hit any ore (1/4 inch or deeper clay) and comes out empty mark the matching location on your map grid with an X, which means no ore. If the straw comes up with “gold ore” then mark the grid intersection with an O. Pop out the ore with the pipe cleaner and continue taking cores. Save the clay plugs you pop out in a cup provided and turn them in when you are done with the box. Remember your budget limits you to selecting 20 core locations to map the ore body. (Note: The straw may come up with a small amount of clay, less than a millimeter or two thick, if it does then still consider this to contain no ore. Only if the straw comes up with approximately a quarter of an inch or more of clay should you consider the “core location” to contain “ore”. Also, try twisting or rotating the straw as you push it in, this way you will not get a false negative. I.e. The straw comes out empty when it should not.)

When you have taken 20 cores, take your grid map and draw a circle around the core locations where you found ore. You now have an approximate map of the Gorman ore body.

1. If one inch on your map is equal to 110 yards, calculate the approximate size (area) of the Gorman Gold ore body. (hint one square on the map is 12,100 square yards)

2. Each square yard of rock you mine will produce 3 tons of ore. How many tons of ore will the Gorman gold ore body produce?

3. Each ton of ore will produce 4 grams of gold, and a gram of gold is worth approximately $12.00. How much money will the Gorman mine produce?

4. It costs $2 to mine a square yard of rock, and another $3 per square yard of rock for transportation and processing of the ore rock. What is the cost of mining and processing the ore? What is the cost if we include the cost of the exploration? will it be economical for the company to mine the Gorman Gold ore body? How much profit will be made from the Gorman Gold ore body if any is at all?
x- no ore found  o- ore found