








# Mineral Extraction and Refining in Canada

Now that you have learned that all matter exists as elements, compounds, solutions, or mixtures, look around at the different materials you see. How many of these materials are elements? Very few elements occur naturally in pure form. Elements such as gold, silver, and copper exist in pure form in nature. Most of the other elements, however, combine easily with oxygen, sulfur, or other elements to form compounds. Some compounds are called **minerals** (Table 1). For example, most iron mines produce the compound iron oxide or magnetite and not the element iron.

**Table 1** Types of Minerals

Element	Mineral name	Mineral formula	Mineral sample
silver, gold, platinum	silver, gold, platinum	Ag, Au, Pt	
calcium	limestone	CaCO <sub>3</sub>	
aluminum	bauxite	Al <sub>2</sub> O <sub>3</sub>	
lead	galena	PbS	
mercury	cinnabar	HgS	
iron	magnetite	Fe <sub>3</sub> O <sub>4</sub>	
copper	malachite	CuCO <sub>3</sub>	

Minerals such as iron oxide are rarely found in pure form in the ground. They are often mixed with many less useful compounds in rock formations called **ore**. The minerals first need to be separated from the ore. Once this is done, the elements need to be separated from the mineral.

## Mining and Metallurgy

The technology of separating a mineral from its ore is called **metallurgy** (Figure 1). It requires knowledge of both the physical (magnetism, for example) and chemical (what compounds it reacts with) properties of the minerals and elements.

To obtain the pure metal in the form of an element, two steps are required:

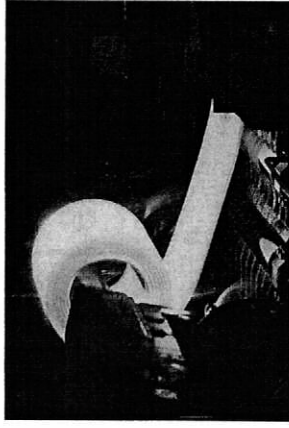
1. The mineral must be separated from the ore.
2. The metal must be separated from the mineral.

The ore must first be broken away from the rock face using explosives. Large ore carriers remove the ore from the base of the rock face and transport it to a crusher. It is now easier to separate the important mineral from waste material. Magnets, for example, can be used to separate magnetic elements such as iron from the waste.

Producing the element from its mineral involves chemical changes. Some of these chemical changes produce oxides of carbon and sulfur, both of which contribute to acid rain. The industry is working to remove these gases in a process called “scrubbing,” so that they will not be released into the atmosphere.

## Challenge

- 2 What element(s) would you include in your time capsule? Why?
- 3 Are there any famous scientists that played a significant role in developing safe mining and metallurgy practices in Canada?



**Figure 1** Iron metal is produced at temperatures of over 1000°C in a blast furnace.

## Understanding the Issue

1. (a) Use Table 1 to write the mineral or chemical formula for each of the following:
  - (i) bauxite
  - (ii) cinnabar
  - (iii) galena
- (b) Identify the desired element in each mineral.
2. Name three elements that occur as pure substances in nature.
3. List four steps that are required to separate an element from the ore in which it is found.

## Exploring

4. Research the methods used to obtain one of the following elements in Canada: nickel, copper, aluminum, iron, gold. Prepare a Bristol board presentation of the information you were able to find.
  - (a) Many communities collect aluminum beverage cans at the curbside for recycling.
  - (b) Is recycling a good alternative to using raw aluminum?
  - (c) How does the cost of recycling compare with the cost of extracting the aluminum from the ground?
  - (d) Which process results in fewer environmental problems?
  - (e) Use the answers to (a)–(c) to decide whether recycling is a reasonable alternative for producing aluminum beverage cans.