Mining in Canada

Location and Types of Minerals
Canada's minerals; can be broken down into four major categories: METALLIC, NON-METALLIC, STRUCTURAL and FUELS. Each type is created under certain geological conditions and, as a result, occurs in specific geological region. Most metallic minerals, or metals, are associated with igneous rock, particularly the Precambrian Shield, which is often called "Canada's Mineral Storehouse".

The shield covers much of Quebec and Ontario, consequently, these provinces produce nearly 50% of this country's metallic minerals. They are particularly important as sources of iron ore, nickel, base metals and precious metals. Base metals include copper, lead and zinc, which are "inferior" in value to precious metals and are used for commercial and industrial purposes. Precious metals ~ mainly gold, silver and platinum - are valued for other than commercial and industrial purposes.

The Appalachian and Cordilleran regions are also significant sources of metallic minerals, though only where they are intrusions of igneous rock into the sedi~entary rocks that largely make up these mountains. B.C. produces over 40% of Canada's copper, and New Brunswick contributes nearly 25% of its zinc.

Metals make up the most valuable category of minerals mined in Canada. However, non-metallic minerals, or non-metals, are also significant. The most important are gypsum, potash, salt and asbestos. They are mainly used in industrial and manufacturing processes in their natural state, and are frequently referred to as industrial minerals. Non-metals are generally found in the sedimentary rocks of Nova Scotia, New Brunswick, Saskatchewan and southern Ontario. They owe their origin to the ancient saltwater seas that once covered these regions. As the seas slowly evaporated, the salts in the water were deposited on the ocean floor in thick layers. Asbestos is an exception: it is contained in igneous rock which has been superheated, twisted, shredded and squeezed to create a metamorphic mineral with fibrous characteristics.

Structural or building minerals include limestone, aggregate (sand and gravel) and clay. lnese rarely receive the glamourous attention accorded to gold or silver, yet as a group they are almost as valuable as non- metals, because they are the basic materials for the construction of most roads and buildings. When aggregate - sand and gravel- is mixed with cement, it becomes concrete. Deposits of aggregate and clay are found in every geological region of Canada, but are most numerous in areas where they was a lot of glacial deposition. Ontario - particularly southern Ontario, because of its geology and large urban and industrial base - dominates Canada's production and consumption of structural minerals.

Fuels, like coal, oil and natural gas are all associated with sedimentary rocks. An the majority of these resources are found in Albel1a and Saskatchewan with smaller deposits in B.C. and Nova Scotia. Urar1ium, another fuel is found in igneous rocks in the Canadian Shield with major deposits found in northern Saskatchewan and Ontario.

From Mine to Marketplace
Canada has some 300 mines producing a vast array of minerals. However, before any of these mines actually reach the point where a mineral or rock can be sold profitably a number of activities must take place. These include exploration, extraction/production and refining. These activities require enormous amounts of investment. The process is always a lengthy one' for example, the Thompson North mine at Thompson Manitoba was opened in 1986 after five years of development, at a cost of $100 million! It is estimated that the average base-metal mine in Canada needs between $50 and $150 million, and between eight and ten years of exploration and development, before it actually goes into production.

Exploration
For many people, hunting for minerals being to mind a scruffy prospector struggling through the woods with a pick, shovel and packsack. In the past many of Canada's greatest mineral discoveries were made by such individuals as they examined exposed surface rocks for signs of mineralization. But despite their successes, the early prospectors were unable to detect most of Canada's mineral wealth, which lies far below the surface.

Modern exploration relies heavily on geophysics, a branch of science that combines geology, the study of rocks, with physics, the study of matter and energy. Geophysical surveys are conducted on the ground or by aircraft towing complex measuring instruments over thousands of square kilometres of wilderness. The instruments measure and collect magnetic, radiation and gravitational data about the rocks beneath the surface. One of the most widely used instruments is the magnetometer, which measures changes in the earth's magnetic field. Geologists look for differences in the regular pattern of the rocks. These may indicate the presence of a mineral deposit like nickel or iron ore.

Once a possible deposit has been located, a detailed study is made to determine its exact location, size and mineral composition. Unless the mineral is exposed on the surface, a drilling crew must be sent in to take thousands of core samples, or "rock worms" of the underlying rock. Core samples are cylindrical pieces of rock extracted with a hollow drill. Only after a close examination and an assay (scientific testing) of the core samples can the geologist begin to know what lies buried in the rock. In most cases, the assay indicates that the valuable-mineral content is non-existent, or so low that mining would not be profitable. On average, only one of a thousand exploration prospects ever develops into a mine!

To Mine or Not to Mine?
Even after a mineral deposit has been discovered, a mining company must still decide whether or not it is an ore body - a mineral deposit from which one or more minerals can be extracted at a profit. Obviously, no company is going to spend perhaps $100 million on a mine, however rich the deposit might be, if other factors make it unprofitable. A number of other considerations must be taken into account

- Quality of the resource - Geologists must map the minerals deposit and determine its size, extent and depth, as well as grade of the mineral content. From this information, projections can be made as to the amount of valuable minerals that could be obtained, the life of the mine, and the cost and the mining method required to extract the ore. The mining company may decide the deposit is not worth mining. Many mineral ores remain buried because they cannot be exploited economically.
- Demand and value - The present and future demand for a mineral, as well as its value in world markets, must be assessed. For example, at the beginning of March 1988, the world price of nickel was $11,000 (U.S.) A tonne; by the end of the same month, the price has

skyrocketed to record levels, hitting $22,500 (U.S.) A tonne. This led the International Nickel Company (INCO) to reopen one mine and develop another.

- Transportation - New mine sites are often isolated and inaccessible. There must be a way to bring in the tonnes of equipment required to open and operate the mine, and to ship the mineral to market. A road or railway may have to be built through rough and rugged terrain. This extra cost may make the project too expensive. The high cost of building railways in the B.C. interior has limited that region's mineral development.
- Labour force. Without workers, a mine cannot function. Unfortunately, most new mines are in areas where there are few towns. This may mean that a brand-new town must be created. Those are only a few of the major concerns a company must face. Others are:
    - Is there an available source of power?
    - Is there an adequate supply of clean water nearby? 18 Which environmental problems might arise?
    - How will government taxes and subsidies affect development?
    - How will the company finance the new mine?

From Ore to Metal

Very rarely will an ore extracted from the earth have a high enough valuable mineral content that it can be used without further processing. This is particularly true of metallic ores, which require considerably more processing than other minerals. Most metallic ores have an ex1remely small percentage of valuable minerals - the rest is waste. The rich nickel ores of the Sudbury region are about 96% waste; most gold ores have less than six grams of gold per tonne of ore.

A variety of processes have been developed to recover the minerals profitably. In the mill, which is usually close to the mine, the ore is crushed and ground into particles the size of grains of sand. Depending on the physical and chemical properties of the valuable minerals, the ore may be washed, sorted, passed over a magnetic field or treated with chemicals. Whichever process is used, the end result is that the valuable minerals are collected in a form called concentrate and the waste, or tailing, is disposed of.

In Sudbury's mills, the concentrate is a mixture of nickel, copper, gold, silver, platinum and cobalt, along with a variety of other minerals and impurities. At the smelter the nickel-rick concentrate is heated to high temperatures, in combination with other chemicals. The heat drives off water and many of the impurities, leaving a metal of about 50% purity. Finally, it must go to a refinery, where it is further purified to almost 100% nickel, and is ready for sale to the industries that use it.

Most other metal-bearing ores follow a similar path from mine to refinery. Some refining processes are simpler than other; all however, involve a series of steps. Most non-metallic and structural minerals require far less processing, since they occur naturally pure or almost pure. Crushing, washing, screening and sorting are the most common methods of processing these minerals.

Questions for

Mining in Canada

1. For the four mineral categories name:
a) the physiographic region in which they are found
b) the rock types
c) three specific examples of minerals

2. Use the data below to complete the pie graphs on the map of Canada, then add all of the usual map essentials.

REGION	METALLIC	NON-METALLIC	STRUCTURAL	FUELS
ATLANTIC	70%	5%	8%	17%
QUEBEC	55%	22%	15%	8%
ONTARIO	70%	15%	10%	5%
PRAIRIES	44%	3%	8%	45%
BRITISH COLUMBIA	54%	2%	6%	38%
YUKON / NWT	97%	0%	3%	0%

3. Explain in one paragraph, how modern exploration methods differ from prospecting during earlier times.

4. Which role would the following people play in deciding whether or not to develop a mine?
    a. a geologist
    b. a marketing specialist
    c. a transportation expert
    d. a town planner
    e. an environmental-protection expert
    f. a government official

5. What determines whether an open-pit or a shaft mine is used?

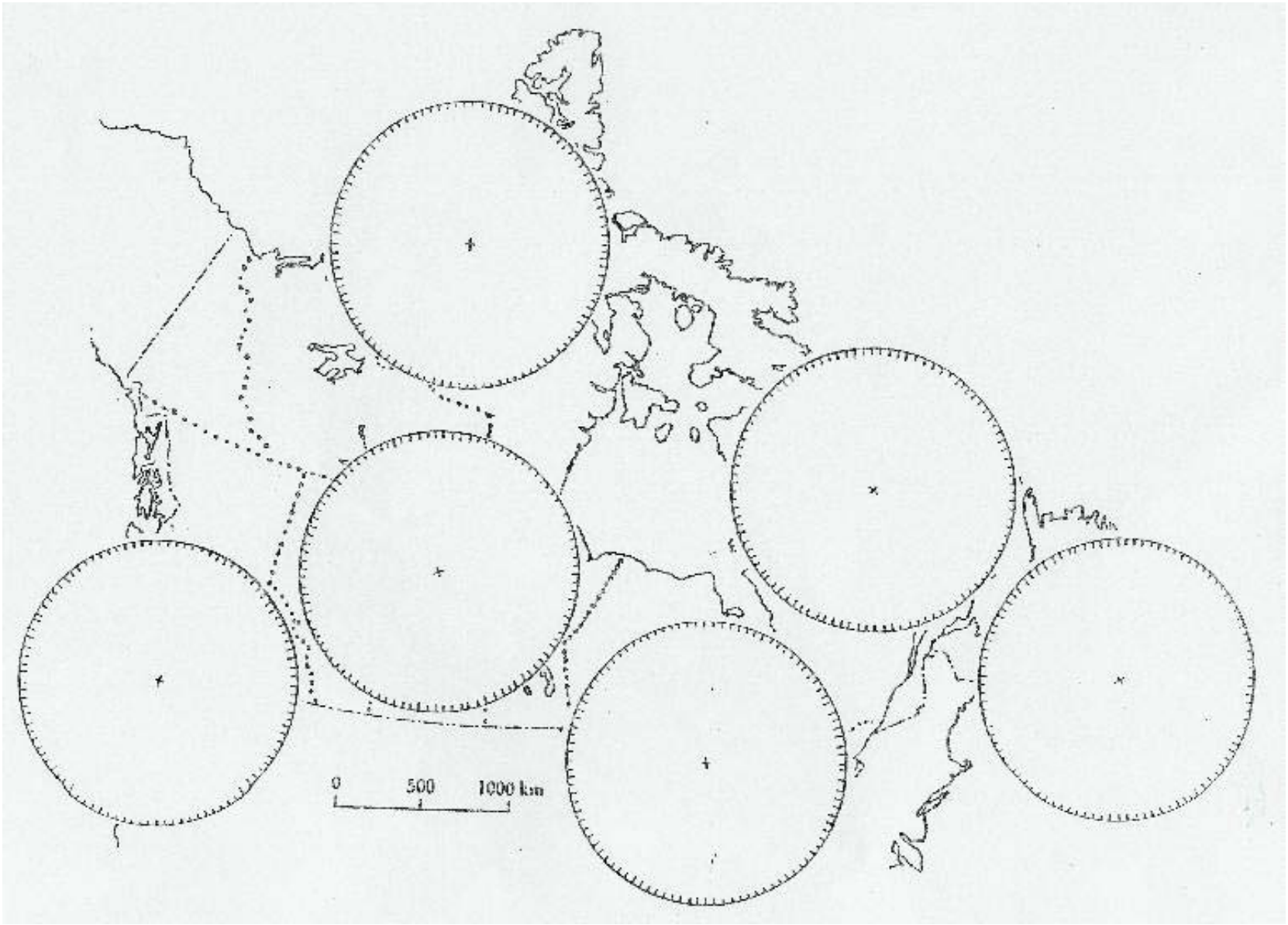
6. Why is an open-pit mine generally safer and cheaper to operate than a shaft mine?

7. Why would large mines need to have additional shafts for ventilation?

8. Why is it necessary to send metallic ores to a mill, smelter and refinery ?

9. What is the purpose of producing a concentrate?

10. Why do most non-metallic and structural minerals require less processing?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