

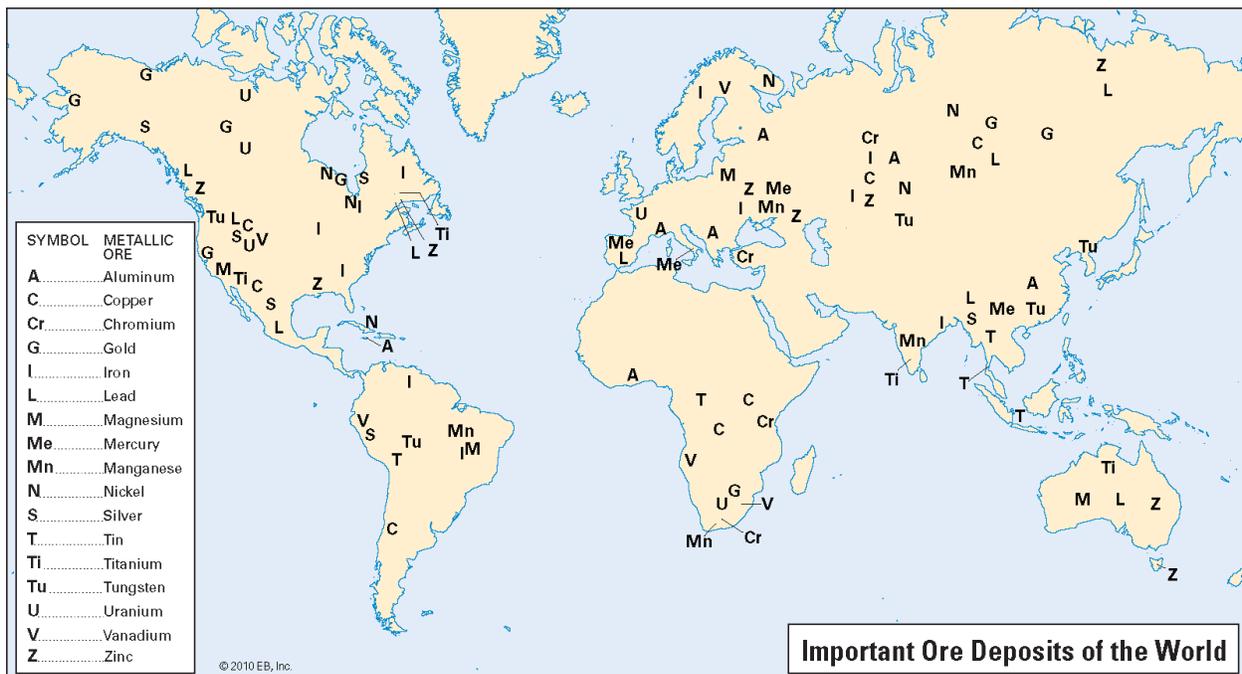
Ore



Figure 1: Hematite is an ore, a kind of mineral that contains metal or another valuable mineral. The metal found in hematite ore is iron.

An ore is a natural combination of minerals from which metals can be extracted at a profit. Originally the term ore was applied only to metallic minerals, but the term now includes nonmetallic substances that have been deposited in rock after its formation. All metals come from ore deposits found in the Earth's crust. Raw ores bear little resemblance to familiar metals such as chromium or nickel. In most cases, the metals in the ores are not in the free, or pure, state. They are in chemical combination with other elements. They are combined with oxygen as oxides, with sulfur as sulfides, and with carbon and oxygen as carbonates. Ores also contain earthy materials such as sand and clay. These worthless substances are separated and discarded.

Large ore deposits can mean great wealth to a country. The struggle for economic and political control of ores has gone on between nations for thousands of years. An industrial nation can process its ores to produce valuable metallic products. If a nation is not technically developed, it can sell its raw ores profitably to industrialized nations.



The average percentage, by weight, of each metal in the Earth's crust is very small. Aluminum (about 8 percent), iron (about 5 percent), and magnesium (about 2 percent) are the most abundant of the commercial metals. No other commercial metal forms more than 1 percent of the Earth's crust. If metals were spread evenly over the Earth, immense amounts of minerals would have to be processed to recover a small weight of pure metal. Fortunately, very high concentrations of metals do occur in relatively small areas. They are the result of geological events that occurred in past ages. The map indicates the regions where commercial mining operations are in progress and where valuable ore deposits are known to be located.

Some metals are extracted from only one ore; others, from many different ores. Rare metals such as gold, platinum, and silver do not form compounds with other substances as readily as other metals. They are found in valuable quantities as free metals. South Africa, Canada, and Russia are the largest producers of gold and platinum. Mexico leads in silver production.

For profitable mining operations, the location of an ore deposit is determined exactly, and the percentage of pure metal estimated. Specialized mining and processing machinery is moved to the mining site. Ore extraction is achieved by either cutting or shearing, as in mining soft or bedded deposits; or by drilling or blasting with explosives, as in mining harder minerals. The mining site also has hoisting, loading, haulage, ventilation, and lighting equipment. New transportation facilities are built and other development costs are met before mining begins.

The history of the Ungava iron mine in Canada illustrates how economic factors control ore mining. As early as 1893 the immense value of these deposits was recognized. However, demand for iron was not great enough to justify the development costs. After World War II, new deposits were needed, and work began in 1950. A 360-mile (580-kilometer) railroad was built from the Ungava district to the Gulf of St. Lawrence. Before the first shipment was made in 1954, \$250,000,000 was spent. By 1959 the Iron Ore Company of Canada, which used the railroad, was the nation's largest iron-ore producer. It accounted for 60 percent of all 1959 shipments.

The amount of metal in the ore to make it profitable varies widely with the current price of the metal and also with the amount of other metals present in the ore. Iron ore should contain about 30 percent iron if it is to be mined profitably. Gold ores containing as little as 0.044 ounce (1.25 grams) of gold per ton can be mined at a profit. Magnesium can be removed from sea water at a profit by special methods. Gold, though present in sea water, cannot yet be extracted profitably.

Thus, the value of the metal and its chemical properties influence production methods.

Lead and zinc ores are usually found together. Large amounts of gold and silver are often contained in copper and lead ores. A lead-zinc ore may contain lead sulfide, zinc sulfide, iron sulfide, iron carbonate, and quartz. Zinc and lead sulfides are present in profitable amounts and are known as ore minerals. The remaining rock and minerals are called gangue.

After the ore is mined, it undergoes a series of separating steps called ore dressing. The ore minerals are separated from the gangue minerals by grinding, screening, gravity concentration, and flotation methods. Pure metals are then obtained from the ore minerals.

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