

CHAPTER 12

MINERAL RESOURCES

Important Concepts

1. An *ore* is a rock that contains a valuable or useful metal at a concentration high enough to make its mining a profitable operation.
2. Mineral deposits include not only metallic minerals from which metals are extracted, but also minerals (for example, mica) and rocks (for example, granite) that are valuable for their physical properties.
3. Based on the process of formation, mineral deposits may be classified into four broad categories: magmatic deposits, sedimentary deposits (including placers), hydrothermal deposits, and metamorphic deposits. The formation of some mineral deposits can be correlated with specific plate tectonic settings in the geologic past.
4. The world distribution of mineral deposits and the global patterns of production and consumption of mineral commodities are very uneven. Although the United States contains less than 5% of the world's population, it consumes huge quantities of the world's rock and mineral resources. This demand is met partly from domestic production and partly from imports.
5. Mineral resources are nonrenewable. Based on the present world reserves and the current rate of world production, most mineral commodities are projected to last only a few decades. The projections are similar for the United States
6. New sources of mineral commodities are needed to meet the future demand. Geophysical and geochemical prospecting, and remote sensing using aerial photography and satellite imagery, can help geologists to discover new mineral deposits.
7. Some unconventional mineral sources include marine placer deposits, hydrothermal ore deposits forming along seafloor-spreading ridges, and seafloor manganese nodules. Rising demand accompanied by rising prices could make subeconomic mineral resources profitable to mine, as could improvements in mineral-processing technology.
8. Conservation measures for extending the lifetimes of current mineral reserves include the substitution of one mineral for another and recycling; however, both of these methods have limitations and are not applicable to all minerals.
9. Mining and mineral processing activities have the potential to produce adverse impacts on the environment. Some of these impacts include disturbance of the surface topography and the pollution of surface and ground waters through the weathering of exposed ore bodies, spoil banks, and tailings.

Key Terms

banded iron formation
concentration factor
evaporite
hydrothermal deposits
kimberlite
magmatic deposits
manganese nodules
mineral resources

ore
pegmatite
placer
remote sensing
reserves
sedimentary deposits
spoil banks
tailings

Multiple Choice

1. Ninety-eight percent of the earth's crust is composed of only _____ elements.
 - a. 5
 - b. 8
 - c. 17
 - d. 23
2. Which of the following does not depend on our geologic understanding of magmatic mineral deposits?
 - a. the discovery of additional mineral deposits
 - b. the prediction of likely locations of future volcanic eruptions
 - c. safer mining methods
 - d. better quality control of the mined ore
3. Of the following nonfuel minerals, the United States has significant reserves only of
 - a. manganese.
 - b. tin.
 - c. molybdenum.
 - d. nickel.
4. Some pegmatites are mined for gemstones such as
 - a. olivine.
 - b. quartz.
 - c. feldspar
 - d. emerald.
5. The metal-rich muds at the bottom of the Red Sea were most likely formed as a result of
 - a. magmatic crystallization.
 - b. hydrothermal activity.
 - c. stream-deposited sediments.
 - d. evaporation.
6. Severe leaching of tropical lateritic soils has produced economically important ore deposits of
 - a. iron.
 - b. copper.
 - c. tin.
 - d. aluminum.

7. The most heavily used metal is
 - a. aluminum.
 - b. copper.
 - c. iron.
 - d. tin.

8. Halite, gypsum, and phosphate are examples of minerals recovered from
 - a. evaporite deposits.
 - b. placer deposits.
 - c. hydrothermal ore deposits.
 - d. magmatic deposits.

9. Worldwide reserves for most metals are projected to last
 - a. a few years.
 - b. a few decades.
 - c. a few centuries.
 - d. about 1000 years.

10. The marine mineral resource having the greatest potential for exploitation in the near future is
 - a. seawater.
 - b. manganese nodules.
 - c. hydrothermal deposits at spreading ridges.
 - d. marine placer deposits.

Fill In the Blanks

1. An _____ is a rock in which a valuable or useful metal occurs at a concentration high enough to make it economically practical to mine.
2. Diamonds are mined from a type of igneous rock called _____ that occurs as pipelike intrusive bodies.
3. _____ ore deposits are formed by warm fluids circulating in the earth's crust.
4. _____ is a name given to hydrothermal vents that emit dark clouds of suspended sulfide minerals.
5. A _____ is a sedimentary rock, consisting of alternating iron-rich and silica rich (or carbonate-rich) layers, that may qualify as an ore of iron.
6. _____ are ore deposits mechanically concentrated by the sorting action of moving water.
7. _____ is the most commonly mined source of aluminum.
8. _____ is investigation by methods such as aerial photography and satellite imagery.
9. _____ are piles of waste rock produced by surface mining.
10. _____ are piles of crushed or ground waste rock produced as a by-product of mineral processing.

True or False

Indicate whether the following statements are true or false. If false, correct the statement to make it true.

- _____ 1. Hydrothermal and magmatic ores are often associated with lithospheric plate boundaries.
- _____ 2. Banded iron formations are relatively recent geological formations.
- _____ 3. The graphite used in “lead” pencils is usually mined from placer deposits.
- _____ 4. The primary use of sulfur in the United States is in the manufacture of explosives.
- _____ 5. The consumption of rock, sand, and gravel in the United States vastly exceeds its consumption of metals and minerals.
- _____ 6. Continued explorations and improvements in mineral-processing technology may make some currently subeconomic mineral deposits profitable to mine.
- _____ 7. Because plants concentrate certain metals within their tissues, they can be used as indicators of those metals.
- _____ 8. Antarctica may contain vast reserves of mineral resources; however, active mineral exploitation must be carefully controlled to preserve Antarctica's environment.
- _____ 9. Substituting some of the uses of one metal with another metal is perhaps the most effective way to extend reserves of the substituted metal.
- _____ 10. A major disadvantage of recycling aluminum is that it takes significantly more energy to recycle scrap aluminum than it does to extract new aluminum from its ore.

Matching

Match each one of the following mineral resources with its correct description or use.

- | | | | |
|---------|----------|----|--|
| ___ 1. | Aluminum | a. | used as a catalyst in automobile emissions-control systems |
| ___ 2. | Copper | b. | third most abundant element in the earth's crust |
| ___ 3. | Lead | c. | used for jewelry and in the electronics industry |
| ___ 4. | Zinc | d. | source of sodium and chlorine |
| ___ 5. | Gold | e. | primarily used for electrical applications |
| ___ 6. | Silver | f. | used in batteries, solders, paints, and ceramics |
| ___ 7. | Platinum | g. | used to make plaster, portland cement, and wallboard |
| ___ 8. | Gypsum | h. | principal use is for photographic materials |
| ___ 9. | Halite | i. | a component of drilling muds |
| ___ 10. | Clay | j. | used to galvanize steel cans and in the manufacture of brass |

Review Questions

1. Explain the concept of “reserves” of a mineral commodity.
2. Briefly describe the different processes by which mineral deposits form.
3. What are placer deposits? Why are placer deposits of gold quite widespread while placer deposits of silver are unknown?
4. How were the projected lifetimes of world mineral reserves presented in table 12.2 calculated? What circumstances may result in a longer lifetime for a particular mineral commodity?
5. Discuss the options available for ensuring the continued supply of mineral commodities.
6. Discuss the potential adverse impacts of the mining/mineral processing industry on the environment. What should we do to address this concern?

Surfing the Net

Excellent compilation of information on world and U.S. mineral resources, including reserves and production statistics, and numerous links for statistical database on reserves and production (Mineral Resources Program, U.S.G.S.):

<<http://minerals.usgs.gov/>> (especially, “Minerals Information”)

Information about surface mining (U.S. Office of Surface Mining):

<<http://www.osmre.gov/>> (especially, “U.S. Coal Production”)

Gemstones of the United States (U.S. Geological Survey):

<http://minerals.usgs.gov/minerals/pubs/commodity/gemstones/sp14-95/>

CHAPTER 12 ANSWER KEY

Multiple Choice

- | | | | |
|--------------------|------|------|-------|
| 1. b | 4. d | 7. c | 10. b |
| 2. b | 5. b | 8. a | |
| 3. c (figure 12.1) | 6. d | 9. b | |

Fill In the Blanks

- | | |
|--------------------------|-------------------|
| 1. ore | 6. Placers |
| 2. kimberlite | 7. Bauxite |
| 3. Hydrothermal | 8. Remote sensing |
| 4. Black smokers | 9. Spoil banks |
| 5. banded iron formation | 10. Tailings |

True or False

1. True
2. False. Banded iron formations are very ancient. Their formation is believed to be related to the accumulation of free oxygen in the earth's atmosphere
3. False. Graphite is usually mined from metamorphic deposits.
4. False. The primary use of sulfur in the United States is in the manufacture of sulfuric acid.
5. True
6. True
7. True
8. True
9. False. Recycling is the most effective way to extend the reserves of a metal.
10. False. One of the major advantages of recycling aluminum is that it takes much less energy to recycle scrap aluminum than it does to extract the metal from aluminum ore.

Matching

1. b 2. e 3. f 4. j 5. c 6. h 7. a 8. g 9. d 10. i