

SOLUTIONS MANUAL

Environmental Geology

Ninth Edition



Carla W.
Montgomery

2 Rocks and Minerals—A First Look

Questions for Review

1. Briefly define the following terms: *ion*, *isotope*, *compound*, *mineral*, and *rock*.

An ion is an atom that has gained or lost electrons and thus has a net electrical charge. Isotopes are atoms of the same element that have different numbers of neutrons in the nucleus (same atomic number, different atomic mass number). A compound is a chemical combination of two or more elements in definite proportions that has a distinctive set of physical properties. A mineral is a naturally occurring, inorganic, solid element or compound, with a definite composition or range in compositions and a regular internal crystal structure. A rock is a solid, cohesive aggregate of one or more minerals.

2. What two properties uniquely define a particular mineral?

A mineral can be uniquely defined or identified by its chemical composition and its crystal structure, taken together.

3. Give the distinctive chemical characteristics of each of the following mineral groups: silicates, carbonates, sulfides, oxides, and native elements.

The silicates consist of silicon and oxygen and, usually, additional elements. Carbonates contain carbonate (CO_3) groups, with carbon and oxygen in the proportions 1:3. Sulfides contain sulfur but not oxygen (as distinguished from sulfates). The oxides consist of one or more metals plus oxygen but lack the other cations necessary to make them carbonates, sulfates, and so on. Native elements are minerals that consist of a single chemical element.

4. What is an igneous rock? How do volcanic and plutonic rocks differ in texture? Why?

An igneous rock is one crystallized from a magma (silicate melt). Volcanic rocks are finer-grained than plutonic rocks because plutonic rocks cool and crystallize more slowly, so there is more time for large crystals to develop.

5. What are the two principal classes of sedimentary rocks?

Sedimentary rocks can be subdivided into clastic rocks, formed of fragments of preexisting rocks, and chemical sedimentary rocks, precipitated from solution.

6. Describe how a granite might be transformed into a sedimentary rock.

Weathering and erosion can break the granite down into smaller fragments and individual mineral grains. The resultant bits can be transported, deposited, buried, and lithified to make a (clastic) sedimentary rock.

7. Name several possible sources of the heat or pressure that can cause metamorphism. What kinds of physical changes occur in the rock as a result?

Burial provides both increased heat (as a consequence of the geothermal gradient) and increased pressure (from the weight of overlying rocks). Intrusion (hot magma rising in the crust) also elevates temperatures locally, and tectonic activity (such as mountain building) can contribute added stress. Rocks may recrystallize, with crystals growing larger and more tightly interlocking; minerals unstable at higher temperatures and pressures may break down, to be replaced by minerals that are stable under the new conditions; directed stress may produce foliation, alignment of platy or elongated minerals.

8. What is the rock cycle?

The rock cycle is the concept that rocks are continually involved in a process of reworking and change, with rock and mineral materials constantly being transformed through the action of geologic processes. Weathering of preexisting rock produces more sediment to become new sedimentary rock, heat and pressure acting on any rock may metamorphose it or even melt it to make new igneous rock, and so on.