The continental crust is made largely of granitic rocks—rocks with a mineral or chemical composition similar to granite. The oceanic crust is composed mostly of basaltic rocks—rocks similar in mineral or chemical composition to basalt. The granite is less dense than the basalt; thus, the granitic continental crust is less dense than the basaltic oceanic crust. See the average value of the density of the continental crust and oceanic crust on the Inferred Properties of Earth's Interior in the *Earth Science Reference Tables*.

Composition of Earth's Interior Many scientists think Earth's inner and outer core are composed largely of iron and nickel. There is much evidence to support this hypothesis, including the iron and nickel composition of many meteorites and Earth's magnetism—iron and nickel are two of a few magnetic elements. In addition, a combination of iron and nickel at the temperatures and pressures believed to be in Earth's core can account for the observed properties of the seismic waves that pass through the core.

The high-density iron-nickel composition of the core and the low-density composition of the crust indicate that the mantle must have a composition different from the crust and the core and an intermediate density.

Earth's crust is composed mostly of rocks and minerals, as illustrated on the various charts in the *Earth Science Reference Tables* depicting minerals, sedimentary rocks, metamorphic rocks, and igneous rocks. Generally, the crust is composed of low-density rocks with a mixture of granitic and basaltic compositions.

Review Questions

29. In developing a model of Earth's deep interior, most of the evidence was derived from
    (1) deep wells
    (2) mining operations
    (3) observation of other planets
    (4) seismic data

30. Through which zones of Earth do primary waves (P-waves) travel?
    (1) only the crust and mantle
    (2) only the mantle and outer core
    (3) only the outer and inner core
    (4) the crust, mantle, outer core, and inner core

31. According to the *Earth Science Reference Tables*, in which group are the zones of Earth's interior correctly arranged in order of increasing average density?
    (1) crust, mantle, outer core, inner core
    (2) crust, mantle, inner core, outer core
    (3) inner core, outer core, mantle, crust
    (4) outer core, inner core, mantle, crust

32. What evidence has been obtained concerning the existence of the Moho and Earth's mantle?
    (1) satellite images
    (2) well drillings
    (3) exposures in deep canyons like the Grand Canyon
    (4) refraction of earthquake waves

33. What is the relationship among density, temperature, and pressure inside Earth?
    (1) As depth increases, density, temperature, and pressure decrease.
    (2) As depth increases, density and temperature increase, but pressure decreases.
    (3) As depth increases, density increases, but temperature and pressure decrease.
    (4) As depth increases, density, temperature, and pressure increase.

34. In which parts of Earth's interior would melted or partially melted material be found?
    (1) stiffer mantle and inner core
    (2) stiffer mantle and outer core
    (3) crust and inner core
    (4) asthenosphere and outer core

35. An earthquake occurs in city A. Recordings on a seismograph in city B show only the presence of P-waves. City A and B are on opposite sides of Earth—180° apart. What does this information allow you to infer about the structure of Earth's interior?

36. How does the composition of the oceanic crust compare with the composition of the continental crust?
(1) The oceanic crust is mainly limestone, while the continental crust is mainly sandstone.
(2) The oceanic crust is mainly limestone, while the continental crust is mainly granitic.
(3) The oceanic crust is mainly basaltic, while the continental crust is mainly sandstone.
(4) The oceanic crust is mainly basaltic, while the continental crust is mainly granitic.

37. As one travels from an ocean shore to the interior of a continent, the thickness of Earth's crust generally
(1) decreases
(2) increases
(3) remains the same

38. How does thickness and density of the continental crust compare to that of the oceanic crust?
(1) The continental crust is thicker and less dense than the oceanic crust.
(2) The continental crust is thicker and denser than the oceanic crust.
(3) The continental crust is thinner and less dense than the oceanic crust.
(4) The continental crust is thinner and denser than the oceanic crust.

39. The overall density of Earth is approximately 5.5 g/cm^3. The average density of Earth's crust is between 2.5 g/cm^3 and 3.0 g/cm^3. What does this suggest about the density of Earth's core?

40. The composition of some meteorites supports the inference that Earth's core is composed of
(1) aluminum and calcium
(2) iron and nickel
(3) silicon and oxygen
(4) magnesium and potassium

41. The temperature of rock located 1000 kilometers below Earth's surface is approximately
(1) 1000°C
(2) 2600°C
(3) 3300°C
(4) 4300°C

Plate Tectonics

People have always wondered about the origin of continents, mountain ranges, volcanoes, earthquakes, and the multitudes of other features and events. In the past, many legends, religious beliefs, and scientific theories have tried to explain Earth's features and events. Some of the older scientific theories include cooling and contraction of Earth, expansion of Earth, and continental drift. None of these earlier theories seems satisfactory for most of the scientific community today. Since the 1960s many new discoveries from the studies of ocean drilling, Earth's magnetism, satellite observations, and detailed analysis of rocks and fossils have led to the plate tectonic theory. This theory has done for the earth sciences what evolution and genetics have done for the biological sciences. It has provided a unifying model to explain most, if not all, major features and events of Earth's lithosphere.

The Plate Tectonic Theory

The basic concept of the **plate tectonic theory** is that Earth's lithosphere is broken up into sections or pieces called **plates**—also called **lithospheric plates** and **tectonic plates**—and their movement and interaction produce major changes in Earth's surface. In this book the term "plates" will mostly be used.

These plates move about Earth's surface at a rate of a few centimeters per year (approximately the rate of fingernail growth). These plates can also move up and down—usually at rates of only millimeters per year—due to uplifting and sinking. The plates can move around and up and down because they are floating on the asthenosphere—a plastic-like layer of the mantle.