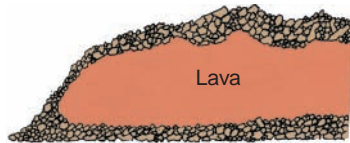


# Glossary

**aa flow** A lava flow with a surface typified by angular, jagged blocks. Contrast with pahoehoe flow.



aa flow

**ablation** Reduction of a glacier by melting, evaporation, iceberg calving, or deflation.

**abrasion** The mechanical wearing away of a rock by friction, rubbing, scraping, or grinding.

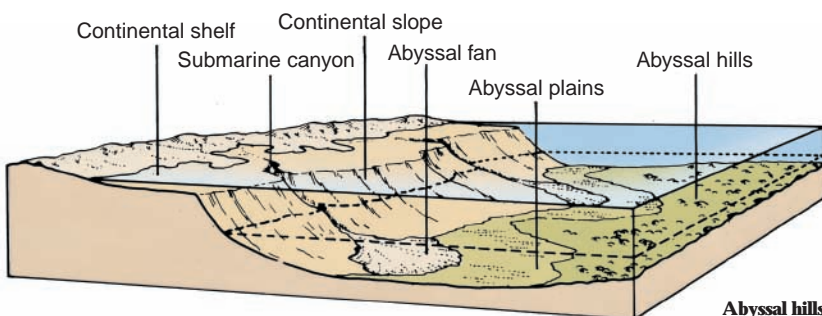
**absolute age** Geologic time measured in a specific duration of years (in contrast to relative time, which involves only the chronologic order of events). Also called numerical age.

**abyssal** Pertaining to the great depths of the oceans, generally 1000 fathoms (2000 m) or more below sea level.

**abyssal hills** The part of the ocean floor consisting of hills rising as much as 1000 m above the surrounding floor. They are found seaward of most abyssal plains and occur in profusion in basins isolated from continents by trenches, ridges, or rises.

**abyssal plains** Flat areas of the ocean floor, having a slope of less than 1:1000. Most abyssal plains lie at the base of a continental rise and are simply areas where abyssal hills are completely covered with sediment.

**accretionary prism** A wedge-shaped body of faulted and folded material scraped off subducting oceanic crust and added to an island arc or continental margin at a subduction zone.



**aftershock** An earthquake that follows a larger earthquake. Generally, many aftershocks occur over a period of days or even months after a major earthquake.

**agate** A variety of cryptocrystalline quartz in which colors occur in bands. It is commonly deposited in cavities in rocks.

**A horizon** The topsoil layer in a soil profile that commonly contains organic matter.

**alluvial fan** A fan-shaped deposit of sediment built by a stream where it emerges from an upland or a mountain range into a broad valley or plain. Alluvial fans are common in arid and semi-arid climates but are not restricted to them.



Alluvial fan

**alluvium** A general term for any sedimentary accumulations deposited by comparatively recent action of rivers. It thus includes sediment laid down in river beds, floodplains, and alluvial fans.

**amorphous solid** A solid in which atoms or ions are not arranged in a definite crystal structure. Examples: glass, amber, obsidian.

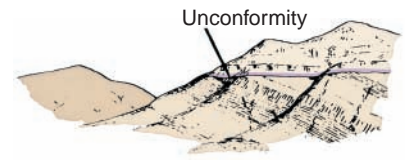
**amphibole** An important rock-forming mineral group of mafic silicates. Amphibole crystals are constructed from double chains of silicon-oxygen tetrahedra. Example: hornblende.

**amphibolite** A metamorphic rock consisting mostly of amphibole and plagioclase feldspar.

**andesite** A fine-grained igneous rock composed mostly of plagioclase feldspar and from 25 to 40% pyroxene, amphibole, or biotite, but no quartz or K-feldspar. It is abundant in mountains bordering the Pacific Ocean, such as the Andes Mountains of South America, from which the name was derived.

**angle of repose** The steepest angle at which loose grains will remain stable without sliding downslope.

**angular unconformity** An unconformity in which the older strata dip at a different angle (generally steeper) than the younger strata.



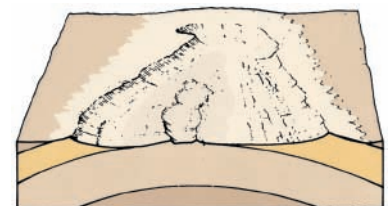
Angular unconformity

**anion** A negatively charged ion.

**anomaly** A deviation from the norm or average.

**anorthosite** A coarse-grained intrusive igneous rock composed primarily of calcium-rich plagioclase feldspar.

**anticline** A fold in which the limbs dip away from the hinge. After erosion, the oldest rocks are exposed in the central core of the fold.

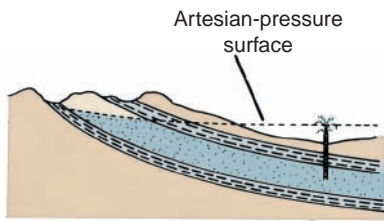


Anticline

**aphanitic texture** A rock texture in which individual crystals are too small to be identified without the aid of a microscope. In hand specimens, aphanitic rocks appear to be dense and structureless.

## G-2 Glossary

**aquifer** A permeable stratum or zone below the Earth's surface through which groundwater moves.



Aquifer

**arch** An arch-shaped landform produced by weathering and differential erosion.

**arête** A narrow, sharp ridge separating two adjacent glacial valleys.

**arid** A dry climate such as exists in deserts.

**arkose** A sandstone containing at least 25% feldspar.

**artesian-pressure surface** The level to which water in an artesian system would rise in a pipe high enough to stop the flow.

**artesian water** Groundwater confined in an aquifer and under pressure great enough to cause the water to rise above the top of the aquifer when it is tapped by a well.

**ash** Volcanic fragments the size of dust particles.

**ash flow** A turbulent blend of unsorted pyroclastic material (mostly fine-grained) mixed with high-temperature gases ejected explosively from a fissure or crater.

**ash-flow tuff** A rock composed of volcanic ash and dust, formed by deposition and consolidation of ash flows.

**assimilation** The process by which hot magma incorporates or dissolves the surrounding solid country rock.

**asteroid** A small, rocky planetary body orbiting the Sun. Asteroids are numbered in the tens of thousands. Most are located between the orbit of Mars and the orbit of Jupiter. Their diameters range downward from 1000 km.

**asthenosphere** The weak zone inside Earth directly below the lithosphere, from 10 to 200 km below the surface. Seismic velocities are distinctly lower in the asthenosphere than in adjacent parts of Earth's interior. The material in the asthenosphere is therefore

believed to be soft and yielding to plastic flow.

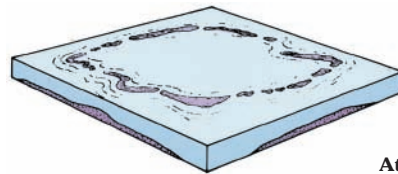
**asymmetric fold** A fold (anticline or syncline) in which one limb dips more steeply than the other.



Asymmetric fold

**atmosphere** The mixture of gases surrounding a planet. The Earth's atmosphere consists chiefly of oxygen and nitrogen, with minor amounts of other gases. Synonymous with air.

**atoll** A ring of low coral islands surrounding a lagoon.



Atoll

**atom** The smallest unit of an element. Atoms are composed of protons, neutrons, and electrons.

**atomic number** The number of protons in the nucleus of an atom. It uniquely defines an element.

**atomic weight** The mass of one atom of an element, essentially the sum of the protons and neutrons in the nucleus of an atom.

**axis** **1** (crystallography) An imaginary line passing through a crystal around which the parts of the crystal are symmetrically arranged. **2** (geophysics) A straight line about which a planet or moon rotates or spins.

**backarc basin** The area behind a subduction-related volcanic arc where folds and faults form. Most oceanic backarcs are extending.

**backswamp** The marshy area of a floodplain at some distance beyond and lower than the natural levees that confine the river.

**backwash** The return sheet flow down a beach after a wave is spent.

**badlands** An area nearly devoid of vegetation and dissected by stream erosion

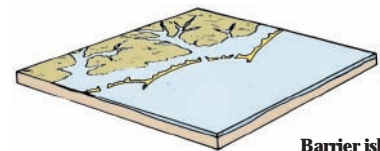
into an intricate system of closely spaced, narrow ravines.

**bajada** The surface of a system of coalesced alluvial fans.

**bar** An offshore, submerged, elongate ridge of sand or gravel built on the seafloor by waves and currents.

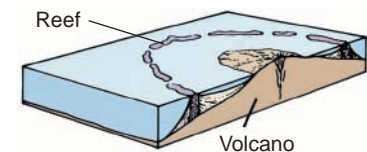
**barchan dune** A crescent-shaped dune, the tips or horns of which point downwind. Barchan dunes form in desert areas where sand is scarce.

**barrier island** An elongate island of sand or gravel formed parallel to a coast.



Barrier island

**barrier reef** An elongate coral reef that trends parallel to the shore of an island or a continent, separated from it by a lagoon.

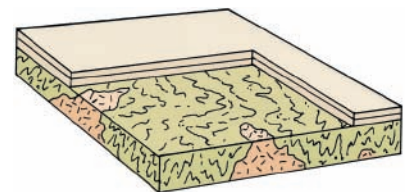


Barrier reef

**basalt** A dark-colored, fine-grained, mafic volcanic rock composed of plagioclase (over 50%) and pyroxene. Olivine may or may not be present.

**base level** The level below which a stream cannot effectively erode. Sea level is the ultimate base level, but lakes form temporary base levels for inland drainage systems.

**basement complex** A series of igneous and metamorphic rocks lying beneath the oldest stratified rocks of a region. In shields, the basement complex is exposed over large areas.

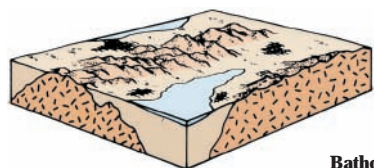


Basement complex

**basin** **1** (structural geology) A circular or elliptical downwarp. After erosion, the youngest beds are exposed in the central part of the structure. **2** (topography)

A depression into which the surrounding area drains.

**batholith** A large body of intrusive igneous rock exposed over an area of at least 100 km<sup>2</sup>.



**Batholith**

**bathymetry** The measurement of ocean depths and mapping of the topography of the ocean floor.

**bauxite** A mixture of various amorphous or crystalline hydrous aluminum oxides and aluminum hydroxides, commonly formed by intense chemical weathering in tropical and subtropical regions. Bauxite is the principal ore of aluminum.

**bay** A wide, curving recess or inlet between two capes or headlands.

**baymouth bar** A narrow, usually submerged ridge of sand or gravel deposited across the mouth of a bay by longshore drift. Baymouth bars commonly are formed by extension of spits along embayed coasts.

**beach** A deposit of wave-washed sediment along a coast between the landward limit of wave action and the outermost breakers.

**bed** A layer of sediment 1 cm or more in thickness.

**bedding plane** A surface separating layers of sedimentary rock.

**bed load** Material transported along the bottom of a stream by rolling or sliding, in contrast to material carried in suspension or in solution.

**bedrock** The continuous solid rock that underlies the regolith everywhere and is exposed locally at the surface. An exposure of bedrock is called an outcrop.

**benioff zone** A zone of earthquakes that dips away from a deep-sea trench and slopes beneath the adjacent continent or island arc.

**B horizon** The solid zone of accumulation underlying the A horizon of a soil profile. Some of the material dissolved by leaching in the A horizon is deposited in the B horizon.

**biochemical sediment** A sediment made of material precipitated as a result of biological processes, such as shells made of calcium carbonate.

**biosphere** The totality of life on or near Earth's surface.

**biotite** "Black mica." An important mafic silicate with silicon-oxygen tetrahedra arranged in sheets.

**bird-foot delta** A delta with distributaries extending seaward and in map view resembling the claws of a bird. Example: the Mississippi Delta.

**block faulting** A type of normal faulting in which segments of the crust are broken and displaced to different elevations and orientations.

**blowout** A dune shaped like a parabola with the concave side toward the wind. Commonly formed along shorelines (same as a parabolic dune).

**blueschist** A fine-grained schistose rock characterized by high-pressure, low-temperature mineral assemblages and typically containing the blue amphibole glaucophane.

**boulder** A rock fragment with a diameter of more than 256 mm (about the size of a volleyball). A boulder is one size larger than a cobble.

**bracketed intrusion** An intrusive rock that was once exposed at the surface by erosion and was subsequently covered by younger sediment. The relative age of the intrusion thus falls between, or is bracketed by, the ages of the younger and older sedimentary deposits.

**braided stream** A stream with a complex of converging and diverging channels separated by bars or islands. Braided streams form where more sediment is available than can be removed by the discharge of the stream.

**breaker** A collapsing water wave.

**breccia** A general term for sediment consisting of angular fragments in a matrix of finer particles. Examples: sedimentary breccias, volcanic breccias, fault breccias, impact breccias.

**brittle** Easily broken or fractured in contrast to plastic flow.

**butte** A somewhat isolated hill, usually capped with a resistant layer of rock and bordered by talus. A butte is an erosional remnant of a formerly more extensive slope.

**calcite** A mineral composed of calcium carbonate (CaCO<sub>3</sub>).

**caldera** A large, more or less circular depression or basin associated with a volcanic vent. Its diameter is many times greater than that of the included vents. Calderas are believed to result from subsidence or collapse and may or may not be related to explosive eruptions.

**calving** The breaking off of large blocks of ice from a glacier that terminates in a body of water.

**capacity** The maximum quantity of sediment a given stream, glacier, or wind can carry under a given set of conditions.

**carbon 14** A radioactive isotope of carbon. Its half-life is 5730 years.

**carbonaceous** Containing carbon.

**carbonate mineral** A mineral formed by the bonding of carbonate ions (CO<sub>3</sub><sup>2-</sup>) with positive ions. Examples: calcite (CaCO<sub>3</sub>), dolomite [CaMg(CO<sub>3</sub>)<sub>2</sub>].

**carbonate rock** A rock composed mostly of carbonate minerals. Examples: limestone, dolomite.

**catastrophism** The belief that geologic history consists of major catastrophic events involving processes that were far more intense than any we observe now. Contrast with uniformitarianism.

**cation** A negatively charged ion.

**cave** A naturally formed subterranean open area, chamber, or series of chambers, commonly produced in limestone by solution activity or in basalt flows as lava tubes.

**cement** Minerals precipitated from groundwater in the pore spaces of a sedimentary rock and binding the rock's particles together.

**Cenozoic** The era of geologic time from the end of the Mesozoic Era (65 million years ago) to the present.

**chalcidony** A general term for fibrous cryptocrystalline quartz.

**chalk** A variety of limestone composed of shells of microscopic oceanic organisms.

**chemical weathering** Chemical reactions that act on rocks exposed to water and the atmosphere so as to change their



**Butte**



unstable mineral components to more stable forms. Oxidation, hydrolysis, carbonation, and direct solution are the most common reactions.

**chert** A sedimentary rock composed of granular cryptocrystalline silica.

**C horizon** The lowest zone of soil consisting of partly decomposed bedrock underlying the B horizon. It grades downward into fresh, unweathered bedrock.

**cinder** A fragment of volcanic ejecta from 0.5 to 2.5 cm in diameter.

**cinder cone** A cone-shaped hill composed of loose volcanic fragments erupted from a central vent.

**cirque** An amphitheater-shaped depression at the head of a glacial valley, excavated mainly by ice plucking and frost wedging.



Cirque

**clastic** **1** Pertaining to fragments (such as mud, sand, and gravel) produced by the mechanical breakdown of rocks. **2** A sedimentary rock composed chiefly of consolidated clastic material.

**clastic texture** The texture of sedimentary rocks consisting of fragments of minerals, rocks, and organic skeletal remains.



Clastic texture

**clay** Sedimentary material composed of fragments with a diameter of less than 1/256 mm. Clay particles are smaller than silt particles.

**clay minerals** A group of hydrous silicates formed by weathering of minerals such as feldspar, pyroxene, or amphibole. Silicate tetrahedra are arranged in sheets.

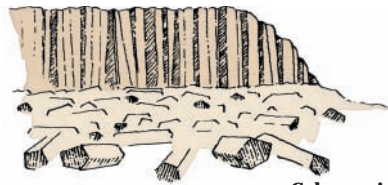
**cleavage** The tendency of a mineral to break in a preferred plane in the crystal lattice.

**coal** A common fuel mineral made mostly of carbon resulting from the metamorphic decomposition of the remains of terrestrial plants. Found in sedimentary rock.

**cobble** A rock fragment with a diameter between 6.4 cm (about the size of a tennis ball) and 25.67 cm (about the size of a volleyball). Cobbles are larger than pebbles but smaller than boulders.

**climate** The long-term average of precipitation, temperature, and wind direction and orientation.

**columnar jointing** A system of fractures that splits a rock body into long prisms, or columns. It is characteristic of lava flows and shallow intrusive igneous flows.



Columnar joint

**comet** A small icy object in orbit around the Sun. The orbits of many comets are elliptical and when they near the Sun, the ice sublimates to make a fuzzy head and long tail of gas and dust.

**competence** The maximum size of particles that a given stream, glacier, or wind can move at a given velocity.

**composite volcano** A large volcanic cone built by extrusion of ash, lava, and shallow intrusions. Synonymous with stratovolcano.



Composite volcano

**compound** A substance made of two or more elements bound together.

**compression** A system of stresses that tends to reduce the volume of or shorten a substance.

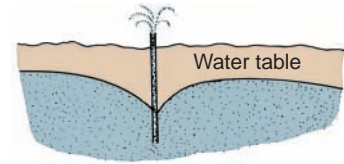
**conchoidal fracture** A type of fracture that produces a smooth, curved surface. It is characteristic of quartz and obsidian.

**concretion** A spherical or ellipsoidal nodule formed by accumulation of mineral matter after deposition of sediment.

**condensation** The process by which a vapor becomes a liquid or a solid.

**conduction** Transmission of heat energy by the impact of moving atoms. Contrast with convection.

**cone of depression** A conical depression of the water table surrounding a well after heavy pumping.



Cone of depression

**conglomerate** A coarse-grained sedimentary rock composed of rounded fragments of pebbles, cobbles, or boulders.

**contact** The surface separating two different rock bodies.

**contact metamorphism** Metamorphism of a rock near its contact with a magma.

**continent** A large landmass composed mostly of granitic rock. Continents rise abruptly above the deep-ocean floor and include the marginal areas submerged beneath sea level.

**continental accretion** The growth of continents by incorporation of deformed sediments, arc magmas, and accreted terranes along their margins.

**continental crust** The type of crust underlying the continents, including the continental shelves. The continental crust is commonly about 35 to 70 km thick. Its density is typically 2.7 g/cm<sup>3</sup>, and the velocities of primary seismic waves traveling through the crust are less than 6.2 km/sec. Contrast with oceanic crust.

**continental drift** The theory that the continents move in relation to one another.

**continental glacier** A thick ice sheet covering large parts of a continent. Present-day examples are found in Greenland and Antarctica.

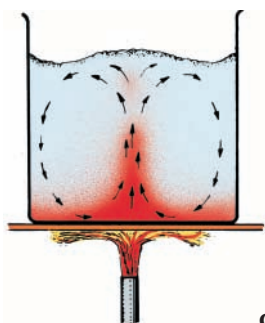
**continental margin** The zone of transition from a continent to the adjacent ocean basin. It generally includes a continental shelf, continental slope, and continental rise.

**continental rise** The gently sloping surface located at the base of a continental slope (see diagram for abyssal hills).

**continental shelf** The submerged margin of a continental mass extending from the shore to the first prominent break in slope, which usually occurs at a depth of about 120 m.

**continental slope** The slope that extends from a continental shelf down to the ocean deep. In some areas, such as off eastern North America, the continental slope grades into the more gently sloping continental rise.

**convection** Transmission of heat energy by the rise of buoyant hot material and sinking of cold material.

**Convection**

**convection cell** The space occupied by a single convection current.

**convergent plate boundary** A plate boundary at which plates collide. Convergent plate boundaries are sites of considerable geologic activity and are characterized by volcanism, earthquakes, and crustal deformation. *See also* subduction zone.

**coquina** A limestone composed of an aggregate of shells and shell fragments.

**Coquina**

**coral** A bottom-dwelling marine invertebrate organism of the class Anthozoa. Most build hard skeletons of calcium carbonate.

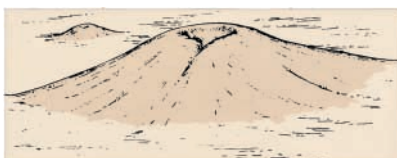
**core** The central part of the Earth below a depth of 2900 km. The core is thought to be composed mostly of iron, in contrast to the overlying mantle of silicate rock.

**Coriolis effect** The tendency of moving fluids on Earth's surface to be deflected to the right in the Northern Hemisphere and to the left in the Southern Hemisphere. Caused by Earth's spin.

**country rock** A general term for rock surrounding an igneous intrusion.

**covalent bond** A chemical bond in which electrons are shared between different atoms so that none of the atoms has a net charge.

**crater** An abrupt circular depression formed by extrusion of volcanic material, by collapse, or by the impact of a meteorite.

**Crater**

**craton** The stable continental crust, including the shield and stable platform areas, most of which have not been affected by significant tectonic activity since the close of the Precambrian Era.

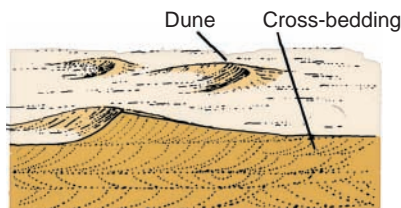
**creep** The imperceptibly slow downslope movement of material as a result of gravity.

**Creep**

**crevasse** **1** (glacial geology) A deep crack in the upper surface of a glacier.

**2** (natural levee) A break in a natural levee.

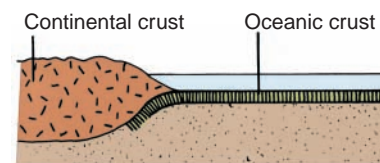
**cross-bedding** Stratification inclined to the original horizontal surface upon which the sediment accumulated. It is produced by deposition on the slope of a dune or sand wave.

**Cross-bedding**

**crosscutting relations, principle of** The principle that a rock body is younger than any rock across which it cuts.

**crust** The outermost compositional layer, or shell, of Earth (or any other differentiated planet). The crust consists of low-density materials compared to the underlying mantle. Earth's crust is generally

defined as the part of the Earth above the Mohorovicic discontinuity. It represents less than 1% of Earth's total volume. *See also* continental crust, oceanic crust.

**Crust**

**cryptocrystalline texture** The texture of rocks composed of crystals too small to be identified with an ordinary microscope.

**crystal** A solid, polyhedral form bounded by naturally formed plane surfaces resulting from growth of a crystal lattice.

**crystal face** A smooth plane formed by growth of the surface of a crystal.

**Crystal face**

**crystal form** The geometric shape of a crystal. Examples: cubic, prismatic.

**crystal lattice** A systematic, symmetrical network of atoms within a crystal.

**crystalline texture** The rock texture resulting from simultaneous growth of crystals.

**crystallization** The process of crystal growth. It occurs as a result of condensation from a gaseous state, precipitation from a solution, or cooling of a melt.

**crystal structure** The orderly arrangement of atoms in a crystal.

**cuesta** An elongate ridge formed on the tilted and eroded edges of gently dipping strata.

**daughter isotope** An isotope produced by radioactive decay of its parent isotope. The quantity of a daughter isotope continually increases with time.

**debris flow** The rapid downslope movement of debris (rock, soil, and mud).

**declination, magnetic** The horizontal angle between true north and magnetic north at a given point on Earth's surface.

**deep-marine environment** The sedimentary environment of the abyssal plains.

**deep-sea fan** A cone-shaped or fan-shaped deposit of land-derived sediment located seaward of large rivers or

submarine canyons. Synonymous with abyssal cone, abyssal fan, and submarine cone.

**deep-sea trench** See trench.

**deflation** Erosion of loose rock particles by wind.

**deflation basin** A shallow depression formed by wind erosion where ground-water solution activity has left unconsolidated sediment exposed at the surface.

**delta** A body of sediment deposited at the mouth of a river. Many are roughly triangular in shape.



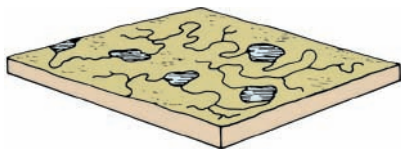
Delta

**dendritic drainage pattern** A branching stream pattern, resembling the branching of certain trees, such as oaks and maples.

**density** Mass per unit volume, expressed in grams per cubic centimeter ( $\text{g}/\text{cm}^3$ ).

**density current** A current that flows as a result of differences in density. In oceans, density currents are produced by differences in temperature, salinity, and turbidity (the concentration of material held in suspension).

**deranged drainage** A distinctively disordered drainage pattern formed in a recently glaciated area. It is characterized by irregular direction of stream flow, few short tributaries, swampy areas, and many lakes.



Deranged drainage

**desert climate** A climate with generally high temperatures, high rates of evaporation, and low precipitation. Most deserts lie at about 30 degrees north or south of the equator.

**desertification** The process of transforming arid land into a barren desert. Often induced by human activities or climate change.

**desert pavement** A veneer of pebbles left in place where wind has removed the finer material.

**detrital** 1 Pertaining to detritus. 2 A rock formed from detritus.

**detritus** A general term for loose rock fragments produced by mechanical weathering.

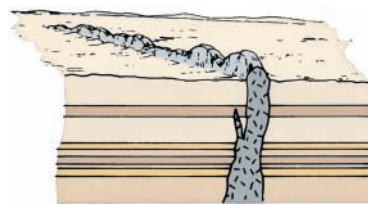
**differential erosion** Variation in the rate of erosion on different rock masses. As a result of differential erosion, resistant rocks form steep cliffs, whereas nonresistant rocks form gentle slopes.

**differential stress** A condition in which the stress applied to a rock body is not the same in all directions.

**differentiated planet** A planetary body in which various elements and minerals are separated according to density and concentrated at different levels. Earth, for example, is differentiated, with heavy metals (iron and nickel) concentrated in the core; lighter minerals in the mantle; and still lighter materials in the crust, hydrosphere, and atmosphere.

**differentiation** See magmatic differentiation and planetary differentiation.

**dike** A tabular intrusive rock that cuts across strata or other structural features of the surrounding rock.



Dike

**dike swarm** A group of associated dikes.

**diorite** A phaneritic intrusive igneous rock consisting mostly of intermediate plagioclase feldspar and pyroxene, with some amphibole and biotite.

**dip** The angle between the horizontal plane and a structural surface (such as a bedding plane, a joint, a fault, foliation, or other planar features).

**disappearing stream** A stream that disappears into an underground channel and does not reappear in the same, or in an adjacent, drainage basin. In karst regions, streams commonly disappear into sinkholes and follow channels through caves.

**discharge** Rate of flow; the volume of water moving through a given cross section of a stream in a given unit of time.

**disconformity** An unconformity in which beds above and below are parallel.

**discontinuity** A sudden or rapid change in physical properties of rocks within Earth. Discontinuities are recognized by seismic data. See also Mohorovicic discontinuity.

**dissolution** The process by which materials are dissolved.

**dissolved load** The part of a stream's load that is carried in solution.

**distributary** Any of the numerous stream branches into which a river divides where it reaches its delta.

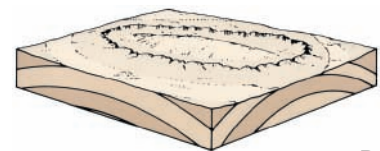
**divergent plate boundary** A plate margin formed where the lithosphere splits into plates that drift apart from one another. Divergent plate boundaries are areas subject to tension, where new crust is generated by igneous activity. See also oceanic ridge.

**divide** A ridge separating two adjacent drainage basins.

**dolomite** 1 A mineral composed of  $\text{CaMg}(\text{CO}_3)_2$ . 2 A sedimentary rock composed primarily of the mineral dolomite.

**dolostone** A sedimentary rock composed mostly of the mineral dolomite. Sometimes referred to simply as dolomite.

**dome** 1 (structural geology) An uplift that is circular or elliptical in map view, with beds dipping away in all directions from a central area. 2 (topography) A general term for any dome-shaped landform.



Dome

**downwarp** A downward bend or subsidence of a part of Earth's crust.

**drainage basin** The total area that contributes water to a single drainage system.

**drift** A general term for sediment deposited directly on land by glacial ice or deposited in lakes, oceans, or streams as a result of glaciation.

**drip curtain** A thin sheet of dripstone hanging from the ceiling or wall of a cave.

**dripstone** A cave deposit formed by precipitation of calcium carbonate from groundwater entering an underground cavern.

**drumlin** A smooth, glacially streamlined hill that is elongate in the direction of ice movement. Drumlins are generally composed of till.



Drumlin



**ductile** Easily bent. Contrast with brittle.  
**dune** A low mound of fine-grained material that accumulates as a result of sediment transport in a current system. Dunes have characteristic geometric forms that are maintained as they migrate. Sand dunes are commonly classified according to shape. *See also* barchan dune, parabolic dune, seif dune, star dune, and transverse dune.

**earthquake** A series of elastic waves propagated in Earth, initiated where stress along a fault exceeds the elastic limit of the rock so that sudden movement occurs along the fault.

**eclogite** A high-grade metamorphic rock made of garnet and pyroxene and lacking plagioclase. As a result, eclogite has a high density.

**ecology** The study of relationships between organisms and their environments.

**ejecta** Rock fragments, glass, and other material thrown out of an impact crater or a volcano.

**ejecta blanket** Rock material (crushed rock, large blocks, breccia, and dust) ejected from an impact crater or explosion crater and deposited over the surrounding area.

**elastic deformation** Temporary deformation of a substance, after which the material returns to its original size and shape. Example: the bending of mica flakes.

**elastic limit** The maximum stress that a given substance can withstand without undergoing permanent deformation either by solid flow or by rupture.

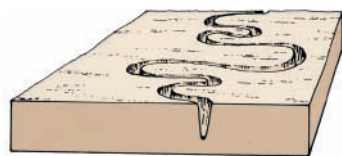
**elastic-rebound theory** The theory that earthquakes result from energy released by faulting; the sudden release of stored strain creates earthquake waves.

**electron** A negatively charged subatomic particle.

**end moraine** A ridge of till that accumulates at the margin of a glacier.

**energy** A measure of the amount of work that can be done, usually measured in ergs (cgs) or joules (mks).

**entrenched meander** A meander cut into the underlying rock as a result of



**Entrenched meander**

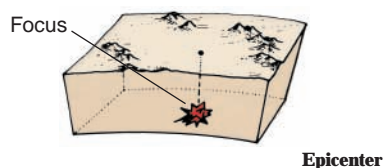
regional uplift or lowering of the regional base level.

**eolian** Pertaining to wind.

**eolian environment** The sedimentary environment of deserts, where sediment is transported and deposited primarily by wind.

**eon** A major subdivision of geologic time consisting of eras. Example: Phanerozoic Eon.

**epicenter** The area on Earth's surface that lies directly above the focus of an earthquake.



**epoch** A division of geologic time; a subdivision of a period. Example: Pleistocene epoch.

**era** A division of geologic time; a subdivision of an eon. Example: Mesozoic Era.

**Eratosthenian Period** The period of lunar history when large craters, the rays of which are no longer visible, such as Eratosthenes, were formed (from 3.1 billion to 0.8 billion years ago).

**erg** A large area covered with sand dunes. A sand sea such as those found in Earth's large deserts.

**erosion** The processes that loosen sediment and move it from one place to another on Earth's surface. Agents of erosion include water, ice, wind, and gravity.

**erratic** A large boulder carried by glacial ice to an area far removed from its point of origin.



**Erratic**

**escarpment** A cliff or very steep slope.

**esker** A long, narrow, sinuous ridge of stratified glacial drift deposited by a stream flowing beneath a glacier in a tunnel or in a subglacial stream bed.

**estuary** A bay at the mouth of a river formed by subsidence of the sand or by a rise in sea level. Fresh water from the river mixes with and dilutes seawater in an estuary.

**eustatic change of sea level** A worldwide rise or fall in sea level resulting

from a change in the volume of water or the capacity of ocean basins.

**evaporite** A rock composed of minerals derived from evaporation of mineralized water. Examples: rock salt, gypsum.

**exfoliation** A weathering process by which concentric shells, slabs, sheets, or flakes are successively broken loose and stripped away from a rock mass.



**Exfoliation**

**exposure** Bedrock not covered with soil or regolith; outcrop.

**extrusive rock** A rock formed from a mass of magma that flowed out on the surface of Earth. Example: basalt.

**faceted spur** A spur or ridge that has been beveled or truncated by faulting, erosion, or glaciation.

**facies** A distinctive group of characteristics within part of a rock body (such as composition, grain size, or fossil assemblages) that differ as a group from those found elsewhere in the same rock unit. Examples: conglomerate facies, shale facies, and brachiopod facies.

**fan** A fan-shaped deposit of sediment. *See also* alluvial fan and deep-sea fan.

**fault** A surface along which a rock body has broken and been displaced.

**fault block** A rock mass bounded by faults on at least two sides.

**fault scarp** A cliff produced by faulting.

**faunal succession, principle of** The principle that fossils in a stratigraphic sequence succeed one another in a definite, recognizable order.

**feldspar** A mineral group consisting of silicates of aluminum and one or more of the metals potassium, sodium, or calcium. Examples: K-feldspar, Ca-plagioclase, and Na-plagioclase.

**felsic** The minerals feldspar and quartz or an igneous or metamorphic rock made predominantly of feldspar and quartz. Contrast with mafic.

**fiord** A glaciated valley flooded by the sea to form a long, narrow, steep-walled inlet.

**firn** Granular ice formed by recrystallization of snow. It is intermediate between snow and glacial ice. Sometimes referred to as neve.

**fissure** An open fracture in a rock.

**fissure eruption** Extrusion of lava along a fissure.



Fissure eruption

**flint** A popular name for dark-colored chert (cryptocrystalline quartz).

**flood basalt** An extensive flow of basalt erupted chiefly along fissures. Synonymous with plateau basalt.

**floodplain** The flat, occasionally flooded area bordering a stream.

**fluvial** Pertaining to a river or rivers.

**fluvial environment** The sedimentary environment of river systems.

**focus** The area within Earth where an earthquake originates.

**fold** A bend, or flexure, in a rock.



Fold

**folded mountain belt** A long, linear zone of Earth's crust where rocks have been intensely deformed by horizontal stresses and generally intruded by igneous rocks. The great folded mountains of the world (such as the Appalachians, the Himalayas, the Rockies, and the Alps) are believed to have been formed at convergent plate margins.

**foliation** A planar feature in metamorphic rocks, produced by the secondary growth of minerals. Three major types are recognized: slaty cleavage, schistosity, and gneissic layering.

**footwall** The block beneath a dipping fault surface.

**foraminifer** Single-celled organisms that secrete calcium carbonate shells. They are an important source of biochemical sediment in the oceans.

**forearc** At a convergent plate margin, the region between the trench and volcanic arc. The forearc is underlain by a long sedimentary basin and accretionary prism.

**foreshore** The seaward part of the shore or beach lying between high tide and low tide.

**formation** A distinctive body of rock that serves as a convenient unit for study and mapping.

**fossil** Naturally preserved remains or evidence of past life, such as bones, shells,

casts, impressions, and trails.

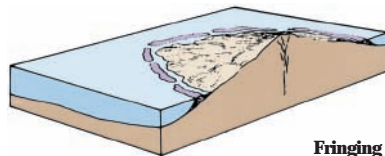
**fossil fuel** A fuel containing solar energy that was absorbed by plants and animals in the geologic past and thus is preserved in organic compounds in their remains. Fossil fuels include petroleum, natural gas, and coal.

**fractional crystallization** The separation of crystals and melt that causes the residual magma to progressively change its composition. Early crystallized mafic minerals commonly are separated by gravitational settling, so that the residual magma is left enriched in silica, sodium, and potassium.

**fracture** An irregular break in a rock or a break in a crystal that is not parallel to a crystal face.

**fracture zone** **1** (field geology) A zone where the bedrock is cracked and fractured. **2** (tectonics) A zone of long, linear fractures on the ocean floor, expressed topographically by ridges and troughs. Fracture zones are the topographic expression of transform faults.

**fringing reef** A reef that lies alongside the shore of a landmass.



Fringing reef

**frost heaving** The lifting of unconsolidated material by the freezing of subsurface water.

**frost wedging** The forcing apart of rocks by the expansion of water as it freezes in fractures and pore spaces.

**gabbro** A dark-colored, coarse-grained rock composed of Ca-plagioclase, pyroxene, and possibly olivine, but no quartz.

**gas** The state of matter in which a substance has neither independent shape nor independent volume. Gases can be compressed and tend to expand indefinitely.

**geode** A hollow nodule of rock lined with crystals; when separated from the rock body by weathering, it appears as a hollow, rounded shell partly filled with crystals.



Geode

**geologic column** A diagram representing divisions of geologic time and the rock units formed during each major period.

**geologic cross section** A diagram showing the structure and arrangement of rocks as they would appear in a vertical plane below Earth's surface.

**geologic map** A map showing the distribution of rocks at Earth's surface.

**geologic time scale** The time scale determined by the geologic column and by radiometric dating of rocks.

**geothermal** Pertaining to the heat of the interior of Earth.

**geothermal energy** Energy useful to human beings that can be extracted from steam and hot water found within Earth's crust.

**geothermal gradient** The rate at which temperature increases with depth.

**geyser** A thermal spring that intermittently erupts steam and boiling water.

**glacial environment** The sedimentary environment of glaciers and their meltwaters.

**glacier** A mass of ice formed from compacted, recrystallized snow that is thick enough to flow plastically.

**glass** **1** A state of matter in which a substance displays many properties of a solid but lacks crystal structure. **2** An amorphous igneous rock formed from a rapidly cooling magma.

**glassy texture** The texture of igneous rocks in which the material is in the form of natural glass rather than crystal.

**global change** A worldwide change, usually referring to a change in climate of the entire planet and not of just a local area or region.

**glossopteris flora** An assemblage of late Paleozoic fossil plants named for the seed fern *Glossopteris*, one of the plants in the assemblage. These flora are widespread in South America, Africa, Australia, India, and Antarctica and provide important evidence for the theory of continental drift.

**gneiss** A coarse-grained metamorphic rock with a characteristic type of foliation (gneissic layering), resulting from alternating layers of light-colored and dark-colored minerals.

**gneissic layering** The type of foliation characterizing gneiss, resulting from alternating layers of the constituent silicic and mafic minerals.

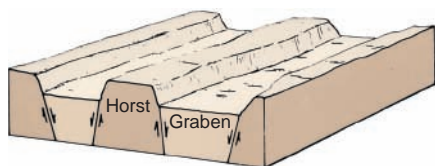


**Gondwanaland** The ancient continental landmass that is thought to have split apart during Mesozoic time to form the present-day continents of South America, Africa, India, Australia, and Antarctica.



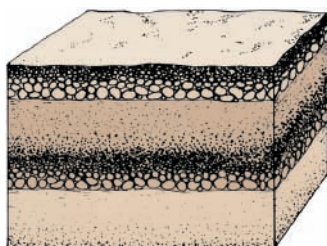
Gondwanaland

**graben** An elongate fault block that has been lowered in relation to the blocks on either side.



Graben

**graded bedding** A type of bedding in which each layer is characterized by a progressive decrease in grain size from the bottom of the bed to the top.



Graded bedding

**graded stream** A stream that has attained a state of equilibrium, or balance, between erosion and deposition, so that the velocity of the water is just great enough to transport the sediment load supplied from the drainage basin, and neither erosion nor deposition occurs.

**gradient** (stream) The slope of a stream channel measured along the course of the stream.

**grain** A particle of a mineral or rock, generally lacking well-developed crystal faces.

**granite** A coarse-grained igneous rock composed of K-feldspar, plagioclase, and quartz, with small amounts of mafic minerals.

**granulite** A high-grade metamorphic rock that typically lacks hydrous minerals like micas and amphibole.

**gravel** The coarsest (greater than 2 cm across) clasts found in clastic sedimentary rocks, includes cobbles and boulders.

**gravity anomaly** An area where gravitational attraction is greater or less than its normal value.

**graywacke** An impure sandstone consisting of rock fragments and grains of quartz and feldspar in a matrix of clay-size particles.

**greenhouse effect** The warming of a planet's atmosphere caused when certain gases (especially water vapor and carbon dioxide) absorb of solar energy reflected off the surface.

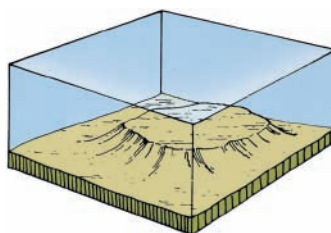
**greenschist facies** Metamorphic conditions typified by low temperature and low pressure.

**greenstone** A low-grade metamorphic rock that commonly has green minerals such as chlorite and talc.

**groundmass** The matrix of relatively fine-grained material between the phenocrysts in a porphyritic rock.

**groundwater** Water below Earth's surface; generally in pore spaces of rocks and soil.

**guyot** A seamount with a flat top.



Guyot

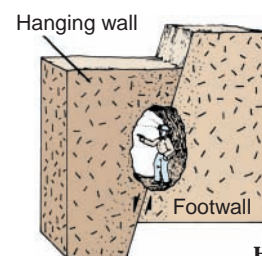
**gypsum** An evaporite mineral composed of calcium sulfate with water ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ).

**half-life** The time required for half of a given sample of a radioactive isotope to decay to its daughter isotope.

**halite** An evaporite mineral composed of sodium chloride ( $\text{NaCl}$ ).

**hanging valley** A tributary valley with the floor lying ("hanging") above the valley floor of the main stream or shore to which it flows. Hanging valleys commonly are created by deepening of the main valley by glaciation, but they can also be produced by faulting or rapid retreat of a sea cliff.

**hanging wall** The surface or block of rock that lies above an inclined fault plane.



Hanging wall

**hardness 1** (mineralogy) The measure of the resistance of a mineral to scratching or abrasion. **2** (water) A property of water resulting from the presence of calcium carbonate and magnesium carbonate in solution.

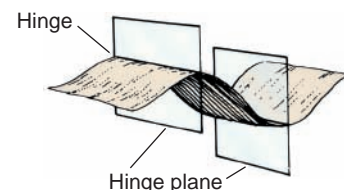
**headland** An extension of land seaward from the general trend of the coast; a promontory, cape, or peninsula.

**headward erosion** Extension of a stream headward, up the regional slope of erosion.

**heat flow** The flow of heat from the interior of Earth.

**high-grade metamorphism** Metamorphism that occurs under high temperature and high pressure.

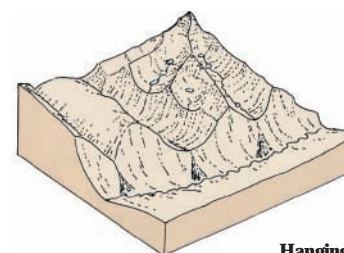
**hinge** The line where folded beds show maximum curvature. The line formed by the intersection of the hinge plane with the bedding surface.



Hinge

**hogback** A narrow, sharp ridge formed on steeply inclined, resistant rock.

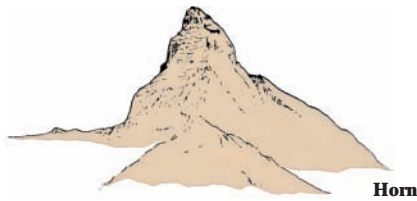
**horizon 1** (geologic) A plane of stratification assumed to have been originally horizontal. **2** (soil) A layer of soil distinguished by characteristic physical properties. Soil horizons generally are



Hanging valley

designated by letters (for example, A horizon, B horizon, C horizon).

**horn** A sharp peak formed at the intersection of the headwalls of three or more cirques.

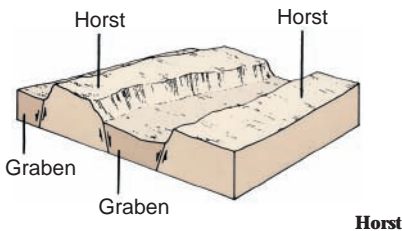


**Horn**

**hornblende** A variety of the amphibole mineral group.

**hornfels** A nonfoliated metamorphic rock of uniform grain size, formed by high-temperature metamorphism. Hornfelses typically are formed by contact metamorphism around igneous intrusions.

**horst** An elongate fault block that has been uplifted in relation to the adjacent rocks.



**Horst**

**hot spot** The expression at Earth's surface of a mantle plume, or column of hot, buoyant rock rising in the mantle beneath a lithospheric plate.

**hummock** A small, rounded or cone-shaped, low hill or a surface of other small, irregular shapes. A surface that is not equidimensional or ridgelike.

**hydrolysis** A chemical reaction wherein hydrogen ions replace other ions in a mineral. Commonly results in the production of hydrous minerals such as clay or complete dissolution of calcite.

**hydraulic** Pertaining to a fluid in motion.

**hydraulic head** The pressure exerted by a fluid at a given depth beneath its surface. It is proportional to the height of the fluid's surface above the area where the pressure is measured.

**hydrologic system** The system of moving water at Earth's surface.

**hydration** Chemical combination of water with other substances.

**hydrosphere** The waters of Earth, as distinguished from the rocks (lithosphere), the air (atmosphere), and living things (biosphere).

**hydrostatic pressure** The pressure within a fluid (such as water) at rest, exerted on a given point within the body of the fluid.

**hydrothermal deposit** A mineral deposit formed by hot water. The high temperature commonly is associated with emplacement of a magma.

**ice sheet** A thick, extensive body of glacial ice that is not confined to valleys. Localized ice sheets are sometimes called ice caps.

**ice wedging** A type of mechanical weathering in which rocks are broken by the expansion of water as it freezes in joints, pores, or bedding planes. Synonymous with frost wedging.

**igneous rock** Rock formed by cooling and solidification of molten silicate minerals (magma). Igneous rocks include volcanic and plutonic rocks.

**inclination, magnetic** The angle between the horizontal plane and a magnetic line of force.

**inclusion** A rock fragment incorporated into a younger igneous rock.

**intermediate-focus earthquake** An earthquake with a focus located at a depth between 70 and 300 km.

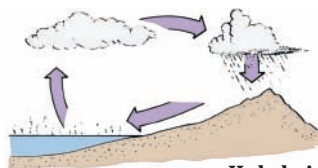
**intermittent stream** A stream through which water flows only part of the time.

**internal drainage** A drainage system that does not extend to the ocean.

**interstitial** Pertaining to material in the pore spaces of a rock. Petroleum and groundwater are interstitial fluids. Minerals deposited by groundwater in a sandstone are interstitial minerals.

**intrusion** 1 Injection of a magma into a preexisting rock. 2 A body of rock resulting from the process of intrusion.

**intrusive rock** Igneous rock that, while it was fluid, penetrated into or between other rocks and solidified. It can later be exposed at Earth's surface after erosion of the overlying rock.



**Hydrologic system**

**inverted valley** A valley that has been filled with lava or other resistant material and has subsequently been eroded into an elongate ridge.

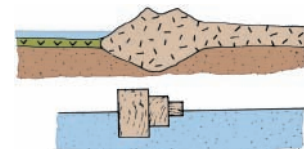
**ion** An atom or combination of atoms that has gained or lost one or more electrons and thus has a net electrical charge.

**ionic bond** A chemical bond formed by electrostatic attraction between oppositely charged ions.

**ionic substitution** The replacement of one kind of ion in a crystalline lattice by another kind that is of similar size and electrical charge.

**island arc** A chain of volcanic islands. Island arcs are generally convex toward the open ocean. Example: the Aleutian Islands.

**isostasy** A state of equilibrium, resembling flotation, in which segments of Earth's crust stand at levels determined by their thickness and density. Isostatic equilibrium is attained by flow of material in the mantle.



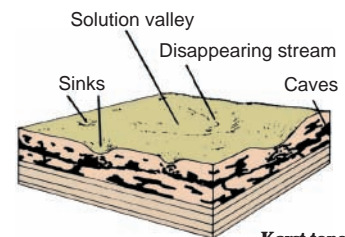
**Isostasy**

**isotope** One of the several forms of a chemical element that have the same number of protons in the nucleus but differ in the number of neutrons and thus differ in atomic weight.

**joint** A fracture in a rock along which no appreciable displacement has occurred.

**kame** A body of stratified glacial sediment. A mound or an irregular ridge deposited by a subglacial stream as an alluvial fan or a delta.

**karst topography** A landscape characterized by sinks, solution valleys, and other features produced by groundwater activity.



**Karst topography**

**kettle** A closed depression in a deposit of glacial drift formed where a block of ice was buried or partly buried and then melted.

**laccolith** A concordant igneous intrusion that has arched up the strata into which it was injected, so that it forms a pod-shaped or lens-shaped body with a generally horizontal floor.



Laccolith

**lag deposit** A residual accumulation of coarse fragments that remains on the surface after finer material has been removed by wind.

**lagoon** A shallow body of seawater separated from the open ocean by a barrier island or reef.

**lahar** A volcanic debris flow.

**lamina** (pl. laminae) A layer of sediment less than 1 cm thick.

**laminar flow** A type of flow in which the fluid moves in parallel lines. Contrast with turbulent flow.

**landform** Any feature of Earth's surface having a distinct shape and origin. Landforms include major features (such as continents, ocean basins, plains, plateaus, and mountain ranges) and minor features (such as hills, valleys, slopes, drumlins, and dunes). Collectively, the landforms of Earth constitute the entire surface configuration of the planet.

**landslide** A general term for relatively rapid types of mass movement, such as debris flows, debris slides, rockslides, and slumps.

**lateral moraine** An accumulation of till deposited along the side margins of a valley glacier. It accumulates as a result of mass movement of debris on the sides of the glacier.

**lateral slip** Nearly horizontal movement (shear) of blocks on either side of a vertical fault.

**laterite** A soil that is rich in oxides of iron and aluminum formed by deep weathering in tropical and subtropical areas.

**Laurasia** The ancient continental landmass that is thought to have split apart to

form Europe, Asia, North America, and Greenland.

**lava** Magma that reaches Earth's surface.

**lava dome** Bulbous lava flow or viscous plug of lava piled near its vent. Most are made of rhyolite.

**leach** To dissolve and remove the soluble constituents of a rock or soil.

**lee slope** The part of a hill, dune, or rock that is sheltered or turned away from the wind. Synonymous with slip face.

**levee, natural** A broad, low embankment built up along the banks of a river channel during floods.

**limb** The flank, or side, of a fold.

**limestone** A sedimentary rock composed mostly of calcium carbonate ( $\text{CaCO}_3$ ).

**lineament** A topographic feature or group of features having a linear configuration. Lineaments commonly are expressed as ridges or depressions or as an alignment of features such as stream beds, volcanoes, or vegetation.

**linear dune** An elongate sand dune oriented in the direction of the prevailing wind.

**liquid** The state of matter in which a substance flows freely and lacks crystal structure. Unlike a gas, a liquid retains the same volume independent of the shape of its container.

**lithification** The processes by which sediment is converted into sedimentary rock. These processes include cementation and compaction.

**lithosphere** The relatively rigid outer zone of Earth, which includes the continental crust, the oceanic crust, and the part of the upper mantle lying above the weaker asthenosphere.

**load** The total amount of sediment carried at a given time by a stream, glacier, or wind.

**loess** Unconsolidated, wind-deposited silt and dust.

**longitudinal profile** The profile of a stream or valley drawn along its length, from source to mouth.

**longitudinal wave** A seismic body wave in which particles oscillate along lines in the direction in which the wave travels. Synonymous with P wave.

**longshore current** A current in the surf zone moving parallel to the shore. Longshore currents occur where waves strike

the shore at an angle.

**longshore drift** The process in which sediment is moved in a zigzag pattern along a beach by the swash and backwash of waves that approach the shore obliquely.

**low-grade metamorphism** Metamorphism that is accomplished under low or moderate temperature and low or moderate pressure.

**luster** The appearance of the light reflected from a mineral surface, described, for example, as dull, glassy, or metallic.

**mafic** A mineral or rock rich in iron and magnesium silicates such as olivine and pyroxene.

**magma** Molten rock, generally a silicate melt with suspended crystals and dissolved gases.

**magmatic differentiation** A general term for the processes by which magmas differentiate. It includes fractional crystallization, magma mixing, and assimilation.

**magmatic segregation** Separation of crystals of certain minerals from a magma as it cools. For example, some minerals (including certain valuable metals) crystallize while other components of the magma are still liquid. These early formed crystals can settle to the bottom of a magma chamber and thus become concentrated there, forming an ore deposit.

**magnetic anomaly** A deviation of observed magnetic inclination or intensity (as measured by a magnetometer) from a constant normal value.

**magnetic reversal** A complete 180-degree reversal of the polarity of Earth's magnetic field.

**magnetosphere** A region of the extreme upper atmosphere that is dominated by the magnetic field and charged particles are trapped in it. It acts as a type of radiation shield.

**magnitude** A measure of the size of an earthquake, usually calculated from the common logarithm of the largest ground motion observed and corrected for distance from the earthquake focus.

**mantle** The zone of the Earth's interior between the base of the crust (the Moho discontinuity) and the core.

**mantle plume** A buoyant mass of hot mantle material that rises to the base of the lithosphere. Mantle plumes commonly produce volcanic activity and



structural deformation in the central part of lithospheric plates.

**marble** A metamorphic rock consisting mostly of metamorphosed limestone or dolomite.

**mare** (pl. maria) Any of the relatively smooth, low, dark areas of the Moon. The lunar maria were formed by extrusion of lava.

**mass movement** The transfer of rock and soil downslope by direct action of gravity without a flowing medium (such as a river or glacial ice). Synonymous with mass wasting.

**matrix** The relatively fine-grained rock material occupying the space between larger particles in a rock. *See also* groundmass.

**meander** A broad, looping bend in a river.



Meander

**medial moraine** A ridge of till formed in the middle of a valley glacier by the junction of two lateral moraines where two valley glaciers converge.

**melange** A mixture of diverse deformed rocks formed in the accretionary prism at a convergent plate margin.

**Mercalli scale** A measure of earthquake intensity determined from the effects on people and buildings, ranges from I (low) to XII (nearly total destruction).

**mesa** A flat-topped, steep-sided highland capped with a resistant rock formation. A mesa is smaller than a plateau but larger than a butte.

**Mesozoic** The era of geologic time from the end of the Paleozoic Era (225 million years ago) to the beginning of the Cenozoic Era (65 million years ago).

**metaconglomerate** A metamorphosed conglomerate.

**metallic bond** A chemical bond in which shared electrons move freely among the atoms.

**metamorphic rock** Any rock formed from preexisting rocks by solid state recrystallization driven by changes in temperature and pressure and by chemical action of fluids.

**metamorphism** Alteration of the minerals and textures of a rock by changes in

temperature and pressure and by a gain or loss of chemical components.

**metasomatism** A change in the chemical composition of a rock during metamorphism, usually caused by the transport of ions by fluids.

**meteoric water** Water derived from the atmosphere, such as rainwater, snow, or hail.

**meteorite** Any particle of solid matter that has fallen to Earth, the Moon, or another planet from space.

**mica** A group of silicate minerals exhibiting perfect cleavage in one direction.

**midocean ridge** Broad fractured swell in the ocean basins. New oceanic crust is formed at this type of divergent plate boundary. Synonymous with oceanic ridge.

**migmatite** A mixture of igneous and metamorphic rocks in which thin dikes and stringers of granitic material interfinger with metamorphic rocks.

**Milankovitch theory** The theory that cyclical climatic changes are caused by variations in Earth's orbital characteristics—eccentricity of the orbit and tilt (obliquity) and precession (wobble) of the spin axis.

**mineral** A naturally occurring inorganic solid having a definite internal structure and a definite chemical composition that varies only within strict limits. Chemical composition and internal structure determine its physical properties, including the tendency to assume a particular geometric form (crystal form).

**Mohorovicic discontinuity** The first global seismic discontinuity below the surface of Earth. It lies at a depth varying from about 5 to 10 m beneath the ocean floor to about 35 km beneath the continents. Commonly referred to as the Moho.

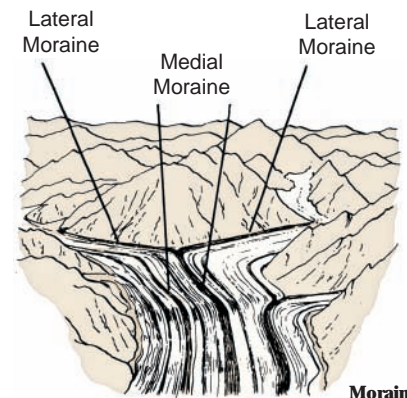
**Mohs hardness scale** A scale of mineral hardness ranging from 1 for soft minerals to 10 for very hard minerals.

**monocline** A bend or fold in gently dipping horizontal strata.



Monocline

**moraine** A general term for a landform composed of till.

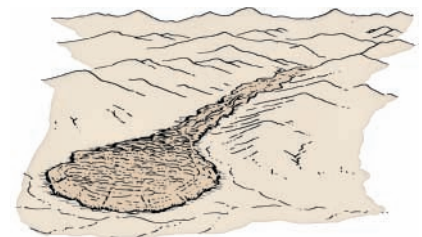


Moraines

**mountain** A general term for any landmass that stands above its surroundings. In the stricter geological sense, a mountain belt is a highly deformed part of Earth's crust that has been injected with igneous intrusions and the deeper parts of which have been metamorphosed. The topography of young mountains is high, but erosion can reduce old mountains to flat lowlands.

**mud crack** A crack in a deposit of mud or silt resulting from the contraction that accompanies drying.

**mudflow** A flowing mixture of mud and water.



Mudflow

**mudrock** A fine-grained sedimentary rock made of clay and silt-size particles. Shale is a finely laminated type of mudrock.

**multiring basin** A large crater (on the Moon they are more than 300 km in diameter) containing a series of concentric ridges and depressions. Example: the Orientale basin on the Moon.

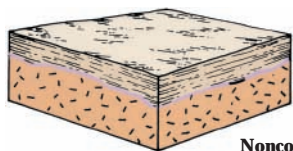
**mylonite** A foliated metamorphic rock formed by intense shearing and deformation of preexisting grains. Formed in the transition between brittle fracture and ductile flow.

**nappe** A large thrust sheet with overturned folds.

**neve** Granular ice formed by recrystallization of snow. Synonymous with firn.

**neutron** A subatomic nuclear particle that has no electrical charge but a mass almost the same as a proton.

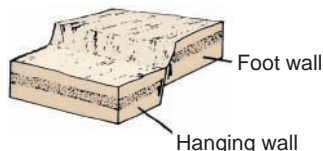
**nonconformity** An unconformity in which stratified rocks rest on eroded granitic or metamorphic rocks.



Nonconformity

**nonfoliated** A metamorphic rock that lacks any preferred orientation of its mineral grains.

**normal fault** A steeply inclined fault in which the hanging wall has moved downward in relation to the footwall.



Normal fault

**numerical age** Geologic time measured in a specific duration of years (in contrast to relative time, which involves only the chronologic order of events). Synonym: absolute age.

**obsidian** A glassy igneous rock with a composition equivalent to that of granite.

**ocean basin** A low part of the lithosphere lying between continental masses. The rocks of an ocean basin are mostly basalt with a veneer of oceanic sediment.

**oceanic crust** The type of crust that underlies the ocean basins. It is generally less than 8 km thick, composed predominantly of basalt and gabbro. Its density is about 3.0 g/cm<sup>3</sup>. The velocities of compressional seismic waves traveling through it exceed 6.2 km/sec. Compare with continental crust.

**oceanic ridge** The continuous ridge, or broad, fractured topographic swell, that extends through the central part of the Arctic, Atlantic, Indian, and South Pacific oceans. It is several hundred kilometers wide, and its elevation above the ocean floor is 600 m or more. The ridge marks a divergent plate boundary where new oceanic lithosphere is being formed.

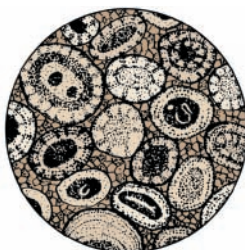
**oil reservoir** Porous rock that can contain oil.

**oil shale** Shale that is rich in hydrocarbon derivatives. In the United States, the chief oil shale is the Green River Formation in the Rocky Mountain region.

**oil trap** Impermeable rocks or structures that block the flow of oil and force it to accumulate into larger bodies.

**olivine** An important silicate mineral with magnesium and iron [(Mg,Fe)<sub>2</sub>SiO<sub>4</sub>].

**oolite** A limestone consisting largely of spherical grains of calcium carbonate in concentric spherical layers.



Oolite

**ooze** (marine geology) Marine sediment consisting of more than 30% shell fragments of microscopic organisms.

**ophiolite** A sequence of rocks characterized by ultramafic rocks at the base and (in ascending order) gabbro, sheeted dikes, pillow lavas, and deep-sea sediments. The typical sequence of rocks constituting the oceanic crust.

**ore deposit** A mass of rock containing metal (or some other commodity like diamonds) of sufficient abundance to be extracted at a profit.

**organic sediment** A sediment deposited through biological means and rich in hydrocarbons, such as coal.

**orogenic** Pertaining to deformation of a continental margin to the extent that a mountain range is formed.

**orogenic belt** A mountain belt.

**orogeny** A major episode of mountain building.

**outcrop** An exposure of bedrock.

**outlet glacier** A tonguelike stream of ice, resembling a valley glacier, that forms where a continental glacier encounters a mountain system and is forced to move through a mountain pass in large streams.

**outwash** Stratified sediment washed out from a glacier by meltwater streams and deposited in front of the end moraine.

**outwash plain** The area beyond the margins of a glacier where meltwater deposits sand, gravel, and mud washed out from the glacier.

**overturned fold** A fold in which at least one limb has been rotated through an angle greater than 90 degrees.



Overturned fold

**oxbow lake** A lake formed in the channel of an abandoned meander.

**oxidation** Chemical combination of oxygen with another substance.

**oxide mineral** A mineral lacking silicon, but containing oxygen bound to a metal. Examples: hematite and magnetite.

**ozone layer** A zone within the stratosphere where ozone (O<sub>3</sub>) is abundant and forms a protection from some of the Sun's harmful ultraviolet radiation.

**pahoehoe flow** A lava flow with a billowy or ropy surface. Contrast with aa flow.

**paleocurrent** An ancient current, which existed in the geologic past, with a direction of flow that can be inferred from cross-bedding, ripple marks, and other sedimentary structures.

**paleogeography** The study of geography in the geologic past, including the patterns of Earth's surface, the distribution of land and ocean, and ancient mountains and other landforms.

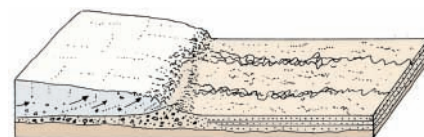
**paleomagnetism** The study of ancient magnetic fields, as preserved in the magnetic properties of rocks. It includes studies of changes in the position of the magnetic poles and reversals of the magnetic poles in the geologic past.

**paleontology** The study of ancient life.

**Paleozoic** The era of geologic time from the end of the Precambrian (600 million years ago) to the beginning of the Mesozoic Era (225 million years ago).

**Pangaea** A former continent from which the present continents originated by plate movement from the Mesozoic Era to the present.

**parabolic dune** A dune shaped like a parabola with the concave side toward the wind. Blowout dune.



Outwash plain

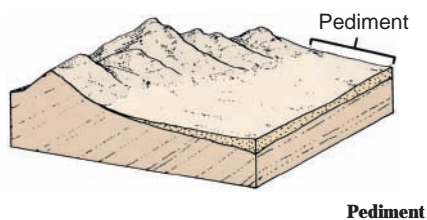
**partial melting** The process by which minerals with low melting points liquefy within a rock body as a result of an increase in temperature or a decrease in pressure (or both) while other minerals in the rock are still solid. If the liquid (magma) is removed before other components of the parent rock have melted, the composition of the magma can be quite different from that of the parent rock. Partial melting is believed to be important in the generation of basaltic magma from peridotite at ocean ridges and in the generation of granitic magma from basaltic crust.

**passive margin** (plate tectonics) A lithospheric plate margin at which crust is neither created nor destroyed. Passive plate margins generally are marked by transform faults.

**peat** An accumulation of partly carbonized plant material containing approximately 60% carbon and 30% oxygen. It is considered an early stage, or rank, in the development of coal.

**pebble** A rock fragment with a diameter between 2 mm (about the size of a match head) and 64 mm (about the size of a tennis ball).

**pediment** A gently sloping erosion surface formed at the base of a receding mountain front or cliff. It cuts across bedrock and can be covered with a veneer of sediment. Pediments characteristically form in arid and semiarid climates.



**pegmatite** A very coarse grained igneous rock typically with a granitic composition.

**pelagic sediment** Deep-sea sediment composed of fine-grained detritus that slowly settles from surface waters. Common constituents are clay, radiolarian ooze, and foraminiferal ooze.

**peninsula** An elongate body of land extending into a body of water.

**perched water table** The upper surface of a local zone of saturation that lies above the regional water table.

**peridotite** A dark-colored ultramafic igneous rock of coarse-grained texture, composed of olivine, pyroxene, but with essentially no feldspar and no quartz.

**period** A division of geologic time smaller than an era and larger than an epoch. Example: Cretaceous Period.

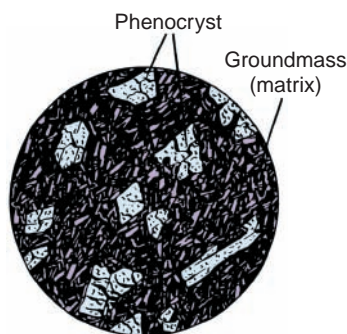
**permafrost** Permanently frozen ground.

**permanent stream** A stream or reach of a stream that flows continuously throughout the year. Synonymous with perennial stream.

**permeability** The ability of a material to transmit fluids.

**phaneritic texture** The texture of igneous rocks in which the interlocking crystals are large enough to be seen without magnification.

**phenocryst** A crystal that is significantly larger than the crystals surrounding it. Phenocrysts form during an early phase in the cooling of a magma when the magma cools relatively slowly.

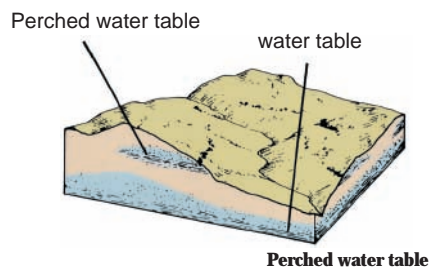


**phyllite** A foliated metamorphic rock intermediate between slate and schist. Small mica crystals give broken surfaces a silky sheen.

**physical weathering** The breakdown of rock into smaller fragments by physical processes such as frost wedging. Synonymous with mechanical weathering.

**physiographic map** A map showing surface features of Earth.

**pillow lava** An ellipsoidal mass of igneous rock formed by extrusion of lava underwater.



**placer** A mineral deposit formed by the sorting or washing action of water. Placers are usually deposits of heavy minerals, such as gold.

**plagioclase** A group of feldspar minerals with a composition range from NaAlSi<sub>3</sub>O<sub>8</sub> to CaAl<sub>2</sub>Si<sub>2</sub>O<sub>8</sub>.

**planetary differentiation** The processes by which the materials in a planetary body are separated according to density, so that the originally homogeneous body is converted into a zoned or layered (shelled) body with a dense core, a mantle, and a crust.

**plankton** Collective term for very small plants and animals that drift near the surface of water. Phytoplankton include bacteria, algae (including diatoms), and fungi. The small animals are called zoo-plankton.

**plastic deformation** A permanent change in a substance's shape or volume that does not involve failure by rupture.

**plate** (tectonics) A broad segment of the lithosphere (including the rigid upper mantle, plus oceanic and continental crust) that floats on the underlying asthenosphere and moves independently of other plates.

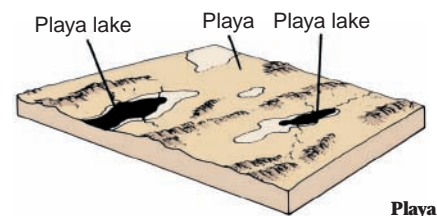
**plateau** An extensive upland region.

**plateau basalt** Basalt extruded in extensive, nearly horizontal layers, which, after uplift, tend to erode into great plateaus. Synonymous with flood basalt.



**plate tectonics** The theory of global dynamics in which the lithosphere is believed to be broken into individual plates that move in response to convection in the upper mantle. The margins of the plates are sites of considerable geologic activity.

**playa** A depression in the center of a desert basin, the site of occasional temporary lakes.



**playa lake** A shallow temporary lake formed in a desert basin after rain.



**Pleistocene** The epoch of geologic time from the end of the Pliocene Epoch of the Tertiary Period (about 2 million years ago) to the beginning of the Holocene Epoch of the Quaternary Period (about 10,000 years ago). The major event during the Pleistocene was the expansion of continental glaciers in the Northern Hemisphere. Synonymous with glacial epoch, ice age.

**plucking** (glacial geology) The process of glacial erosion by which large rock fragments are loosened by ice wedging, become frozen to the bottom surface of the glacier, and are torn out of the bedrock and transported by the glacier as it moves. The process involves the freezing of subglacial meltwater that seeps into fractures and bedding planes in the rock.

**plume** See mantle plume.

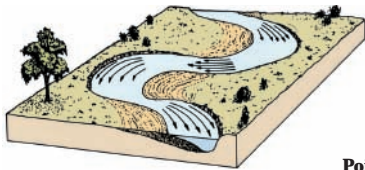
**plunge** The inclination, with respect to the horizontal plane, of any linear structural element of a rock. The plunge of a fold is the inclination of the axis of the fold.

**plunging fold** A fold with its axis inclined from the horizontal.

**pluton** Igneous rock formed beneath Earth's surface.

**pluvial lake** A lake that was created under former climatic conditions, at a time when rainfall in the region was more abundant than it is now. Pluvial lakes were common in arid regions during the Pleistocene.

**point bar** A crescent-shaped accumulation of sand and gravel deposited on the inside of a meander bend.



Point bar

**polar climate** The climate that prevails at Earth's poles, with temperatures commonly below freezing and precipitation low.

**polarity epoch** A relatively long period of time during which Earth's magnetic field is oriented in either the normal direction or the reverse direction.

**polarity event** A relatively brief interval of time within a polarity epoch; during a polarity event, the polarity of Earth's magnetic field is reversed with respect to the prevailing polarity of the epoch.

**polar wandering** The apparent move-

ment of the magnetic poles with respect to the continents.

**pole of rotation** A pole of the imaginary axis about which a tectonic plate rotates.

**polymorphism** The ability of a chemical compound to crystallize with more than one kind of crystal structure. For example,  $\text{Al}_2\text{SiO}_5$  may crystallize as three different minerals, depending on the prevailing temperature and pressure.

**pore fluid** A fluid, such as groundwater or liquid rock material resulting from partial melting, that occupies pore spaces of a rock.

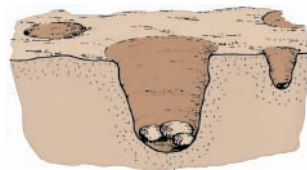
**pore space** The spaces within a rock body that are unoccupied by solid material. Pore spaces include spaces between grains, fractures, vesicles, and voids formed by dissolution.

**porosity** The percentage of the total volume of a rock or sediment that consists of pore space.

**porphyritic texture** The texture of igneous rocks in which some crystals are distinctly larger than others.

**porphyry copper** Deposits of copper disseminated throughout a porphyritic granitic rock.

**pothole** A hole formed in a stream bed by sand and gravel swirled around in one spot by eddies.



Pothole

**Precambrian** The division of geologic time from the formation of Earth (about 4.5 billion years ago) to the beginning of the Cambrian Period of the Paleozoic era (about 600 million years ago). Also, the rocks formed during that time. Precambrian time constitutes about 90% of Earth's history.

**pressure ridge** An elongate uplift of the congealing crust of a lava flow, resulting from the pressure of underlying and still fluid lava.

**primary sedimentary structure** A structure of sedimentary rocks (such as cross-bedding, ripple marks, or mud cracks) that originates contemporaneously with the deposition of the sediment (in contrast to a secondary structure, such as a joint or fault, which originates after the rock has been formed).

**primary wave** See P wave.

**proton** A positively charged nuclear particle.

**pumice** A light-colored volcanic rock with abundant vesicles in natural glass.

**P wave (primary seismic wave)** A type of seismic wave, propagated like a sound wave, in which the material involved in the wave motion is alternately compressed and expanded.

**pyroclastic** Pertaining to fragmental rock material formed by volcanic explosions.



Pyroclastic flow

**pyroxene** A group of rock-forming silicate minerals composed of single chains of silicon-oxygen tetrahedra. Compare with amphibole, which is composed of double chains.

**quartz** An important rock-forming silicate mineral composed of silicon-oxygen tetrahedra joined in a three-dimensional network. It is distinguished by its hardness, glassy luster, and conchoidal fracture.

**quartzite** A sandstone recrystallized by metamorphism.

**radioactivity** The spontaneous disintegration of an atomic nucleus with the emission of energy.

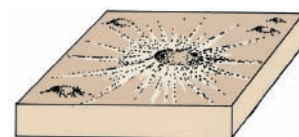
**radiocarbon** A radioactive isotope of carbon,  $^{14}\text{C}$ , which is formed in the atmosphere and is absorbed by living organisms.

**radiogenic heat** Heat generated by radioactivity.

**radiometric dating** Determination of the age in years of a rock or mineral by measuring the proportions of an original radioactive material and its decay product.

**rain shadow** A dry area lying downwind from a high mountain chain.

**rayed crater** A meteorite crater that has a system of rays extending like splash marks from the crater rim.



Rayed crater

**recharge** Replenishment of the ground-water reservoir by the addition of water.  
**recrystallization** Reorganization of elements of the original minerals in a rock resulting from changes in temperature and pressure and from the activity of pore fluids.

**reef** A solid structure built of shells and other secretions of marine organisms, particularly coral.

**regional metamorphism** Metamorphism of large areas of crust, usually during mountain building at convergent plate margins. Contrast with contact metamorphism.

**regolith** The blanket of soil and loose rock fragments overlying the bedrock.

**regression** A drop in sea level causes the shoreline to move downslope.

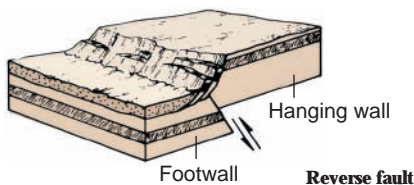
**relative age** The age of a rock or an event as compared with some other rock or event.

**relative dating** Determination of the chronologic order of a sequence of events in relation to one another without reference to their ages measured in years. Relative geologic dating is based primarily on superposition, faunal succession, and crosscutting relations.

**relative time** Geologic time as determined by relative dating, that is, by placing events in chronologic order without reference to their ages measured in years.

**relief** The difference in altitude between the high and the low parts of an area.

**reverse fault** A fault in which the hanging wall has moved upward in relation to the footwall; a high-angle thrust fault.



**rhyolite** A fine-grained volcanic rock composed of quartz, K-feldspar, and plagioclase. It is the extrusive equivalent of a granite.

**Richter scale** A logarithmic scale for expressing the magnitude of an earthquake in terms of the energy dissipated in it. A modified version of this scale is commonly used.

**rift system** A system of faults resulting from extension.

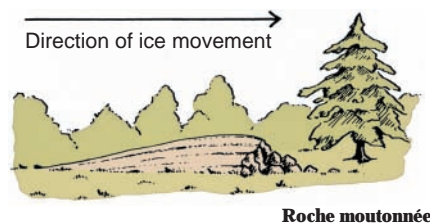
**rift valley** **1** A valley of regional extent formed by block faulting in which tensional stresses tend to pull the crust apart. Synonymous with graben. **2** The down-dropped block along divergent plate margins.

**rip current** A current formed on the surface of a body of water by the convergence of currents flowing in opposite directions. Rip currents are common along coasts where longshore currents move in opposite directions.

**ripple marks** Small waves produced on a surface of sand or mud by the drag of wind or water moving over it.

**river system** An integrated system of tributaries and a trunk stream, which collect and funnel surface water to the sea, a lake, or some other body of water. A river with all of its tributaries.

**roche moutonnée** An abraded knob of bedrock formed by an overriding glacier. It typically is striated and has a gentle slope facing the upstream direction of ice movement.



Roche moutonnée

**rock** An aggregate of minerals that forms an appreciable part of the lithosphere.

**rockfall** The most rapid type of mass movement, in which rocks ranging from large masses to small fragments are loosened from the face of a cliff.

**rock flour** Fine-grained rock particles pulverized by glacial erosion.

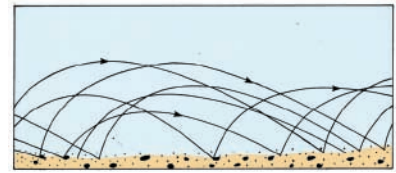
**rock glacier** A mass of poorly sorted, angular boulders cemented with interstitial ice. It moves slowly by the action of gravity.

**rockslide** A landslide in which a newly detached segment of bedrock suddenly slides over an inclined surface of weakness (such as a joint or bedding plane).

**runoff** Water that flows over the land surface.

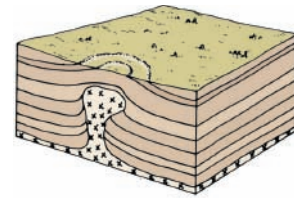
**sag pond** A small lake that forms in a depression, or sag, where active or recent movement along a fault has impounded a stream.

**saltation** The transportation of particles in a current of wind or water by a series of bouncing movements.



Saltation

**salt dome** A dome produced in sedimentary rock by the upward movement of a body of salt.



Salt dome

**saltwater encroachment** Displacement of fresh groundwater by salt water in coastal areas, due to the greater density of salt water.

**sand** Sedimentary material composed of fragments ranging in diameter from 0.0625 to 2 mm. Sand particles are larger than silt particles but smaller than pebbles. Much sand is composed of quartz grains, because quartz is abundant and resists chemical and mechanical disintegration, but other materials, such as shell fragments and rock fragments, can also form sand.

**sandstone** A sedimentary rock composed mostly of sand-sized particles, usually cemented by calcite, silica, or iron oxide.

**saturated** The condition wherein the pore spaces in a rock are completely filled with water.

**saturated zone** The zone in the subsurface in which all pore spaces are filled with water. Contrast with the overlying unsaturated zone.

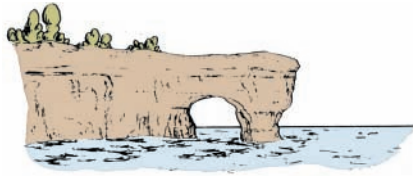
**scarp** A cliff produced by faulting or erosion.

**schist** A medium-grained or coarse-grained metamorphic rock with strong foliation (schistosity) resulting from parallel orientation of platy minerals, such as mica, chlorite, and talc.

**schistosity** The type of foliation that characterizes schist, resulting from the parallel arrangement of coarse-grained platy minerals, such as mica, chlorite, and talc.

**scoria** A dark colored volcanic rock containing abundant vesicles.

**sea arch** An arch cut by wave erosion through a headland.



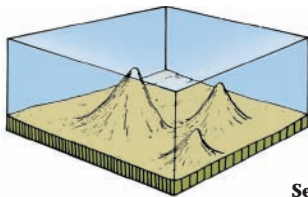
Sea arch

**sea cave** A cave formed by wave erosion.

**sea cliff** A cliff produced by wave erosion.

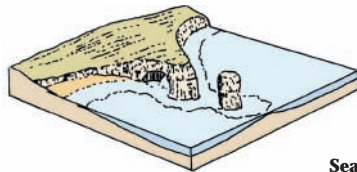
**seafloor spreading** The theory that the seafloor spreads laterally away from the oceanic ridge as new lithosphere is created along the crest of the ridge by igneous activity.

**seamount** An isolated, conical mound rising more than 1000 m above the ocean floor. Seamounts are probably submerged shield volcanoes.



Seamount

**sea stack** A small, pillar-shaped, rocky island formed by wave erosion through a headland near a sea cliff.



Sea stack

**secondary wave** See S wave.

**sediment** Material (such as gravel, sand, mud, and lime) that is transported and deposited by wind, water, ice, or gravity; material that is precipitated from solution; deposits of organic origin (such as coal and coral reefs).

**sedimentary environment** A place where sediment is deposited and the physical, chemical, and biological conditions that exist there. Examples: rivers, deltas, lakes, and shallow-marine shelves.

**sedimentary rock** Rock formed by the accumulation and consolidation of sediment.

**seep** A spot where groundwater or other fluids (such as oil) is discharged at Earth's surface.

**seif dune** A linear dune of great height and length.

**seismic** Pertaining to earthquakes or to waves produced by natural or artificial earthquakes.

**seismic discontinuity** A surface within Earth at which seismic wave velocities abruptly change.

**seismic gap** The part of an active fault that has experienced little or no seismic activity for a long time.

**seismic ray** The path along which a seismic wave travels. Seismic rays are perpendicular to the wave crest.

**seismic reflection profile** A profile of the configuration of the ocean floor and shallow sediments on the floor obtained by reflection of artificially produced seismic waves.

**seismic wave** A wave or vibration produced within Earth by an earthquake or artificial explosion.

**seismograph** An instrument that records seismic waves.

**settling velocity** The rate at which a grain falls through water or air.

**shadow zone** (seismology) An area where there is very little or no direct reception of seismic waves from a given earthquake because of refraction of the waves in Earth's core. The shadow zone for P waves is between about 105 and 142 degrees from the epicenter.

**shale** A fine-grained clastic sedimentary rock formed by consolidation of clay and mud.

**shallow-marine environment** The sedimentary environment of the continental shelves, where the water is usually less than 200 m deep.

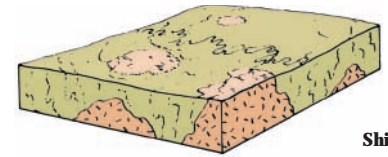
**shear** Stress that causes two adjacent rock bodies to slide past one another.

**shear wave** A type of seismic wave wherein the elastic vibrations of the particles are transverse to the direction the wave is moving. Shear waves cannot pass through liquids. Synonym: S wave.

**sheeting** A set of joints formed essentially parallel to the surface. It allows layers of rock to break off as the weight of overlying rock is removed by erosion. It is especially well developed in granitic rock.

**shield** An extensive area of a continent where igneous and metamorphic rocks are exposed and have approached equilibrium with respect to erosion and isostasy. Rocks of the shield are usually

very old (that is, more than 600 million years old).



Shield

**shield volcano** A volcano shaped like a flattened dome and built up almost entirely of numerous flows of fluid basaltic lava. The slopes of shield volcanoes seldom exceed 10 degrees, so that in profile they resemble a shield or broad dome.

**shore** The zone between the waterline at high tide and the waterline at low tide. A narrow strip of land immediately bordering a body of water, especially a lake or an ocean.

**silica** Silicon dioxide; quartz is the most common form.

**silicate** A mineral containing silicon-oxygen tetrahedra, in which four oxygen atoms surround each silicon atom.

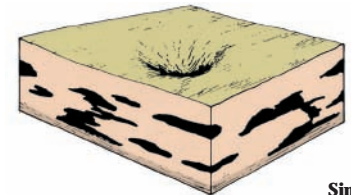
**silicon-oxygen tetrahedron** The structure of the ion  $\text{SiO}_4^{-2}$ , in which four oxygen atoms surround a silicon atom to form a four-sided pyramid, or tetrahedron.

**sill** A tabular body of intrusive rock injected between layers of the enclosing rock.

**silt** Sedimentary material composed of fragments ranging in diameter from 1/265 to 1/16 mm. Silt particles are larger than clay particles but smaller than sand particles.

**siltstone** A fine-grained clastic sedimentary rock composed mostly of silt-sized particles.

**sinkhole** A depression formed by the collapse of a cavern roof.



Sinkhole

**slate** A fine-grained metamorphic rock with a characteristic type of foliation (slaty cleavage), resulting from the parallel arrangement of microscopic platy minerals, such as mica and chlorite.

**slaty cleavage** The type of foliation that characterizes slate, resulting from the



## G-18 Glossary

parallel arrangement of microscopic platy minerals, such as mica and chlorite. Slaty cleavage forms distinct zones of weakness within a rock, along which it splits into slabs.

**slip face** See lee slope.

**slope retreat** Progressive recession of a scarp or the side of a hill or mountain by mass movement and stream erosion.

**slump** A type of mass movement in which material moves along a curved surface of rupture.

**snowline** The line on a glacier separating the area where snow remains from year to year from the area where snow from the previous season melts.

**soil** The surface material of the continents, produced by disintegration of rock; regolith that has undergone chemical and physical weathering and includes organic material.

**soil profile** A vertical section of soil showing the soil horizons and parent material.

**solid** The state of matter in which a substance has a definite shape and volume and some fundamental strength.

**solifluction** A type of mass movement in which material moves slowly down-slope in areas where the soil is saturated with water. It commonly occurs in permafrost areas.

**solution valley** A valley produced by solution activity, either by dissolution of surface materials or by removal of subsurface materials, such as limestone, gypsum, or salt.

**sorting** The separation of particles according to size, shape, or weight. It occurs during transportation by running water or wind.

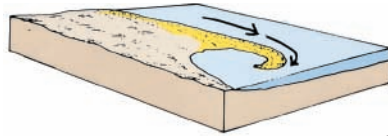
**spatter cone** A low-steep-sided volcanic cone built by accumulation of splashes and spatters of lava (usually basaltic) around a fissure or vent.

**spheroidal weathering** The process by which corners and edges of a rock body become rounded as a result of exposure to weathering on all sides, so that the rock acquires a spheroidal or ellipsoidal shape.



Spheroidal weathering

**spit** A sandy bar projecting from the mainland into open water. Spits are formed by deposition of sediment moved by longshore drift.



Spit

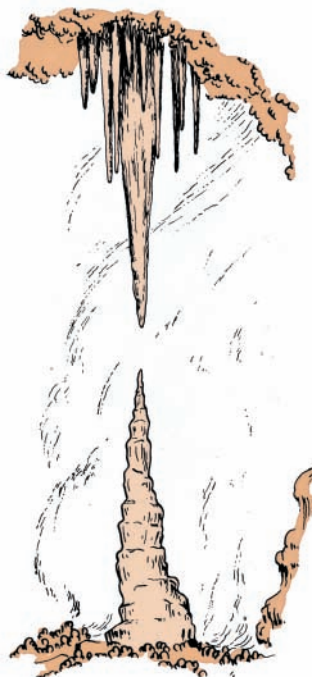
**splay** A small deltaic deposit formed on a floodplain where water and sediment are diverted from the main stream through a crevasse in a levee.

**spring** A place where groundwater flows or seeps naturally to the surface.

**stable platform** The part of a continent that is covered with flat lying or gently tilted sedimentary strata and underlain by a basement complex of igneous and metamorphic rocks. The stable platform has not been extensively affected by crustal deformation.

**stalactite** An icicle-shaped deposit of dripstone hanging from the roof of a cave.

**stalagmite** A conical deposit of dripstone built up from a cave floor.



Stalactite

Stalagmite

**star dune** A mound of sand with a high central point and arms radiating in various directions.

**stock** A small, roughly circular intrusive body, usually less than 100 km<sup>2</sup> in surface exposure.

**strata** (plural of stratum) Layers of rock, usually sedimentary.

**stratification** The layered structure of sedimentary rock.

**stratosphere** The portion of Earth's atmosphere between about 11 km to 50 km and in which temperature increases gradually to about 0° C and clouds rarely form.

**stratovolcano** A steep-sided volcano built up of ash, lava flows, and shallow intrusions. Synonymous with composite volcano.

**streak** The color of a powdered mineral.

**stream load** The total amount of sediment carried by a stream at a given time.

**stream order** The hierarchical number of a stream segment. The smallest tributary has the order number of 1, and successively larger tributaries have progressively higher numbers.

**stream piracy** Diversion of the headwaters of one stream into another stream. The process occurs by headward erosion of a stream having greater erosive power than the stream it captures.



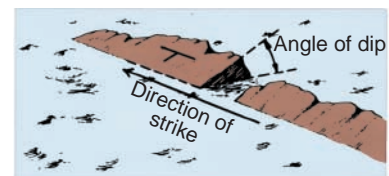
Stream piracy

**stream terrace** One of a series of level surfaces in a stream valley representing the dissected remnants of an abandoned floodplain, stream bed, or valley floor produced in a previous stage of erosion or deposition.

**stress** Force applied to a material that tends to change its dimensions or volume; force per unit area.

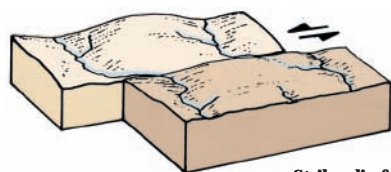
**striation** A scratch or groove produced on the surface of a rock by a geologic agent, such as a glacier or stream.

**strike** The bearing (compass direction) of a horizontal line on a bedding plane, a fault plane, or some other planar structural feature.



Strike

**strike-slip fault** A fault in which movement has occurred parallel to the strike of the fault.



Strike-slip fault

**strike valley** A valley that is eroded parallel to the strike of the underlying non-resistant strata.

**strip mining** A method of mining in which soil and rock cover are removed to obtain the sought-after material.

**subaerial** Occurring beneath the atmosphere or in the open air, with reference to conditions or processes (such as erosion) that occur on the land.

**subaqueous** Occurring beneath water, with reference to conditions or processes that occur on the floors of rivers, lakes, and oceans.

**subduction** Subsidence of the leading edge of a lithospheric plate into the mantle.

**subduction zone** An elongate zone in which one lithospheric plate descends beneath another. A subduction zone is typically marked by an oceanic trench, lines of volcanoes, and crustal deformation associated with mountain building. *See also* convergent plate boundary.

**sublimation** The conversion of a solid to a gas without melting. Example: carbon dioxide passes directly from dry ice to a vapor that is heavier than air.

**submarine canyon** A V-shaped trench or valley with steep sides cut into a continental shelf or continental slope.

**subsidence** A sinking or settling of a part of Earth's crust with respect to the surrounding parts.

**superposition, principle of** The principle that, in a series of sedimentary strata that has not been overturned, the oldest rocks are at the base and the youngest are at the top.

**surface wave** A seismic wave that travels along Earth's surface. Contrast with P waves and S waves, which travel through Earth and at higher velocities.

**suspended load** The part of a stream's load that is carried in suspension for a considerable period of time without con-

tact with the stream bed. It consists mainly of mud, silt, and sand. Contrast with bed load and dissolved load.

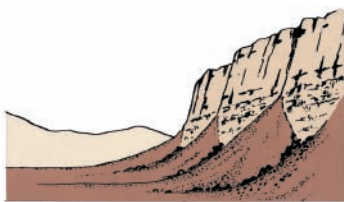
**suture** A belt of intensely deformed rocks that marks the site of continental collision.

**swash** The rush of water up onto a beach after a wave breaks.

**S wave** (secondary or shear seismic wave) A seismic wave in which particles vibrate at right angles to the direction in which the wave travels. Contrast with P wave.

**syncline** A fold in which the limbs dip toward the axis. After erosion, the youngest beds are exposed in the central core of the fold.

**talus** Rock fragments that accumulate in a pile at the base of a ridge or cliff.



Talus

**tectonic creep** Slow, apparently continuous movement along a fault (as opposed to the sudden rupture that occurs during an earthquake).

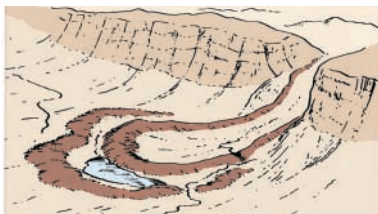
**tectonics** The branch of geology that deals with regional or global structures and deformational features of Earth.

**temperate climate** A moderate climate found at mid-latitudes on Earth, with adequate precipitation for plant growth and no extreme temperatures.

**tension** Stress that tends to pull materials apart.

**tephra** A general term for pyroclastic material ejected from a volcano. It includes ash, dust, bombs, and other types of fragments.

**terminal moraine** A ridge of material deposited by a glacier at the line of maximum advance of the glacier.



Terminal moraine

**terra** (pl. terrae) A densely cratered highland on the Moon.

**terrace** A nearly level surface bordering a steeper slope, such as a stream terrace or wave-cut terrace.



Terrace

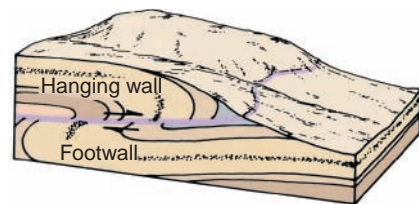
**texture** The size, shape, and arrangement of the particles that make up a rock.

**thermohaline circulation** The convection of the ocean caused by differences in temperature and salinity.

**thin section** A slice of rock mounted on a glass slide and ground to a thickness of about 0.03 mm, thin enough for light to pass through many kinds of minerals.

**threshold velocity** The velocity at which a grain of a certain size will be picked up by a flowing fluid such as water. The threshold velocity for large particles is higher than for small particles.

**thrust fault** A low-angle fault (45 degrees or less) in which the hanging wall has moved upward in relation to the footwall. Thrust faults are caused by horizontal compression.



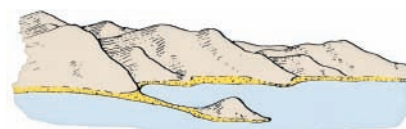
Thrust fault

**tidal flat** A large, nearly horizontal area of land covered with water at high tide and exposed to the air at low tide. Tidal flats consist of fine-grained sediment (mostly mud, silt, and sand).

**till** Unsorted and unstratified glacial deposit.

**tillite** A rock formed by lithification of glacial till (unsorted, unstratified glacial sediment).

**tombolo** A beach or bar connecting an island to the mainland.



Tombolo

**topography** The shape and form of Earth's surface as expressed in elevations above or below sea level.

**transform fault** A special type of strike-slip fault forming the boundary between two moving lithospheric plates, usually along an offset segment of the oceanic ridge.



Transform fault

**transpiration** The process by which water vapor is released into the atmosphere by plants.

**transverse dune** An asymmetrical dune ridge that forms at right angles to the direction of prevailing winds.

**travertine terrace** A terrace formed from calcium carbonate deposited by water on a cave floor.

**trellis drainage pattern** A drainage pattern in which tributaries are arranged in a pattern similar to that of a garden trellis.



Trellis drainage pattern

**trench** A narrow, elongate depression of the deep-ocean floor oriented parallel to the trend of a continent or an island arc.

**tropical climate** A climate that is frost-free with temperatures high enough to support year-round plant growth and abundant precipitation. This climate prevails near the equator.

**tributary** A stream flowing into or joining a larger stream.

**troposphere** The lowermost zone of the atmosphere, where most of the weather occurs.

**tsunami** A seismic sea wave; a long, low wave in the ocean caused by an earthquake, faulting, or a landslide on the sea floor. Its velocity can reach 800 km per hour. Tsunamis are commonly and incorrectly called tidal waves.

**tuff** A fine-grained rock composed of volcanic ash.

**turbidite** A sedimentary rock deposited by a turbidity current. Graded bedding is characteristic.

**turbidity current** A current in air, water, or any other fluid caused by differences in the amount of suspended matter (such as mud, silt, or volcanic dust). Marine turbidity currents, laden with suspended sediment, move rapidly down continental slopes and spread out over the abyssal floor.



Turbidity current

**turbulent flow** A type of flow in which the path of motion is very irregular, with eddies and swirls. Contrast with laminar flow.

**ultramafic rock** An igneous rock composed entirely of mafic minerals.

**unconformity** A discontinuity in the succession of rocks, containing a gap in the geologic record. A buried erosion surface. *See also* angular unconformity, nonconformity.

**uniformitarianism** The theory that geologic events are caused by natural processes, many of which are operating at the present time.

**unsaturated zone** The zone below the surface and above the water table, in which pore spaces are usually filled with air.

**upwarp** An arched or uplifted segment of the crust.

**U-shaped valley** A valley with a U-shaped profile caused by glacial erosion. Contrast with the V-shape of a typical stream valley.

**valley glacier** A glacier that is confined to a stream valley. Synonymous with alpine glacier and mountain glacier.

**varve** A pair of thin sedimentary layers, one relatively coarse-grained and light-colored, and the other relatively fine-grained and dark-colored, formed by deposition on a lake bottom during a period of one year. The coarse-grained layer is formed during spring runoff, and the fine-grained layer is formed during the winter when the surface of the lake is frozen.

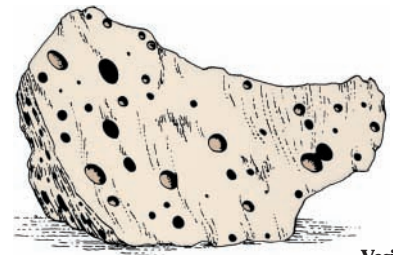
**ventifact** A pebble or cobble shaped and polished by wind abrasion.



Ventifact

**vein** A tabular rock body deposited in a fracture. Many ore minerals were deposited in veins when hot fluids flowed through fractures.

**vesicle** A small hole formed in a volcanic rock by a gas bubble that became trapped as the lava solidified.



Vesicle

**viscosity** The tendency within a body to resist flow. An increase in viscosity implies a decrease in fluidity, or ability to flow.

**volatile** 1 Capable of being readily vaporized. 2 A substance that can readily be vaporized, such as water or carbon dioxide.

**volcanic ash** Dust-sized particles ejected from a volcano.

**volcanic bomb** A hard fragment of lava that was liquid or plastic at the time of ejection and acquired its form and surface markings during flight through the air. Volcanic bombs range from a few millimeters to more than a meter in diameter.



Volcanic bomb



Varve



**volcanic neck** The solidified magma that originally filled the vent or neck of an ancient volcano and has subsequently been exposed by erosion.



**Volcanic neck**

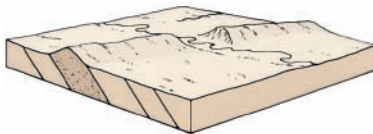
**volcanism** The processes by which magma and gases are transferred from Earth's interior to the surface.

**wash** A dry stream bed.



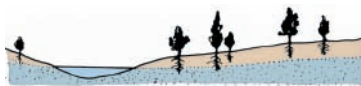
**Wash**

**water gap** A pass in a ridge through which a stream flows.



**Water gap**

**water table** The upper surface of the zone of saturation.



**Water table**

**wave base** The lower limit of wave transportation and erosion, equal to half the wavelength.

**wave-built terrace** A terrace built up from wave-washed sediments. Wave-built terraces usually lie seaward of a wave-cut terrace.

**wave crest** The highest part of a wave.

**wave-cut cliff** A cliff formed along a coast by the undercutting action of waves and currents.

**wave-cut platform** A terrace cut across bedrock by wave erosion. Synonymous with wave-cut terrace.

**wave-cut terrace** See wave-cut platform.

**wave height** The vertical distance between a wave crest and the preceding trough.

**wavelength** The horizontal distance between similar points on two successive waves, measured perpendicular to the crest.

**wave period** The interval of time required for a wave crest to travel a distance equal to one wavelength; the interval of time required for two successive wave crests to pass a fixed point.

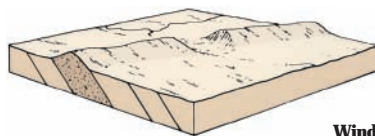
**wave refraction** The process by which a wave is bent or turned from its original direction. In sea waves, as a wave approaches a shore obliquely, part of it reaches the shallow water near the shore while the rest is still advancing in deeper water; the part of the wave in the shallower water moves more slowly than the part in the deeper water. In seismic waves, refraction results from the wave encountering material with a different density or composition.

**wave trough** The lowest part of a wave, between successive crests.

**weathering** The processes by which rocks are chemically altered or physically broken into fragments as a result of exposure to atmospheric agents and the pressures and temperatures at or near Earth's surface, with little or no transportation of the loosened or altered materials.

**welded tuff** A rock formed from particles of volcanic ash that were hot enough to become fused together.

**wind gap** A gap in a ridge through which a stream, now abandoned as a result of stream piracy, once flowed.



**Wind gap**

**wind shadow** The area behind an obstacle where air movement is not capable of moving material.

**X-ray diffraction** In mineralogy, the process of identifying mineral structures by exposing crystals to a beam of X rays and studying the resulting diffraction patterns.

**yardang** An elongate ridge carved by wind erosion. The ridges are parallel to

the prevailing winds in arid regions with soft sediment at the surface.

**yazoo stream** A tributary stream that flows parallel to the main stream for a considerable distance before joining it. Such a tributary is forced to flow along the base of a natural levee formed by the main stream.

**zeolite facies** A metamorphic facies formed at relatively low temperature and pressure where zeolite minerals are stable.