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## Glossary

For each entry, a link to the chapter in which the word first appears is provided.

### A

**aa** ([Chapter 4](#)) a lava flow that solidifies with a blocky high-relief surface

**ablation** ([Chapter 16](#)) melting of ice in the context of glaciation

**ablation till** ([Chapter 16](#)) till that is formed when englacial and supraglacial sediments are deposited because the ice that was supporting them melts

**abyssal plain** ([Chapter 18](#)) the flat surface of the deep ocean, typically beyond the limits of the continental slopes

**abyssalpelagic zone** ([Chapter 18](#)) the deeper parts of the ocean, between 4000 and 6000 metres.

**accretion (plate tectonics)** ([Chapter 21](#)) the process by which continental blocks (terranes) are added to existing continental areas

**accretion (planetary)** ([Chapter 22](#)) the process by which solid celestial bodies are added to existing bodies during collisions

**acid rock drainage** ([Chapter 5](#)) the production of acid from oxidation of sulphide minerals (especially pyrite) in either naturally or anthropogenically exposed rock

**aeolian** ([Chapter 6](#)) processes related to transportation and deposition of sediments by wind

**aerobic** ([Chapter 18](#)) processes that take place in the presence of abundant oxygen

**aerosol** ([Chapter 4](#)) an aggregate of fine solid particles or a small droplet of liquid suspended in the air

**aftershock** ([Chapter 11](#)) an earthquake that can be shown to have been caused by another earthquake

**aggregate** ([Chapter 20](#)) unconsolidated materials (typically sediments) that are used in the construction industry

**albedo** ([Chapter 19](#)) the reflectivity of a surface of a planet (expressed as the percentage of light that reflects)

**albite** ([Chapter 2](#)) sodium-rich plagioclase feldspar

**alpine glacier** ([Chapter 16](#)) a glacier formed in a mountainous region and confined to a valley (same as valley glacier)

- amphibole** ([Chapter 2](#)) a double-chain ferromagnesian silicate mineral (e.g., hornblende)
- amphibolite** ([Chapter 7](#)) a foliated metamorphic rock in which the mineral amphibole is an important component
- amplification** ([Chapter 11](#)) in the context of seismic shaking the process by which the amplitude of the seismic waves are enhanced, especially because the
- amplitude** ([Chapter 17](#)) for any type of wave, the difference in height between a crest and the adjacent trough
- anaerobic** ([Chapter 18](#)) processes that take place without oxygen
- andesite** ([Chapter 3](#)) a volcanic rock of intermediate composition
- anion** ([Chapter 2](#)) a negatively charged ion
- angular unconformity** ([Chapter 8](#)) a geological boundary at the base of a sedimentary layer where the sedimentary rock beneath has been tilted or folded and then eroded
- anorthite** ([Chapter 2](#)) calcium-rich plagioclase feldspar
- Antarctic Bottom Water** ([Chapter 18](#)) water at abyssal depths in the ocean that forms from the sinking of dense cold water adjacent to Antarctica
- anticline** ([Chapter 12](#)) an upward fold where the beds are known not to be overturned
- anthracite** ([Chapter 20](#)) a high grade of coal (92 to 98% carbon) that is formed from deep burial and weak metamorphism
- anthropogenic** ([Chapter 19](#)) resulting from the influence of humans
- antiform** ([Chapter 12](#)) an upward fold where it is not known if the beds have been overturned
- aphanitic** ([Chapter 3](#)) an igneous texture characterized by crystals that are too small to see with the naked eye
- aquifer** ([Chapter 14](#)) a body of rock or sediment that has sufficient permeability to allow it to be used as a source of groundwater
- aquitard** ([Chapter 14](#)) a body of rock or sediment that has insufficient permeability to allow it to be used as a source of groundwater
- arch** ([Chapter 17](#)) a rock weathering remnant in the form of an arch (typically along a coast and resulting from wave erosion)
- arenite** ([Chapter 6](#)) a sandstone with less than 15% silt and clay
- arete** ([Chapter 16](#)) a sharp ridge that separates adjacent glacially carved valleys

**arkose** ([Chapter 6](#)) a sandstone with more than 10% feldspar and more feldspar than lithic fragments

**arkosic arenite** ([Chapter 6](#)) an arkose with less than 15% clay/silt matrix

**artesian well** ([Chapter 14](#)) a well that is completed in a confined aquifer and in which the water level in the well rises above the top of the aquifer

**asteroid** ([Chapter 22](#)) a rocky body orbiting the Sun

**asteroid belt** ([Chapter 22](#)) the region between the orbits of Mars and Jupiter that is populated with many asteroids

**asthenosphere** ([Chapter 1](#)) the part of the mantle, from about 100 to 200 kilometres below surface, within which the mantle material is close to its melting point, and therefore relatively weak

**asymmetrical** ([Chapter 12](#)) in the context of folds, where the two sides of the fold make significantly different angles with respect to the axial plane

**atoll** ([Chapter 18](#)) a ring-shaped carbonate (or coral) reef or series of islands

**atomic mass** ([Chapter 2](#)) the total number of neutrons plus protons in an atom

**atomic number** ([Chapter 2](#)) the total number of protons in an atom

**attitude** ([Chapter 12](#)) the orientation of a sloping geological feature, such as a bedding plane or fracture

**aureole** ([Chapter 7](#)) a zone of metamorphism around a source of heat such as a magma body

**axial plane** ([Chapter 12](#)) a plane that can be traced through all of the hinge lines of a fold

## B

**back reef** ([Chapter 6](#)) the zone of shallow water on the shore-side of a reef

**background** (geochemistry) ([Chapter 20](#)) the typical level of an element in average rocks or sediments

**backwash** ([Chapter 17](#)) the wash of wave water down the slope of a beach

**banded iron formation** ([Chapter 6](#)) an iron-bearing sedimentary rock that is rich in minerals such as hematite and magnetite, which may be interbedded with chert

**bank-full stage** ([Chapter 13](#)) the water level of stream when it is in flood and just about to flow over its banks

**barrier reef** ([Chapter 18](#)) a carbonate (or coral) reef that forms a barrier to waves along a coast

**basal sliding** ([Chapter 16](#)) the motion of glacial ice along the base of a glacier that is warm enough to have liquid water

**basalt** ([Chapter 1](#)) a volcanic rock of mafic composition

**base level** ([Chapter 13](#)) in the context of a stream the base level is the lowest level that it can erode down to, as defined by the ocean, a lake or another stream that it flows into

**batholith** ([Chapter 3](#)) an irregular body of intrusive igneous rock that has an exposed surface of at least 100 km<sup>2</sup>

**bathypelagic zone** ([Chapter 18](#)) the moderately deep parts of the ocean, between 1000 and 4000 metres.

**baymouth bar** ([Chapter 17](#)) a spit that extends across the mouth of a bay

**beach face** ([Chapter 17](#)) the part of the beach that is relatively steep and lies between the high and low tide levels

**bed** ([Chapter 6](#)) a sedimentary layer

**bed load** ([Chapter 6](#)) the fraction of a stream's sediment load that typically rests on the bottom and is moved by saltation and traction

**bedding** ([Chapter 6](#)) repeated layering in a sedimentary rock

**bentonite** ([Chapter 15](#)) a type of smectite clay that has strong swelling properties and is effective at absorbing dissolved ions

**berm** ([Chapter 17](#)) a flat area of a beach in the backshore area (above the high tide level)

**big-bang theory** ([Chapter 22](#)) the theory that the universe started with a giant explosion approximately 13.77 billion years ago

**biotite** ([Chapter 2](#)) a sheet silicate mineral (mica) that includes iron and or magnesium, and is therefore a ferromagnesian silicate

**biozone** ([Chapter 8](#)) a stratigraphic interval that can be defined on the basis of a specific fossil

**bituminous** ([Chapter 20](#)) a medium-grade type of coal with 70 to 92% carbon

**blueschist** ([Chapter 7](#)) a metamorphic facies characterized by relatively low temperatures and high pressures, such as can exist within a subduction zone

**body wave** ([Chapter 9](#)) a seismic wave that travels through rock (e.g., a P-wave or an S-wave)

**boulder** ([Chapter 6](#)) a sediment clast with a diameter of at least 256 millimetres

**Bowen reaction series** ([Chapter 3](#)) the scheme that defines the typical order of crystallization of minerals from magma

**braided** ([Chapter 13](#)) a stream pattern which is characterized by abundant sediment and numerous intertwining channels around bars

**breakwater** ([Chapter 17](#)) a structure built offshore in order to deflect the energy of waves

**breccia** ([Chapter 6](#)) a sedimentary- or volcanic-rock texture characterized by angular clasts

**brunisol** ([Chapter 5](#)) a relatively immature forest soil, lacking in well-defined horizons

## C

**caldera** ([Chapter 4](#)) a volcanic depression that is many times larger than the volcanic vents within it

**caliche** ([Chapter 5](#)) a white calcium-carbonate rich layer within soils in arid regions

**calving** ([Chapter 16](#)) the loss of ice from the front of a glacier by collapse into water

**Canadian Shield** ([Chapter 21](#)) the exposed part of the continent Laurentia

**carbonate** ([Chapter 2](#)) a mineral in which the anion is  $\text{CO}_3^{2-}$

**carbonate compensation depth** ([Chapter 18](#)) the depth in the ocean (typically around 4000 metres) below which carbonate minerals are soluble

**cation** ([Chapter 2](#)) a positively charged ion

**cementation** ([Chapter 6](#)) the process by which minerals are precipitated between grains in sediments

**Cenozoic** ([Chapter 1](#)) the most recent of the eras, representing the past 65.5 Ma of geological time

**chemical sedimentary rock** ([Chapter 6](#)) a sedimentary rock comprised of material that was transported as ions in solution

**chernozem** ([Chapter 5](#)) a black soil typical of grasslands in cold climates such as the Canadian Prairies

**chert** ([Chapter 6](#)) a very fine grained sedimentary rock formed almost entirely of silica

**chlorite** ([Chapter 2](#)) a ferromagnesian sheet silicate mineral, typically present as fine crystals and forming from the low-temperature metamorphism of mafic rock

**cinder cone** ([Chapter 4](#)) a steep-sided volcano comprised almost entirely of loose rock fragments and typically formed during a single eruptive event

**cirque** ([Chapter 16](#)) a steep-sided semi-circular basin eroded by a glacier at the head of its valley

**clast** ([Chapter 6](#)) a sedimentary fragment of mineral or rock

**clastic sedimentary rock** ([Chapter 6](#)) a sedimentary rock comprised of material that was transported as clasts or fragments

**clay** ([Chapter 6](#)) sediment particle that is less than 1/256 millimetres in diameter

**clay mineral** ([Chapter 6](#)) a hydrous sheet silicate mineral that typically exists as clay-sized grains

**claystone** ([Chapter 6](#)) a sedimentary rock comprised mostly of clay-sized grains

**cleavage** ([Chapter 2](#)) the tendency for a mineral to break along smooth planes that are predetermined by its lattice structure

**climate feedback** ([Chapter 19](#)) a process by which the physical effects of a climate forcing can have other effects (either negative or positive) on the climate

**climate forcing** ([Chapter 19](#)) a mechanism, such as a change in greenhouse gas levels, that forces the climate to change

**coal-bed methane** ([Chapter 20](#)) methane that is trapped within the porosity of coal

**coastal straightening** ([Chapter 17](#)) the tendency for an irregular coast to be straightened over time by coastal erosion processes

**cobble** ([Chapter 6](#)) sediment particle that is between 64 and 256 millimetres in diameter

**col** ([Chapter 16](#)) the low point or pass along a ridge between two glacial valleys

**columnar jointing** ([Chapter 4](#)) the fracturing of rock or sediment (but typically volcanic rock) into columns that are typically six-sided

**composite volcano (or stratovolcano)** ([Chapter 4](#)) a volcano that is constructed of alternating layers of pyroclastic debris and lava flows

**concentrate** (mining) ([Chapter 20](#)) a product of ore processing that includes a specific ore mineral, separated from the rest of the rock

**concordant** ([Chapter 3](#)) parallel to pre-existing layering or foliation within a rock

**cone of depression** ([Chapter 14](#)) the depression of the water table around a well that is heavily pumped

**confined aquifer** ([Chapter 14](#)) an aquifer that lies below a confining layer

**confining layer** ([Chapter 14](#)) an aquitard that overlies an aquifer and restricts the flow of water down from the surface

**conglomerate** ([Chapter 6](#)) a sedimentary rock that is comprised predominantly of rounded grains that are larger than 2 mm

**contact metamorphism** ([Chapter 7](#)) metamorphism that takes place adjacent to a source of heat, such as a body of magma

**continental drift** ([Chapter 10](#)) the concept that tectonic plates can move across the surface of the Earth

**continental glacier** ([Chapter 16](#)) a glacier that covers a significant part of a continent and has an area of at least 50,000 km<sup>2</sup>

**continental shelf** ([Chapter 18](#)) the shallow (typically less than 200 metres) and flat sub-marine extension of a continent

**continental slope** ([Chapter 18](#)) the steeper part of a continental margin, that slopes down from a continental shelf towards the abyssal plain

**contractionism** ([Chapter 10](#)) the now discredited theory that mountain ranges formed as a result of the contraction of the Earth

**convergent boundary** ([Chapter 10](#)) a plate boundary at which the two plates are moving towards each other

**Cordilleran Ice Sheet** ([Chapter 16](#)) the continental glacier that covered part of western North America, including almost all of British Columbia, part of the Yukon, and part of northern Washington, during the Pleistocene glaciations

**core** ([Chapter 1](#)) the metallic interior part of the Earth, extending from a depth of 2900 kilometres to the centre

**core-mantle boundary** ([Chapter 9](#)) the boundary, at a 2900 kilometre depth, between the mantle and the core

**Coriolis effect** ([Chapter 18](#)) the tendency for moving bodies (e.g., ocean currents) to rotate on the surface of the Earth, clockwise in the northern hemisphere and counter-clockwise in the southern hemisphere

**cosmic microwave background** ([Chapter 22](#)) radiation left over from the an early stage in the development of the universe at the time when protons and neutrons were recombining to form atoms

**country rock** ([Chapter 3](#)) the original rock of a region, into which younger rock (typically igneous) rock has been intruded

**covalent bond** ([Chapter 2](#)) a bond between two atoms in which electrons are shared

**crater** ([Chapter 4](#)) a volcanic depression that is related to a specific volcanic vent

**craton** ([Chapter 21](#)) a region of ancient (typically Precambrian) crystalline rock (equivalent to a shield)

**creep** ([Chapter 15](#)) the very slow (a millimetre to centimetre per year) flow of unconsolidated material on a gentle slope

**crest** ([Chapter 17](#)) the highest point on a wave

**crevasse** ([Chapter 16](#)) an open fissure on the surface of a glacier

**cross bedding** ([Chapter 6](#)) small-scale inclined bedding within larger horizontal beds

**crust** ([Chapter 1](#)) the uppermost layer of the Earth, ranging in thickness from about 5 kilometres (in the oceans) to over 50 kilometres (on the continents)

**cyanobacteria** ([Chapter 6](#)) photosynthetic bacteria that evolved in the early Archean

D

**“D” layer** ([Chapter 9](#)) (d-double-prime layer) a low seismic velocity zone within the basal 200 km of the mantle

**debris flow** ([Chapter 15](#)) a gravity-driven flow of water and sediment that includes a significant proportion of coarse (cobble to boulder) material

**decline** ([Chapter 20](#)) in mining a decline is a sloped tunnel used to access lower parts of a mine with wheeled equipment

**decompression melting** ([Chapter 3](#)) melting (or partial melting) of rock resulting from a reduction in pressure without a significant reduction in temperature

**dendritic** ([Chapter 13](#)) a pattern of drainage channels that resembles the branches in a tree

**density** ([Chapter 2](#)) weight per volume of a substance (e.g., g/cm<sup>3</sup>) used widely in the context of minerals or rocks

**deranged** ([Chapter 13](#)) a pattern of drainage channels that is chaotic

**detrital** ([Chapter 6](#)) referring to fragments of rocks or minerals

**diatom** ([Chapter 18](#)) photosynthetic algae that make their tests (shells) from silica

**differentiation** ([Chapter 22](#)) the un-mixing of a magma, typically by the physical separation of minerals that crystallize early and settle towards the bottom

**diorite** ([Chapter 3](#)) an intermediate intrusive igneous rock

**dip** ([Chapter 12](#)) the angle below horizontal at which a sedimentary bed or other feature slopes

**discharge** ([Chapter 6](#)) the volume of water flow in a stream expressed in terms of volume per unit time (e.g., m<sup>3</sup>/s)

**discharge area** ([Chapter 14](#)) the part of an aquifer where groundwater discharge takes place

**disconformity** ([Chapter 8](#)) a boundary between parallel sedimentary layers where some erosion of the lower layer has taken place

**discordant** ([Chapter 3](#)) a geological feature that is not parallel to any existing layering in the country rock

**divalent** ([Chapter 2](#)) an ion with a charge of +2 or -2

**divergent** ([Chapter 10](#)) a plate boundary at which the two plates are moving towards away from each other



**dodecahedron** ([Chapter 2](#)) an object with twelve surfaces, such as a garnet crystal

**dolomite** ([Chapter 6](#)) a calcium-magnesium carbonate mineral  $(\text{Ca,Mg})\text{CO}_3$

**dolomitization** ([Chapter 6](#)) the addition of magnesium to limestone during which some or all of the calcium carbonate is converted to dolomite

**dolostone** ([Chapter 6](#)) a carbonate rock made up primarily of the mineral dolomite

**drainage basin** ([Chapter 13](#)) the catchment area of a stream, including the area where all surface water drains into the stream

**drop stone** ([Chapter 16](#)) a fragment of rock within otherwise fine-grained sediment that has been dropped from floating ice on a body of water

**drumlin** ([Chapter 16](#)) a streamlined glacial erosional feature comprised of sediments and/or bedrock

**dyke** ([Chapter 3](#)) a tabular intrusive igneous body that is discordant to any existing layering in the country rock

## E

**eccentricity** ([Chapter 19](#)) in the context of Milankovitch Cycles, the degree to which the Sun is offset from the geometric centre of the Earth's orbit

**eclogite** ([Chapter 7](#)) a garnet-pyroxene-glaucophane bearing rock that is the product of high-pressure metamorphism of oceanic crustal rock, typically within a subduction zone

**effusive** ([Chapter 4](#)) a volcanic eruption dominated by the relatively gentle flow of lava

**El Niño** ([Chapter 19](#)) a periodic climatic situation in which warm water extends all or most of the way to the eastern edge of the equatorial Pacific

**elastic deformation** ([Chapter 11](#)) the deformation of material (including rock) from which it can fully recover if the stress is removed

**electron** ([Chapter 2](#)) a sub-atomic particle of essentially no mass and a single negative charge

**end moraine** ([Chapter 16](#)) a deposit of sediment that accumulates at the front of a glacier

**englacial** ([Chapter 16](#)) within a glacier, referring especially to sediment carried within the glacial ice

**epicentre** ([Chapter 11](#)) the location on the surface vertically above the location (i.e., "hypocentre" or "focus") where an earthquake takes place

**epipelagic zone** ([Chapter 18](#)) the upper layer of water (0 to 200 metres) in areas of the open ocean

**epithermal deposit** ([Chapter 20](#)) a mineral deposit formed near to surface in an area of hydrothermal activity, typically associated with a body of magma

**equilibrium line** ([Chapter 16](#)) on a glacier, the line between the zone of accumulation and the zone of ablation (in late summer the equilibrium line is the boundary between snow-covered ice and bare ice)

**equipotential lines** ([Chapter 14](#)) in the context of groundwater an equipotential line connects locations with equal hydraulic head or water pressure

**esker** ([Chapter 16](#)) a ridge of sediment deposited by a sub-glacial stream

**eustatic sea level change** ([Chapter 17](#)) sea level change related to a change in the volume of the oceans, typically because of an increase or decrease in the amount of glacial ice on land

**exfoliation** ([Chapter 5](#)) the fracturing of rock that results from a reduction in the pressure when overlying rock is eroded away

**exoplanet** ([Chapter 22](#)) a planet that orbits a star other than the Sun

**extrusive** ([Chapter 3](#)) igneous rock that cooled at surface

F

**fall** ([Chapter 15](#)) in mass wasting, the vertical or near-vertical fall of rock

**fault** ([Chapter 12](#)) a boundary in rock or sediment along which displacement has taken place

**feedback** ([Chapter 19](#)) a process by which the physical effects of a climate forcing can have other effects (either negative or positive) on the climate

**feldspar** ([Chapter 2](#)) a very common framework silicate mineral

**felsic** ([Chapter 3](#)) silica rich (>65% SiO<sub>2</sub>) in the context of magma or igneous rock

**ferric** ([Chapter 2](#)) the oxidized form of an ion of iron (Fe<sup>3+</sup>)

**ferromagnesian** ([Chapter 2](#)) referring to a silicate mineral that contains iron and or magnesium

**ferrous** ([Chapter 2](#)) the reduced (non-oxidized) form of an ion of iron (Fe<sup>2+</sup>)

**fetch** ([Chapter 17](#)) the distance over which wind blows to form waves

**finger lake** ([Chapter 16](#)) a lake that occupies a glacial valley

**firn** ([Chapter 16](#)) the granular transitional state between snow and ice within a glacier

**flood plain** ([Chapter 13](#)) the area that is occupied by water when a stream floods and overtops its banks

**flow** ([Chapter 15](#)) the fluid-like motion of material during mass-wasting

**flow path** ([Chapter 14](#)) the path that groundwater flows along between a recharge area and a discharge area

**flowing artesian well** ([Chapter 14](#)) an artesian well in which the water level naturally rises above the surface of the ground

**flux melting** ([Chapter 3](#)) melting of rock that is facilitated by the addition of a flux (typically water) which lowers the rocks melting point

**focus** (earthquake) ([Chapter 11](#)) the actual point below surface at which an earthquake takes place (equivalent to hypocentre)

**foliated** ([Chapter 7](#)) the existence of foliation in a metamorphic rock

**foliation** ([Chapter 7](#)) the alignment of mineralogical or structural features of a rock – especially a metamorphic rock

**footwall** ([Chapter 12](#)) the lower surface of a non-vertical fault

**foraminifera** ([Chapter 18](#)) a single-celled protist with a shell that is typically made of  $\text{CaCO}_3$

**fore-reef** ([Chapter 6](#)) the zone on the ocean side of a reef

**formation** ([Chapter 6](#)) a unit of sedimentary rock that is lithologically consistent and sufficiently thick and extensive to be shown on a geological map at the scale that is typically used in the area in question

**fracking** ([Chapter 20](#)) fracturing rock by injecting water and chemicals down a well at very high pressure (equivalent to hydraulic fracturing)

**fractional crystallization** ([Chapter 3](#)) the sequential crystallization of minerals from magma, and the physical separation of early-forming crystals from the magma in the area where they crystallized

**fracture** ([Chapter 2](#)) a break within a body of rock in which the rock on either side is not displaced

**fringing reef** ([Chapter 18](#)) a reef adjacent to a shoreline where there is either a very narrow back reef area or none at all (in which case the reef is effectively attached to the shore)

**frost line** ([Chapter 22](#)) in the context of planetary systems the boundary beyond which volatile components (e.g., water, carbon dioxide, methane, ammonia etc.) are frozen

**frost wedging** ([Chapter 5](#)) the situation where the expansion of freezing water pries rock apart

## G

**Ga** ([Chapter 1](#)) (giga annum) billions of years before the present

**gabbro** ([Chapter 3](#)) a mafic intrusive igneous rock

**Gaia hypothesis** ([Chapter 19](#)) the hypothesis advanced by James Lovelock that the organisms have affected the atmosphere and oceans such that conditions on Earth have been kept habitable, in spite of significantly changing energy received from the Sun

**galaxy** ([Chapter 22](#)) a gravitationally-bound system of stars and interstellar matter

**gas giant** ([Chapter 22](#)) a large planet composed mostly of hydrogen and helium (e.g. Jupiter)

**geosyncline** ([Chapter 10](#)) a kilometre thick deposit of sediments that has accumulated along the edge of a continent and is sufficient mass to depress the crust beneath it

**geothermal gradient** ([Chapter 1](#)) the rate of increase of temperature with depth in the Earth (typically around 30° C/km within the crust)

**giant impact hypothesis** ([Chapter 22](#)) the theory that the Moon formed when a Mars-sized planet (Theia) collided with the Earth at 4.5 Ga

**glacial period** ([Chapter 16](#)) a period of Earth's history during which glacial ice was present over a sufficient extent to have left recognizable evidence

**glacial groove** ([Chapter 16](#)) a straight line created on a rock surface by erosion by a rock fragment embedded in the base of glacial ice (larger and deeper than a glacial striation)

**glacial striation** ([Chapter 16](#)) a straight line created on a rock surface by erosion by a rock fragment embedded in the base of glacial ice (finer than a glacial groove – typically less than 1 centimetre wide)

**glacier** ([Chapter 16](#)) a long lasting (centuries or more) body of ice on land that moves under its own weight

**glaciofluvial** ([Chapter 16](#)) referring to sediments deposited from a stream that is derived from a glacier

**glaciolacustrine** ([Chapter 16](#)) referring to sediments deposited within a lake in a glacial environment

**glaciomarine** ([Chapter 16](#)) referring to sediments deposited within the ocean in a glacial environment

**glaucophane** ([Chapter 7](#)) a blue-coloured sodium-magnesium bearing amphibole mineral that forms during metamorphism at high pressures and relatively low pressures, typically within a subduction zone

**gneiss** ([Chapter 7](#)) high-grade metamorphic rock in which the mineral components are separated into bands

**graben** ([Chapter 12](#)) a down-dropped fault block, bounded on either side by normal faults

**grade** ([Chapter 7](#)) in the context of a mineral deposit, the amount of a specific metal or mineral expressed as a proportion of the whole rock

**graded bedding** ([Chapter 6](#)) an individual sedimentary layer that shows a distinctive gradation in grain size (normal graded bedding is finer towards the top, reverse graded bedding is coarser towards the top)

**gradient** ([Chapter 13](#)) the slope of a stream bed over a specific distance, typically expressed in m per km

**granite** ([Chapter 1](#)) a felsic intrusive igneous rock

**granule** ([Chapter 6](#)) a sedimentary particle ranging in size from 2 to 4 millimetres in diameter

**greenhouse gas** ([Chapter 22](#)) a gaseous molecule with 3 or more atoms that is able to absorb infrared radiation

**greenhouse effect** ([Chapter 22](#)) in the context of climate, the ability of an atmosphere to absorb infrared radiation due to the presence of greenhouse gases

**greenschist** ([Chapter 7](#)) a foliated metamorphosed rock (typically derived from basalt) in which the green colouration is derived from either chlorite, epidote or green amphibole

**greenstone** ([Chapter 7](#)) a non-foliated metamorphosed rock (typically derived from basalt) in which the green colouration is derived from either chlorite, epidote or green amphibole

**greywacke** ([Chapter 6](#)) a sandstone with more than 15% silt and clay, and with a significant proportion of sand-sized rock fragments

**groundwater** ([Chapter 13](#)) water that lies beneath the surface of the ground

**group** ([Chapter 6](#)) a stratigraphically-continuous series of related formations

**groyne** ([Chapter 17](#)) a man-made structure extending from the shore built to deflect the energy of waves

**gyre** ([Chapter 18](#)) a closed circular ocean current

H

**habit** ([Chapter 2](#)) a characteristic crustal form or combination of forms of a mineral

**habitable zone** ([Chapter 22](#)) the region around a star that is considered to be suitable for a life-bearing planet

**Hadean** ([Chapter 1](#)) the first eon of Earth history, extending from 4.57 to 3.80 Ga

**halide** ([Chapter 2](#)) a mineral in which the anion is one of the halide elements (e.g., halite – NaCl or fluorite – CaF<sub>2</sub>)

**halite** ([Chapter 1](#)) NaCl, a halide mineral also known as table salt

**halogen** ([Chapter 2](#)) an element in the second-last column of the periodic table that forms anions with a negative-1 charge

**hanging valley** ([Chapter 16](#)) a glacial valley created by a tributary glacier which does not erode as deeply as the main-valley glacier that it joins

**hanging wall** ([Chapter 12](#)) the upper surface of a non-vertical fault

**headland** ([Chapter 17](#)) a point extending out to sea

**horn** ([Chapter 16](#)) a peak that has been eroded on at least three sides by glaciers

**hornfels** ([Chapter 7](#)) a fine-grained metamorphic rock that is not foliated

**horst** ([Chapter 12](#)) an uplifted fault block, bounded on either side by normal faults

**hot spot** ([Chapter 10](#)) the surface area of volcanism and high heat flow above a mantle plume

**hydrated mineral** ([Chapter 7](#)) a mineral that includes either hydroxyl (OH) or water (H<sub>2</sub>O) in its chemical formula (e.g., gypsum CaSO<sub>4</sub>·2H<sub>2</sub>O)

**hydraulic conductivity** ([Chapter 14](#)) an expression of the rate at which a liquid will flow through a porous medium, as determined by the permeability of the medium and the viscosity of the liquid

**hydraulic fracturing** ([Chapter 20](#)) fracturing rock by injecting water and chemicals down a well at very high pressure (equivalent to fracking)

**hydrolysis** ([Chapter 5](#)) a reaction between a mineral and water in which H<sup>+</sup> ions are added to the mineral and a chemically equivalent amount of cations are released into solution

**hydroxide** ([Chapter 2](#)) the anion OH<sup>-</sup> or an mineral that includes that anion

**hydrothermal alteration** ([Chapter 7](#)) chemical alteration of minerals by hot water solutions

**hypocentre** ([Chapter 11](#)) the actual point below surface at which an earthquake takes place (equivalent to focus)

I

**ice giant** ([Chapter 22](#)) a planet that is comprised mainly of gases heavier than hydrogen and helium, including oxygen, carbon, nitrogen, and sulfur (e.g., Uranus and Neptune)

**igneous** ([Chapter 3](#)) a rock formed from the cooling of magma

**illite** ([Chapter 2](#)) a clay mineral with a composition similar to that of muscovite mica

**imbricate** ([Chapter 6](#)) aligned and overlapping, like the tiles on a roof

**index fossil** ([Chapter 8](#)) a fossil with a distinctive appearance and a wide geographic range but from a relatively restricted time range, thus making it useful for dating a correlating rocks from different regions (the most useful index fossils are from organisms that lived for less than a million years)

**inert** ([Chapter 2](#)) in chemistry, an element that does not readily react with other elements (e.g., neon)

**infiltration** ([Chapter 14](#)) the recharge of groundwater from the downward percolation of surface water

**insolation** ([Chapter 19](#)) a measure of the intensity of solar energy at a specific location or time (expressed in W/m<sup>2</sup>)

**intensity** ([Chapter 11](#)) in seismology, a qualitative measure of the amount of shaking at specific location, based on what was felt by observers, or the amount of damage done

**Intergovernmental Panel on Climate Change** ([Chapter 19](#)) (IPCC) an international body established in 1988 by the UN's World Meteorological Organization and the UN Environment Program to prepare periodic reports on the status of global climate change and its mitigation

**intrusive** ([Chapter 3](#)) an igneous rock that has cooled slowly beneath the surface

**ionic bond** ([Chapter 2](#)) a bond in which electrons are transferred from one atom to another, thus forming ions

**ion** ([Chapter 2](#)) an atom that has either gained or lost electrons and has thus become charged (or a group of atoms that also has a charge – e.g.,  $\text{HCO}^{3-}$ )

**isoclinal fold** ([Chapter 12](#)) a tight fold in which the limbs are parallel to each other

**isostasy** ([Chapter 9](#)) the equilibrium between a block of crust floating on the underlying plastic mantle

**isostatic sea level change** ([Chapter 17](#)) the effect on relative sea level of a vertical adjustment of the crust resulting from a change in the mass of the crust (e.g., from losing or gaining ice)

**isotope** ([Chapter 8](#)) an form of an element that differs from other forms because it has a different number of neutrons (e.g.,  $^{16}\text{O}$  has 8 protons and 8 neutrons while  $^{18}\text{O}$  has 8 protons and 10 neutrons)

## J

**joint** ([Chapter 12](#)) a fracture in rock

**Jovian planet** ([Chapter 22](#)) a gas giant

## K

**ka** ([Chapter 1](#)) (kilo annum) thousands of years before the present

**kaolinite** ([Chapter 2](#)) a clay mineral that does not have cations other than Al and Si

**karst** ([Chapter 14](#)) the solutional erosion of an area with soluble rock (typically limestone) to form depressions and caves

**kettle** ([Chapter 16](#)) a depression formed at the front of a large glacier when a stranded ice block that was surrounded by sediment eventually melts

**kettle lake** ([Chapter 16](#)) a lake that forms within a kettle

**kimberlite** ([Chapter 4](#)) an ultramafic volcanic rock that originates at significant depth (> 200 metres) in the mantle (some kimberlites include diamonds)

**Kuiper belt** ([Chapter 22](#)) a region of the Solar System beyond the orbit of Neptune that is populated by small objects and dwarf planets (including Pluto)

L

**laccolith** ([Chapter 3](#)) concordant intrusion in which the central part has formed an upward dome

**lahar** ([Chapter 4](#)) a mudflow or debris flow that is either caused by a volcanic eruption, or forms on the flank of a volcano as a result of flooding not related to an eruption

**landfill gas** ([Chapter 14](#)) gases produced within a landfill during the microbial breakdown of landfill components (most are dominated by carbon dioxide and methane)

**large igneous province** ([Chapter 4](#)) a very large area of mafic volcanic rock produced by a massive eruption typically related to a mantle plume

**lateral moraine** ([Chapter 16](#)) a deposit of rocky material that forms along the margin of a valley or alpine glacier, mostly from the freeze-thaw release of material from the steep slopes above

**lattice** ([Chapter 1](#)) the regular and repeating three-dimensional structure of a mineral

**Laurentide Ice Sheet** ([Chapter 16](#)) the continental glacier that extended across central eastern North America during the Pleistocene, covering most of Canada and a significant part of the United States

**lava levée** ([Chapter 4](#)) a ridge that forms along the edge of a lava flow because the magma at the edge cools faster than that in the middle

**lava tube** ([Chapter 4](#)) a tube that forms as mafic lava flows along a channel and lava leveés build up on either side, eventually forming a roof (once a lava tube forms it insulates the flowing magma, allowing it to stay hot a liquid for longer and therefore flow much further)

**leachate** ([Chapter 14](#)) in the context of landfills, the liquid (rainwater) that passes through the waste and becomes contaminated with soluble components from the waste

**levée** ([Chapter 13](#)) on a stream, the ridge that naturally forms along the edge of the channel during flood events

**level** ([Chapter 20](#)) in mining, a horizontal mine opening

**light year** ([Chapter 22](#)) the distance that light can travel in one year ( $9.4607 \times 10^{12}$  km)

**lignite** ([Chapter 20](#)) a low-grade type of coal with less than 70% carbon

**limbs** ([Chapter 12](#)) the layers of rock on either side of a fold

**limestone** ([Chapter 6](#)) a sedimentary rock that is comprised mostly of calcite

**liquefaction** ([Chapter 11](#)) the tendency for unconsolidated and water saturated sediments to lose strength during seismic shaking



**lithic arenite** ([Chapter 6](#)) an arenite in which there is more than 10% lithic clasts and in which there are more lithic clasts than feldspar clasts

**lithic clasts** ([Chapter 6](#)) fragments of rock (e.g., basalt) that are included in the sand-sized grains in sandstone, or in the larger grains in conglomerate

**lithification** ([Chapter 6](#)) the conversion of unconsolidated sediments into rock by compaction and cementation

**lithosphere** ([Chapter 1](#)) the rigid outer part of the Earth, including the crust and the mantle down to a depth of about 100 kilometres

**lodgement till** ([Chapter 16](#)) sediment that accumulates at the base of a glacier and typically has a wide range of grain sizes (including clay) and is well compacted

**longshore current** ([Chapter 17](#)) the movement of water along a shoreline produced by the approach of waves at an angle to the shore

**longshore drift** ([Chapter 17](#)) the movement of sediment along a shoreline resulting from a longshore current and also from the swash and backwash on a beach face

**Love wave** ([Chapter 11](#)) a surface seismic wave, with horizontal motion, that develops in relatively weak (e.g., unconsolidated) materials at surface

**luvisol** ([Chapter 5](#)) a cold climate forest soil formed in which clay has been removed from the A horizon and relocated into the B horizon

## M

**Ma** ([Chapter 1](#)) (Mega annum) millions of years before the present

**mafic** ([Chapter 3](#)) silica poor (<45% SiO<sub>2</sub>) in the context of magma or igneous rock

**magma** ([Chapter 1](#)) molten rock typically dominated by silica

**magnetic chronology** ([Chapter 8](#)) the study of the timing of reversals of the Earth's magnetic field, and the application of that understanding to dating geological materials

**magnitude** ([Chapter 11](#)) a measure of the amount of energy released by an earthquake

**mantle** ([Chapter 1](#)) the middle layer of the Earth, dominated by iron and magnesium rich silicate minerals and extending for about 2900 kilometres from the base of the crust to the top of the core

**mantle plume** ([Chapter 3](#)) a plume of hot rock (not magma) that rises through the mantle (either from the base or from part way up) and reaches the surface where it spreads out and also leads to hot-spot volcanism

**marble** ([Chapter 7](#)) metamorphosed limestone (or dolostone) in which the calcite or dolomite has been recrystallized into larger crystals

- mass wasting** ([Chapter 15](#)) the mass failure, by gravity, of rock or unconsolidated material on a slope
- meander cutoff** ([Chapter 13](#)) the formation of a shorter stream channel across the narrow boundary between two meanders on a stream
- meandering** ([Chapter 13](#)) the sinuous path taken by a stream within a wide flat flood plain
- medial moraine** ([Chapter 16](#)) a lateral moraine that has been shifted towards the centre of a valley glacier at a point where two glaciers meet
- member** ([Chapter 6](#)) a subdivision of a formation
- mesopelagic zone** ([Chapter 18](#)) the upper middle zone of the open ocean extending from a 200 to 1000 metre depth
- metallic lustre** ([Chapter 2](#)) the lustre of a mineral into which light does not penetrate but only reflects off of the surface
- metallic bond** ([Chapter 2](#)) a type of bond in which abundant electrons are easily shared amongst cations
- metamorphism** ([Chapter 3](#)) the transformation of a parent rock into a new rock as a result of heat and pressure that leads to the formation of new minerals, or recrystallization of existing minerals, without melting
- metasomatism** ([Chapter 7](#)) metamorphism facilitated by ion transfer through water
- meteoroid** ([Chapter 22](#)) a fragment of either stony or metallic debris in space
- methane hydrate** ([Chapter 18](#)) a combination of water ice and methane in which the methane is trapped inside “cages” in the ice
- mica** ([Chapter 2](#)) a sheet silicate mineral (e.g., biotite)
- migmatite** ([Chapter 7](#)) a rock that is a mixture of metamorphic and igneous rock, formed at very high grades of metamorphism when a part of the parent rock starts to melt
- Milankovitch cycles** ([Chapter 19](#)) millennial-scale variations in the orbital and rotational parameters of the Earth that have subtle effects on the Earth’s climate
- Mohorovičić discontinuity** ([Chapter 9](#)) the boundary between the crust and the mantle
- moment magnitude** ([Chapter 11](#)) a way of estimating earthquake magnitude based on the area of the rupture surface and the amount of displacement
- monogenetic** ([Chapter 4](#)) a volcano that forms in a single eruptive event
- moraine lake** ([Chapter 16](#)) a finger lake that forms within a glacial valley and is dammed by an end moraine

**mud crack** ([Chapter 6](#)) a desiccation crack formed in mud that has accumulated in a small body of water that later dries up or drains

**mudflow** ([Chapter 15](#)) a mass-wasting event involving the flow of mud (sand, silt and clay) within a channel

**mudrock** ([Chapter 6](#)) an inclusive term for mudstone, shale and claystone

**muscovite** ([Chapter 2](#)) a potassium-bearing non-ferromagnesian mica

## N

**native element** ([Chapter 2](#)) (also native element mineral) a mineral that consists of only one element (e.g., native gold)

**nebula** ([Chapter 22](#)) a cloud of interstellar dust and gases

**negative feedback** ([Chapter 19](#)) a process that results in a decrease in that process (in the context of climate change it is a process that reduces the change in climate, such as the enhanced growth of vegetation in response to an increase in atmospheric carbon dioxide)

**neutron** ([Chapter 2](#)) a sub-atomic particle with a mass of 1 and a charge of 0

**nonconformity** ([Chapter 8](#)) a geological boundary where non-sedimentary rock is overlain by sedimentary rock

**non-ferromagnesian mineral** ([Chapter 2](#)) a silicate mineral that does not contain iron or magnesium (e.g., feldspar)

**non-metallic lustre** ([Chapter 2](#)) the lustre of a mineral into which light does not penetrate

**normal fault** ([Chapter 12](#)) a non-vertical fault along which the hanging wall (upper surface) has moved down relative to the footwall

**normal force** ([Chapter 15](#)) the component of the gravitational force that acts directly into the slope

**North Atlantic Deep Water** ([Chapter 18](#)) deep Atlantic Ocean water that has descended in the far north of the basin in the area between Scandinavia and Greenland

**nunatak** ([Chapter 16](#)) a rocky peak that extends above the ice level of a continental glacier

## O

**obliquity** ([Chapter 19](#)) in the context of Milankovitch Cycles, the angle of the tilt of the Earth's rotational axis with respect to the plane of its orbit around the Sun

**ocean plain** ([Chapter 18](#)) the extremely flat surface of the deep ocean floor in areas unaffected by plate tectonic processes and volcanism

**oil window** ([Chapter 20](#)) the depth range, which is approximately 2000 to 4000 metres, within which the temperature is appropriate for the formation of oil from organic matter in sedimentary rock

**oid** ([Chapter 6](#)) a small (approximately 1 millimetre) sphere of calcite formed in areas of tropical shallow marine water with strong currents

**olivine** ([Chapter 2](#)) a silicate mineral made up of isolated silica tetrahedra and with either iron or magnesium (or both) as the cations

**Oort cloud** ([Chapter 22](#)) a spherical cloud of icy objects extending from between about 5,000 and 500,000 astronomical units (Sun-Earth distances) from the Sun (thought to be the source area of comets)

**open-pit mine** ([Chapter 20](#)) a mine that is open to the surface

**outcrop** ([Chapter 5](#)) a surface exposure of rock that is part of the crust (bedrock)

**outwash plain** ([Chapter 16](#)) an extensive region of sand and gravel deposited by streams flowing out of a glacier (same as sandur)

**overturned** ([Chapter 12](#)) a geological feature that has been tilted to the point where it is upside down

**oxbow** ([Chapter 13](#)) a part of a stream meander that has become isolated from the rest of the stream as the result of a meander cutoff

**oxidation** ([Chapter 5](#)) the reaction between a mineral and oxygen

**oxide** ([Chapter 2](#)) a mineral in which the anion is oxygen (e.g., hematite  $\text{Fe}_2\text{O}_3$ )

P

**pahoehoe** ([Chapter 4](#)) a lava flow with a ropy surface texture formed when the surface cools and hardens while the lava beneath is still flowing

**paleomagnetic** ([Chapter 10](#)) past variations in the intensity and polarity of the Earth's magnetic field

**Pangea** ([Chapter 10](#)) the supercontinent that existed between approximately 300 and 180 Ma

**paraconformity** ([Chapter 8](#)) an interruption representing a period of non-deposition, without tilting or erosion, in a sequence of sedimentary rocks

**parasitic fold** ([Chapter 12](#)) a fold within a fold

**parent rock** ([Chapter 7](#)) the rock that was already in existence when a process of metamorphism started

**partial melting** ([Chapter 3](#)) the process during which only specific mineral components of a rock melt in response to changing conditions

**parting** ([Chapter 6](#)) a narrow gap between individual sedimentary layers

**passive margin** ([Chapter 10](#)) a boundary between a continent and an ocean at which there is no tectonic activity (e.g., the eastern edge of North America)

**paternoster lake** ([Chapter 16](#)) one of a series of rock basin lakes

**pebble** ([Chapter 6](#)) a sedimentary particle ranging in size from 2 to 64 millimetres (includes granule)

**pelagic** ([Chapter 18](#)) the part of a lake or the ocean that is not close to shore

**permafrost** ([Chapter 19](#)) ground that remains frozen for two or more years

**permanentism** ([Chapter 10](#)) the now discredited theory that the features on the Earth have not changed significantly over geological time

**permeability** ([Chapter 14](#)) an expression of the ease with which liquid will flow through a porous medium

**phaneritic** ([Chapter 3](#)) a rock texture in which the individual crystals or grains are visible to the naked eye

**Phanerozoic** ([Chapter 1](#)) the most recent eon of geological time, encompassing the Paleozoic, Mesozoic and Cenozoic

**phenocryst** ([Chapter 3](#)) a relatively large crystal within an igneous rock

**phyllosilicate** ([Chapter 2](#)) a silicate mineral in which the silica tetrahedra are made up of sheets

**phosphate** ([Chapter 2](#)) a mineral in which the anion is  $\text{PO}_4^{3-}$

**photic zone** ([Chapter 18](#)) the upper 200 metres of the ocean or a lake, where, depending on the turbidity of the water, light can penetrate

**phreatic eruption** ([Chapter 4](#)) a steam-drive volcanic eruption that takes place when surface or near-surface water is heated by volcanic activity

**phyllite** ([Chapter 7](#)) a metamorphic rock with slaty cleavage and a sheen on the surface produced by aligned micas

**pillow** ([Chapter 4](#)) a pillow-shaped mass of volcanic rock (typically basalt) formed when magma erupts beneath the surface

**pillow lava** ([Chapter 4](#)) a volcanic rock (typically basalt) that is made up primarily of pillows

**pipe** ([Chapter 3](#)) a cylindrical body of igneous rock, typically resulting from a feeder conduit to a volcano

**plate** ([Chapter 1](#)) a region of the lithosphere that is considered to be moving across the surface of the Earth as a single unit

**plate tectonics** ([Chapter 1](#)) the concept that the Earth's crust and upper mantle (lithosphere) is divided

into a number of plates that move independently on the surface and interact with each other at their boundaries

**plinian eruption** ([Chapter 4](#)) a large volcanic eruption in which a column of hot tephra and gases rises many kilometres into the atmosphere

**pluton** ([Chapter 3](#)) a body of intrusive igneous rock

**podsol** ([Chapter 55](#)) a soil with well-developed horizons formed in temperate forested regions

**podsolization** ([Chapter 5](#)) the process of the formation of podsol

**polar wandering path** ([Chapter 10](#)) a path of varying magnetic pole positions defined by paleomagnetic data (in fact it is now understood that the continents have wandered, not the poles, so a more appropriate term is “apparent polar wandering path”)

**polymerize** ([Chapter 3](#)) the formation of molecular chains within a fluid (e.g., a magma) that lead to an increase in the fluid’s viscosity

**polymorphs** ([Chapter 7](#)) two or more minerals with the same chemical formula but different crystal structures

**porosity** ([Chapter 14](#)) the percentage of open pore space within a body of rock or sediment

**porphyritic** ([Chapter 3](#)) an igneous texture in which some of the crystals are distinctively larger than the rest

**porphyry deposit** ([Chapter 20](#)) a mineral deposit (of copper or molybdenum especially) in which part of the host rock is a porphyritic stock

**positive feedback** ([Chapter 19](#)) a process that results in an increase in that process (in the context of climate change it is a process that enhances the change in climate, such as the reduced reflectivity of the Earth’s surface when ice melts)

**potassium feldspar** ([Chapter 2](#)) feldspar with the formula  $\text{KAlSi}_3\text{O}_8$

**potentiometric surface** ([Chapter 14](#)) the imaginary surface defined by the levels to which water would rise in a series of wells drilled into a confined aquifer

**precession** ([Chapter 19](#)) in the context of Milankovitch Cycles, the variation in the direction at which the Earth’s rotational axis is pointing

**principle of cross-cutting relationships** ([Chapter 6](#)) the principle that a body of rock that cuts across or through another body of rock is younger than that other body

**principle of faunal succession** ([Chapter 6](#)) the principle that life on Earth has evolved in an orderly way, and that we can expect to always find fossils of a specific type in rocks of a specific age

**principle of inclusions** ([Chapter 6](#)) the principle that inclusions within a body of rock must be older than the rock

**principle of original horizontality** ([Chapter 6](#)) the principle that sedimentary beds are originally deposited in horizontal layers

**principle of superposition** ([Chapter 6](#)) the principle that in a sequence of layered rocks that is not overturned or interrupted by faulting, the oldest will be at the bottom and the youngest at the top

**proglacial** ([Chapter 16](#)) referring to the area in front of a glacier

**proton** ([Chapter 2](#)) a sub-atomic particle with a mass of 1 and a charge of 1

**protoplanetary disk** ([Chapter 22](#)) a rotating cloud of gas and dust surrounding a young star

**pumice** ([Chapter 4](#)) a highly vesicular felsic volcanic rock (typically composed mostly of glass)

**p-wave** ([Chapter 9](#)) a seismic body wave that is characterized by deformation of the rock in the same direction that the wave is propagating (compressional vibration)

**pyroclastic** ([Chapter 4](#)) volcanic material formed during an explosive eruption

**pyroclastic density current** ([Chapter 4](#)) a body of hot pyroclastic rock and gases that is flowing rapidly down the flank of a volcano

**pyroxene** ([Chapter 2](#)) a single chain silicate mineral

## Q

**quartz** ([Chapter 2](#)) a silicate mineral with the formula  $\text{SiO}_2$

**quartz sandstone** ([Chapter 6](#)) a sandstone in which more than 90% of the grains are quartz

**quartzite** ([Chapter 7](#)) a metamorphic rock formed from the contact or regional metamorphism of sandstone

## R

**radial** ([Chapter 13](#)) a pattern of streams radiating out from a central point, typically an isolated mountain

**radioactivity** ([Chapter 9](#)) the natural transformation of unstable isotopes into new elements

**radiolaria** ([Chapter 18](#)) microscopic (0.1 to 0.2 millimetres) marine protozoa that produce silica shells

**Rayleigh wave** ([Chapter 11](#)) a surface seismic wave, with vertical motion

**recharge** ([Chapter 14](#)) the transfer of surface water into the ground to become groundwater

**recharge area** ([Chapter 14](#)) an area of an aquifer where recharge is predominant over discharge

**rectangular** ([Chapter 13](#)) a drainage pattern in which tributaries typically flow at right angles to each other and meet at right angles

**recumbent fold** ([Chapter 12](#)) a fold that is overturned such that its limbs are close to horizontal

**redshift** ([Chapter 22](#)) the increase in wavelength of light resulting from the fact that the source of the light is moving away from the observer

**reef** ([Chapter 17](#)) a mound of carbonate formed in shallow tropical marine environments by corals, algae and a wide range of other organisms

**regional metamorphism** ([Chapter 7](#)) metamorphism caused by burial of the parent rock to depths greater than 5 kilometres (typically takes place beneath mountain ranges, and extends over areas of hundreds of km<sup>2</sup>)

**remnant magnetism** ([Chapter 10](#)) magnetism of a body of rock that formed at the time the rock formed and is consistent with the magnetic field orientation that existed at that time and place

**reservoir rock** ([Chapter 20](#)) rock into which petroleum has migrated and is now trapped

**residual soil** ([Chapter 5](#)) soil formed by weathering of the underlying rock or sediment

**retrograde metamorphism** ([Chapter 7](#)) metamorphism that takes place at a lower temperature than that at which the rock originally formed or was previously metamorphosed

**reverse fault** ([Chapter 12](#)) a non-vertical fault along which the hanging wall (upper surface) has moved up relative to the footwall

**rhyolite** ([Chapter 3](#)) a felsic volcanic rock

**ridge push** ([Chapter 10](#)) the concept that at least part of the mechanism of plate motion is the push of oceanic lithosphere down from a ridge area

**rip current** ([Chapter 17](#)) a strong flow of water outward from a beach

**ripple** ([Chapter 6](#)) on a series of small parallel ridges formed within sediment that has accumulated in moving water or wind

**rip-rap** ([Chapter 17](#)) angular rock fragments, typically boulder sized, used to armour slopes and shorelines against erosion

**roche moutonnée** ([Chapter 16](#)) a product of glaciation in which a bedrock protrusion is eroded into a streamlined shape that has a broken or jagged leading (down-ice) edge

**rock avalanche** ([Chapter 15](#)) a rapid turbulent flow of broken bedrock fragments down a steep slope

**rock basin lake** ([Chapter 16](#)) a lake situated in a rock basin carved at the upper end of an alpine glacier

**rock cycle** ([Chapter 3](#)) the series of processes through which rocks are transformed from one type to another



**rock fall** ([Chapter 15](#)) the near-vertical fall or bouncing of rock released from a steep slope

**rock slide** ([Chapter 15](#)) the translational motion of an essentially intact body of rock down a slope (rock slides are typically slow, because once they start to move fast the rock body becomes fragmented and then flows as a rock avalanche)

**runoff** ([Chapter 14](#)) flow of water down a slope, either across the ground surface, or within a series of channels

**rupture** ([Chapter 11](#)) breaking of rock subject to stress, typically resulting in an earthquake

**rupture surface** ([Chapter 11](#)) the area over which rock rupture takes place during an earthquake

## S

**sackung** ([Chapter 15](#)) an escarpment or trough at the top of a slow-moving rock slide (sackungen)

**saltation** ([Chapter 13](#)) the bouncing of particles along a stream bottom or desert floor

**sand** ([Chapter 6](#)) a mineral or rock fragment ranging in size from 1/16th to 2 millimetres

**sandstone** ([Chapter 1](#)) a rock that is primarily comprised of sand-sized particles

**sandur** ([Chapter 16](#)) an extensive region of sand and gravel deposited by streams flowing out of a glacier (same as outwash plain)

**saturated zone** ([Chapter 14](#)) the part of an aquifer, or any body of rock, that is saturated with water

**schist** ([Chapter 1](#)) a metamorphic rock with visible aligned mica crystals

**sea cave** ([Chapter 17](#)) a shallow cave formed on a rocky shore by wave erosion

**sea cliff** ([Chapter 17](#)) a coastal escarpment that is typically eroding inland as a result of wave action

**sea-floor spreading** ([Chapter 10](#)) the formation of new oceanic crust by volcanism at a divergent plate boundary

**sector collapse** ([Chapter 4](#)) the sudden collapse of a significant part of the flank of a volcano

**sedimentary rock** ([Chapter 3](#)) rock that has formed by the lithification of sediments

**sediments** ([Chapter 3](#)) unconsolidated particles of mineral or rock

**seismic** ([Chapter 11](#)) pertaining to earthquakes

**seismic moment** ([Chapter 11](#)) a measurement of an earthquake's energy based on longwave vibrations, or on the product of the fault area and displacement

**seismic reflection sounding** ([Chapter 10](#)) measurement of the properties of sediments based on detection of sounds generated at surface and reflected from layers beneath the surface

**septae** ([Chapter 8](#)) calcareous partitions between the successive living chambers in a cephalopod

**septic system** ([Chapter 14](#)) a system constructed to facilitate the dispersion and detoxification of sewage (typically includes a septic tank and a drainage field)

**shaft** ([Chapter 20](#)) a vertical opening at a mine

**shale** ([Chapter 6](#)) a silt- and clay-rich rock that has evidence of layering

**shear force** ([Chapter 15](#)) the component of the gravitational force in the direction parallel to a slope

**shear strength** ([Chapter 15](#)) the strength of a body of rock or sediment that counteracts the shear force

**shear stress** ([Chapter 12](#)) the stress placed on a body of rock or sediment adjacent to a fault

**sheeted dykes** ([Chapter 10](#)) a series of near-vertical dykes formed in the vicinity of a spreading ridge when magma from depth flows into fractures formed by extensional forces

**sheet silicate** ([Chapter 2](#)) a silicate mineral in which the silica tetrahedra are combined within sheets

**sheetwash** ([Chapter 5](#)) overland flow of water, typically related to a heavy precipitation event

**shield** ([Chapter 4](#)) a region of ancient (typically Precambrian) crystalline rock (equivalent to a craton)

**shield volcano** ([Chapter 4](#)) a low-profile volcano formed primarily from eruptions of low-viscosity mafic magma

**SIAL (sialic)** ([Chapter 10](#)) referring to rock or magma in which silica and aluminum are the predominant components (generally equivalent to felsic)

**silica** ([Chapter 2](#)) a form of the mineral quartz ( $\text{SiO}_2$ )

**silica tetrahedron** ([Chapter 2](#)) a combination of 1 silicon atom and 4 oxygen atoms that form a tetrahedron

**silicate** ([Chapter 1](#)) a mineral that includes silica tetrahedra

**silicon** ([Chapter 2](#)) the 14th element

**silicone** ([Chapter 2](#)) resin or caulking made from silicon-oxygen chains and various organic molecules

**sill** ([Chapter 3](#)) an igneous intrusion that is parallel to existing layering in the country rock

**silt** ([Chapter 6](#)) sedimentary particles ranging in size from 1/256th to 1/16th of a millimetres

**SIMA (simatic)** ([Chapter 10](#)) referring to rock or magma in which silica, magnesium and iron are the predominant components (generally equivalent to mafic)

**skarn** ([Chapter 7](#)) the contact metamorphism (and metasomatism) of limestone

**slab pull** ([Chapter 10](#)) the concept that at least part of the mechanism of plate motion is the pull of oceanic lithosphere down into the mantle

**slate** ([Chapter 7](#)) a fine-grained metamorphic rock that splits easily into sheets

**slaty cleavage** ([Chapter 7](#)) the tendency for slate or phyllite to split into sheets (note that this is the only situation in this textbook where the term “cleavage” is applied to a rock as opposed to a mineral)

**slide** ([Chapter 15](#)) the downward movement of rock or sediment on a slope as an intact mass

**slump** ([Chapter 15](#)) a slide in which the nature of the motion is rotational (typically only develops in unconsolidated sediments)

**smectite** ([Chapter 2](#)) a fine-grained sheet silicate mineral that can accept water molecules into interlayer spaces, resulting in swelling

**smelter** ([Chapter 20](#)) a refinery at which minerals are processed to produce pure metals

**snowline** ([Chapter 22](#)) in astronomy the radius around a star at which represents the boundary between gases (or liquids) and solids

**soil horizon** ([Chapter 5](#)) a layer, within a well-developed soil, that is physically or chemically different from layers above or below

**solar system** ([Chapter 22](#)) a star and the planets surrounding it

**solar wind** ([Chapter 22](#)) a stream of ionized (charged) particles away from the Sun

**solid solution** ([Chapter 2](#)) the substitution of one element for another in a mineral (e.g., iron can be substituted for magnesium in the mineral olivine)

**solifluction** ([Chapter 15](#)) the flow of water saturated sediment or soil over a stronger and less permeable substrate

**source rock** ([Chapter 20](#)) the sedimentary rock from which petroleum originates prior to its migration into a reservoir rock

**speleothem** ([Chapter 6](#)) a solutionally-formed feature within a limestone cave (e.g., a stalactite)

**spit** ([Chapter 17](#)) a sand or coarser deposit extending from shore out into open water

**spring** ([Chapter 14](#)) the flow of groundwater onto the surface

**stack** ([Chapter 17](#)) a prominent rocky island that is a remnant of the erosion of a headland

**stage** ([Chapter 13](#)) the level of water in a stream

**stalactite** ([Chapter 6](#)) a cone-shaped speleothem that is suspended from the roof of a cave

**stalagmite** ([Chapter 6](#)) a cone-shaped speleothem that forms on the floor of a cave

**step-pool** ([Chapter 13](#)) a characteristic of stream flow in which water flows from one pool to another, typically on a stream with a steep gradient

**stock** ([Chapter 3](#)) an irregular pluton with an exposed area less than 100 km<sup>2</sup>

**stopping** ([Chapter 3](#)) the fracturing and incorporation of fragments of country rock as a magma body moves upward through the crust

**strain** ([Chapter 12](#)) the deformation of rock that is subjected to stress

**streak** ([Chapter 2](#)) the mark left on a porcelain plate when a mineral sample is ground to a powder by being rubbed across the plate (typically considered to provide a more reliable depiction of the colour than the whole sample)

**stream** ([Chapter 13](#)) any body of flowing water

**stress** ([Chapter 12](#)) a force applied to a rock

**stress transfer** ([Chapter 11](#)) the change in the pattern of stress on a region of rock as a result of an earthquake (typically stress is reduced in the area of a rupture zone, but is increased elsewhere in the vicinity)

**strike** ([Chapter 12](#)) the compass direction of a horizontal line on a sloped surface (e.g., bedding plane, fracture etc.)

**strike-slip fault** ([Chapter 12](#)) a fault that is characterized by motion that is close to horizontal and parallel to the strike direction of the fault

**subaerial eruption** ([Chapter 4](#)) a volcanic eruption that takes place on land

**subaqueous eruption** ([Chapter 4](#)) a volcanic eruption that takes place under water

**subducted** ([Chapter 1](#)) when part of a plate is forced beneath another plate along a subduction zone

**subduction zone** ([Chapter 10](#)) the sloping region along which a tectonic plate descends into the mantle beneath another plate

**subglacial** ([Chapter 16](#)) beneath a glacier

**sulphate** ([Chapter 2](#)) a mineral in which the anion is SO<sub>4</sub><sup>2-</sup>

**sulphide** ([Chapter 2](#)) a mineral in which the anion is S<sup>2-</sup>

**supergroup** ([Chapter 21](#)) a stratigraphically-continuous series of related groups

**superterrane** ([Chapter 21](#)) a number of terranes that are contiguous

**supraglacial** ([Chapter 16](#)) on the surface of a glacier

**surf zone** ([Chapter 17](#)) the near-shore zone where waves are breaking into surf

**suture** ([Chapter 8](#)) the line on the surface of a cephalopod that marks the boundary between a septum and the outer shell

**swash** ([Chapter 17](#)) the upward motion of a wave on a beach (typically takes place at the same angle that the waves are approaching the shore)

**s-wave** ([Chapter 9](#)) a seismic body wave that is characterized by deformation of the rock transverse to the direction that the wave is propagating

**symmetrical** ([Chapter 12](#)) a fold in which the limbs are at the same angle to the hinge

**syncline** ([Chapter 12](#)) a downward fold where the beds are known not to be overturned

**synform** ([Chapter 12](#)) a downward fold where it is not known if the beds are overturned

T

**tailings** ([Chapter 20](#)) the fine-grained waste rock from a plant used to concentrate ore minerals

**talus slope** ([Chapter 15](#)) a sloped deposit of angular rock fragments at the base of a rocky escarpment

**tarn** ([Chapter 16](#)) a lake within a rock basin

**tectonic plate** ([Chapter 1](#)) a region of the lithosphere that is considered to be moving across the surface of the Earth as a single unit

**tectonic sea level change** ([Chapter 17](#)) relative sea level change related to the vertical motion of a crustal block caused by tectonic processes

**tephra** ([Chapter 4](#)) fragments of volcanic rock (including volcanic ash) ejected during an explosive eruption

**terminal moraine** ([Chapter 16](#)) and end moraine that marks the farthest forward advance of a glacier

**terrane** ([Chapter 7](#)) a block of crust that has geological features that are distinctive from neighbouring regions, and is assumed to have been moved from elsewhere by tectonic processes

**terrestrial planet** ([Chapter 22](#)) a planet with a rocky mantle and crust and metallic core (e.g., Earth)

**terrigenous** ([Chapter 18](#)) referring to sedimentary particles that originated on a continent

**test** ([Chapter 6](#)) the shell-like hard parts (either silica or carbonate) of small organisms such as radiolarian and foraminifera

**thrust fault** ([Chapter 11](#)) a low angle reverse fault

**till** ([Chapter 16](#)) unsorted sediment transported and deposited by glacial ice

**tiltmeter** ([Chapter 4](#)) a sensitive instrument used to monitor subtle changes in the tilt of the land, particularly in studies of active volcanoes

**tombolo** ([Chapter 17](#)) a sand or coarser deposit connecting an island or rocky prominence to a larger body of land

**traction** ([Chapter 13](#)) a force that contributes to the movement of particles situated on a stream bed or desert floor

**transform fault** ([Chapter 10](#)) a boundary between two plates that are moving horizontally with respect to each other

**travertine** ([Chapter 6](#)) a deposit of calcium carbonate that forms at springs, hot springs or within limestone caves

**trellis** ([Chapter 13](#)) a drainage pattern in which tributaries typically flow parallel to one other but meet at right angles

**trigger** ([Chapter 15](#)) an event, such as an earthquake or a heavy rainfall, that triggers the onset of a mass wasting event

**trough** ([Chapter 17](#)) the lowest point of a wave

**truncated spur** ([Chapter 16](#)) the steep end of a ridge or arête that has been eroded by a main-valley glacier

**tsunami** ([Chapter 11](#)) a long-wavelength wave produced by the vertical motion of the floor of the ocean or a large lake, typically related either to an earthquake or a sub-marine mass wasting event

**tufa** ([Chapter 6](#)) a form of travertine that is especially porous as it forms around existing vegetative material.

**tuya** ([Chapter 4](#)) a flat-topped volcanic hill or mountain that formed when an eruption took place beneath a glacier and the melting led to the formation of a lake that then resulted in the wave-erosion of the top of the volcano

## U

**unconfined aquifer** ([Chapter 14](#)) an aquifer that is not overlain by a confining layer

**unconformity** ([Chapter 8](#)) a geological boundary at the base of a sedimentary layer

**unconformity-type uranium deposit** ([Chapter 20](#)) a uranium deposit that has formed at a nonconformity between sandstone and older rock

**uncompressed density** ([Chapter 22](#)) the density of planetary material that it would have if it was not compressed by the planet's gravitational force

**underground storage tank** ([Chapter 14](#)) (UST) an underground tank for storing liquids, most commonly for liquid fuel

**unsaturated zone** ([Chapter 14](#)) the rock or sediment above the water table

**U-shaped valley** ([Chapter 16](#)) a relatively straight valley with a flat bottom and steep sides that has been carved by a valley glacier

V

**valley glacier** ([Chapter 16](#)) a glacier formed in a mountainous region and confined to a valley (same as alpine glacier)

**varve** ([Chapter 16](#)) a recognizable layer within sediments that represents a single year of deposition

**vesicular** ([Chapter 3](#)) an igneous texture characterized by holes left by gas bubbles

**volcanic glass** ([Chapter 2](#)) magma that has cooled within minutes, not allowing time for the formation of crystals

**volcanic-hosted massive sulphide** ([Chapter 20](#)) a mineral deposit hosted by volcanic rocks and including zones where most of the rock is made up of sulphide minerals (including ore minerals and pyrite)

W

**wacke** ([Chapter 6](#)) a sandstone with more than 15% clay and silt

**water table** ([Chapter 14](#)) the upper surface of the saturated zone in an unconfined aquifer

**wave base** ([Chapter 17](#)) the depth of water that is affected by the sub-surface orbital motion of wave action (approximately one-half of the wavelength)

**wave-cut platform** ([Chapter 17](#)) a nearly-horizontal bench of rock eroded by waves within the surf zone (equivalent to wave-cut terrace)

**wavelength** ([Chapter 17](#)) the distance between the crests of two waves

**weathering** ([Chapter 5](#)) a range of processes taking place in the surface environment, through which solid rock is transformed into sediment and ions in solution

**Western Canada Sedimentary Basin** ([Chapter 21](#)) a large basin in the western interior of Canada, east of the Rocky Mountains, extending from the northern United States to the Northwest Territories

**Wisconsin Glaciation** ([Chapter 16](#)) the most recent advance of the Pleistocene glaciations, extending from 85 to 11 ka

X

**xenolith** ([Chapter 3](#)) a fragment of country incorporated into igneous rock, commonly as a result of stoping

Y

**youthful stream** ([Chapter 13](#)) a stream that is actively down-cutting its valley in an area that has recently been uplifted

Z

**zone of ablation** ([Chapter 16](#)) the part of a glacier, below the equilibrium line, where there is net loss of ice mass due to melting and calving

**zone of accumulation** ([Chapter 16](#)) the part of a glacier, above the equilibrium line, where there is net gain of ice mass because not all of the snow that falls each winter is able to melt during the following summer