[Template:Other uses](/wiki/Template:Other_uses" \o "Template:Other uses)

[thumb|right|An actively eroding](/wiki/File:Eroding_rill_in_field_in_eastern_Germany.jpg) [rill](/wiki/Rill) on an [intensively-farmed](/wiki/Intensive_farming) field in [eastern](/wiki/New_states_of_Germany) [Germany](/wiki/Germany)

In [earth science](/wiki/Earth_science), **erosion** is the action of surface processes (such as [water flow](/wiki/Surface_runoff) or [wind](/wiki/Wind)) that remove [soil](/wiki/Soil), [rock](/wiki/Rock_(geology)), or dissolved material from one location on the [Earth's crust](/wiki/Earth's_crust#Crust), then [transport](/wiki/Sediment_transport) it away to another location.[[1]](#cite_note-1) The particulate breakdown of rock or soil into [clastic](/wiki/Clastic) [sediment](/wiki/Sediment) is referred to as *physical* or *mechanical* erosion; this contrasts with *chemical* erosion, where soil or rock material is removed from an area by its dissolving into a solvent (typically water), followed by the flow away of that solution. Eroded [sediment](/wiki/Sediment) or solutes may be transported just a few millimetres, or for thousands of kilometres.

Natural rates of erosion are controlled by the action of [geomorphic](/wiki/Geomorphology) drivers, such as [rainfall](/wiki/Rain); bedrock wear in [rivers](/wiki/River); coastal erosion by the sea and [waves](/wiki/Wind_wave); [glacial](/wiki/Glacier) plucking, [abrasion](/wiki/Abrasion_(geology)), and scour; areal flooding; [wind](/wiki/Aeolian_processes) abrasion; [groundwater](/wiki/Groundwater) processes; and [mass movement](/wiki/Mass_wasting) processes in steep landscapes like [landslides](/wiki/Landslide) and [debris flows](/wiki/Debris_flow). The rates at which such processes act control how fast a surface is eroded. Typically, physical erosion proceeds fastest on steeply sloping surfaces, and rates may also be sensitive to some climatically-controlled properties including amounts of water supplied (e.g., by rain), storminess, wind speed, wave [fetch](/wiki/Fetch_(geography)), or atmospheric temperature (especially for some ice-related processes). [Feedbacks](/wiki/Feedback) are also possible between rates of erosion and the amount of eroded material that is already carried by, for example, a river or glacier.[[2]](#cite_note-2)[[3]](#cite_note-3) Processes of erosion that produce sediment or solutes from a place contrast with those of [deposition](/wiki/Deposition_(geology)), which control the arrival and emplacement of material at a new location.[[1]](#cite_note-1) While erosion is a natural process, human activities have increased by 10-40 times the rate at which erosion is occurring globally. Excessive (or accelerated) erosion causes both "on-site" and "off-site" problems. On-site impacts include decreases in [agricultural productivity](/wiki/Agricultural_productivity) and (on [natural landscapes](/wiki/Natural_landscape)) [ecological collapse](/wiki/Ecological_collapse), both because of loss of the nutrient-rich upper [soil layers](/wiki/Soil_horizon). In some cases, the eventual end result is [desertification](/wiki/Desertification). Off-site effects include [sedimentation of waterways](/wiki/Sediment#Erosion_and_agricultural_sediment_delivery_to_rivers) and [eutrophication](/wiki/Eutrophication) of water bodies, as well as sediment-related damage to roads and houses. Water and wind erosion are the two primary causes of [land degradation](/wiki/Land_degradation); combined, they are responsible for about 84% of the global extent of degraded land, making excessive erosion one of the most significant [environmental problems](/wiki/Environmental_problems) world-wide.<ref name=BlancoConservation>[Template:Cite book](/wiki/Template:Cite_book)</ref>[Template:Rp](/wiki/Template:Rp)[[4]](#cite_note-4)[Template:Rp](/wiki/Template:Rp)

[Intensive agriculture](/wiki/Intensive_farming), [deforestation](/wiki/Deforestation), [roads](/wiki/Road), anthropogenic [climate change](/wiki/Climate_change) and [urban sprawl](/wiki/Urban_sprawl) are amongst the most significant human activities in regard to their effect on stimulating erosion.[[5]](#cite_note-5) However, there are many [prevention and remediation](/wiki/Erosion#Prevention_and_remediation) practices that can curtail or limit erosion of vulnerable soils.

[thumb|thumb|A](/wiki/File:KharazaArch.jpg) [natural arch](/wiki/Natural_arch) produced by the wind erosion of differentially weathered rock in Jebel Kharaz, [Jordan](/wiki/Jordan). [thumb| A wave-like sea cliff produced by](/wiki/File:大连国家地质公园9-海蚀崖.JPG) [coastal erosion](/wiki/Coastal_erosion), in Jinshitan Coastal National Geopark, [Dalian](/wiki/Dalian), [Liaoning Province](/wiki/Liaoning_Province), [China](/wiki/China).

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## Physical processes[[edit](/index.php?title=(none)&action=edit&section=1)]

### Rainfall and surface runoff[[edit](/index.php?title=(none)&action=edit&section=2)]

[thumb|right|](/wiki/File:Water_and_soil_splashed_by_the_impact_of_a_single_raindrop.jpg)[Soil](/wiki/Soil) and water being [splashed](/wiki/Splash_(fluid_mechanics)) by the impact of a single [raindrop](/wiki/Raindrop). [Rainfall](/wiki/Rainfall), and the [surface runoff](/wiki/Surface_runoff) which may result from rainfall, produces four main types of soil erosion: *splash erosion*, *sheet erosion*, *rill erosion*, and *gully erosion*. Splash erosion is generally seen as the first and least severe stage in the soil erosion process, which is followed by sheet erosion, then rill erosion and finally gully erosion (the most severe of the four).[[4]](#cite_note-4)[Template:Rp](/wiki/Template:Rp)[[6]](#cite_note-6) In *splash erosion*, the [impact of a falling raindrop](/wiki/Rainfall#Raindrop_impacts) creates a small crater in the soil,[[7]](#cite_note-7) ejecting soil particles. The distance these soil particles travel can be as much as 0.6 m (two feet) vertically and 1.5 m (five feet) horizontally on level ground.

If [the soil is saturated](/wiki/Surface_runoff#Saturation_excess_overland_flow), or if the rainfall rate is [greater than the rate at which water can infiltrate](/wiki/Surface_runoff#Infiltration_excess_overland_flow) into the soil, surface runoff occurs. If the runoff has sufficient [flow energy](/wiki/Fluid_dynamics), it will [transport](/wiki/Sediment_transport) loosened soil particles ([sediment](/wiki/Sediment)) down the slope.[[8]](#cite_note-8) *Sheet erosion* is the transport of loosened soil particles by overland flow.[[8]](#cite_note-8)[thumb|A](/wiki/File:Rummu_aherainemägi2.jpg) [spoil tip](/wiki/Spoil_tip) covered in rills and gullies due to erosion processes caused by rainfall: [Rummu](/wiki/Rummu), [Estonia](/wiki/Estonia) [*Rill*](/wiki/Rill) *erosion* refers to the development of small, [ephemeral](/wiki/Ephemeral) concentrated flow paths which function as both sediment source and [sediment](/wiki/Sediment) delivery systems for erosion on hillslopes. Generally, where water erosion rates on disturbed upland areas are greatest, rills are active. Flow depths in rills are typically of the order of a few centimetres (about an inch) or less and along-channel slopes may be quite steep. This means that rills exhibit [hydraulic](/wiki/Hydraulic) physics very different from water flowing through the deeper, wider channels of streams and rivers.[[9]](#cite_note-9) [Template:Anchor](/wiki/Template:Anchor) [*Gully erosion*](/wiki/Gully_erosion) occurs when runoff water accumulates and rapidly flows in narrow channels during or immediately after heavy rains or melting snow, removing soil to a considerable depth.<ref name=Boardman>[Template:Cite book](/wiki/Template:Cite_book)</ref>[[10]](#cite_note-10)[[11]](#cite_note-11)

### Rivers and streams[[edit](/index.php?title=(none)&action=edit&section=3)]

[Template:Details](/wiki/Template:Details) [thumb|Dobbingstone](/wiki/File:Dobbingstone_Burn_-_geograph.org.uk_-_1291882.jpg) [Burn](/wiki/Burn_(landform)), [Scotland](/wiki/Scotland), showing two different types of erosion affecting the same place. Valley erosion is occurring due to the flow of the stream, and the boulders and stones (and much of the soil) that are lying on the stream's banks are [glacial till](/wiki/Glacial_till) that was left behind as ice age glaciers flowed over the terrain. *Valley* or *stream erosion* occurs with continued water flow along a linear feature. The erosion is both [downward](/wiki/Downcutting), deepening the valley, and [headward](/wiki/Headward_erosion), extending the valley into the hillside, creating [head cuts](/wiki/Head_Cut_(stream_geomorphology)) and steep banks. In the earliest stage of stream erosion, the erosive activity is dominantly vertical, the valleys have a typical **V** cross-section and the stream gradient is relatively steep. When some [base level](/wiki/Base_level) is reached, the erosive activity switches to lateral erosion, which widens the valley floor and creates a narrow floodplain. The stream gradient becomes nearly flat, and lateral deposition of sediments becomes important as the stream [meanders](/wiki/Meander) across the valley floor. In all stages of stream erosion, by far the most erosion occurs during times of flood, when more and faster-moving water is available to carry a larger sediment load. In such processes, it is not the water alone that erodes: suspended abrasive particles, [pebbles](/wiki/Pebble) and [boulders](/wiki/Boulder) can also act erosively as they traverse a surface, in a process known as *traction*.[[12]](#cite_note-12) *Bank erosion* is the wearing away of the banks of a [stream](/wiki/Stream) or [river](/wiki/River). This is distinguished from changes on the bed of the watercourse, which is referred to as *scour*. Erosion and [changes in the form of river banks](/wiki/River_bank_failure) may be measured by inserting metal rods into the bank and marking the position of the bank surface along the rods at different times.[[13]](#cite_note-13) *Thermal erosion* is the result of melting and weakening [permafrost](/wiki/Permafrost) due to moving water.[[14]](#cite_note-14) It can occur both along rivers and at the coast. Rapid [river channel migration](/wiki/River_channel_migration) observed in the [Lena River](/wiki/Lena_River) of [Siberia](/wiki/Siberia) is due to thermal erosion, as these portions of the banks are composed of permafrost-cemented non-cohesive materials.[[15]](#cite_note-15) Much of this erosion occurs as the weakened banks fail in large slumps. Thermal erosion also affects the [Arctic](/wiki/Arctic) coast, where wave action and near-shore temperatures combine to undercut permafrost bluffs along the shoreline and cause them to fail. Annual erosion rates along a [Template:Convert](/wiki/Template:Convert) segment of the Beaufort Sea shoreline averaged [Template:Convert](/wiki/Template:Convert) per year from 1955 to 2002.[[16]](#cite_note-16)

### Coastal erosion[[edit](/index.php?title=(none)&action=edit&section=4)]

[Template:Main](/wiki/Template:Main) [Template:See also](/wiki/Template:See_also) [thumb|](/wiki/File:Wavecut_platform_southerndown_pano.jpg)[Wave cut platform](/wiki/Wave_cut_platform) caused by erosion of cliffs by the sea, at [Southerndown](/wiki/Southerndown) in South [Wales](/wiki/Wales). [thumb|Erosion of the](/wiki/File:Erosion_of_Boulder_Clay_in_Filey_Bay.JPG) [boulder clay](/wiki/Boulder_clay) (of [Pleistocene](/wiki/Pleistocene) age) along cliffs of [Filey](/wiki/Filey) Bay, Yorkshire, England. Shoreline erosion, which occurs on both exposed and sheltered coasts, primarily occurs through the action of currents and [waves](/wiki/Ocean_surface_wave) but sea level (tidal) change can also play a role.

[*Hydraulic action*](/wiki/Hydraulic_action) takes place when air in a joint is suddenly compressed by a wave closing the entrance of the joint. This then cracks it. [*Wave pounding*](/wiki/Wave_pounding) is when the sheer energy of the wave hitting the cliff or rock breaks pieces off. [*Abrasion*](/wiki/Abrasion_(geology)) or *corrasion* is caused by waves launching seaload at the cliff. It is the most effective and rapid form of shoreline erosion (not to be confused with *corrosion*). [*Corrosion*](/wiki/Corrosion) is the dissolving of rock by [carbonic acid](/wiki/Carbonic_acid) in sea water.[Template:Citation needed](/wiki/Template:Citation_needed) [Limestone](/wiki/Limestone) cliffs are particularly vulnerable to this kind of erosion. *Attrition* is where particles/seaload carried by the waves are worn down as they hit each other and the cliffs. This then makes the material easier to wash away. The material ends up as [shingle](/wiki/Shingle_beach) and sand. Another significant source of erosion, particularly on carbonate coastlines, is the boring, scraping and grinding of organisms, a process termed [*bioerosion*](/wiki/Bioerosion).[[17]](#cite_note-17) [Sediment](/wiki/Sediment) is transported along the coast in the direction of the prevailing current ([longshore drift](/wiki/Longshore_drift)). When the upcurrent amount of sediment is less than the amount being carried away, erosion occurs. When the upcurrent amount of sediment is greater, sand or gravel banks will tend to form as a result of [deposition](/wiki/Deposition_(geology)). These banks may slowly migrate along the coast in the direction of the longshore drift, alternately protecting and exposing parts of the coastline. Where there is a bend in the coastline, quite often a buildup of eroded material occurs forming a long narrow bank (a [spit](/wiki/Spit_(landform))). [Armoured](/wiki/Armor_(hydrology)) beaches and submerged offshore [sandbanks](/wiki/Shoal) may also protect parts of a coastline from erosion. Over the years, as the shoals gradually shift, the erosion may be redirected to attack different parts of the shore.[Template:Citation needed](/wiki/Template:Citation_needed)

### Chemical erosion[[edit](/index.php?title=(none)&action=edit&section=5)]

Chemical erosion is the loss of matter in a landscape in the form of [solutes](/wiki/Solution). Chemical erosion is usually calculated from the solutes found in streams. [Anders Rapp](/wiki/Anders_Rapp) pioneered the study of chemical erosion in his work about [Kärkevagge](/wiki/Kärkevagge) published in 1960.[[18]](#cite_note-18)

### Glaciers[[edit](/index.php?title=(none)&action=edit&section=6)]

[thumb|Glacial](/wiki/File:MorainesLakeLouise.JPG) [moraines](/wiki/Moraines) above [Lake Louise](/wiki/Lake_Louise,_Alberta), in [Alberta, Canada](/wiki/Alberta,_Canada). [Glaciers](/wiki/Glacier) erode predominantly by three different processes: abrasion/scouring, [plucking](/wiki/Plucking_(glaciation)), and ice thrusting. In an abrasion process, debris in the basal ice scrapes along the bed, polishing and gouging the underlying rocks, similar to sandpaper on wood. Glaciers can also cause pieces of bedrock to crack off in the process of plucking. In ice thrusting, the glacier freezes to its bed, then as it surges forward, it moves large sheets of frozen sediment at the base along with the glacier. This method produced some of the many thousands of lake basins that dot the edge of the [Canadian Shield](/wiki/Canadian_Shield). The erosion caused by glaciers worldwide erodes mountains so effectively that the term *glacial buzz-saw* has become widely used, which describes the limiting effect of glaciers on the height of mountain ranges.[[19]](#cite_note-19) As mountains grow higher, they generally allow for more glacial activity (especially in the [accumulation zone](/wiki/Accumulation_zone) above the glacial equilibrium line altitude),[[20]](#cite_note-20) which causes increased rates of erosion of the mountain, decreasing mass faster than [isostatic rebound](/wiki/Isostatic_rebound) can add to the mountain.[[21]](#cite_note-21) This provides a good example of a [negative feedback loop](/wiki/Negative_feedback_loop). Ongoing research is showing that while glaciers tend to decrease mountain size, in some areas, glaciers can actually reduce the rate of erosion, acting as a *glacial armour*.[[19]](#cite_note-19) These processes, combined with erosion and transport by the water network beneath the glacier, leave [moraines](/wiki/Moraine), [drumlins](/wiki/Drumlin), ground moraine (till), kames, kame deltas, moulins, and [glacial erratics](/wiki/Glacial_erratic) in their wake, typically at the terminus or during [glacier retreat](/wiki/Retreat_of_glaciers_since_1850).[Template:Citation needed](/wiki/Template:Citation_needed)

### Floods[[edit](/index.php?title=(none)&action=edit&section=7)]

At extremely high flows, [kolks](/wiki/Kolk), or [vortices](/wiki/Vortex) are formed by large volumes of rapidly rushing water. Kolks cause extreme local erosion, plucking bedrock and creating pothole-type geographical features called [Rock-cut basins](/wiki/Rock-cut_basin). Examples can be seen in the flood regions result from glacial [Lake Missoula](/wiki/Lake_Missoula), which created the [channeled scablands](/wiki/Channeled_scablands) in the [Columbia Basin](/wiki/Columbia_Basin) region of eastern [Washington](/wiki/Washington_(state)).[[22]](#cite_note-22)

### Wind erosion[[edit](/index.php?title=(none)&action=edit&section=8)]

[thumb|](/wiki/File:Im_Salar_de_Uyuni.jpg)[Árbol de Piedra](/wiki/Árbol_de_Piedra), a rock formation in the [Altiplano](/wiki/Altiplano), [Bolivia](/wiki/Bolivia) sculpted by wind erosion. [Template:Main](/wiki/Template:Main) Wind erosion is a major [geomorphological](/wiki/Geomorphological) force, especially in [arid](/wiki/Arid_region) and [semi-arid](/wiki/Semi-arid_region) regions. It is also a major source of land degradation, evaporation, desertification, harmful airborne dust, and crop damage—especially after being increased far above natural rates by human activities such as [deforestation](/wiki/Deforestation), [urbanization](/wiki/Urbanization), and [agriculture](/wiki/Agriculture).[[23]](#cite_note-23)[[24]](#cite_note-24) Wind erosion is of two primary varieties: [*deflation*](/wiki/Aeolian_processes#Wind_erosion), where the wind picks up and carries away loose particles; and [*abrasion*](/wiki/Abrasion_(geology)), where surfaces are worn down as they are struck by airborne particles carried by wind. Deflation is divided into three categories: (1) [*surface creep*](/wiki/Downhill_creep), where larger, heavier particles slide or roll along the ground; (2) [*saltation*](/wiki/Saltation_(geology)), where particles are lifted a short height into the air, and bounce and saltate across the surface of the soil; and (3) [*suspension*](/wiki/Suspension_(chemistry)), where very small and light particles are lifted into the air by the wind, and are often carried for long distances. Saltation is responsible for the majority (50-70%) of wind erosion, followed by suspension (30-40%), and then surface creep (5-25%).<ref name=BlancoWind>[Template:Cite book](/wiki/Template:Cite_book)</ref>[Template:Rp](/wiki/Template:Rp)[[25]](#cite_note-25) Wind erosion is much more severe in arid areas and during times of drought. For example, in the [Great Plains](/wiki/Great_Plains), it is estimated that soil loss due to wind erosion can be as much as 6100 times greater in drought years than in wet years.[[26]](#cite_note-26)

### Mass movement[[edit](/index.php?title=(none)&action=edit&section=9)]

[thumb|Wadi in](/wiki/File:NegevWadi2009.JPG) [Makhtesh Ramon](/wiki/Makhtesh_Ramon), Israel, showing gravity collapse erosion on its banks. [*Mass movement*](/wiki/Mass_wasting) is the downward and outward movement of rock and sediments on a sloped surface, mainly due to the force of [gravity](/wiki/Gravity).[[27]](#cite_note-27)[[28]](#cite_note-28) Mass movement is an important part of the erosional process, and is often the first stage in the breakdown and transport of weathered materials in mountainous areas.<ref name=Nichols>[Template:Cite book](/wiki/Template:Cite_book)</ref>[Template:Rp](/wiki/Template:Rp) It moves material from higher elevations to lower elevations where other eroding agents such as streams and [glaciers](/wiki/Glacier) can then pick up the material and move it to even lower elevations. Mass-movement processes are always occurring continuously on all slopes; some mass-movement processes act very slowly; others occur very suddenly, often with disastrous results. Any perceptible down-slope movement of rock or sediment is often referred to in general terms as a [landslide](/wiki/Landslide). However, landslides can be classified in a much more detailed way that reflects the mechanisms responsible for the movement and the velocity at which the movement occurs. One of the visible topographical manifestations of a very slow form of such activity is a [scree](/wiki/Scree) slope.[Template:Citation needed](/wiki/Template:Citation_needed)

[*Slumping*](/wiki/Slump_(geology)) happens on steep hillsides, occurring along distinct fracture zones, often within materials like [clay](/wiki/Clay) that, once released, may move quite rapidly downhill. They will often show a spoon-shaped [isostatic depression](/wiki/Isostatic_depression), in which the material has begun to slide downhill. In some cases, the slump is caused by water beneath the slope weakening it. In many cases it is simply the result of poor engineering along [highways](/wiki/Highway) where it is a regular occurrence.[Template:Citation needed](/wiki/Template:Citation_needed)

*Surface creep* is the slow movement of soil and rock debris by gravity which is usually not perceptible except through extended observation. However, the term can also describe the rolling of dislodged soil particles [Template:Convert](/wiki/Template:Convert) in diameter by wind along the soil surface.[Template:Citation needed](/wiki/Template:Citation_needed)

## Factors affecting erosion rates[[edit](/index.php?title=(none)&action=edit&section=10)]

### Climate[[edit](/index.php?title=(none)&action=edit&section=11)]

The amount and intensity of [precipitation](/wiki/Rainfall) is the main [climatic factor](/wiki/Climate) governing soil erosion by water. The relationship is particularly strong if heavy rainfall occurs at times when, or in locations where, the soil's surface is not well protected by [vegetation](/wiki/Vegetation). This might be during periods when [agricultural activities](/wiki/Agriculture) leave the soil bare, or in [semi-arid](/wiki/Semi-arid_climate) regions where vegetation is naturally sparse. Wind erosion requires strong winds, particularly during times of drought when vegetation is sparse and soil is dry (and so is more erodible). Other climatic factors such as average temperature and temperature range may also affect erosion, via their effects on vegetation and soil properties. In general, given similar vegetation and ecosystems, areas with more precipitation (especially high-intensity rainfall), more wind, or more storms are expected to have more erosion.

In some areas of the world (e.g. the [mid-western USA](/wiki/Midwestern_United_States)), rainfall intensity is the primary determinant of erosivity, with higher intensity rainfall generally resulting in more soil erosion by water. The size and velocity of [rain drops](/wiki/Rain_drop) is also an important factor. Larger and higher-velocity rain drops have greater [kinetic energy](/wiki/Kinetic_energy), and thus their impact will displace soil particles by larger distances than smaller, slower-moving rain drops.<ref name=BlancoWater>[Template:Cite book](/wiki/Template:Cite_book)</ref>[Template:Rp](/wiki/Template:Rp)

In other regions of the world (e.g. [western Europe](/wiki/Western_europe)), runoff and erosion result from relatively low intensities of [stratiform rainfall](/wiki/Precipitation_types#Stratiform) falling onto previously saturated soil. In such situations, rainfall amount rather than intensity is the main factor determining the severity of soil erosion by water.<ref name=Boardman/>

### Vegetative cover[[edit](/index.php?title=(none)&action=edit&section=12)]

[Template:See also](/wiki/Template:See_also) Vegetation acts as an interface between the atmosphere and the soil. It increases the [permeability](/wiki/Permeability_(earth_sciences)) of the soil to rainwater, thus decreasing runoff. It shelters the soil from winds, which results in decreased wind erosion, as well as advantageous changes in microclimate. The roots of the plants bind the soil together, and interweave with other roots, forming a more solid mass that is less susceptible to both water and wind erosion. The removal of vegetation increases the rate of surface erosion.[[29]](#cite_note-29)

### Topography[[edit](/index.php?title=(none)&action=edit&section=13)]

The topography of the land determines the velocity at which [surface runoff](/wiki/Surface_runoff) will flow, which in turn determines the erosivity of the runoff. Longer, steeper slopes (especially those without adequate vegetative cover) are more susceptible to very high rates of erosion during heavy rains than shorter, less steep slopes. Steeper terrain is also more prone to mudslides, landslides, and other forms of gravitational erosion processes.<ref name=BlancoWater/>[Template:Rp](/wiki/Template:Rp)[[30]](#cite_note-30)[[31]](#cite_note-31)

### Tectonics[[edit](/index.php?title=(none)&action=edit&section=14)]

[Template:Main](/wiki/Template:Main) Tectonic processes control rates and distributions of erosion at the Earth's surface. If tectonic action causes part of the Earth's surface (e.g., a mountain range) to be raised or lowered relative to surrounding areas, this must necessarily change the gradient of the land surface. Because erosion rates are almost always sensitive to local slope (see above), this will change the rates of erosion in the uplifted area. Active tectonics also brings fresh, unweathered rock towards the surface, where it is exposed to the action of erosion.

However, erosion can also affect tectonic processes. The removal by erosion of large amounts of rock from a particular region, and its deposition elsewhere, can result in a lightening of the load on the [lower crust](/wiki/Crust_(geology)) and [mantle](/wiki/Mantle_(geology)). Because tectonic processes are driven by gradients in the stress field developed in the crust, this unloading can in turn cause [tectonic](/wiki/Tectonic_uplift) or [isostatic uplift](/wiki/Isostasy) in the region.<ref name=Nichols/>[Template:Rp](/wiki/Template:Rp)[[32]](#cite_note-32) In some cases, it has been hypothesised that these twin feedbacks can act to localise and enhance zones of very rapid exhumation of deep crustal rocks beneath places on the Earth's surface with extremely high erosion rates, for example, beneath the extremely steep terrain of [Nanga Parbat](/wiki/Nanga_Parbat) in the western [Himalayas](/wiki/Himalaya). Such a place has been called a "[tectonic aneurysm](/wiki/River_anticlines#Tectonic_aneurysms)".[[33]](#cite_note-33)

## Erosion of Earth systems[[edit](/index.php?title=(none)&action=edit&section=15)]

### Mountain ranges[[edit](/index.php?title=(none)&action=edit&section=16)]

[Template:See also](/wiki/Template:See_also) [Template:Expand section](/wiki/Template:Expand_section) [Mountain ranges](/wiki/Mountain_range) are known to take many million of years to erode to the degree they effectively cease to exist. Scholars Pitman and Golovchenko estimate that it takes probably more than 450 million years to erode a mountain mass similar to the [Himalaya](/wiki/Himalaya) into an almost-flat [peneplain](/wiki/Peneplain) if there are no major [sea level changes](/wiki/Sea_level#Change).[[34]](#cite_note-34) Erosion of mountains massifs can create a pattern of equally high summits called [summit accordance](/wiki/Summit_accordance).[[35]](#cite_note-35) Examples of heavily eroded mountain ranges include the [Timanides](/wiki/Timanide_Orogen) of Northern Russia. Erosion of this [orogen](/wiki/Orogeny) has produced [sediments](/wiki/Sediment) that are now found in the [East European Platform](/wiki/East_European_Platform), including the Cambrian [Sablya Formation](/wiki/Sablya_Formation) near [Lake Ladoga](/wiki/Lake_Ladoga). Studies of these sediments points that its likely that the erosion of the orogen was beginning in the Cambrian and then became stronger in [Ordovician](/wiki/Ordovician).<ref name=Orlovetal2011>[Template:Cite journal](/wiki/Template:Cite_journal)</ref>

### Soils[[edit](/index.php?title=(none)&action=edit&section=17)]

[Template:Further](/wiki/Template:Further) If the rate of erosion is higher than the rate of soil formation the soils are being destroyed by erosion.<ref name=Migon>[Template:Cite encyclopedia](/wiki/Template:Cite_encyclopedia)</ref> Where soil is not destroyed by erosion, erosion can in some cases prevent the formation of soil features that form slowly. [Inceptisols](/wiki/Inceptisol) are common soils that form in areas of fast erosion.[[36]](#cite_note-36) While erosion of soils is a natural process, human activities have increased by 10-40 times the rate at which erosion is occurring globally. Excessive (or accelerated) erosion causes both "on-site" and "off-site" problems. On-site impacts include decreases in [agricultural productivity](/wiki/Agricultural_productivity) and (on [natural landscapes](/wiki/Natural_landscape)) [ecological collapse](/wiki/Ecological_collapse), both because of loss of the nutrient-rich upper [soil layers](/wiki/Soil_horizon). In some cases, the eventual end result is [desertification](/wiki/Desertification). Off-site effects include [sedimentation of waterways](/wiki/Sediment#Erosion_and_agricultural_sediment_delivery_to_rivers) and [eutrophication](/wiki/Eutrophication) of water bodies, as well as sediment-related damage to roads and houses. Water and wind erosion are the two primary causes of [land degradation](/wiki/Land_degradation); combined, they are responsible for about 84% of the global extent of degraded land, making excessive erosion one of the most significant [environmental problems](/wiki/Environmental_problems) world-wide.[[4]](#cite_note-4)[[37]](#cite_note-37)

## See also[[edit](/index.php?title=(none)&action=edit&section=18)]

[Template:Colbegin](/wiki/Template:Colbegin)

* [Badland](/wiki/Badland)
* [Biorhexistasy](/wiki/Biorhexistasy)
* [Bridge scour](/wiki/Bridge_scour)
* [Cellular confinement](/wiki/Cellular_confinement)
* [Coastal sediment supply](/wiki/Coastal_sediment_supply)
* [Food security](/wiki/Food_security)
* [Geomorphology](/wiki/Geomorphology)
* [Groundwater sapping](/wiki/Groundwater_sapping)
* [Highly erodible land](/wiki/Highly_erodible_land)
* [Ice jacking](/wiki/Ice_jacking)
* [Lessivage](/wiki/Lessivage)
* [Marine terrace](/wiki/Marine_terrace)
* [Riparian strips](/wiki/Riparian_strips)
* [River anticlines](/wiki/River_anticlines)
* [Sediment transport](/wiki/Sediment_transport)
* [Space weathering](/wiki/Space_weathering)
* [Sphericity scale](/wiki/Sphericity_scale)
* [TERON (Tillage erosion)](/wiki/TERON_(Tillage_erosion))
* [Vetiver System](/wiki/Vetiver_System)
* [Weathering](/wiki/Weathering)

[Template:Colend](/wiki/Template:Colend)

## References[[edit](/index.php?title=(none)&action=edit&section=19)]

[Template:Reflist](/wiki/Template:Reflist)

## Further reading[[edit](/index.php?title=(none)&action=edit&section=20)]

[Template:Refbegin](/wiki/Template:Refbegin)

* [Template:Cite book](/wiki/Template:Cite_book)
* [Template:Cite book](/wiki/Template:Cite_book)
* [Template:Cite journal](/wiki/Template:Cite_journal)
* [Template:Cite book](/wiki/Template:Cite_book)
* [Template:Cite book](/wiki/Template:Cite_book)

[Template:Refend](/wiki/Template:Refend)

## External links[[edit](/index.php?title=(none)&action=edit&section=21)]

[Template:Sister project links](/wiki/Template:Sister_project_links)

* [The Soil Erosion Site](http://www.soilerosion.net/)
* [International Erosion Control Association](http://www.ieca.org/)
* [Soil Erosion Data](http://eusoils.jrc.ec.europa.eu/library/themes/erosion/) in the European Soil Portal
* [USDA National Soil Erosion Laboratory](http://www.ars.usda.gov/main/site_main.htm?modecode=36021500)
* [The Soil and Water Conservation Society](http://www.swcs.org/)

[Template:River morphology](/wiki/Template:River_morphology)

[Template:Authority control](/wiki/Template:Authority_control)

[Category:Erosion](/wiki/Category:Erosion) [Category:Soil science](/wiki/Category:Soil_science) [Category:Agronomy](/wiki/Category:Agronomy) [Category:Industrial agriculture](/wiki/Category:Industrial_agriculture) [Category:Environmental soil science](/wiki/Category:Environmental_soil_science) [Category:Environmental issues](/wiki/Category:Environmental_issues) [Category:Desertification](/wiki/Category:Desertification)