

LANDSCAPES AND LANDFORMS

SNAPSHOT 1:



Canyons National Park, USA. Image source: L Chaffer

GEOMORPHIC PROCESSES that shape landscapes and landforms

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GLOSSARY

Landscape – the appearance of an area created by a combination of physical and cultural features that have evolved over time e.g. coastal or urban landscapes.

Landforms – individual features of the Earth's crust identified by their shape e.g. beach

Geomorphic processes – natural processes including weathering, erosion, deposition, mass movement and tectonic activity that transform the lithosphere

Geomorphic hazard – hazard events originating in the lithosphere e.g. volcanic eruptions, earthquakes, tsunamis and mass movement (landslides or avalanches).

GEOMORPHIC PROCESSES

1. Tectonic processes (Earth's tectonic plates)

Earth's crust is broken into segments known as tectonic plates which move slowly in different directions due to currents in the mantle. Plate movements create distinctive landforms at the plate boundaries (margins) such as mountains and valleys and also cause geomorphic hazards such as volcanic eruptions and earthquakes.

SOURCE A: Earth's tectonic plates



THINK

How does the location of Australia compare to New Zealand in relation to Earth's tectonic plates.

Is this good or bad for Australia?

Source: Shutterstock

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The direction of plate movements will determine the geomorphic processes that change the Earth's crust.

- At **DIVERGENT** boundaries the plates move apart allowing molten magma to rise and form new crust in the form of ridges, valleys and volcanoes. Landforms created by divergent plates include the Mid Atlantic Ridge and the Great African Rift Valley.
 - * New crust is created on divergent boundaries.
- At **CONVERGENT** boundaries plates collide
 - mountains form where the crust is folded under pressure and forced upwards e.g. Himalayan Mountains
 - trenches and mountains form where an oceanic plate dives beneath a continental plate (this is

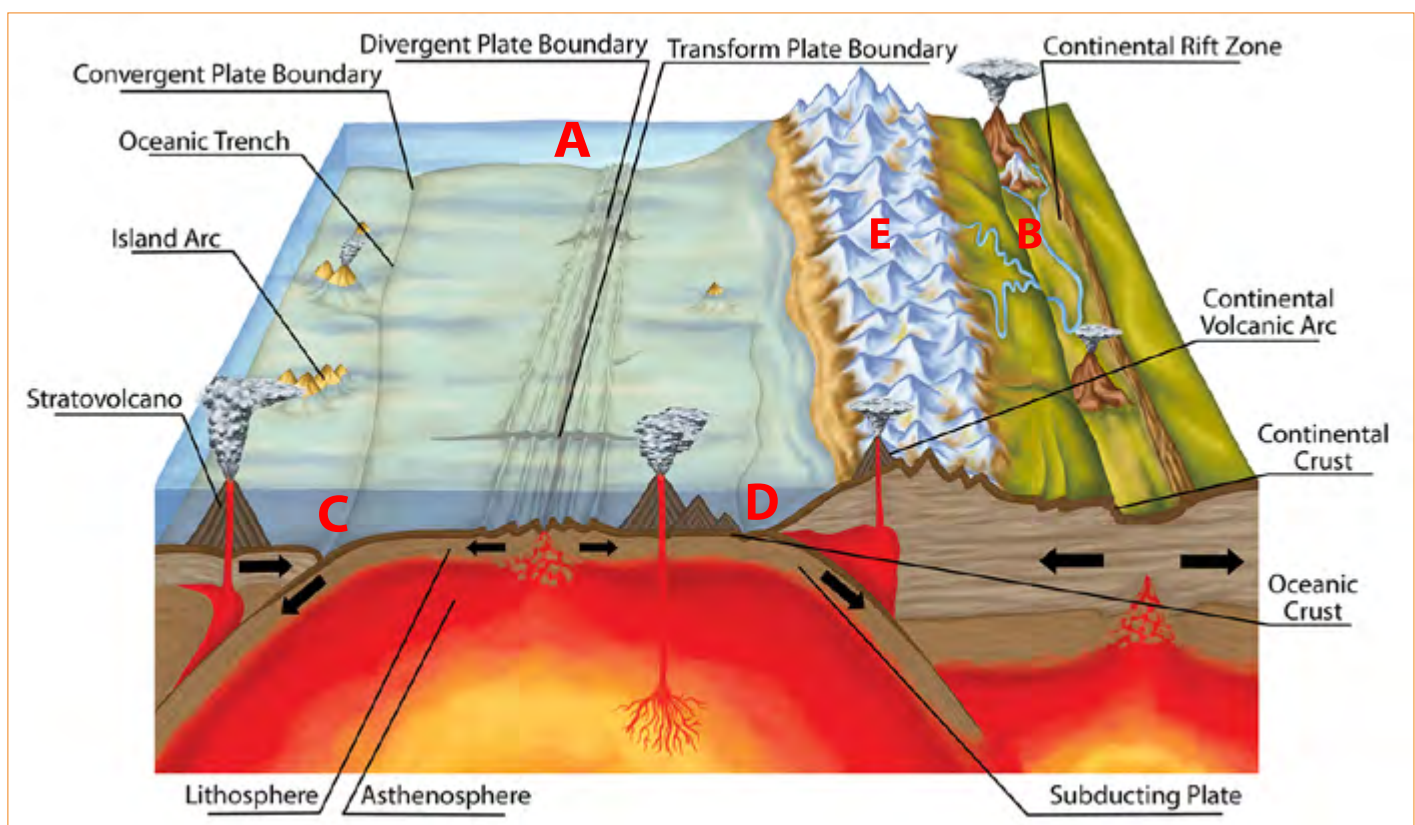
known as subduction). Crust is destroyed during subduction e.g. Peruvian Trench and Andes Mountains

* Crust is destroyed on convergent boundaries.

- At **TRANSFORM** boundaries rift valleys and block mountains form when plates move vertically along their boundaries. Eg East African Rift Valley. Plates moving horizontally frequently become stuck resulting in tension building up. Earthquake are common along transform boundaries such as the San Andreas Fault when built up tension caused by plates 'sticking' is released.

* Crust is cracked and broken at transform boundaries but is not created or destroyed.

SOURCE B: Tectonic processes at plate boundaries



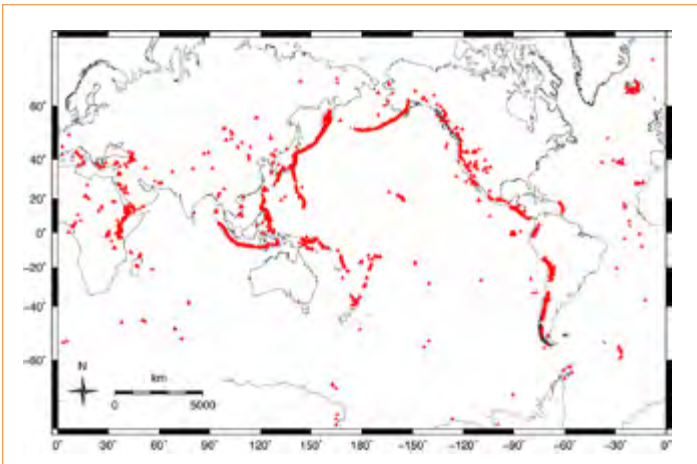
Source: Shutterstock

• The MID ATLANTIC RIDGE

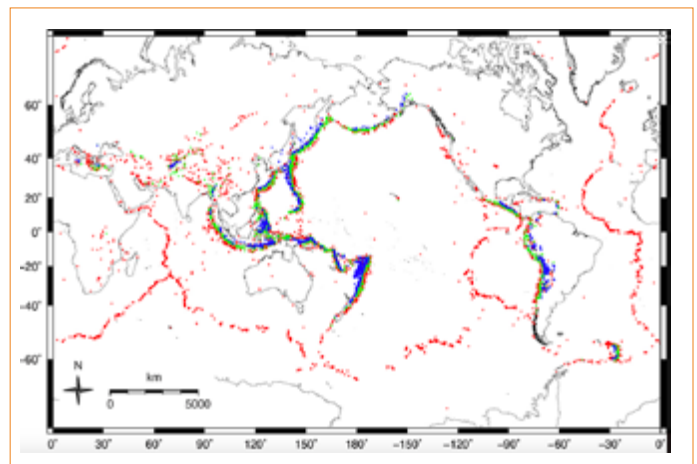
The mid ocean ridge, one of the largest geological landforms on Earth, consists of an underwater mountain range in the Atlantic Ocean running from 87°N to 54°S and rising approximately 3 km above the ocean floor. The ridge is a divergent plate boundary with successive underwater ridges created from magma rising between the tectonic plates. The youngest rocks are nearest to the fault and the combined features extend 1000 to 1500 km wide. There are many transform faults where movements occur sideways or vertically at breaks in the crust. Although mostly underwater there are many volcanic islands of varying size along the ridge including Iceland where many landscapes and landforms are shaped by volcanic and geothermal activity. The ridge, is growing at a rate of about 2.5 cm per year in an east-west direction, widening the Atlantic Ocean in the process.

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SOURCE C: Geomorphic hazards at plate boundaries



3A This map shows the location of volcanoes that have been active within the past 10,000 years (red triangles).



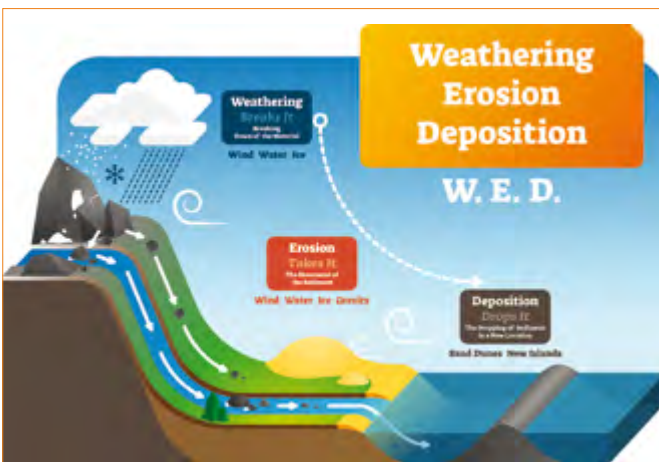
3B This map shows the locations of all earthquakes with a magnitude greater than 4.5 for the years 2015 and 2016. The colours indicate earthquake depth; red <35 km, green 35-100 km, and blue >100 km.

Source: <https://uhlibraries.pressbooks.pub/historicalgeologylab/chapter/chapter01-plate-tectonics/>

2. Weathering, erosion and deposition

Weathering, erosion and deposition are the main geomorphic processes transforming the Earth's surface into distinct landscapes and unique landforms.

SOURCE D: Geomorphic processes: Weathering, Erosion and Deposition.



Source: Shutterstock

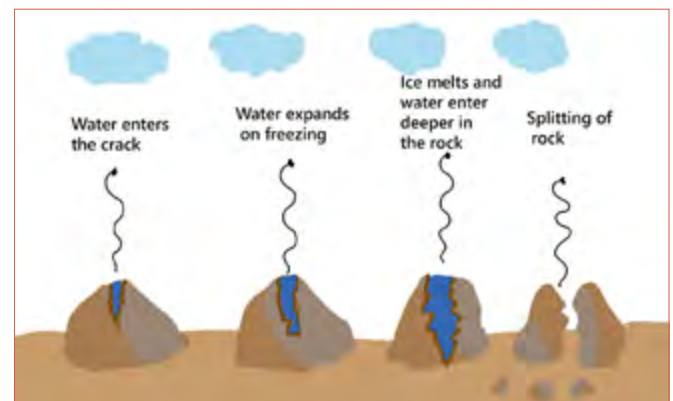
How does weathering shape the land?

Weathering is the breakdown of rocks or the loosening of surface minerals when exposed to processes caused by climate, chemical reactions, plants and animals. Weathering occurs in place (in situ) and occurs before erosion. Weathered rock is more easily eroded. Physical or chemical processes cause weathering.

Physical weathering processes include the freezing and thawing of water in crevices and joints; the growth of salt crystals; the heating and cooling of surface rock; the action of plant roots and animals.

Chemical weathering occurs when rock minerals react to compounds in the air and water. Some chemical weathering processes include carbonation (a weak acid forms when Carbon dioxide mixes with rainwater) and oxidation (Oxygen reacts to iron in rock).

SOURCE E: How water and plants can physically weather rocks



Source: <https://geography-revision.co.uk/gcse/agriculture/coastal-transportation-deposition/>

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How does erosion shape the land?

Erosion is the natural process of removal and transportation of weathered material from its original location to a place where it will be deposited. **The agents of erosion** include water, ice, wind and gravity. Waterfalls, coastal rock platforms and valleys are formed by erosion.

Moving water collects weathered material with the erosive power of the water increasing with volume and the speed at which it moves. Fast flowing rivers in mountains have more erosive power than slow flowing rivers on floodplains. Glaciers move millions of tonnes of rock to create deep steep sided valleys and waves carve distinctive landform features from rocky headlands on coasts.

Erosion processes include:

- **hydraulic action** is the physical force of water removing and transporting rock particles and sediment
- **abrasion** is the physical action of rocks and sand transported by water and wind acting like sandpaper to wear away the land

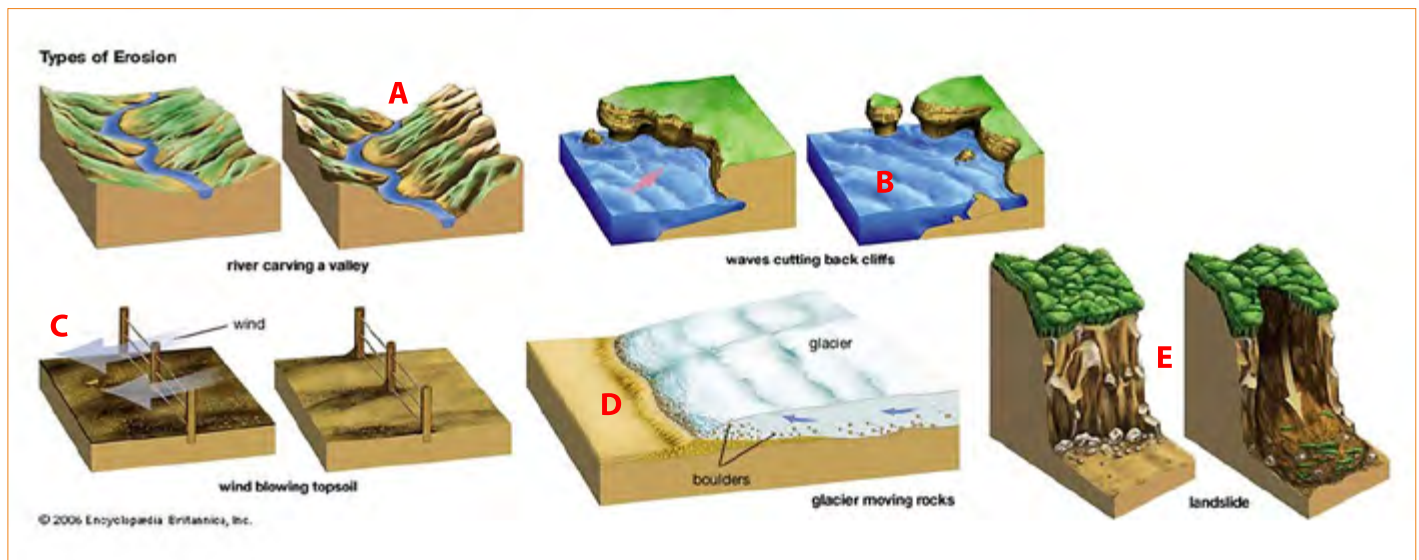
- **attrition** is the physical process of transported rocks colliding and wearing each rock into a smaller, more rounded shape.
- **corrosion** is the chemical process of water dissolving rock minerals and transporting these in solution

Mass movement (mass wasting) is also considered a process of erosion. When weathered rock can no longer resist the force of gravity it falls to a new location at a lower altitude. Gravity transports the rock or sediment downhill.

Landscapes shaped by erosion:

- Fluvial landscapes are shaped by rivers
- Glacial landscapes are shaped by ice
- Mountain landscapes can be shaped by water and/or ice
- Coastal landscapes are shaped by ocean waves and currents
- Arid landscapes are shaped by wind and water
- Agricultural and urban landscapes are shaped by human activities that are influenced by the natural landscape and natural processes.

SOURCE F: Examples of erosion shaping landscapes and landforms



Source: <https://www.britannica.com/science/erosion-geology>

Fluvial, arid, coastal, karst, mountain and glacial landscapes

These landscapes are recognised by unique features and landforms created by geomorphic processes. It is the landforms that give these landscapes their identity. The vegetation communities and human structures layered onto these features vary globally. The spatial distribution of these landscapes can be mapped at a range of scales because of the common landform features they contain.

How does deposition shape the land?

Deposition occurs when eroded rock particles are dropped in a new location usually after the agent of erosion loses the power to carry the material any further. Glaciers deposit eroded rock known as moraine at the sides and front of the glacier. Rivers deposit sediment when they flow across a flat floodplain. Waves drop sediment on a beach when the water soaks into a beach. Wind moves sand in coastal and desert landscapes to create sand dunes. If dunes are not stabilised by plants dunes will continue to change size and shape over time.



Desert dunes in the Sahara Desert Morocco. L Chaffer



Large coastal dunes in Oregon USA. L Chaffer

Human or constructed landscapes

Some landscapes are recognised by the dominant human activity. These include agricultural, industrial and urban landscapes. These are influenced by the underlying landform features but are not created by them. Sometimes the geomorphic forces that created the landscape can be observed but often these constructed landscapes hide the natural landscape below.



Capetown, South Africa is an urban landscape influenced by the surrounding coastal and mountain landscapes.

Source: Shutterstock

Biotic Landscapes

Some landscapes are recognised by their dominant type of natural vegetation or habitat (biosphere) e.g. rainforest, coniferous (boreal) forest, grassland and tundra. It is the features of the biosphere that give these landscapes their identity, not the underlying landforms. Rainforests for example are found on floodplains and mountains while tundra is found at high latitudes such as the arctic and also at high altitude such as mountain tops above the treeline.



Tundra landscape. Hannes Grobe, AWI - Own work, CC BY-SA 2.5, <https://commons.wikimedia.org/w/index.php?curid=2978170>

THINK

Can you name one place you know where weathering, erosion and deposition have all shaped the landscape?