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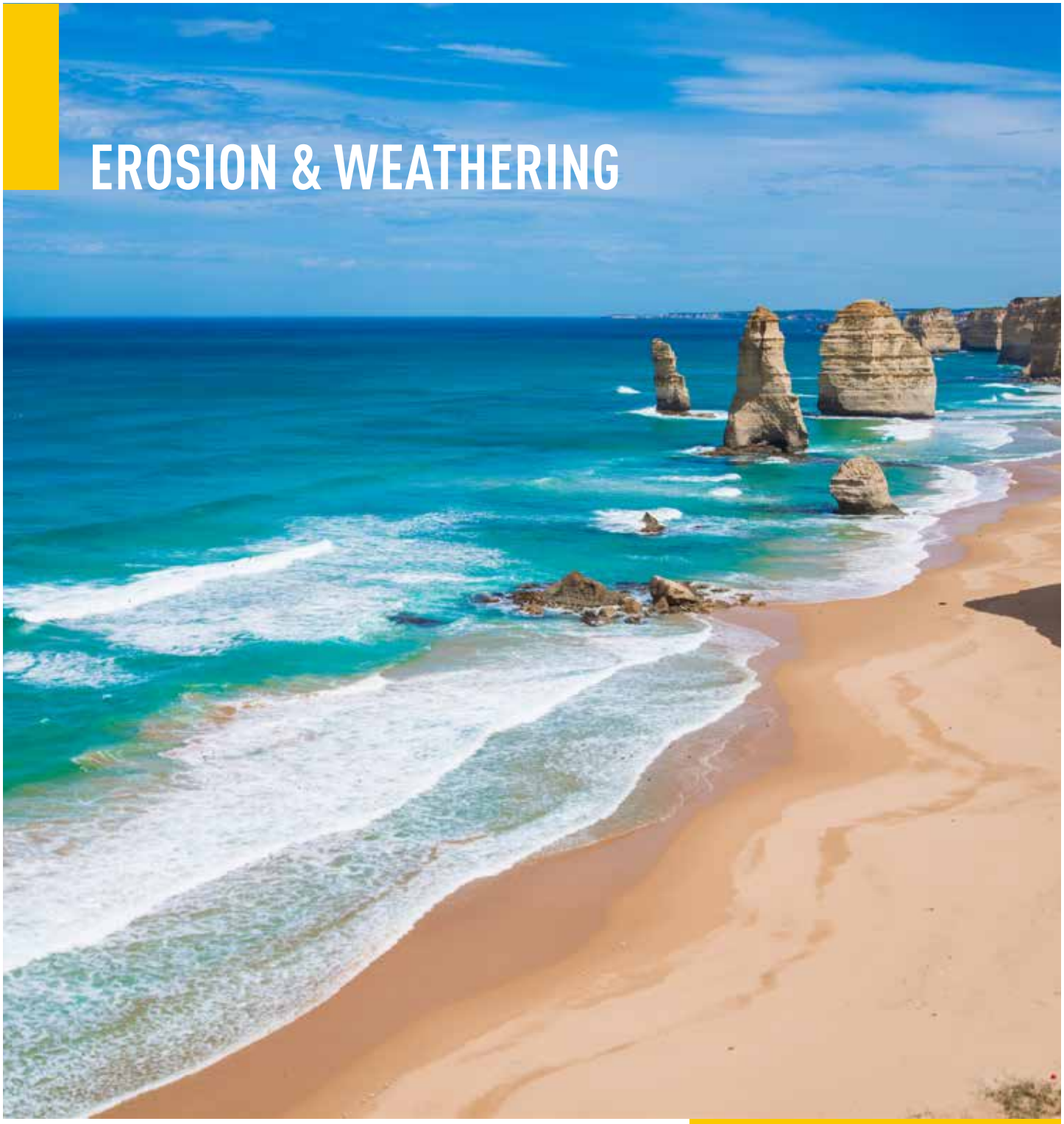
Educational Travel & Experiences

EROSION & WEATHERING



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Erosion & Weathering

Weathering involves two processes that often work together to decompose rocks. Both types of weathering work on the rocks as they rest in place, no movement is involved in either process.

Erosion takes place only if a rock particle is actually moved by a flowing agent such as air, water, or ice. When gravity is the cause of the movement, it is called mass wasting. So rock falls, slumps, and debris falls are instances of mass wasting.

In many natural environments, you will be able to see obvious signs of erosion. In fact, erosion plays an active role in creating formations like hills, valleys, and islands. By removing sediment from areas that were once covered by glaciers, erosion also shapes the shorelines of lakes and coastlines, and transports material downhill from elevated sites.

Four processes take place during the process of erosion: Detachment is the process of disengaging a particle from its surroundings. Entrainment occurs when a particle is lifted by an agent of erosion. Transport is the movement of eroded material by way of a mediums like air, water, or ice. Erosion ends with deposition, when transported particles fall out of the transporting medium and settle on a new surface.

CHEMICAL WEATHERING
A chemical change that alters some or all of the minerals within a rock.

MECHANICAL WEATHERING
A physical breaking of rocks into pieces without changing the chemical make-up of the minerals inside them.

On the left below are examples of landscapes with noticeable signs of erosion. On the right are examples of agents of erosion. Can you identify which is the most common agent of erosion for each landscape? Draw a line to show a match.

Desert Landscapes	**Ice**
Coastal Landscapes	**Molten Rock**
Glacial Landscapes	**Waves**
Humid Landscapes	**Rain**
Volcanic Landscapes	**Wind**

Waterfalls

Water is a very powerful agent of erosion. One of the most frequent side effects of fresh water erosion is the creation of waterfalls. New waterfalls begin when streams that flow from soft rock to hard rock erode the soft rock, leaving a hard ledge over which the stream falls, creating a waterfall.

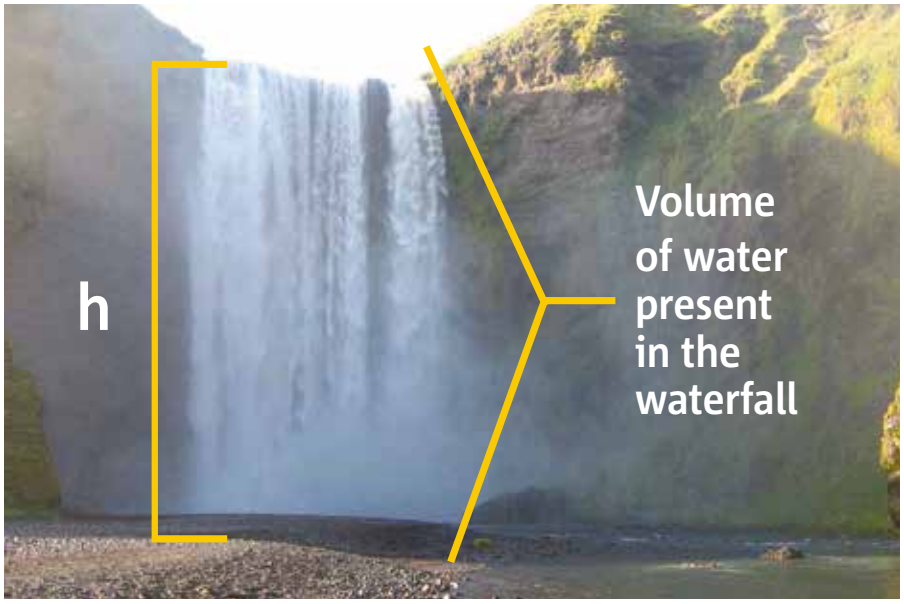
The velocity of a stream increases as it approaches a waterfall, and as speed increases, so does the rate of erosion. Sometimes, the erosion at the base of a waterfall can cause it to retreat.

Additionally, erosion behind a waterfall can also cause a rock shelter or cave-like structure to form. Read the next page to find about more about the different kinds of waterfalls that are caused by erosion.

Waterfalls do not have a standard classification system. They are sometimes classified by their volume of water, their width, their height, and even the way water descends. The most frequently accepted scientific approach is to use volume. The calculation is based on how much water is present during the vertical drop of the waterfall. The following diagram outlines this principle.

The velocity of water flow increases as it approaches the top of the waterfall. This erodes the rocks at the waterfall edge, often causing them to be flat and smooth.

The rushing water and sediment that it carries are a powerful force of erosion to the plunge pool at the base of the waterfall. This can cause whirlpools and hollow out the rock face, creating a cave like structure behind the waterfall.



A few of the geometrical waterfall classifications:

Plunge: Drops vertically without touching the cliff face.

Horsetail: Drops vertically while maintaining some contact with bedrock.

Fan: Fans out as the drop.

Punchbowl: Has a plunge pool deeper than the height of the waterfall.

Block: Has a rectangular shape. Sometimes these waterfalls are wider than their height.

Tiered: Has more than one vertical tier from a singular perspective.

Segmented: Splits into two or more parallel threads.

Chute: Has a watercourse forced into a narrow channel resulting in an ejection of water.

Scree: Flows over loose rocks down a gentle slope.

Slide: Flows over a low-angle slope.

Can waterfalls make you happy? Scan this code to learn more.

Coastal Erosion

Coasts erode as a result of high energy waves, long fetches (lengths of water over which a given amount of wind has blown), high exposure to the elements, and a lack of newly deposited material. Eroding coasts are also influenced by the longshore drifts (coastal transport process by which sediments are along the shoreline).

There are three main types of coastal erosion: Abrasion occurs when waves transport material and gradually wear away at the coastline or cliff like sandpaper. Hydraulic action is the process by which air trapped in the water is forced into cracks in a cliffside. Over time the cracks are widened and destabilize the cliff causing fragments to break off.

The process of attrition takes place as a result of the water causing rocks to crash into each other which breaks them down into smaller pieces.

Shoreline cliffs are a common result of erosion and form when waves scour away at the base of coastal rock formations until a wave-cut notch forms. This notch enlarges, undercutting the cliff above until it is so thin that it collapses. As a cliff retreats, a beach may eventually develop in its place and act as a buffer to slow the process of erosion. Here are a few other common results of shoreline erosion are:

Wave-Cut Platforms are gently sloping rock ledges that extend from the high tide line at the base of a cliff to below the low tide level. Rock pools form in the hard bedrock of the platforms creating small habitats for coastal ecosystems.

Headlands are pieces of land that jut out from the coastline, where they often flank bays and are surrounded by water on three sides. They consist of stronger, more resistant rock than the bays. Due to the way waves refract around the headlands, the energy stored within the waves concentrates on the sides of the headlands and over time develops coastal features like caves, arches, and stacks.

Caves are formed mainly by hydraulic action. When waves force their way into cracks in a cliff face, the sediment in the water grinds away at the cliff creating a cave.

Coastal Erosion

Stacks are the final result of waves hitting the sides of headlands, first forming caves, then arches as the back wall of the cave is eroded away, and finally stacks as the top connecting piece of the arch washes away.

Arches occur when a headland is eroded on both sides and what was a cave breaks through to the other side.

Bays are surrounded by land on three sides and occur in sheltered, low energy zones where the shore has weaker, less resistant rock.

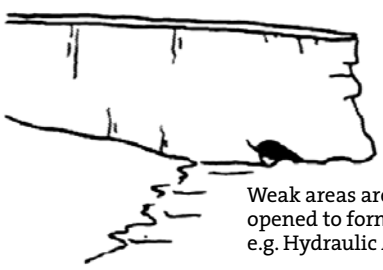
The Twelve Apostles is a collection of limestone stacks along the Great Ocean Road in Victoria. Despite the name, only eight Apostles remain. Why? The strong winds and harsh waves from the Southern Ocean gradually erode the soft limestone, forming caves. The arches of the caves eventually collapse, creating individual stacks. Over time, it is believed the existing cliff faces will become new stacks.

Before

After

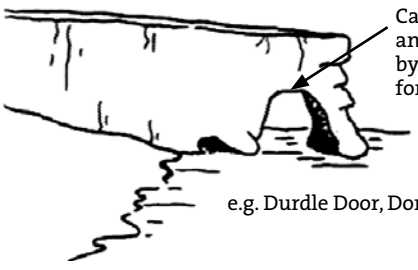
Erosion of a Headland

1.



Weak areas are attacked by waves and opened to form a CAVE (due to erosion e.g. Hydraulic Action)

2.



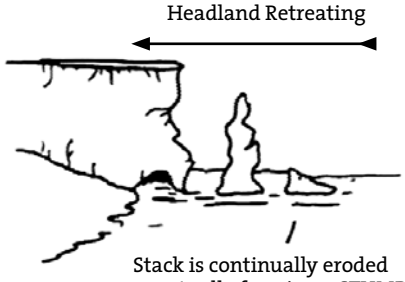
Cave widened and deepened by erosion to form an ARCH

e.g. Durdle Door, Dorset

3.

As the roof of the arch is continually undercut it eventually collapses leaving an isolated STACK
e.g. Old Harry, Dorset

4.



Headland Retreating

Stack is continually eroded eventually forming a STUMP

Coastal Erosion

Other examples of geologic formations are below. Can you identify how some of these other famous geologic formations were created?

The London Arch – Victoria

The Three Sisters – New South Wales

The Grotto – Victoria

The Pinnacles – Western Australia

Wave Rock – Western Australia