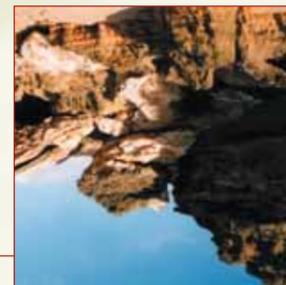




Fallen arches

Natural rock arches can collapse suddenly. Fractures in the arch or the rocks under it could indicate that it is unsafe, but you cannot be sure just by looking at it. Admire natural arches from a distance unless you think they are safe. Even then, only spend a short time near the arch.



Boulders – dangerous if disturbed

If you lean, climb or sit on a boulder it may roll or fall, hurting you or other people. If you dig under a boulder, it can fall or roll on you. Make sure a boulder is not going to move before you trust it!

Caves can clobber you

Pieces may fall unexpectedly from the roof of a cave, and heat from fires might trigger collapse. Only go into caves that are open to the public, and light fires only in an outside fireplace.



Sand can suffocate

Sand cave-ins do happen...Sand can bury you! Dig only shallow holes or build small structures that cannot bury or suffocate you if they collapse. Never tunnel into sand!



Ledges let you down

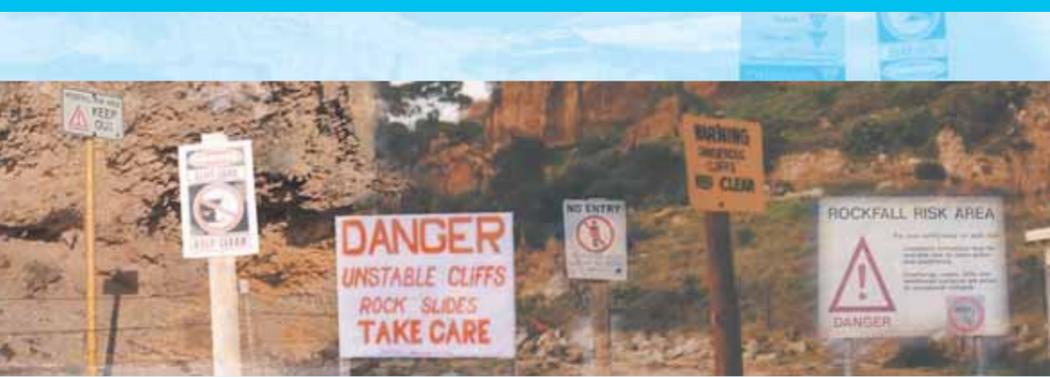
Some rock ledges look stronger than they are. Your weight can break them. If other people get on the ledge too, it is even more likely to break. Jumping on a rock ledge might break it. Sit or stand on a rock ledge only if you are sure it is safe. Do not jump on it!

Cliffs and overhangs drop rocks

Boulders fall without warning from cliffs and overhangs. The sharp, broken rocks you see at the bottom of a cliff fell from the cliff. Keep a safe distance from cliffs and watch out for falling rocks. Sit under trees or bring your own shade instead of using overhangs for shelter.



Going to the beach is fun, but there are hidden dangers you should be aware of.



Your role

- Take notice of warning signs. They tell you something is dangerous.
- Keep away from dangerous rock formations and do not dig deep holes or tunnel into sand, even if there are no warning signs.
- If you suspect imminent danger, contact the local council or organisation responsible for the coastline in that area.
- Warn people who are doing something dangerous.

To find out more about natural hazards

Go to the Geoscience Australia website at www.ga.gov.au or phone 02 6249 9111. Check out the Australian Landslide Database at this web address, or Emergency Management Australia's Disasters Database at www.ema.gov.au.

We need your help!

Geoscience Australia's Australian Landslide Database includes rock falls, displaced boulders and sand cave-ins. If you see or hear of any of these, please let Geoscience Australia know so we can improve the database and keep it up-to-date.

Contact details

Phone: 02 6249 9111

Email: landslides@ga.gov.au

Write to: Risk Research Group, Attention: Landslides, Geoscience Australia, GPO Box 378, Canberra ACT 2601.

This pamphlet is produced jointly by Geoscience Australia and Emergency Management Australia. (June 2004)



SHORE safety

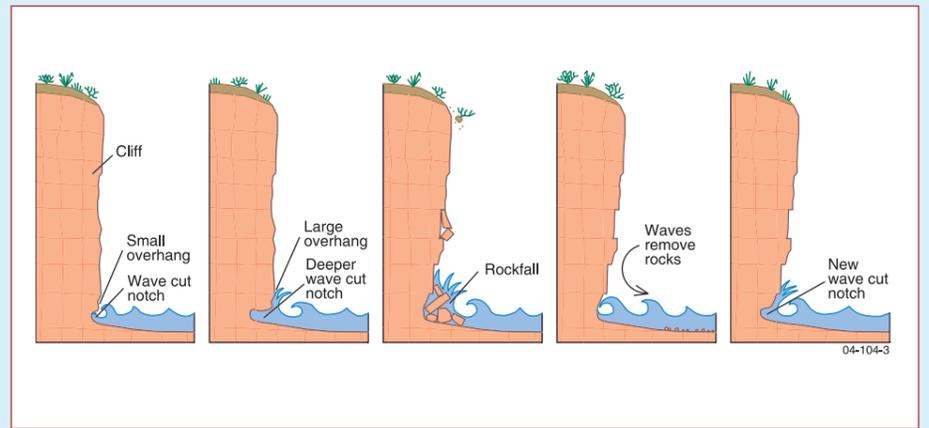


Why do cliffs and overhangs drop rocks?

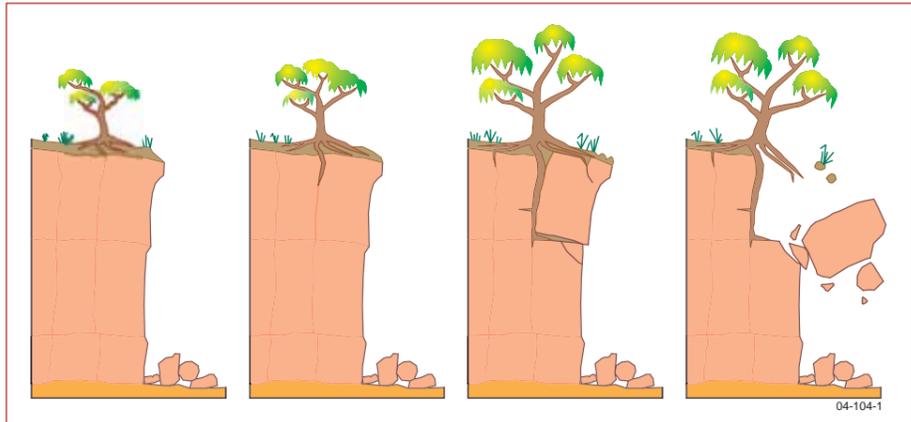
- Cliffs are formed and wear away by erosion. Water and wind blast the rock with solid particles, waves pound the cliffs, and water dissolves minerals in the rocks.
- As the cliffs wear away, they form overhangs that weaken, break and fall suddenly.
- Rocks can also fall off cliffs if water or tree roots enter cracks behind the cliff face.

On 27 September 1996, people were sheltering under an overhang in a limestone cliff near Gracetown, Western Australia. The overhang and part of the cliff behind collapsed, and about 2500 tonne of rock and sand fell. Nine people were killed and three others injured. The collapse was partly attributed to the rock absorbing water and becoming heavier.

Remember, it is natural for rocks to fall off cliffs!



Stages in erosion of a cliff by waves.



How the roots of vegetation can cause rock falls.

Why does sand kill?

People like to have fun on the beach and to dig in sand. It is safe as long as you do not excavate or build structures that can collapse and bury you.

- Slopes of dry sand are very unstable because there is no attraction between the grains.
- Wet sand dries out quickly. Also, vibrations (from wind, waves or footsteps) can make sand slopes collapse, even when wet.
- When you tunnel or dig deep holes in sand, the tunnel or hole can cave in at any time.

On 20 January 2004, a 15 year old boy at Ocean Grove, Victoria, died after digging a deep hole which collapsed on top of him.

Why are boulders dangerous if disturbed?

- A boulder remains in place because its shape, weight distribution and resting surface are in equilibrium.
- If you sit, lean against, or climb on to a boulder, you are changing its weight distribution, and it may move, killing or injuring you, or threatening people below.
- If you dig under a boulder, you remove its support and it may tip or drop on to you.

On 9 April 1997, a man on Hinchinbrook Island, Queensland, became trapped for 48 hours under a one tonne boulder and lost both legs after he leaned against it and it fell on him.

Why might ledges let you down?

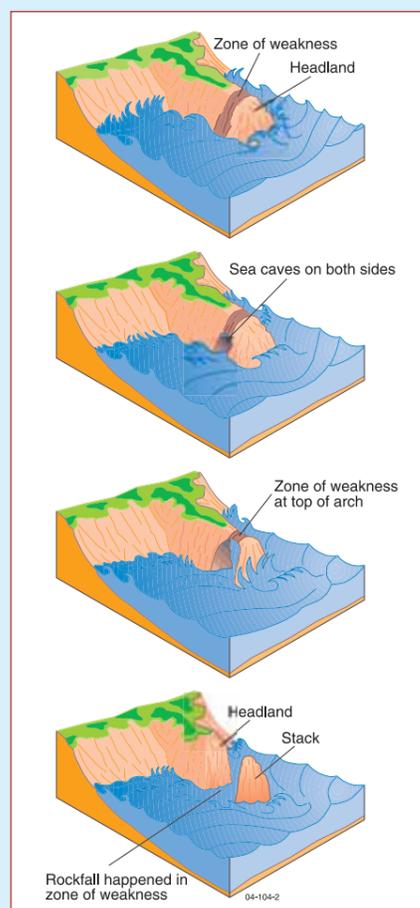
- Ledges will stay where they are as long as the strength of the rock can support the weight of the overhang. If the ledge absorbs water it will become heavier and may break.
- If you sit or stand on a rock ledge, you are increasing the weight on it and the rock might not have the strength to carry its own weight and yours, too.

On 21 February 2004, two tourists stood on a blocky sandstone ledge at the top of a coastal cliff at Bangalley Head, north of Sydney. The block, which they had been standing on, fell because the ground under it was unstable. One man fell forward over the cliff and died. The other fell backward on to the headland and suffered a few scratches.

Why might a cave clobber you?

- Caves are tunnels formed by erosion.
- The cave roof may suddenly collapse under its own weight, or drop boulders.
- Lighting a fire in a cave heats the roof unevenly, and may cause pieces of rock to break away and fall.

In April 1958, at Port Willunga, South Australia, rocks and rubble fell from a cliff onto a party who were about to eat lunch in a cave by the beach. Two men were killed and one woman was critically injured.



Why do arches fall?

- Sea caves and rock arches form by marine erosion when a headland, with fractures (joints) across it, is attacked by waves that swing around and break against the sides of the headland. The joints wear away faster because the rock is cracked and weaker.
- A natural rock arch is formed by the meeting of two sea caves, one on each side of a headland.
- Eventually the arch collapses under its own weight forming a stack.

London Bridge, a well-known tourist attraction on the south coast of Victoria, was a double natural archway in limestone. On 15 January 1990, the inner arch collapsed stranding two tourists on the stack.

Left: Stages in the formation of sea caves, arches and stacks by erosion of a rocky headland by the sea.

