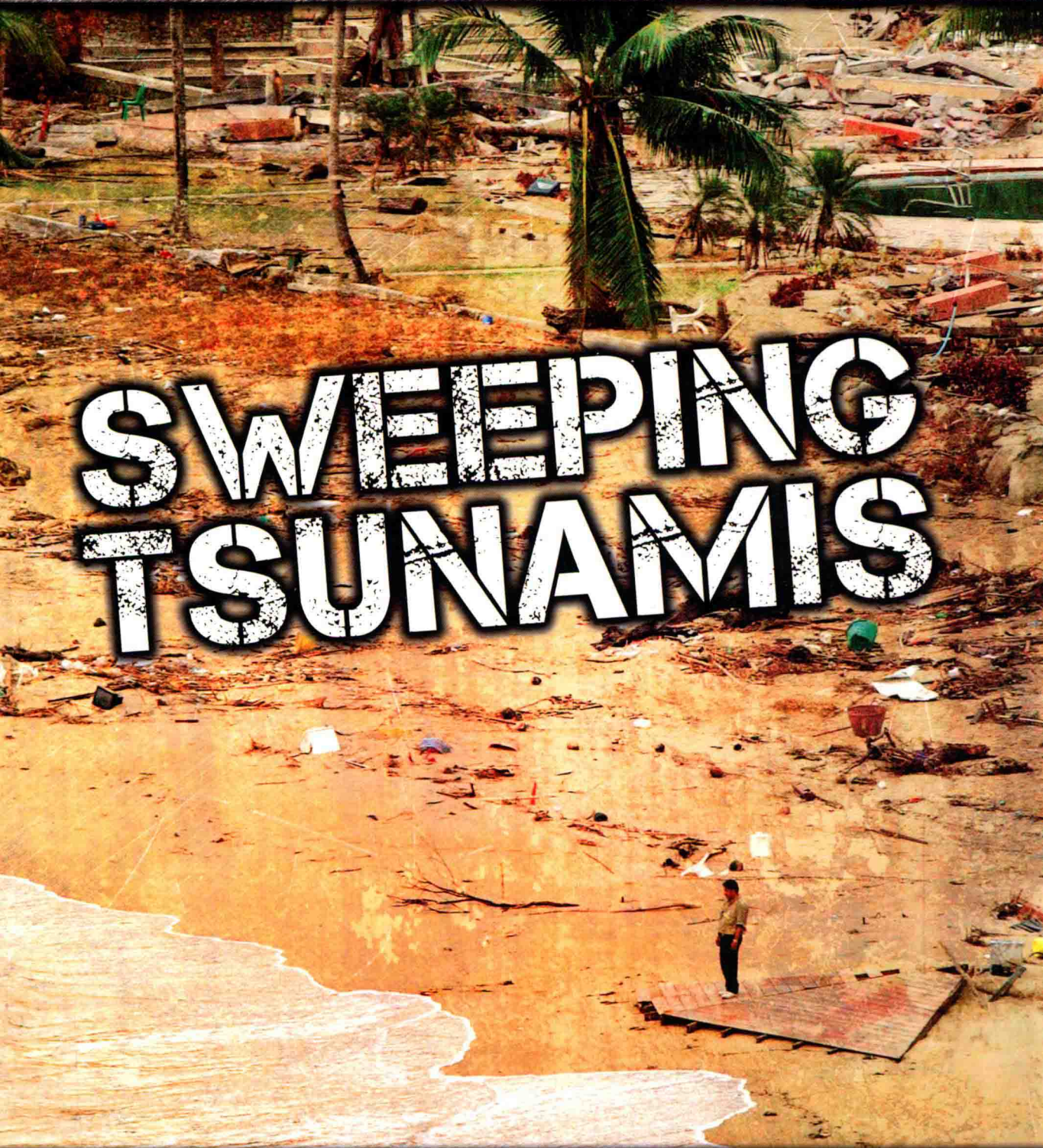


AWESOME FORCES OF NATURE



SWEEPING TSUNAMIS



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SWEEPING TSUNAMIS

Revised and updated



Louise and Richard Spilsbury

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What is a tsunami?

A tsunami is a huge destructive ocean wave. It is nothing like an ordinary wave. As ocean waves move into shallow water, their narrow foaming tips curl over and 'break' (collapse). A tsunami hits land as a dark, fast-moving ledge of water that rarely breaks as it nears shore. Most tsunamis are barely noticeable in deep parts of oceans, but they get bigger as they approach land.

TSUNAMI FACTS

- ❶ The biggest tsunamis are the most destructive waves on the planet.
- ❷ The fastest tsunamis in the world can reach speeds of 800 kilometres per hour.
- ❸ Tsunamis have reached heights of 40 metres above the normal level of the sea.



Big tsunamis may move towards the land at hundreds of kilometres per hour. This photo, of a first tsunami wave, was taken by a tourist on the island of Penang, Malaysia, in December 2004.

Awesome force

Big tsunamis are like huge walls of water. They can be tens of metres tall and several kilometres wide, containing millions of tonnes of water. The water smacks hard onto land with the same force as a wall of concrete.

Anything in the way of a big tsunami – from people to giant ships or lorries – may be swept away, crushed, or buried under water. Trees and telegraph poles are snapped like matchsticks. Homes, schools, and lighthouses may collapse as if made of cardboard. Over the past 100 years, tsunamis have killed hundreds of thousands of people and caused millions of pounds' worth of damage around the world.

The 2004 Indian Ocean tsunami caused flooding on Koh Racha Island, in Thailand. This luxury hotel was destroyed by three large waves.



Harbour waves

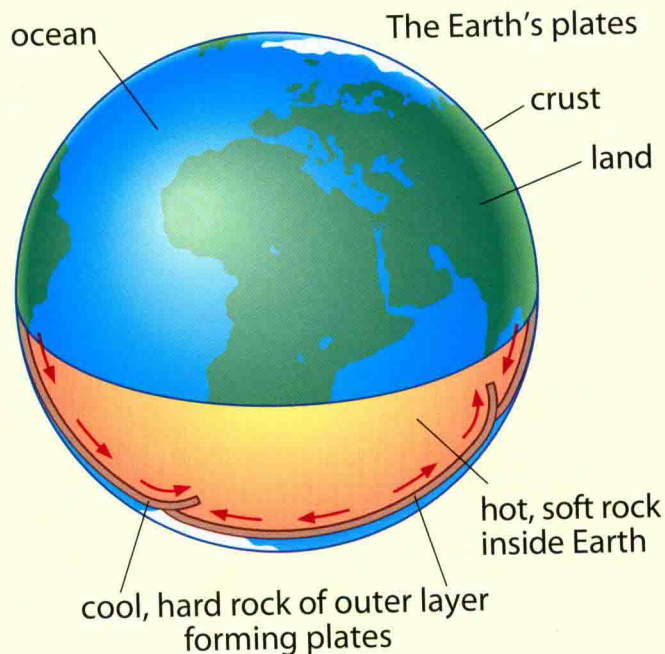
'Tsunami' is a Japanese word that means 'harbour wave'. It was given this name because of the great devastation caused around the coastal harbours of Japan by many tsunamis.

What causes a tsunami?

Tsunamis usually happen when giant chunks of land at the bottom of the ocean move as the result of an **earthquake**. Millions of tonnes of seawater move in to fill the gap. This causes a series of waves on the surface of the ocean – a bit like the ripples that spread out when you drop a stone into a pond or lake.

Earth movements

The outer layer of the Earth is made of solid rock. On mountain tops it can be bare, on deserts it may be covered with sand, and in oceans it is covered with seawater. Incredibly, this rock is always moving, although it does this very slowly. Deep inside the Earth it is so hot that the rock is melted into a sticky liquid. The cooler, lighter rock of the surface floats around on top of this liquid in enormous chunks called **plates**.



As the Earth's plates move, they push and slide against each other. Sometimes the plates stick and then one suddenly slips, causing an earthquake.

Other causes of tsunamis

All tsunamis start when massive amounts of seawater are suddenly moved. Sometimes the **lava** in the Earth spurts out at gaps or thin spots in the plates. This is what we call a **volcano**. When underwater volcanoes explode, they destroy rocks around them and this can start tsunamis.

Tsunamis can also be started when large amounts of rock or ice on mountains suddenly break free and fall into water. Tsunamis could even happen if a large meteorite (a piece of rock from space) plunged into an ocean.



In 1883, the Krakatoa volcano in Indonesia erupted. The whole island collapsed and caused 35-metre high tsunamis that sped towards neighbouring islands, killing 36,000 people.

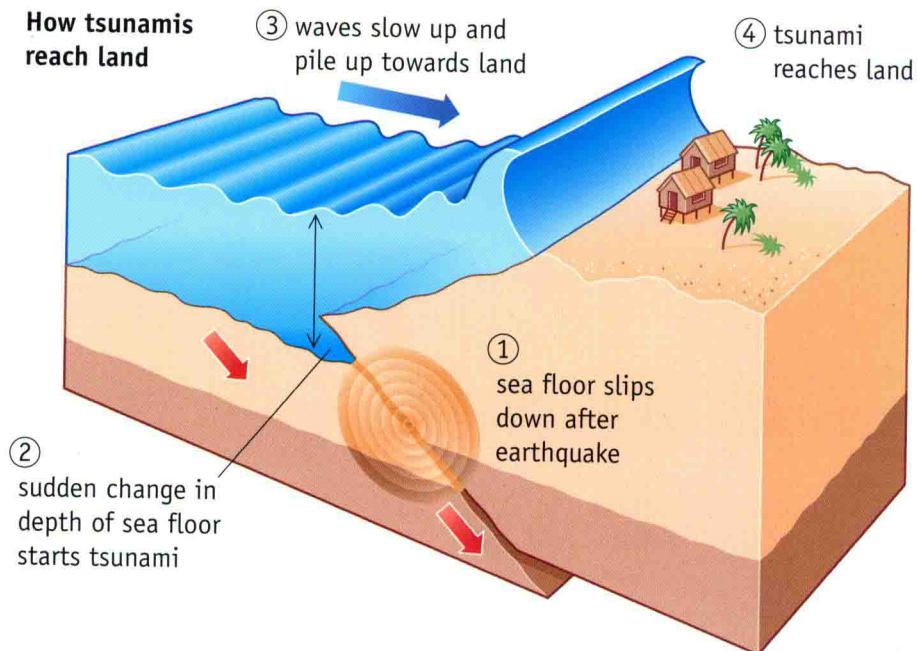
Deep beginnings

Tsunamis move outwards from the point where they start. Imagine you are on a plane flying over an ocean. If an **earthquake** struck hundreds of metres below on the **seafloor**, all you would see is crumpled water for an instant. The sea would then flatten again and a tsunami would speed away.

Tsunamis travel fastest in deep water. The **crest** of a tsunami in deep water may be only one metre tall. This crest is just the tip of a deep wave that reaches tens of metres into the water. As the wave moves towards shallower water, its bottom slows down as it touches the seafloor but the top pushes forward at speed. The water then bunches up and the tsunami is at its tallest as it reaches the coast.

Tsunamis can build to great heights as they get closer to land. Although they slow down, they can still hit coastlines at hundreds of kilometres per hour.

How tsunamis reach land



Enormous forces

Tsunamis shift immense quantities of water at such speed that they can travel over very long distances. In 1960, an earthquake off Chile in South America started a tsunami. The tsunami travelled 15,000 kilometres in 22 hours before hitting the coast of Japan. A big tsunami is barely slowed down when it flows over a small island, but it usually stops after it hits a **continent**. Some large tsunamis bounce back off continents and move back and forth over whole oceans, getting gradually weaker, over several days.

Tsunamis and tidal waves

Tsunamis are sometimes wrongly called tidal waves. Tidal waves are waves caused by **tides**. Tides are the regular rise and fall of the level of the oceans, caused by the pull of **gravity** of the Moon and the Sun. Especially high tides sometimes cause large tidal waves, but never tsunamis.



After the first tsunami waves, weaker waves continue to hit the mainland, adding to the damage. Here, the town of Hakkaduwa in Sri Lanka is being hit by the later waves of the 2004 Indian Ocean tsunami.

Where do tsunamis happen?

Most tsunamis happen in the Pacific Ocean. Some of the countries most at risk from tsunamis are Japan, the USA, Papua New Guinea, and Chile, because they border the Pacific. Tsunamis happen here because a part of the Earth's outer surface, called the Pacific **plate**, lies underneath the Pacific Ocean. There are lots of **earthquakes** and **volcanoes** along the edges of this plate, where it meets other plates. This area is often called the 'Ring of Fire'.

Where else do they happen?

Tsunamis affect other coasts where earthquakes happen in the ocean. They have hit countries in the Indian Ocean, Canada, which is at the edge of the Atlantic Ocean, and countries in the Mediterranean Sea.



The countries around the edge of the Pacific Ocean are all at risk from tsunamis. But certain Pacific islands, such as Hawaii, are at particular risk because they are in the middle of the Ring of Fire. Tsunamis can approach from all sides!

Shape of the land

Some parts of coasts are more affected by tsunamis than others. Towns and villages in greatest danger are those at **sea level** less than two kilometres from the sea. Even quite small tsunamis can travel a long way over flat land like this.

Tsunamis are also dangerous in curved bays or at the end of **fjords** (river valleys with steep sides). The waves get very high between their narrow sides. When tsunamis reach **headlands**, which are narrow strips of land sticking out to sea, they wrap around it. Then water floods onto land from both sides.

TSUNAMI FACTS

- 1 The highest tsunami ever recorded happened in Lituya Bay in Alaska in 1958. A **landslide** fell into the narrow fjord, causing a wave over 500 metres high – that's nearly as tall as the CN tower in Canada!



Tsunamis can roll much further inland over a flat coastline like this, than they can over a steep or hilly shore.

What happens in a tsunami?

Tsunamis move very fast. If someone sees one approaching, then it is probably too late for them to get away from it! Sometimes, though, there are signs that a tsunami is on its way.

Many tsunami survivors describe how the **sea level** drops. Water is suddenly sucked away from the shore, uncovering sand, mud, and reefs on the sea floor and leaving fish and boats stranded. The reason for this is that the water has moved to fill the space on the ocean floor created by an **earthquake**. Then the water returns in waves.

“ *I saw the entire bay suddenly drain of water with a quiet roar.*’

Mark Vanderkam, a survivor of the tsunami that hit Thailand in 2004

”

Before the first tsunami waves arrive, the sea is sucked back from the shore. This is what it looked like at Galle in Sri Lanka right before the 2004 tsunami hit.



Wave train

As the sea gurgles out from land, there is sometimes a very strong wind. This is air being pushed in front of the speeding tsunami. A big tsunami often comes in a series of waves called a wave train. The time between each wave **crest** may be minutes or even as long as an hour. Between each tsunami crest there is a **trough**, when water is again sucked out to sea. It seems like the water is being pulled by an enormous vacuum cleaner before it shoots back!



The first tsunami wave to break may not cause the most damage. Other, more damaging waves, may arrive later.

The first tsunami may not be the worst – the biggest, most dangerous waves in a wave train are often the third and eighth waves to arrive. After the tsunamis have struck, it may take days before normal ocean waves get back to their expected sizes.