



BBC NEWS

Tsunami: Anatomy of a disaster

By Helen Lambourne

At 0059 GMT on 26 December 2004, a magnitude 9.3 earthquake ripped apart the seafloor off the coast of northwest Sumatra. Over 100 years of accumulated stress was released in the second biggest earthquake in recorded history. It unleashed a devastating tsunami that travelled thousands of kilometres across the Indian Ocean, taking the lives of more than 200,000 people in countries as far apart as Indonesia, the Maldives, Sri Lanka and Somalia.

THE EARTHQUAKE

Two hundred and forty kilometres (150 miles) off the coast of Sumatra, deep under the ocean floor, at the boundary between two of the world's tectonic plates, lies a 1,200km (745 miles) trench called the Andaman-Sumatran subduction zone. At about the same speed as your fingernails grow, the lower plate, carrying India, is being forced or subducted beneath the upper plate, carrying most of South-East Asia, dragging it down, causing huge stresses to build up. These stresses were released on 26 December. Shaking from this giant mega-thrust earthquake woke people from sleep as far away as Thailand and the Maldives. Unlike the more frequent strike-slip earthquakes of Kobe or Los Angeles, which last for a matter of seconds, subduction zone quakes last for several minutes. The shaking during the Indonesian event went on for eight minutes. Nobody knows how many died in the actual quake itself, but scientists have since visited the nearby island of Simueleu and found something astonishing. The whole island has been tilted by the force of the earthquake, causing coral, submerged beneath the ocean for thousands of years, to be thrust out of the water on the east side; bays in the west have been drained. "We were astonished to find ourselves walking through a pristine marine ecosystem, missing only its multitude of colours, its fish, and its water," said Professor Kerry Sieh, from the California Institute of Technology, US. Yet, when the shaking from the earthquake subsided, no-



one had any idea that the tremors had set in motion something far more deadly - a tsunami.

THE TSUNAMI

Deep under the Indian Ocean, at the epicentre of the quake, the 20m (65ft) upward thrust of the seafloor set in motion a series of geological events that were to devastate the lives of millions. Billions of tonnes of seawater, forced upward by the movement of the seabed now flowed away from the fault in a series of giant waves. The only people in the world to have any idea what had happened were thousands of kilometres away on the island of Hawaii. But, relying on seismic data alone, the scientists at the Pacific Tsunami Warning Centre had no idea the earthquake had unleashed an ocean-wide tsunami. It was a full 50 minutes after they first picked up the tremors that they issued a warning of a possible local tsunami. Thirty minutes after the shaking had subsided, the first wave, travelling eastwards, crashed into Sumatra.

On the shores directly facing the epicentre, the waves reached heights of 20m (65ft), stripping vegetation from mountain sides 800m (0.5 mile) inland, capsizing freighters and throwing boats into the trees. The city of Banda Aceh, just a few kilometres further round the coast was almost completely destroyed, killing tens of thousands of people in just 15 minutes.

WHAT THE ELEPHANTS KNEW

Leaving a devastated Sumatra behind, the series of waves continued across the Andaman Sea towards Thailand. A herd of elephants in the mountains seemed to know it was coming. They began behaving strangely, stamping the ground and tugging at their chains, eventually breaking away to run to the hills. Elephants have special bones in their feet that enable them to sense seismic vibrations long before we can. Animals taking to the hills was not the only sign that something was about to happen. Due to the complex way in which the seafloor ruptured, some waves set off travelling with the crest first, others travelling trough first. The trough, reaching the shores of Thailand, caused the sea to disappear off the beaches. It is one of the classic warning signs of an approaching tsunami. Tragically, many tourists went down to the beach to look, some to rescue fish left flapping on the sand. A few minutes



later, the first wave hit Thailand. A thousand tonnes of water crashed down on each metre of beach. At Khao Lak, the wave reached 10m (30ft) and caused billions of pounds of damage. The human cost was far greater - nearly 5,000 confirmed dead and 3,000 still missing. At the same time, the westbound series of waves were heading for Sri Lanka. In the deeper waters of the Indian Ocean, barely noticeable at just a 30cm (1ft) above the surface, they were travelling at some 800km/h (500 miles per hour).

SRI LANKA

The first wave hit Sri Lanka with no recede and no warning. The waves, up to six of them, weighing over 100 billion tonnes, rushed inland like a giant tide. As they hit Sri Lanka's southern tip, they began to change direction, an effect called refraction. The part of a wave closest to the shore slowed down in the shallow water, leaving the outer part, travelling at faster speeds, to bend around the island. The southwest coast of Sri Lanka, the side that should have been safe, was suddenly in the waves' direct line. Cities such as Galle were destroyed; over 4,000 people died in this region alone. The waves carried on further north to India, where they killed 10,000 people.

THE MALDIVES

Next in the waves' line, was one of the lowest lying countries on Earth - the Maldives. Miraculously, although 80 people died here, this country escaped relatively unscathed. It seems that due to their unique geography, being the tips of underwater volcanoes and without a continental shelf to push the wave height up, the tsunami just washed through. Coral reefs are also thought to have protected the country, acting like a giant underwater colander, stripping the waves of energy. As the waves left the Maldives, they passed through a narrow gap between the island chains, focusing their energy directly at Somalia, where 300 people lost their lives. In Kenya, the waves, when they hit were small; their energy further removed by the land masses of the Seychelles and Diego Garcia. They had also seen the news reports and evacuated the beaches; only one person died.