

# After the TSUNAMI disaster

Owen Gaffney reports on NERC and the Boxing Day earthquake.

## What can NERC do?

'We were enormously shocked and saddened by what we saw,' said David Ovidia, head of the British Geological Survey (BGS) international team, after visiting the affected areas in the Indian Ocean.

Six hundred scientists met in Bangkok in January for a conference on the tsunami's impact and future preventative measures.

'We have an agreed list of scientific activities that the affected countries would like the developed world to do. Some need immediate action,' said David after the meeting. 'Environmental scientists in the region are highly talented but working flat out. They need essential equipment and specific expertise.'

The main priorities are: contaminated water supplies, building an early warning system, rebuilding towns and cities.

The Department of Mineral Resources, Thailand's geological survey, requested urgent assistance to create geological maps so

they can decide where to build safely and plot potential escape routes from another tsunami.

'I sent one of our experts, Andy Gibson, immediately. He will be there for a month initially, but we are confident we'll get funding to expand this to nine months,' said David.

Dangerous limestone sink holes have opened up across Indonesia, Thailand and other areas, probably caused by both the earthquake and the tsunami. 'We are sending people with Global Positioning Systems to locate and map these sink holes,' said David.

Contaminated water is a grave concern, probably for many years to come. Nearly everyone uses groundwater. Most of the wells have been contaminated with salt, and the clear-up operation is compounding the problem.

'They are flattening buildings and bulldozing debris into hollows. The debris includes contaminants like diesel and car batteries. These will eventually leak out and get in to the groundwater,' said David.

Denis Peach from BGS outlined the extent of the problem, 'In the Maldives 75% of water comes from freshwater lenses that lie beneath the atolls and float on heavier, salty water. The other 25% comes from desalination.

'The wave swamped the islands. Seventeen or 18 islands have no fresh water. Islands with fresh water could still be in trouble: eventually, even in highly impermeable rock, salt water will filter down through to the fresh water. It will take months, even years to flush out the system. The worst affected city, Banda Aceh, in Sumatra, was completely reliant on its groundwater supply. Nearly all rural communities in Sri Lanka, Thailand and the Indonesian coastal zone use ground wells,' he added.

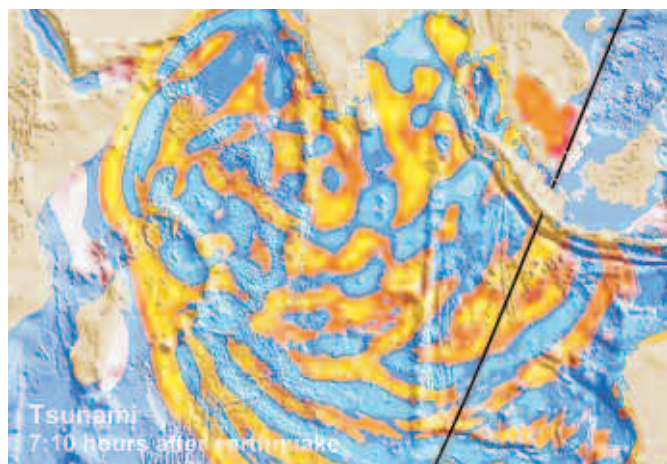
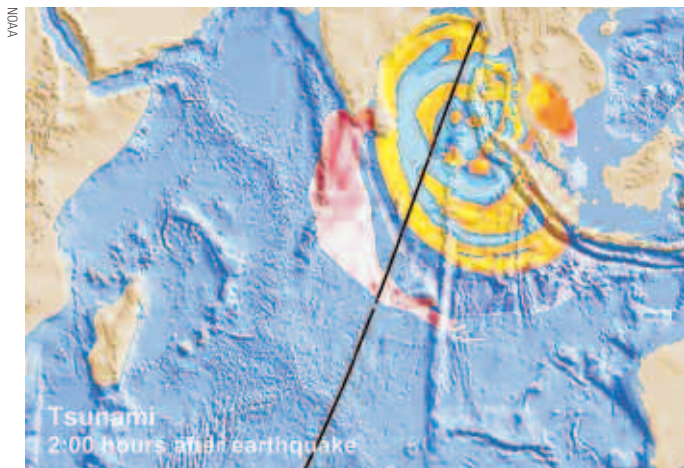
'The rebuilding process in Sumatra will take much longer than elsewhere. The town of Banda Aceh will need to be rebuilt. They are still only clearing the mess,' said David.

Martin Culshaw, a member of the BGS team sent to the Indian Ocean with David Ovidia, did extensive geological mapping in Banda Aceh in the 1970s.

'He has invaluable data and photographs,' said David, 'We have offered his services, and his maps, to the Indonesian authorities.'

## Damage recorded south of South Africa

Scientists on board NERC's *RSS Discovery* reported possibly the most distant damage the tsunami caused: on Boxing Day a 2m high wave washed away the entire crop of penguin eggs on beaches on the Crozet islands, halfway between South Africa and Antarctica, about 1,600 miles south east of Durban.



## Early Warning

The scientific conference in Bangkok agreed that alongside aid and rebuilding, an early warning system must be put in place. The region wants a permanent system by May 2006; until then countries will use temporary systems.

'Each country wants individual responsibility for an early warning system, though they are prepared to work as part of a nodal network. The countries don't necessarily want a high-tech western system imposed on them,' said David.

'A lot of the technology used in the Pacific will not work in the Indian Ocean. A tsunami can take eight or nine hours to cross the Pacific, whereas parts of the Indian Ocean could just get an hour's warning.'

## Could it happen here?

Roger Musson from BGS said a similar sized earthquake in the Atlantic Ocean is unlikely as the subduction zones – where one tectonic plate is pushed beneath another – are not long enough.'

'Really huge earthquakes need a chain reaction where one bit fails after another, producing a long rupture length. In 1960 seismologists registered a 9.4 earthquake, the largest ever, down the long, straight Chilean coast,' he said.

The subduction zone off the Sumatran coast is thousands of kilometres long. In the last 200 years it has experienced several major earthquakes: in 1797, 1833, 1843, 1861, 1941 and 2002. Seismologists always knew there would be more, but could not say whether there would be many small ones or one large one.

Roger said earlier earthquakes provide some clues, 'November 2002 saw an earthquake of about magnitude 7.5 on the Richter scale. Nobody paid much attention to it, but this may be what started the whole process, because the immediate beginning of the Boxing Day rupture was right at the end of the 2002 rupture zone.'

'The rupture spread north pulling down one section of the plate boundary after another, like dominoes, spreading at perhaps 2km per second. It probably only took ten minutes to travel from the epicentre up to the end of the rupture in the Andaman Islands 1000km away.'

He added that other natural events, such as underwater landslides or volcanoes, could cause tsunamis in the Atlantic, and these have proved devastating in the past.

Many recent press and TV reports have discussed the possibility of a volcanic eruption in the Canary Islands causing a massive landslide into the ocean, creating a truly devastating tsunami.

Simon Boxall at Southampton Oceanography Centre (SOC) believes the risks are minimal, 'It would depend on all the rocks falling at once. It is more likely to happen bit by bit than all in one go.'

'If a landslide did generate a large tsunami it could affect certain coastlines around the Atlantic: Portugal and the eastern seaboard of the United States. The UK might be spared because our continental shelf stretches out 1000km. Our shallow waters would protect us by dissipating the tsunami's energy.'

A consensus on the type of early warning system still needs to be reached.

Simon said, 'There is something to be said for having a pressure mounted system around the world. This measures distance between the sea surface and the seabed – it would not just be useful for tsunamis, it could also be used to detect storm surges. In November 1970, 200,000 people died in the Bay of Bengal on account of storm surges and a further 20,000 people in the 1980s. They are more common and more lethal than tsunamis.'



*Banda Aceh shoreline as recorded on June 23, 2004 (top) and December 28, 2005 (bottom).*

## Thailand's coral reefs

NERC has given urgency funding to Barbara Brown, at the University of Newcastle upon Tyne, to look at the tsunami's effects on coral reefs in western Thailand. Barbara will work with Thai scientists at the Phuket Marine Biological Center and use long-term data sets to evaluate the damage caused to the coral and try to predict how fast the damaged areas will recover.

## NERC diver lives to tell the tale

At 9.30am on Boxing Day, Claus Svendsen, from the Centre for Ecology & Hydrology, and his wife Caroline were 24m beneath the Indian Ocean surface. They were ten minutes into a dive around the north of Ko Born Island, 30 miles off Thailand's west coast, when the current abruptly changed direction from east to west.

The divers watched a shoal of fish stemming the tide turn and swim against the new current. After a minute, and just as abruptly, both the fish and current turned back again. The divers were confused. The current built and the shoal struggled to hold its course.

'Suddenly the fish bolted,' said Claus. 'We've no idea where they went but we didn't see any more fish. The flow turned

into a torrent. We needed shelter so we swam towards the seabed. We were probably doing 15 miles per hour. I kept thinking 'don't hit the rocks, don't hit the rocks!' The visibility kept getting worse and there were too many obstacles. We realised we'd be safer away from the seabed,' said Claus.

They swam upwards, into the tsunami, and were whipped along for ten minutes before surfacing east of the island, over a mile from their original dive spot. Other divers from the boat were found up to three miles away.

'Some were caught in a back eddy on the west of the island and others were dragged out to sea, but amazingly no one was injured,' explained Claus.

'We knew something strange had happened but we didn't know what. The water level when we jumped in was extremely low compared to previous days so we were expecting the tide to build to a reasonable strength, but not like that.'

As they travelled back towards the mainland south of Khan Lak the ship's radio was alive with news of freak waves.

'We started finding bits of houses, car seats, gas cylinders, fridges and furniture in the water. We tried to pick up anything that could endanger other boats but had to give up. Then we saw two bodies floating in the water. We knew we were lucky to be alive.'

Koh Bon is one of the Similan Islands, a group of nine islands in the Indian Ocean. The national park rangers are the only permanent residents, though tourists and fishermen stay the odd night. Whilst the islands were badly hit, on the mainland around Khao Lak around 2000 people died.

'We were in the best place we could have been. As we were doing a drift dive, the boat was off its mooring with the engine running. If it had been on a mooring close to the shore it would have ended up on the rocks.'

Divers are helping in the clear up operation. Armed with large rubbish bags, they have been collecting debris off the Andaman Sea's coral reefs.



*The divers returned to devastation.*

## Mapping the seabed at the epicentre

Marine geologists from BGS and SOC spent several weeks helping to survey the massive earthquake zone off the Sumatran coast. The group joined the Royal Navy ship *HMS Scott* to identify seafloor features that may be due to the recent earthquake. The NERC team advised on which areas to survey and interpreting the data.

Lisa McNeill from SOC said, 'This is the first major offshore earthquake since modern investigative techniques, like swath bathymetry, became available. It will provide the base map to further geological understanding of the region.'

Swath bathymetry uses sonar to give detailed 3D data of the deep sea floor. Like a lawnmower, the ship travels up and down the survey area scanning a 6km wide swath of the seabed. The survey's first results are expected around May.

Simon Boxall, also at SOC but not on the trip, said, 'This is the first time we've been able to get detailed pictures of the seabed immediately after an earthquake; before sediments build up over the fracture.'

'We hope the data will tell us more about the mechanisms of earthquakes and may lead to better prediction techniques. The big problem is we haven't got much information on what the sea floor was like before the earthquake.'

Latest bulletins from the *HMS Scott* cruise are at [www.intermargins.org/tsunami1.html#a2](http://www.intermargins.org/tsunami1.html#a2)