AUSGEO news ISSUE 78 June 2005

Australian Government
Geoscience Australia

GEOSCIENCE AUSTRALIA'S ROLE IN THE *Australian Tsunami Warning System*

Federal government initiative to provide a warning system for future tsunamis.

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In the 2005-2006 Federal Budget handed down on 10 May the Australian Government announced the creation of the Australian Tsunami Warning System (ATWS). The ATWS will play a major role in the operation of an international tsunami warning system for the Indian Ocean. The system will also serve to warn Australians of tsunamis that may impact our coasts, both east and west, as well as provide leadership for regional tsunami warning in the southwest Pacific.

The Australian Government will provide funding over the next four years for the ATWS which will be jointly operated around the clock by Geoscience Australia and the Bureau of Meteorology, with Emergency Management Australia handling the public awareness and disaster response aspects of the system.

How Geoscience Australia will contribute

Geoscience Australia's main role will be to provide a monitoring and analysis capability that can rapidly detect earthquakes in the region with the potential to generate tsunamis ('tsunamigenic' earthquakes). When such an event occurs, Geoscience Australia will work with the Bureau of Meteorology to verify that a tsunami has been generated and assess what impact it might have. The Bureau of Meteorology already has in place much of the infrastructure for broadcasting the warnings and so ATWS will make use of this existing infrastructure.

Geoscience Australia will also bring to bear its well-established strength in risk assessment for other hazards such as earthquakes, floods and storm surges in order to improve the overall effectiveness of the ATWS. In addition Geoscience Australia and the Bureau of Meteorology, together with Australian Agency for International Development (AusAID), will have important roles in providing overseas technical assistance and training to build in-country capacity in both the Indian Ocean and the southwest Pacific regions.

International and regional cooperation

For the ATWS to work it is important to integrate with the international effort and with the Pacific Warning Centre.

The international groundwork for ATWS's contribution to an Indian Ocean system has already been laid at meetings of UNESCO's Intergovernmental Oceanographic Commission held in Paris and Mauritius earlier this year, at which representatives of the Department of Foreign Affairs and Trade, the Bureau of Meteorology and Geoscience Australia consulted with their counterparts from other Indian Ocean countries. An international role for ATWS in the southwest Pacific will build on initiatives already planned for this region in consultation with the AusAID and the South Pacific Applied Geoscience Commission.

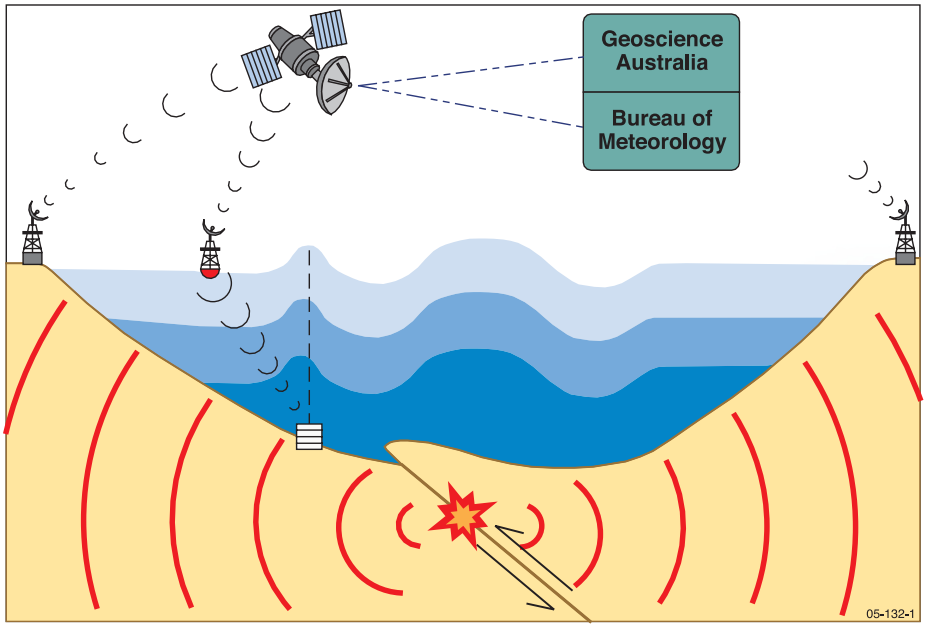

Figure 1. An undersea earthquake causes displacement of both the seafloor and the sea surface, and the spreading out of seismic waves (in red). The disturbance in the sea surface radiates outward as a tsunami, which travels much slower than the seismic waves. Once the seismic waves are detected by distant (usually land-based) seismometers, sea-level data from coastal tide gauges or DART buoys are analysed to determine whether a tsunami has actually been generated.

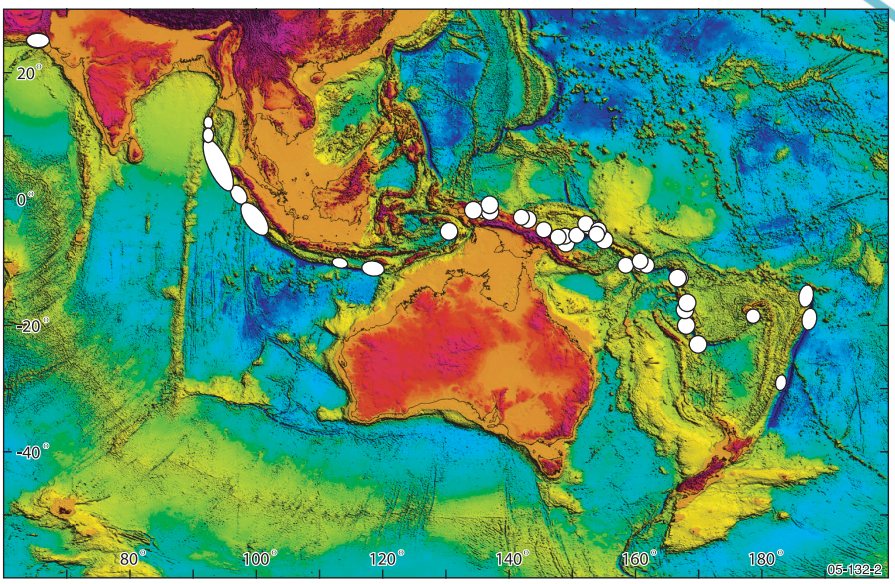

Figure 2. A map of the earth's surface, showing the major tectonic plate boundaries and locations of historic tsunamigenic earthquakes. The tsunami threat to the region originates from the system of subduction zone plate boundaries (also known as ocean trenches) extending through Indonesia, New Guinea, Vanuatu, Fiji and the trench systems to the north and south of New Zealand.

The ATWS proposal involves four major components:

- a monitoring capability
- an analysis capability leading to the ability to issue an alert
- a communication capability to broadcast the alert
- trained emergency response personnel and an educated public.

The science behind the system

All tsunami warning systems are based on the idea that most tsunamis are caused by earthquakes, and since the seismic waves generated by earthquakes travel much faster than the tsunamis, tsunamigenic earthquakes can be detected long before the arrival of the tsunami (figure 1). Most undersea earthquakes do not generate tsunamis, however. If tsunami warnings were based on earthquake occurrence alone, there would be so many false alarms that people would soon lose confidence in the warning system. For this reason, direct monitoring of sea-level data is required after a large earthquake, in order to verify that a tsunami has actually occurred.

The monitoring components of a tsunami warning system therefore consist of a seismographic network for monitoring earthquakes, to be operated by Geoscience Australia, and a network of sea-level monitoring stations, to be operated by the Bureau of Meteorology. The sea-level network will include several 'DART buoys', which are sophisticated systems used to measure tsunami heights in the open ocean. The operations centres of both agencies will receive data from all of these observation platforms, and 'mirrored' analysis systems will be maintained at Geoscience Australia's headquarters in Canberra and the Bureau of Meteorology's operations centre in Melbourne.

The ability to rapidly detect and characterise as potentially tsunamigenic any large earthquake in the Australian region will require a substantial expansion in Geoscience Australia's current earthquake monitoring and analysis capability, which has hitherto been focused on the comparatively small and infrequent earthquakes that occur in Australia.

Warnings in real time

As illustrated in figure 2, earthquakes that cause tsunamis occur near the system of ocean trenches that surrounds Australia from the northwest off Sumatra, eastward along the Indonesian archipelago to New Guinea and the Pacific islands, and then down the Kermadec Trench to south of New Zealand. Tsunamis generated in these trenches can reach Australia within two to four hours, so earthquakes must be detected and characterised within minutes in order to time for a warning to be effective.

Rapid and accurate analysis of earthquakes in these source zones will require a network of seismographic stations that provides adequate coverage of the source zones and transmission of data to Geoscience Australia's analysis centre in real time. The seismographic network envisioned for ATWS is composed of a combination of new and existing stations, some owned and maintained by Geoscience Australia and others shared with international partners in the region.

Coordination critical

The operations centre responsible for analysing this data at Geoscience Australia will require a sophisticated and robust information technology and communications infrastructure, and will be staffed round the clock. Establishing such a facility is a fundamental change in course for Geoscience Australia, and will require some changes from the way Geoscience Australia has operated in the past. Close coordination of our activities with the Bureau of Meteorology and liaison with other tsunami warning systems in the region will be critical to the success of ATWS.

The scientific role played by Geoscience Australia and the Bureau of Meteorology will assist Australia's initiative to contribute to the establishment of a durable and effective tsunami warning system in the Indian Ocean and southwest Pacific regions as well as providing a warning system for Australia. It also represents a dramatic expansion in Geoscience Australia's efforts to work with our neighbours in the Indian and Pacific oceans to apply expertise in geoscience to problems of concern to all countries in the region.

It is only through efforts such as these that we will in future be better placed to reduce the terrible loss of life that can be caused by major geologic upheavals, such as the earthquake and tsunami of Boxing Day 2004.

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