MNF Voyage Highlights

Voyage #:	IN2022_V05
Voyage title:	The tsunamigenic submarine landslides and deep-marine canyons of Australia's Tasman Sea Margin: Causes and Consequences
Mobilisation:	Hobart, Thursday, 26th May 2020
Depart:	Hobart, 0800 Saturday, 28th May 2022
Return:	Brisbane, 1000 Sunday, 3rd July 2022
Demobilisation:	Hobart, Monday, 5th July 2022
Voyage Manager:	Max McGuire
Chief Scientist:	Associate Professor Thomas C.T. (Tom) Hubble
Affiliation:	The University of Sydney
Principal Investigators:	Associate Professor Hannah Power (UoN) Professor David Airey (USyd) Associate Professor Maria Seton (USyd Dr Michael Kinsela (UoN) Dr Scott Nichol (Geoscience Australia) Dr Martin Jutzler (Utas)
Project name:	Submarine landslides on the eastern Australian continental margin: sedimentological and geomechanical characteristics, timing and triggers, and tsunamigenic potential
Affiliations:	University of Sydney, The University of Newcastle, and Geoscience Australia

Voyage Highlights

The Chief Scientist

Associate Professor Tom Hubble has taught the Introductory Geology and Engineering Geology for University of Sydney's School of Geosciences since 1989. His research work has focused on the collection and interpretation of geological samples and geophysical data sets in marine, estuarine and riverine settings. This work has included characterization of river-bank collapse mechanisms and determination of the role tree-roots play in stabilizing river-banks as well as investigations of the marine geology and submarine landslides of the south-eastern Australian continental margin. These investigations integrate multi-beam sonar data and sediment properties data within numerical models to develop and test conceptual geological models of submerged-slope failures and to evaluate the potential for these slope failures to generate tsunami.

Title

The tsunamigenic submarine landslides and deep-marine canyons of Australia's Tasman Sea margin: Causes and Consequences.

Purpose

This cruise investigated six areas of south-east Australia's continental margin between Wollongong and Fraser Island where major submarine landslide scars and deep-marine canyons have been identified by earlier work. The larger landslide scars present on the Southeast Australian Continental Slope range between 25 and 200 square kilometres in area and are up to 200 metres thick. Numerical modelling studies of these features indicate that they were potentially tsunamigenic. In particular, it has been shown that if the material removed from these erosional features was shed downslope as rapidly-moving blocks or avalanches of sediment, then this process could have generated moderate to large tsunami similar in size to the Aitape event which devasted the coastal communities of Papua New Guinea and killed 2000 people in 1998.

The main objectives of the voyage were to:

1. Map the deep seafloor downslope from the submarine landslides located offshore Bulli, Brooms Head and Yamba, Byron Bay, Noosa Heads and Wide Bay to identify where the potential submarine sediment deposits derived from these landslides are located.
2. Collect seismic reflection profiles of the submarine landslide scars and deposits to determine their internal structure and the potential contribution of the continental margin's subsurface geological structure to submarine landslide occurrence.

3. Collect deep-sea sediment samples from the landslide scars and the landslide deposits to determine the specific characteristics of the materials involved that cause the submarine landslides to form and to date the time in the geological past when the landslides occurred.
4. Map continental shelf-features associated with the delivery of sediment to the continental slope.

Contribution to the nation

The data acquired on this voyage improves our understanding of how the submarine landslide scars and canyons located offshore the south-eastern Australian coastline formed; and why they are located in the particular places where they occur.

Prior to the voyage it was thought that extensive volumes of slope sediment that had accumulated on the continental margin over millions of years may have been removed from the landslide scars as giant slabs of material that had travelled large distances downslope and out onto the deep ocean floor at high speed. We found no strong evidence for this process having occurred in the recent geological past at the sites investigated during the voyage. The characteristics of the deposits and the distances of transport involved suggest that submarine landsliding more likely occurred as a series of progressive, incremental events and at lower speeds than suggested by earlier work.

The structure and inclination of apparently stronger sediment layers located deeper down in the sediment sequence as well as the structure of the hard-rock geological basement layer on which continental slope sediments have been deposited are additional factors in determining where large submarine landslides are located. The larger submarine landslide scars are apparently developed on segments of the margin's continental slope where the stronger sediment layers are inclined at a steeper angle or the geological basement layer is located at deeper levels, than the adjacent areas of the continental slope which do not present large submarine landslide scars. Our data also suggest that the continental margin's landslide scars and the adjacent deep-water deposits of ocean floor sediment have been substantially modified due to erosion by deep-water currents.

These findings will be of interest to the international community of scientists who study submarine landslides as well as the government authorities who manage and coordinate disaster responses for coastal New South Wales and Queensland.

As a result of this voyage

1. We have a better understanding of the processes controlling the formation and geographical distribution of submarine landslides on the eastern Australian continental margin and have identified that the sediment layer geometry and the structure of the geological basement are likely controlling factors on where they have occurred.
2. We have mapped 44,250 square kilometres of the continental shelf, slope and abyssal plain with the ship's multibeam echo sounders during the 10,375 kilometre long voyage.
3. We have acquired eleven geophysical profiles of South Eastern Australia's continental margin comprised of 525 kilometers of new seismic reflection data.
4. We have collected sixteen dredge samples, ten kasten cores and six piston cores of continental shelf, continental slope, and abyssal plain sediments that provide the geological and geotechnical samples required to determine the timing of major geological events that formed the margin and will enable us to better understand how these materials are eroded and removed from the continental slope.

Next steps

We have commenced a program of geological interpretation of the seismic reflection, sub-bottom profile, and bathymetric data collected on the voyage as well as a program of geotechnical testing and palaeontological and sedimentological laboratory studies of the samples collected on the voyage. These data will be used to inform and refine our geological and geomechanical models of the processes responsible for submarine landsliding, submarine canyon formation, and continental shelf sediment transport processes offshore south-east Australia.

On completion of the interpretation phase of the project, the results will be presented at major international conferences (e.g., the annual AGU fall meeting, EGU meetings, and the International Geological Congress), the regular specialist group conference on Submarine Mass Movements and Their Consequences (ISSMTC), and to local professional meetings of geologists, coastal scientists, and engineers. We will also submit the findings of the cruise to major international peer-reviewed journals such as Marine Geology, Landslides, and Natural Hazards. In addition, we will communicate our findings to the disaster and natural hazards management community including the Australian Tsunami Advisory Group (ATAG), the NSW and Sydney Coastal Councils Group, NSW State Emergency Service, Queensland Fire and Emergency Services, and other appropriate state government departments and instrumentalities.