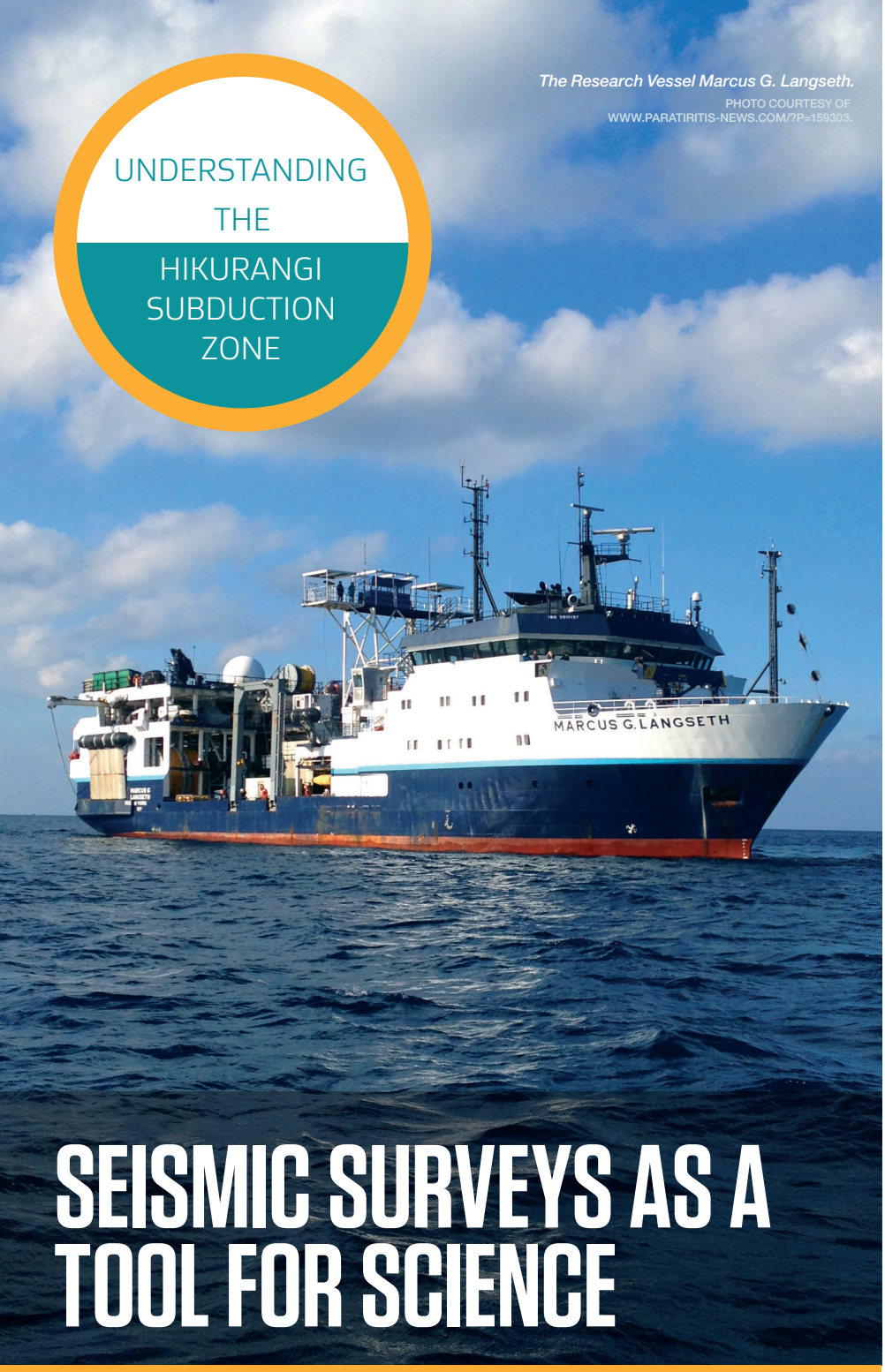
UNDERSTANDING THE HIKURANGI SUBDUCTION ZONE



The Research Vessel Marcus G. Langseth.
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SEISMIC SURVEYS AS A TOOL FOR SCIENCE

The Hikurangi plate boundary, off the East Coast of New Zealand's North Island, is part of the Pacific ring of fire – where the Pacific tectonic plate dives beneath the Australian plate. This boundary is what we call a subduction zone. Subduction zones develop a type of fault that is responsible for the largest and most powerful earthquakes and tsunamis in the world, such as Sumatra 2004, Chile 2010, and Japan 2011.

We can't prevent earthquakes but we can prepare for them. The focus of New Zealand and international research will help to understand how, why, and how often the Hikurangi subduction zone fault moves in large earthquakes, and what an earthquake like this will mean for our local communities. The *Hikurangi Subduction Earthquakes and Slip Behaviour* research project will use a variety of tools to gather and analyse data, including seismic surveys.

WHY USE SEISMIC SURVEYS AS A TOOL FOR SCIENCE?

The only way to determine which sections of the subduction zone are more prone to large earthquakes is by collecting detailed images of layers beneath the seafloor using sound waves. These seismic images reveal the internal structure of the Hikurangi subduction zone fault off the East Coast - allowing us to understand the processes that control earthquakes and tsunamis. Seismic surveys complement the data collected from scientific drilling and evidence of older earthquakes and tsunamis onshore.

THE HIKURANGI SEISMIC SURVEYS

The U.S. Marcus G. Langseth (R/V Langseth) is specially designed to conduct the Hikurangi seismic surveys. The vessel tows an array of individual sound sources that are tuned and combined to radiate a sound wave downward to the seafloor. These sources expel compressed air from cylindrical chambers – a bit like inflating and collapsing a large balloon.

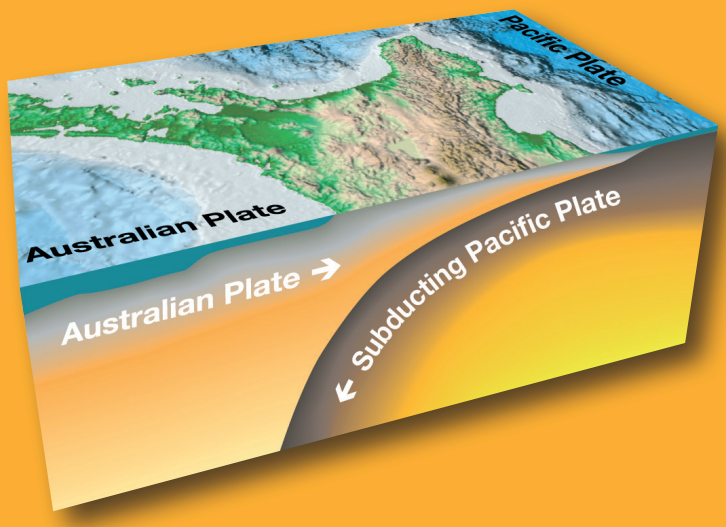
The sound source is generated approximately every 50 m along a ship track (i.e. once every 20-30 seconds). The echoes that bounce back from layers in the earth are recorded on a streamer towed behind the vessel and on sensitive seismographs located onshore and on the seabed. Scientists process all the recorded echoes to construct an image, like a medical sonogram, of the layers within the earth.

WHAT PRECAUTIONS WILL BE TAKEN TO PROTECT MARINE ANIMALS?

Mitigation strategies will exceed internationally accepted standards and are based on input from marine mammal and fish science experts. The surveys will comply with all regulations, including the U.S. Marine Mammal Protection Act, U.S. Endangered Species Act, and NZ's Department of Conservation's *Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Operations* (see More Information below). Protection strategies include:

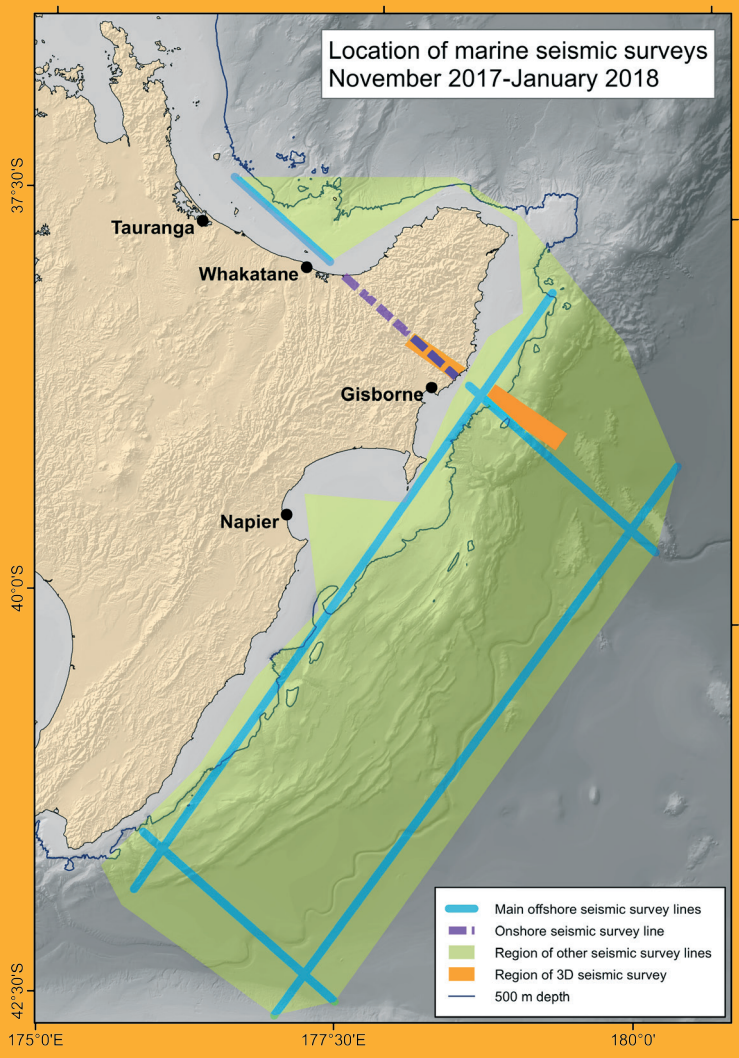
1. At the beginning of each survey the sound source will be increased very slowly over a period of thirty minutes, giving animals time to move away from the area if disturbed.
2. Qualified marine mammal observers will be on board to continuously record species occurrence, abundance, and behaviour, and to give the alert to stop the survey if a marine mammal enters the exclusion zone.
3. A Passive Acoustic Monitoring (PAM) system will operate 24 hours a day during the survey. PAM is a combination of sophisticated listening devices and computer software to filter and identify marine mammal noises. It listens for vocalisations of marine mammals so the sound source can be immediately shut down if necessary.
4. The R/V Langseth and other research vessels have completed more than a decade's worth of academic/government seismic surveys without any marine mammal stranding or disruption to fishing.

Loud noise is known to cause behavioural responses in marine mammals, and could potentially result in physical harm if an animal was close enough to the seismic source. Therefore, an exclusion zone is constantly monitored and the source is immediately shut down if animals are seen close.

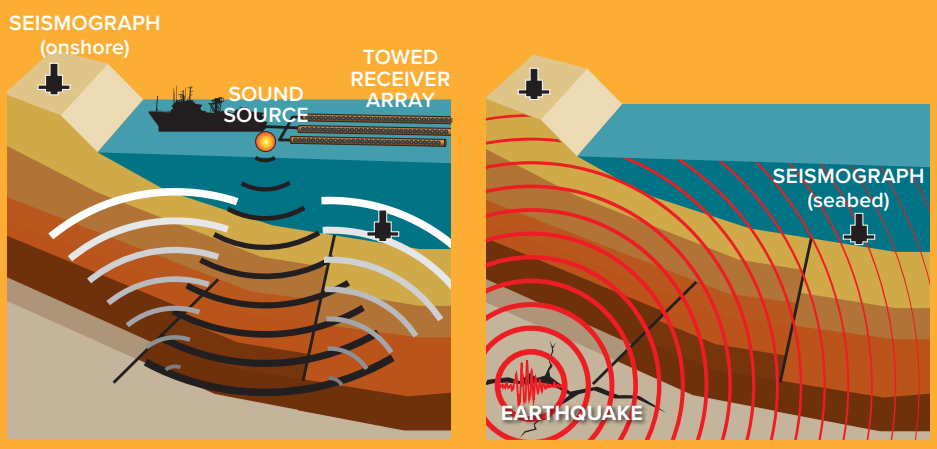


Slice through the North Island of New Zealand showing the Pacific tectonic plate diving beneath the Australian plate. The contact between these plates is called the Hikurangi subduction zone fault.

IMAGE BY DARREN D'CRUZ, GNS SCIENCE.



Map of the East Coast of NZ's North Island showing the location of the seismic surveys planned for November 2017 to January 2018. The onshore seismic survey line indicates the location of seismographs that will be installed to record marine sound sources and naturally occurring earthquakes.



The marine seismic survey (left) involves a sound source and a towed array of sensors which record waves that have bounced off sub-surface layers. Onshore and seabed seismic instruments record the boat's sound source as well as naturally occurring earthquakes (right)

IMAGES BY DARREN D'CRUZ, GNS SCIENCE.

WHEN AND WHERE WILL THE HIKURANGI SEISMIC SURVEYS HAPPEN?

The seismic data will be collected offshore of the East Coast of the North Island and Bay of Plenty in late 2017, and then collected in a small region offshore Gisborne in early 2018. Onshore, there will be land stations (seismographs) in a line from Opotiki to Gisborne from November 2017 to March 2018. Seismographs are highly sensitive measuring devices which will collect data from marine seismic surveys and local earthquakes.

DO SEISMIC SURVEYS CAUSE EARTHQUAKES?

No. The sound and energy sent to the seafloor could not trigger an earthquake, as they do not have enough energy to affect the stresses in the Earth's crust, which are the forces that cause earthquakes. As a comparison, the sound emitted during these scientific seismic surveys is less than the sound made by a lightning strike on the sea surface.

WILL THE DATA COLLECTED BE AVAILABLE TO THE PUBLIC?

Yes. The data collection will be completed early in 2018 and then analysed. Reports and data will be available in public archives in the U.S, New Zealand and the U.K in mid to late 2019.

WHO IS FUNDING THIS WORK?

The Hikurangi seismic data collection is funded by the U.S. National Science Foundation (NSF) and the Natural Environment Research Council (NERC), and will involve scientists from universities in the U.S, Japan, U.K, and New Zealand. New Zealand scientist participation is supported by funding from the Ministry of Innovation and Employment (MBIE) Endeavour Fund - the *Hikurangi Subduction Earthquakes and Slip Behaviour Research* project. The Hikurangi seismic project is not associated with or funded by any oil exploration company.

MORE INFORMATION

To read more about the Department of Conservation's Seismic Code of Conduct:
www.doc.govt.nz/our-work/seismic-surveys code-of-conduct

For more information on administration of the U.S. Marine Mammal Protection Act and Endangered Species Act visit:
www.nmfs.noaa.gov/pr/laws/mmpa/ and **www.nmfs.noaa.gov/pr/laws/esa/**

For more information on this project visit:
www.gns.cri.nz/hikurangi

CONTACT

If you have questions please email:
hikurangi.surveys@gns.cri.nz

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