

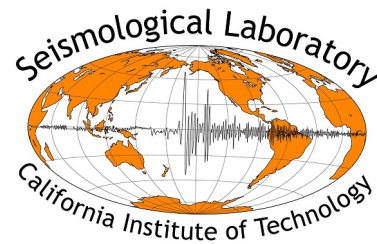
# Student Experiences aboard the R/V *Marcus G. Langseth*: South Island Subduction Initiation Experiment

Brandon Shuck

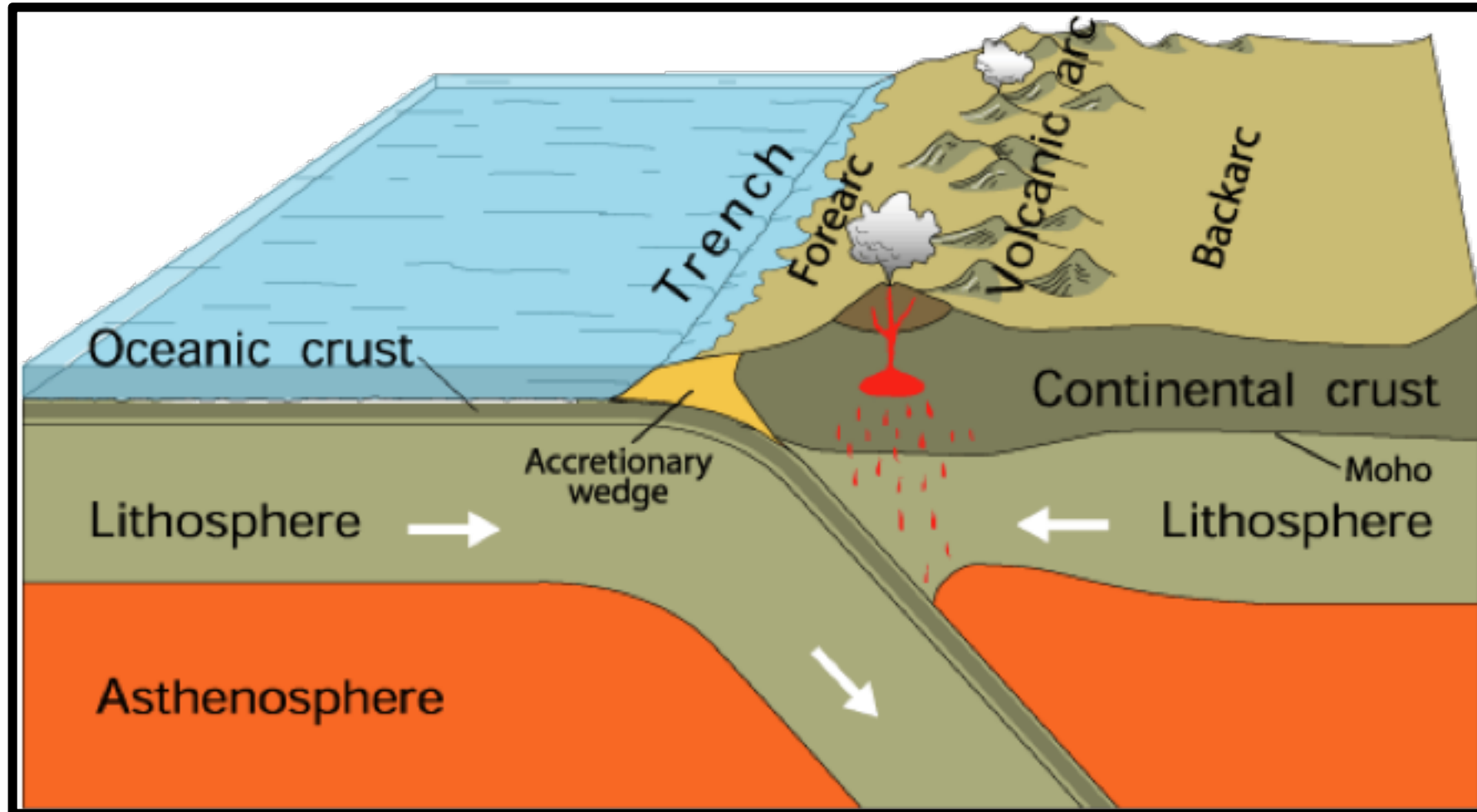
PhD Student

The University of Texas at Austin

Institute for Geophysics



Subduction zones are important – but how do they form?

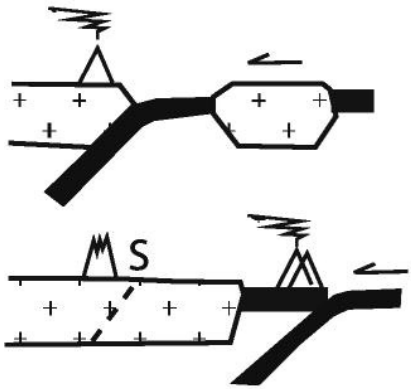


USGS

# How To Start A New Subduction Zone

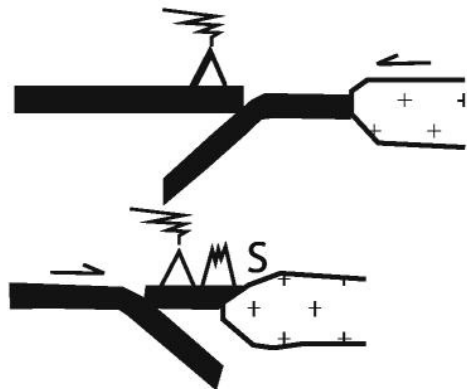
## INDUCED

### *Transference*



S = Suture

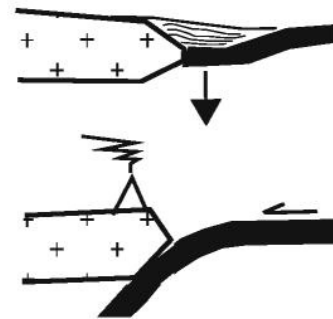
### *Polarity Reversal*



← = Subducting Plate

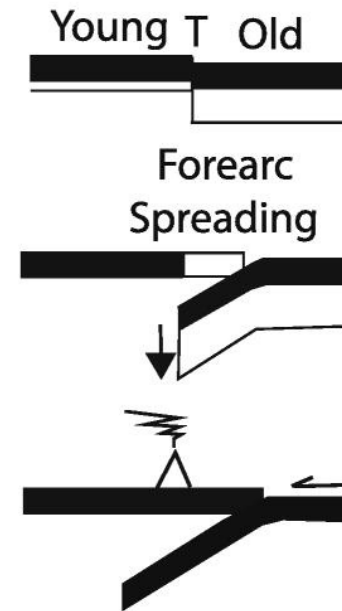
## SPONTANEOUS

### *Passive Margin Collapse*



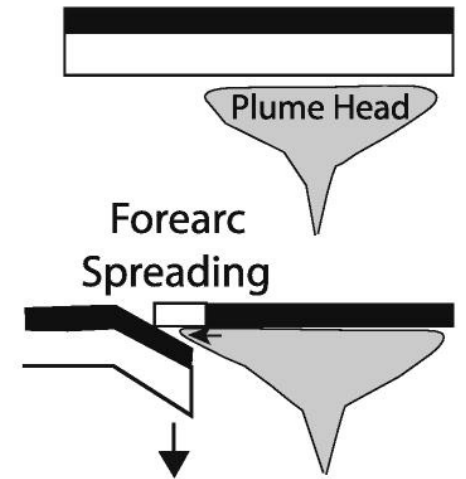
T = Transform Fault or Fracture Zone

### *Transform Collapse*



Eocene Western Pacific

### *Plume Head Margin Collapse*



Cretaceous Caribbean  
Eocene Cascadia

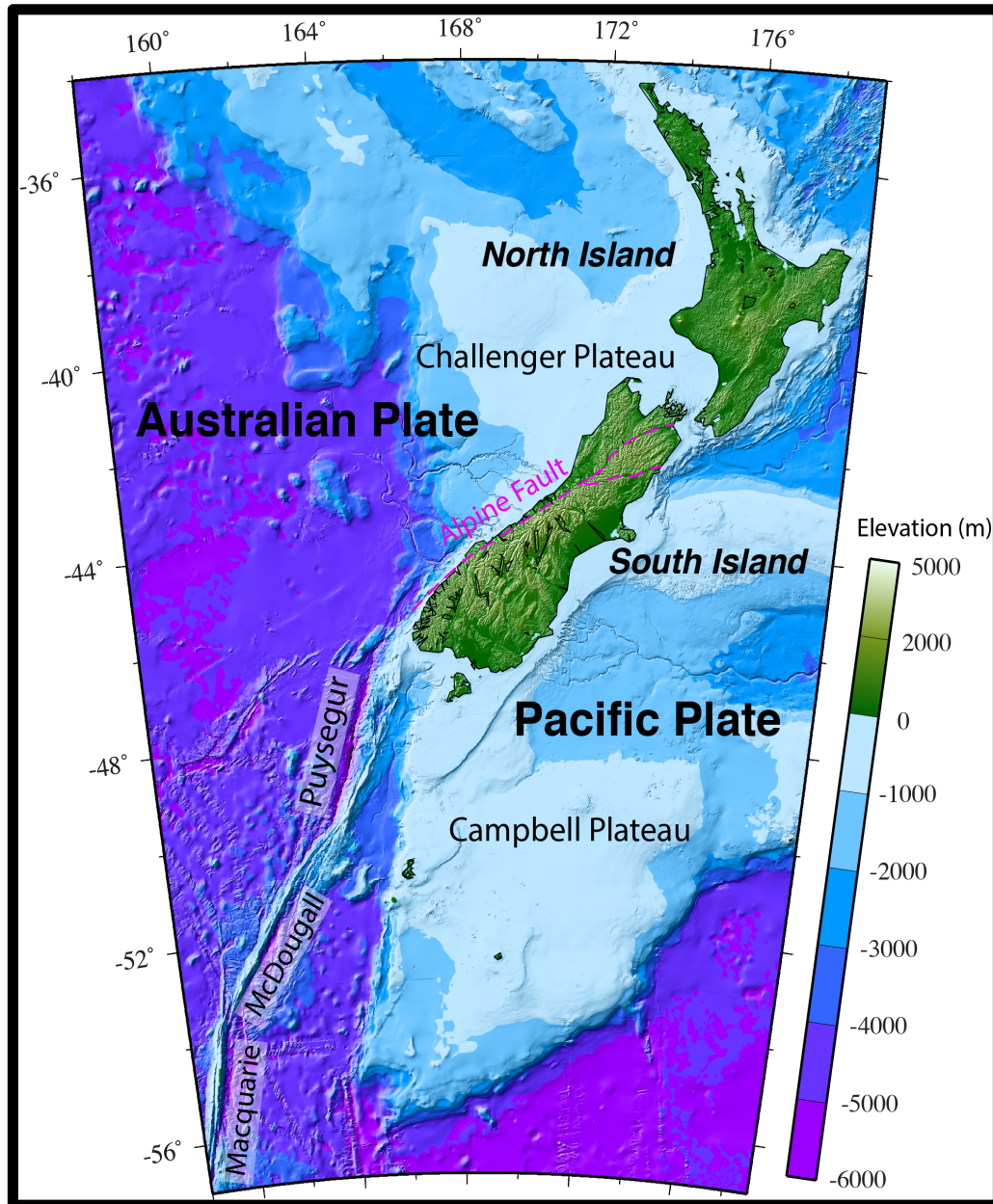
No Cenozoic Examples  
Indian Ocean (someday?)

Miocene Solomon Arc

Gibraltar Arc?

Stern and Gerya (2017)

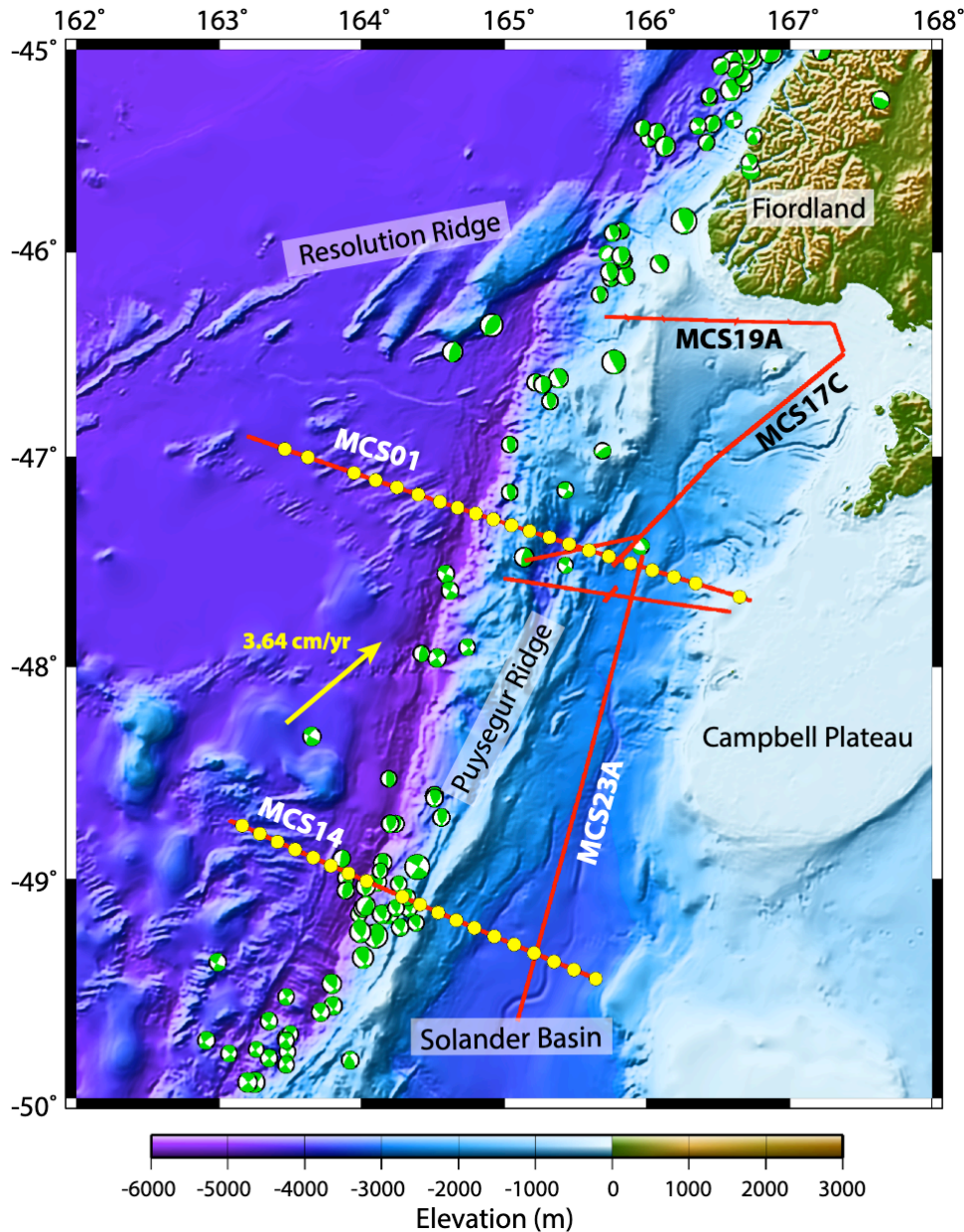
# Puysegur Trench



*Best place globally to study  
subduction initiation*

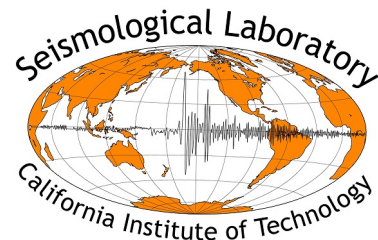
- Underthrusting of Australian plate beneath Pacific plate
- Young, “incipient subduction”
- Past plate motion is well constrained
- Roughly 150-200 km of margin-perpendicular convergence
- Geologic record is not overprinted
- Evidence of very young arc magmatism
- Active Benioff zone to ~150 km

# South Island Subduction Initiation Experiment (SISIE)



- February 17<sup>th</sup> -March 20<sup>th</sup>, 2018
- Collected 1252 km of multichannel seismic data
- Two ocean-bottom seismometer lines
- Multibeam bathymetry, CHIRP sub-bottom profiler, gravity, and magnetics data

Caltech, UTIG, and Victoria University of Wellington  
5 PI's, 3 technicians, 10 students



# Victoria Pier, Dunedin, South Island February 17<sup>th</sup>, 2018



# Ocean-Bottom Seismometer work

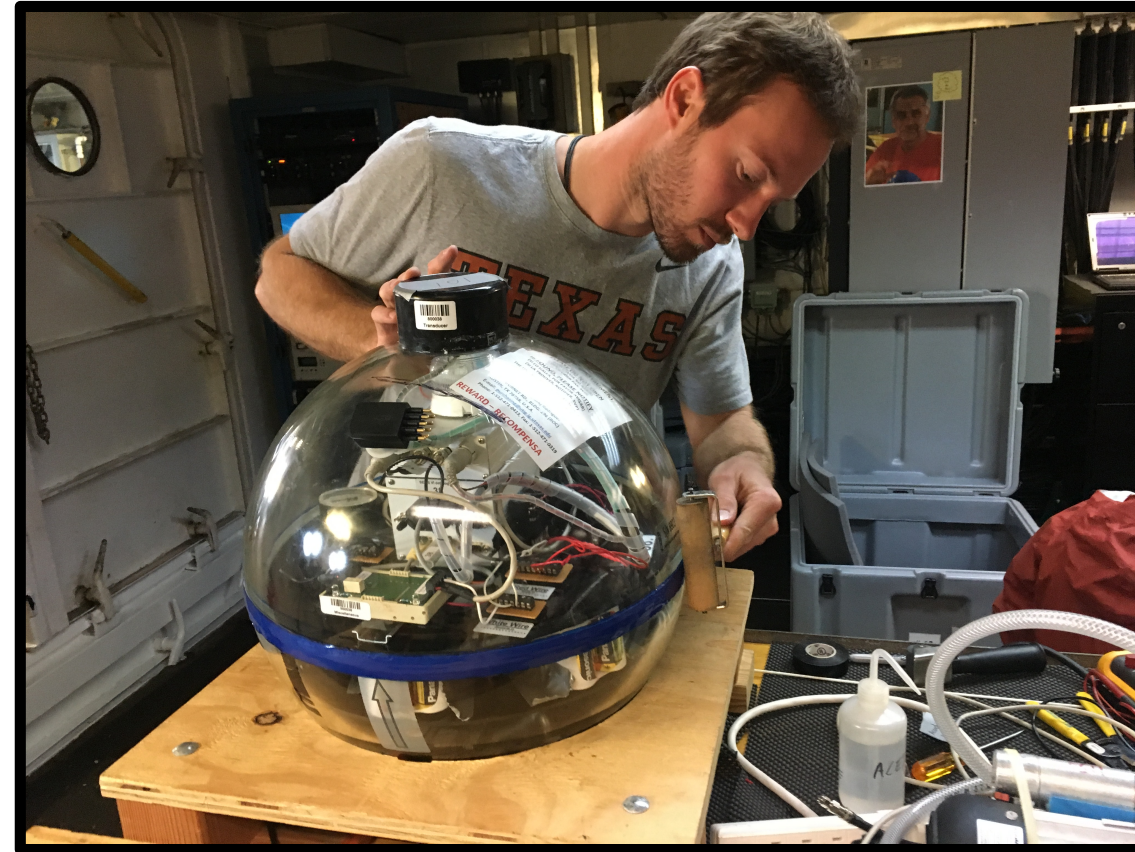


## Programming the OBS



- Attach wires and batteries
- GPS clock synchronization
- Test geophone, radio signal, probe
- Set recording and pop-up times

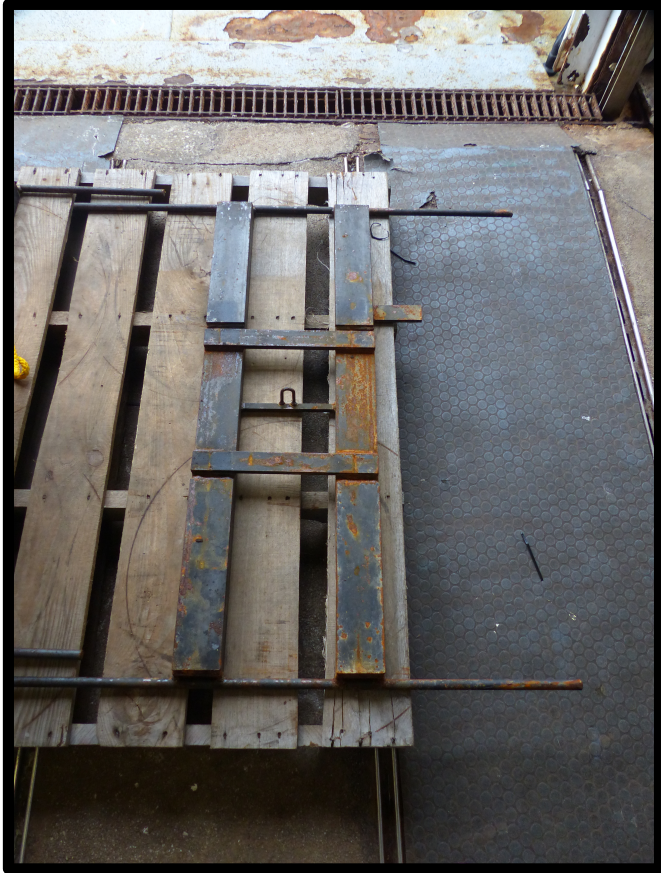
## Sealing the OBS



- Clean glass rim
- Apply vacuum for negative pressure
- Lots of tape!
- Place in protective orange “hard-hat”



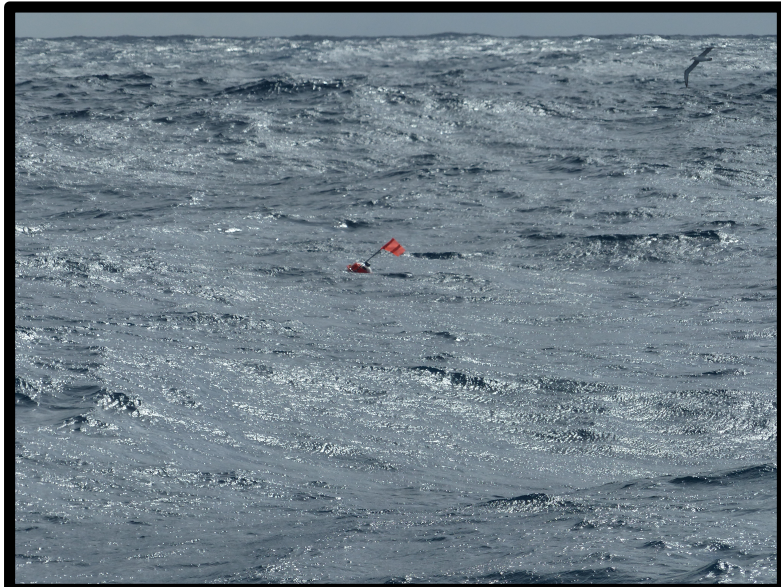
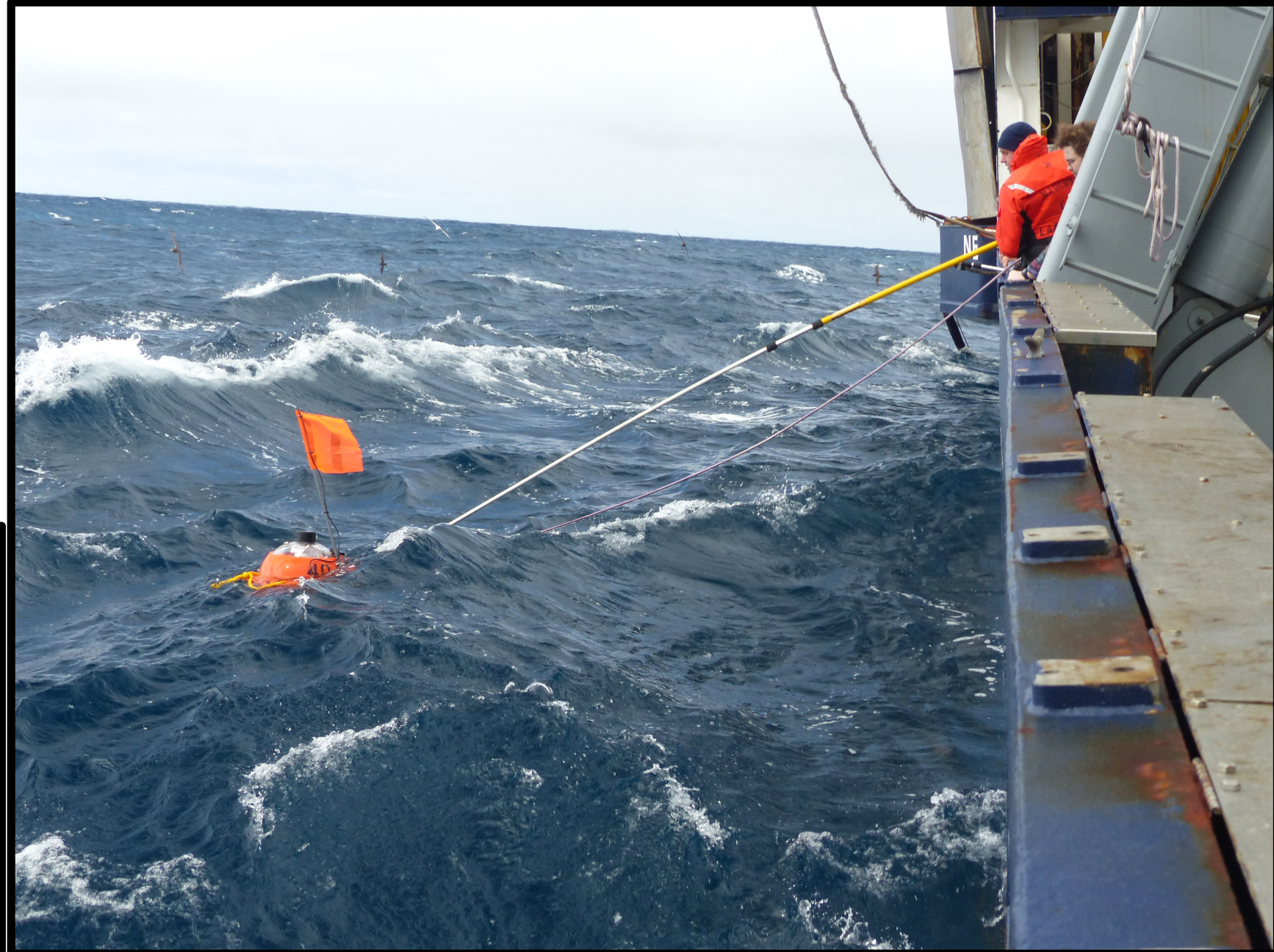
# Preparing the OBS



# Mounted OBSs ready for deployment

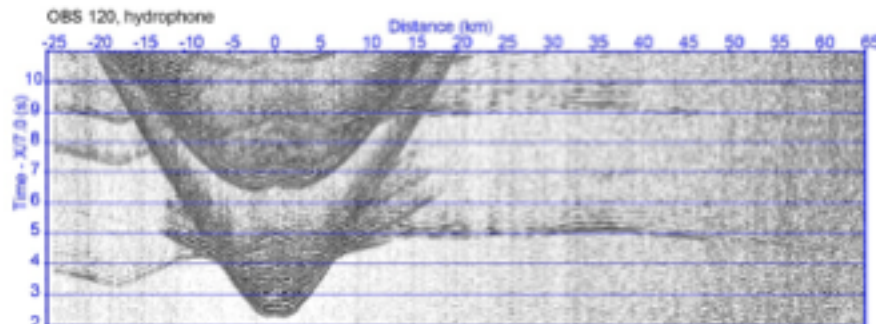


# Recovery: I spy... an OBS!



# A great success!

- Recovered 42 out of 43 instruments successfully
- OBS recovered from 5,901 m (deepest ever by U.S. team?)
- Safe deployment and recovery in rough weather

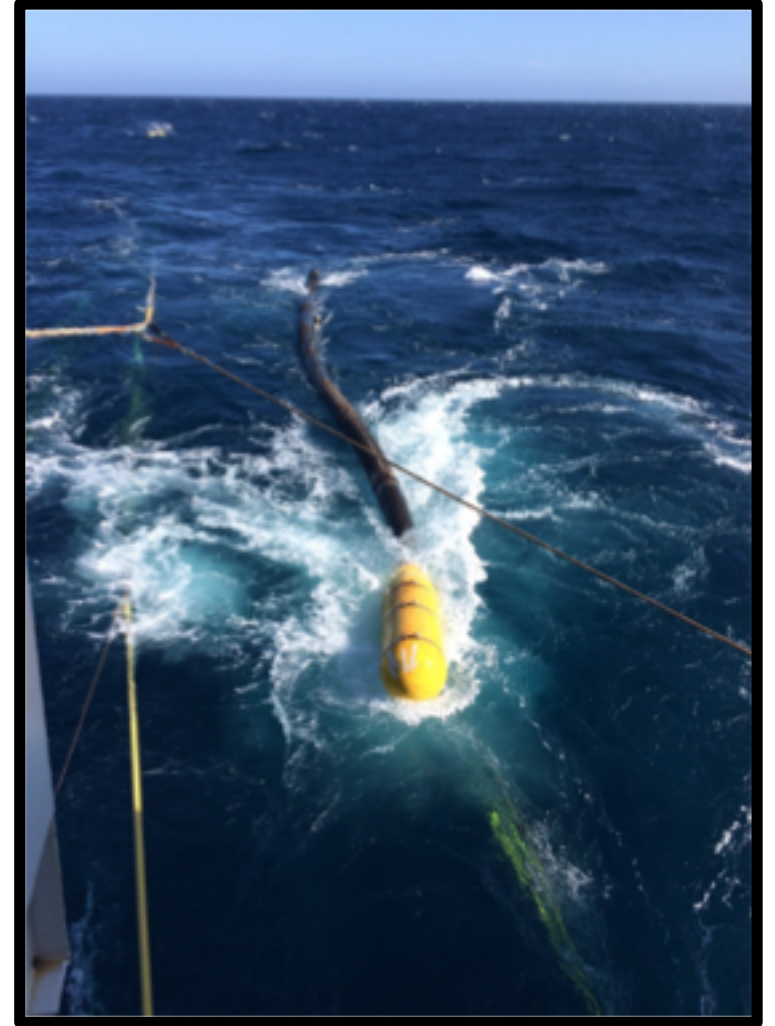
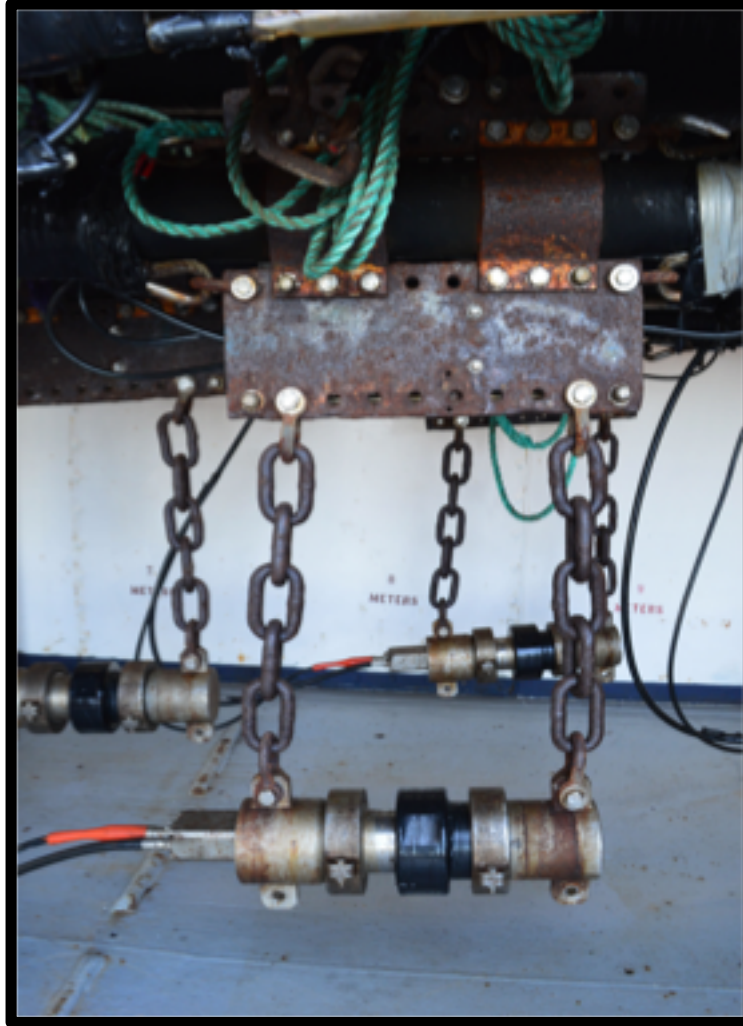


# Hands-on experience with a seismic streamer

## Attaching the Birds



# Learning about the acoustic source airgun arrays



Seismic lab – students “watch-stand” the data



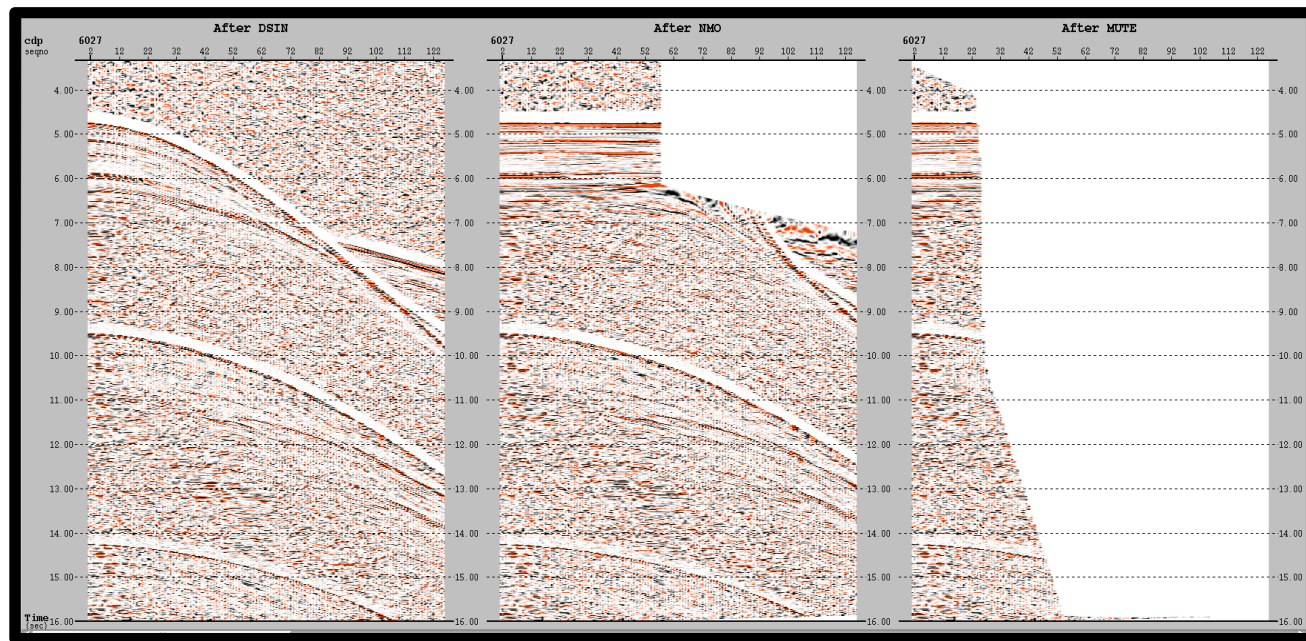
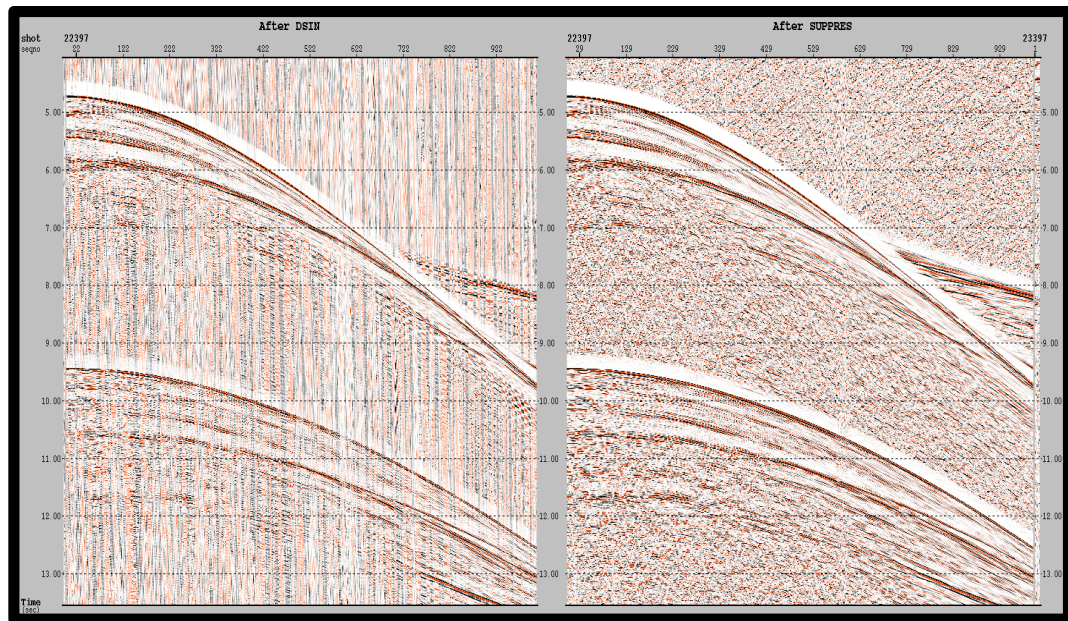
# MG&G class

- SISIE objectives
- Tectonic history of NZ
- Subduction zones
- Seismic acquisition, processing, and interpretation
- Multibeam
- CHIRP
- Magnetics
- Gravity



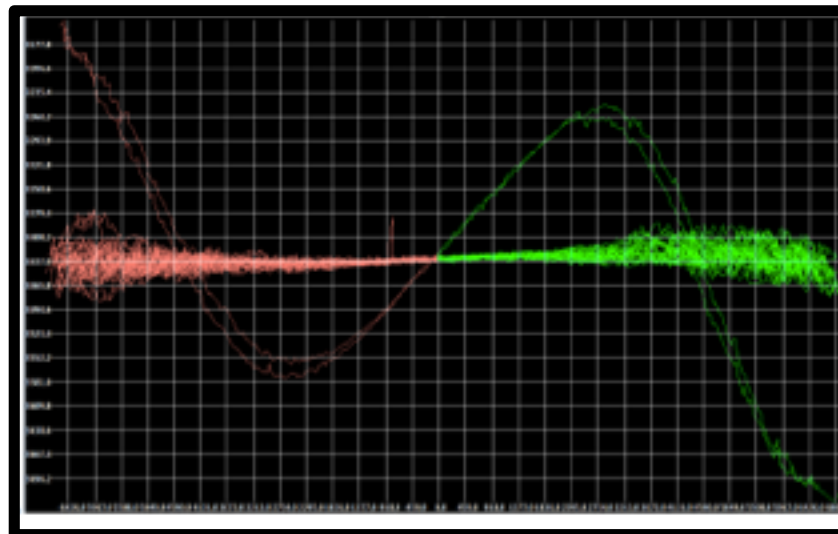
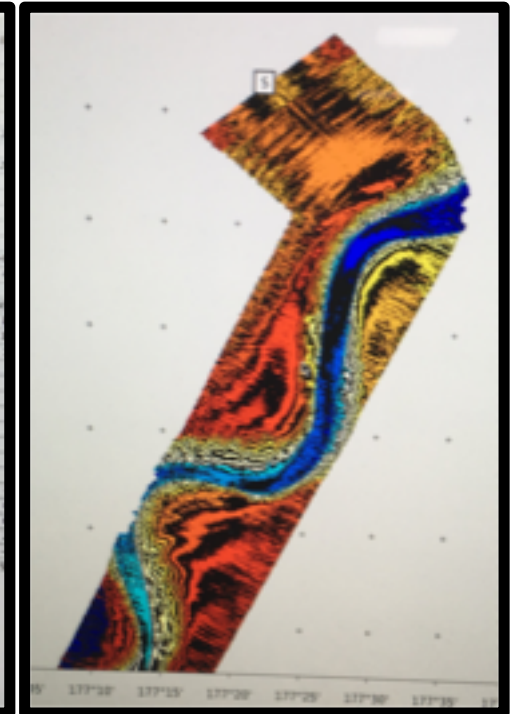
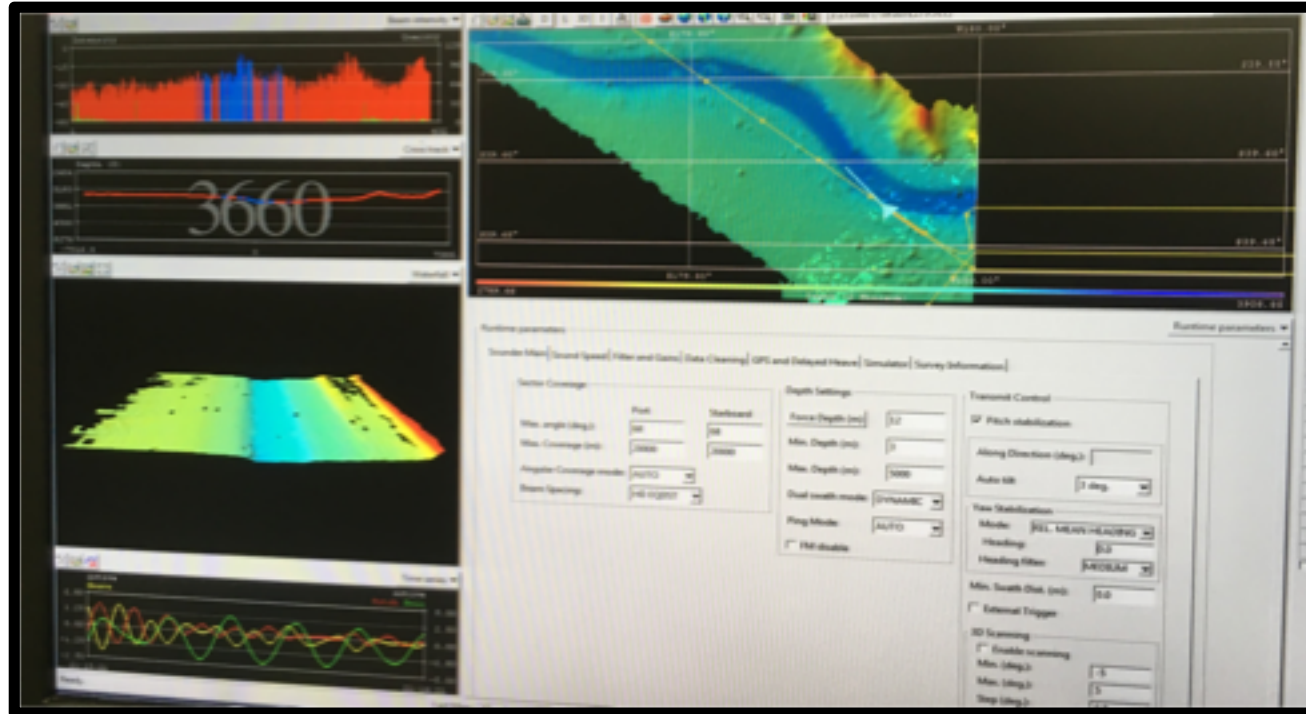


# MCS processing



Real-time uploading data, converting to SEG-Y format, and standard processing sequence: Trace editing, noise suppression, velocity analysis, multiple attenuation, mute, stacking and migration

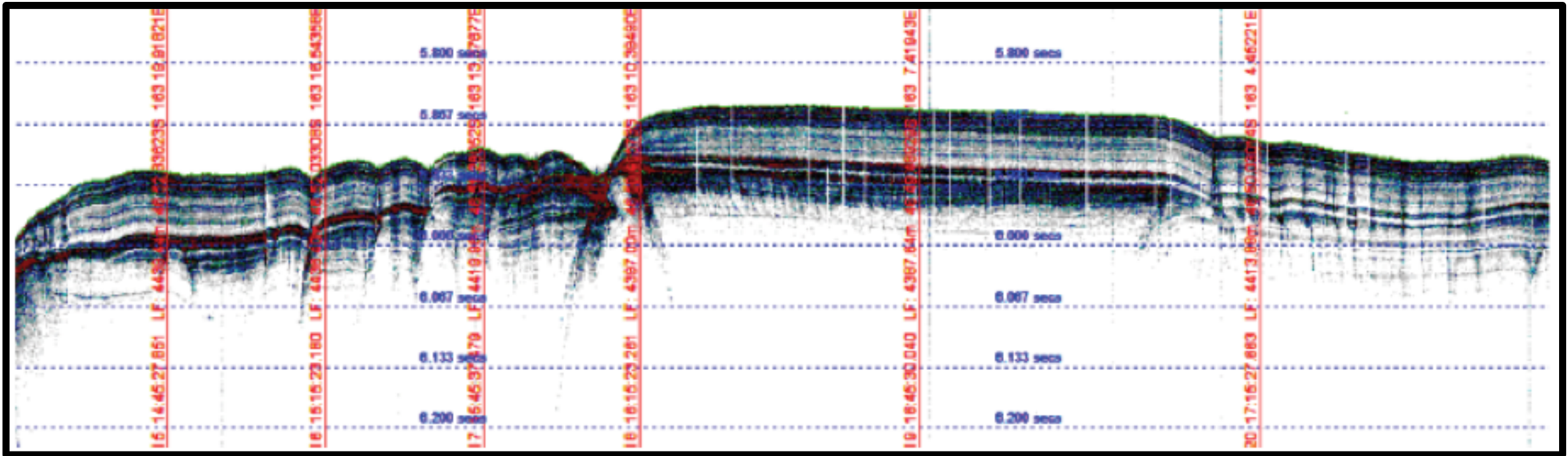
# Multibeam bathymetry



- Ping edited artifacts
- Created bathymetry grids

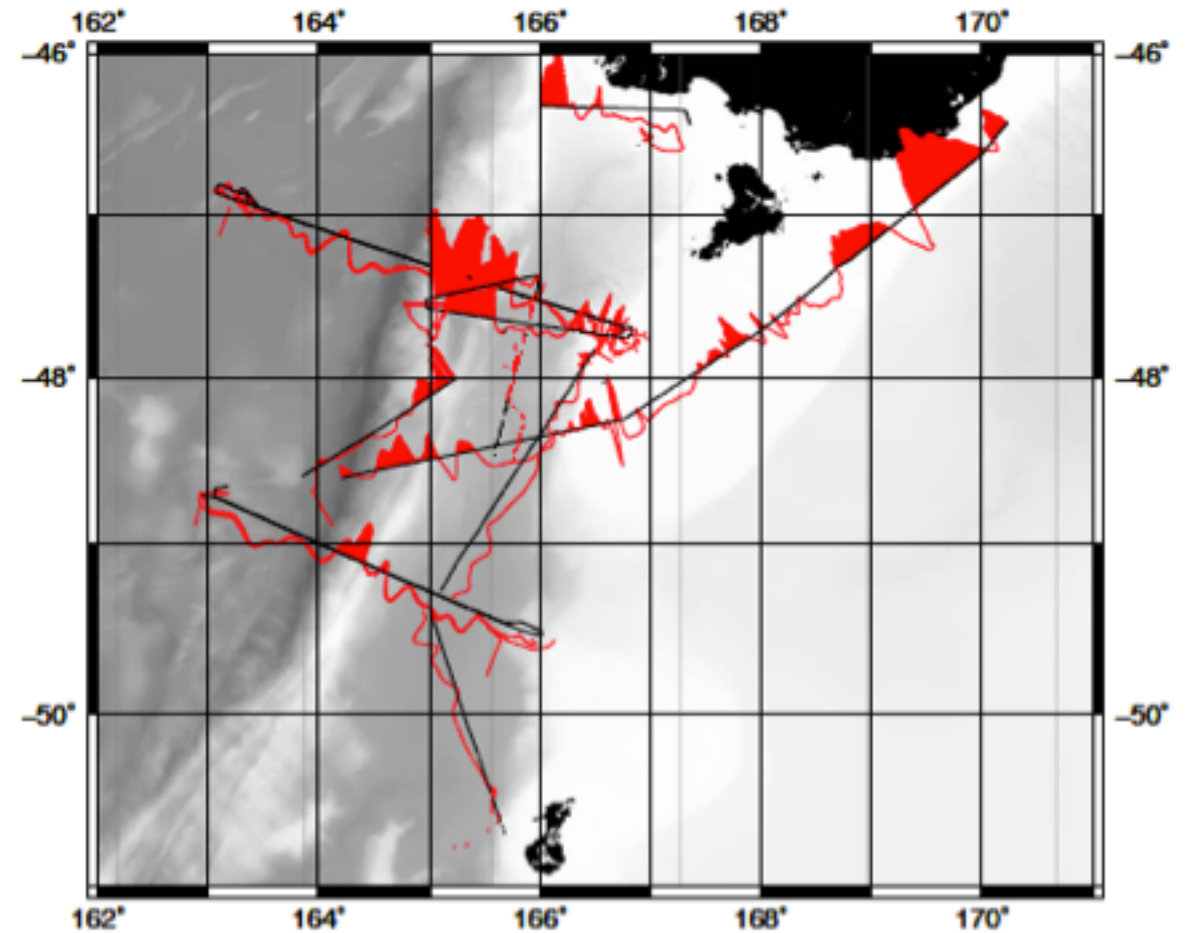
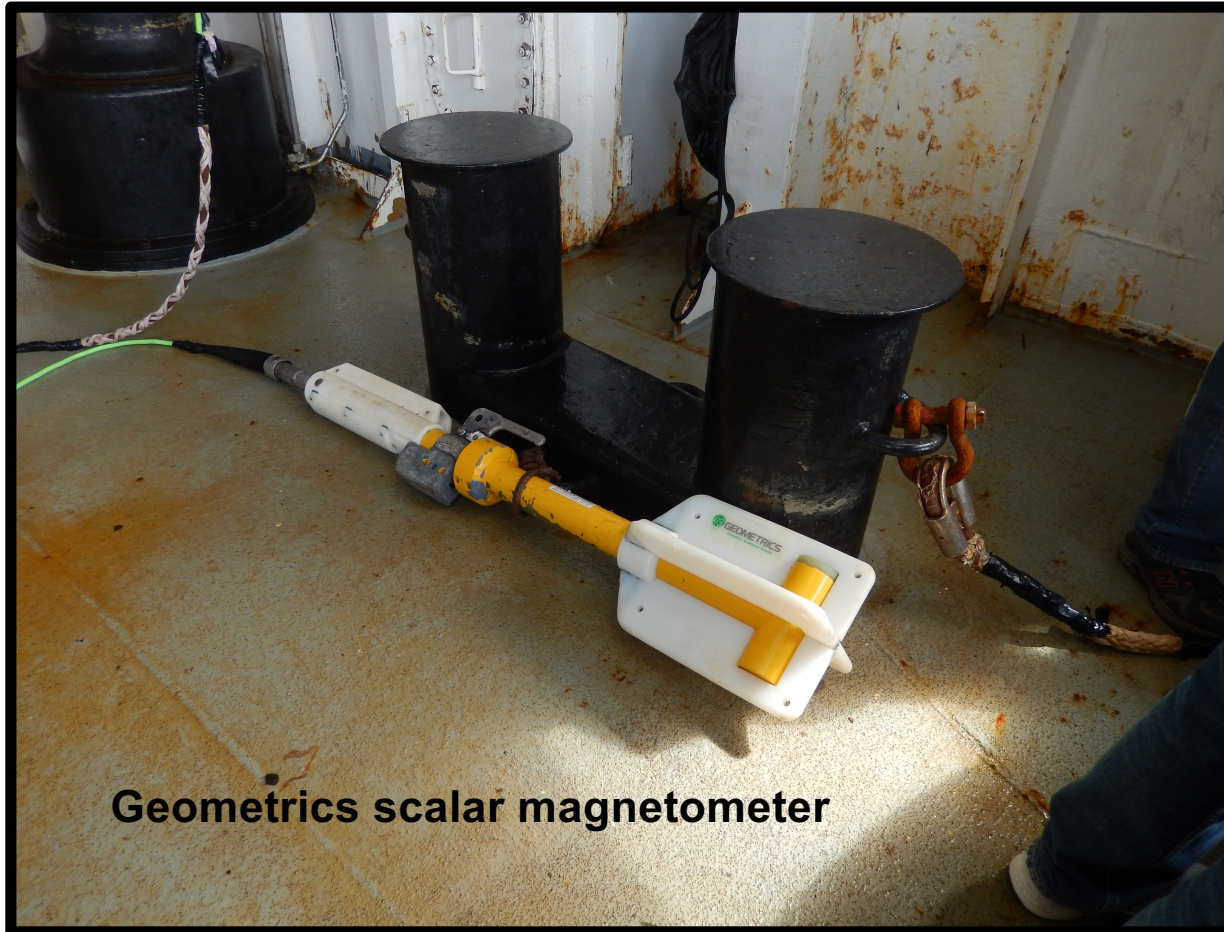
# CHIRP – 3.5 kHz Sub-bottom profiler

- Detailed shallow imaging
- Detection of recently active faults



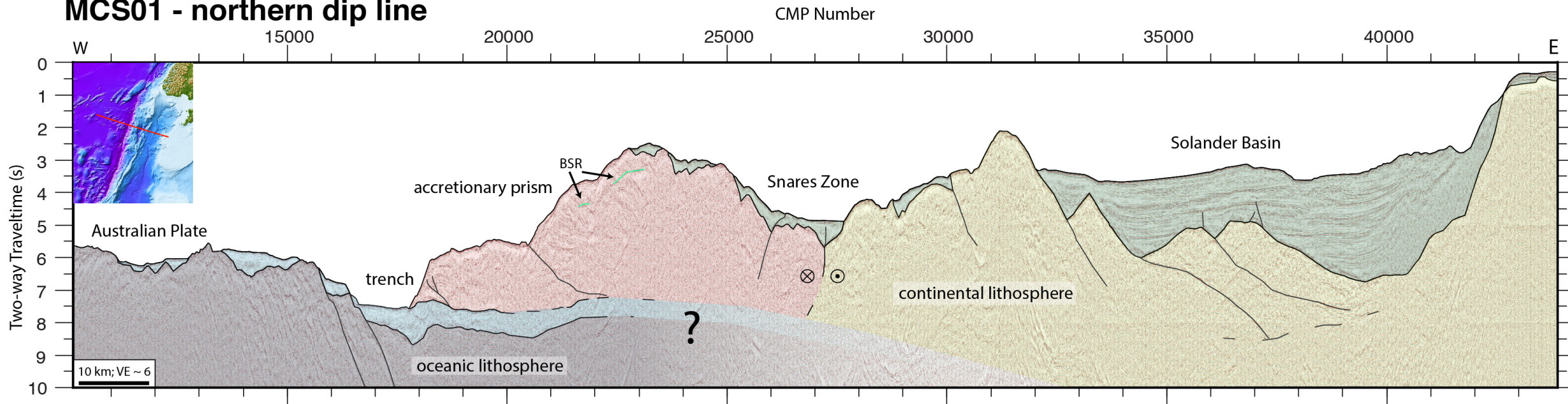
# Magnetics data

- Subtract IGRF12 from the total observed magnetic magnitude to obtain magnetic anomaly values

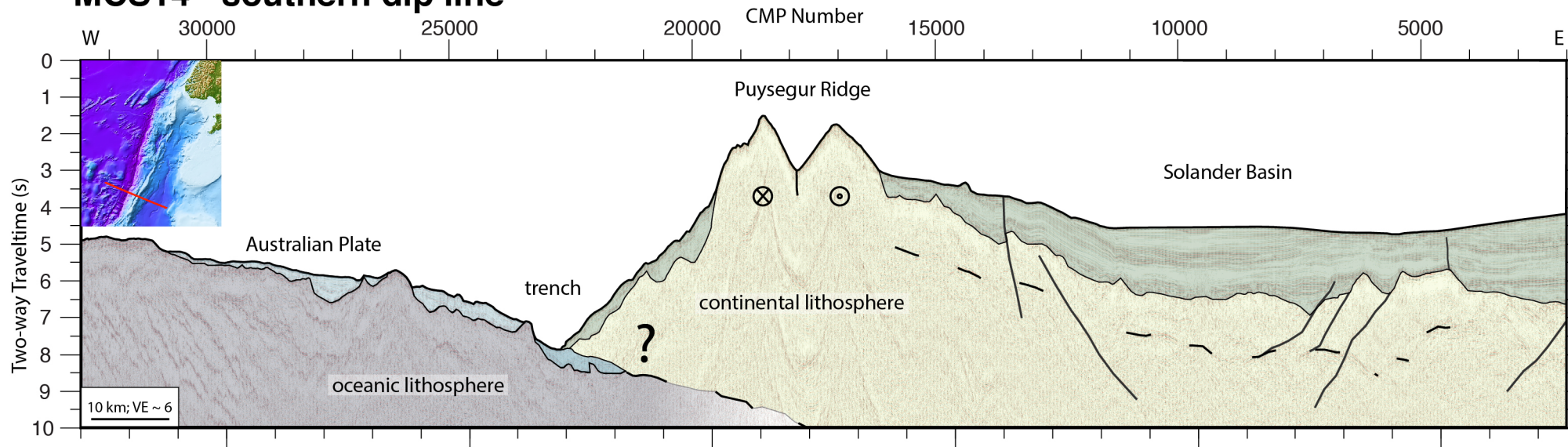


# Early results – striking differences from north to south

## MCS01 - northern dip line



## MCS14 - southern dip line



Back after 34 days at sea ...



To see more results from SISIE

**Oral Session: Thursday 4-6 pm**

**T44A-04** SISIE Overview

*Mike Gurnis*

**T44A-05** Snares Zone and Strike-Slip

*Sean Gulick*

**Poster Session: Friday Morning**

**T51E-0207** Gravity Modeling

*Erin Hightower*

**T51E-0208** Tomography/Velocities

*Harm Van Avendonk*

**T51E-0209** Seismic Reflection Images

*Brandon Shuck*

**T51E-0210** Bathymetry Analysis

*Joann Stock*

# Crustal Reflectivity Experiment Southern Transect (CREST)

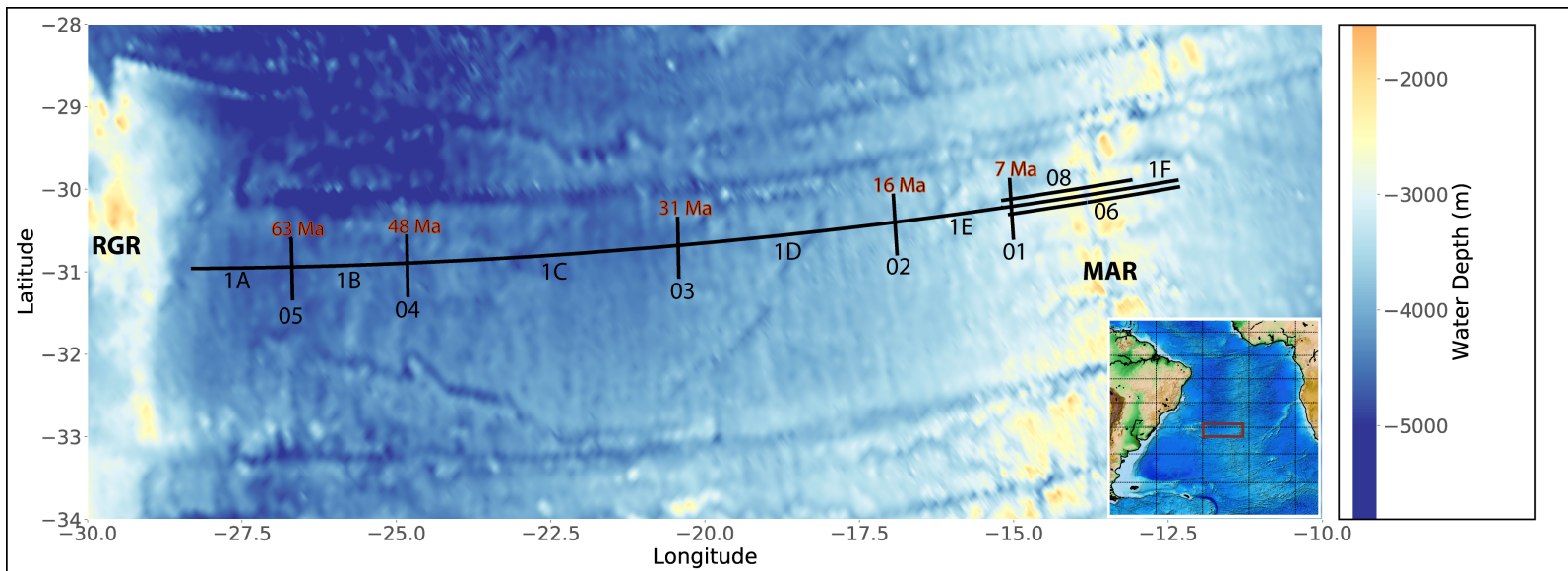


*"I was fortunate enough to sail on the R/V Langseth and participate in the collection of the seismic data I am using for my Ph.D. research.*

*I was able to take part in all aspects of seismic data collection, which has helped increase my understanding of the data in ways I cannot fully describe.*

*If you want to understand your data, help collect it"*

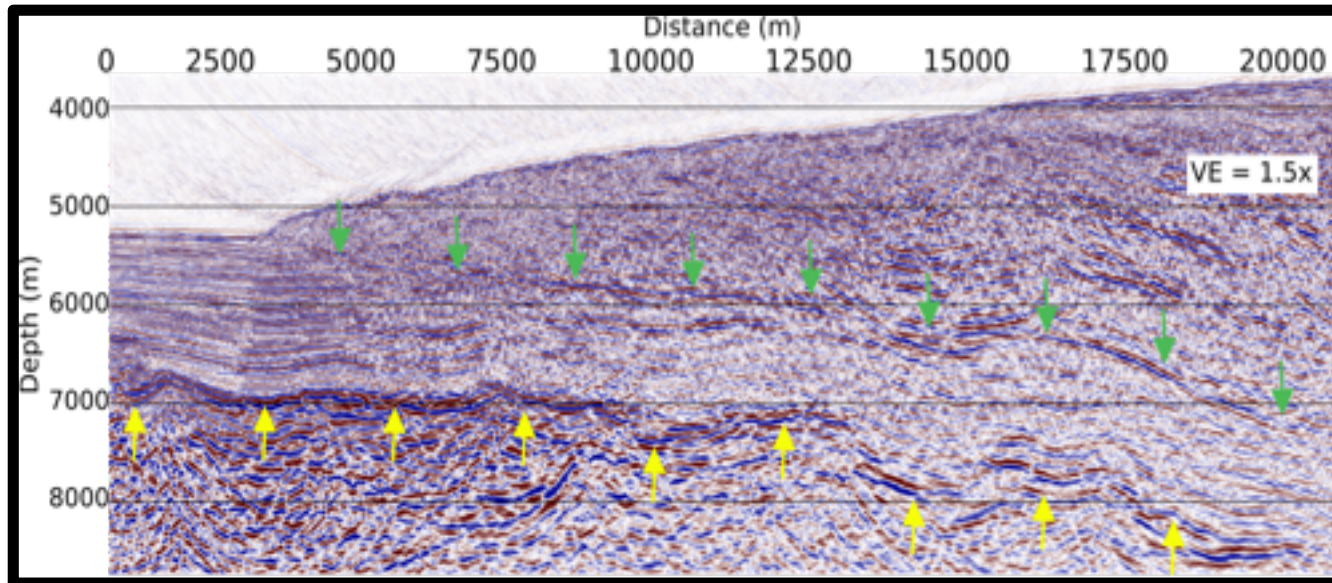
*– Justin Estep, Texas A&M*



# Crustal Examination from Valdivia to Illapel to Image Huge Earthquakes (CEVICHE)



*“Sailing on the Langseth and collecting the data for my research was a really great experience because I got to learn about all the work and details that go into collecting seismic data, which will help if I become a PI one day. I also enjoyed meeting and working with Chilean scientists, who are affected by the earthquakes in the area I study” – Kelly Olsen, UTIG*

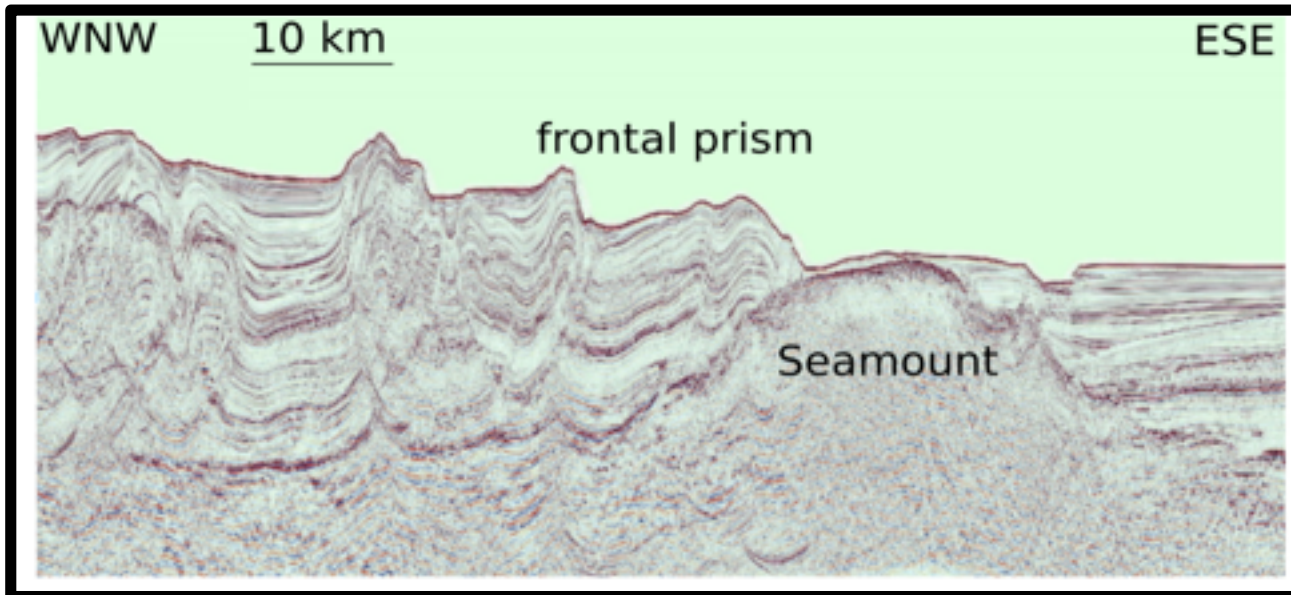




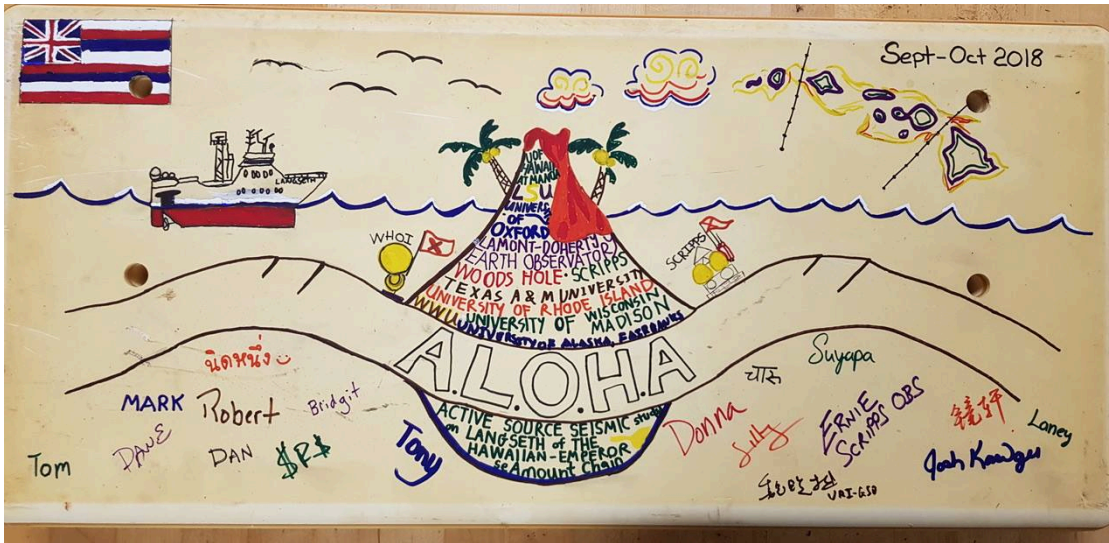
# Seismogenesis at Hikurangi Integrated Research Experiment (SHIRE)



*"By sailing aboard the Langseth and assisting the technical staff, I learned more about seismic acquisition than I ever could have from a book or course."* - Andrew Gase, UTIG

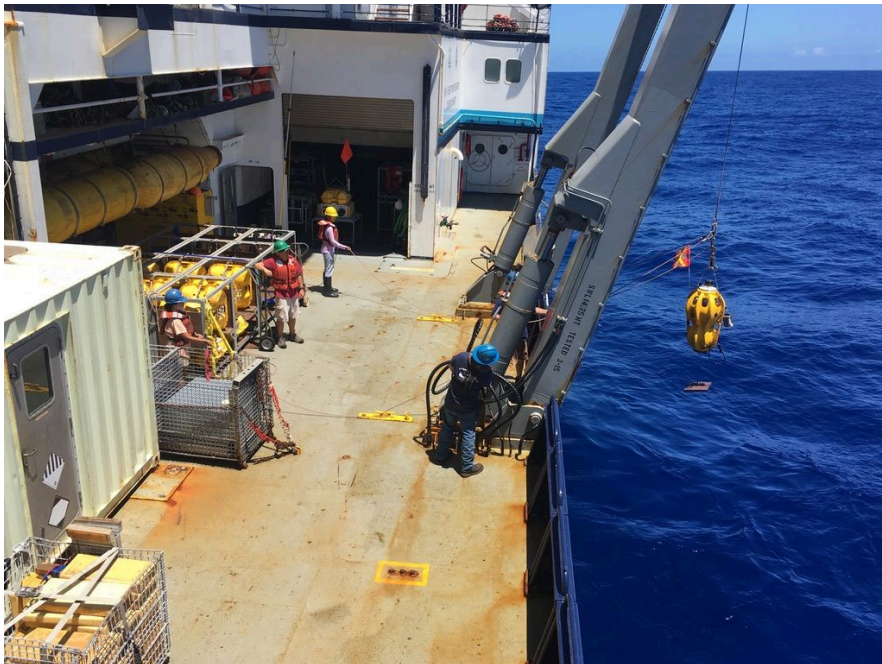


# Hawaiian-Emperor Seamount Seismic Experiment



*“My favorite part of the field experience was meeting all of the personal responsible for the cruises success. The Langseth crew are especially outgoing and always willing to let you jump in and help out.*”

*As someone studying marine geophysics, participating in the Hawaii cruise was a unique learning experience and likely the culmination of my Masters degree.”*



-Mark McClernan  
University of Alaska



Questions?

