



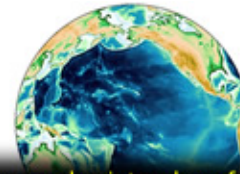
Geodynamic Processes at *Rifting* and *Subducting Margins*



***Workshop to Cultivate and Coordinate
GeoPRISMS Studies of the Hikurangi
Subduction Margin***

December 14, 2014 - Grand Hyatt San Francisco

*Conveners: Laura Wallace, Mike Underwood, Samer Naif, Bill Frey,
Stephen Bannister, Nathan Bangs*



to understand the complex interplay of processes
that govern the evolution of continental margins



120 scientists in attendance



Subduction Cycles and Deformation Implementation Workshop

Bastrop, Texas

January 5-7, 2011

<http://www.geoprisms.org/science-plan.html>

Workshop report: GeoPRISMS Newsletter No. 26

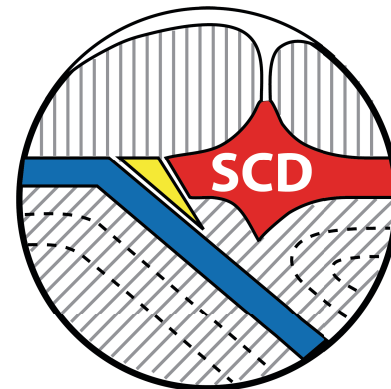


Key Topics - SCD

- Controls on the size, frequency and slip behavior of subduction plate boundaries
- Spatial and temporal patterns of deformation through the seismic cycle
- Linkages between volatile release and the rheology of the plate boundary interface
- Storage, transfer, and release of volatiles through subduction systems
- Geochemical products of subduction and creation of continental crust
- Subduction zone initiation and arc system formation
- Feedbacks between surface processes and subduction zone dynamics

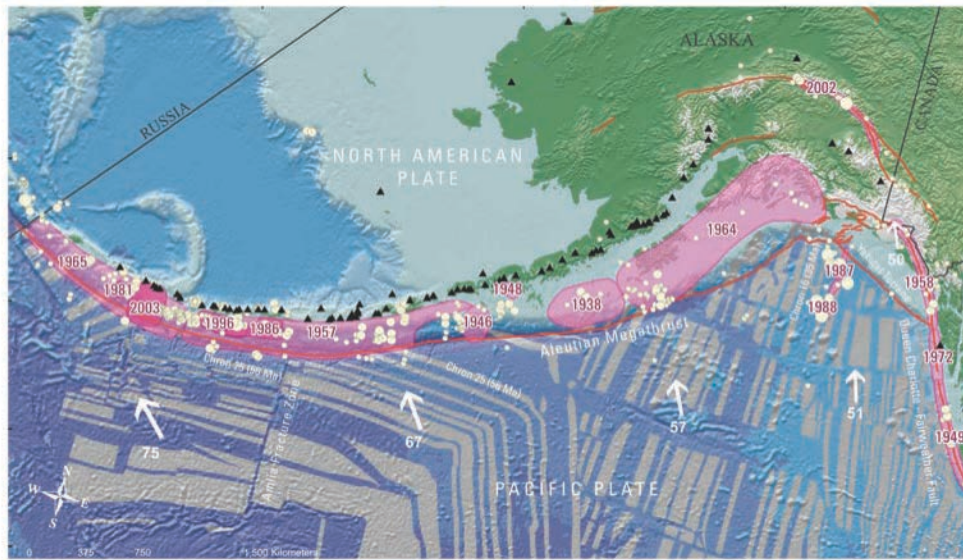
Thematic Studies - SCD

- Identifying controls on fault slip behavior and deformation history
- Understanding mantle wedge dynamics
- Fore-arc to back-arc volatile fluxes
- Metamorphic and igneous conditions and processes at depth
- Subduction initiation

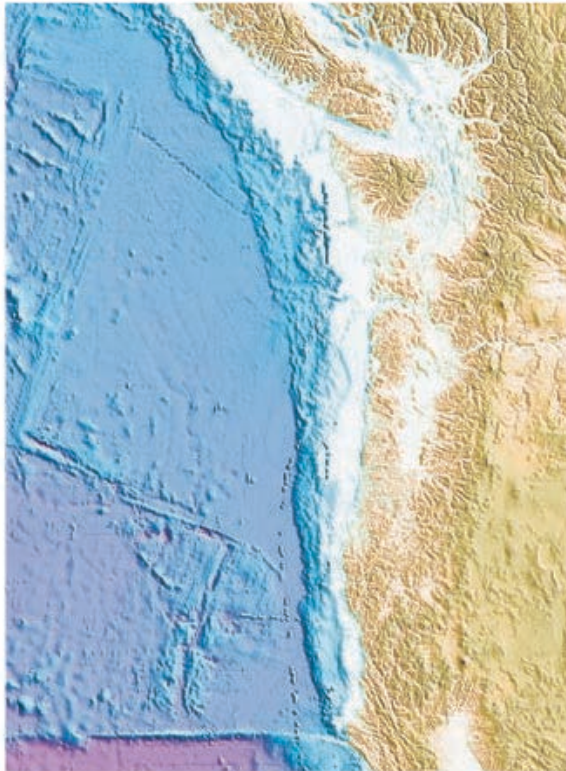


SCD Primary Sites

Alaska-Aleutians



Cascadia



New Zealand

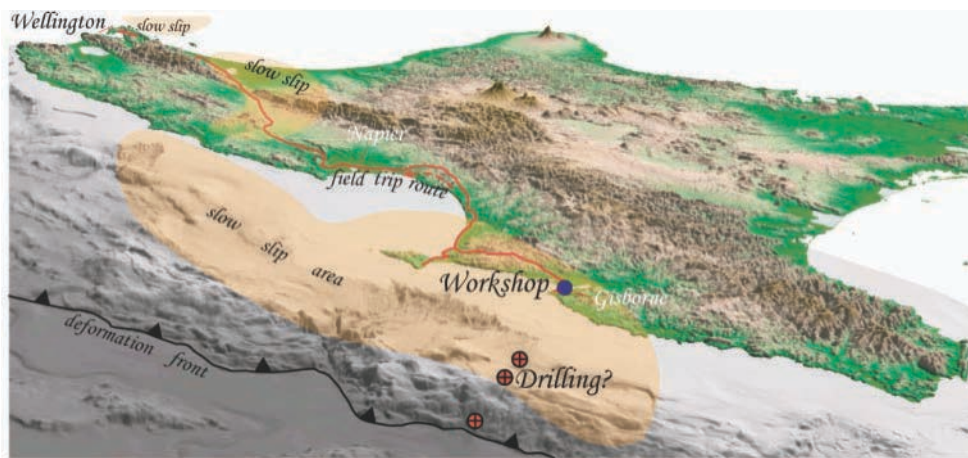
IODP Workshop on Using Ocean Drilling to Unlock the Secrets of Slow-Slip Events

Gisborne, NZ
August 1-5, 2011



Workshop report: GeoPRISMS Newsletter No. 27

70 scientists in attendance



New Zealand Primary Site Implementation Planning Workshop

Wellington, NZ
April 14-16, 2012



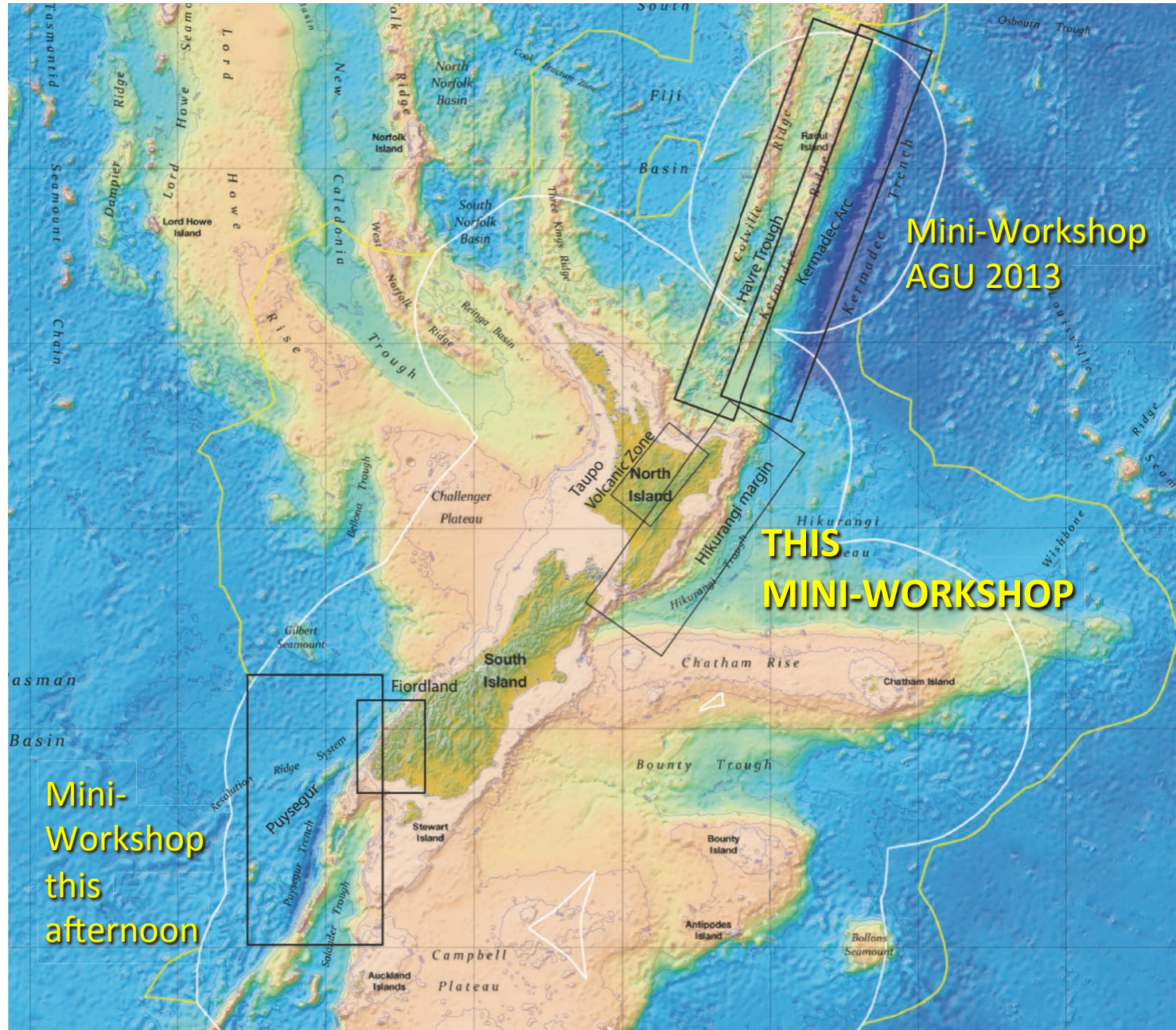
~170 participants from 10 countries



Main Topics – New Zealand

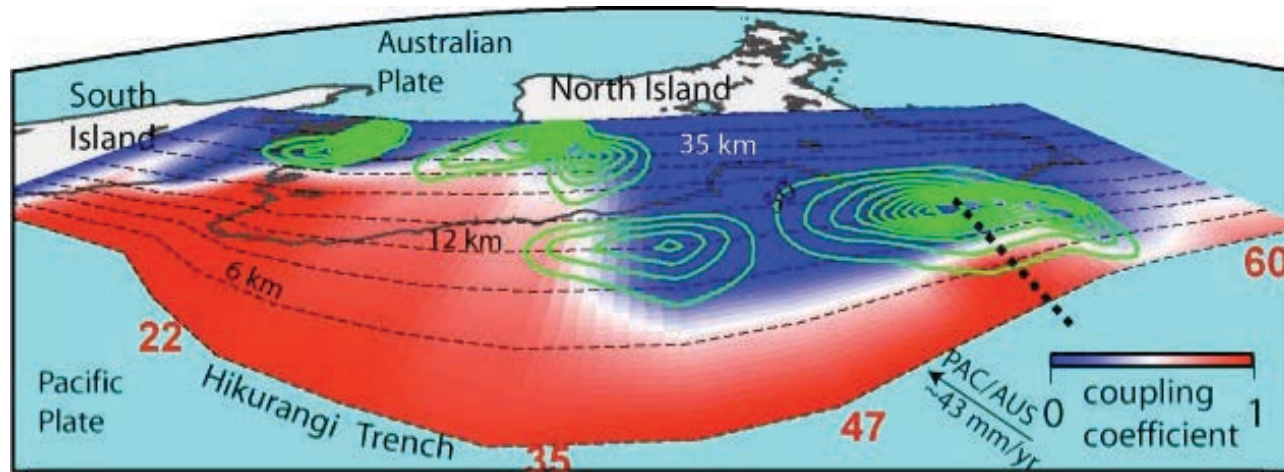
- What are the geological, geochemical, and geophysical responses to **subduction initiation** and early arc evolution, and how do they affect subduction zone formation?
- What are the pathways and sources of **magmas and volatiles** emerging in the arc and forearc, and how do these processes interact with upper plate extension?
- What controls subduction **thrust slip behavior** and its spatial variability?
- What are the **feedbacks** between climate, sedimentation, and forearc deformation?

Main Regions of SCD GeoPRISMS Interest



Along-Strike Variations in the Hikurangi Subduction System

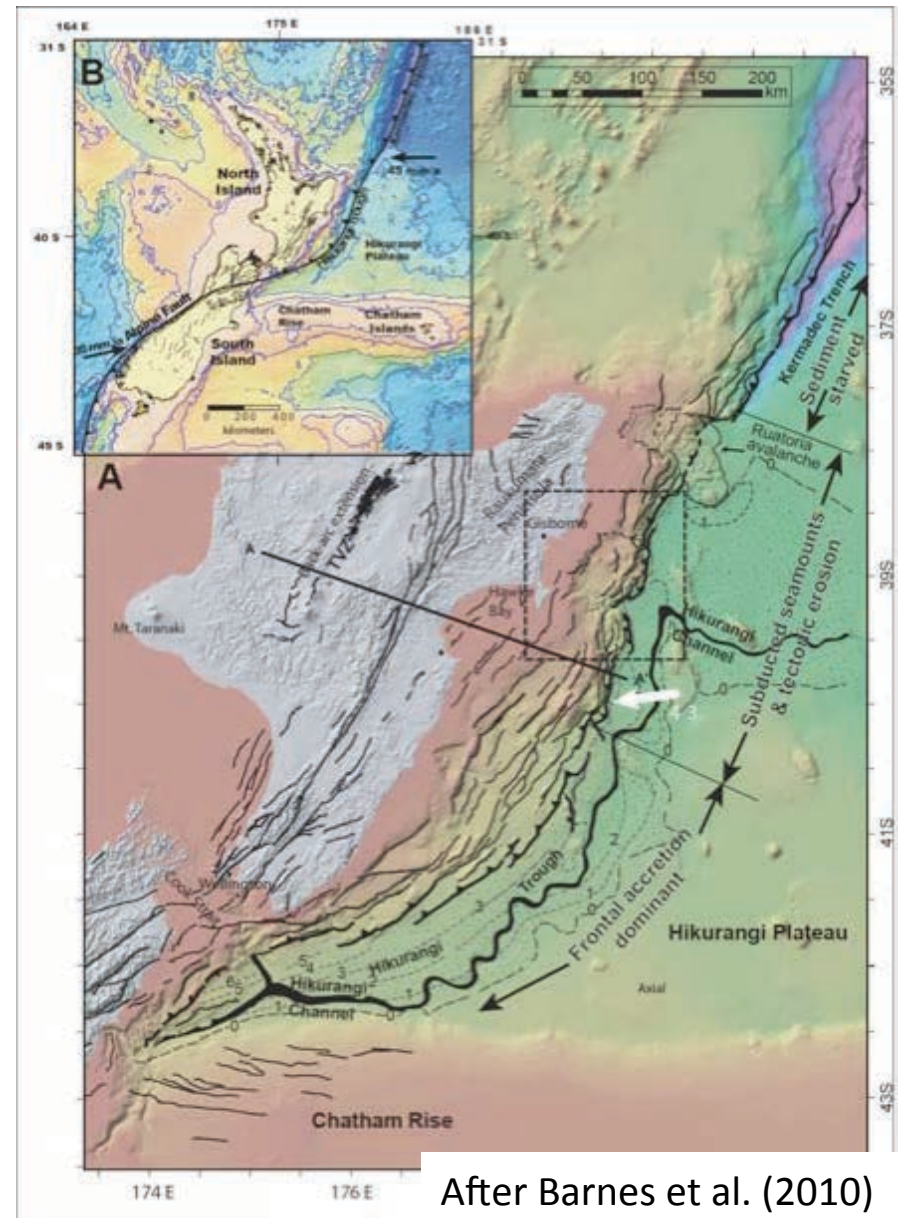
Red = stick-slip
Blue = aseismic



Southern segment (Wairarapa)	Central segment (Hawke's Bay)	Northern segment (Raukumara)
<ul style="list-style-type: none"> ● deep slow slip events (SSEs) and strong interseismic coupling ● frontal accretion dominant ● few seamounts entering margin 	<ul style="list-style-type: none"> ● shallow SSEs and weak interseismic coupling ● tectonic erosion/moderate-low accretion ● numerous seamounts impacting margin 	<ul style="list-style-type: none"> ● tectonic erosion/negligible accretion
← increasing thickness of sediment on the incoming plate		
<ul style="list-style-type: none"> ● fluids emerging in forearc have no mantle component ● tectonic contraction and strike-slip in upper plate 	<ul style="list-style-type: none"> ● Seeps and springs in forearc have a strong mantle signature—=from mantle of subducting plate? ● back-arc extension and strike-slip in upper plate 	
← increasing convergence rate at trench		
<ul style="list-style-type: none"> ● wedge taper angle 4-6 degrees 	<ul style="list-style-type: none"> ● accretionary wedge taper angle 6-10 degrees 	

SCD Key Topics -- Hikurangi

- Controls on size, frequency, & slip behavior of subduction plate boundaries
- Spatial-temporal deformation patterns at subduction zones
- Effects of volatile release & transfer on the plate-boundary interface
- Feedbacks between surface processes & subduction dynamics
- Volatile storage, transfer, & release in subduction systems



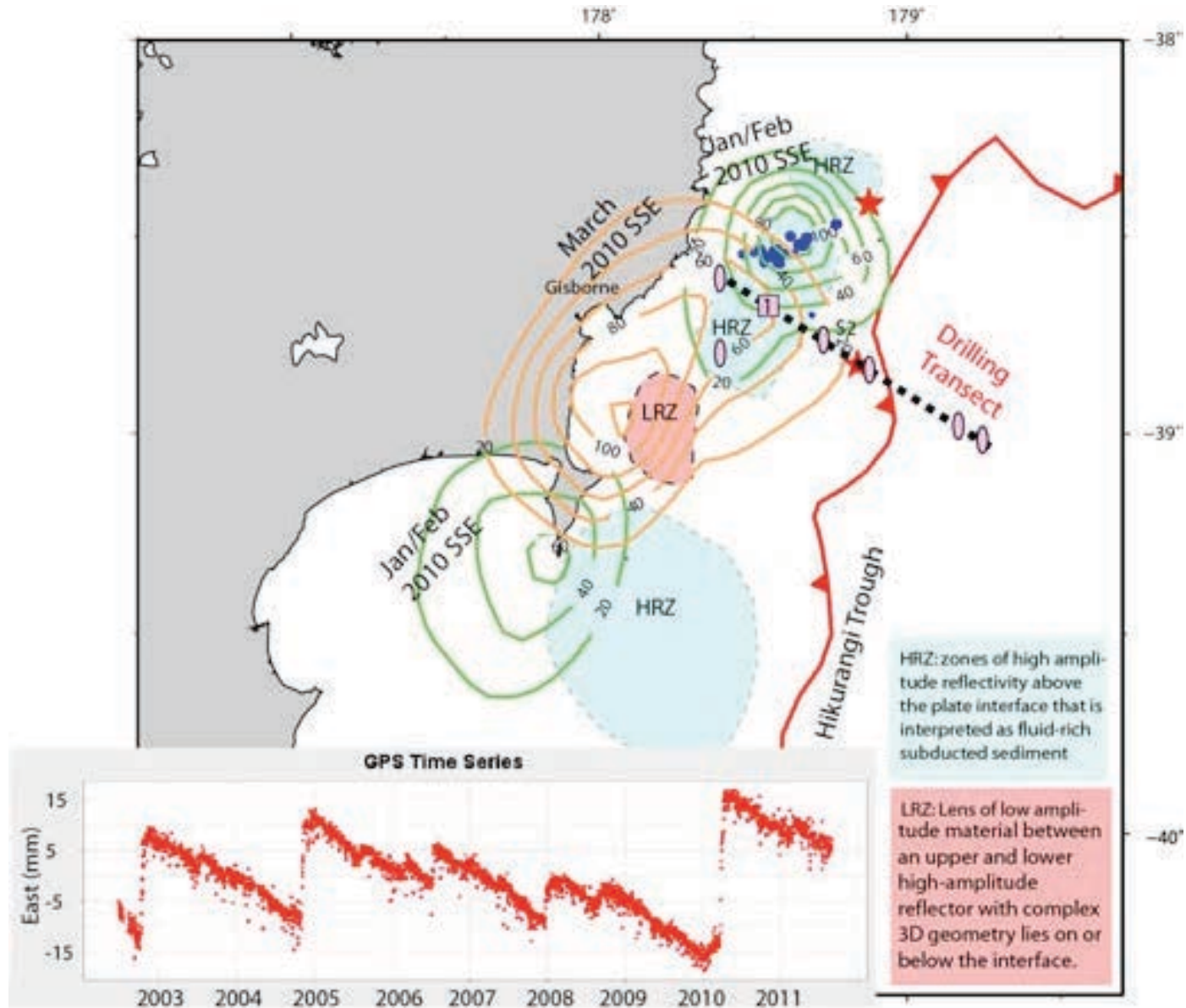
GeoPRISMS Science Plan:

“The Hikurangi margin is well suited to studying the causes and consequences of the spectrum of slip behavior along subduction megathrusts, given geophysical and geological evidence for pronounced along-strike changes in margin tectonics and subduction interface behavior.”

“Also, a complete late Neogene record of strain, and tectonic and eustatic controls on sedimentation in the Hikurangi subduction wedge, are preserved along the east coast of the North Island and in adjacent submarine basins.”

“The well-preserved sedimentary record makes it an ideal location to address the feedbacks between climate, sedimentation, and forearc deformation.”

Location of slip on northern Hikurangi interface during 2010 SSEs



Wallace and Beavan (2010)

International Partnership



Data from networks available at: www.geonet.org.nz

Potential GeoPRISMS Studies –

1. Geophysical Studies

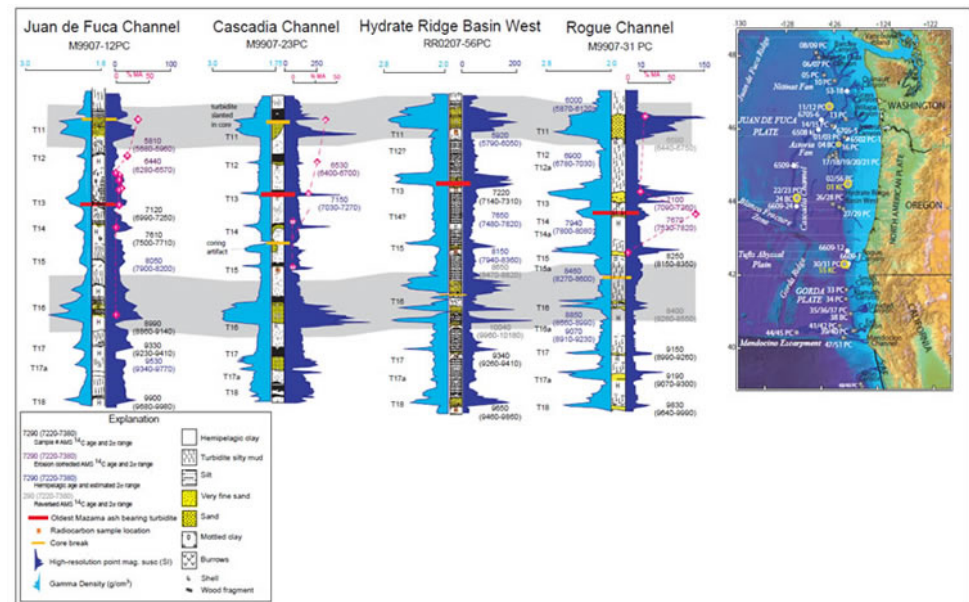
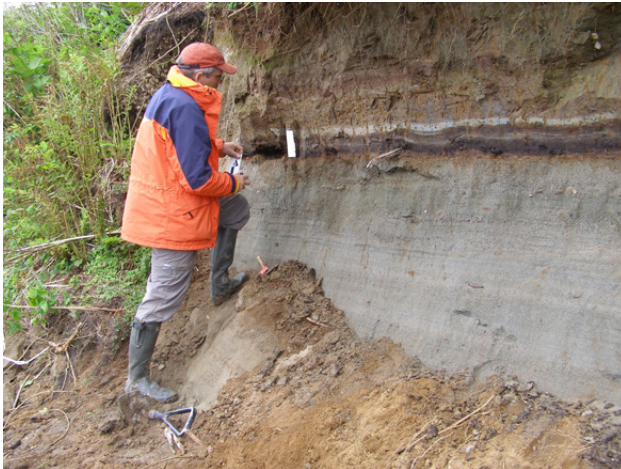


- Heat flow
- OBS deployments
- Seafloor and sub-seafloor geodetic studies
- Onshore geodetic instrumentation (e.g., strain, tilt meters)
- 3-D seismic survey (linked to IODP transect)
- Offshore MT and controlled-source electromagnetics
- Integrated interpretation (numerical modeling)

Potential GeoPRISMS Studies –

2. Paleoseismology

- Investigation of new sites onshore
- Correlative offshore archives from turbidites



Potential GeoPRISMS Studies

3. Fluid/Rock Sampling & Observatories

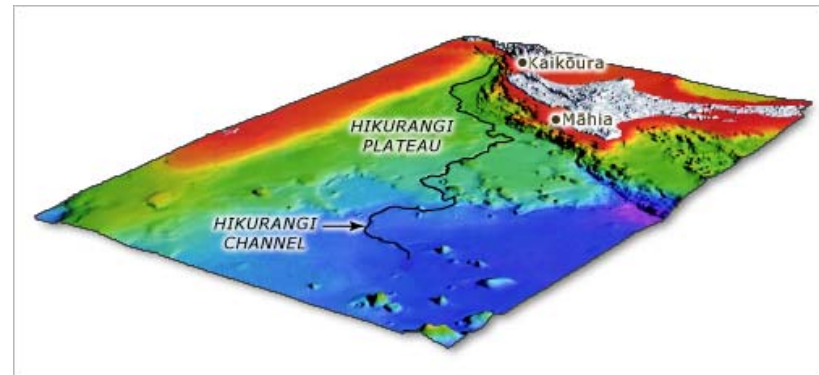
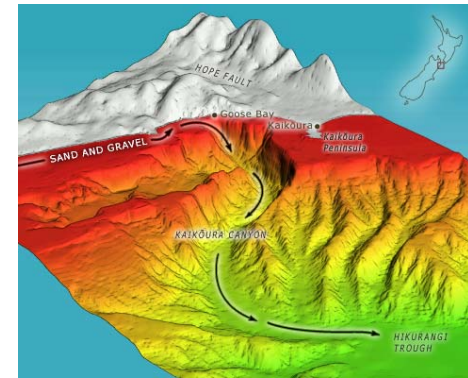
- IODP drilling and coring
 - Comprehensive characterization of subduction inputs
- Coordinated onshore sampling for along-strike assessment of composition => Pliocene
- IODP observatories (CORK-type)
- Integration with:
 - Passive/active seismic arrays
 - Numerical modeling



Potential GeoPRISMS Studies

4. *Sediment Feedbacks and Structure*

- Holistic characterization of trench wedge
 - Canyon incision, submarine MTDs
 - Climate, eustatic SL fluctuations
 - Uplift/unroofing of sediment sources
- 4-D interplay between sediment, subduction accretion/erosion, frontal prism architecture
 - Along strike, back to Pliocene
- Integrated with:
 - Seismic imaging
 - Sampling onshore/offshore
 - IODP drilling





Today's Goals:

Update community on funded/proposed projects

Identify unfulfilled priorities

Encourage “heroes” to organize new proposals

Foster collaborations

