

# **AASE - Marine Seismic Community Update**

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Susan Schwartz, UC Santa Cruz

Anne Sheehan, University of Colorado, Boulder

Donna Shillington, Lamont-Doherty Earth Observatory

Spahr Webb, Lamont-Doherty Earth Observatory

Doug Wiens, Washington University in St. Louis

Lindsay Worthington, University of New Mexico

**2017 Pre-AGU**

**GeoPRISMS mini-Workshop.**

Sunday December 10, 2017

**New Orleans**

# History of project -

- 2014 Workshop in Snowbird Utah on the Future of the Amphibious Array.

What should happen to the Amphibious Array Facility after Cascadia?

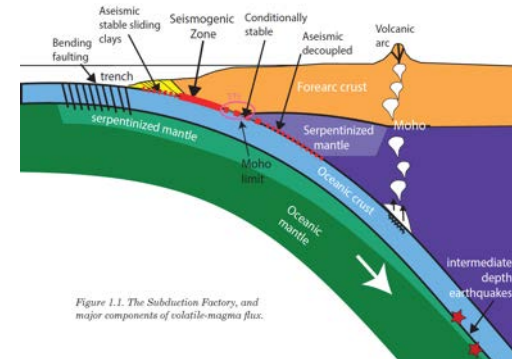
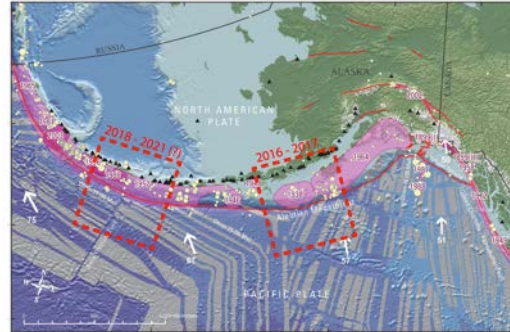


Figure 1.1. The Subduction Factory, and major components of isostatic-magma flux.

- March 2016 NSF Dear Colleague Letter - NSF 16-061

NSF 16-061  
Dear Colleague Letter: Onshore-Offshore Seismological Studies of the Aleutian Arc

March 15, 2016

Dear Colleague:

There is gathering momentum and interest in the community in developing new activities that span the traditional Earth-Ocean Science boundaries. This is especially relevant at subduction zones where active processes span the coastline. Subduction zones are among the most dynamic features on Earth, producing large and powerful earthquakes that

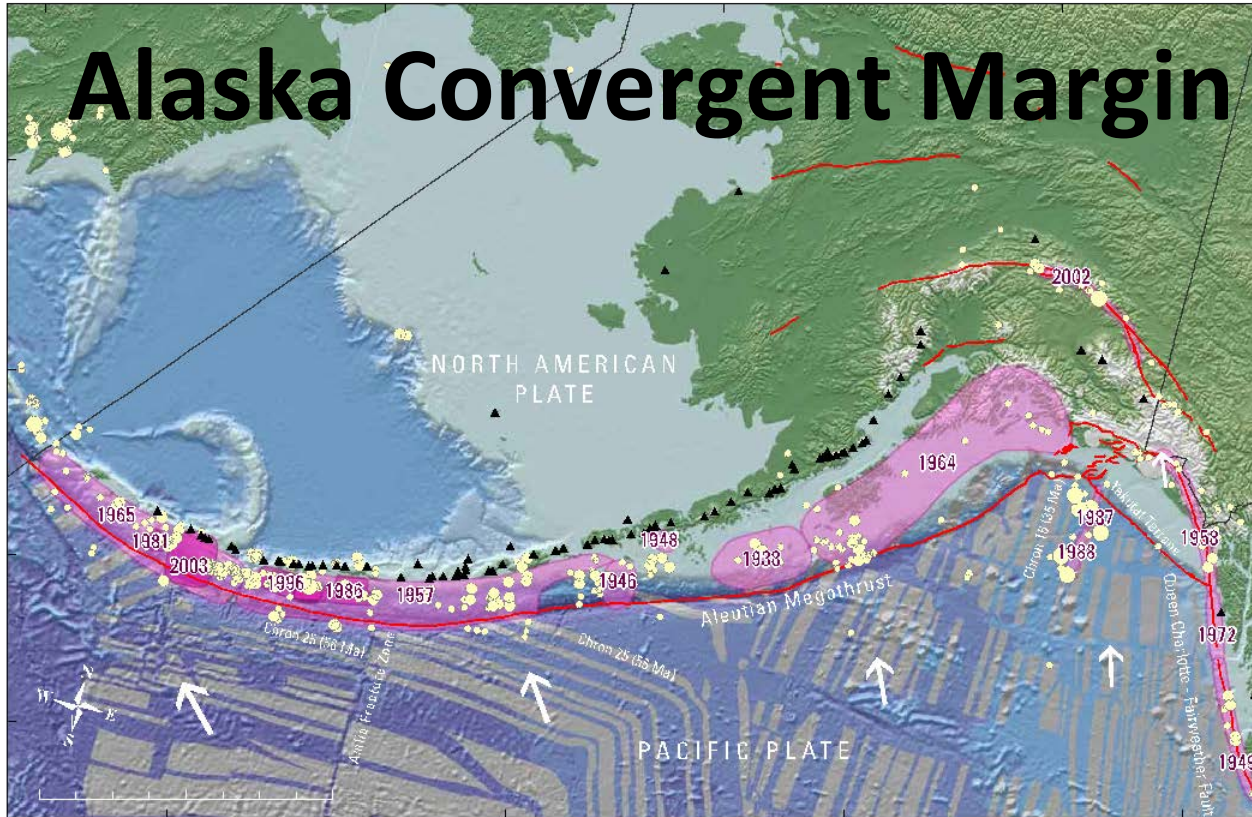
- Formation of PI Team:  
Webinar and open invitation/web forum
- July 2016 Submission of Community Experiment Proposal

- August 2017 Awarded

## Principal Investigators:

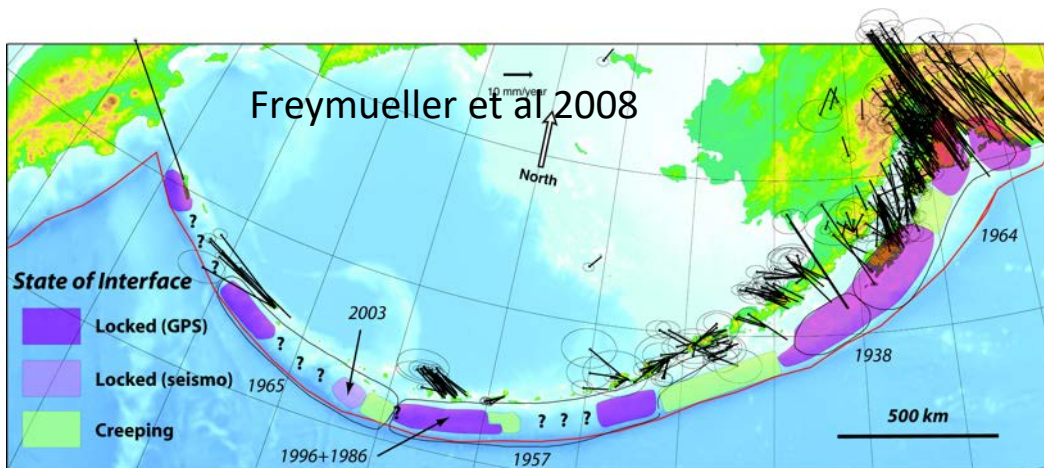
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Spahr Webb, LDEO  
Doug Wiens, Wash. U.  
Lindsay Worthington, U. New Mexico

# Alaska Convergent Margin



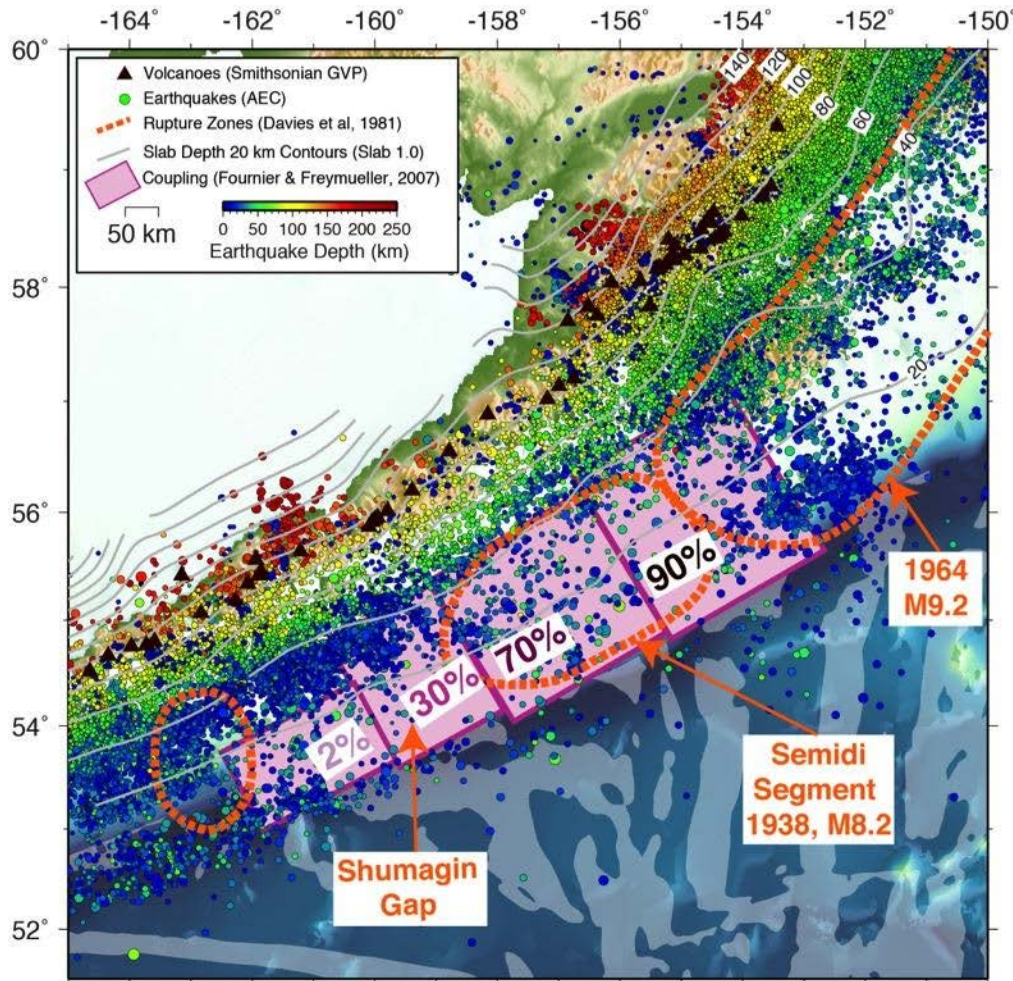
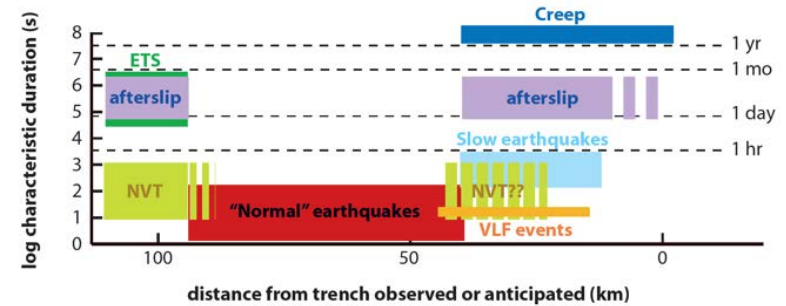
## Why Alaska?

1. Significant interseismic seismicity
2. Along strike trends in inputs
3. Changes in style of arc magmatism along strike
4. Change in seismogenic behavior along strike
5. Good information on upper and lower plate structure
6. Time is good to capitalize on EarthScope efforts in Alaska



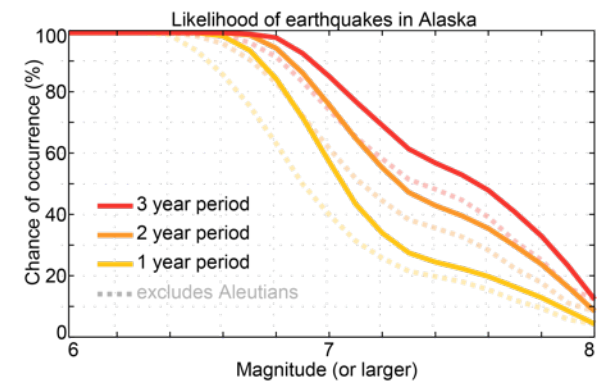
# Experiment– Science Targets

## Variability in Slip Behavior and Seismicity along the Seismogenic Zone:



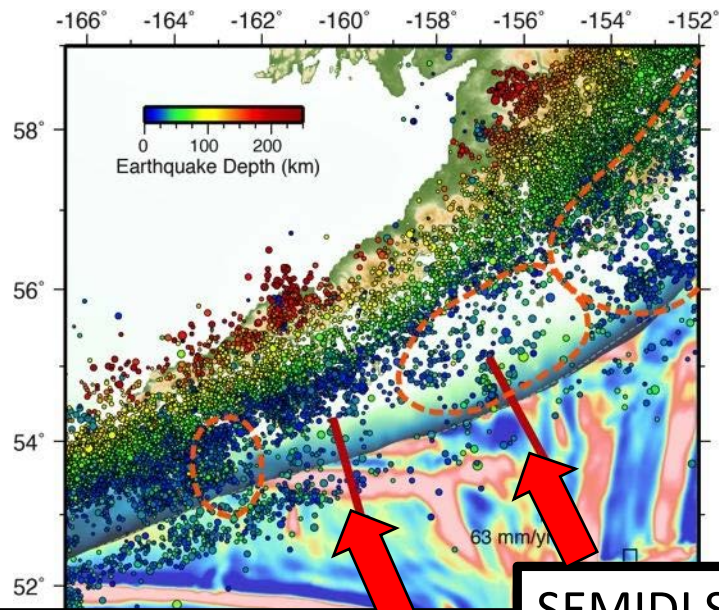
Seismicity : AEC catalog  
 GPS: Fournier and Freymueller (2007),  
 Slab depth contours: Syracuse & Abers, 2006

From: *Earthquake occurrence rate in Alaska*  
 Michael West, AEC



# Experiment– Science Targets

Seismic imaging constraints on material and volatile cycling

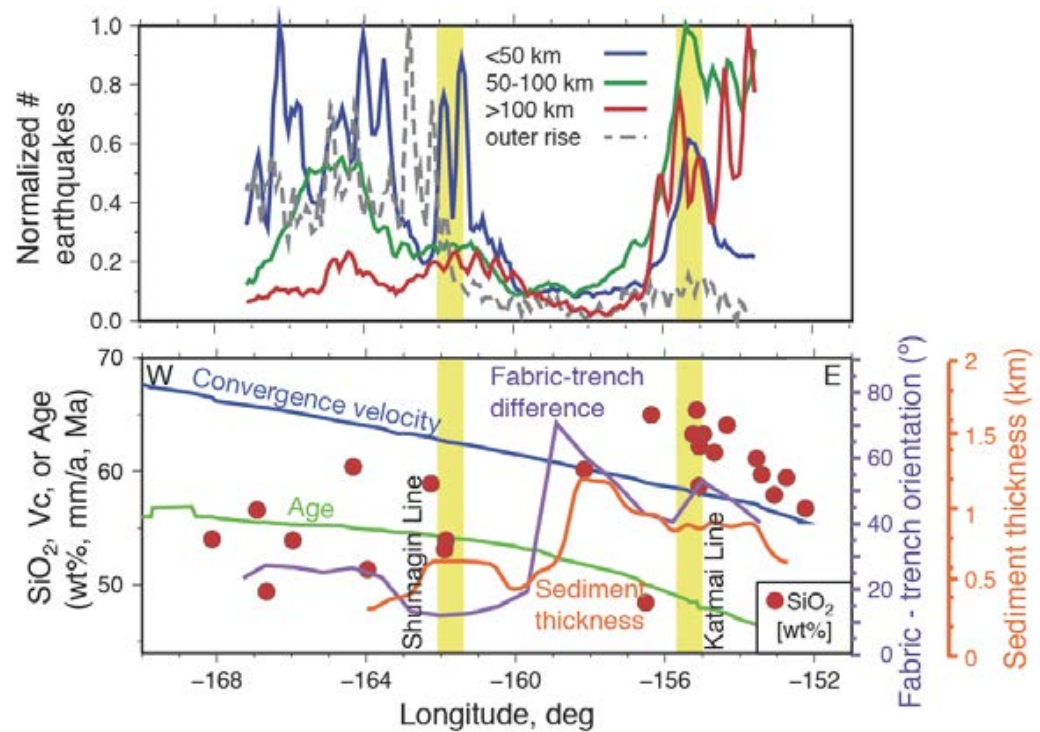


## SHUMAGIN GAP

Less sediments,  
More basement roughness  
More hydration

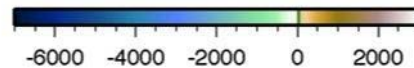
## SEMIDI SEGMENT:

More sediments,  
Less basement roughness  
Less hydration

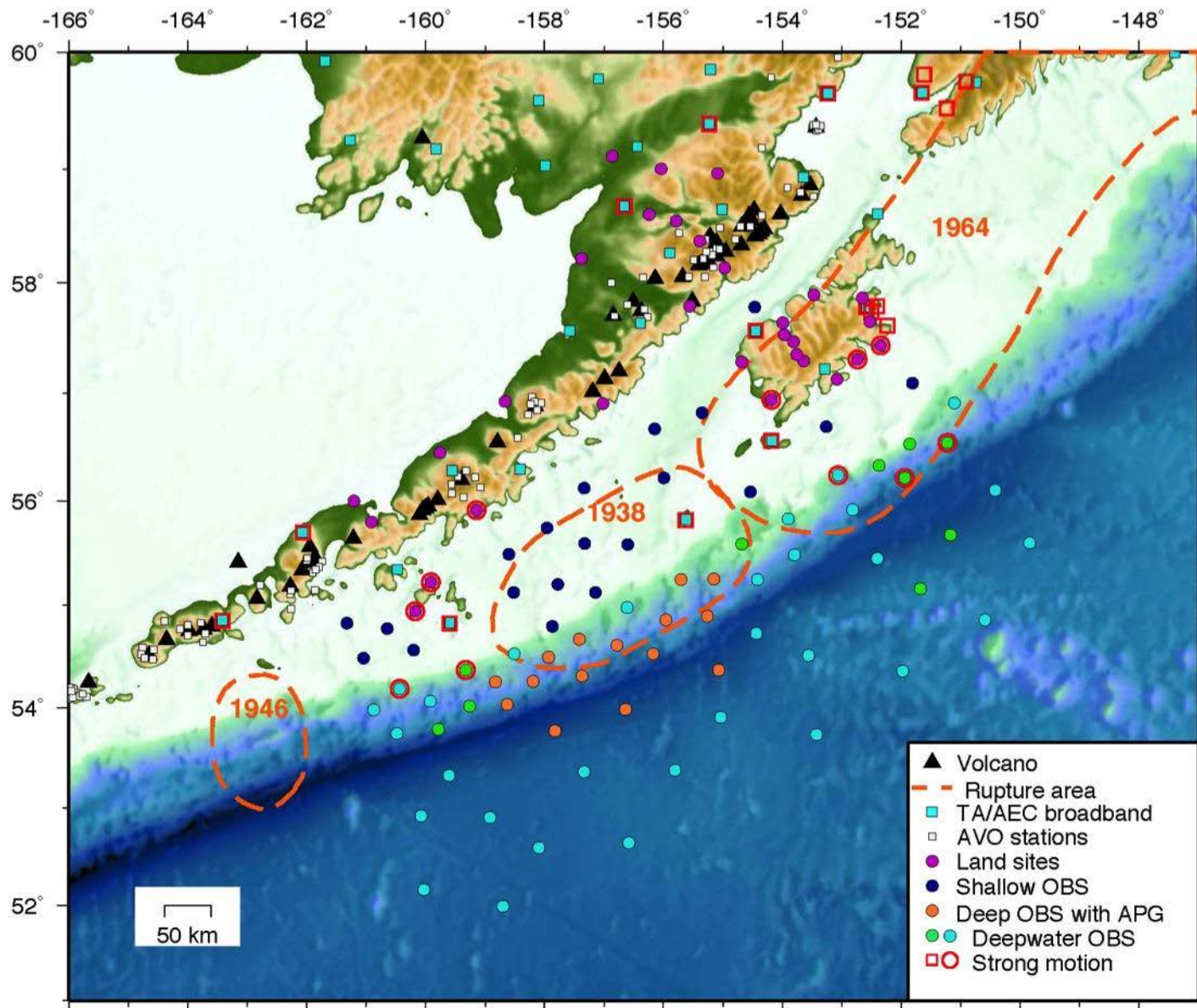


Along-strike variations in arc properties and inputs. SiO<sub>2</sub> from Buurman et al. (2014), plate parameters from Syracuse and Abers (2006), others from Shillington et al. (2015). Yellow lines are locations of more densely instrumented transects

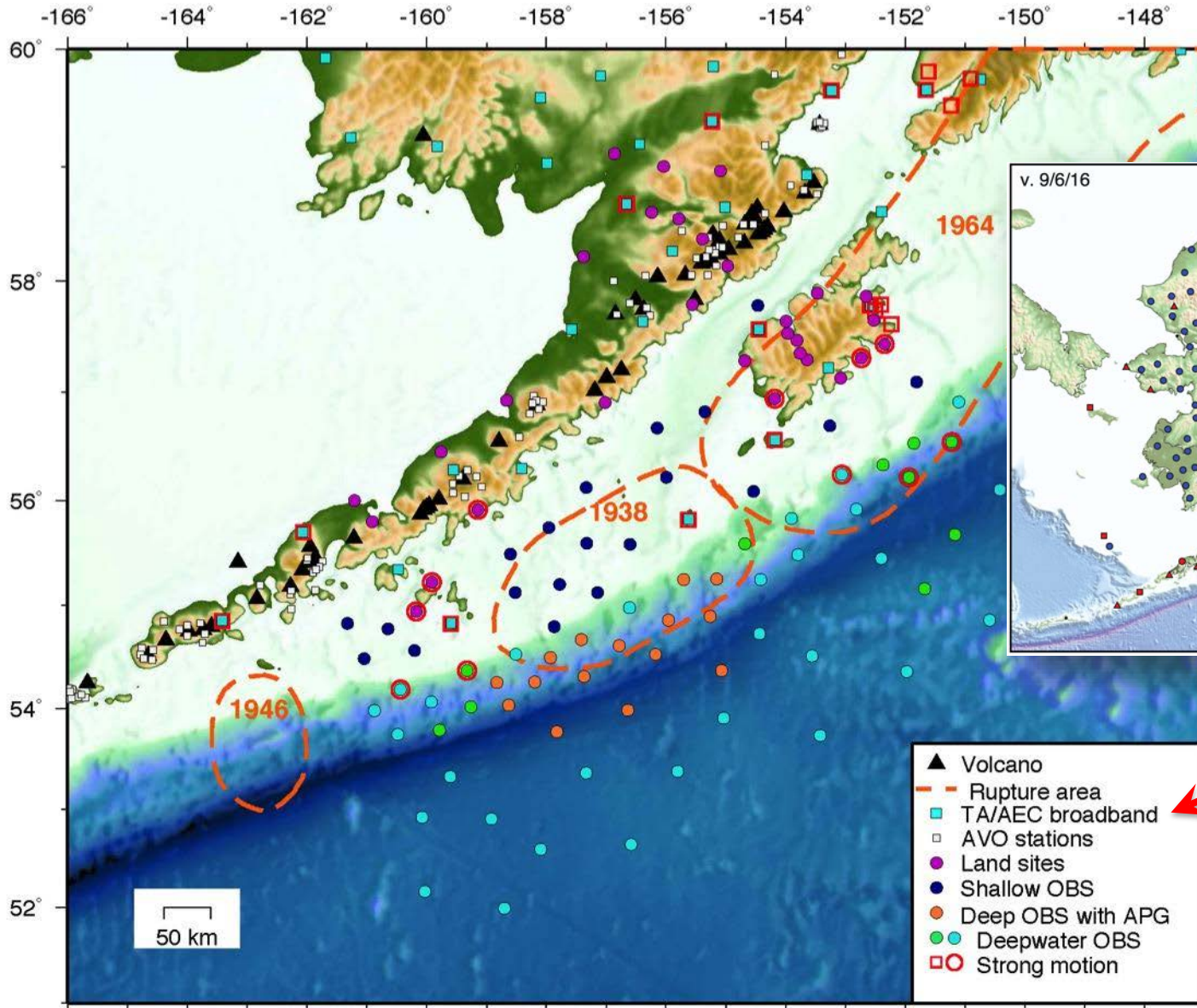
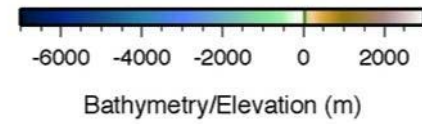
# Current station map, ~15 months



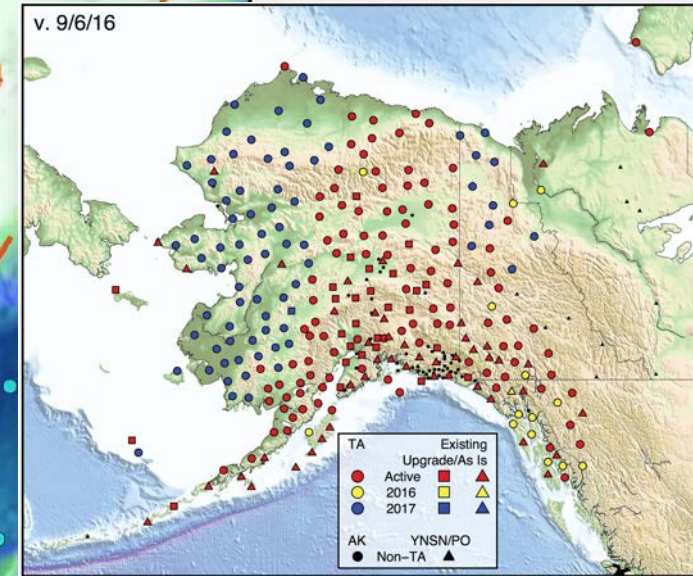
Bathymetry/Elevation (m)



# Current station map, ~15 months



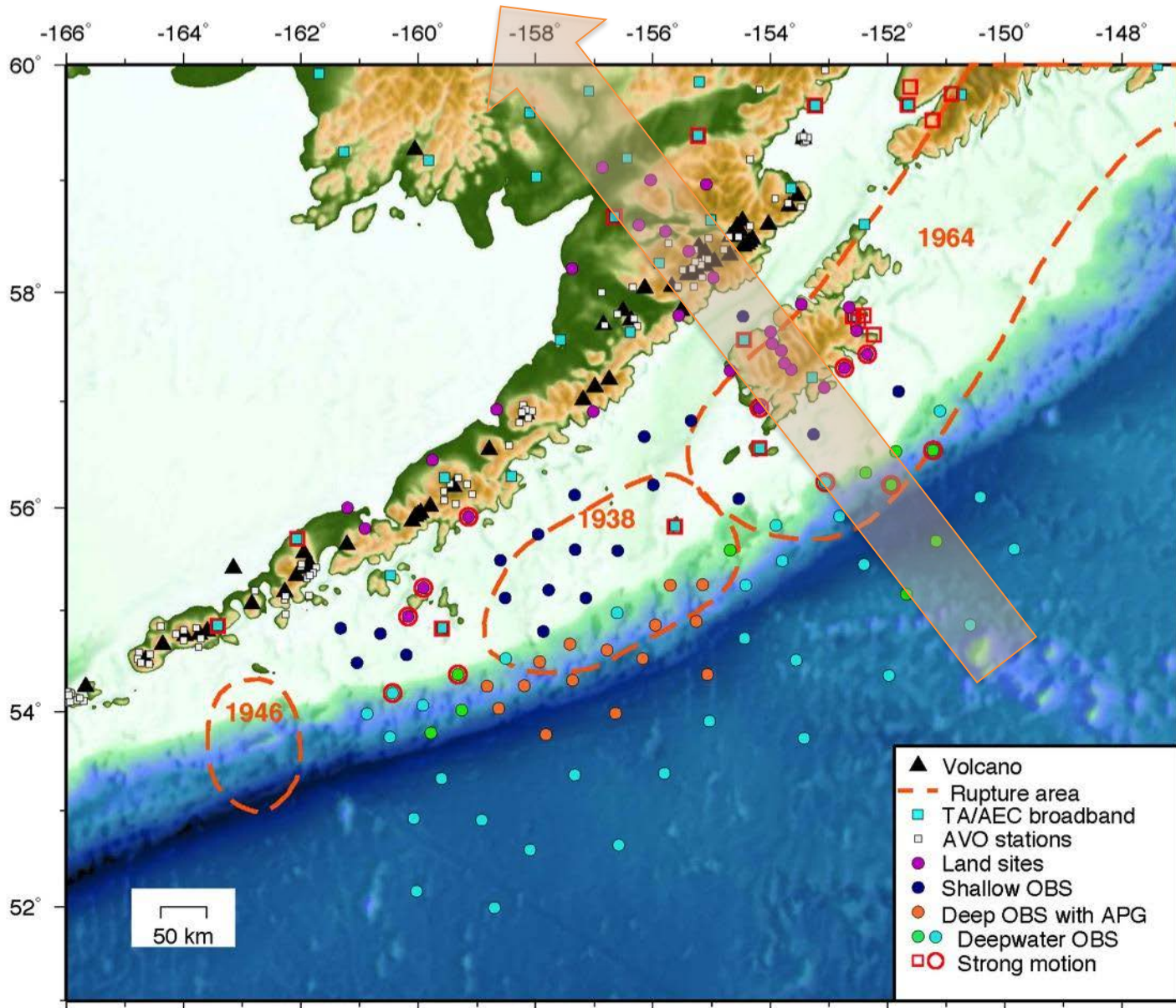
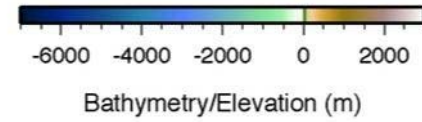
1. Concurrent with TA



- ▲ Volcano
- - - Rupture area
- TA/AEC broadband
- AVO stations
- Land sites
- Shallow OBS
- Deep OBS with APG
- Deepwater OBS
- Strong motion

EarthScope  
Transportable  
Array (TA) –  
*deployed until  
late 2019*

# Current station map, ~15 months



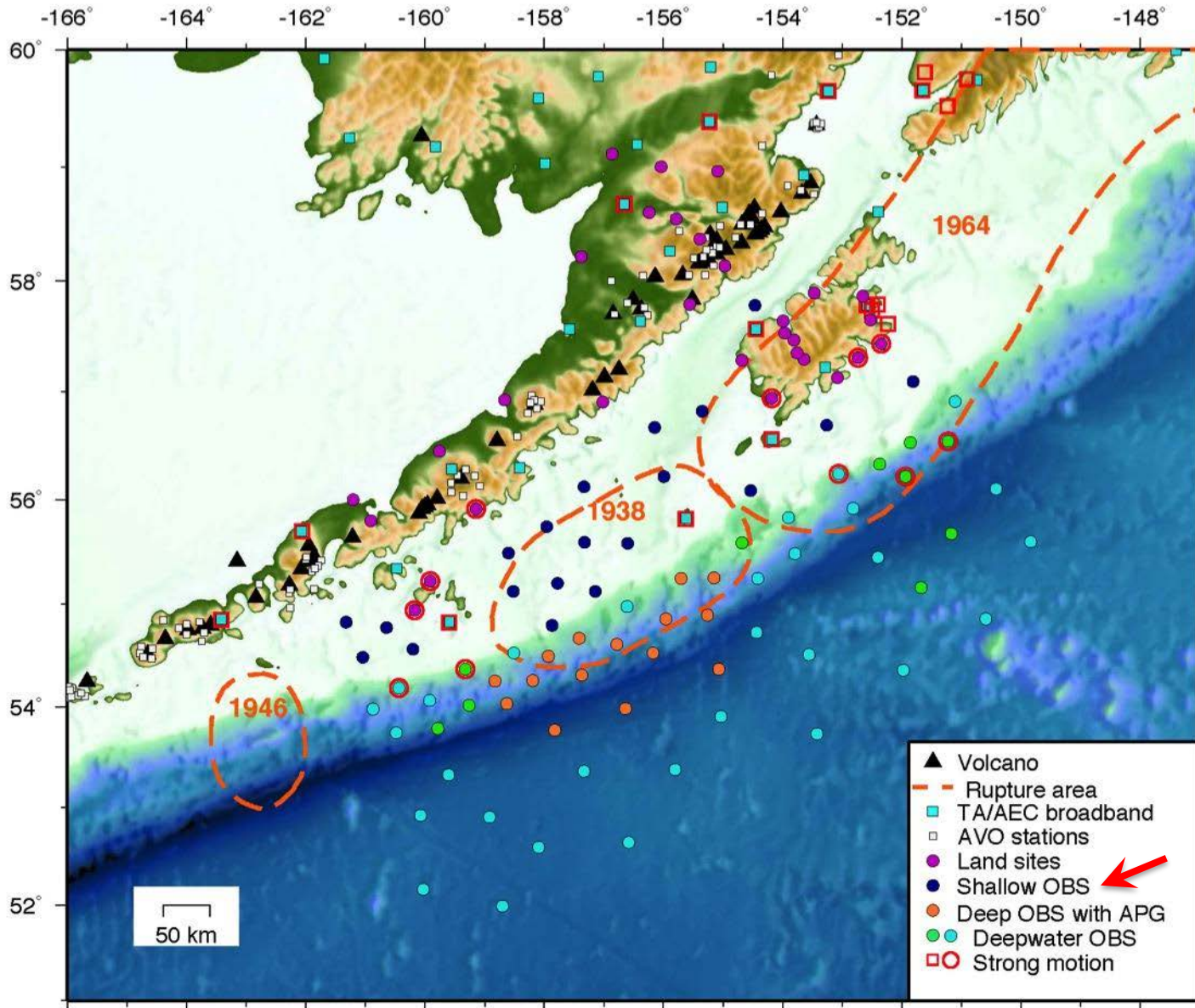
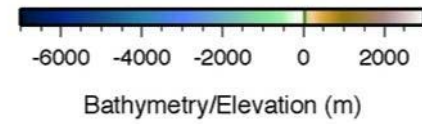
1. Concurrent with TA

2. Dense transect crossing

*Integrates with TA stations ~1000 km behind the arc*



# Current station map, ~15 months

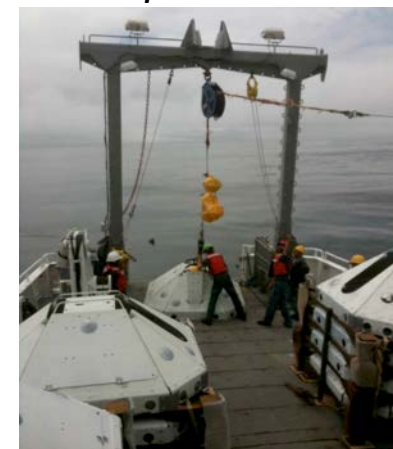


1. Concurrent with TA

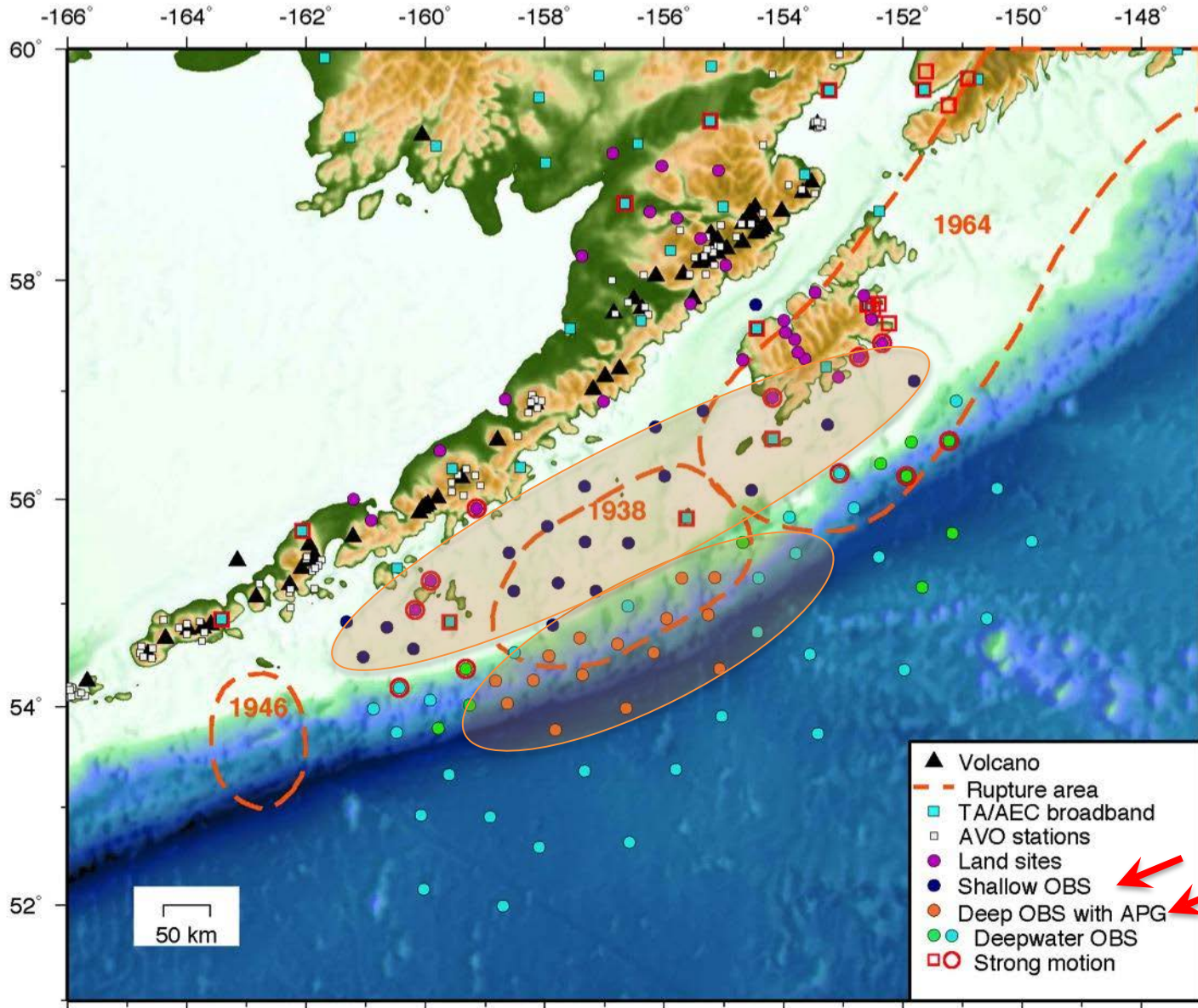
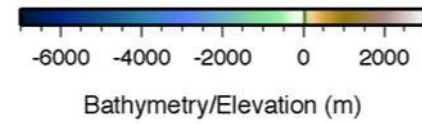
2. Dense transect crossing Kodiak/Katmai

3. Shallow water

*< 200, water depth*



# Current station map, ~15 months



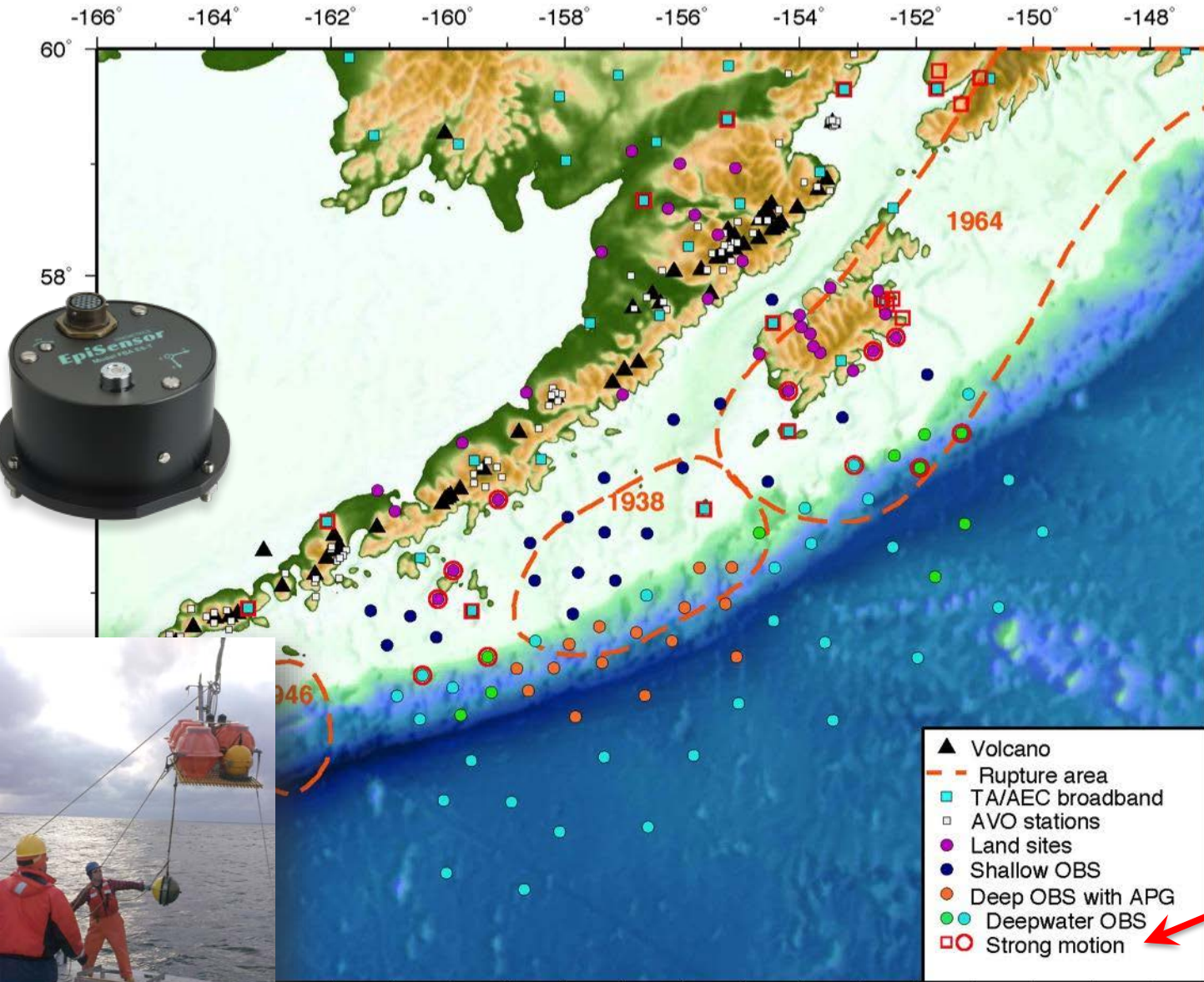
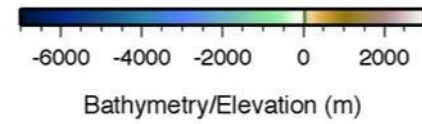
1. Concurrent with TA

2. Dense transect crossing Kodiak/Katmai

3. Shallow water TRMS

4. Significant array of seafloor APGs

# Current station map, ~15 months



1. Concurrent with TA

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3. Shallow water TRMS

4. Significant array of seafloor APGs

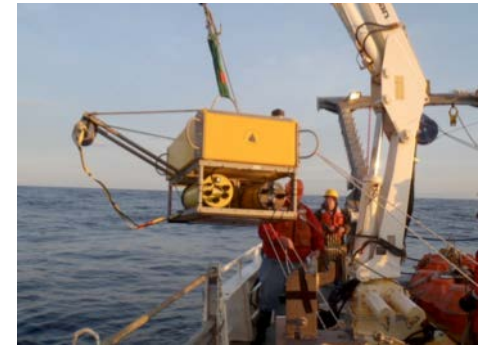
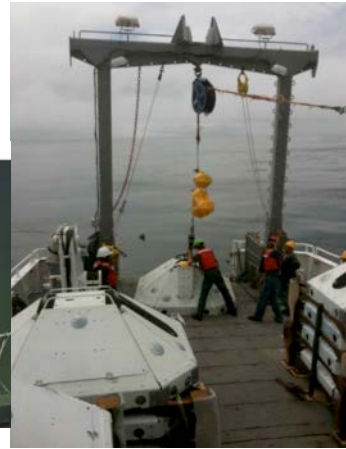
5. Seafloor strong motion OBS

6. Land strong motion stations

# New Capabilities and Environmental Adaptations

- Shallow water, trawl resistant instruments, with adaptations for quicker recovery (pop-ups)
- Roughly half of the OBSs are equipped with high precision absolute pressure gauges
- OBS retrofitted to last up to 15 months on the sea floor
- 5 OBS with new (MEMS internal memory – is this right John?) seafloor accelerometers
- 6 onshore sites will include accelerometers (complement 8 TA stations with accelerometers in study area)
- Land instrumentation with postholes and bear-proof electronics- configured to allow 16-18 months of continuous operation on a single set of (air cell) batteries

Site M09B showing evidence of having been hit by a trawler.



# Array design for studying plate boundary slip behavior:

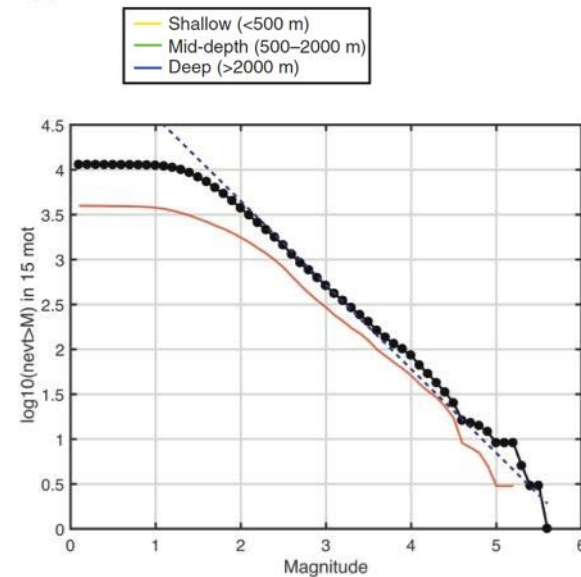
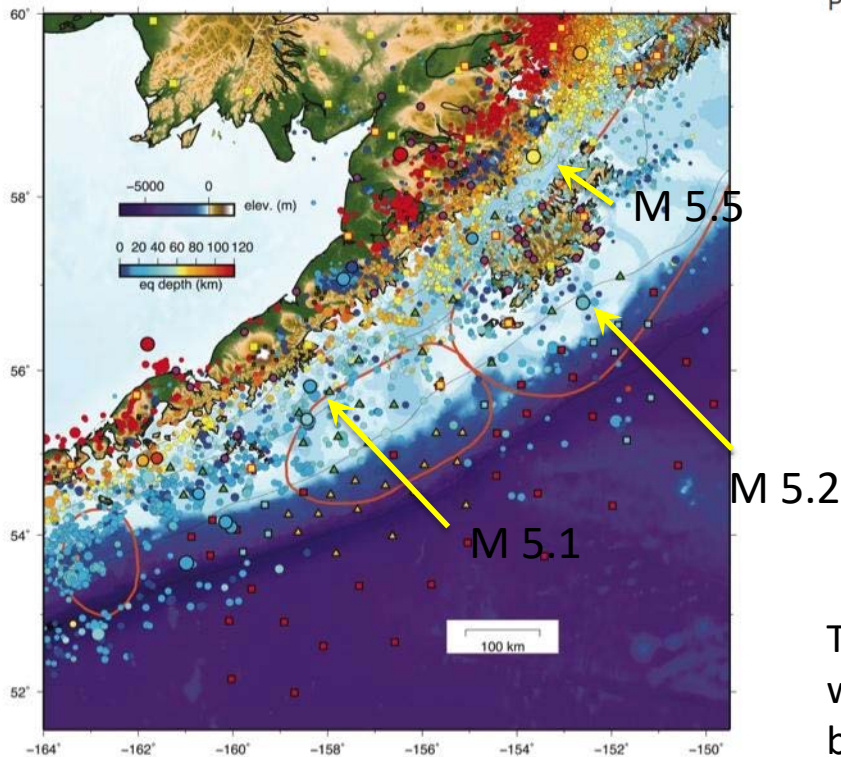
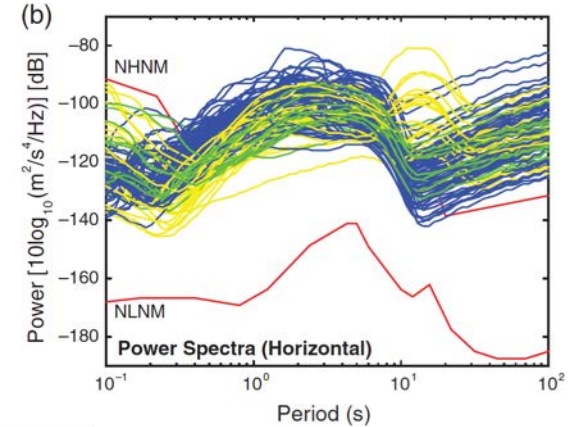
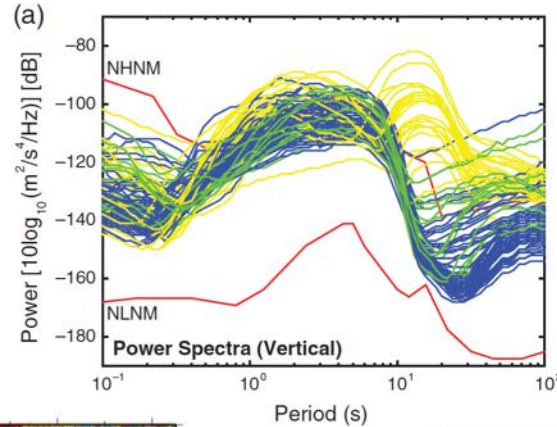
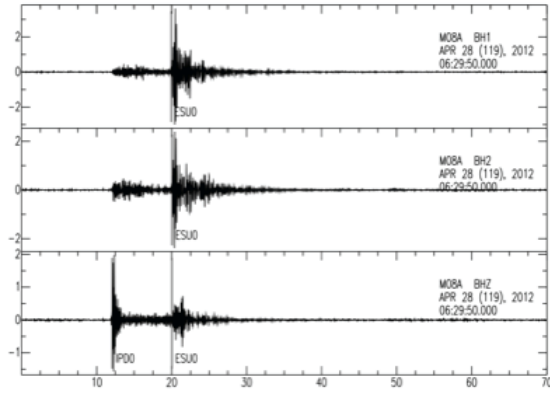
- Potential for geodetic signals on pressure sensors
- APGs and strong motion for on-scale recordings of larger events.



**Li, S., J.T. Freymueller (2017),  
Spatial variation of slip  
behavior beneath the Alaska  
Peninsula along Alaska-  
Aleutian Subduction  
Zone. Manuscript in**

# Anticipated earthquake observations:

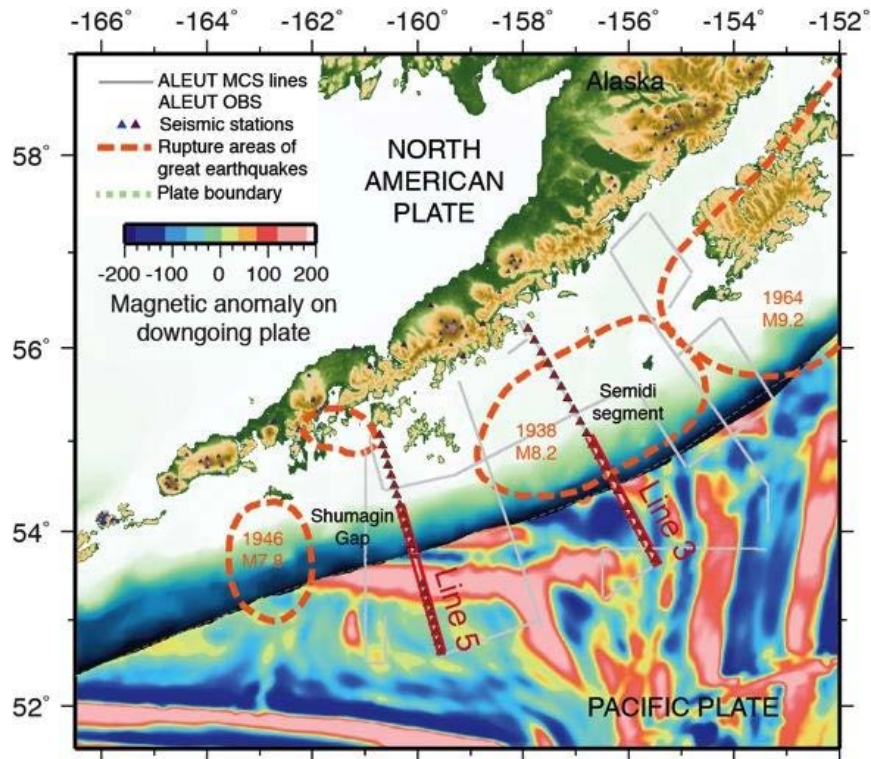
## Cascadia recordings: Care of Emily Morton



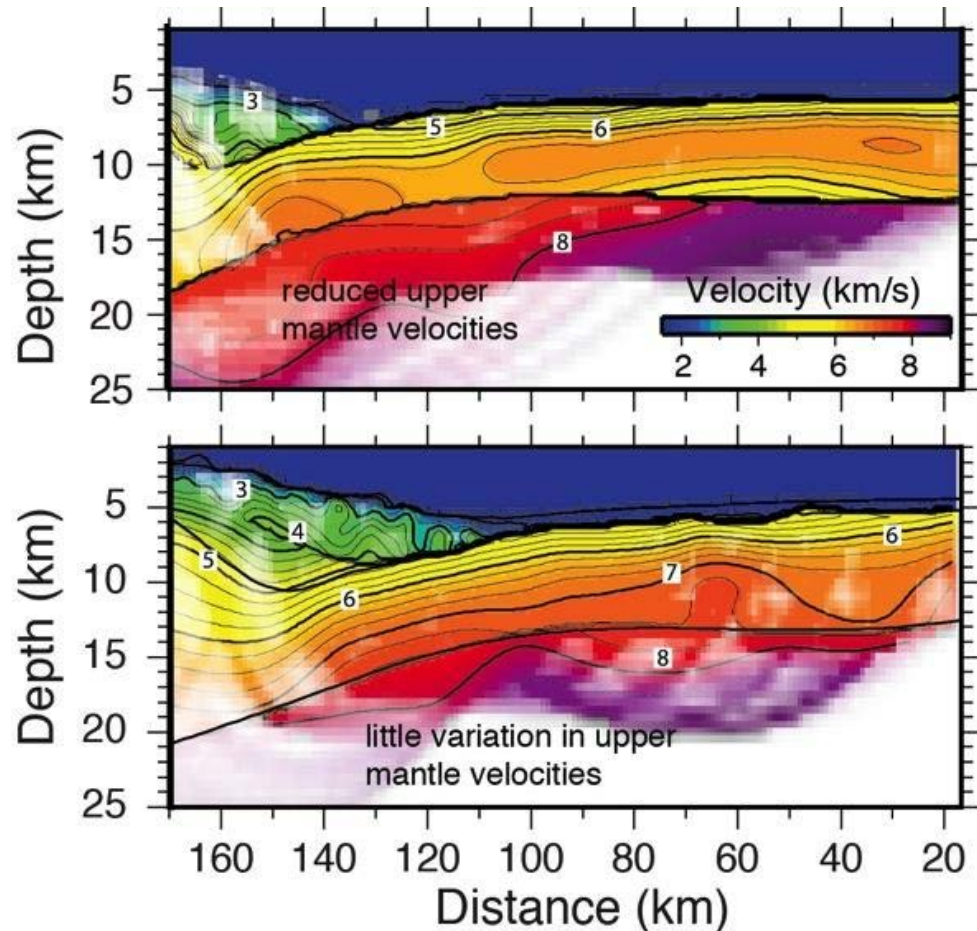
Thousands to ~ten of thousand of  $M > 2$  events within the array, 100k regional events recorded by the array; 100 events  $> M4$

# Complementary arrays and datasets

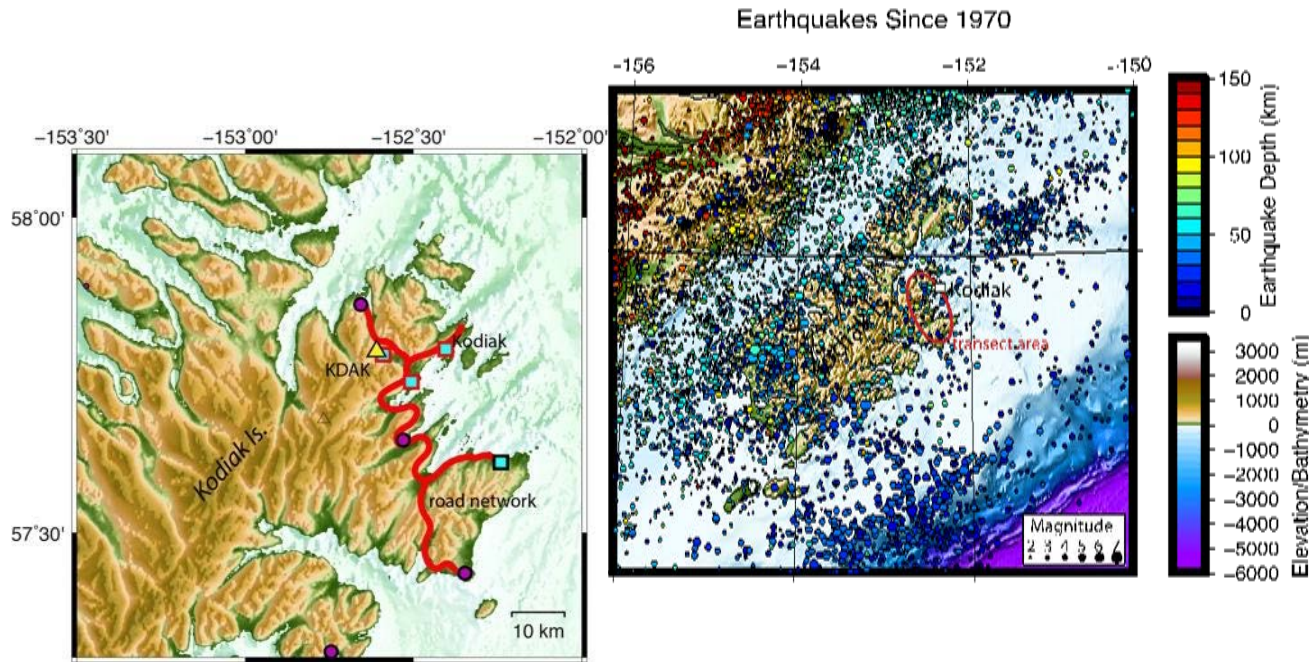
Alaska Langseth Experiment to Understand the megaThrust



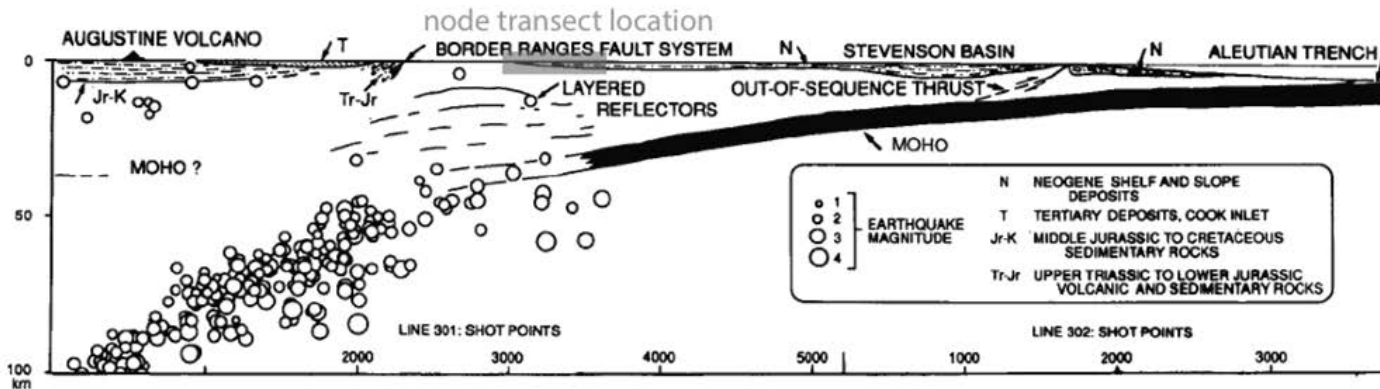
Shillington, Bécel, Nedimović et al.,  
*Nature Geoscience*, 2015



# Proposed Node Transect for 2019



- ~250 10 Hz 3-C 'nodes'
- Instruments from PASSCAL, Utah (Fan Chi Lin), UTEP (Marianne Karplus)
- ~50 km transect across SE Kodiak Island
- 30-40 km above plate interface
- 1 month of data (May/June 2019)



**Open access to community via IRIS DMC asap following recovery and data download**



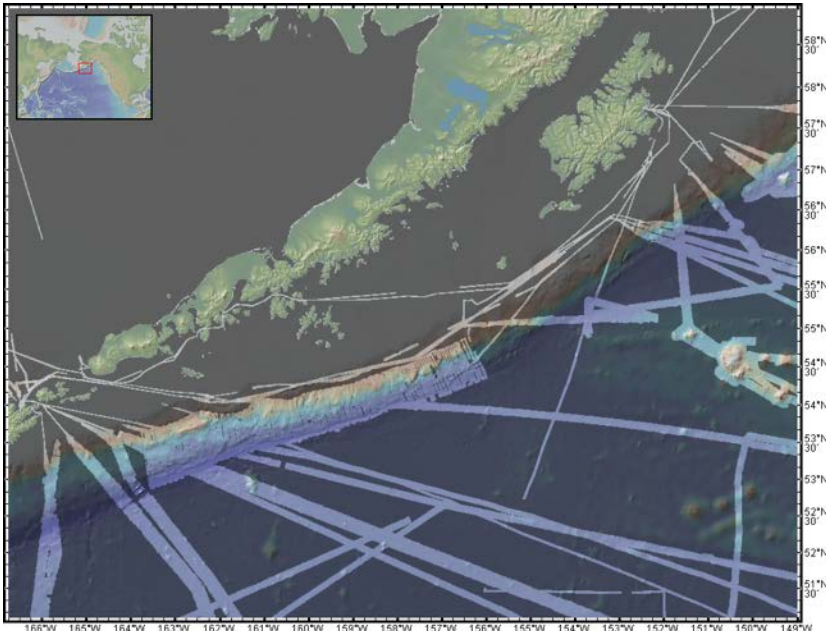
# Education and Outreach

- **Apply to Sail:** Cruises 1-3 will have 6 “apply-to-sail” berths for grad. students, early-career scientists & non-specialists
  - Open to a broader audience,
  - Mid-career scientists are encouraged to apply!
- **K12 Educators:** 2 berths for K-12 Teachers Onboard each cruise with a focus on curriculum development and & designing social media outreach efforts
- **Undergraduate program in Summer of 2019:** 10 undergrads, will be involved in “U-Cruise” coupled w pre-cruise workshop



# Evolving Marine deployment plan and Considerations:

- Ships and timescale of deployment cruises:
  - May 2018: Deploy LDEO instruments (45) & land sites
  - July 2018: Deploy WHOI instruments (30)
  - August 2018, May-June 2019: Service land instruments
  - late summer, 2019: Recover all



## Other considerations:

- Multibeam bathymetry mapping
- Depth distribution of sensors, trawling considerations

Website –

<http://geoprisms.org/research/community-projects/alaska/>



**Keep checking in for updates on:**

- Ship/cruise schedule
- Details on Nodal Supplement
- Outlook for recovery and data availability
- *Will This Scale of Project continue to be possible after planned changes in OBSIC?*

