

AASE - Marine Seismic Community Update

Emily Roland – eroland@uw.edu

PI Team: **Geoff Abers, Cornell University (Lead)**

Aubrey Adams, Colgate University

Peter Haeussler, USGS Alaska Science Center

*Emily Roland, University of Washington

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 AGU- Fall MSROC

Sunday December 10, 2017

New Orleans

GeoPRISMS Mini-Workshops

Sunday December 10, 2017
2017 AGU Fall Meeting

Register before November 21



8:30-1pm

ENAM science advances:
Progress and outlook

1:30-5:30pm

Introduction to GeoPRISMS/MARGINS data resources,
mini-lessons, and effective broader impacts

6-9pm

Amphibious community experiments in Alaska and related opportunities

Amphibious community experiments in Alaska and related opportunities

📍 Westin Canal Place

100 Rue Iberville, New Orleans, LA, 70130

Crescent Ballroom – 11th Floor

Sunday December 10, 2017, 6:00 PM – 9:00 PM

5:30 | Snacks & Coffee

6:00 | Introductions and welcome – GeoPRISMS Chair Demian Saffer and Aubreya Adams

6:20 | Overview of past work in the Alaska subduction zone and highlights from the similar Cascadia Initiative amphibious array – Geoff Abers

6:40 | AACSE overview and opportunities for engagement – Emily Roland

6:50 | Break

7:15 | Highlights of volcano seismology work in the region – John Paskievitch (Alaska Volcano Observatory) or Jeff Freymueller

7:30 | Regional geodesy and other geophysical observations – Shanshan Li (University of Alaska, Fairbanks)

7:45 | Short format presentations about complementary projects in the region.

Speakers:

Carl Tape – Southern Alaska Lithosphere and Mantle Observation Network (SALMON)

Kerry Key – Updates from the MTand seismic investigation of Okmok Volcano

Terry Plank – Recent Aleutian Volcano Research (~10 min)

Dave Chadwell – Seafloor Geodesy in Alaska (~8 min)

Harold Tobin – SZ4D (~5 min)

9:00 | Workshop Adjourns

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?

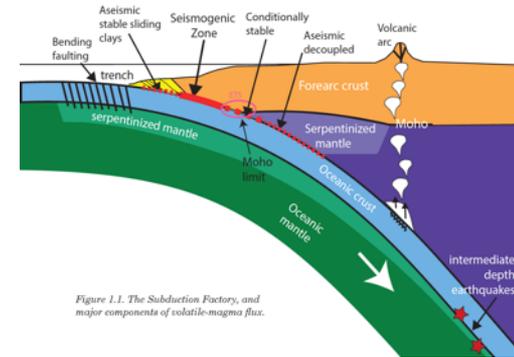
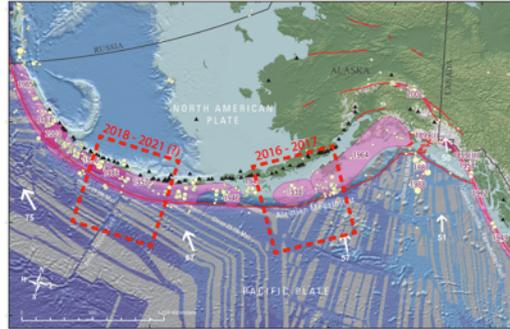


Figure 1.1. The Subduction Factory, and major components of isostatic-magma flux.

- 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

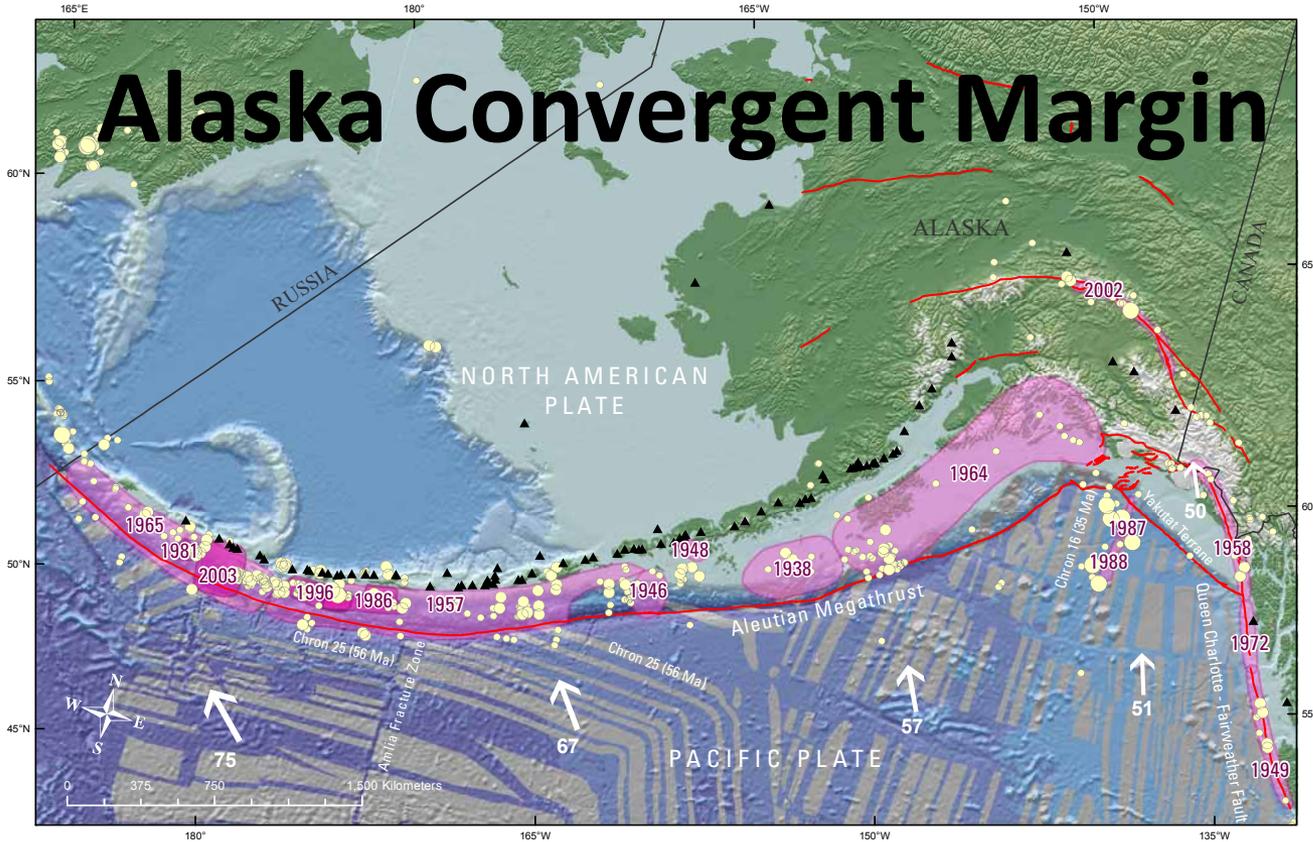
- Formation of PI Team:
Webinar and open invitation/web forum
- July 2016 Submission of Community Experiment Proposal

- August 2017 Awarded

Principal Investigators:

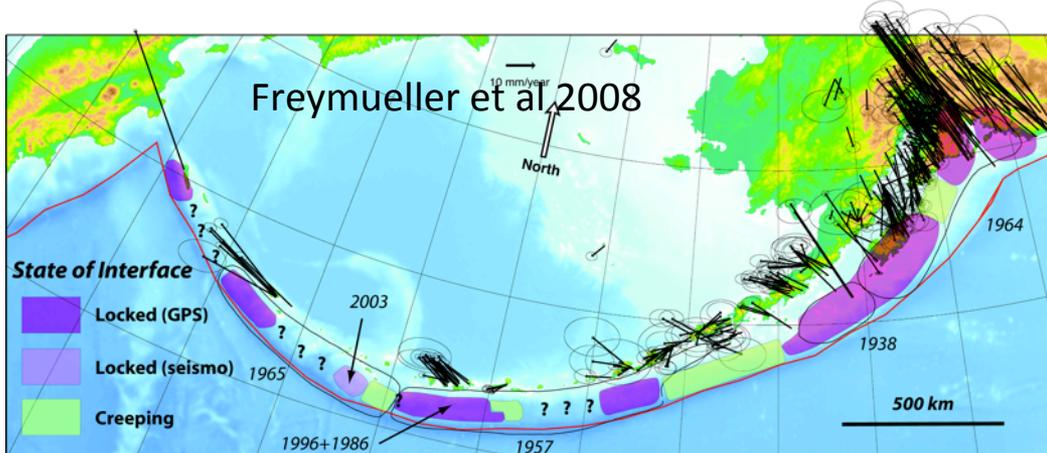
Geoff Abers, Cornell University (Lead)
Aubrey Adams, Colgate University
Peter Haeussler, USGS
Emily Roland, U. Washington
Susan Schwartz, U.C. Santa Cruz
Anne Sheehan, U.C, Boulder
Donna Shillington, LDEO
Spahr Webb, LDEO
Doug Wiens, Wash. U.
Lindsay Worthington, U. New Mexico

Alaska Convergent Margin



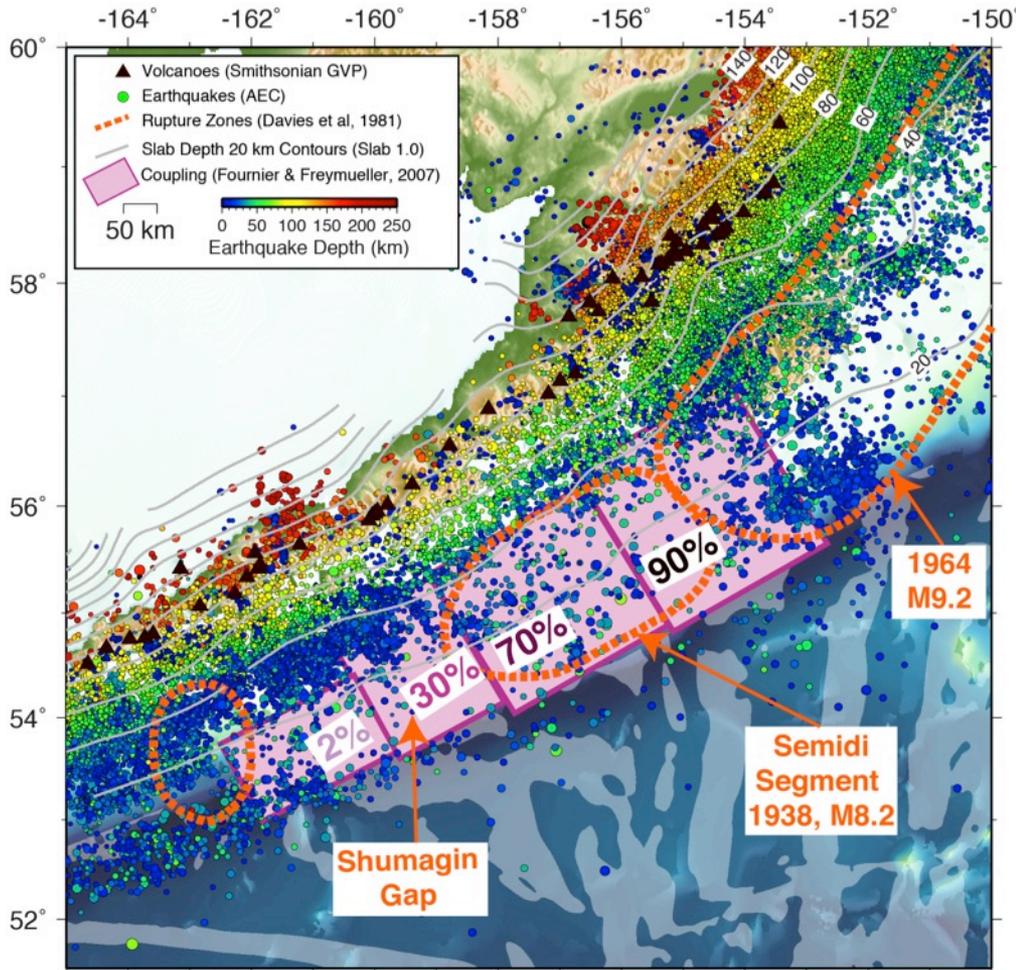
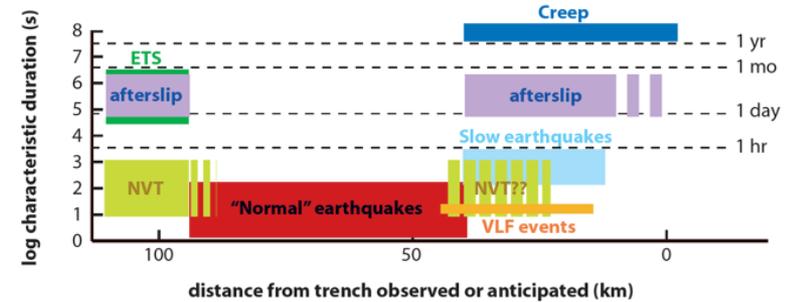
Why Alaska?

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



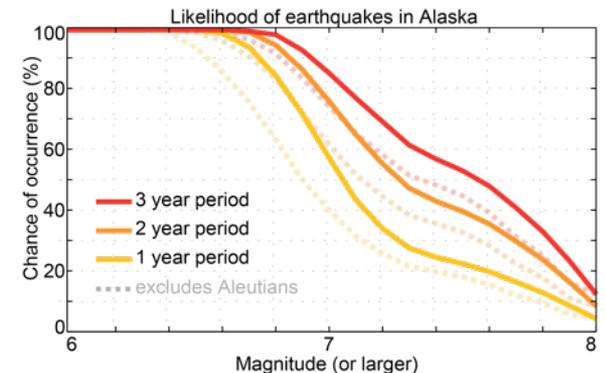
Experiment– Science Targets

Variability in Slip Behavior and Seismicity along the Seismogenic Zone:



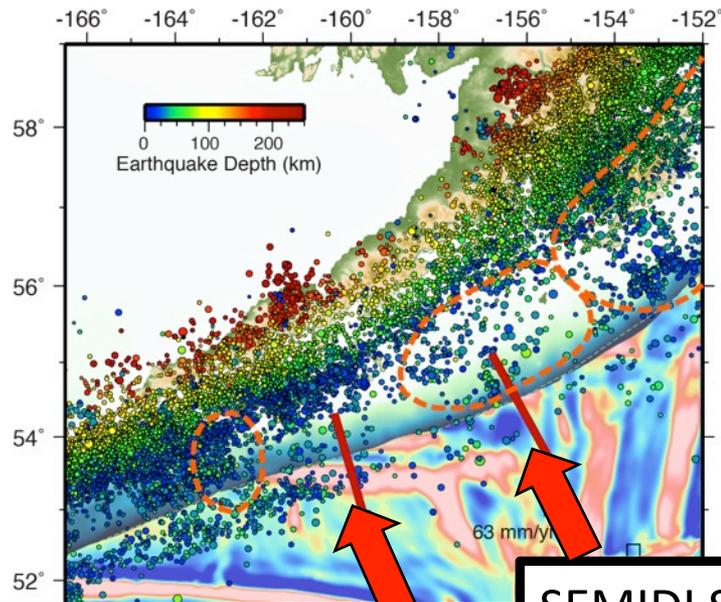
*Seismicity : AEC catalog
 GPS: Fournier and Freymueller (2007),
 Slab depth contours: Syracuse & Abers,
 2006*

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



Experiment– Science Targets

Seismic imaging constraints on material and volatile cycling

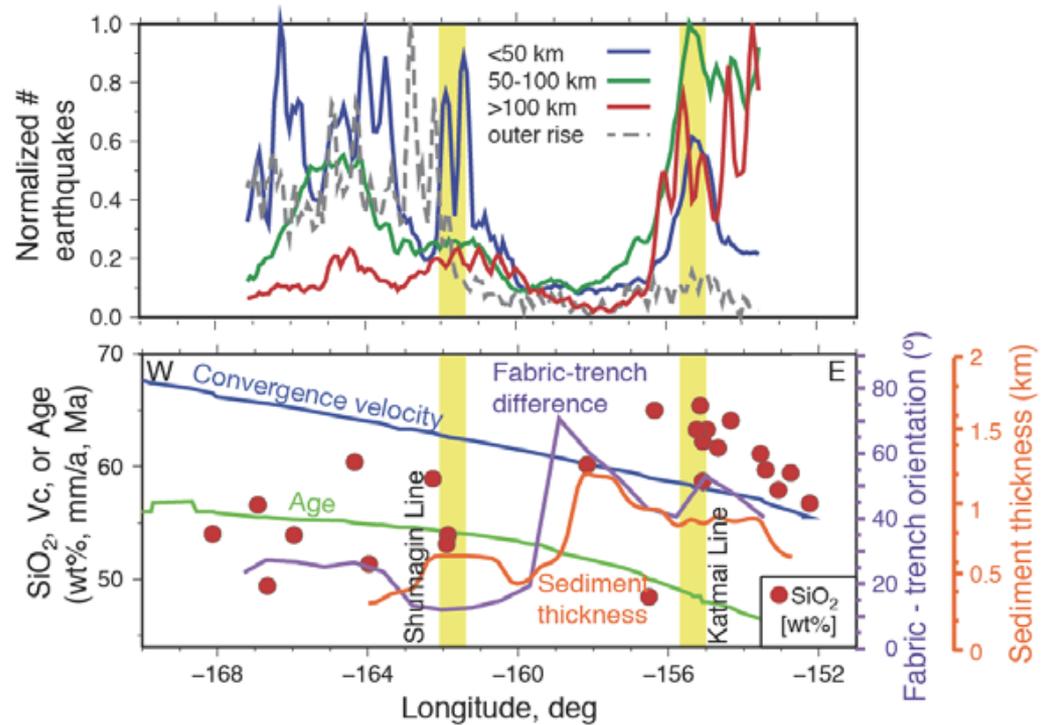


SHUMAGIN GAP

Less sediments,
More basement roughness
More hydration

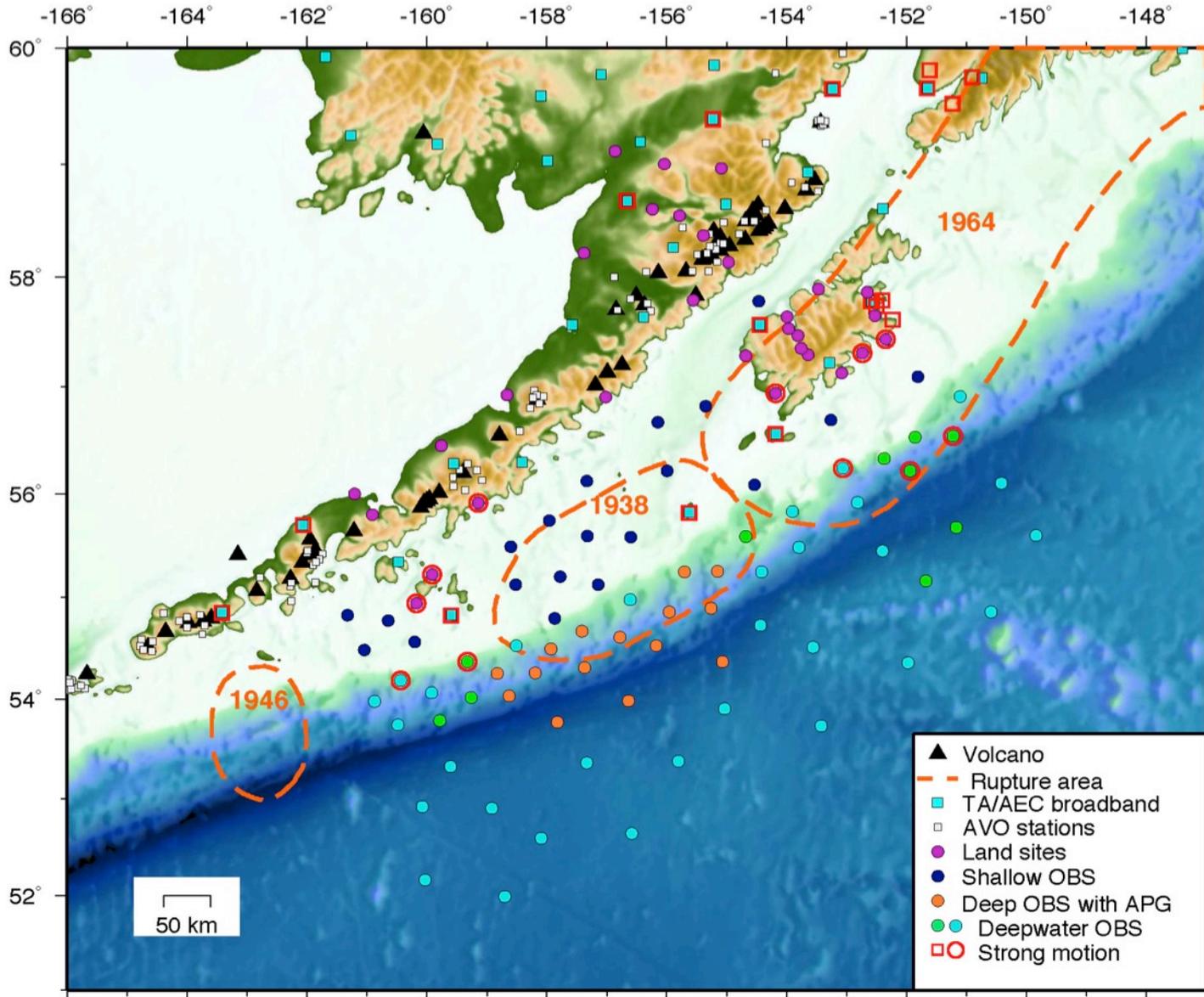
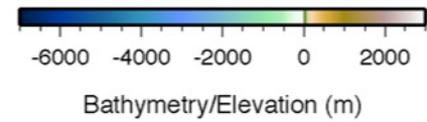
SEMIDI SEGMENT:

More sediments,
Less basement roughness
Less hydration

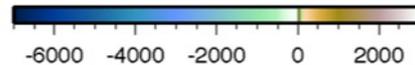


Along-strike variations in arc properties and inputs. SiO₂ from Buurman et al. (2014), plate parameters from Syracuse and Abers (2006), others from Shillington et al. (2015). Yellow lines are locations of more densely instrumented transects

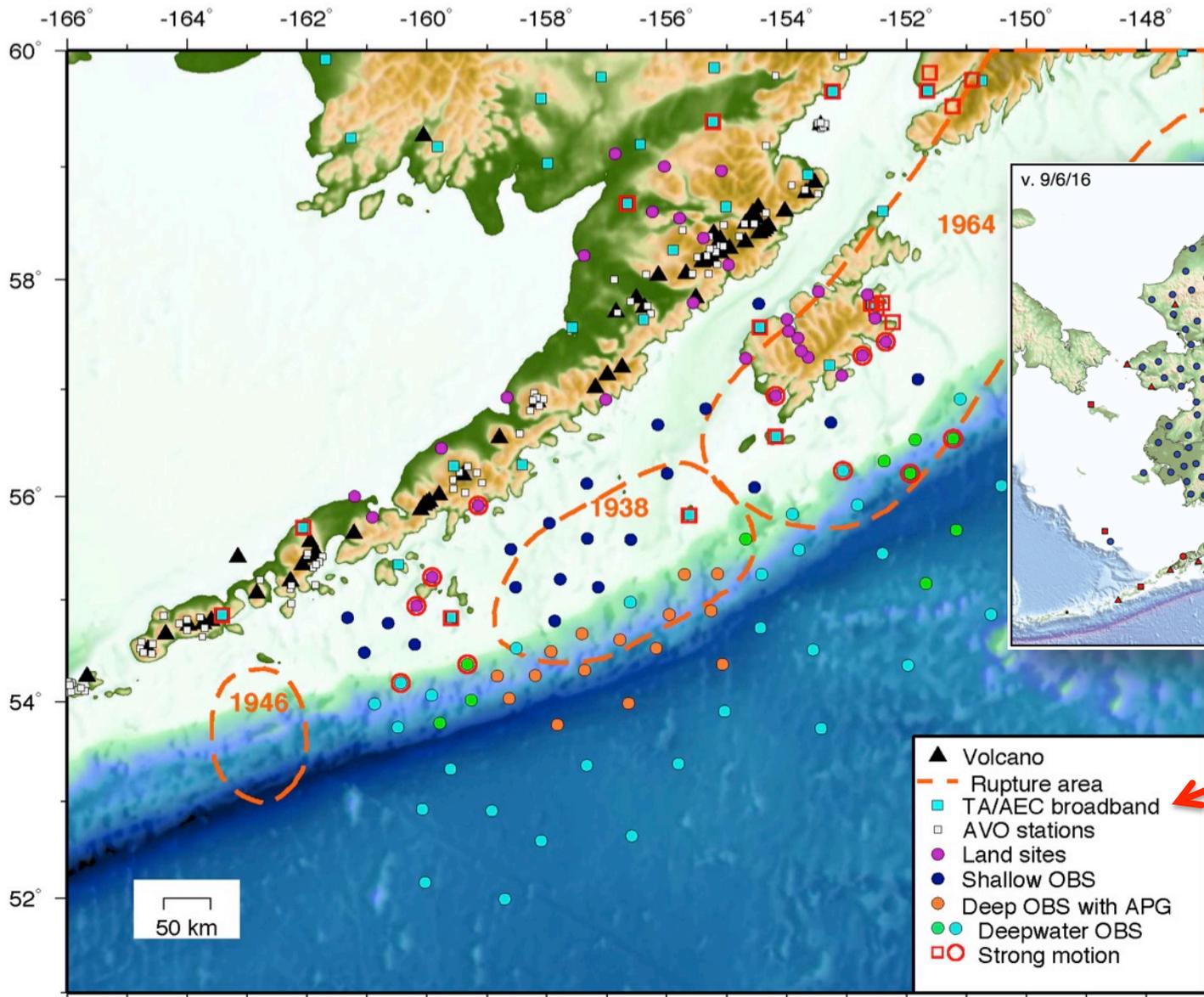
Current station map, ~15 months



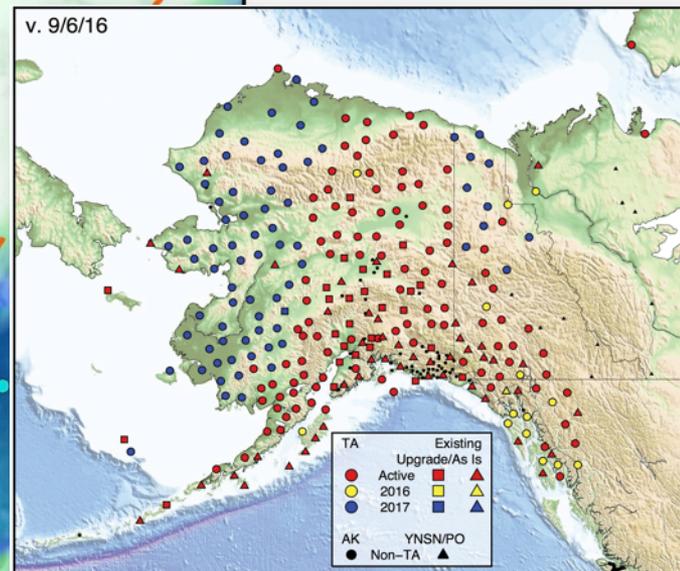
Current station map, ~15 months



Bathymetry/Elevation (m)

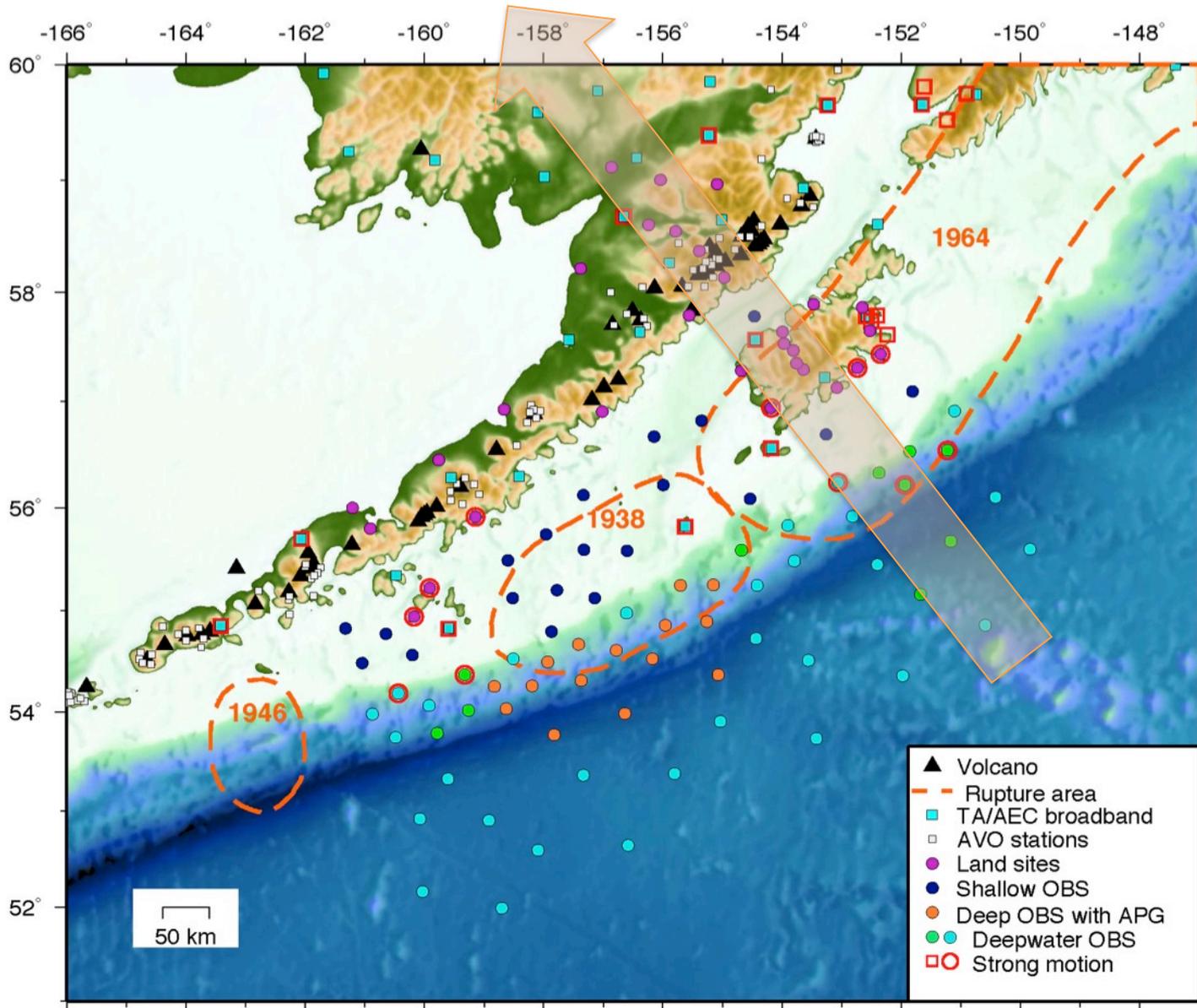
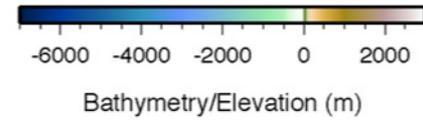


1. Concurrent with TA



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

Current station map, ~15 months

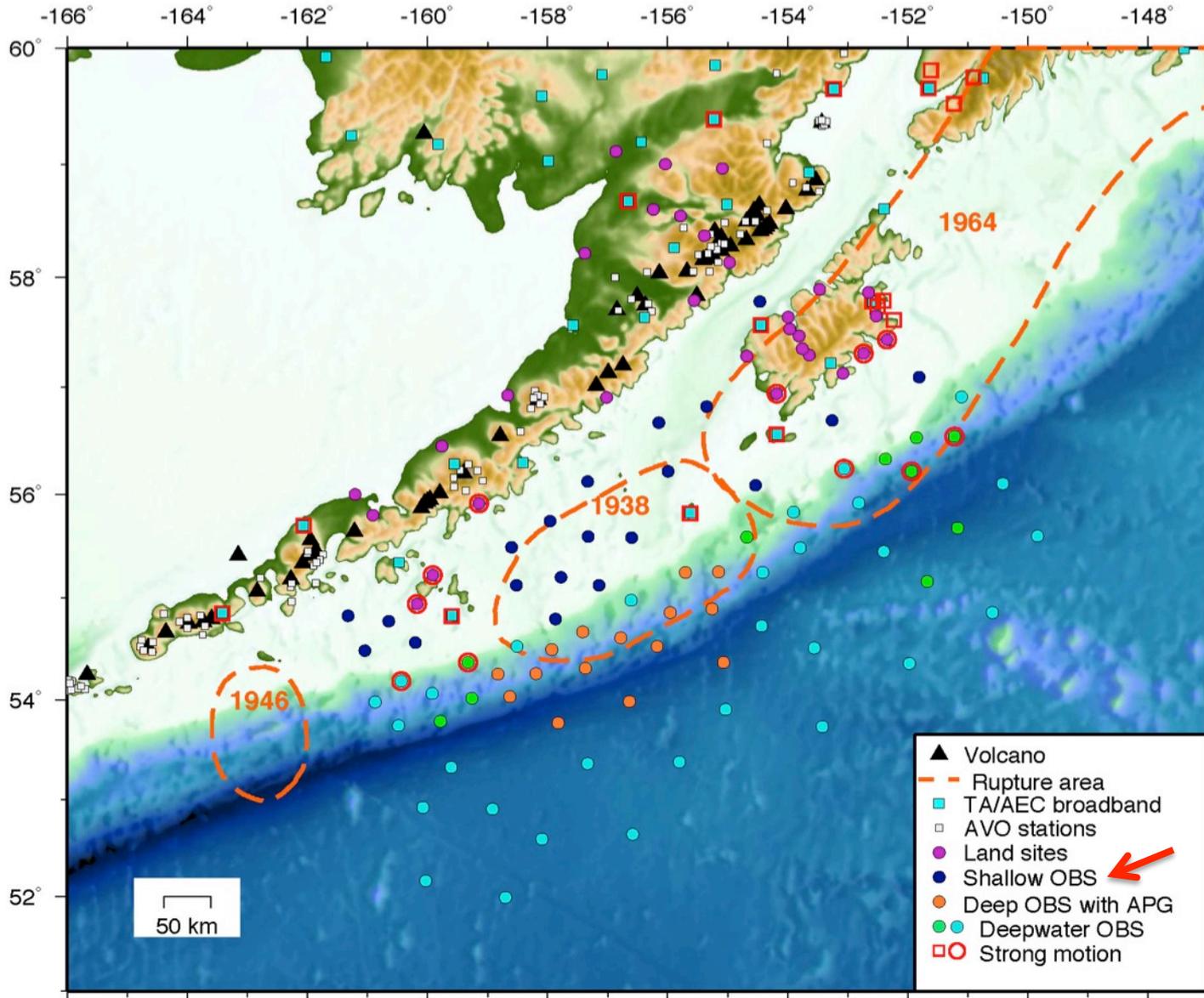
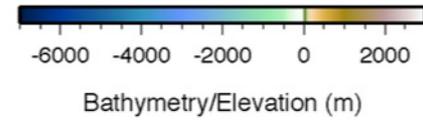


1. Concurrent with TA

2. Dense transect crossing Kodiak/

Integrates with TA stations ~1000 km behind the arc

Current station map, ~15 months

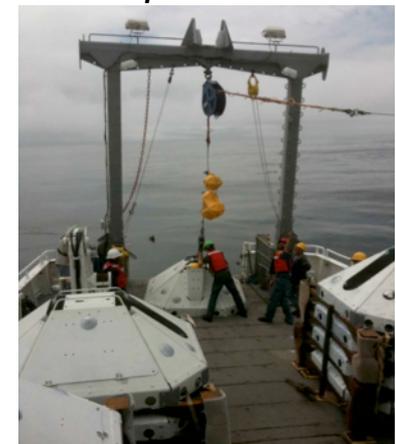


1. Concurrent with TA

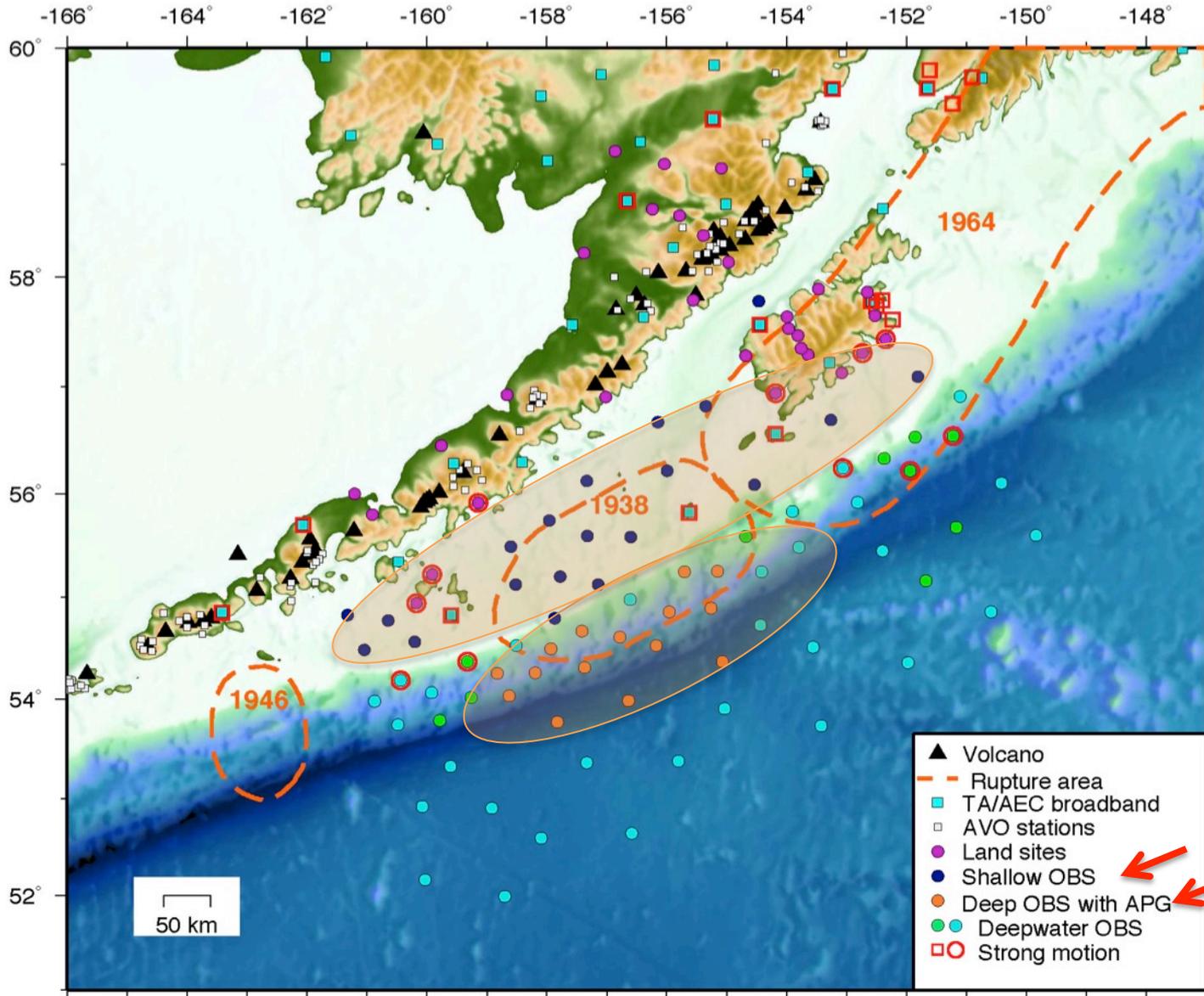
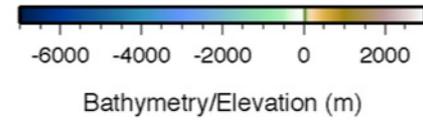
2. Dense transect crossing Kodiak/Katmai

3. Shallow water

< 200, water depth



Current station map, ~15 months



1. Concurrent with TA

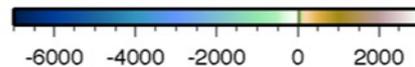
2. Dense transect crossing Kodiak/Katmai

3. Shallow water TRMS

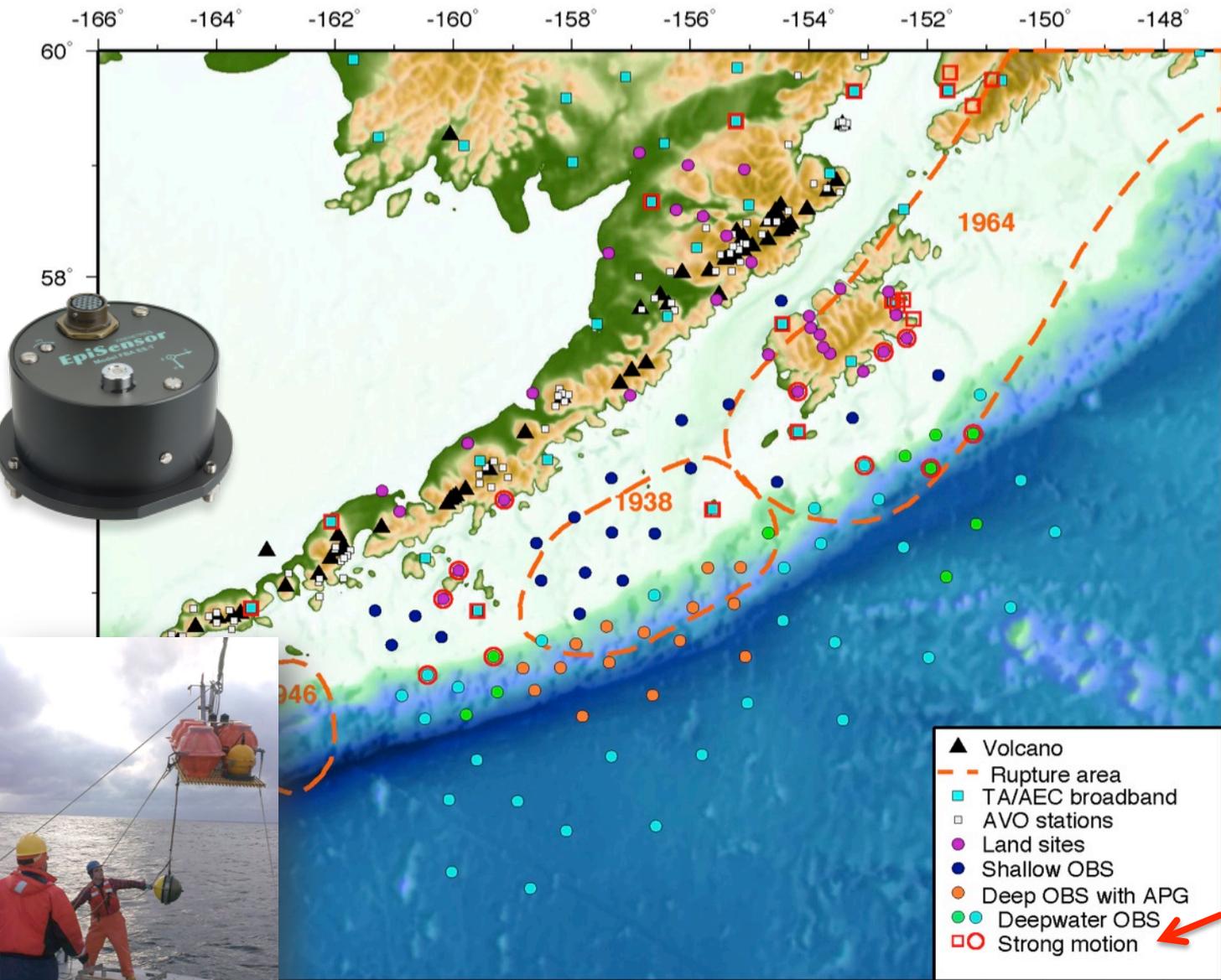
4. **Significant array of seafloor APGs**

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

Current station map, ~15 months



Bathymetry/Elevation (m)



1. Concurrent with TA

2. Dense transect crossing Kodiak/Katmai

3. Shallow water TRMS

4. Significant array of seafloor APGs

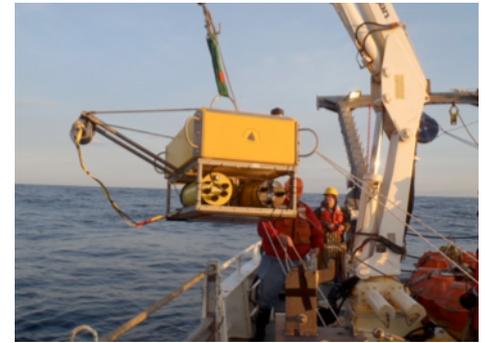
5. Seafloor strong motion OBS

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

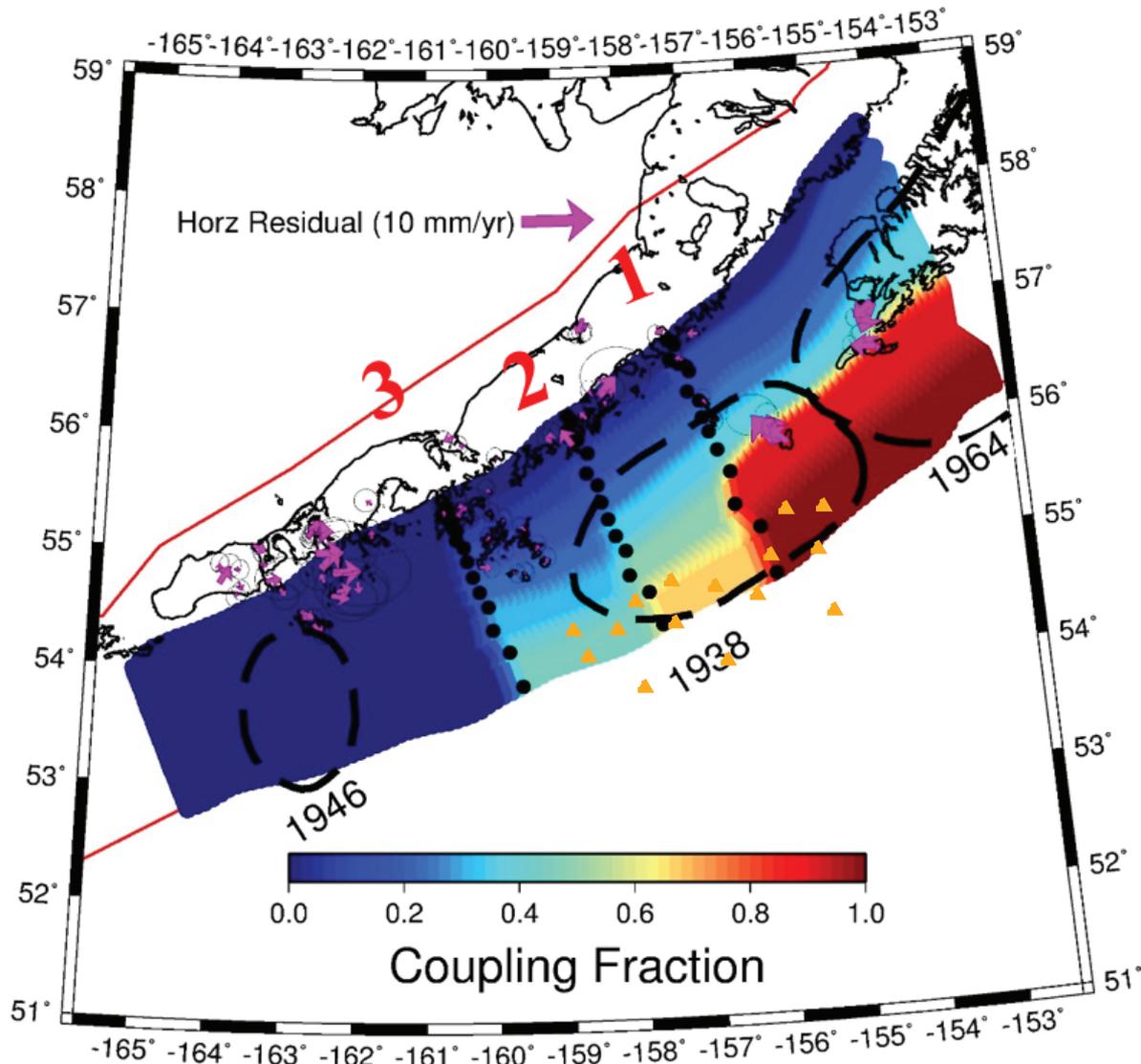
Site M09B showing evidence of having been hit by a trawler.



Array design for studying plate boundary slip behavior:

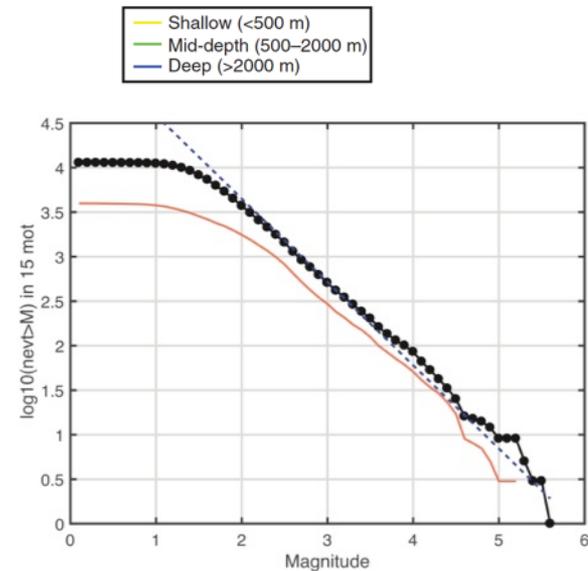
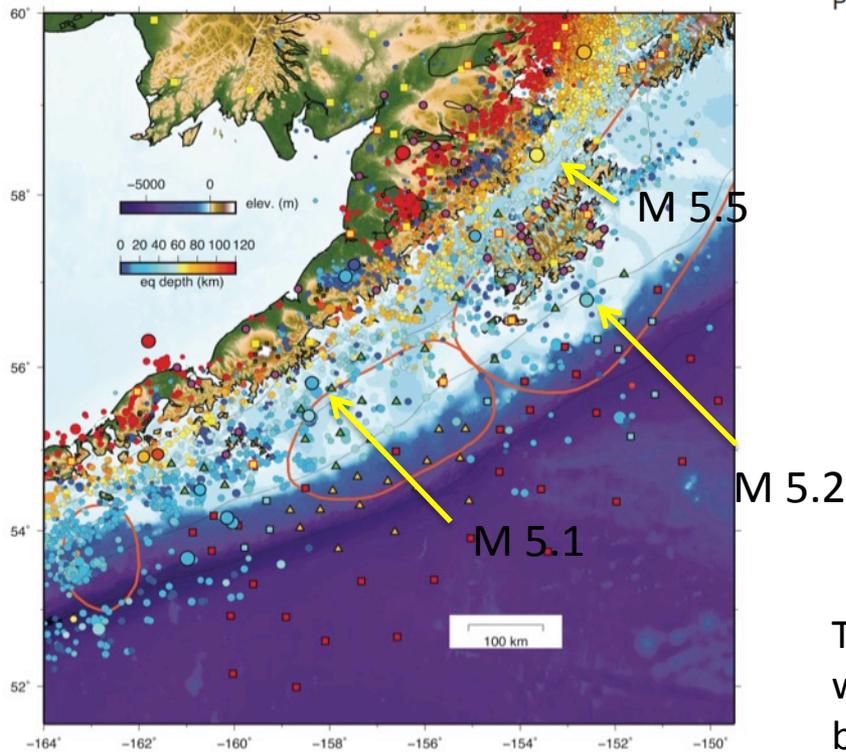
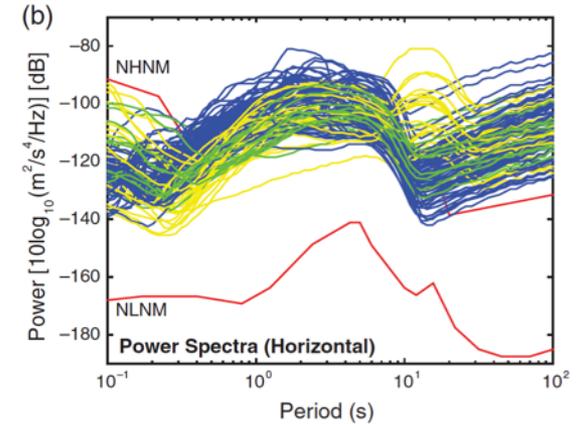
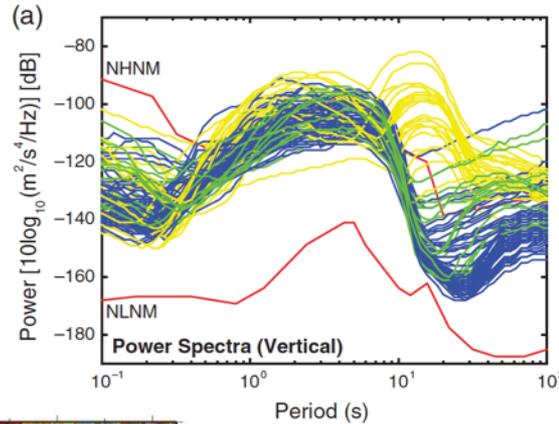
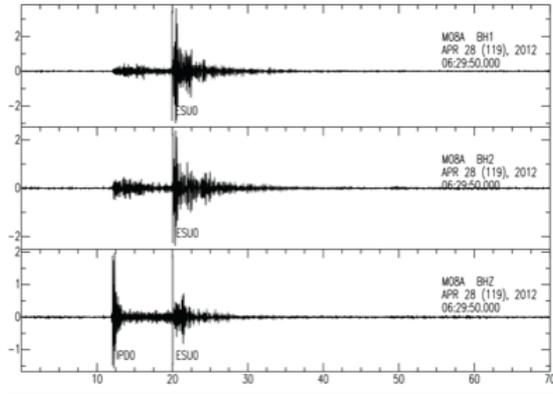
- Potential for geodetic signals on pressure sensors
- APGs and strong motion for on-scale recordings of larger events.

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



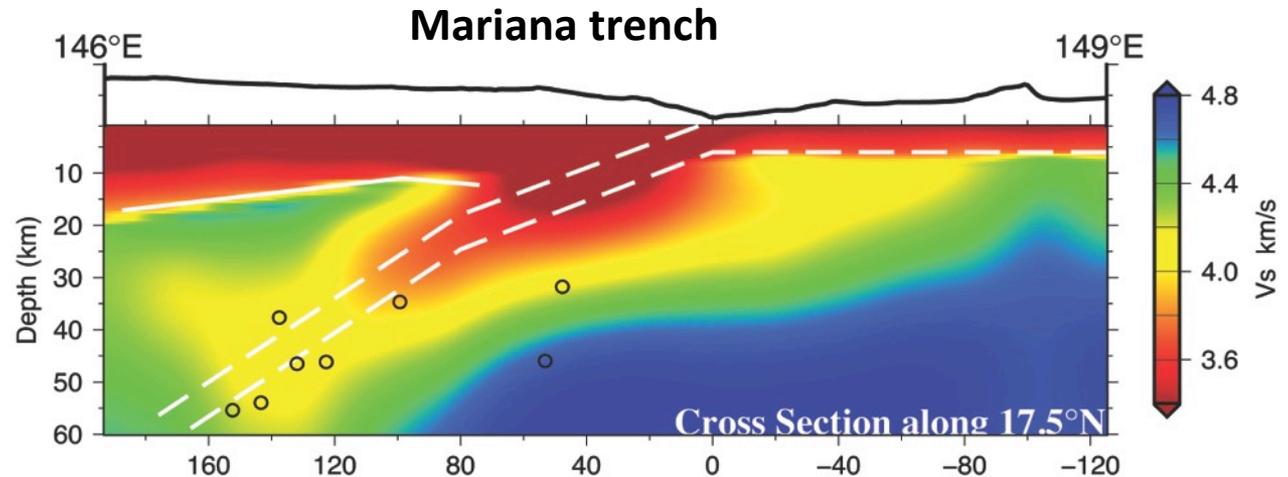
Anticipated earthquake observations:

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

Array design for shear and surface wave imaging, receiver functions, shear wave splitting:



Chen Cai work in progress - Slow Vs anomaly in incoming plate and forearc, indicating mantle serpentinization. Based on Ambient Noise Tomography.— See poster at this meeting.

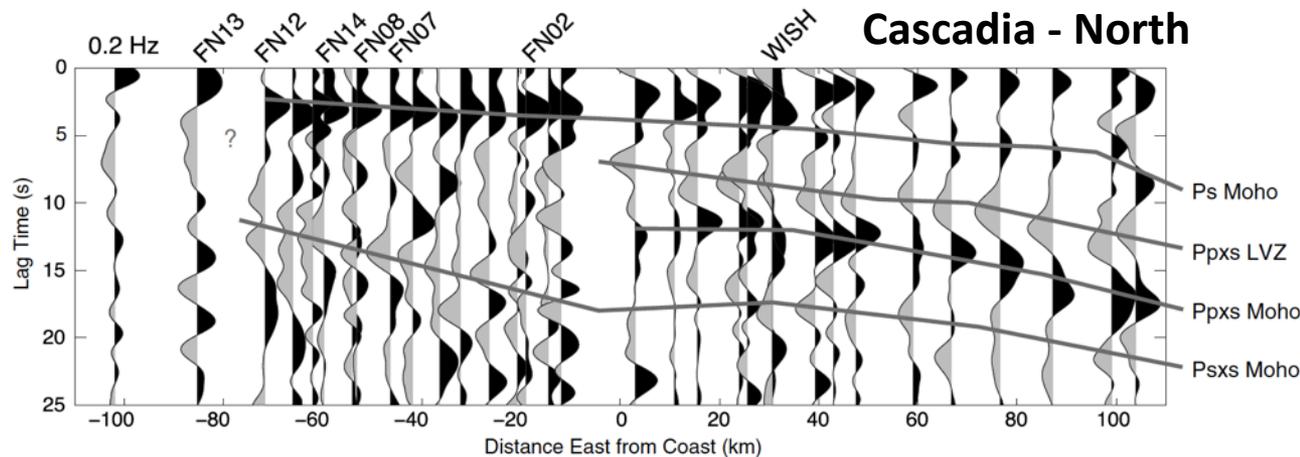
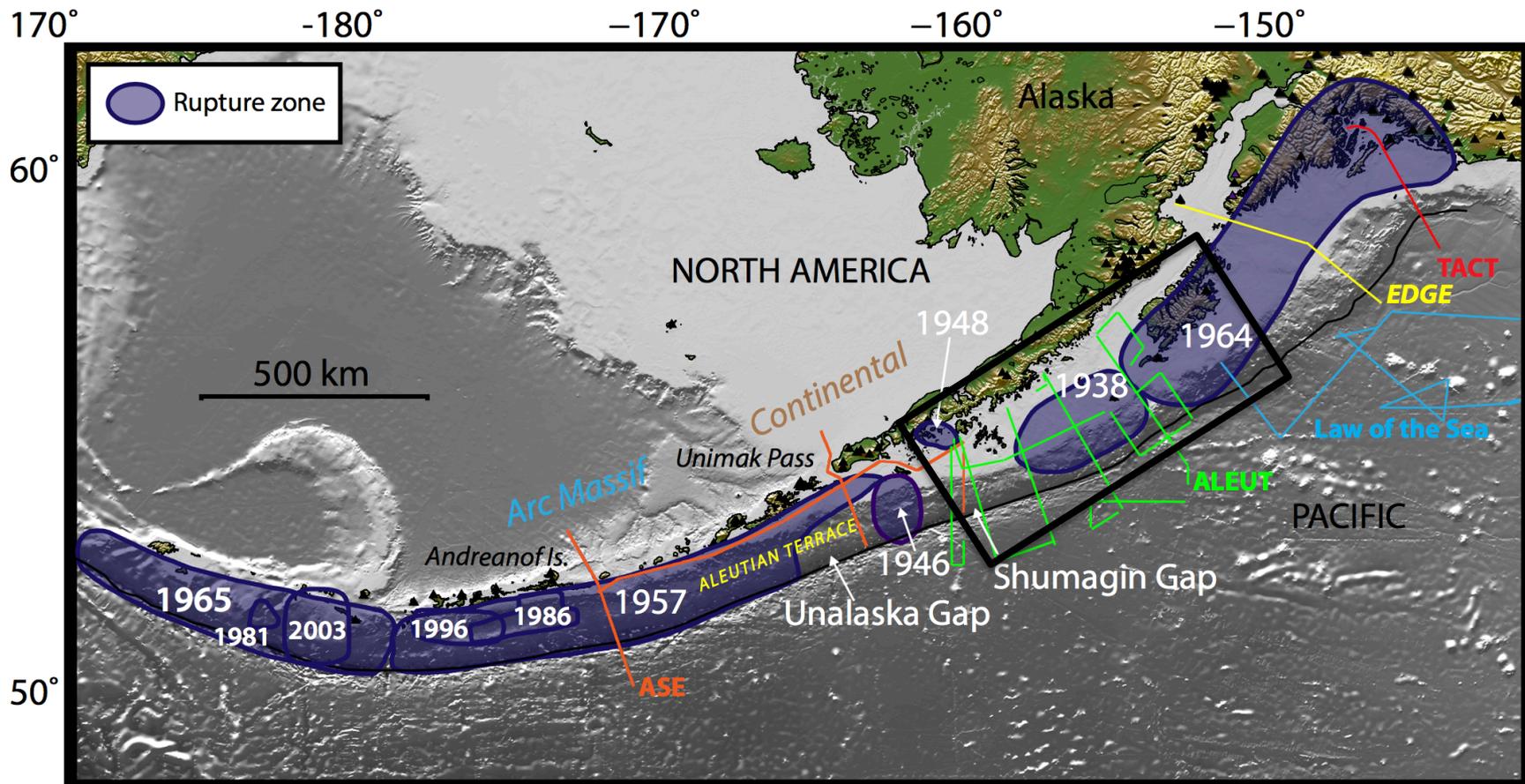


Figure 7. from Janiszewski and Abers 2015 - Stacks of RFs plotted by distance along an east–west profile at 47° N. Stations east of the coastline are in the CAFE array, and those west of it are in the Cascadia Initiative FN OBS array.

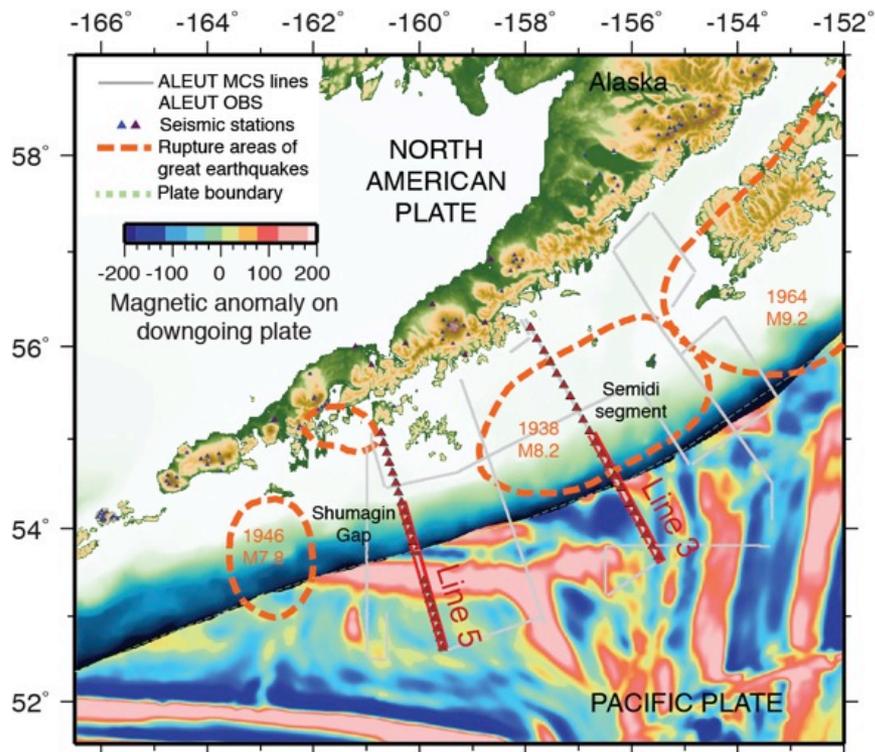
Complementary arrays and datasets

- TA in Alaska + AEC stations
- AVO short period to broadband station updates
- Complementary Imaging and campaign geophysical observations:

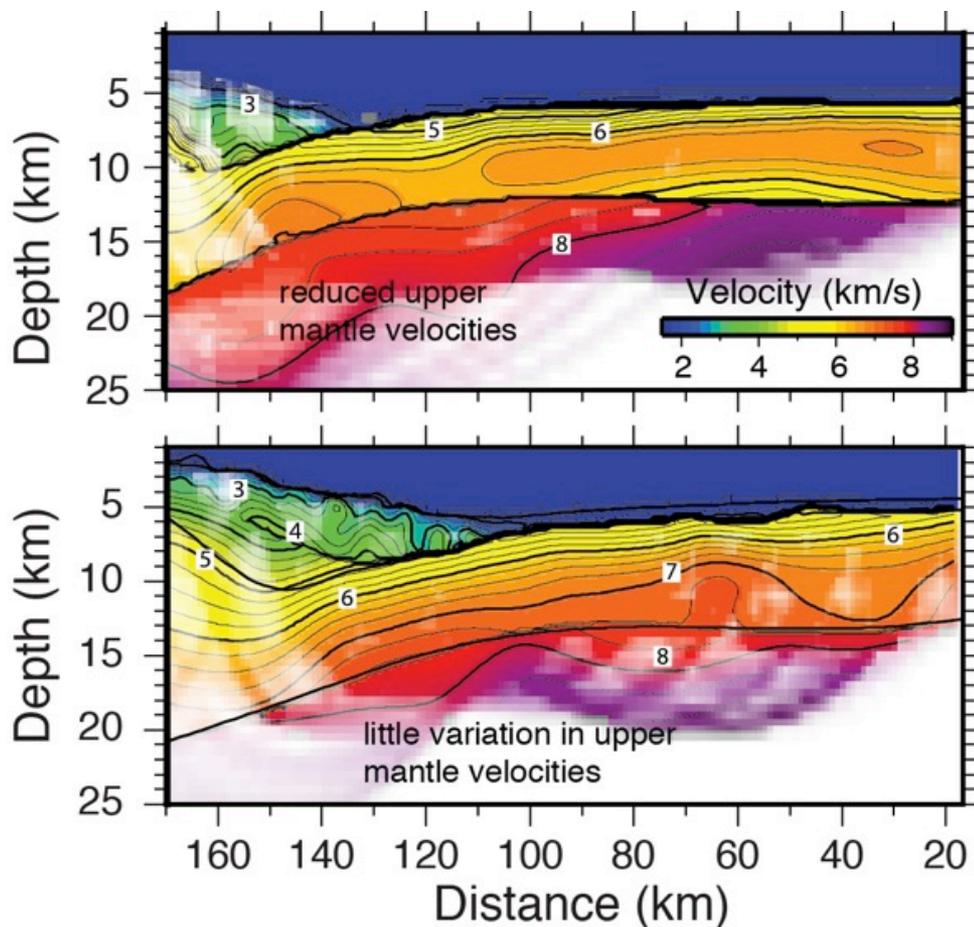


Complementary arrays and datasets

Alaska Langseth Experiment to Understand the megaThrust

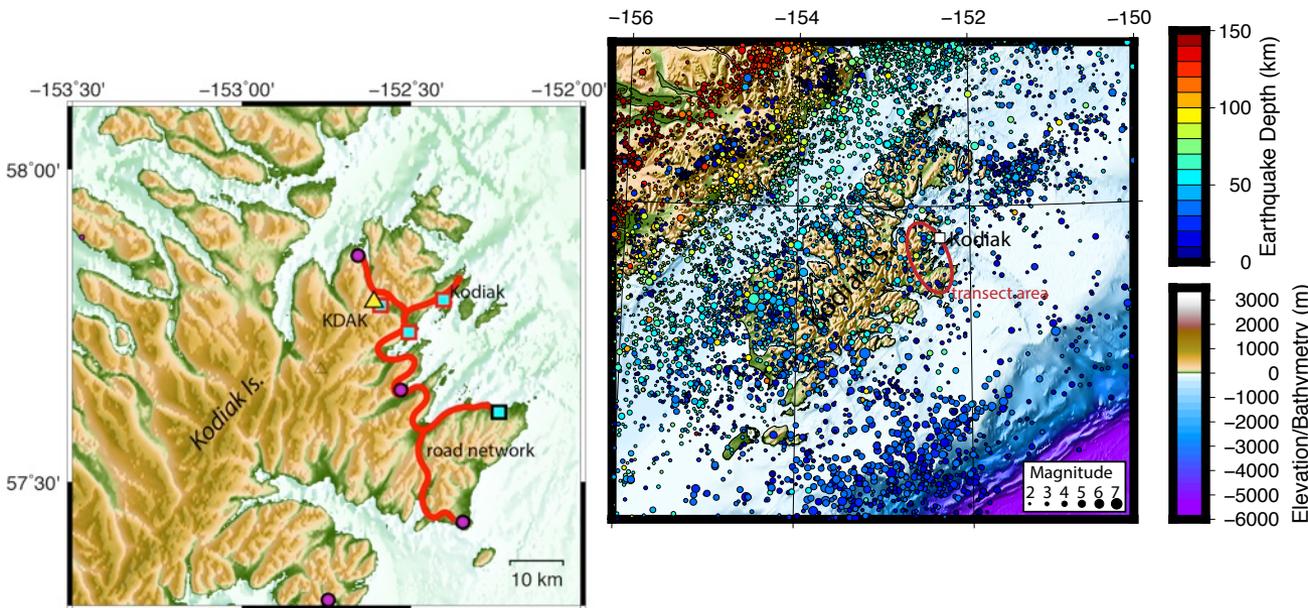


Shillington, Bécel, Nedimović et al.,
Nature Geoscience, 2015

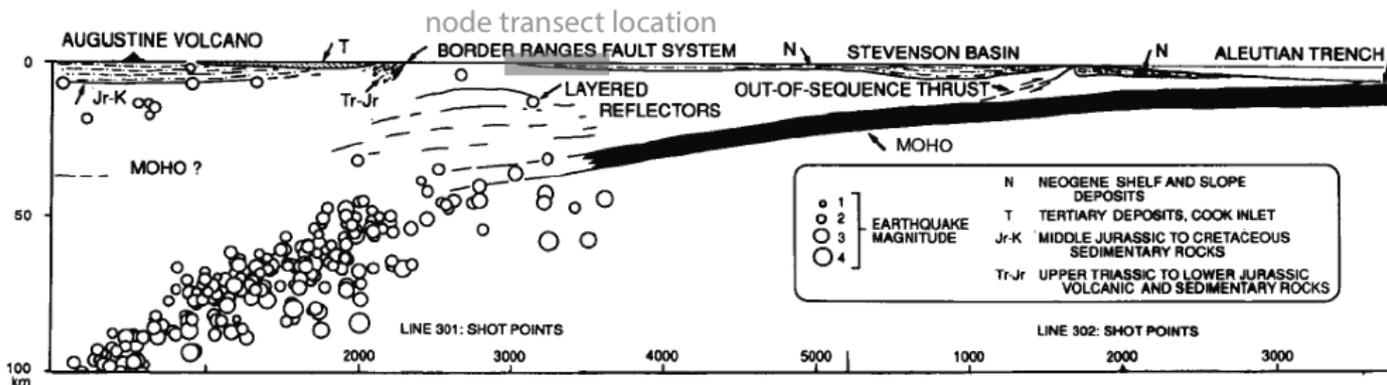


Proposed Node Transect for 2019

Earthquakes Since 1970



- ~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

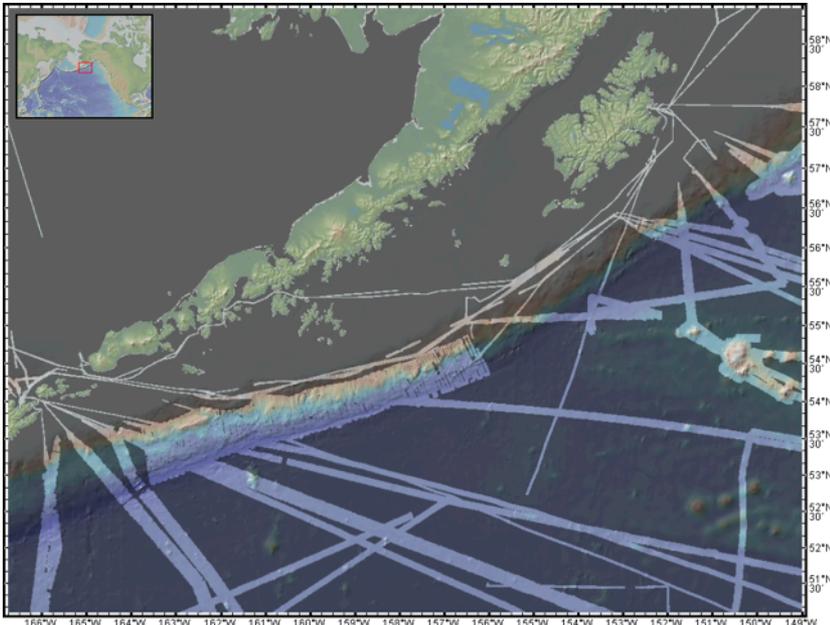
Education and Outreach

- **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?*

