Illuminating the Cascadia Plate Boundary Zone and Accretionary Wedge with a Regional-Scale Ultra-Long Offset Multi-Channel Seismic Study

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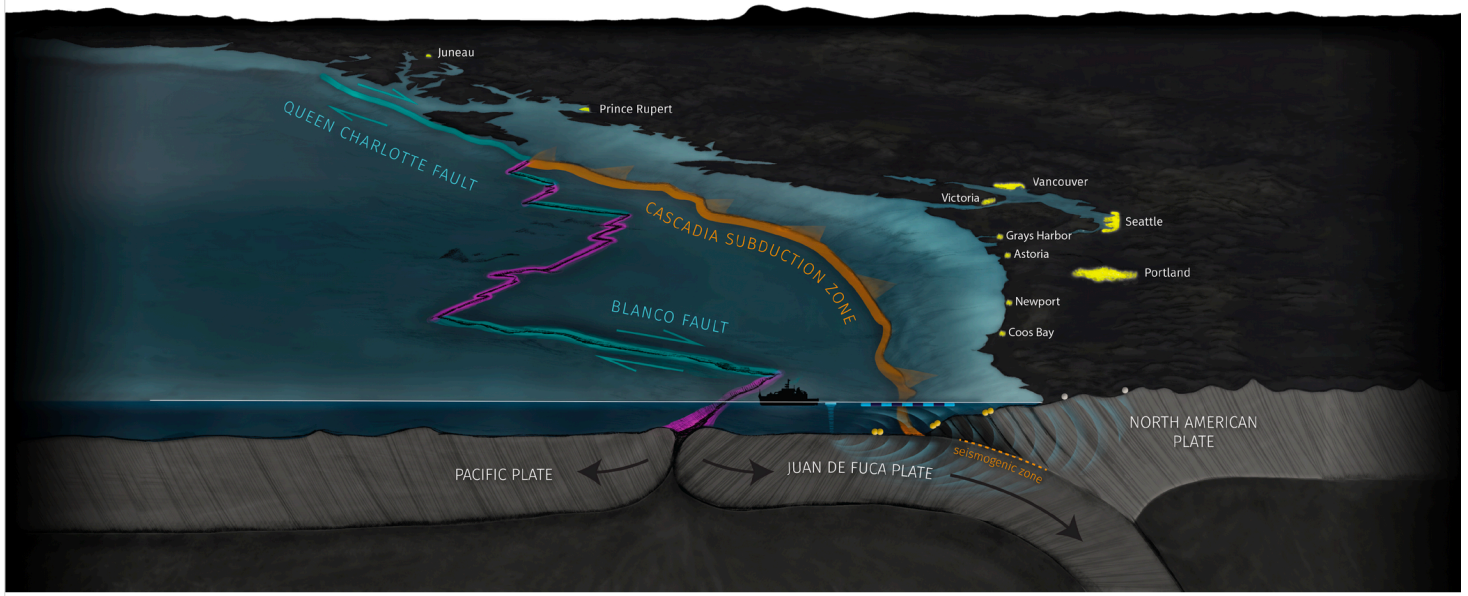


Goals and Objectives

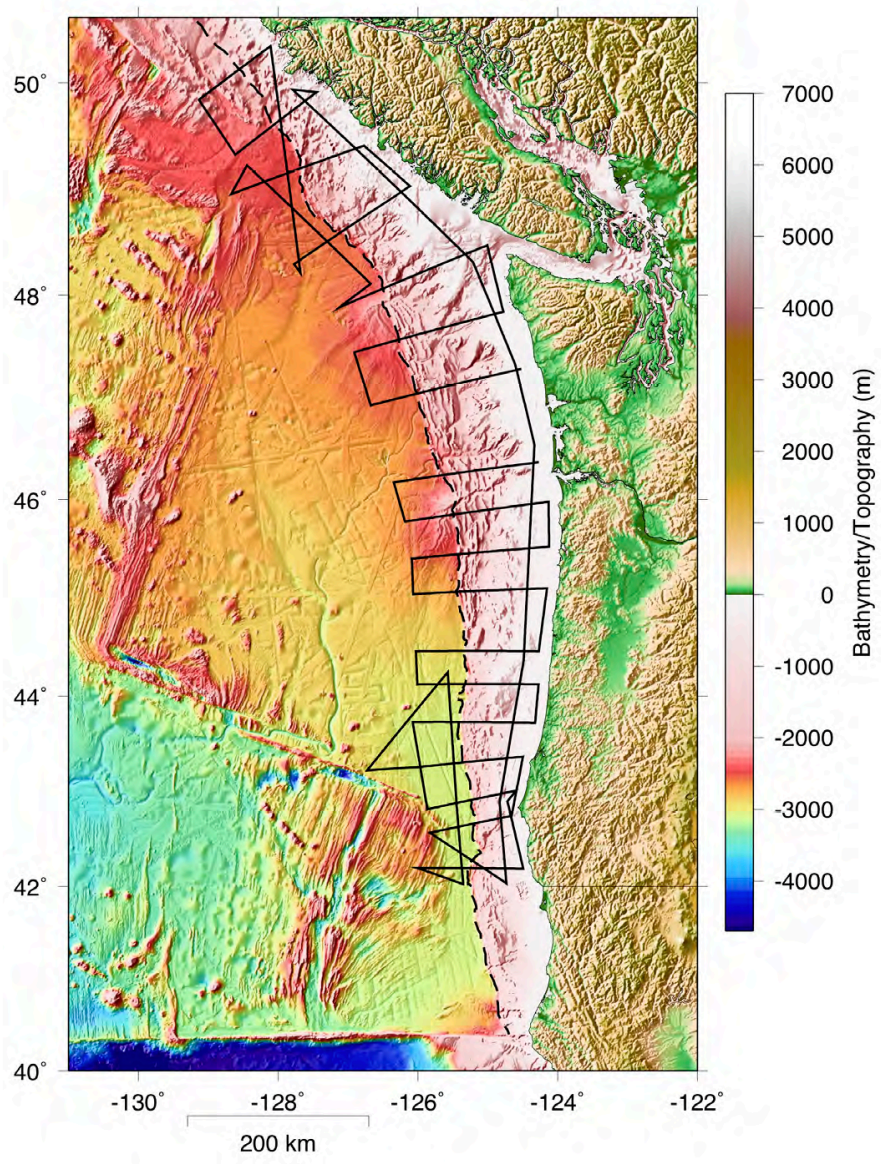
Characterize subducting plate and accretionary wedge structure, and properties of the megathrust at Cascadia with acquisition and processing of ultra-long-offset (15 km) MCS data

Motivating Science Questions

1. Are there any systematics in the structure and properties of the incoming Juan de Fuca plate, the megathrust zone, and accretionary wedge associated with inferred paleorupture segmentation?
2. Are there down-dip variations in megathrust geometry and reflectivity indicative of transitions in fault properties, and what are the properties of the potentially tsunamigenic shallow portion of the megathrust?

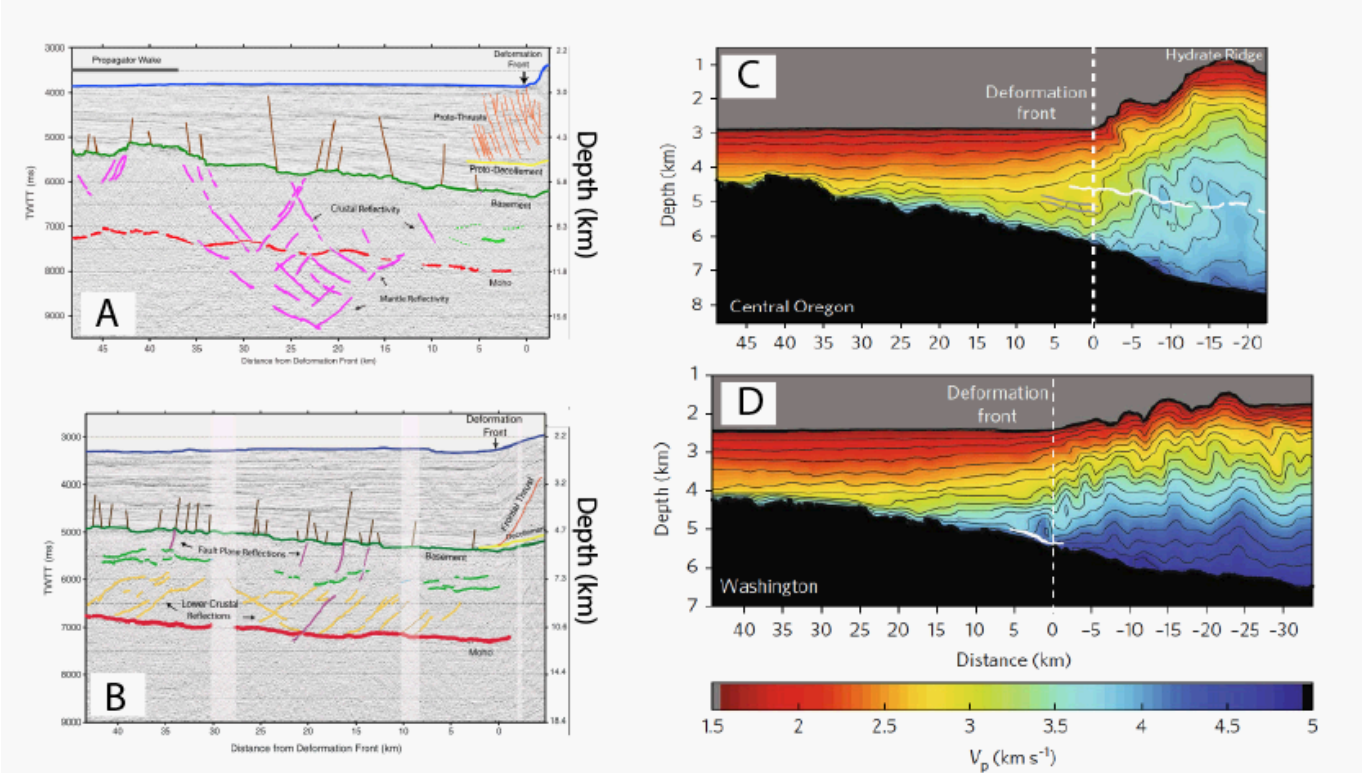
Objectives

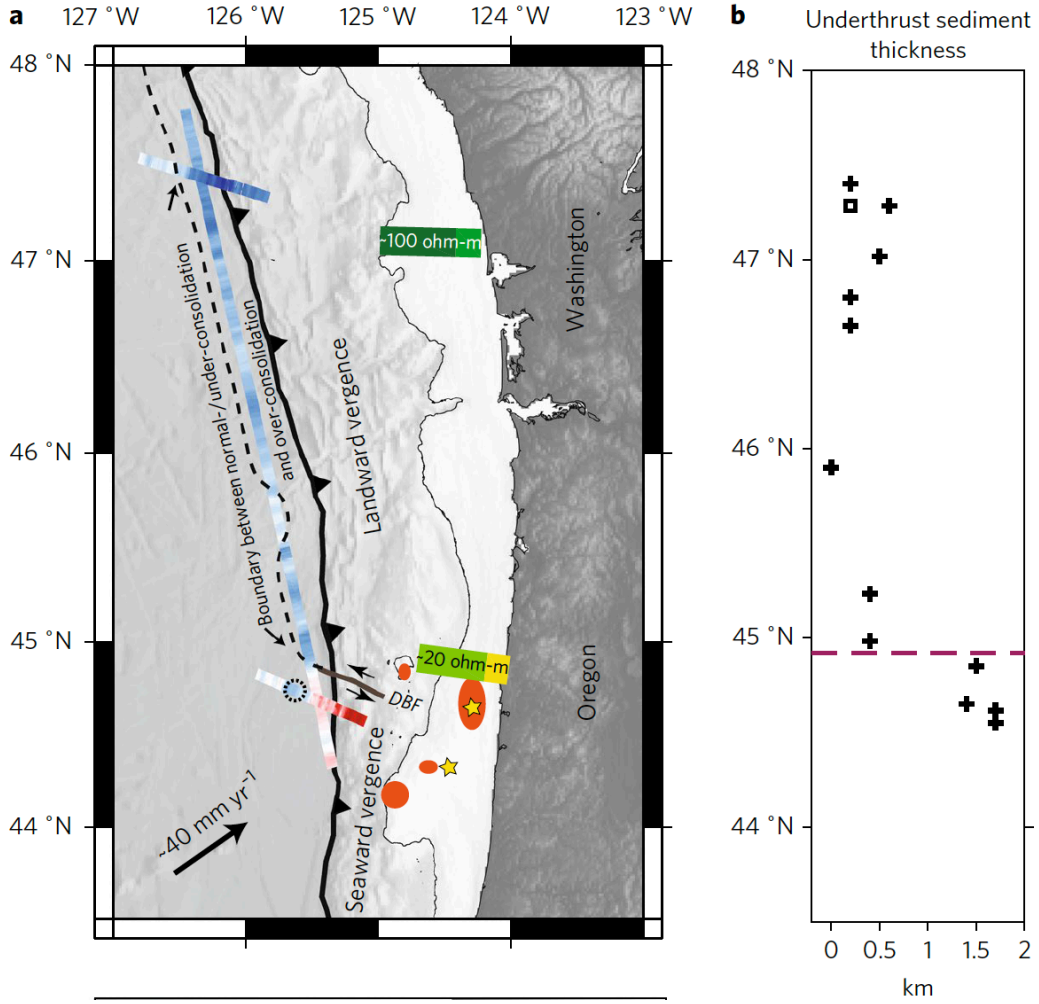
1. Deformation and topography of the incoming plate.
2. Depth, topography and reflectivity of the megathrust.
3. Sediment properties and amount of sediment subduction.
4. Structure and evolution of the accretionary wedge, including geometry/reflectivity of fault networks.
5. How these properties vary along strike and down dip across what may be the full width of the seismogenic zone at Cascadia.



Deformation and topography of the incoming plate.
Sediment properties and amount of sediment subduction.

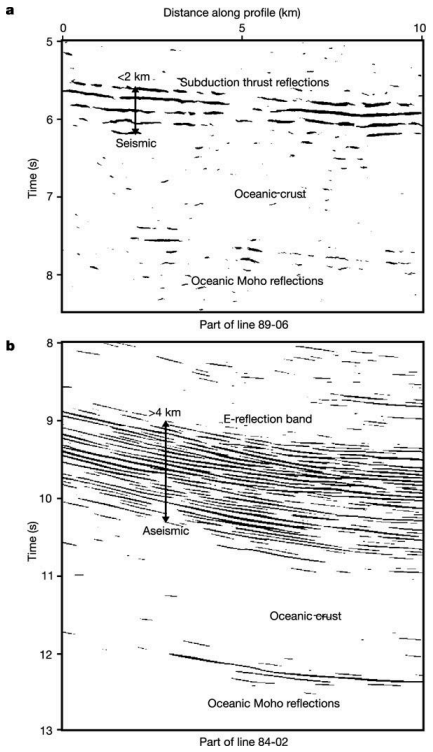
Structure and evolution of the accretionary wedge.



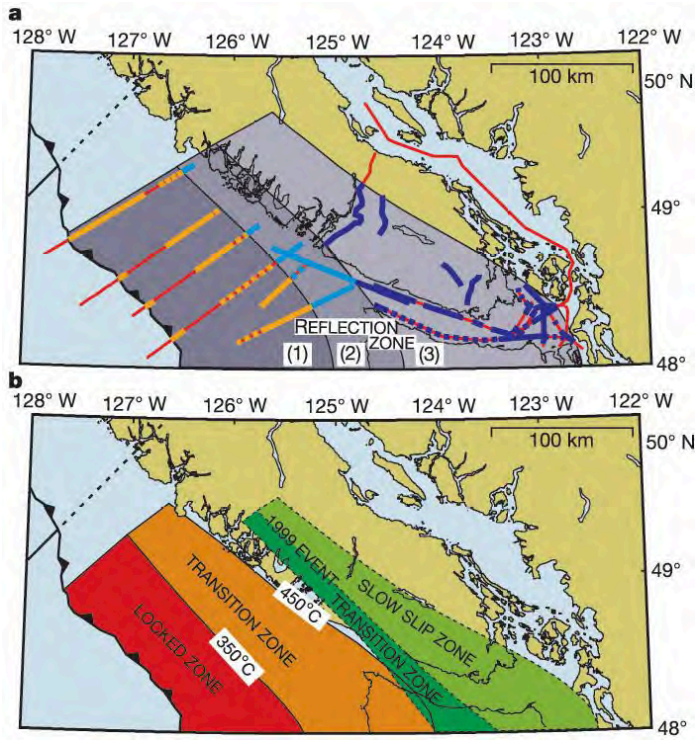


Han et al. (2016; 2017)

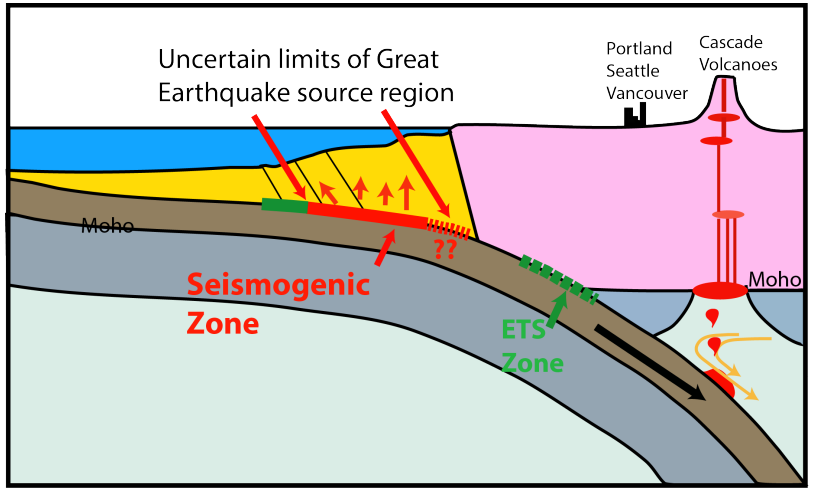
Depth, topography and reflectivity of the megathrust.



Nedimović et al., 2003



Thin reflection band- orange
Transition – blue
No reflectivity- red

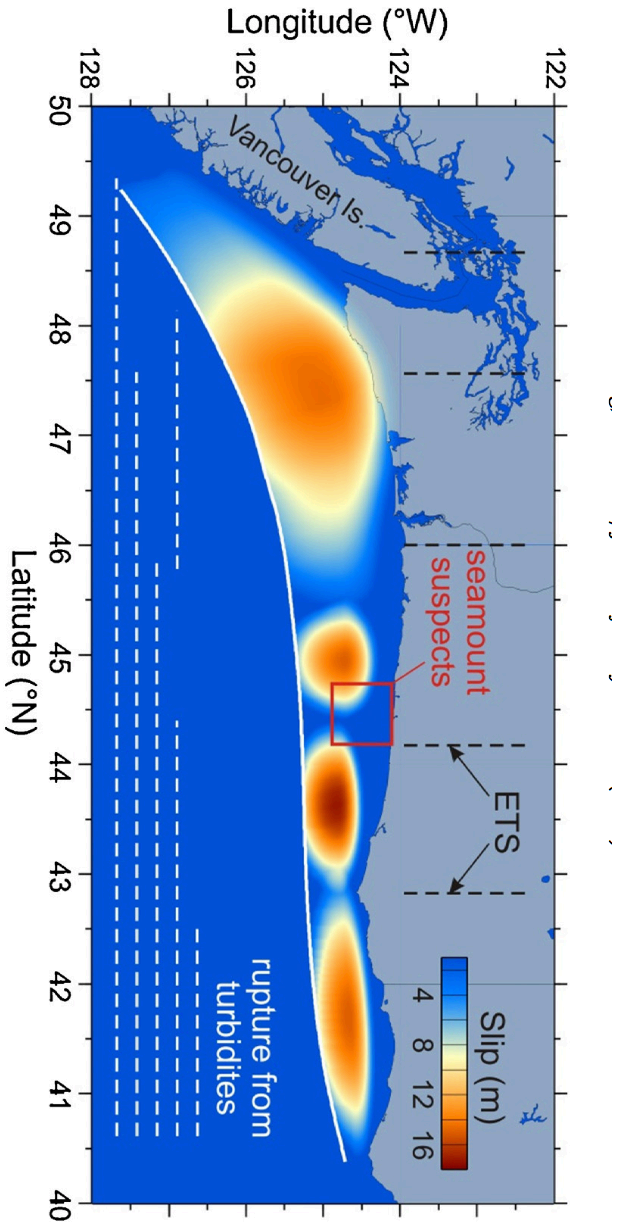


Changes in reflectivity at downdip limit of seismogenic zone?

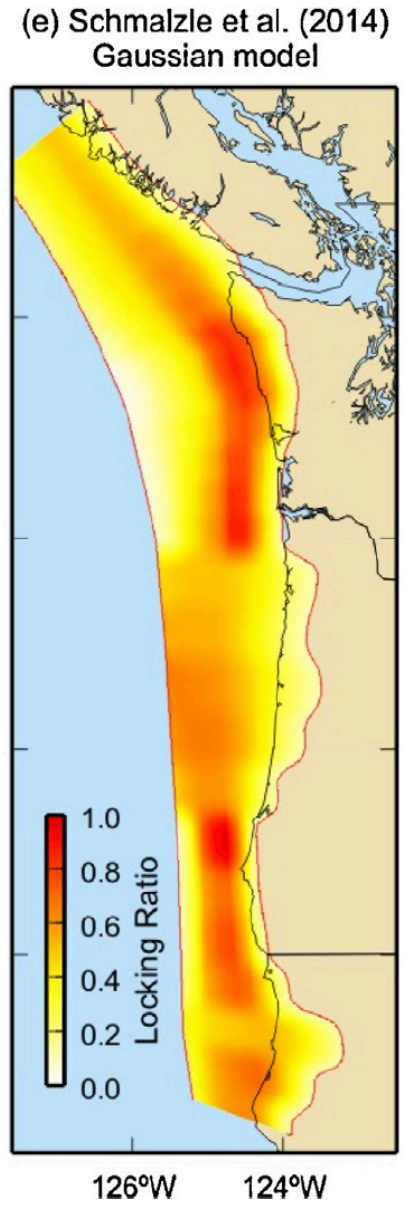
Along margin segmentation in subduction zone properties:

Plate interface: co-seismic slip, paleo rupture, current locking status, ETS

Accretionary wedge



Wang et al., 2013



Schmalzle et al., 2014

Acquisition and Processing Plan

ACQUISITION

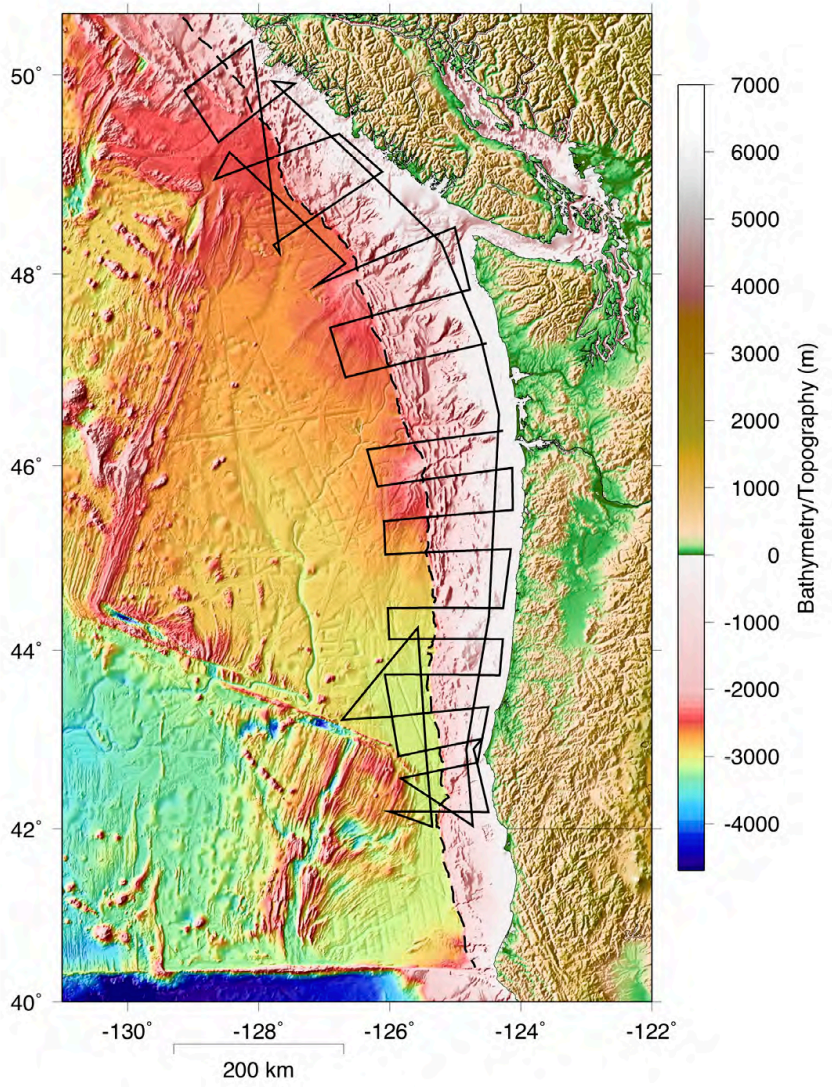
- R/V M. Langseth, June 1- July 10, 2021
- 15-km-long streamer, 1,200 channels, 12-m depth
- Source: 6,600 cu.in, 37.5 m shot spacing, 12-m depth
- 15-s records, 2 ms sampling rate

PROCESSING

- 1. At-sea: post-stack time migrated images.
- 2. ION (GXT Group): pre-stack depth migration

DATA AVAILABILITY

- 1. Raw shot gathers: immediately after the
- cruise
- 2. Processed PSTM/PSDM: after completion, end of Year 2
- approx.

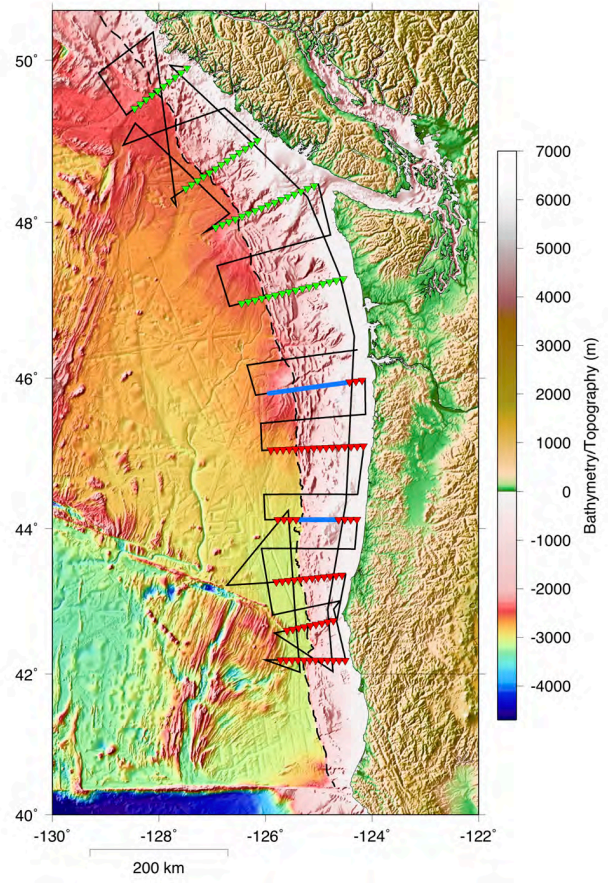


Complementary Programs

An Open-Access, Controlled-Source Seismic Dataset Across the Cascadia Accretionary Wedge From Multi-Scale Regional OBS and Focused Large-N Nodal Arrays

PI: J.P. Canales (WHOI)
Co-PIs: N. Miller (USGS)
D. Lizarralde (WHOI)

Deployment of OBS and OBN arrays



Cascadia202!: Seeing Beneath the Surface of the Cascadia Subduction Zone

PI: Anne Trehu (OSU)

Emilie Hooft (UO)

Kevin Ward (SDSMT)

Erin Wirth (USGS)

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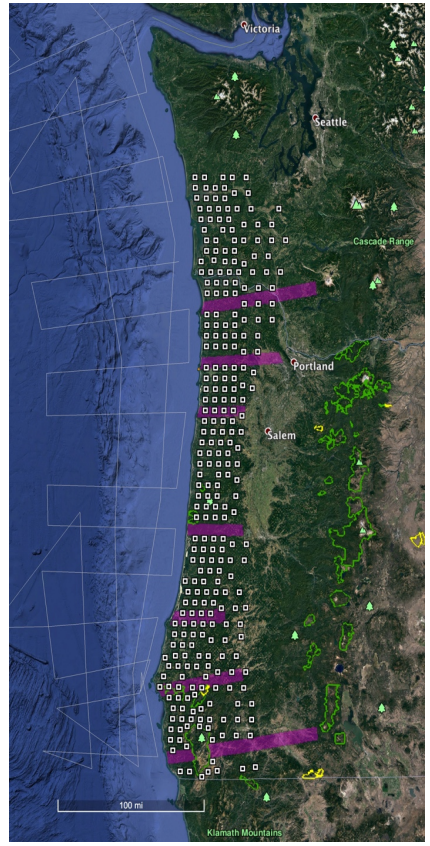
Deployment of land seismometers (10-15 km spacing) and nodal arrays (1 km spacing)



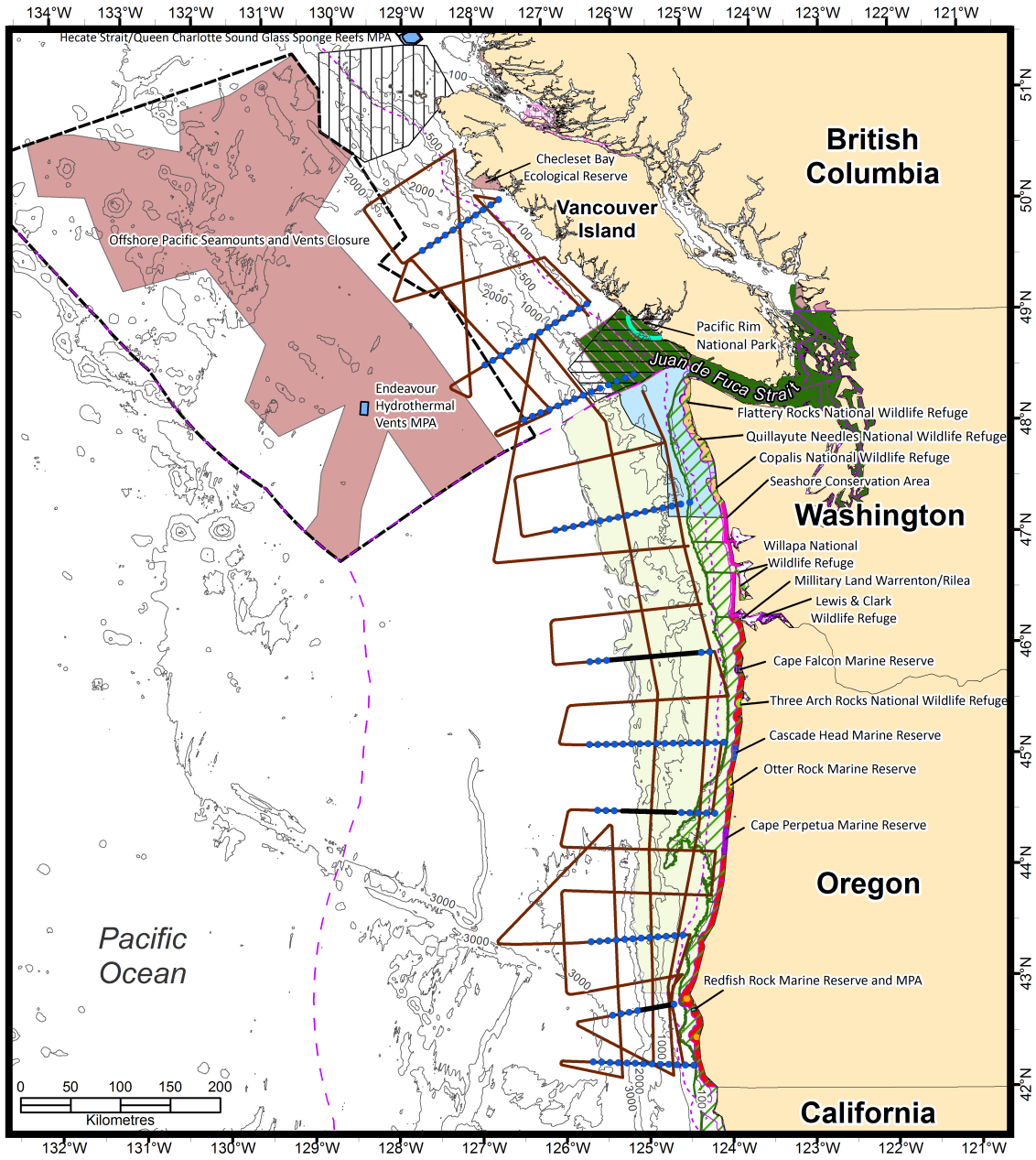
Track Plan

Current plan:
Modifications for Orcas critical habitat
Daylight only shooting in shallow water and chase boat.

Permit process- public comment period for NMFS IHA last winter closed

Permit process for NMFS and OR/WA coastal states close to complete.

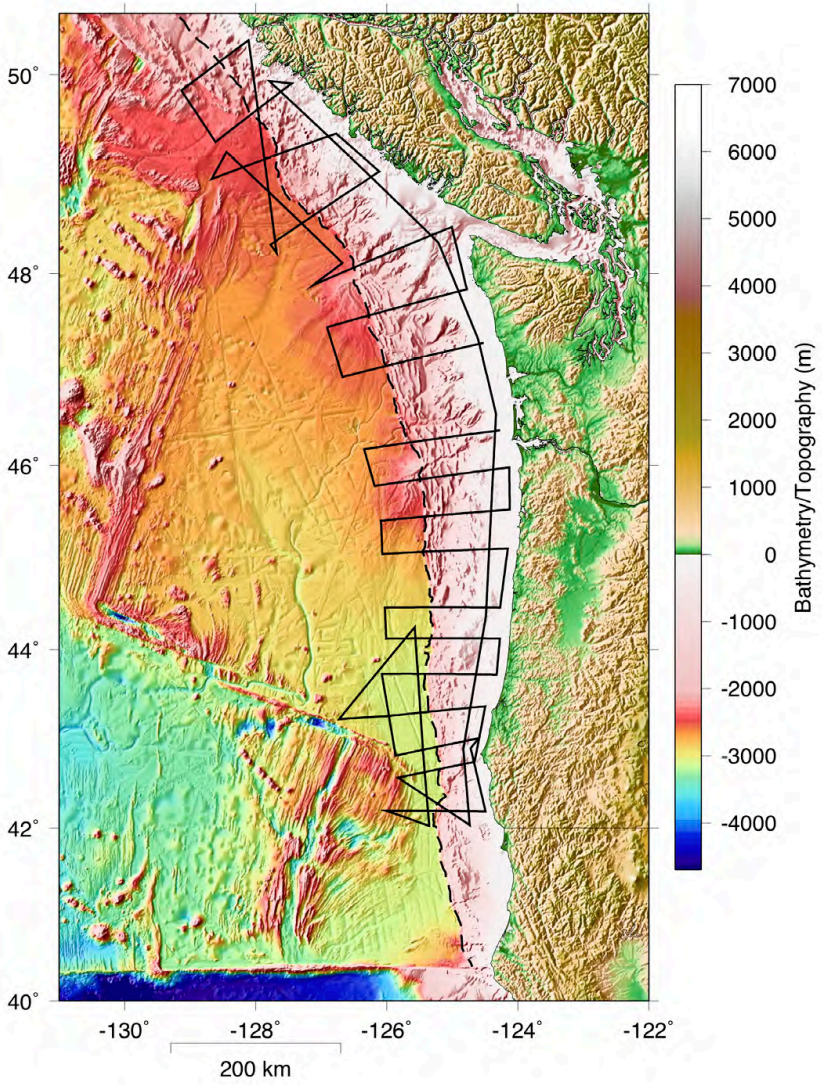
Permit resubmitted for Canadian portion.

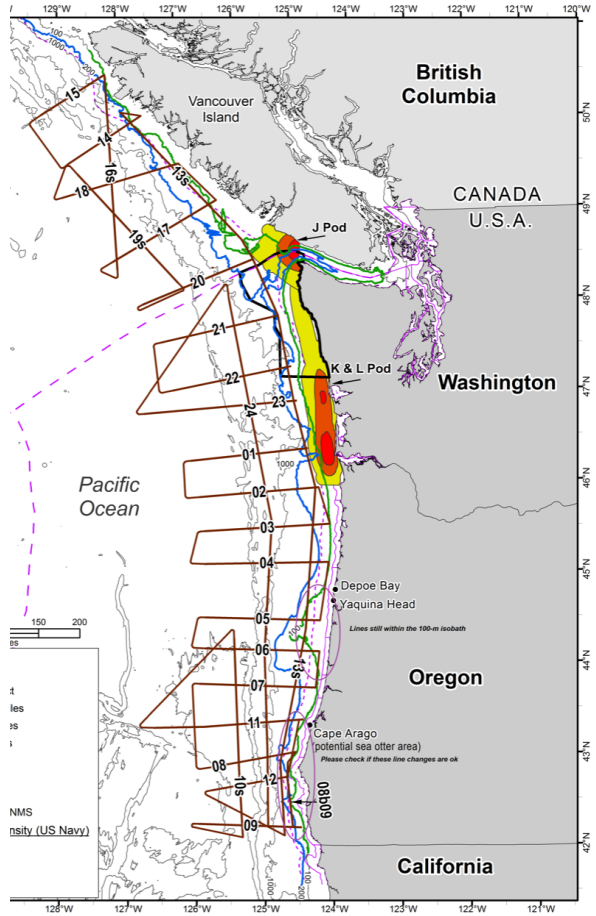


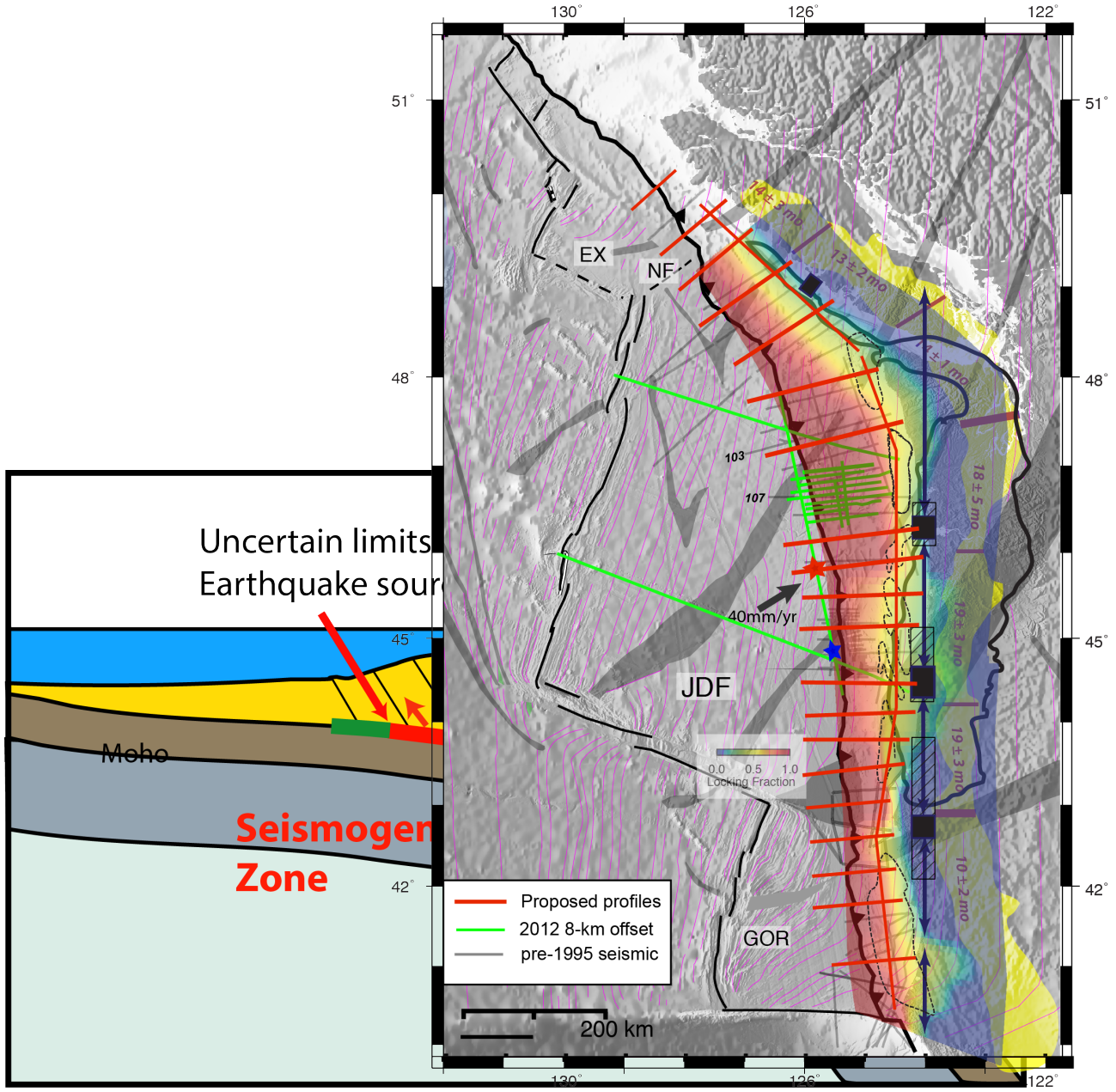
Track Plan

Show existing seismic wi

Original plan – proposed
based on experience wit
regulatory agencies for e
seismic studies offshore
the southern region from






130°
126°
122°
51°
48°
45°
42°
EX
NF
JDF
GOR
14 ± 3 mo
13 ± 2 mo
11 ± 1 mo
18 ± 5 mo
18 ± 3 mo
19 ± 3 mo
10 ± 2 mo
103
107
40mm/yr
0.0 0.5 1.0
Locking Fraction
Proposed profiles
2012 8-km offset
pre-1995 seismic
200 km
Uncertain limits
Earthquake sour
Moho
Seismogen
Zone