Exploring the lithospheric velocity structure of the Pacific Northwest

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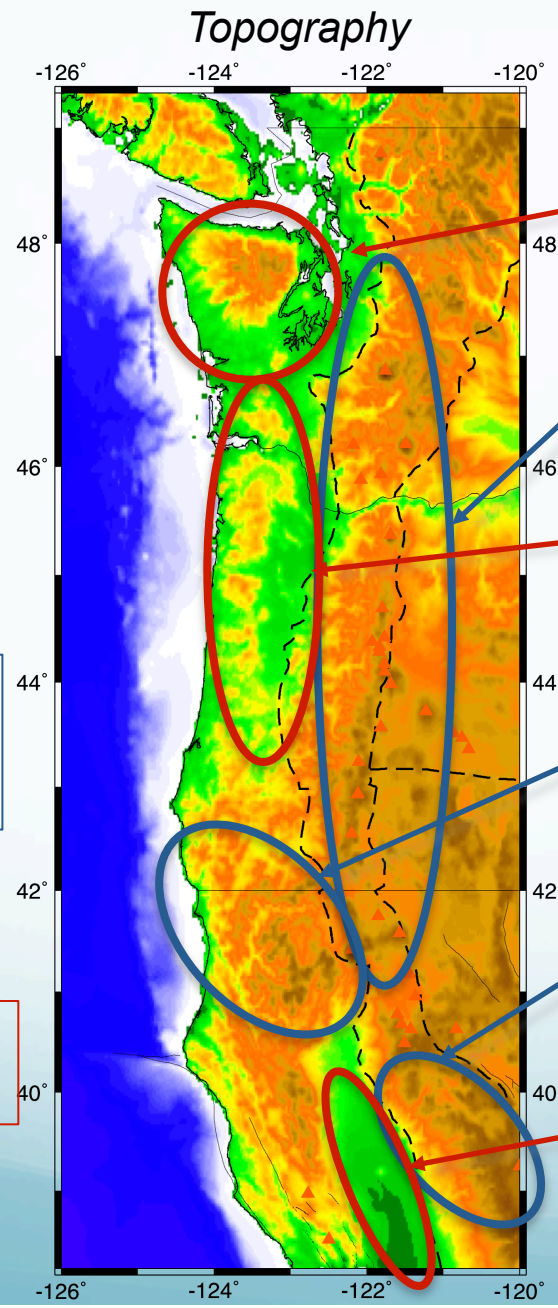
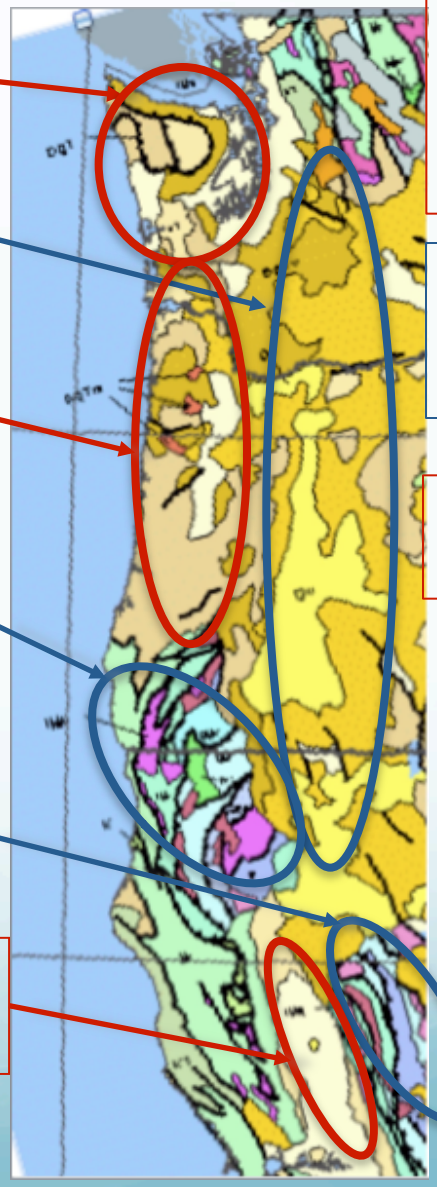
Study Region





Olympic Peninsula

Cascades Range

Forearc flats

Klamath Mountains

Sierra Nevada

Great Valley

Quaternary Sediments over Neogene volcanics

Quaternary and Tertiary volcanics

Quaternary Sediments

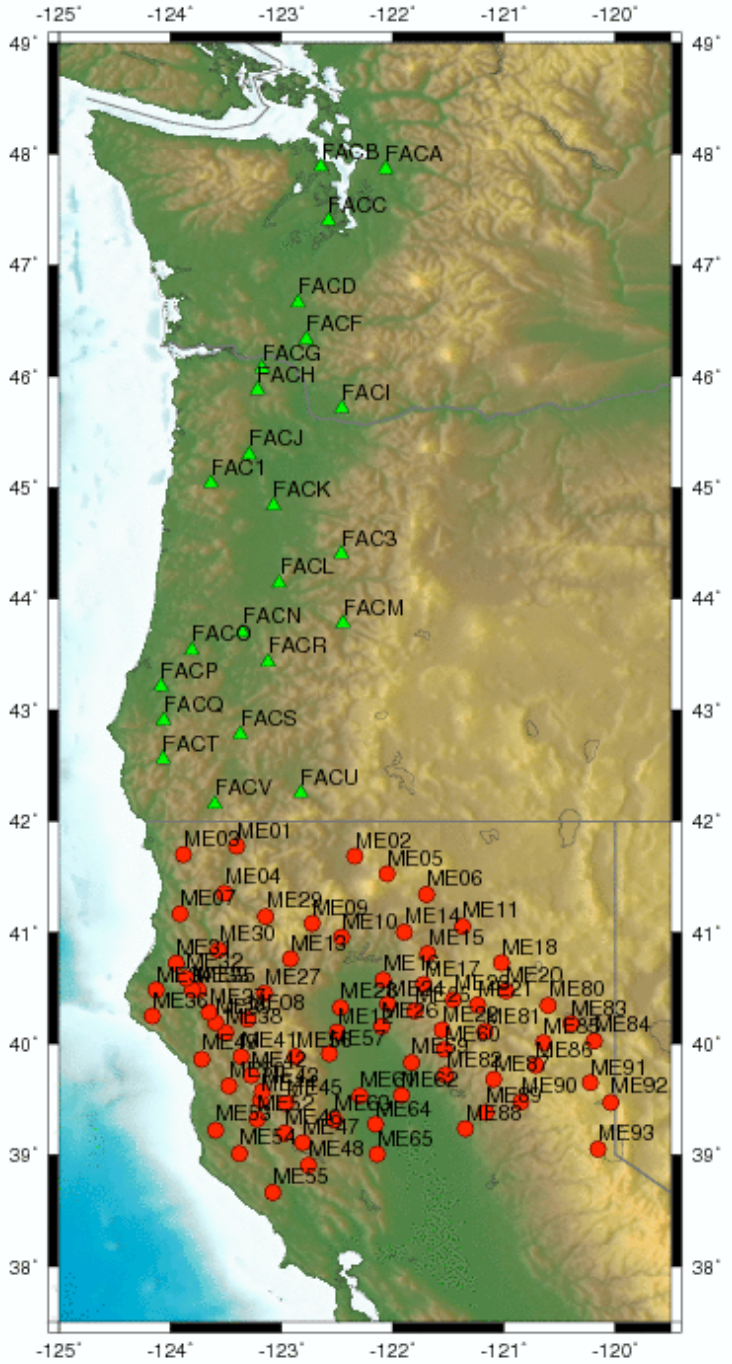
Mesozoic granites overlain by cenozoic sediments

Mesozoic granites and sediments

Quaternary sediments

Flexible Array Data

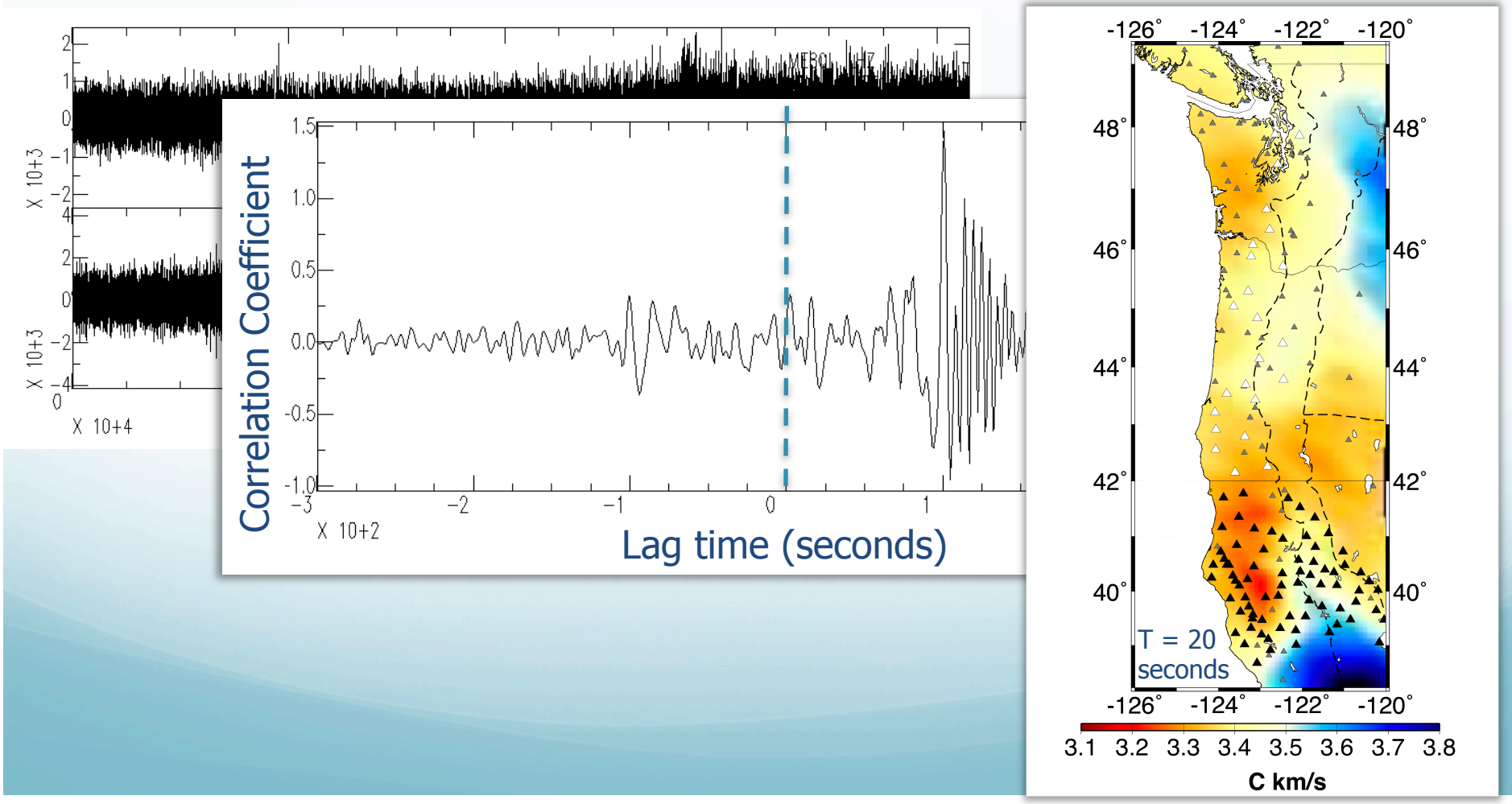
- ✧ Flexible Array Mendocino Experiment
- ✧ FlexArray along Cascadia Experiment for Segmentation
- ✧ ~100 CMG-3T broadband seismometers.
- ✧ ~10 – 40 km spacing throughout region



Ambient Noise Tomography

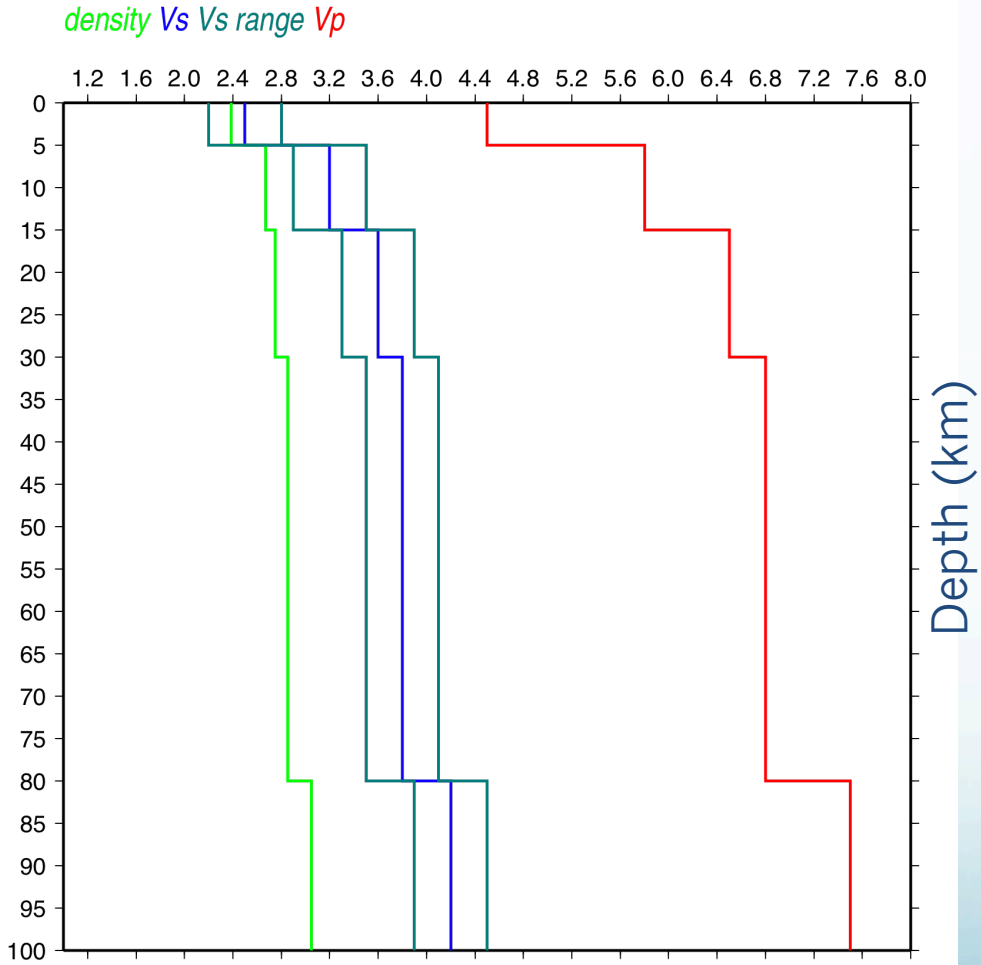
$$CC(A,B,t) \propto G(R_{AB},t) + G(R_{BA},t)$$

Noise → Stacked Correlograms → Regional Tomography



Monte Carlo Inversion

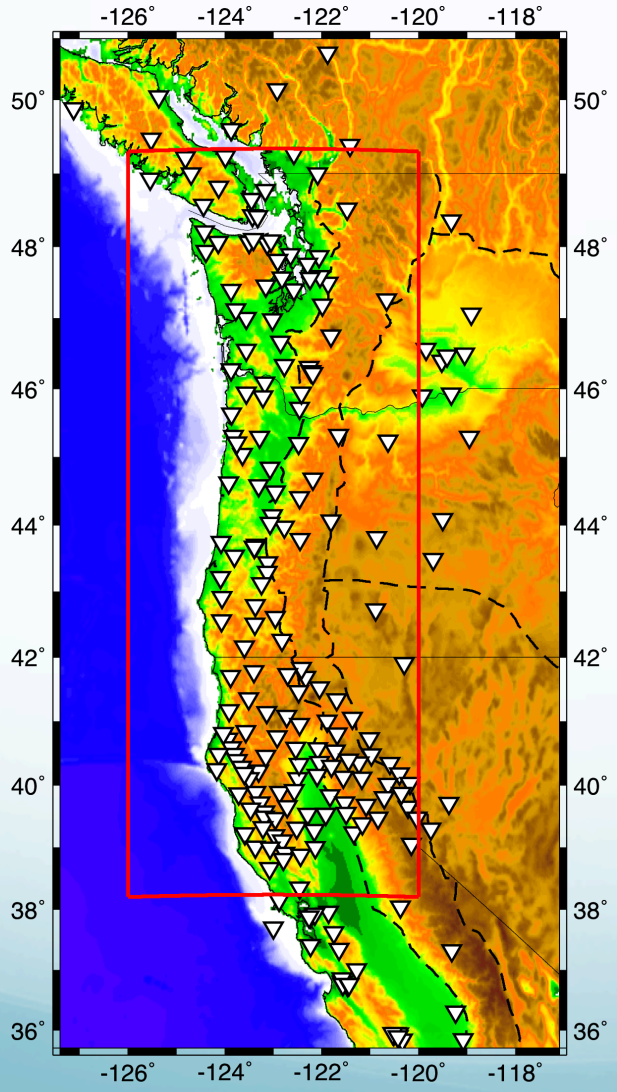
Standard starting model



Mean ± 1 σ models

Vs (km/s)

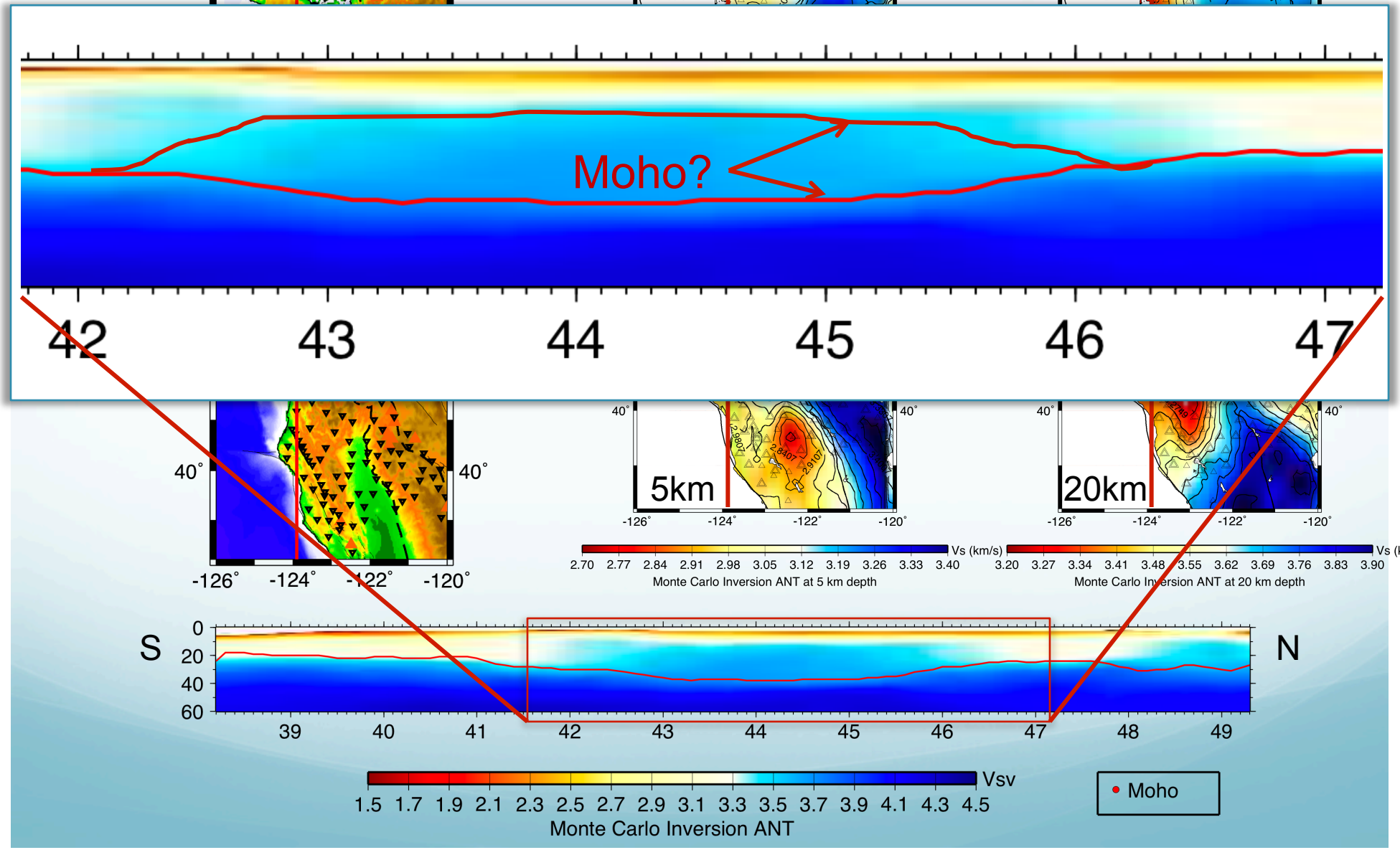
Station Coverage



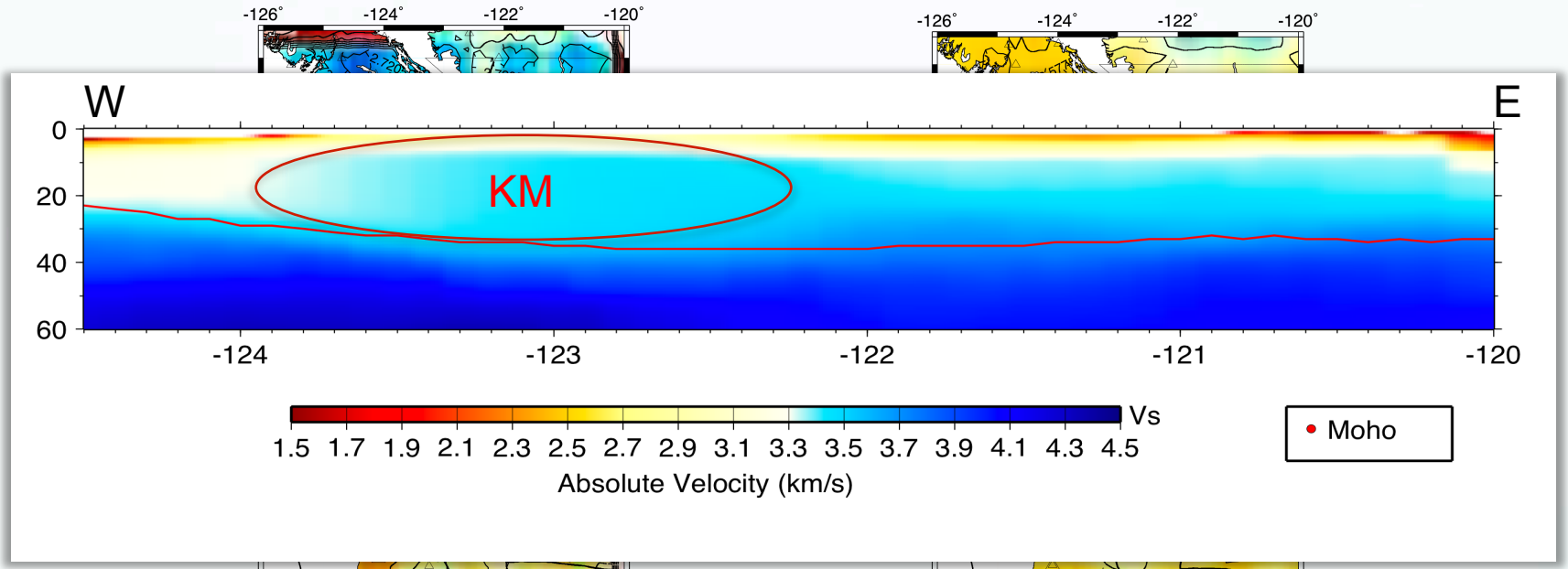
Data from IRIS DMC, NCEDC NetDC, and CNDC autoDRM.

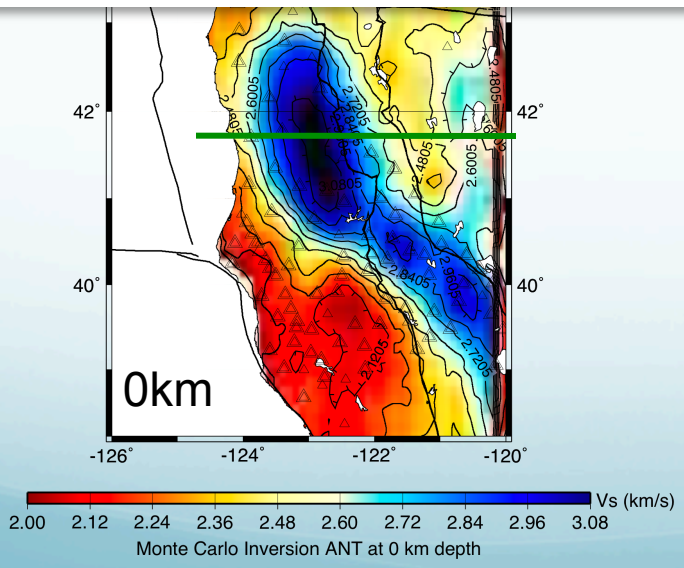
Networks include:
XQ (Mendocino)
YW (FACES)
TA (Transportable Array)
BK (Berkeley Digital Seismological Network)
CN (Canadian National)
UW (University of Washington)
UO (University of Oregon)
II / IU (IRIS GSN)

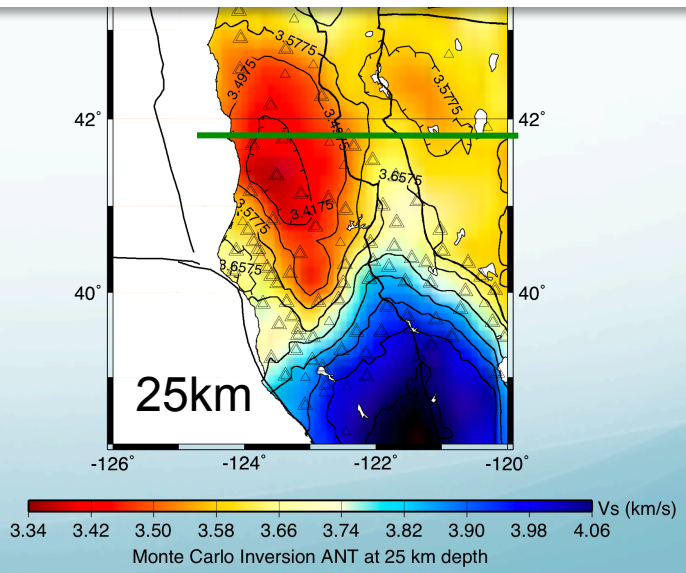
Forearc Flats



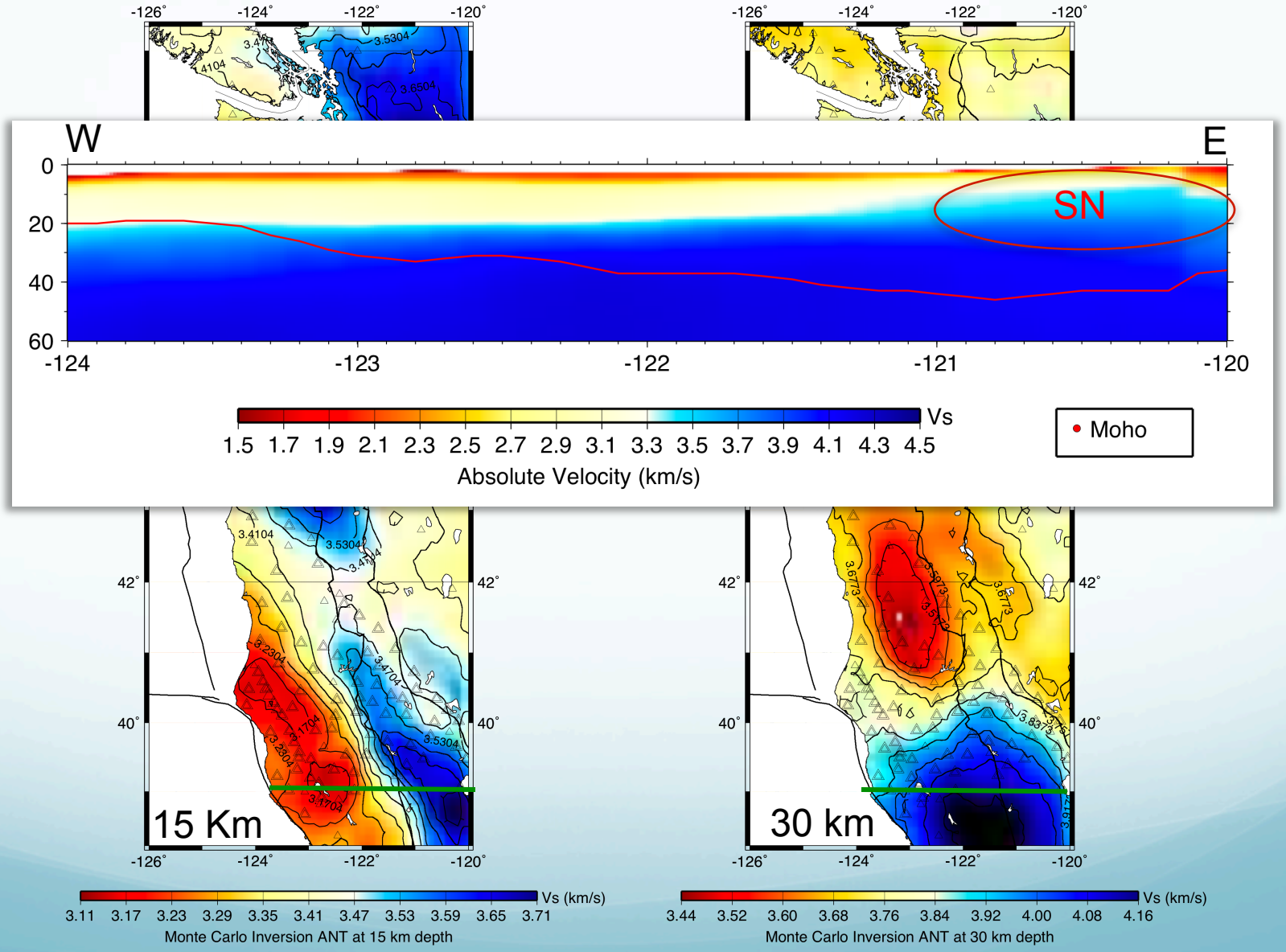
Klamath Mountains



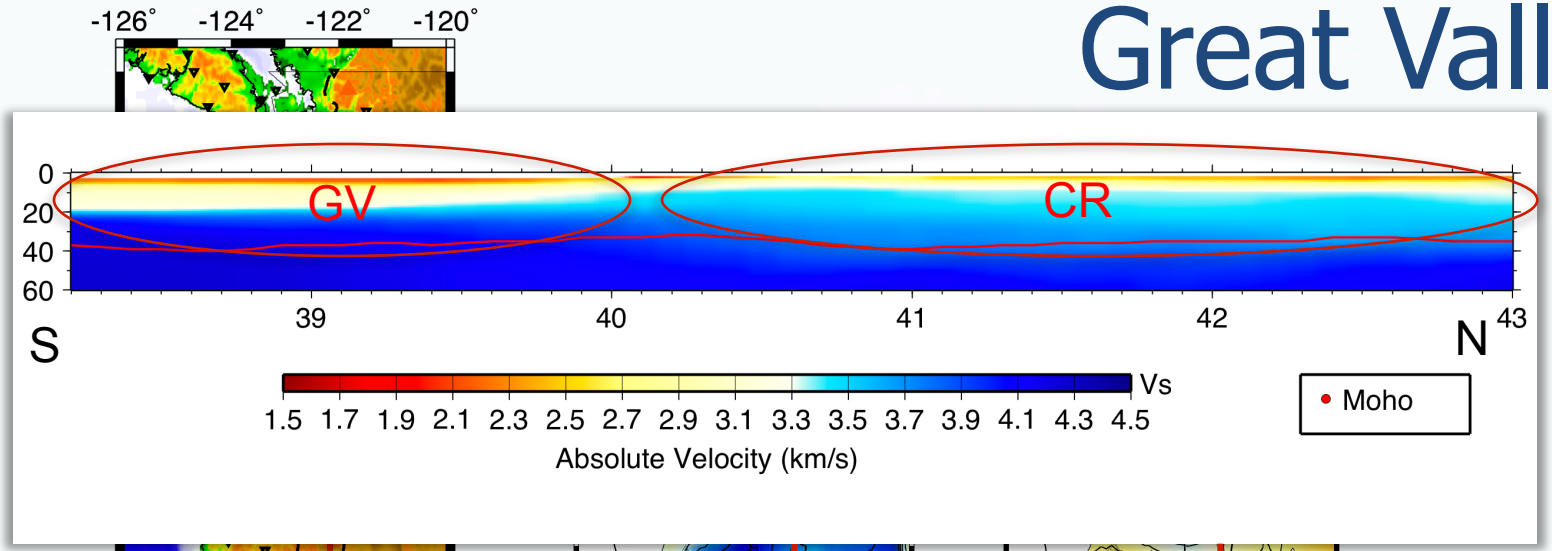


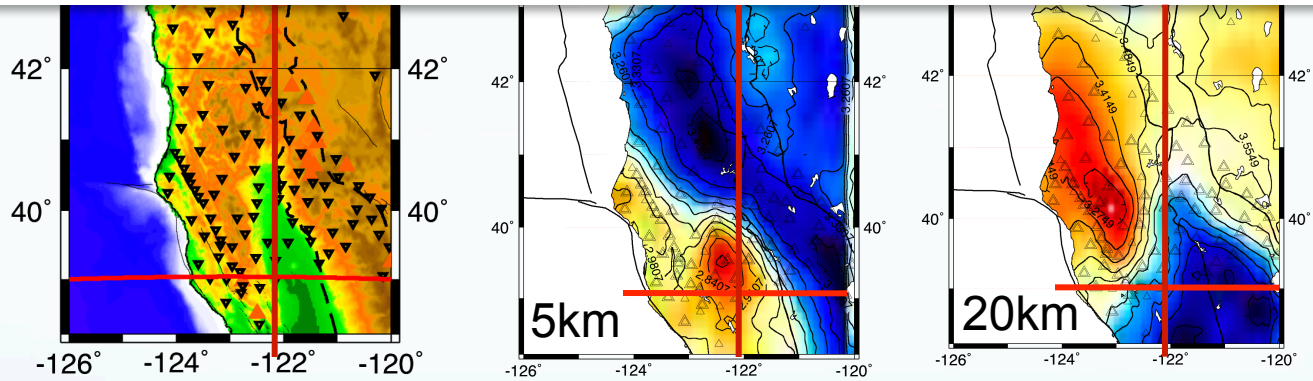


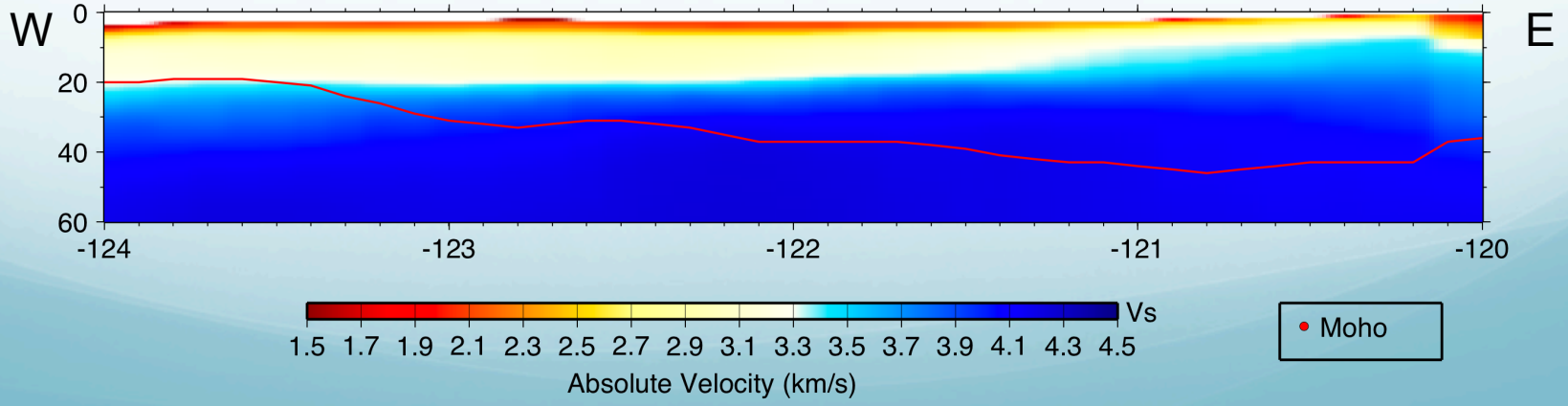
Sierra Nevada



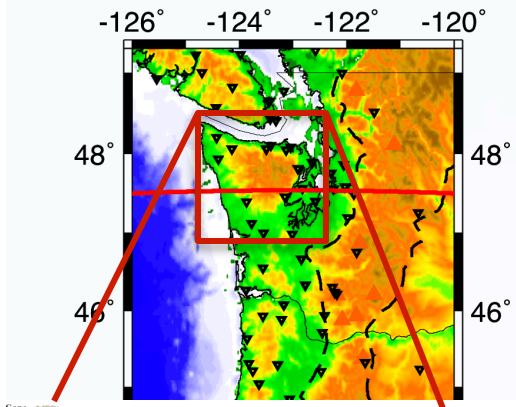
Great Valley

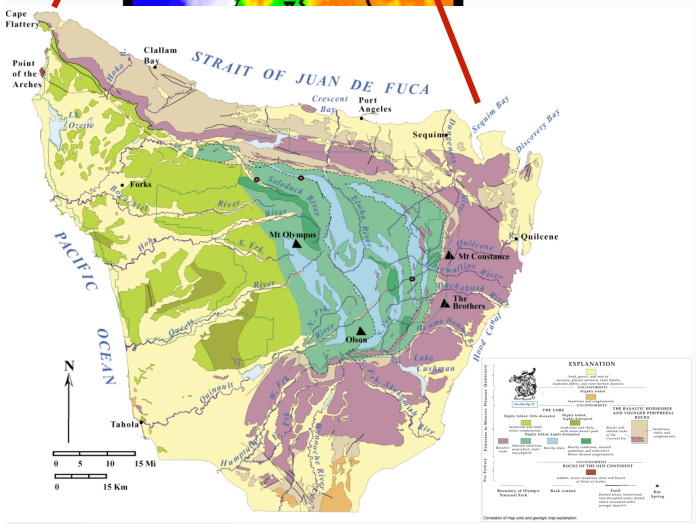


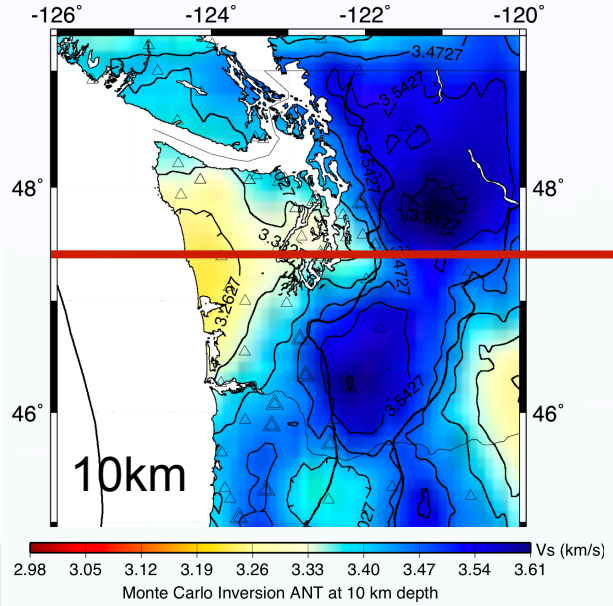


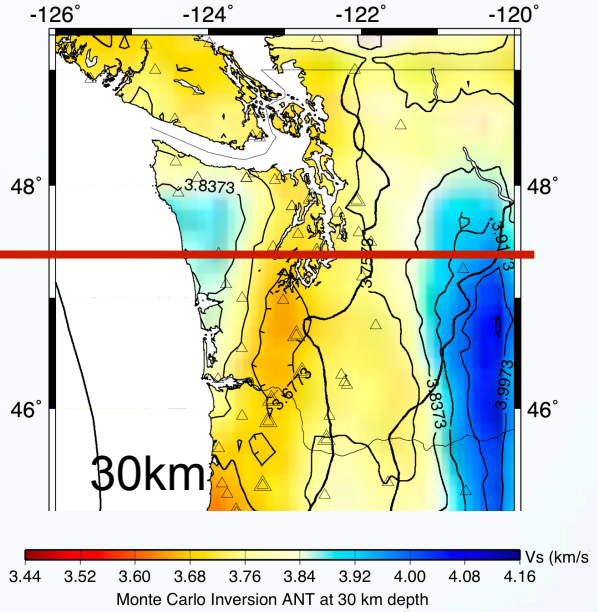


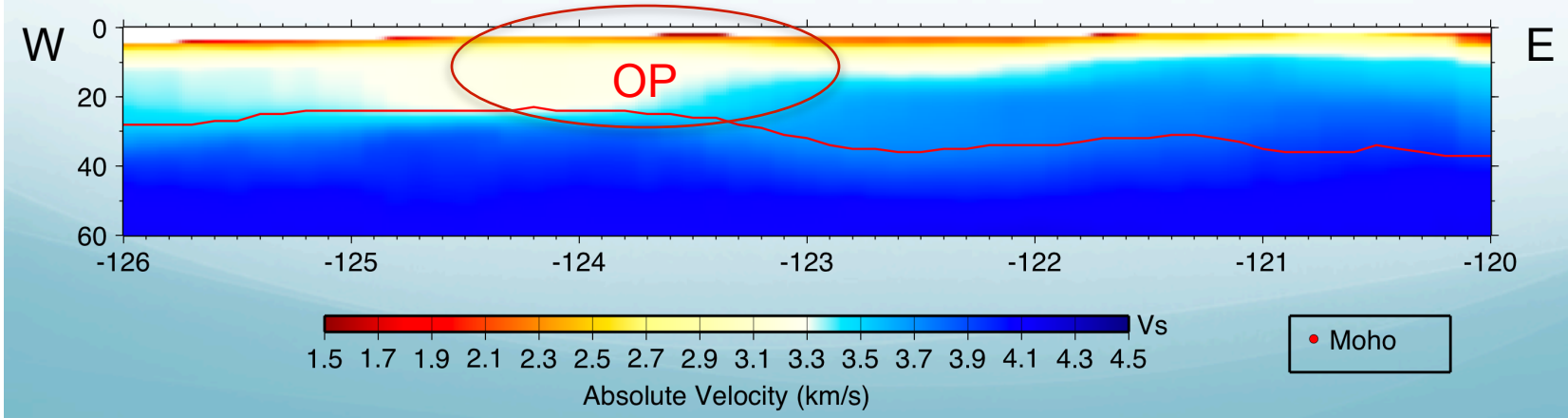
Olympic Peninsula



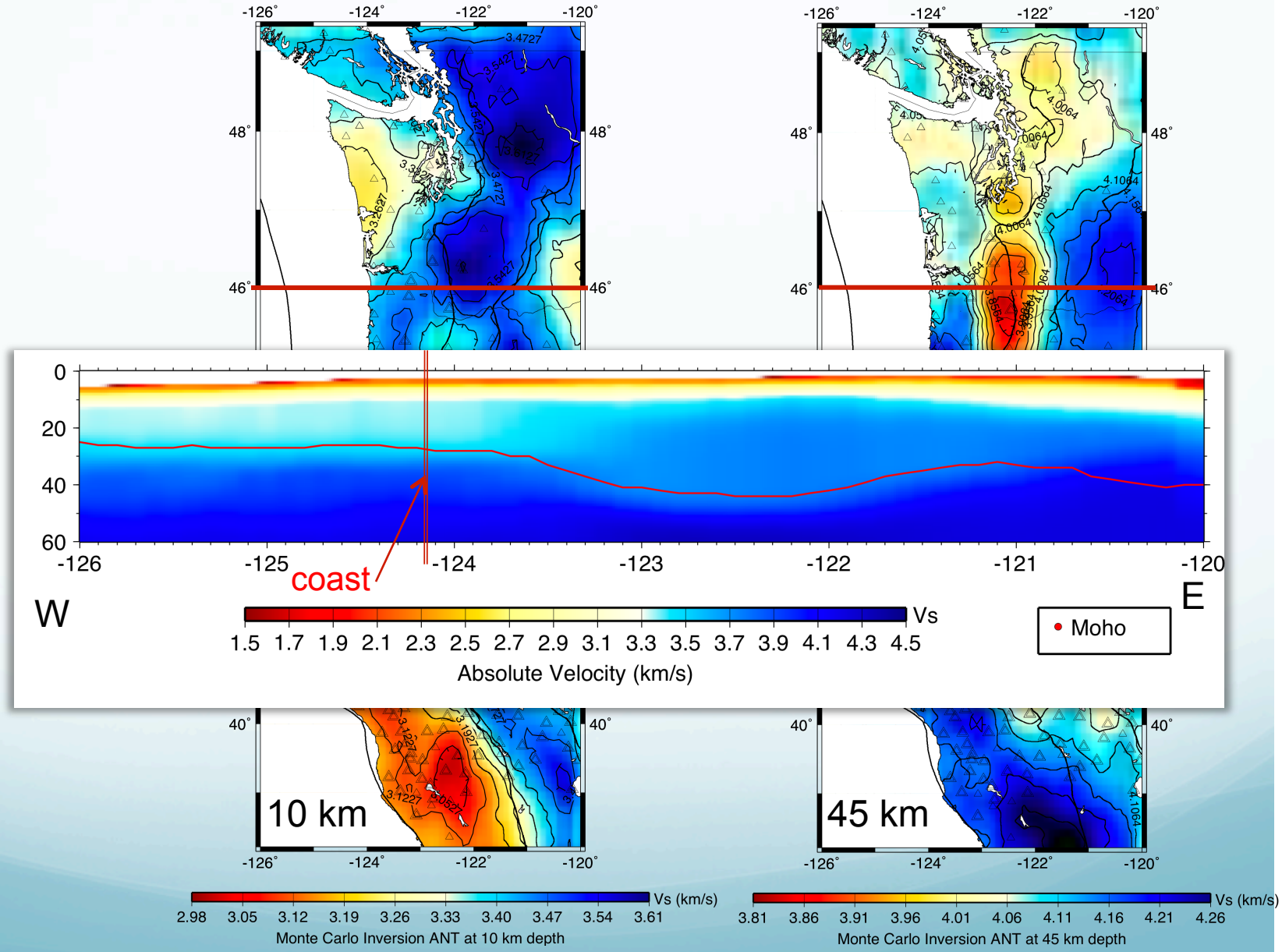




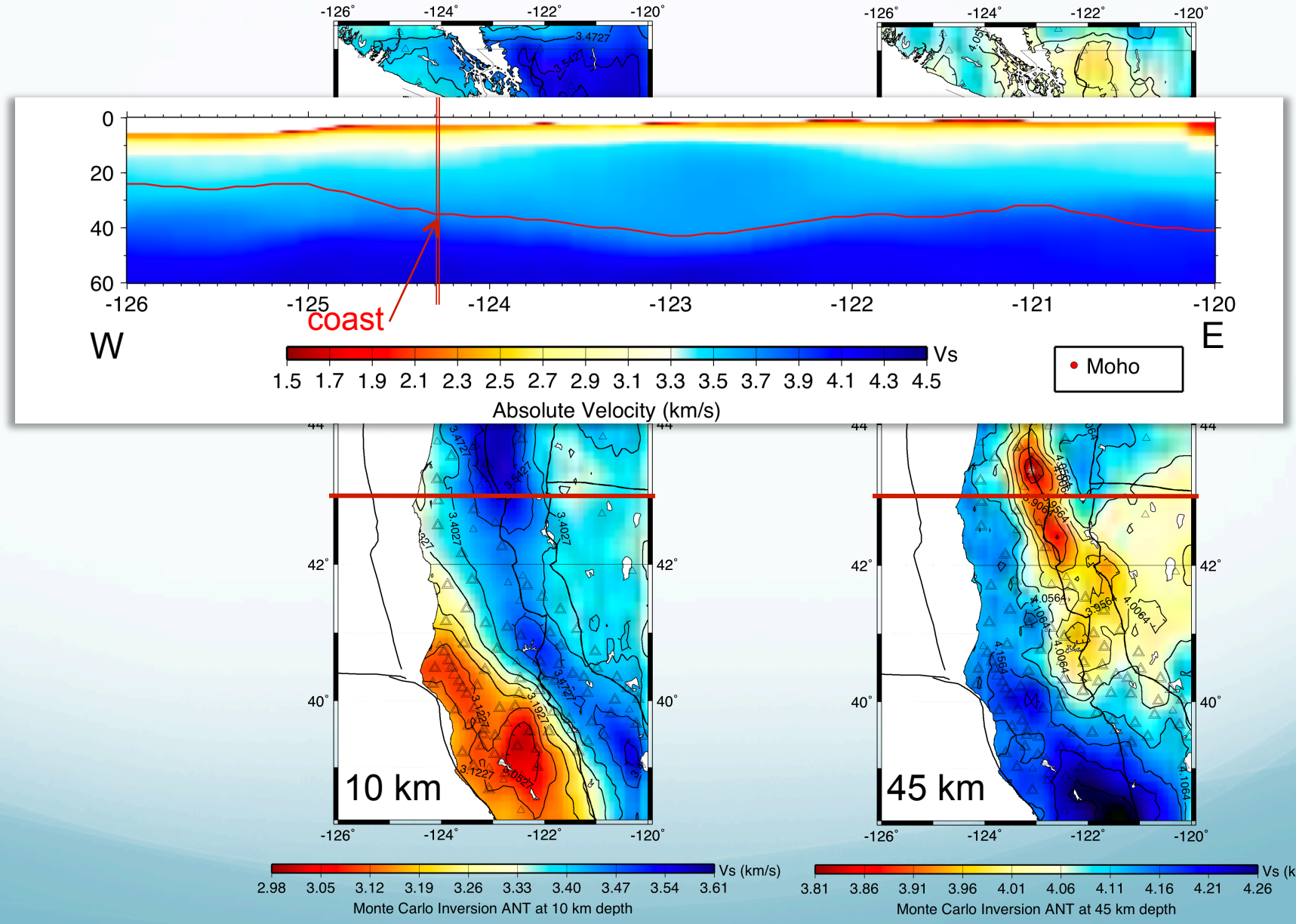




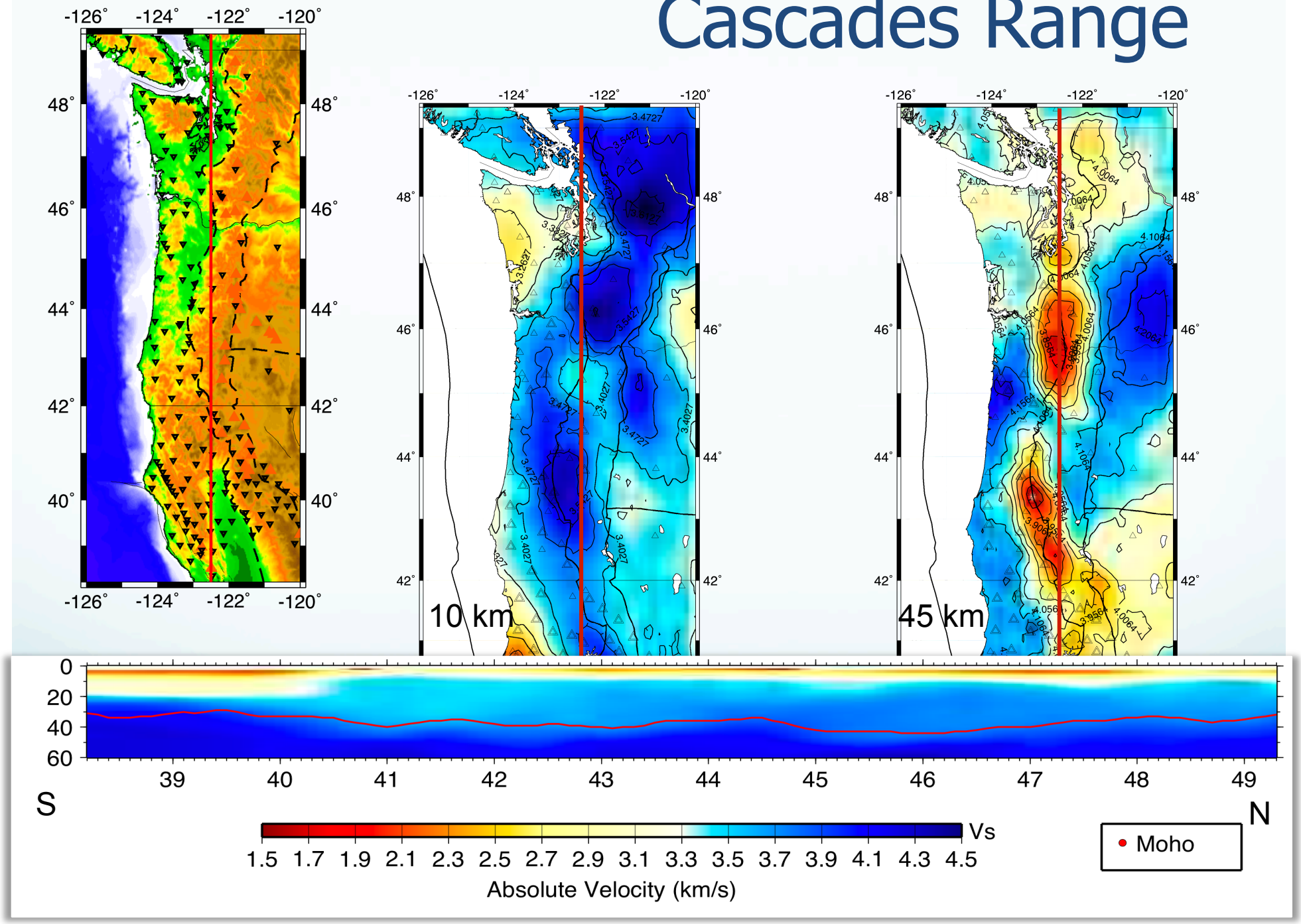
Cascades Range



Cascades Range

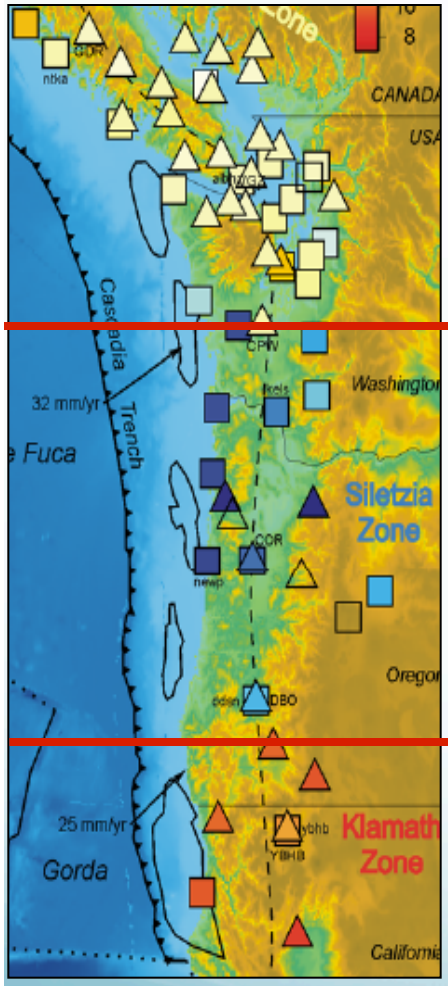


Cascades Range



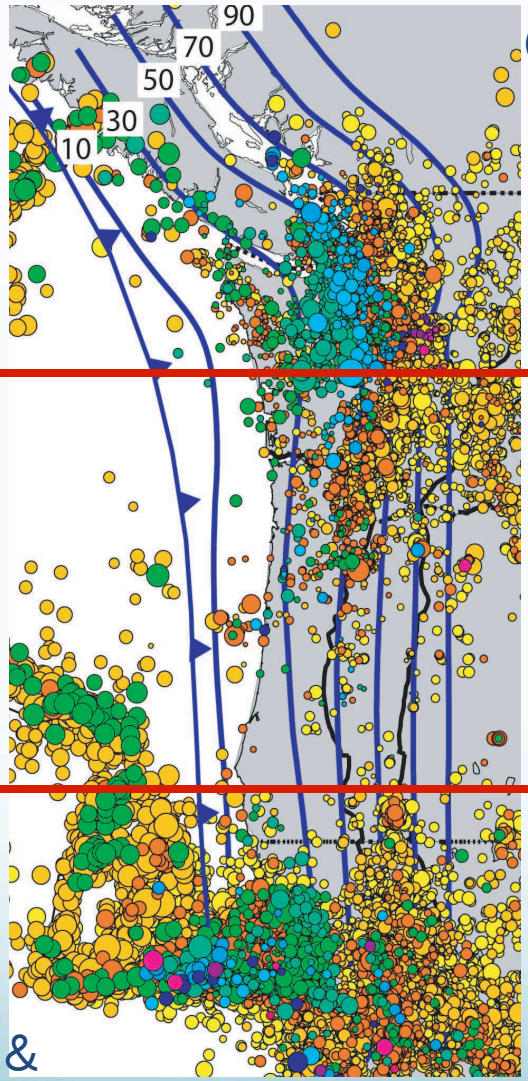
Segmentation

ETS Periodicity

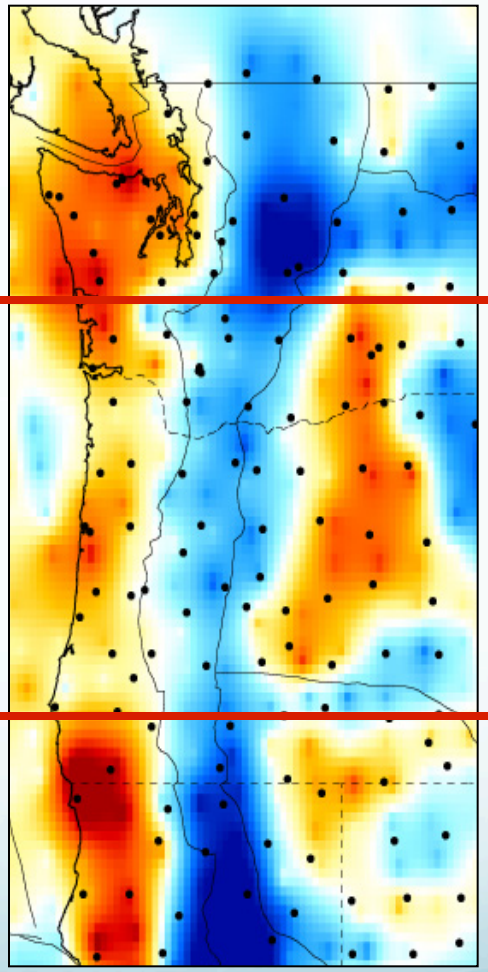


Brudzinski & Allen 2007

Deep Earthquakes

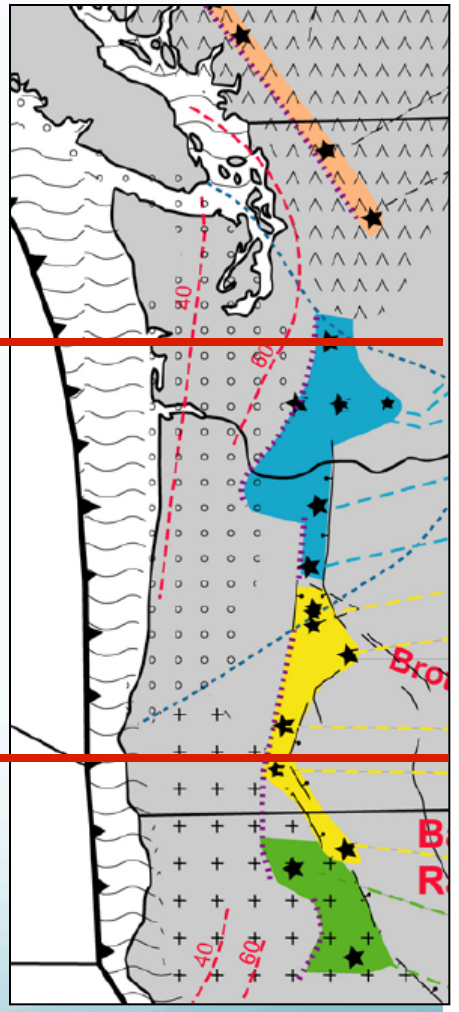


P-wave Velocity (200km)

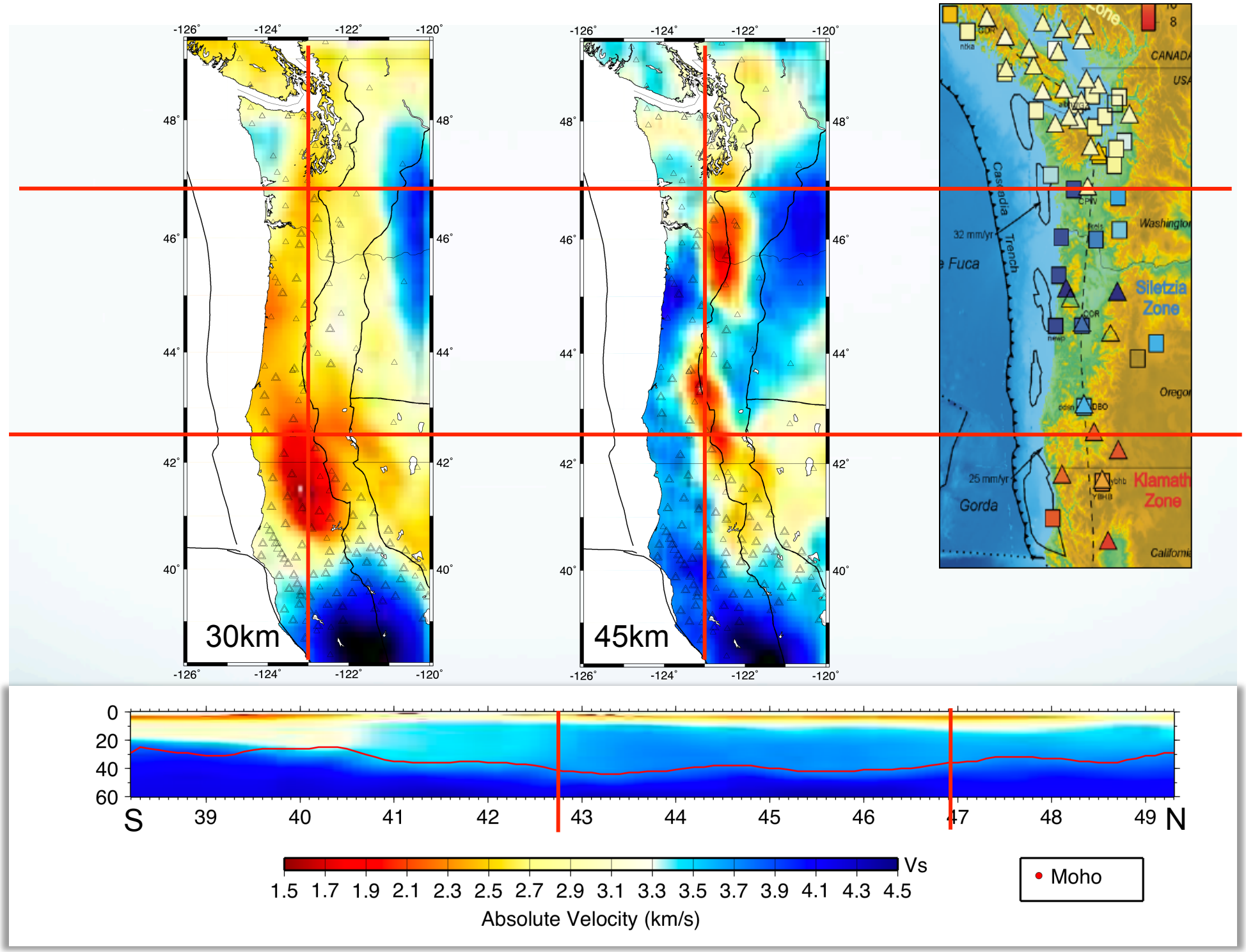


Allen, 2008

Arc volcanism



Schmidt et al., 2007


-126°
-124°
-122°
-120°
48°
46°
44°
42°
40°
30km
45km
CANADA
USA
Cascadia
Trench
32 mm/yr
Fuca
Siletzia
Zone
Washington
Oregon
25 mm/yr
Gorda
Klamath
Zone
California
0
20
40
60
S
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N
Vs
1.5 1.7 1.9 2.1 2.3 2.5 2.7 2.9 3.1 3.3 3.5 3.7 3.9 4.1 4.3 4.5
Absolute Velocity (km/s)
Moho

Proposal

- Incorporate longer temporal and spatial correlations.
- Use transverse-transverse component correlations to extract love waves and estimate shallow structure and crustal anisotropy.
- Use FK-analysis to determine the time and frequency dependent sources of noise.
- Extend the method of diffuse wavefield imaging to other phenomena (coda, tremor, etc...)

Conclusions

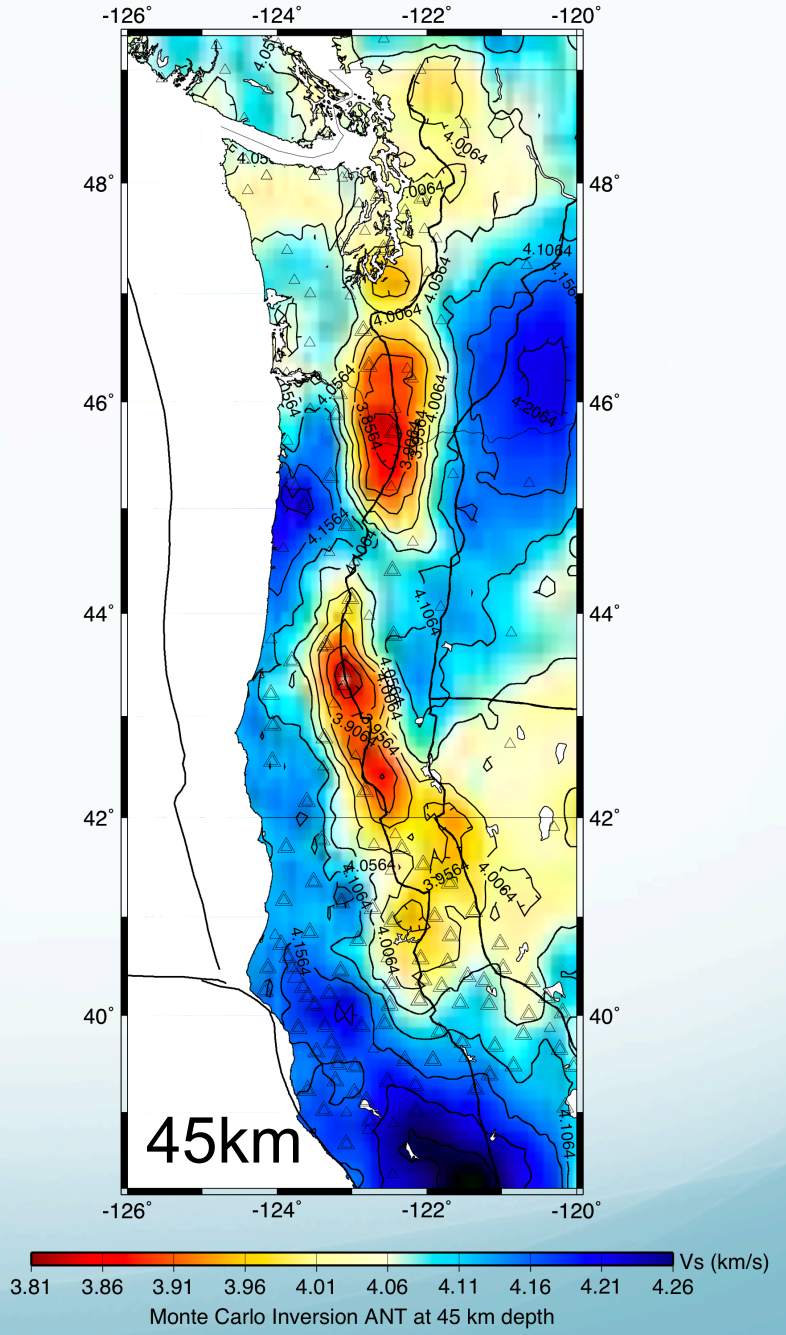
✧ Ambient Noise Tomography is once again proven as an invaluable tool for temporary passive seismic studies.

✧ The forearc sediments are very slow and underlain by fast crust or the slow mantle wedge.

✧ The Klamath Mountains, Sierra Nevada, and Cascades Range are seen to be fast volcanic rocks with significant crustal roots.

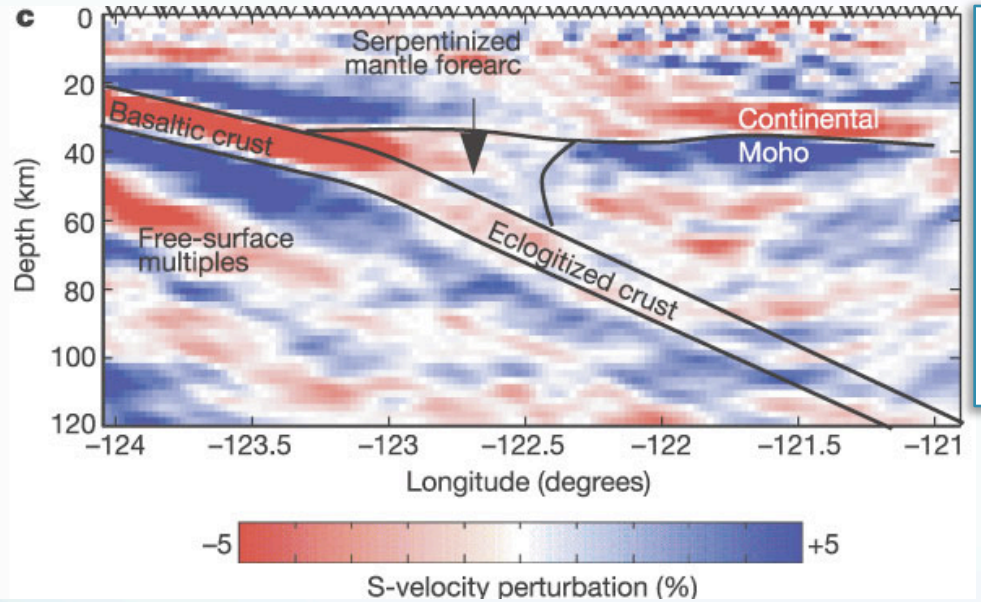
✧ The California Great Valley is abutted on the east by the Sierra Nevadas and on the North by the Cascades with measureable gradients.

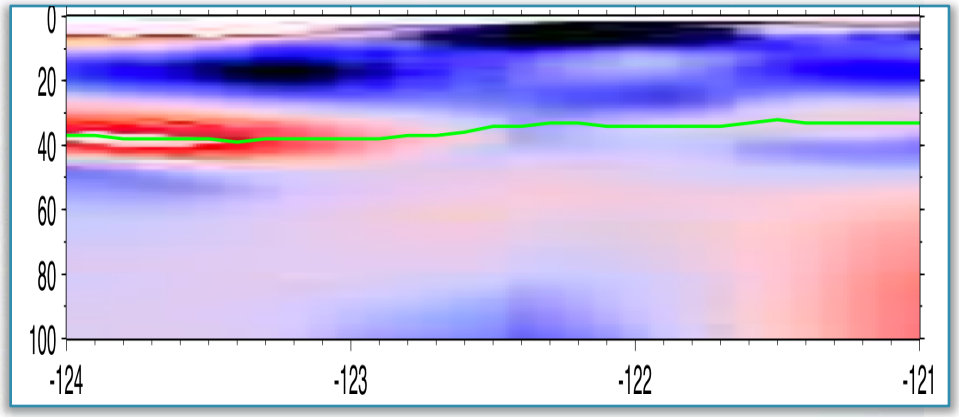
✧ The regional segmentation is also seen in surface wave structure

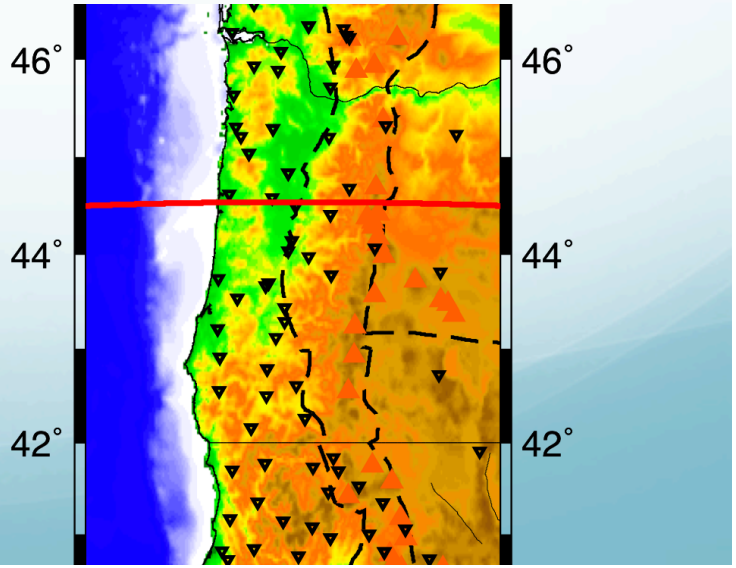


Bostock et al 2002

This study



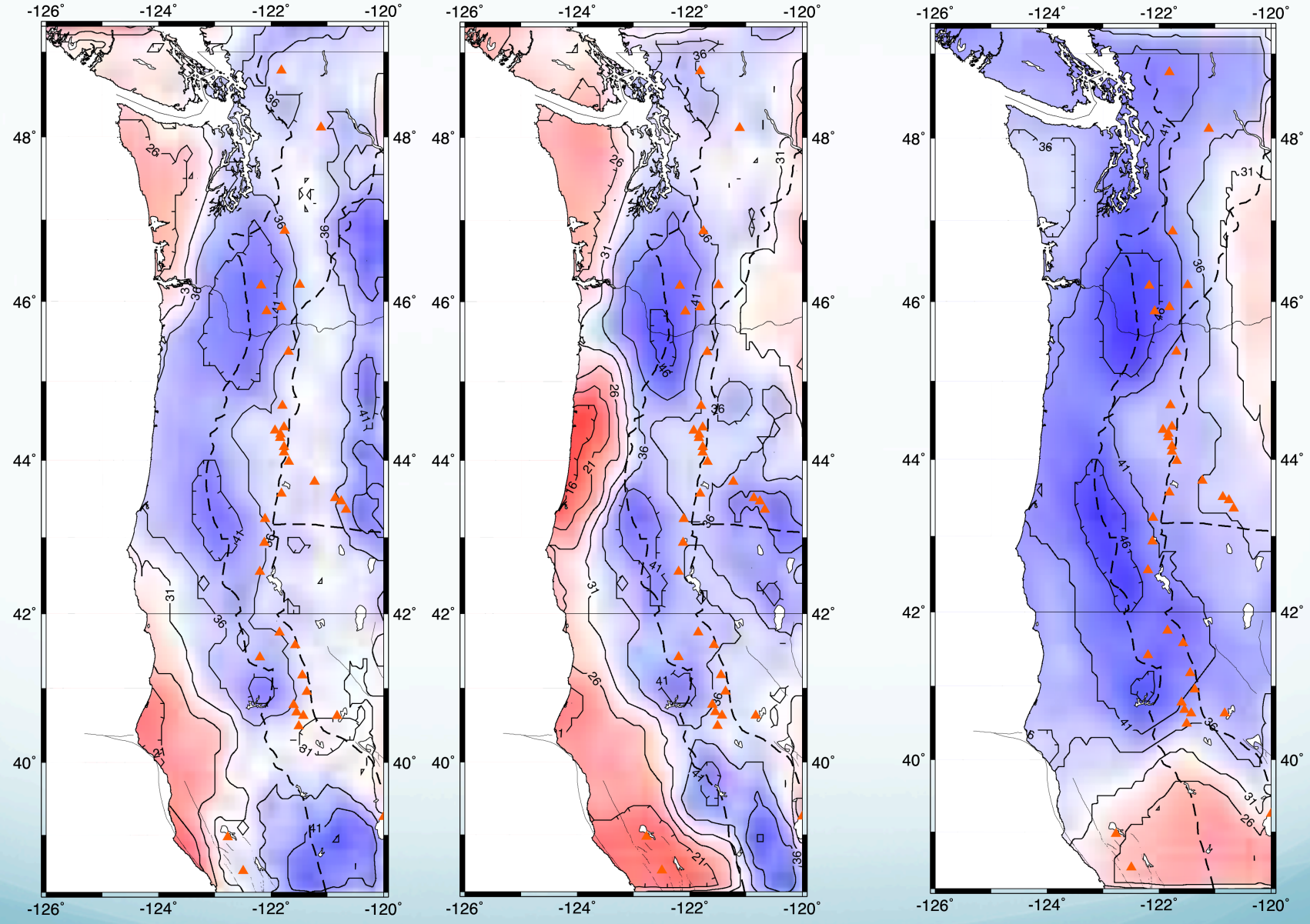


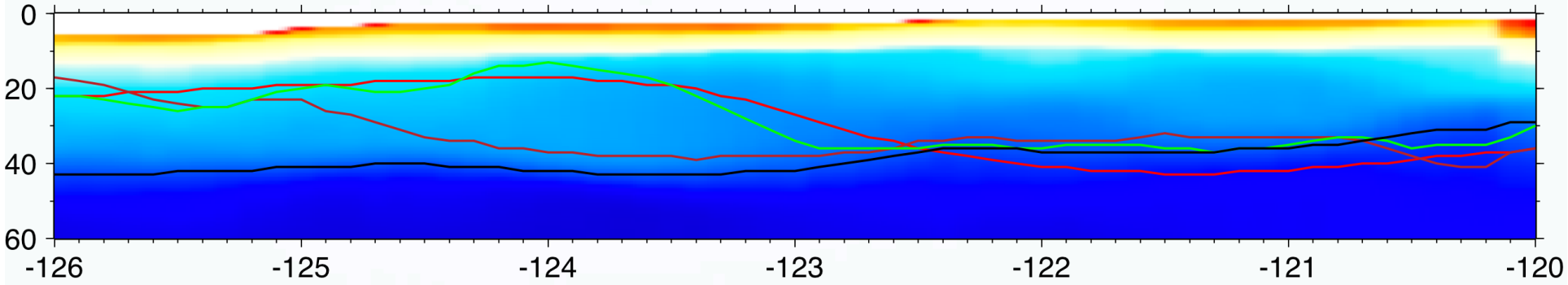


Crust 2.0 +/- 10km

Levander +/- 10km

Isosurface 3.9km/s

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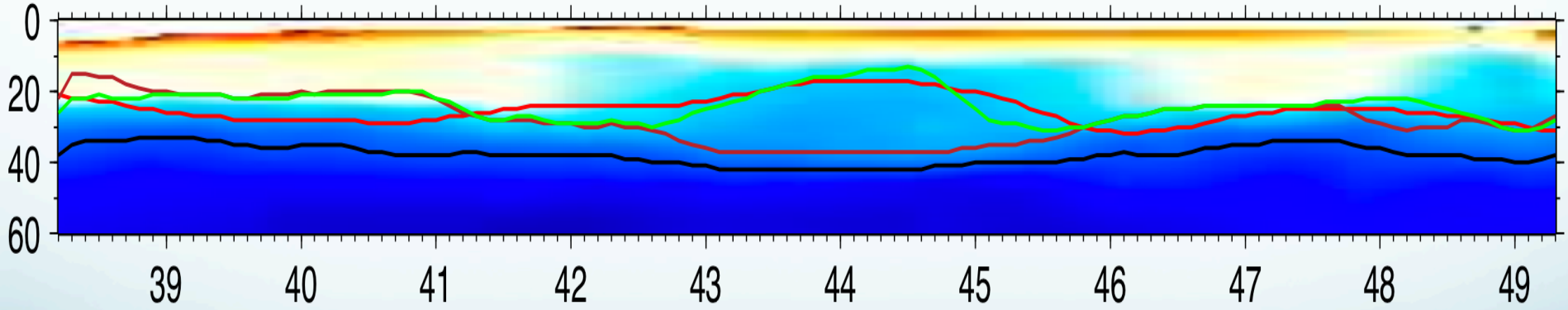
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