Imaging with the Generalized Radon Transform: a review of the theory and applications (to subduction zones)

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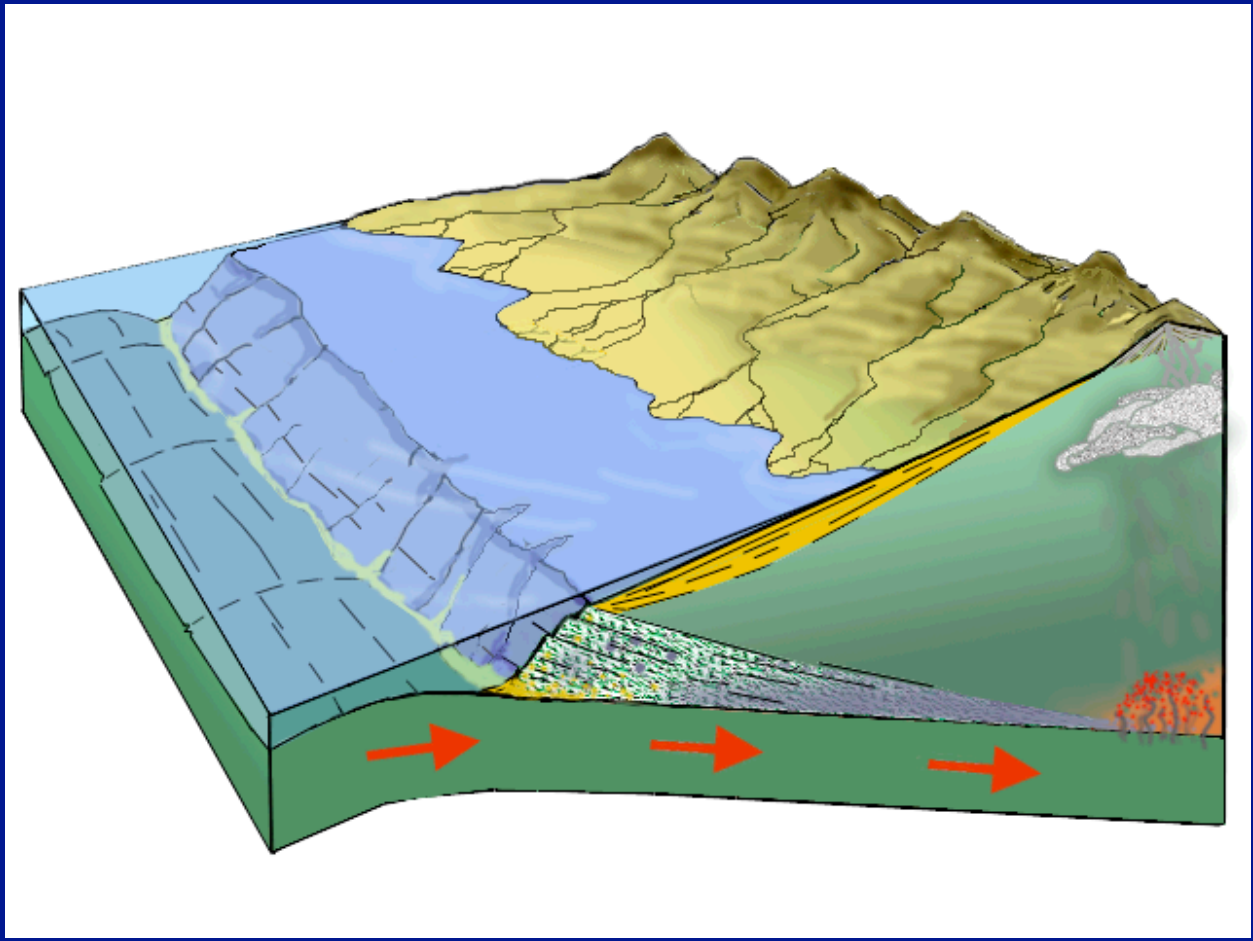
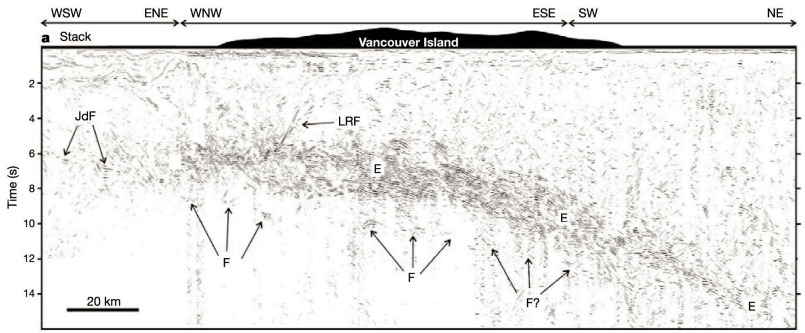
Subduction zone



T. Atwater & J. Iwerks (http://animations.geol.ucsb.edu)

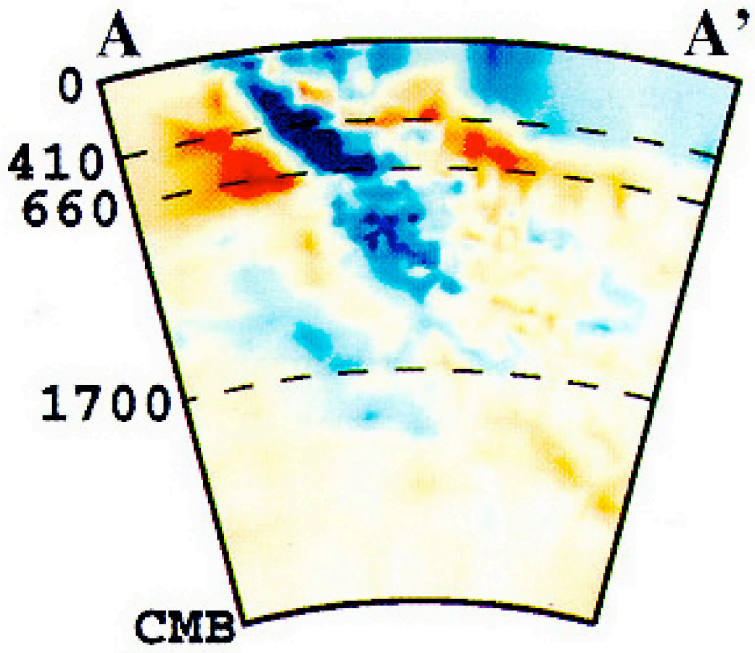
Seismic images of subduction zones

local



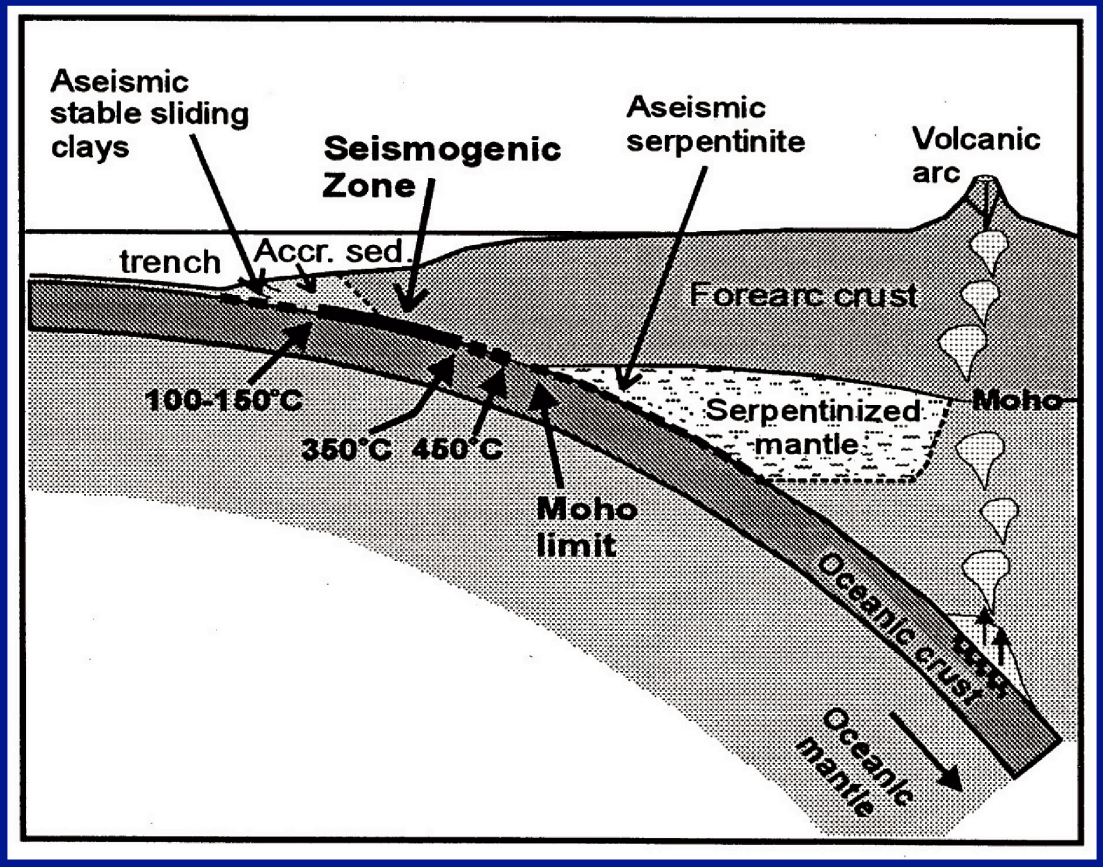
Calvert, 2004

global



Karason & van der Hilst, 2000

Need for high-resolution images at regional scale



Oleskevich, Hyndman and Wang, 1999

outline

- method: 2D GRT inversion
- application to the Alaska subduction zone
- other successful applications
- outlook

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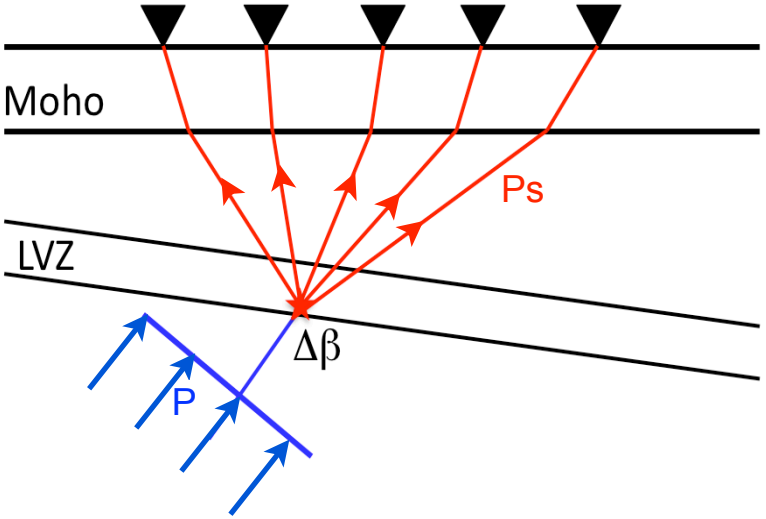
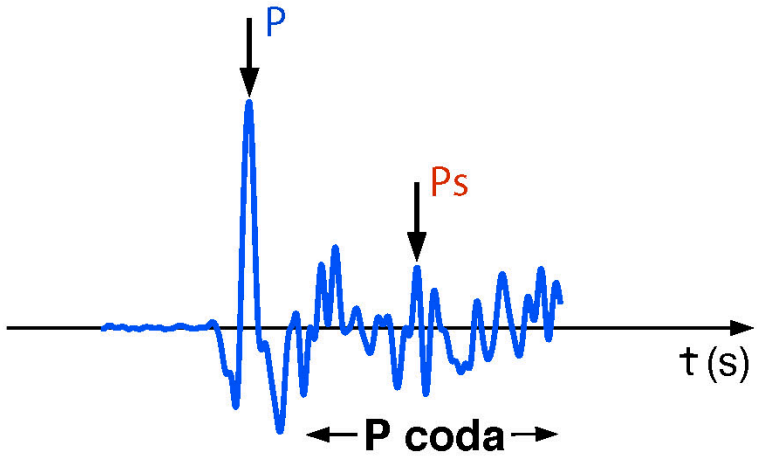
The input data: teleseismic scattered waves

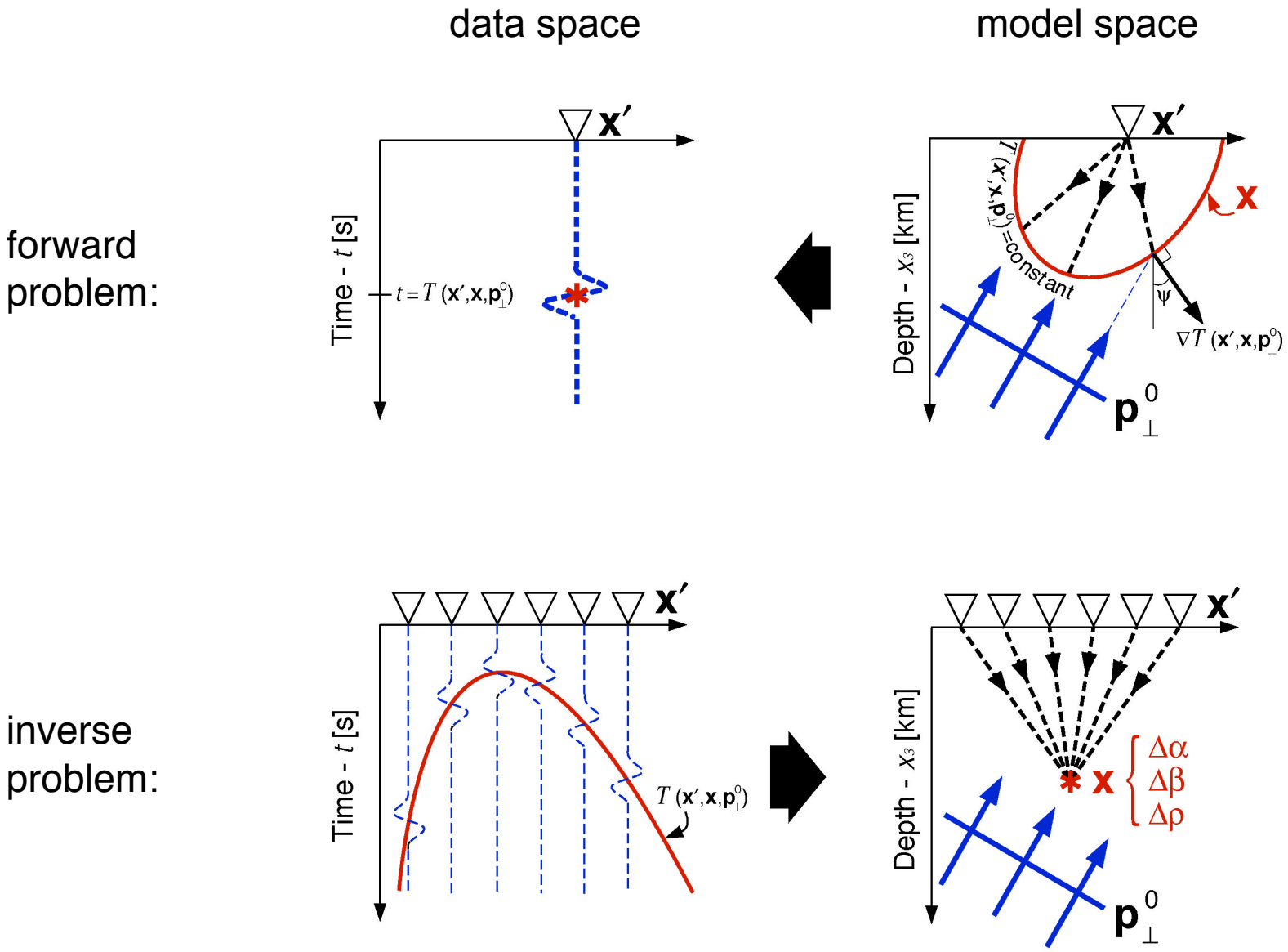
model:



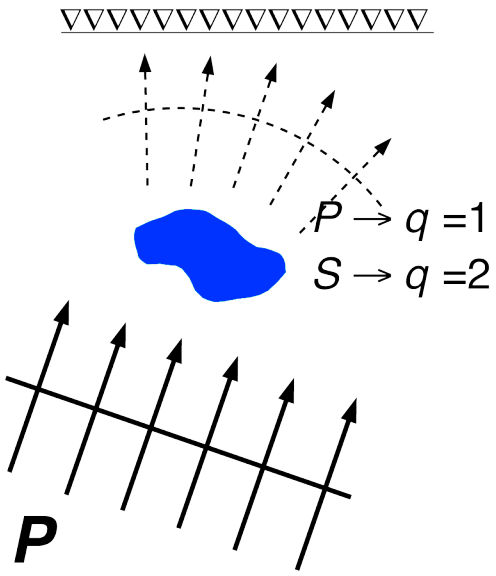
data:

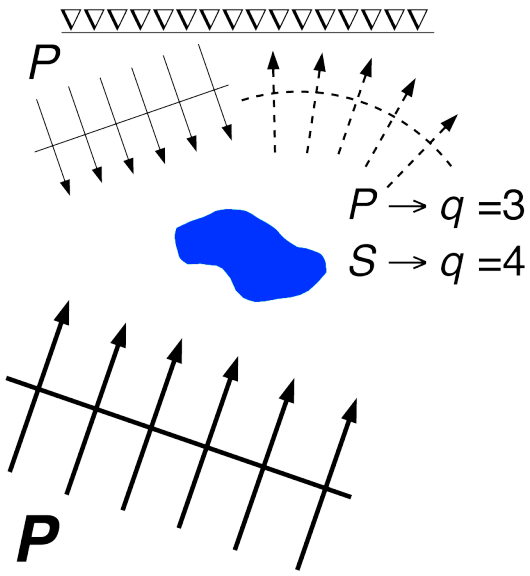


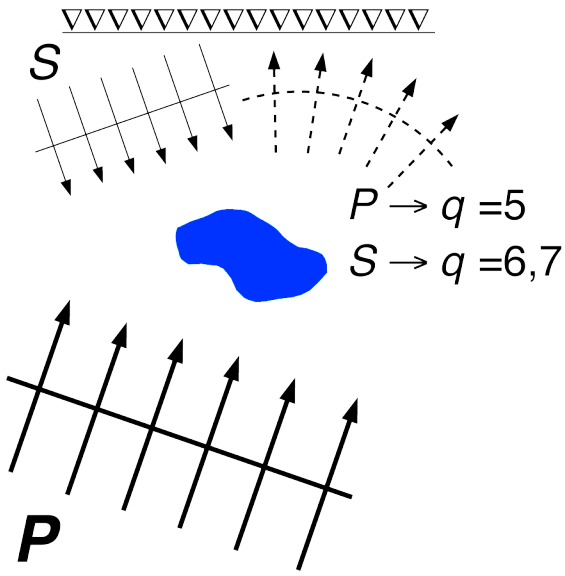
2-D Generalized Radon Transform (GRT) inversion



Forward and back-scattered modes







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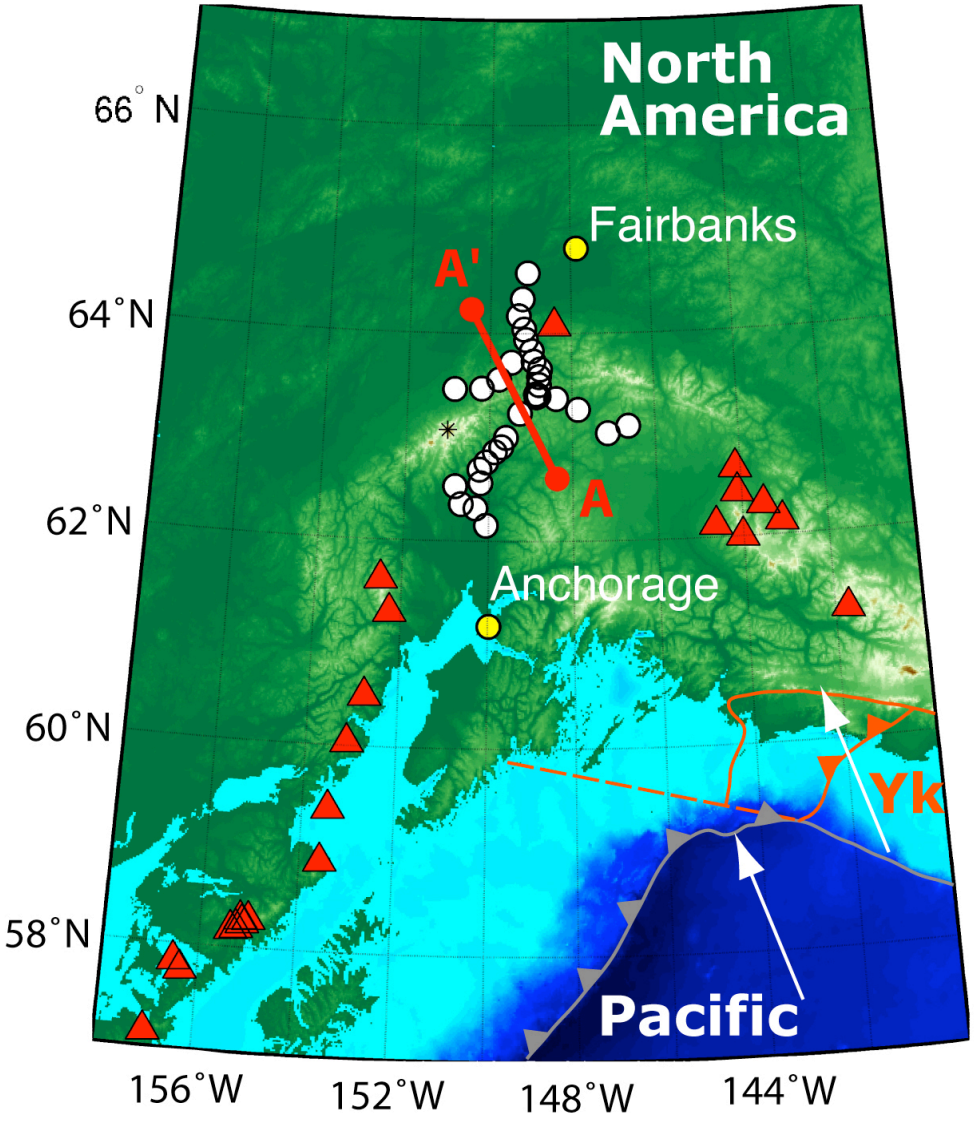
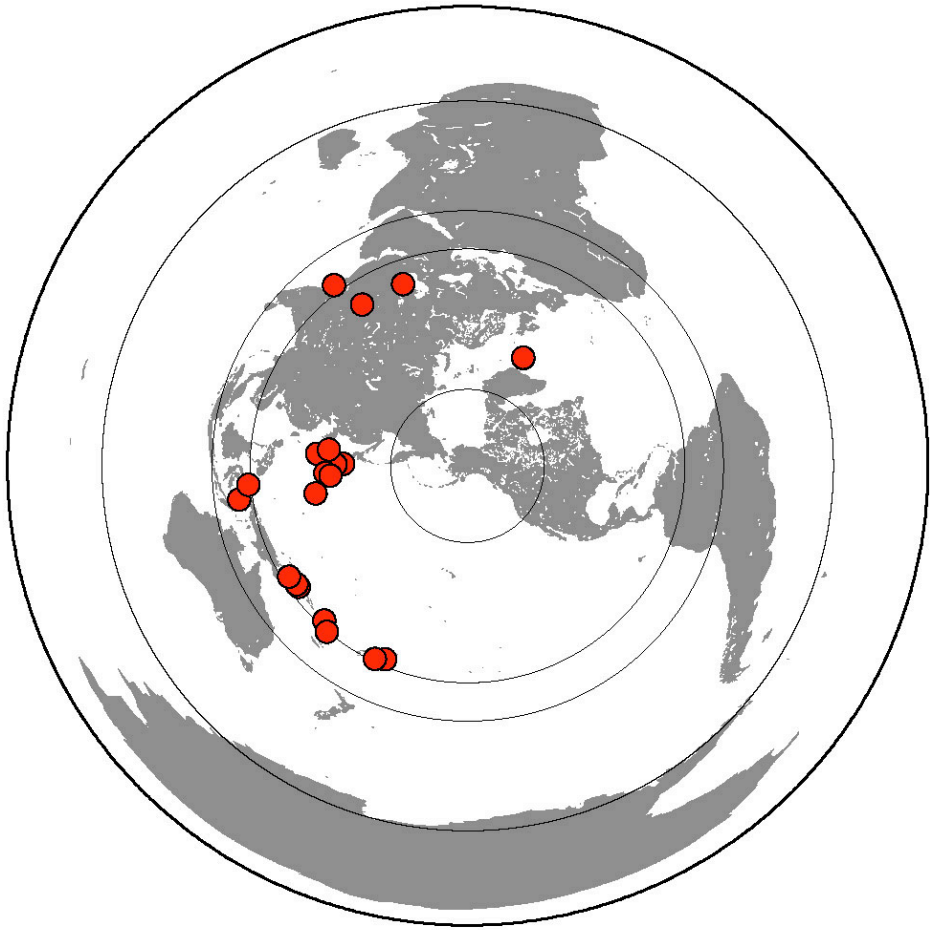
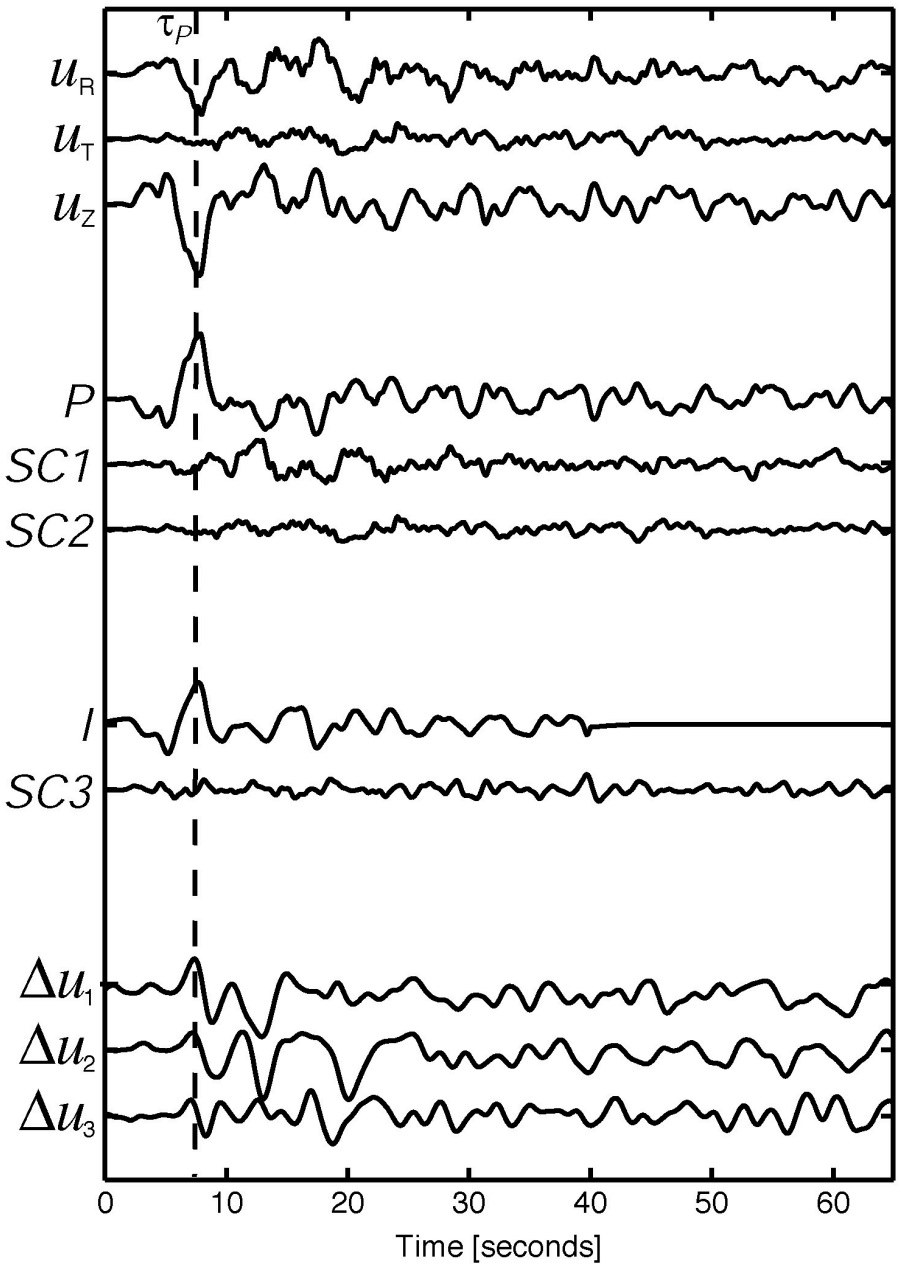
Alaska subduction zone



data selection and preprocessing



Data preprocessing



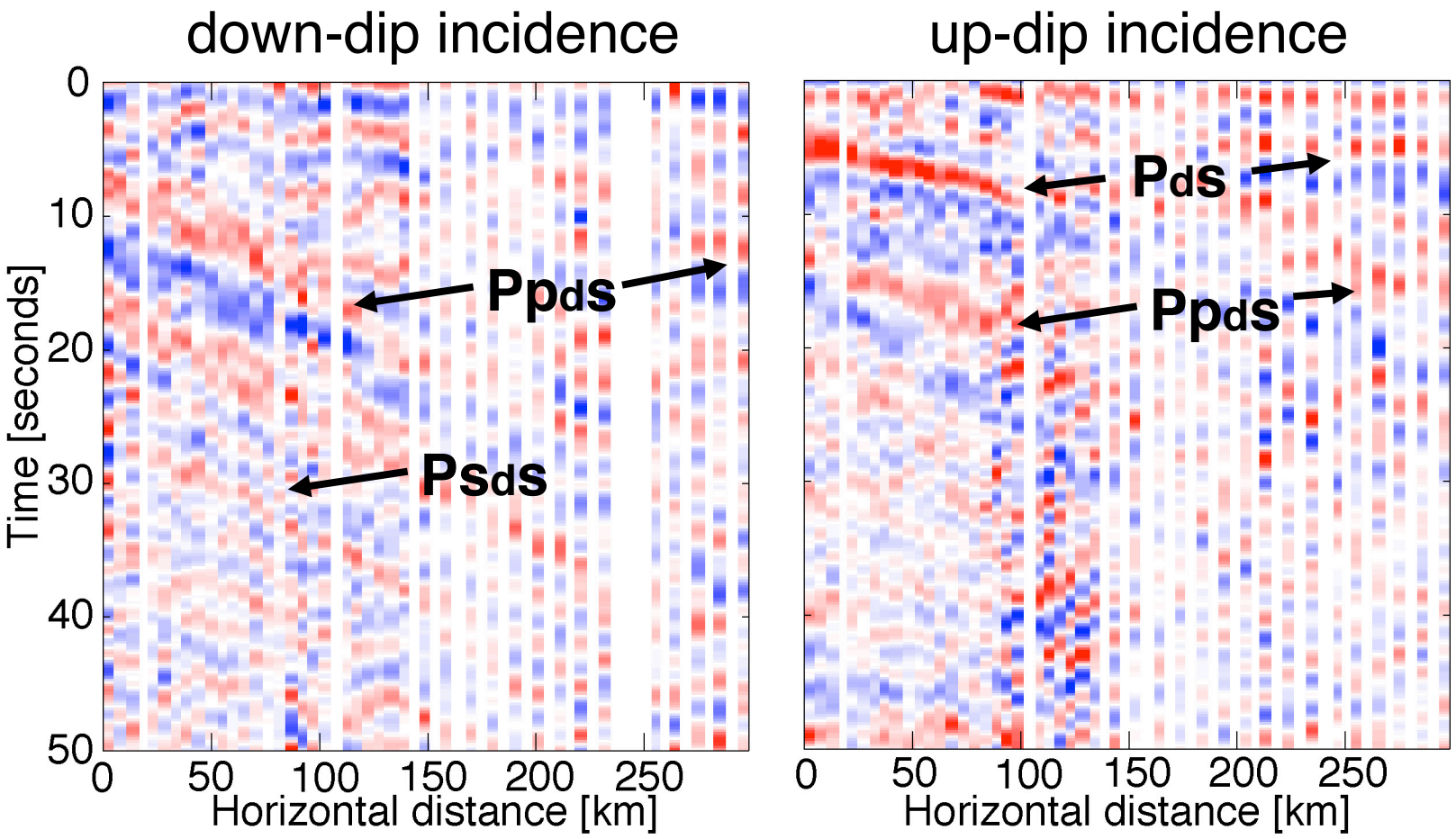
radial
transverse
vertical

free-surface
transfer matrix

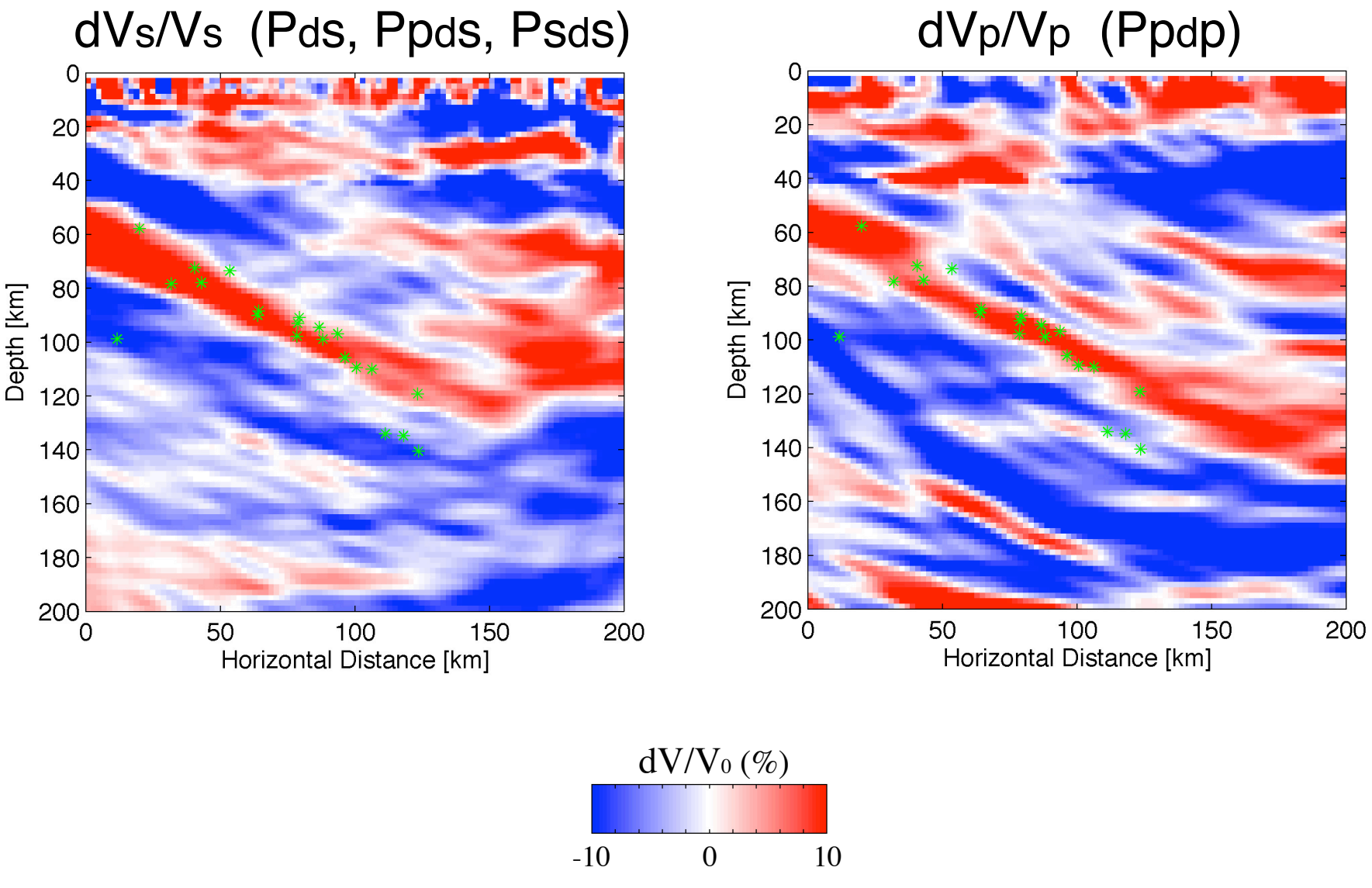
eigenimage
decomposition

scattered wavefield

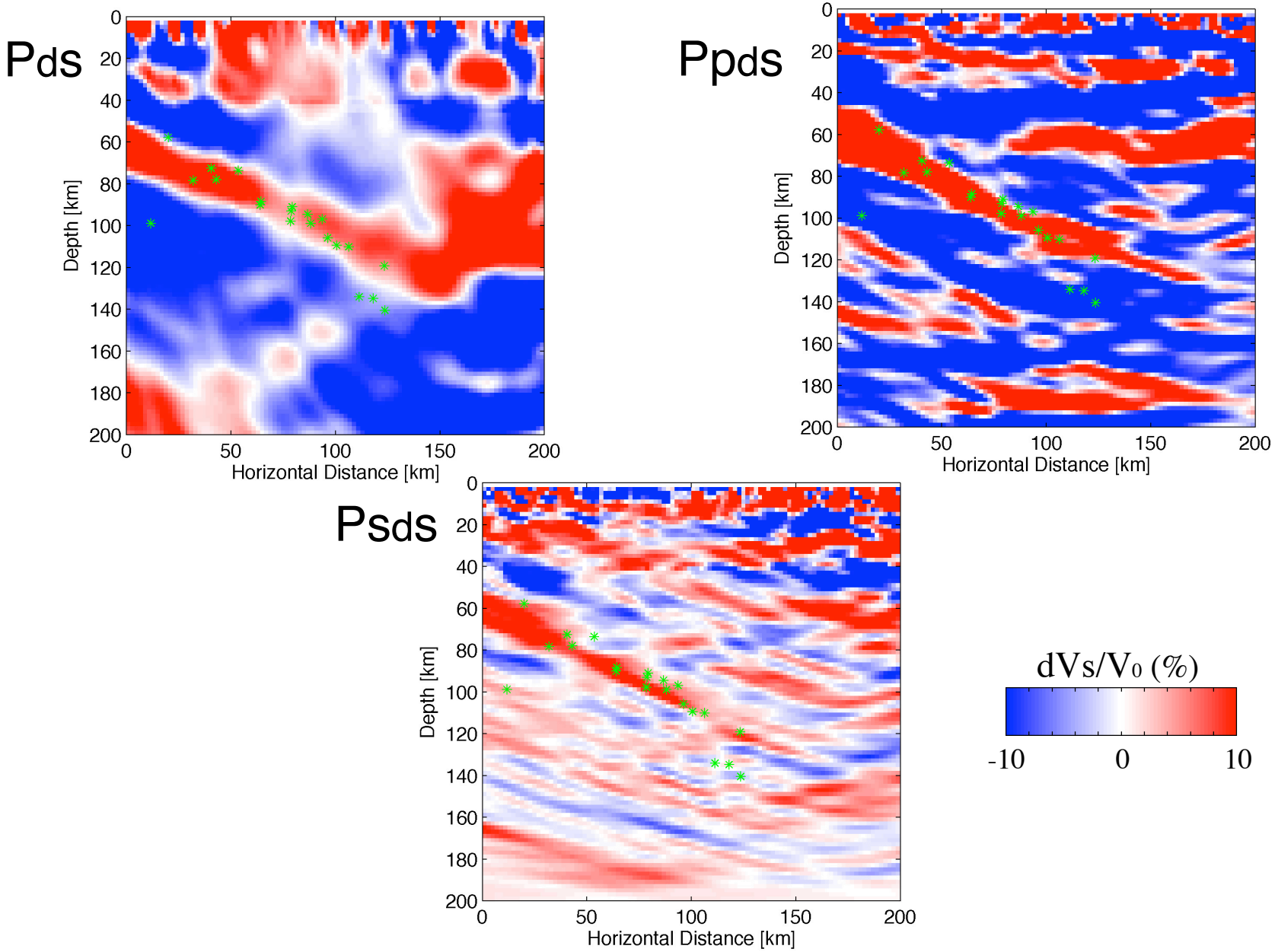
data


down-dip incidence
up-dip incidence
Time [seconds]
0
10
20
30
40
50
0
50
100
150
200
250
Horizontal distance [km]
PpdS
PsdS
PdS
PpdS

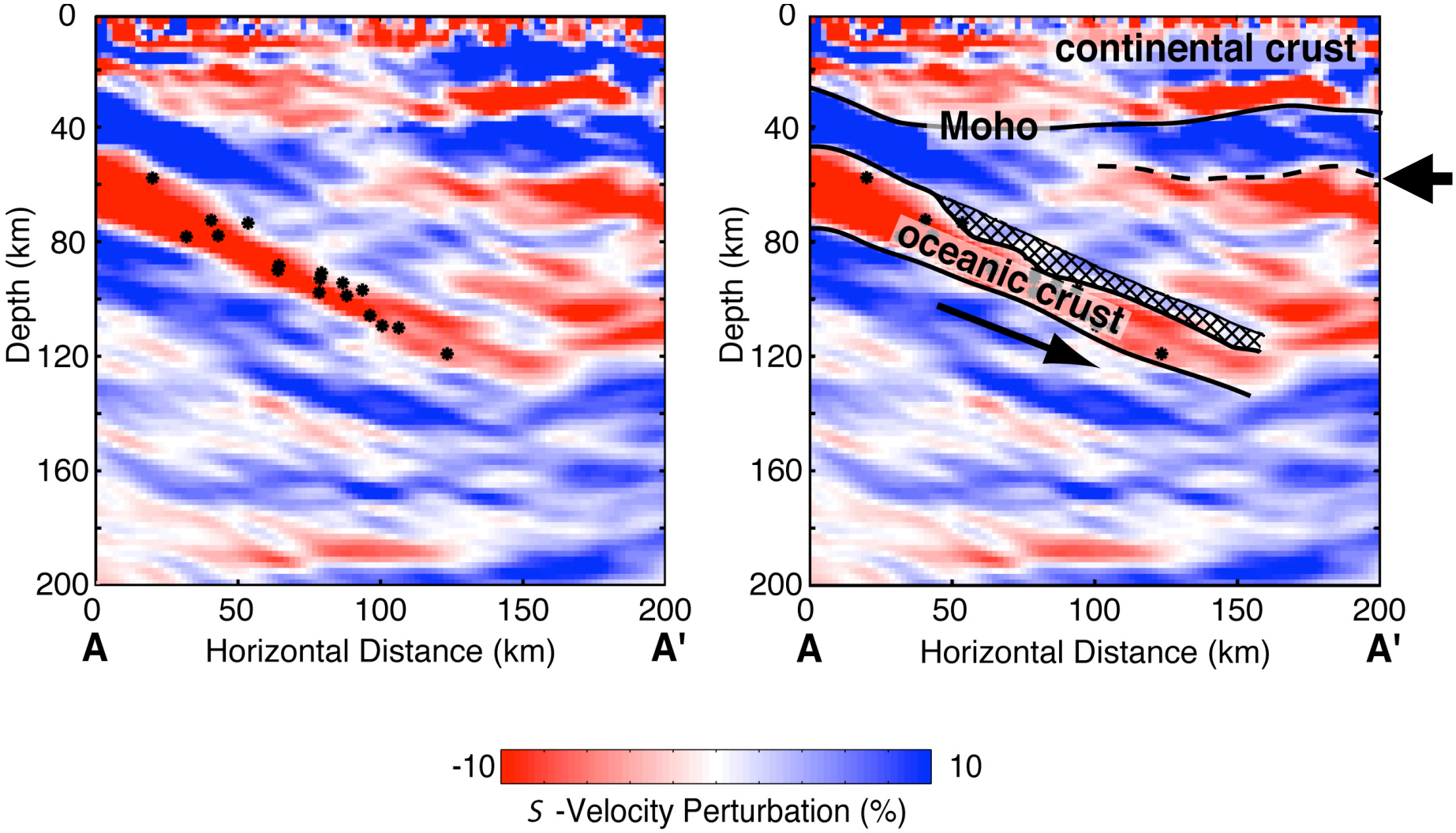
Composite images



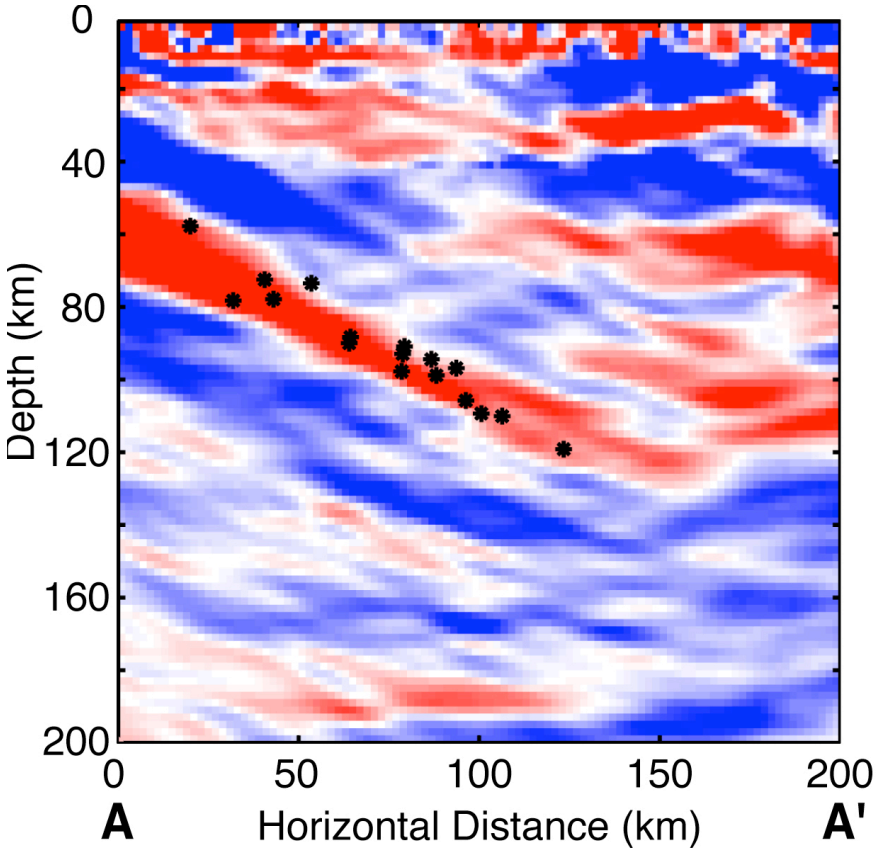
Individual scattering modes

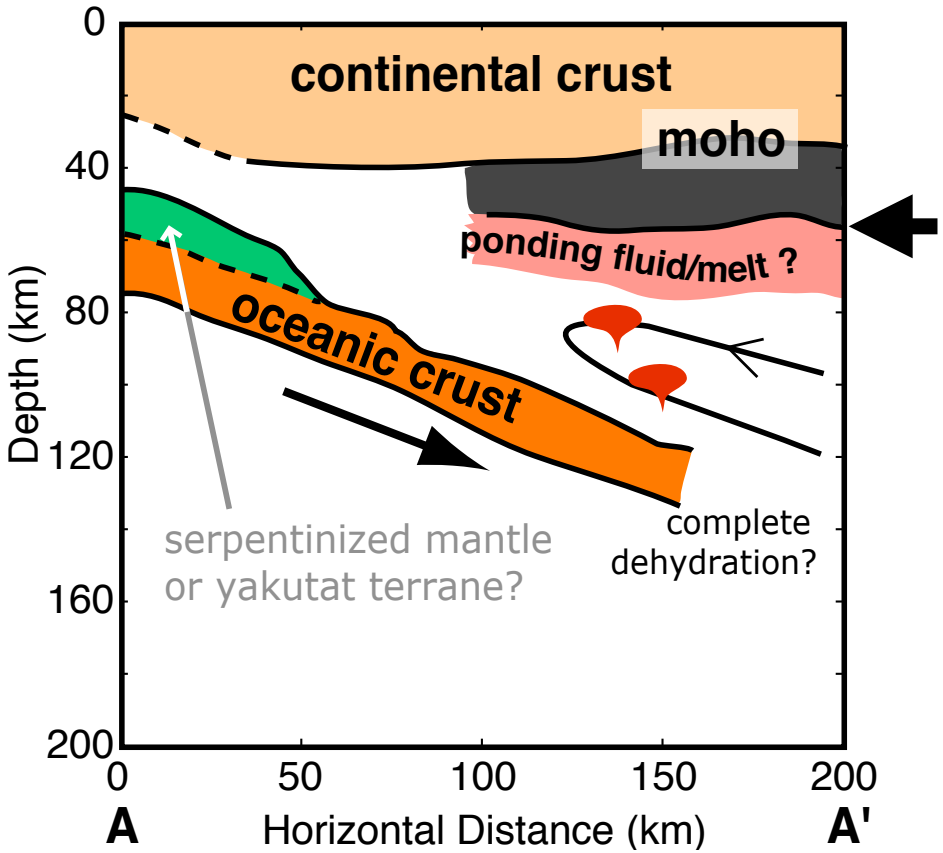


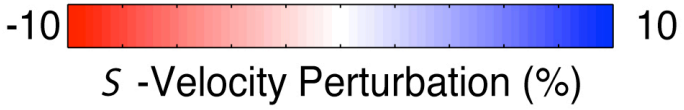
Interpretation of the dVs/Vs profile



Interpretation of the dVs/Vs profile







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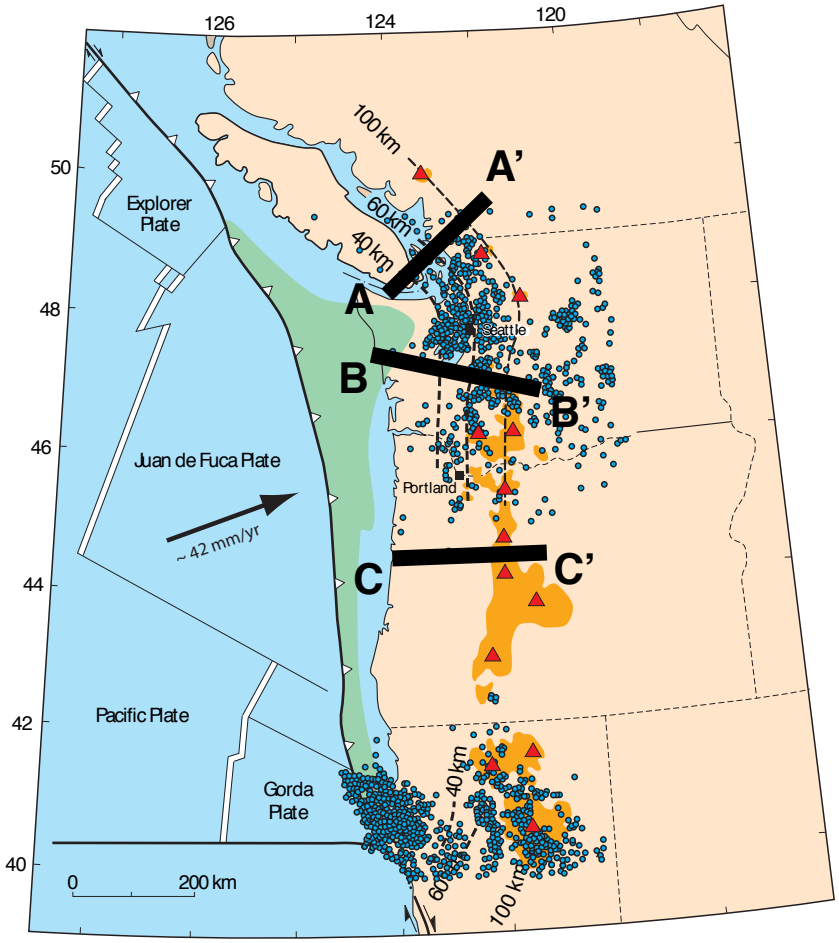
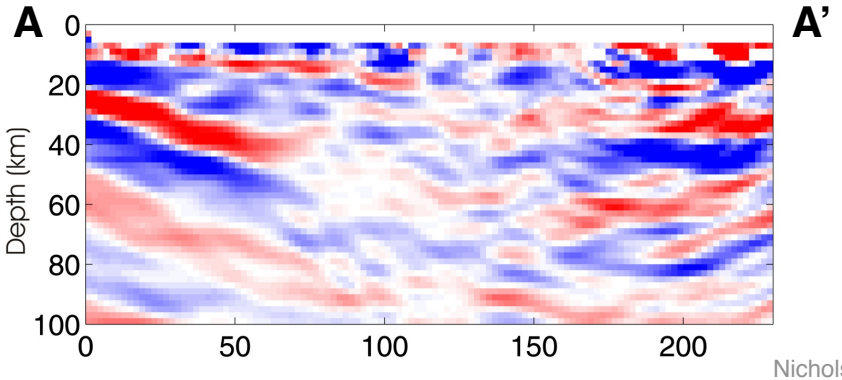
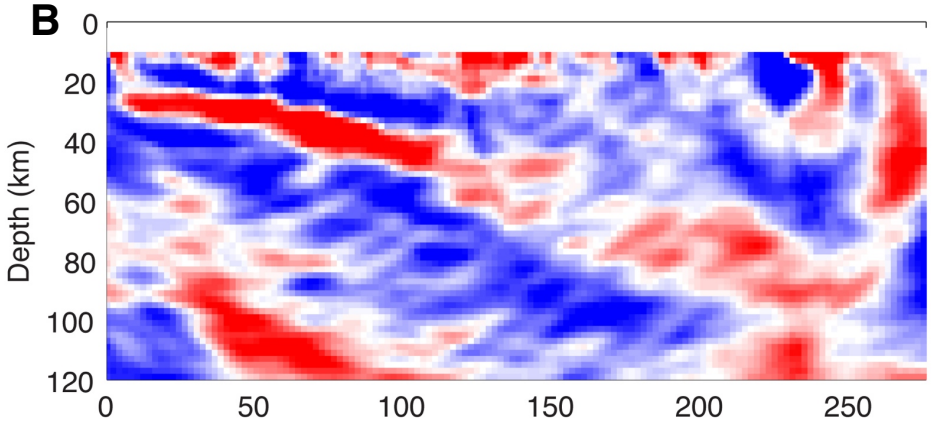
Cascadia



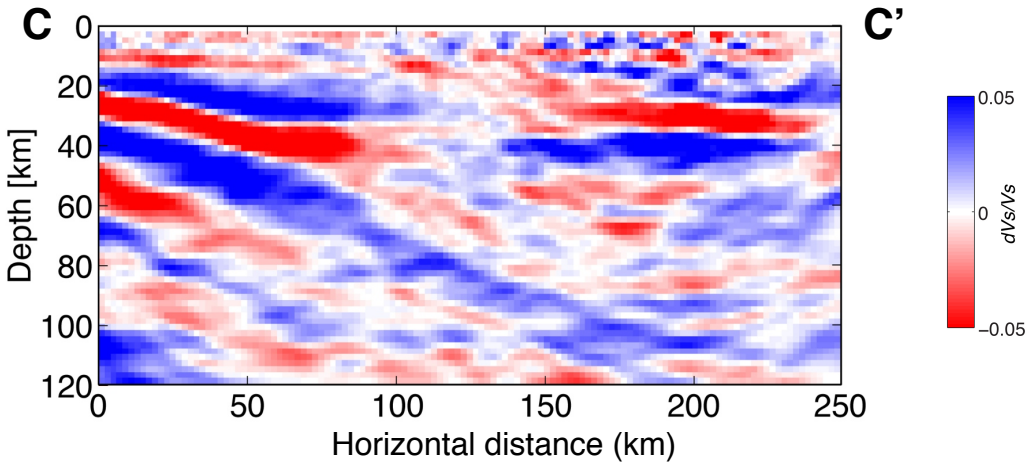
Romanyuk et al., 1998



Nicholson et al., 2005

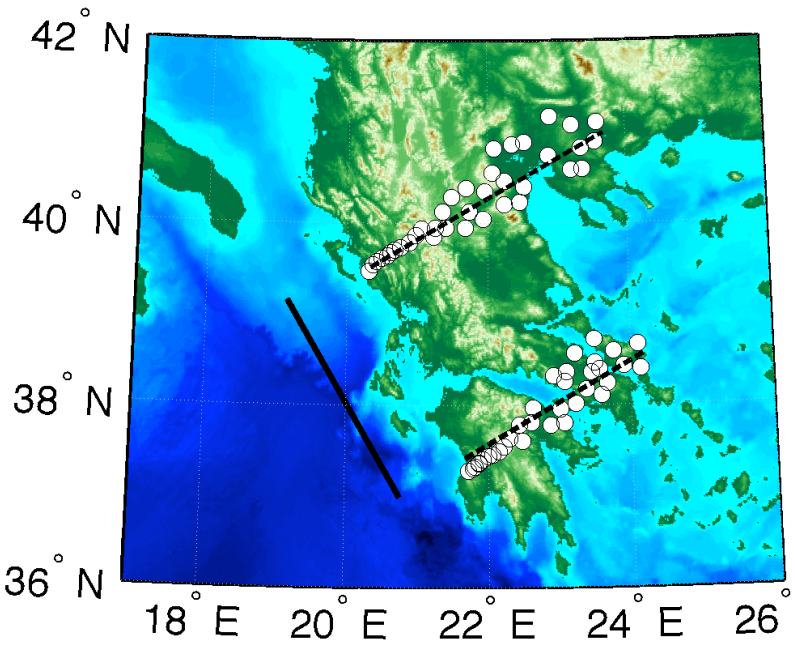


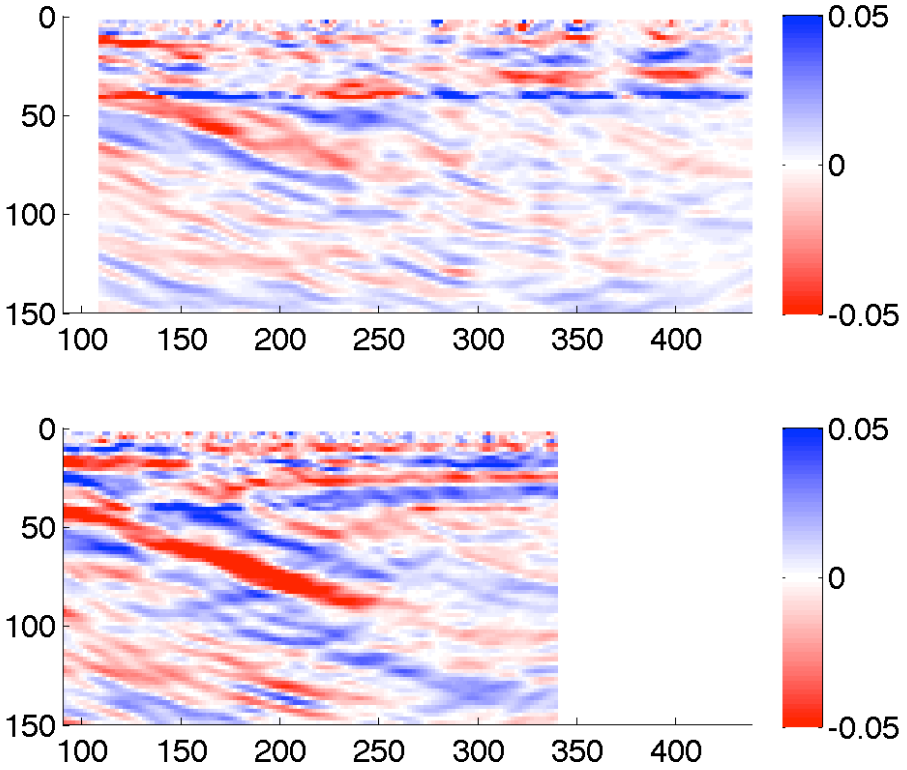
MacKenzie et al., 2008



Rondenay et al., 2001

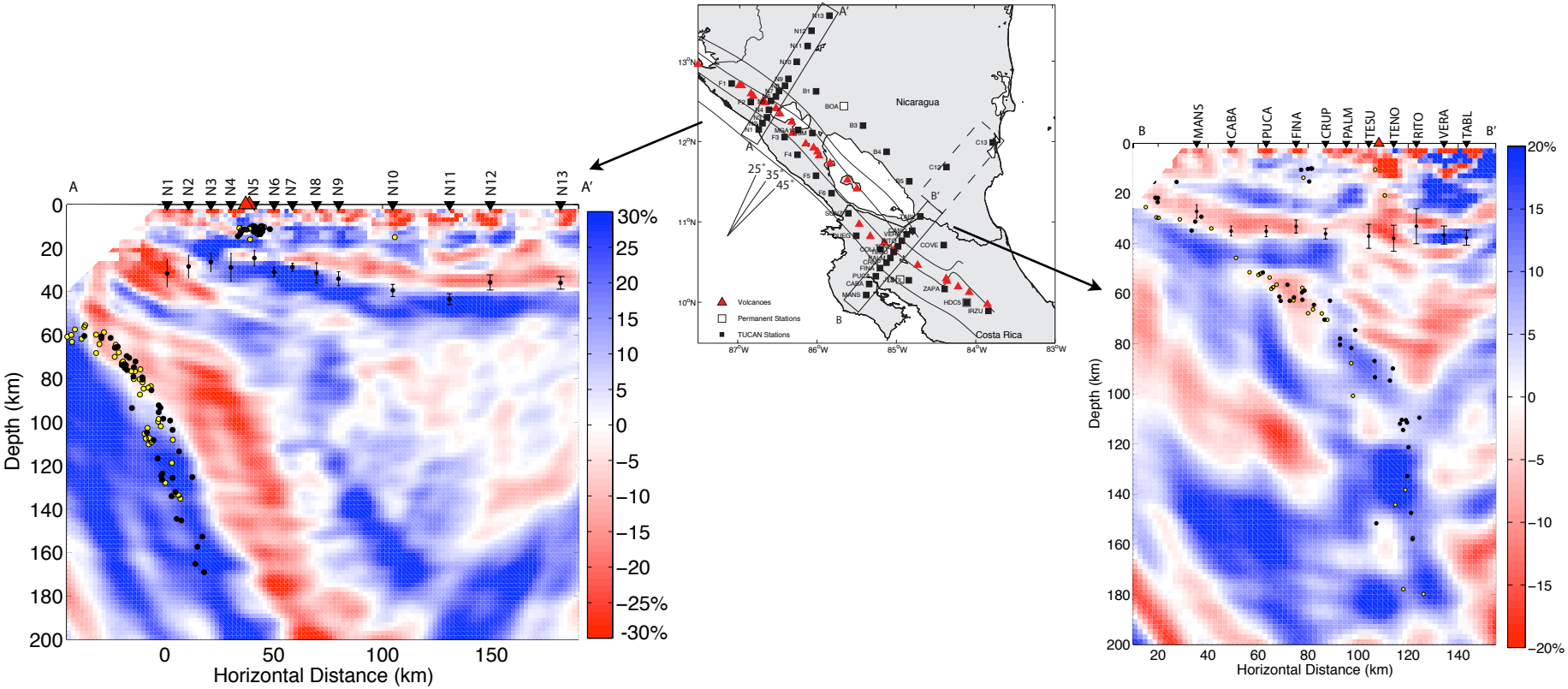
Hellenic subduction zone





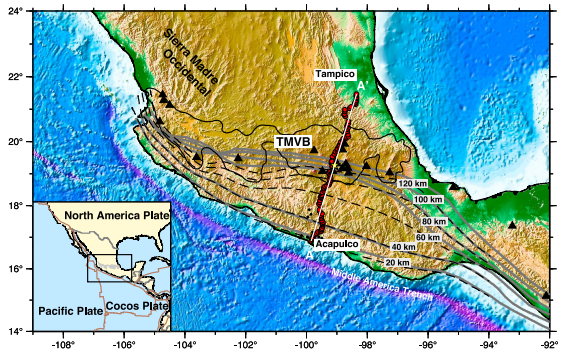
Pearce et al., JGR, 2012

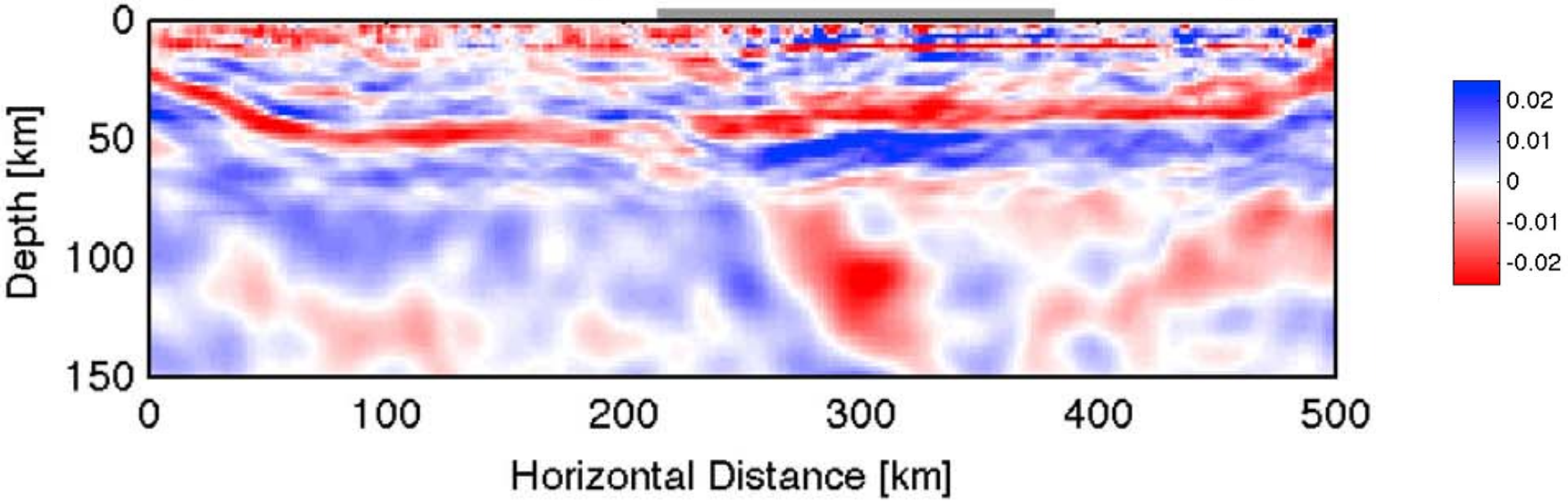
Central America



MacKenzie et al., 2010

Mexico





Kim et al., 2012

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- other less successful applications
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Outlook

- Generalize the problem: complex background medium, 3-D scattering, coda of other incident waves (e.g., S)

- Move toward methods that invert the full waveforms (see talk by Qinya Liu)

- Integrate complementary datasets: across branches of seismology (e.g., controlled seismic data + passive seismic data, local + teleseismic sources, interferometry), across disciplines of geophysics **(seismic and magnetotelluric data)**