Seismic anisotropy in subduction zones

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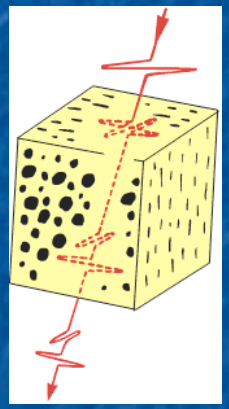
Approaches to determine seismic anisotropy

Shear wave splitting:

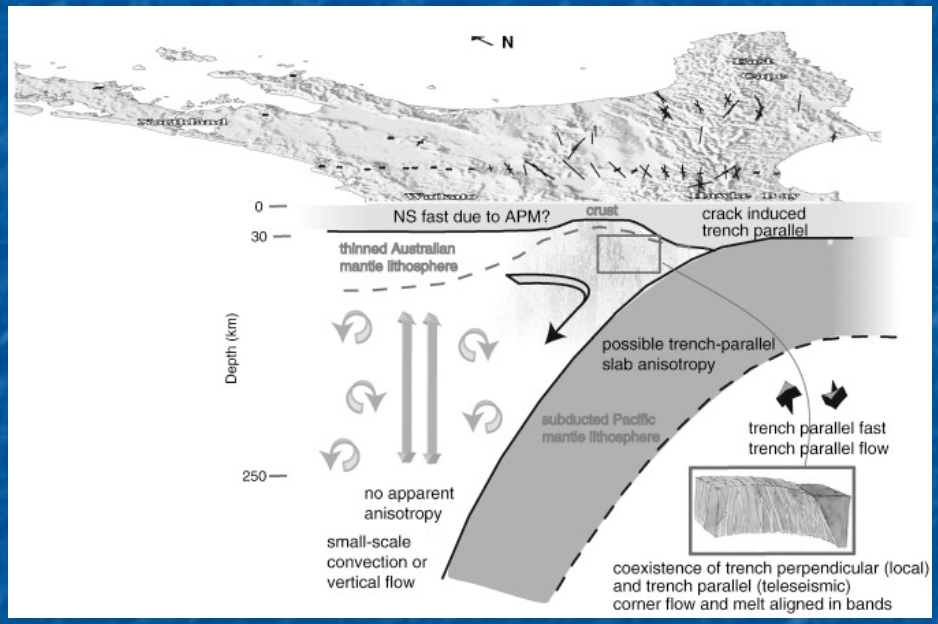


Surface waves:
Azimuthal variations of surface wave propagation

(Discrepancy between Love and Rayleigh waves: SH vs SV)

Anisotropic structure of North Island, New Zealand

PhD work of Sonja Greve:
Shear wave splitting measurements + interpretation



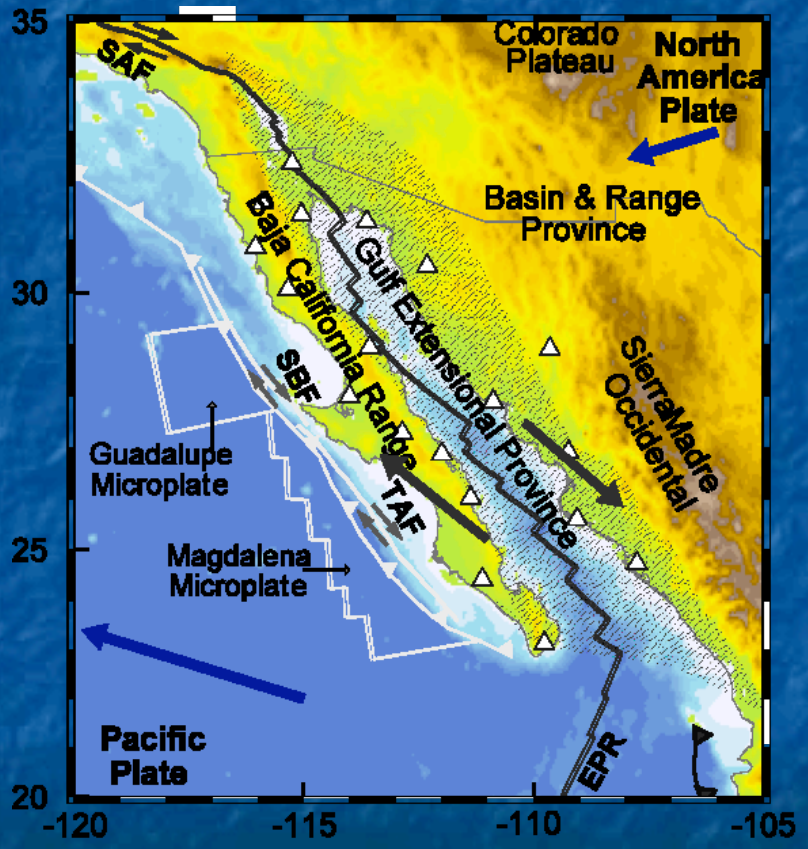
Greve et al., 2008

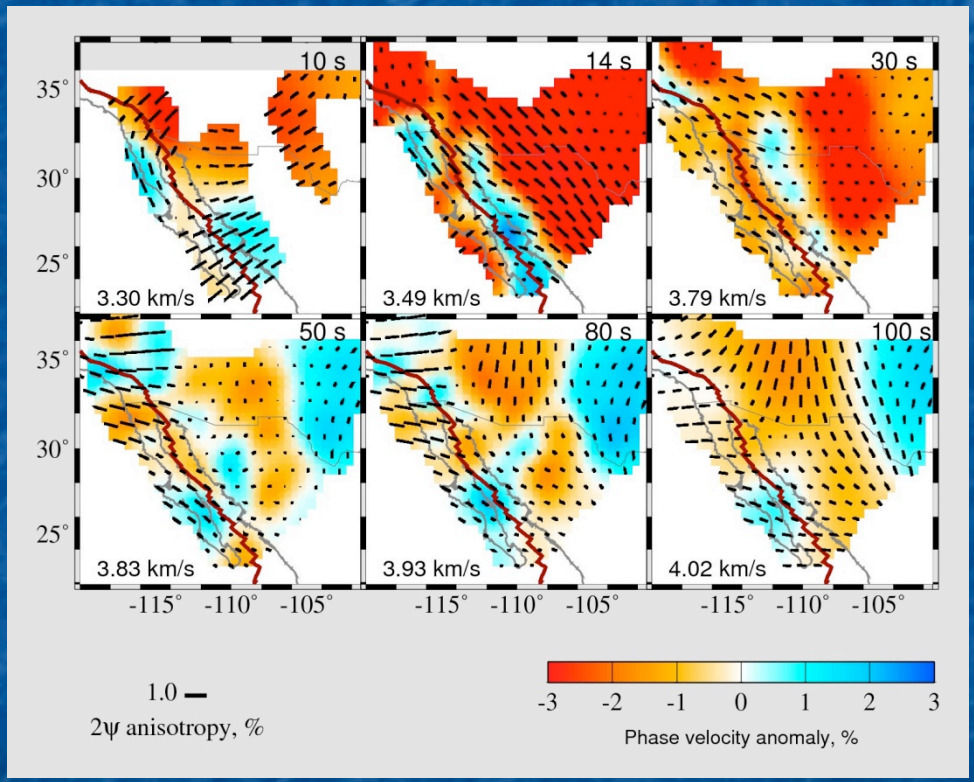
- Fore-arc:
  dt ≈ 2.5 s, trench parallel
  → trench parallel flow beneath slab
- Central Volcanic Region:
  dt ≤ 4.5 s(!), trench parallel
  → melt segregation in wedge
- Back-arc:
  no apparent splitting
  → small scale mantle convection

See Sonja's poster!

Structure of Gulf of California, Mexico

PhD work of Xiaomei Zhang

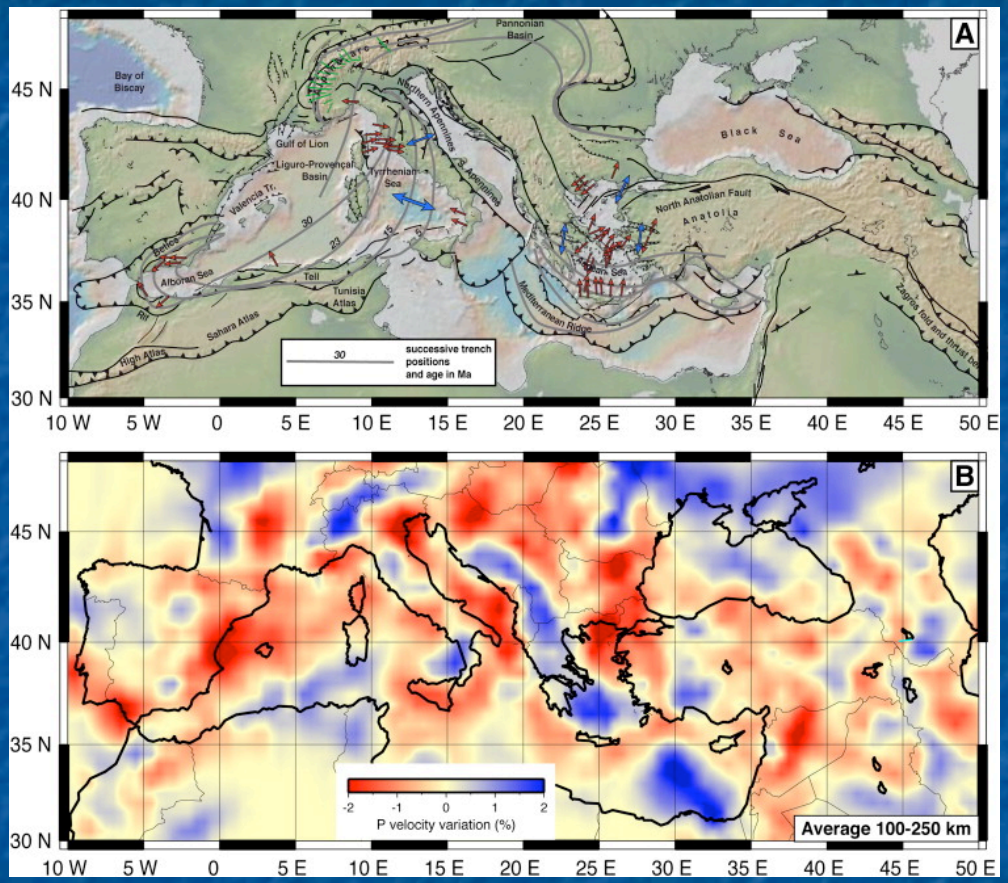




Zhang et al., 2009

Depth dependence of anisotropy

Mediterranean: Tyrrhenian Sea



Jolivet et al., 2009

Rollback and trench migration since 30 Ma

→

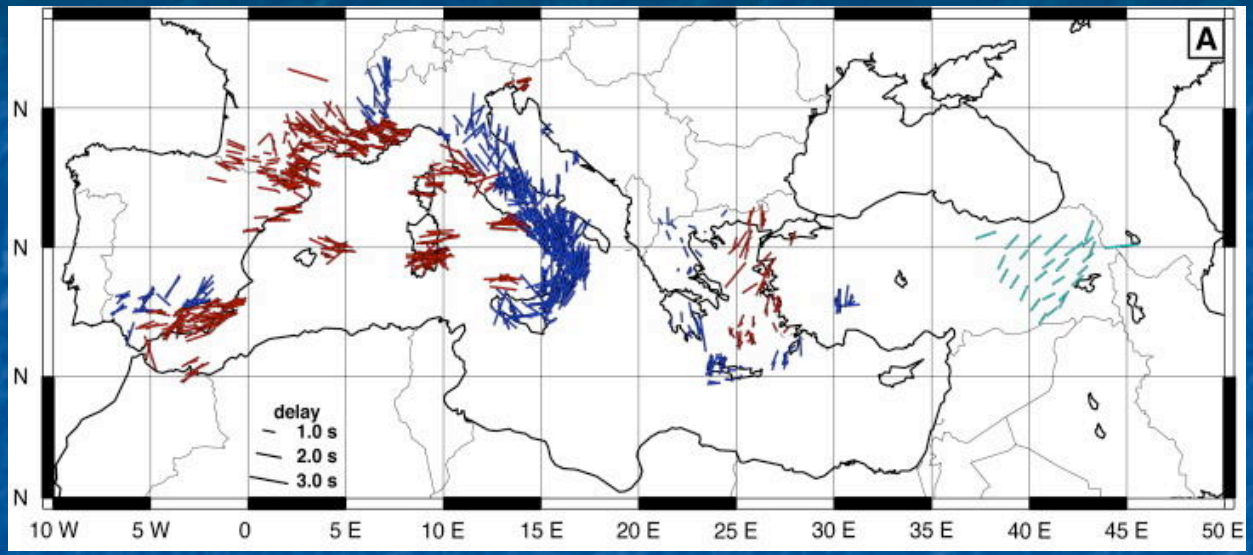
Extension in back-arc region

→

Formation Tyrrhenian basin (slab detachment, rotation)

Mantle flow?

Tyrrhenian Sea: SKS splitting



Jolivet et al., 2009

Agreement between:
- SKS splitting measurements
- Crustal stretching directions from metamorphic rocks

→ Crustal deformation under control of mantle flow:
EW stretching in Tyrrhenian Sea

But: No SKS splitting measurements in Tyrrhenian Sea.

What about depth dependence of mantle flow and lateral variations?

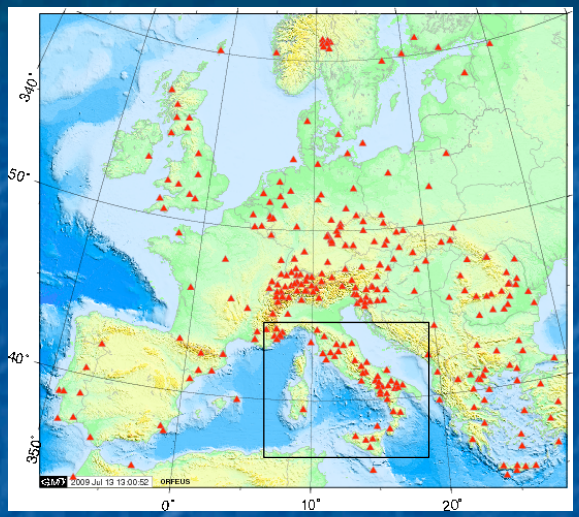
Anisotropy in Tyrrhenian Sea (project ER1)

Aim:
Lateral and depth dependence of seismic anisotropy in Tyrrhenian Sea

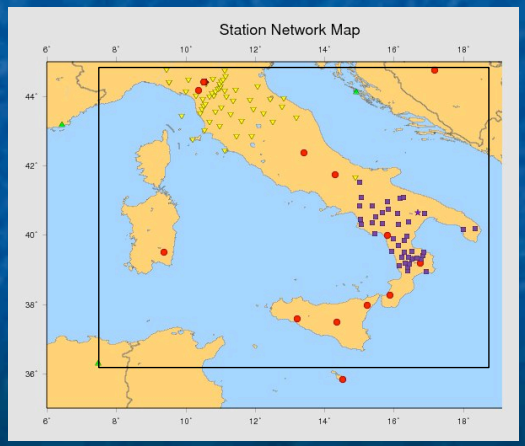
How:
- Interstation surface wave measurements (data from temporary + permanent networks)
- Surface wave tomography
- Inversion for anisotropic shear velocity structure

- Combine surface wave and SKS splitting data

→ Geodynamic interpretation in terms of mantle flow



ORFEUS: permanent stations 2009



IRIS: 2 temporary networks 2004-2006