The Active North Ligurian Domain: New geophysical Insight from the SEFASILS Cruise

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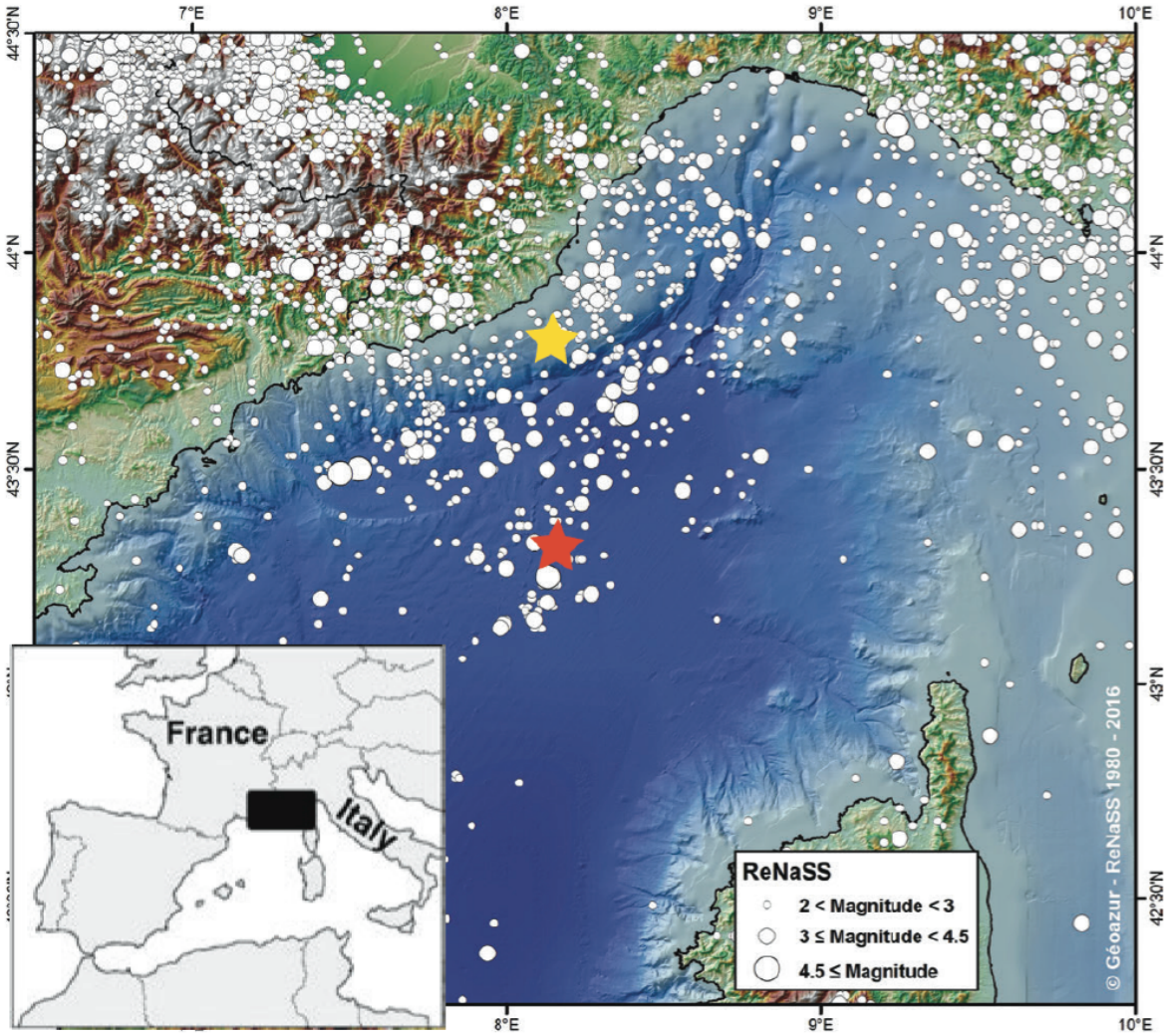
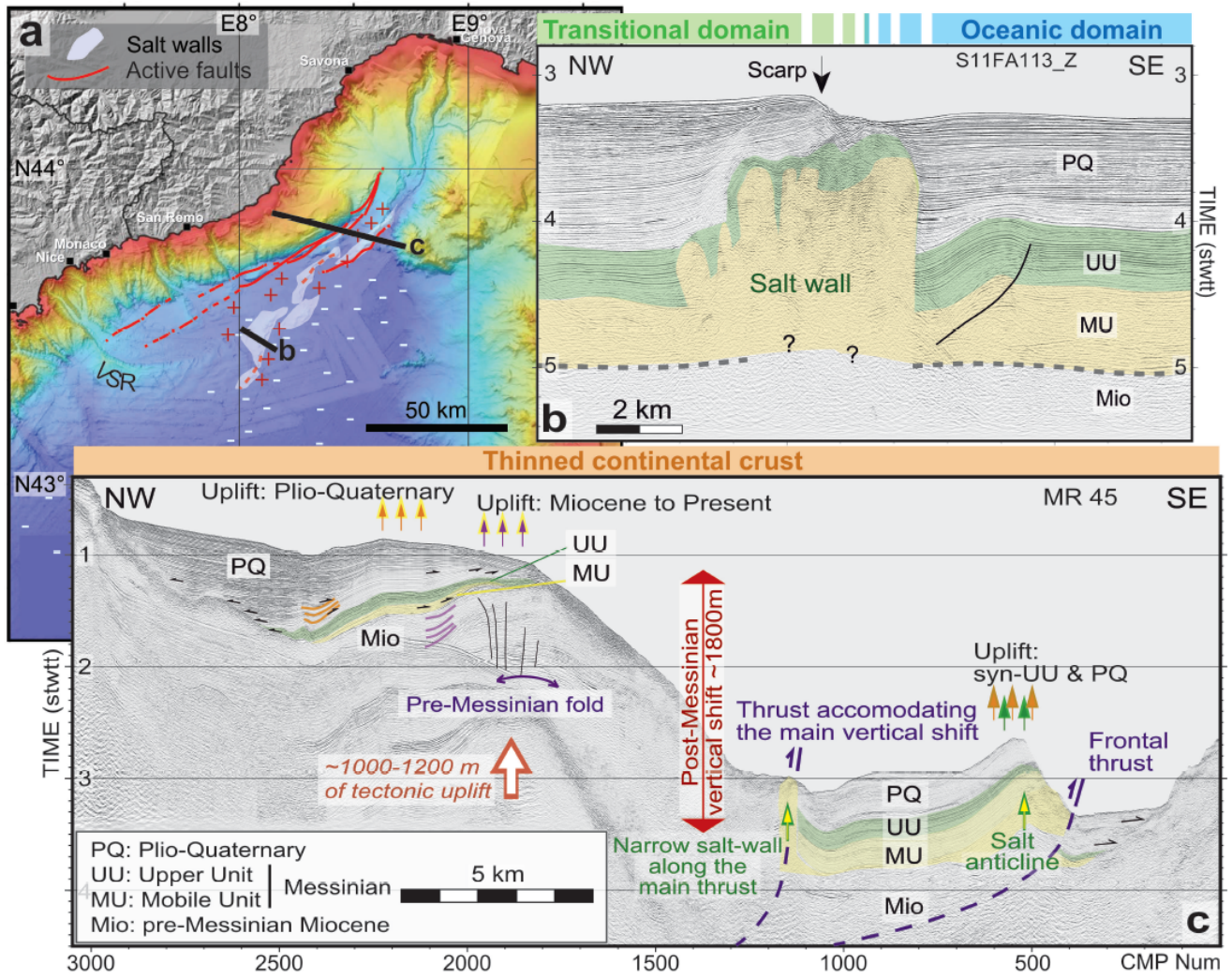
The Active North Ligurian Margin



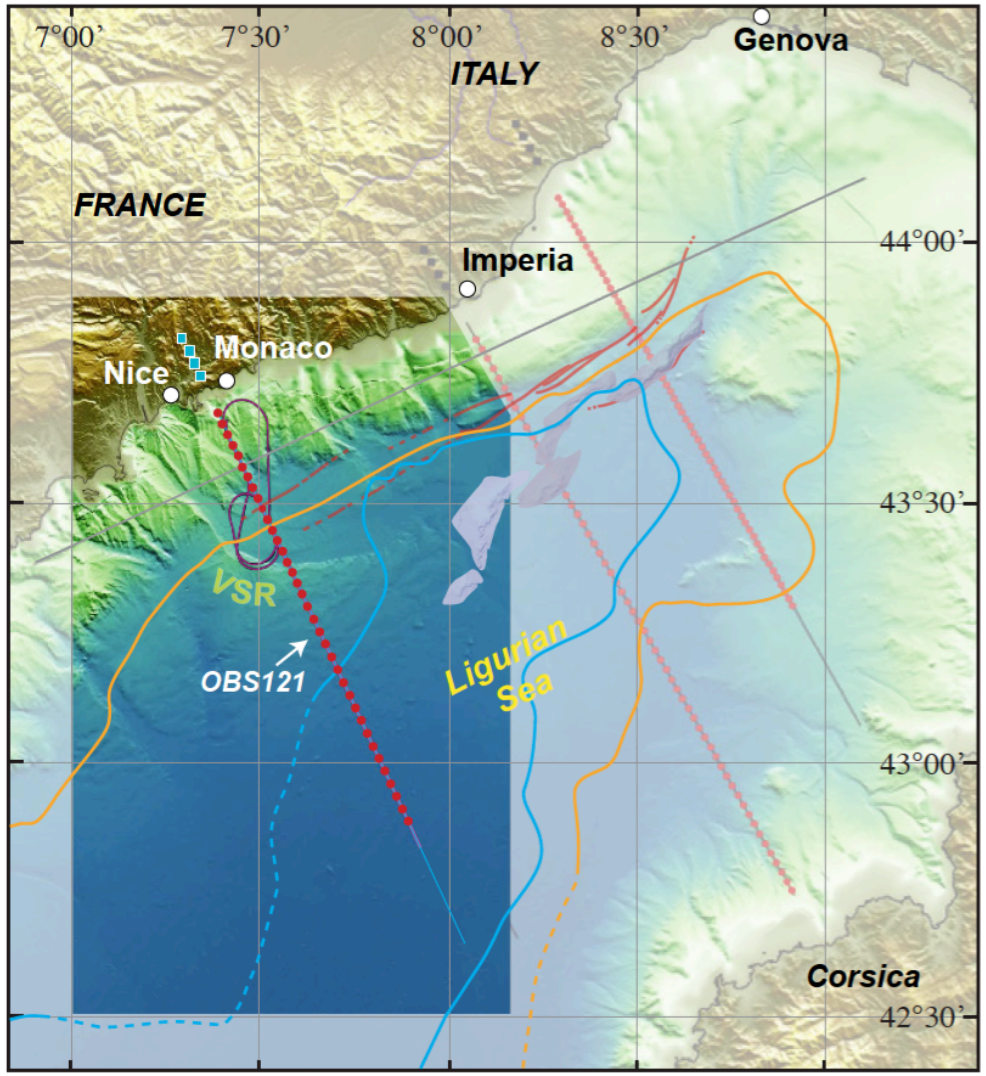
- Notable seismicity
- Seemingly diffuse but with some hints of alignments
- The toe of the margin is underlined, as is an oblique direction trending NE-SW
- Historical events include 1887, Mw 6.6-6.9 Ligurian earthquake (offshore Imperia, Larroque et al., 2012) and 1960 Ml 6.0 event (farther in the basin, Réhault et al., 1984)
- Focal mechanisms essentially compressive
- Geodetic motions barely indicate horizontal motion (< 1 mm/yr convergence between Corsica an Po plain, Larroque et al., 2009)

The Active North Ligurian Margin

- Uplift of the margin pronounced offshore Imperia (1887 epicentral area) – visible in morphology
- Offset of Messinian stratigraphic markers attest to more than 1 km uplift (Larroque et al., 2010) → Margin inversion underway
- Fault lineaments identified at the margin's toe, all the way to Nice area
- Suspected overprint of salt and deep seated tectonics in the basin – anomalous salt wall ~coincident with offshore seismicity alignment (Sage et al., 2018)



The SEFASILS Active Seismic Experiment



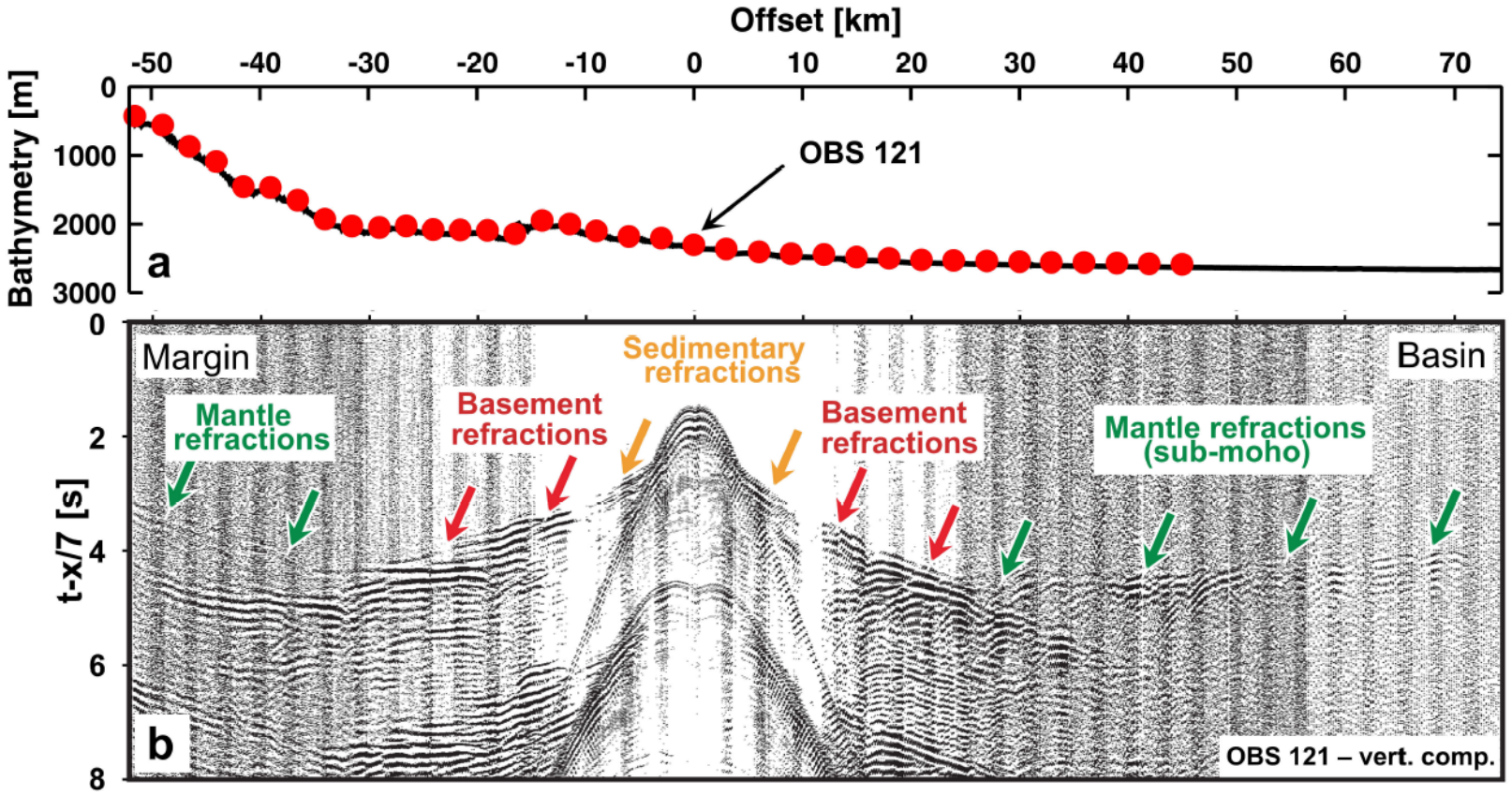
- Main seismogenic faults within the basin yet to be imaged
- Challenging target due to steep bathymetry, thick sedimentary cover, screening salt units
- No deep seismic reflection acquisition over the last 25 years (and little refraction acquisitions)
- Need for fresh geophysical insight → SEFASILS cruise
- Cruise had to be split into 2 legs due to issues with permits for Italian waters – 1st leg has been acquired to date
- Environmental issues for leg 2…

The SEFASILS Active Seismic Experiment

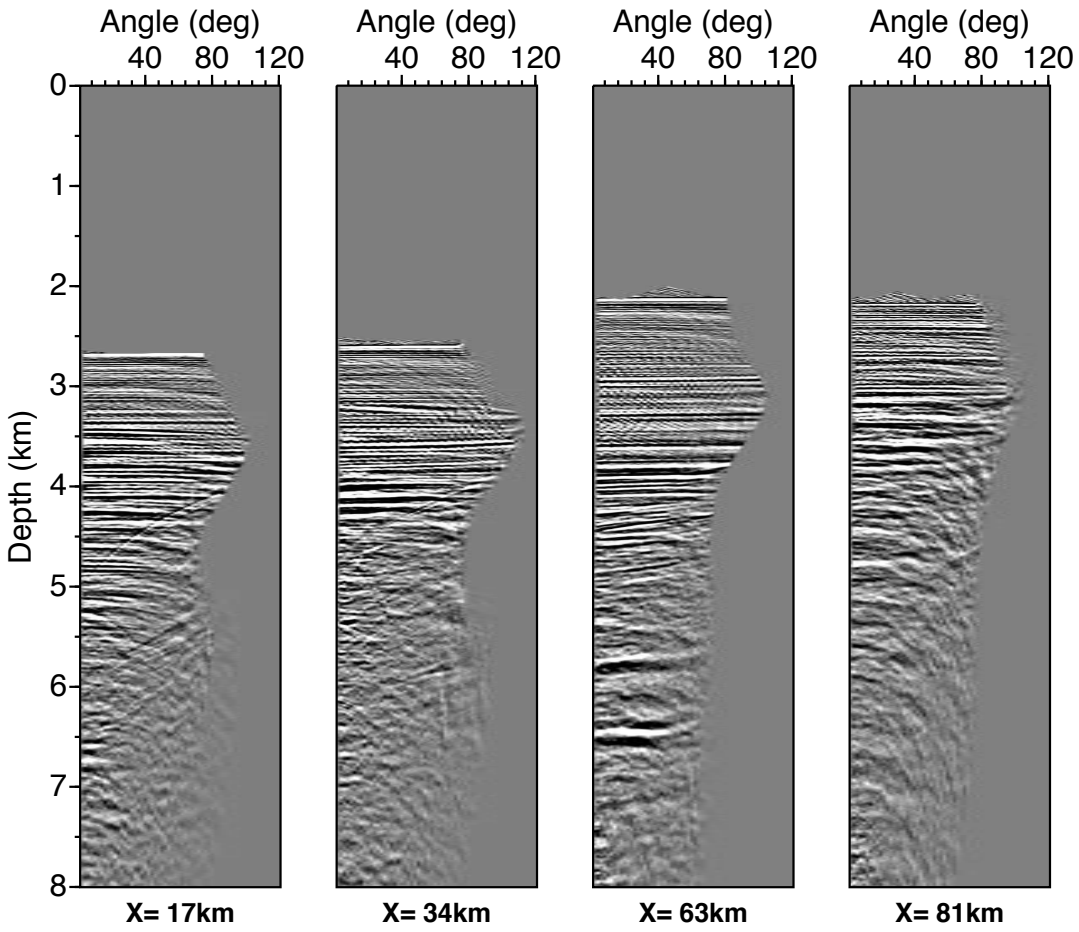
- Novembre 2018
- One transverse profile across margin and basin
- 36 OBSs for refraction experiment (2 to 2.5 km spacing) – 2 intercalated shot passes to avoid wraparound noise
- 2 MCS passes with refraction and reflection source tunings (SEFA13/SEFA14)
- 4990/2570 in^3, 27/45 Hz dominant freq. for refraction/reflection sources

SEFASILS Acquisitions – Refraction Data

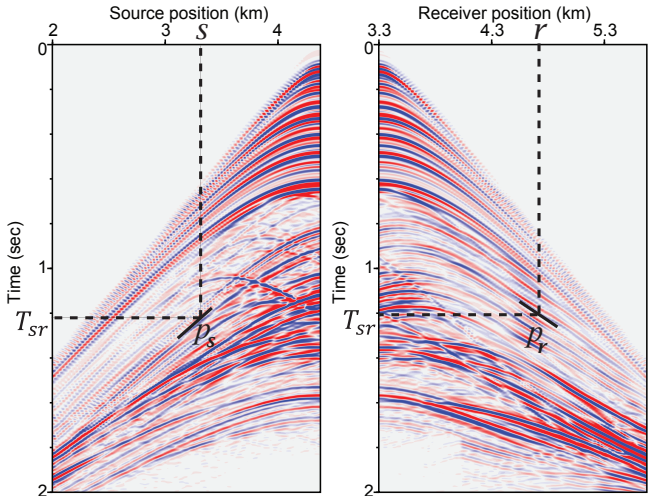
- 35 OBSs provided data over 4 components
- Data from shot profiles merged with navigation to produce OBS gathers
- Traveltime picking underway
- First arrival travel time tomography to come soon
- Refraction/reflection and possibly Full Waveform tomography to come after

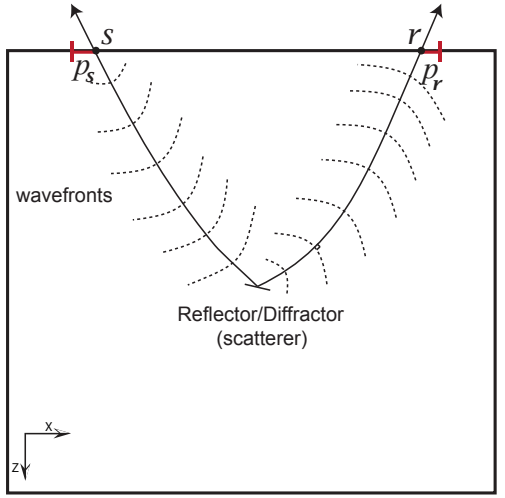


SEFASILS Acquisitions – MCS Data/Methods



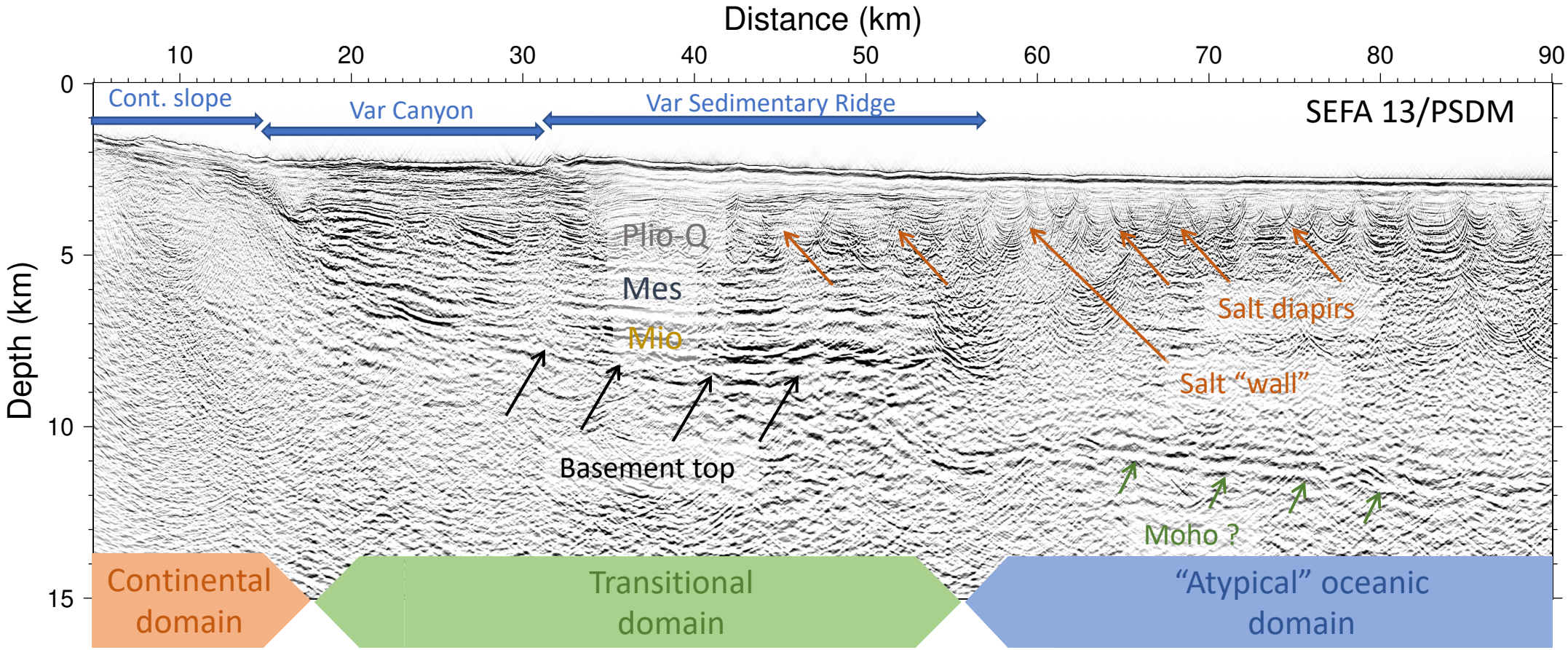
- Good Pre Stack Depth Migration (PSDM) requires accurate velocity model
- Velocity models derived from focusing analysis (flattening of events in Common Image Gathers, Al Yahia, 1990) and from parsimonious, adjoint-state stereotomography (Sambolian et al., 2019)





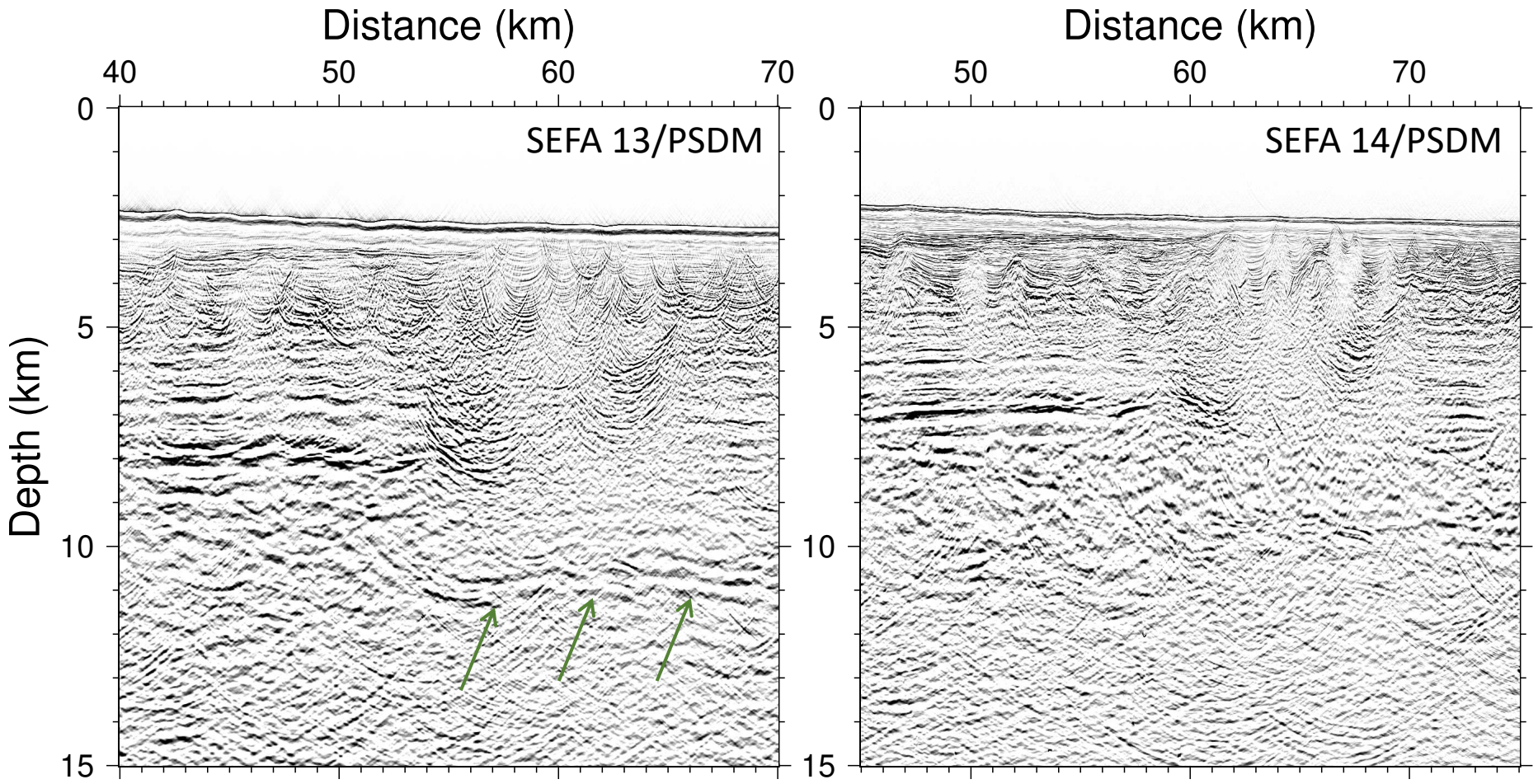
SEFASILS Acquisitions – MCS Data/Results

1- General overview: main structures



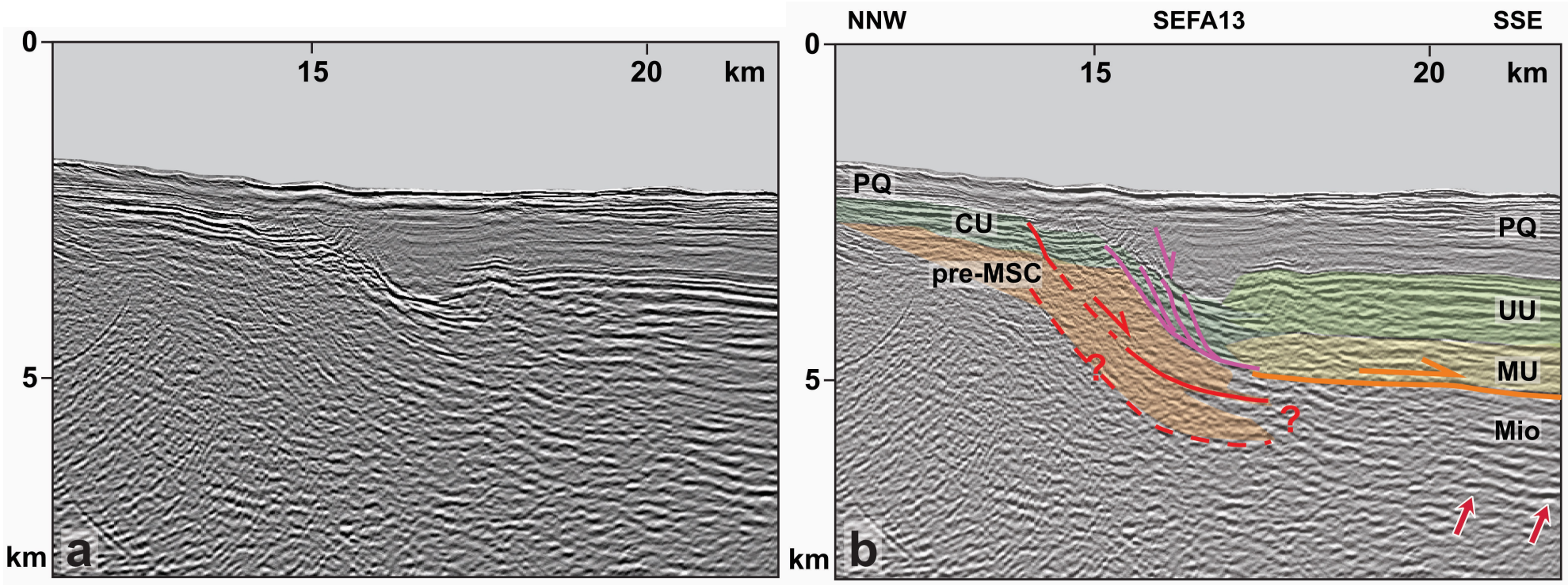
SEFASILS Acquisitions – MCS Data/Results

2- Source comparison: refraction vs. reflection



SEFASILS Acquisitions – MCS Data/Results

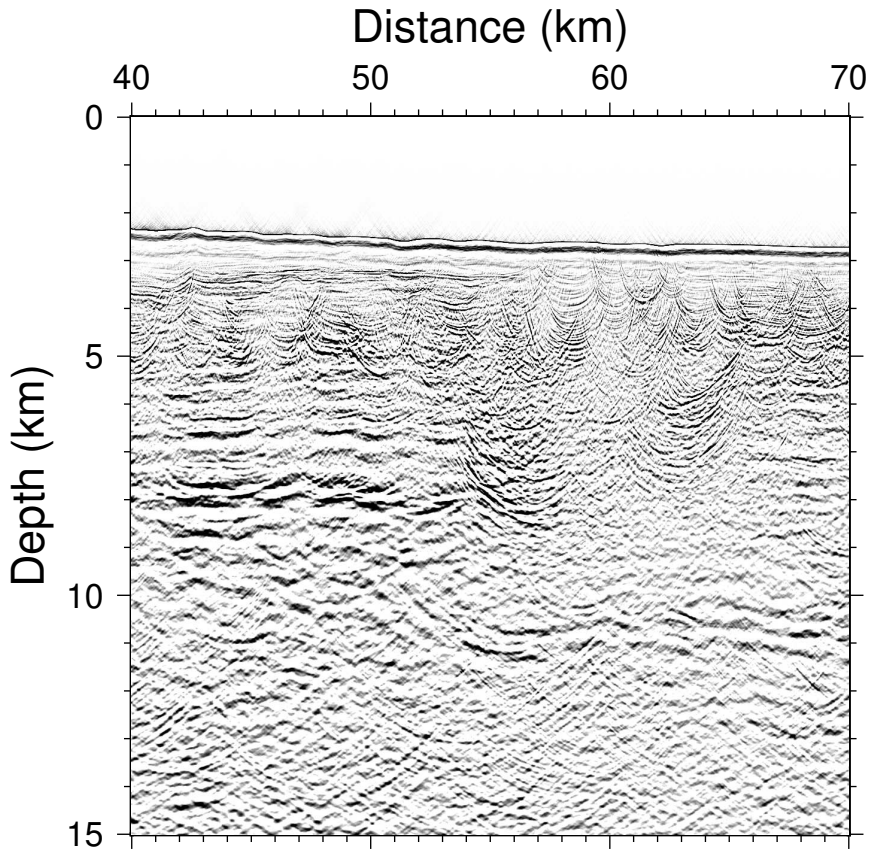
3- Margin toe: possible indirect evidence for uplift

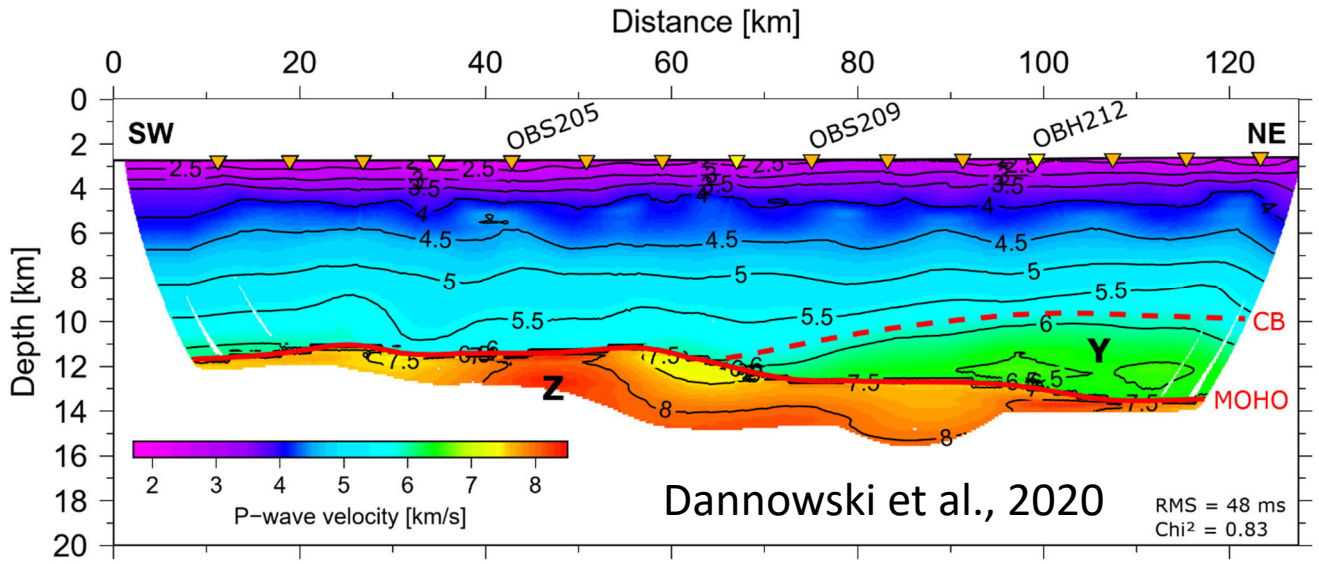


- Hints for interference between documented extensional salt tectonics and possible gravity-driven processes possibly related to uplift (also apparent from convex up bathymetric profile, Petit et al., 2014)
- No direct observable of related reverse faulting beneath the margin (yet)

SEFASILS Acquisitions – MCS Data/Results

4- Deep basin: crust or no crust?





- Large structural discontinuity across the salt wall
- Dannowski et al. (2020) advocate for the absence of any oceanic crust in the basin, with mantle transition ~12 km depth
- Need for tomographic velocities from OBSs (ongoing work)

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