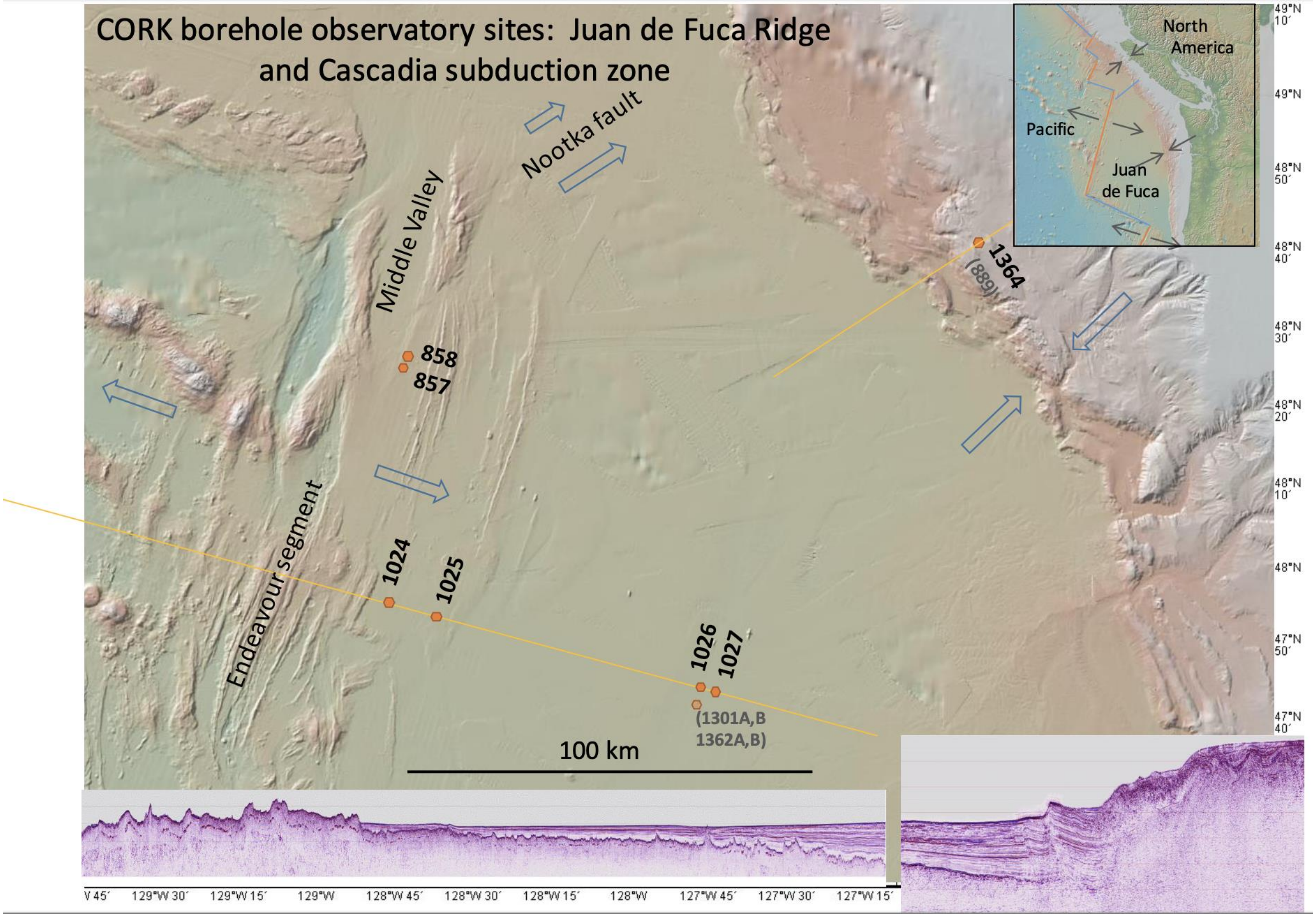
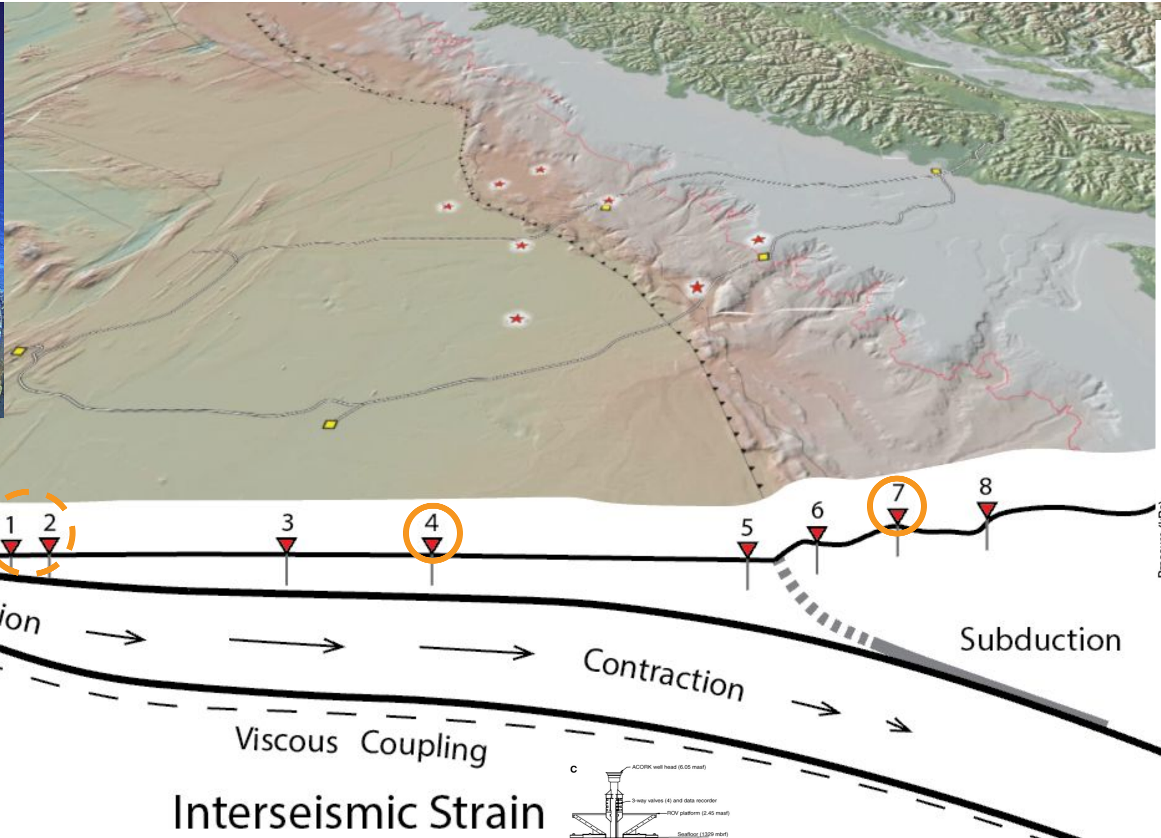
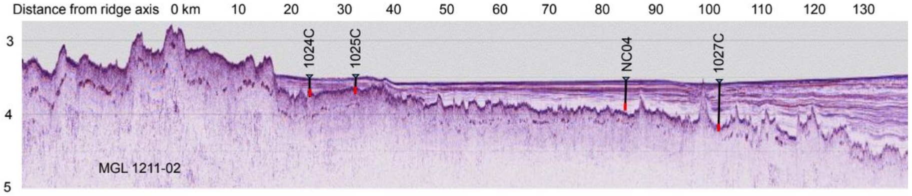
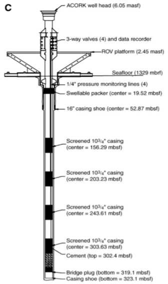


CORK borehole observatory sites: Juan de Fuca Ridge and Cascadia subduction zone
North America
Pacific
Juan de Fuca
Nootka fault
Middle Valley
858
857
1364
(889)
Endeavour segment
1024
1025
1026
1027
(1301A,B
1362A,B)
100 km
49°N 10′
49°N
48°N 50′
48°N 40′
48°N 30′
48°N 20′
48°N 10′
48°N
47°N 50′
47°N 40′
W 45′
129°W 30′
129°W 15′
129°W
128°W 45′
128°W 30′
128°W 15′
128°W
127°W 45′
127°W 30′
127°W 15′







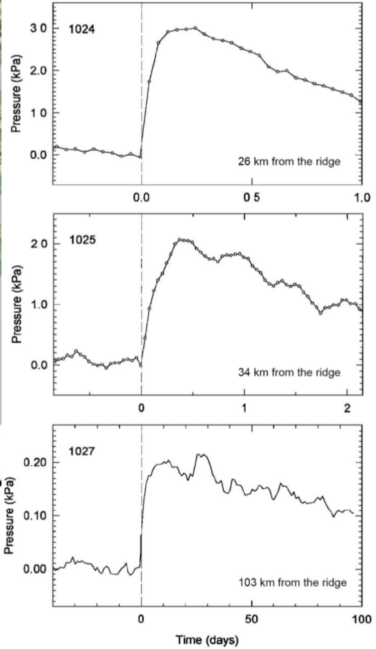
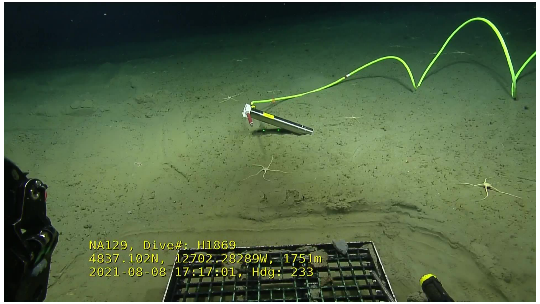
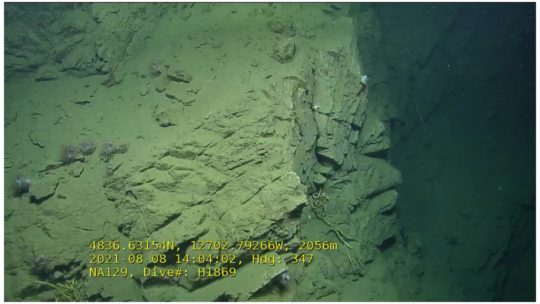


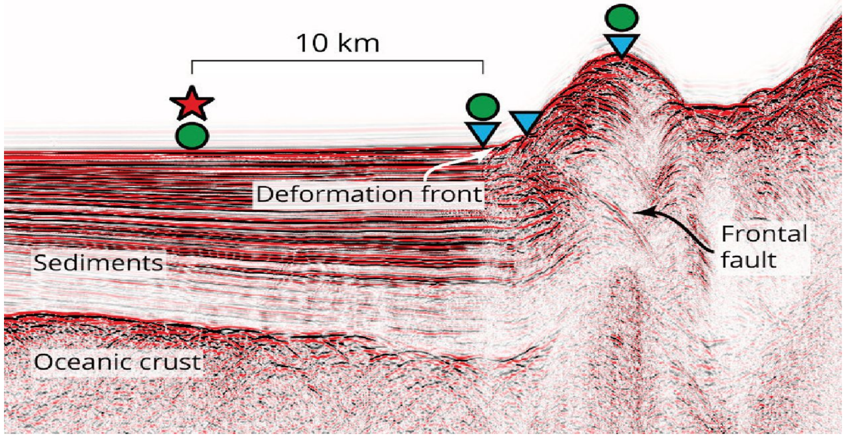
Figure 3. Pressure anomalies associated with a seafloor spreading event on the northern Juan de Fuca Ridge in 1999 (from Davis et al., 2001). Using the relationship shown in Fig. 2d, inferred volumetric strain is estimated at -0.2, -0.1, and -0.01 microstrain at each of the three sites. The CORK observatory site locations are shown in Figure 6.

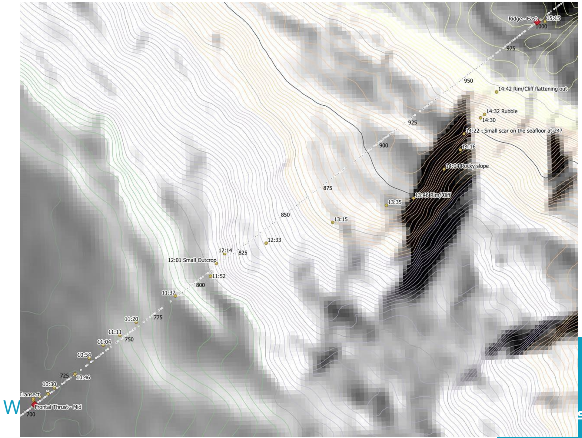
Deformation-front Observatory



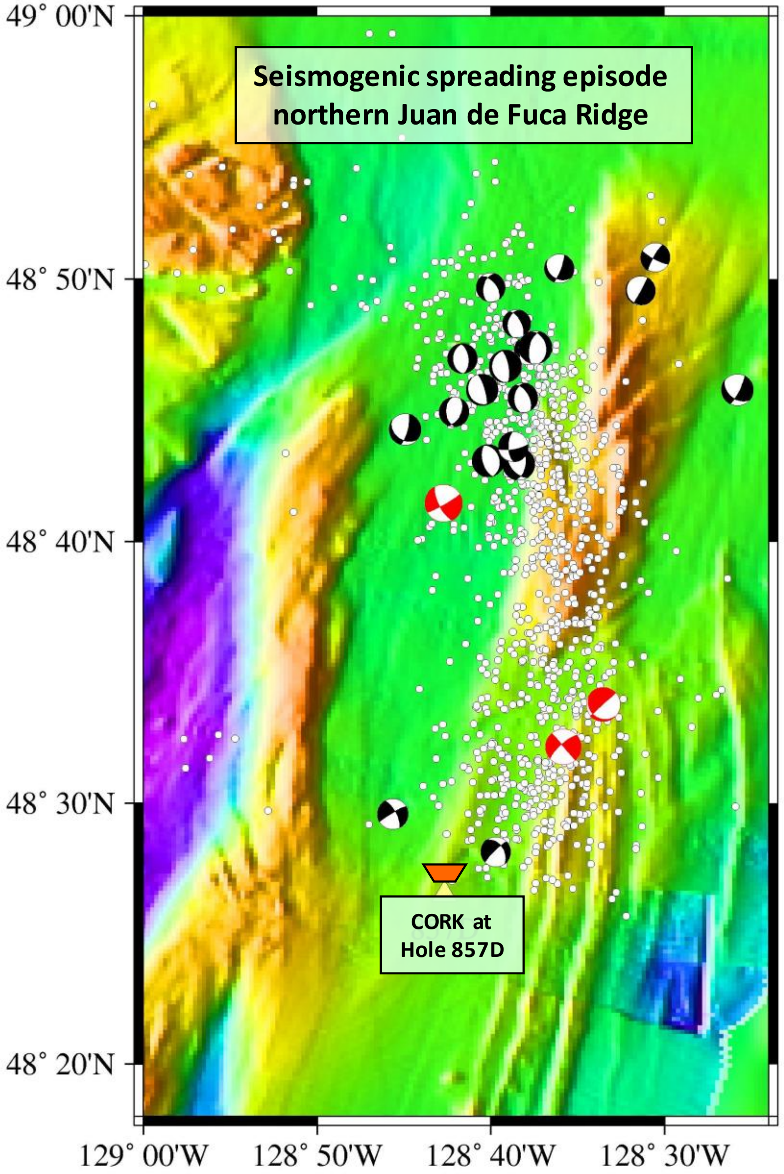


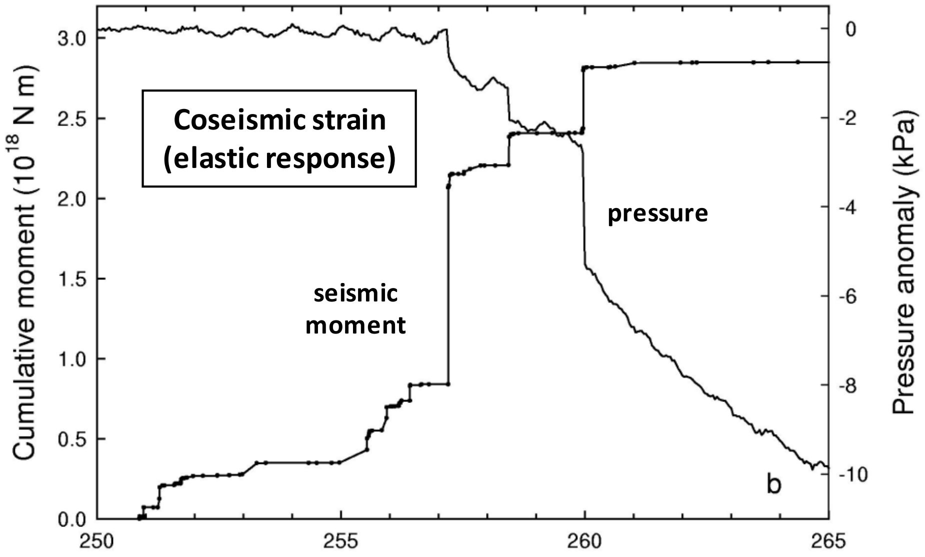
Acceleration, Pressure, and Temperature
Instrument (APT) – green circles

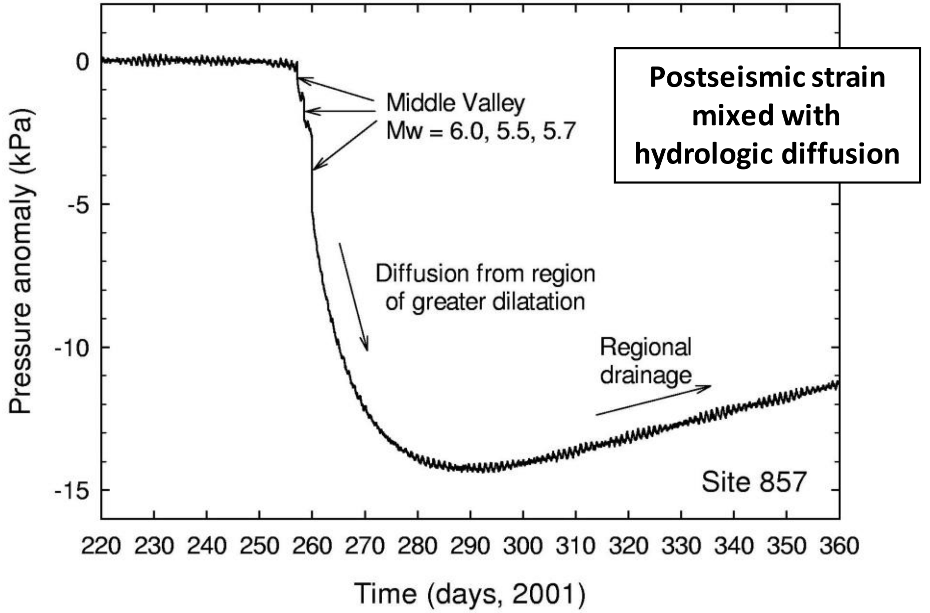




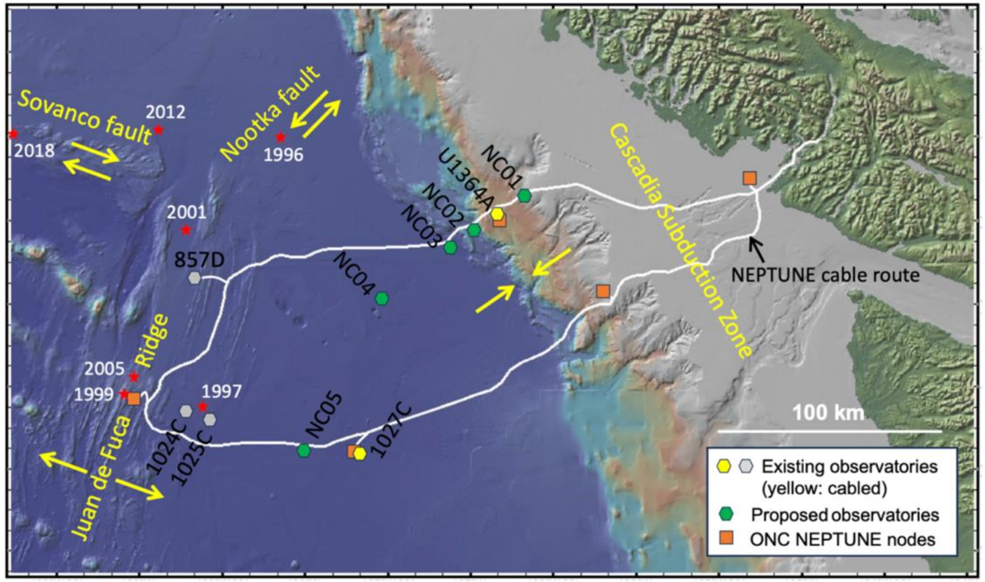
Near-field strain at Hole 857D, Middle Valley

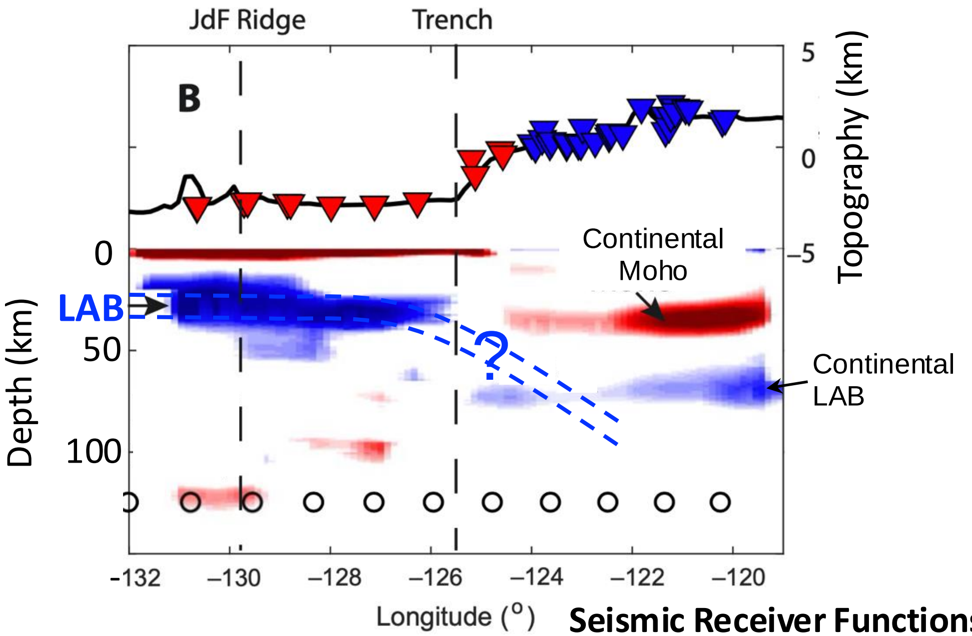






Lithosphere-Asthenosphere Boundary (LAB) beneath the northern Juan de Fuca Plate

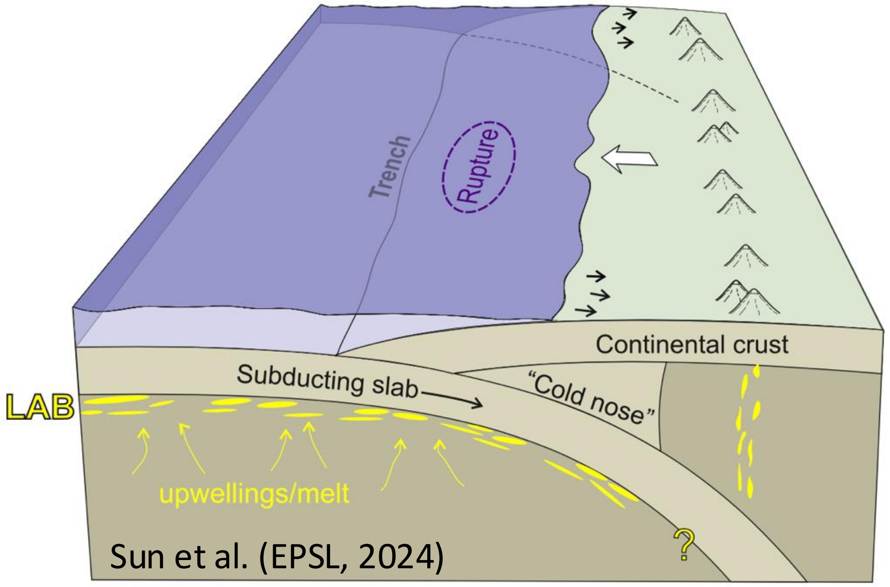




Seismic Receiver Functions

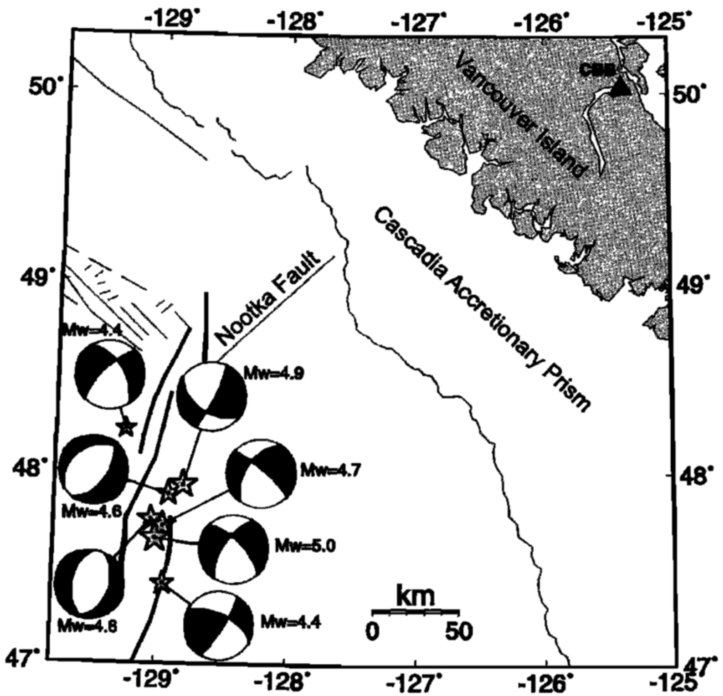
Rychert et al. (Sci. Adv., 2018)

- Seismic receiver function observations suggest a widespread LAB for the entire JdF plate
- Observations of deformation following several large megathrust earthquakes and modelling study suggest **a thin and weak LAB** (viscosity $<1\times10^{17}$ Pa s) – expected to facilitate lithospheric stress transfer over large distances (Sun et al., 2024).

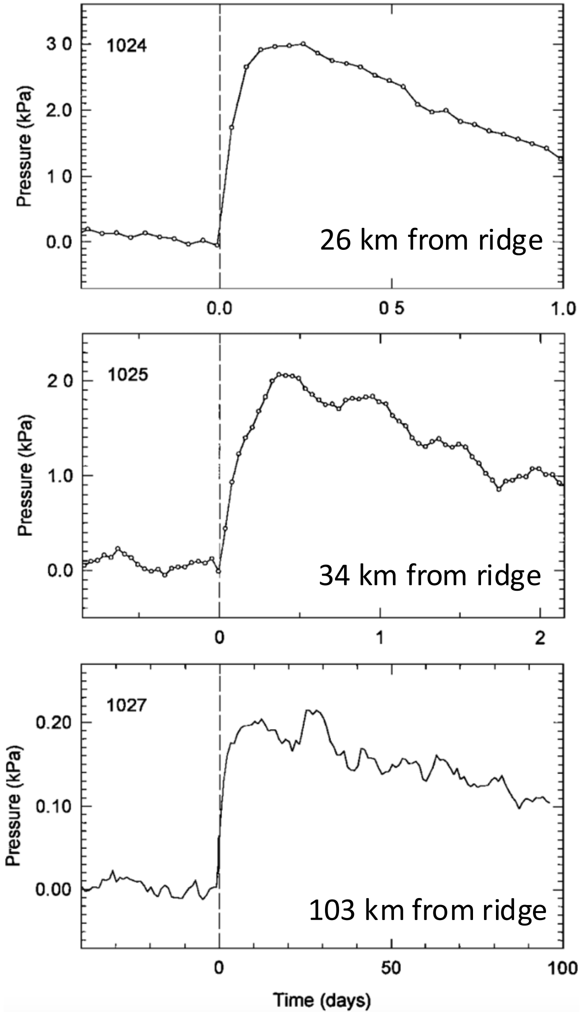


Sun et al. (EPSL, 2024)

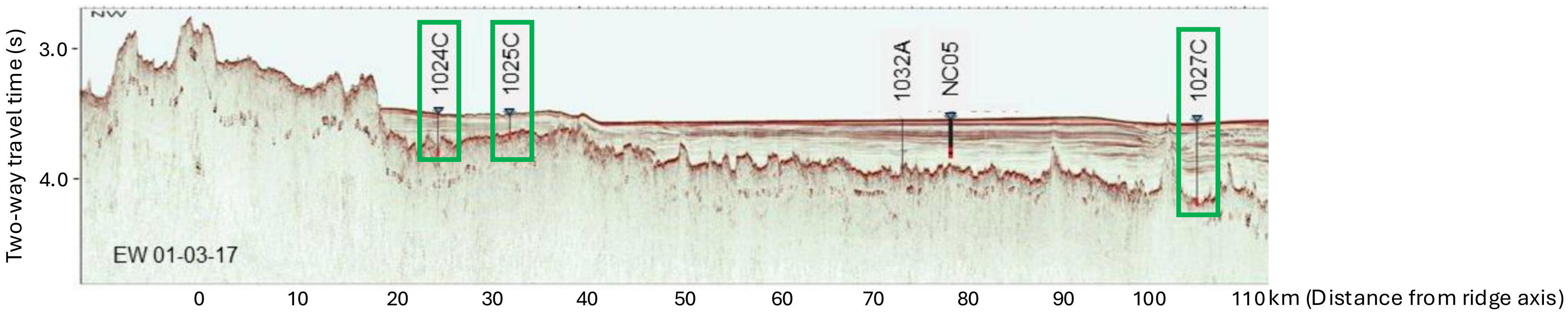
Pressure anomalies associated with the 1999 northern Juan de Fuca Ridge spreading event



Davis et al. (2001)



- A rapid Pf increase, followed by a slower rise and then a much slower decay
- Different characteristic times between sites
- Signals were explained by hydraulic diffusion, but the role of viscoelastic stress transfer deserves further study.
- 1-hr sampling rate at that time; much higher rate (1 s.p.s.) nowadays with cable connection



Establishing Plate-Scale Borehole Observatories to Study How Plate Boundaries Communicate

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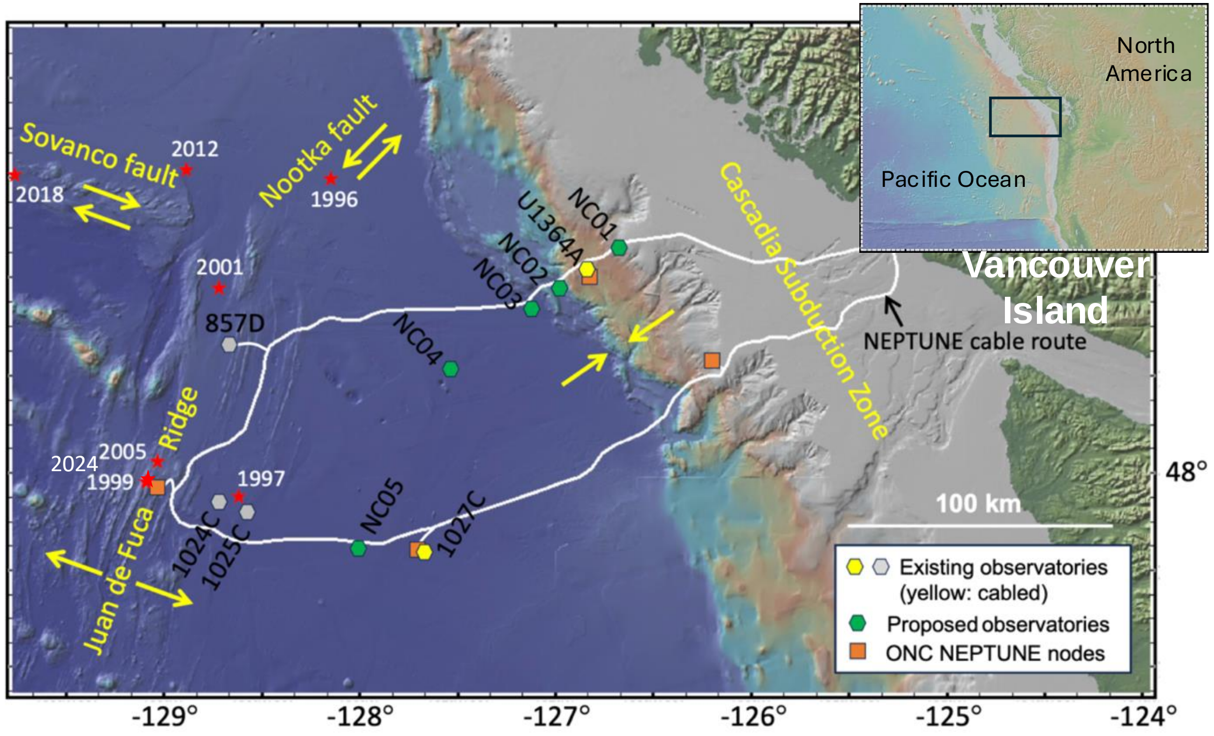
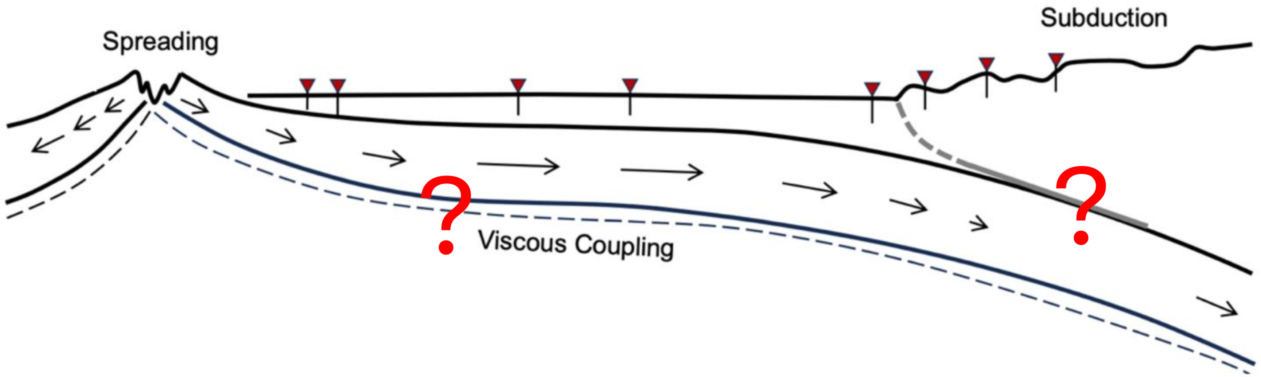
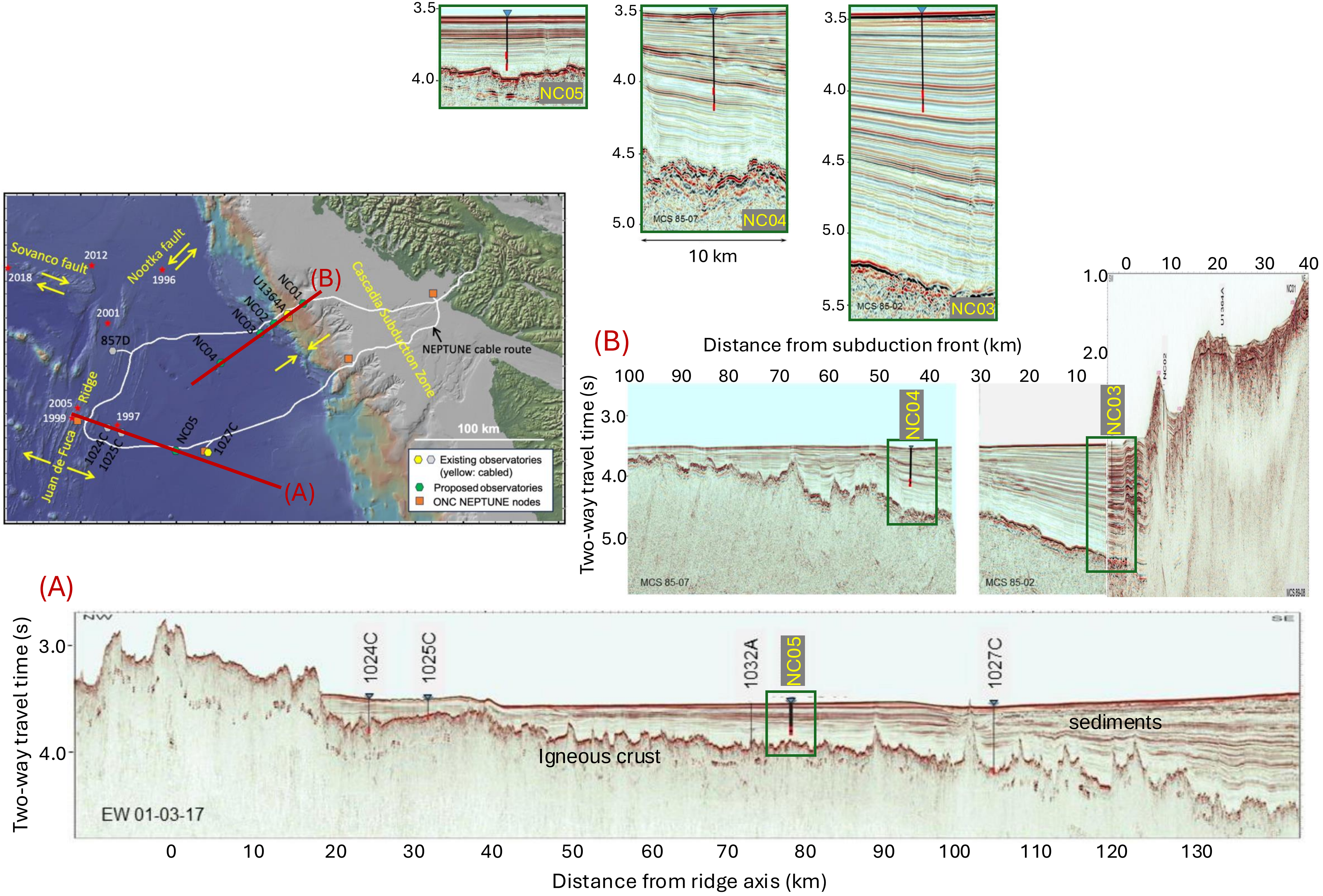




Scientific Objectives:

- Defining the locking state of Cascadia subduction zone (CSZ) megathrust
- Studying the interplay between tectonically active plate boundaries and CSZ
- Studying rheology of the lithosphere-asthenosphere system
- Opportunity for real-time observation by connecting with Ocean Networks Canada’s NEPTUNE cabled observatory



NC05
NC04
MCS 85-07
10 km
NC03
MCS 85-02
Sovanco fault
Nootka fault
2012
2018
1996
2001
857D
U1364A
NC01
NC02
NC03
NC04
(B)
Cascadia Subduction Zone
NEPTUNE cable route
Juan de Fuca Ridge
2005
1999
1997
1024C
1025C
NC05
1027C
100 km
(A)
Existing observatories (yellow: cabled)
Proposed observatories
ONC NEPTUNE nodes
(B)
Distance from subduction front (km)
Two-way travel time (s)
MCS 85-07
MCS 85-02
(A)
Two-way travel time (s)
NW
SE
1024C
1025C
1032A
NC05
1027C
sediments
Igneous crust
EW 01-03-17
Distance from ridge axis (km)

Structural context at Holes 1026B and 1027C