Imaging the Cascadia Subduction Zone with Marine Active Source Seismic Data

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The Cascadia subduction zone has hosted numerous great earthquakes, up to Mw ~9.0, during the Holocene and poses a significant earthquake and tsunami threat to the heavily populated Pacific Northwest. However, with little instrumentally recorded seismicity, the geometry and physical properties of the megathrust in the seismogenic zone are still poorly known. In June-July 2021, we conducted the **CA**scadia **S**eismic **I**maging **E**xperiment (CASIE21), a regional active source seismic survey on board R/V *Langseth* to characterize the structure and physical properties of the incoming plate, overriding plate, and the plate interface of the Cascadia subduction zone. Multichannel seismic data were acquired using an air gun source of 6600 in^3 and a streamer of 12km/15km length. The data were processed through a sequence of navigation merge, noise and multiple suppression, velocity model building, and pre-stack depth migration. The new seismic images and accompanying high-resolution velocity models along 18 dip lines and 7 strike lines span the offshore region from Vancouver Island to southern Oregon and provide new constraints on sediment subduction, outer wedge strength, and submarine landslides along this margin. We find that offshore Vancouver Island, Washington, and northern Oregon (north of 45˚N), thrust faults in the accretionary prism extend close to the top of the oceanic crust, indicating very little sediment subduction. Offshore central and southern Oregon (42.5˚N-45˚N), a sediment layer up to 2 km thick subducts beneath the outer wedge. This region of thick sediment subduction coincides with narrow and weak outer wedge characterized by reduced seismic velocity, numerous massive landslide deposits imaged seaward of the deformation front, and reduced locking of the plate interface. South of 42.5˚N, where the incoming sediment thickness significantly reduces, the decollement forms near the basement with minimal sediment subduction. In this talk, I will present new seismic images and high-resolution velocity models of the sediment sections. The cause of along strike variations of sediment subduction and outer wedge strength in relation to incoming plate topography and backstop geometry, and their impact on plate interface locking status will be discussed.

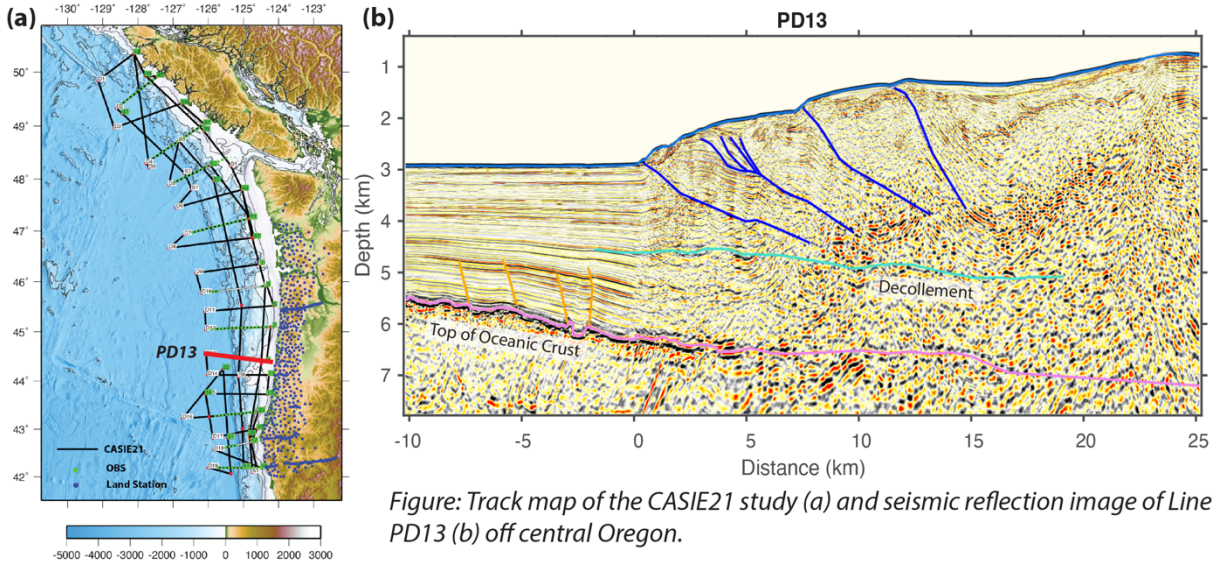

Figure: Track map of the CASIE21 study (a) and seismic reflection image of Line PD13 (b) off central Oregon.