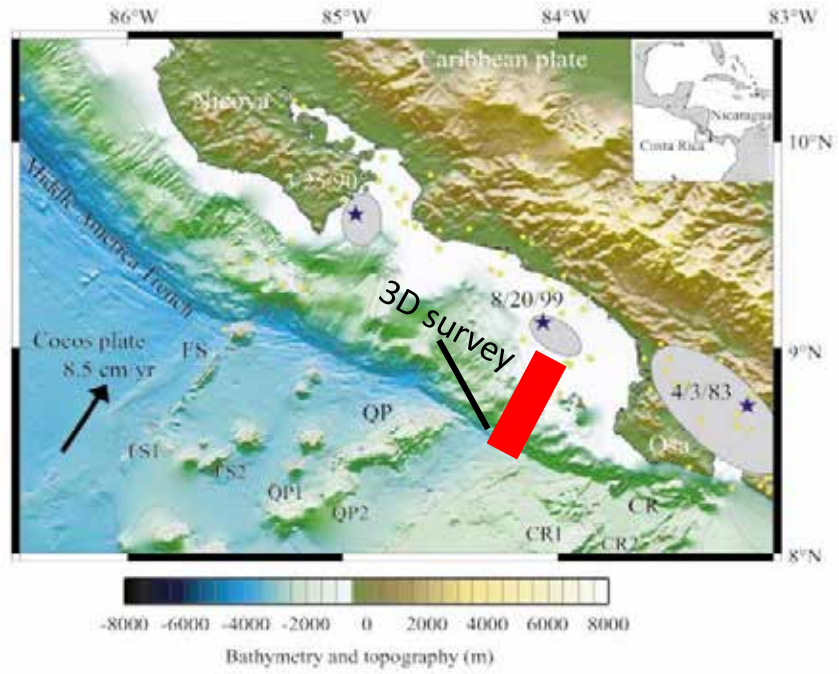
# A 3D look at the structure, fluids, and the seismogenic zone along the Costa Rica margin

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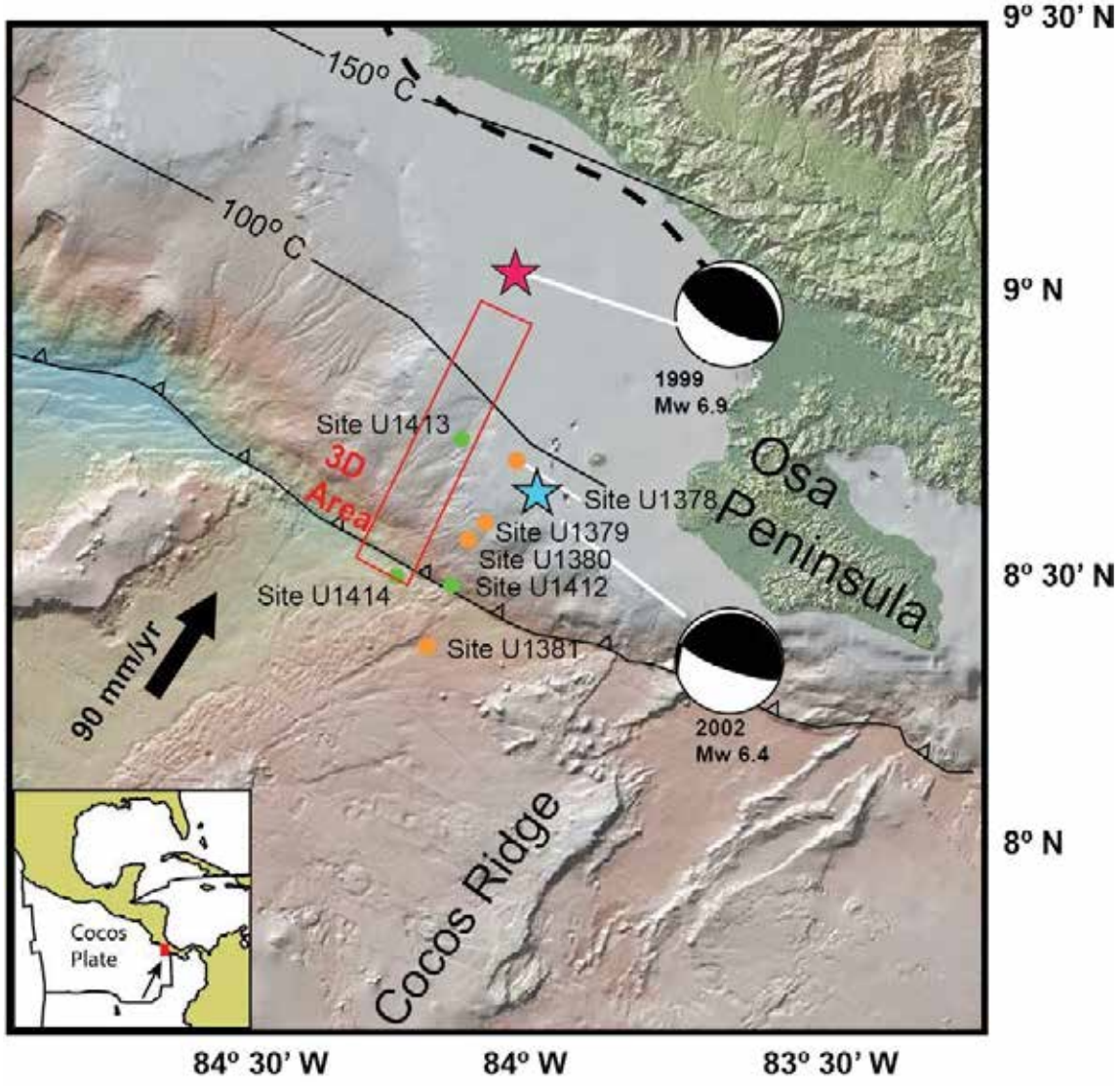
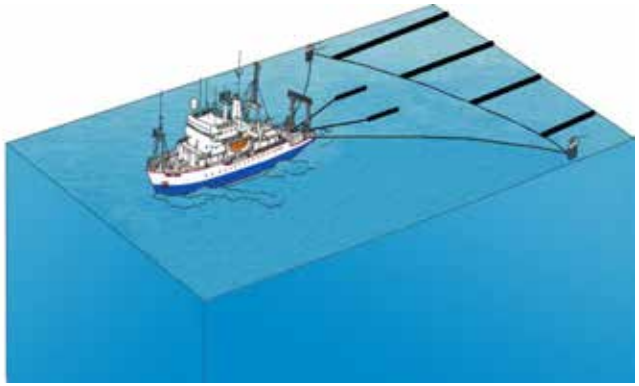
NSF

REPSOL

# 2011 3D Survey







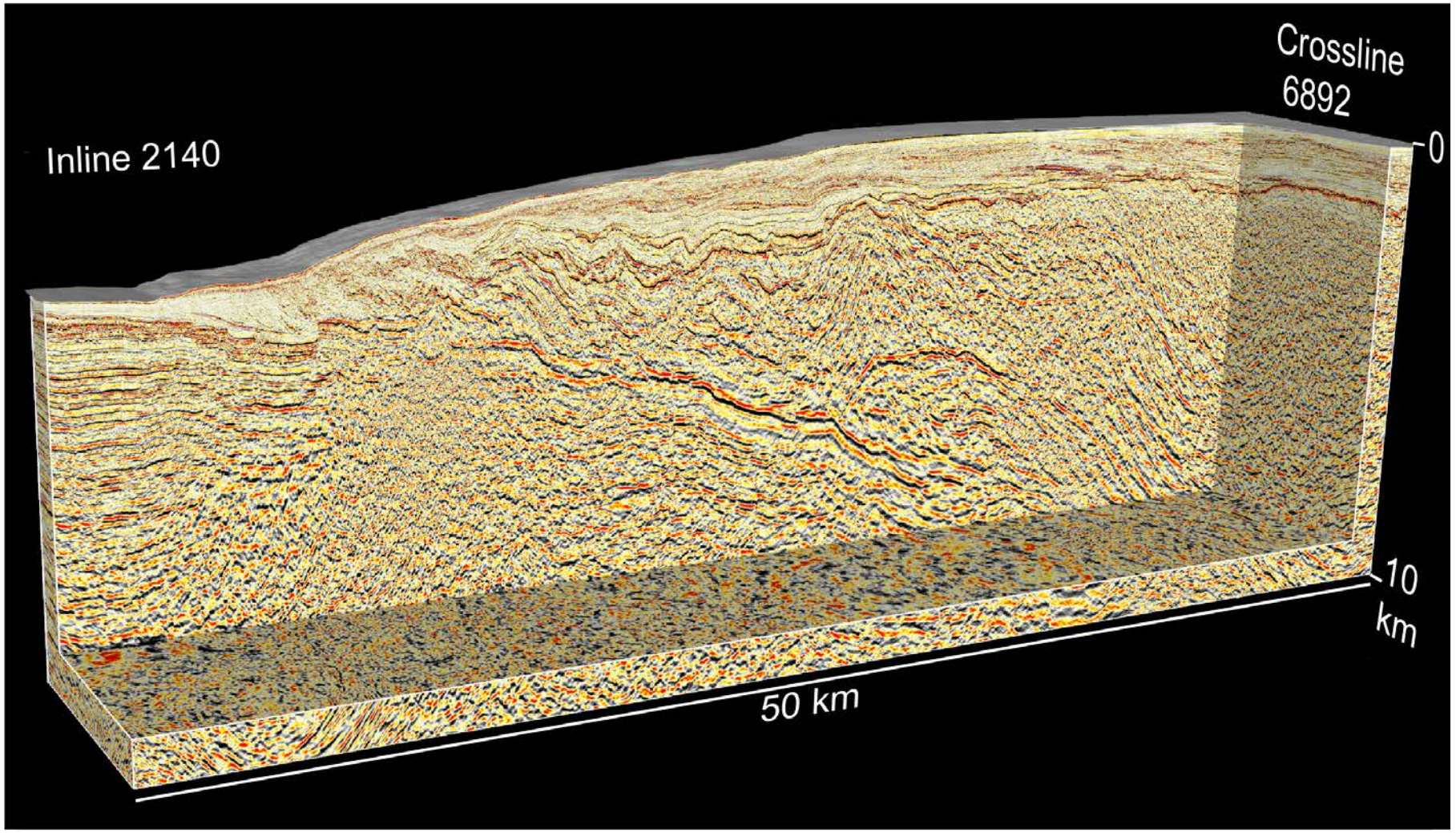
# Overview

How do the structure and tectonics of the Costa Rica margin control the development of the seismogenic zone?

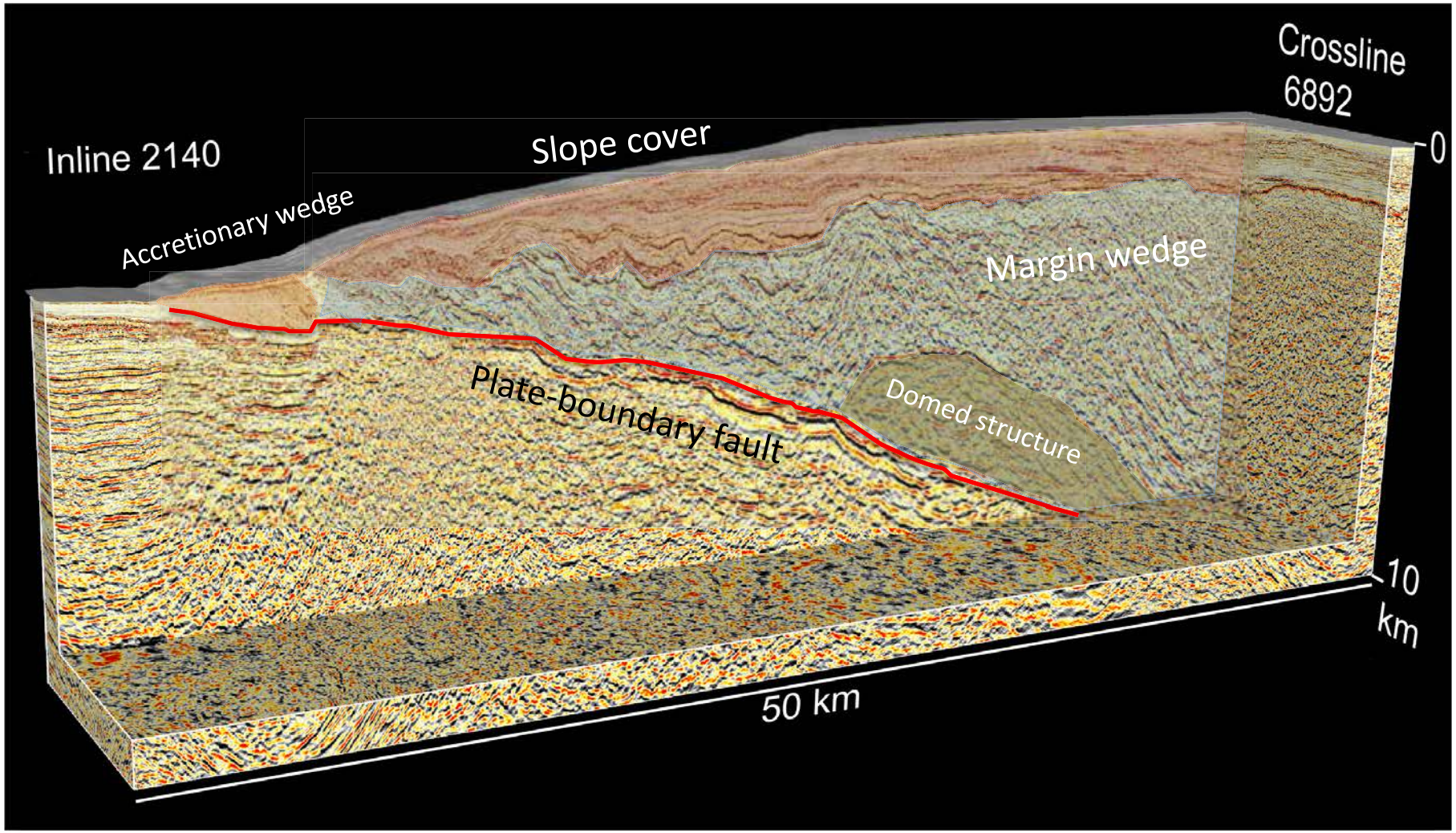
- Look at the relationship between plate-boundary fault structure/properties and earthquakes.

- Examine structure/tectonics of the overriding plate.

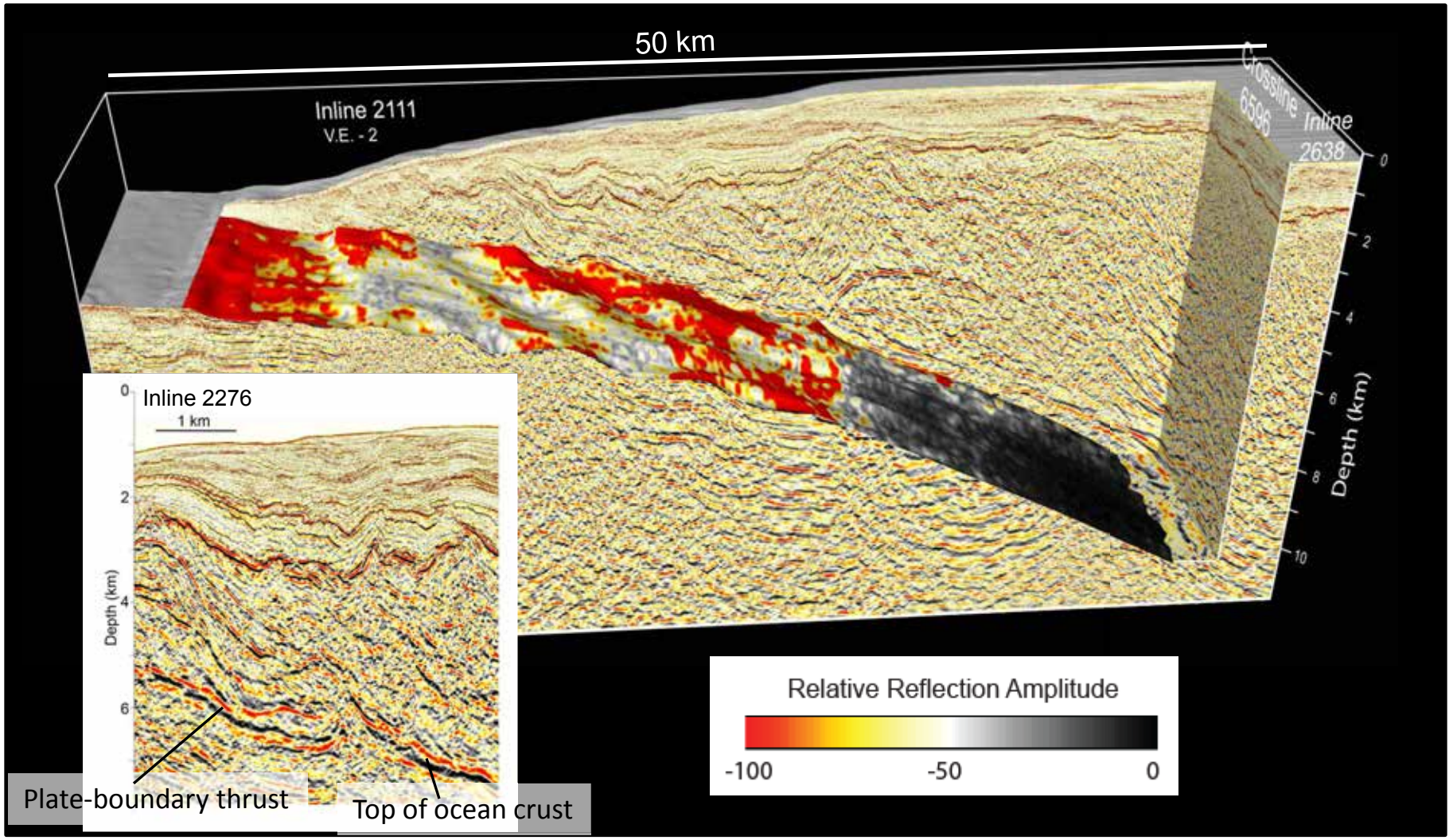
# Costa Rica margin structure



# Overview of the Costa Rica 3D seismic volume

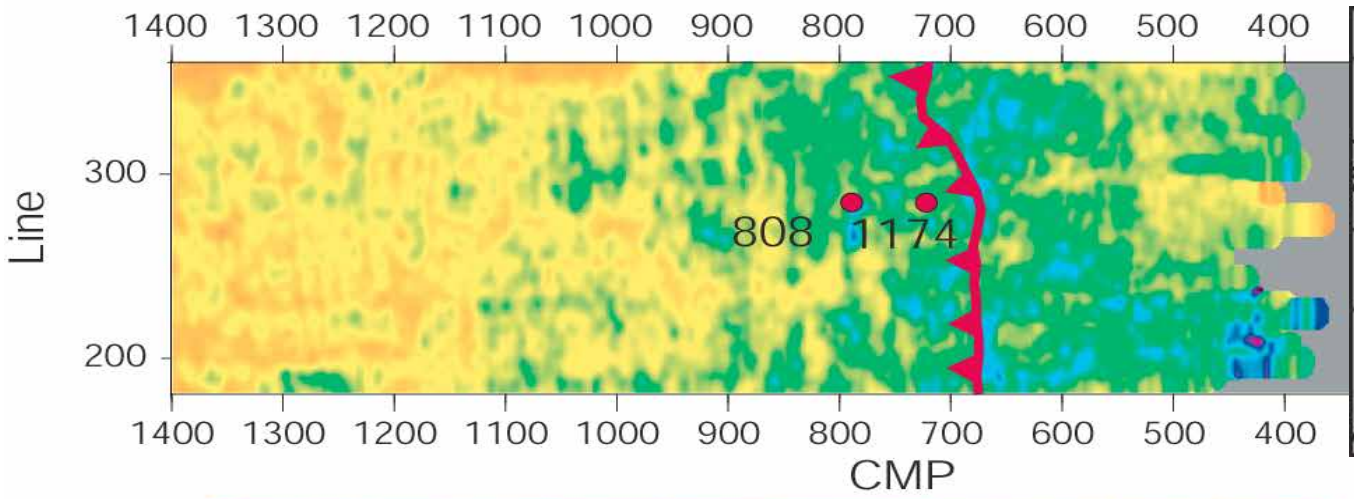


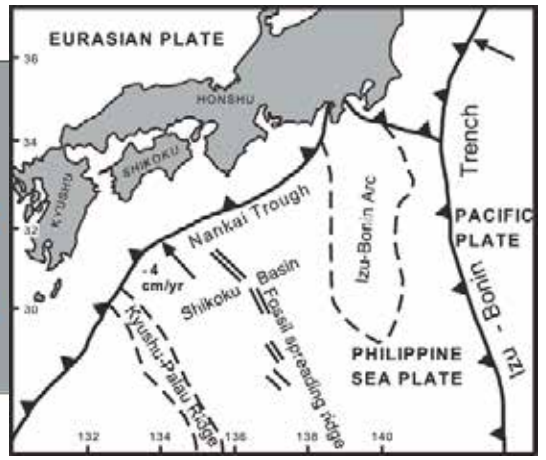
# Plate-boundary thrust reflection amplitude



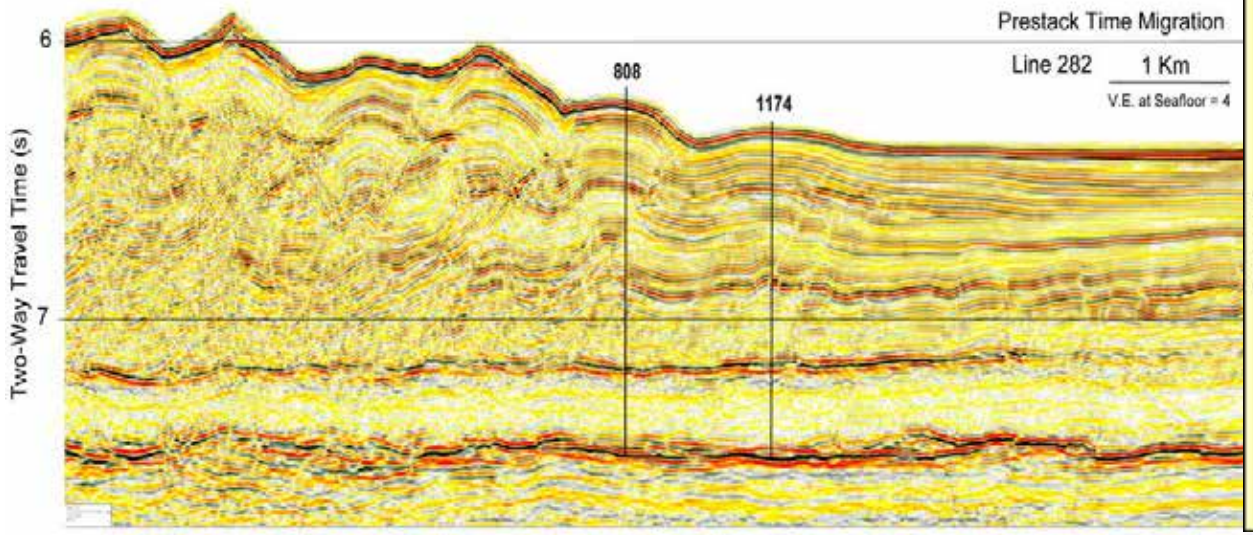

Bangs et al., JGR 2015

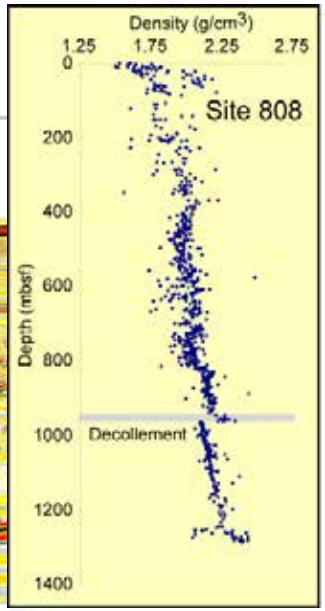
# Nankai Muroto transect decollement amplitude

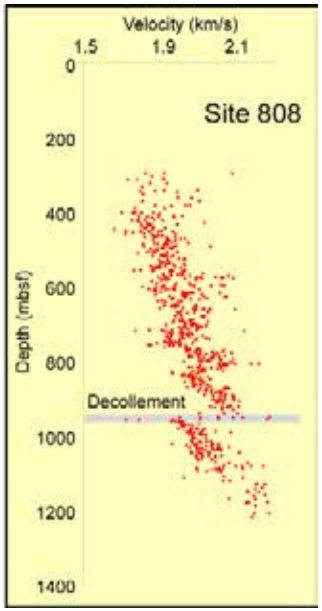


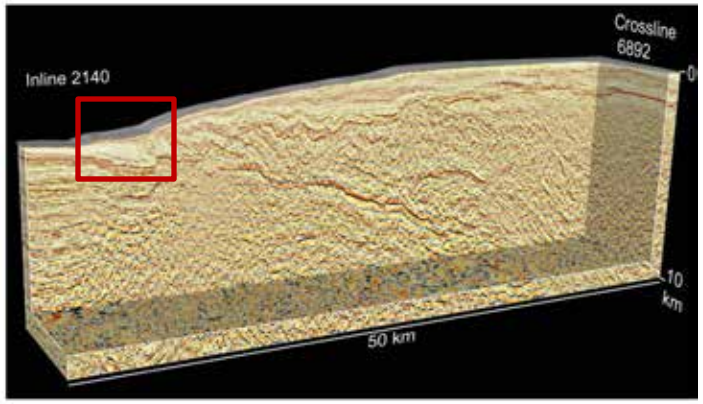


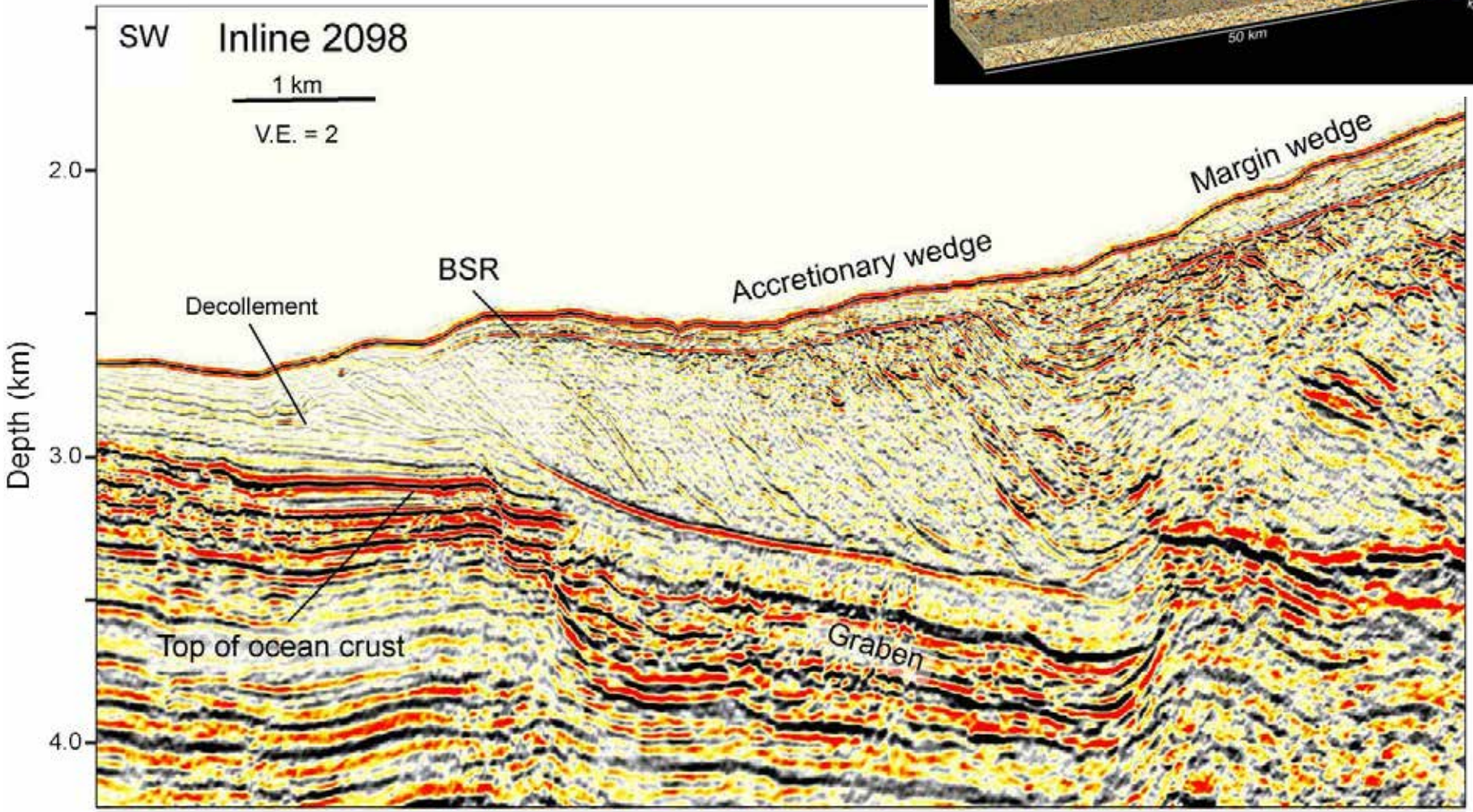



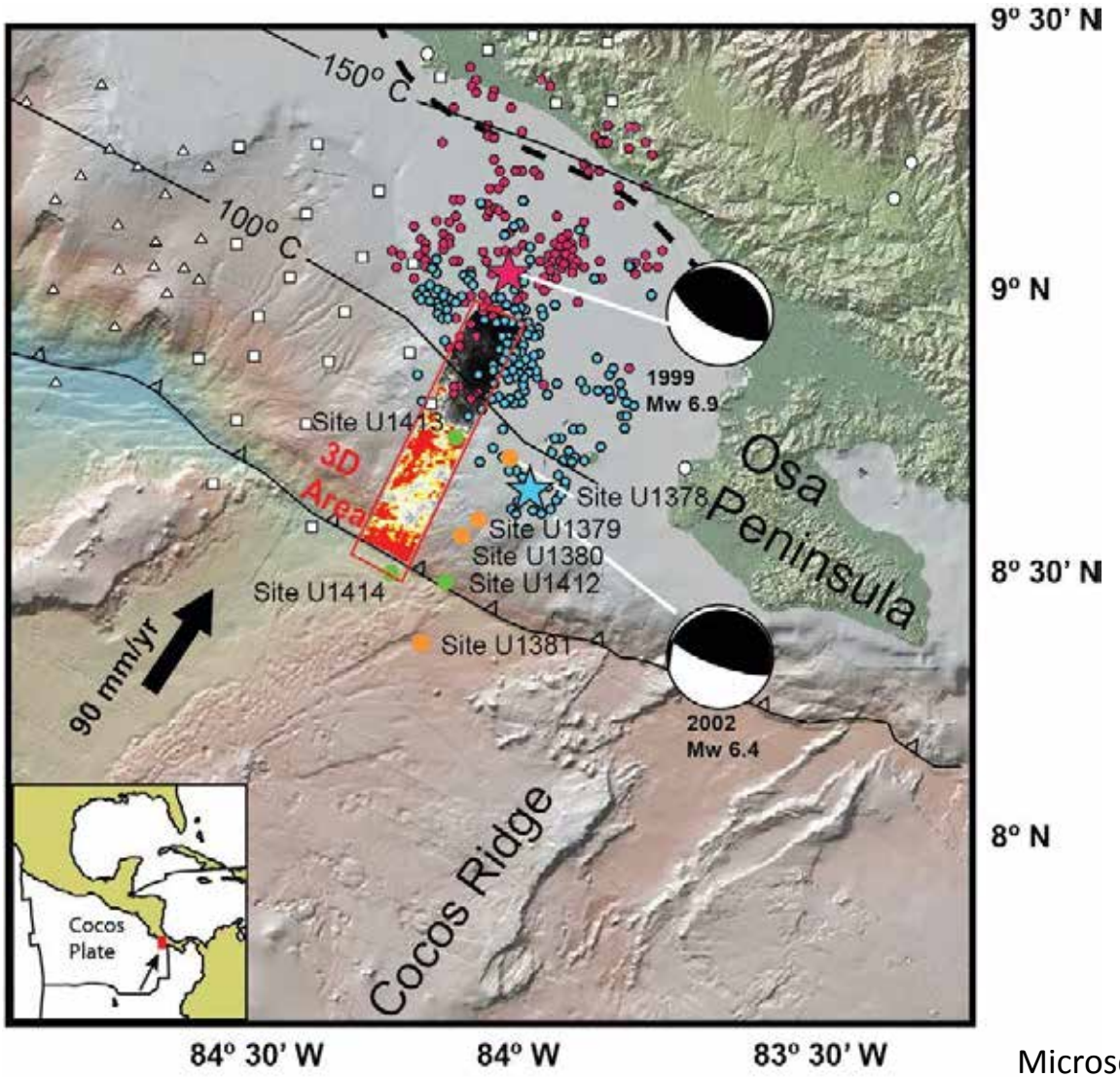



# Thin incoming sediments and minimal frontal accretion



# Plate-boundary reflection amplitude and seismicity




What controls the fluid accumulation along the plate-boundary thrust?

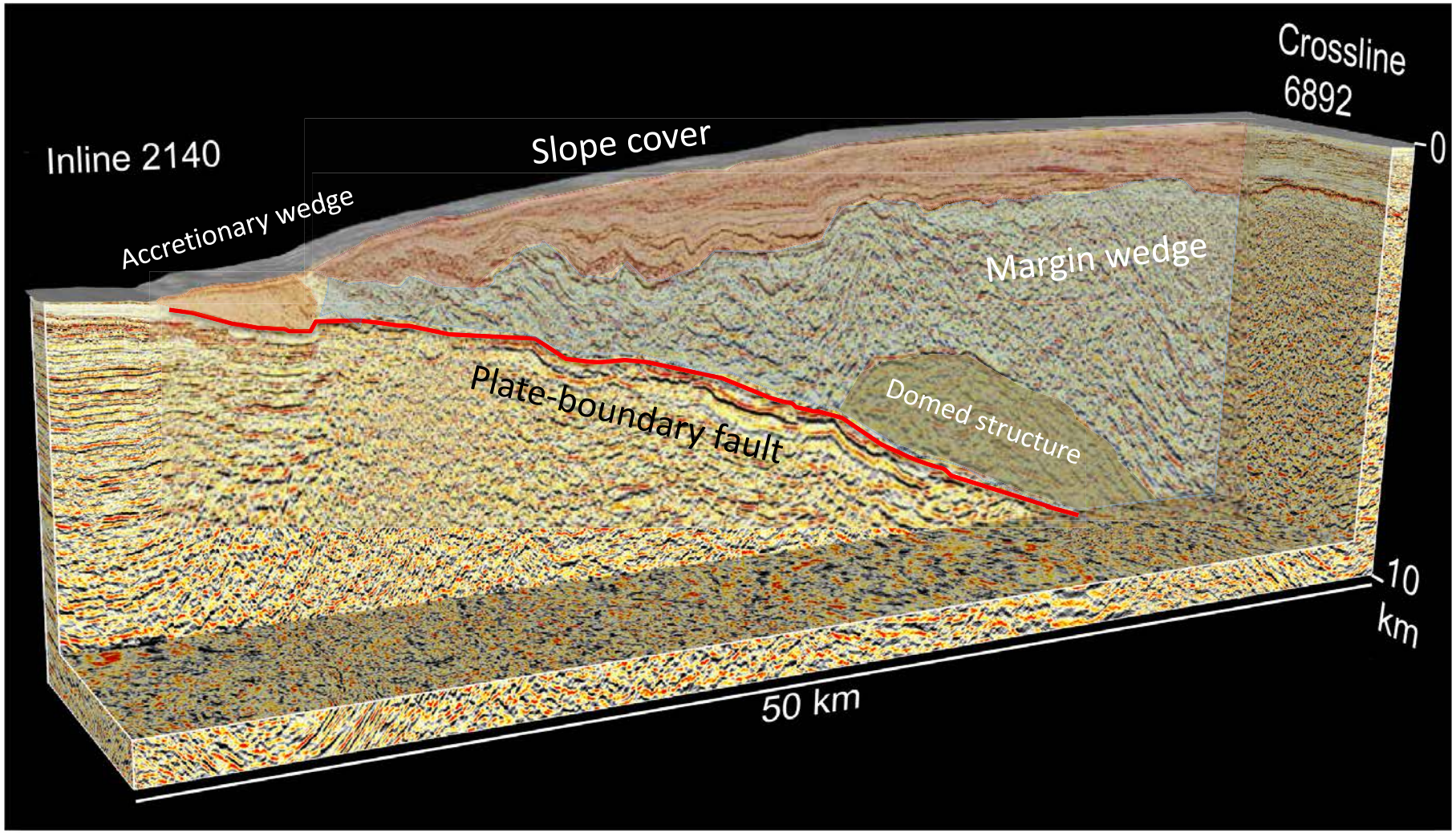
How does the upper plate structure influence fluid migration?

How does the upper plate structure develop?

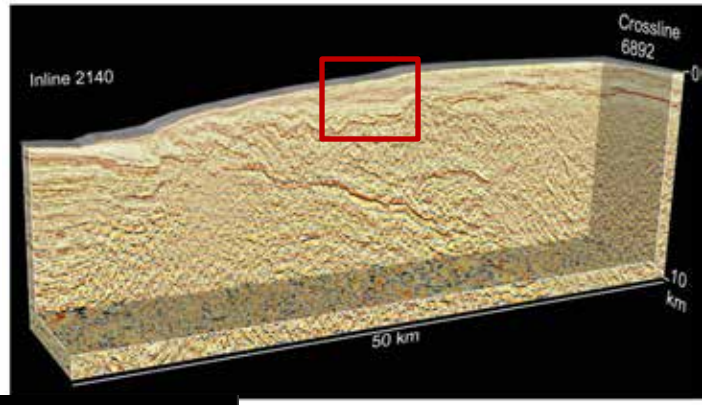
Microseismicity from Arroyo et al. 2013

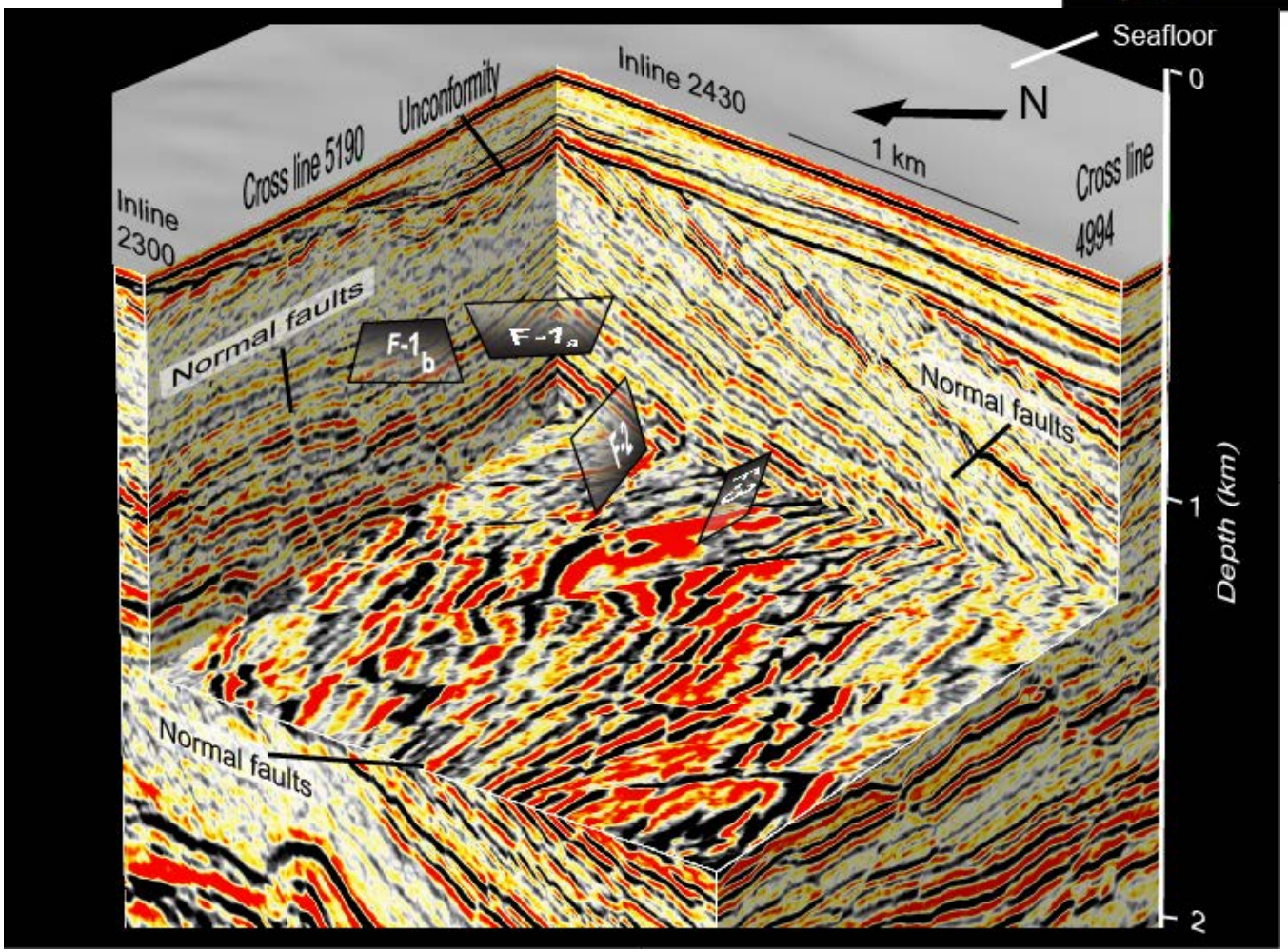
Isotherms from Harris et al. 2010

# What is the structure of the overriding plate?



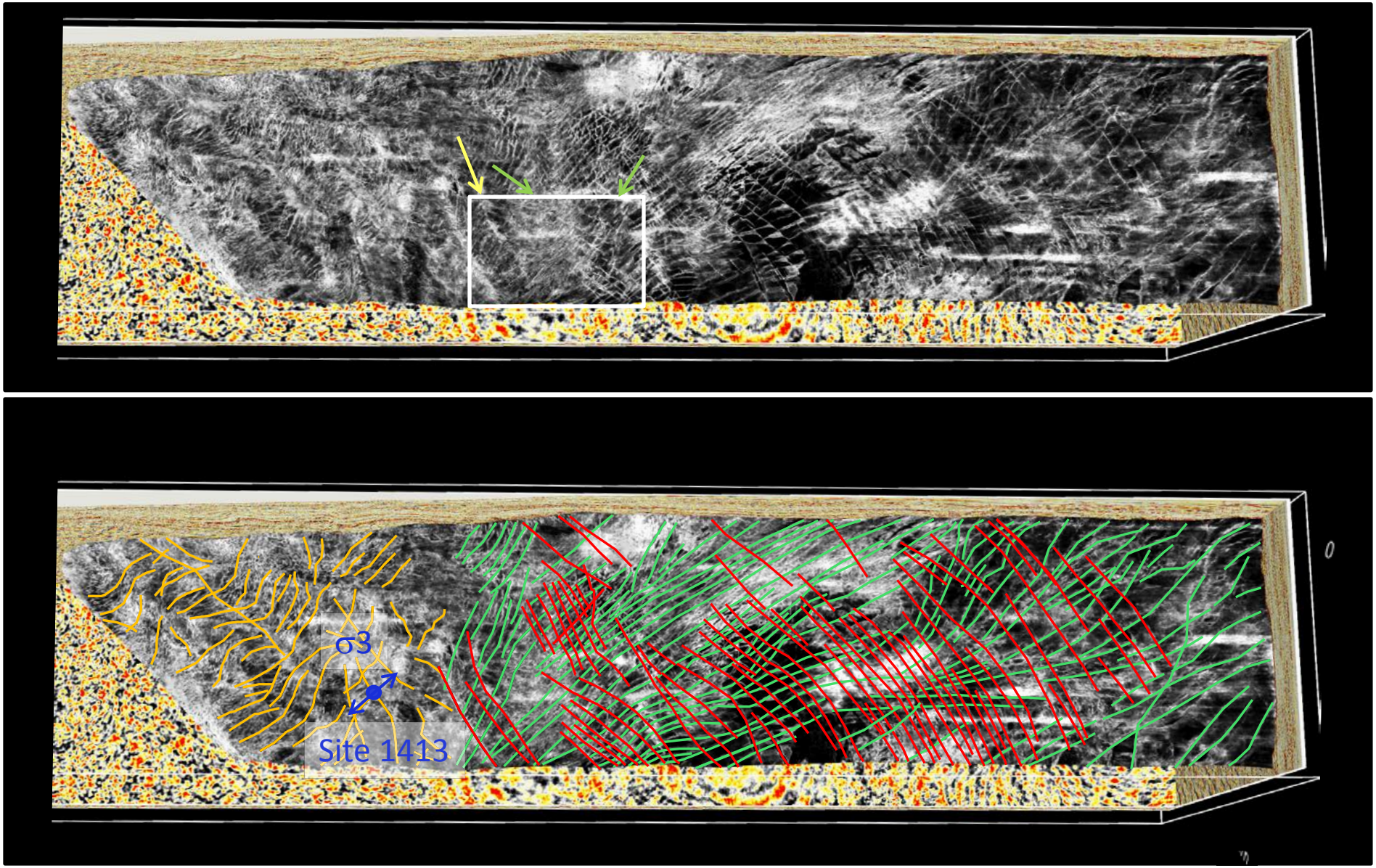
# Extensive normal faulting within the slope cover



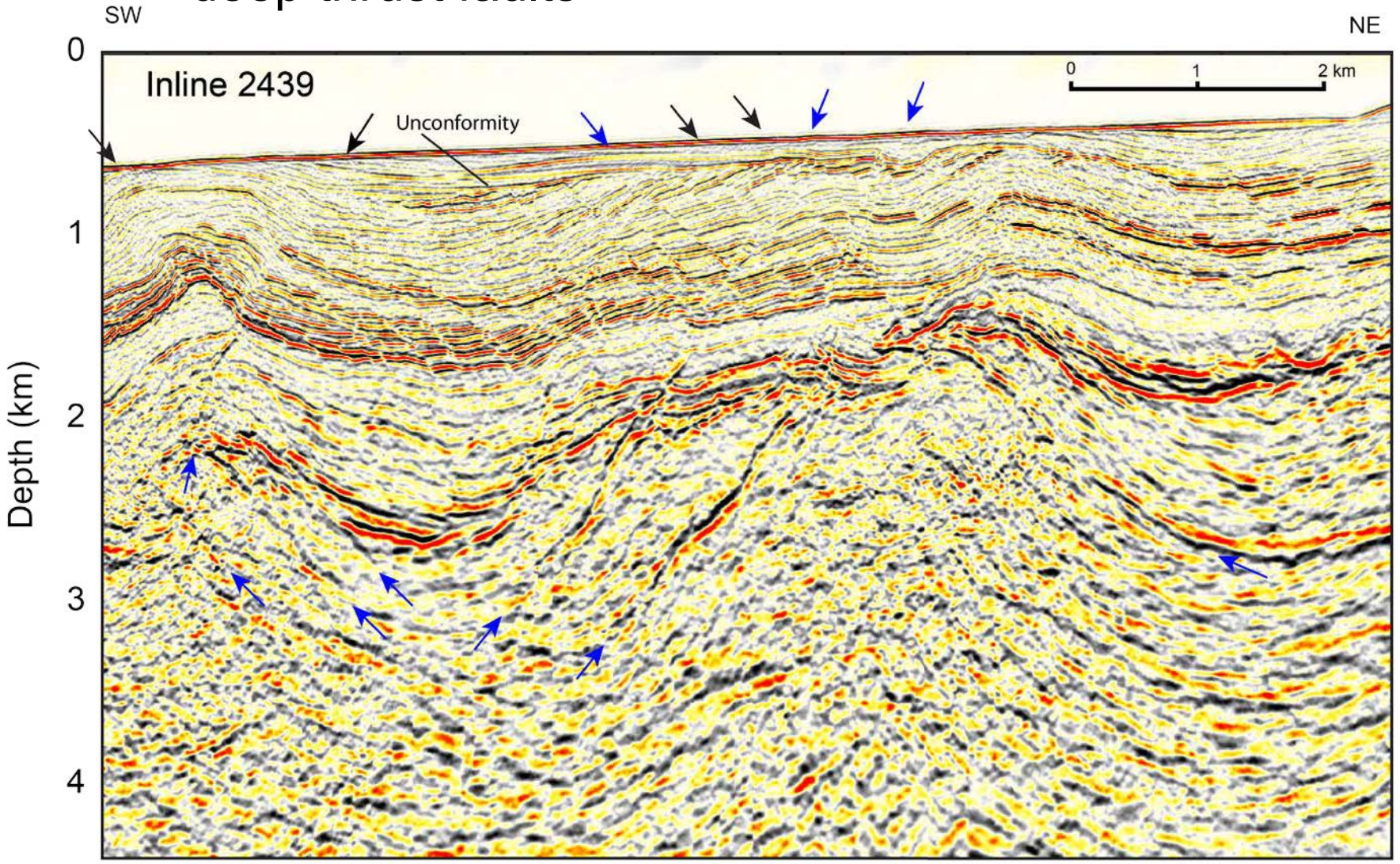
# Fault patterns in the slope cover

Seismic Coherence of slope cover projected on top of margin wedge

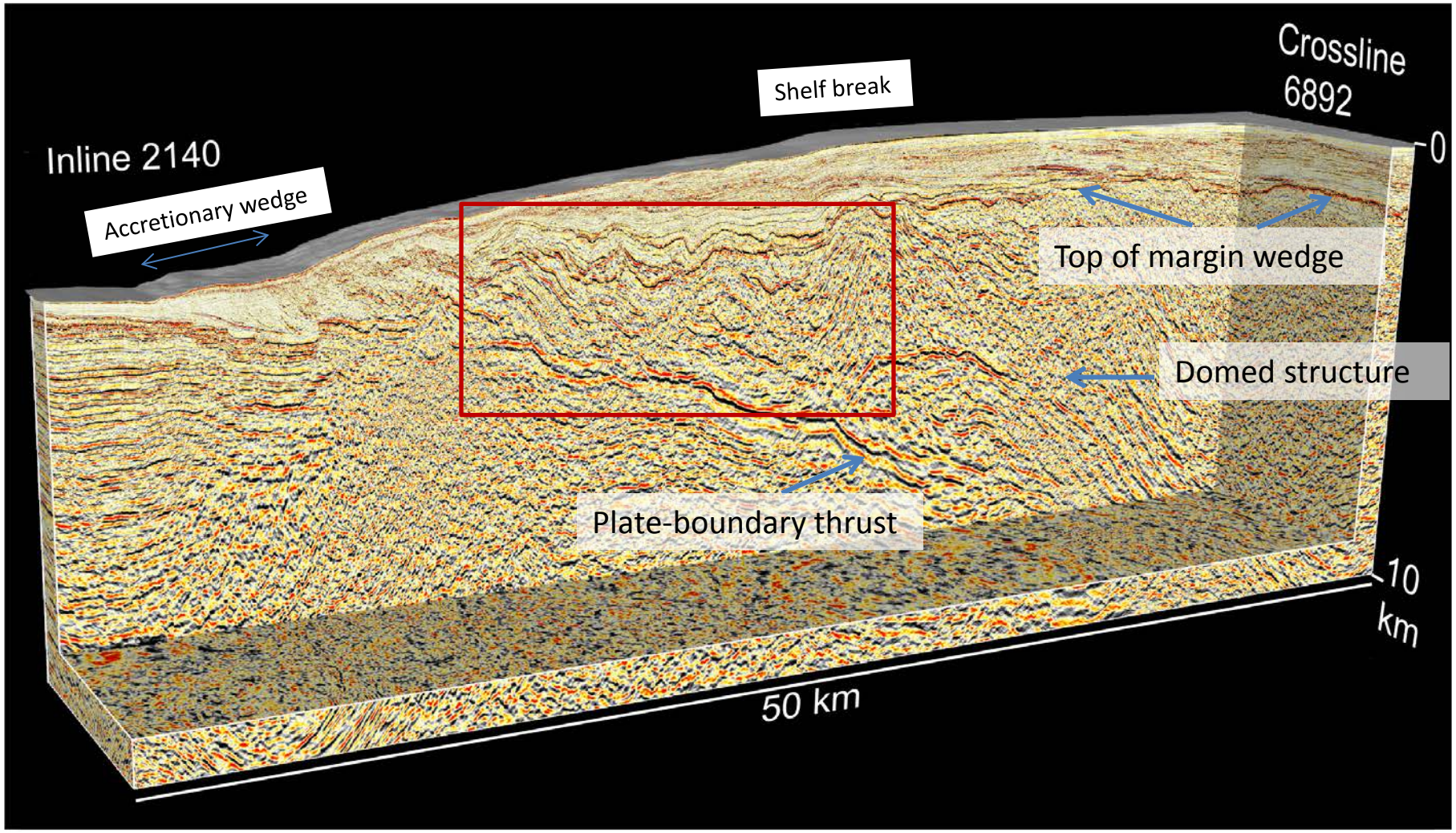


# Margin wedge and slope cover faults

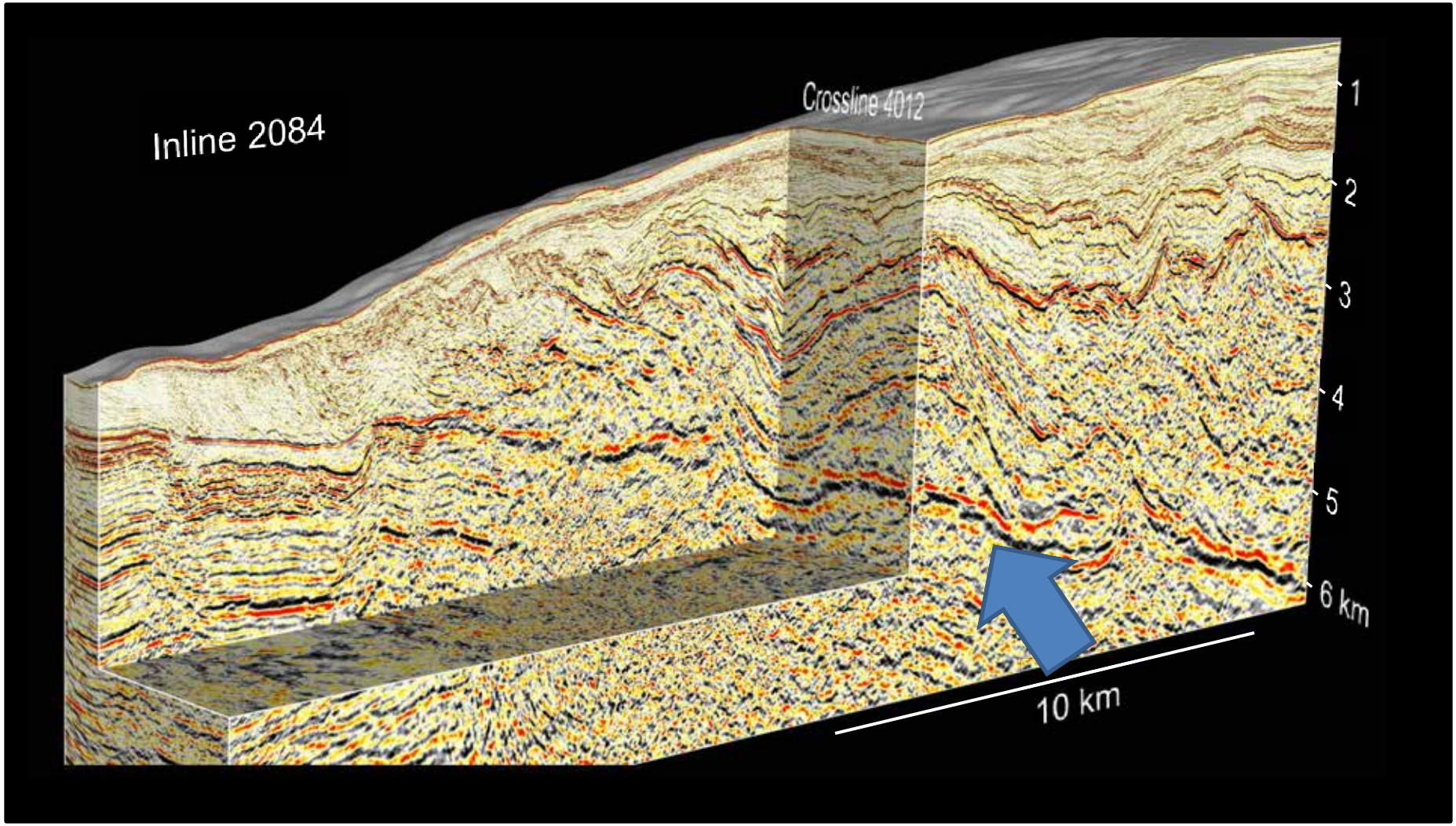
shallow penetrating normal faults
deep thrust faults



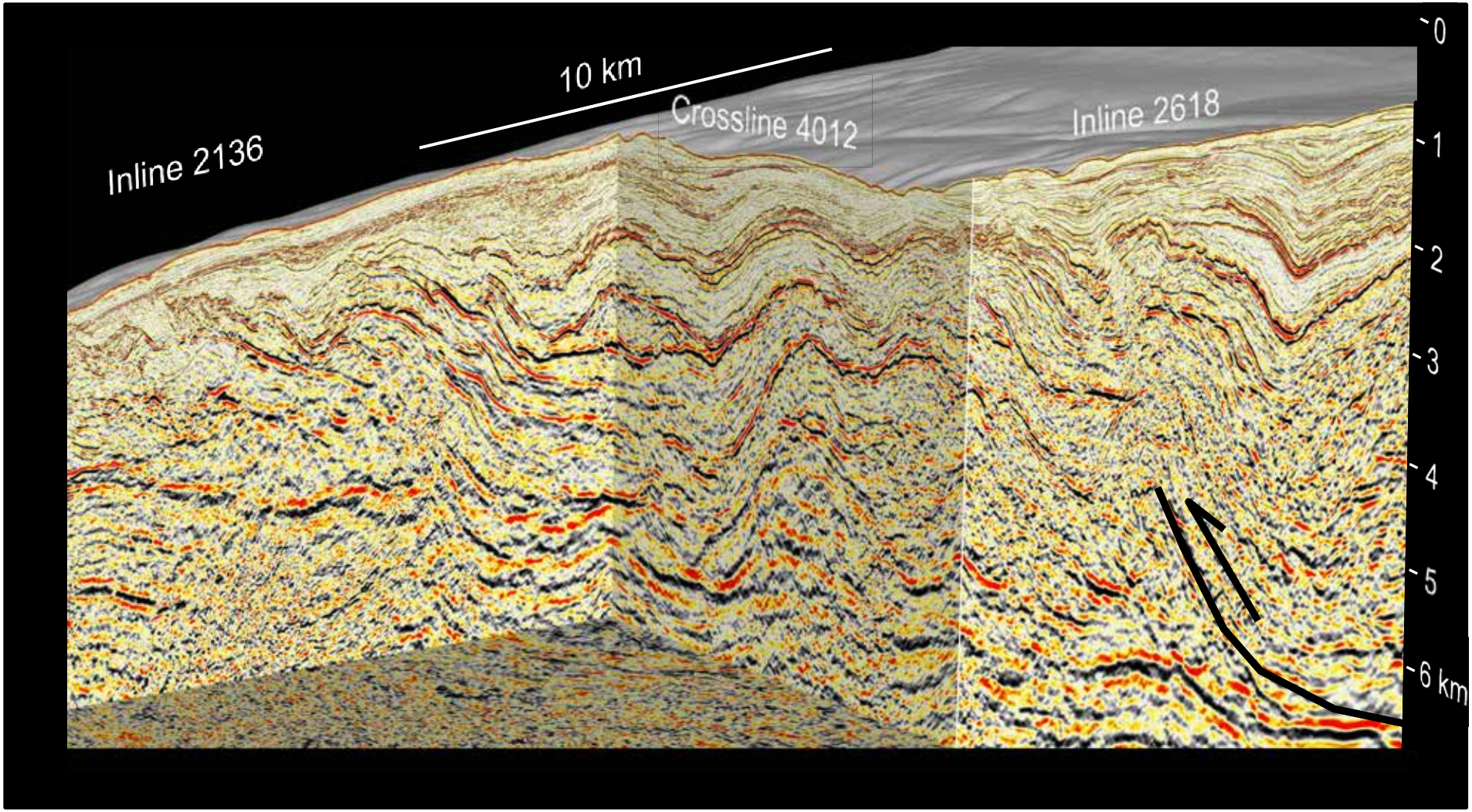
# Margin Wedge



# Folds, layering and thrusts within the margin wedge

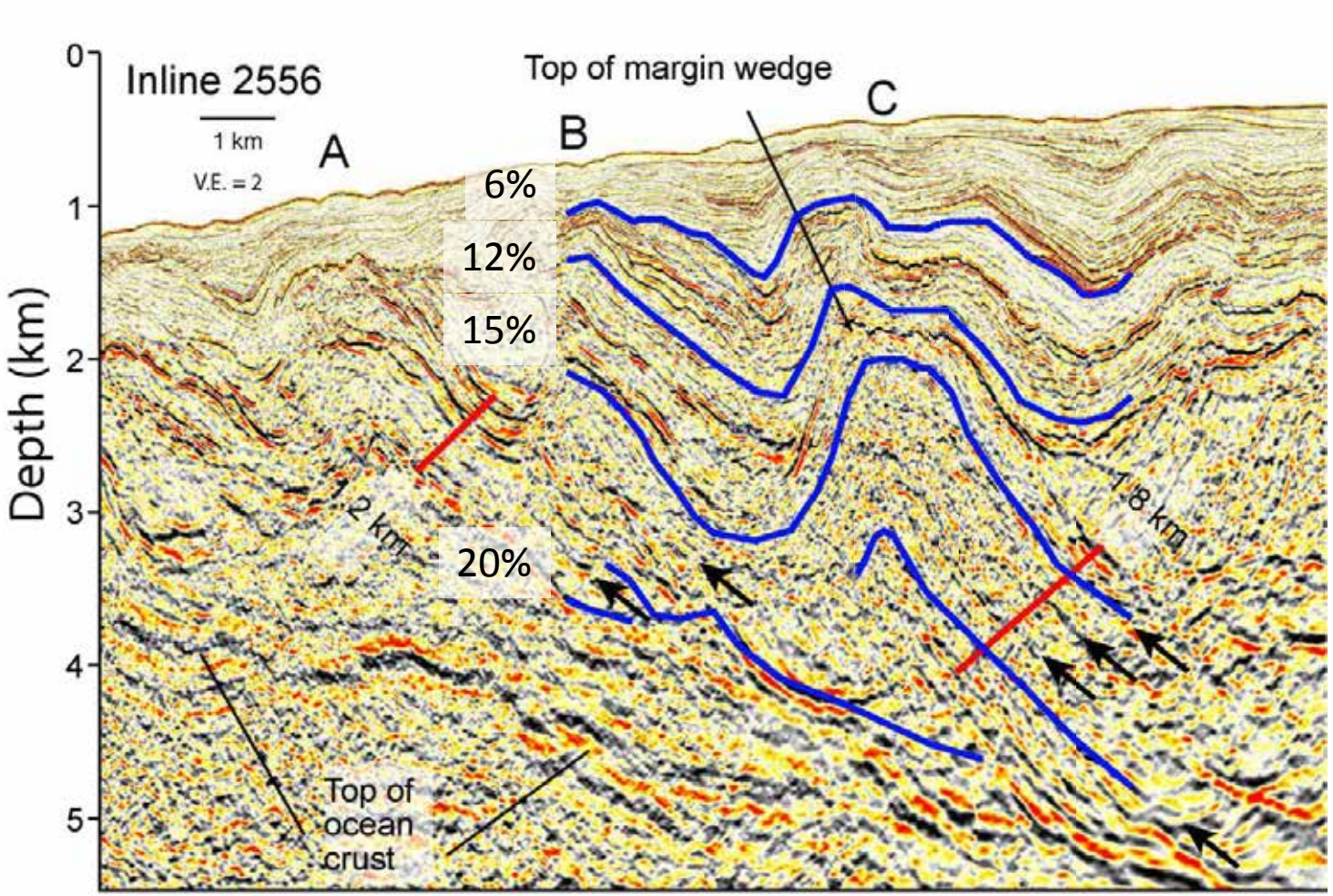


# Margin wedge thrusts cutting through entire overriding plate connecting into the plate-boundary thrust



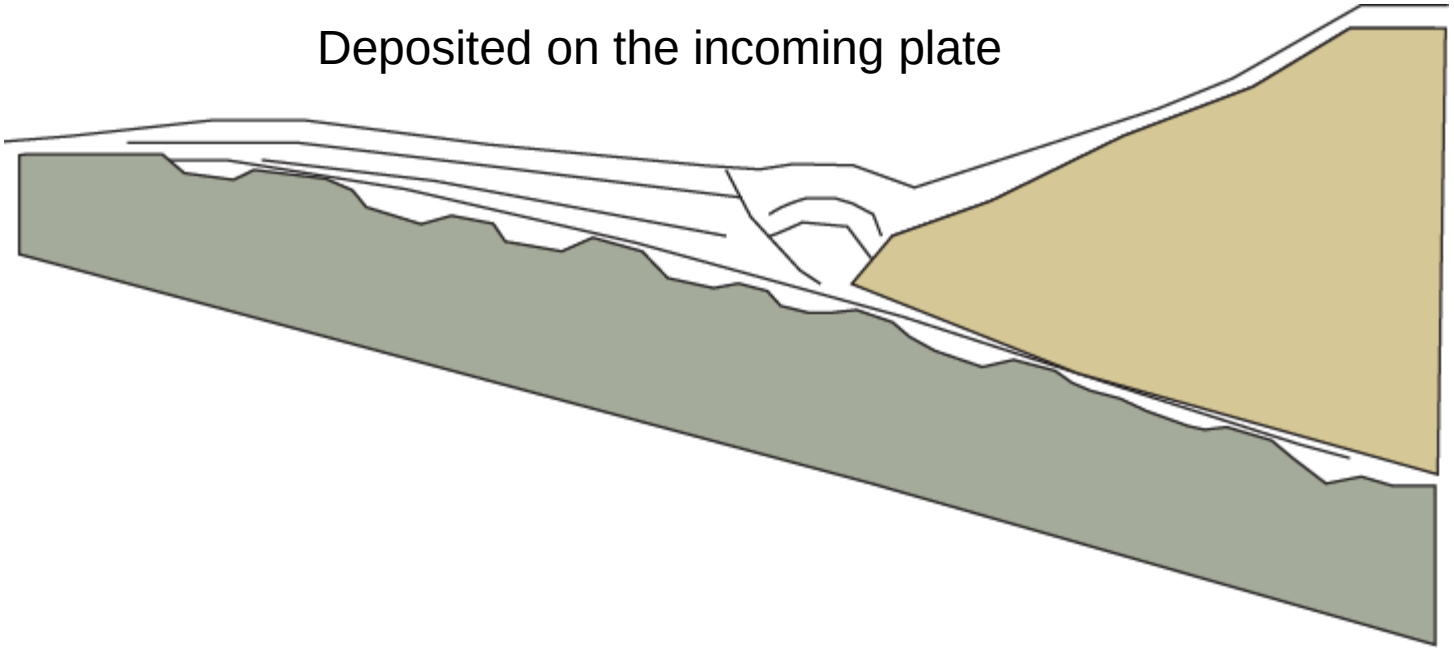
Fault-propagation folds within sediment sequences

Folded margin wedge strata directly extend to the plate-boundary thrust

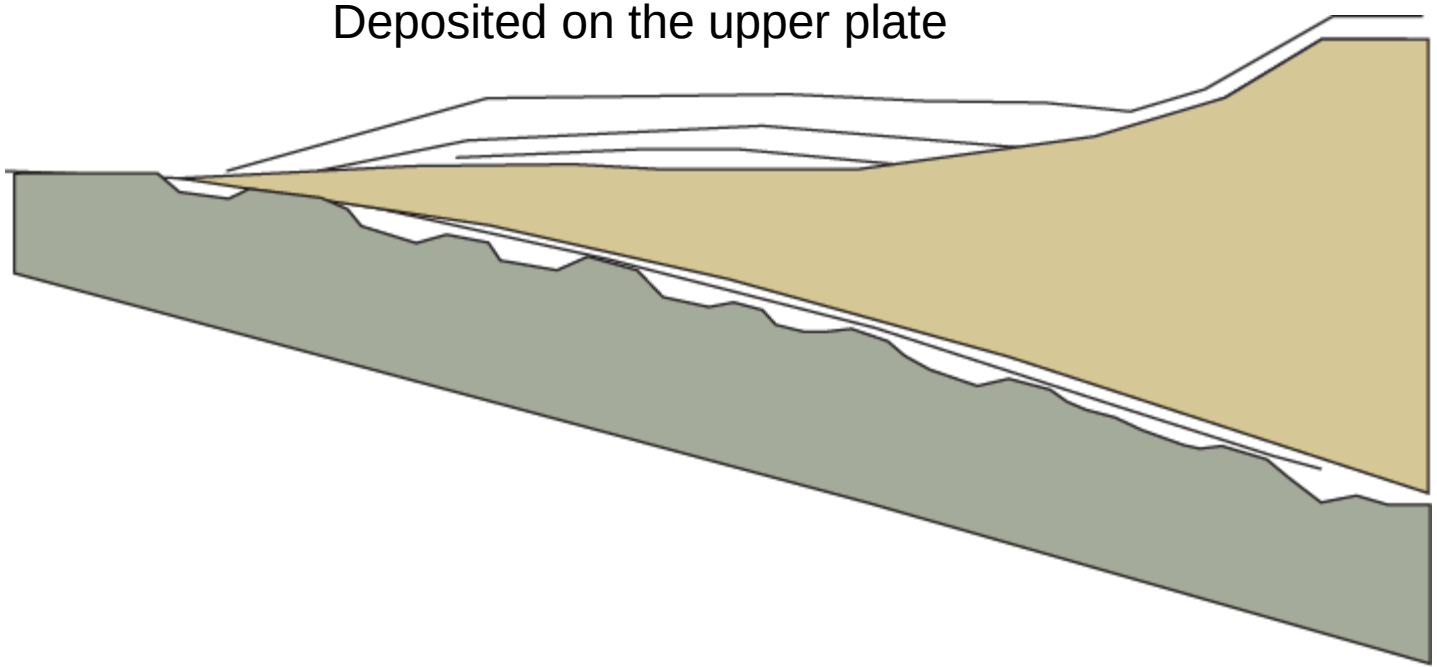


# What is the origin of the margin wedge sediment?

Deposited on the incoming plate

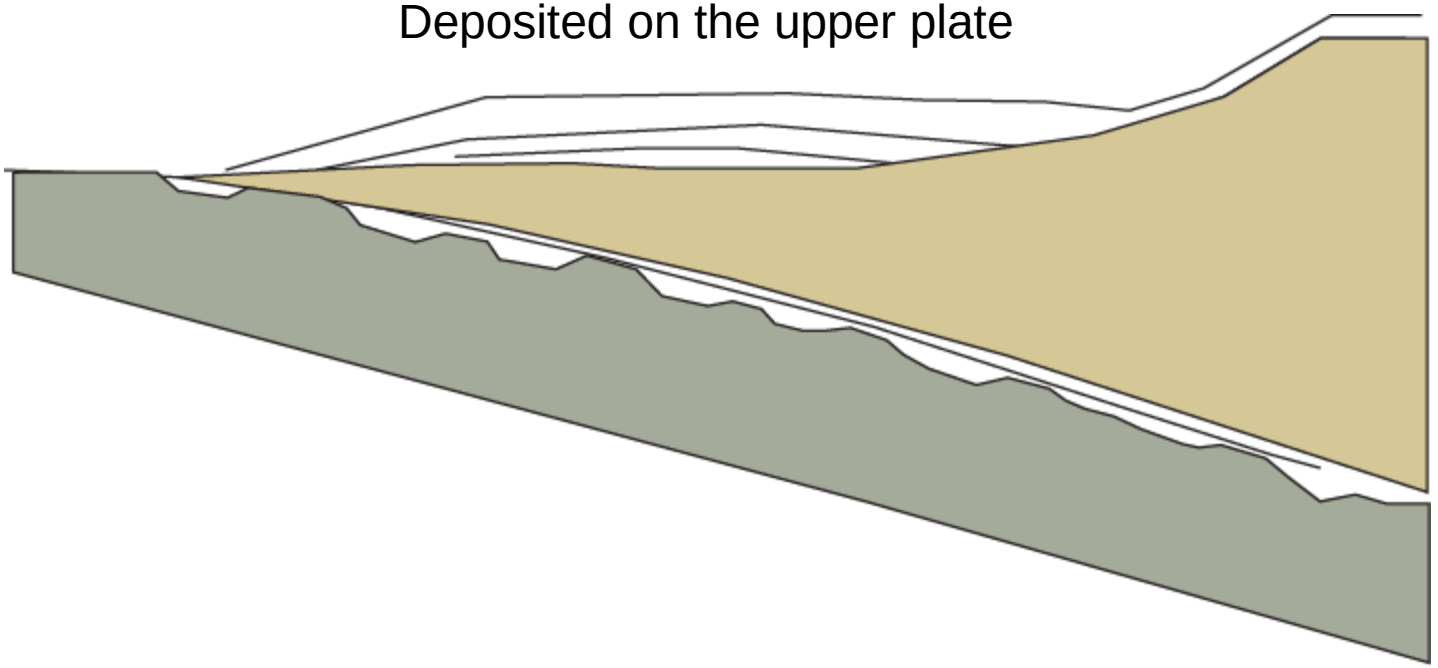


Deposited on the upper plate

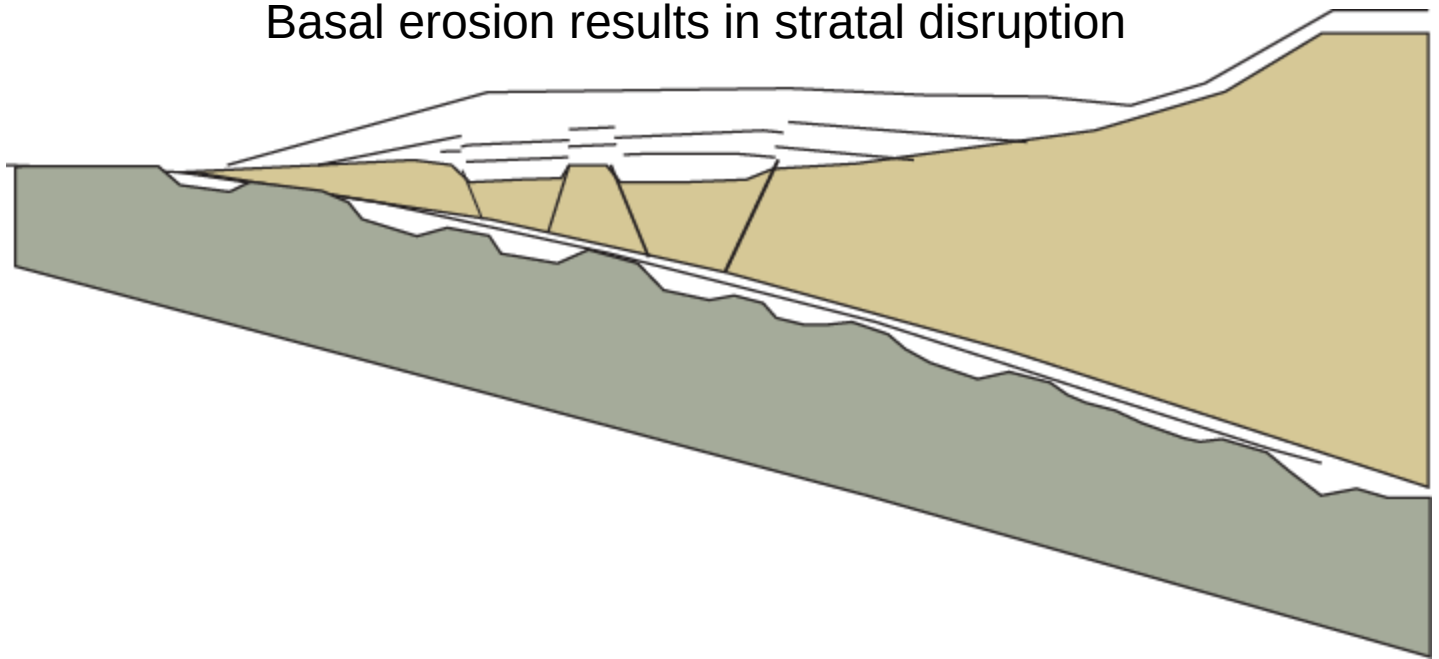


# Erosional model

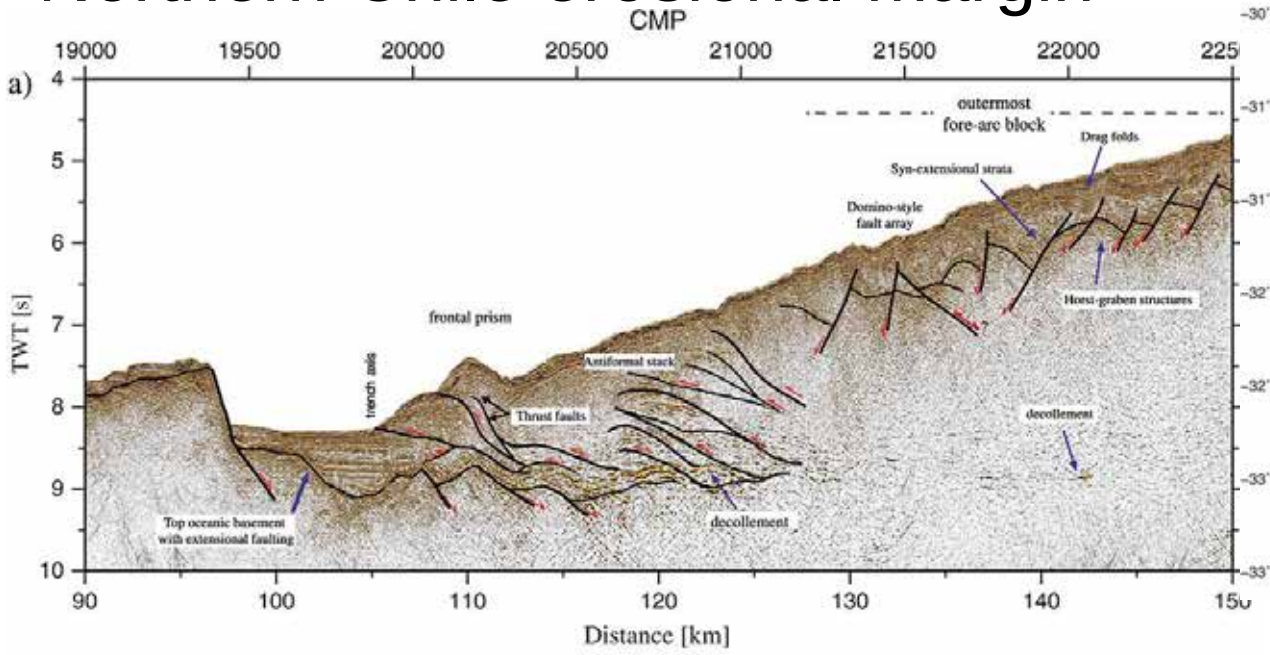
Deposited on the upper plate

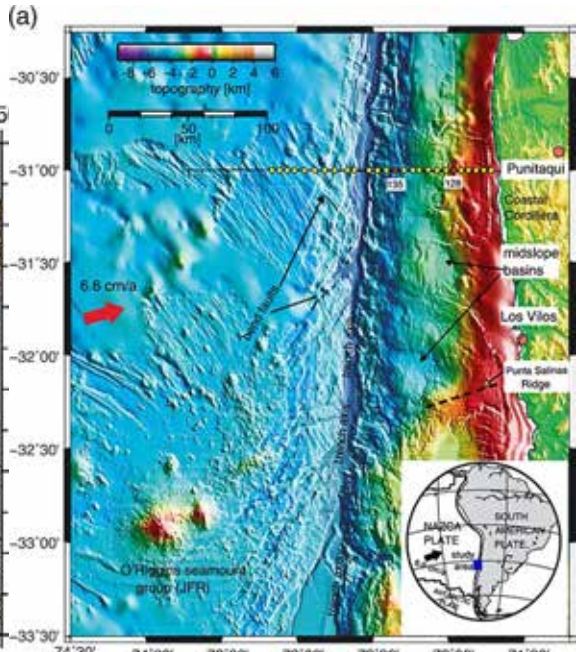


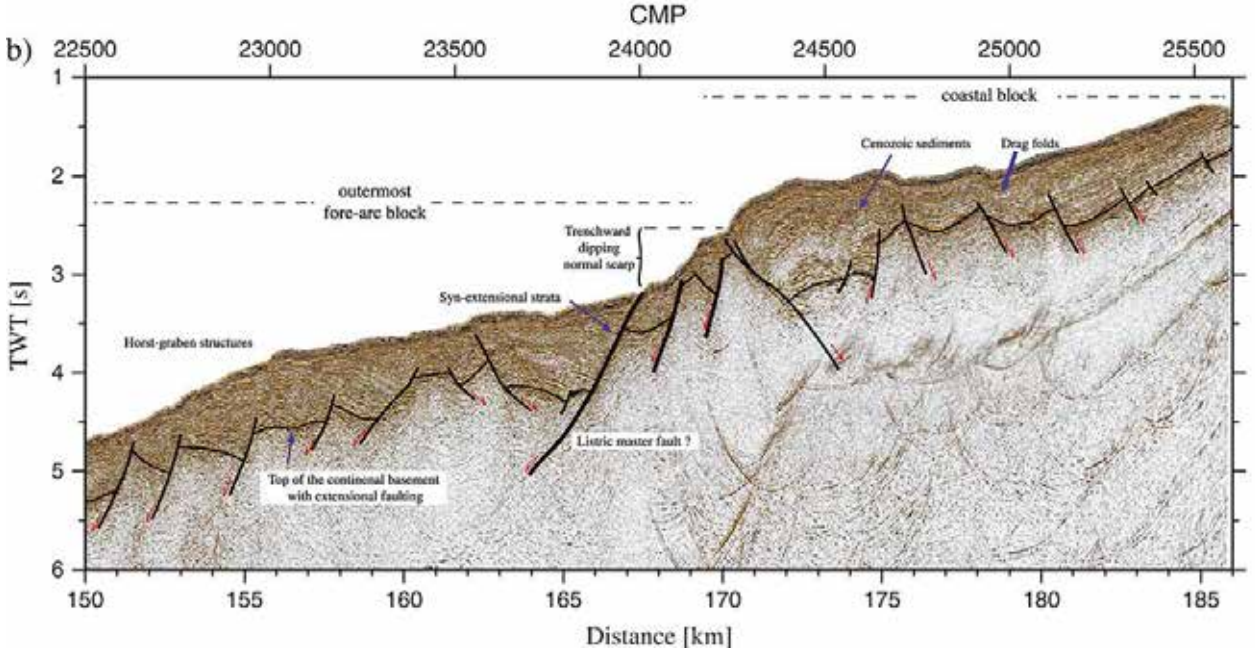
Basal erosion results in stratal disruption



# Northern Chile erosional margin



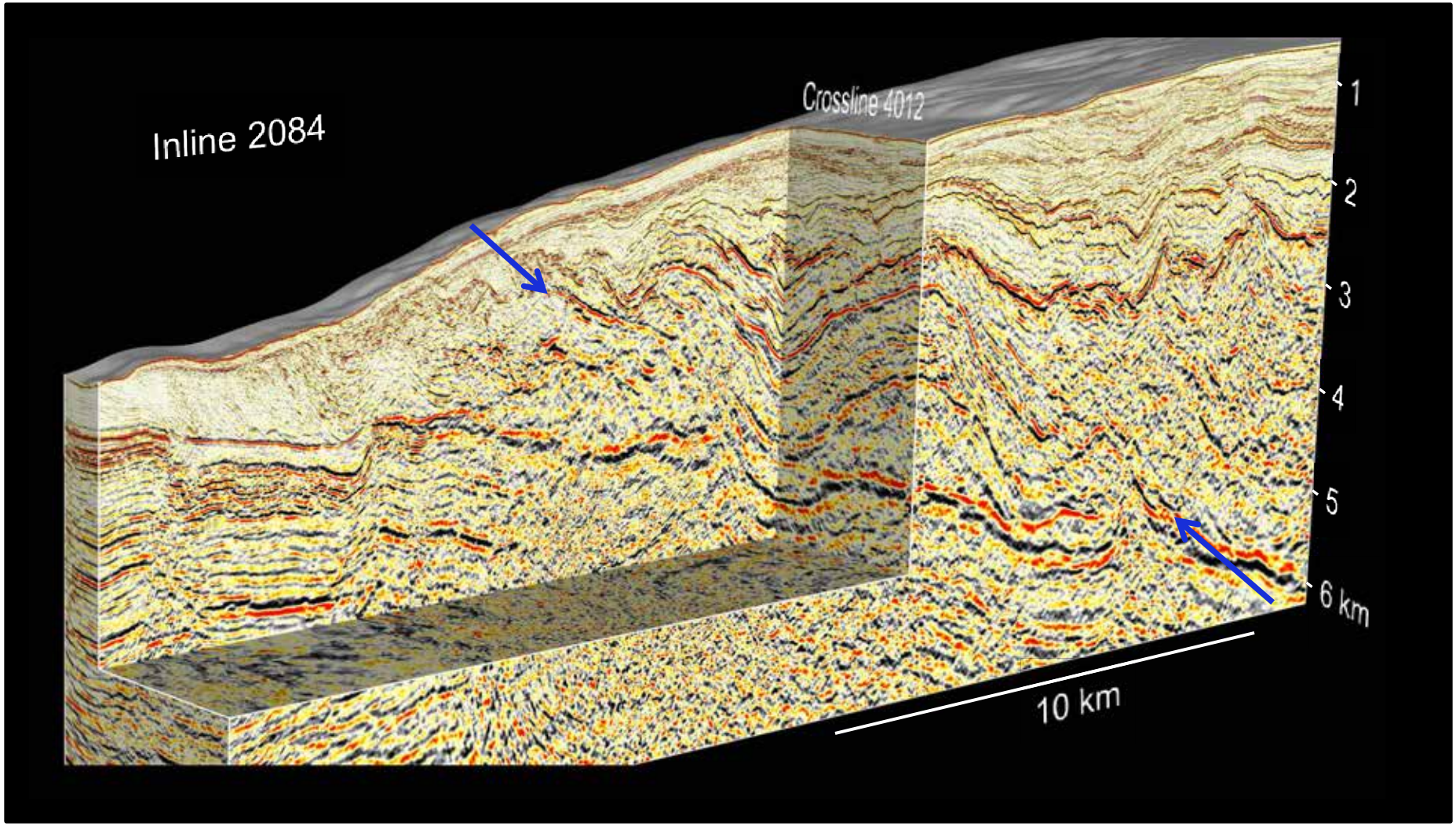



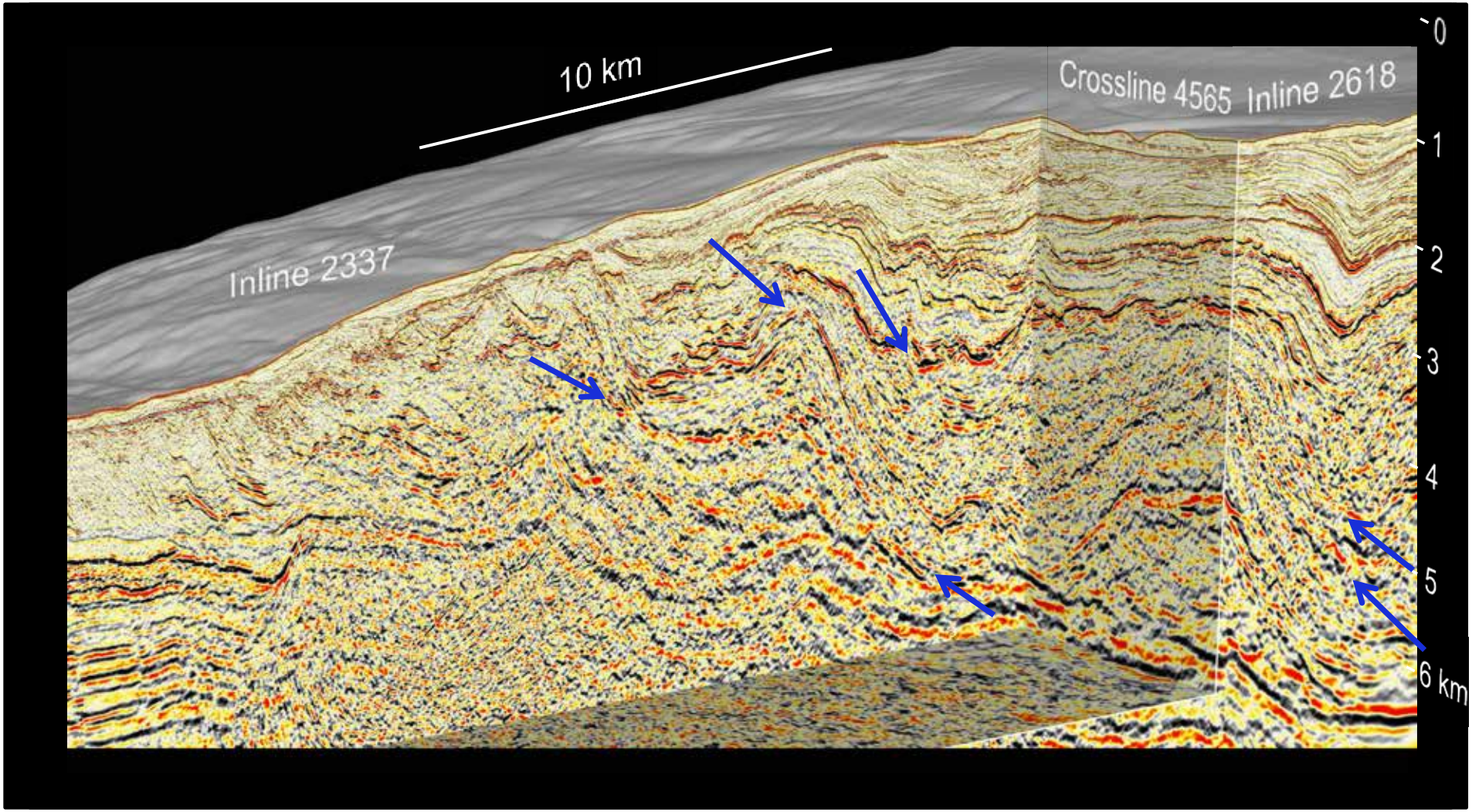

Extensive through-going normal faults with stratal disruption ~ 1 km

Contreras-Reyes et al., 2014

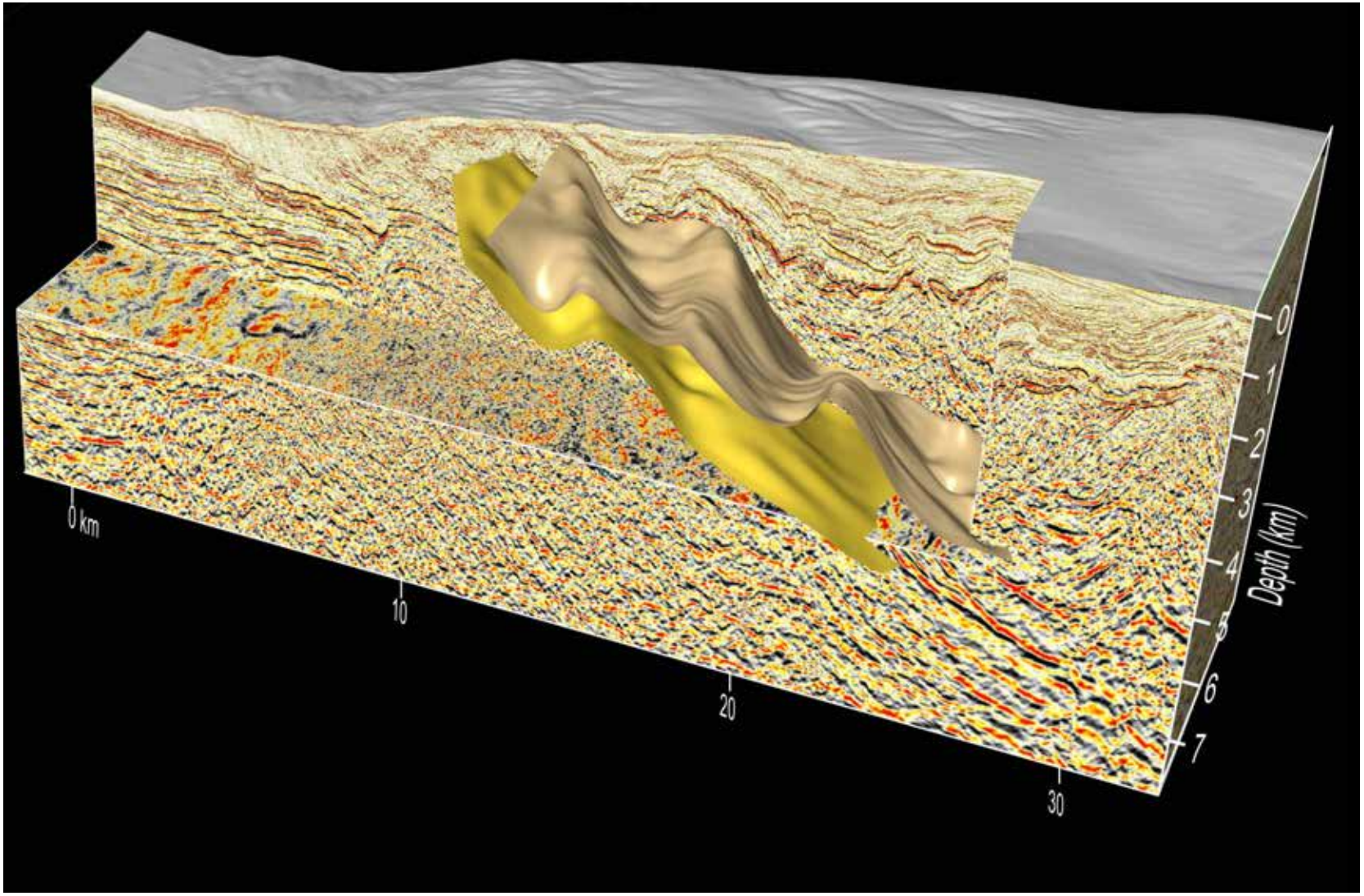
# Continuous Margin Wedge Strata



# Continuous margin wedge strata

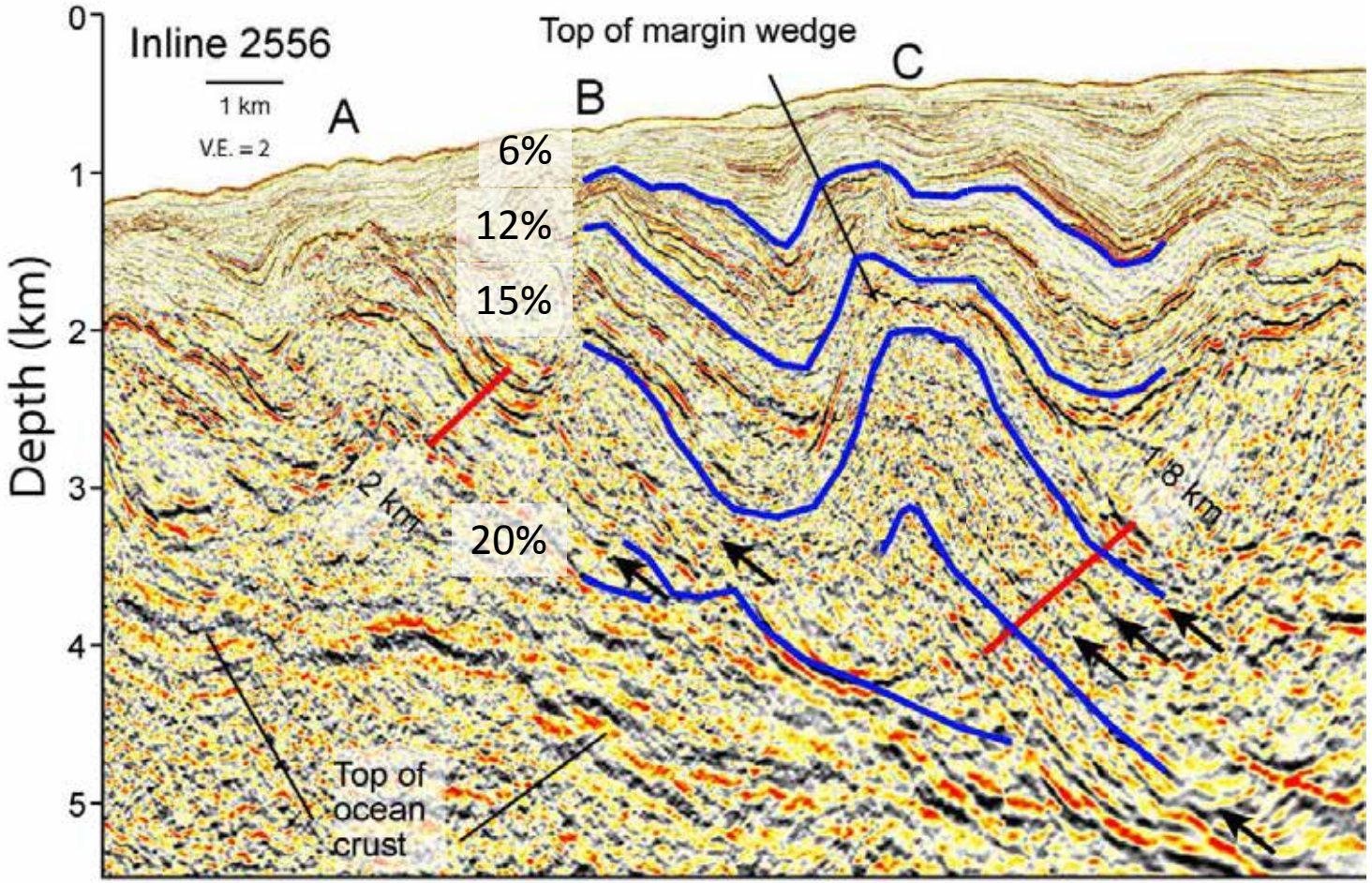


# Folded margin wedge strata mapped in 3D



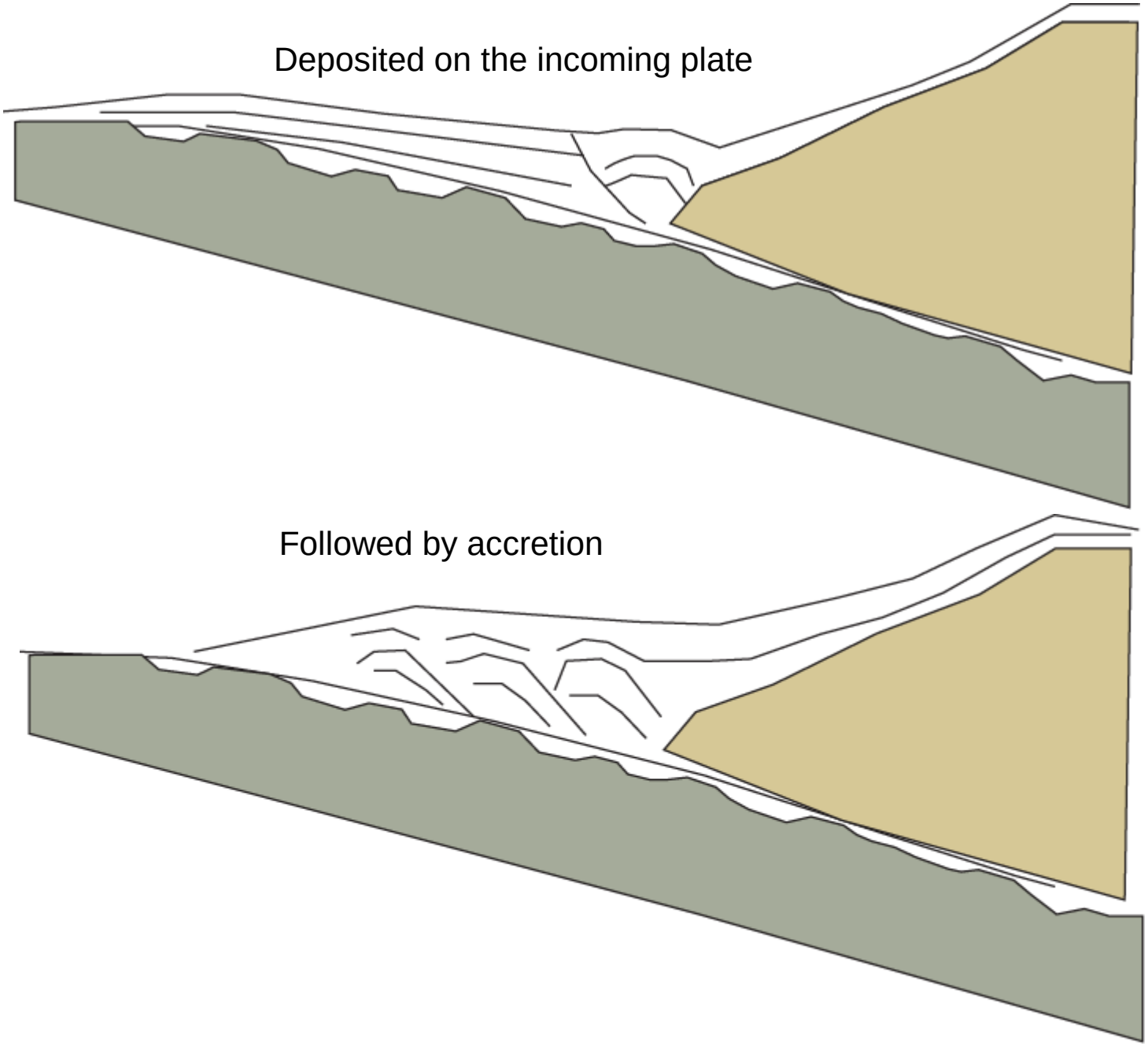
# Margin wedge strata thinning and shortening

- Progressive shortening
- Thinning sequences in seaward direction

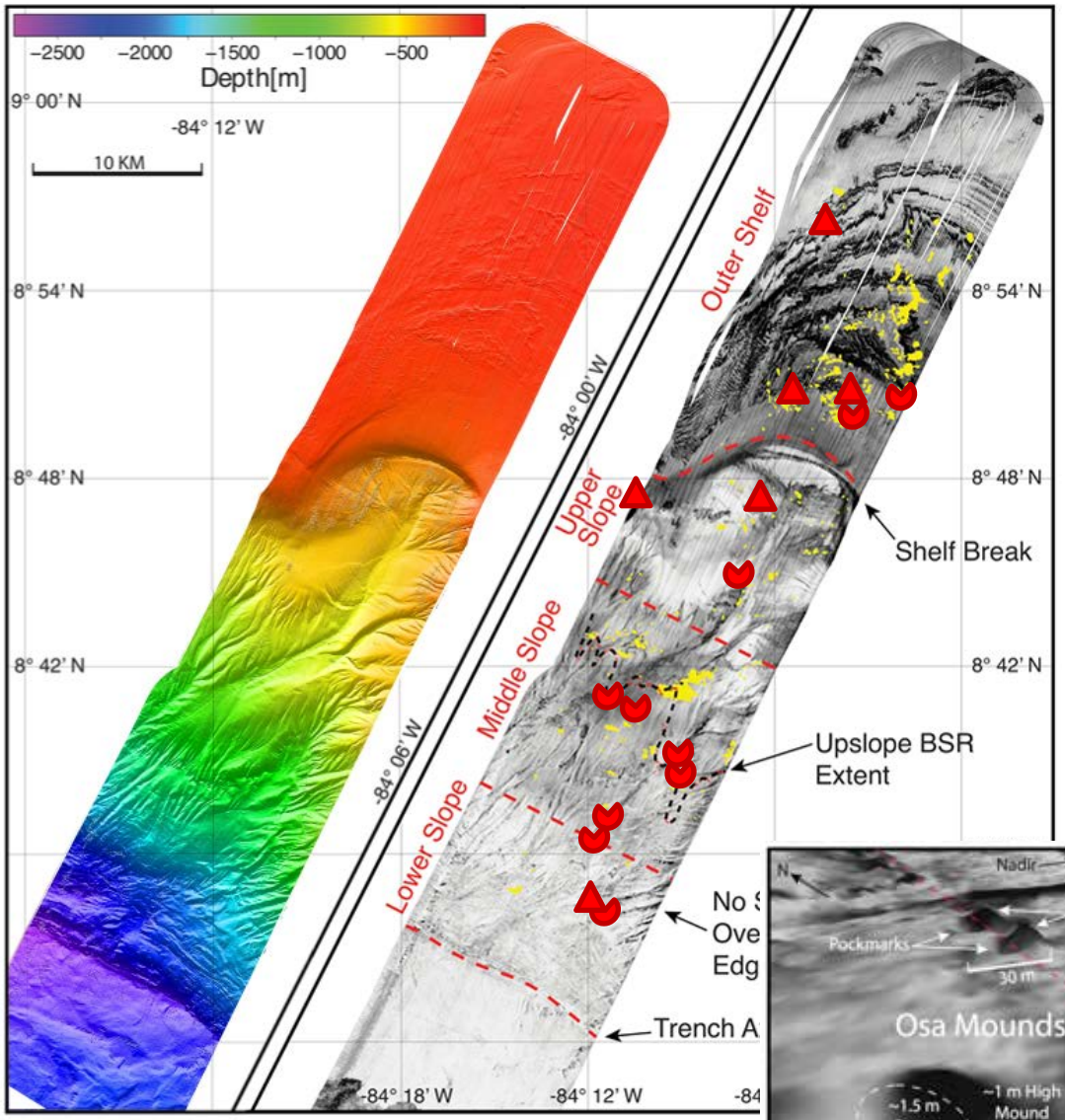


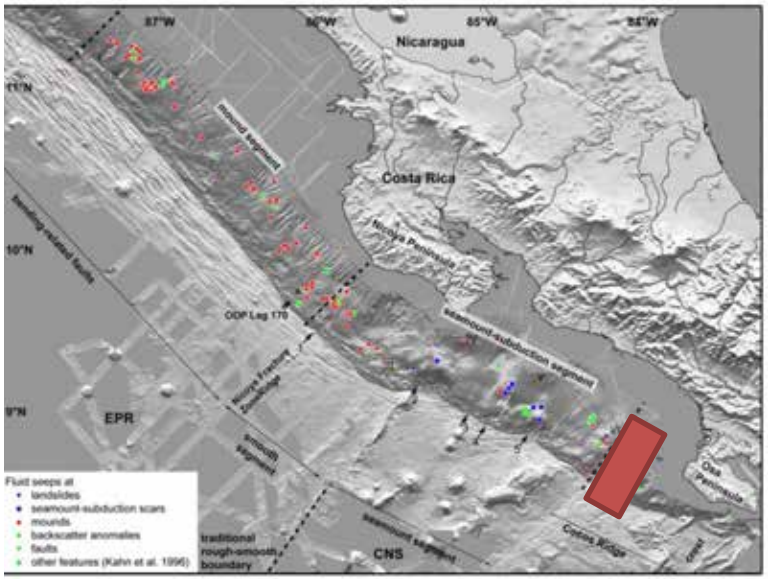

No evidence of underlying basement

# Accretionary model

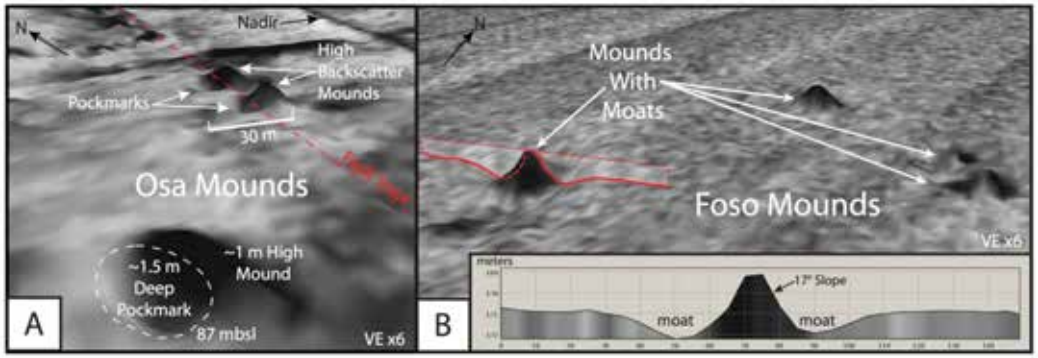


# Seafloor vents



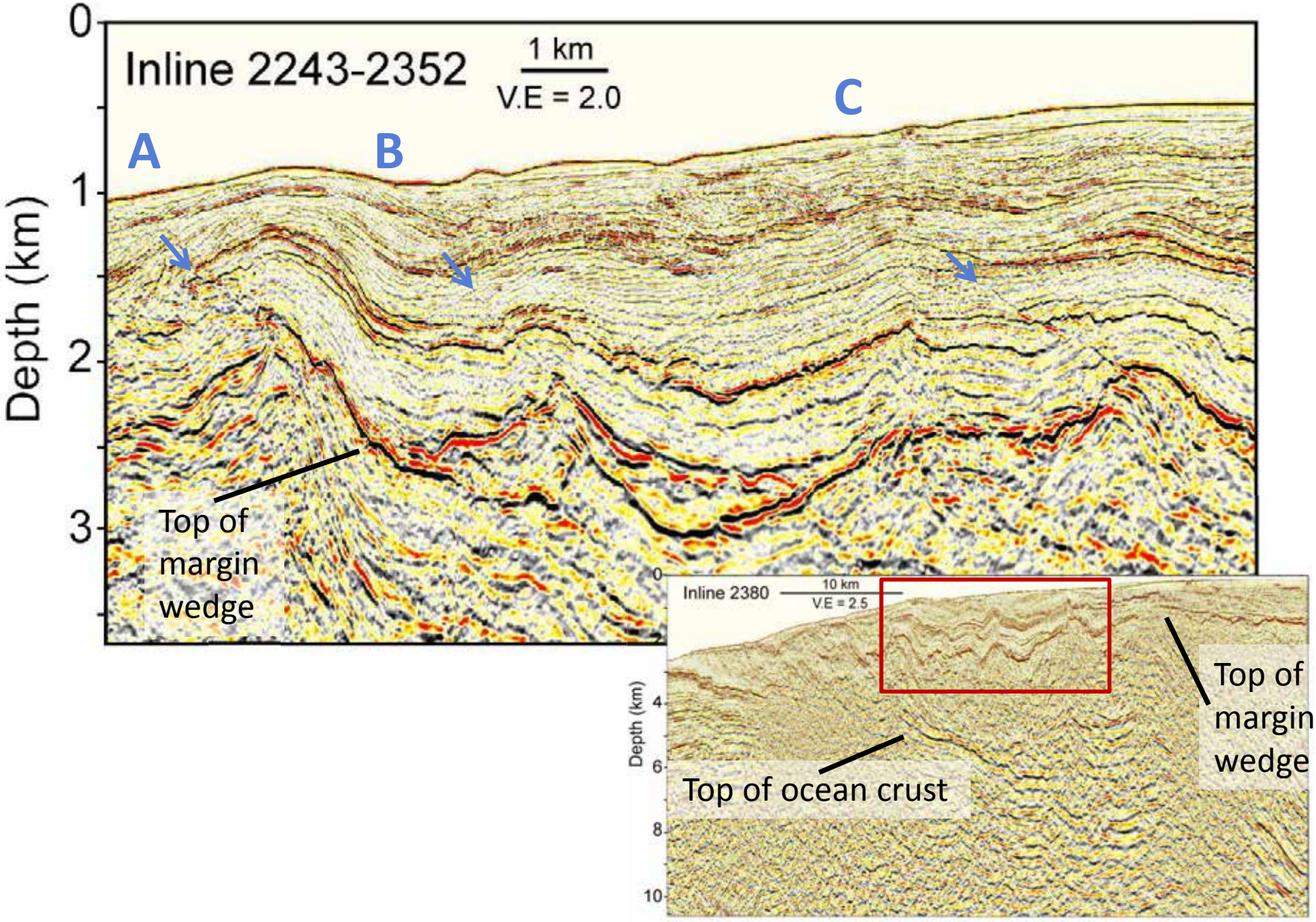




From Sahling et al., 2013

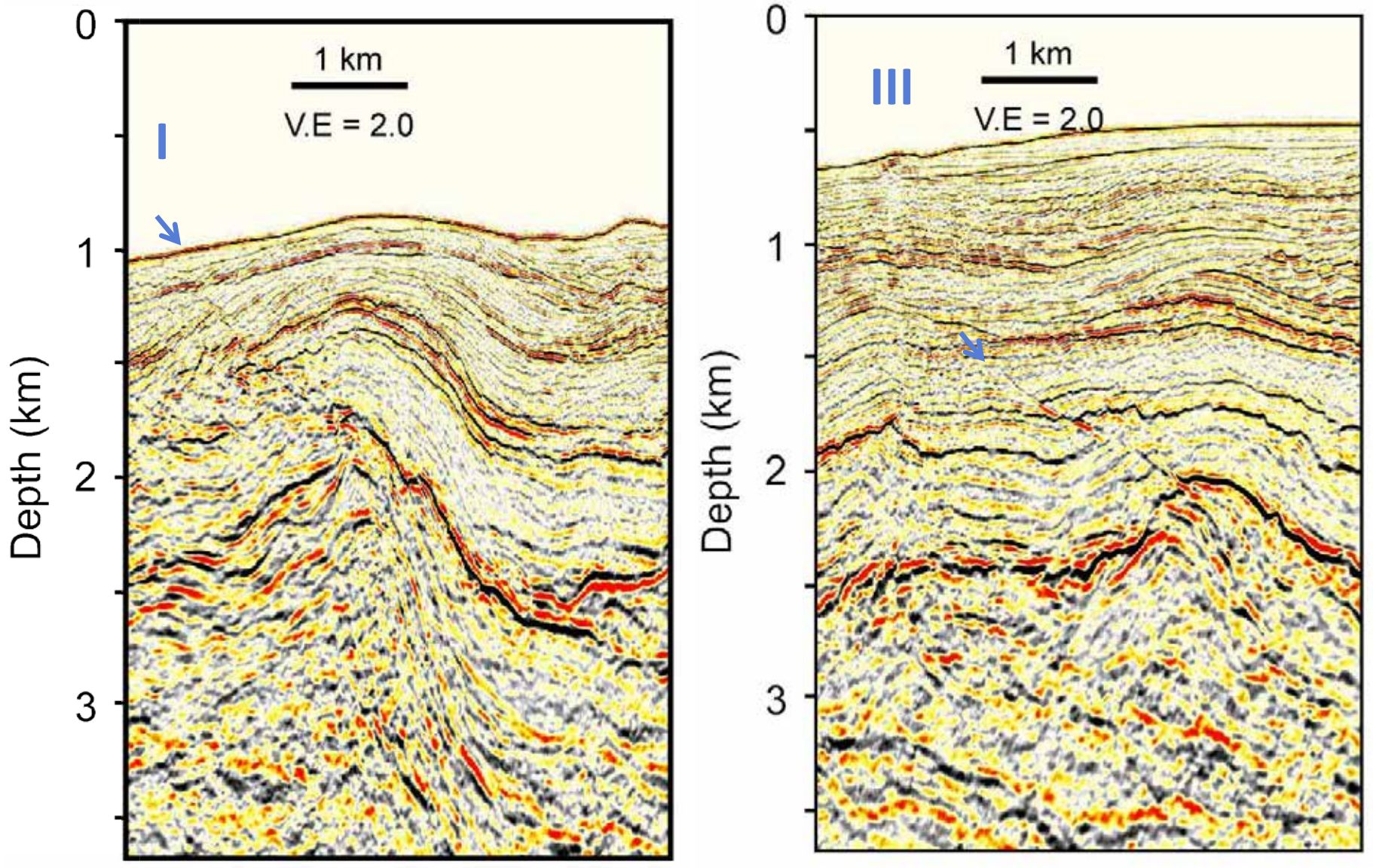



From Kluesner et al., 2013

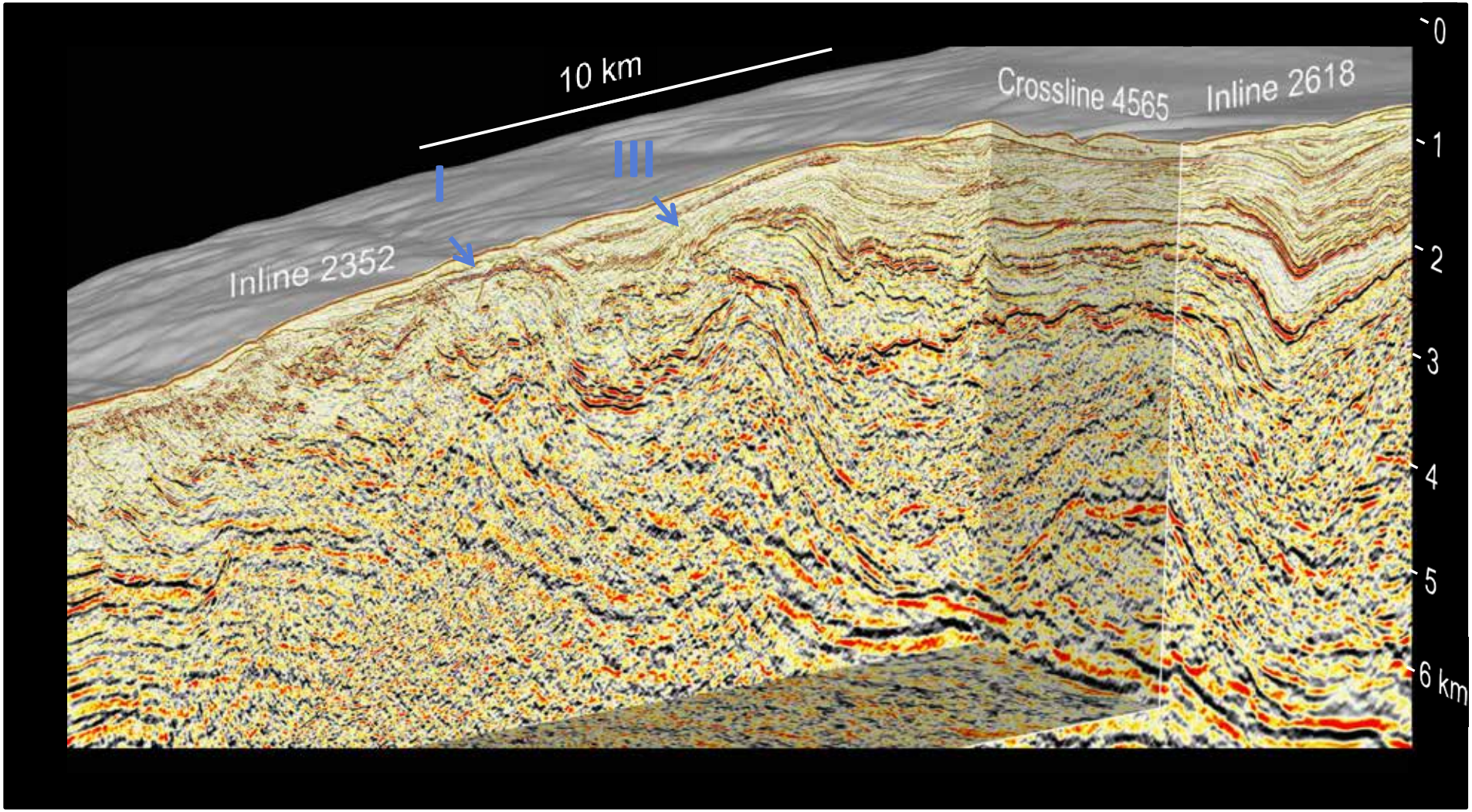
# Connectivity to margin wedge



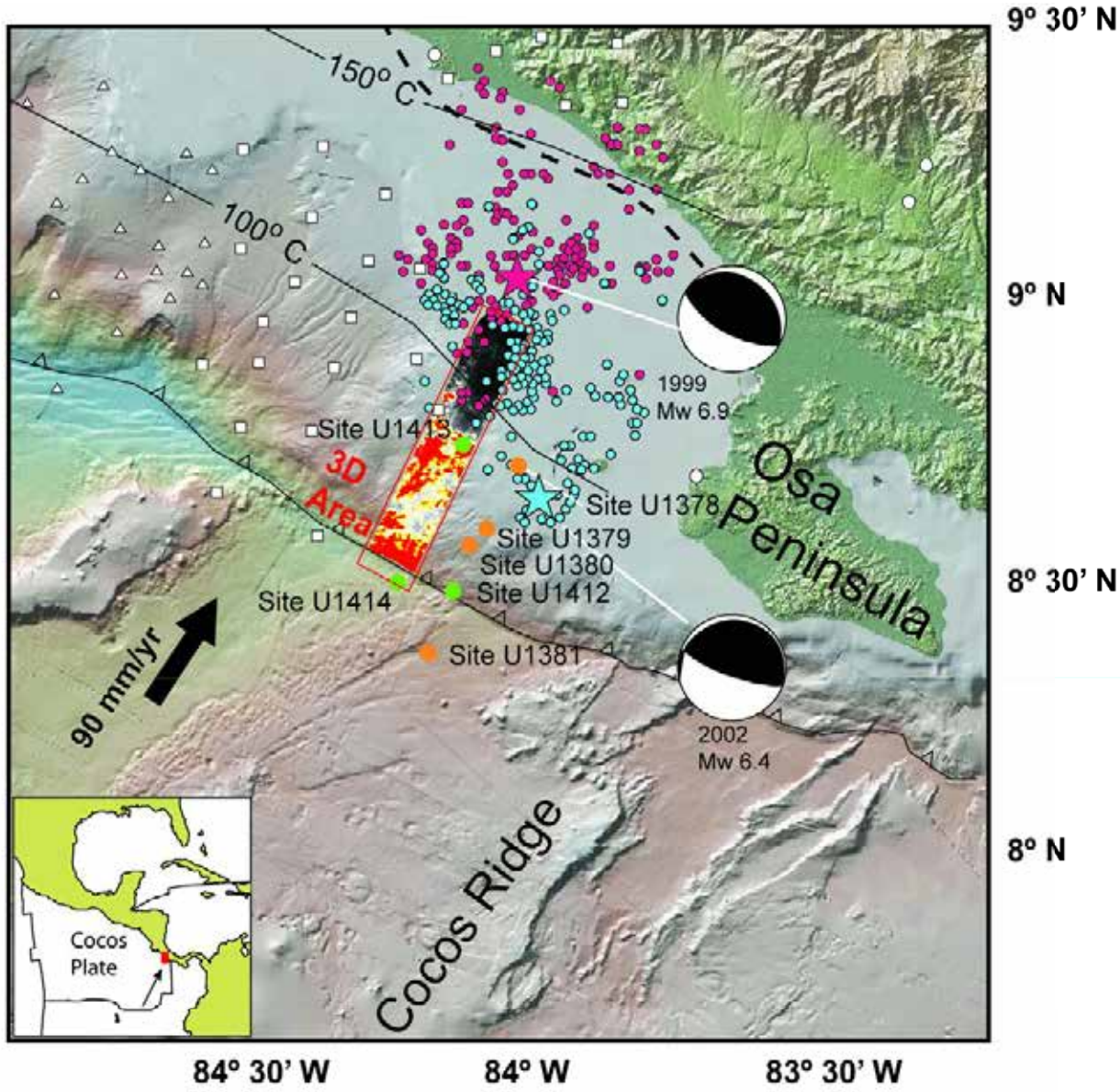
# Connectivity to margin wedge



# Fault-plane reflections and their links to margin wedge fabric



# Conclusions




The plate-boundary thrust along the Costa Rica margin develops a highly reflective, aseismic, presumably weak fault down to ~ 5 km, 30 km from the trench.

The structure of the margin wedge is consistent with an episode of recent sediment accretion.

Do fluid-rich, potentially weak plate-boundaries within the shallow forearc develop as a characteristic of accretionary margins?