



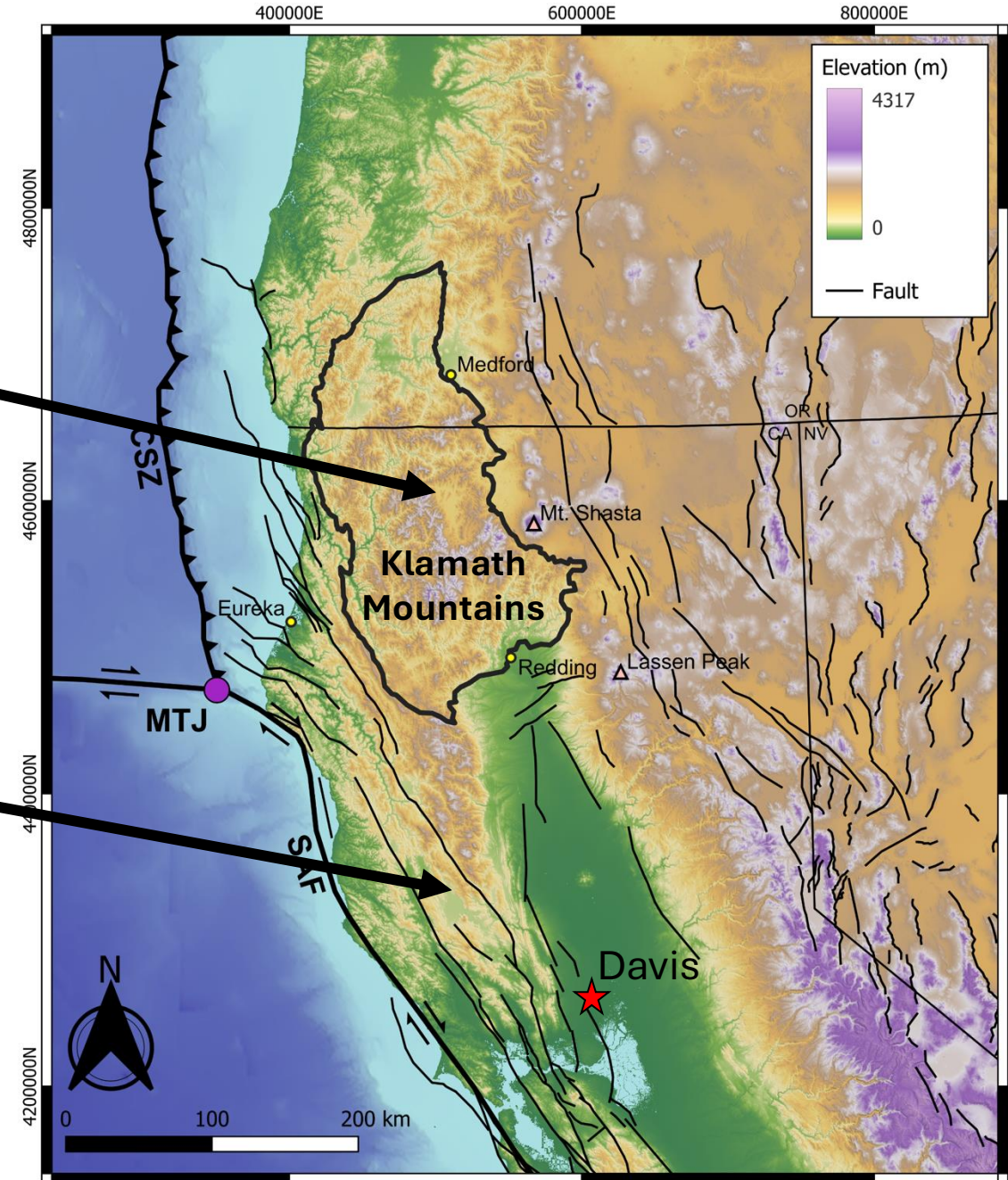
Active Extension of the Southern Cascadia Forearc & Absence of Extension within the Northern Coast Range

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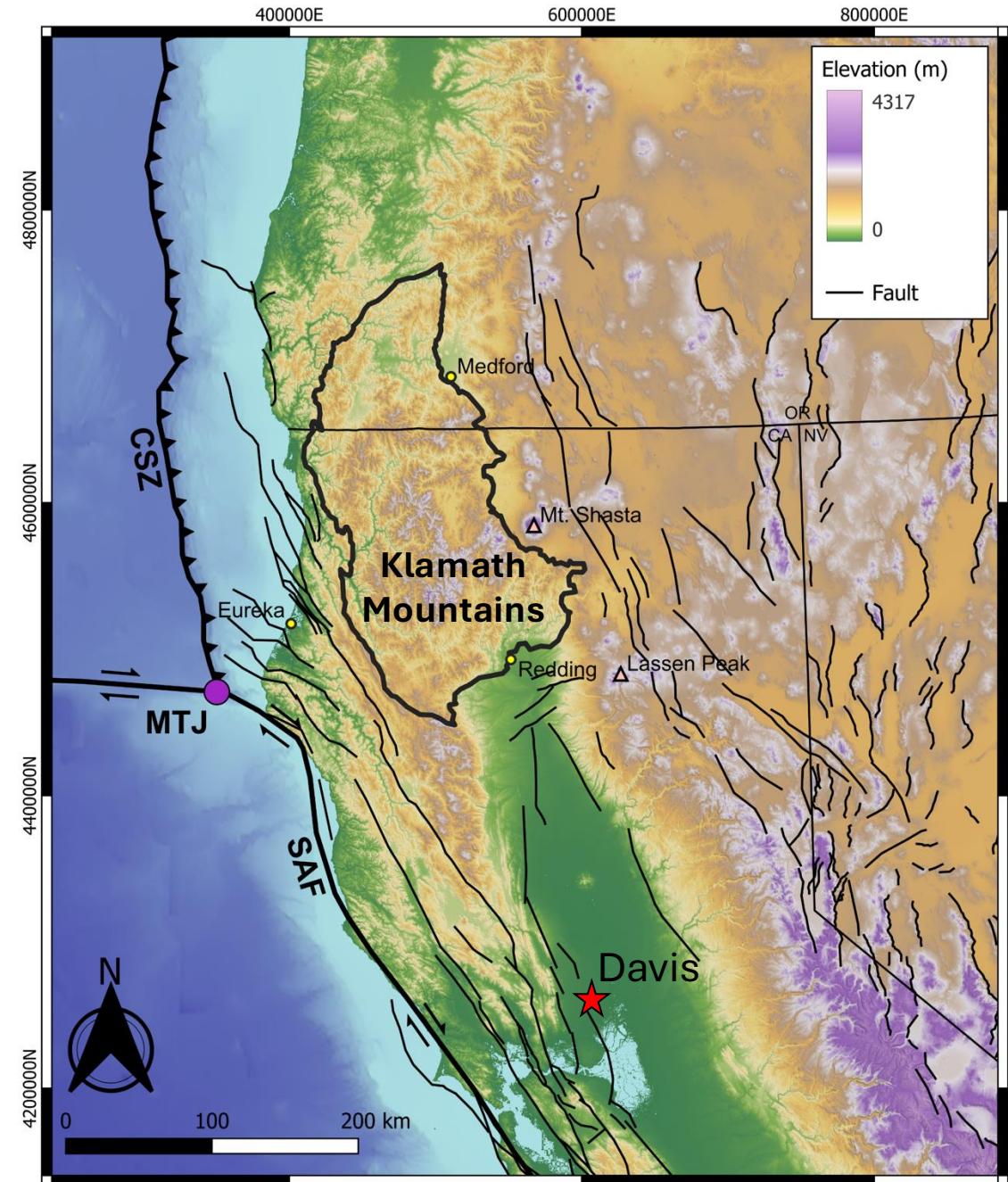
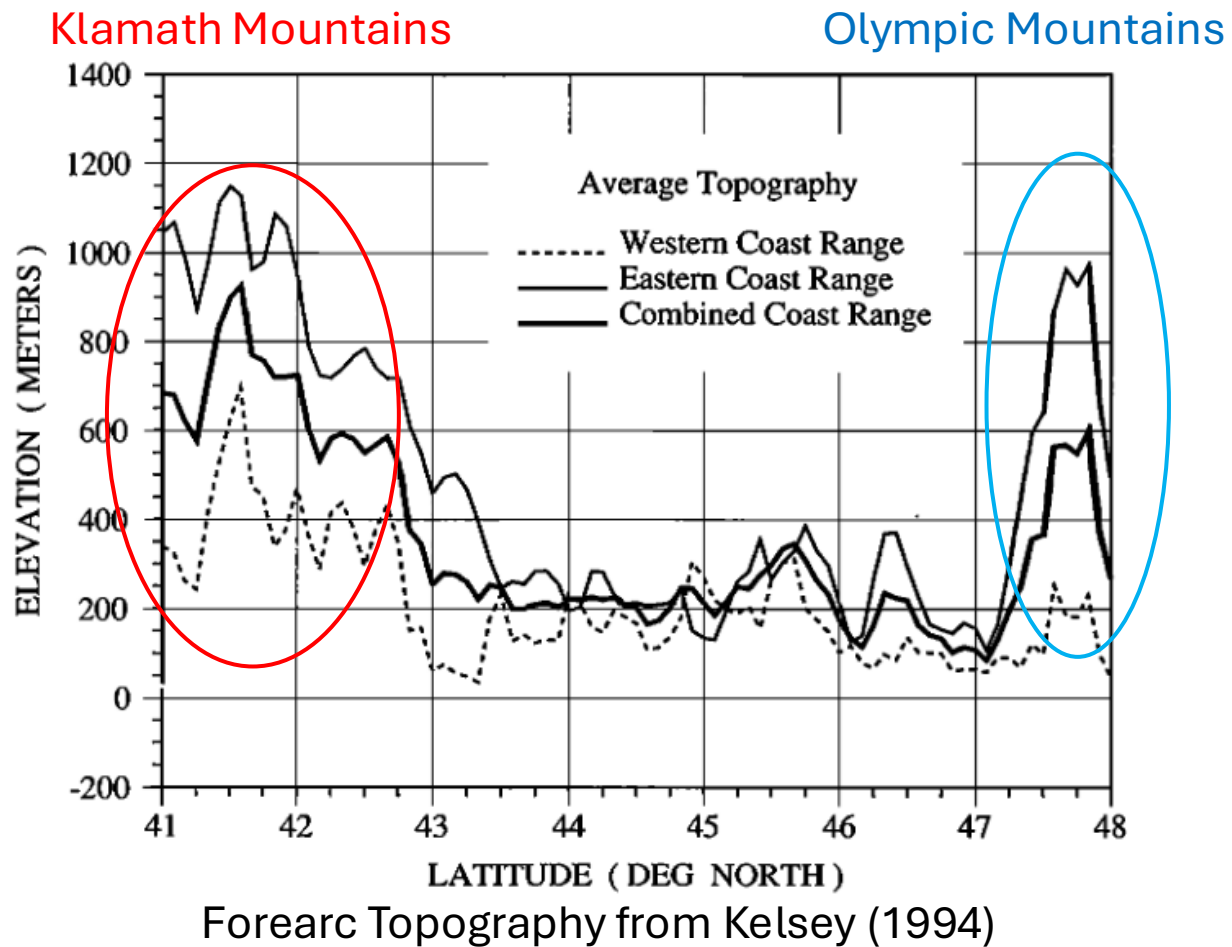
Talk Outline:

Active east-west extension here
within the Klamath Mountains,
due to subcretion / underplating.

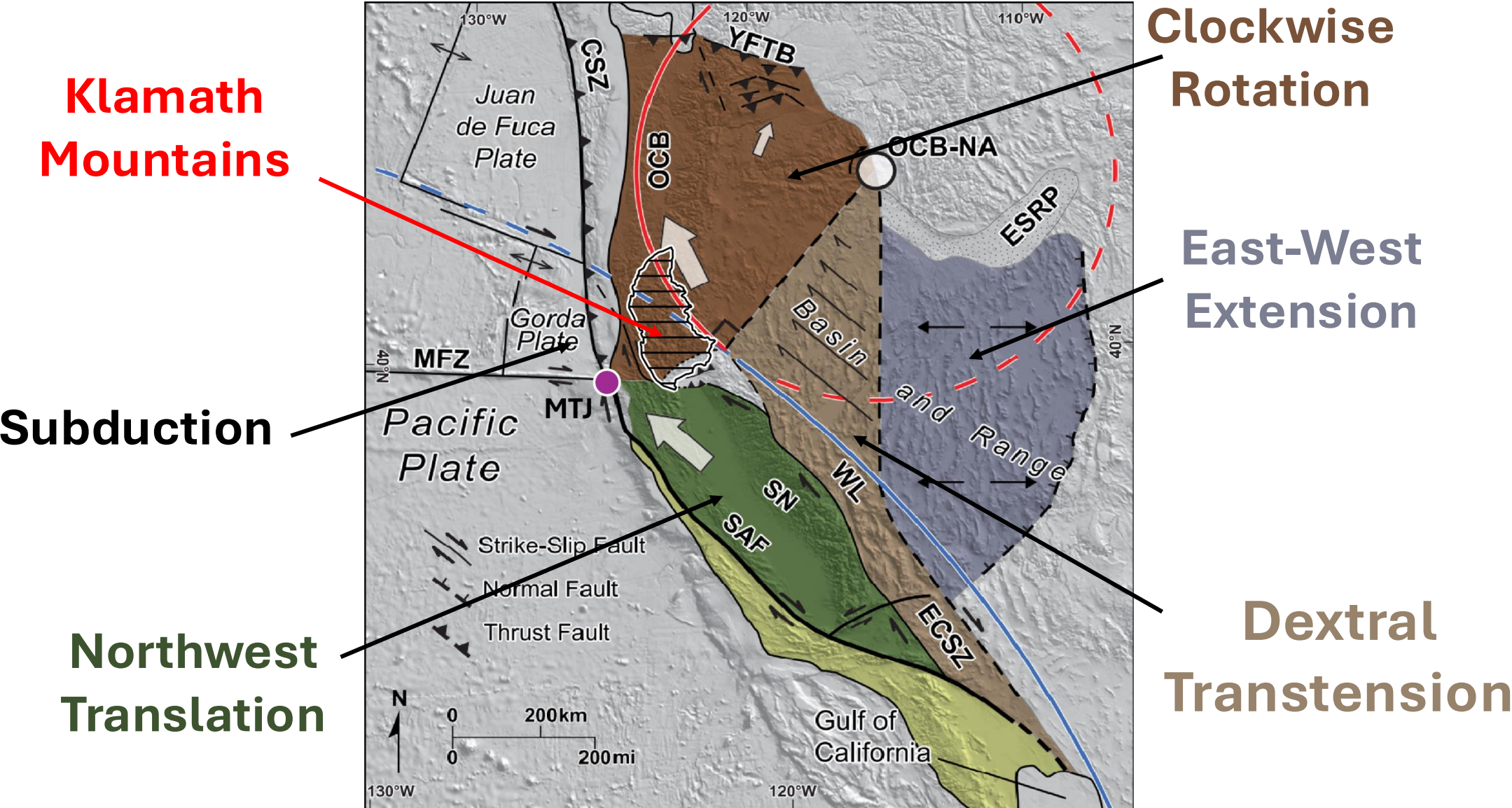
Absence of extension here
within Northern Coast Range,
contrary to MCC prediction.



Klamath Mountains are the highest topography of Cascadia Forearc. Why no active faults?



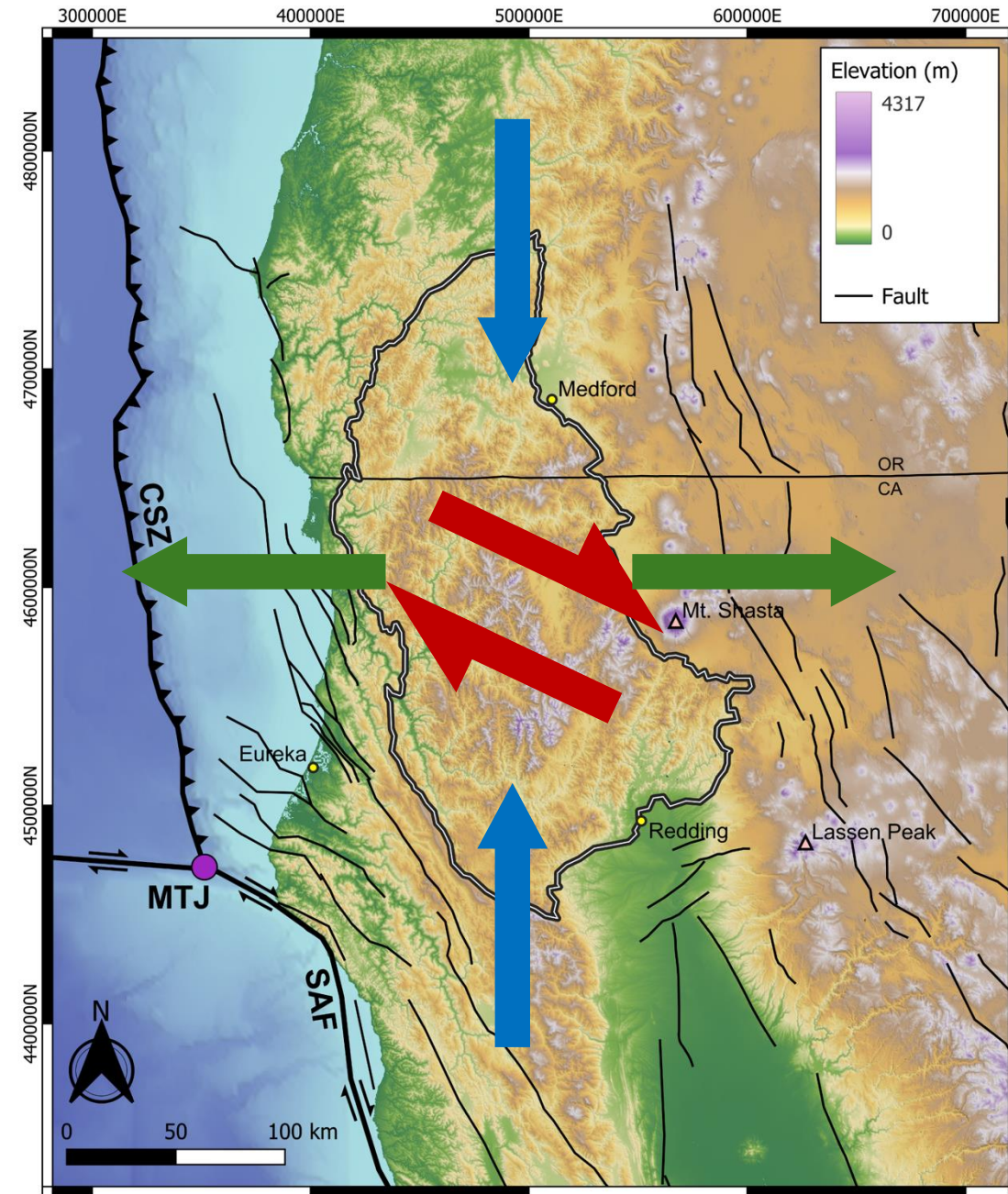
Klamath Mountains Reside at a Tectonic Intersection



Unruh and Humphrey (2017)

Hypotheses for what the Klamath Mountains *should* be doing

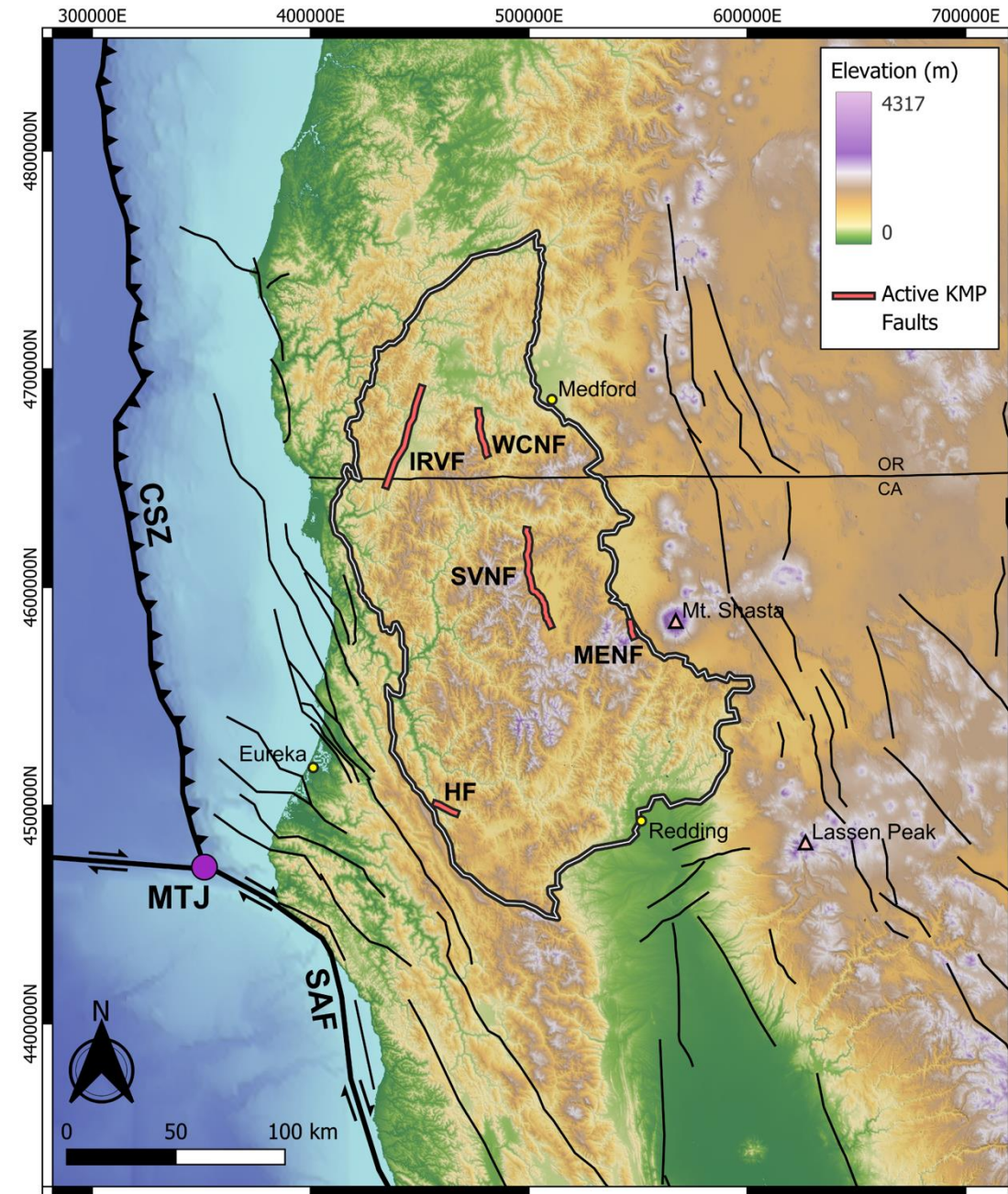
- WNW-directed **dextral transpression** (Unruh & Humphrey, 2017)
- East-west **extension** due to slab rollback (Humphreys & Coblenz, 2007)
- North-south **contraction** (Hammond & Thatcher, 2005)
- **Rotate** rigidly (Mckenzie et al., 2022)



Lynch (2025 MS thesis) used newly released lidar data to document four active faults:

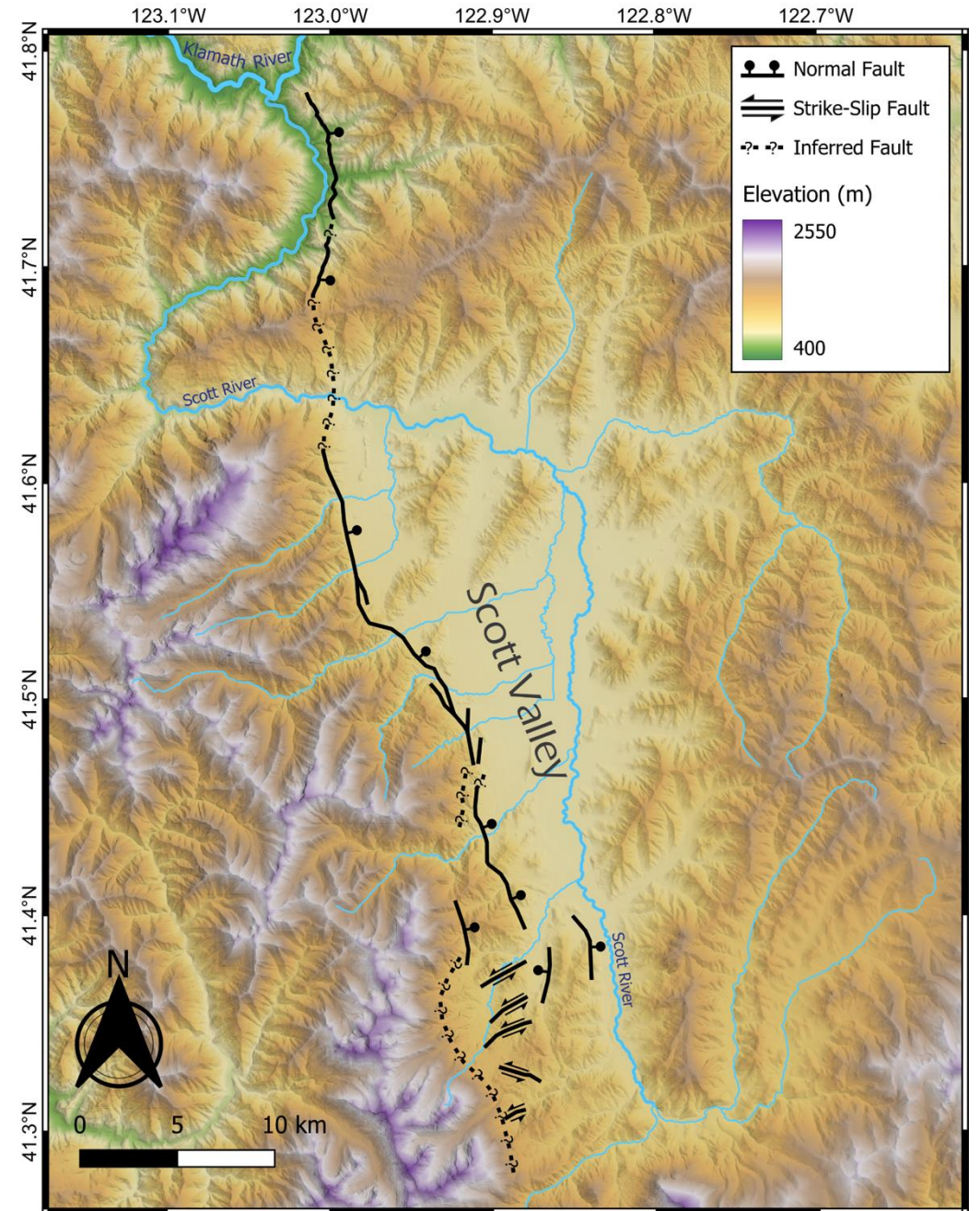
- Scott Valley normal fault (SVNF)
- Hyampom strike-slip fault (HF)
- Mount Eddy normal fault (MENF)
- Williams Creek normal fault (WCNF)

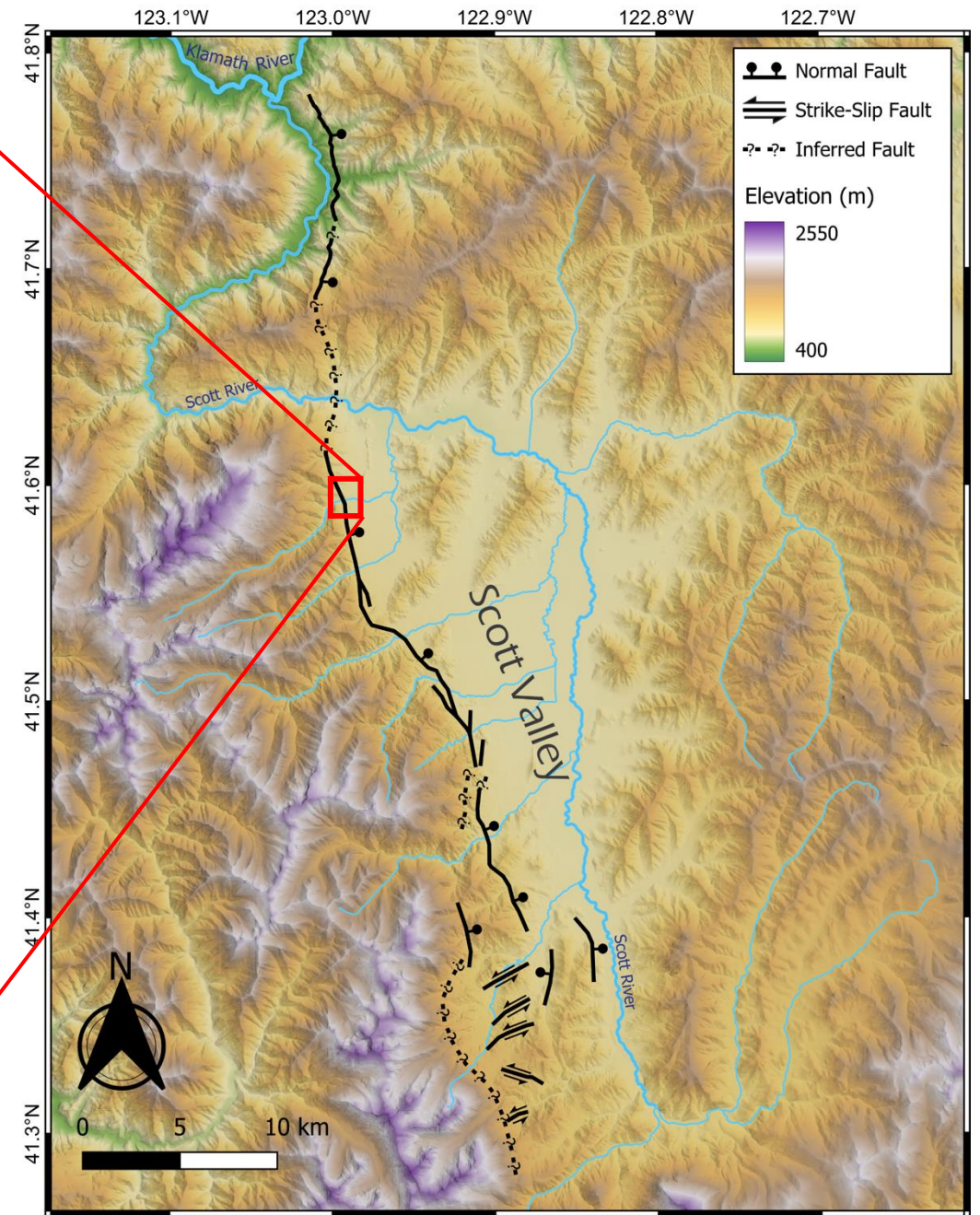
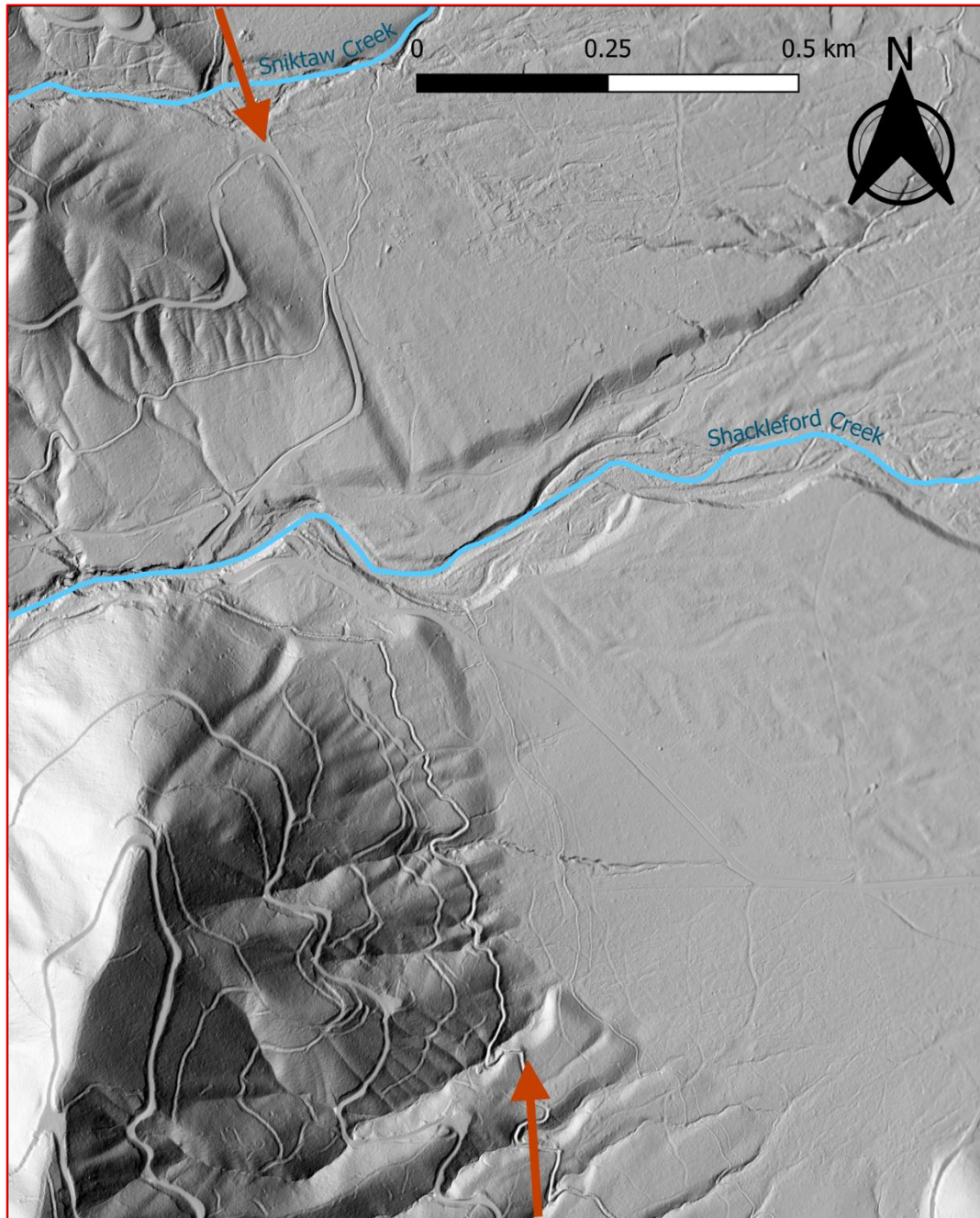
Yule (1996) and Kirby (2023) propose reverse slip on Illinois River Valley fault (IRVF) but no scarps or folding evident.

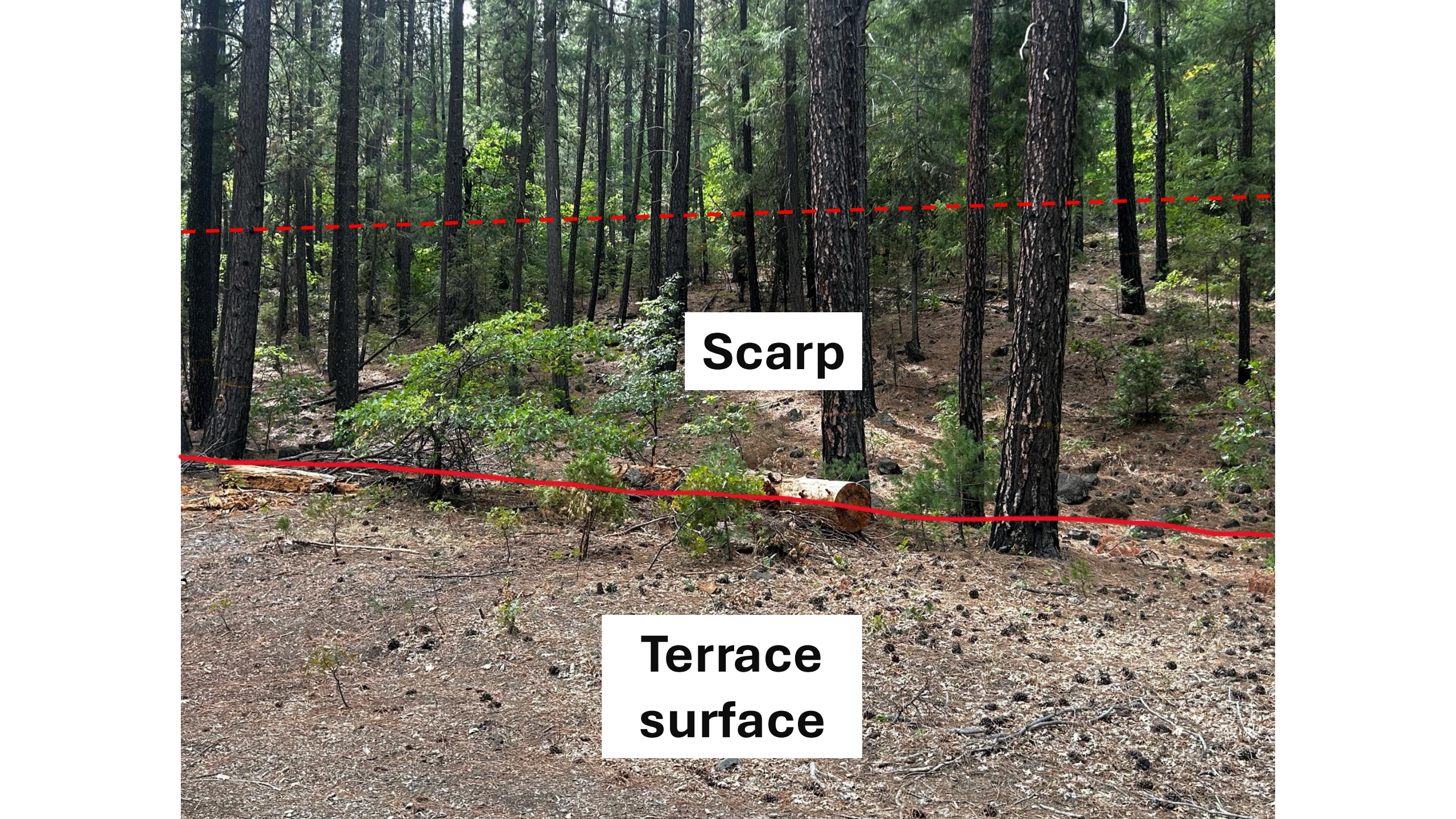


Scott Valley Normal Fault

- Fault-bounded intramontane basin
- Footwall is a steep east-facing mountain front (~2500 m peaks)
- Hangingwall is a flat valley (~800 m) with bedrock ridges surrounded by alluvial fill.
- Fault scarps extend for 55 km along west side of valley, extending almost to the Klamath River





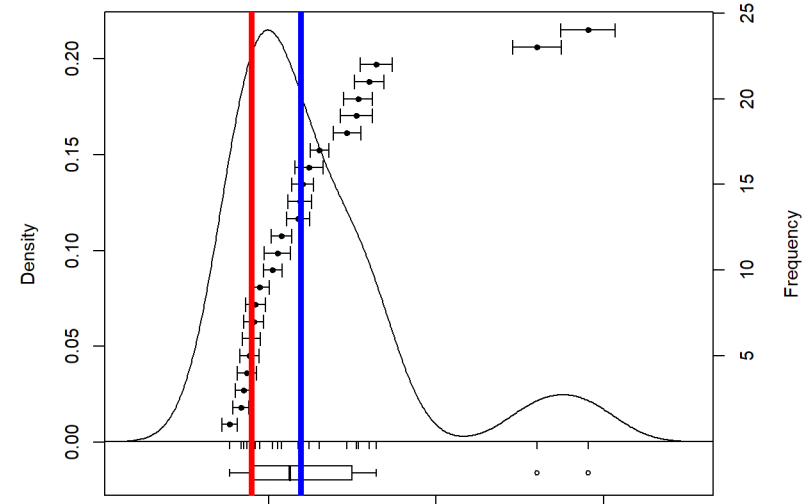
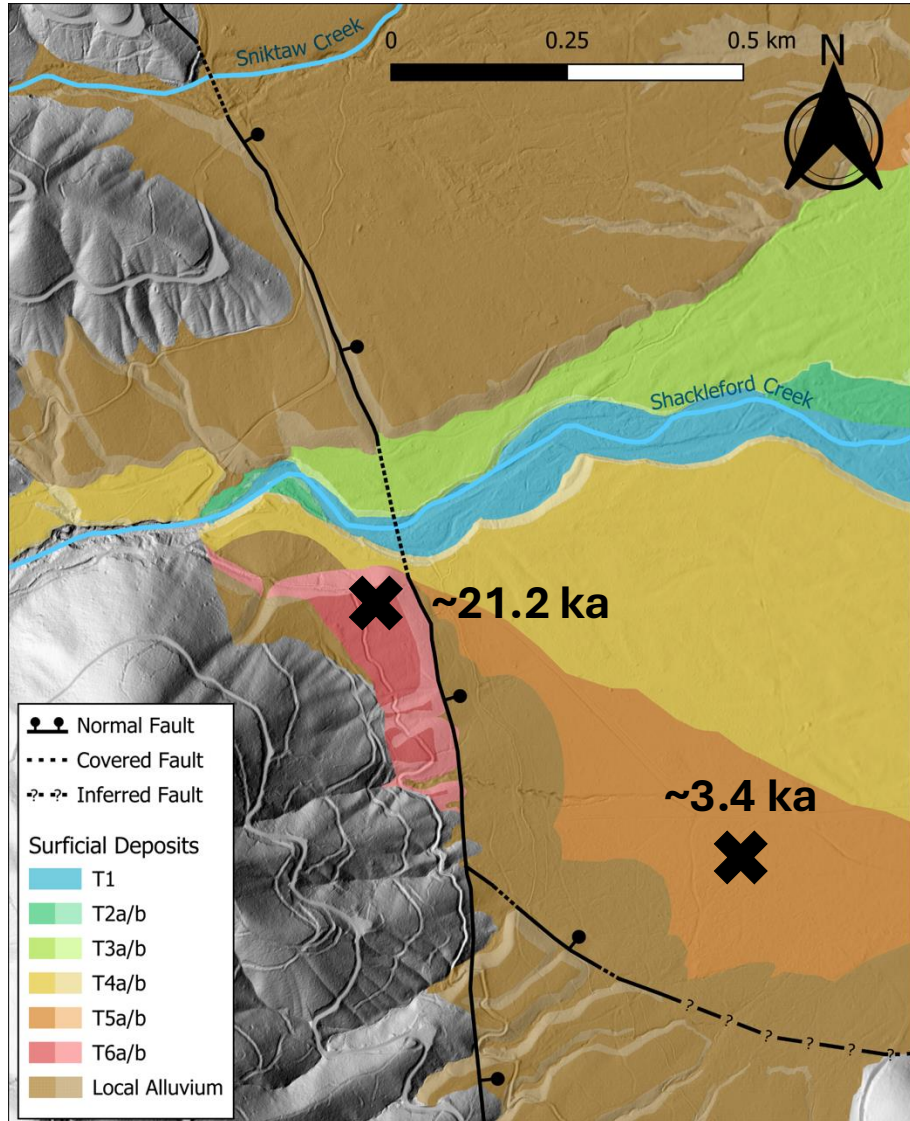
A photograph of a forest landscape. In the foreground, there is a sloping ground covered with dry pine needles and small green shrubs. A solid red line runs horizontally across the middle of the image, slightly below the center. Above this line, a dashed red line runs horizontally across the top of the image. In the background, there are many tall, thin pine trees. The ground appears to be a mix of soil and rocks.

Scarp

**Terrace
surface**

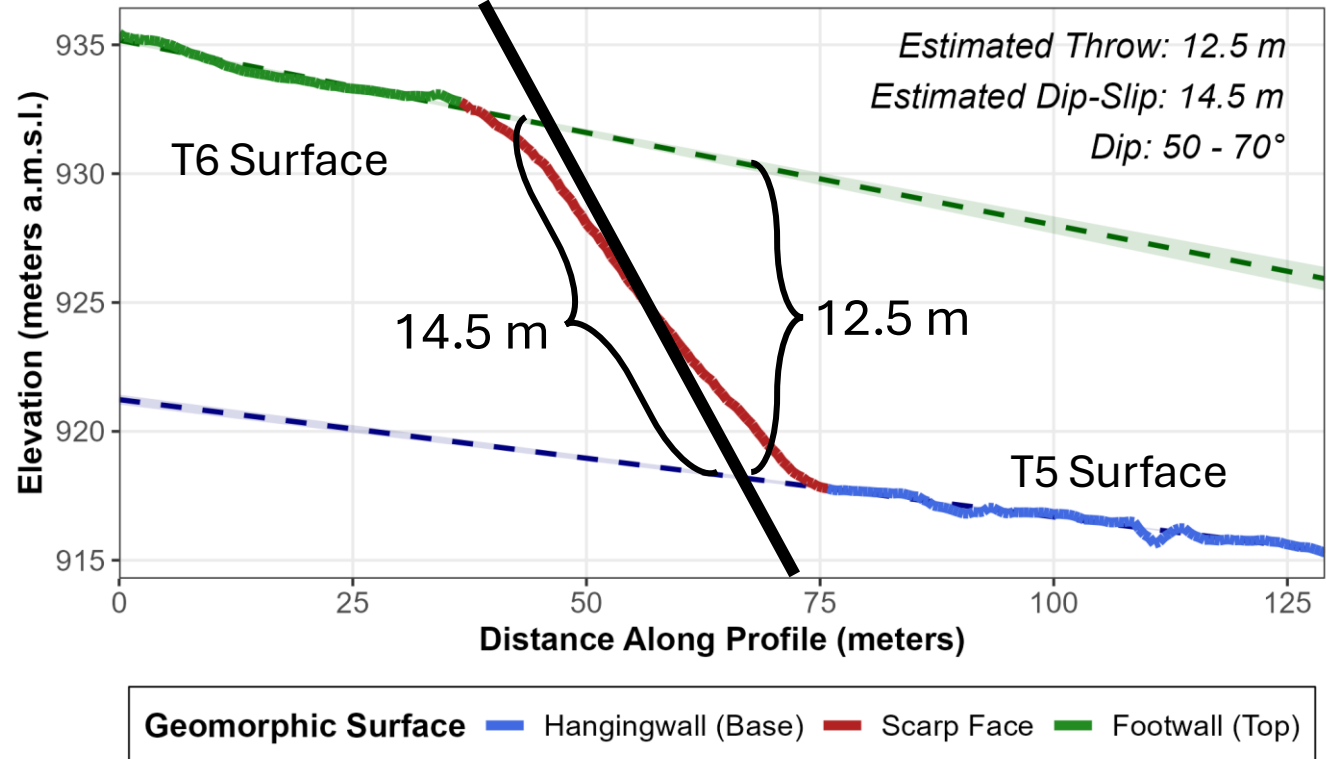
Slip Rate: ≥ 0.7 mm/yr

(Extension Rate ≥ 0.35 mm/yr)



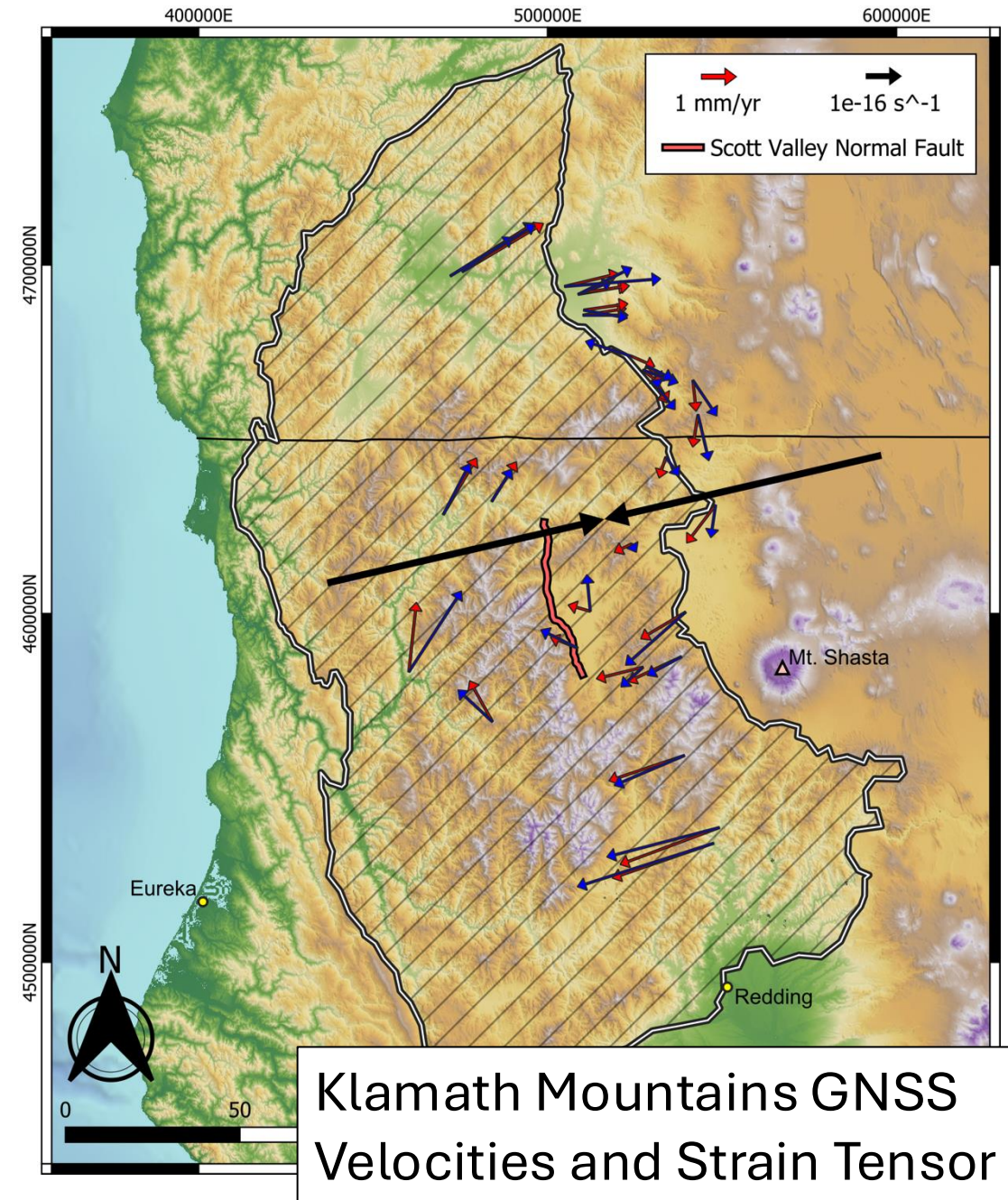
Hangingwall and footwall consist of stream gravel overlain by overbank silt. IRSL shows younger T5 silts bury T6 fan surface. Thus slip rate is a minimum.

SVNF (Shackleford Creek) Scarp Profile

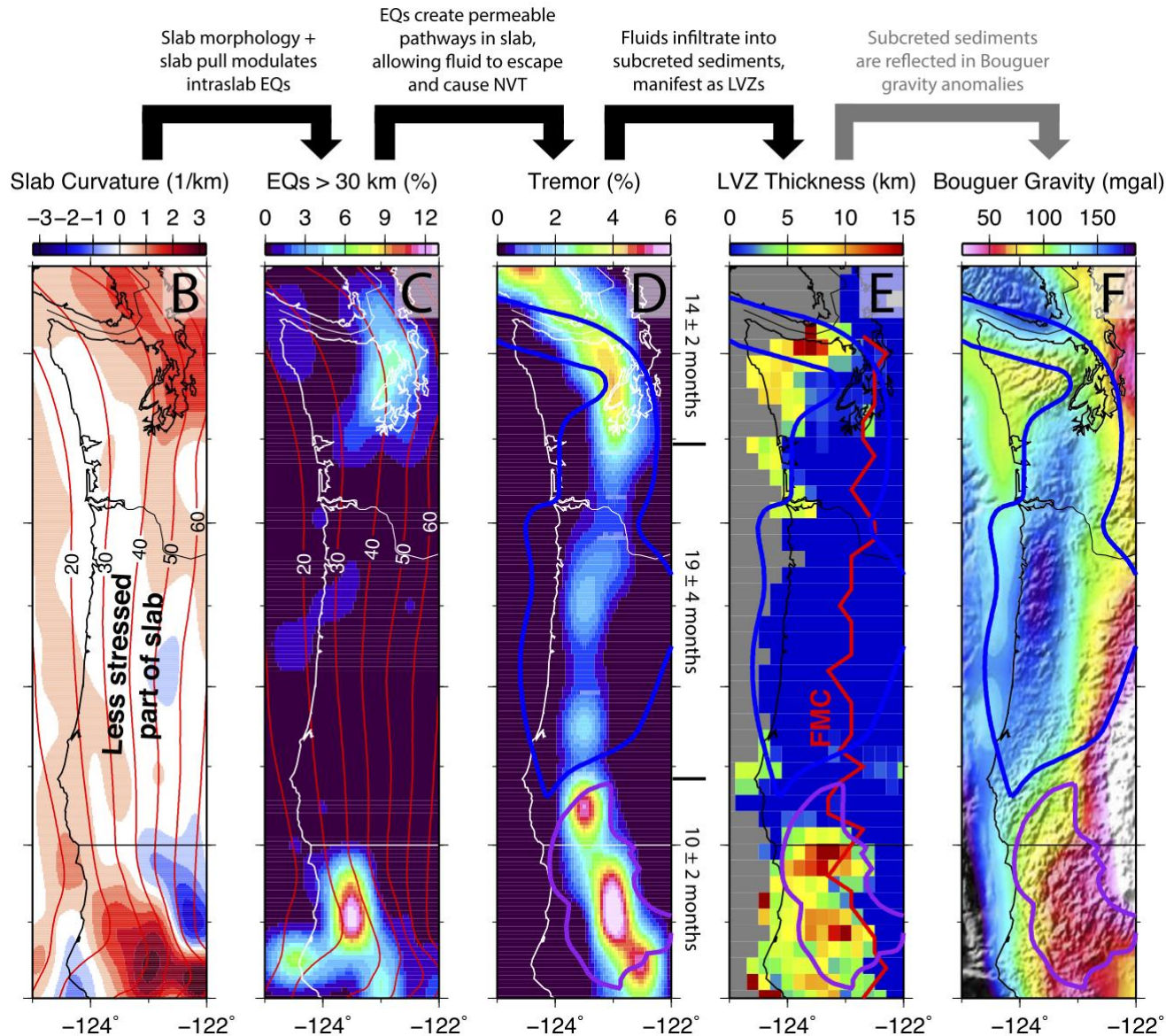


Is Extension Coupled to Cascadia EQ Cycle?

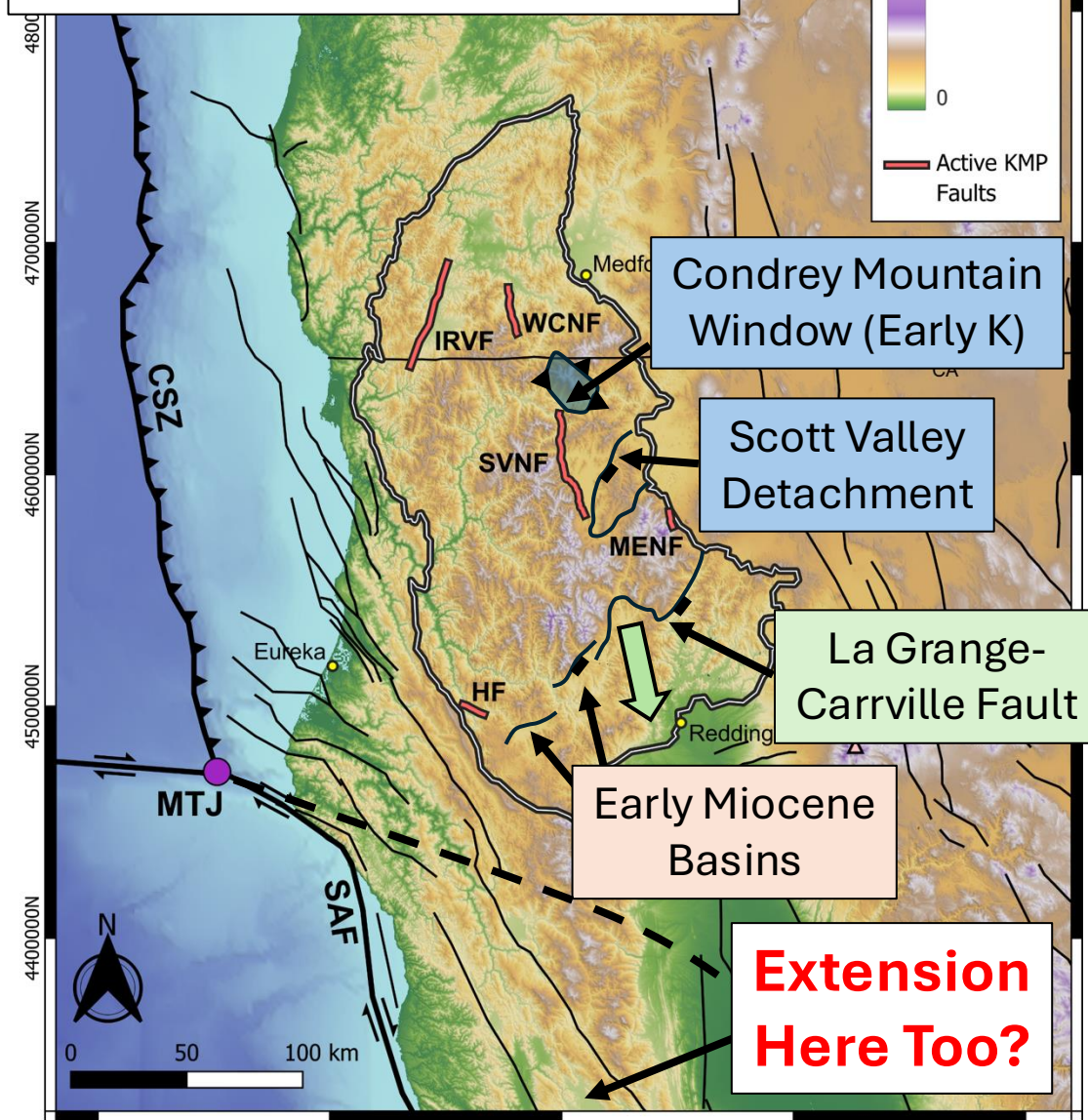
- The Klamath Mountains presently undergo **east-west compression**
 - Normal faulting is not expected under these conditions
- Compression is due to locking of Cascadia subduction zone
- Megathrust events may produce a *stress reversal* (Perfettini et al., 2005; Kato et al., 2011)
- Normal fault slip events in the Klamath Mountains may be synchronized with Cascadia Megathrust events



Does Subcretion / Underplating Drive Klamath Mountains Extension?

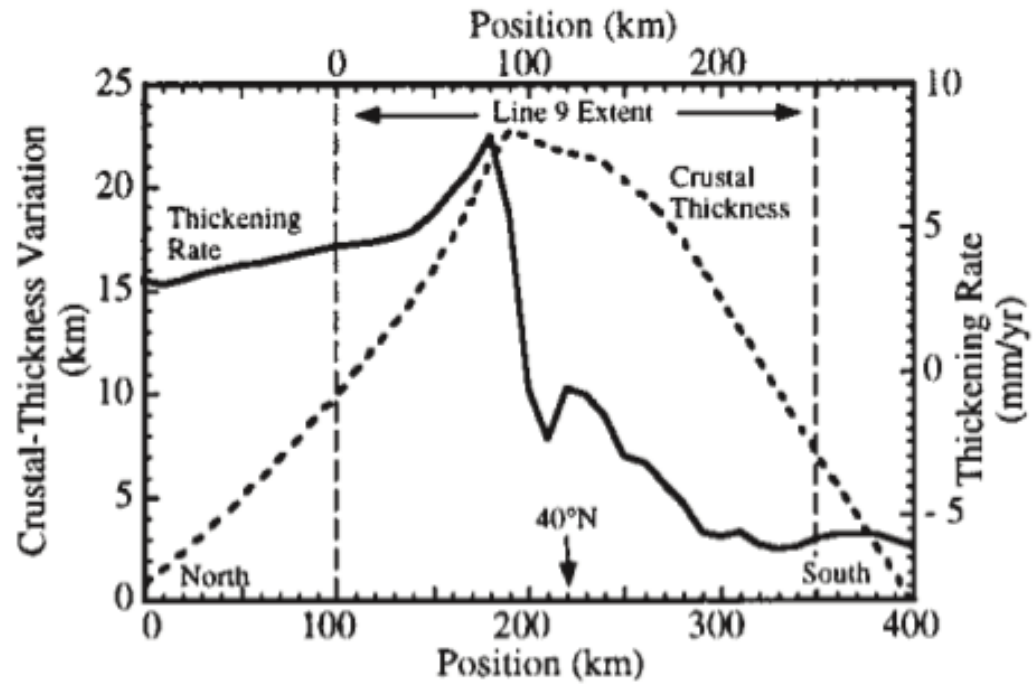


Evidence for Episodic Underplating & Extension

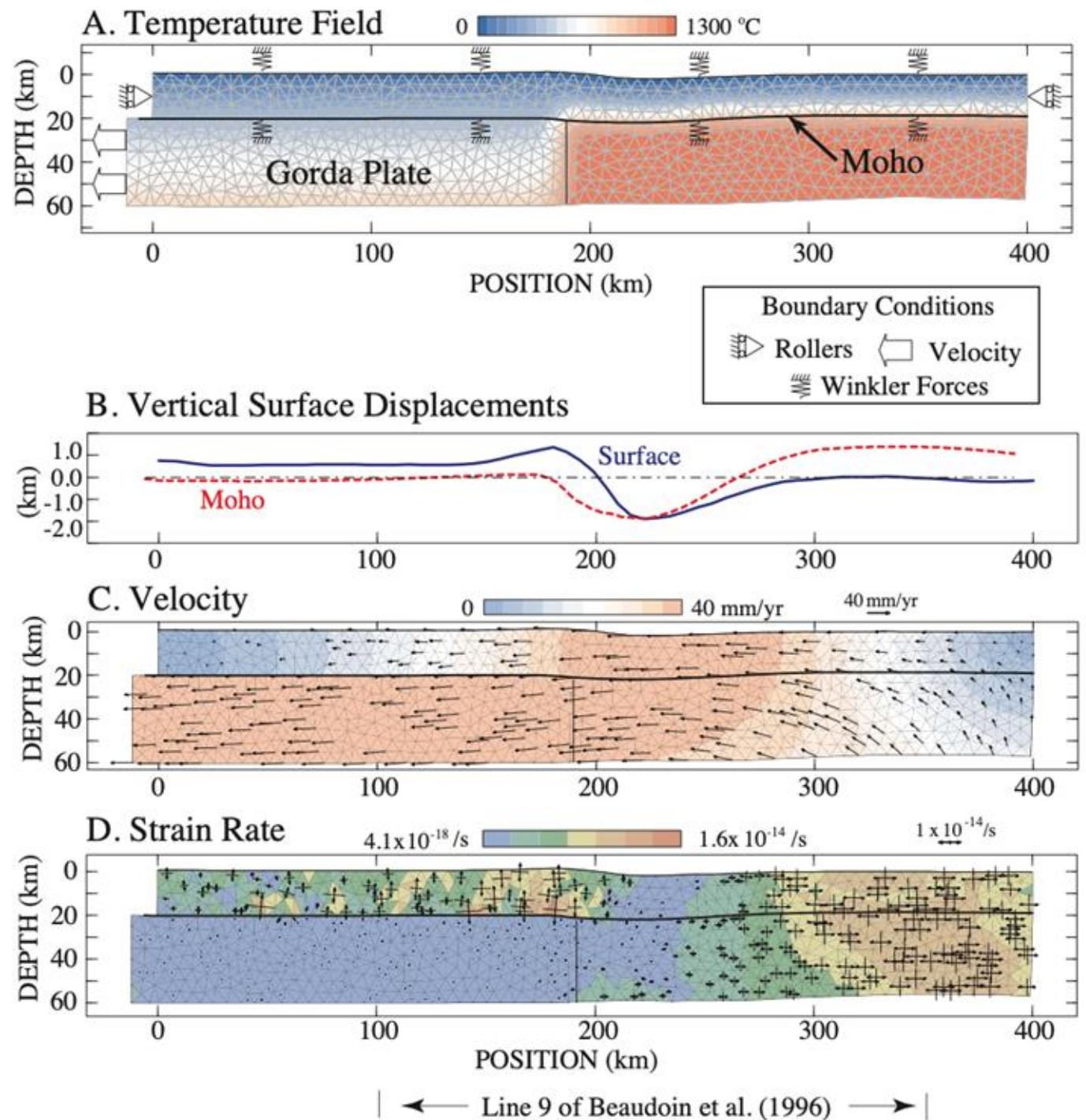


Cashman & Elder, 2002; Batt et al. 2010; Chapman et al. 2024

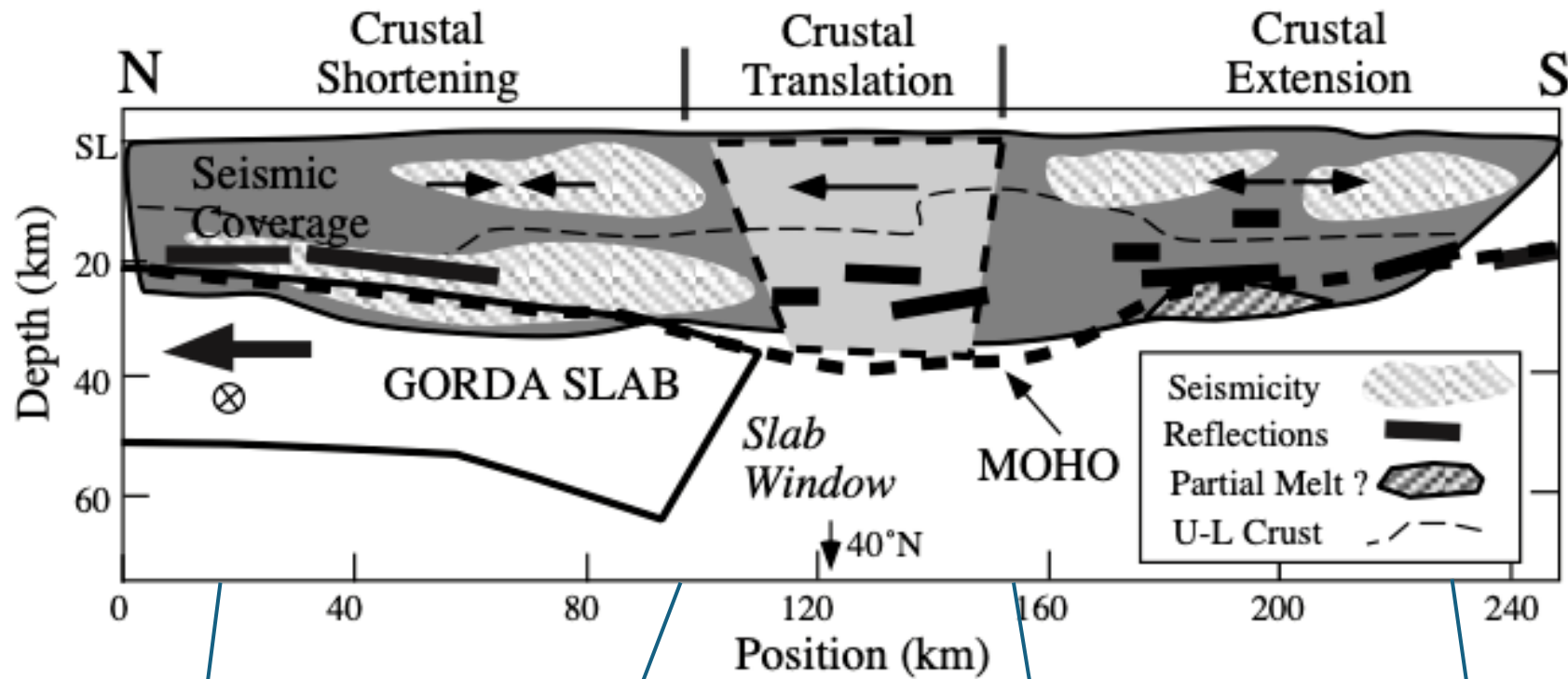
Mendocino Crustal Conveyor Model Predicts Rapid Extension of Northern Coast Ranges



Figures from Furlong & Govers (1999)



Mass Balance Analysis of MCC Model



Each box =
2000 km²

100 km x 20 km

80 km
x 25 km

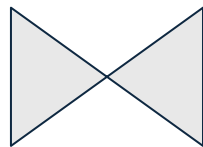
67 km
x 30 km

80 km
x 25 km

100 km x 20 km

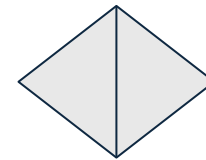


40 km/Myr

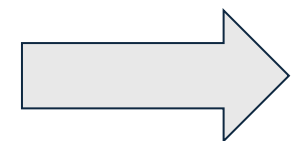


13 mm/yr
shortening

Shortened
33 km in
2.5 Myr

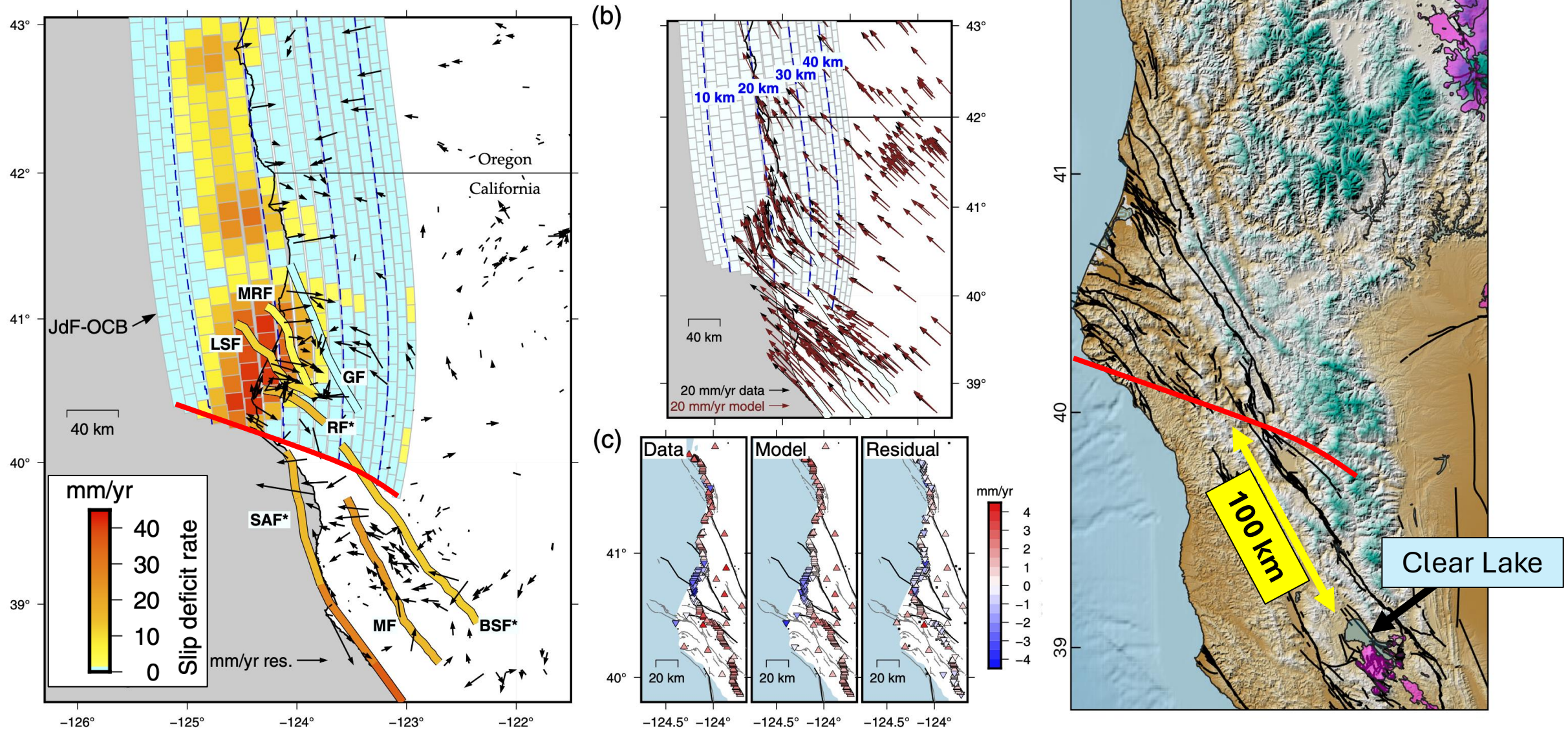


**13 mm/yr
extension (!)**

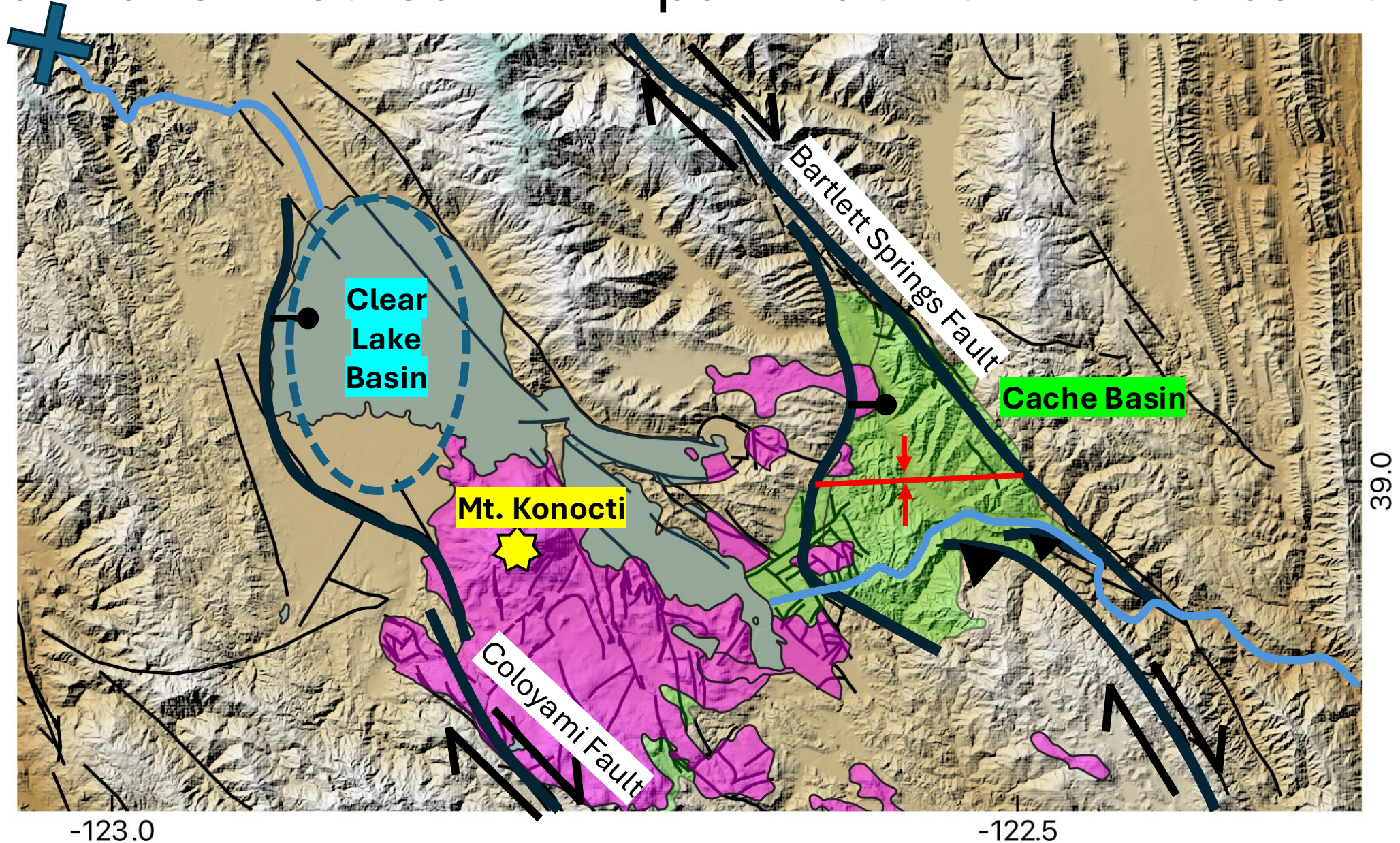


40 km/Myr

Where is MCC-Predicted Extension?



Clear Lake: Nested Pull-Apart Basins with Volcanism



Active Extension and the Absence of Extension

- Active faults show east-west extension of Klamath Mountains.
- Extension here occurs above subduction zone, in area of geodetically measured contraction.
- Widespread, rapid extension predicted by MCC model is absent from the Northern Coast Ranges.
- MTJ crustal deformation appear most consistent with:
 - Subcretion and extensional collapse of Klamath Mountains
 - NW propagation of wide dextral shear zone [above Pioneer fragment?]
 - Contraction of Eel River basin where dextral faults terminate
 - No extension in wake of MTJ passage except at stepovers