

Sediment Accretion during Horst and Graben Subduction associated with the Tohoku Earthquake, Northern Japan

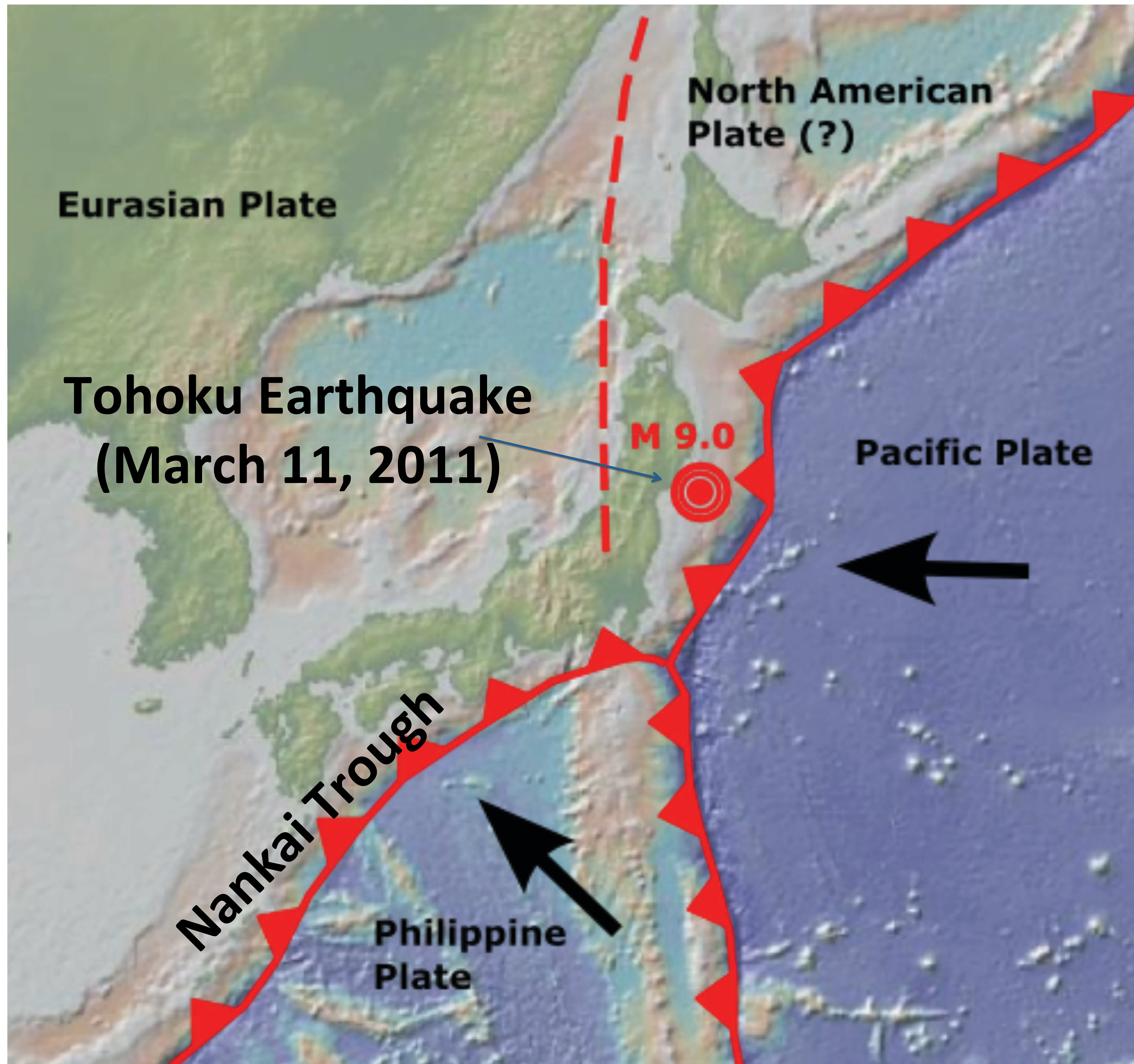
By Casey Moore, UC Santa Cruz and
Fred Chester, Texas A&M University

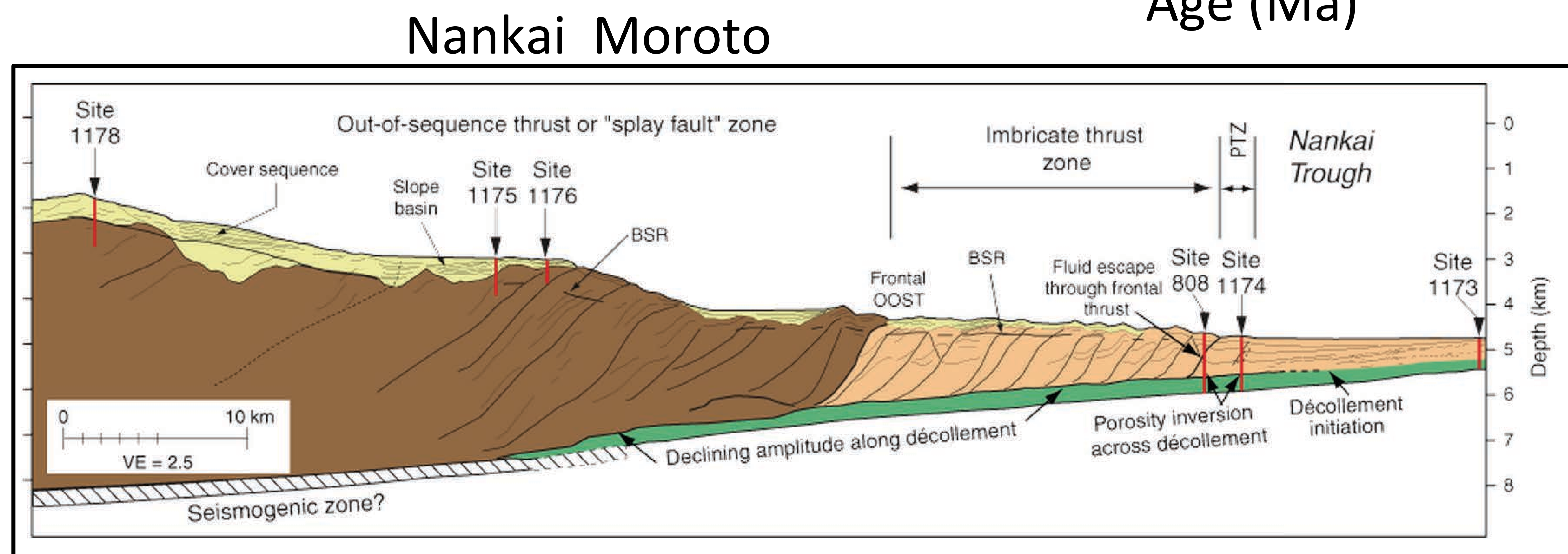
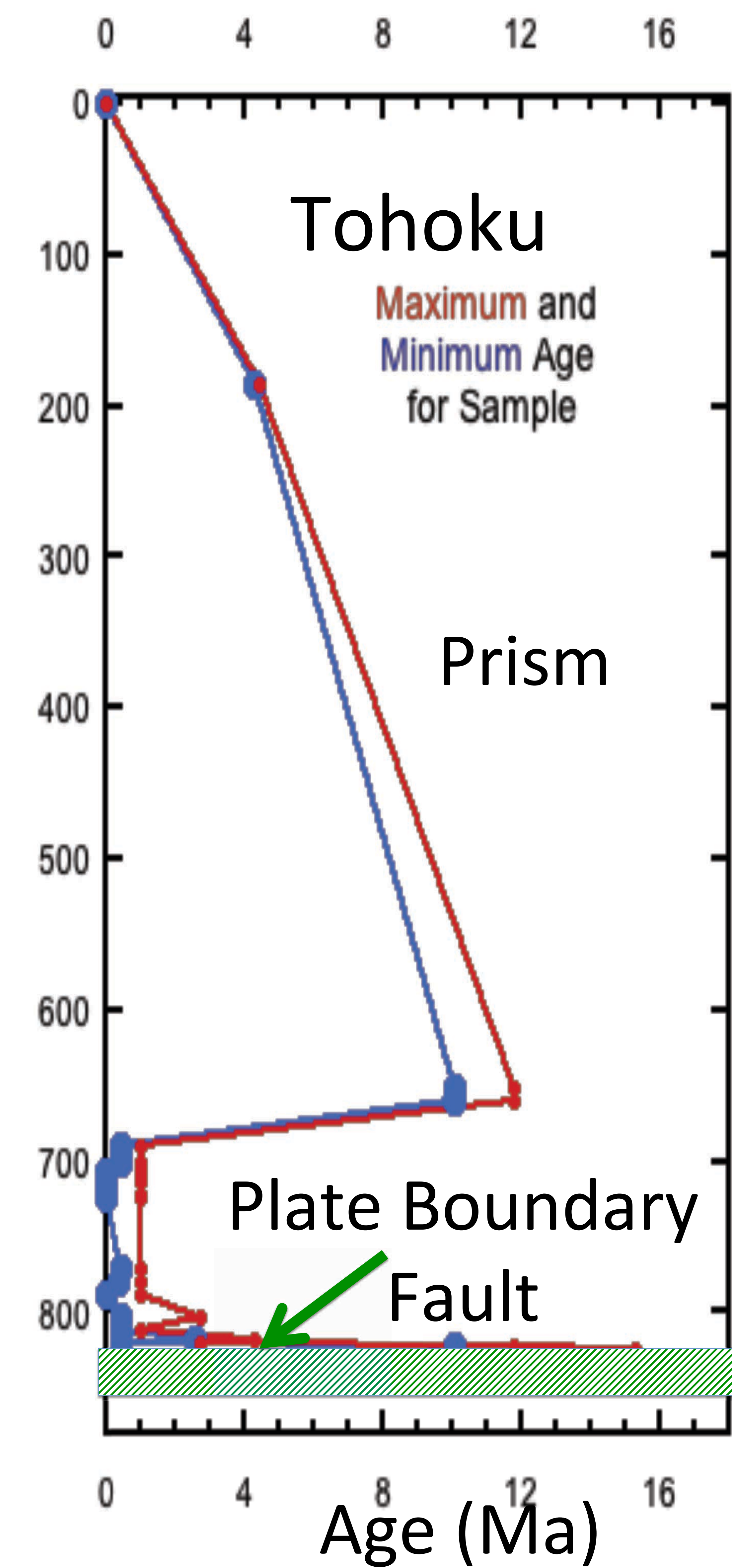
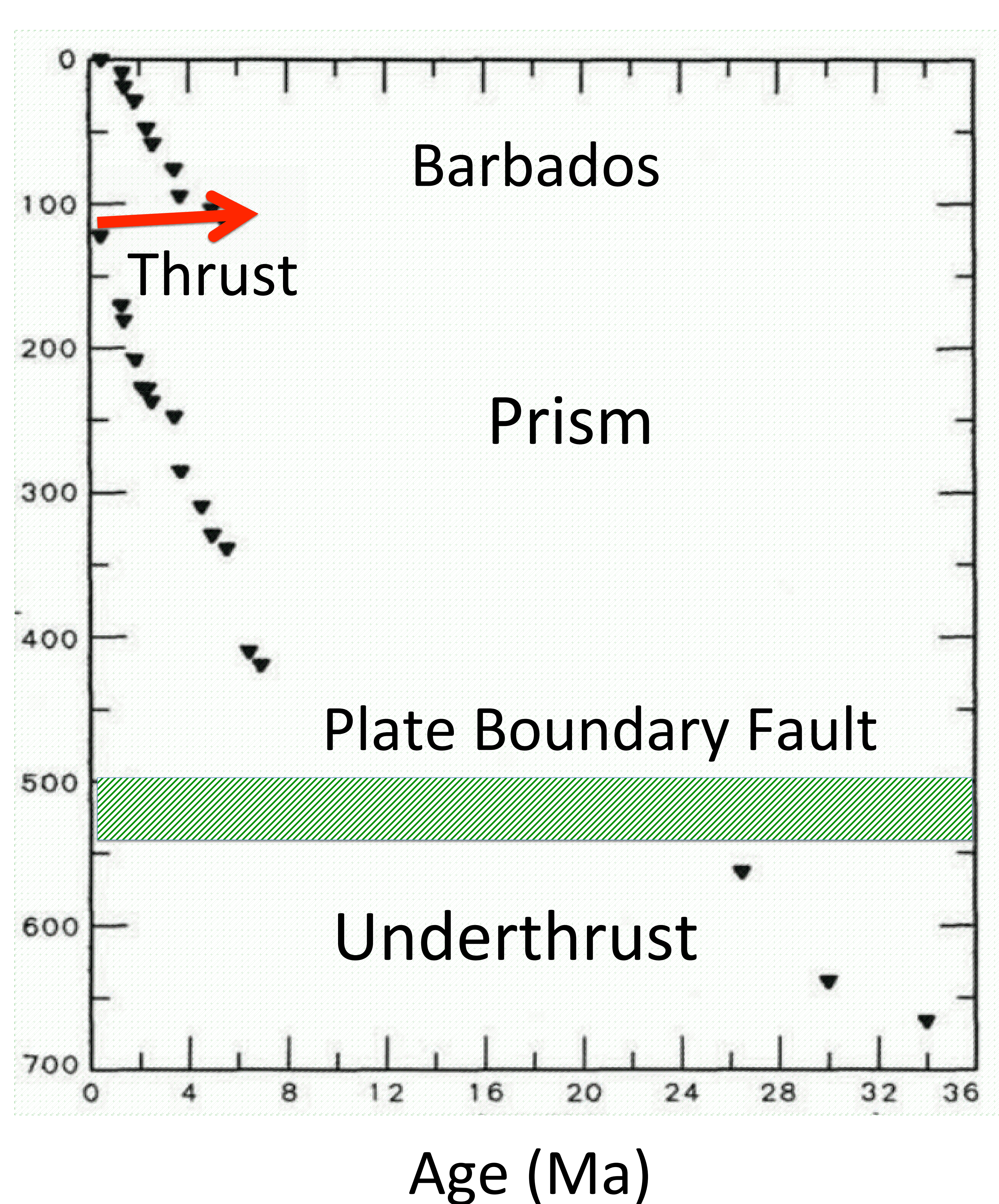
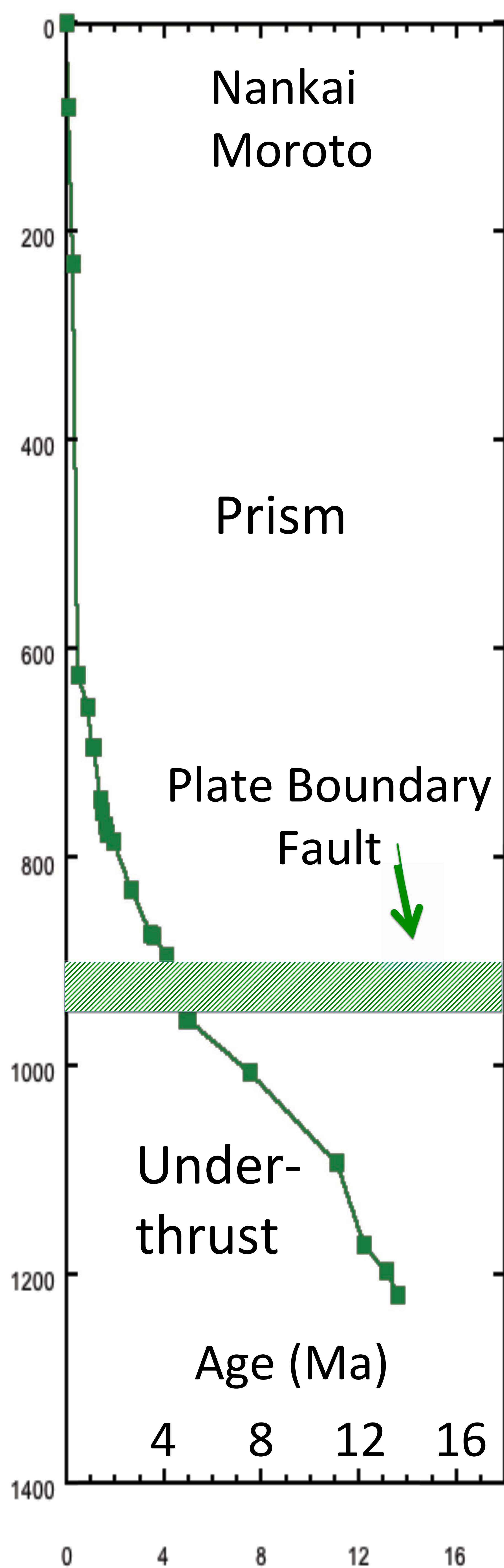
Who Forgot the
Paleontologists
Anyway ?

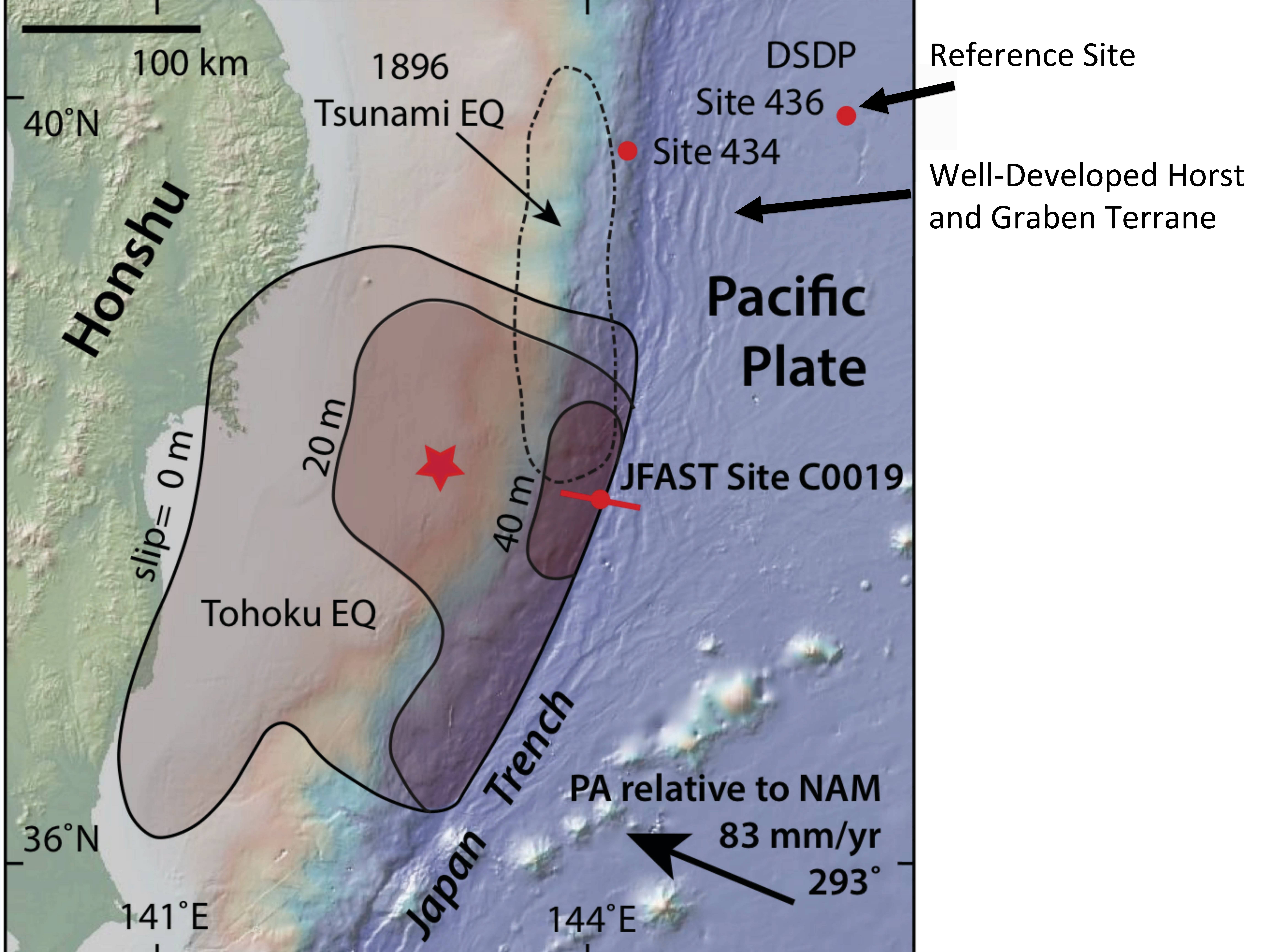
A story of oddball
stratigraphy



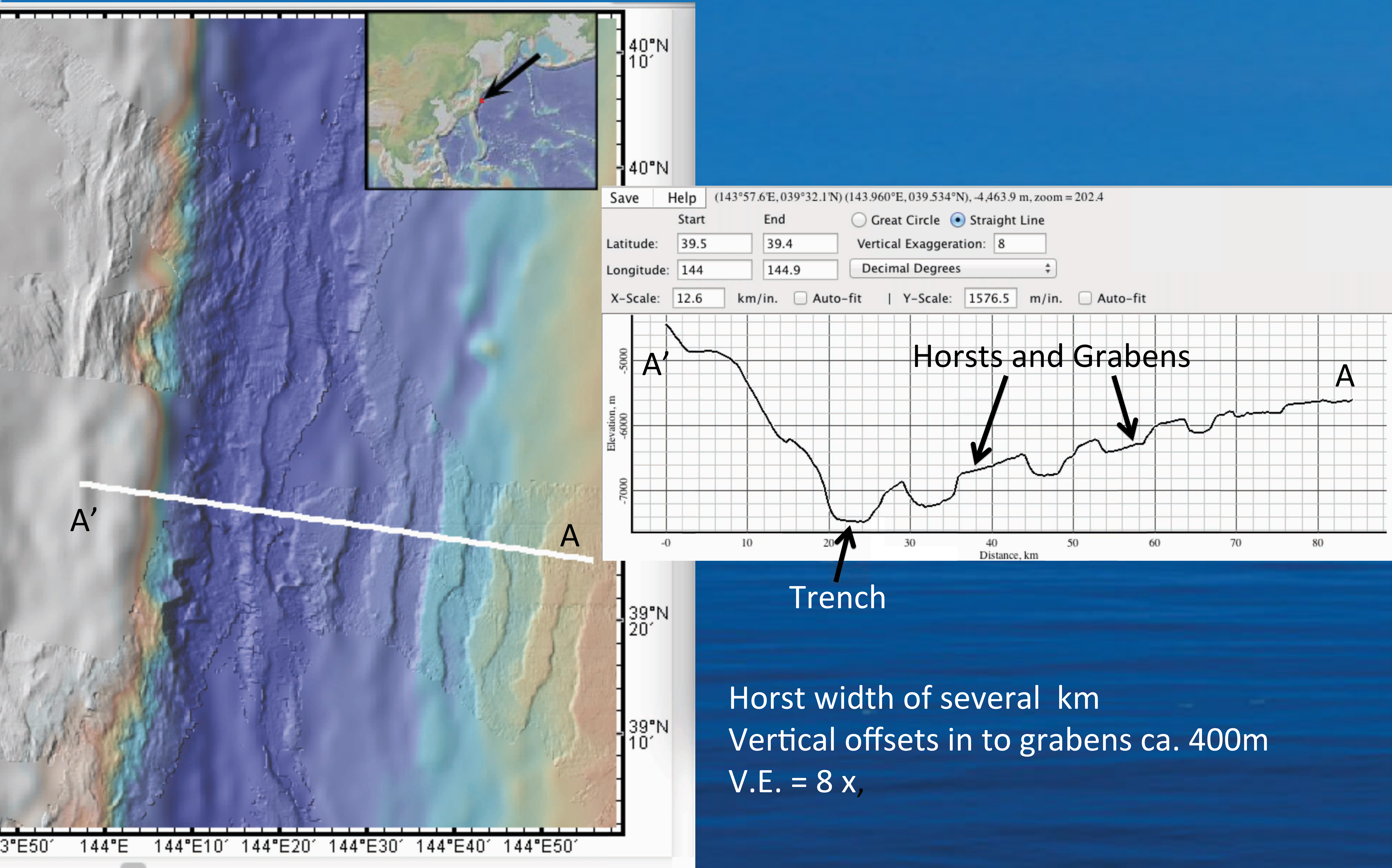
Japan: A Nexus of Plate Boundaries







Incoming Horst and Graben Terrane off Northern Japan (GeoMapApp data)

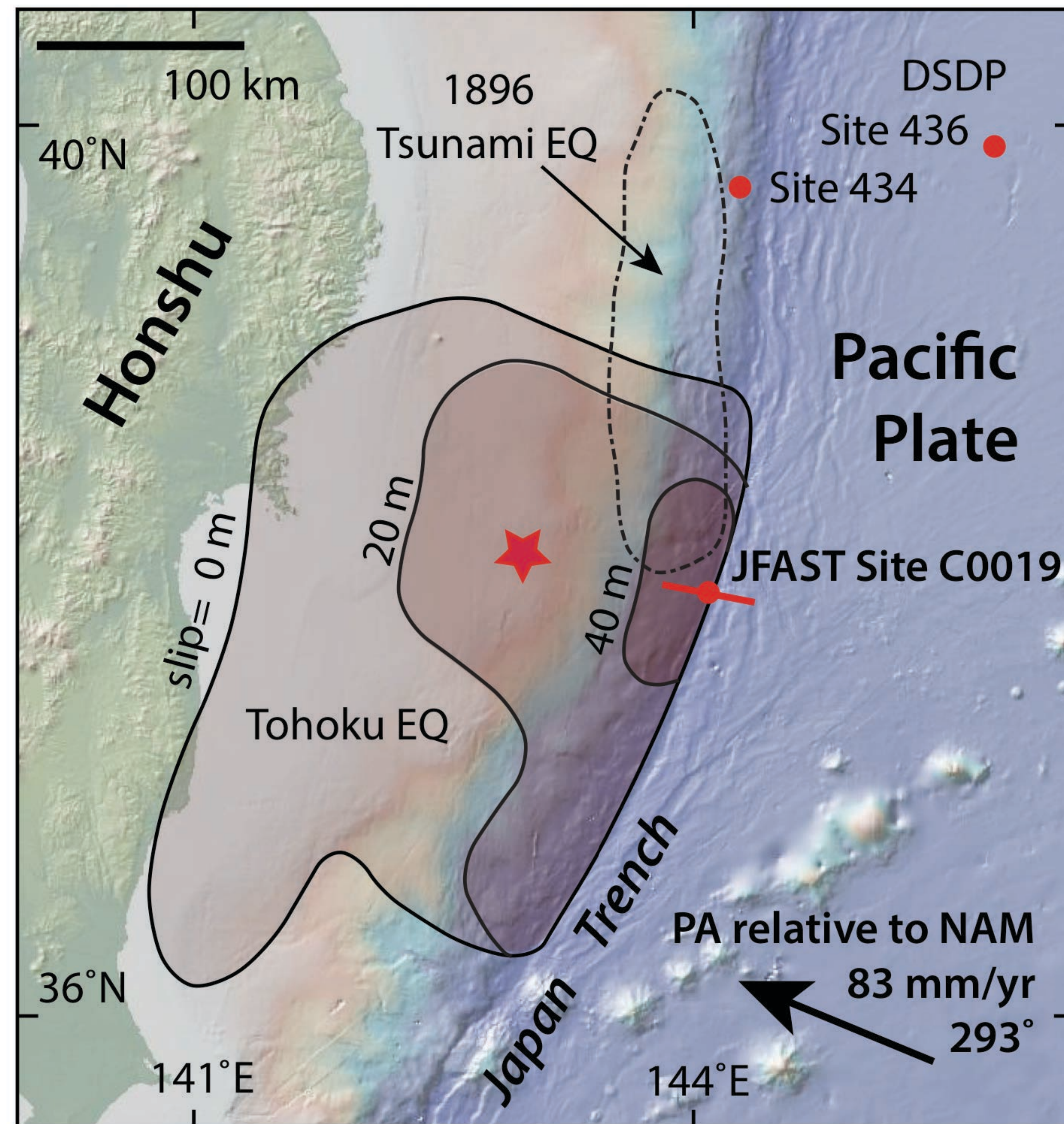


Horst width of several km
Vertical offsets in to grabens ca. 400m
V.E. = 8 x,

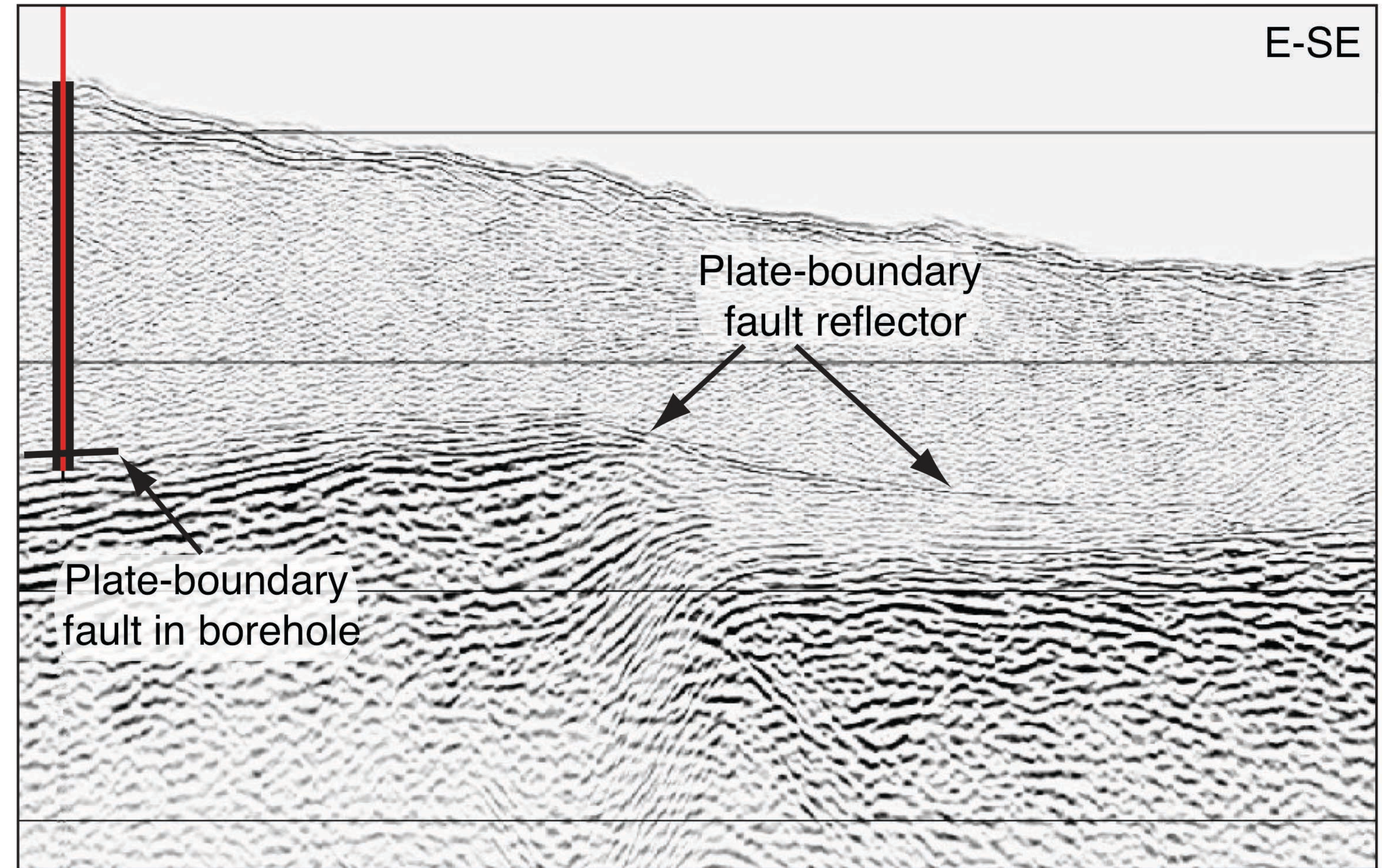
Tohoku-oki Earthquake-related Deformation (Kodiara et al., 2012, Nakamura et al., 2013, Chester et al., 2013)

- Deformation of graben fill
- Plate Boundary Fault dives beneath graben fill, and tends to emerge near trench axis
- Overall ~ 50 m of displacement

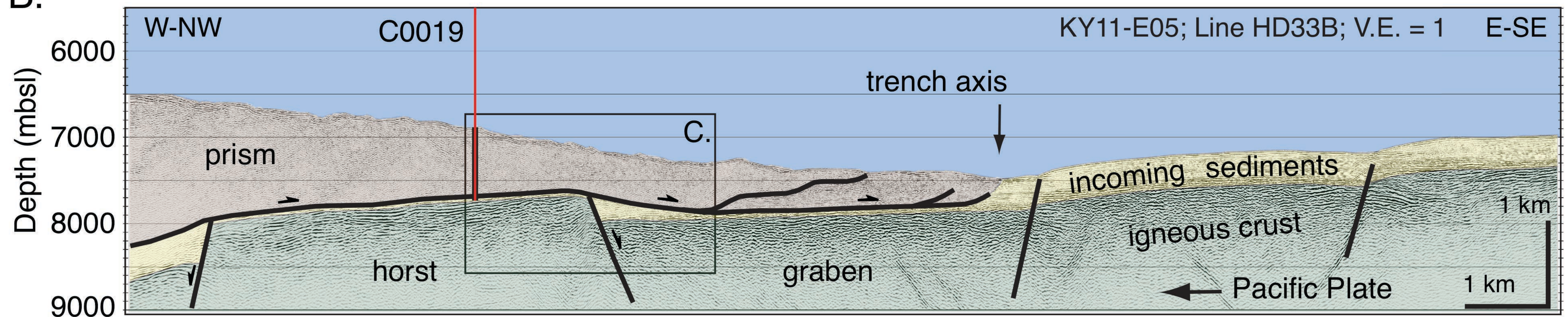
A.



C.



B.



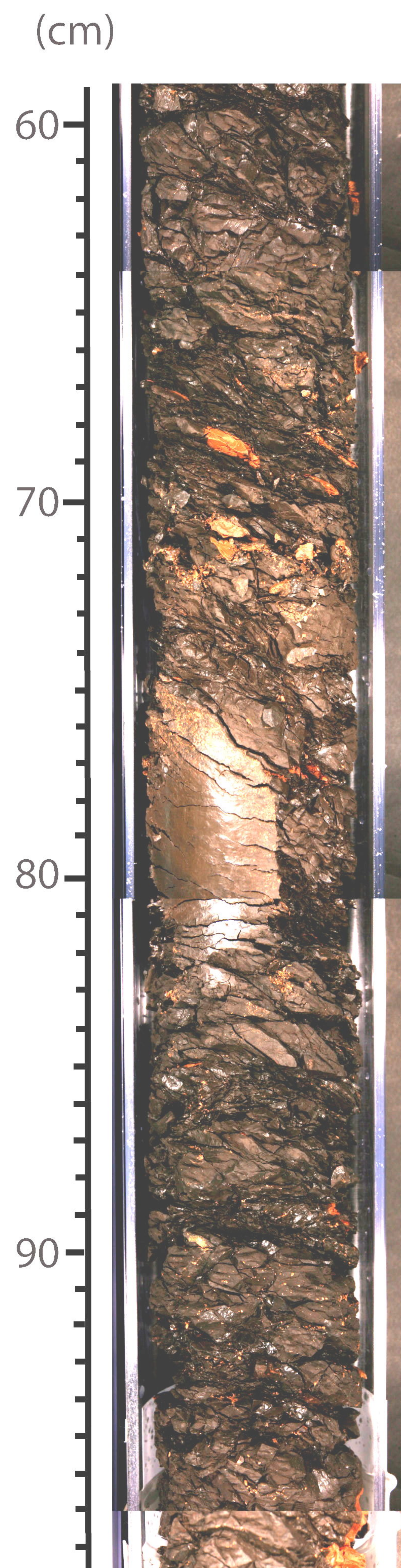
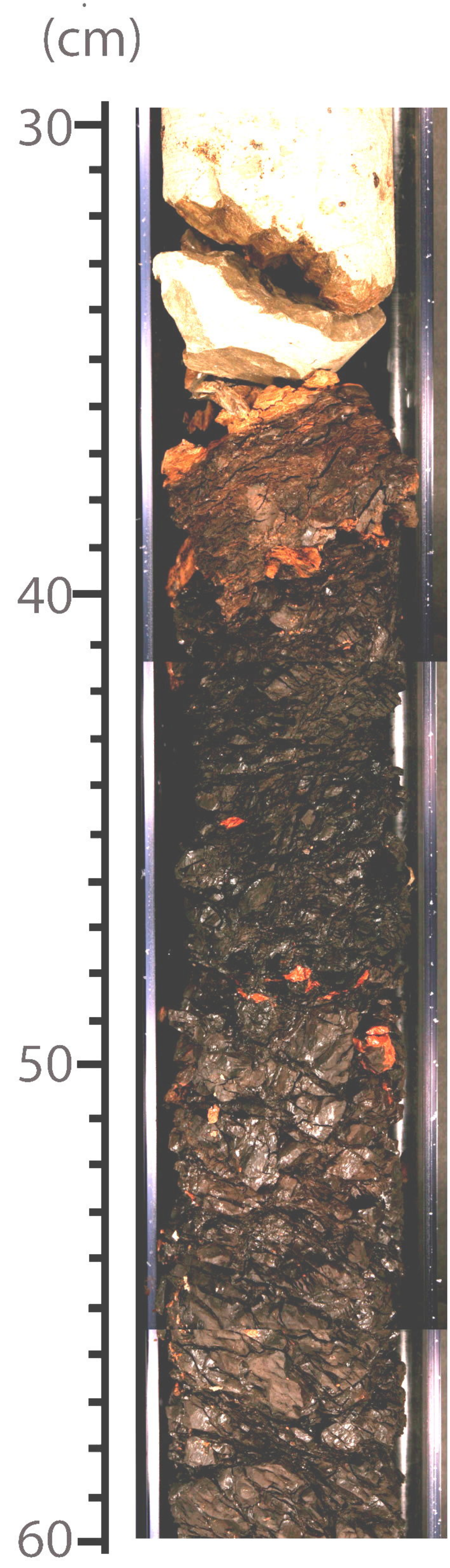
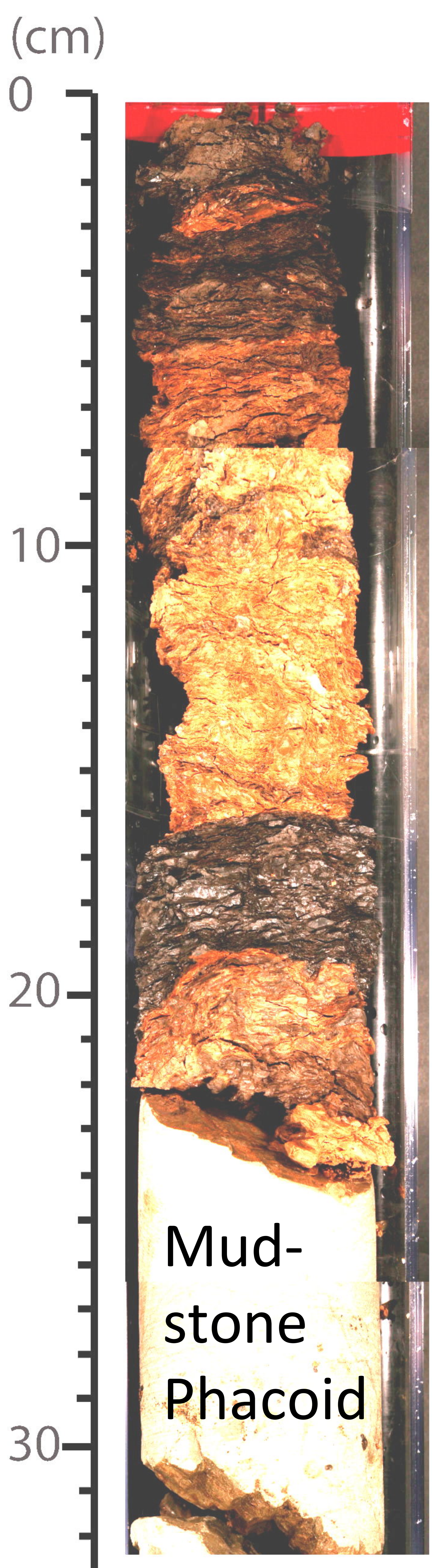


Plate Boundary Fault:
Very Fine Grained,
Rich in Smectite

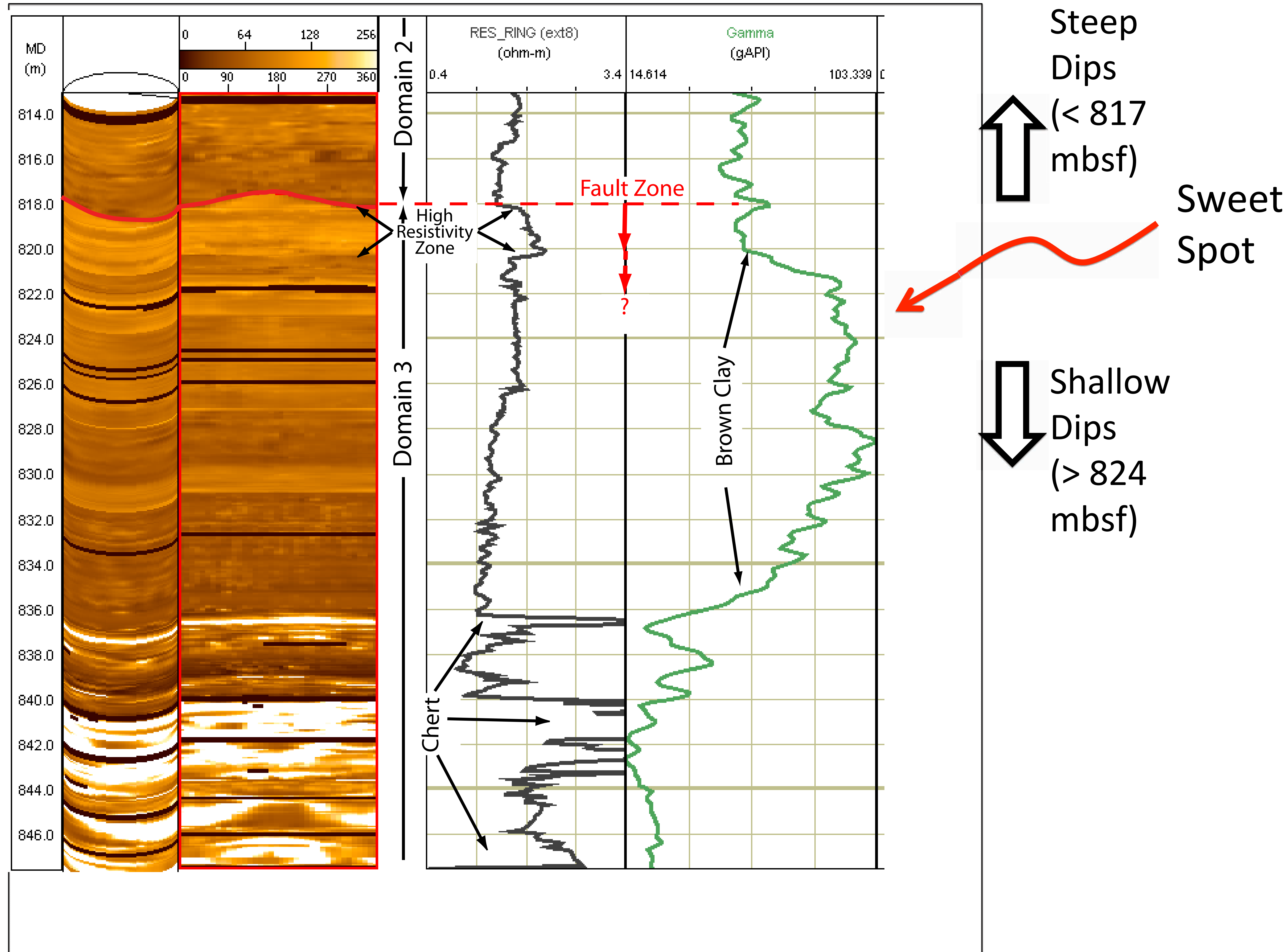
1 m Core of Scaly
Claystone

Detail of 49-58 cm

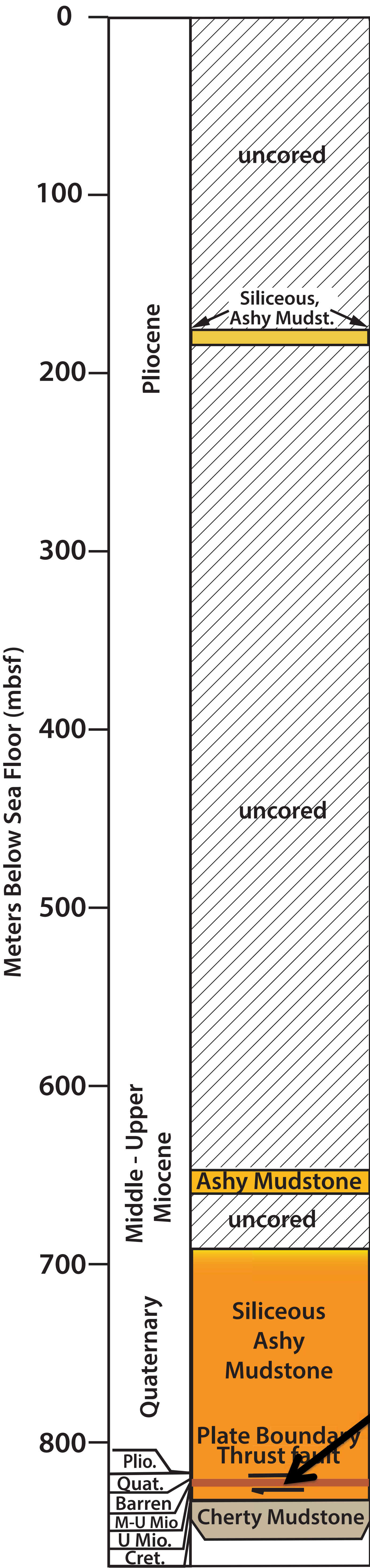
49



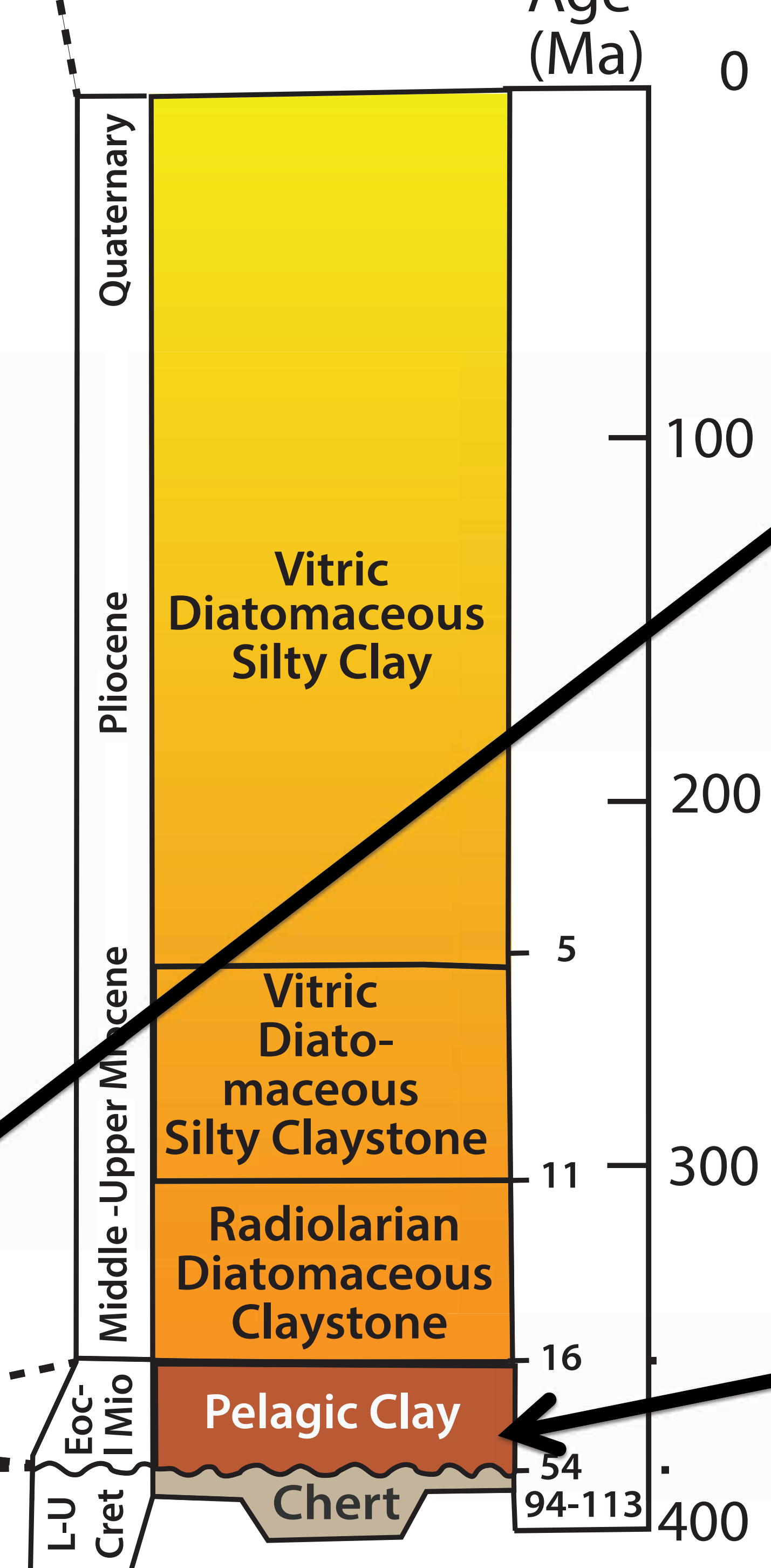
Resistivity Image of Plate Boundary Fault Zone Borehole



Site C0019



Reference Site 436



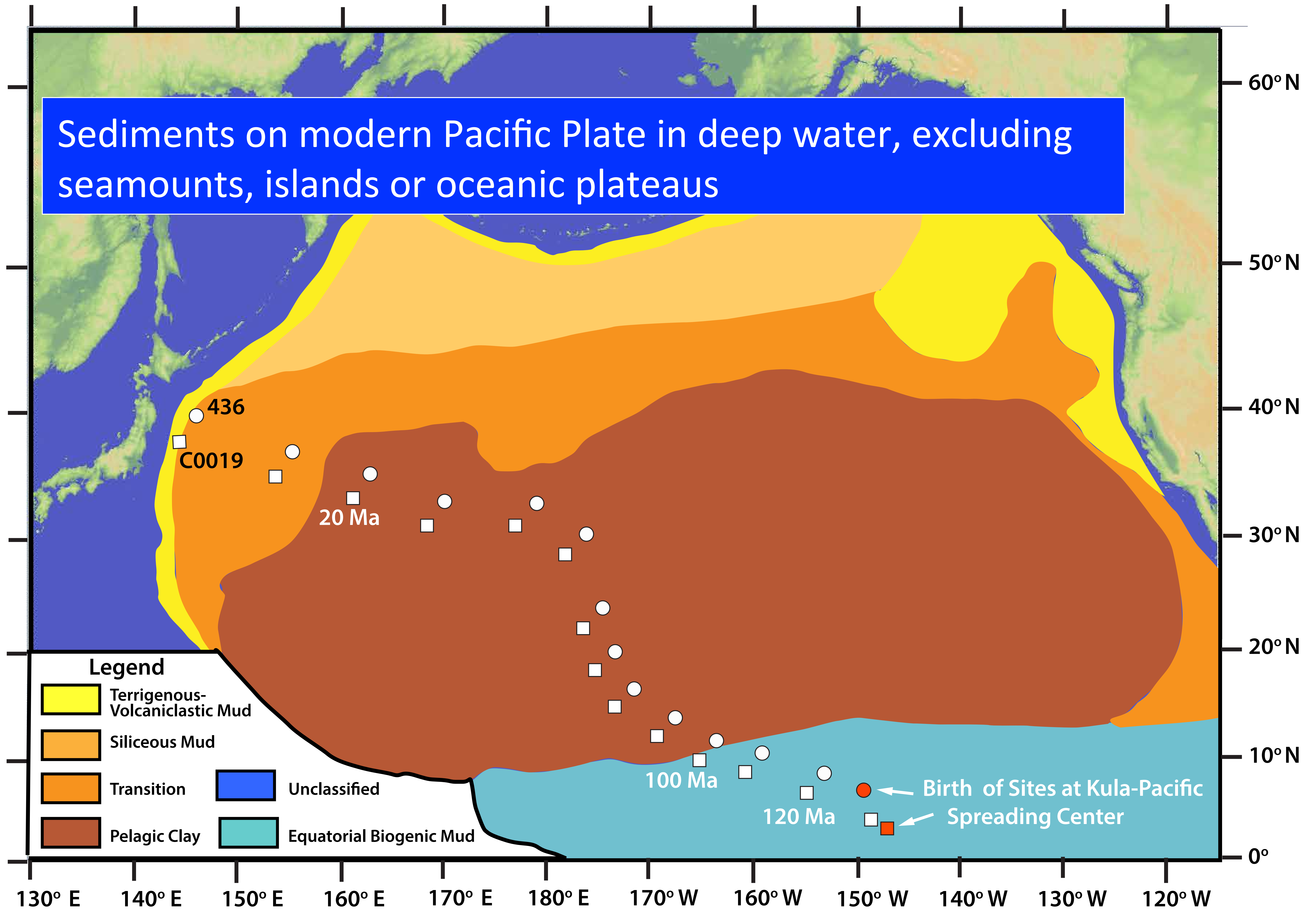
Capturing The the Graben-filling Sediment
 Plate Boundary Fault is very weak
 Due to enrichment in smectite and fine grain size

Ikari et al., 2015 Sliding Friction = 0.2- 0,26 verses 0.5 in wall rock

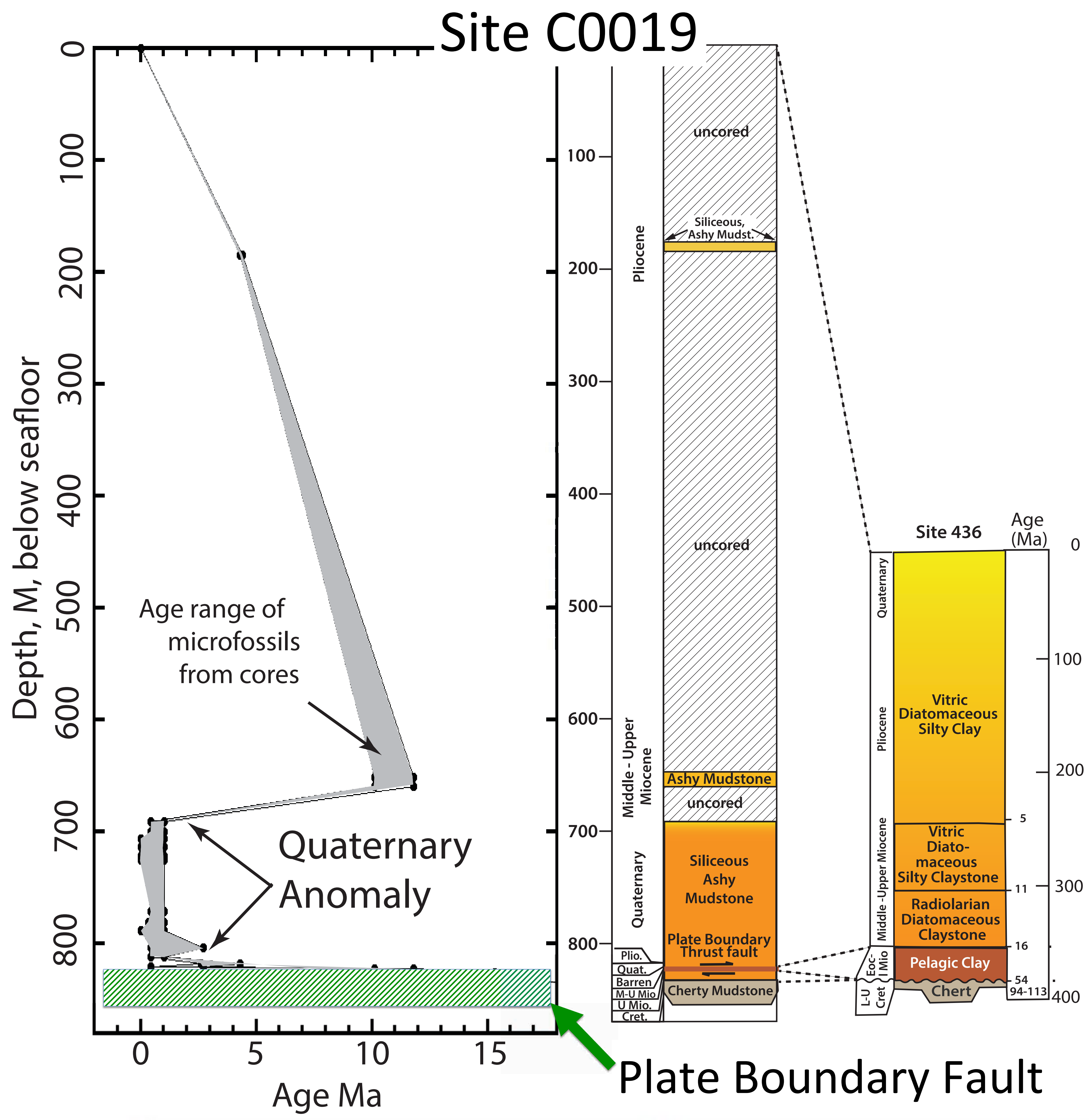
Ujiie et al., 2013. Coefficient of friction: 0.15 to 0.05

Fulton et al., 2013. Apparent coefficient of friction: 0.08

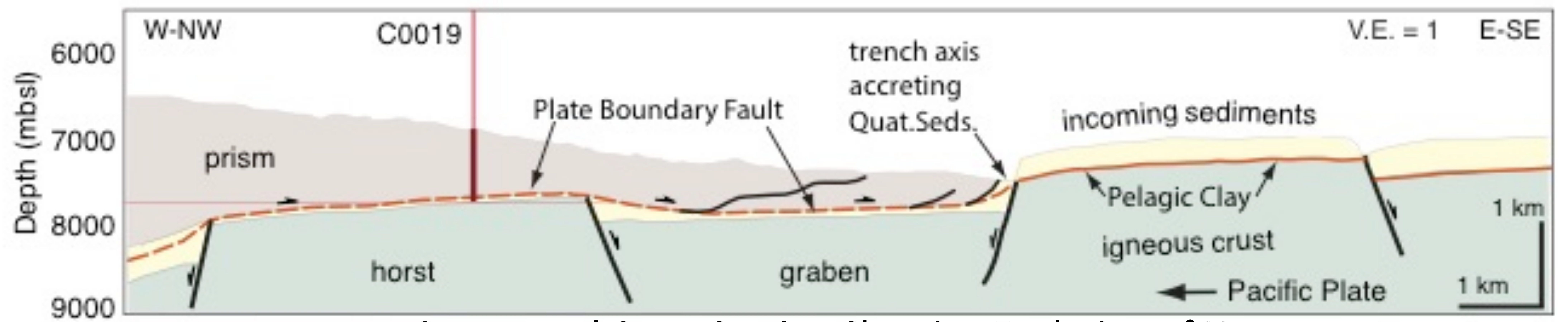
Kameda, et al. 2015. Smectite enrichment
 Sawai et al, 2014 Coefficient of friction in Pelagic Clay Site 436: < 0.2
 Pleagic Clay Unit thickness about 47.5 m but boundaries transitional).



(Absolute plate motion in moving hotspot reference frame Doubrovine, 2012; sediment distribution from Moore et al., 2015)



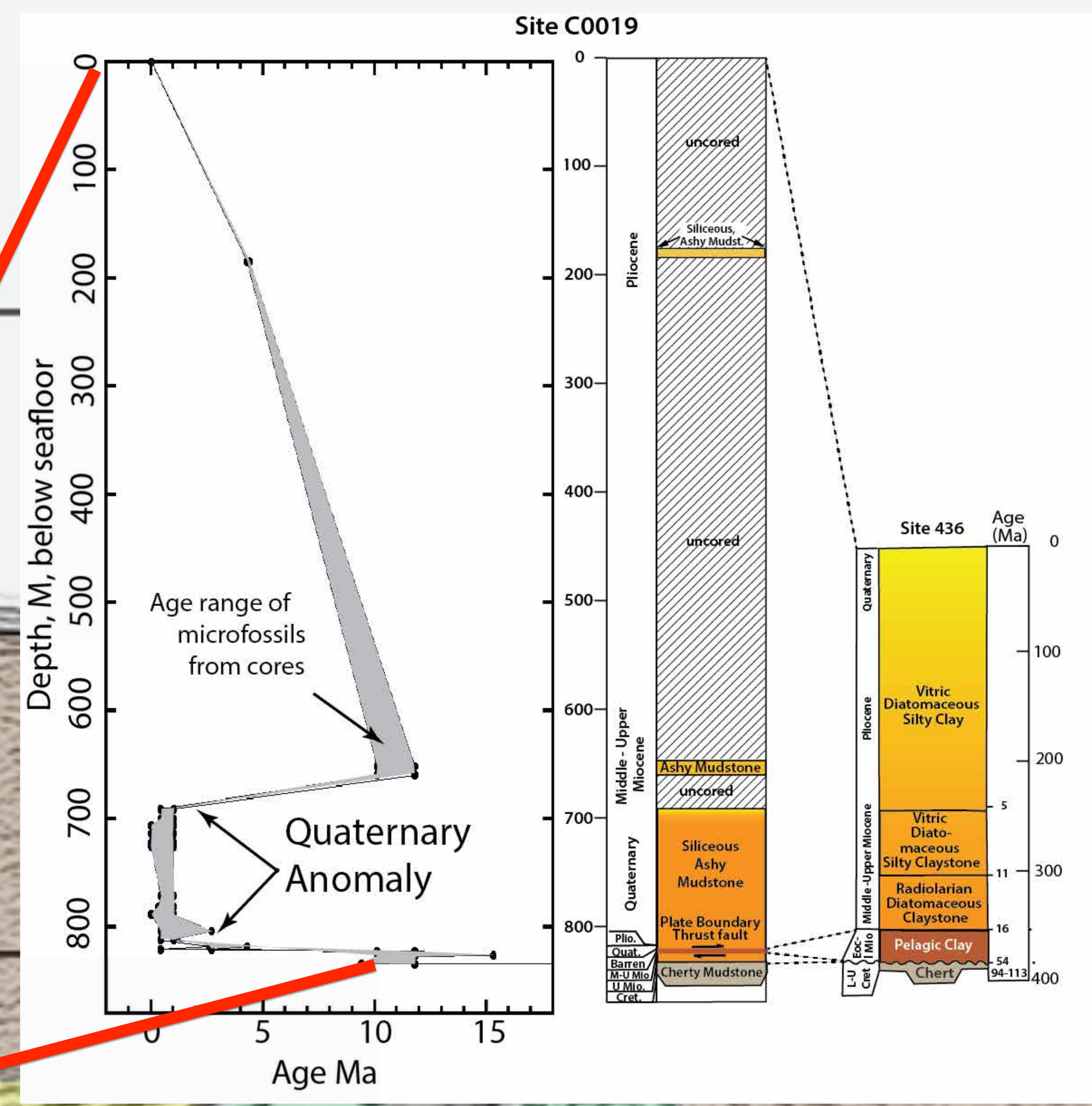
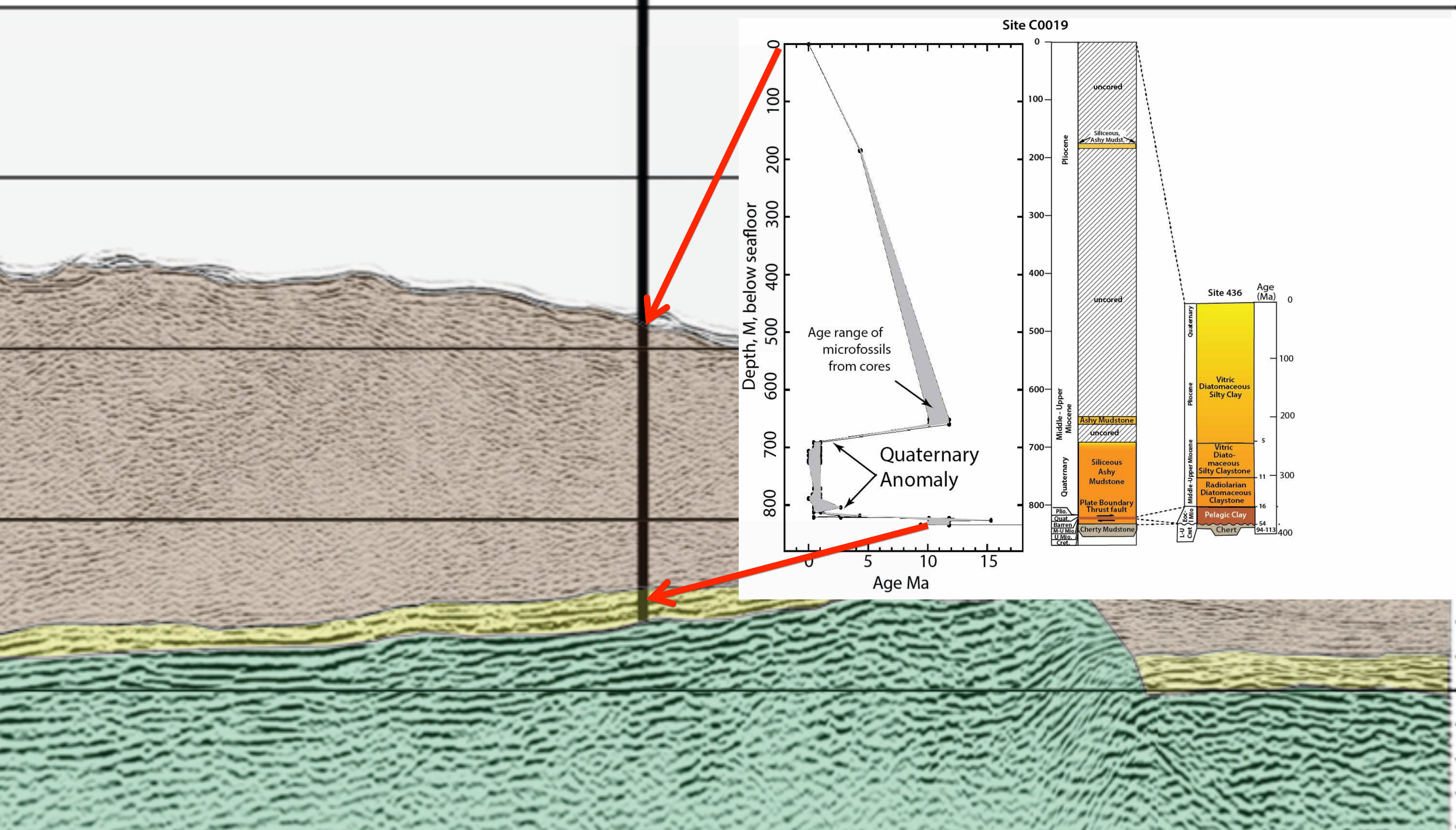
Thick (120m)
 Quaternary section
 lies just above plate
 boundary fault
 Where from?

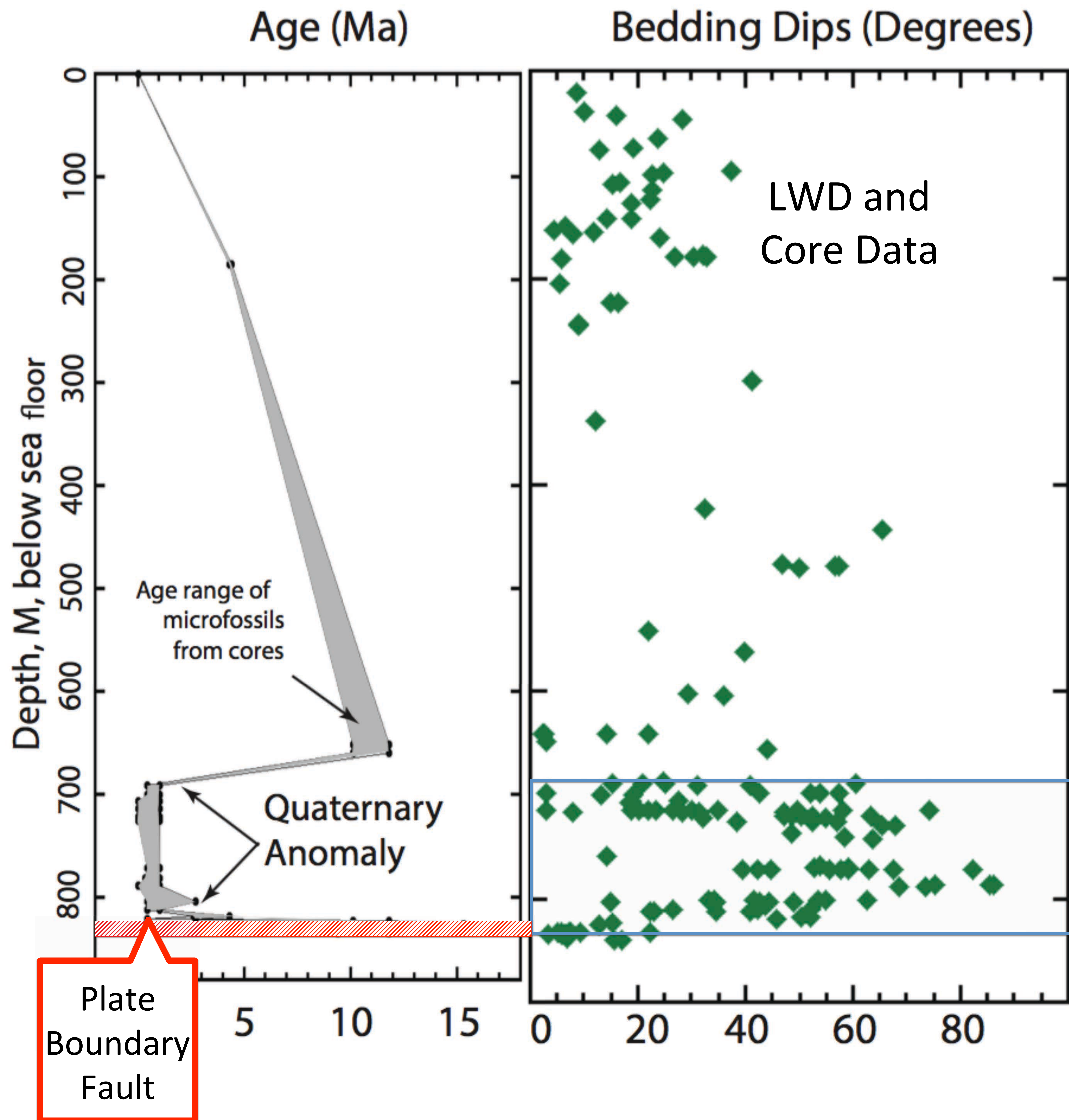


Conceptual Cross Section Showing Evolution of Horst

CMP number (3.125 m/CMP)
Hole C0019B

13760 13600 13440 13280 13120 12960 12800 12640 12480





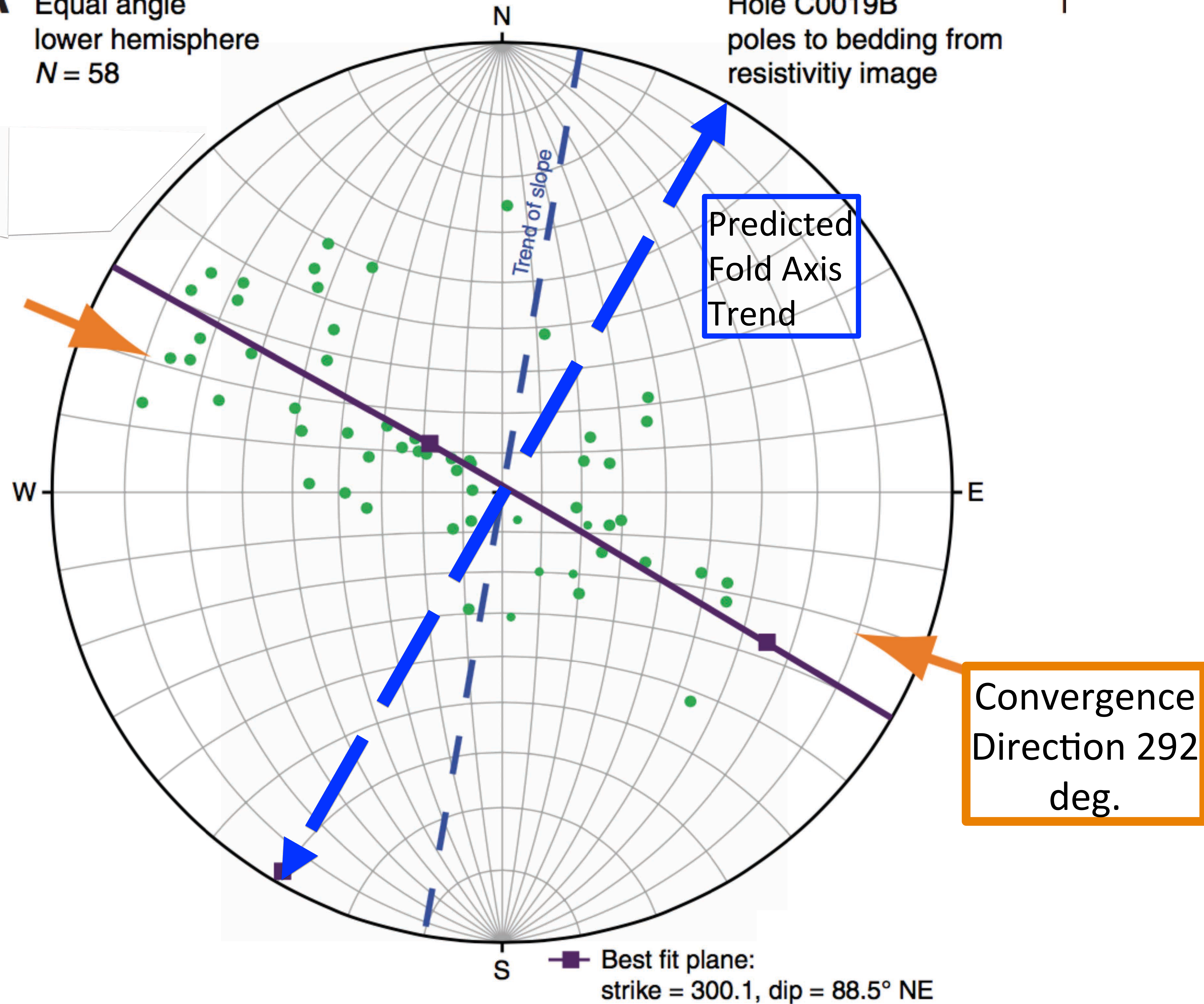
- 1) Plate boundary Fault
Correlates with basal low dip zone
- 2) Shallow dips about 120 m shallower than Plate Boundary Fault may represent shear zone at upper boundary of Quaternary deposits

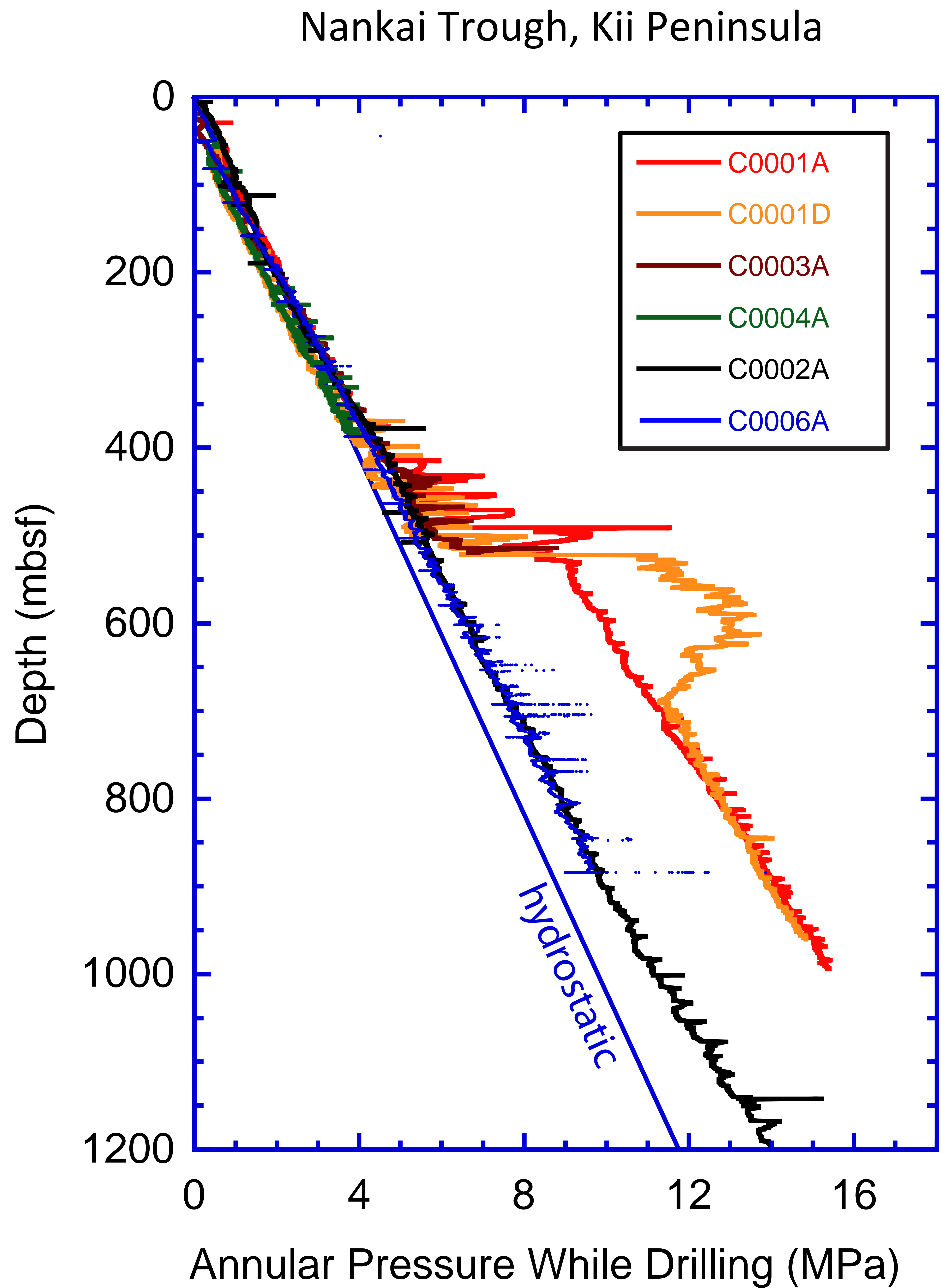
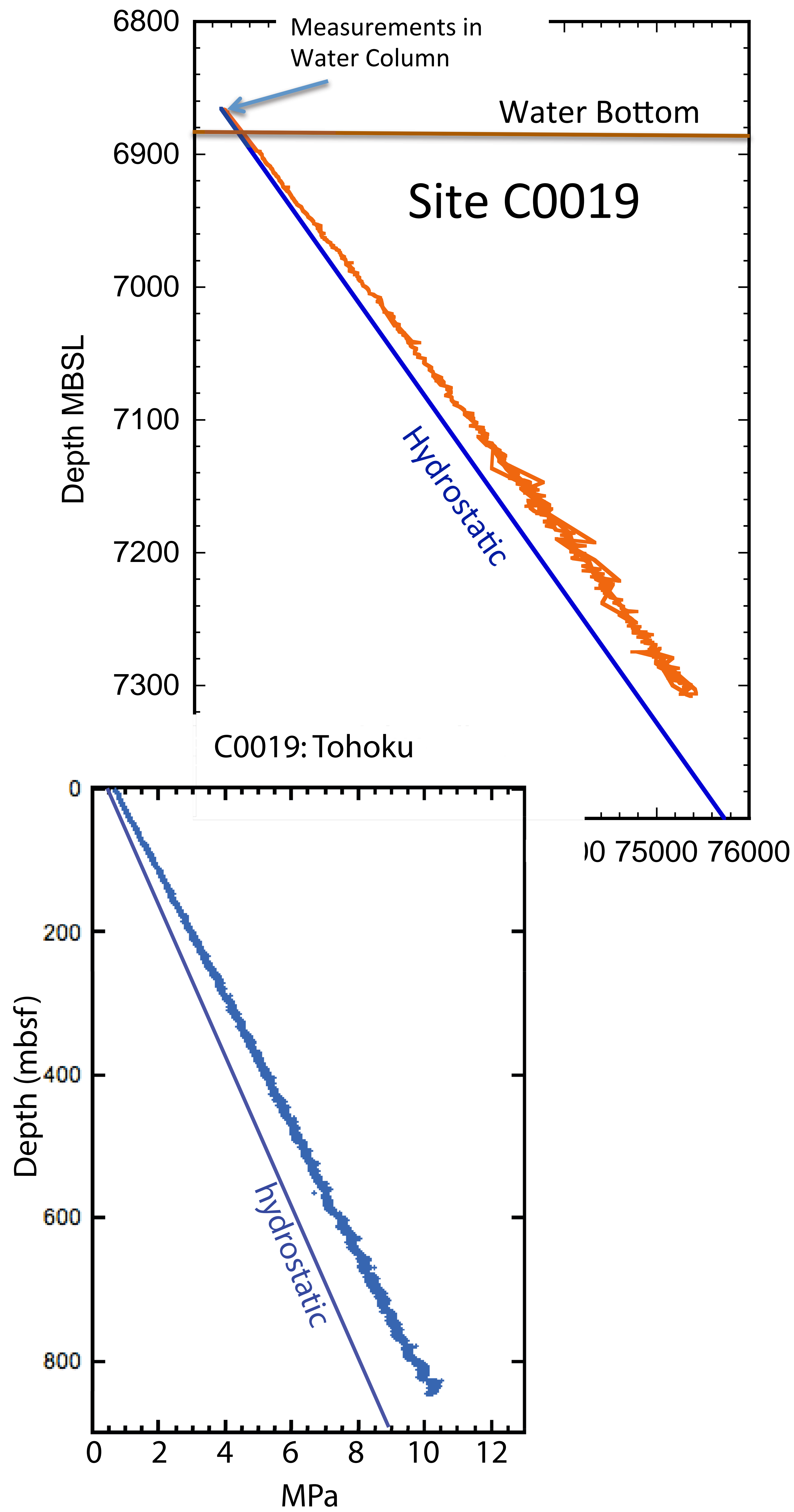
Shear Zone: Dips steeper in core and shallower on the flanks



A Equal angle
lower hemisphere
 $N = 58$

Hole C0019B
poles to bedding from
resistivity image





Observations and Conclusions

- At the Tohoku Location, Accretion wins over subduction or subduction erosion because of extremely wide-spread, weak basal shear zone in smectitic pelagic clay overlying strong basal horst and graben terrane
- Quaternary “slab” reflects early development of complex structural geology in a rapidly converging or high strain system
- Structural Processes operating in absence of lots of fluids fluids, based on interpretation of Annular Pressure While Drilling.