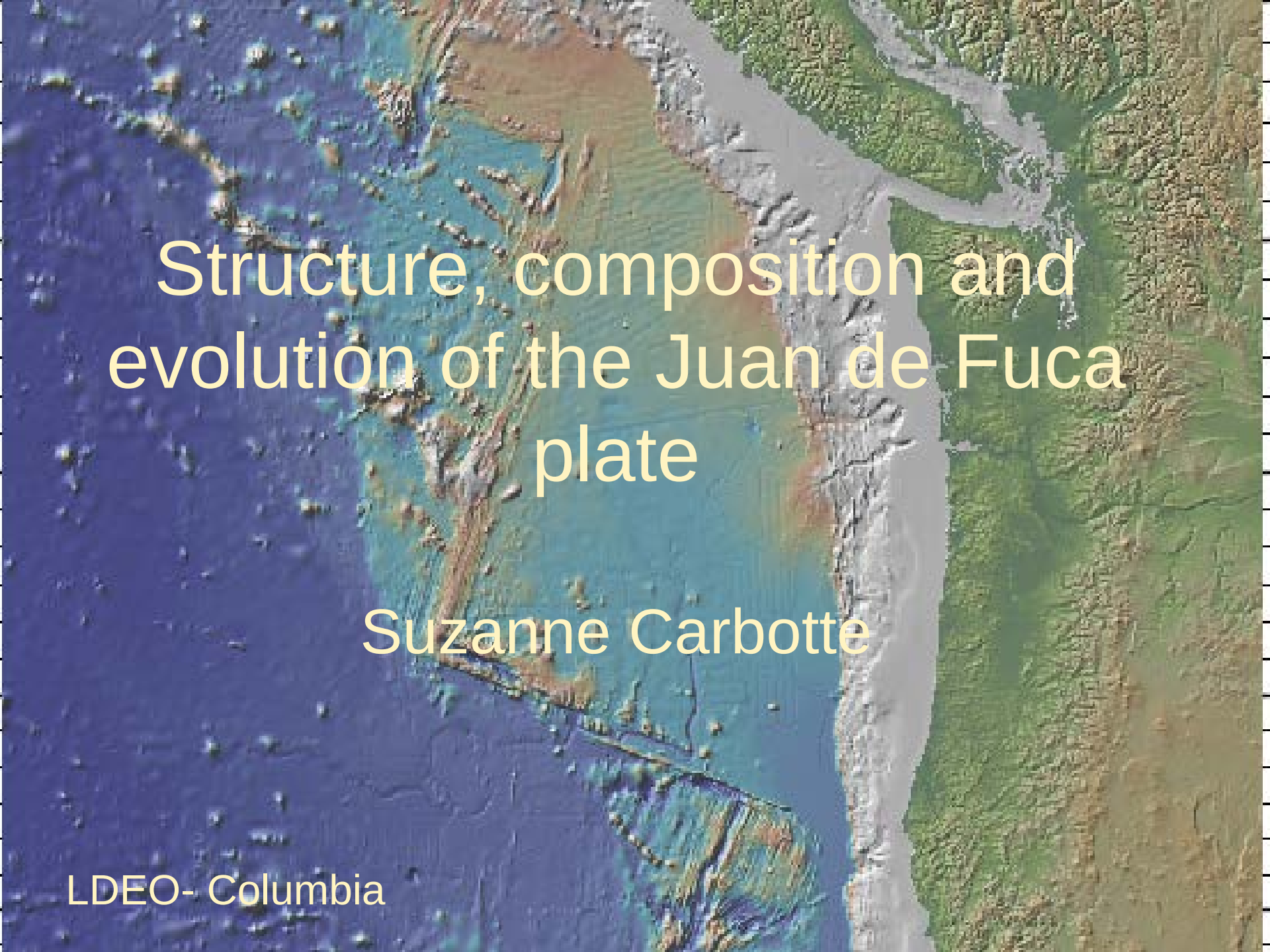
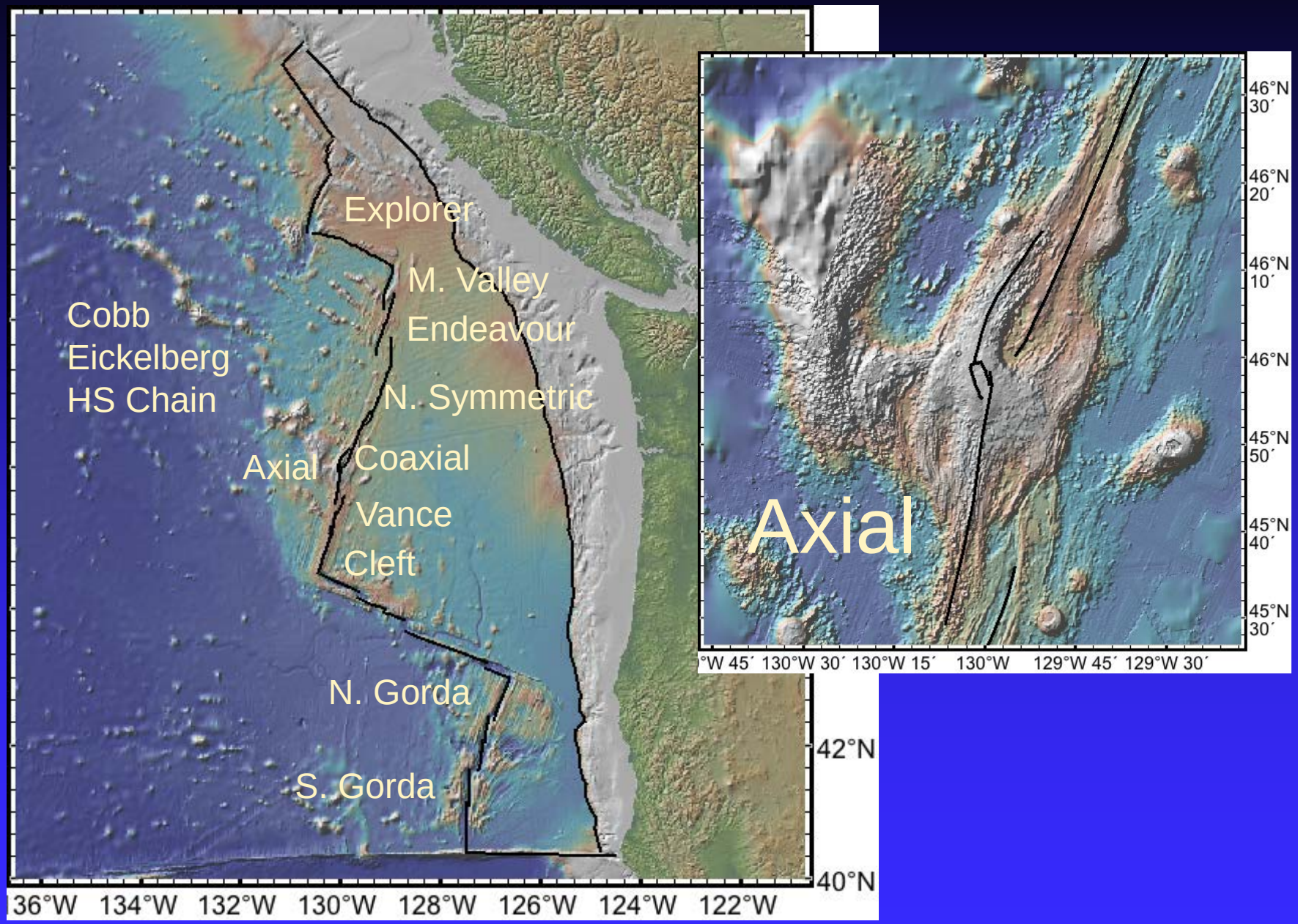
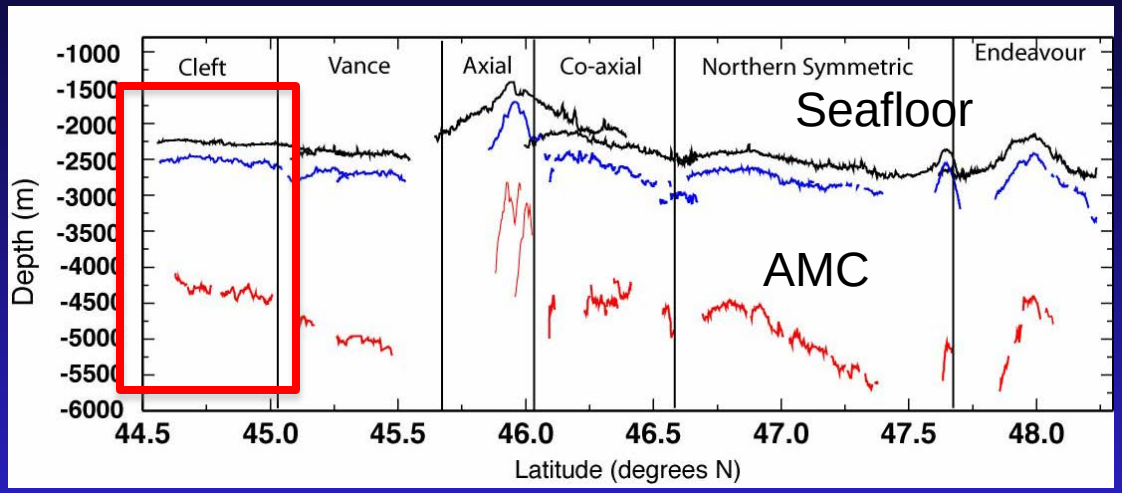


Structure, composition and evolution of the Juan de Fuca plate

Suzanne Carbotte

LDEO- Columbia

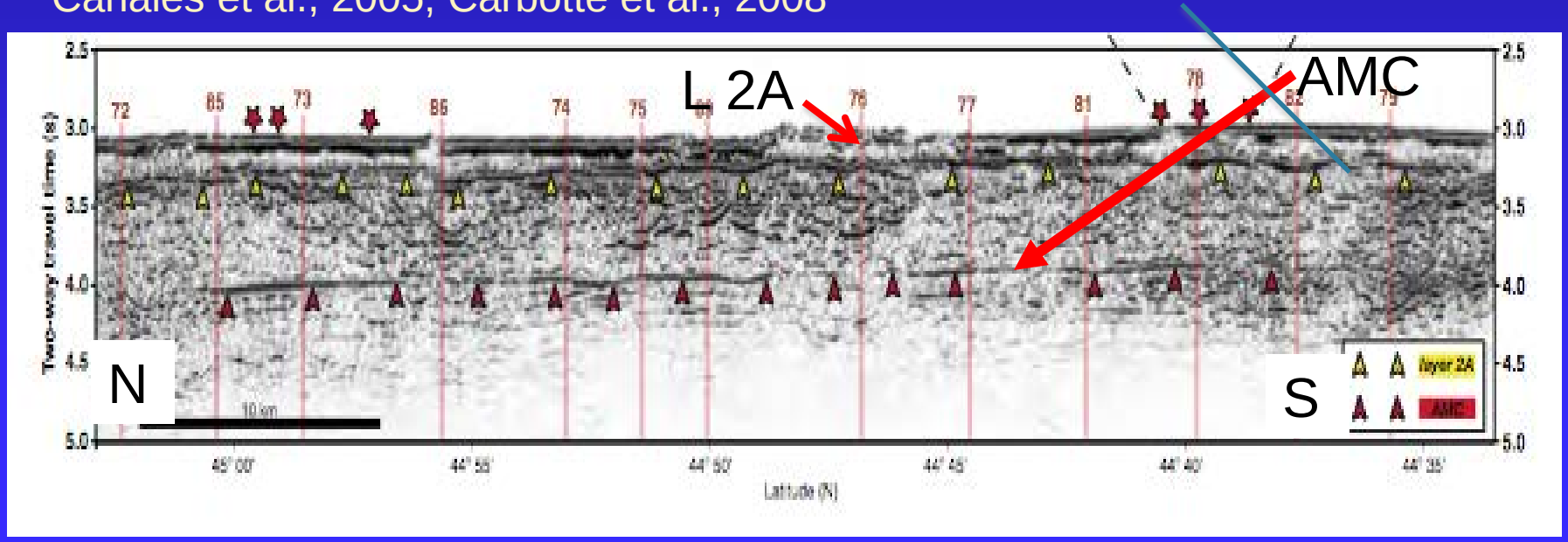

Explorer
M. Valley
Endeavour
N. Symmetric
Coaxial
Vance
Cleft
N. Gorda
S. Gorda
Cobb
Eickelberg
HS Chain
Axial
Axial
46°N 30′
46°N 20′
46°N 10′
46°N
45°N 50′
45°N 40′
45°N 30′
°W 45′ 130°W 30′ 130°W 15′ 130°W 129°W 45′ 129°W 30′
42°N
40°N
36°W 134°W 132°W 130°W 128°W 126°W 124°W 122°W



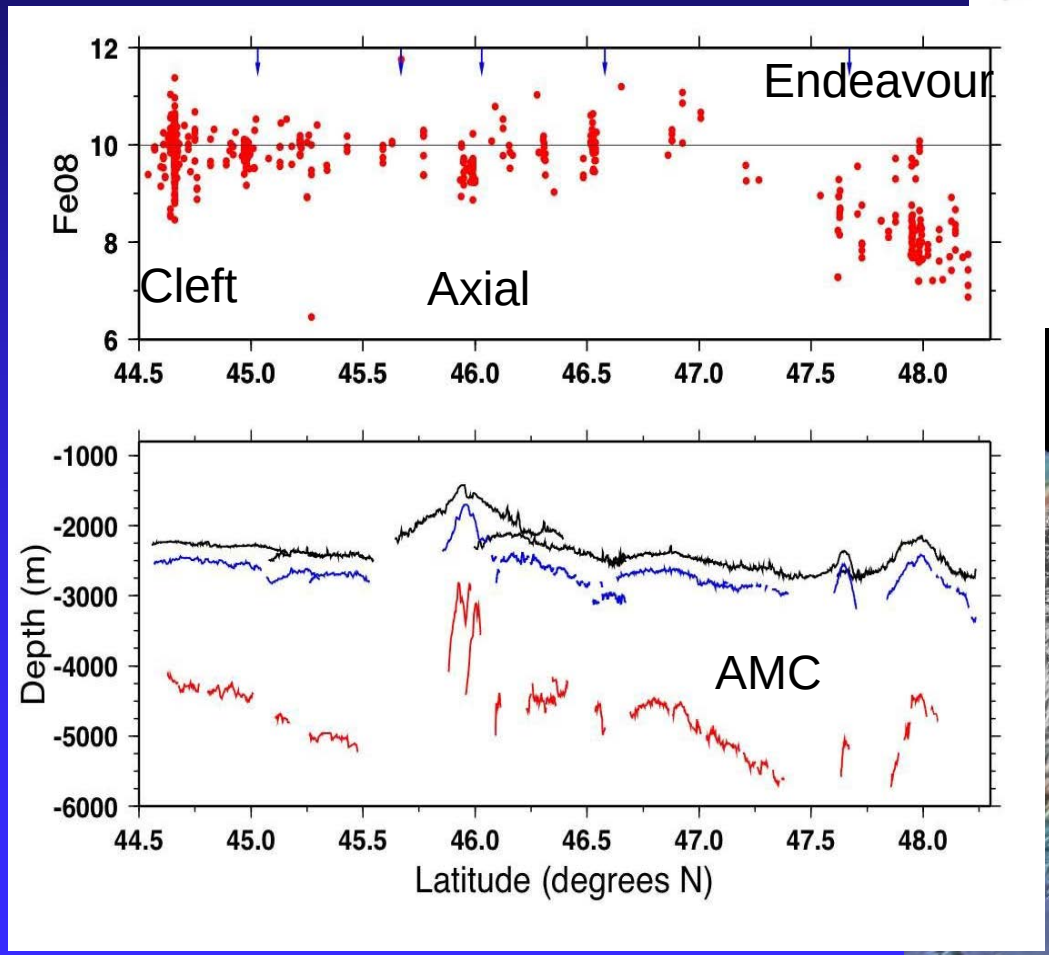
Seismic structure of crust:

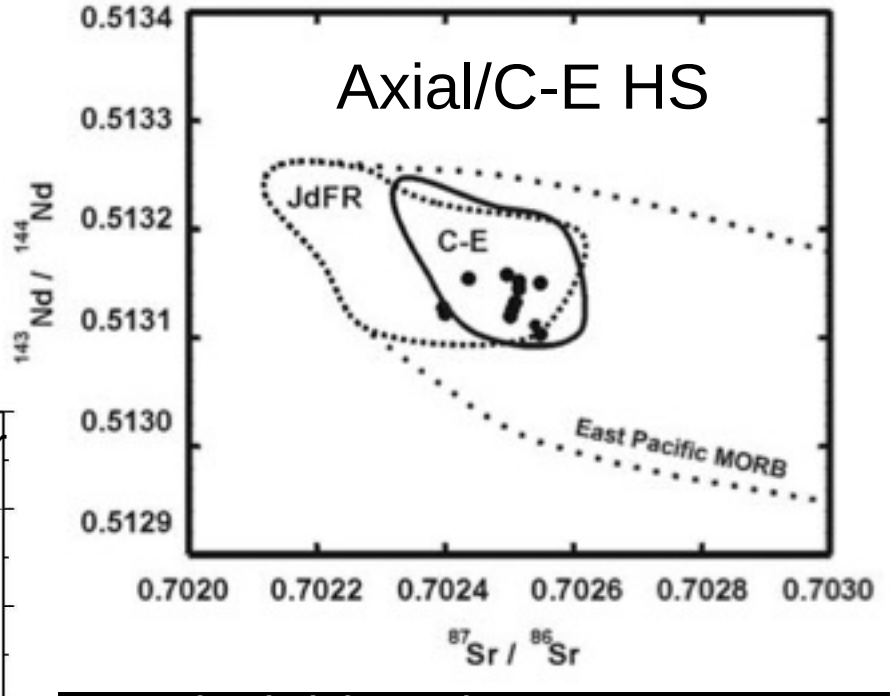
L2A~500 m thick
L2/3 bdy 2-3 km bsf

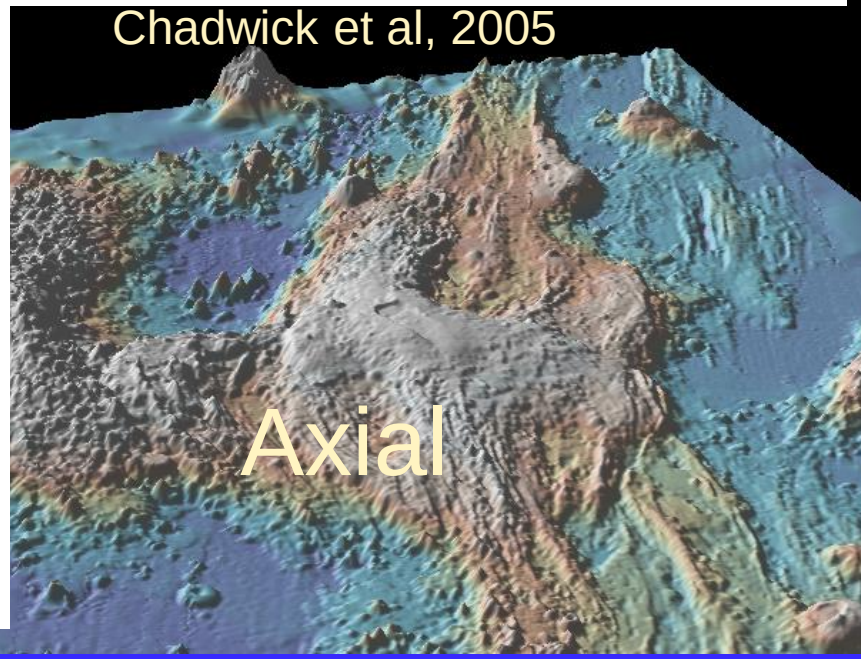
Canales et al., 2005; Carbotte et al., 2008



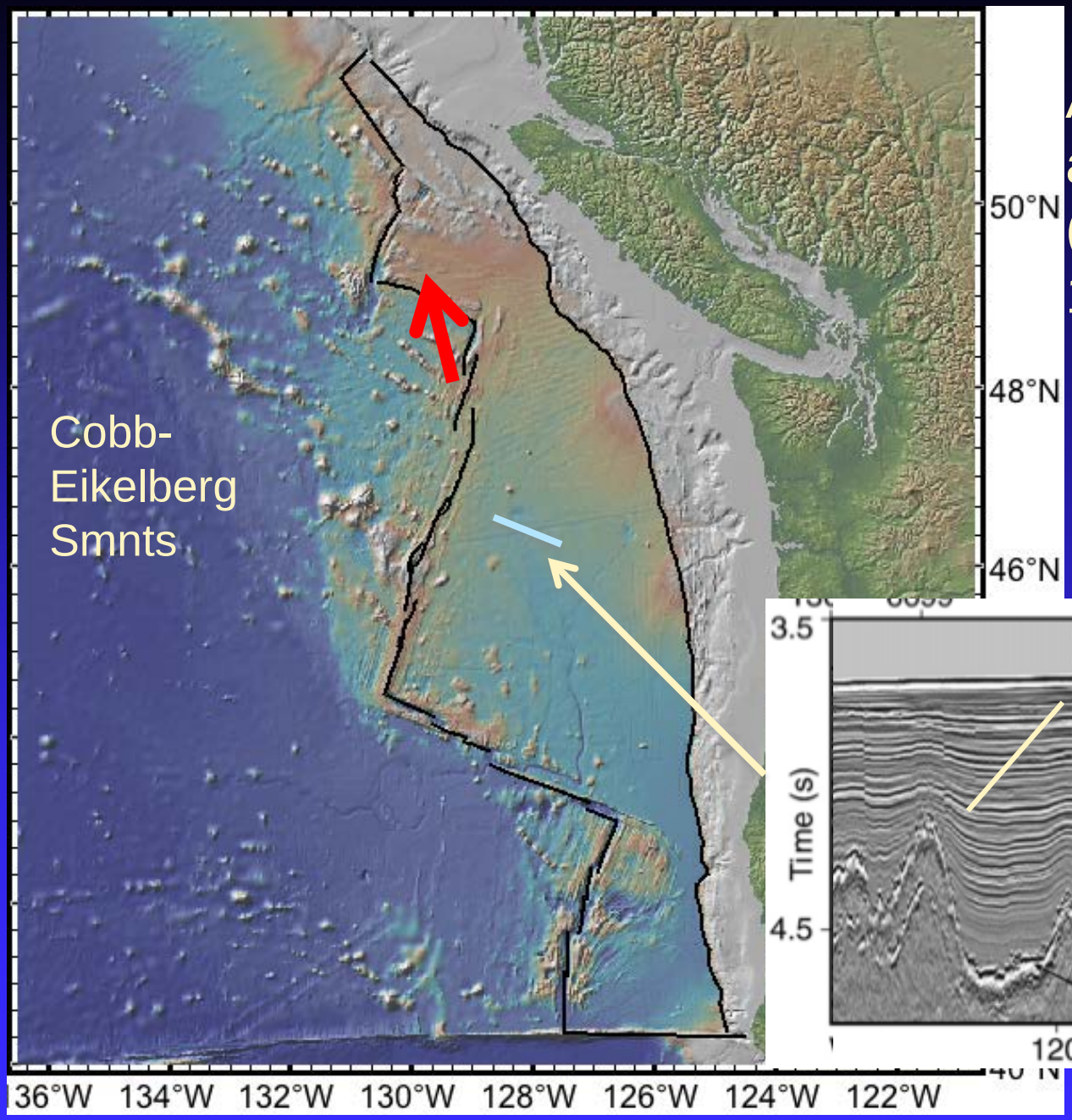
Ridge Axis Geochemistry





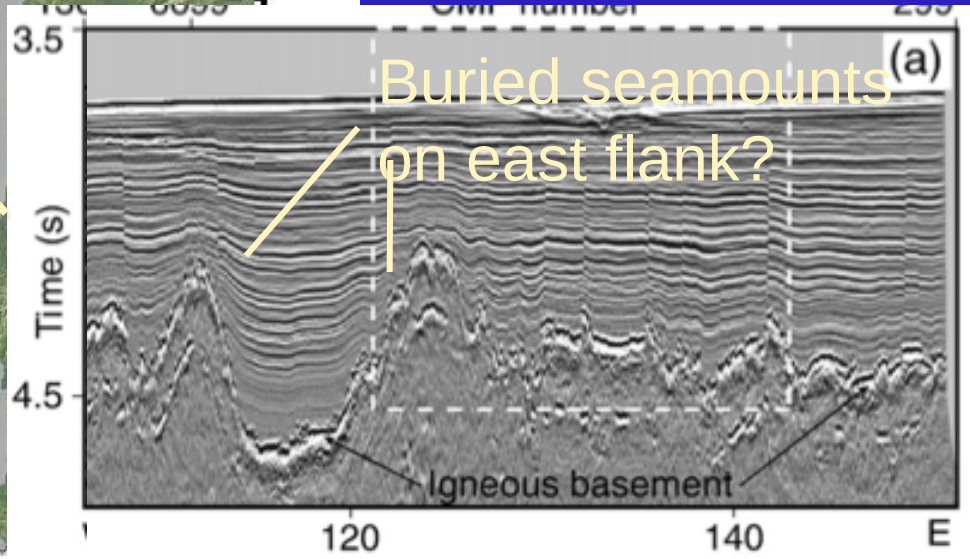


From PetDB and M Perfit, pers comm.



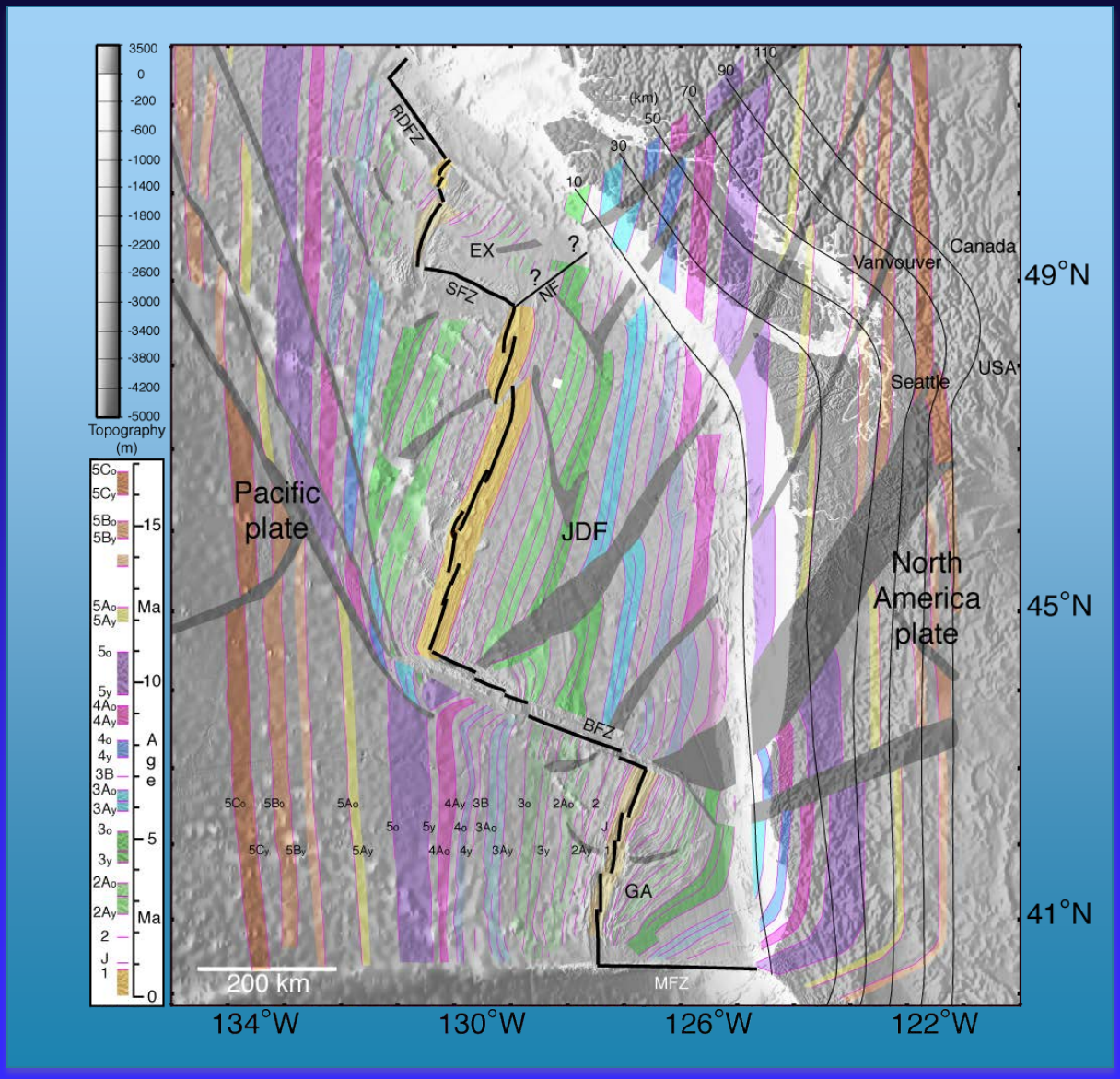
Abundant seamounts, asymmetric distribution (Davis and Karsten, 1986)

Small mantle melt anomalies and formation near axis



Nedimovic et al., 2009

Plate Age and Segmentation

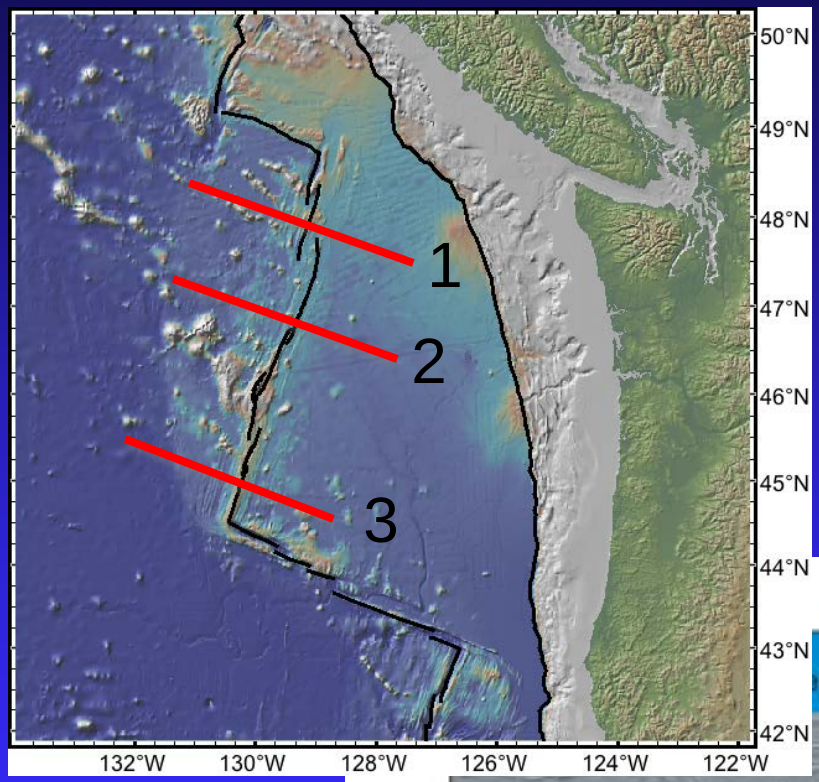


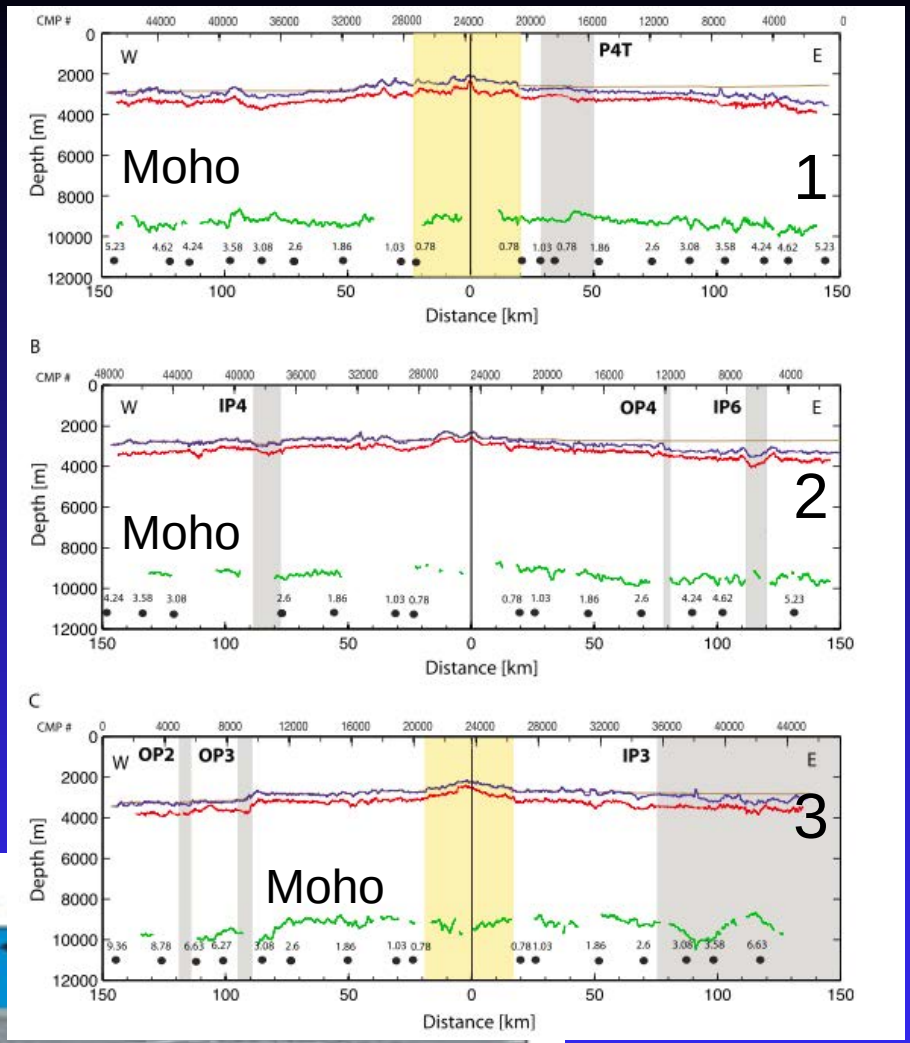
Past 25 Ma:

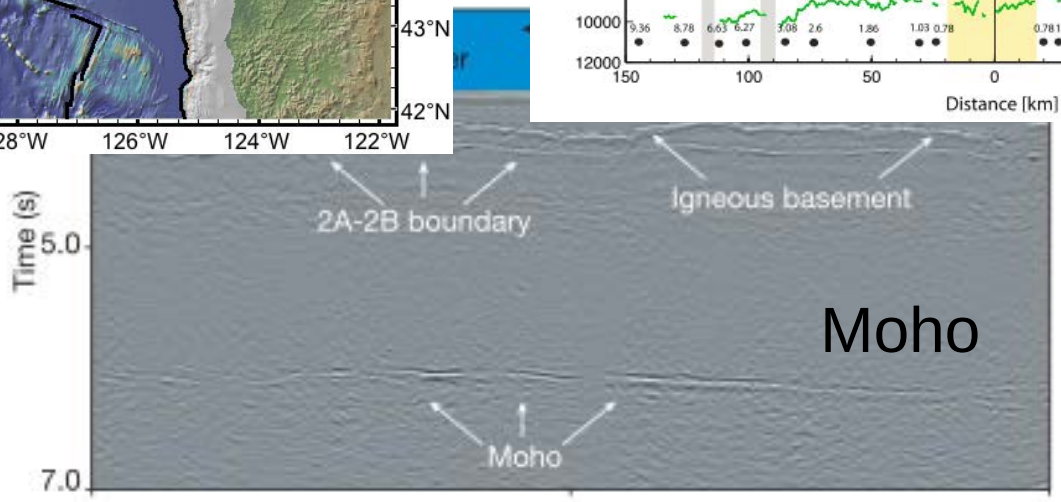
- 6 major episodes of rift propagation
- 10-15˚ clockwise shift at 5.9 Ma
- Initiation of Blanco TF

Plate Isochrons: Wilson, 1993; 2002 Plate Isodepth: McCrory et al., 2004

Crustal thickness

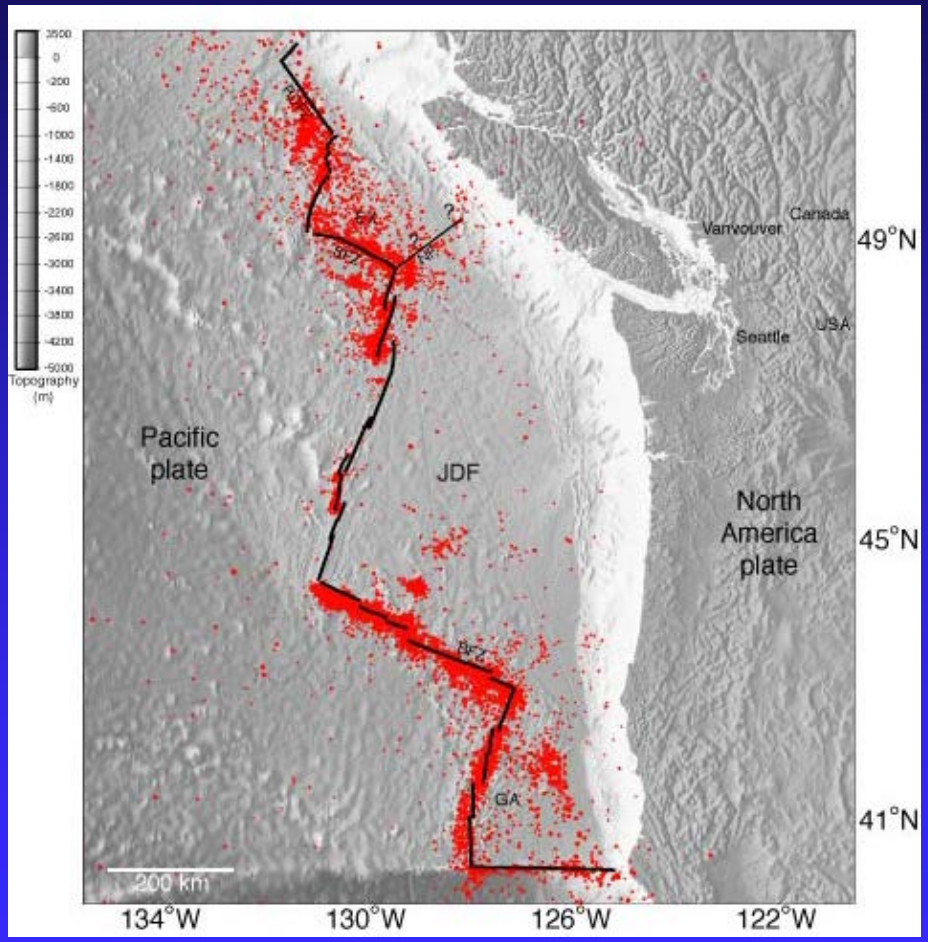


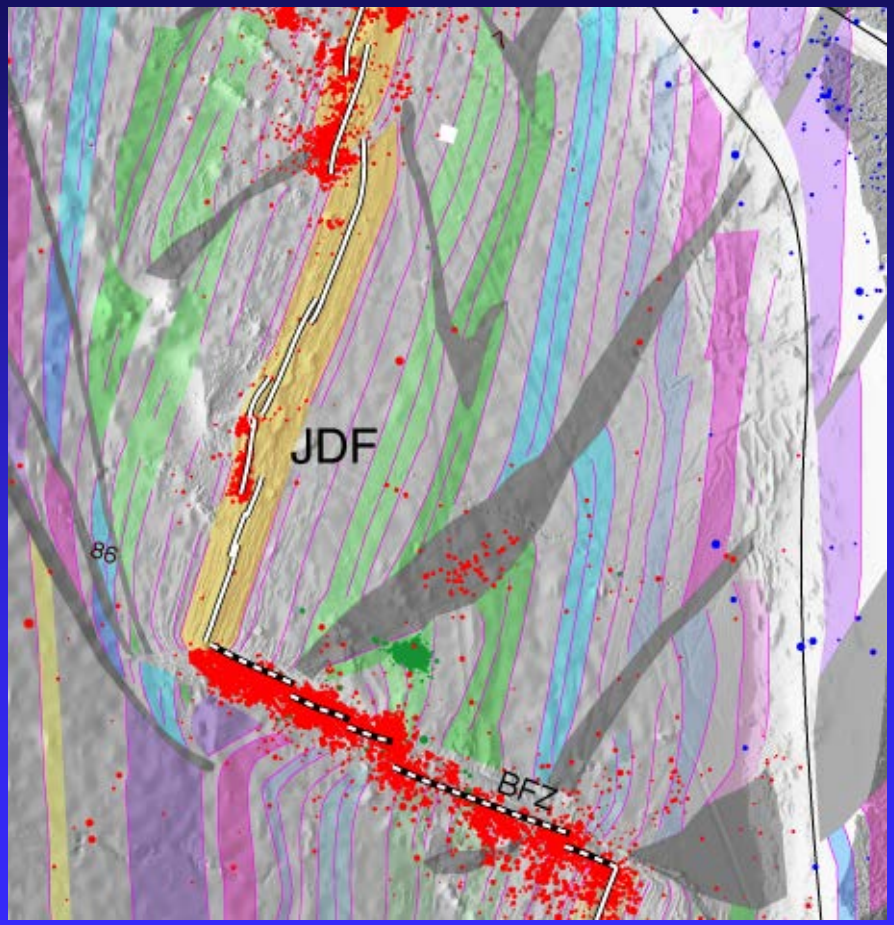




Nedimovic et al., 2005; Carbotte et al 2008

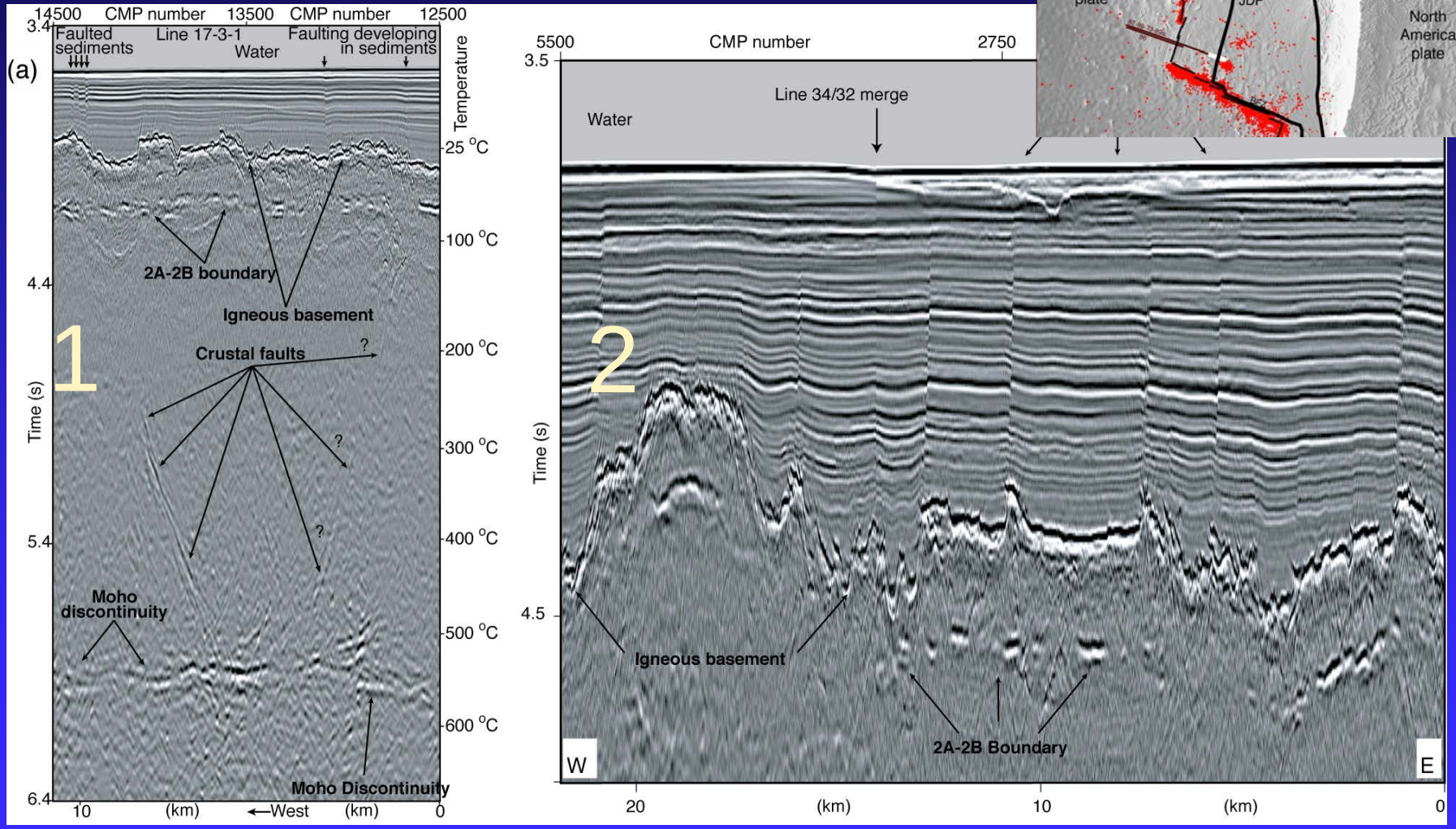
Plate Seismicity

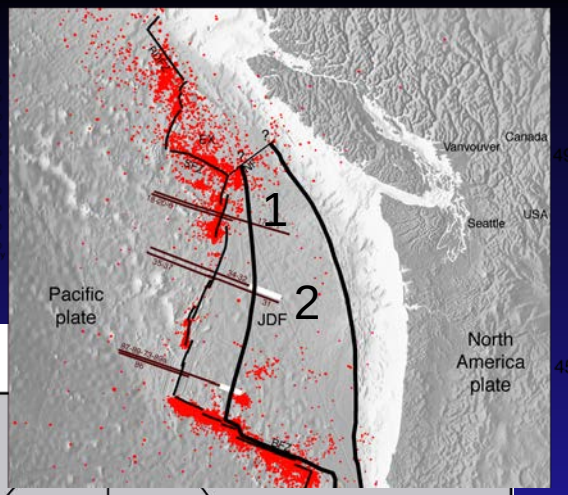




Red- SOSUS detected seismicity

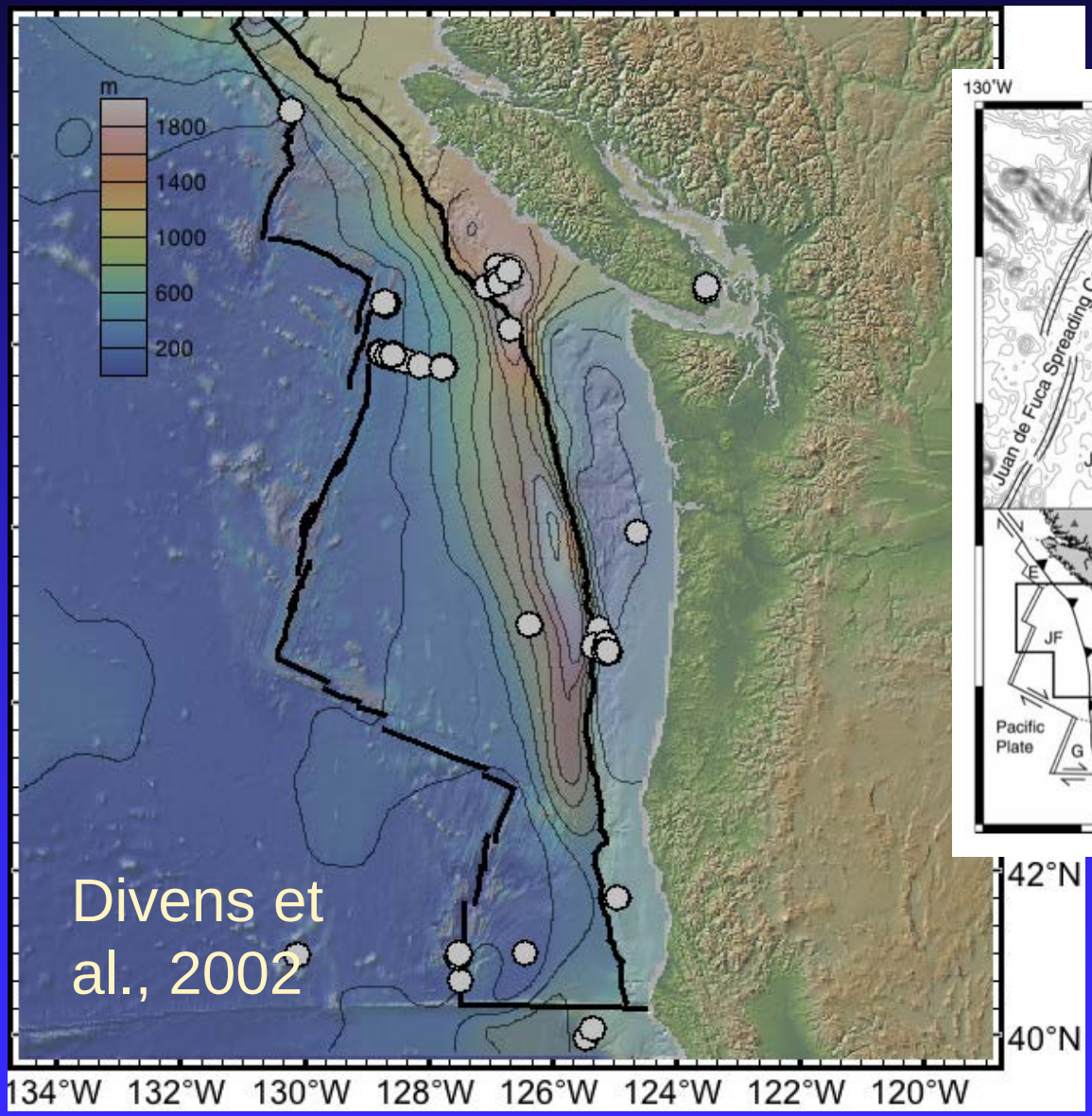
Faulting in plate interior

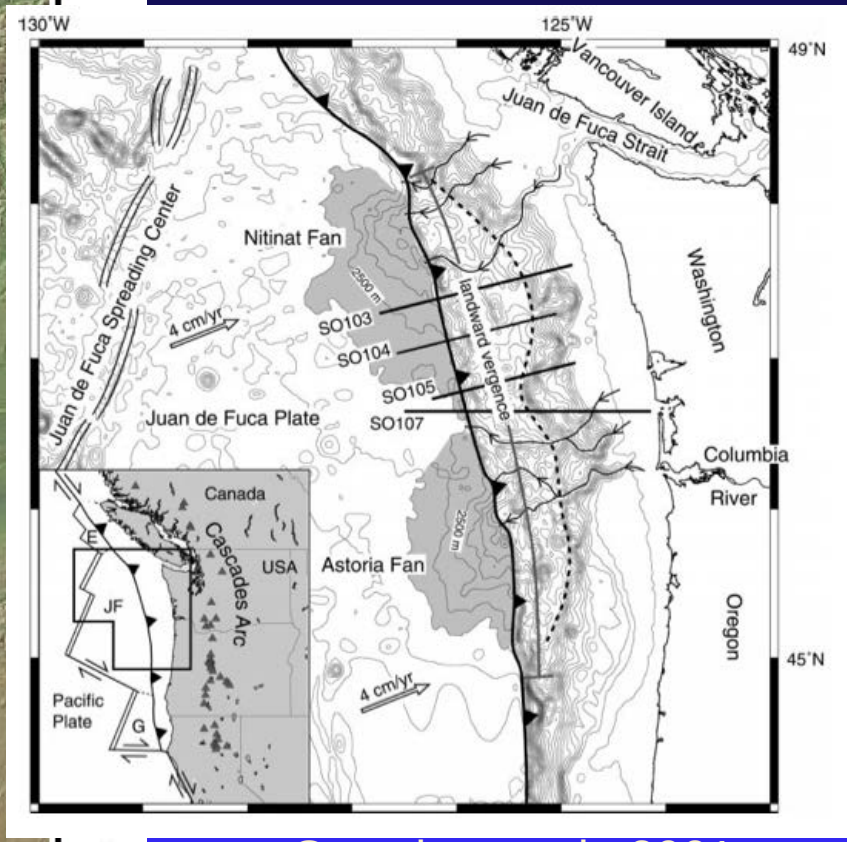




Nedimovic et al., 2009

Sediment Distribution





Gutscher et al., 2001

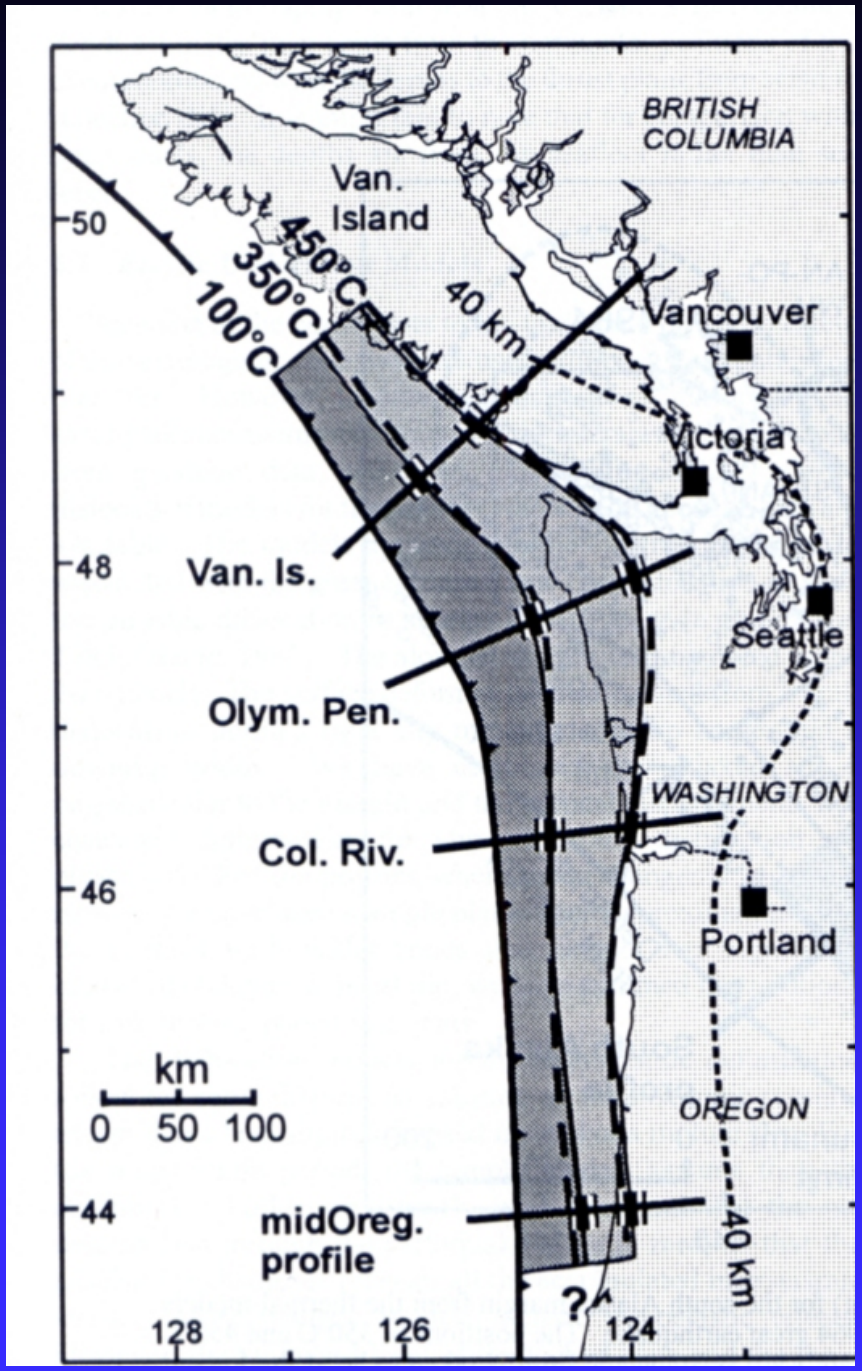
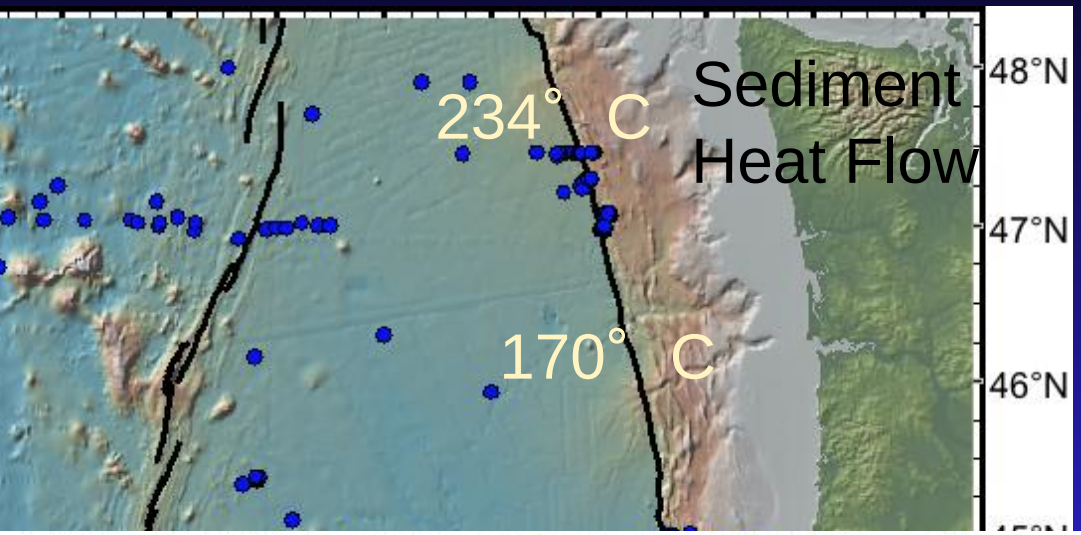
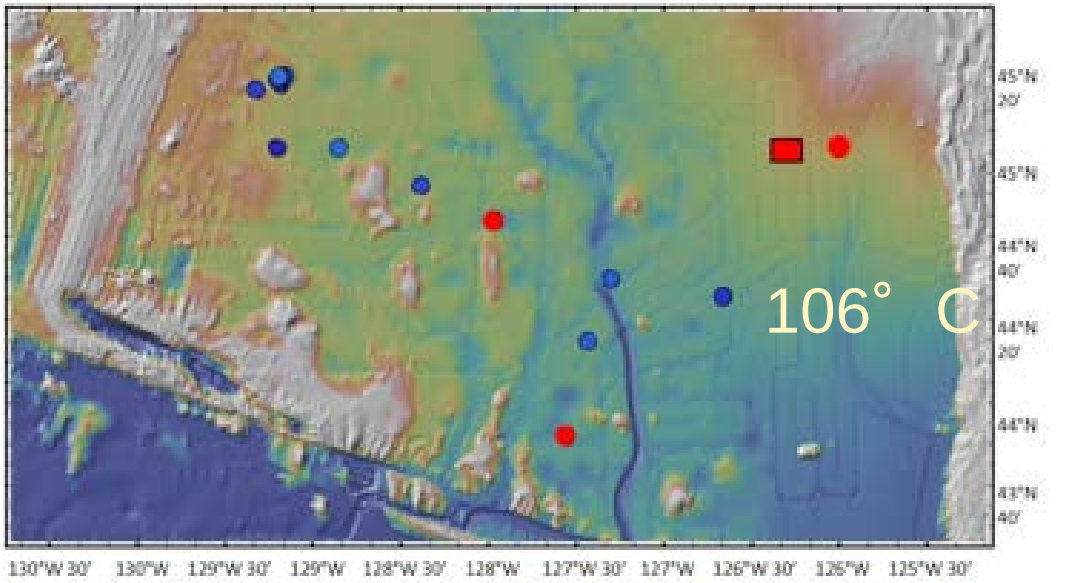


Plate thermal structure

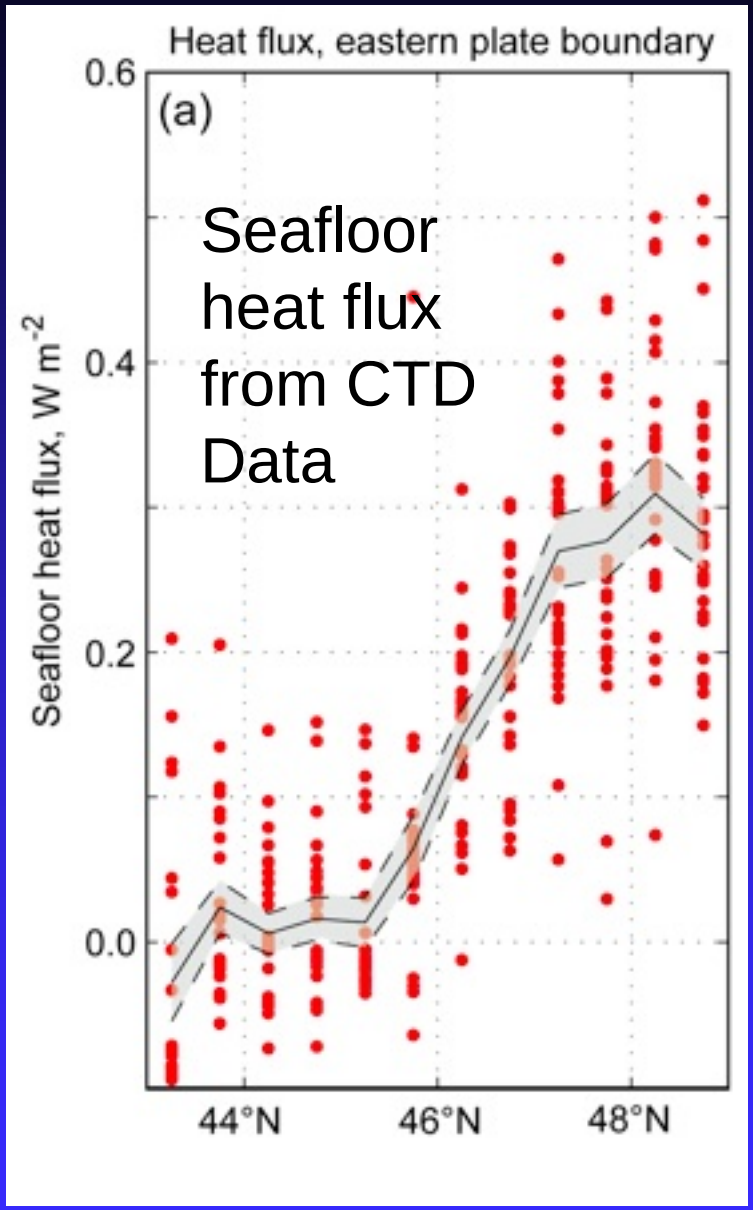
Oleskevich et al., 1999, Hyndman and Wang, 1993; Wang et al., 1995

Heat Flow Data



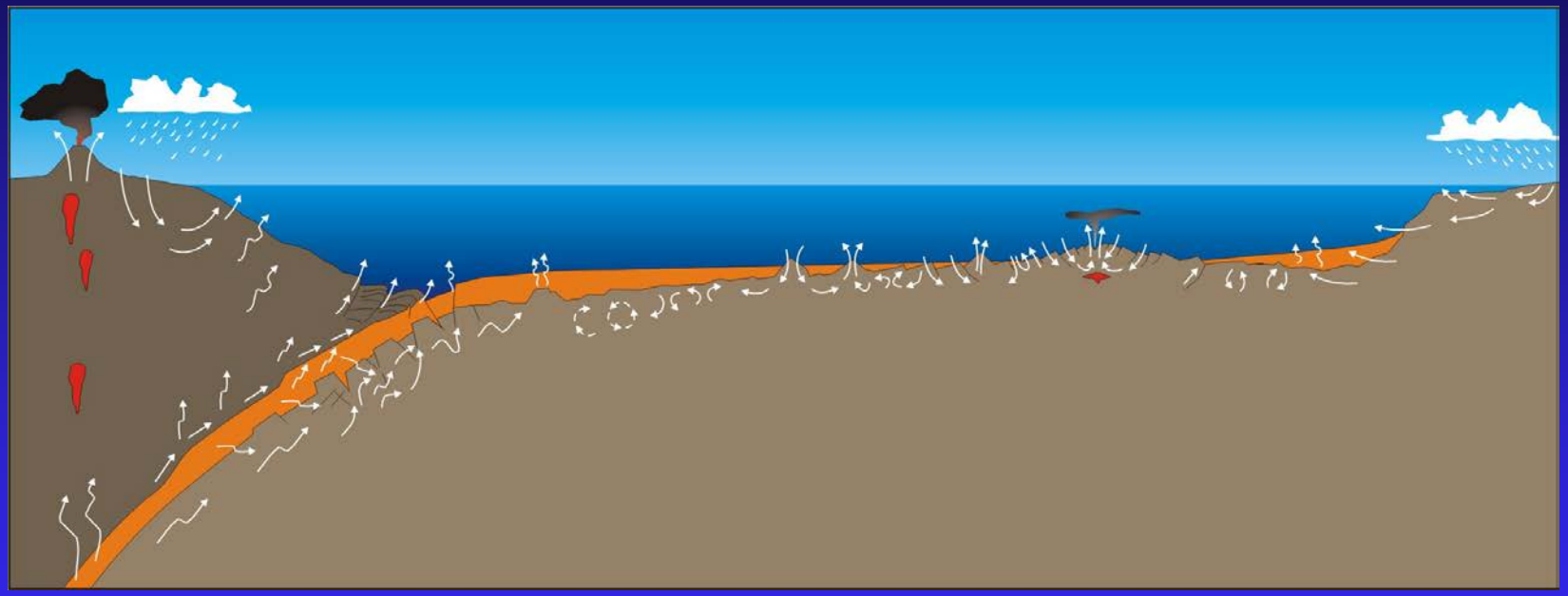


Johnson et al., G-Cubed in press



Hautala et al., 2009

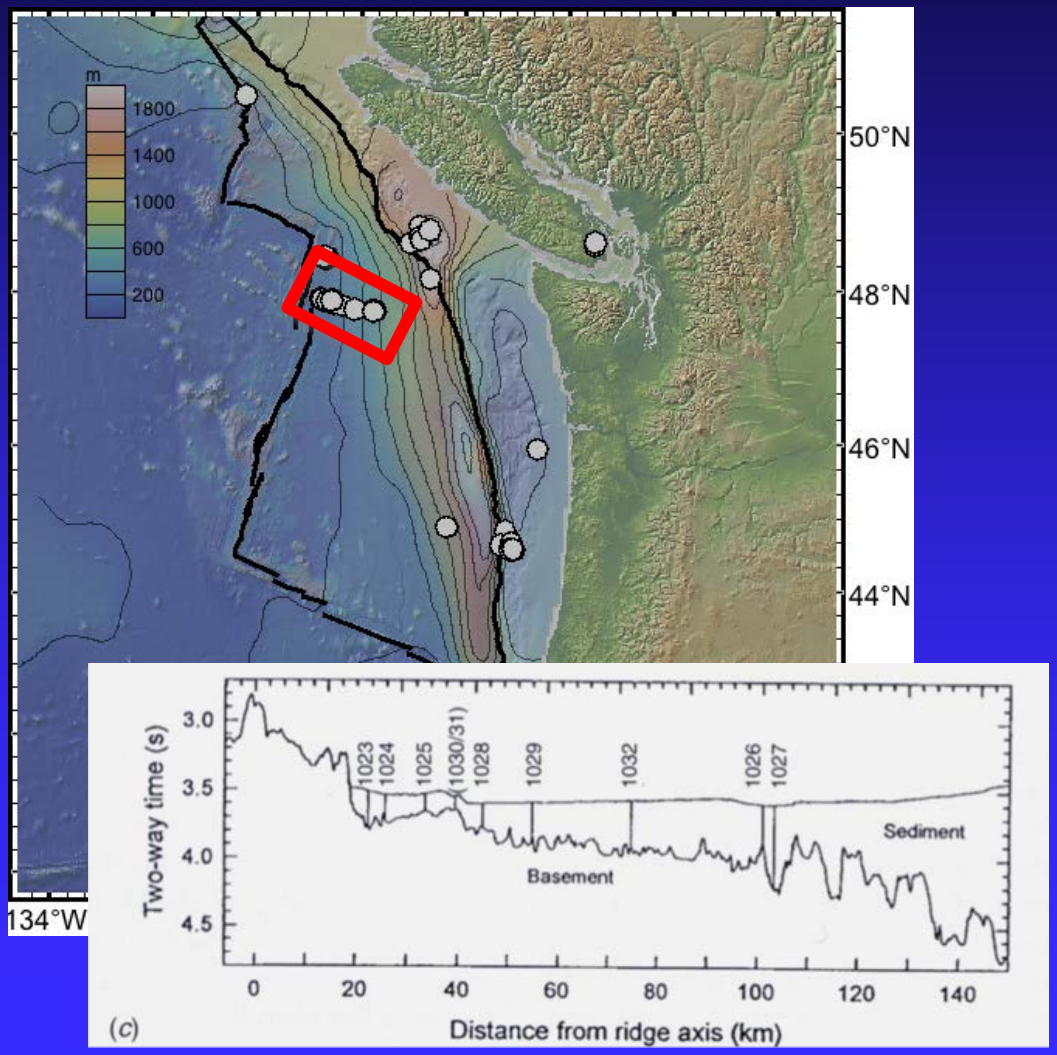
Plate Evolution



Davis et al., 2004

Hydrogeology of Oceanic Lithosphere – Davis and Elderfield, 2004

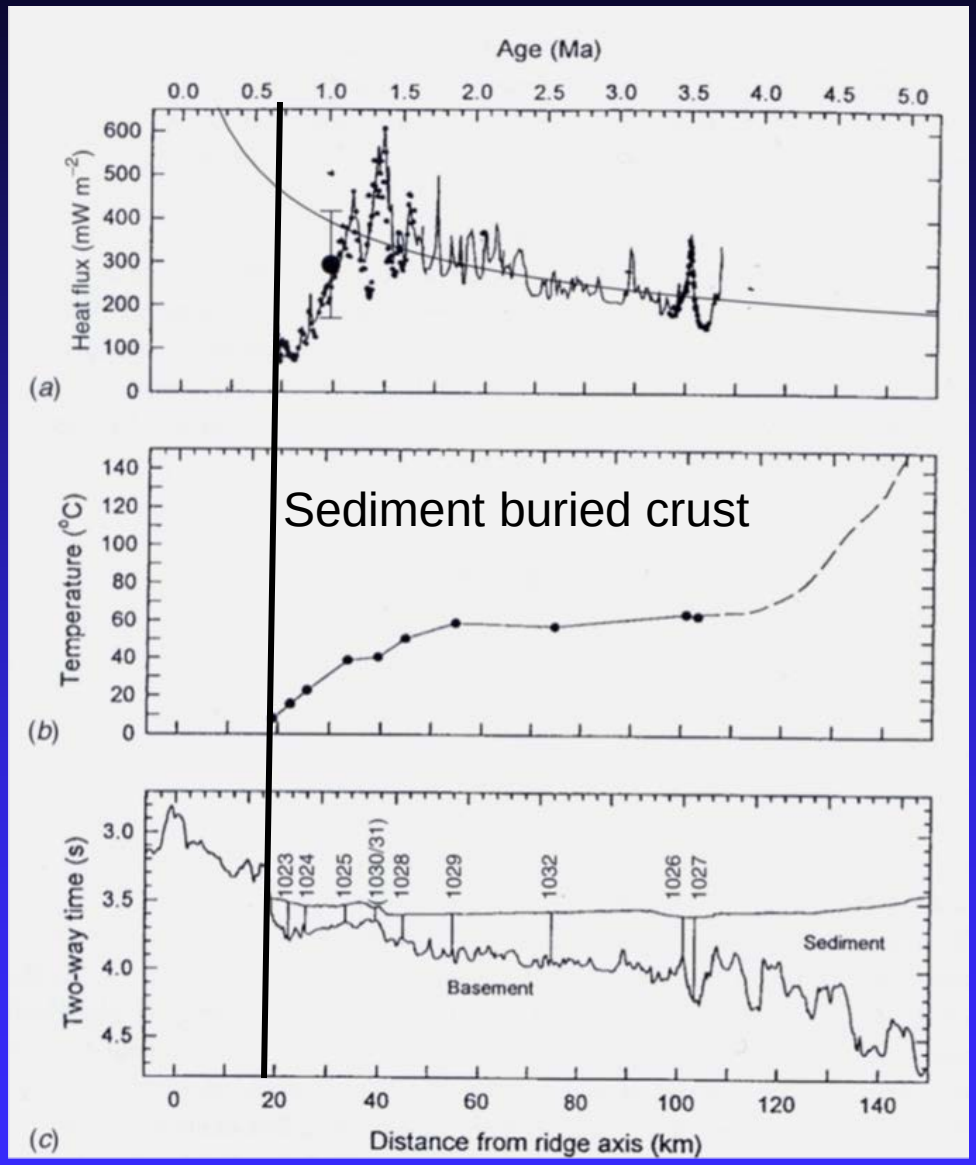
ODP/IODP FlankFlux Experiment



- Fluid flow rates/flux
- Sediment/basement porosity/permeability
- Turbidite stratigraphy/age/composition
- Sediment/basement pore fluids
- Basalt alteration

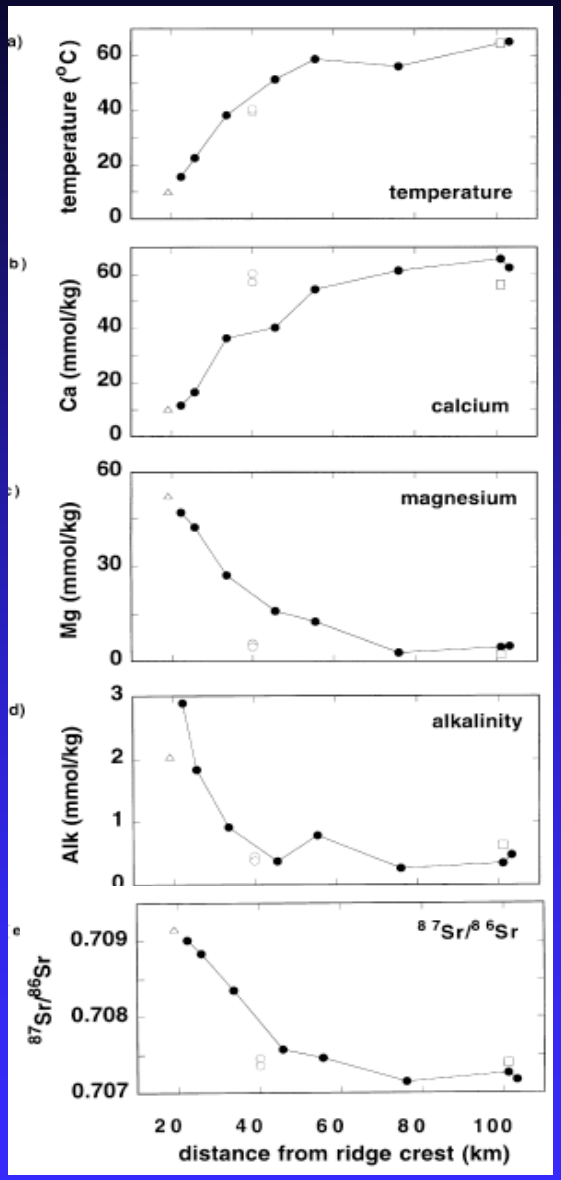
e.g. Davis et al., 1992; 1997, 1999; Fisher et al., 1995; Underwood et al 2005; Elderfield et al., 1999, Hunter et al., 1999

Heat Flow, Basement Temperature



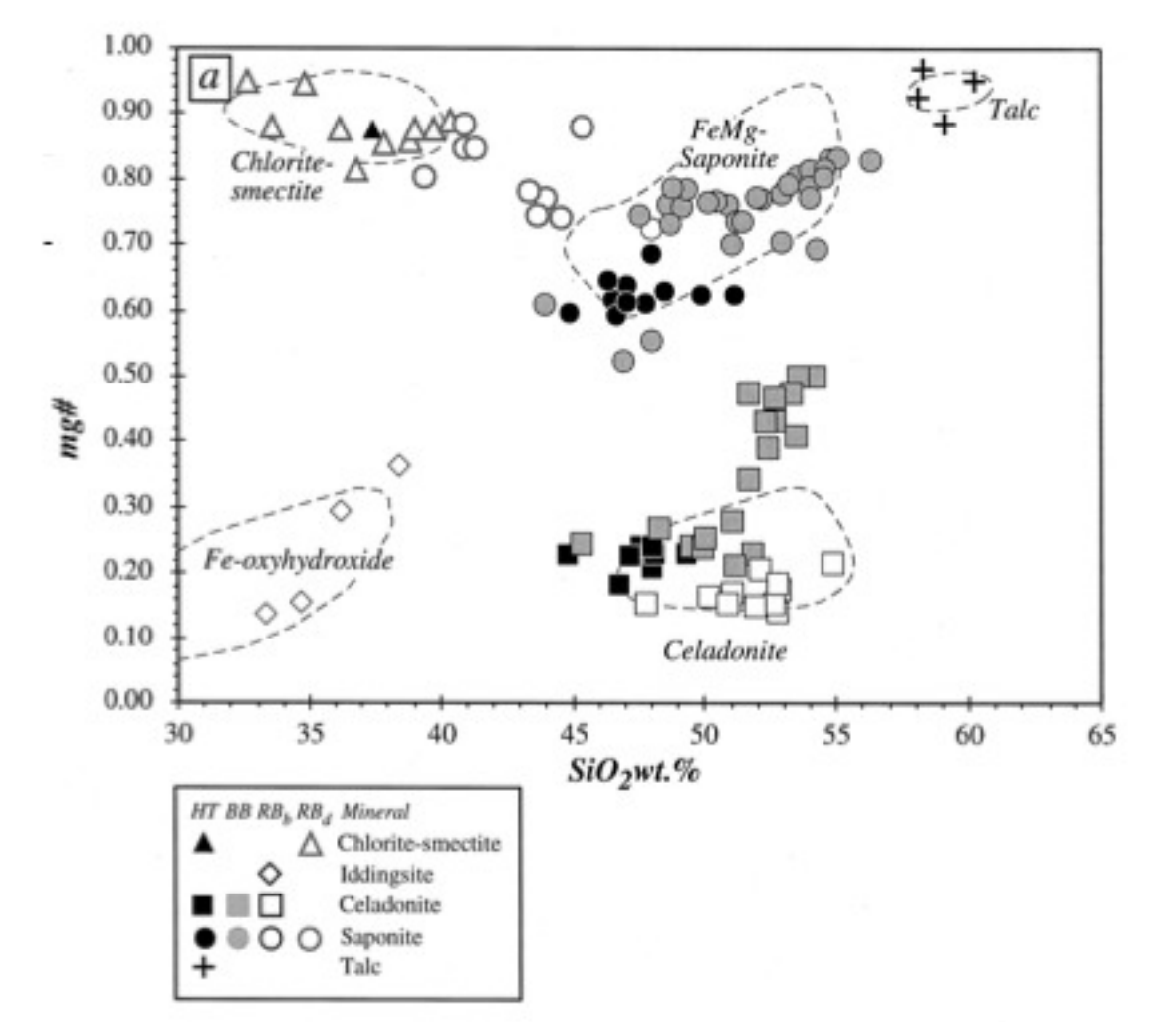
Davis et al., 1999

Pore fluid Chemistry



Elderfield et al., 1999

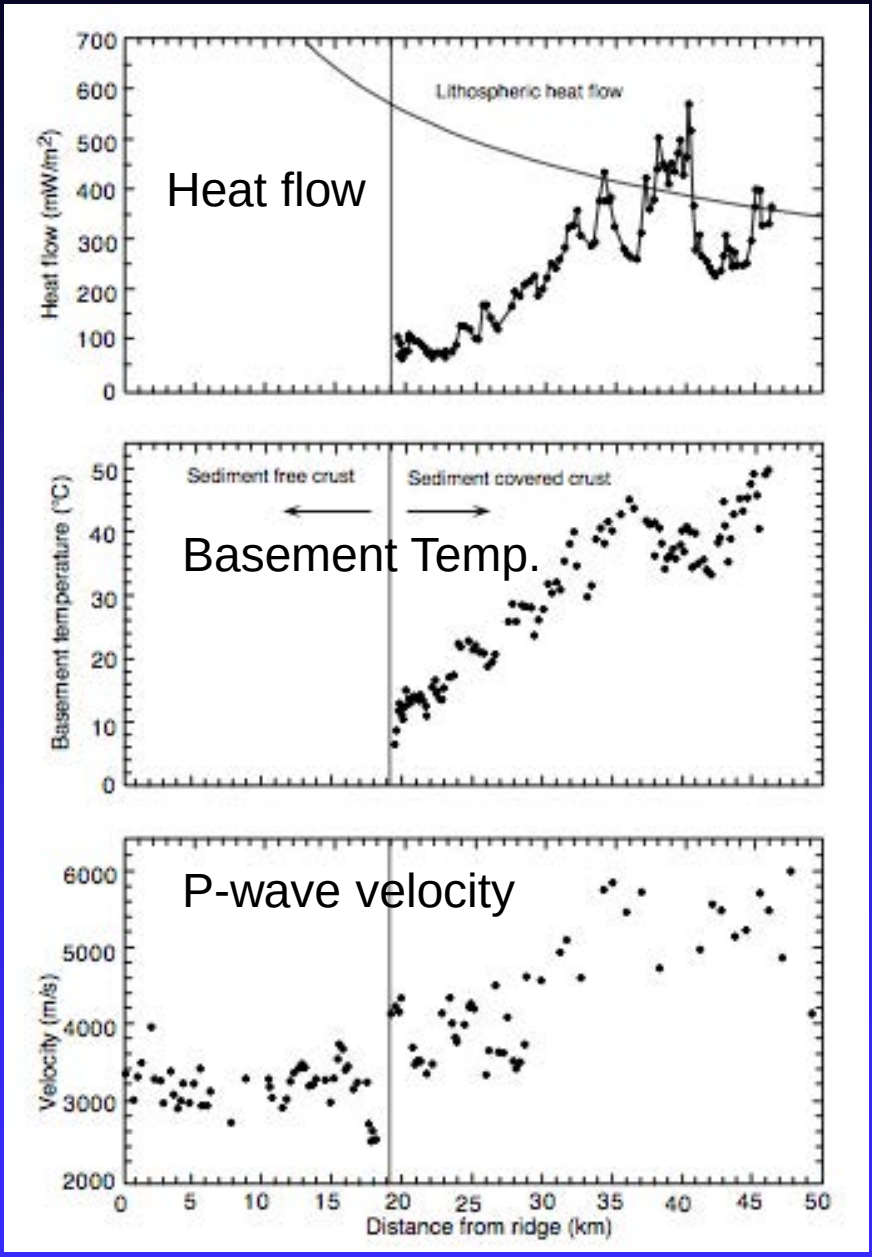
Basalt Alteration



Hunter et al., 1999

4 phases of alteration identified:

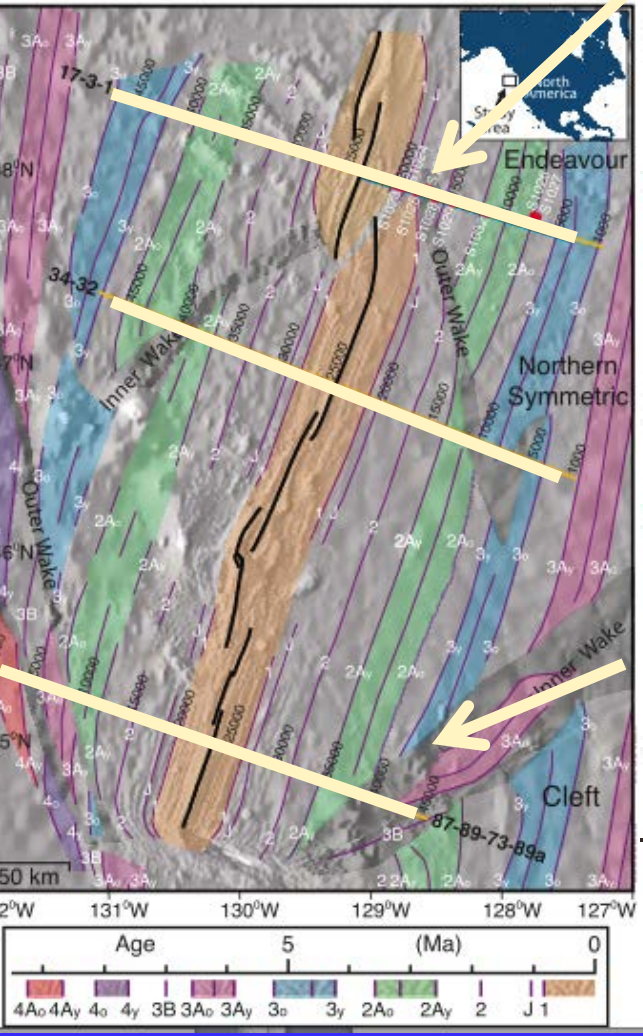
- chlorite, smectite,
- celadonite
- Saponite
- carbonate



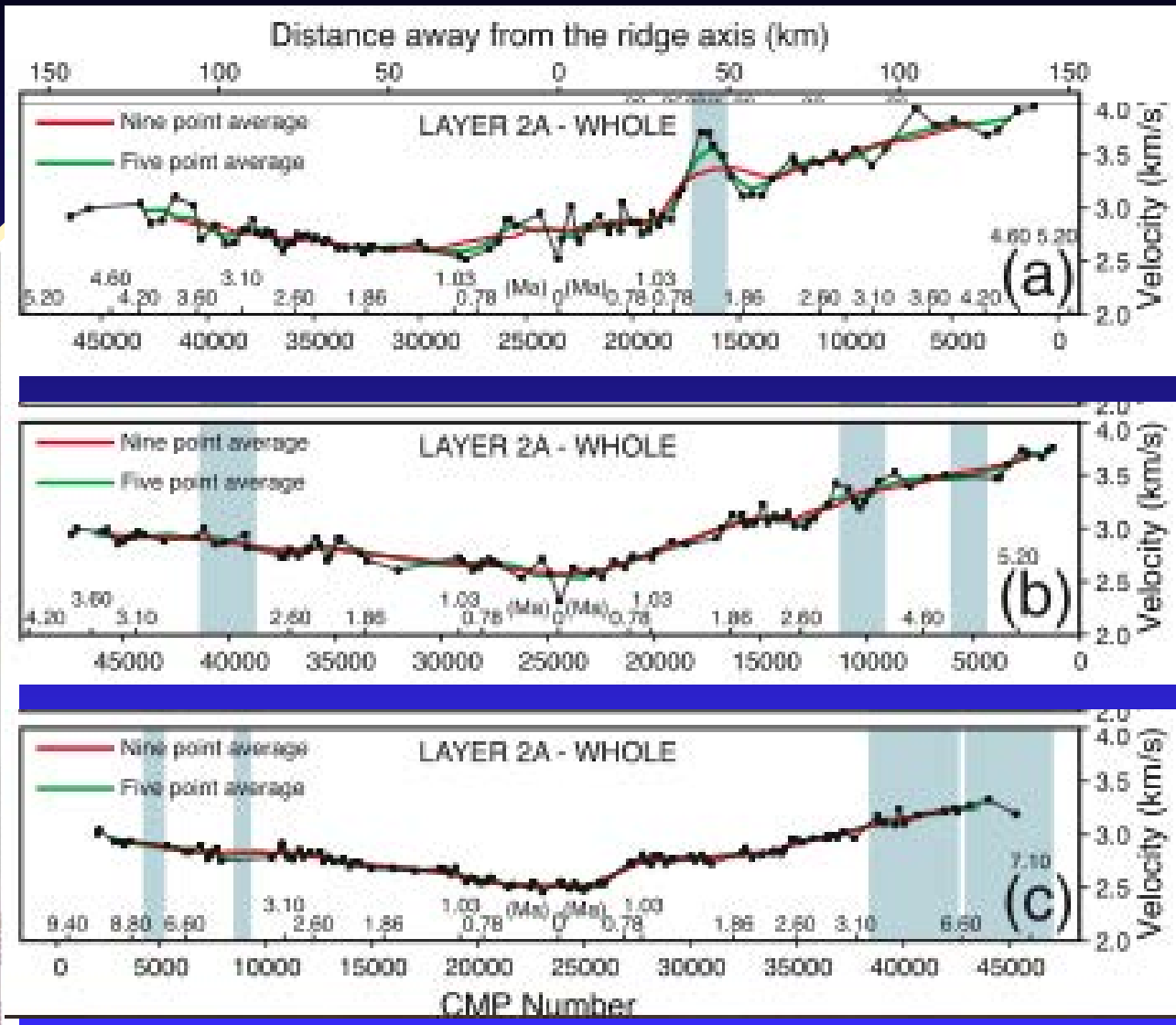
Increase in seismic layer 2A velocities accompany rise in basement temperatures

Rohr, 1994

Alteration of Layer 2A



Nedimovic et al. 2008



Vp increases with age- porosity infill with increasing alteration. Change in Vp varies with sediment cover

Questions pertaining to downgoing plate

- What is nature of shallow mantle that gives rise to abundant seamount production in NE Pacific? Impact of buried seamounts on subduction zone?

- What is influence of primary segmentation of plate defined by propagator wakes on subduction?

- Does faulting extend across plate interior? Bending related faulting? Extent of crustal/mantle alteration?

- Ridge flank hydrothermal circulation. Geometry and depth extent and variations across Cascadia basin?

- Gradients along trench in plate thermal structure, sedimentation, and extent of alteration- What are impacts on subduction zone structure?