Plate Tectonics: Is Cascadia a Typical Subduction Plate Margin?

Earthquakes

Sea floor magnetc anamolies

Contnental drift reconstructions based on sea floor magnetic anamolies

Subduction: the role of density changes in oceanic plates

Subduction zone lower plates: Circum—Pacific examples

Volcanoes

http://earthquake.usgs.gov/earthquakes/map/

Earthquake magnitudes greater than 2.5

http://www.emsc-csem.org/#2

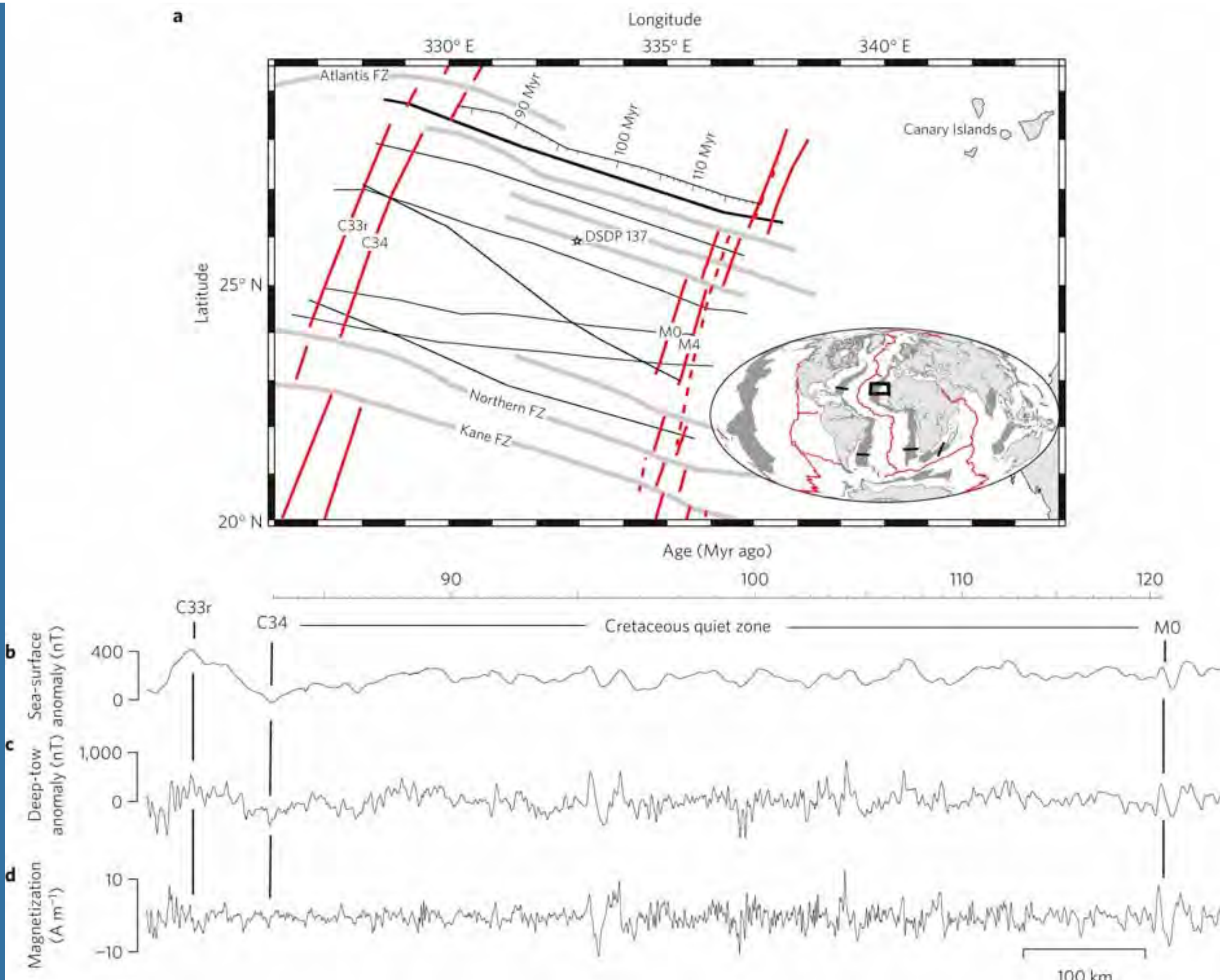
Recent Earthquakes in Europe

http://ds.iris.edu/seismon/

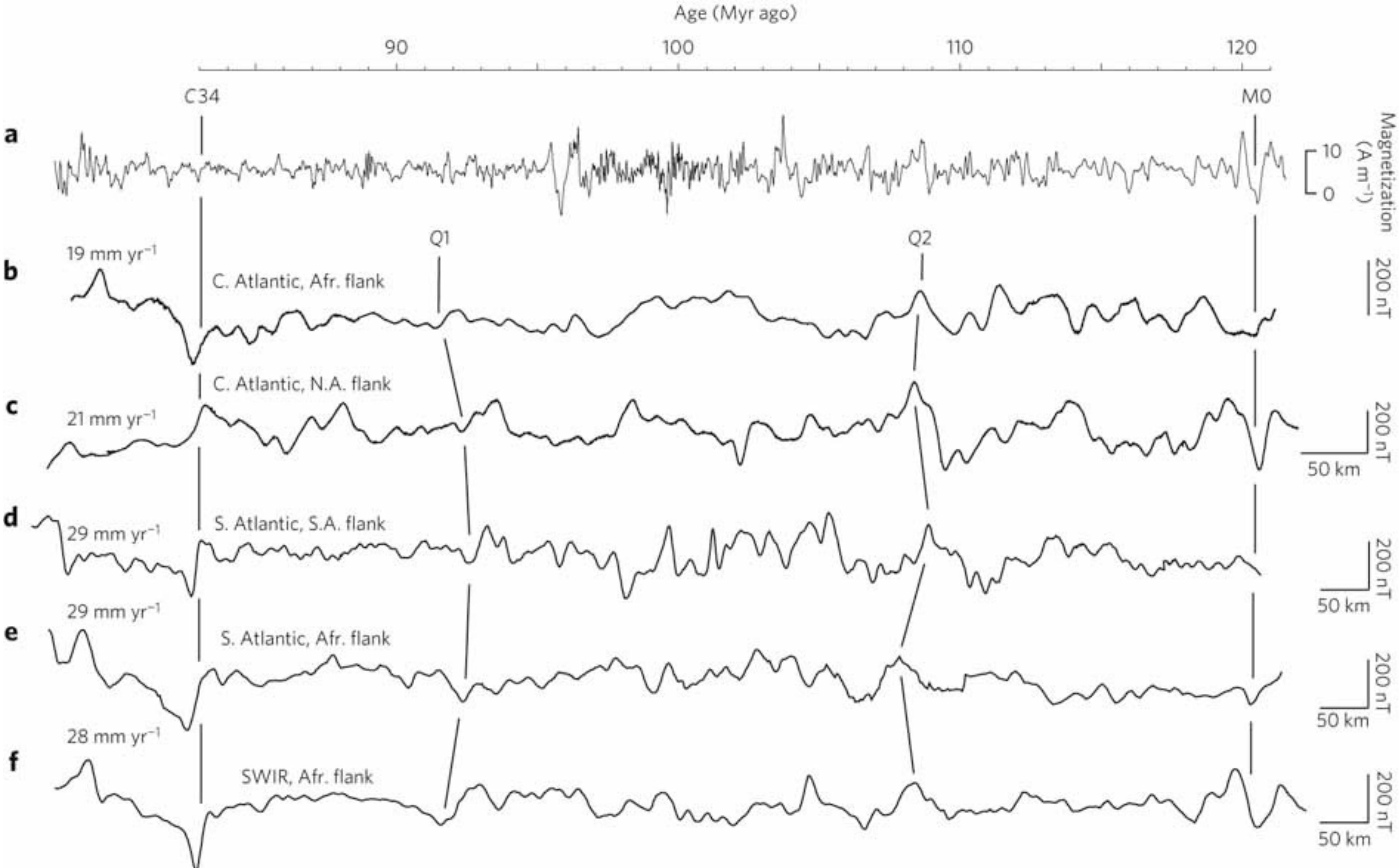
Recent Earthquakes Across the World

http://pnsn.org/earthquakes/recent

Recent Earthquakes in the Pacific Northwest



hPp://www.nature.com/ngeo/journal/v5/n3/fig_tab/ngeo1404_F1.html



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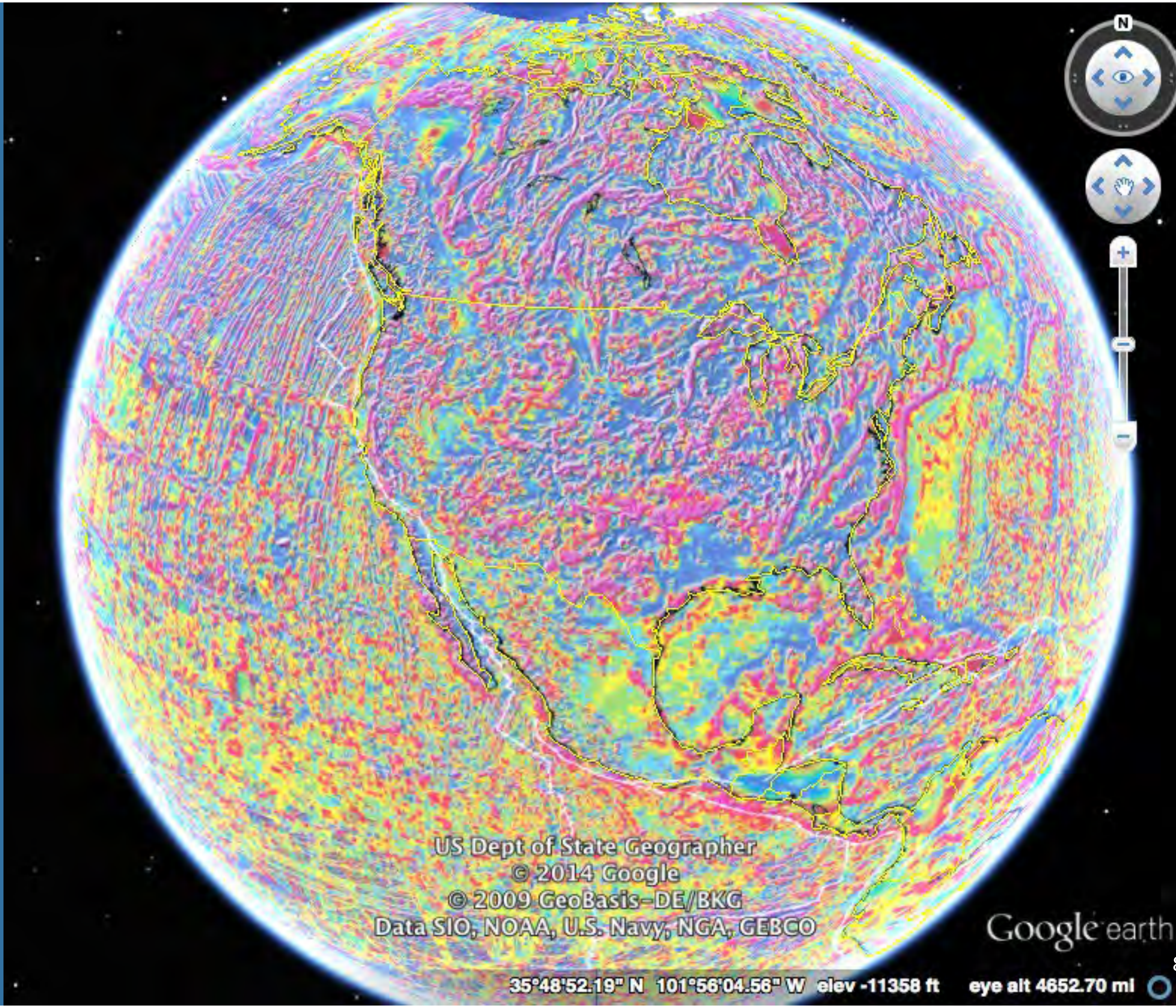
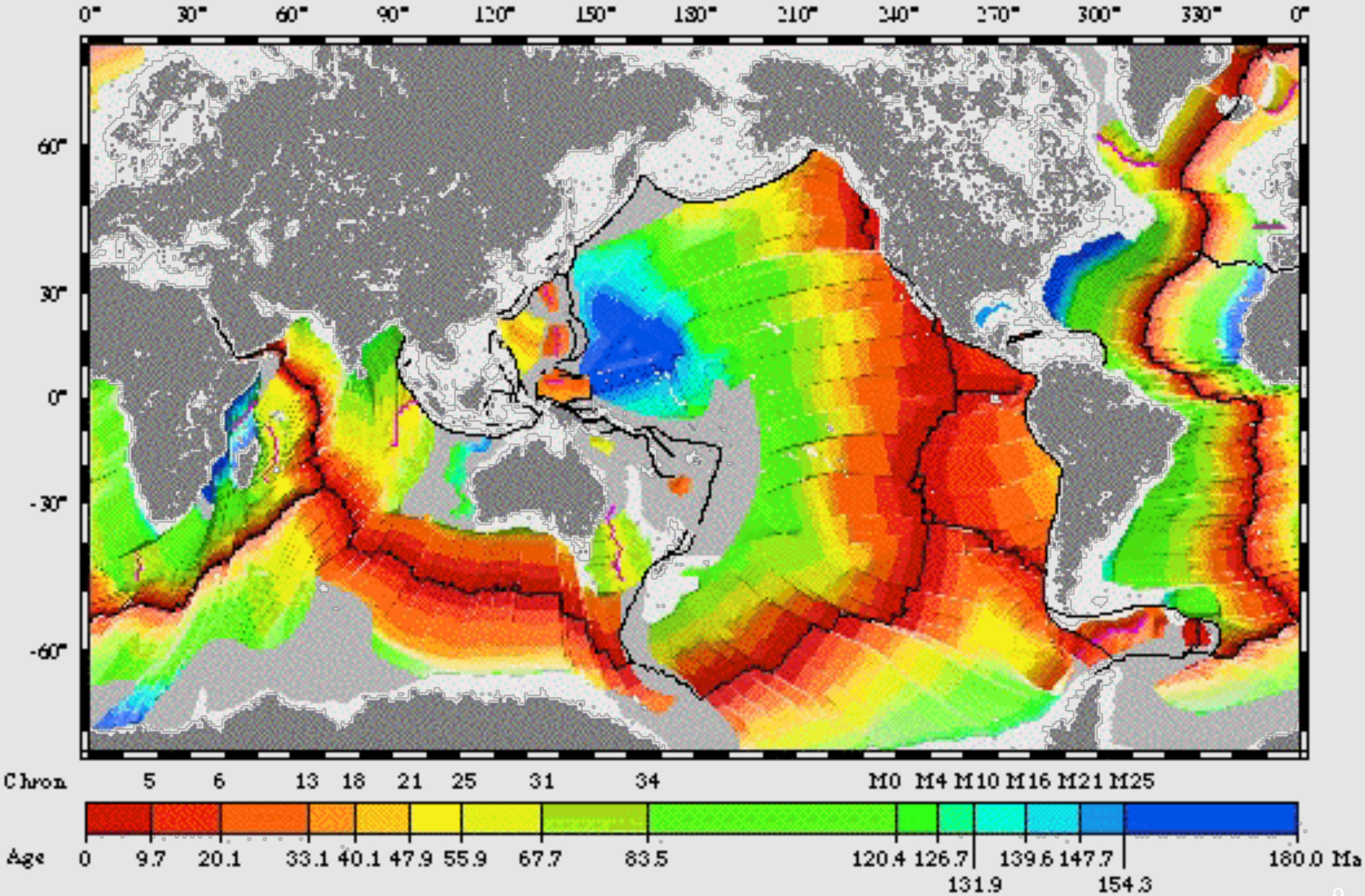
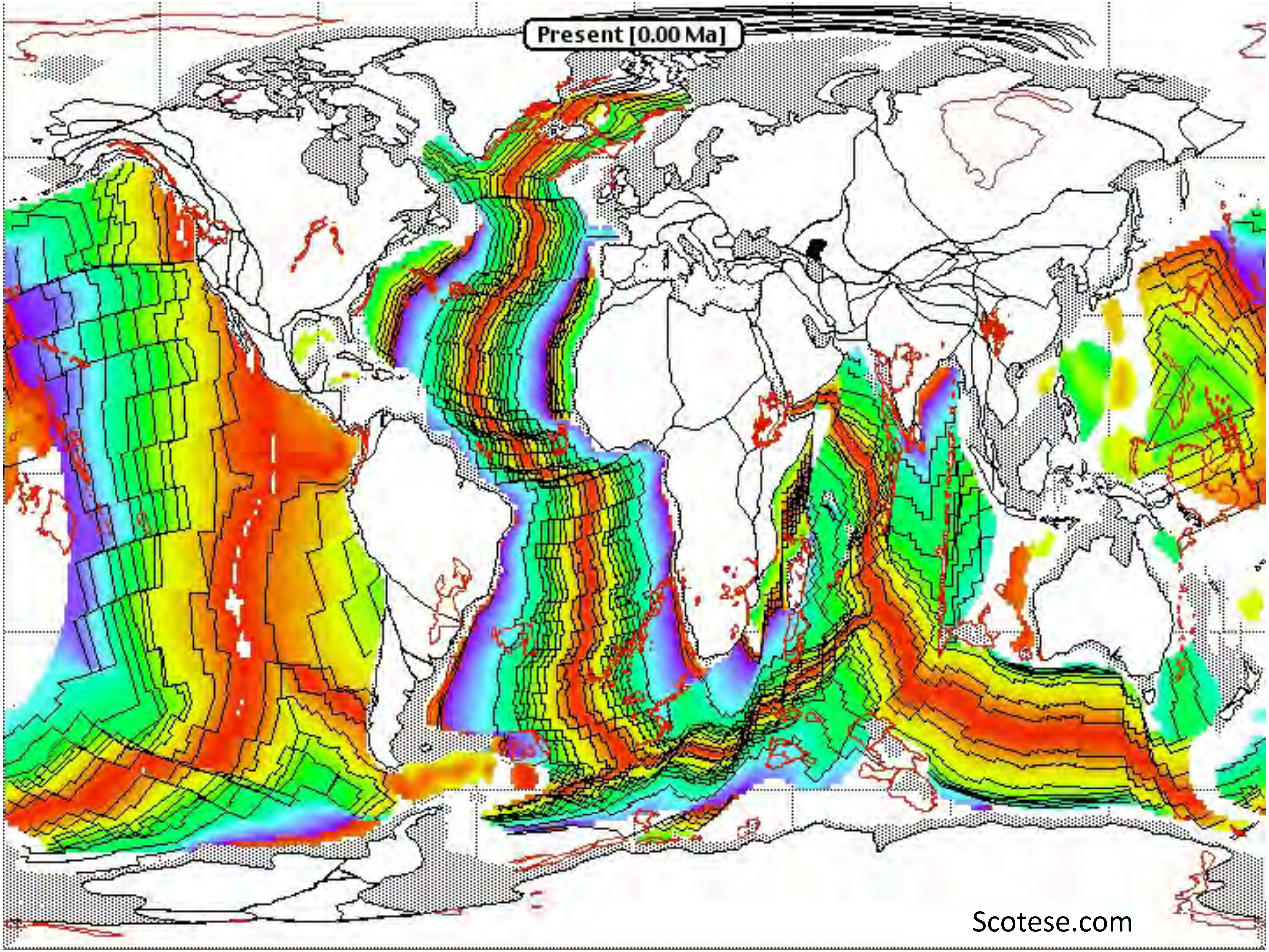

US Dept of State Geographer
© 2014 Google
© 2009 GeoBasis-DE/BKG
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Google earth
35°48'52.19" N 101°56'04.56" W elev -11358 ft
eye alt 4652.70 mi

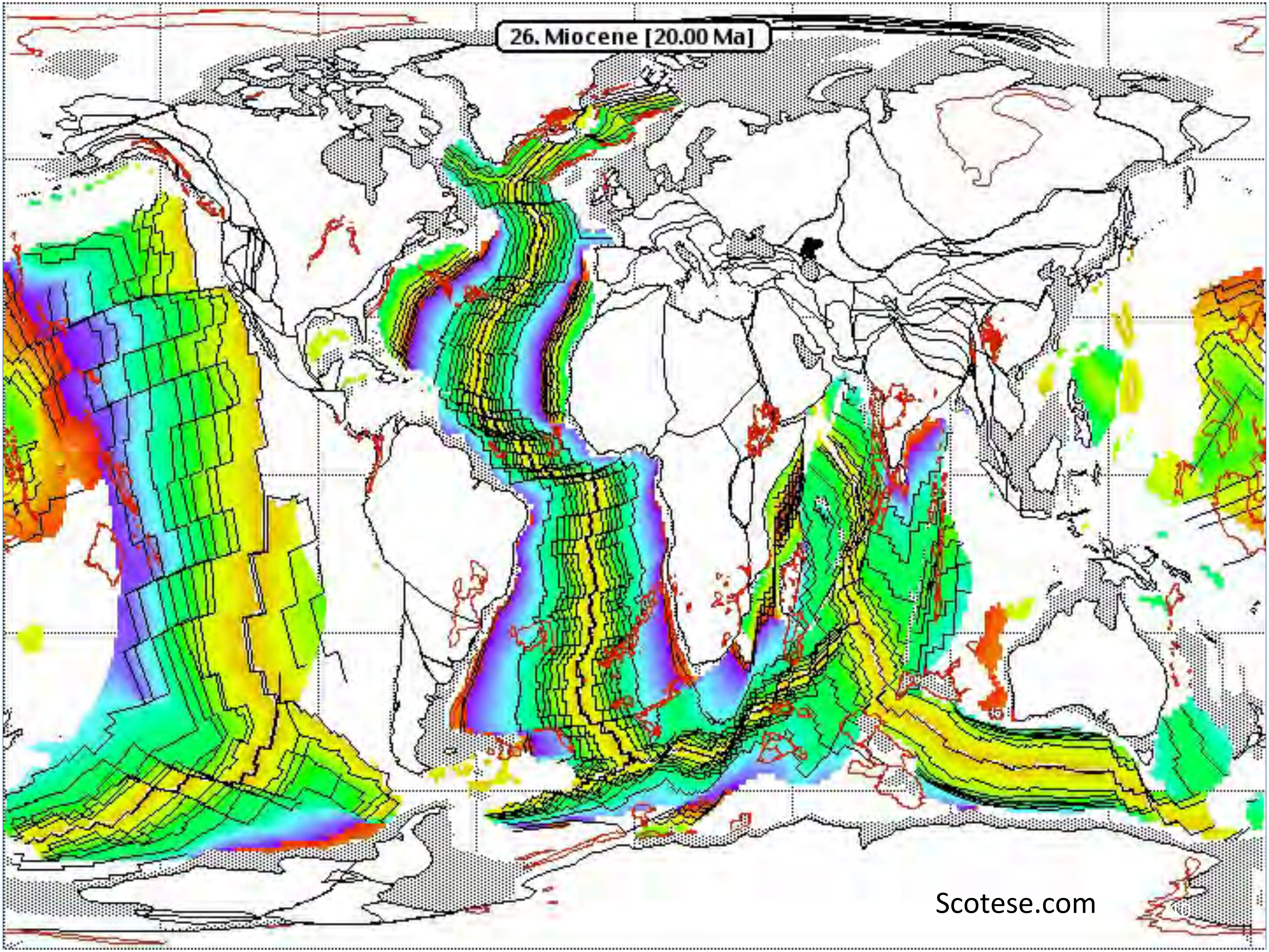
Digital Isochrons of the Ocean Floor

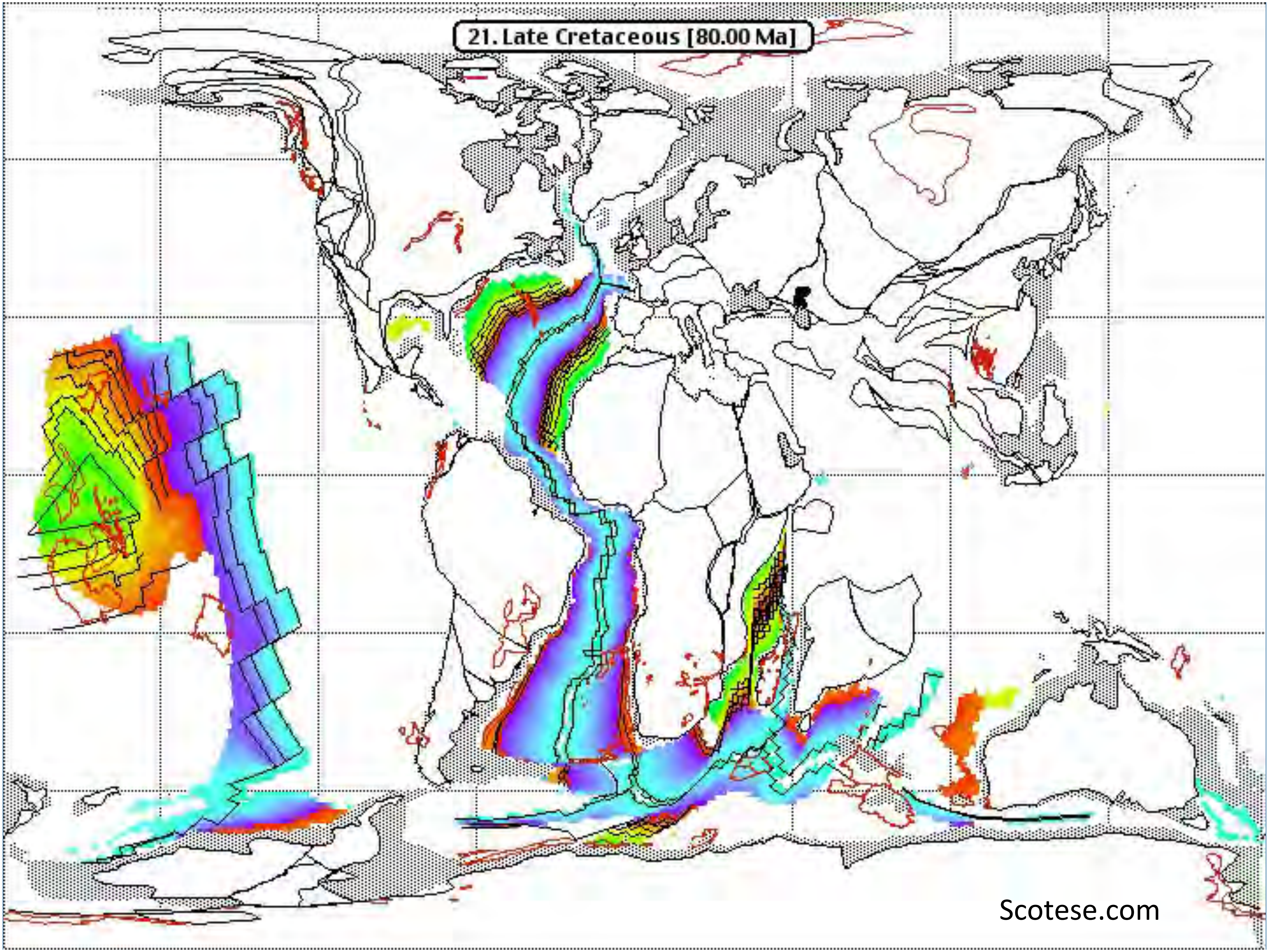
R.D. Müller, W.R. Roest, J.-Y. Royer, L.M. Gahagan, J.G. Sclater

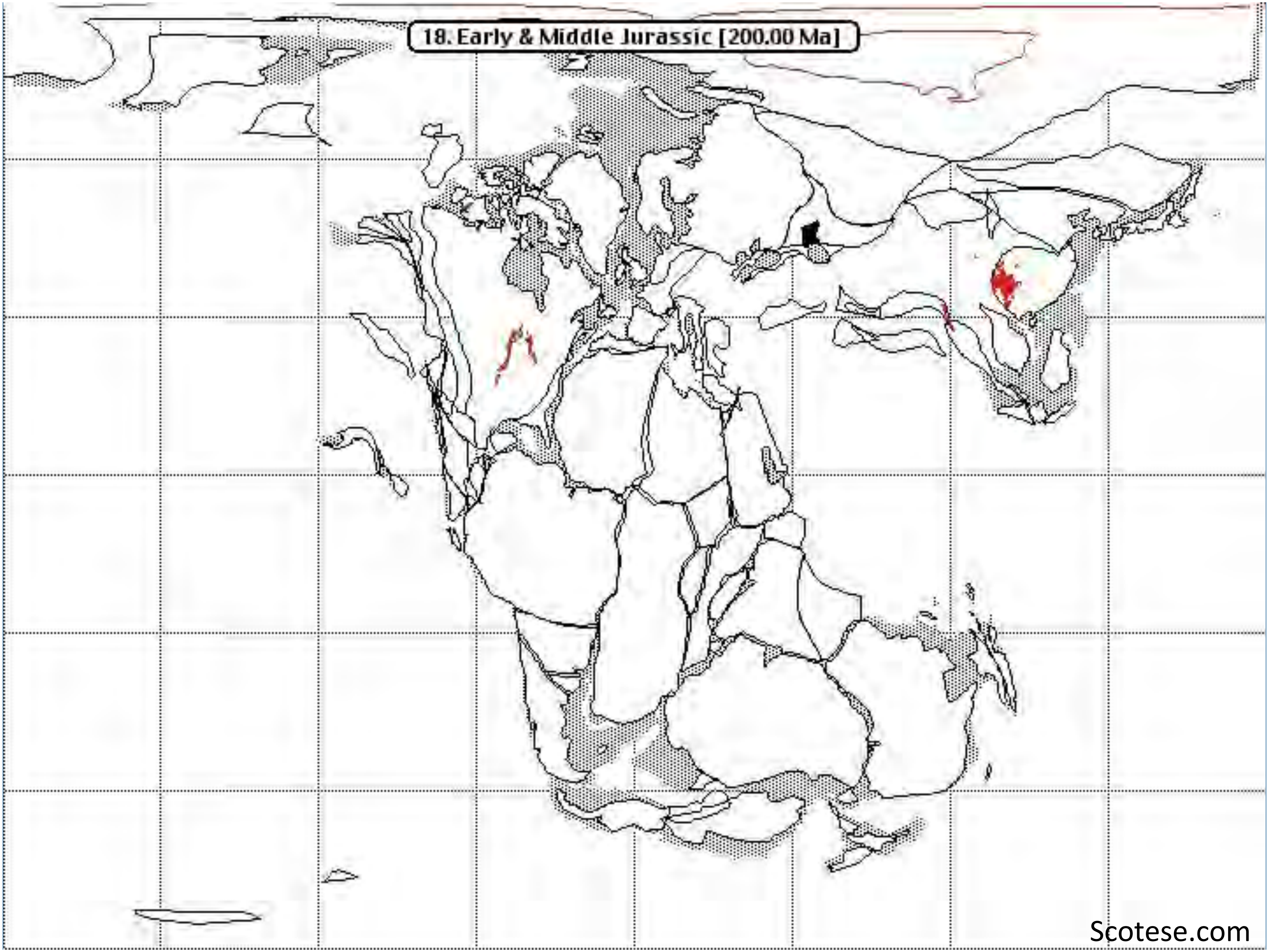




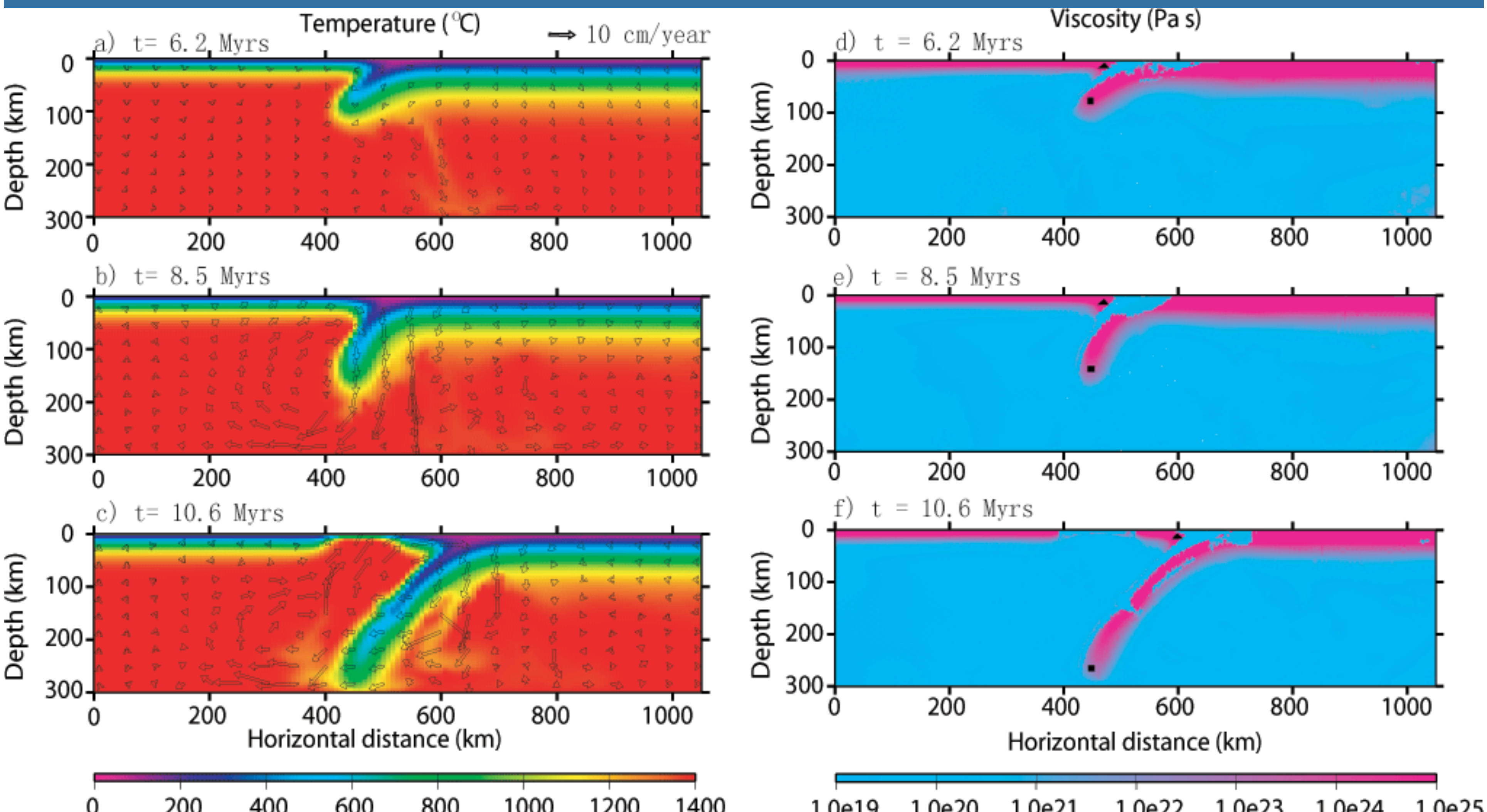
Scotese.com


26. Miocene [20.00 Ma]
Scotese.com


21. Late Cretaceous [80.00 Ma]
Scotese.com


18. Early & Middle Jurassic [200.00 Ma]
Scotese.com

Ini7a7on of Subduc7on due to increasing density of ocean plate (Leng & Gurnis 2011)



hPp://www.gps.caltech.edu/~gurnis/Images/Wei_SI_G3_Fig3.gif

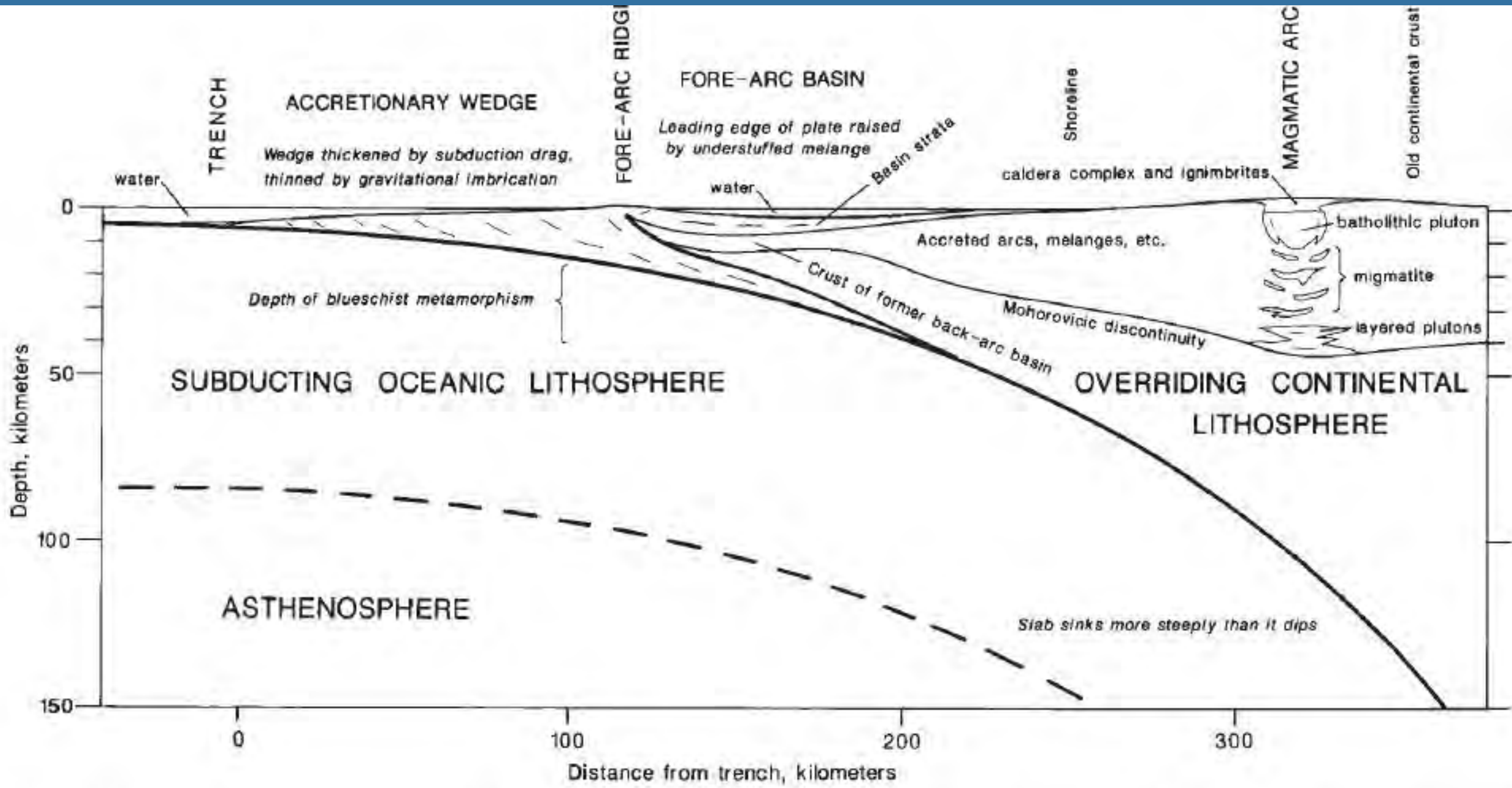


Figure 3. Cross section of convergent margin between continental and oceanic plates. The trench is the broad dihedral angle between the top of the gently inclined subducting oceanic plate and the top of the accretionary wedge of, mostly, scraped-off trench sediments. The presence of a forearc basin indicates that the thin leading edge of the overriding plate was not crumpled during the period recorded by basin sedimentation. This section is scaled to fit modern Sumatra and Cretaceous California, which are dimensionally similar except that the former is currently active and the latter is variably eroded to expose deeper features. After Hamilton (1995); there is no vertical exaggeration.

Hamilton 2007

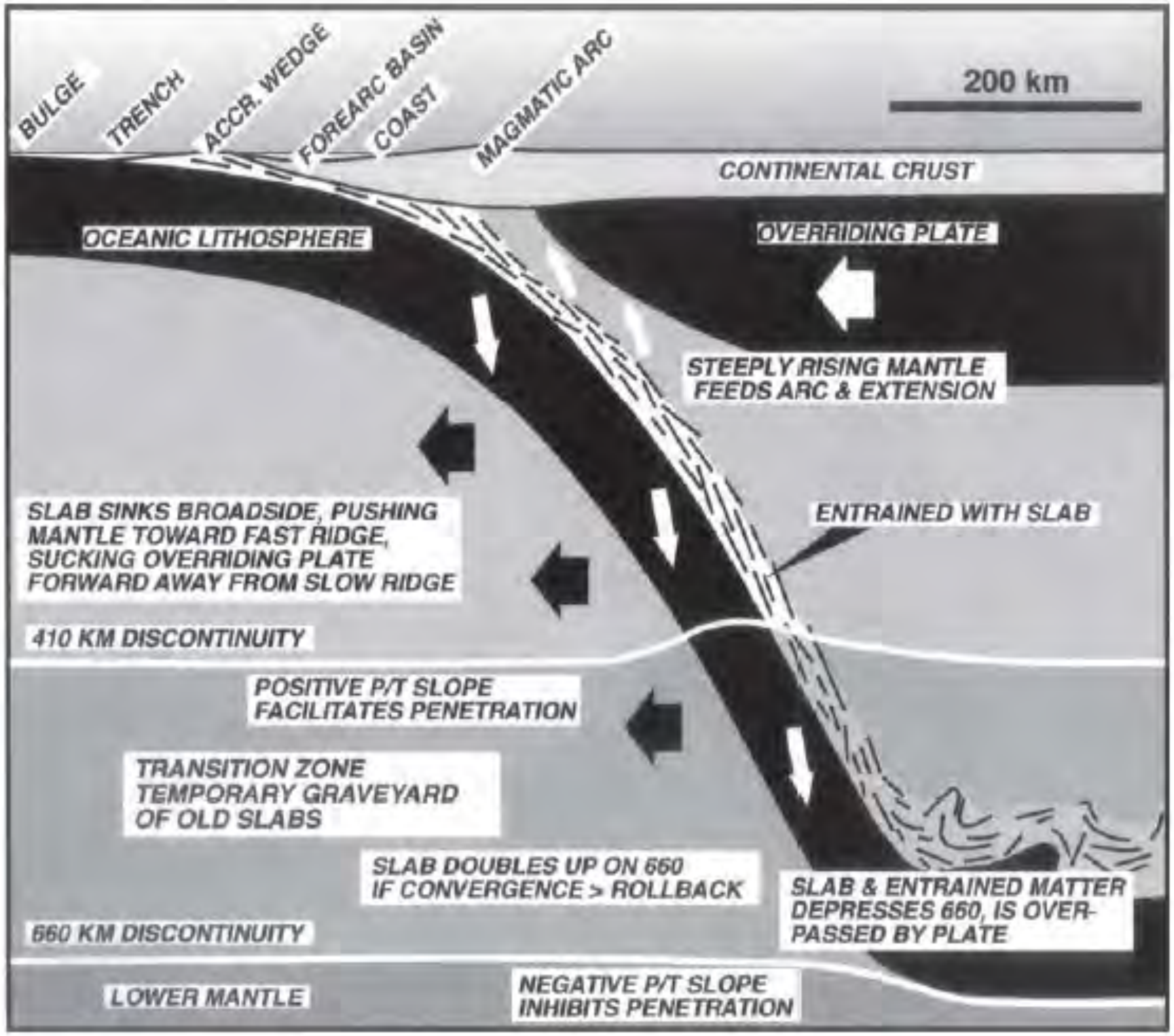
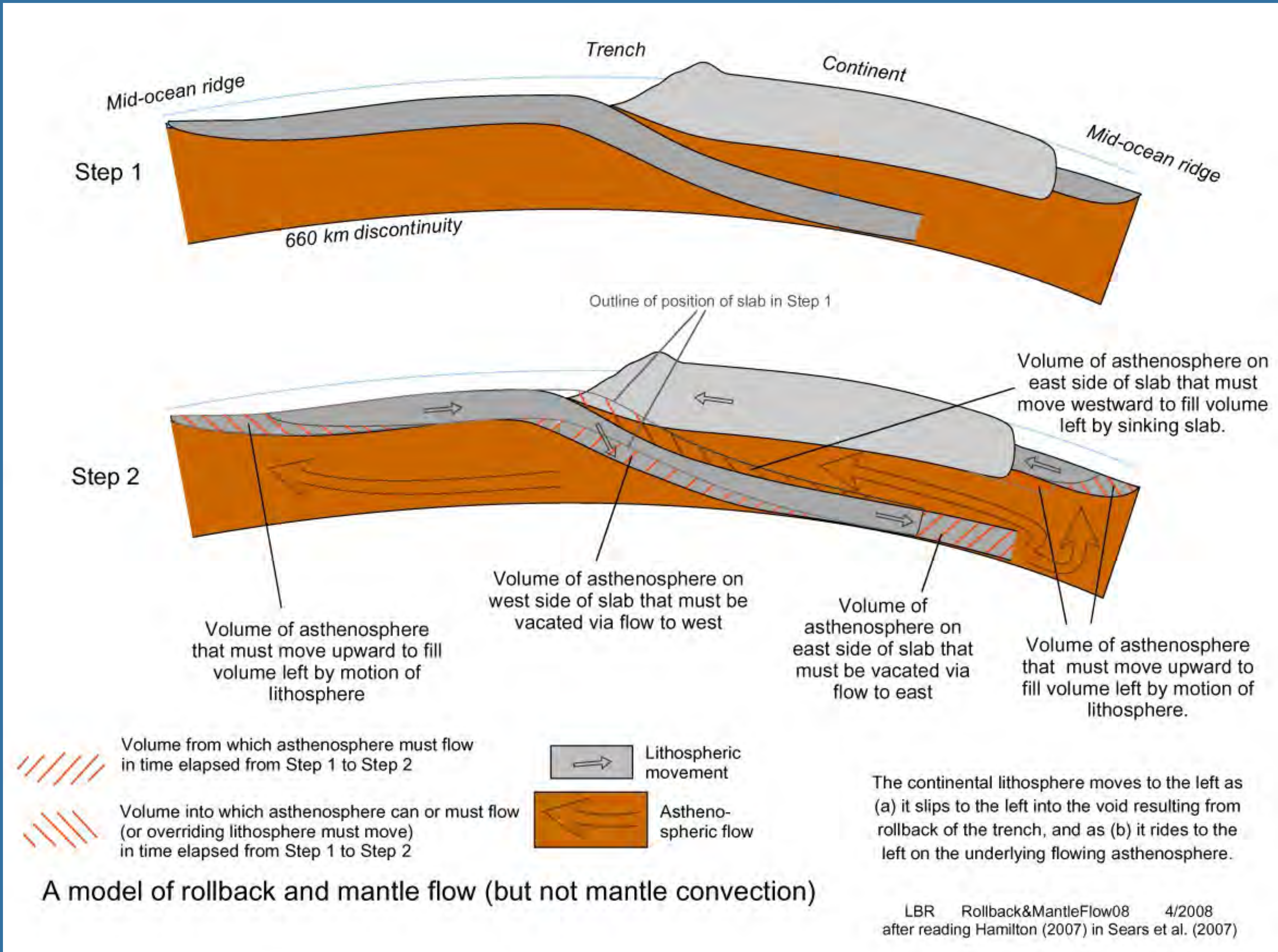


Figure 17. Subduction drive of plate tectonics. A subducting slab, sinking broadside as its upper hinge rolls back, pushes all sublithosphere upper mantle back under the incoming plate, and forces rapid seafloor spreading. The sunken slab is plated down, behind an advancing lower hinge, on the 660 km discontinuity and is over-passed as the overriding plate is sucked forward by the retreating slab. The sunken slab is thus transferred to a slow-spreading ocean behind the continent. Circulation is confined to the upper mantle. Figure is after Hamilton (2003).

Hamilton 2007


Trench
Continent
Mid-ocean ridge
Mid-ocean ridge
Step 1
660 km discontinuity
Outline of position of slab in Step 1
Step 2
Volume of asthenosphere on east side of slab that must move westward to fill volume left by sinking slab.
Volume of asthenosphere on west side of slab that must be vacated via flow to west
Volume of asthenosphere that must move upward to fill volume left by motion of lithosphere
Volume of asthenosphere on east side of slab that must be vacated via flow to east
Volume of asthenosphere that must move upward to fill volume left by motion of lithosphere.
Volume from which asthenosphere must flow in time elapsed from Step 1 to Step 2
Volume into which asthenosphere can or must flow (or overriding lithosphere must move) in time elapsed from Step 1 to Step 2
Lithospheric movement
Astheno-spheric flow
The continental lithosphere moves to the left as (a) it slips to the left into the void resulting from rollback of the trench, and as (b) it rides to the left on the underlying flowing asthenosphere.
A model of rollback and mantle flow (but not mantle convection)
LBR Rollback&MantleFlow08 4/2008
after reading Hamilton (2007) in Sears et al. (2007)

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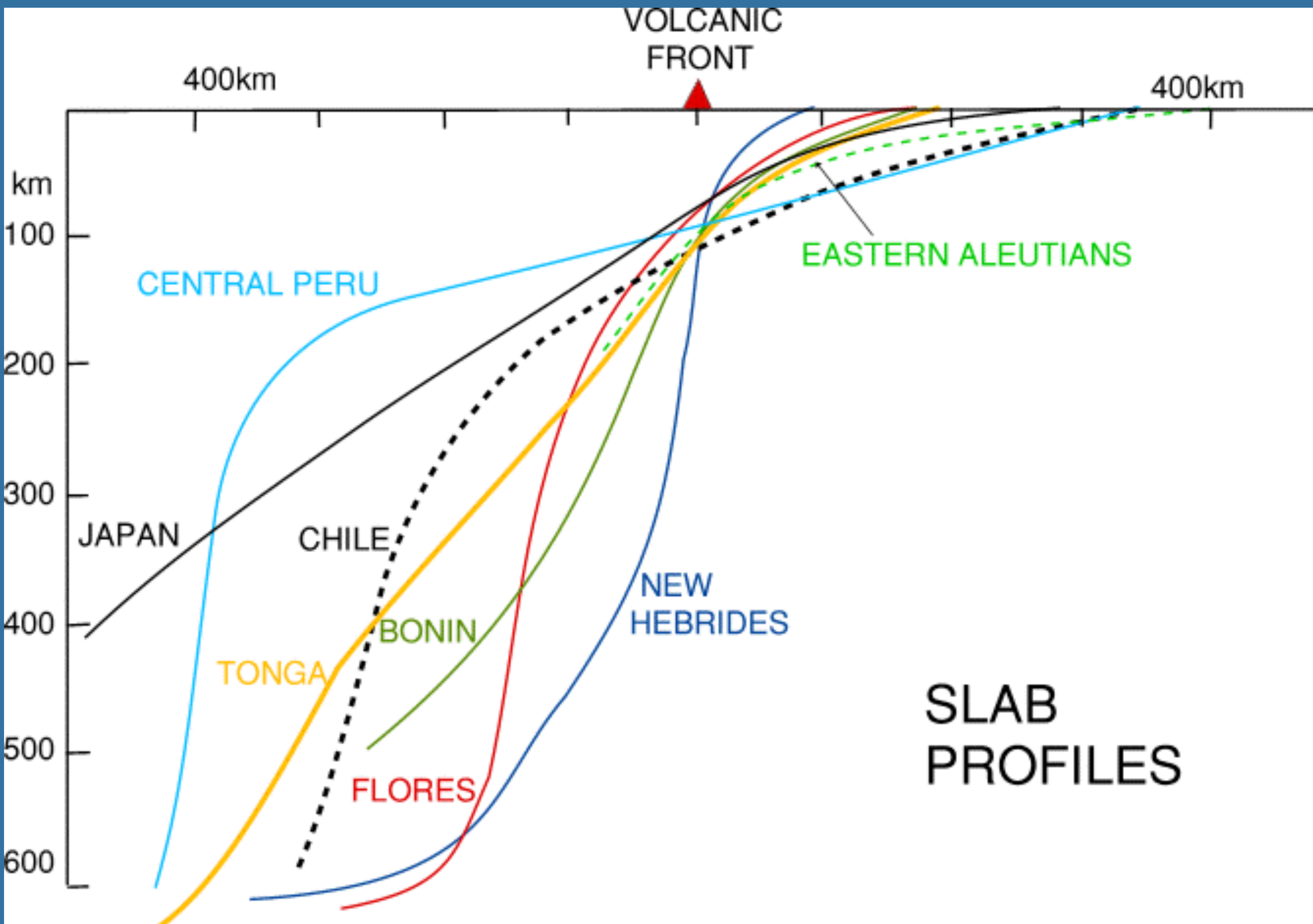

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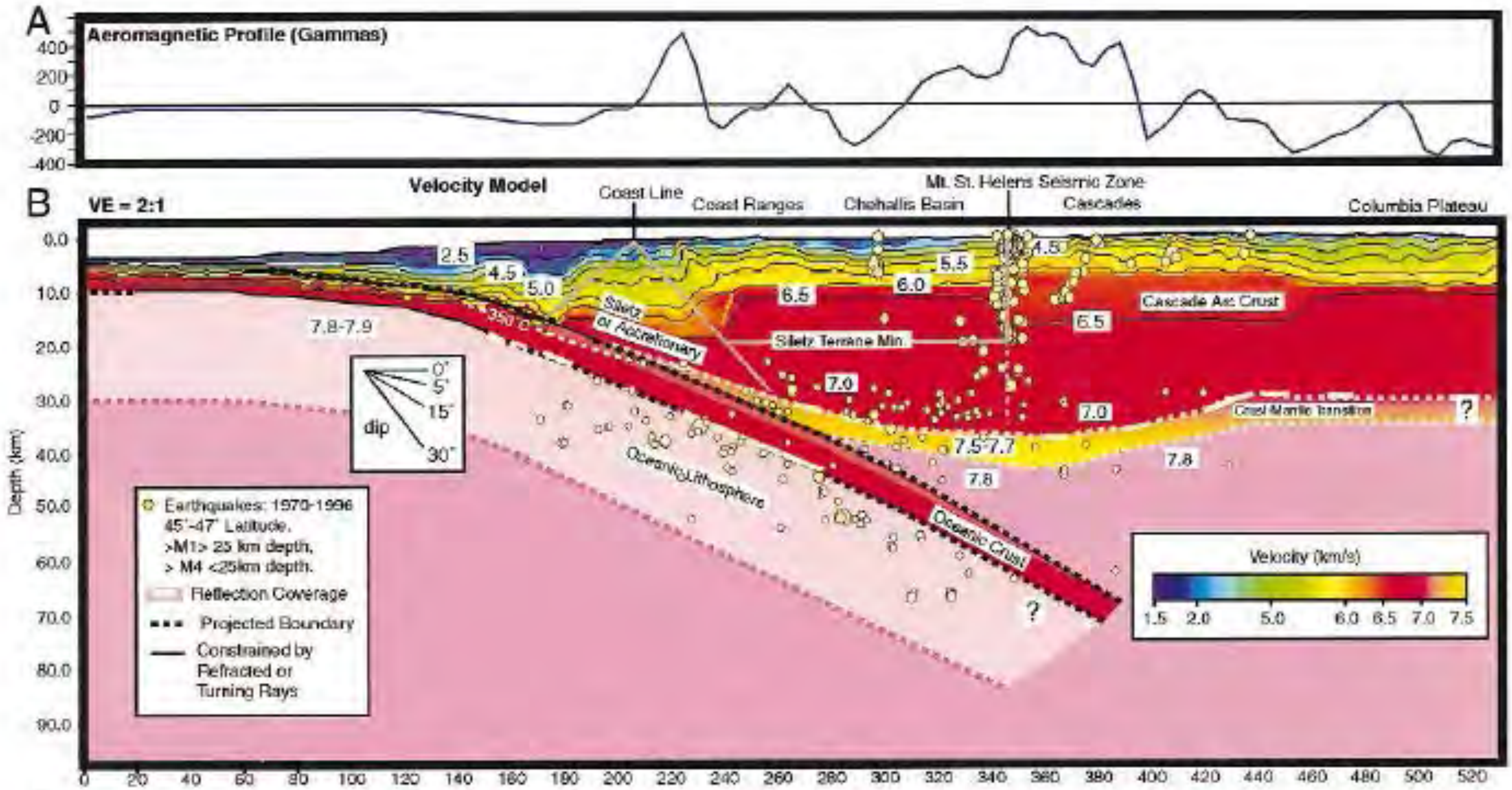
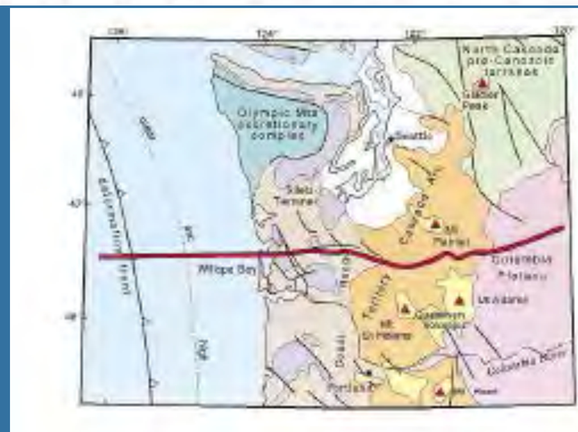
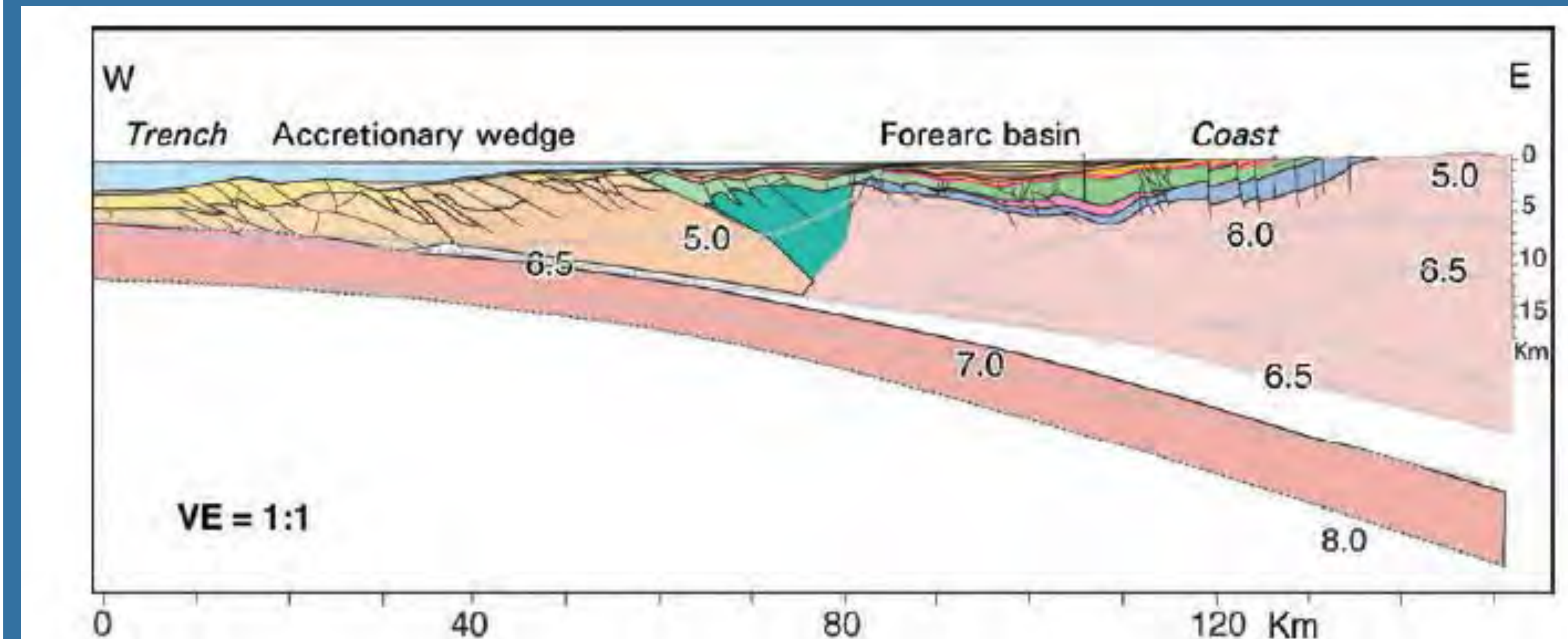


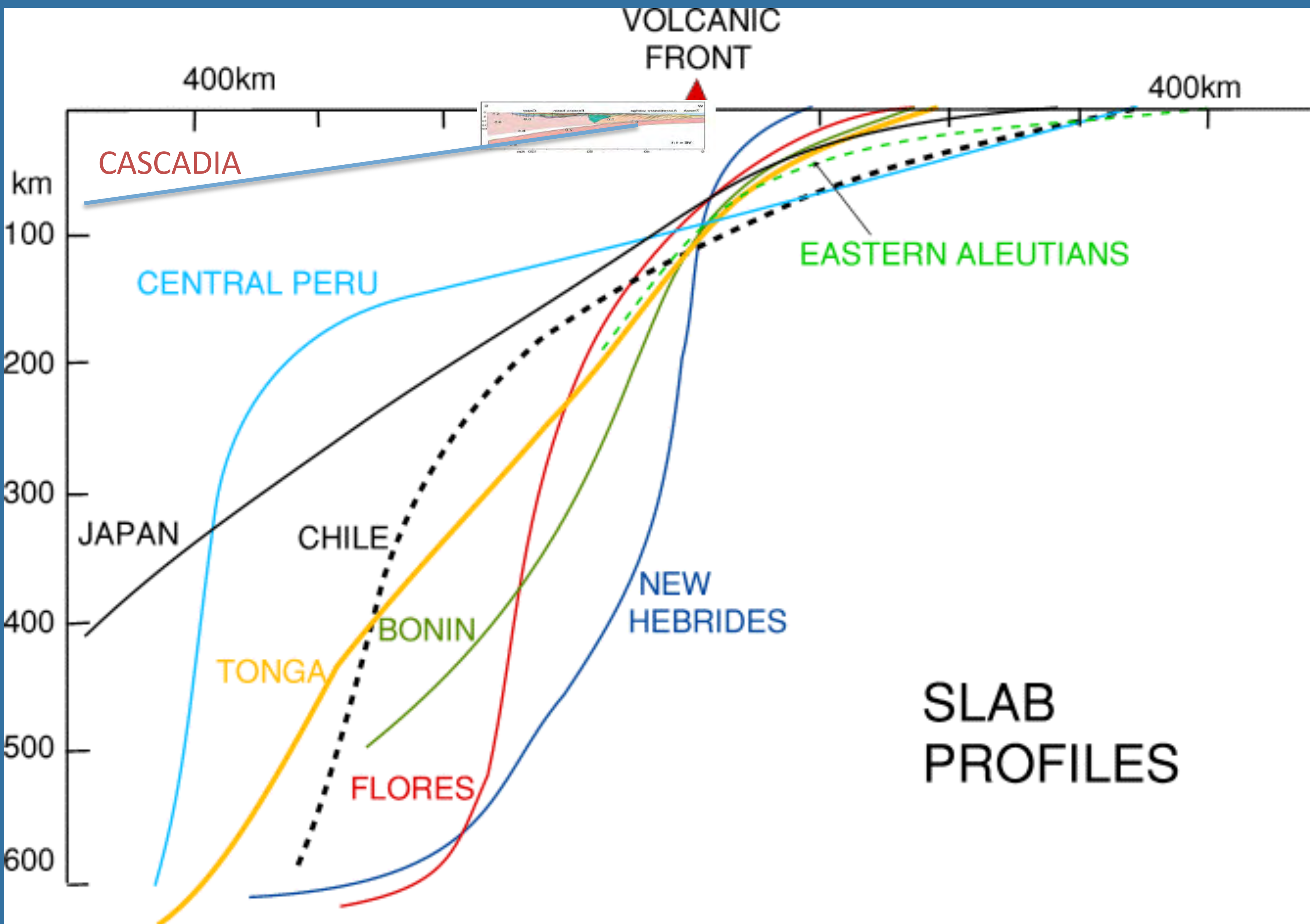
A
Aeromagnetic Profile (Gammas)
400
200
0
-200
-400
B
VE = 2:1
Velocity Model
Coast Line
Coast Ranges
Chehalis Basin
Mt. St. Helens Seismic Zone
Cascades
Columbia Plateau
Depth (km)
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
2.5
4.5
5.0
5.5
6.0
6.5
7.0
7.5-7.7
7.8
7.8-7.9
350°C
Siletz or Accretionary
Siletz Terrane Min
Cascade Arc Crust
Crust-Mantle transition
Oceanic Lithosphere
Oceanic Crust
dip
0°
5°
15°
30°
?
Earthquakes: 1970-1996
45°-47° Latitude,
>M1> 25 km depth,
> M4 <25km depth.
Reflection Coverage
Projected Boundary
Constrained by Refracted or Turning Rays
Velocity (km/s)
1.5
2.0
5.0
6.0
6.5
7.0
7.5
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460
480
500
520



North Cascade pre-Cenozoic terranes
Olympic Mts accretionary complex
Seattle
Columbia Plateau



Hamilton 2007



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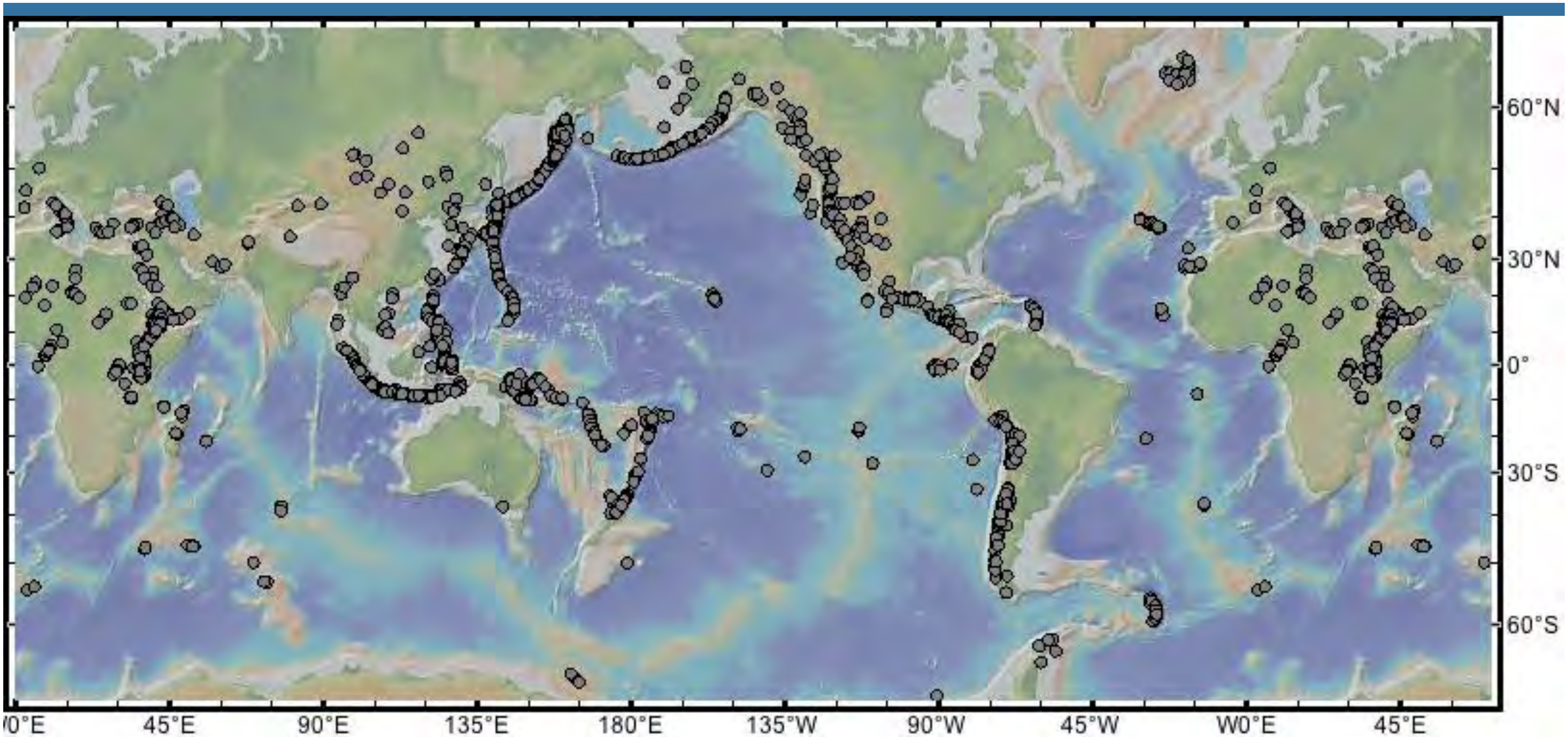
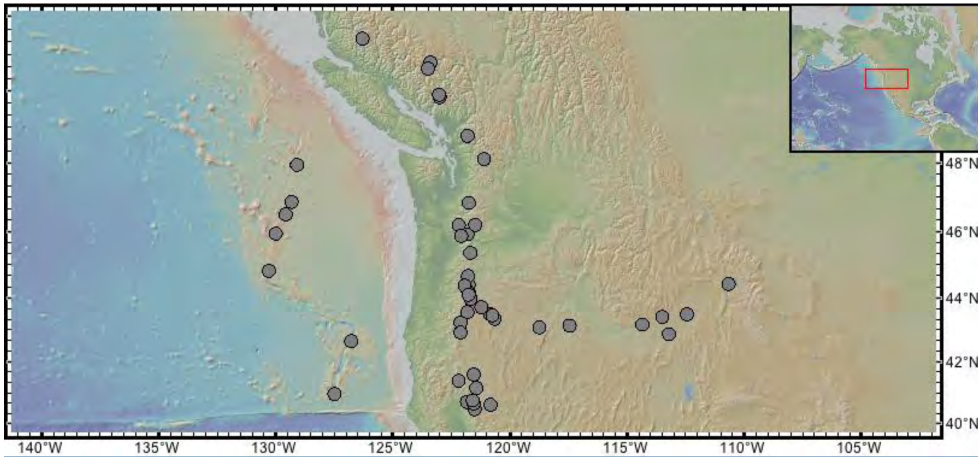
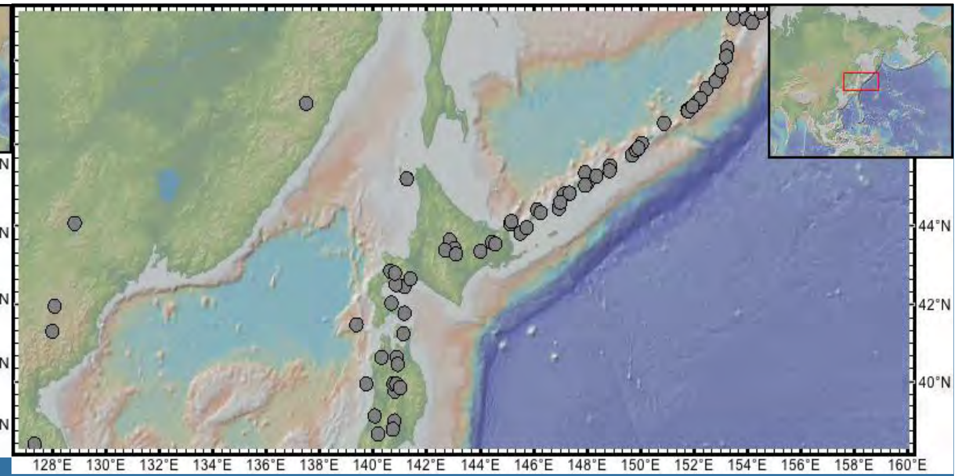


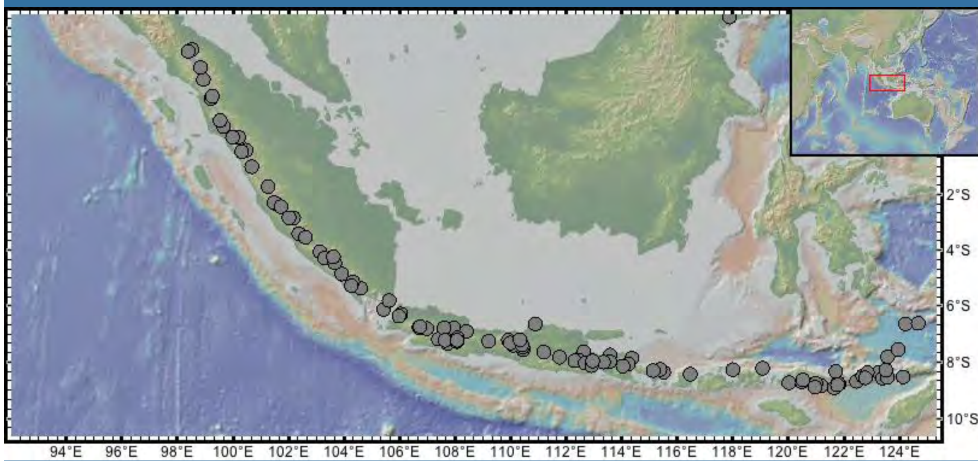
Major World Volcanoes



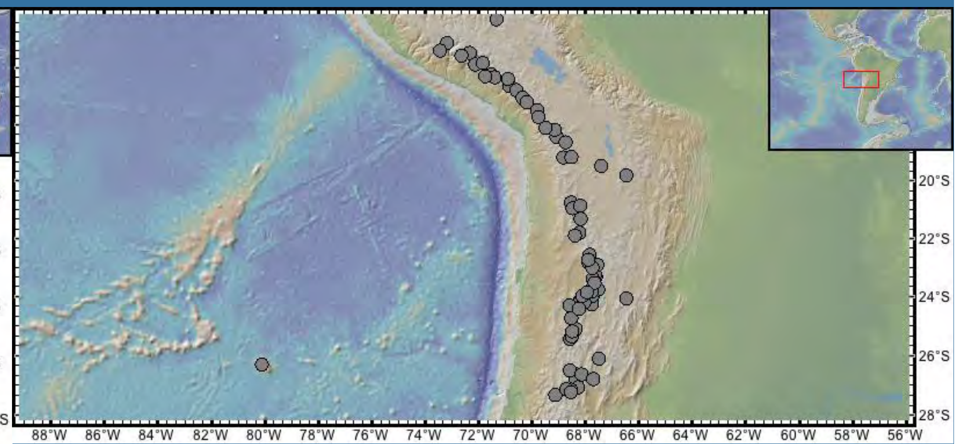
Cascadia Volcanoes



Japanese Volcanoes



Indonesia Volcanoes



Bolivia—Chile Volcanoes

http://www.volcano.si.edu/reports_weekly.cfm

Smithsonian Wekly Volcano Report Site