

# Plate Tectonic History of Western North America

Bright Horizons #6 Cruise

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# Absolute velocity of surface points with respect to the Interior of the Earth (cm/yr)

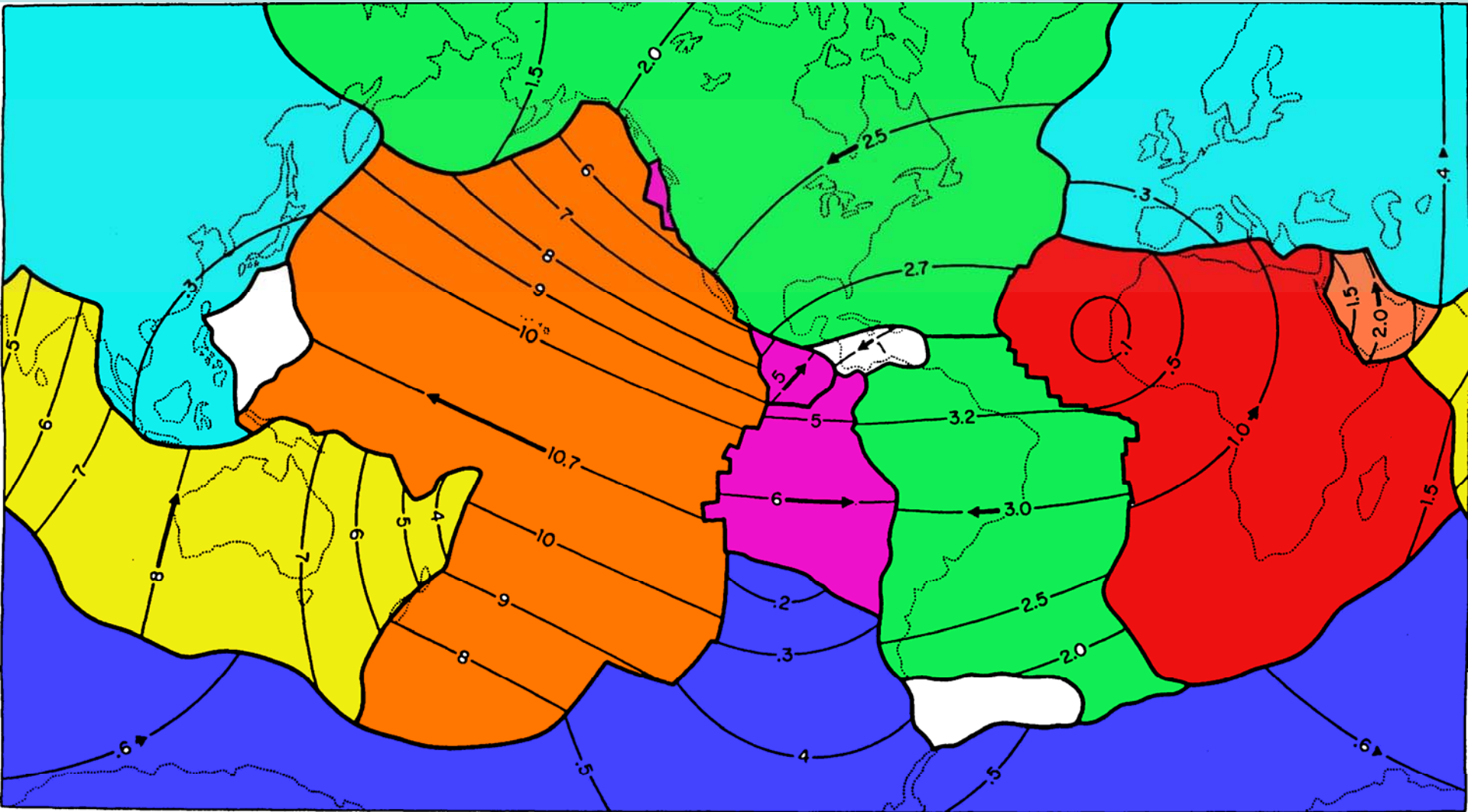
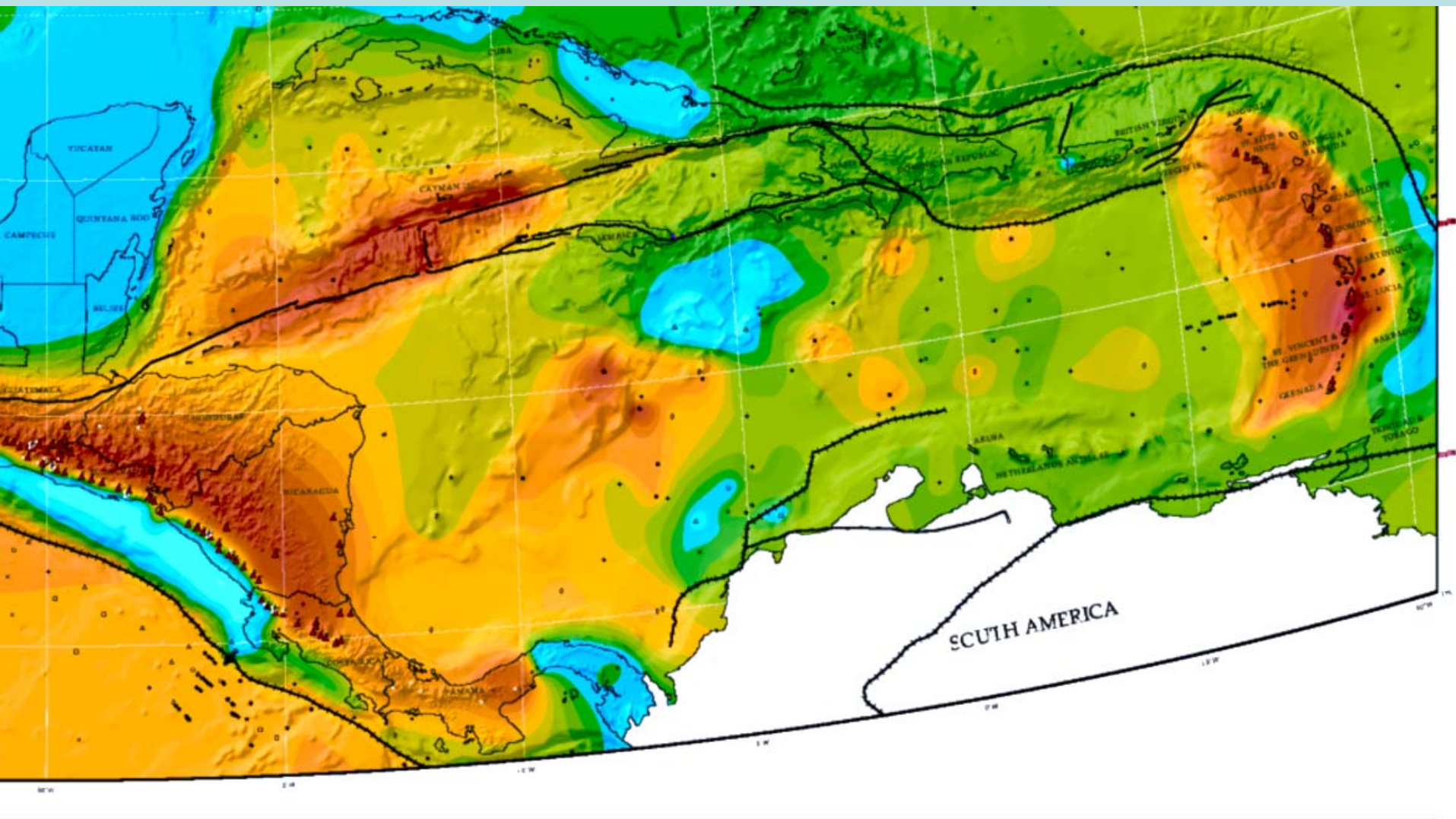


Figure 4.5.4 Absolute velocities of lithospheric plates, calculated from the absolute rotation vectors of *Minster and Jordan [1978]*. Contour values in centimeters per year; arrows indicate general direction of plate motion. Bold lines are plate boundaries. POLLACK ET AL.

Pollack (1984) based on Minster and Jordan (1978)

# Heat Flow Map of the Carribbean Plate (mW/m<sup>2</sup>)

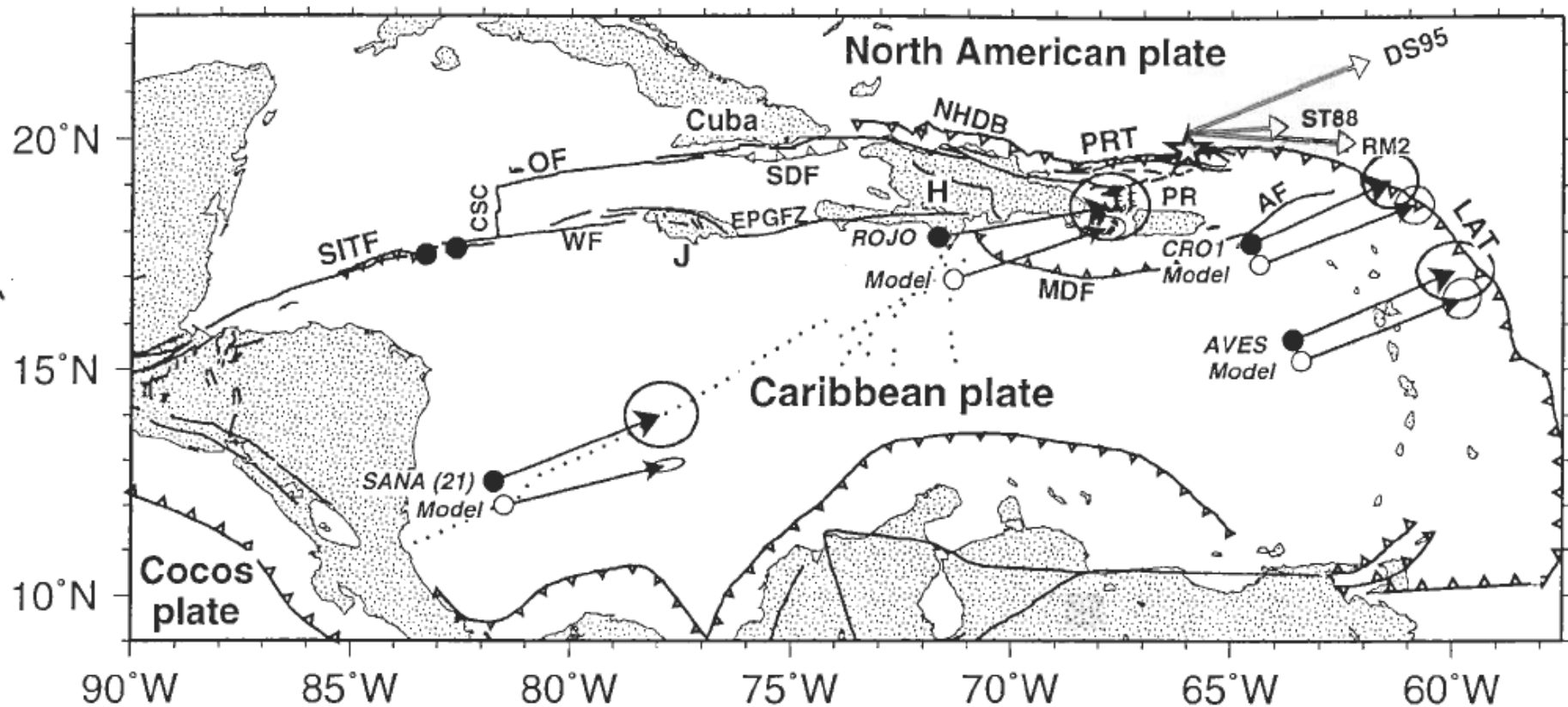


# The Caribbean

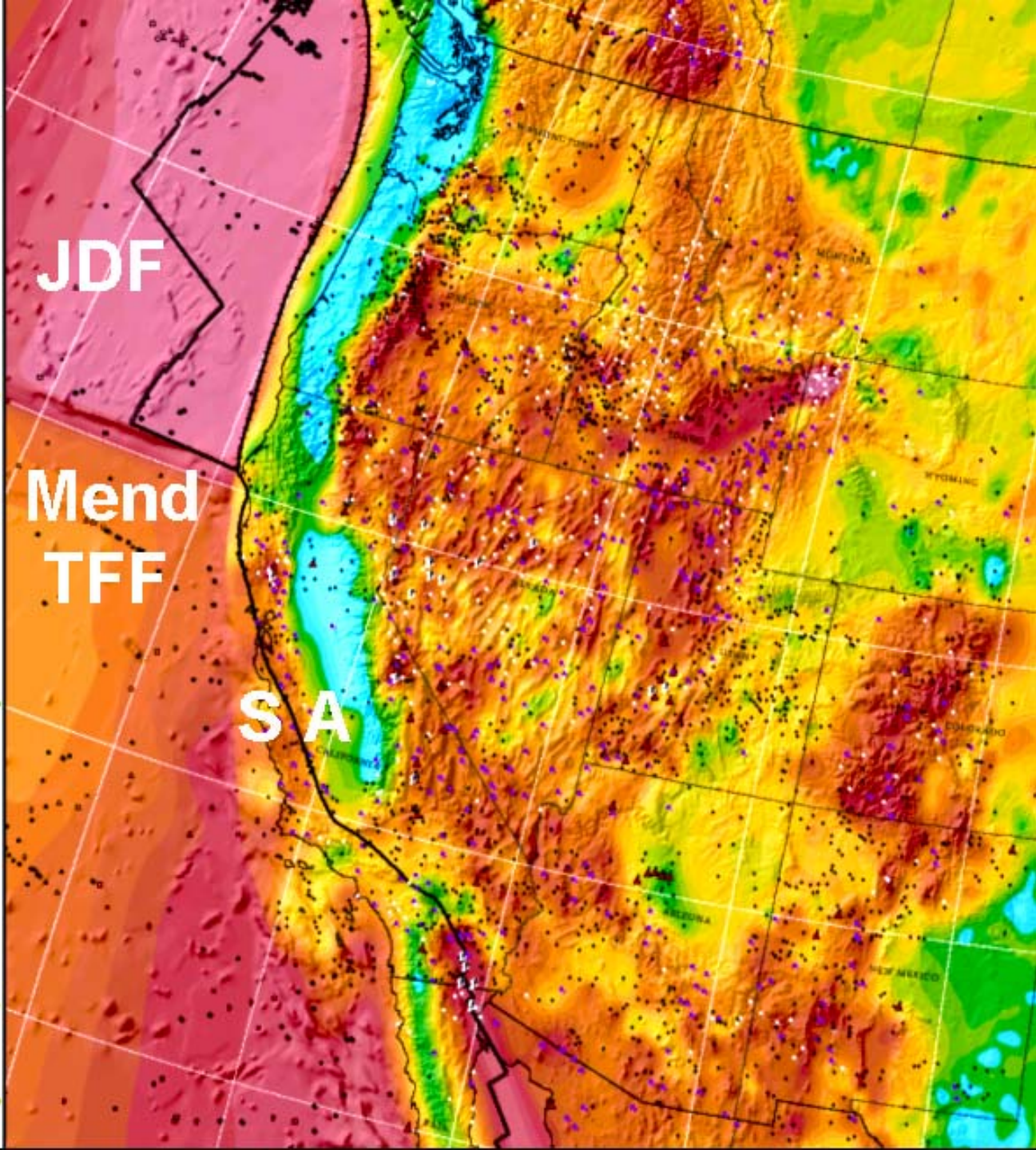


Huttrer ranks the islands, in order of development potential,

1. Guadeloupe
2. St. Lucia
3. Dominica
4. St. Vincent
5. Nevis
6. Saba
7. St. Kitts
8. Grenada
9. Martinique
10. Montserrat
11. Statia



**Figure 1.** Regional map, locations of data in Table 1 (filled circles), and CA-NA GPS velocities. Ellipses show 2D,  $1\sigma$  uncertainties. Model velocities (open circles) are computed at GPS station locations using the hybrid CA-NA



# Trench or Subduction Zone Boundaries:

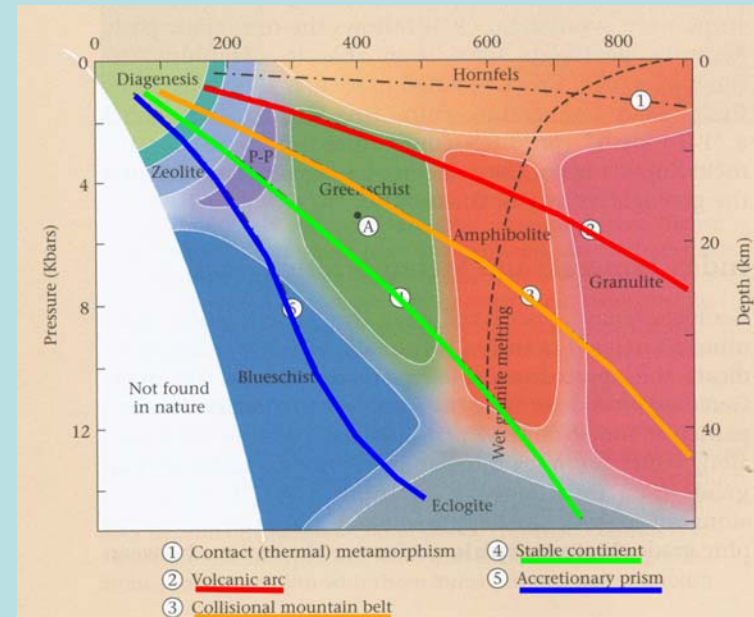
## *Examples-Japan and Central America*

### A. Three-fold Tectonic Division of Subduction Zones

- Marginal Seas/Inner Belt/Back Arc
- Magmatic Front-Volcanic Arc
- Outer Belt/Nonvolcanic Arc

### B. Paired Orogeny

- High Temp Belt
- Low Temp Belt



# Idealized Models of Subduction Zone mountain Belts in Compressional and Extensional Settings

## EXTENSIONAL SUBDUCTION ZONE SETTING

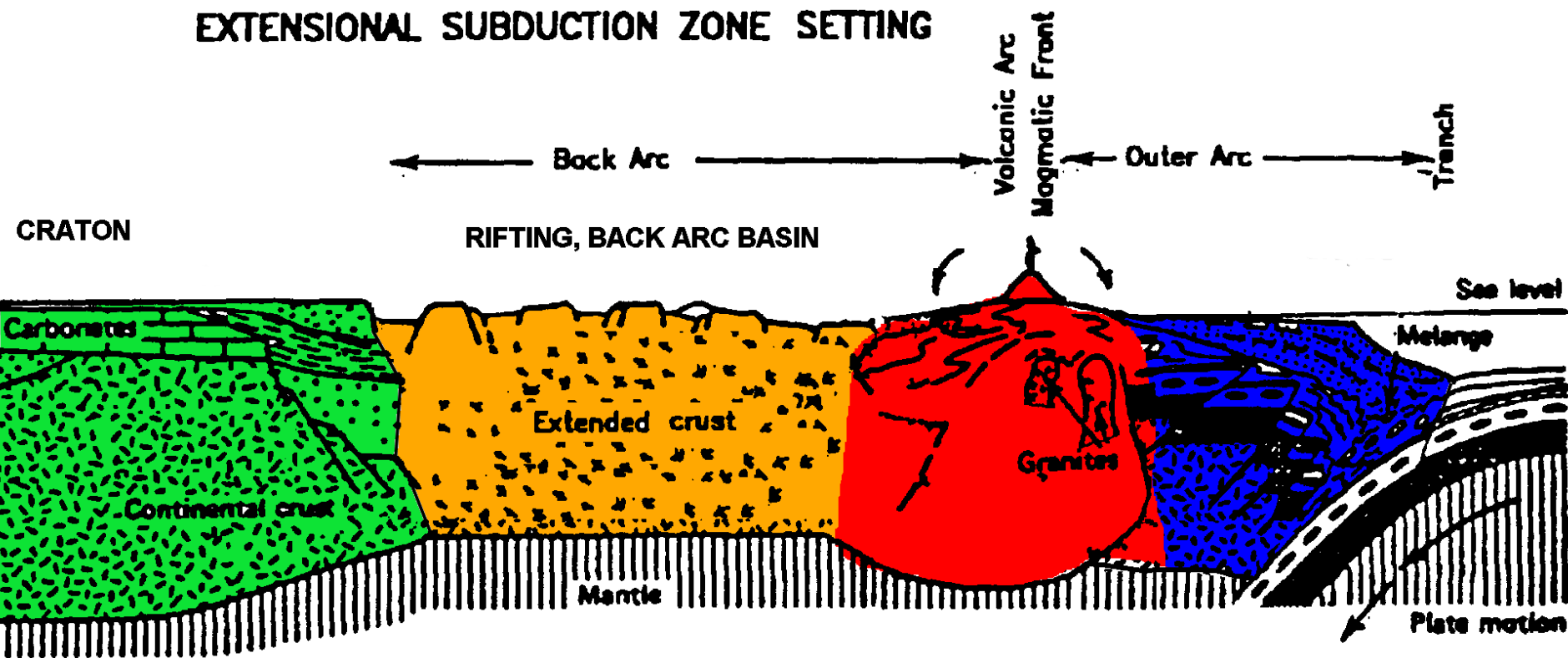
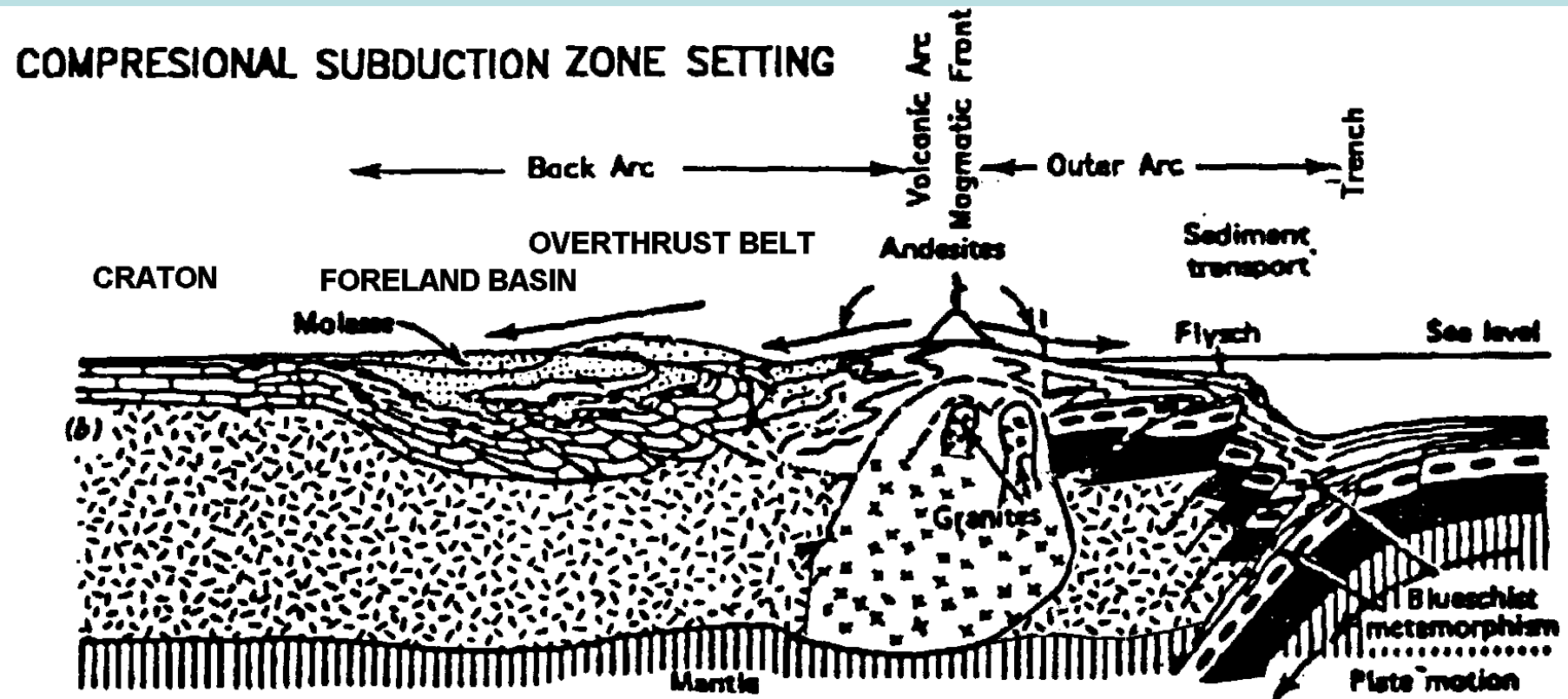




Figure 6.4.1 Ideal models of Cordilleran mountain belts in a compressional setting and in an extensional setting.



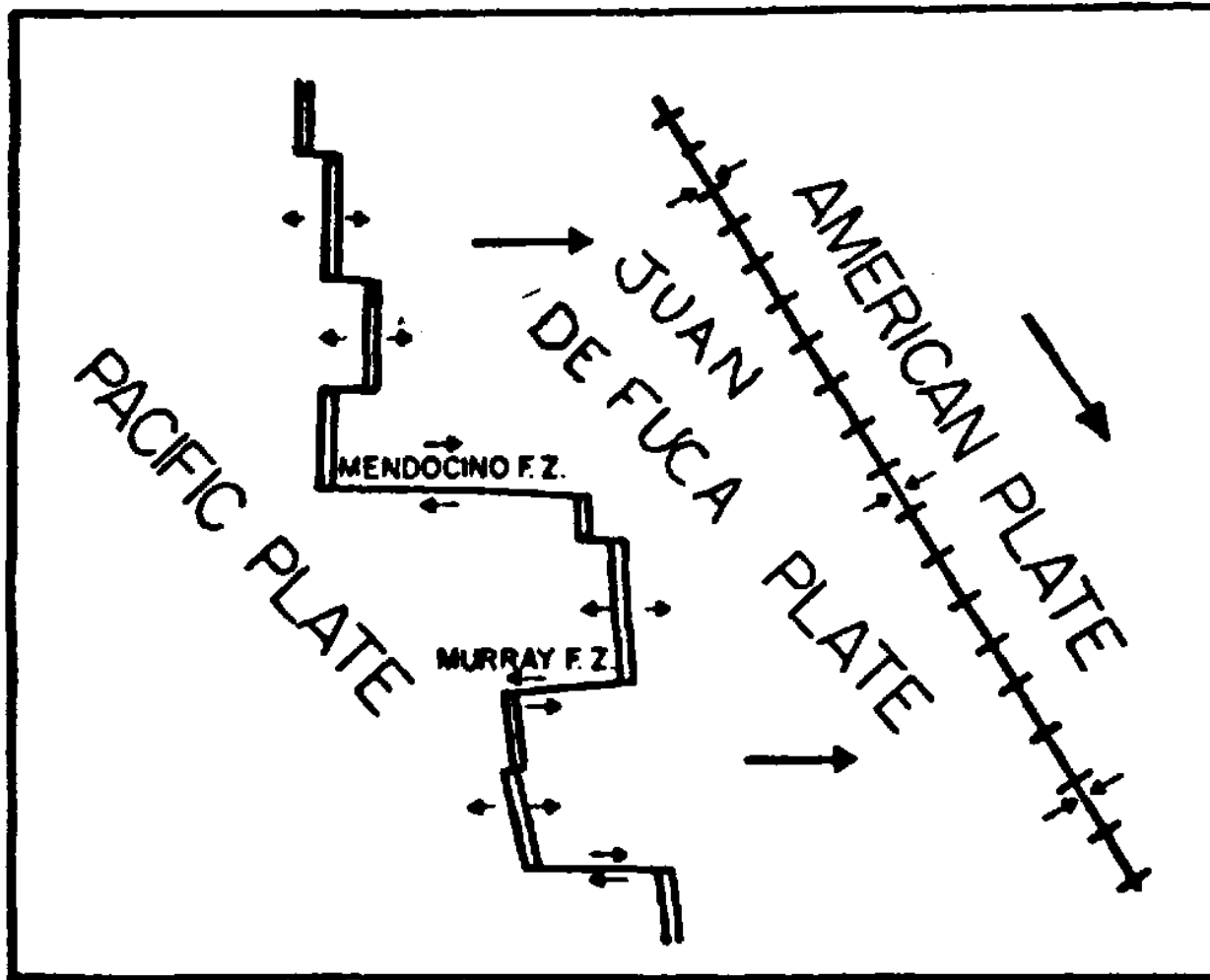
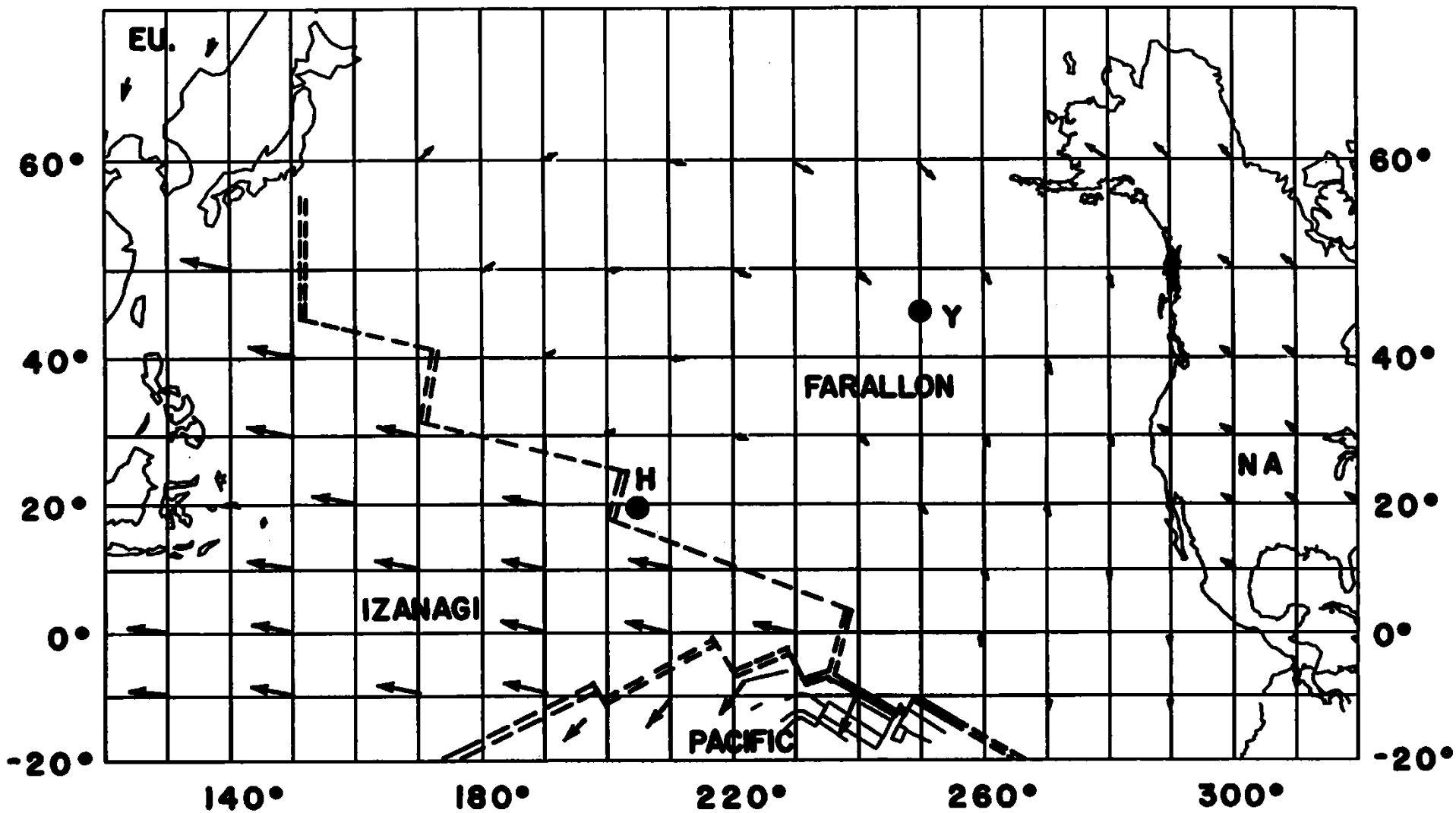
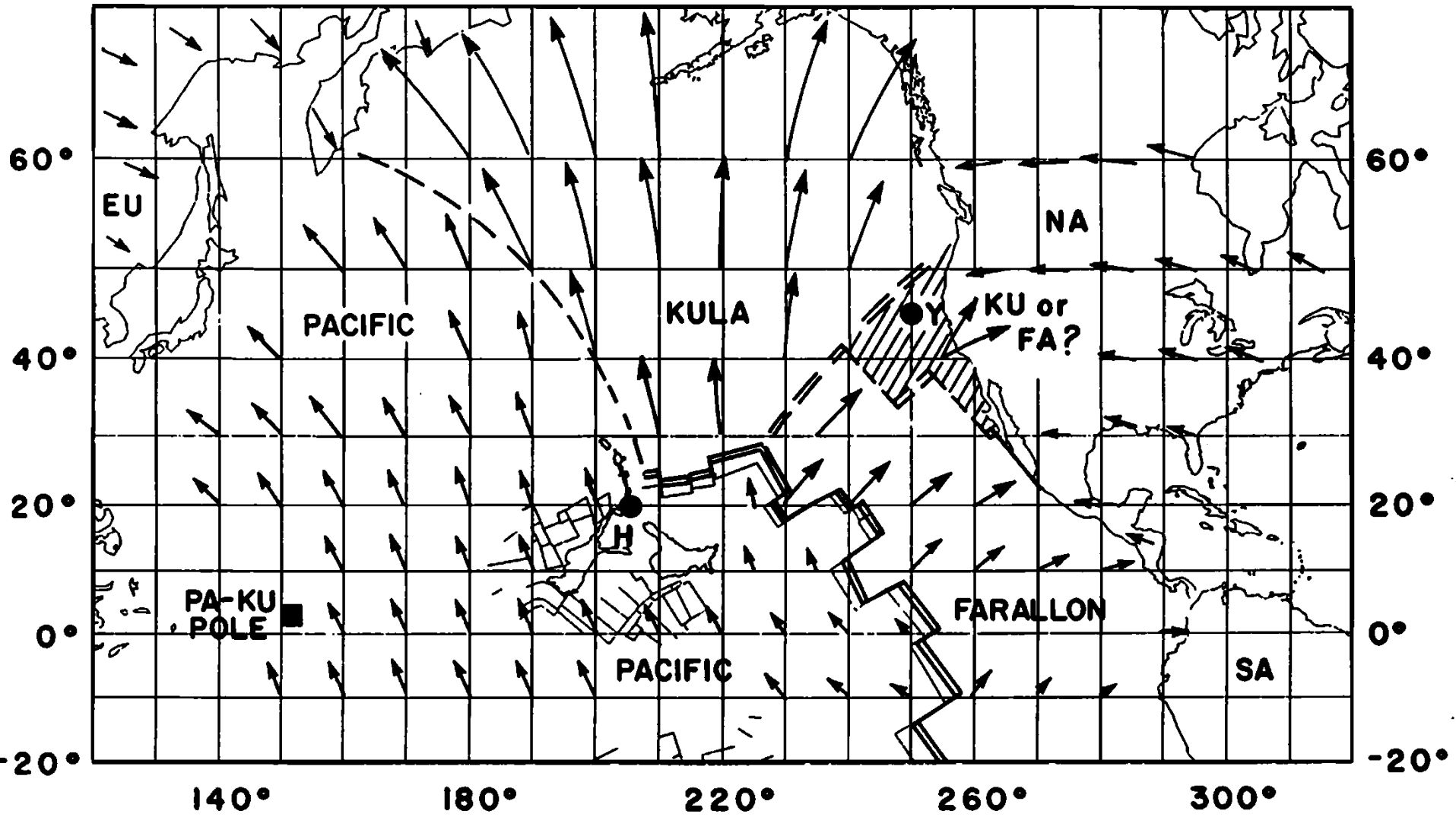


Figure 6.1.1 Configuration of plate boundaries at the time of anomaly 21, about 53 m.y. ago. Magnetic anomalies and fracture zones are being created by the ridges and transform faults between 2 rigid oceanic plates. Large arrows show motions of plates with respect to the Pacific plate which is arbitrarily held fixed. Small arrows show relative motions at points along plate boundaries.

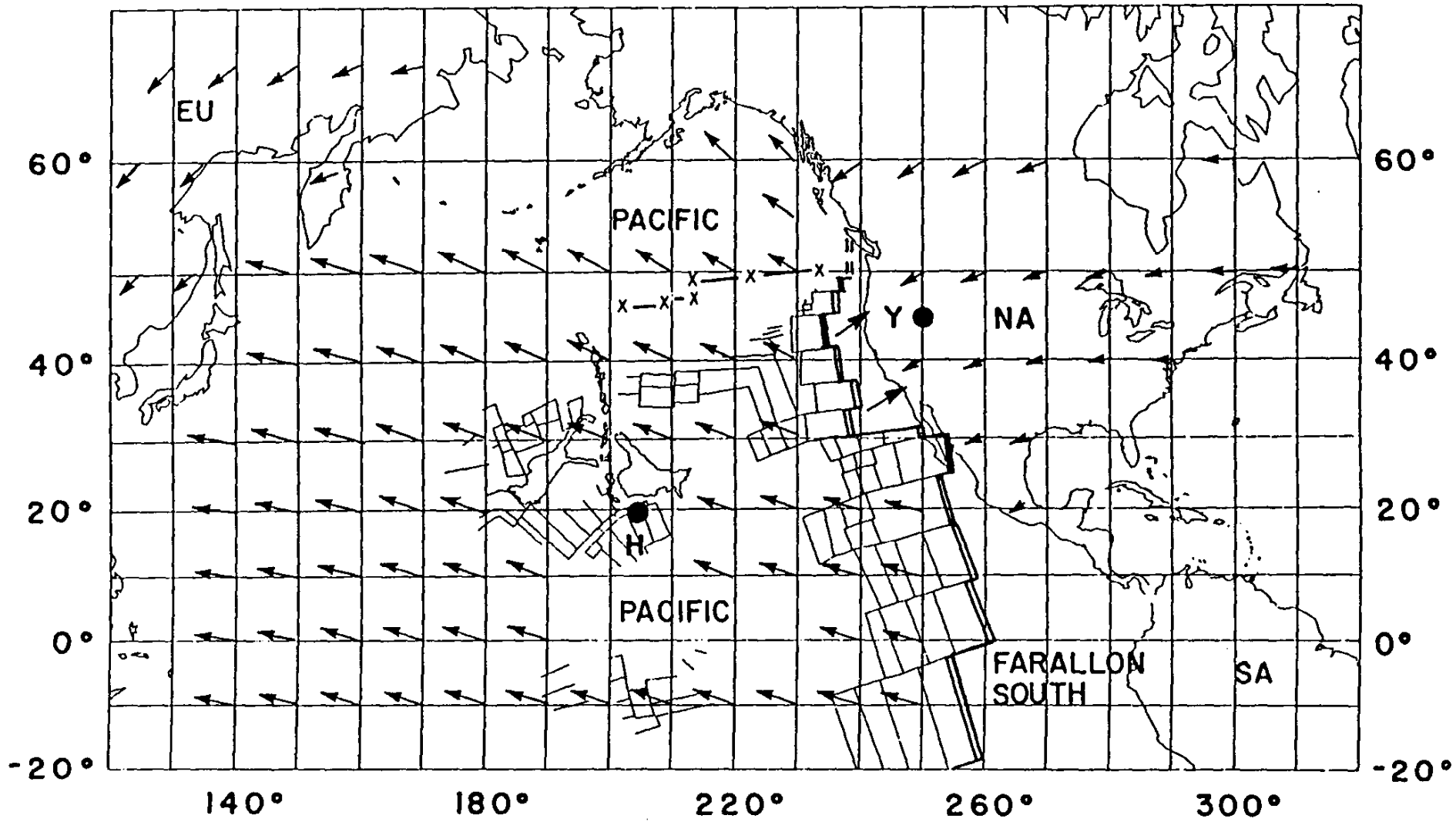
140 Ma (135-145)



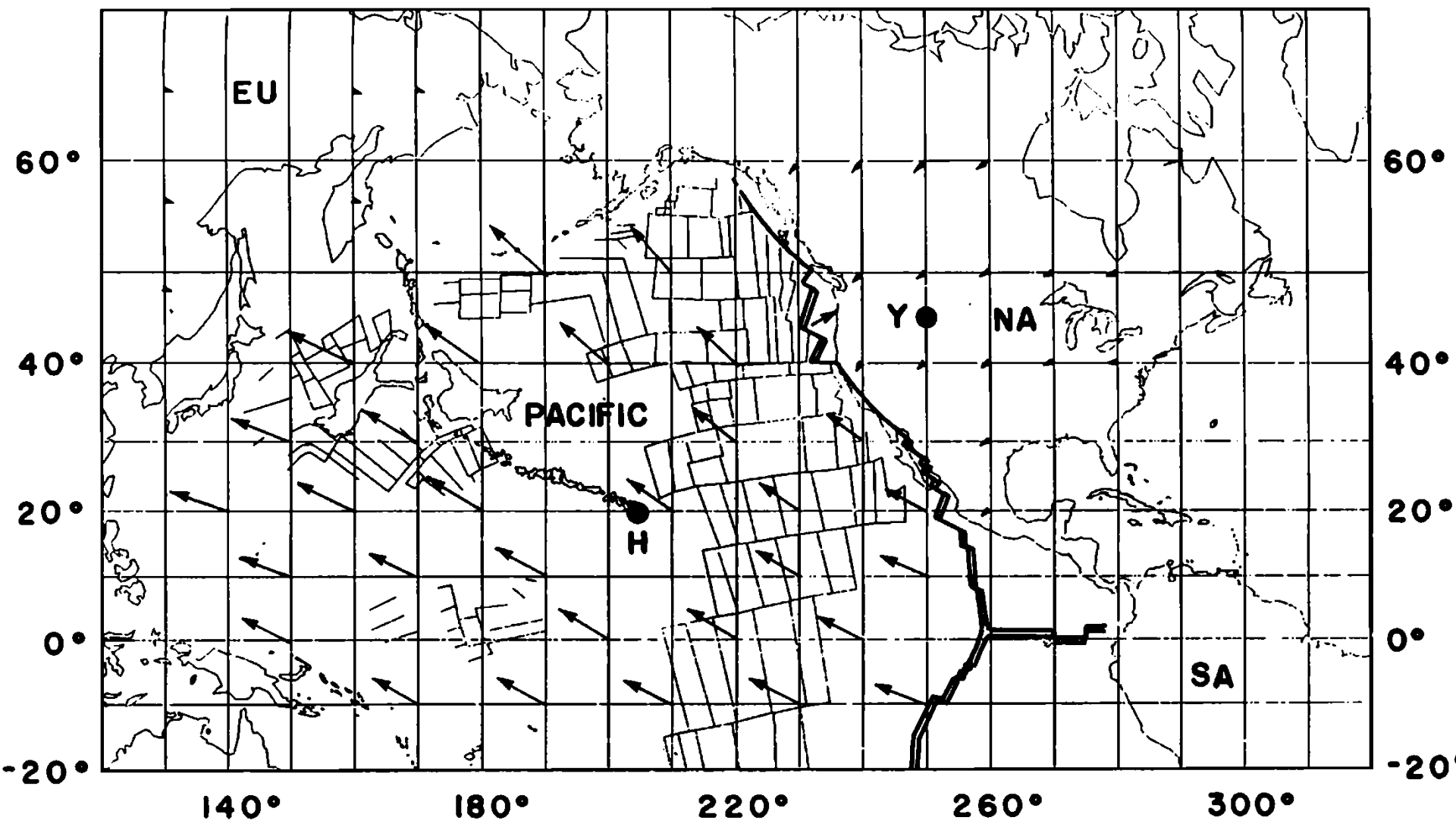
65 Ma (65-71)



37 Ma (37-43)



**PRESENT (0-5)**

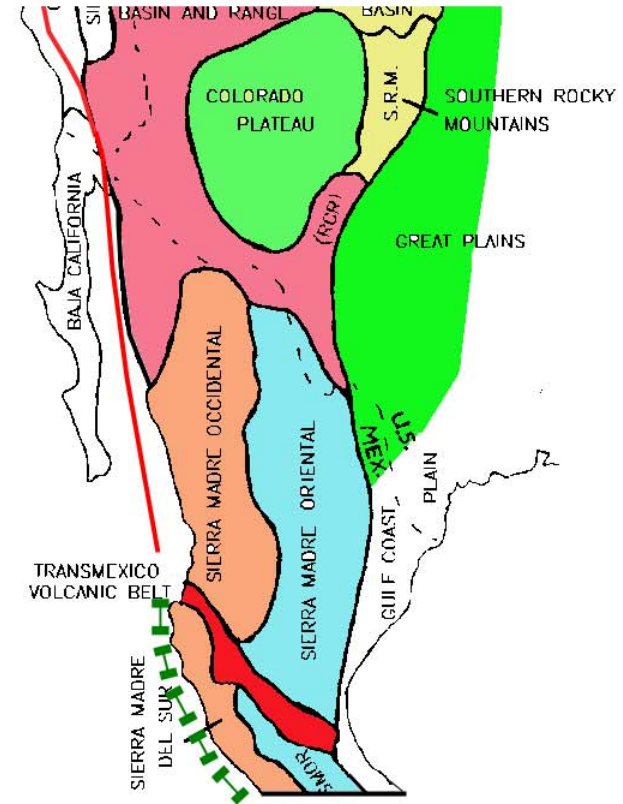
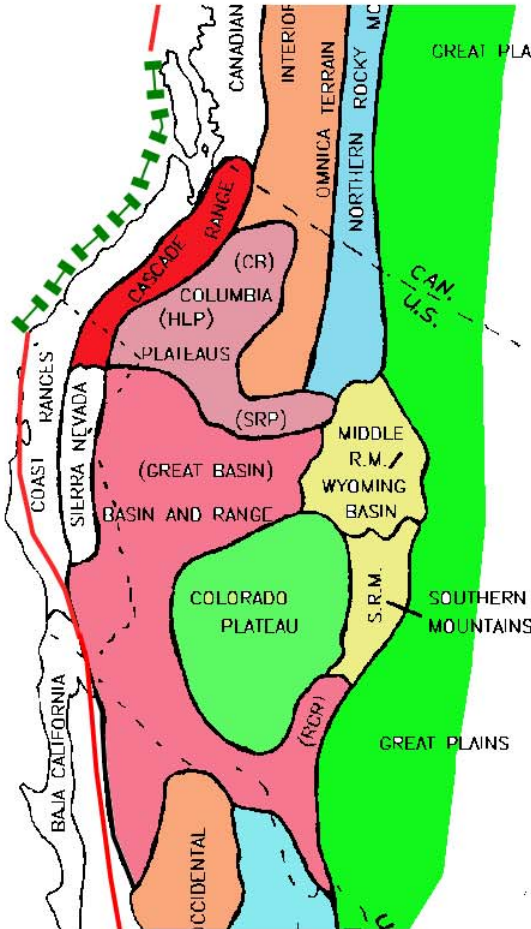
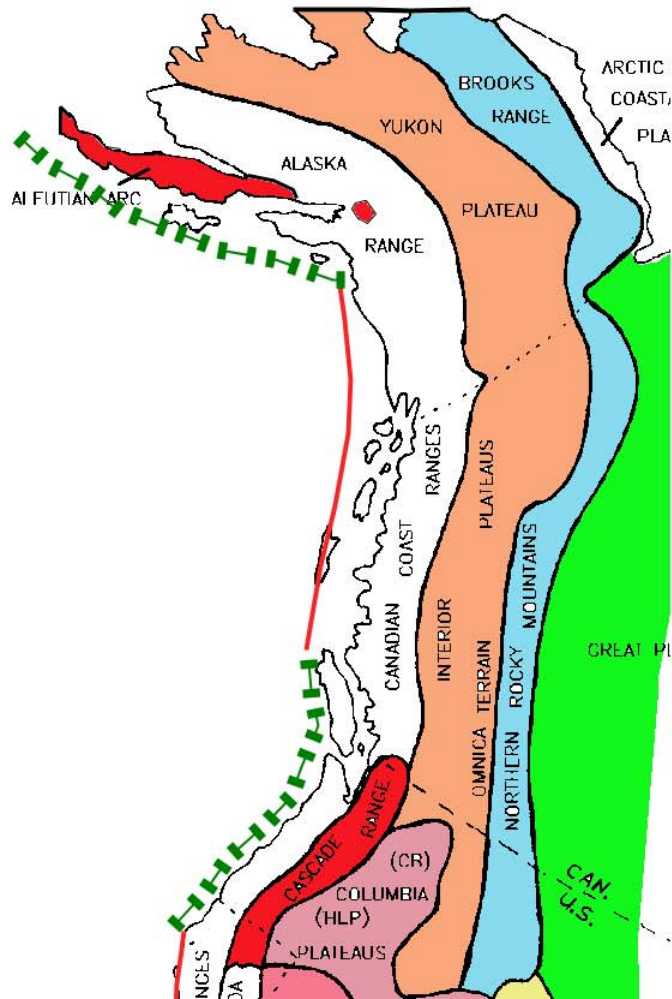


Red Areas  
Salmon Areas

Active Volcanic Arcs  
Back Arcs

Pink Areas  
Blue Areas

Extension  
Thin Skinned Shortening



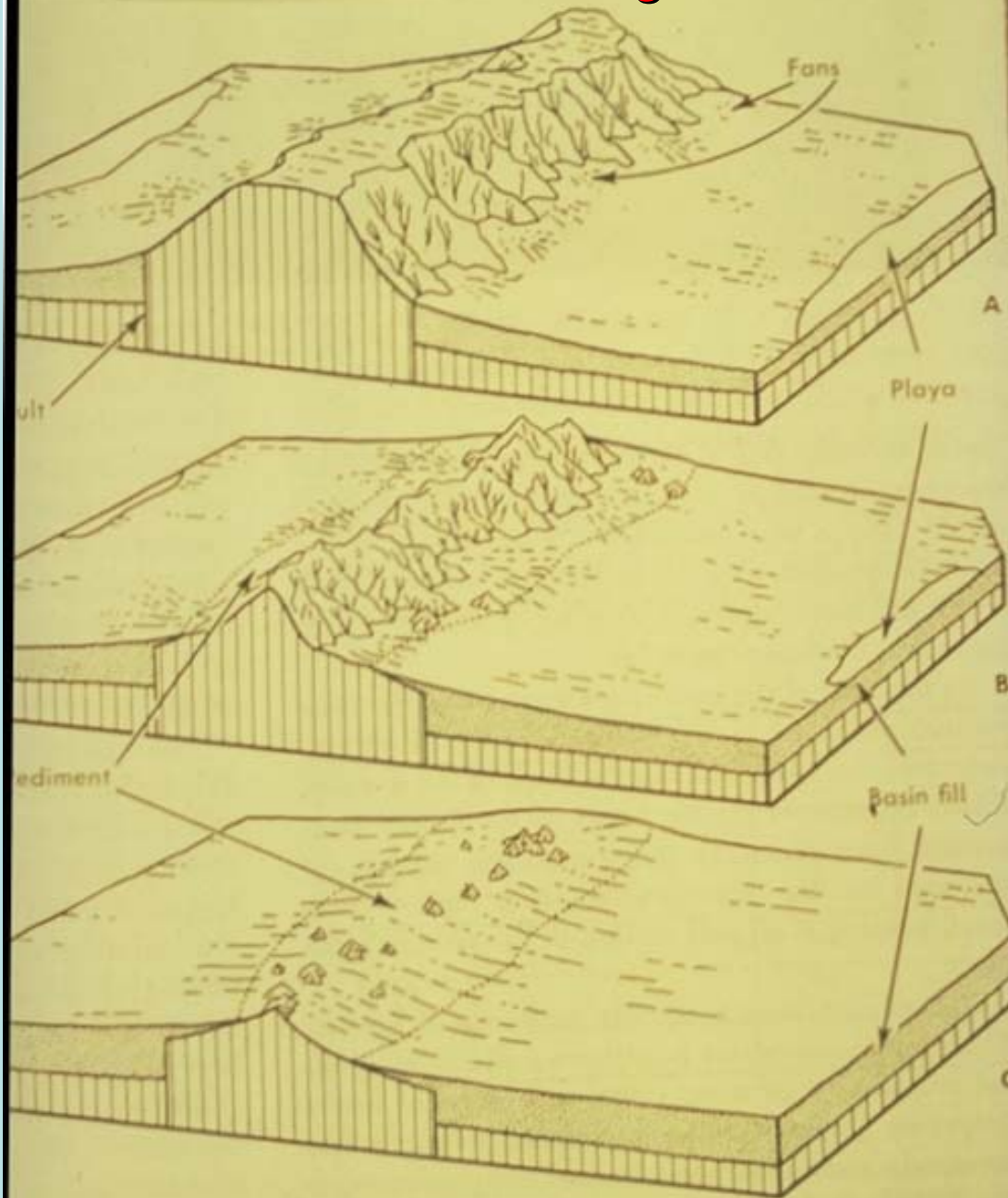
Green Areas  
White Areas

Stable Continent  
Margin Areas

Purple Area  
Yellow Areas

Yellowstone Hot Spot  
Thick Skinned Shortening

# Basin and Range









# California Coast, Melange Sediments and Serpentine









# Sierra Nevada, Granite, Roots of a Volcanic Arc

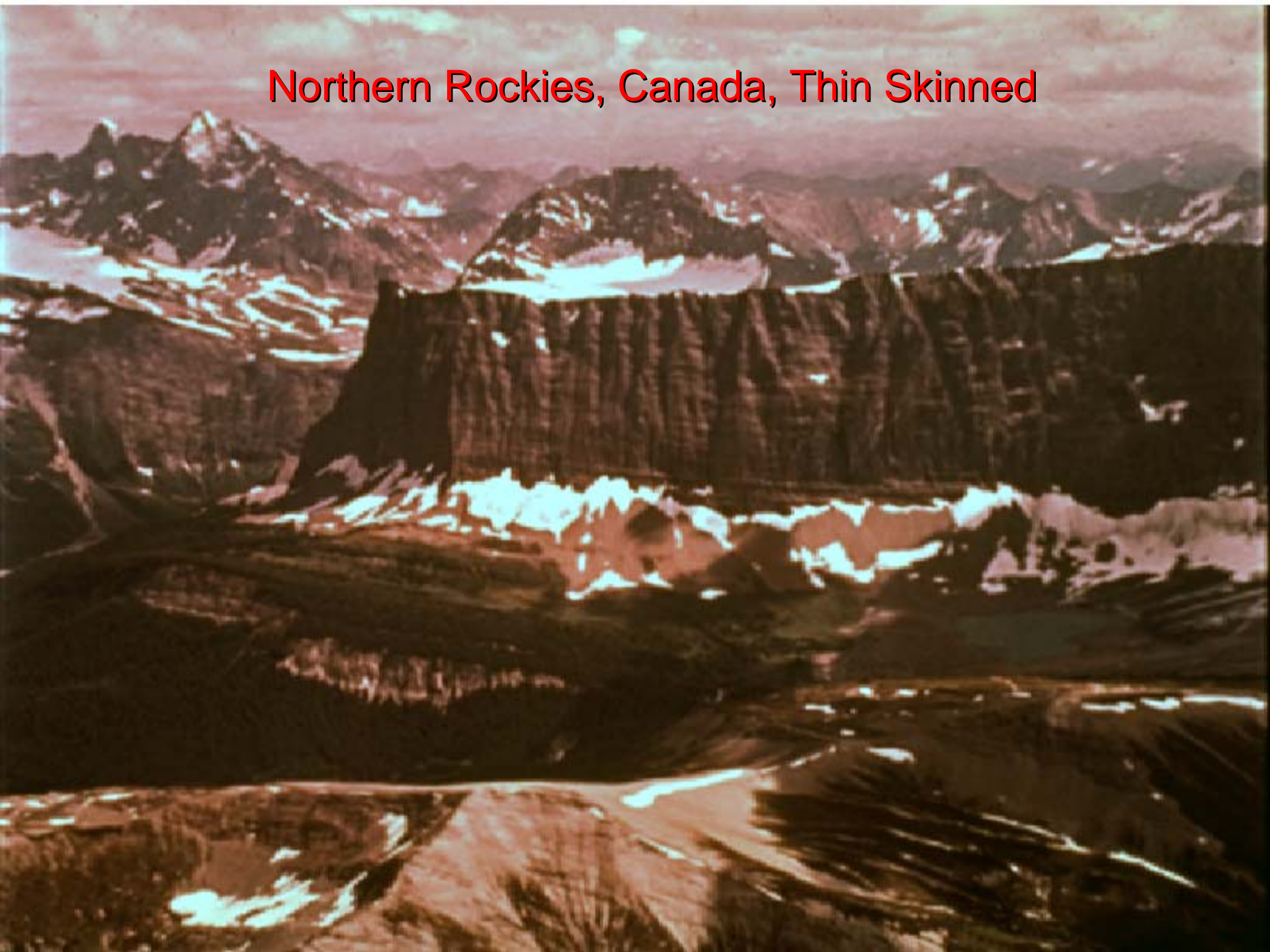


# Colorado Plateau



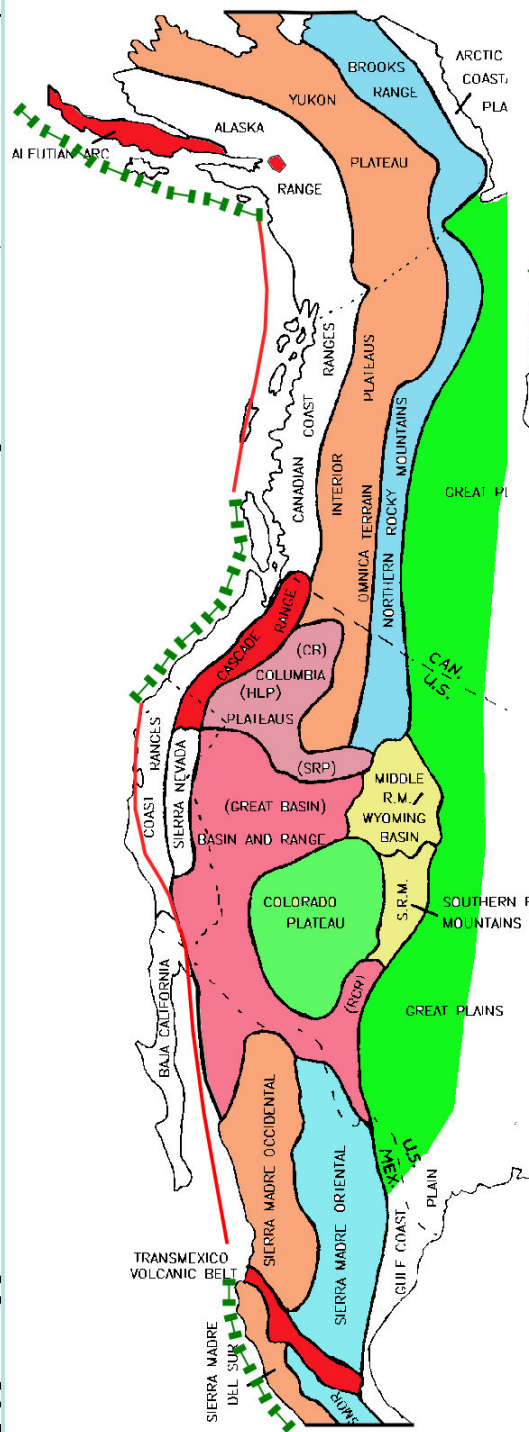
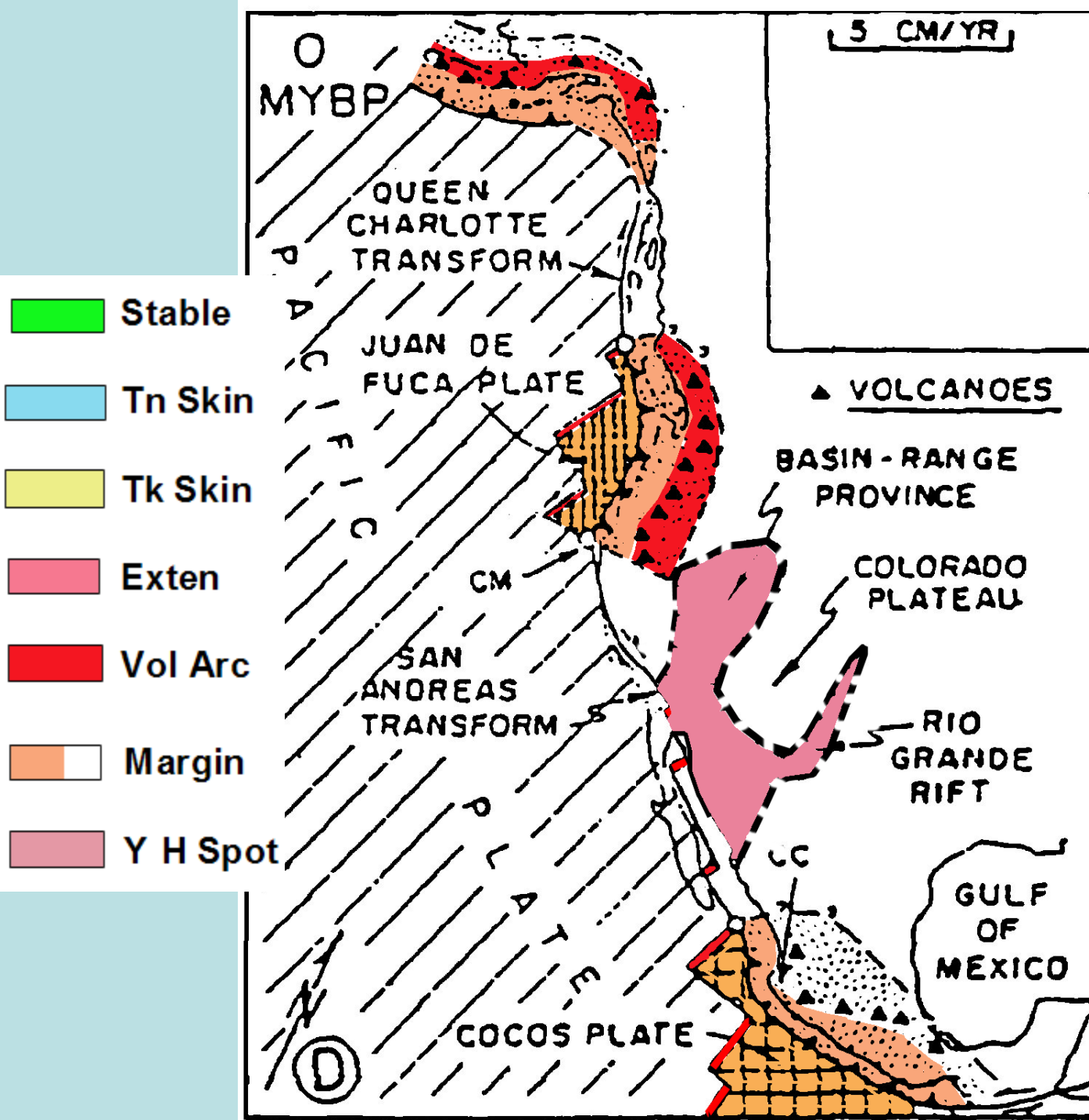


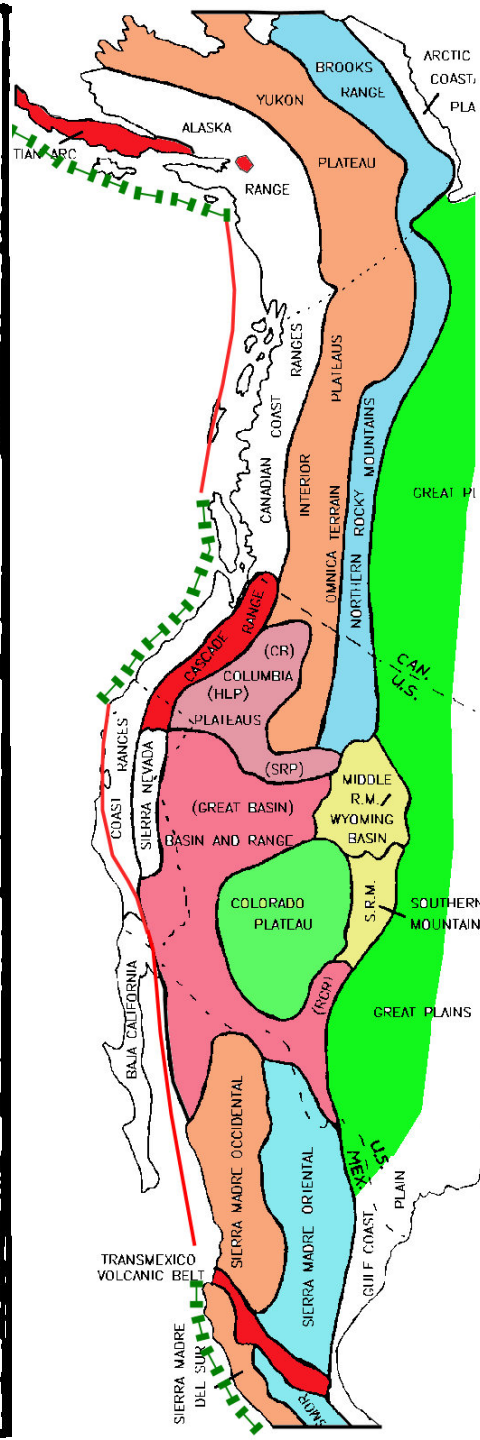
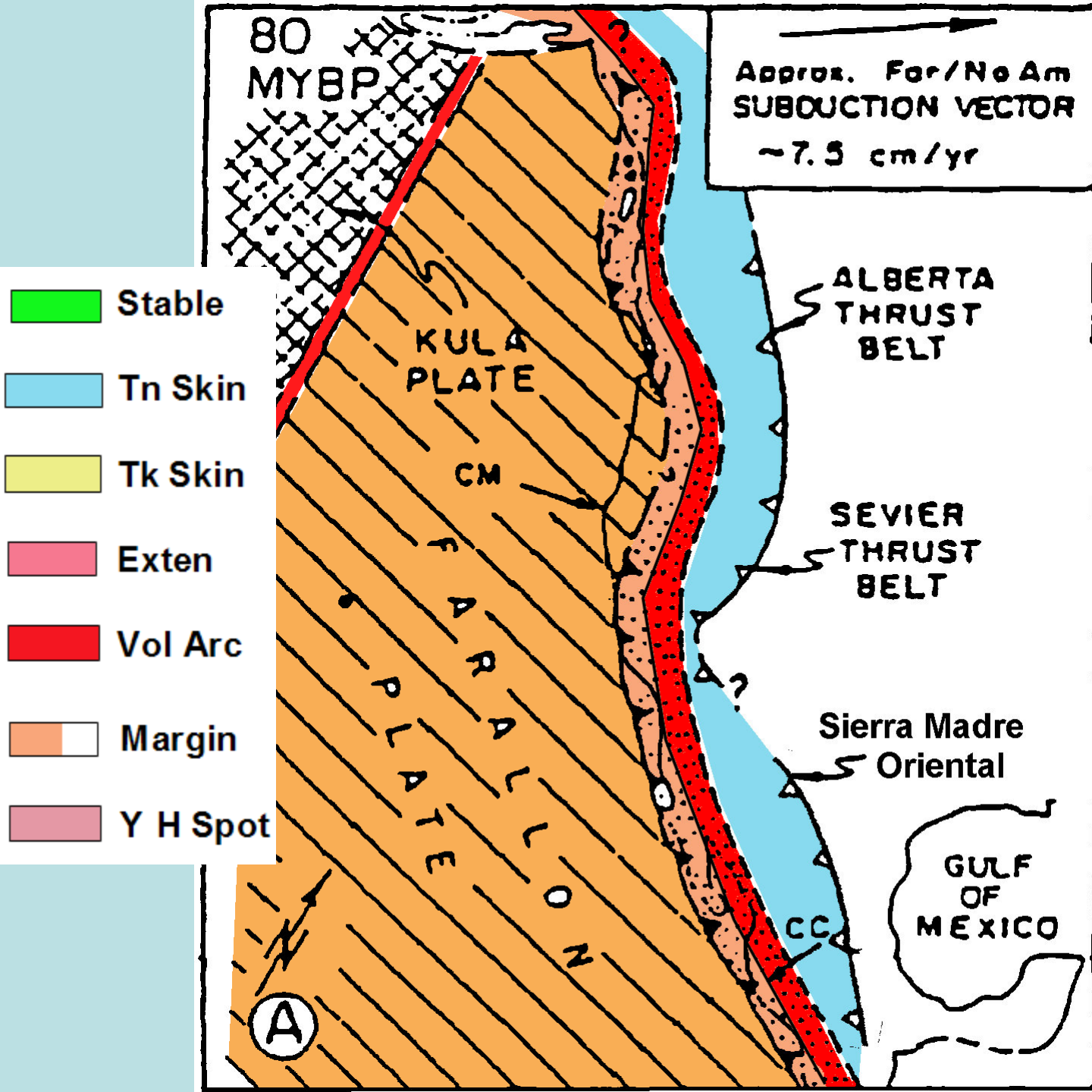
# Northern Rockies, Canada, Thin Skinned

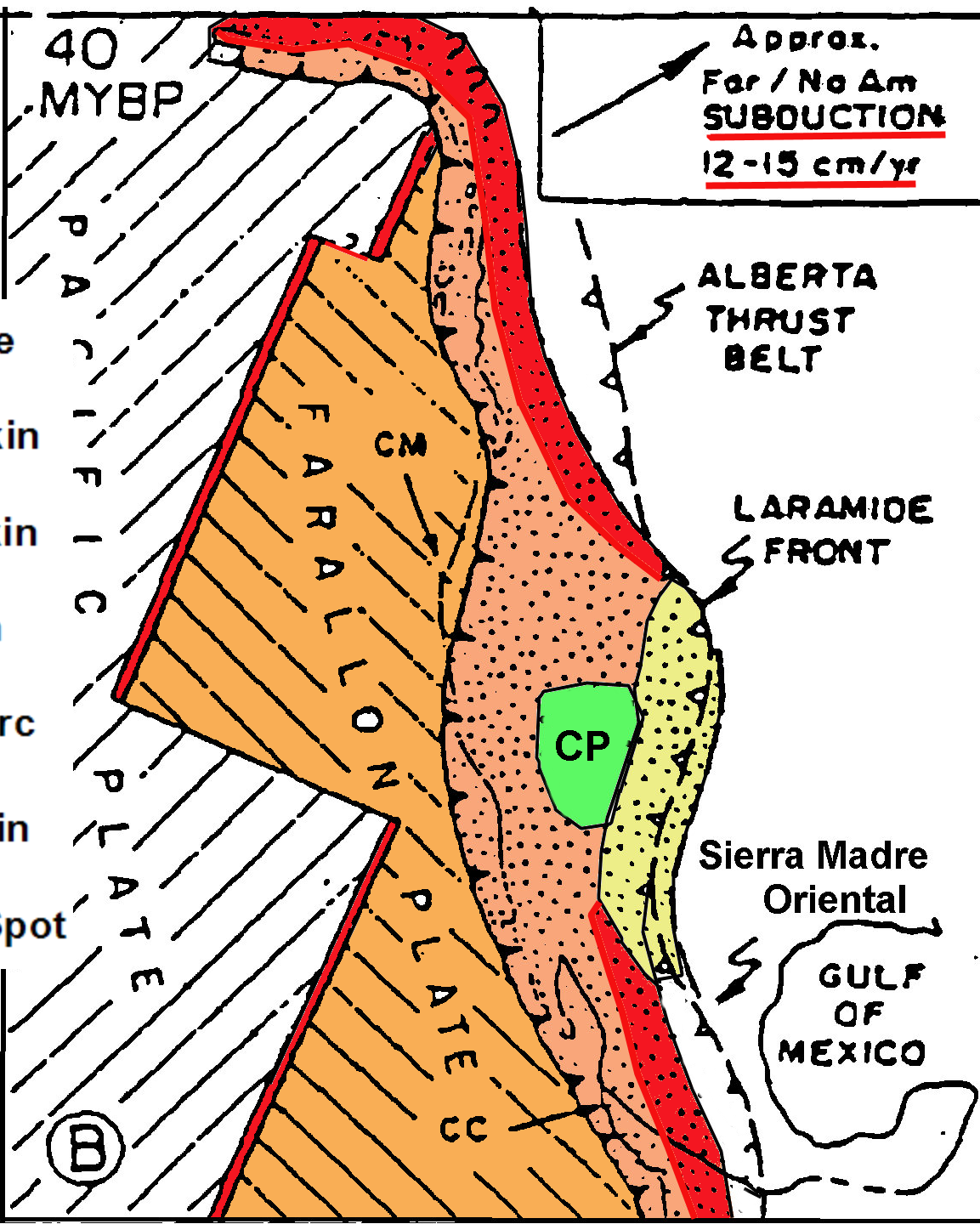


# **Beartooth Plateau, Middle Rocky Mountains-Thick Skinned**

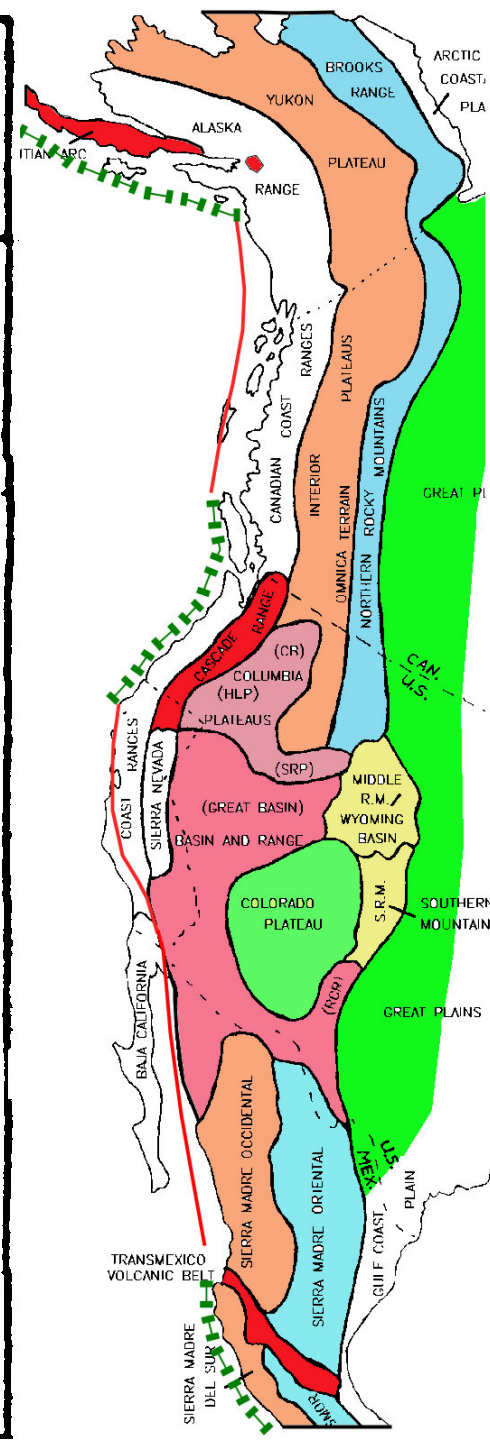


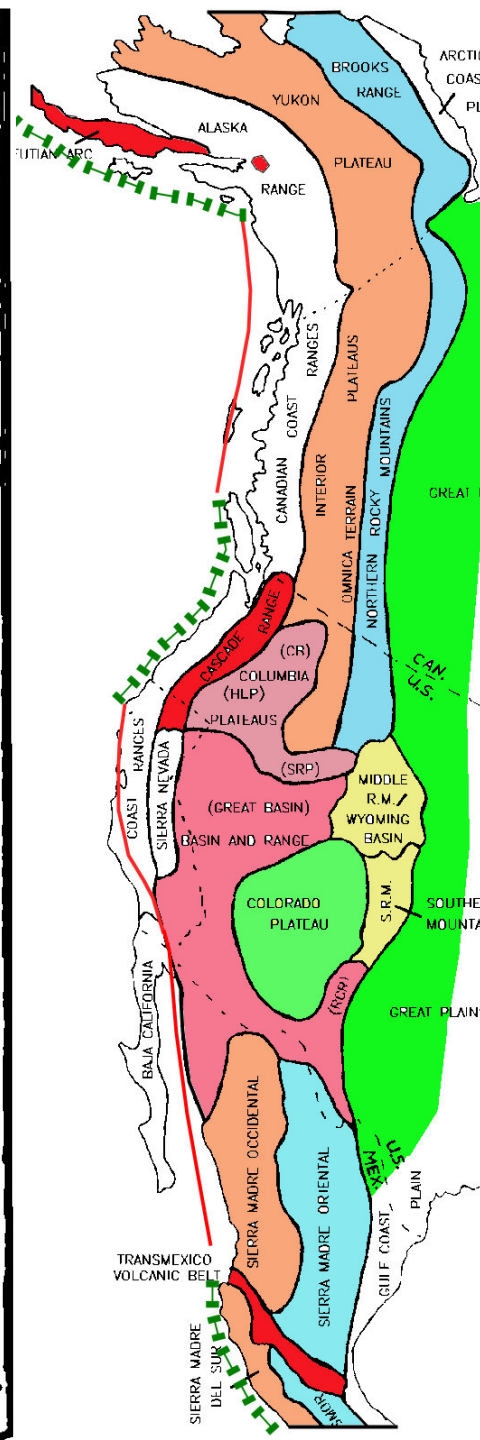
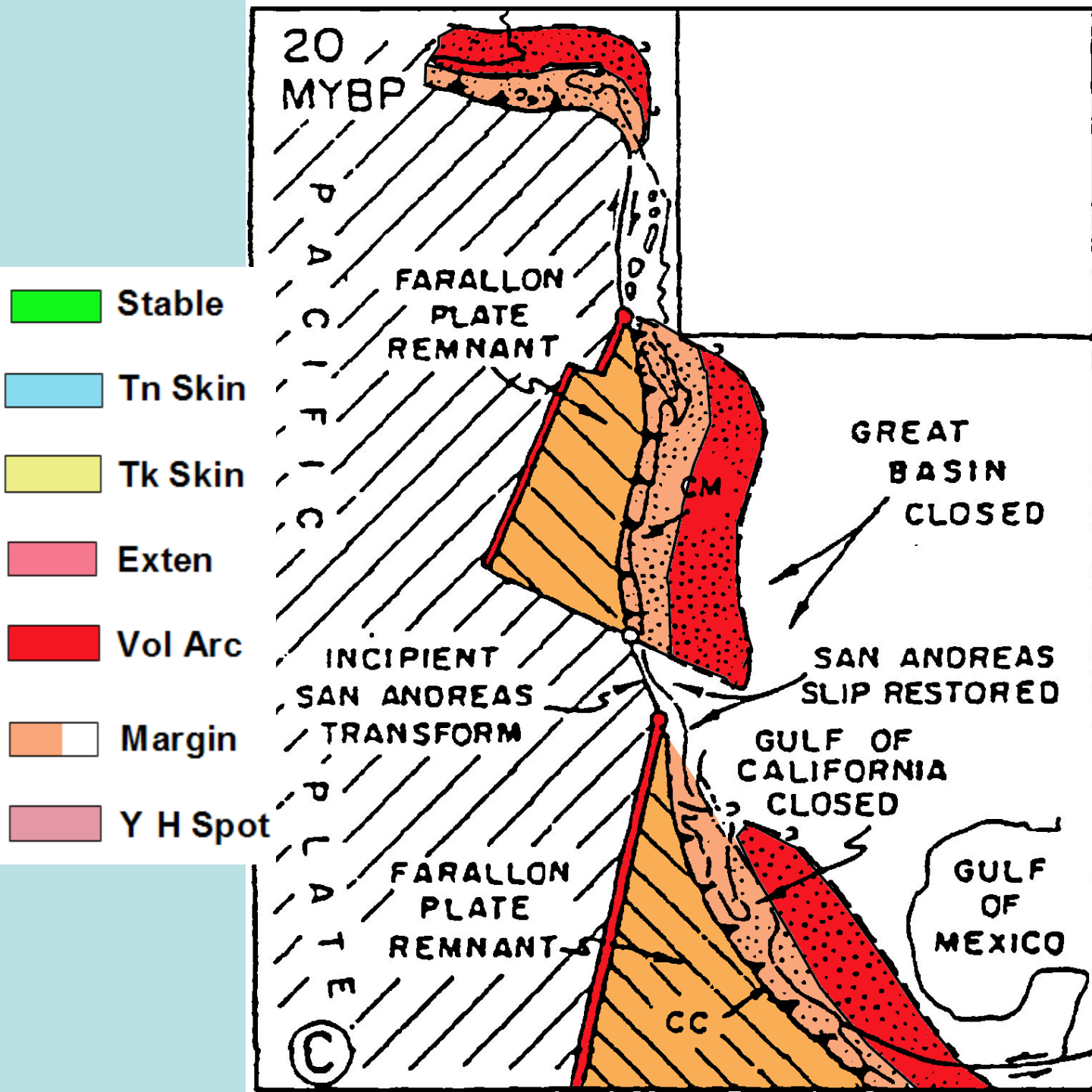






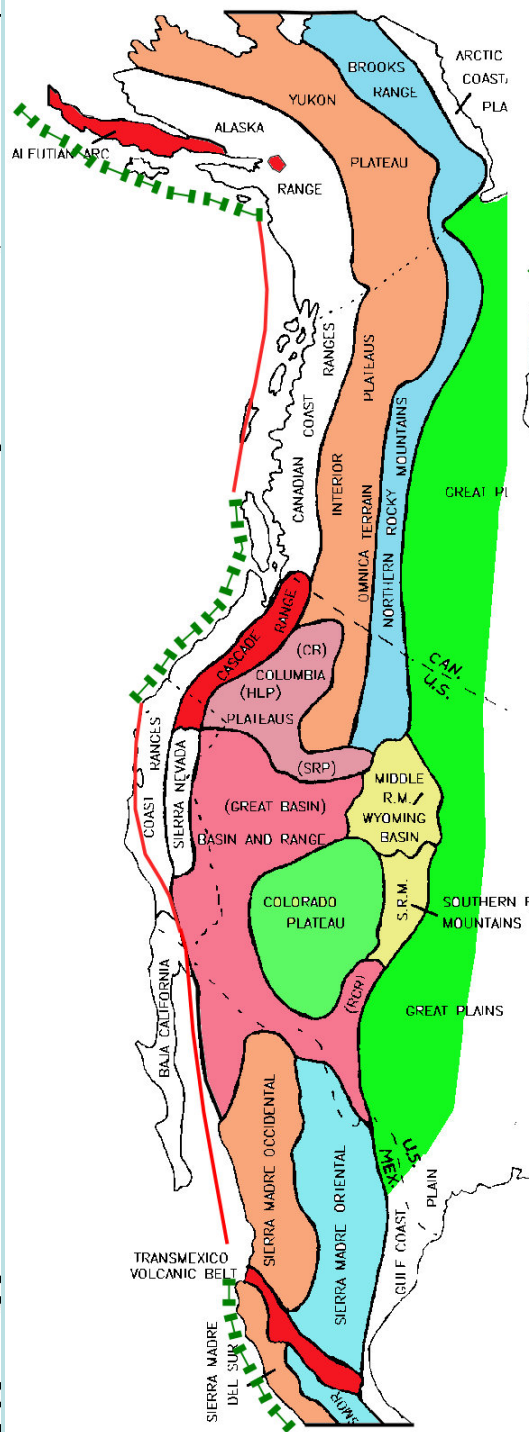
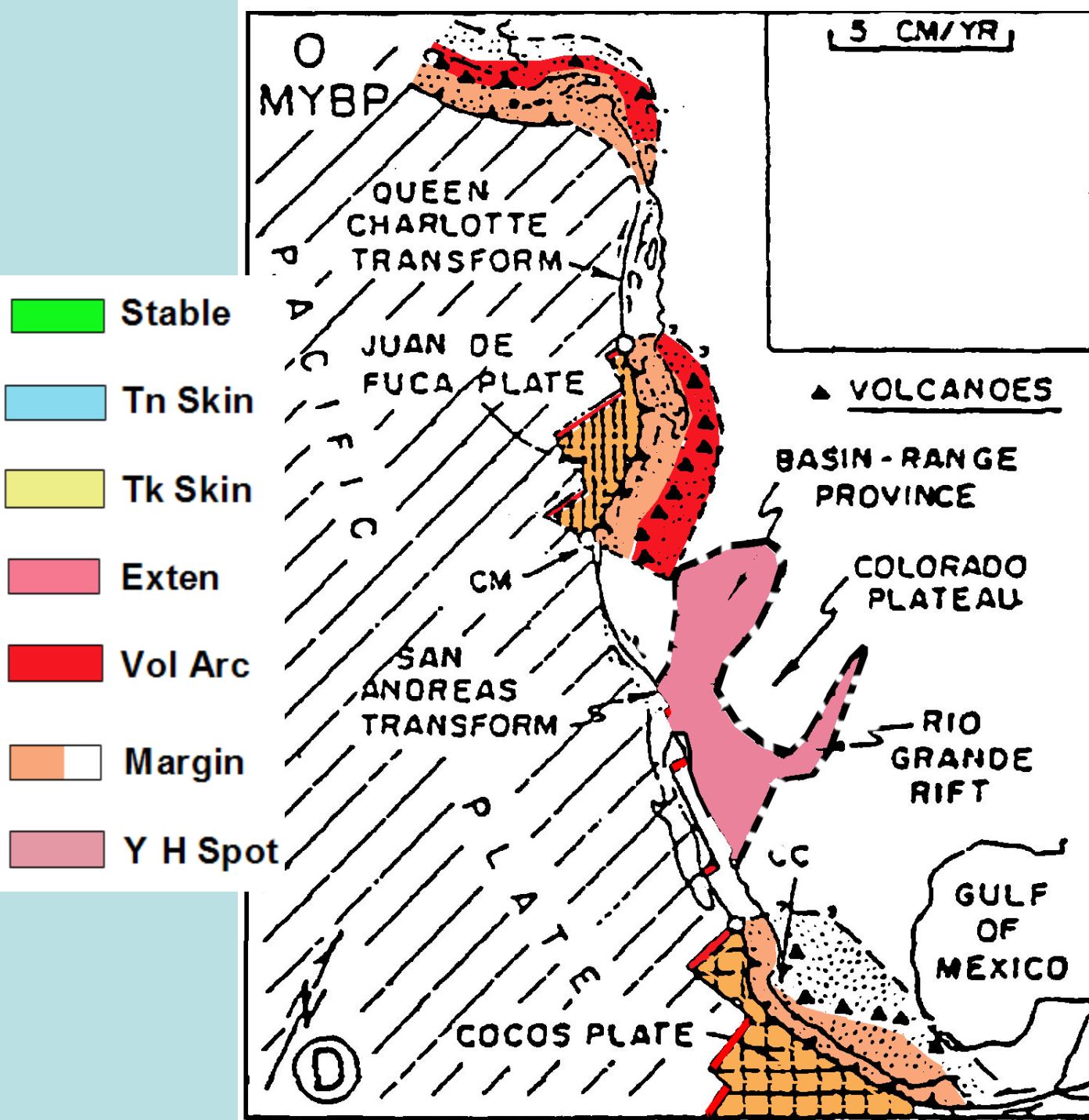
- Stable
- Tn Skin
- Tk Skin
- Exten
- Vol Arc
- Margin
- Y H Spot

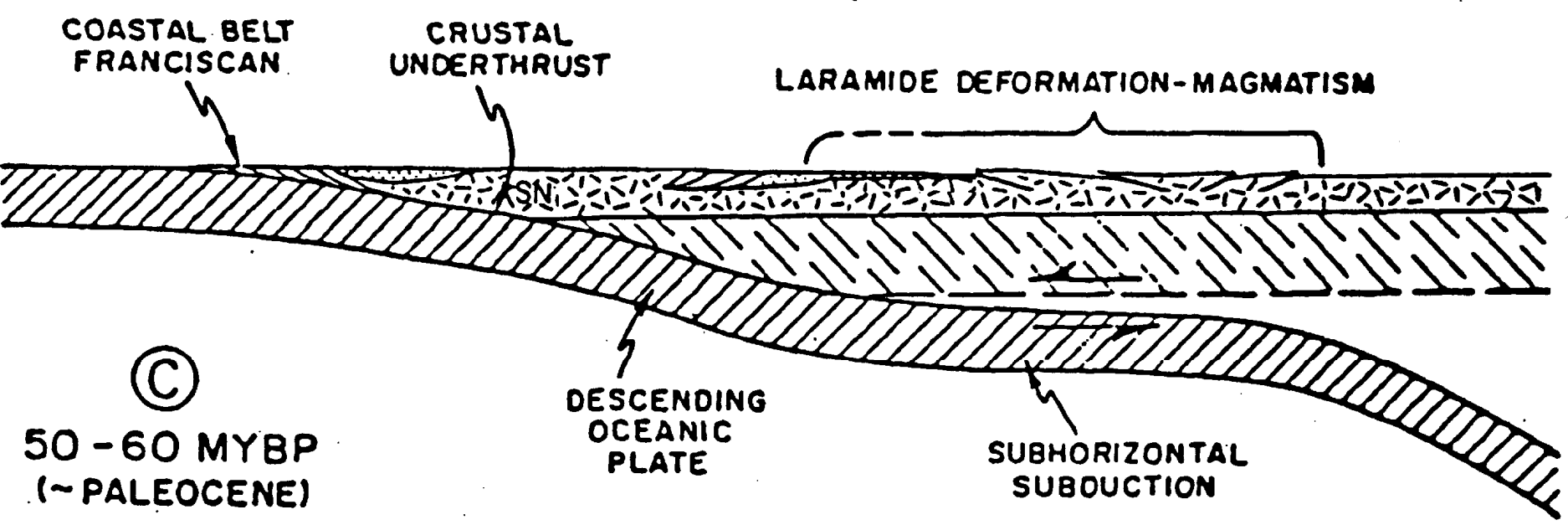
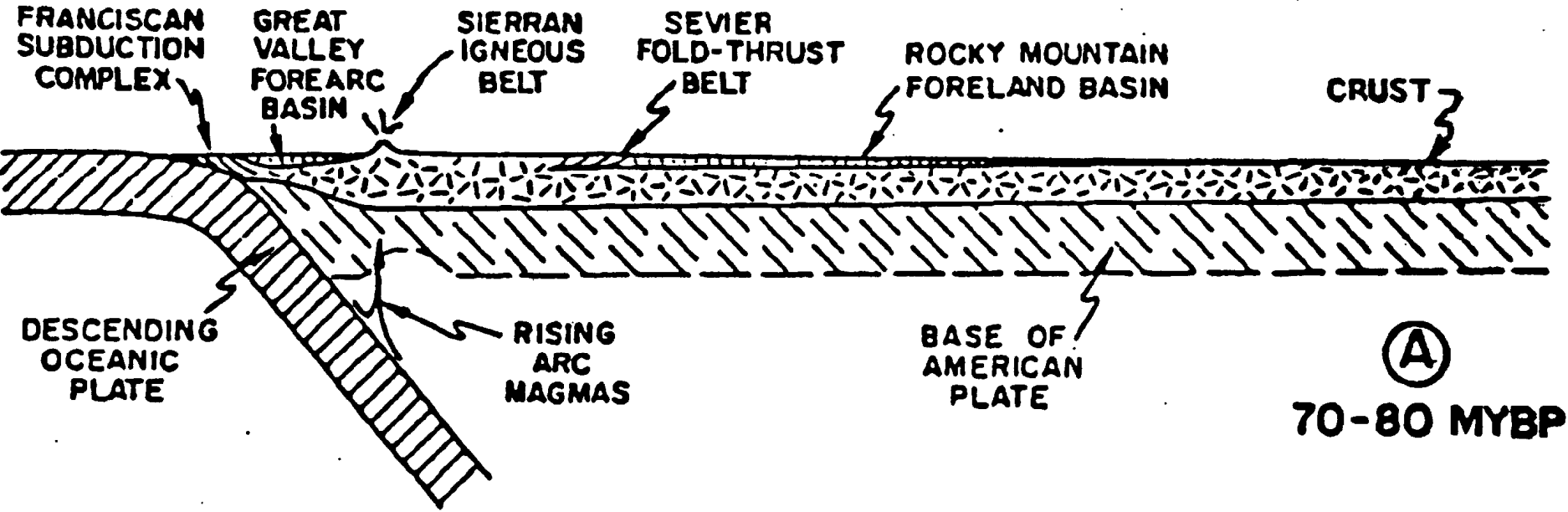




- Stable
- Tn Skin
- Tk Skin
- Exten
- Vol Arc
- Margin
- Y H Spot

©

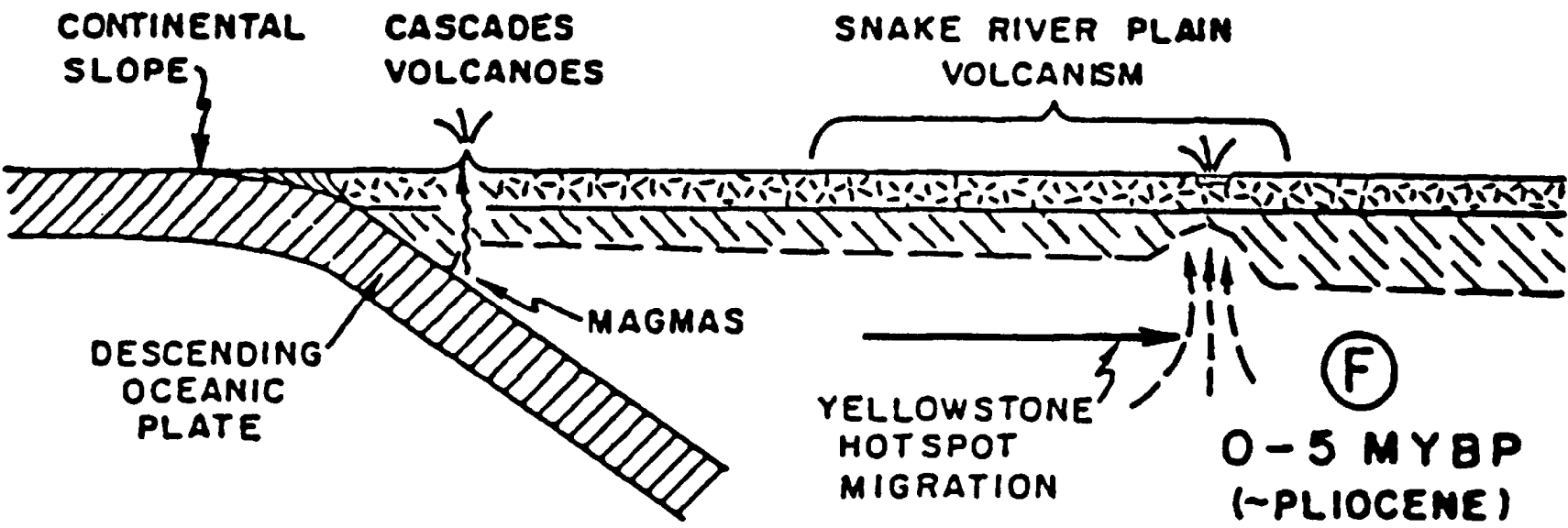
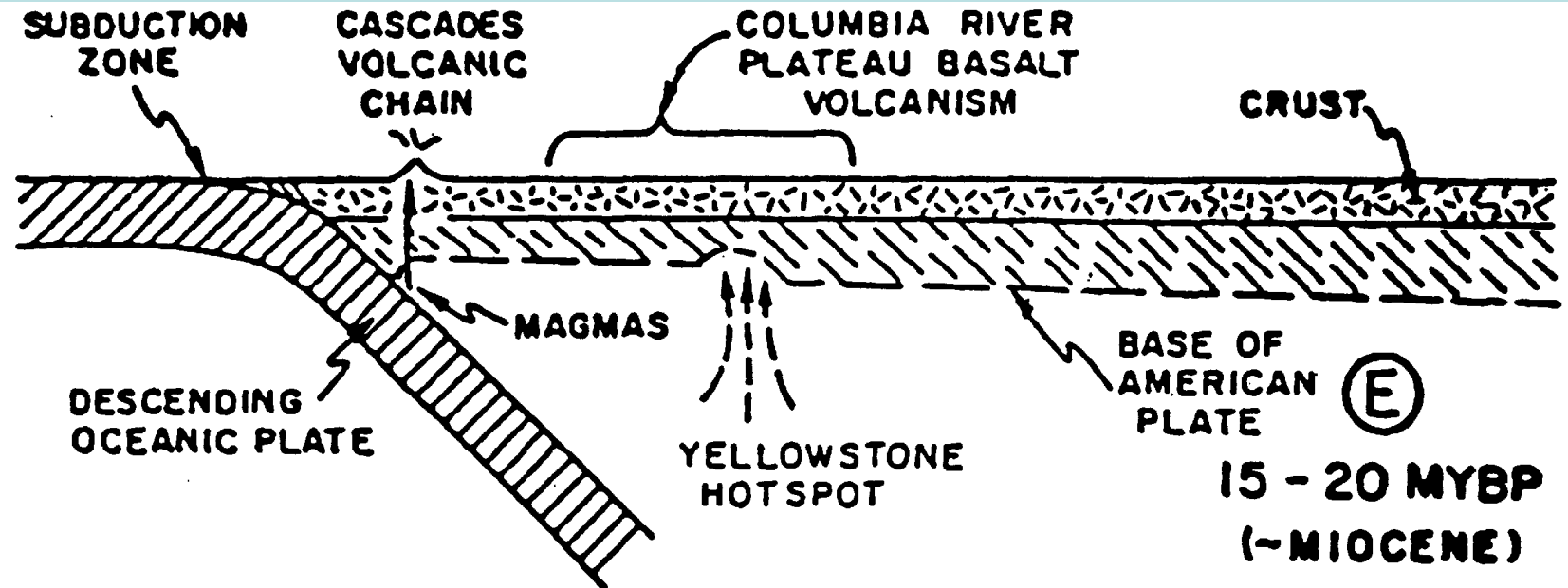




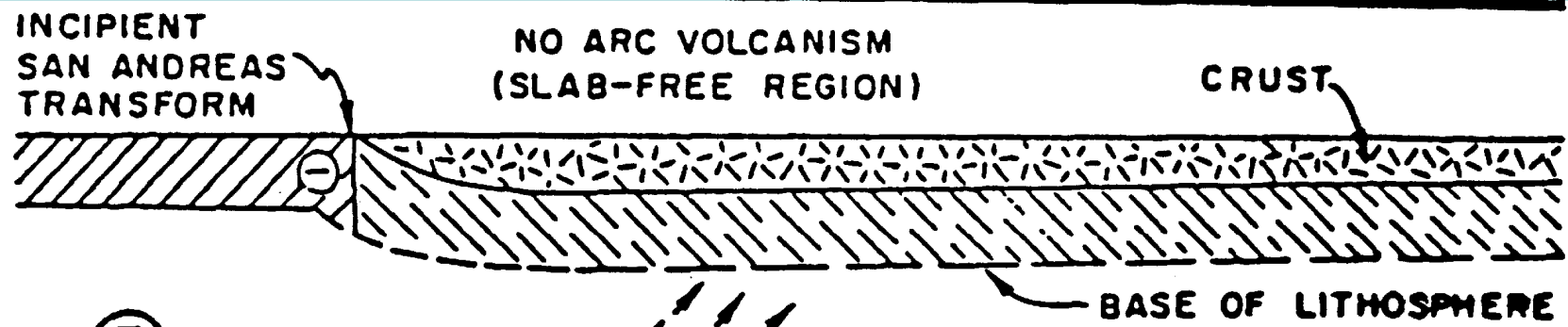


# Pacific Northwest 0 to 20 Ma

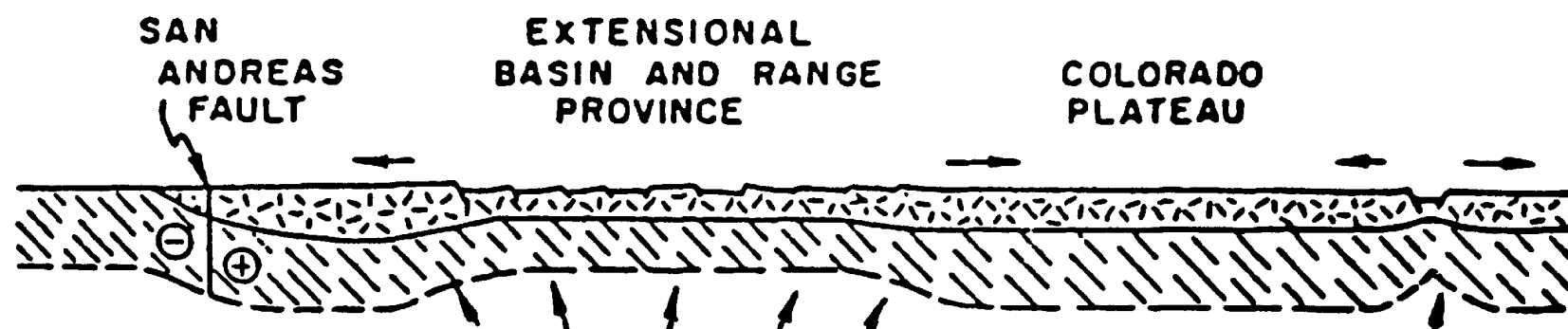
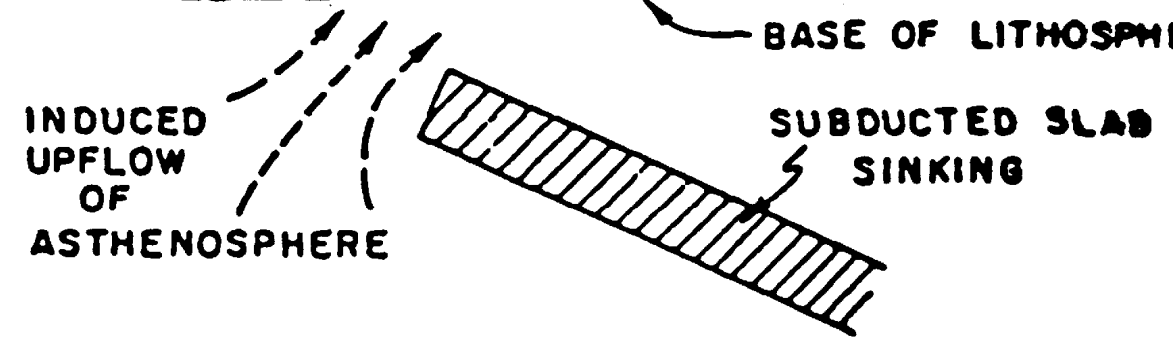
CASCADES SUBDUCTION SYSTEM  
(PACIFIC NORTHWEST)



**SAN ANDREAS TRANSFORM SYSTEM  
(CALIFORNIA COAST)**



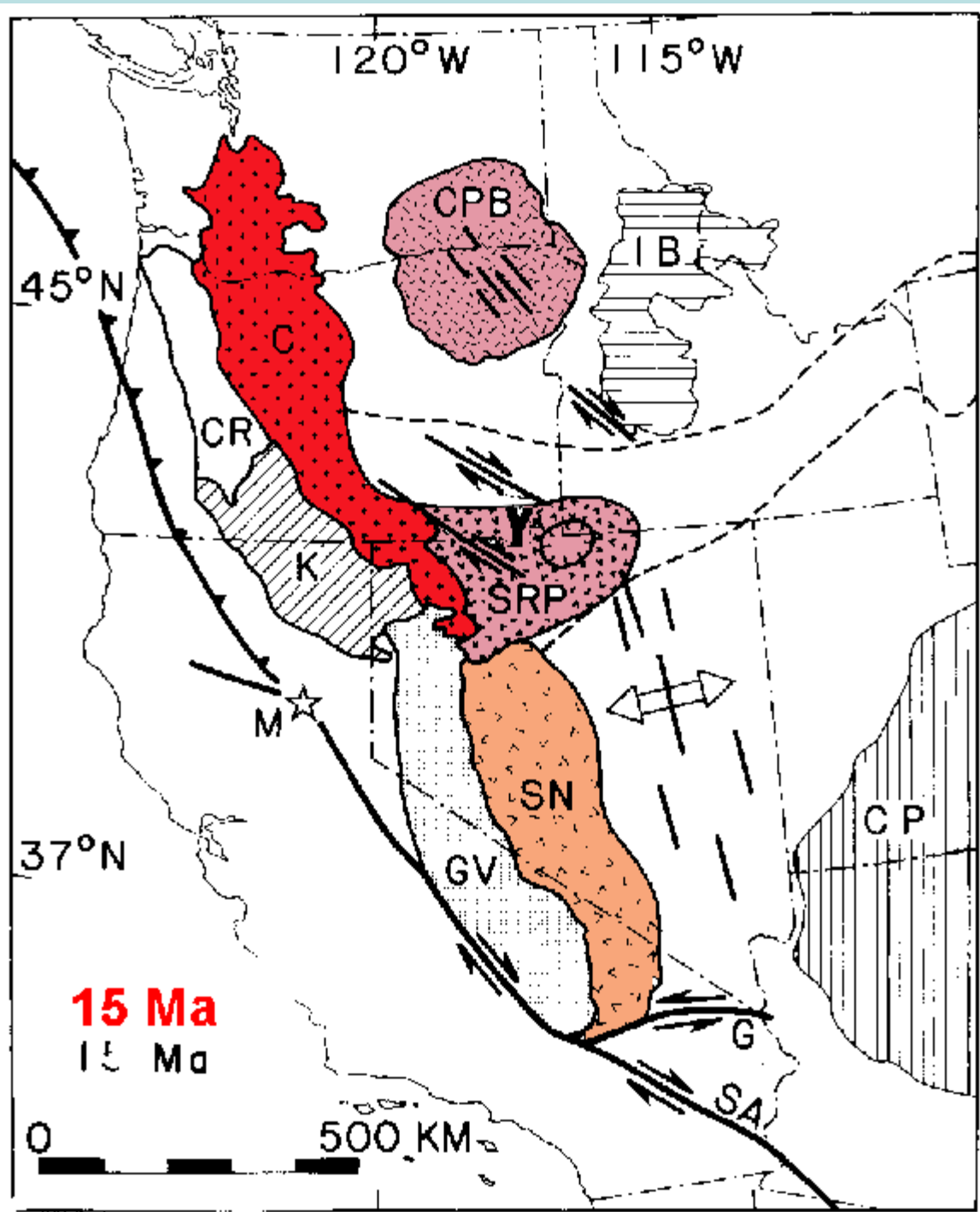
**(E)**  
15 - 20 MYBP  
(~MIOCENE)

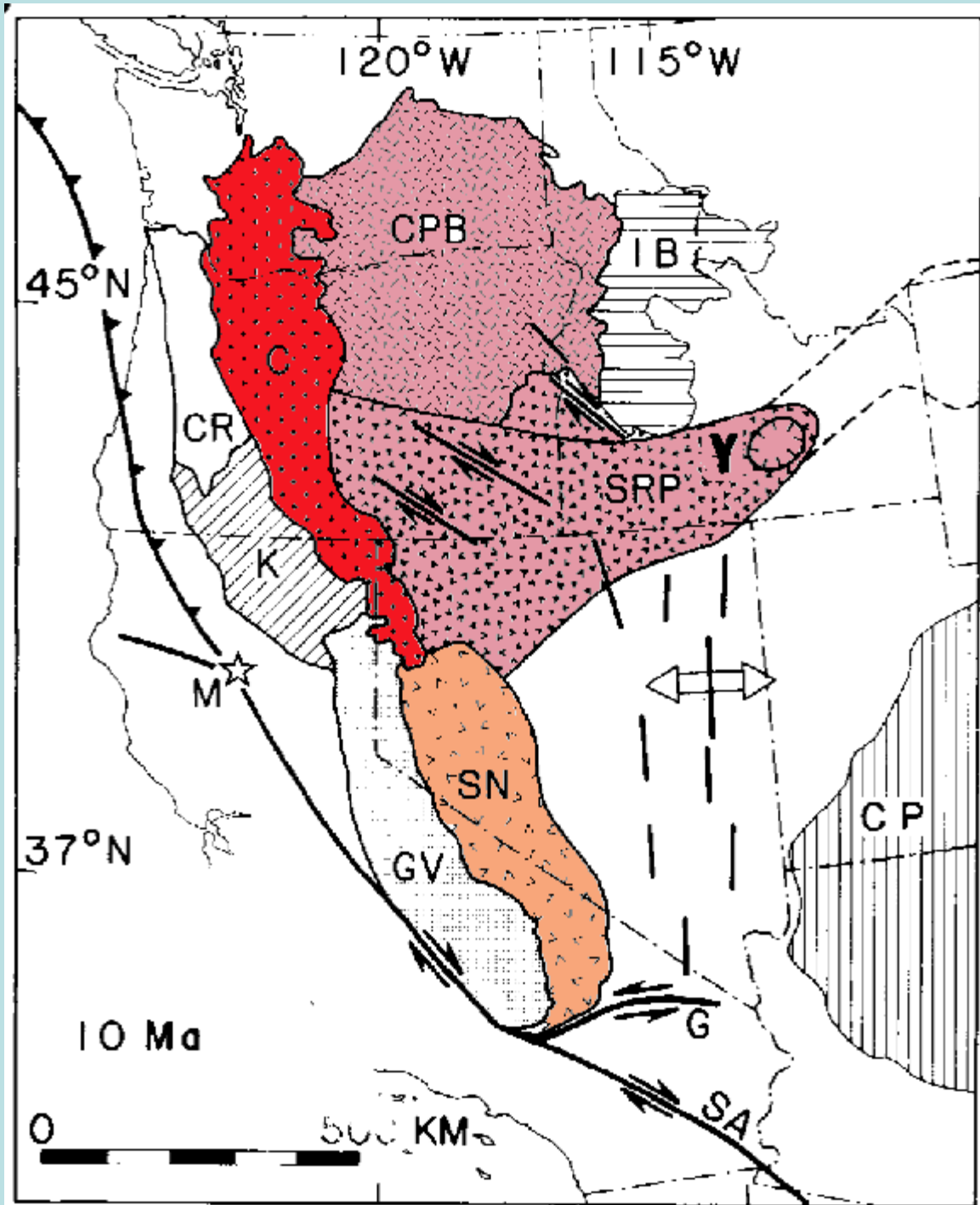


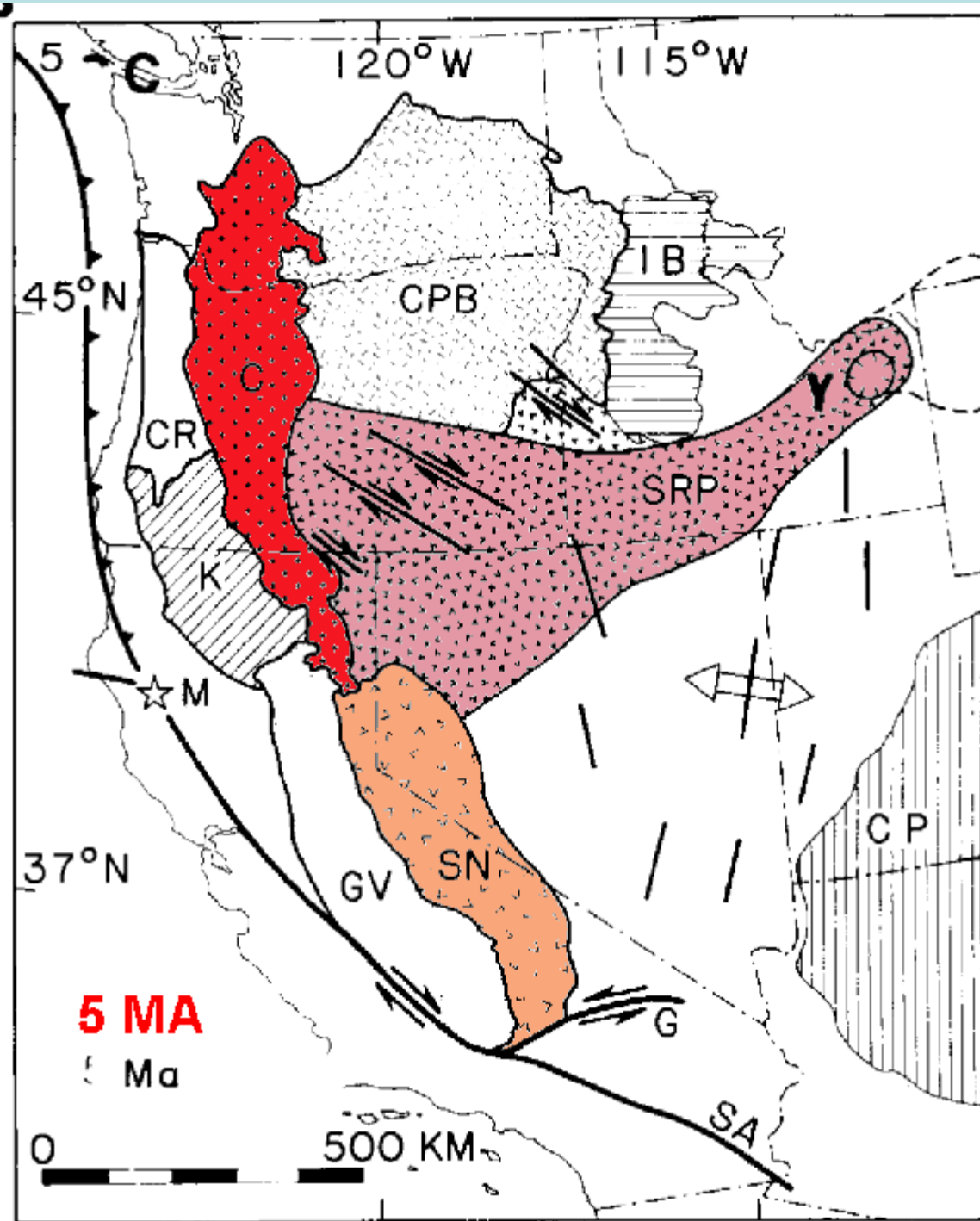
**(F)**  
0 - 5 MYBP  
(~PLIOCENE)

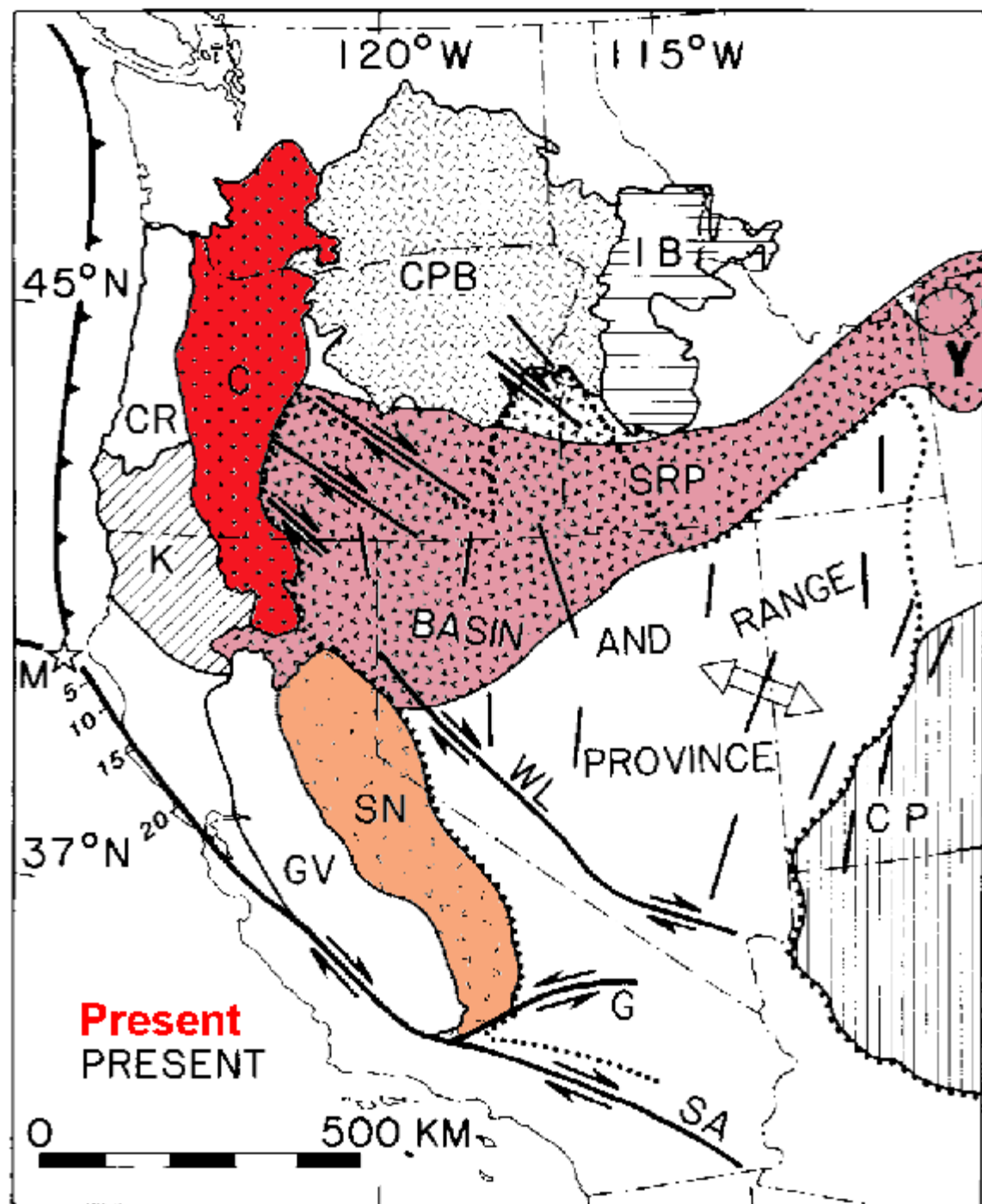
UPWELLING ASTHENOSPHERE  
REPLACES SUBDUCTED SLABS

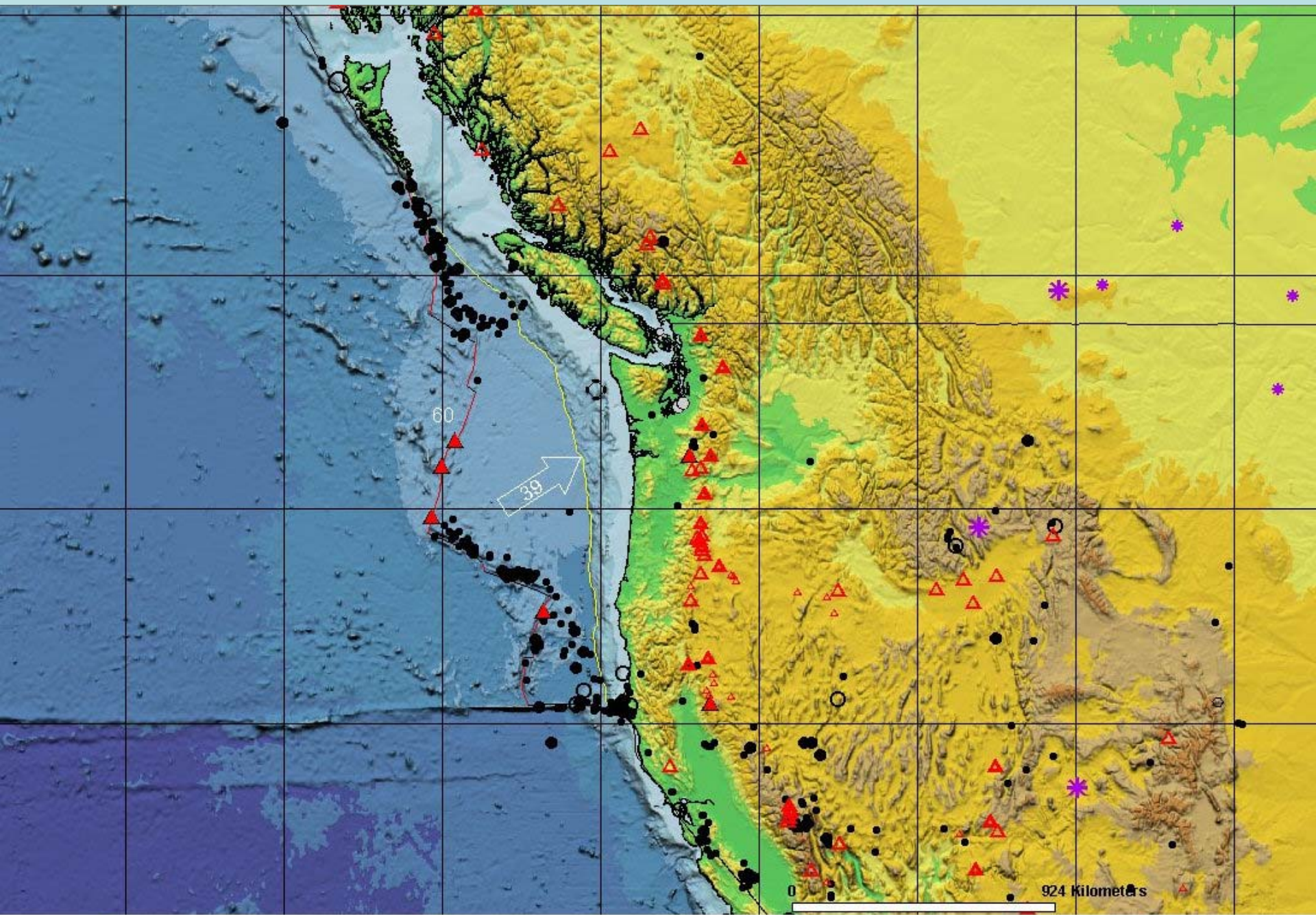
RIO GRANDE RIFT  
250 KM



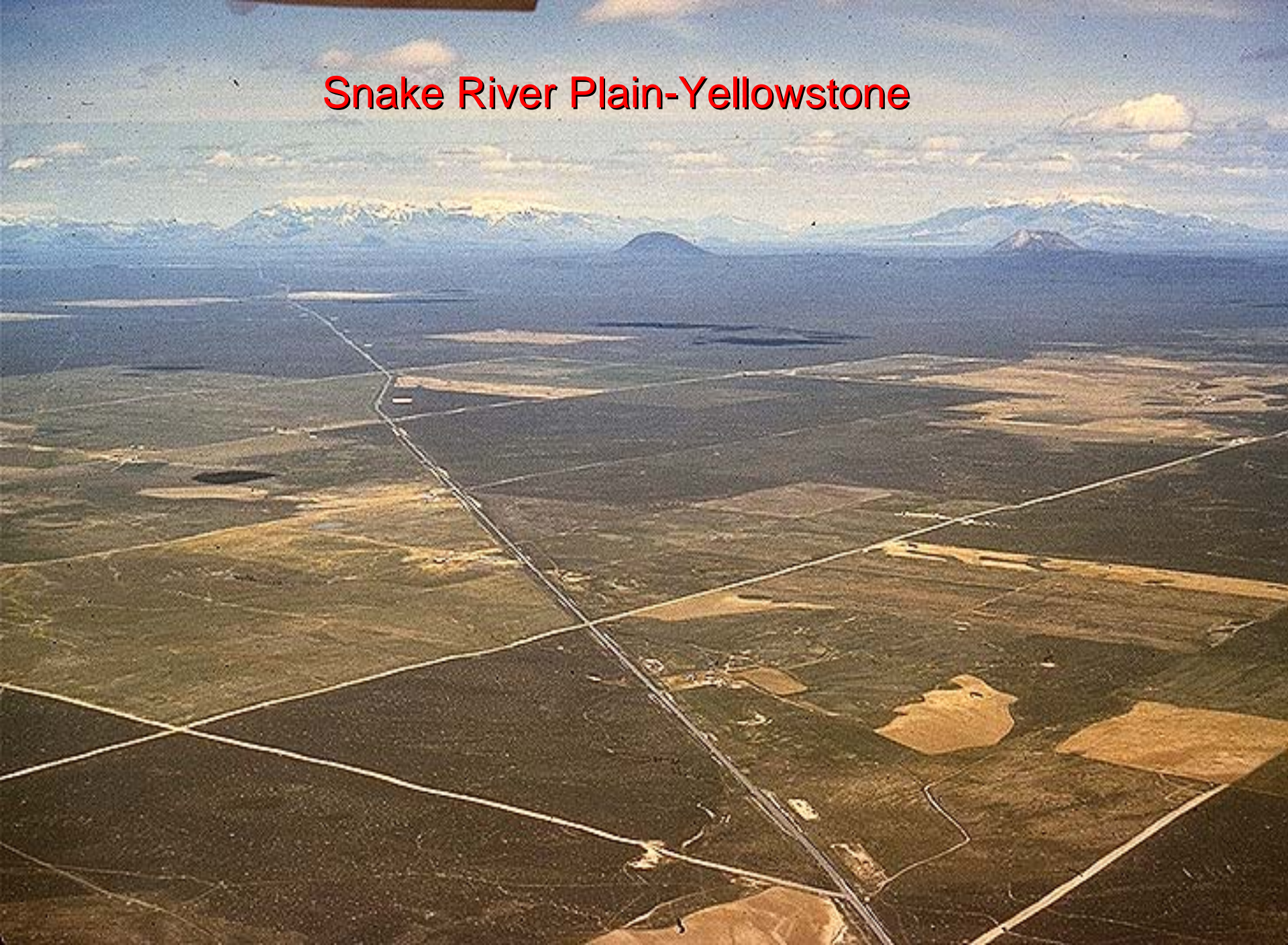








# Snake River Plain-Yellowstone









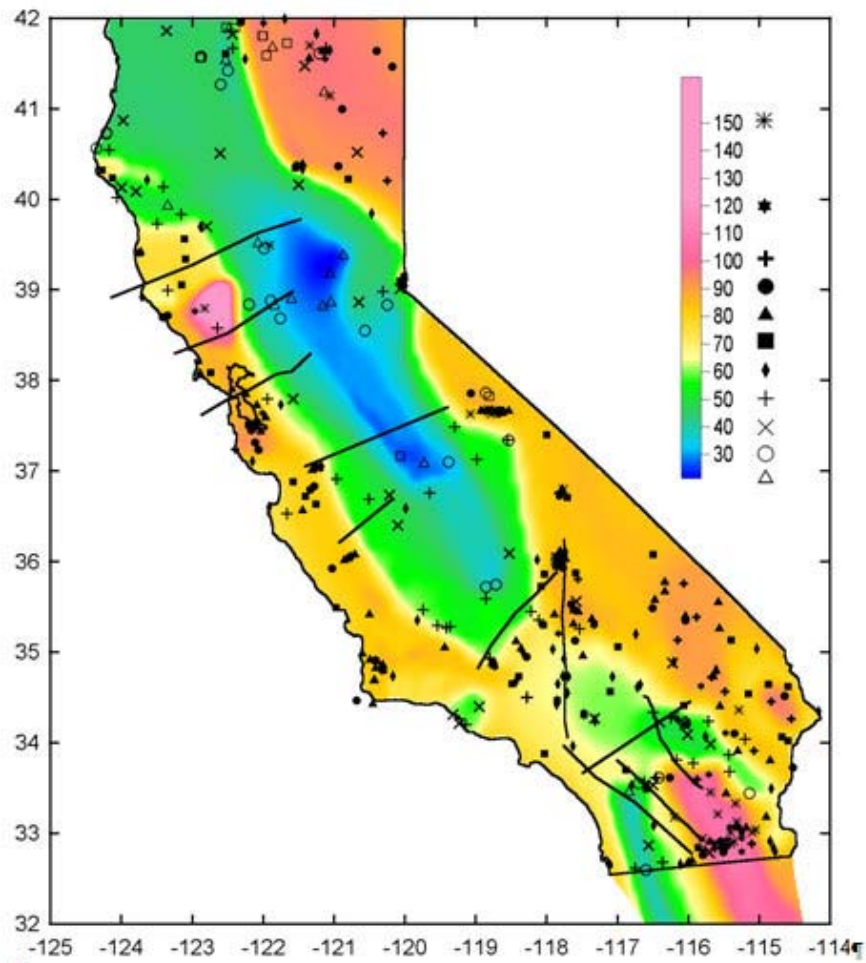


Figure 1a Heat flow

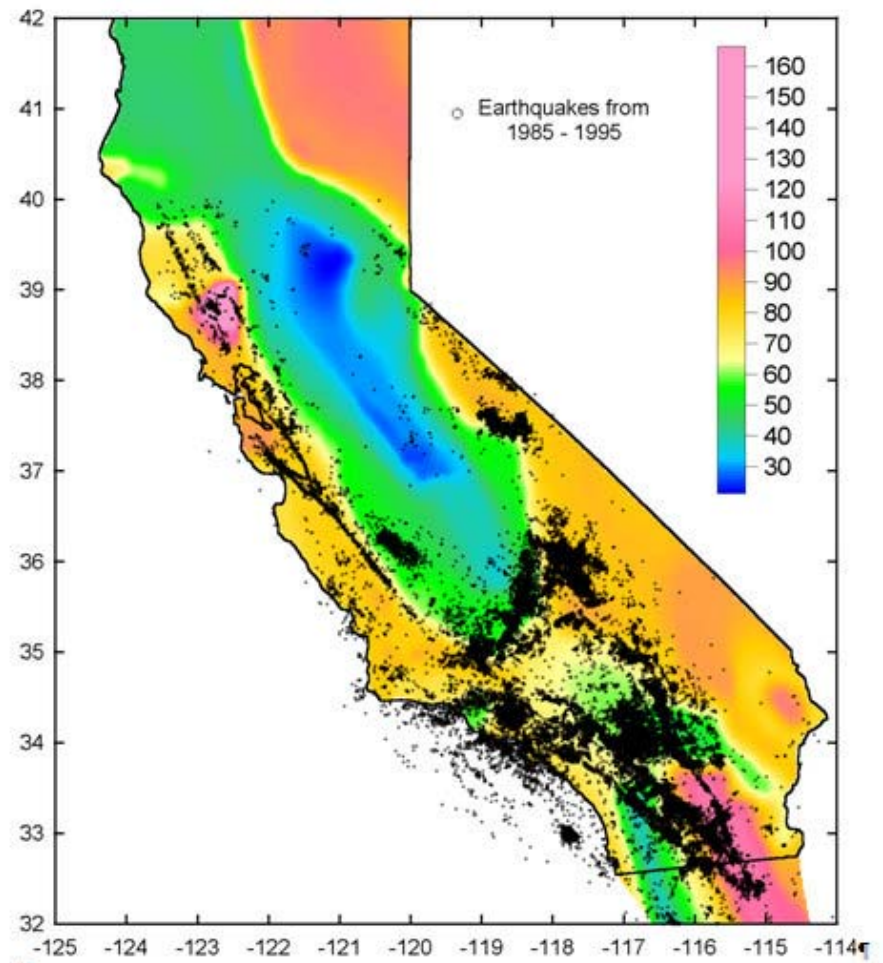
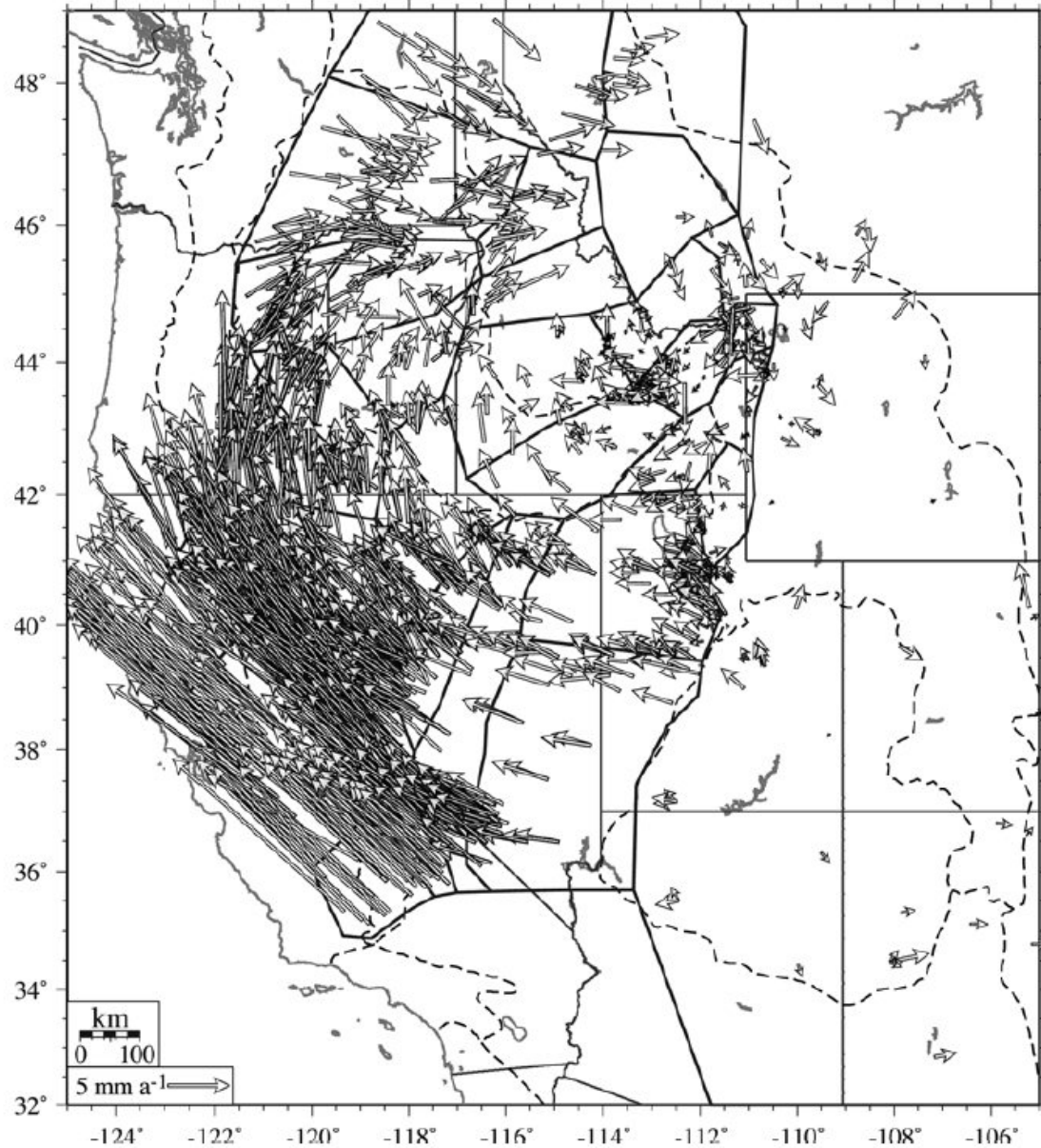
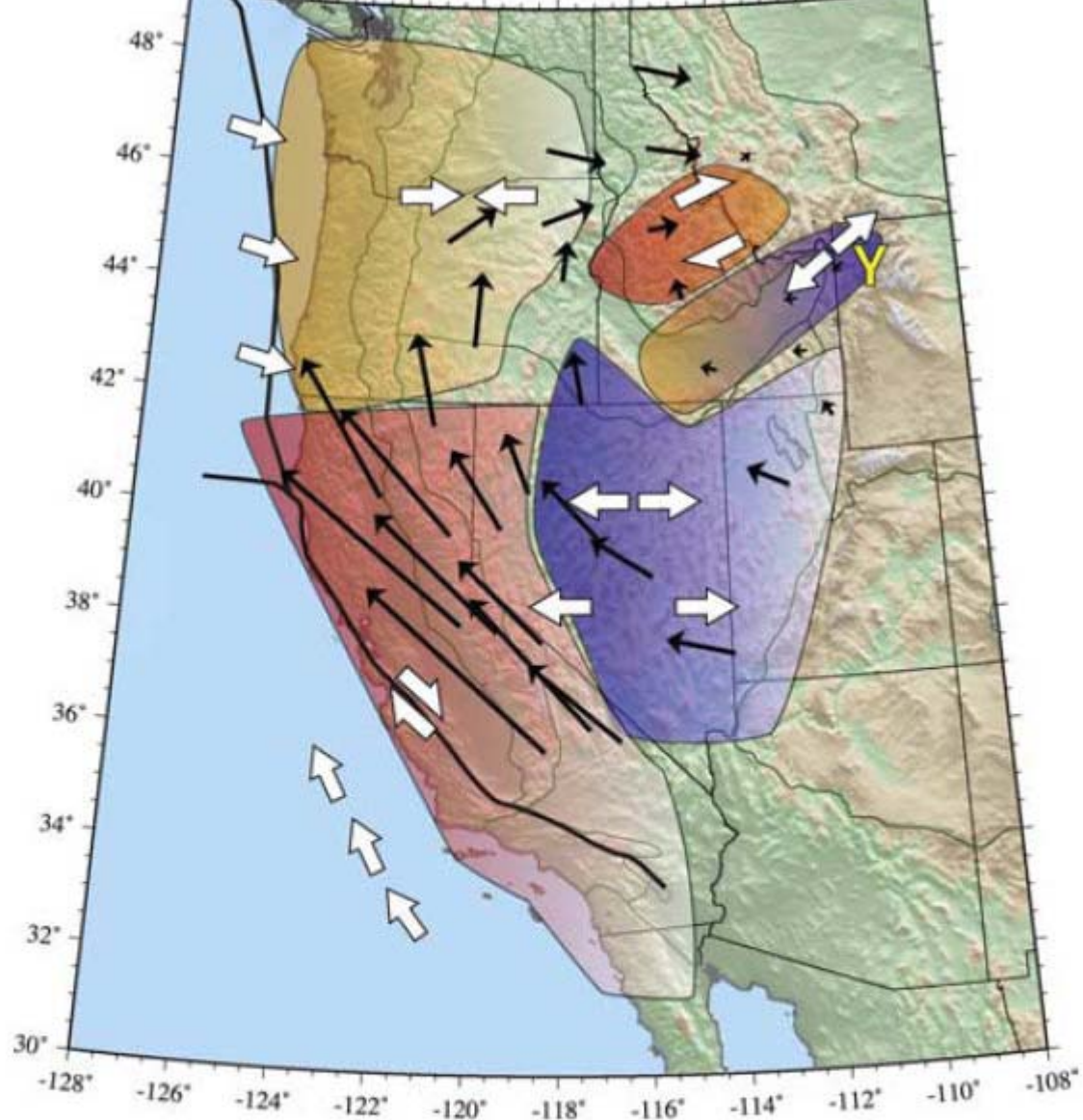


Figure 1b Earthquakes

Section Break (Continuous)



**Figure 5.** GPS site velocities used in our block modeling. Tectonic provinces are marked with dashed lines and block boundaries with heavy, black lines. GPS-derived velocities were corrected for postseismic deformation and transformed into the model reference frame prior to plotting.



**Figure 12.** Summary of contemporary deformation of the western United States. Block velocities from our final model are shown as black arrows, while the large white arrows indicate the general sense of regional motion and are not to scale. Colored regions highlight deformation types.





















