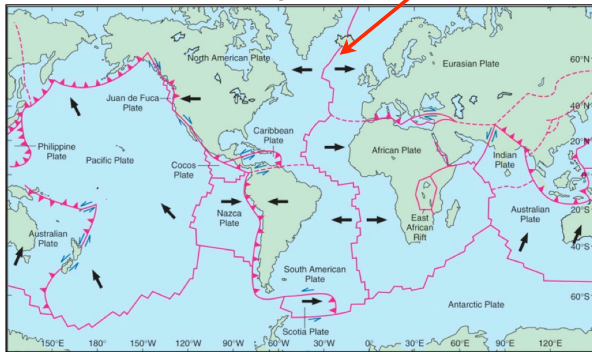


# Tectonics Review



- Plate Boundaries
  - What type of plate boundary is this?
  - Constructive or divergent

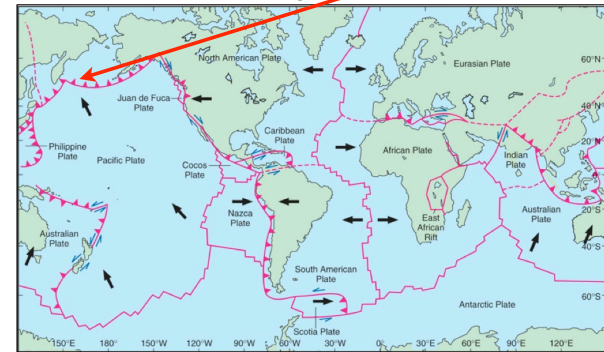


1

# Tectonics Review



- Plate Boundaries
  - What type of plate boundary is this?
  - Destructive or convergent

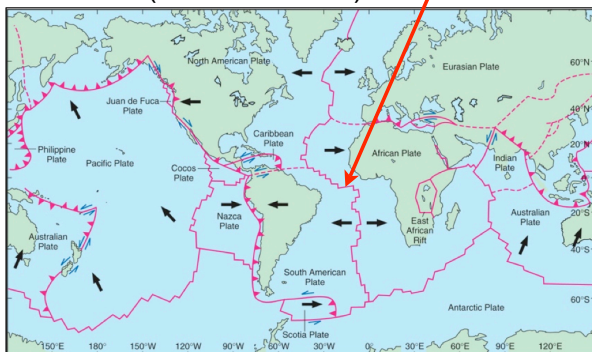


2

# Tectonics Review



- Plate Boundaries
  - What type of plate boundary is this?
  - Transform (or conservative)

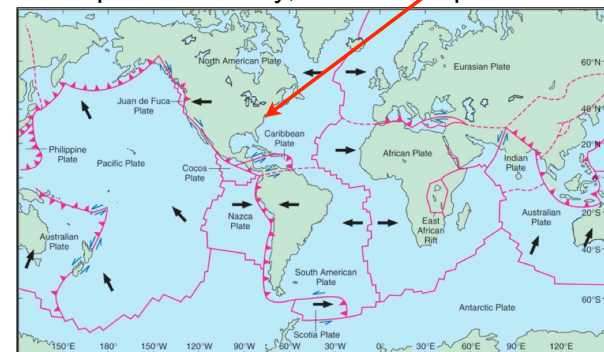


3

# Tectonics Review



- Plate Boundaries
  - What type of plate boundary is this?
  - Not a plate boundary; middle of a plate

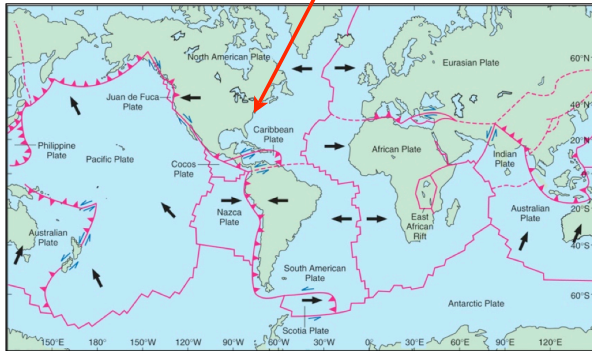


4

## Tectonics Review



- Continental margins
  - What type of margin is this?
  - Passive or trailing; not on a plate boundary

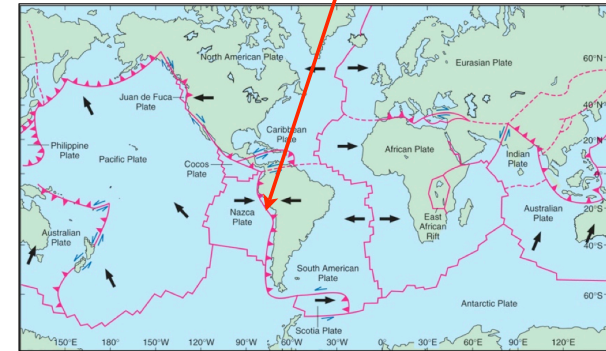


5

## Tectonics Review



- Continental margins
  - What type of margin is this?
  - Active or leading; not on a plate boundary

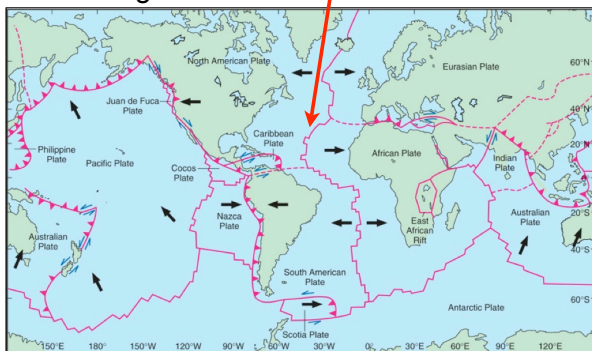


6

## Tectonics Review



- Continental margins
  - What type of margin is this?
  - Not a margin—no continent!



7

## Volcano Chains



- What are the 3 types of volcanic chains?
  - Mid-ocean ridge
  - Subduction zone
  - Hot spot
- How could you tell which type from a map?
  - Is it on a plate boundary?
    - No: hot spot
    - Yes: Rift valley vs. individual mountains?
    - Is there a trench parallel to it?
  - Trend of height along its length (or not)
    - Age & volcanic activity too

8

# Sea-Floor Valleys



- What are the 4 types of valleys?
  - Trench, Submarine canyon
  - Rift valley, Fracture zone
- How could you tell which type from a map?
  - Is it on or along a margin?
    - Is it parallel or perpendicular to the shelf break?
      - Trench vs. canyon
      - Seismic activity
  - Is it on or along a mid-ocean ridge?
    - Is it parallel or perpendicular to the ridge axis?
      - Rift valley vs. fracture zone
      - Seismic activity

# West Coast Tectonics



- Northward extension of E. Pacific Rise
  - N. American Plate moving westward
  - Overran EP rise
- A couple of unusual situations
  - California
  - OR/WA/BC

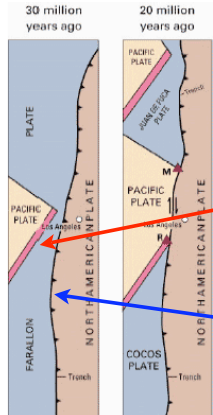


Garrison Fig. 3.15 p. 68

# W. Coast Tectonics



- Former Farallon plate
  - Created at ancestral E.P. Rise
    - Moving eastward
    - N. America moving westward
  - Subducting under W. Coast
    - Building Rocky Mts.
- N. America overran E.P. Rise



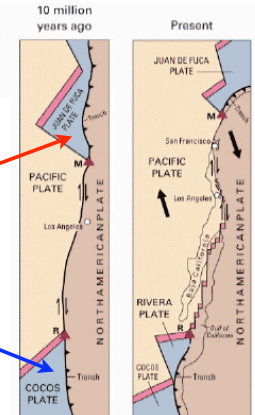
Spreading center (divergent boundary)      Subduction zone (convergent boundary)

Transform fault, arrows show relative movement  
SAFZ, San Andreas fault zone

▲ Triple plate junction  
M, Mendocino  
R, Rivera

# W. Coast

- Former Farallon plate
  - Separated into 2 plates
    - Juan de Fuca to north
    - Cocos to south
  - Still subducting under W. Coast
  - Rift valley now underneath N. American continent
    - Pacific plate still moving NW-ward



Spreading center (divergent boundary)      Subduction zone (convergent boundary)

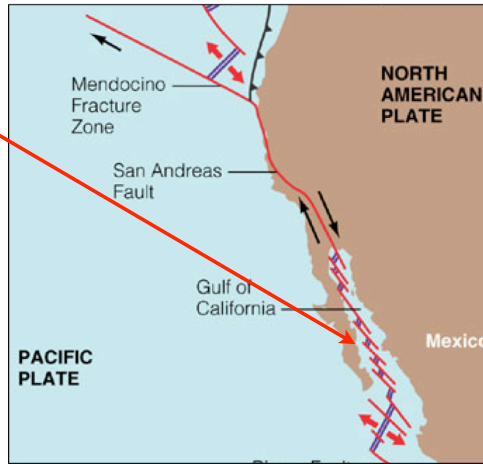
Transform fault, arrows show relative movement  
SAFZ, San Andreas fault zone

▲ Triple plate junction  
M, Mendocino  
R, Rivera

# California Tectonics



- Rifting split Baja from mainland
  - Tilts: spreading is N & S
- What is San Andreas?
  - Transform fault
  - Goes offshore at Mendocino
  - Joins to next spreading ctr.



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Garrison Fig. 3.25 p. 74

# NW Tectonics



- E. Pacific Rise continues north
  - From transform fault
- Further split into segments & renamed
  - Explorer Ridge
  - Juan de Fuca Ridge
  - Gorda Ridge



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[www.washington.edu/burkemuseum/geo\\_history\\_wa/Cascade%20Episode.htm](http://www.washington.edu/burkemuseum/geo_history_wa/Cascade%20Episode.htm)

# NW Tectonics



- Remnants of Farallon Plate
  - Still moving eastward
- Split into segments & renamed
  - Explorer Plate
  - Juan de Fuca Plate
  - Gorda Plate
  - Which plate is this?
  - Pacific



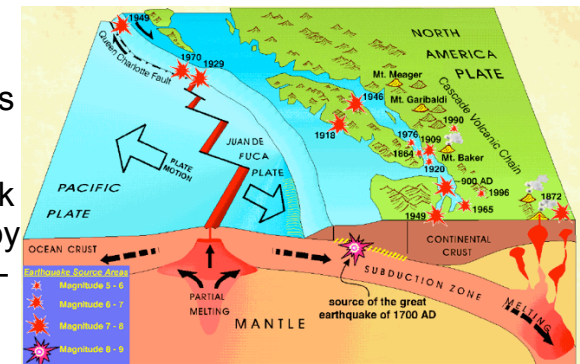
15

[www.washington.edu/burkemuseum/geo\\_history\\_wa/Cascade%20Episode.htm](http://www.washington.edu/burkemuseum/geo_history_wa/Cascade%20Episode.htm)

# West Coast Tectonics



- Subduction of oceanic plates still occurring
  - Cause of outer coastal megaquakes (Lecture 1)
  - Cause of Cascade volcanoes
- Review:
  - What rock created by these volcanoes? Why?



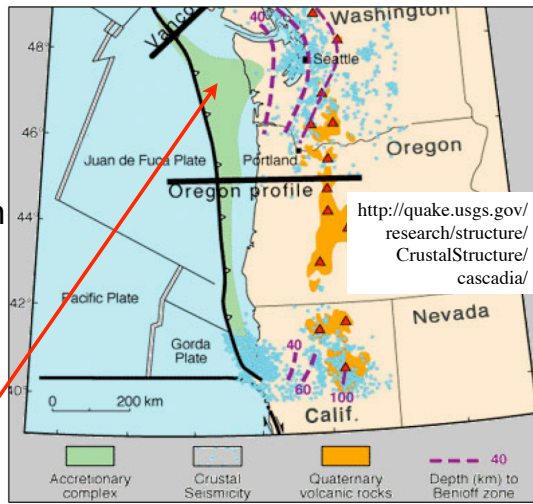
16

[http://geoscience.nrcan.gc.ca/vancouver/earth\\_e.php](http://geoscience.nrcan.gc.ca/vancouver/earth_e.php)

# Northwest Anomalies



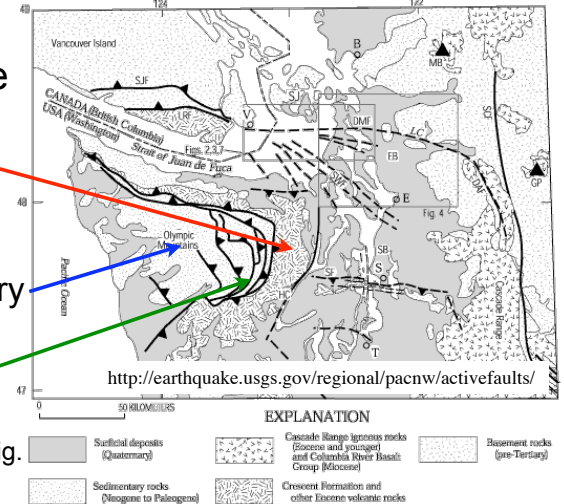
- Not all oceanic crust subducts
  - N. American margin like a bulldozer
  - Chunks of JDF plate "accrete" to continent



# Northwest Anomalies



- Oceanic crust on the continent
  - Sea-floor basalt
  - Sea-floor sedimentary rocks
  - Collision faults

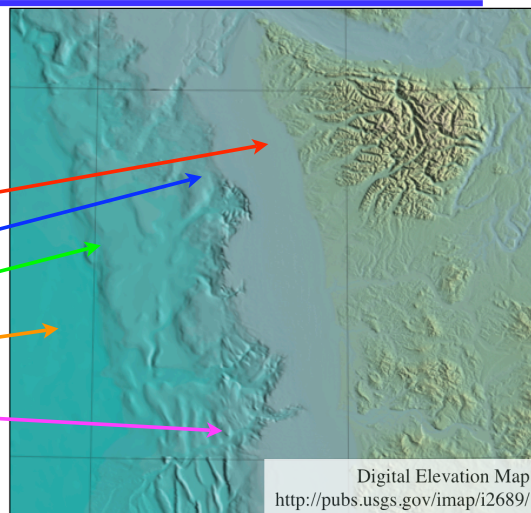


- Garrison Fig. 4.15 p. 97

# Northwest Anomalies



- Name the sea floor feature
  - Shelf
  - Slope
  - Rise
  - Plain
  - Canyon

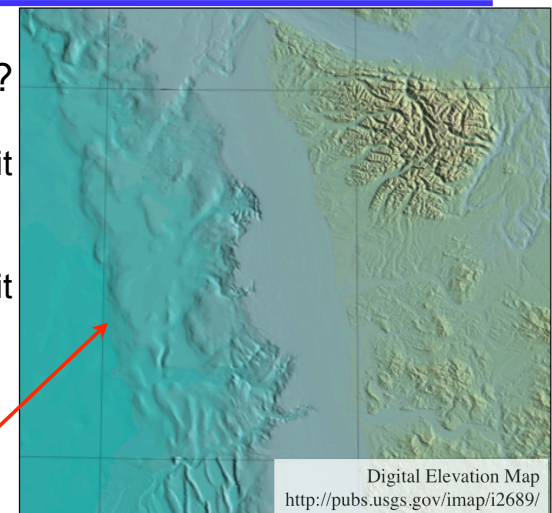


Digital Elevation Map  
<http://pubs.usgs.gov/imap/i2689/>

# Northwest Anomalies



- What's wrong with this map?
  - What type of margin does it look like?
    - Passive
  - What type is it really?
    - Active
  - What's missing?
    - Trench



Digital Elevation Map  
<http://pubs.usgs.gov/imap/i2689/>

# Northwest Anomalies



- The trench is there but filled with sediment
  - Open ocean (“hemipelagic” sediments)
  - Turbidites
  - Subducting crust
  - “Accretionary wedge (“Bulldozer”)

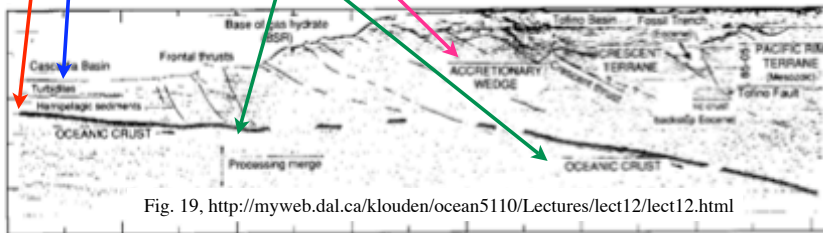
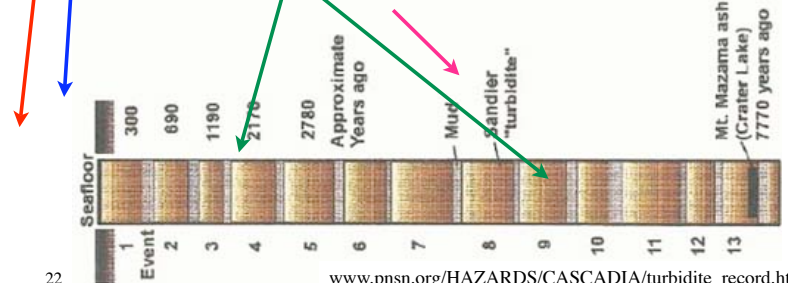


Fig. 19, <http://myweb.dal.ca/klouden/ocean5110/Lectures/lect12/lect12.html>

# Northwest Anomalies



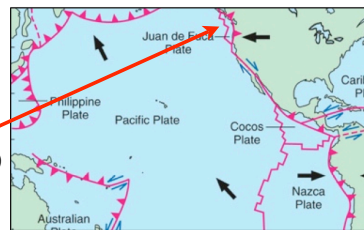
- Turbidite sediment layers
  - Provide a record of turbidity current occurrence
  - Triggered by subduction zone quakes
    - Schematic diagram of core sample from Washington continental rise



# Northwest Anomalies



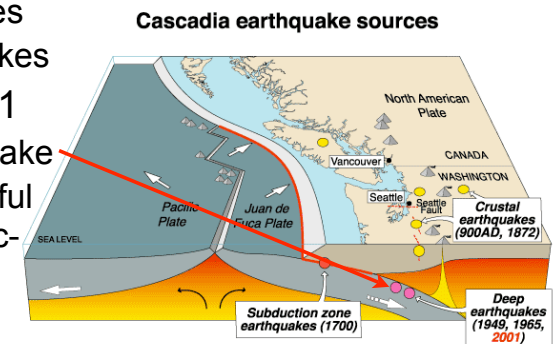
- Why a buried trench here & not at other subduction zones?
  - E.g. Japan or Peru
  - Rift valley is very close to continent
    - Sea floor is young
    - Has not sunk very deep by isostasy
    - So trench is shallow & easily filled
  - Wet climate & young mountains
    - Lots of erosion
    - Lots of sediment



# West Coast Tectonics



- Actually 3 types of quakes
  - Outer coastal (subduction zone) quakes
  - Deep quakes
  - Crustal quakes
- Feb. 28 2001
  - A “deep” quake
  - Less powerful than subduction zone quakes

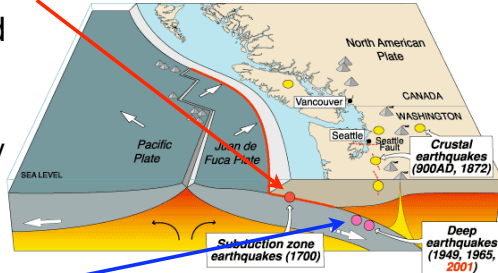


# West Coast Tectonics

- Subduction zone “locks”

- Friction of cold crustal plates colliding

- Stores energy
- Large quake when plates finally slip



- Deep quakes

- Plate alteration rather than slippage

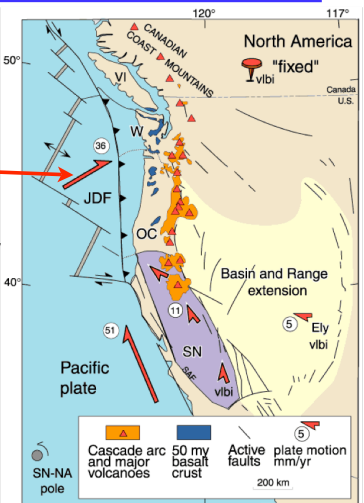
Source	Affected area	Max. Size	Recurrence
● Subduction Zone	W.WA, OR, CA	M 9	500-600 yr
● Deep Juan de Fuca plate	W.WA, OR,	M 7+	30-50 yr
● Crustal faults	WA, OR, CA	M 7+	Hundreds of yr?

<http://geomaps.wr.usgs.gov/pacnw/pacnweq/casceq.html>

# Crustal Quakes

- JDF & NA plate do not collide head-on

- JDF moving ENE ~36 mm (1.5 in) per year
- Pacific moving NNW ~51 mm (2 in.) per year
- N. & interior continent thought to be “fixed”
- S. & coastal continent squeezed & cracked
- “Blocks” rotating

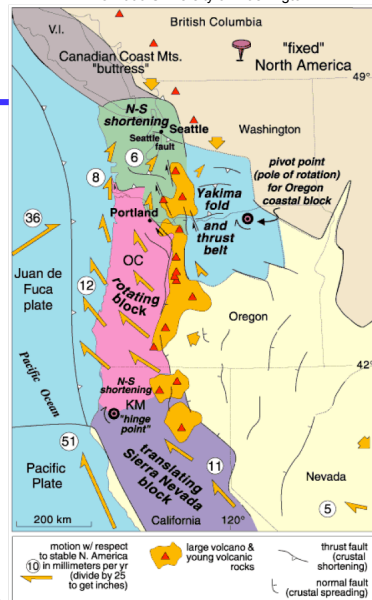


<http://geomaps.wr.usgs.gov/pacnw/rescasp1.html>

# Crustal Quakes

- Does subduction “cause” the crustal quakes?

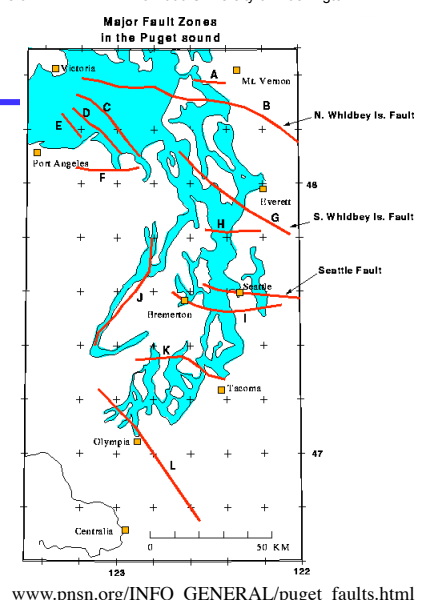
- Ultimately, yes
- But crustal quakes aren’t simultaneous with subduction quakes
- Part of larger complex
  - Similar relationship to San Andreas Fault



<http://geomaps.wr.usgs.gov/pacnw/rescasp1.html>

# Seattle Fault

- Actually a complex of faults
  - “Crustal blocks”
  - Shallow quakes
- Most dangerous of 3 types
  - As measured by potential life & property loss
  - Close to populated & developed areas



[www.pnsn.org/INFO\\_GENERAL/puget\\_faults.html](http://www.pnsn.org/INFO_GENERAL/puget_faults.html)