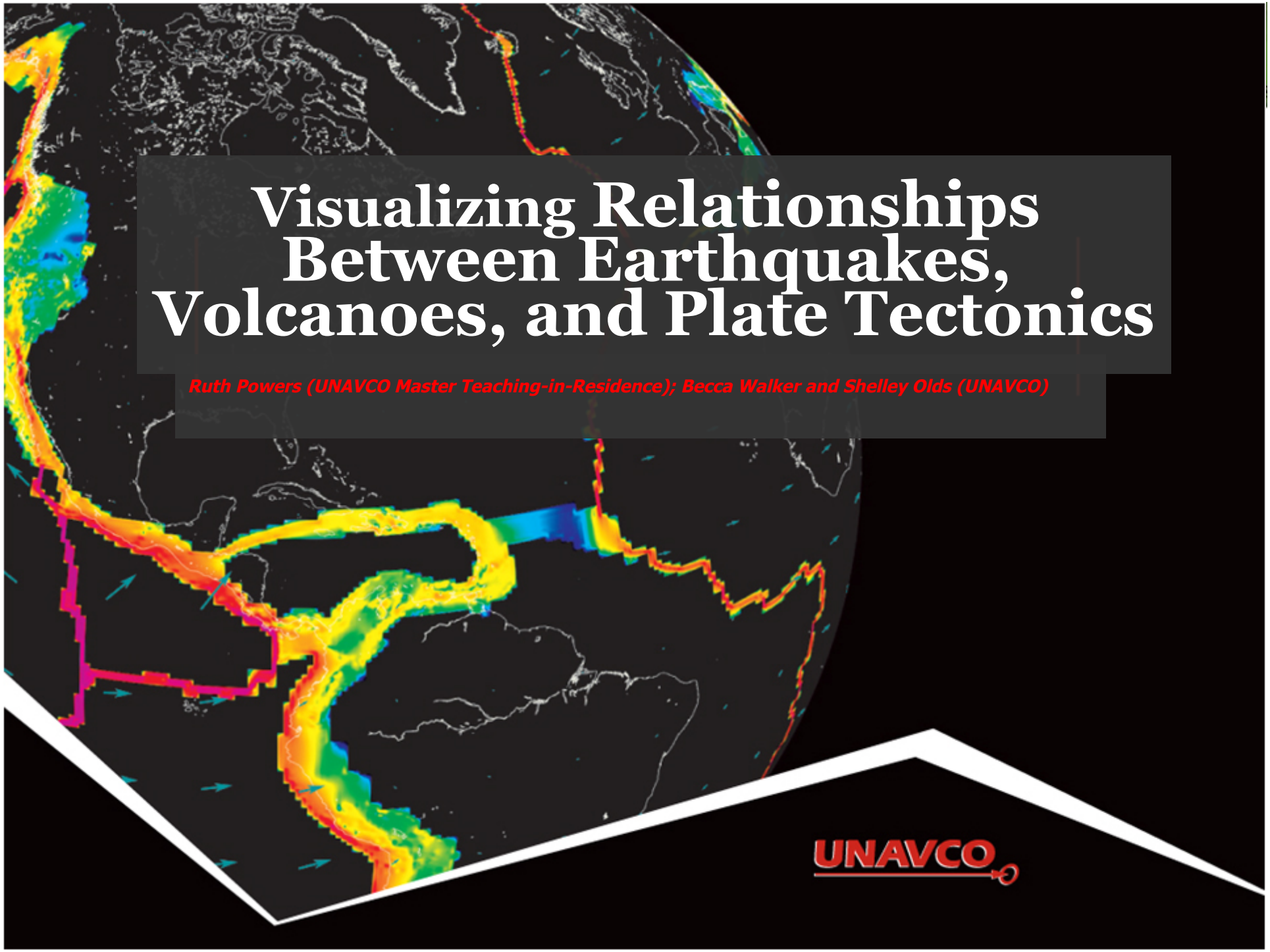


Visualizing Relationships Between Earthquakes, Volcanoes, and Plate Tectonics

Ruth Powers (UNAVCO Master Teaching-in-Residence); Becca Walker and Shelley Olds (UNAVCO)

UNAVCO

Activity Outcomes

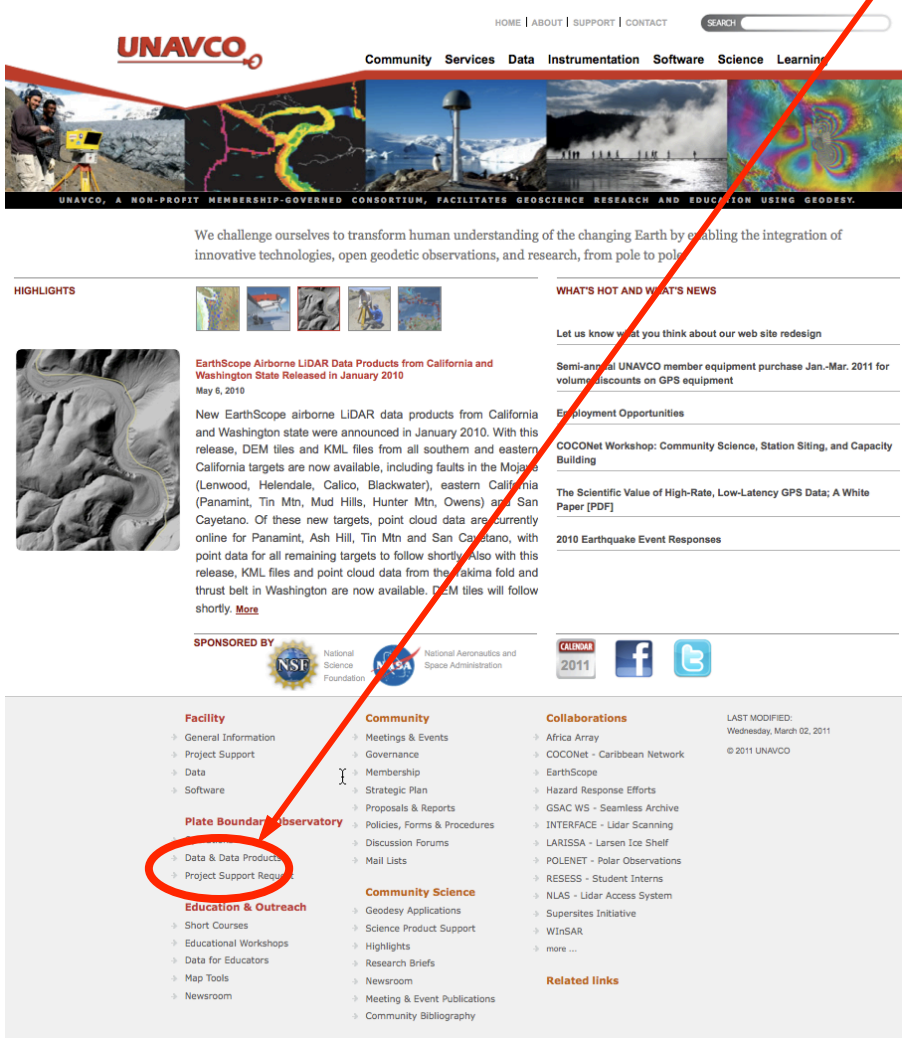
Learners should be able to…

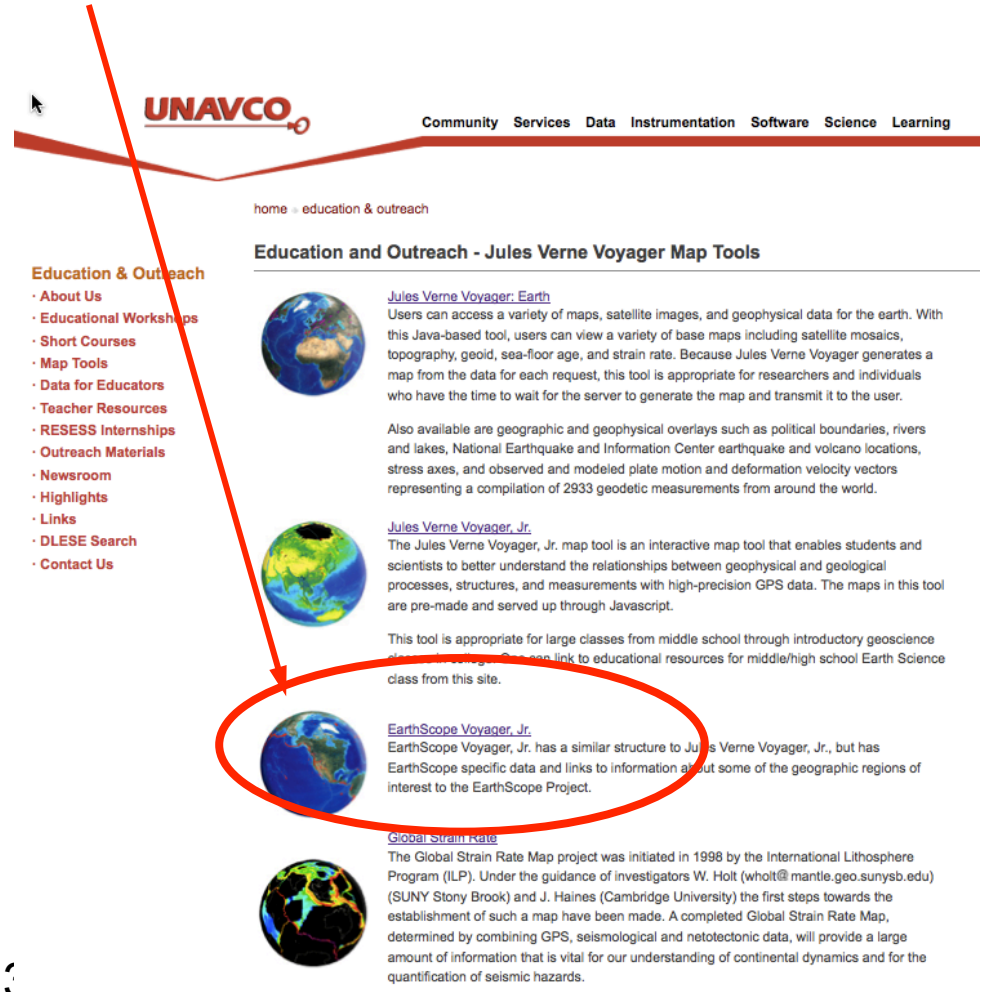
- Describe how the locations of earthquakes, volcanoes, and velocity vectors from GPS stations in the Western United States inform us about plate boundary zones
- Describe and draw a velocity vector
- Analyze regional plate motion and crustal deformation based on velocity vector maps
- Describe the difference between a plate boundary and plate boundary zone

Part 1: Prepare Your Map for Study

Go to: http://www.unavco.org/

Click on **Map Tools**, then **EarthScope Voyager Jr**.

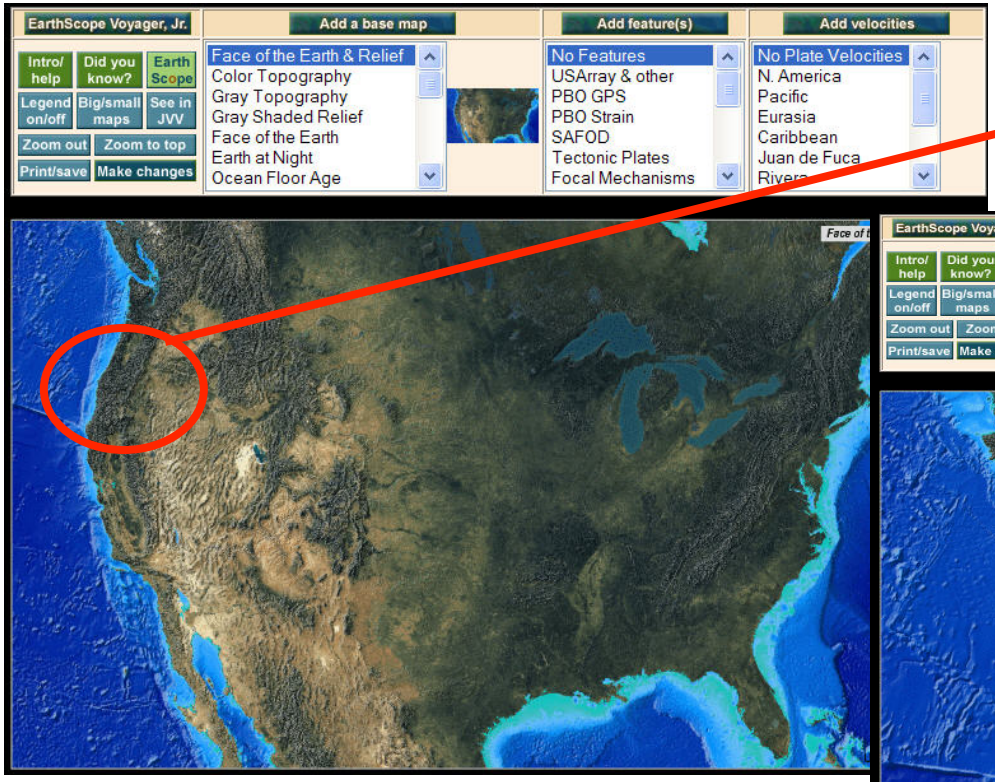




Getting Oriented to the Map

Getting Oriented to the Map

Zoom Into the Western U.S.

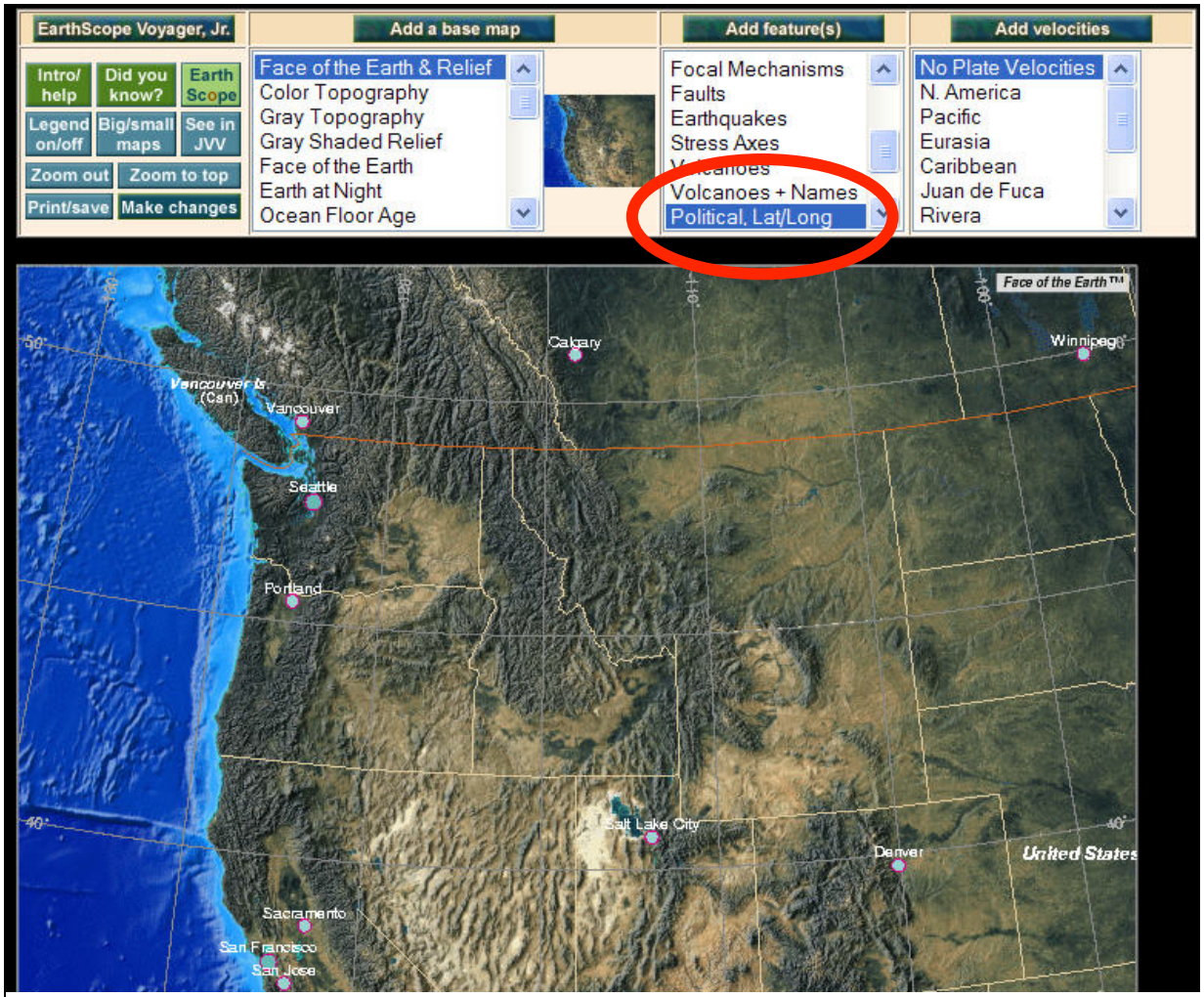


Click on map to zoom in

Zoom into the United States

Zoom into the Western United States

Add Political Lat/Long under Add Features

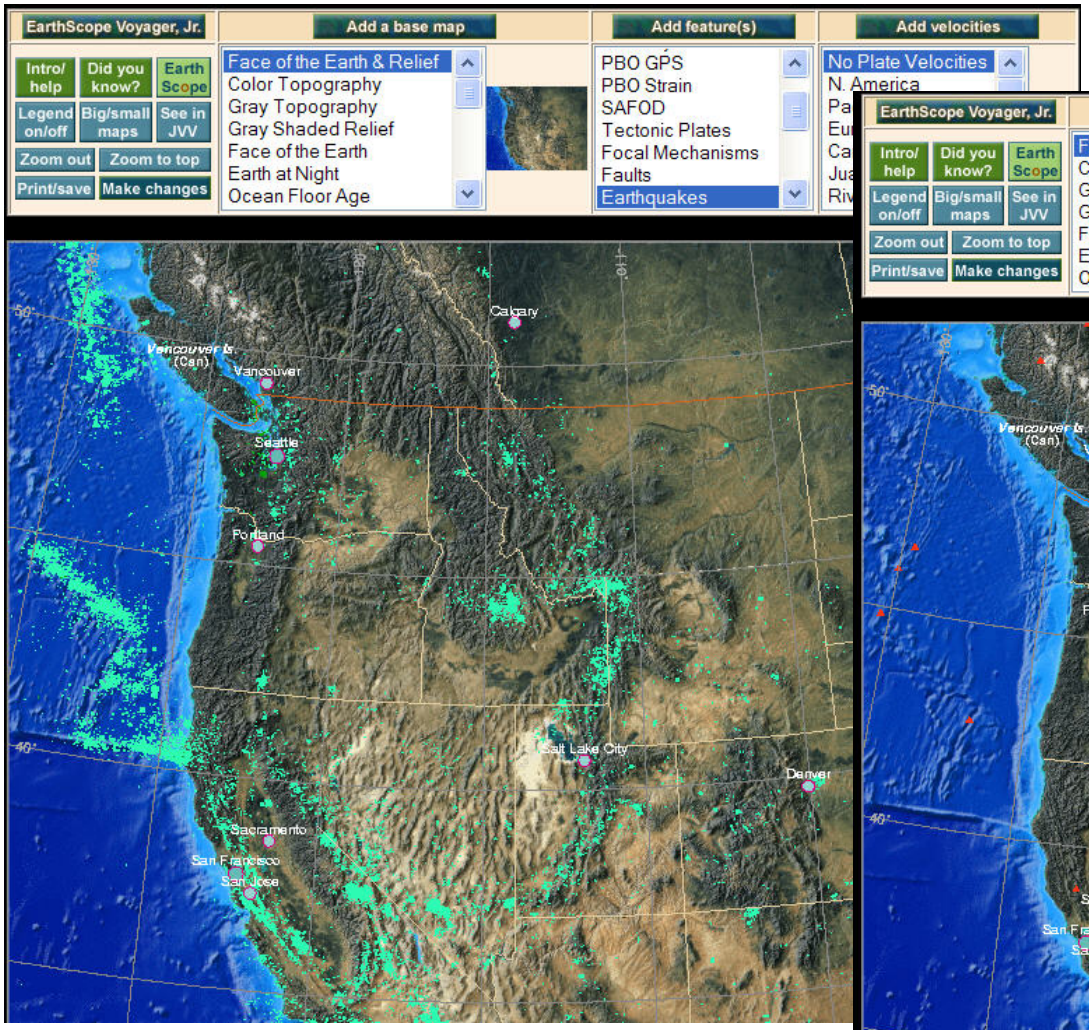


Add political boundaries and latitude/longitude lines

Part 2: Compare Earthquake and Volcano Locations

- Work with a partner
- Follow the instructions:
  - Add your feature (hold ctrl- or command-key to keep the **Political, Lat/Long**)
  - Study your map
  - Answer the questions
  - Draw the locations of your feature
  - Share your findingd
- Stop at Part 3

Earthquake and Volcano Distribution



Earthquakes and Volcanoes

Discussion:

A. What geographic features (mountains, plains, valleys, etc) are frequently where there are only:
   - Earthquakes?
   - Volcanoes?

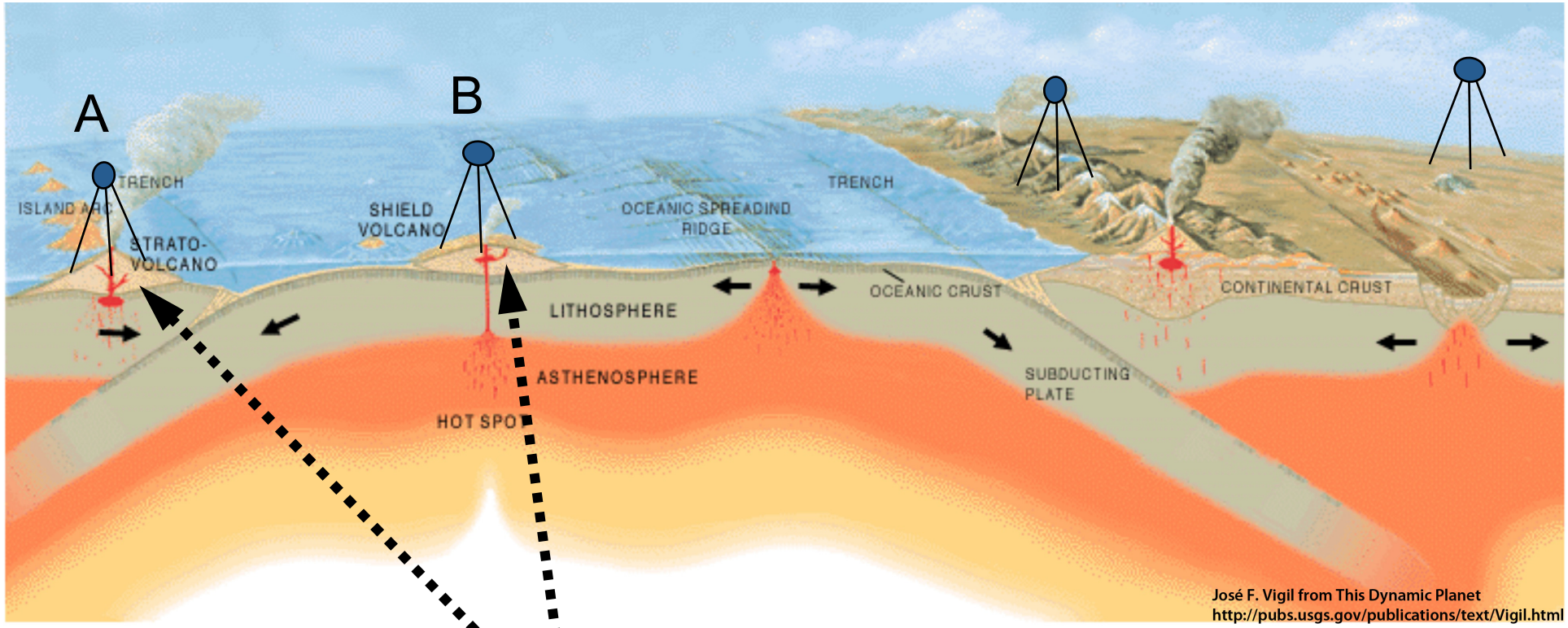
B. In which regions do you find earthquakes and volcanoes near each other? What's there?

C. Summarize the relationships you discovered.

D. What explanation can you provide for the observed relationships?

Part 3: Examine GPS Vector Data

GPS station positions change as plates move.

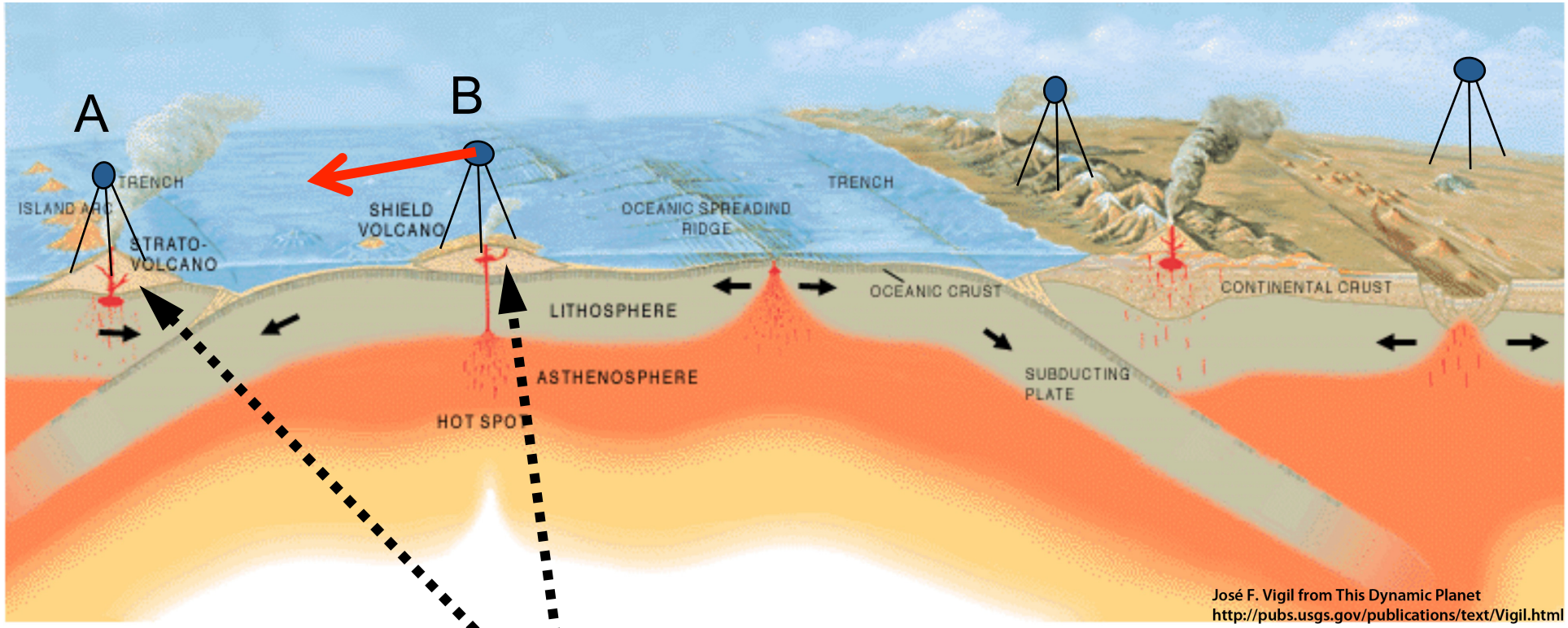


How will GPS Station B's position change relative to GPS Station A?

GPS stations are not to scale

Part 3: Examine GPS Vector Data

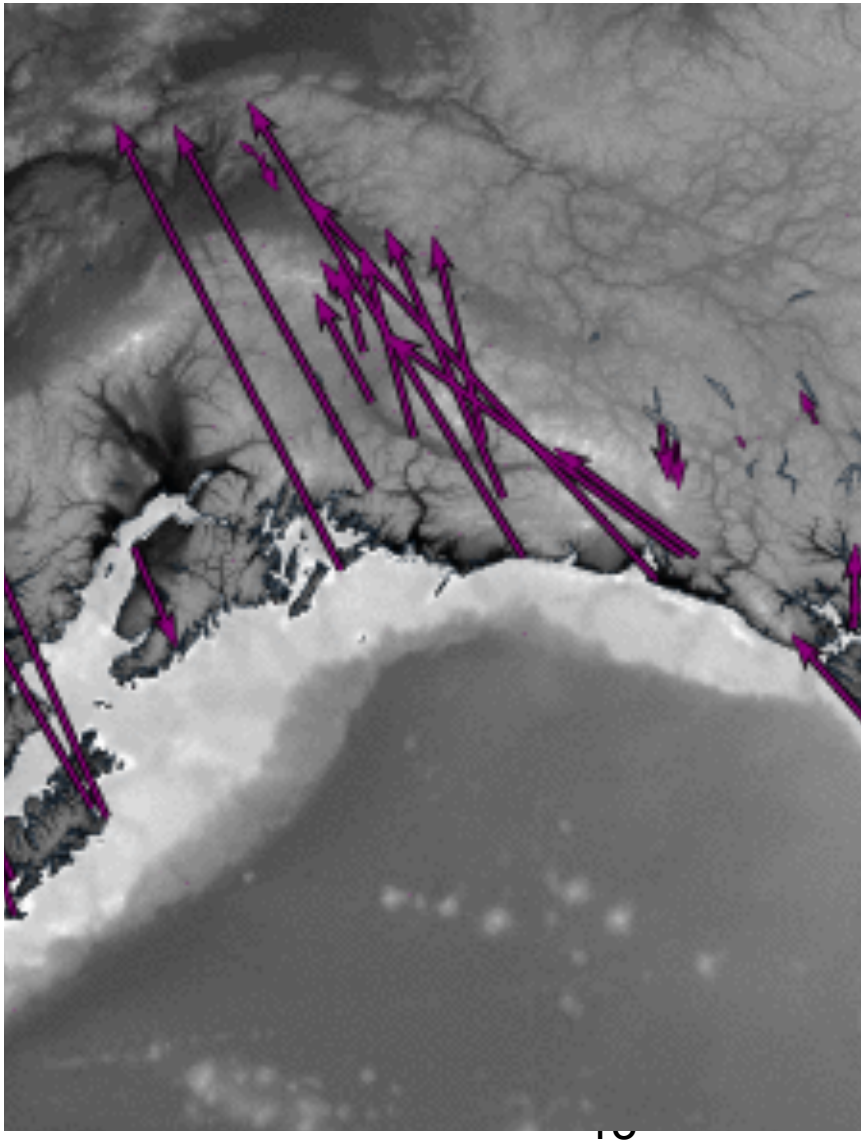
GPS station positions change as plates move.



GPS Station B is moving toward A.

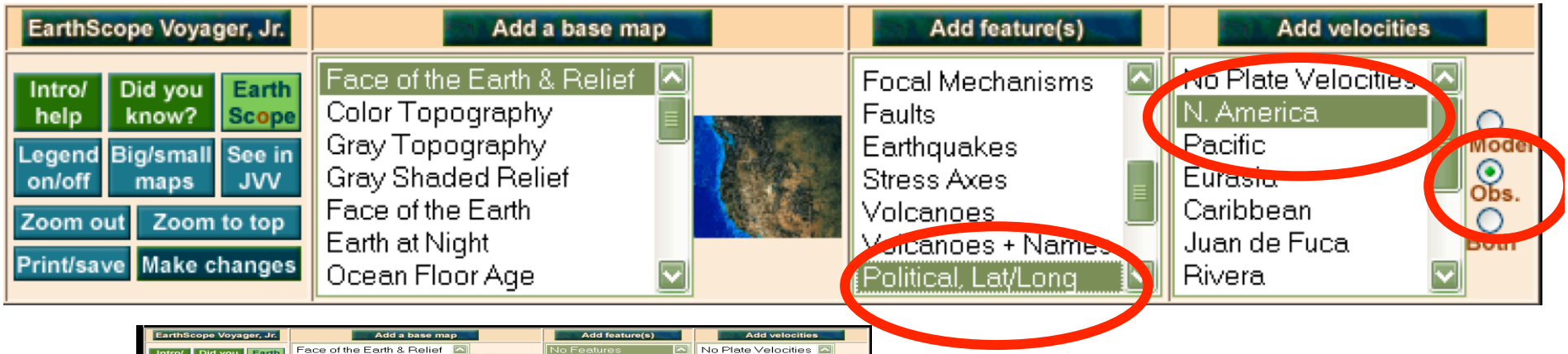
GPS stations are not to scale

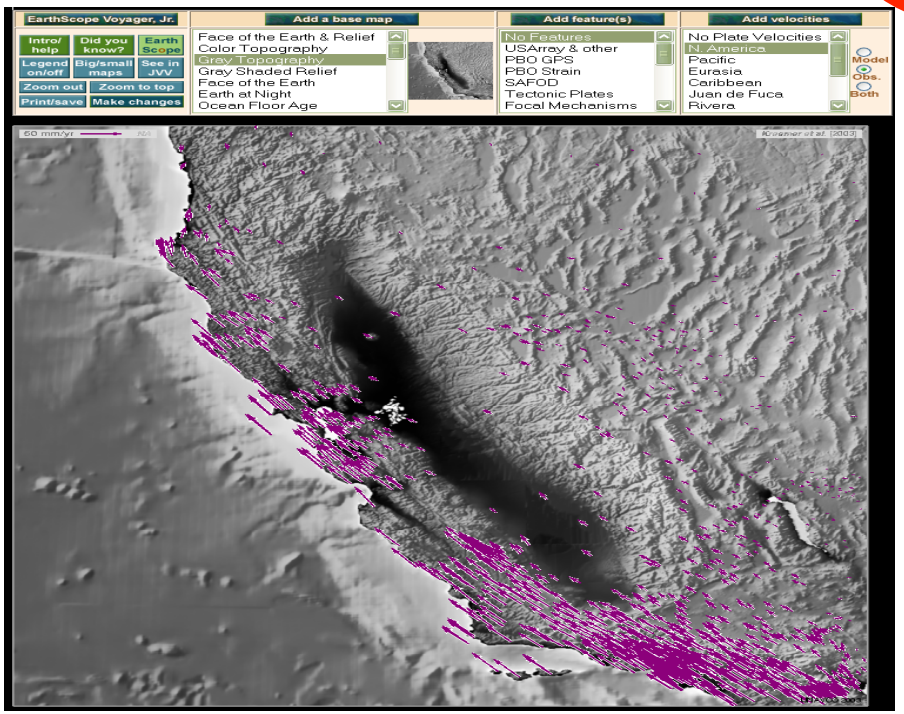
About Velocity Vectors



- Length of the vector arrow = how fast the plate is moving (magnitude).
- Direction of the vector arrow = the direction that the plate is moving *at that GPS station*
- Tail of vector = location of GPS station

Add Features and Velocity Vectors





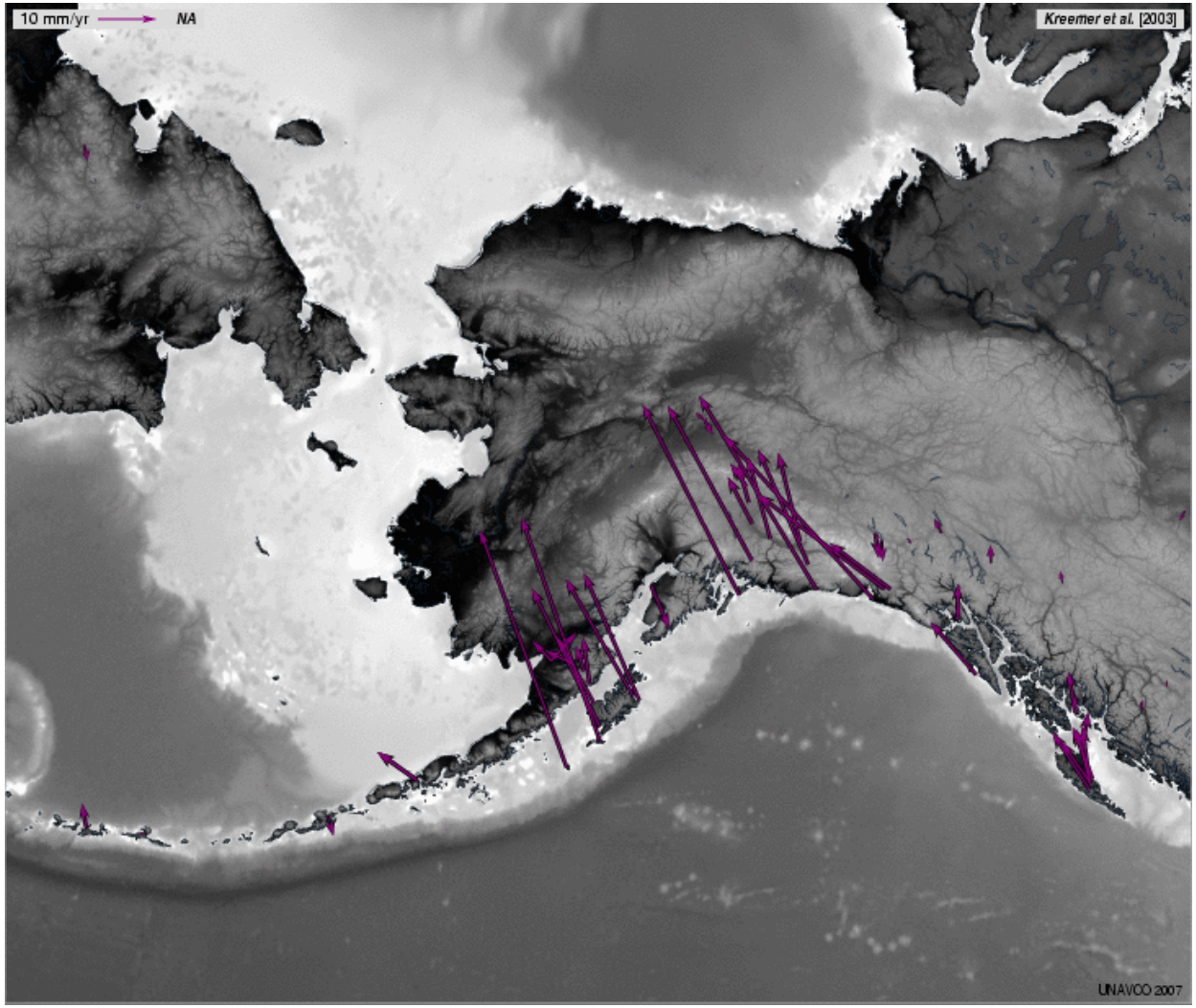
Part 3 continued: Sketch and Study the Vectors

- Sketch some of the observed velocity vectors on your map of the Western United States
- Answer questions on page 8
- Discuss with your teammate

Neighboring Frames of Reference: North America

Reference frame North America (SNARF) *which means:*

- The rest of the world's plates move, while the North America plate stays fixed.
- Near Alaska, the vector arrows are pointing to the *North West (NW)* because the Pacific plate is moving to the *NW…*

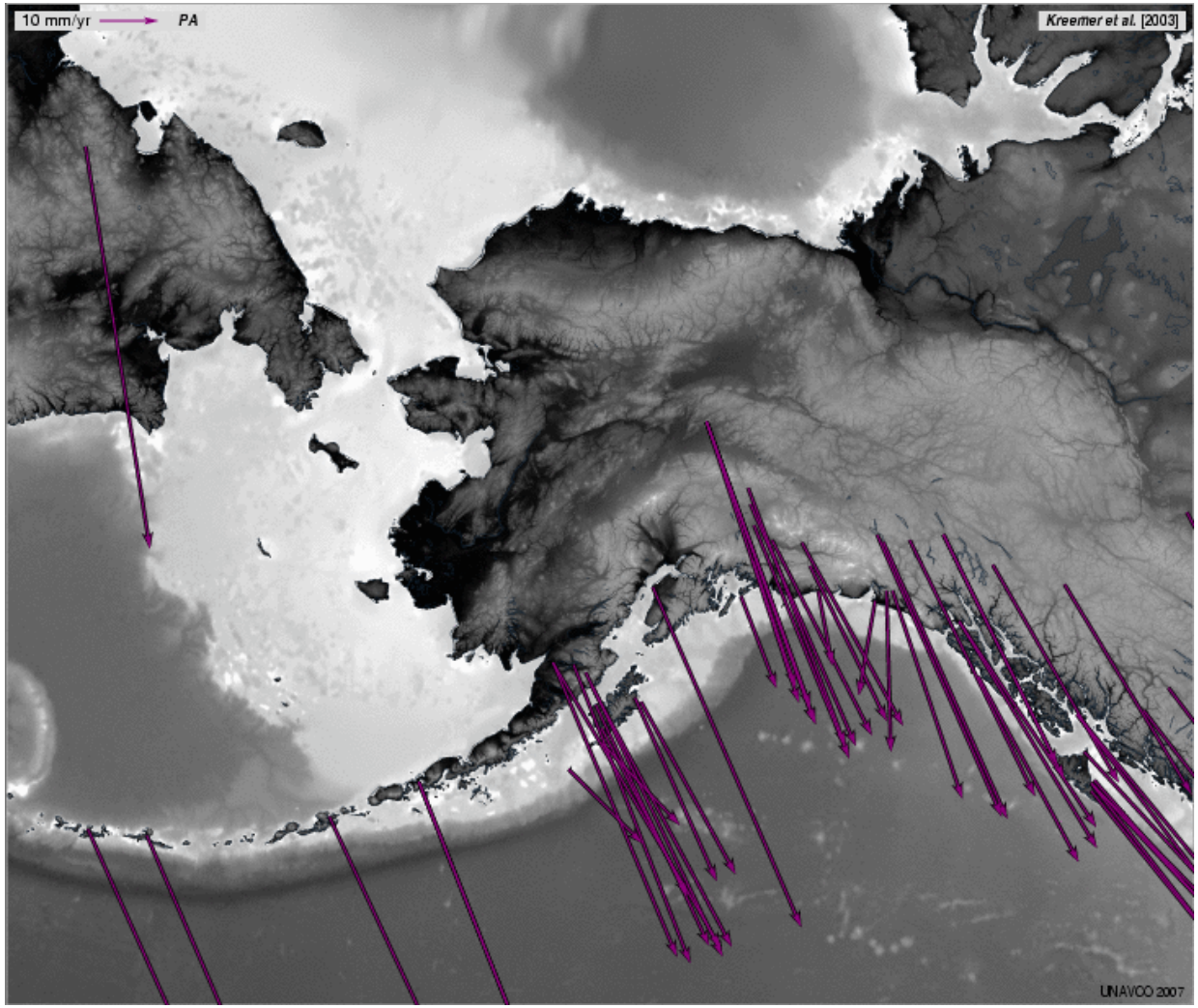


and *the edge of Alaska* is also moving NW

Neighboring Frames of Reference: Pacific Plate

Pacific plate as reference frame:

- Pacific plate doesn't move
- Near Alaska, the vector arrows point South East
- Alaska is moving to the *South East…*

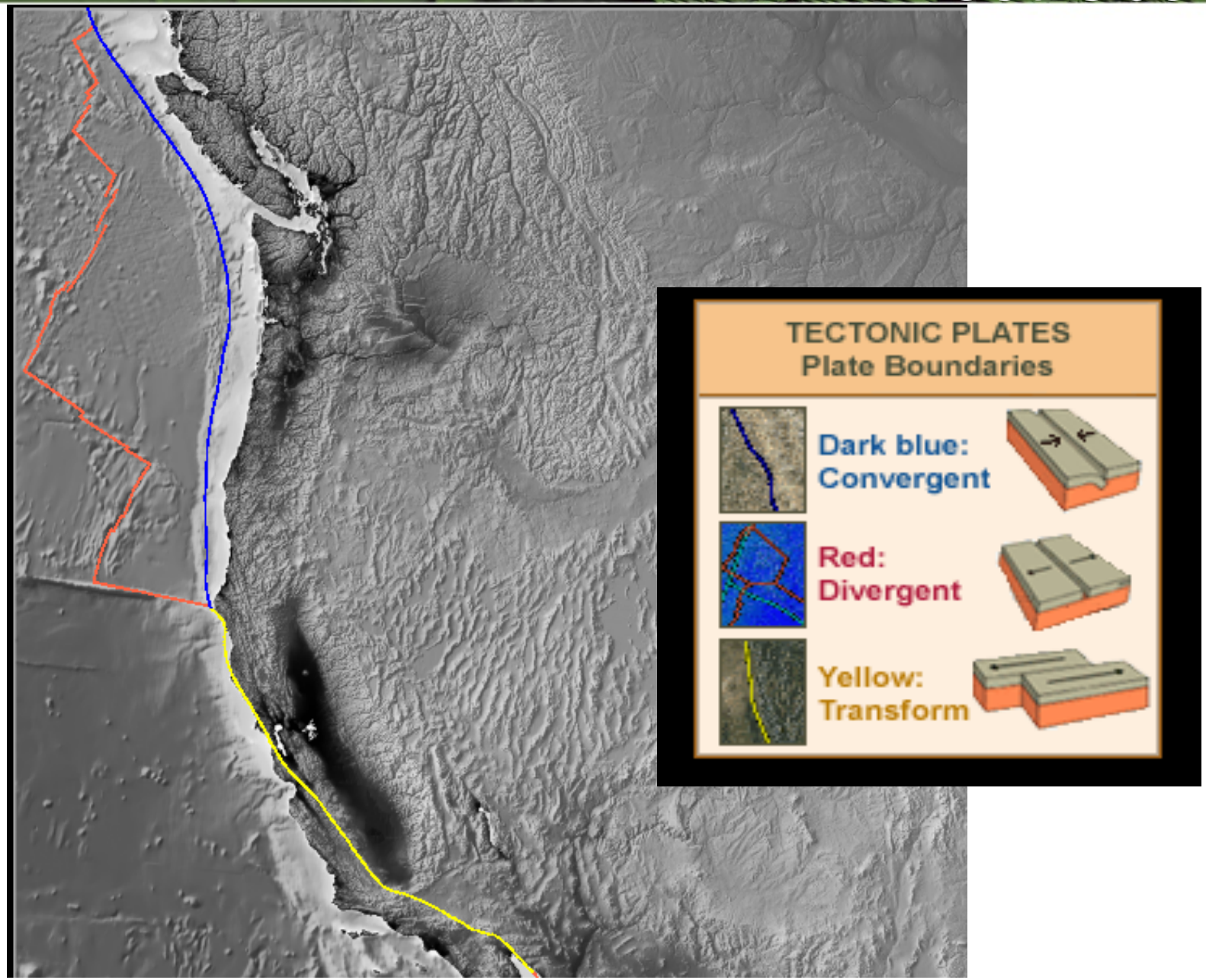


Part 4: Put It All Together

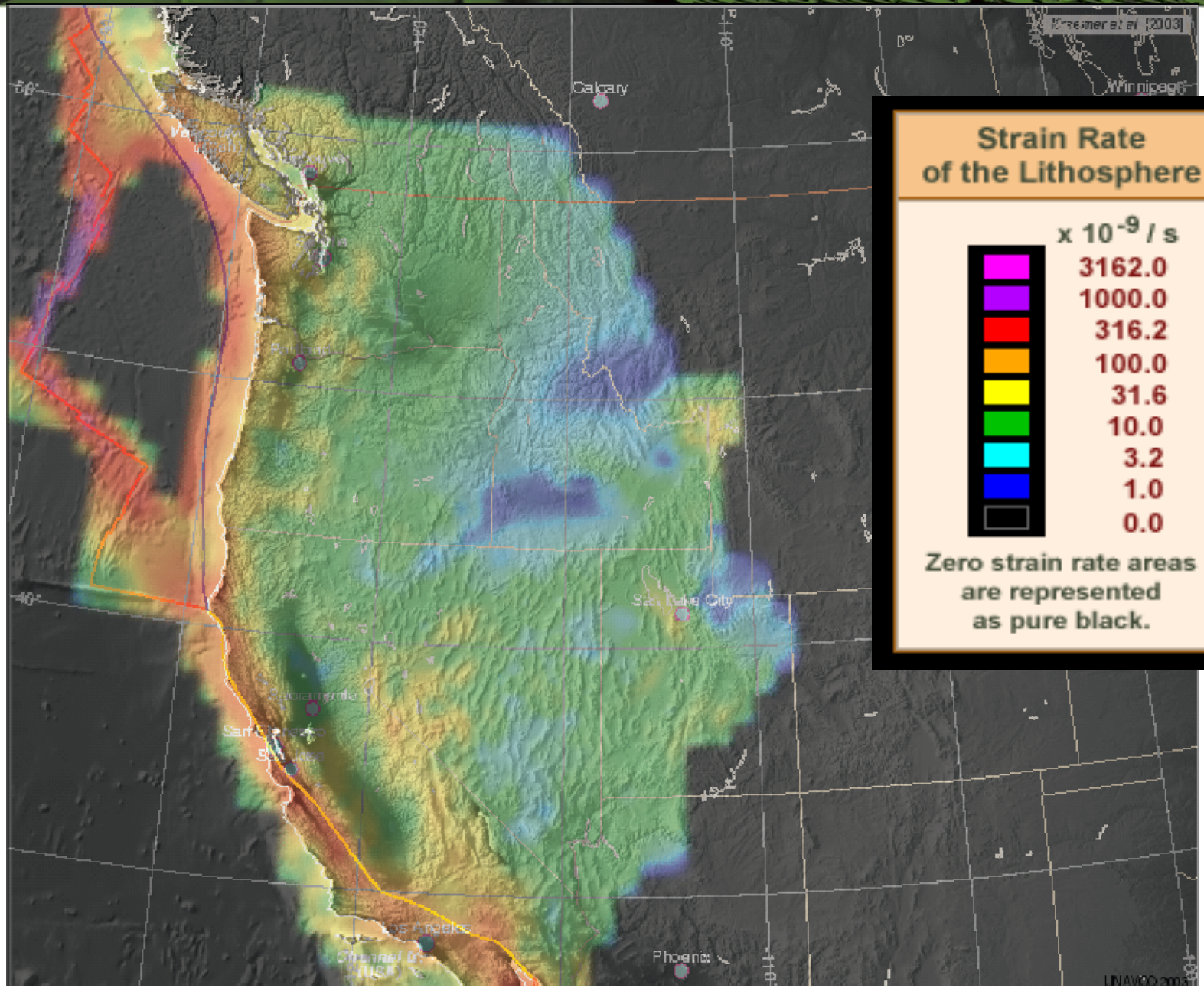
Part 4: Sketch and Study the Modeled Vectors

- Sketch vectors where they are very different from each other
- Draw where you believe the plate boundaries are located
- Compare with plate boundaries in EarthScope Voyager Jr.
- Answer questions
- Discuss with your teammate

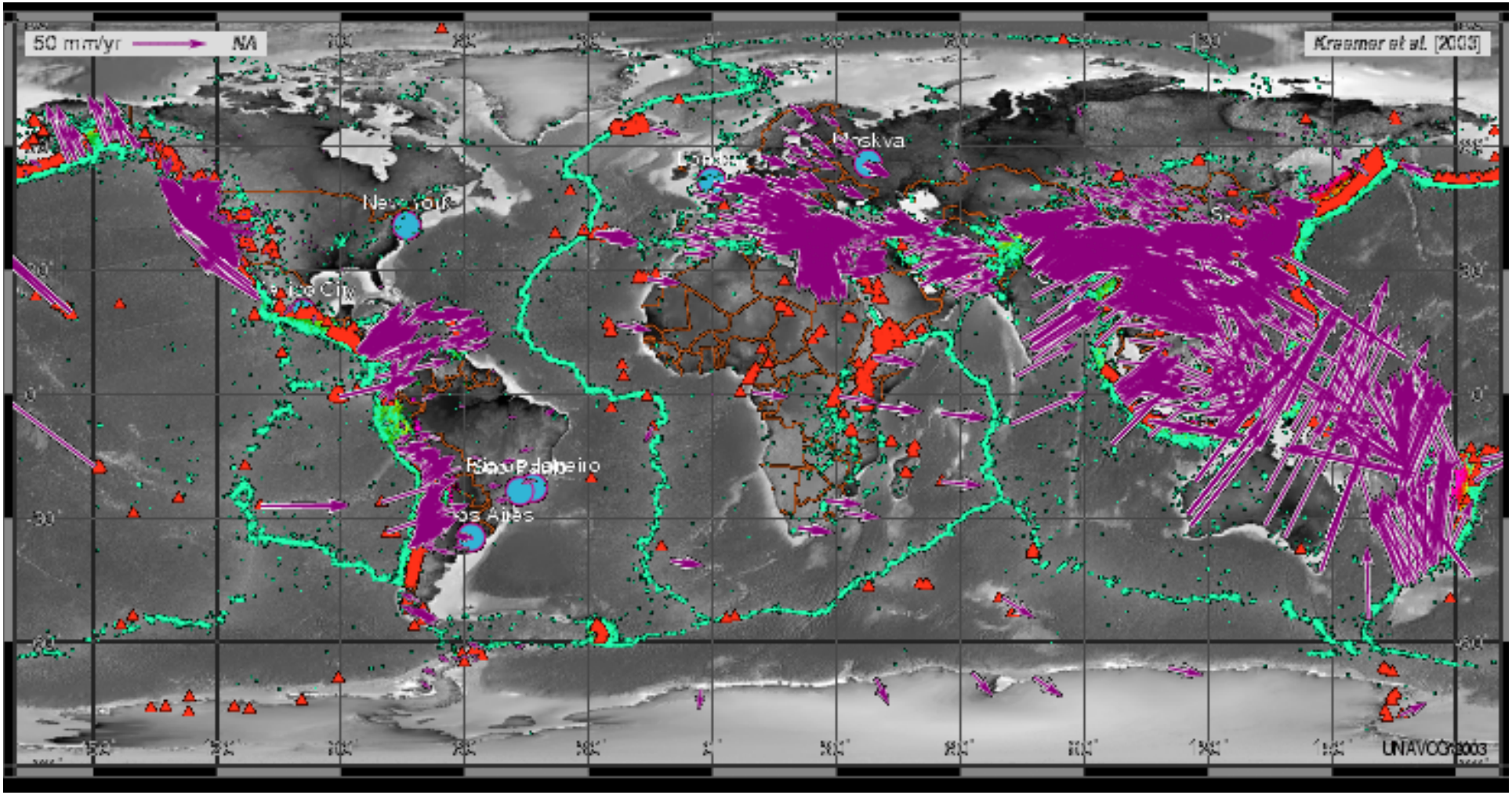
Plate Boundaries Along the West Coast



Thinking of Boundaries as Zones



Global Motion



Wrap Up

What we did:

- Explored locations of earthquakes and volcanoes
- Compared plate motion between the Pacific Northwest and California
- Determined plate boundary zones using multiple lines of evidence: GPS plate velocity vector maps, earthquake and volcano locations

Other Tools to Explore

- UNAVCO GPS, Earthquake, Volcano Viewer
  - http://facility.unavco.org/data/maps/GPSVelocityViewer/GPSVelocityViewer.html
- Google Earth: Learn about plate tectonics
  - Link is available from here: http://www.unavco.org/edu_outreach/data/data.html
- IRIS Earthquake Browser
  - www.iris.edu.ieb

Thank You!

Contact:

education@unavco.org

http://www.unavco.org/

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