



Visualizing Relationships Between Earthquakes, Volcanoes, and Plate Tectonics

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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

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

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

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Community Services Data Instrumentation Software Science Learning

UNAVCO, A NON-PROFIT MEMBERSHIP-GOVERNED CONSORTIUM, FACILITATES GEOSCIENCE RESEARCH AND EDUCATION USING GEODESY.

We challenge ourselves to transform human understanding of the changing Earth by enabling the integration of innovative technologies, open geodetic observations, and research, from pole to pole.

HIGHLIGHTS

WHAT'S HOT AND WHAT'S NEWS

Let us know what you think about our web site redesign

Semi-annual UNAVCO member equipment purchase Jan.-Mar. 2011 for volume discounts on GPS equipment

Employment Opportunities

COCOnet Workshop: Community Science, Station Siting, and Capacity Building

The Scientific Value of High-Rate, Low-Latency GPS Data; A White Paper [PDF]

2010 Earthquake Event Responses

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Facility

- General Information
- Project Support
- Data
- Software
- Plate Boundary Observatory
- Data & Data Products
- Project Support Request

Community

- Meetings & Events
- Governance
- Membership
- Strategic Plan
- Proposals & Reports
- Policies, Forms & Procedures
- Discussion Forums
- Mail Lists

Community Science

- Geodesy Applications
- Science Product Support
- Highlights
- Research Briefs
- Newsroom
- Meeting & Event Publications
- Community Bibliography

Collaborations

- Africa Array
- COCOnet - Caribbean Network
- EarthScope
- Hazard Response Efforts
- GSAC WS - Seamless Archive
- INTERFACE - Lidar Scanning
- LARISSA - Larsen Ice Shelf
- POLENET - Polar Observations
- RESESS - Student Interns
- NLAS - Lidar Access System
- Supersites Initiative
- WinSAR
- more ...

Related Links

LAST MODIFIED: Wednesday, March 02, 2011 © 2011 UNAVCO

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Community Services Data Instrumentation Software Science Learning

home - education & outreach

Education and Outreach - Jules Verne Voyager Map Tools

Education & Outreach

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- Map Tools
- Data for Educators
- Teacher Resources
- RESESS Internships
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Jules Verne Voyager: Earth

Users can access a variety of maps, satellite images, and geophysical data for the earth. With this Java-based tool, users can view a variety of base maps including satellite mosaics, topography, geoid, sea-floor age, and strain rate. Because Jules Verne Voyager generates a map from the data for each request, this tool is appropriate for researchers and individuals who have the time to wait for the server to generate the map and transmit it to the user.

Also available are geographic and geophysical overlays such as political boundaries, rivers and lakes, National Earthquake and Information Center earthquake and volcano locations, stress axes, and observed and modeled plate motion and deformation velocity vectors representing a compilation of 2933 geodetic measurements from around the world.

Jules Verne Voyager, Jr.

The Jules Verne Voyager, Jr. map tool is an interactive map tool that enables students and scientists to better understand the relationships between geophysical and geological processes, structures, and measurements with high-precision GPS data. The maps in this tool are pre-made and served up through Javascript.

This tool is appropriate for large classes from middle school through introductory geoscience classes. [Click here](#) to link to educational resources for middle/high school Earth Science class from this site.

EarthScope Voyager, Jr.

EarthScope Voyager, Jr. has a similar structure to Jules Verne Voyager, Jr., but has EarthScope specific data and links to information about some of the geographic regions of interest to the EarthScope Project.

Global Strain Rate

The Global Strain Rate Map project was initiated in 1998 by the International Lithosphere Program (ILP). Under the guidance of investigators W. Holt (wholt@mantle.geo.sunysb.edu) (SUNY Stony Brook) and J. Haines (Cambridge University) the first steps towards the establishment of such a map have been made. A completed Global Strain Rate Map, determined by combining GPS, seismological and neotectonic data, will provide a large amount of information that is vital for our understanding of continental dynamics and for the quantification of seismic hazards.

Getting Oriented to the Map

EarthScope Voyager, Jr.

Intro/help Did you know? EarthScope Legend on/off Big/small maps See in JVV Zoom out Zoom to top Print/save Make changes

Add a base map

- Face of the Earth & Relief
- Color Topography
- Gray Topography
- Gray Shaded Relief
- Face of the Earth
- Earth at Night
- Ocean Floor Age

Add feature(s)

- No Features
- USArray & other
- PBO GPS
- PBO Strain
- SAFOD
- Tectonic Plates
- Focal Mechanisms

Add velocities

- No Plate Velocities
- N. America
- Pacific
- Eurasia
- Caribbean
- Juan de Fuca
- Rivera

Face of the Earth™

United States

Getting Oriented to the Map

EarthScope Voyager, Jr.

Intro/help Did you know? Earth Scope Legend on/off Big/small maps See in JVV Zoom out Zoom to top Print/save Make changes

Add a base map

Face of the Earth & Relief

- Color Topography
- Gray Topography
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- Hiviera

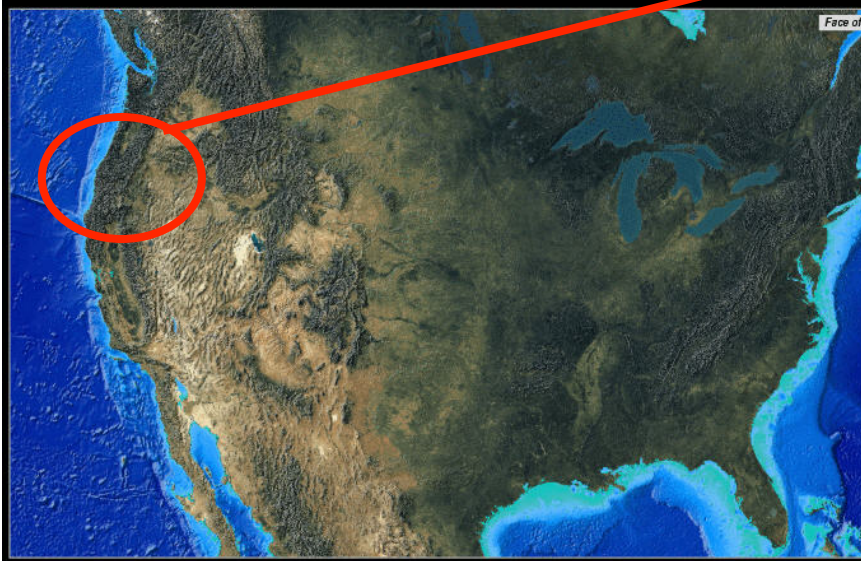
Face of the Earth™

United States

Zoom Into the Western U.S.



Click on map to
zoom in

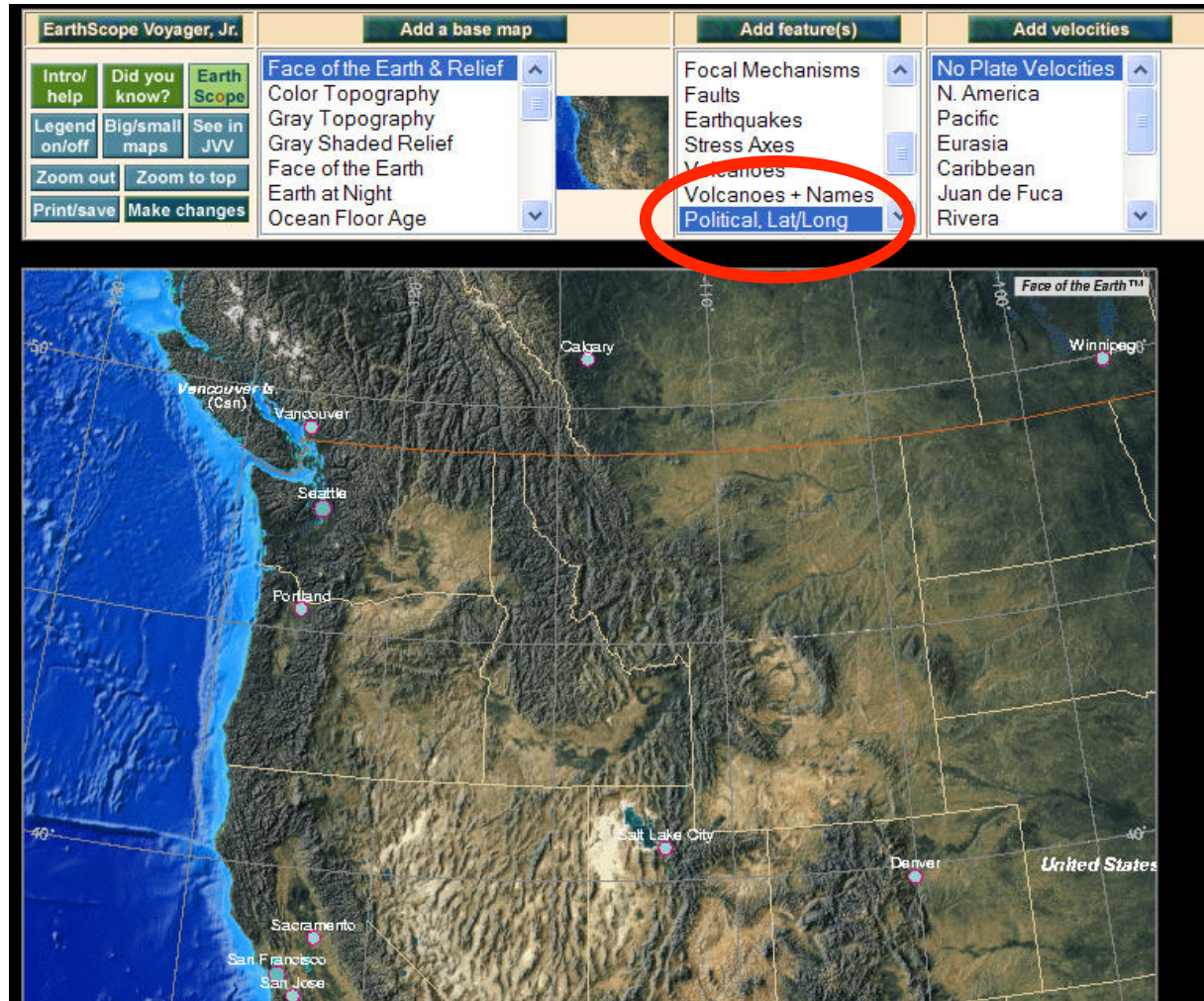


Zoom into the
United States



Zoom into the Western
United States

Add Political Lat/Long under Add Features



Add political boundaries and
latitude/longitude lines

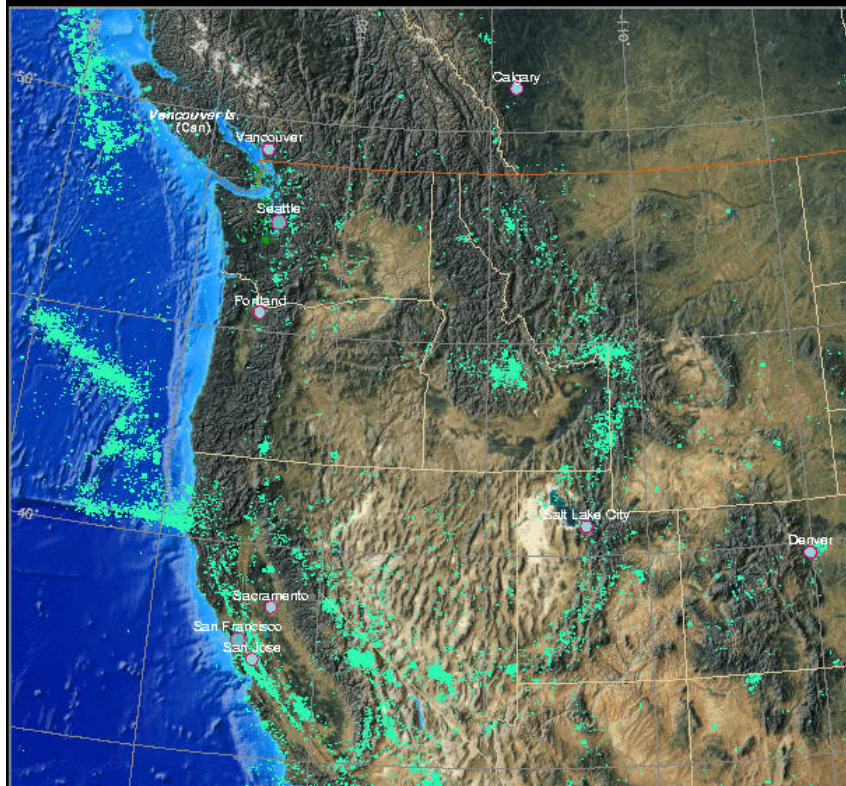
Part 2: Compare Earthquake and Volcano Locations

- 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 findings
- Stop at Part 3

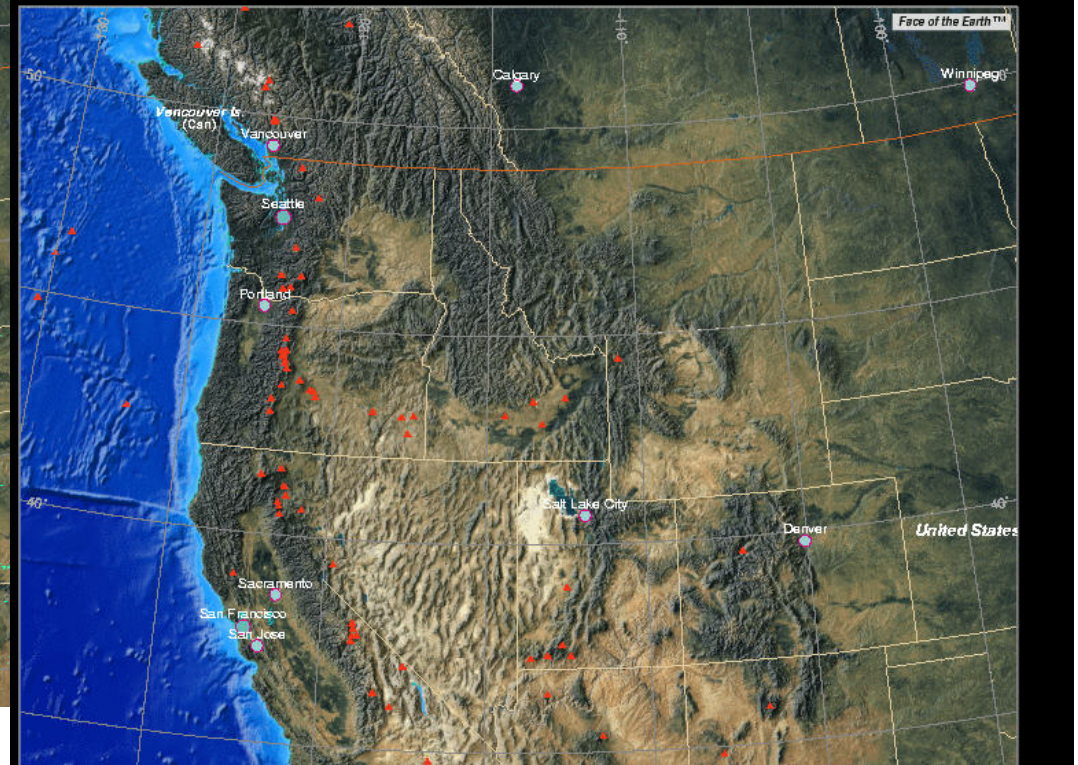


Earthquake and Volcano Distribution

EarthScope Voyager, Jr.			Add a base map	Add feature(s)	Add velocities
Intro/ help	Did you know?	Earth Scope	Face of the Earth & Relief	PBO GPS	No Plate Velocities
Legend on/off	Big/small maps	See in JVJ	Color Topography	PBO Strain	N. America
Zoom out	Zoom to top		Gray Topography	SAFOD	
Print/save	Make changes		Gray Shaded Relief	Tectonic Plates	
			Face of the Earth	Focal Mechanisms	
			Earth at Night	Faults	
			Ocean Floor Age	Earthquakes	



EarthScope Voyager, Jr.			Add a base map	Add feature(s)	Add velocities
Intro/ help	Did you know?	Earth Scope	Face of the Earth & Relief	SAFOD	No Plate Velocities
Legend on/off	Big/small maps	See in JVJ	Color Topography	Tectonic Plates	N. America
Zoom out	Zoom to top		Gray Topography	Focal Mechanisms	Pacific
Print/save	Make changes		Gray Shaded Relief	Faults	Eurasia
			Face of the Earth	Earthquakes	Caribbean
			Earth at Night	Stress Axes	Juan de Fuca
			Ocean Floor Age	Volcanoes	Rivera



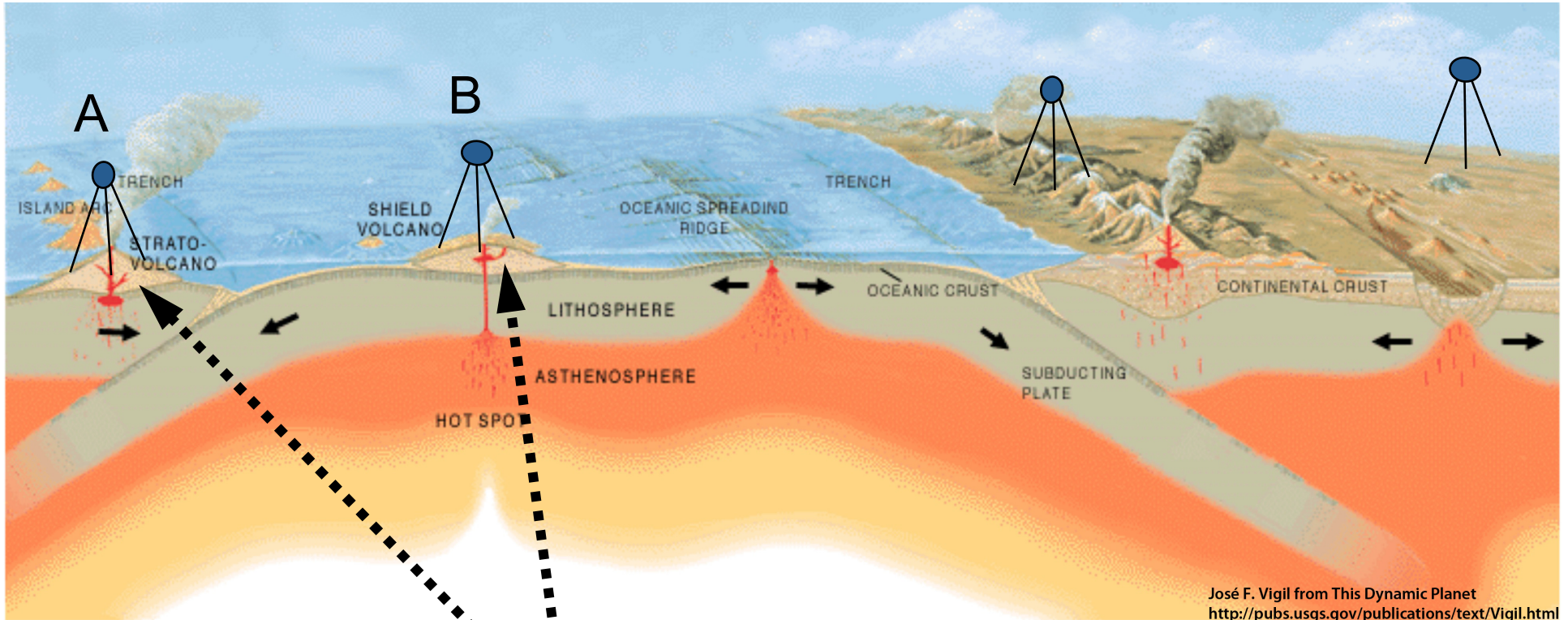
Discussion:

- 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.

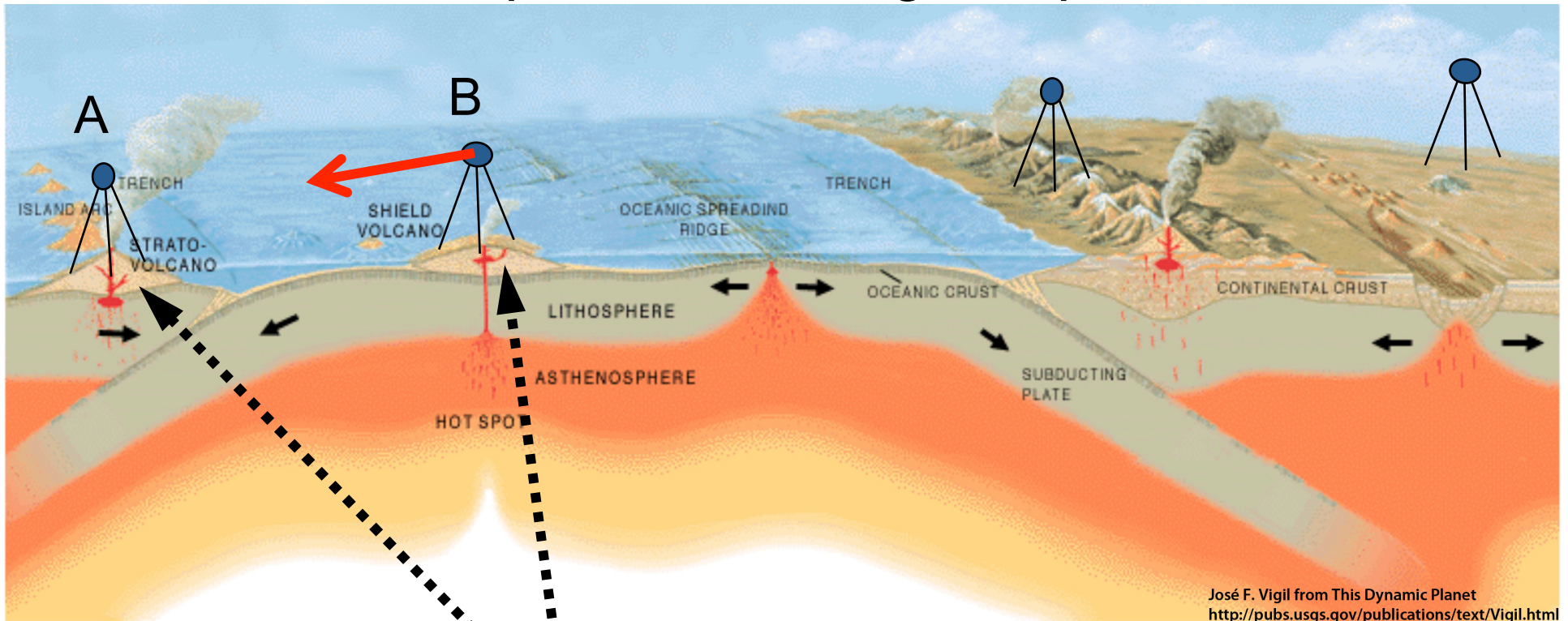


How will GPS Station B's position change relative to GPS Station A?

GPS stations are not to scale

Part 3: Examine GPS Vector Data

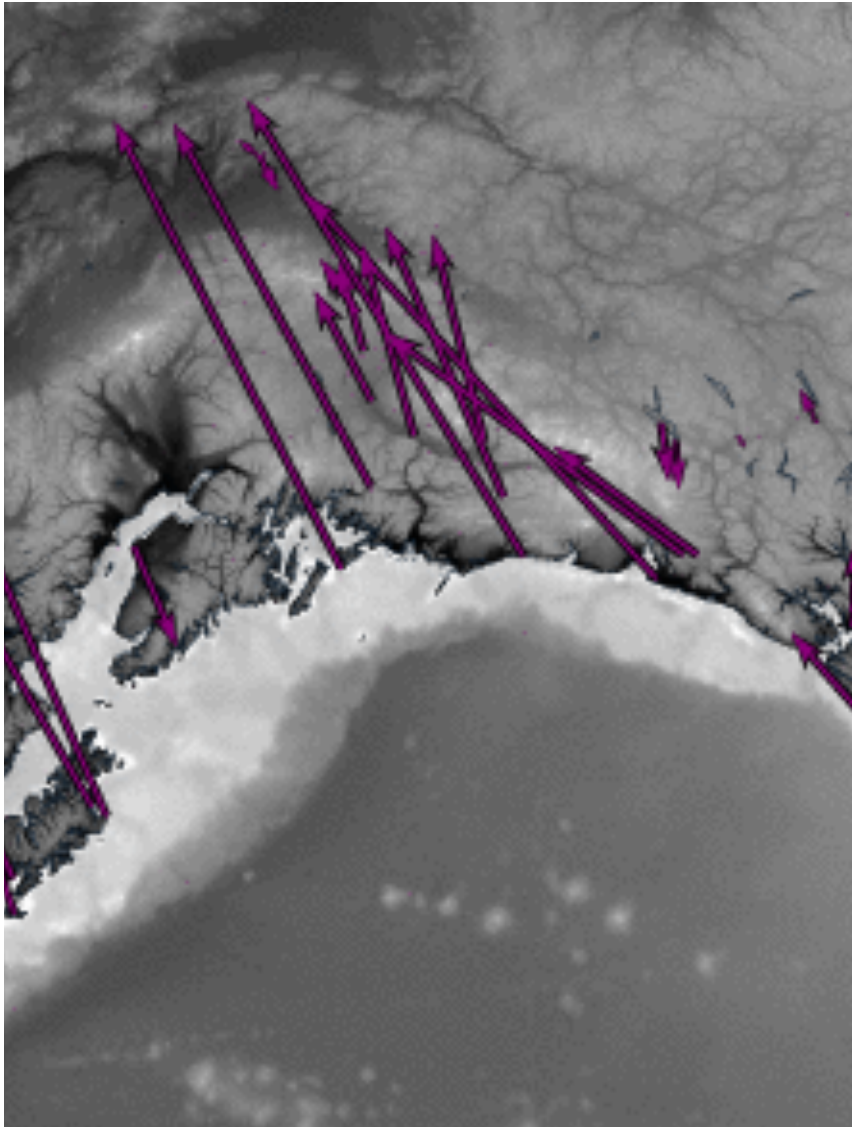
GPS station positions change as plates move.



GPS Station B is moving toward A.

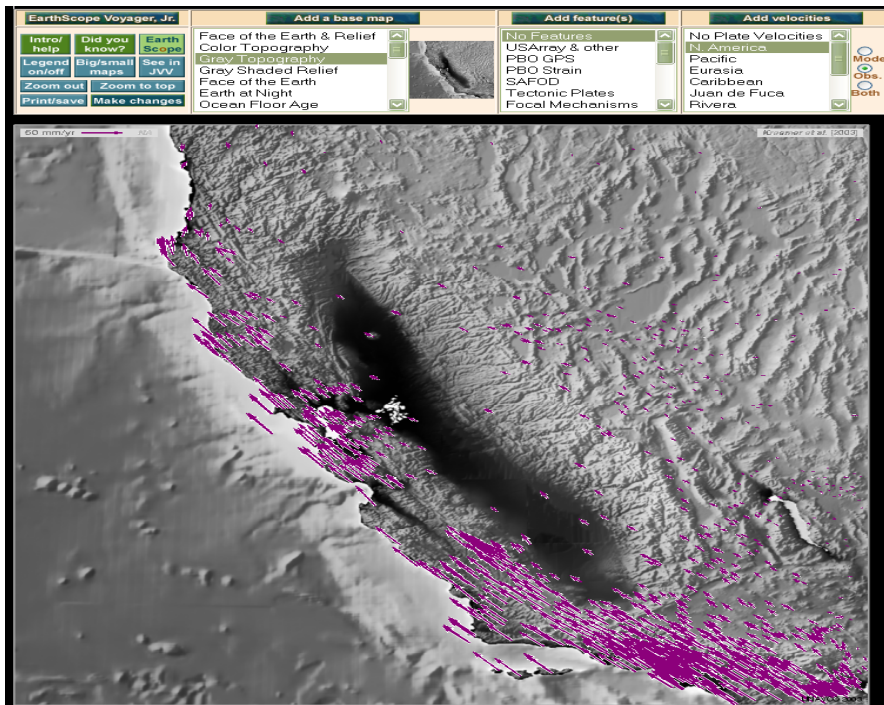
GPS stations are not to scale

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



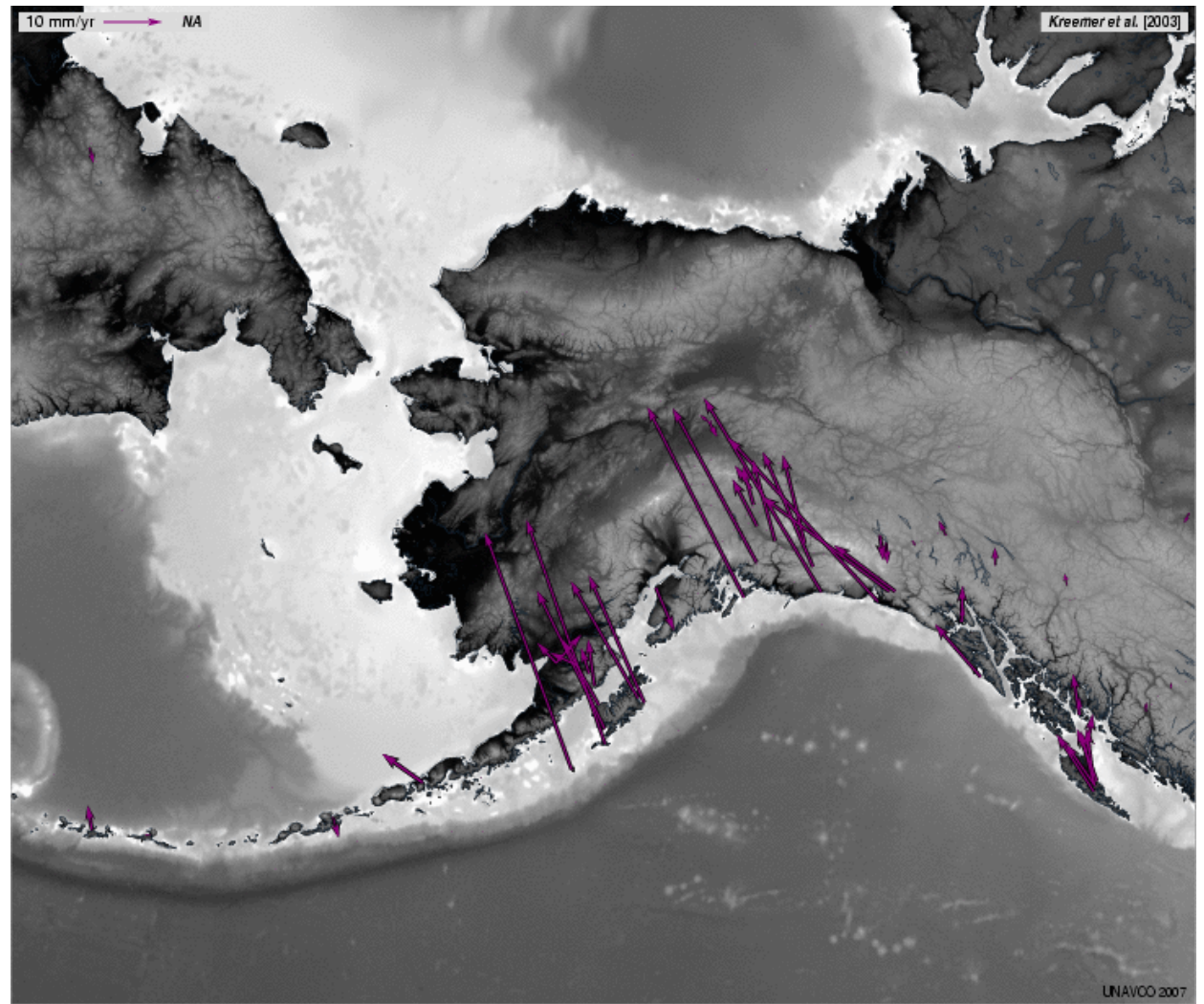
Part 3 continued: Sketch and Study the Vectors

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



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

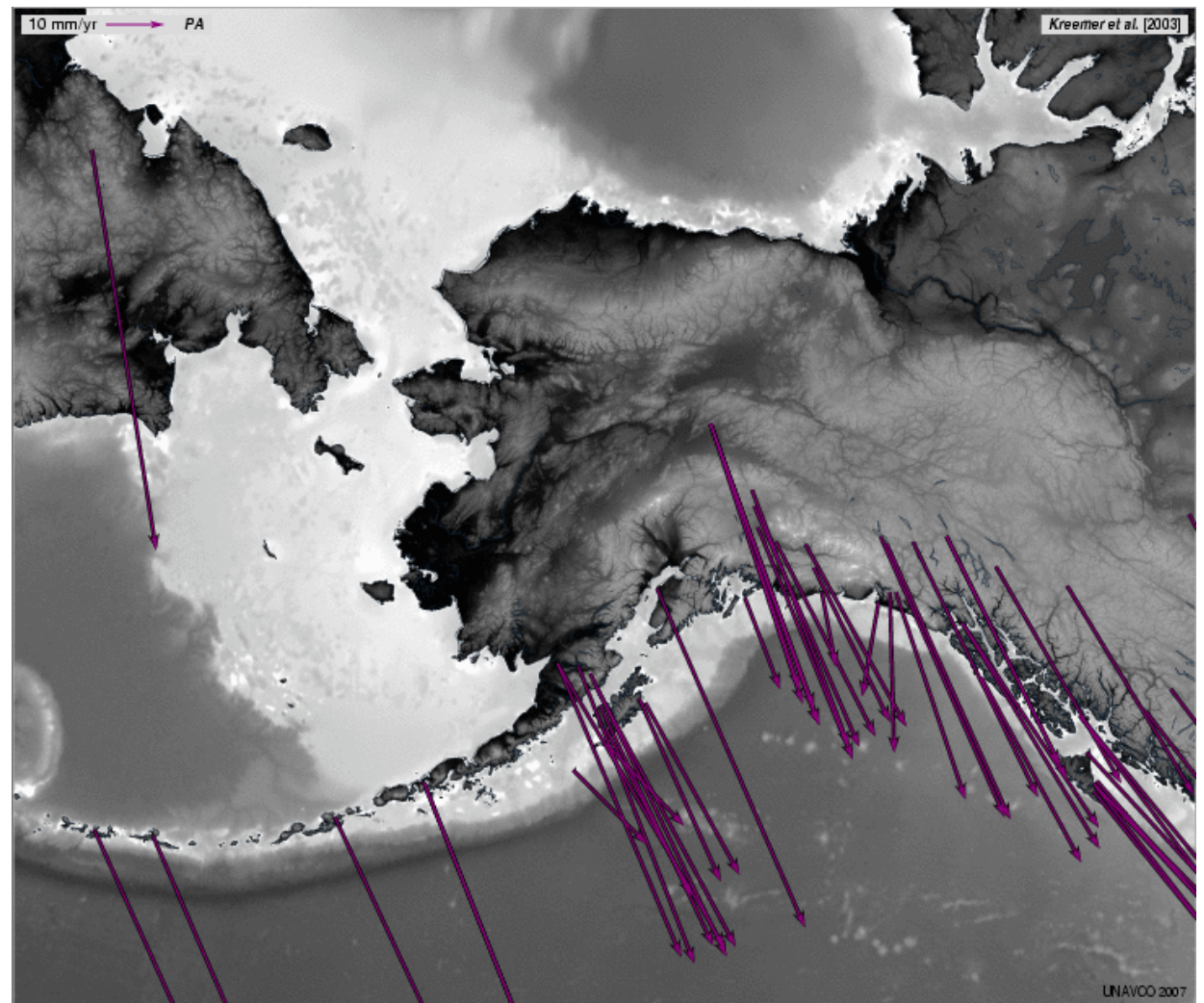
- The rest of the world's plates move, while the North America plate stays fixed.
- Near Alaska, the vector arrows are pointing to the *North West (NW)* because the Pacific plate is moving to the NW...



and *the edge of Alaska* is also moving NW

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

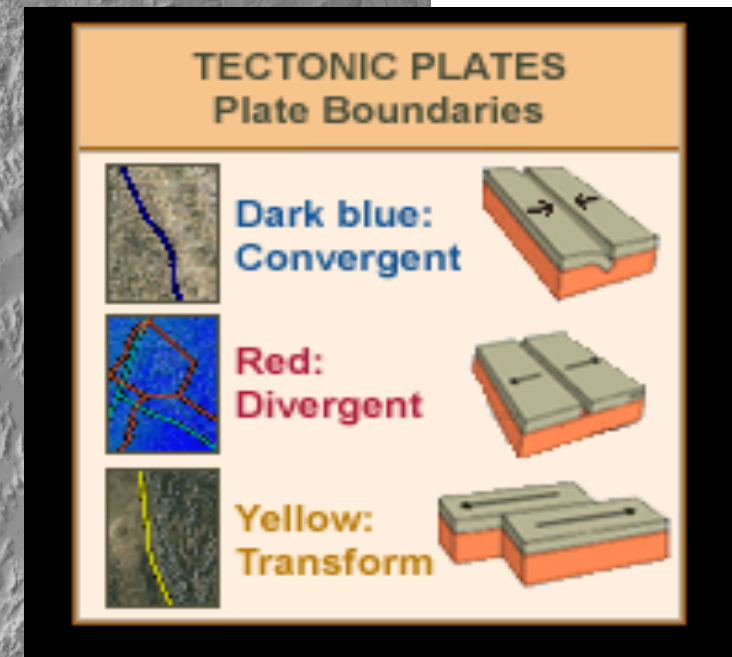
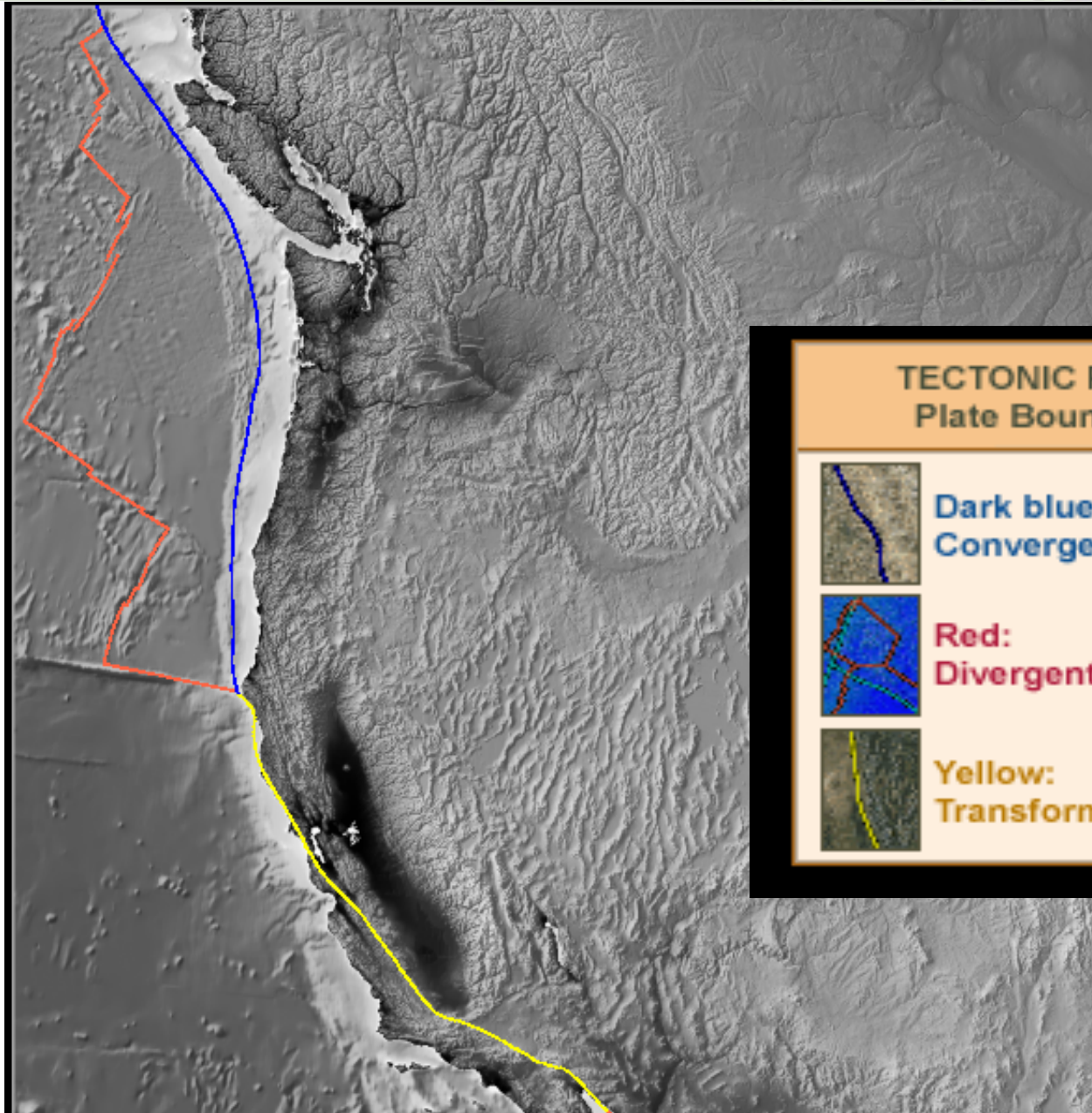


Part 4: Sketch and Study the Modeled Vectors

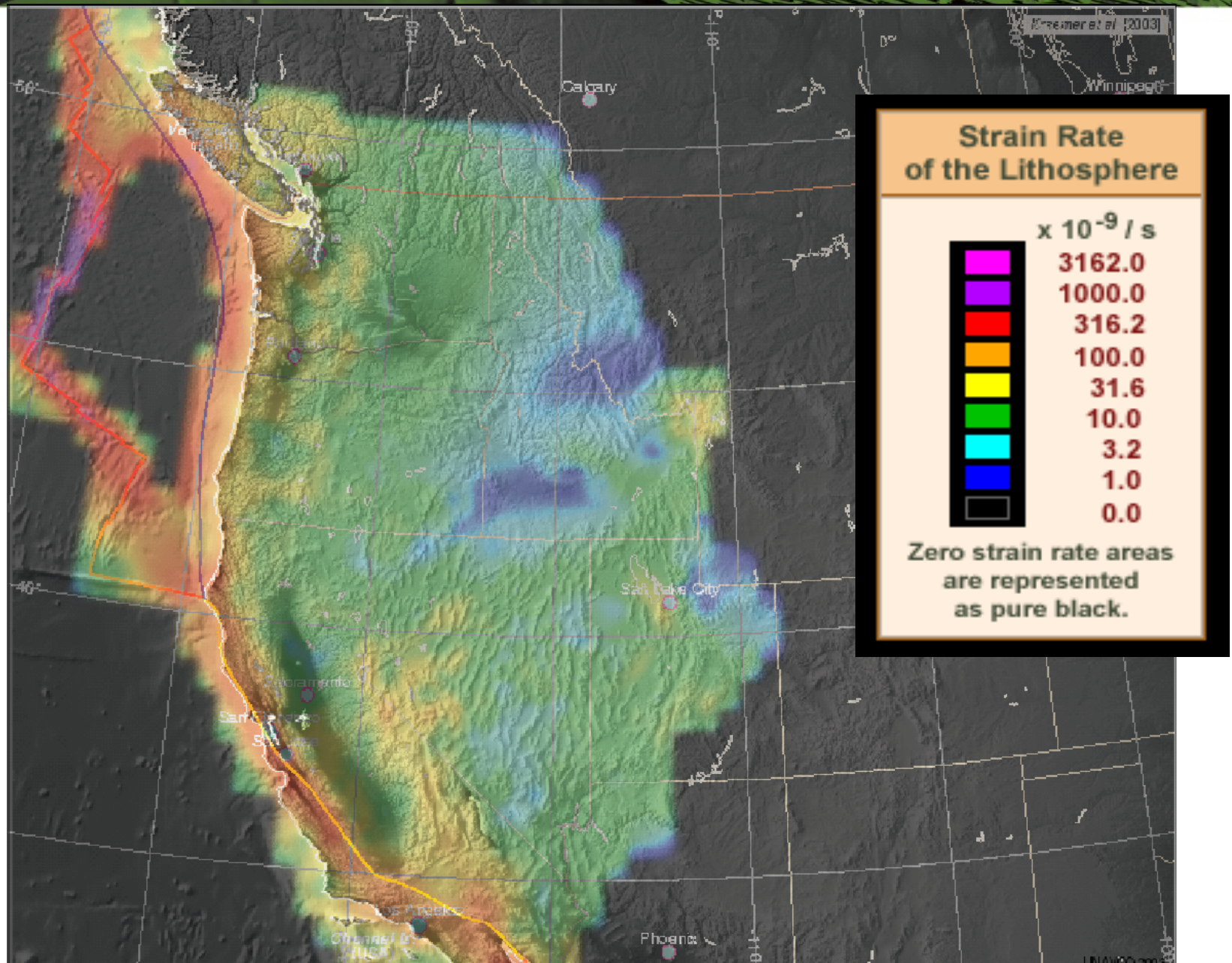
- Sketch vectors where they are very different from each other
- Draw where you believe the plate boundaries are located
- Compare with plate boundaries in EarthScope Voyager Jr.
- Answer questions
- Discuss with your teammate

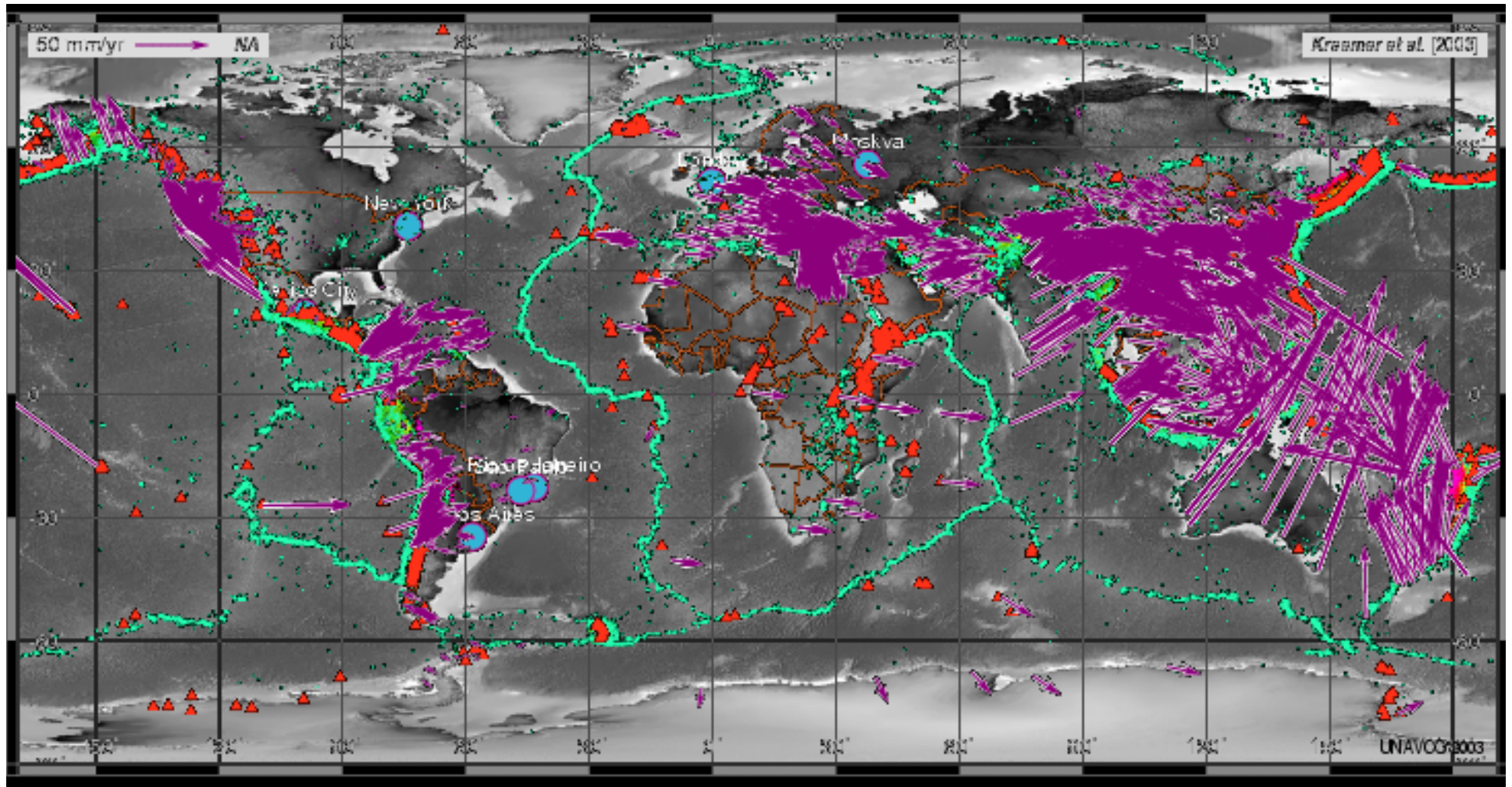


Plate Boundaries Along the West Coast



Thinking of Boundaries as Zones





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

- 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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