EarthScope Colorado Plateau - Rio Grande Rift Interpretive Workshop

New Mexico Museum of Natural History and Science
October 26-28, 2009

Workshop Overview

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EarthScope Education and
Outreach Manager
EarthScope National Office
Oregon State University

www.earthscope.org

Colorado Plateau - Rio Grande Rift Interpretive Workshop

Supported by funds from the National Science Foundation to the EarthScope National Office

Special thanks to:

New Mexico Museum of Natural and Cultural History!

Jayne Aubele

Senior Educator/Geologist

….. and fantastic workshop organizer ☺

Vulcan Volcano

Petroglyph National Monument, New Mexico

Robert A Lillie

Petroglyph National Monument, New Mexico

Potential Workshop Theme:

Beauty and the Beast:
"The same earthquake and volcanic activity that threatens our lives also nourishes our spirits by forming the dramatic landscape of the Colorado Plateau and Rio Grande Rift."

W. R. Hansen, U. S. Geological Survey

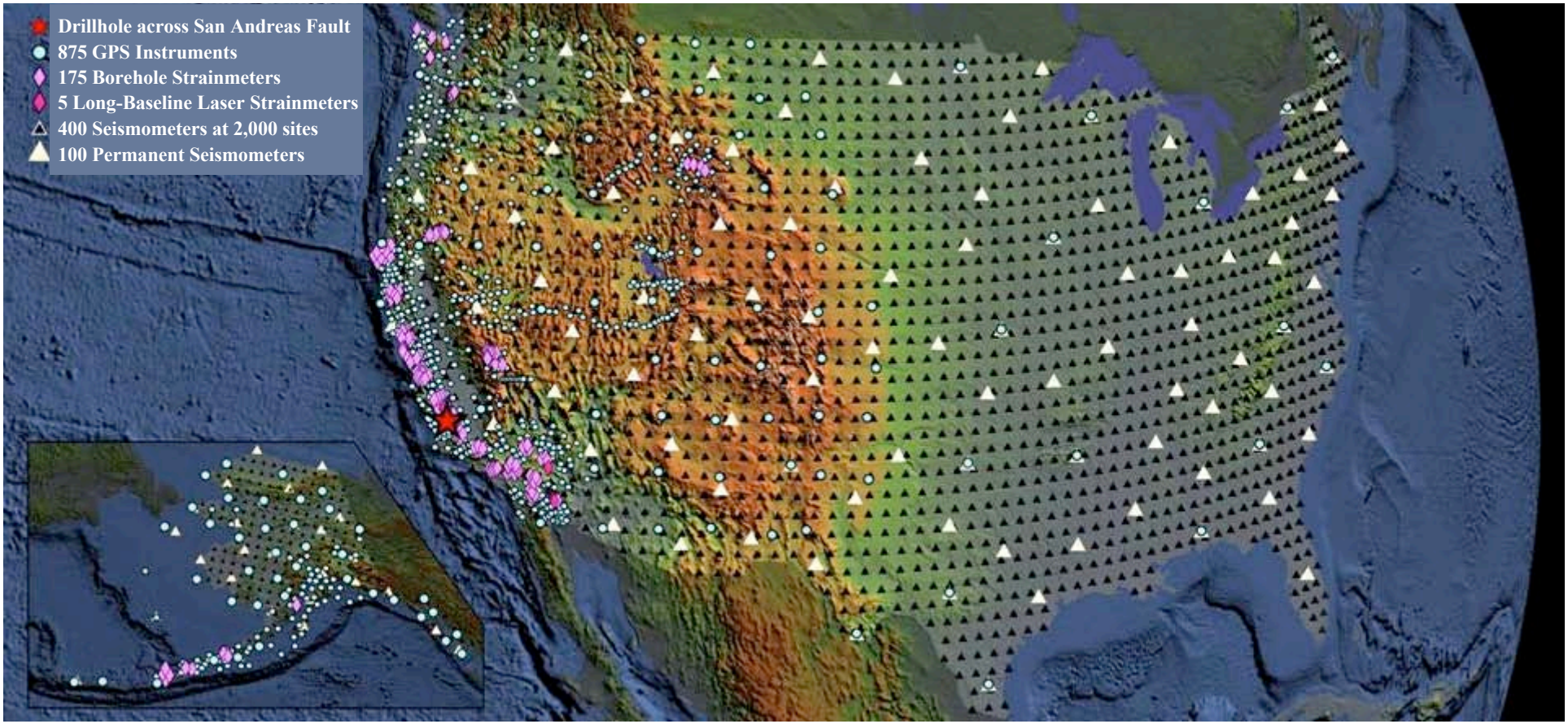
Rainbow Bridge National Monument, Utah

EarthScope

A nationwide effort to …..

- Explore the structure and evolution of North American continent
- Study processes that cause earthquakes and volcanic eruptions

EarthScope has three main “observatories” …..



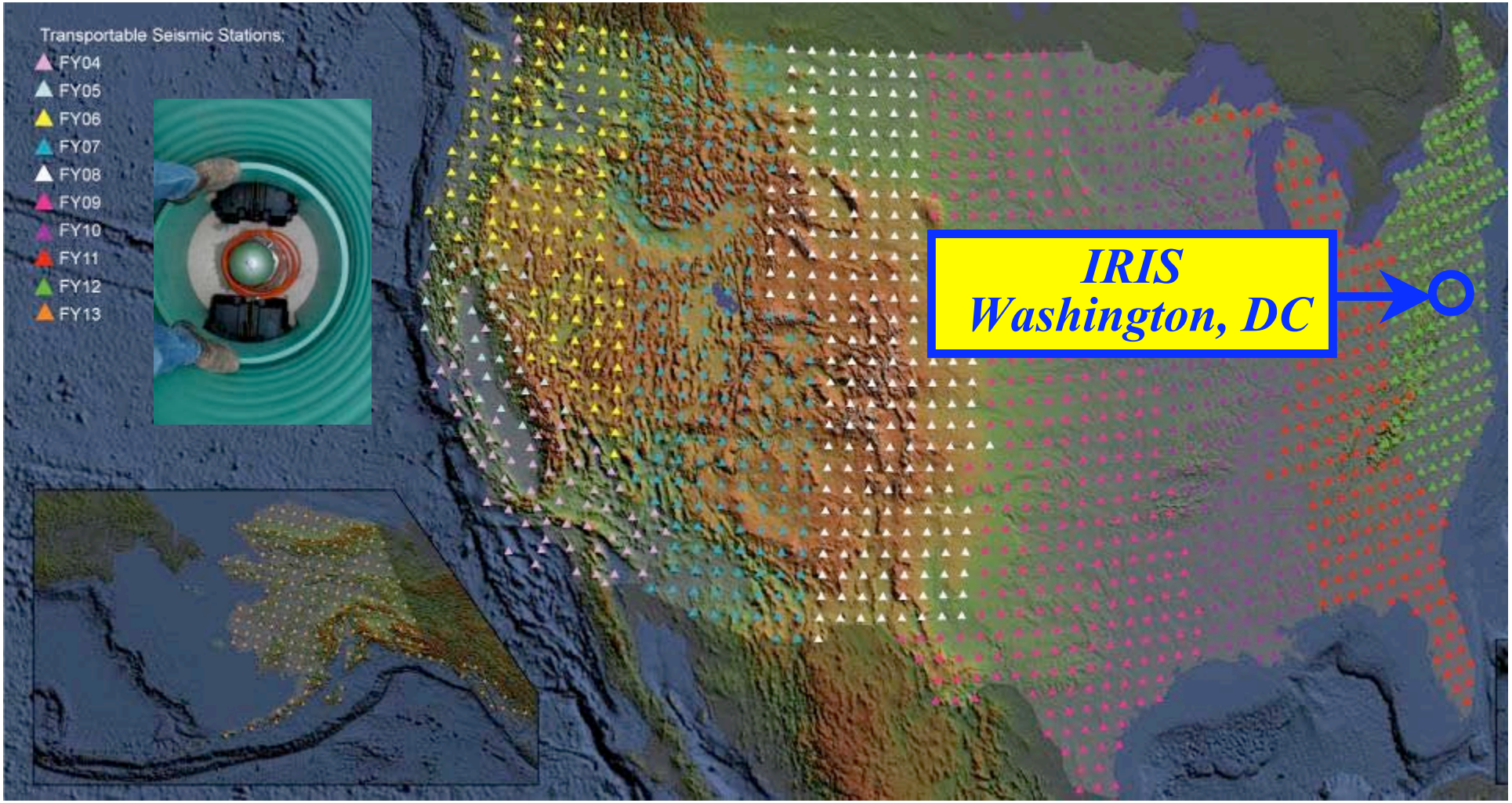
earth scope

Observatories

1. USArray

USArray:

- **Includes 400 Transportable Seismometers**
- **Each station occupies a site for 1½ to 2 years**
- **10 years to leap-frog across the country**



earth scope

Observatories

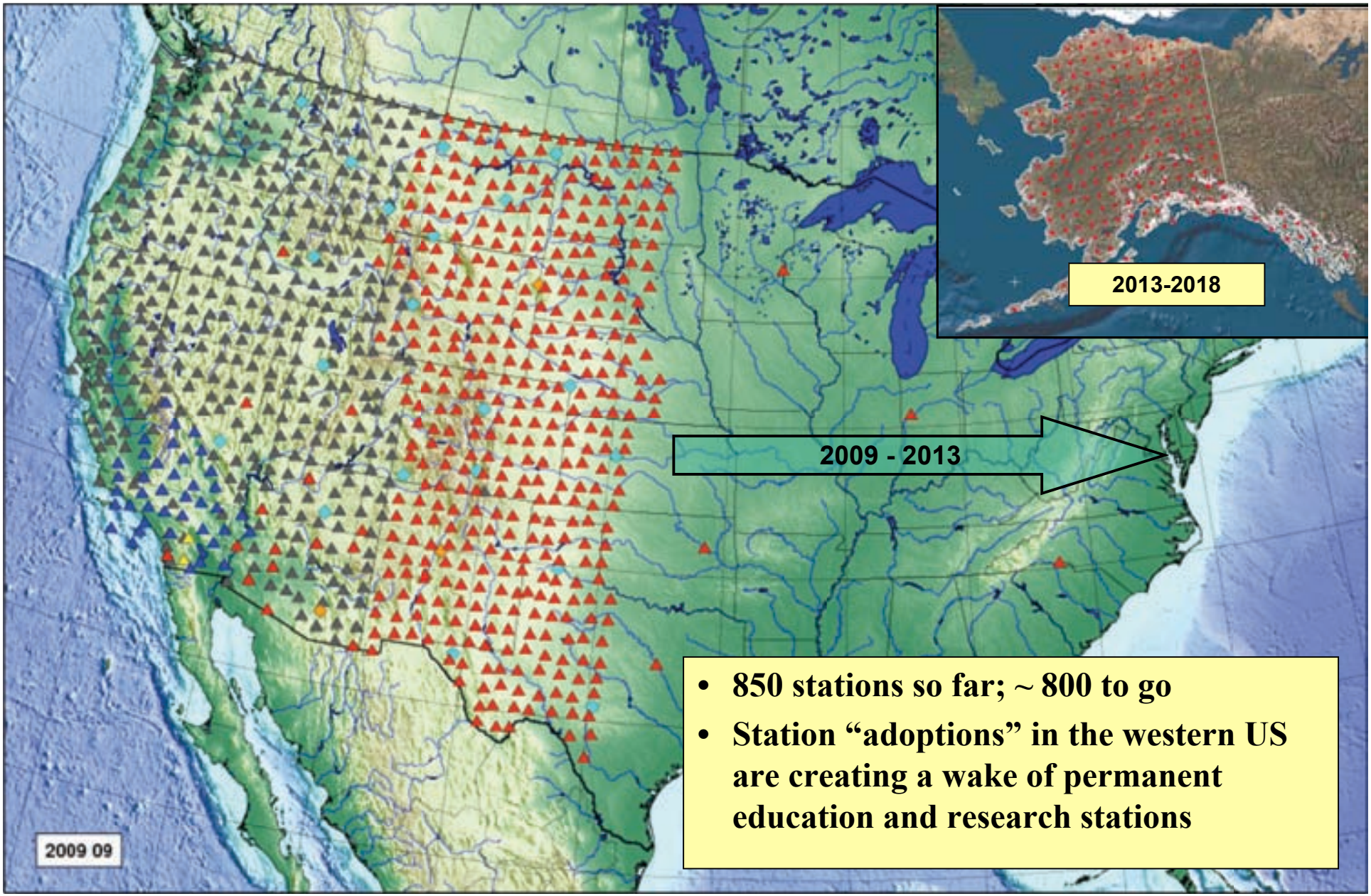
Transportable Array (TA) Station Deployment, 2004-2009

USArray

earth scope

Observatories

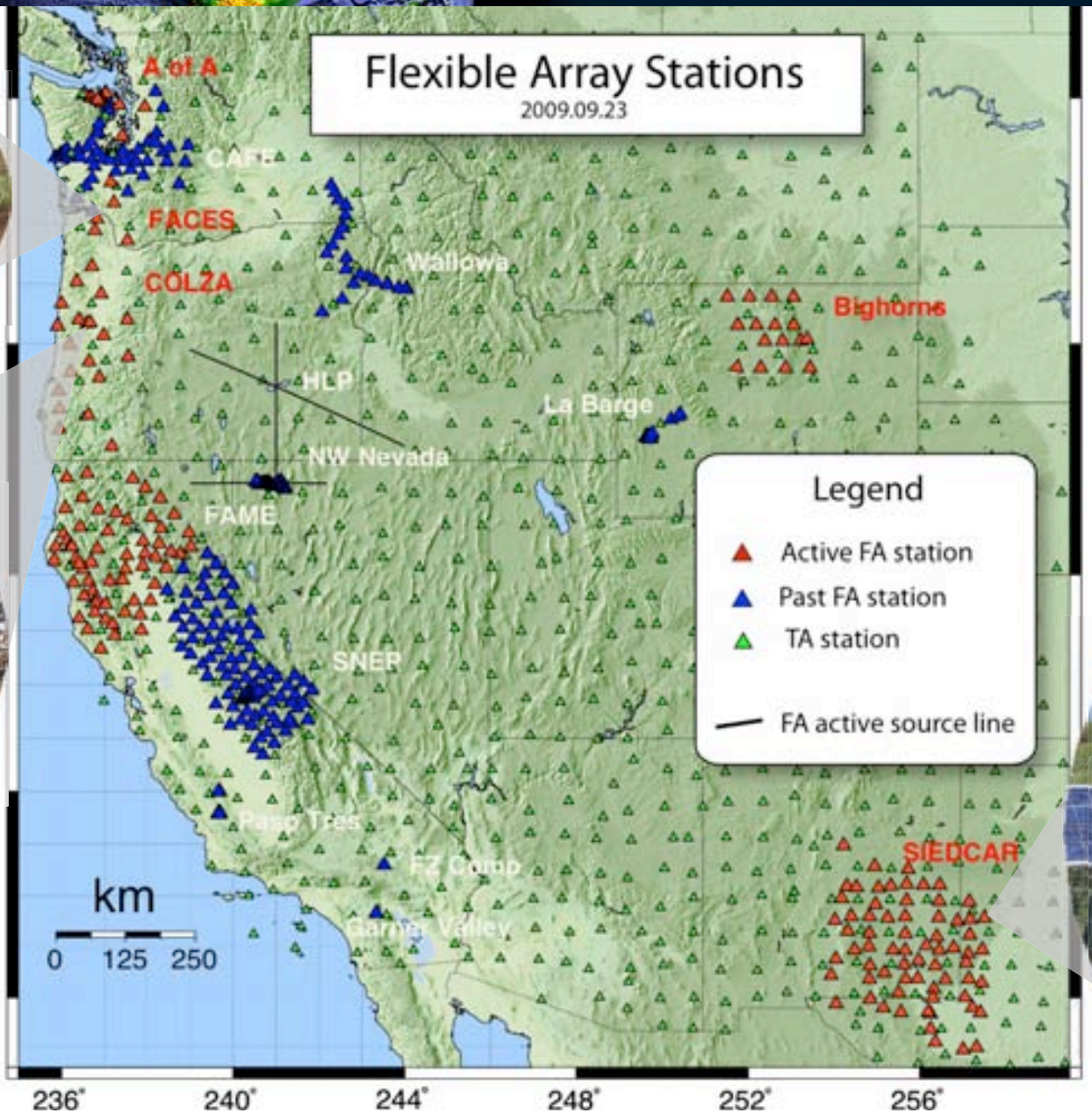
1. USArray



- 850 stations so far; ~ 800 to go
- Station “adoptions” in the western US are creating a wake of permanent education and research stations

1. USArray

Observatories

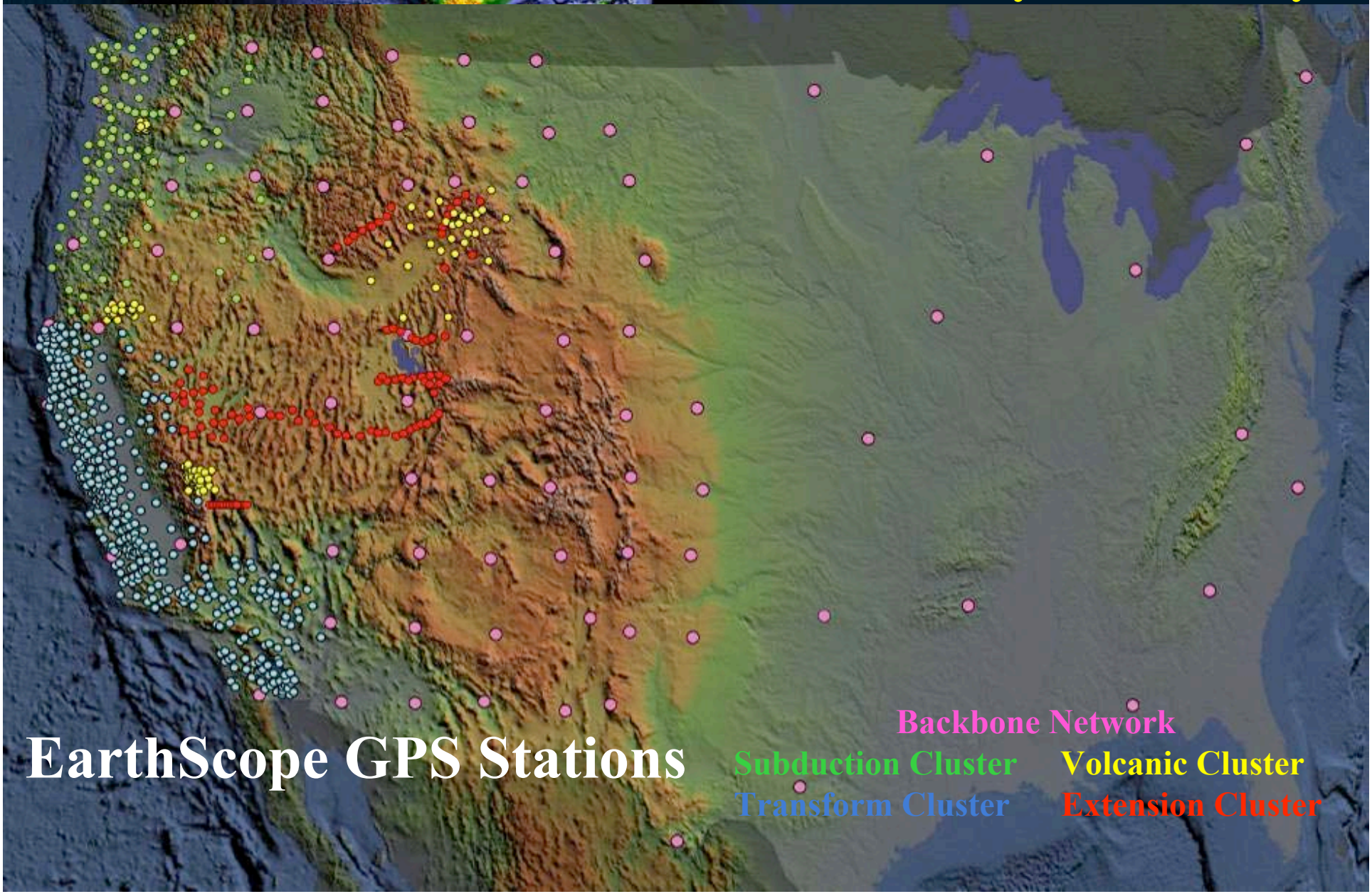


earth scope

Observatories

2. PBO

Plate Boundary Observatory

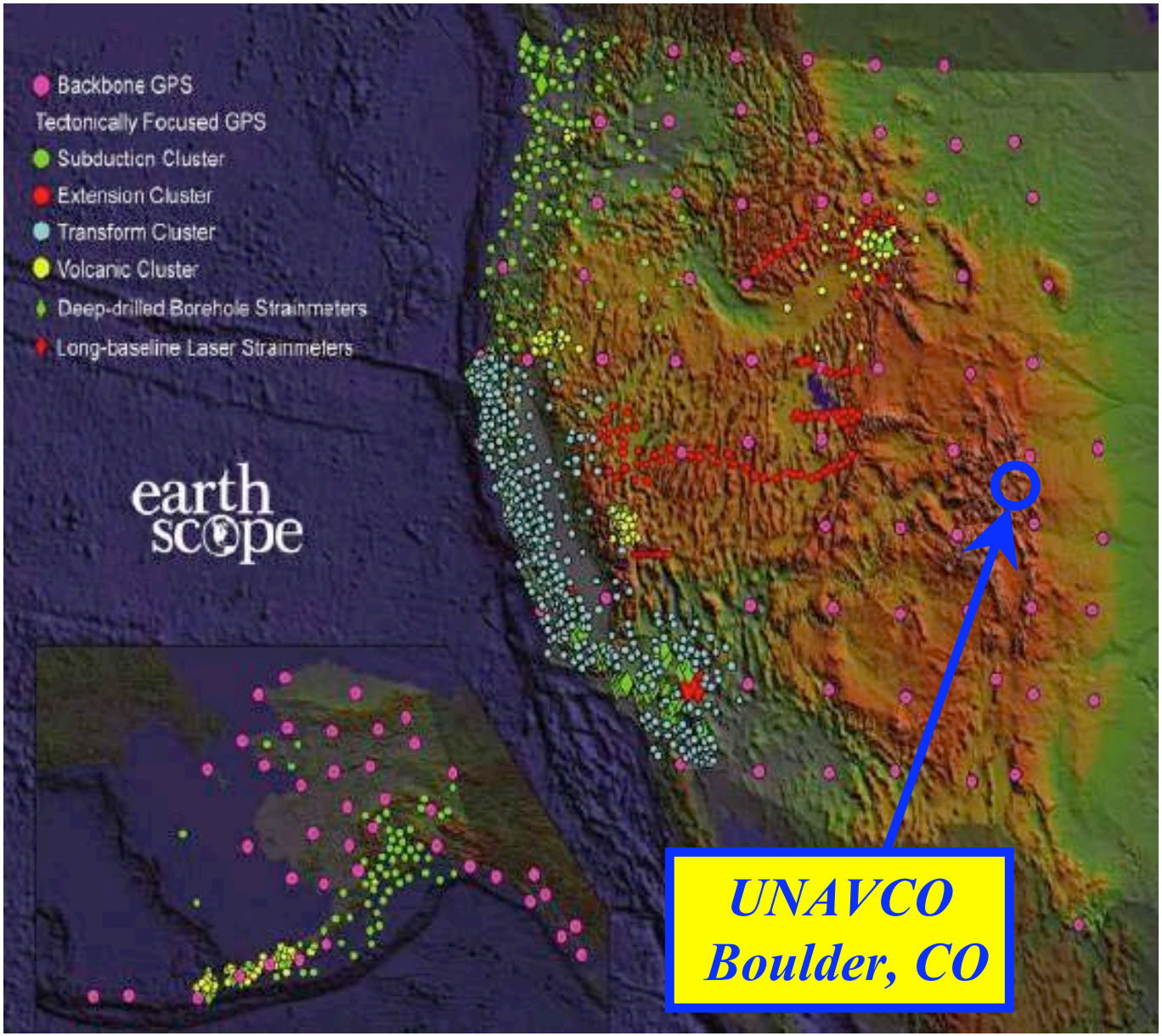


earth scope Observatories

2. PBO
Plate Boundary Observatory

- GPS Instruments
- Strainmeters

GSP Station
California State University
at San Bernardino



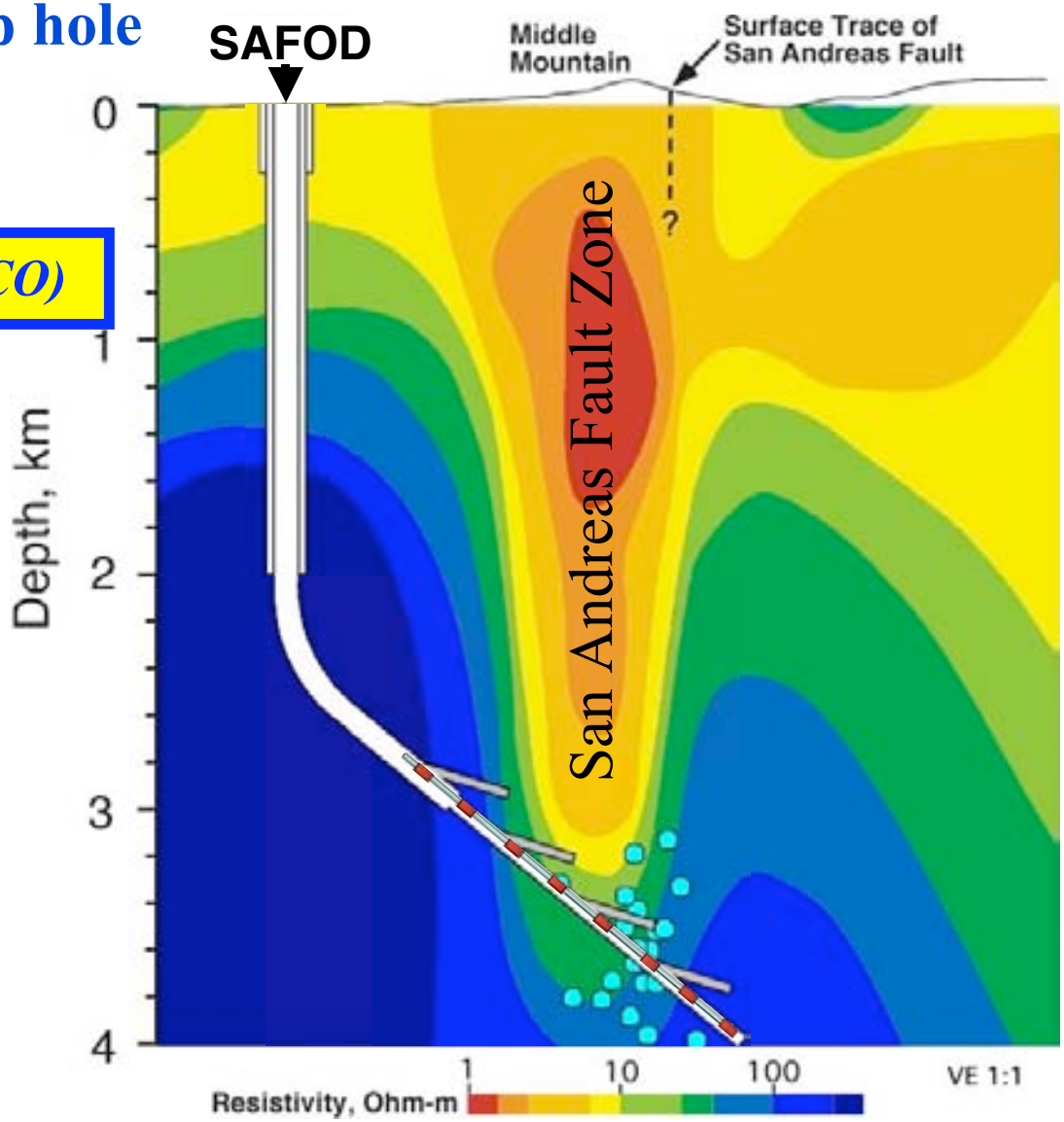
3. SAFOD

San Andreas Fault Observatory at Depth

- 4 kilometer (2½ mile) deep hole
- Core samples
- Geophysical monitoring

Stanford University (now UNAVCO)

earth scope
SAFOD

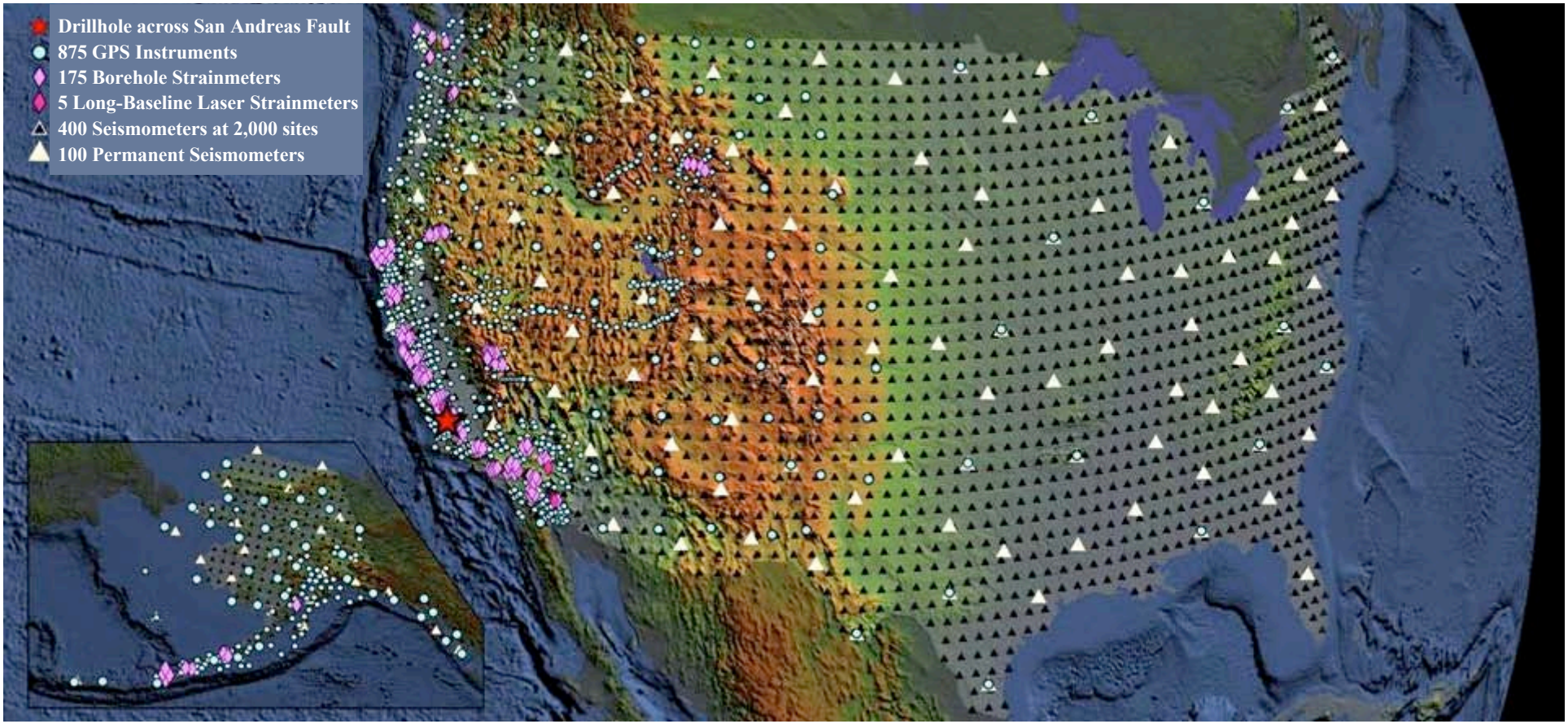


Scoping Our World

- A microscope images worlds smaller than us ……

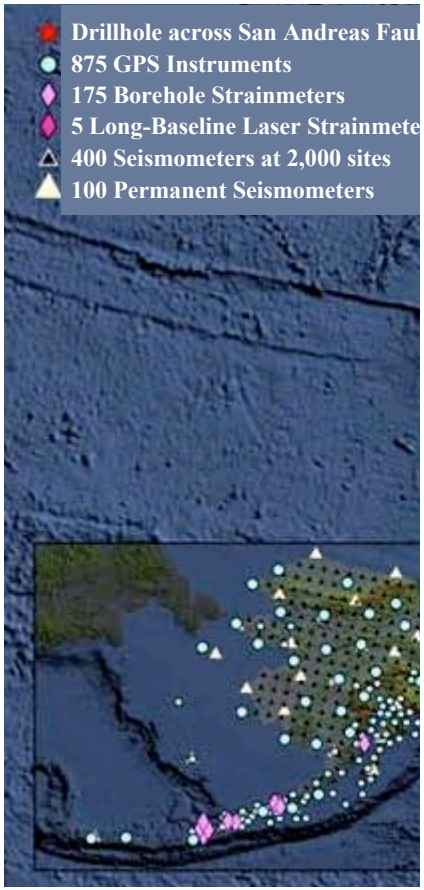
- EarthScope images the world we live on ……

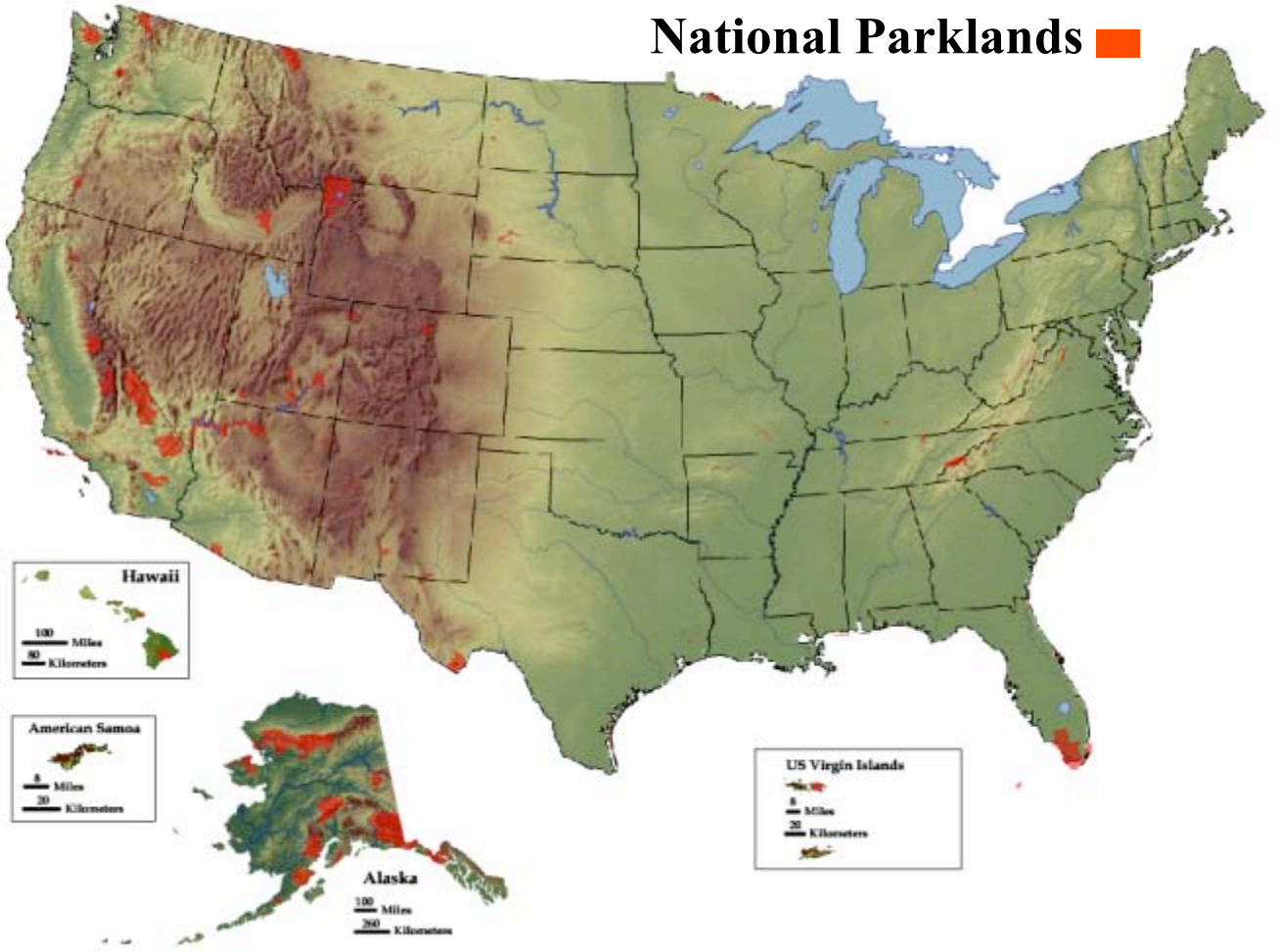
- A telescope images worlds far, far away ……



Informal Education Workshops

For Interpretive Professionals in Parks and Museums





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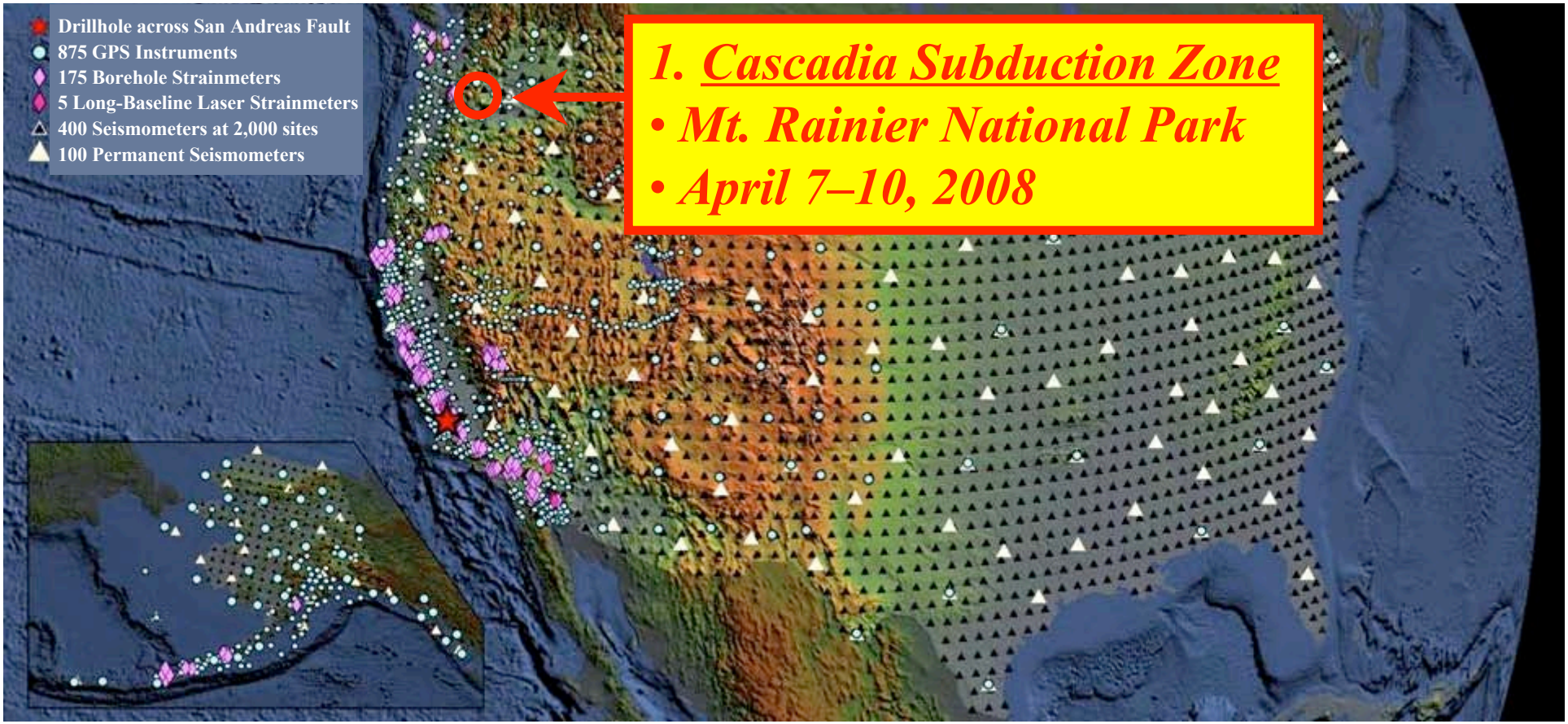

www.earthscope.org/eno/parks

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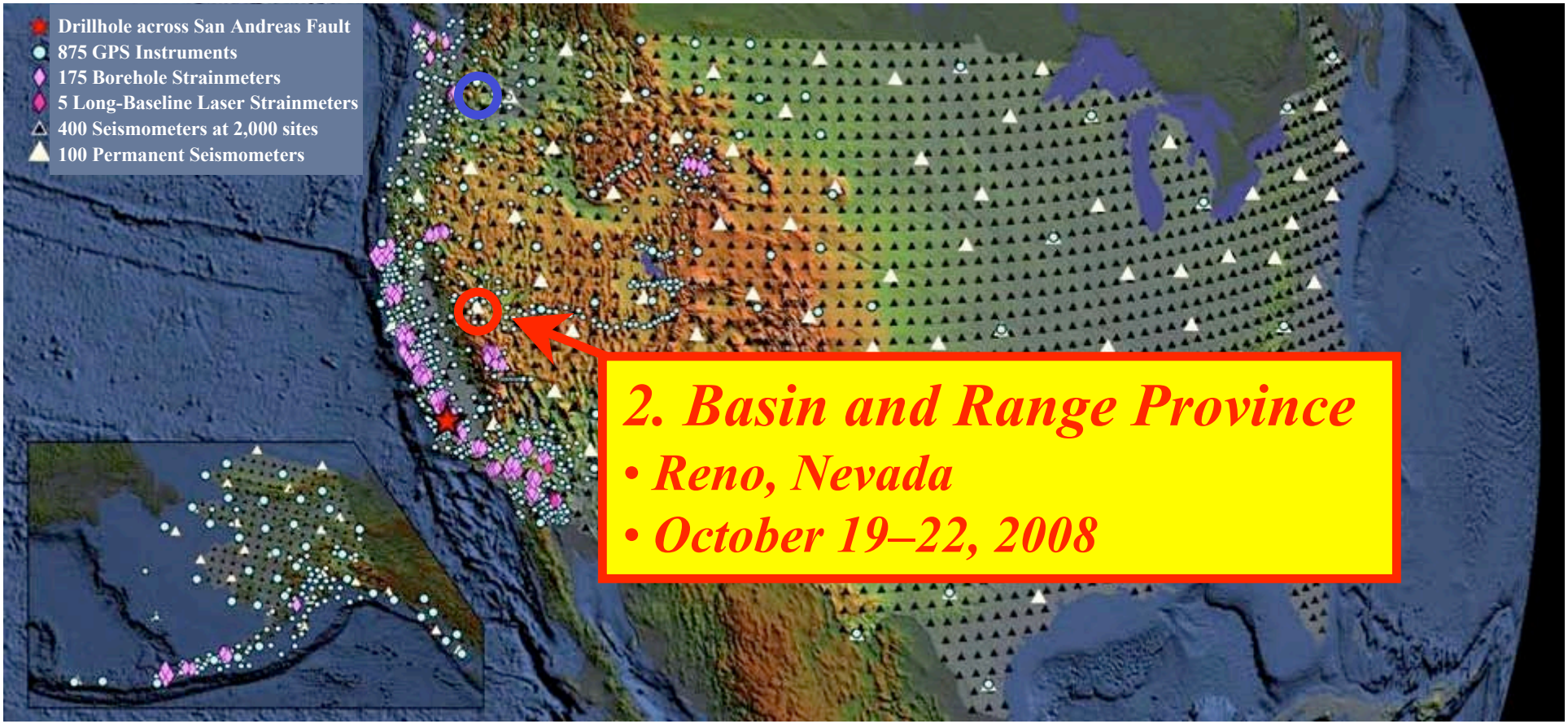

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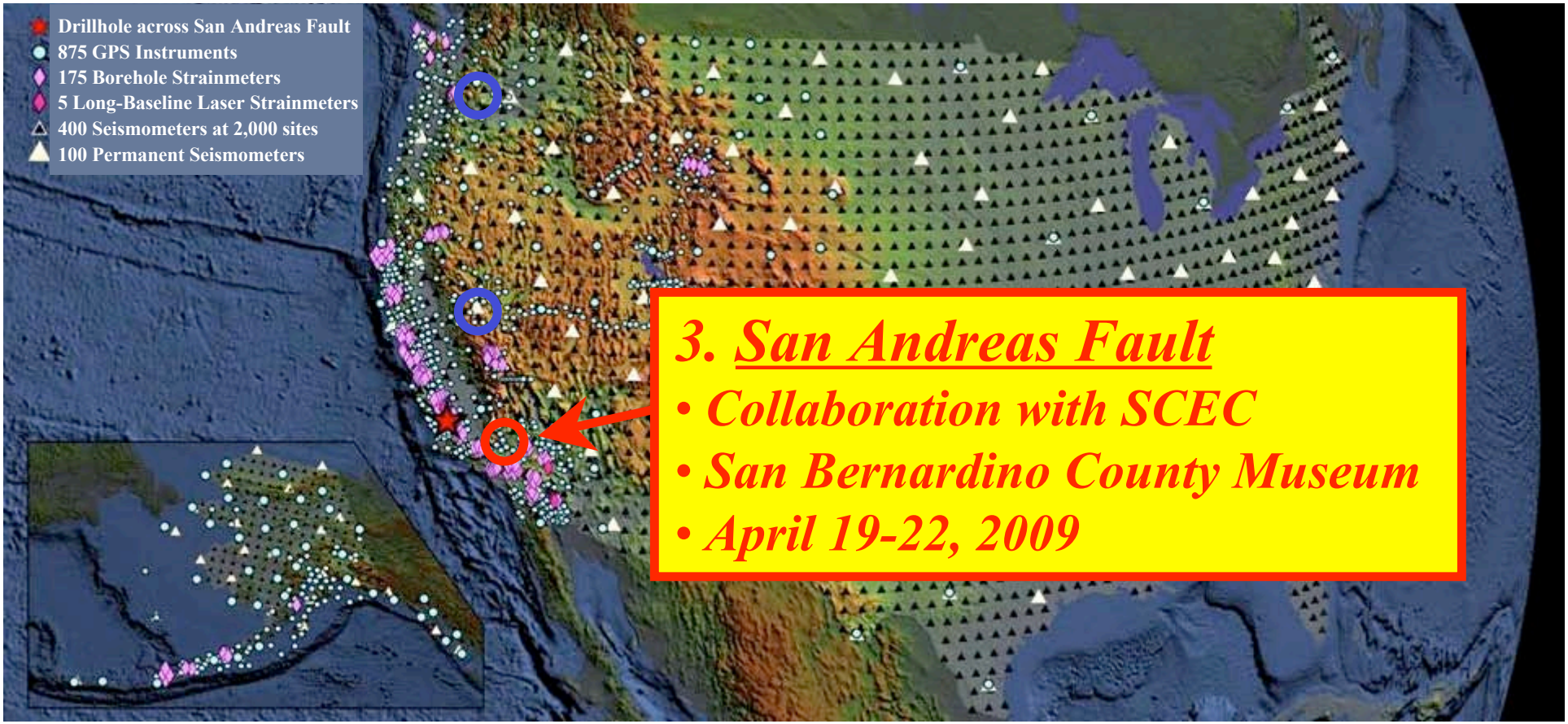

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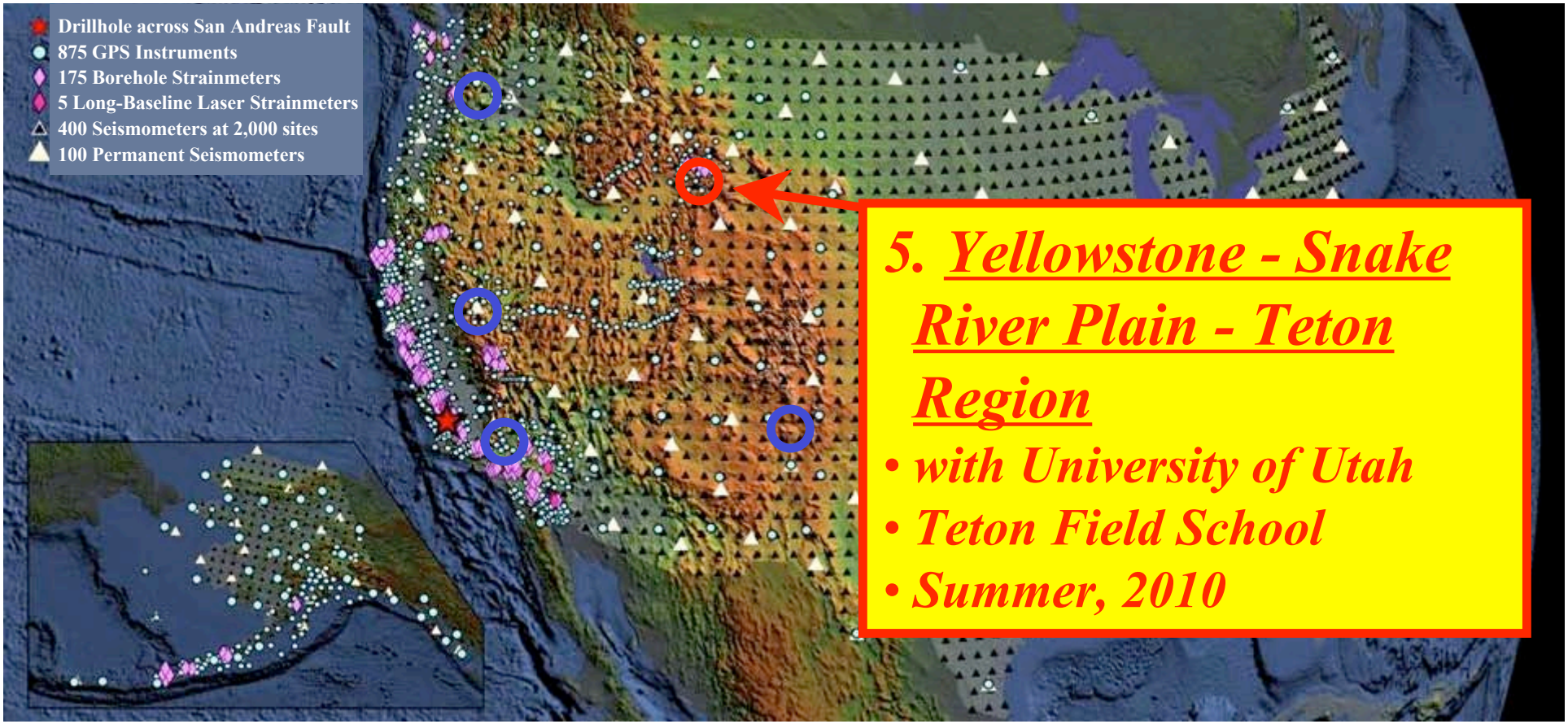

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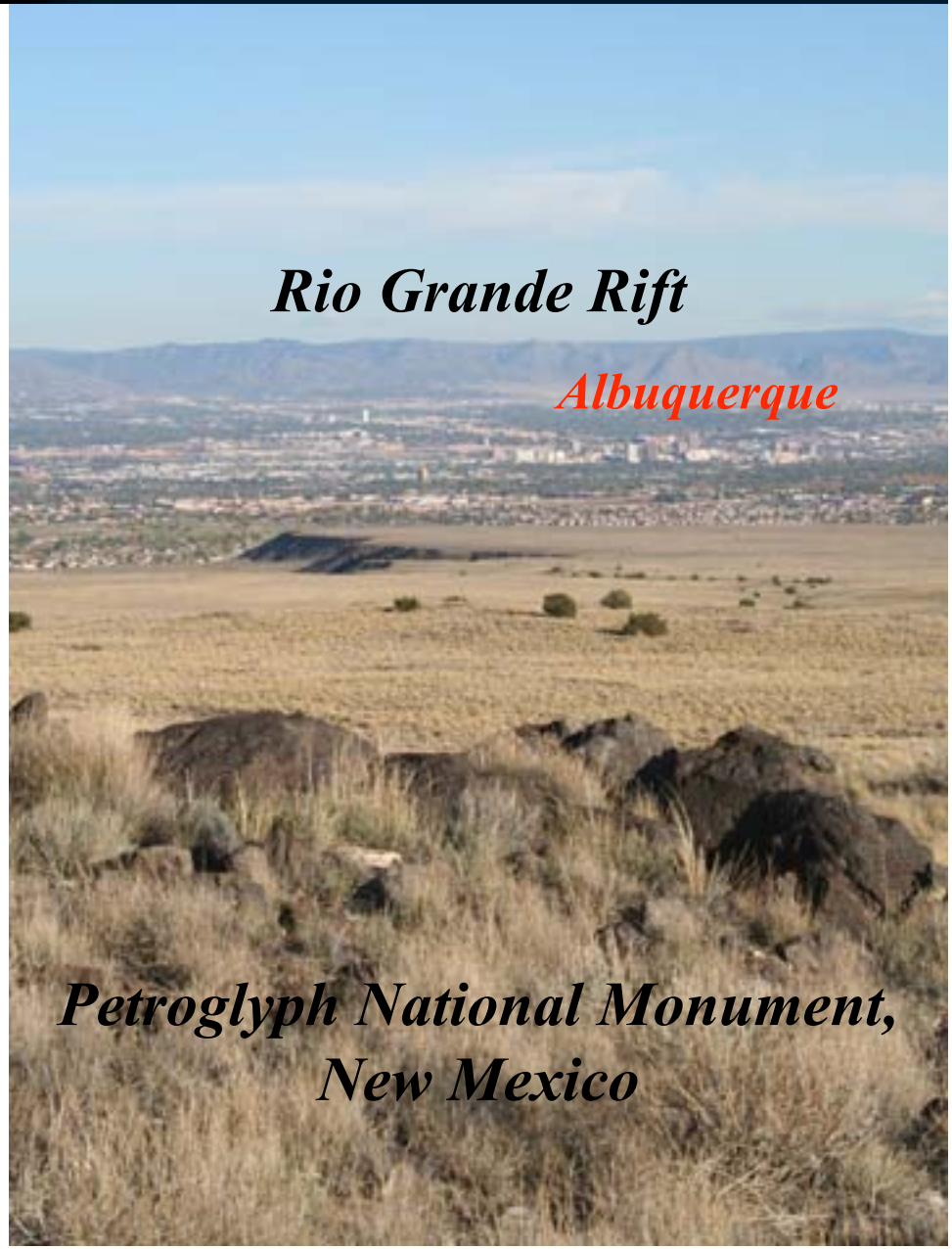
Colorado Plateau - Rio Grande Rift Interpretive Workshop

- **Science Content**
  - Basic geology: plate tectonics and the dynamic landscape
  - EarthScope monitoring of the landscape
- **Interpretive Methods**
  - "Beauty and the Beast"
    - Inspiring landscapes are formed by geological processes
    - Same processes result in earthquakes and volcanic eruptions
  - Participants participate:
    - Work in groups to prepare and present interpretive programs that incorporate EarthScope
    - Field trip to brainstorm about landscape and EarthScope observations



Colorado Plateau - Rio Grande Rift
Interpretive Workshop, Oct. 26-28, 2009

Participant Organizations

1. Arizona State University, Tempe, AZ
2. Pecos National Historical Park, Pecos, NM
3. New Mexico Dept of Cultural Affairs, Bernalillo, NM
4. Canyonlands National Park, Moab, UT
5. Southern California Earthquake Center, Los Angeles, CA
6. Red River Community House, Red River, NM
7. Glen Canyon National Recreation Area, Page, AZ
9. Rio Grande Nature Center State Park, Albuquerque, NM
10. Four Corners School of Outdoor Education, Flora Vista, NM
11. National Mus of Nuclear Sci and History. Albuquerque, NM
12. Great Sand Dunes National Park and Pres, Mosca, CO
13. Hueco Tanks State Park and Historic Site, El Paso, TX
14. Smithsonian Institution, Napa, CA
15. Lafayette College, Easton, PA
16. Glen Canyon National Recreation Area, Page, AZ
17. Chinle Unified School District #24, Chinle, AZ
18. Doyon/Aramark JV (DNP&P), Colorado Springs, CO
19. National Park Service, Mountainair, NM
20. NM Museum of Natural History & Science, Albuquerque, NM
21. Great Sand Dunes National Park and Pres, Mosca, CO
22. Public Lands Interpretive Association, Flagstaff, AZ
23. San Bernardino County Museum, Redlands, CA
24. Edinboro University of Pennsylvania, Edinboro, PA
25. Asombro Institute for Science Education, Las Cruces, NM
26. Rough Rock Community School, Chinle, AZ
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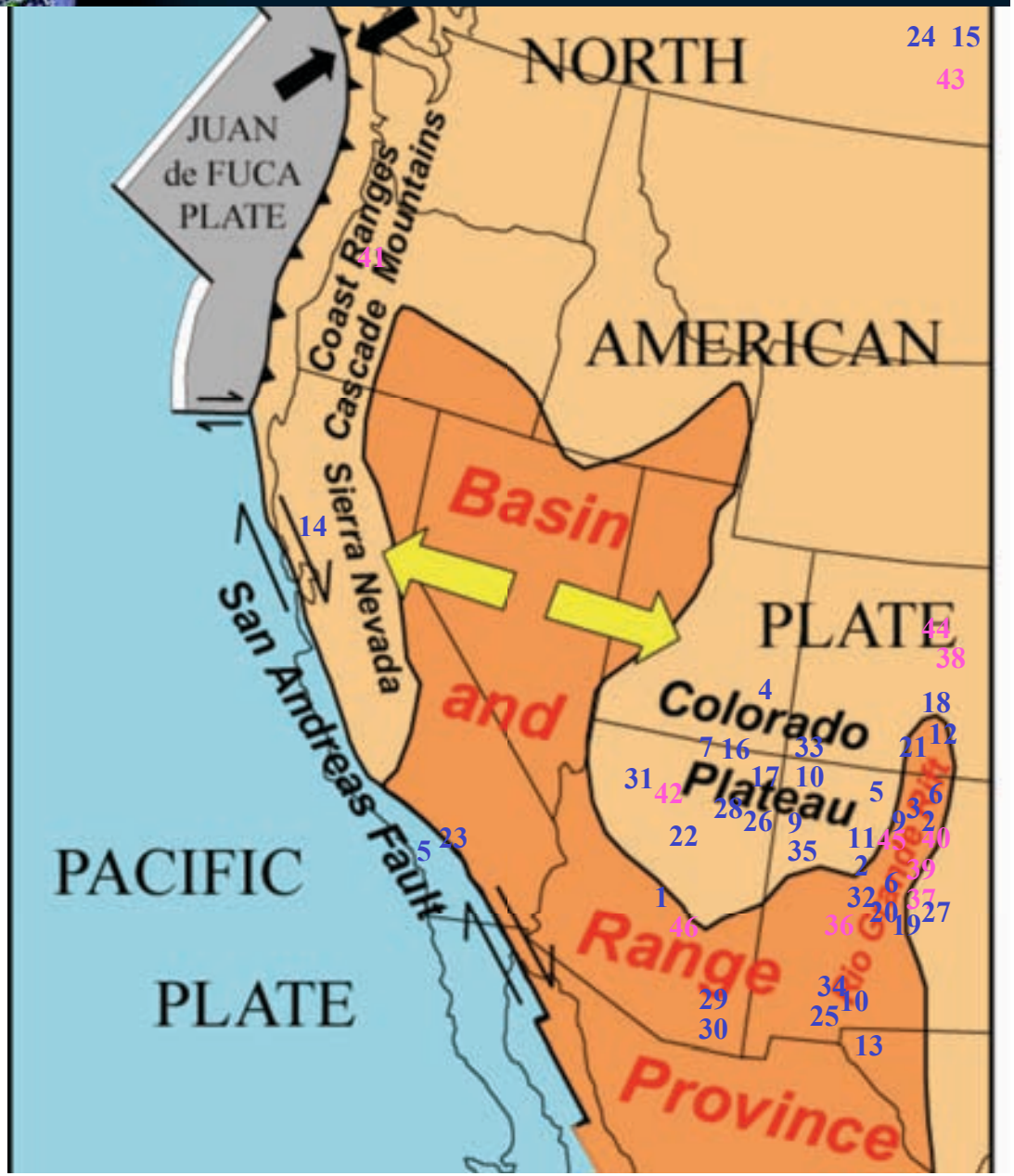
33. Four Corners School of Outdoor Education, Cortez, CO
34. Asombro Institute for Science Education, Las Cruces, NM
35. Bureau of Land Management, Grants, NM

Instructors

36. Rick Aster, New Mexico Tech, Socorro, NM
37. Jayne Aubele, New Mex Mus Nat Hist and Sci, Albuquerque, NM
38. Henry Berglund, University of Colorado, Boulder, CO
39. Laurie Crossey, University of New Mexico, Albuquerque, NM
40. Karl Karlstrom, University of New Mexico, Albuquerque, NM
41. Bob Lillie, Oregon State University, Corvallis, OR
42. Allyson Mathis, Grand Canyon National Park, Grand Canyon, AZ
43. Patrick McQuillan, Incorp Res Instit for Seismol, Washington, DC
44. Shelley Olds, UNAVCO, Inc., Boulder, CO
45. Mousumi Roy, University of New Mexico, Albuquerque, NM
46. Steve Semken, Arizona State University, Tempe, AZ



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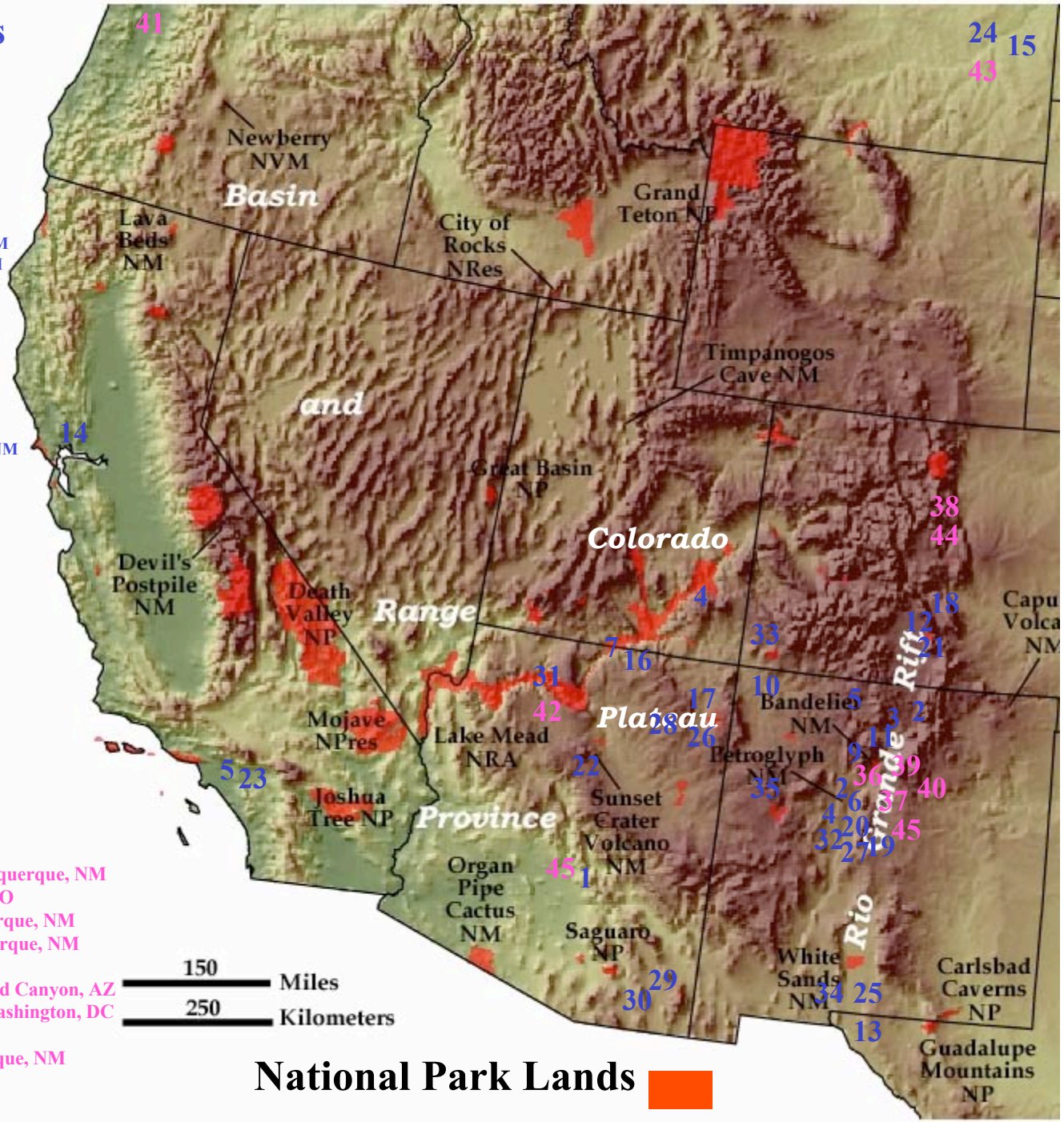


Introductions

1. Who? Where from? Why this workshop?

2. What's your favorite park - other than your own ☺ - and why?

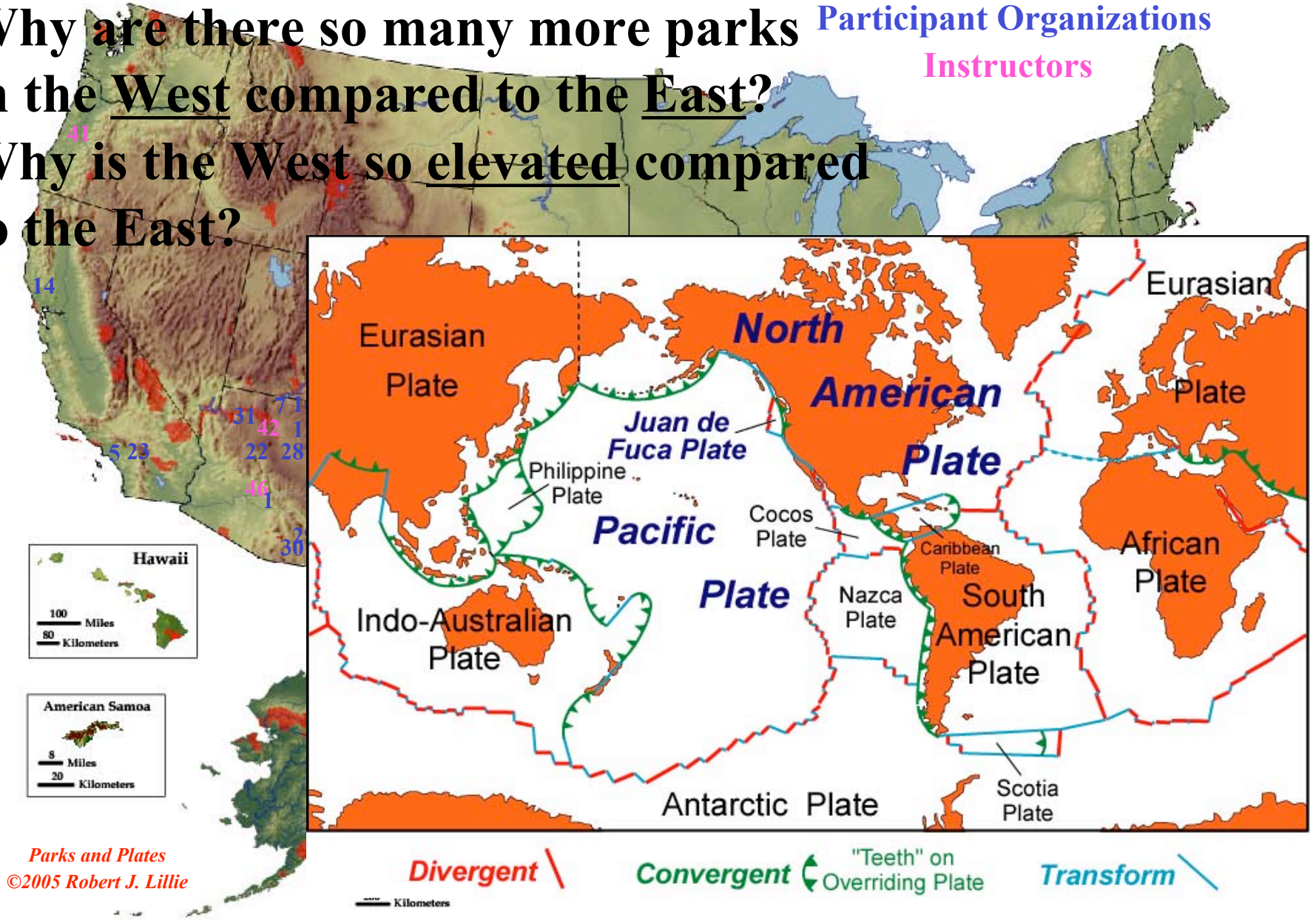
Park Lands: East vs. West

Why are there so many more parks in the West compared to the East?

Why is the West so elevated compared to the East?

Participant Organizations

Instructors



Parks and Plates

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PLATE TECTONICS

- **Tectonics:**
- **From the Greek "*tecton*"**
  - **builder**
  - **"architect"**
- **The study of large features on Earth's surface and the processes that form them.**

"PLATE TECTONICS"

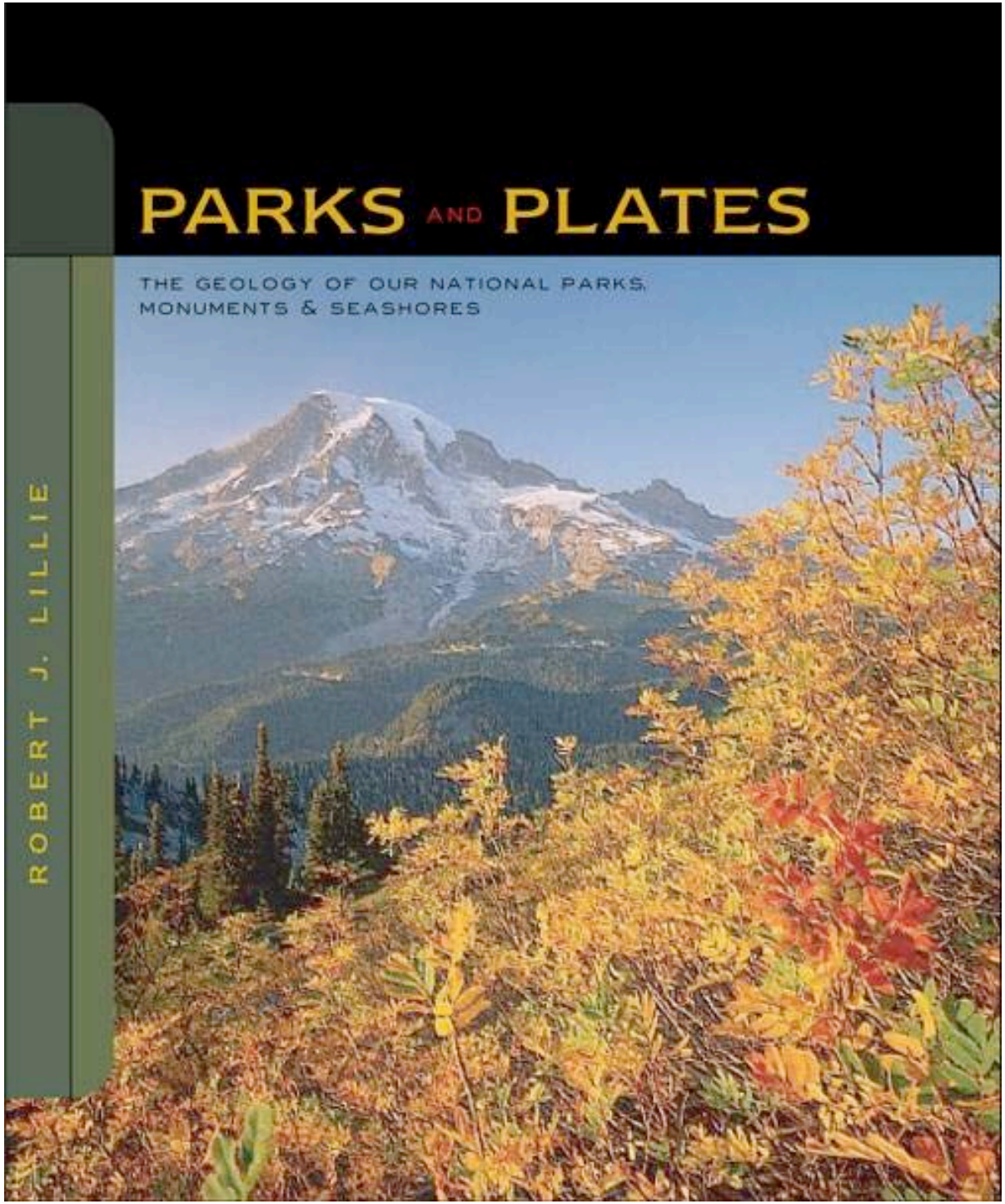
- **Large features:**
  - **continents**
  - **ocean basins**
  - **mountain ranges**
- **and processes:**
  - **earthquakes**
  - **volcanic eruptions**
- **due to movement of plates of Earth's outer shell.**

Cracked Egg Shell!

Parks and Plates
©2005 Robert J. Lillie

Landscapes of national parks due to processes:

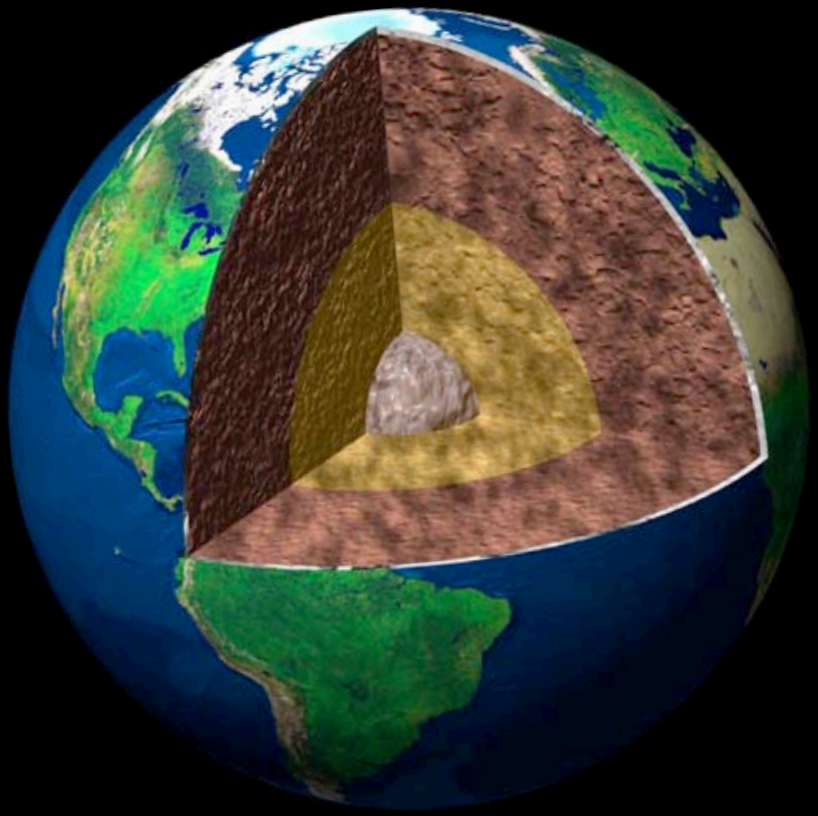
- At plate boundaries
  1. Where they pull apart (divergent)
  2. Where they crash together (convergent)
  3. Where they slide past one another (transform)
- And at hotspots



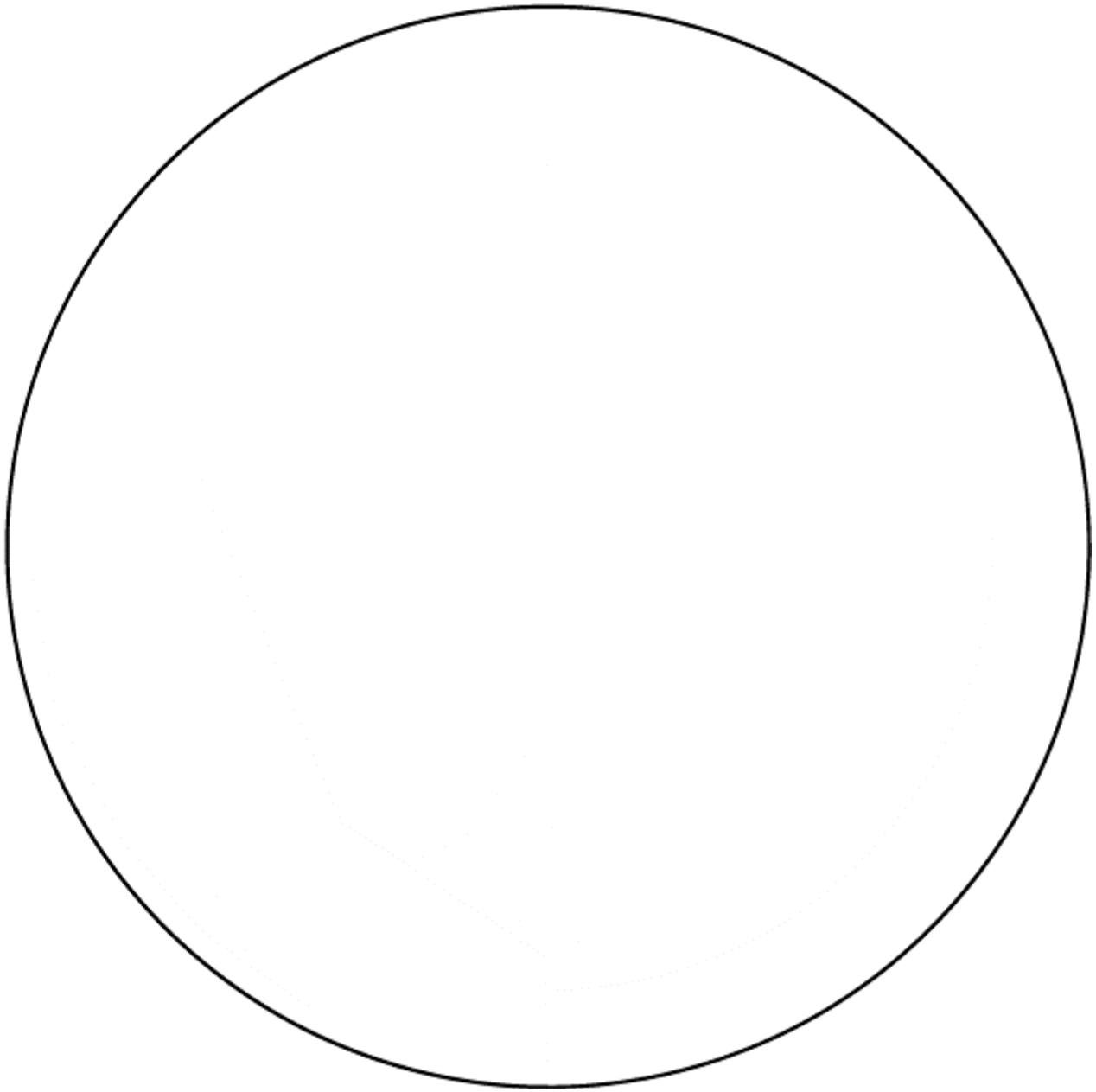
National Aeronautics and Space Administration

EarthScope

Like a "Hubble Telescope" aimed into the Earth ☺



Classical Divisions of the Earth
(Chemical Composition)



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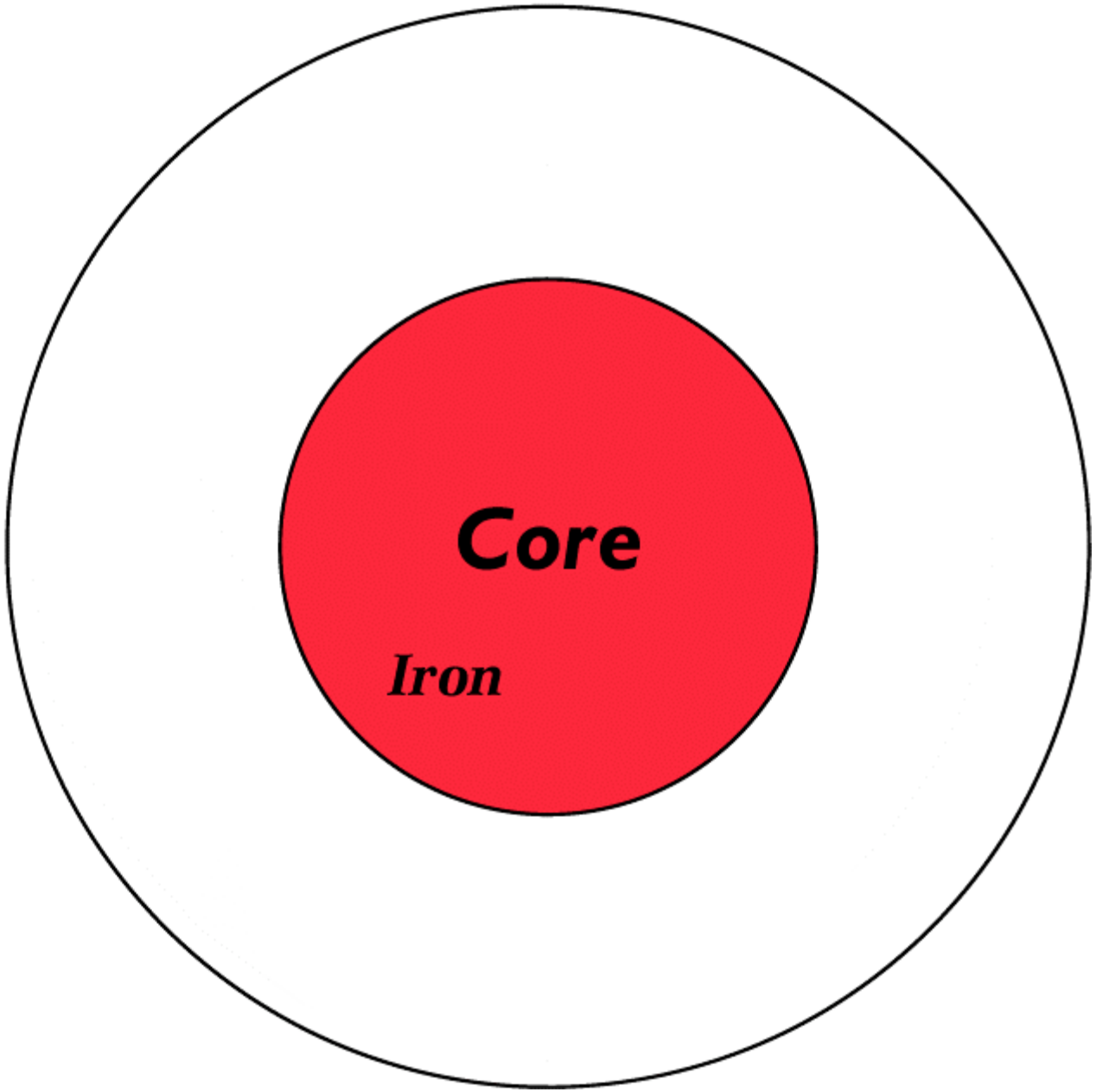

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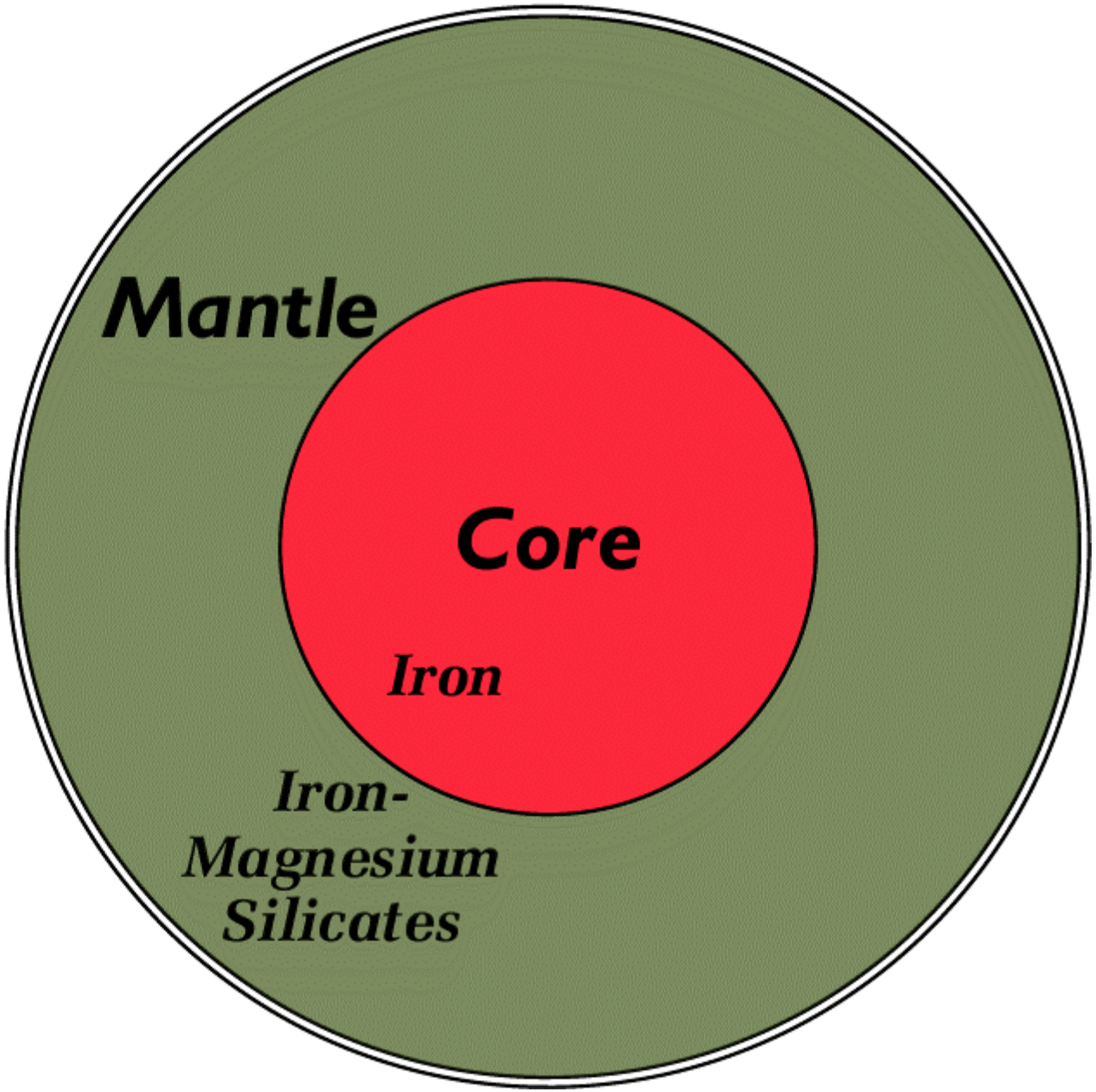

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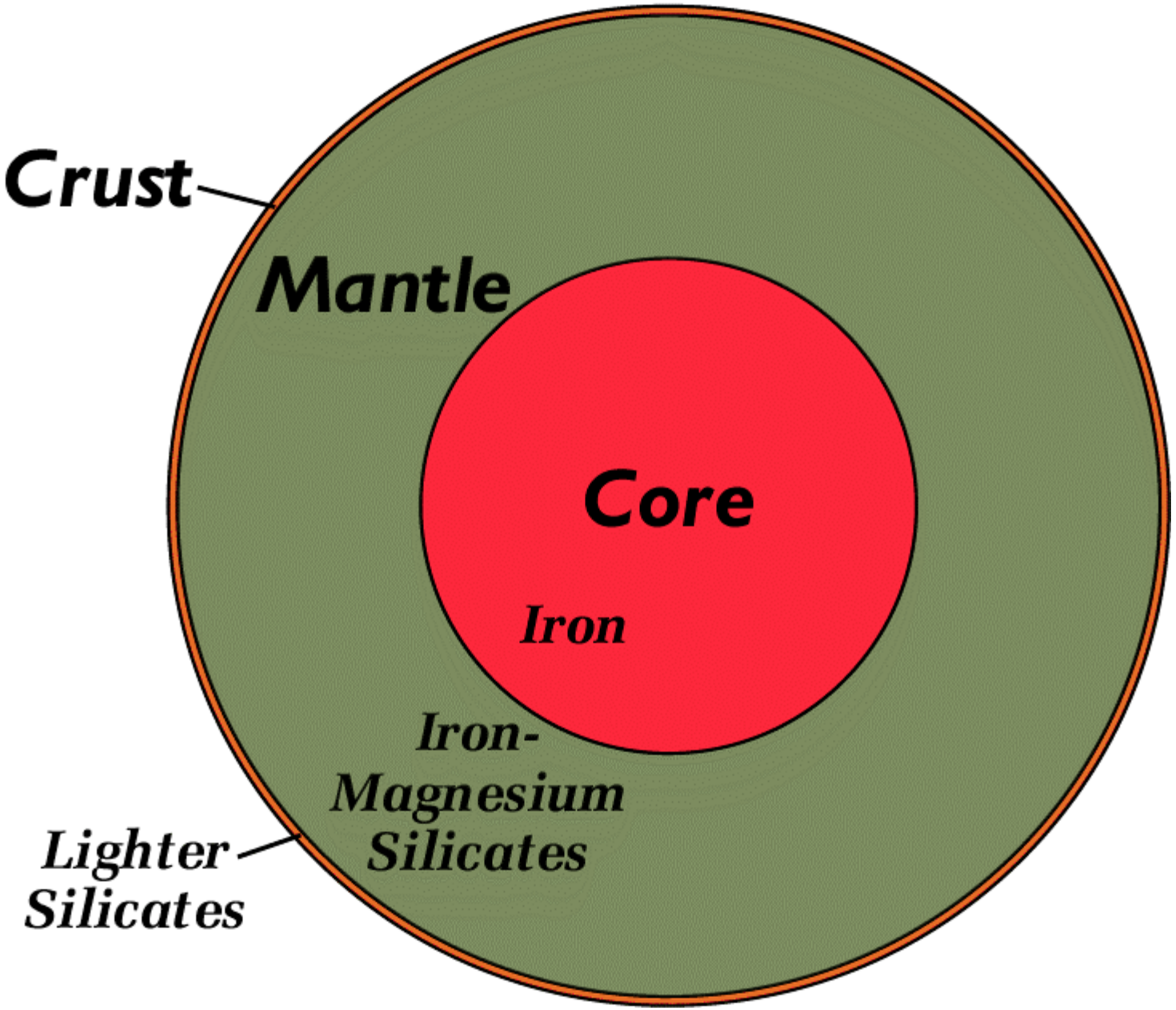
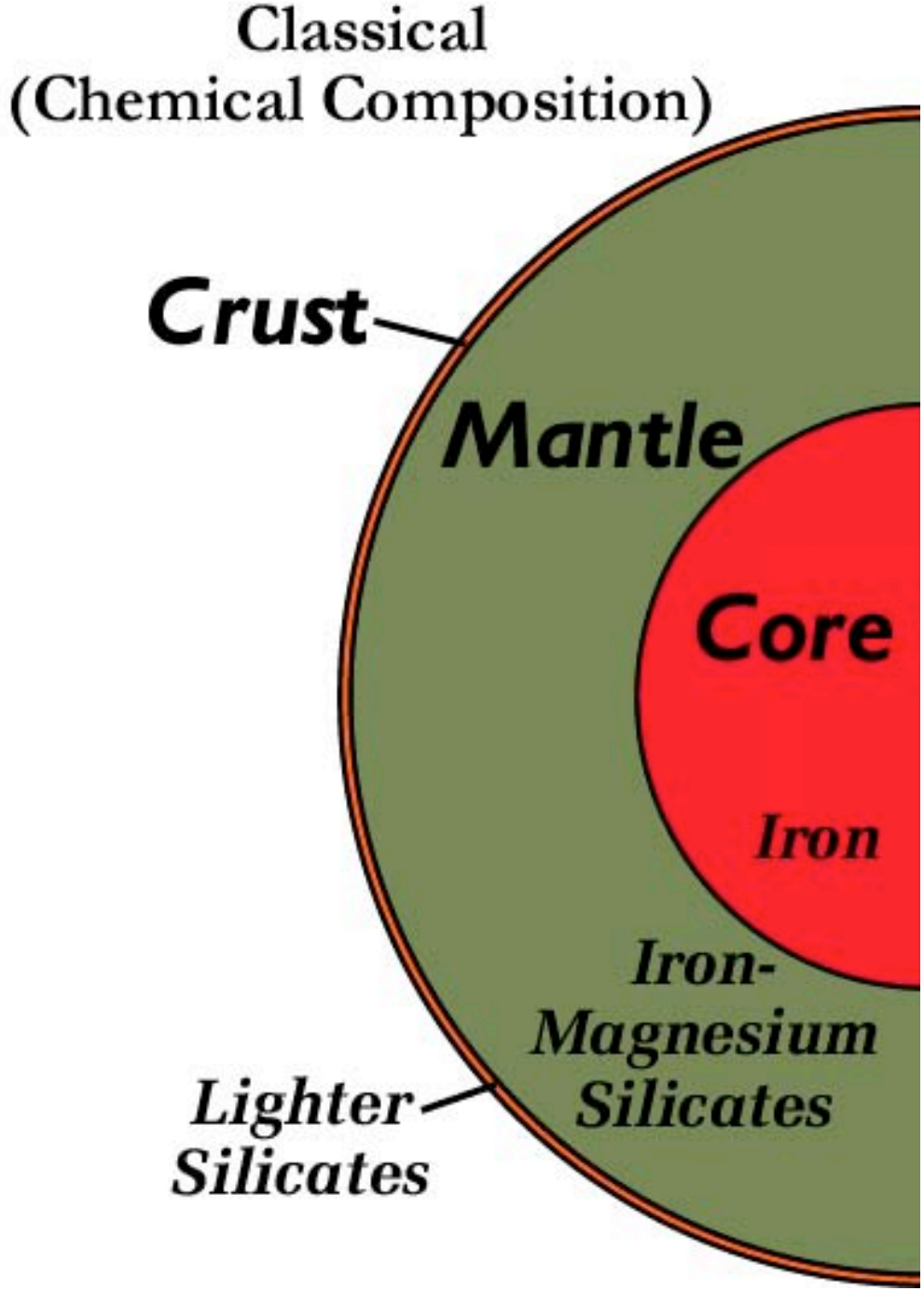
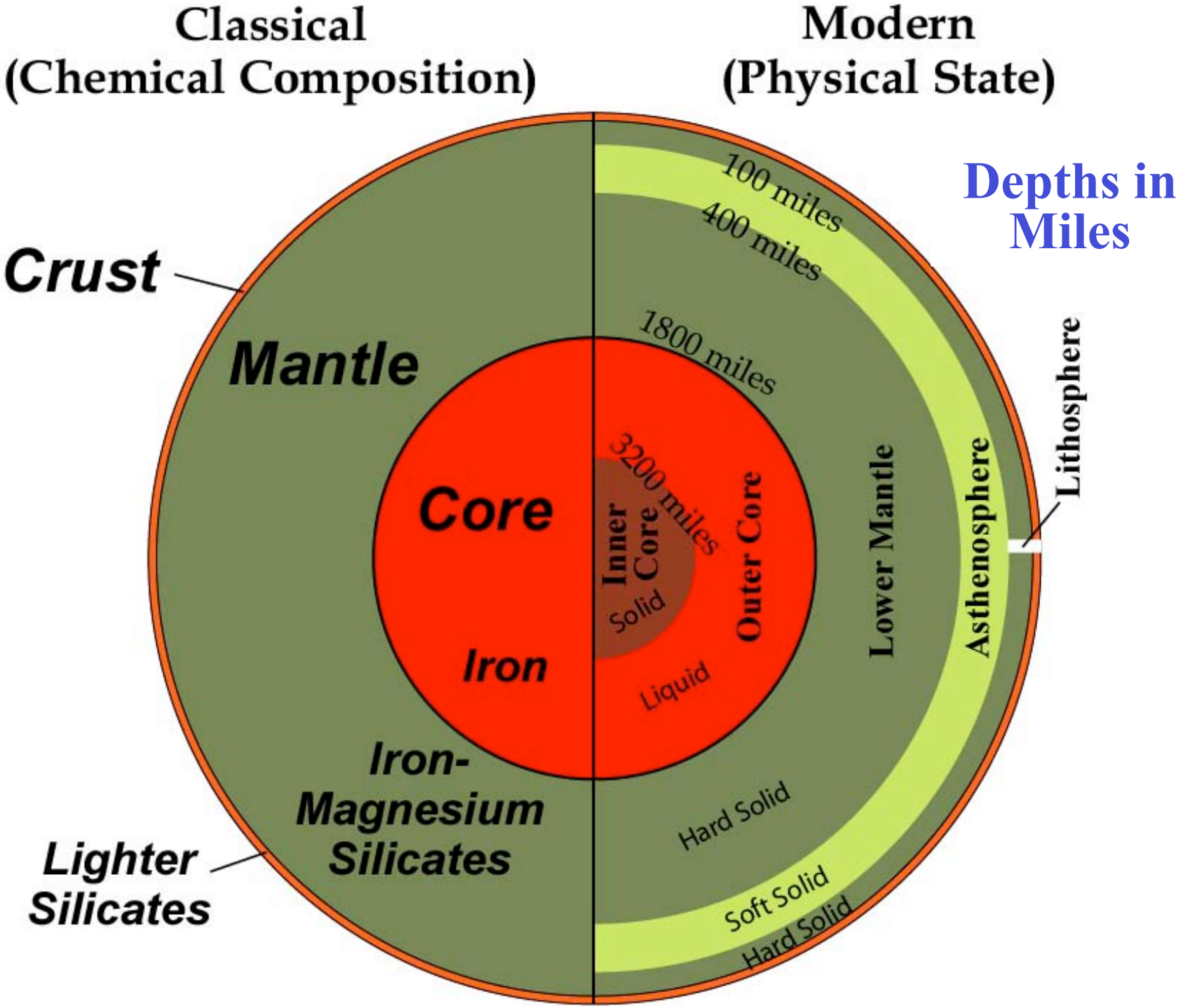
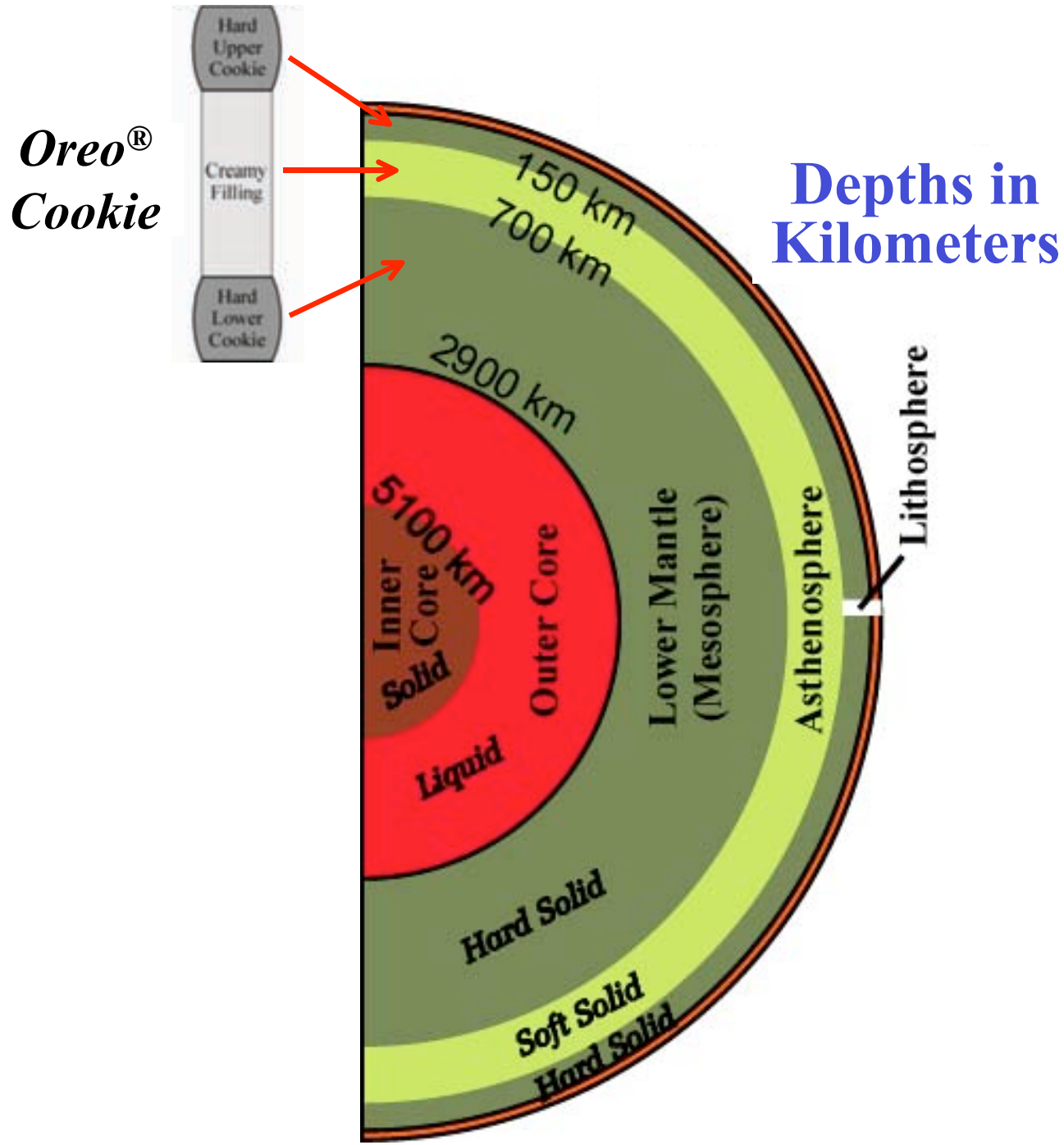



Classical
(Chemical Composition)
Crust
Mantle
Core
Iron
Iron-
Magnesium
Silicates
Lighter
Silicates


Classical
(Chemical Composition)
Modern
(Physical State)
Depths in Miles
Crust
Mantle
Core
Iron
Iron-
Magnesium
Silicates
Lighter
Silicates
100 miles
400 miles
1800 miles
3200 miles
Inner Core
Solid
Outer Core
Liquid
Lower Mantle
Hard Solid
Asthenosphere
Soft Solid
Lithosphere
Hard Solid


Oreo®
Cookie
Hard Upper Cookie
Creamy Filling
Hard Lower Cookie
Depths in Kilometers
150 km
700 km
2900 km
5100 km
Inner Core
Solid
Outer Core
Liquid
Lower Mantle (Mesosphere)
Asthenosphere
Lithosphere
Hard Solid
Soft Solid
Hard Solid

Oreo® Cookie

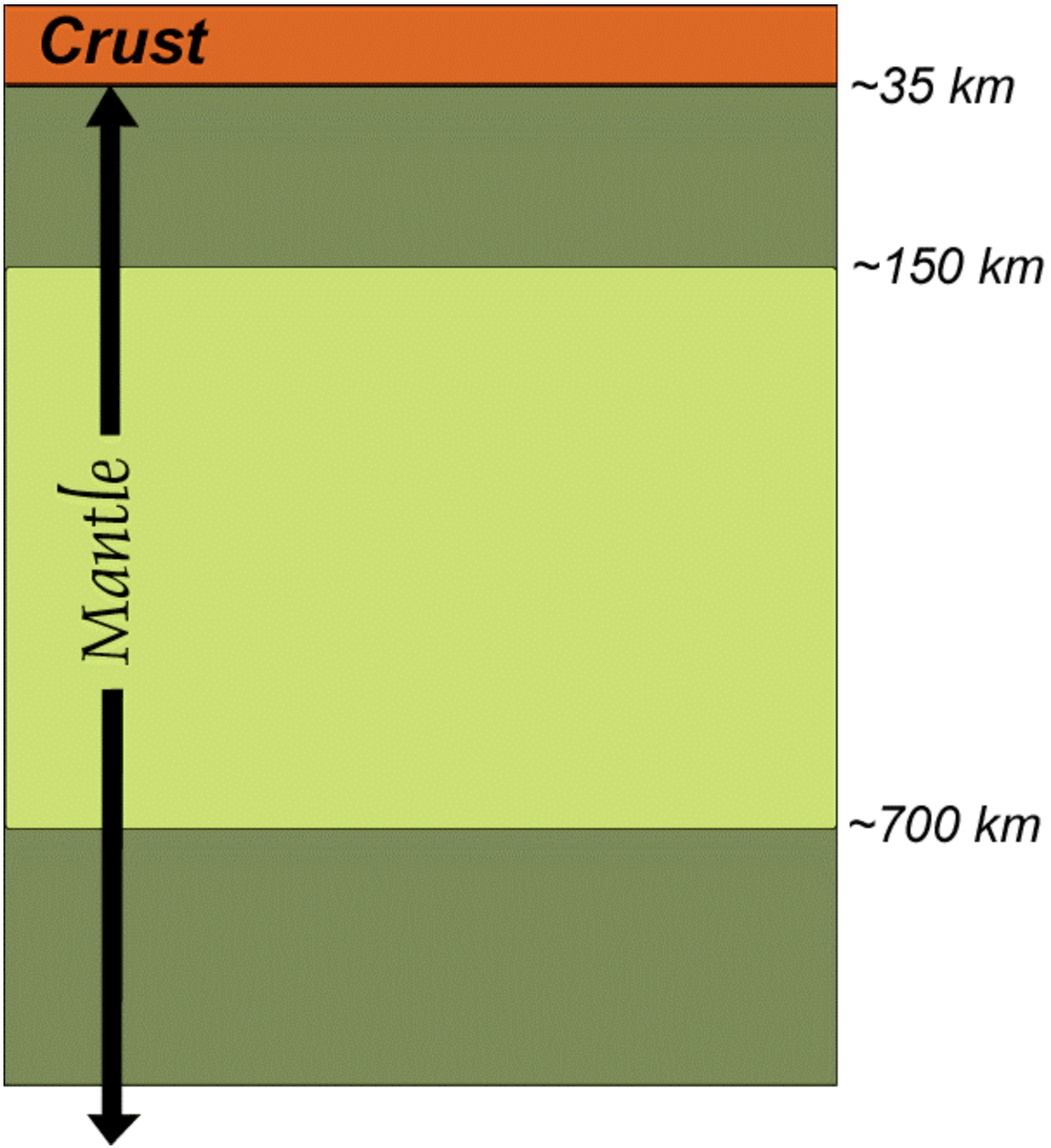
Oreo® Cookie


Hard
Upper
Cookie
Creamy
Filling
Hard
Lower
Cookie


Crust
~35 km

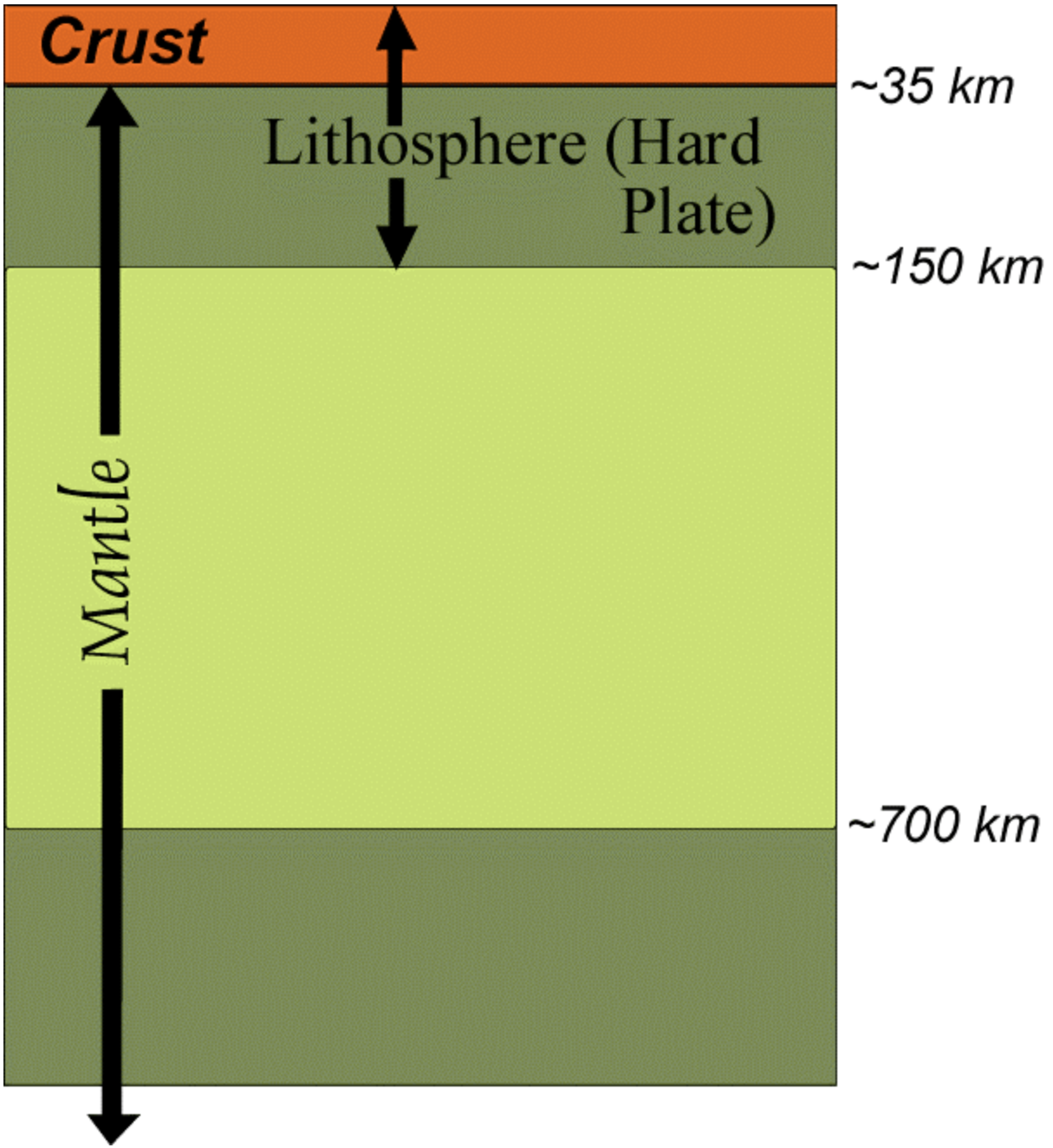
Oreo® Cookie


Hard
Upper
Cookie
Creamy
Filling
Hard
Lower
Cookie


Crust
~35 km
~150 km
Mantle
~700 km

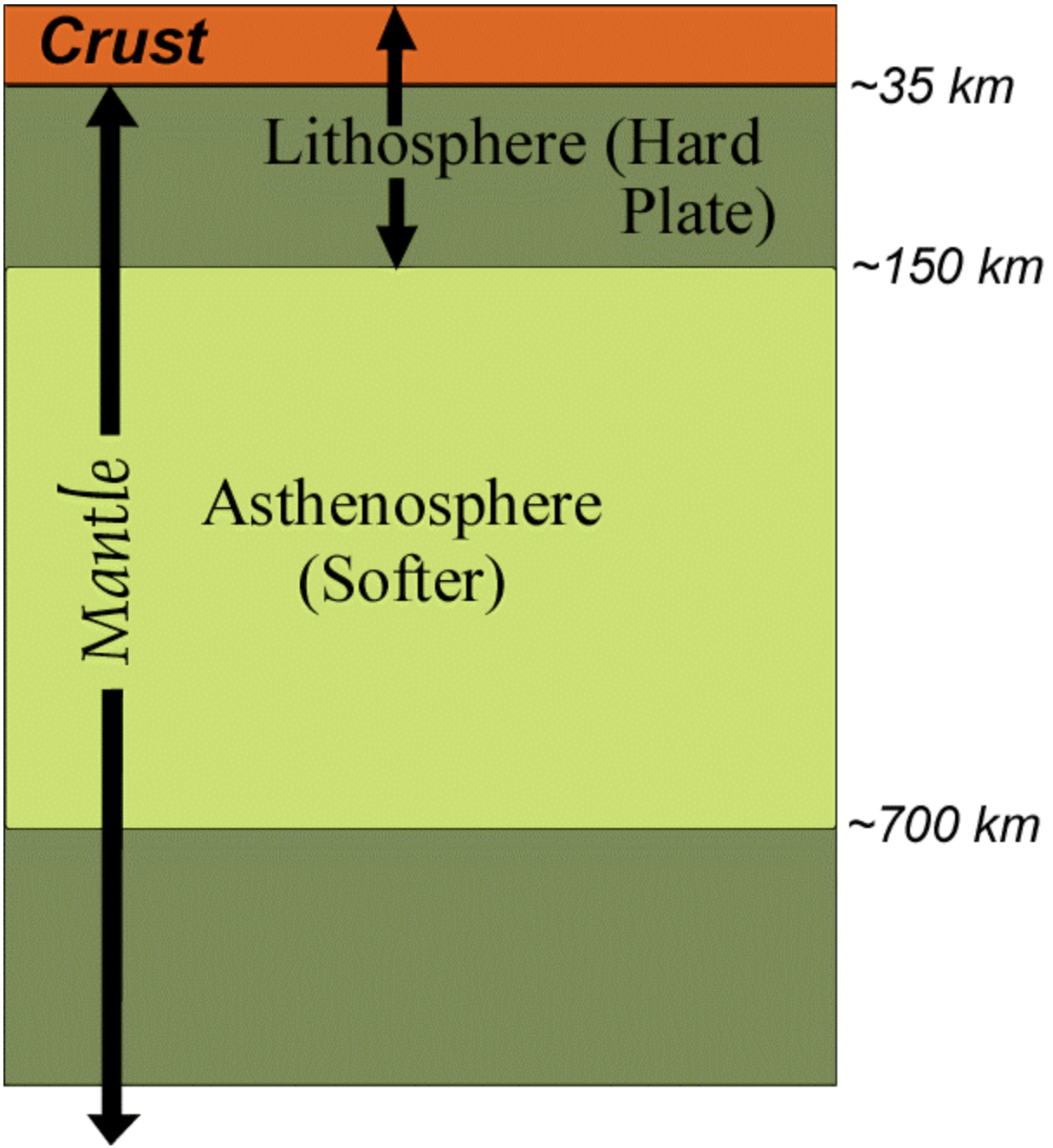
Oreo® Cookie


Hard Upper Cookie
Creamy Filling
Hard Lower Cookie


Crust
Lithosphere (Hard Plate)
Mantle
~35 km
~150 km
~700 km

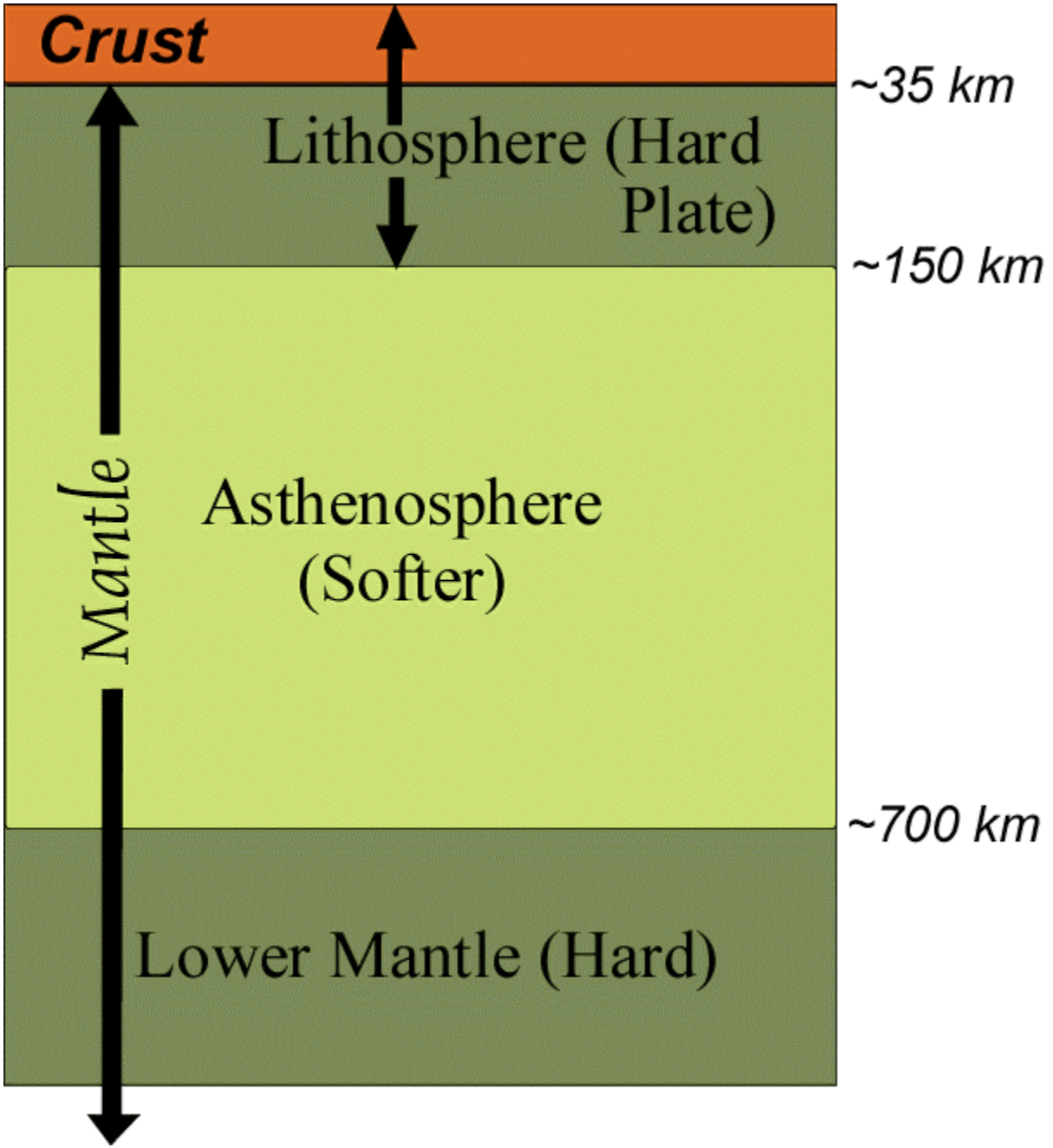
Oreo® Cookie


Hard Upper Cookie
Creamy Filling
Hard Lower Cookie


Crust
Lithosphere (Hard Plate)
Mantle
Asthenosphere (Softer)
~35 km
~150 km
~700 km

Oreo® Cookie


Hard Upper Cookie
Creamy Filling
Hard Lower Cookie


Crust
~35 km
Lithosphere (Hard Plate)
~150 km
Mantle
Asthenosphere (Softer)
~700 km
Lower Mantle (Hard)


Robert J. Lillie

Oreo® Psycho-Personality Test

www.superkids.com/aweb/pages/humor/050199.sht

- **Psychologists have discovered that the manner in which people eat Oreo® cookies provides great insight into their personalities. Choose which method best describes your favorite method of eating Oreos:**
- **1. The whole thing at once.**
  2. One bite at a time.
  3. Slow and methodical nibbles examining the results of each bite afterwards.
  4. In little feverous nibbles.
  5. Dunked in some liquid (milk, coffee …..)
  6. Twisted apart, the inside, then the cookie.
  7. Twisted apart, the inside, and toss the cookie.
  8. Just the cookie, not the inside.
  9. I just like to lick them, not eat them.
  10. I don't have a favorite way because I don't like Oreos.

6. Twisted apart, the inside, then the cookie.

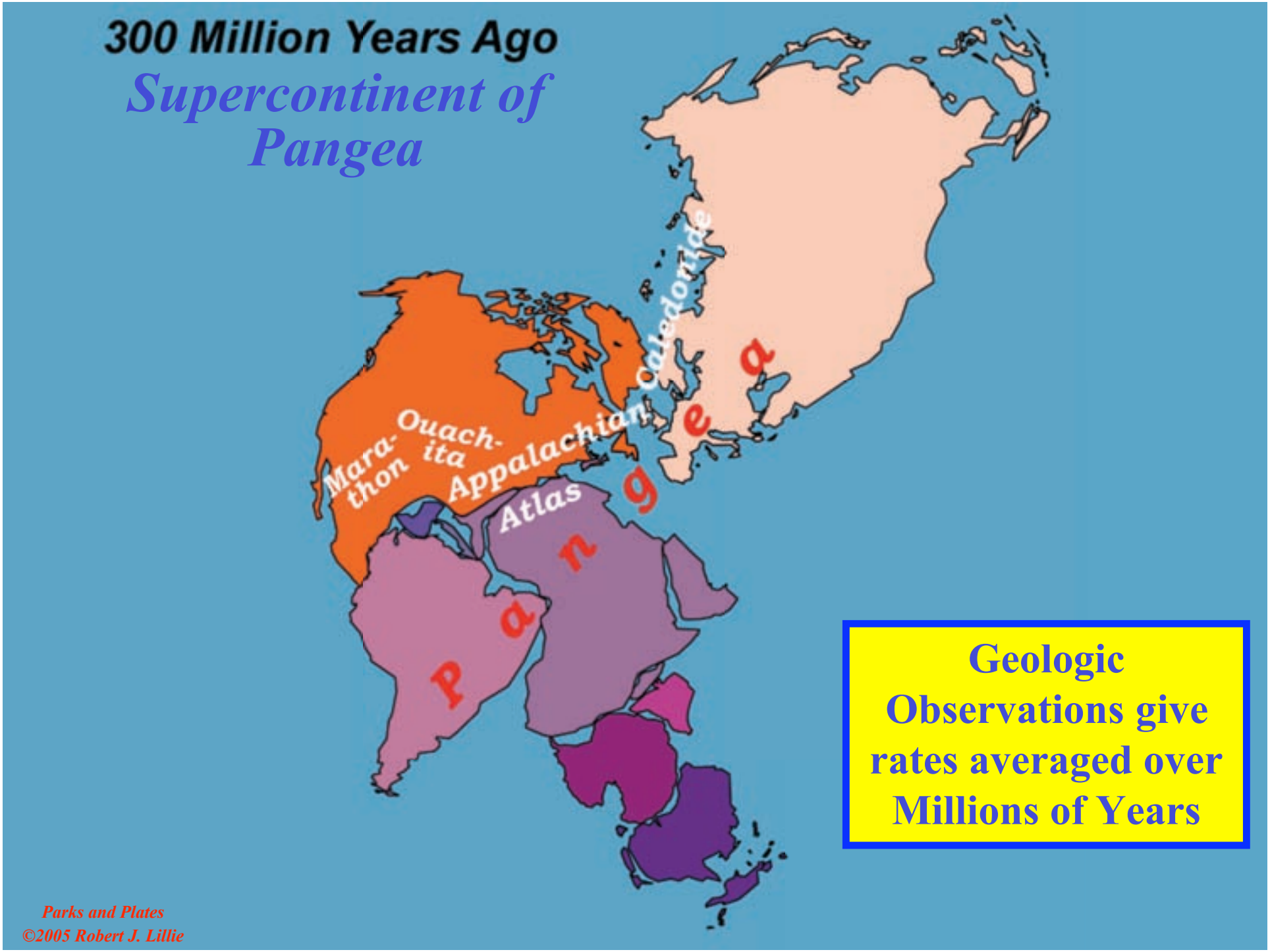
- You have a highly curious nature.
- You take pleasure in breaking things apart to find out how they work, though you're not always able to put them back together, so you destroy all the evidence of your activities.
- You deny your involvement when things go wrong.
- You are a compulsive liar and exhibit deviant, if not criminal, behavior.

Sliding Plate over Asthenosphere

Robert J. Lillie

Divergent Plate Boundary


Mid-Atlantic
Ridge


300 Million Years Ago
Supercontinent of Pangea
Mara-thon
Ouach-ita
Appalachian
Caledonide
Atlas
Pangea
Geologic Observations give rates averaged over Millions of Years
Parks and Plates
©2005 Robert J. Lillie

Today *Atlantic Ocean Ocean Continues to Open*

Geologic Observations give rates averaged over Millions of Years

Parks and Plates
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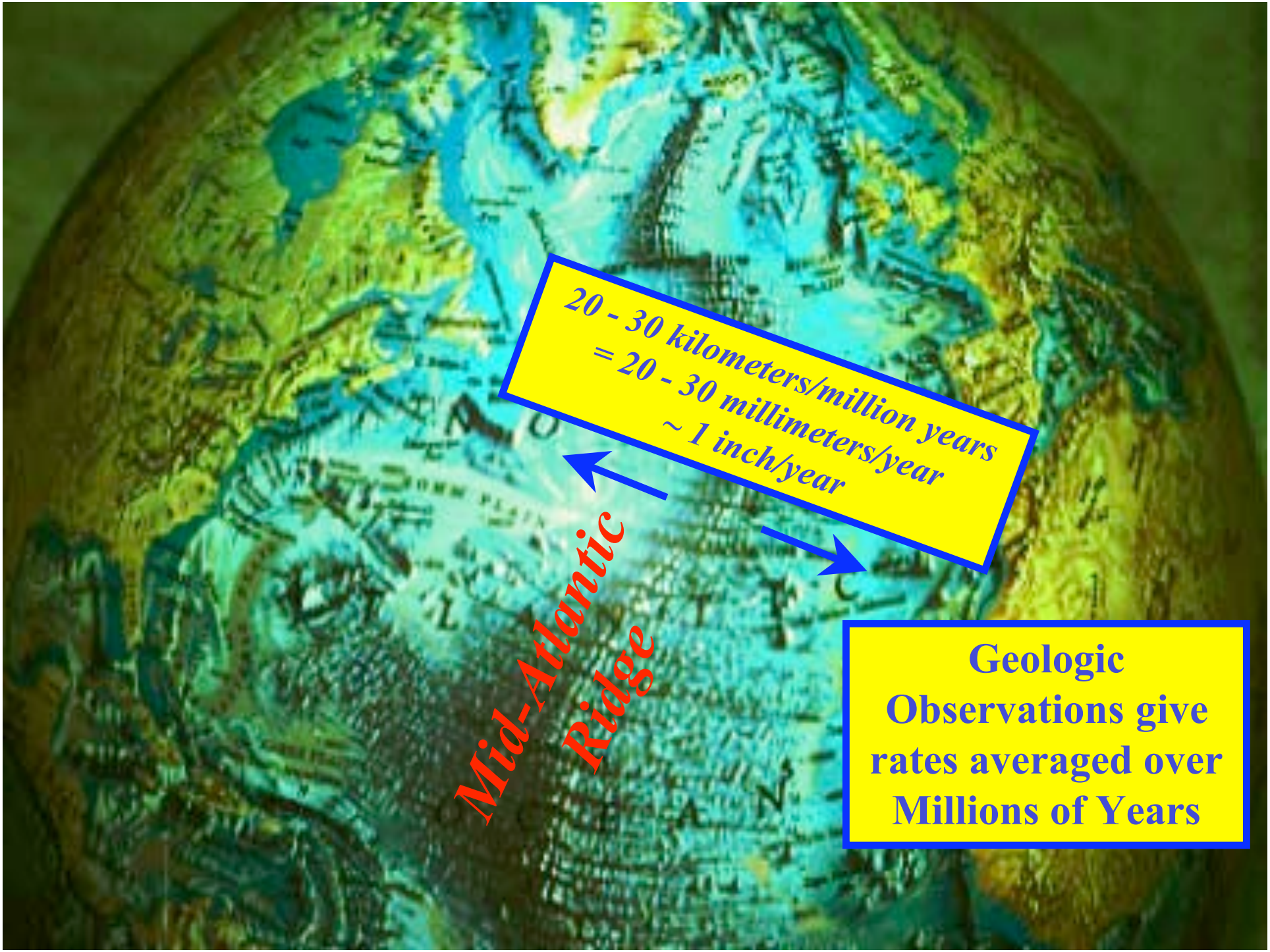
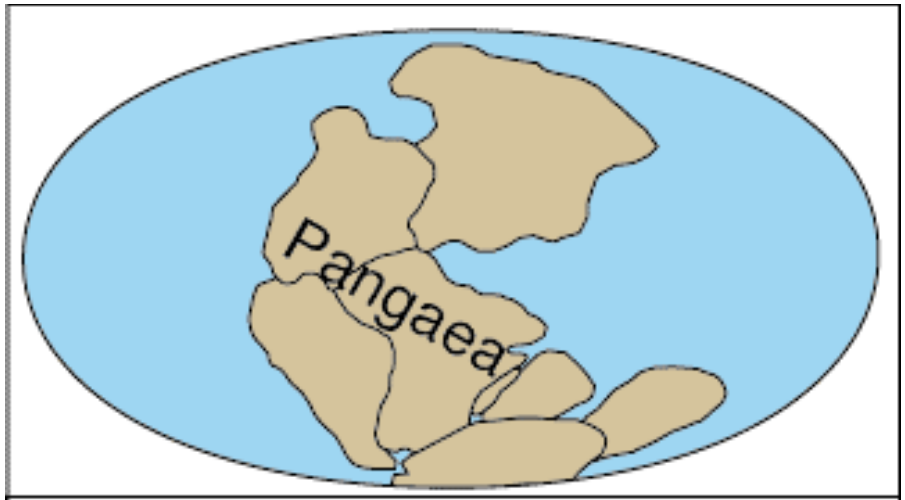

20 - 30 kilometers/million years
= 20 - 30 millimeters/year
~ 1 inch/year
Mid-Atlantic Ridge
Geologic Observations give rates averaged over Millions of Years

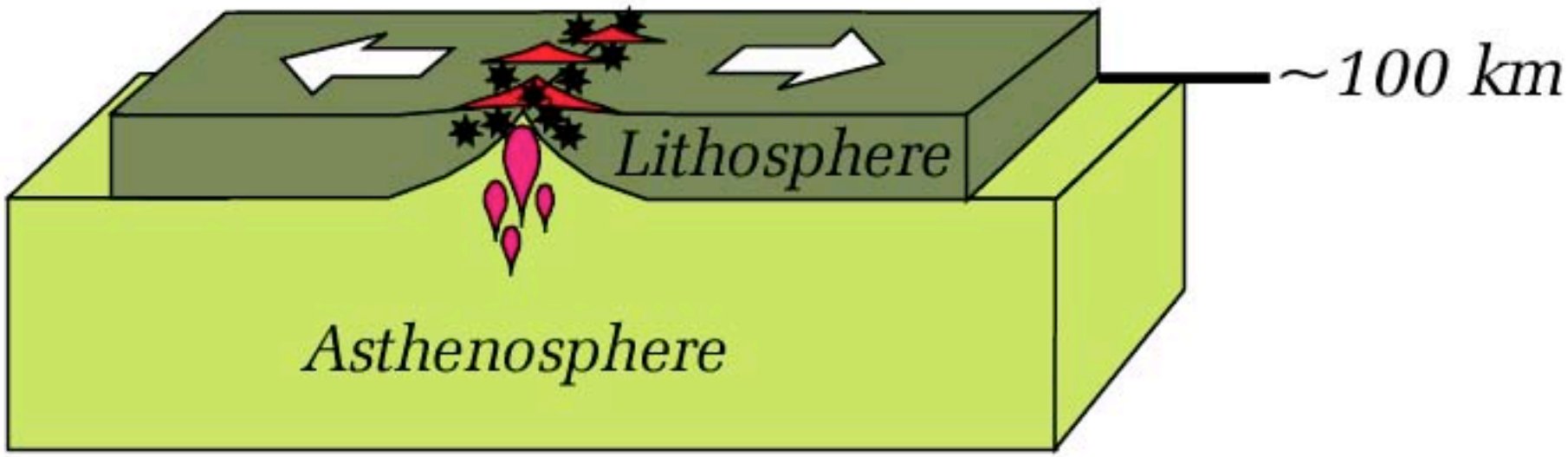
Wegener's Dream

"This [direct measurement of continental drift] must be left to the geodesists. I have no doubt that in the not too distant future we will be successful in making a precise measurement of the drift of North America relative to Europe."-- **Alfred Wegener, 1929**



200 million years ago all of the present-day continents combined to form a single supercontinent called Pangaea.

Divergent Plate Boundary



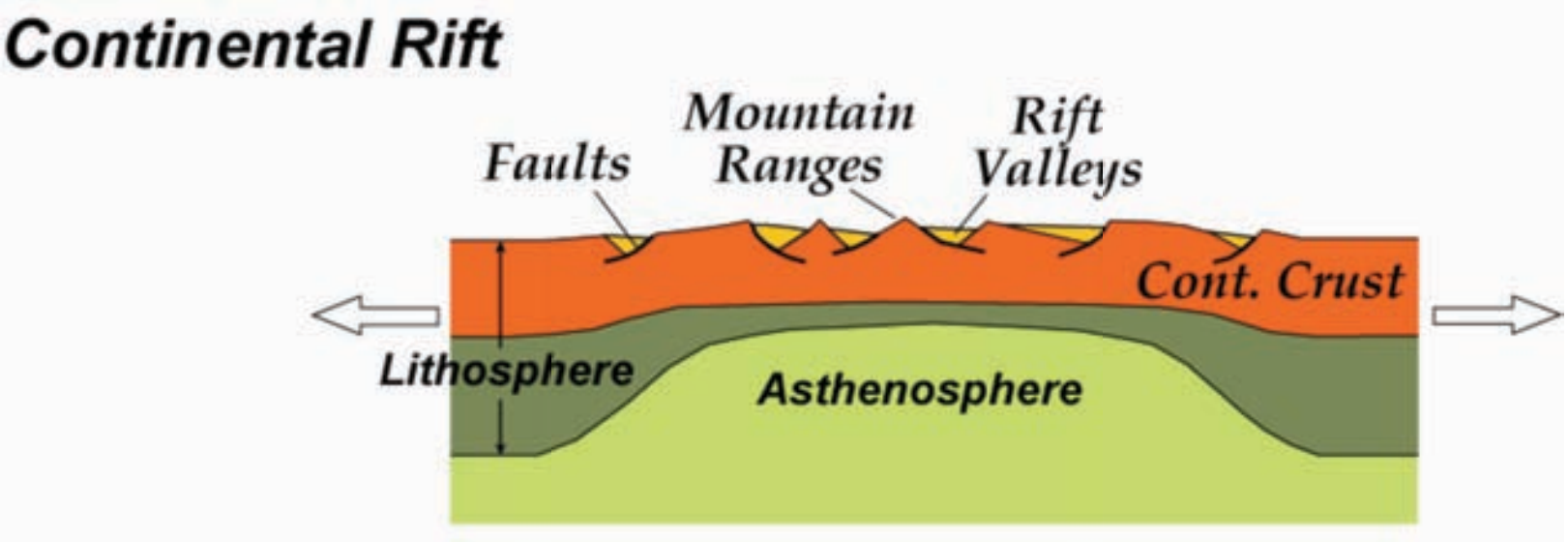
Volcanoes

Earthquakes

- Small to Moderate Size
- Very Large

Characteristics of Divergent Plate Boundaries

1) **Pull-Apart (Extensional) Forces:**
   - Fault-Block mountains
   - "Basins" and "Ranges"
2) **Elevated Topography:**
   - Due to shallow, hot mantle (asthenosphere)
3) **Volcanism:**
   - Hot asthenosphere rises and melts as pressure drops



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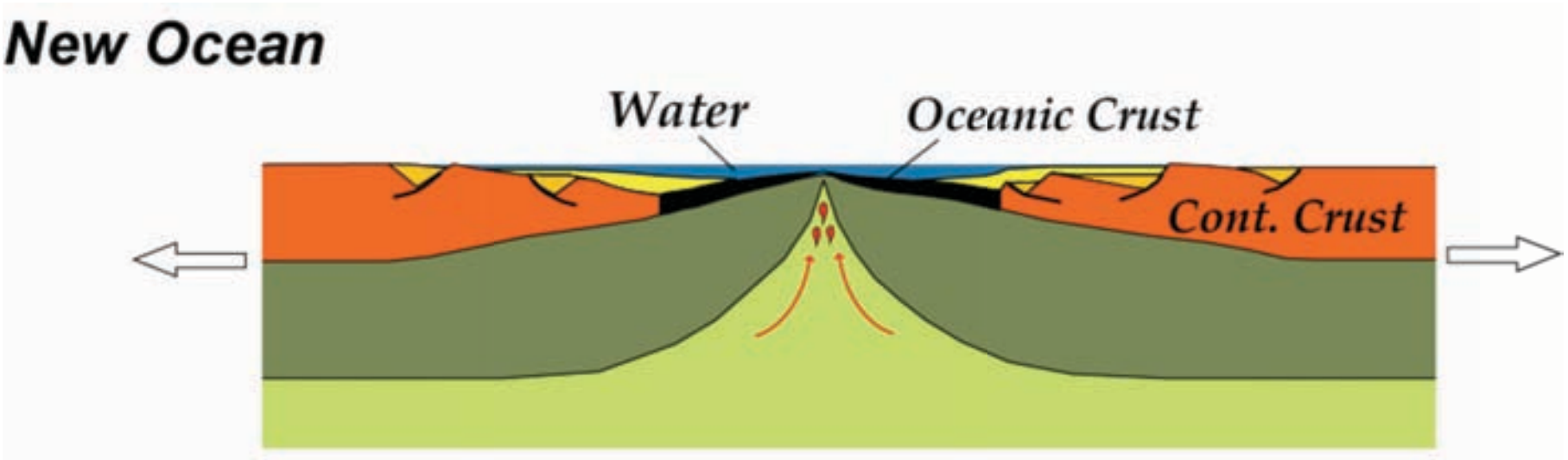
Characteristics of Divergent Plate Boundaries

4) Continental Rifting can eventually open an entire ocean.

- Elevated topography and volcanism at a mid-ocean ridge



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Characteristics of Divergent Plate Boundaries

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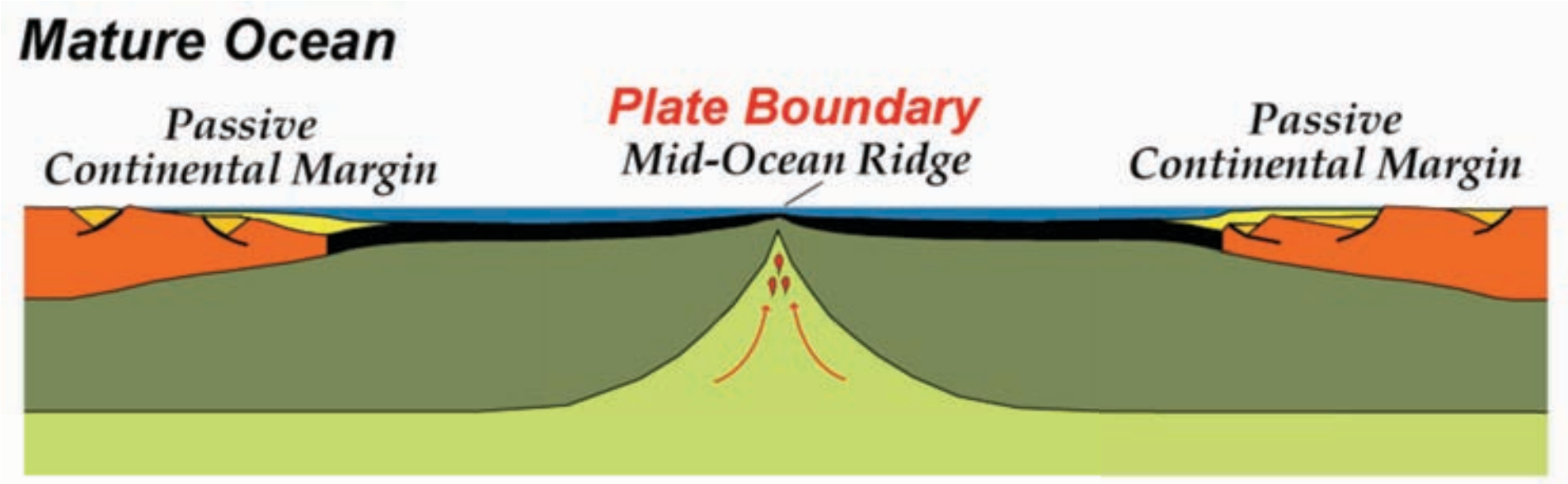

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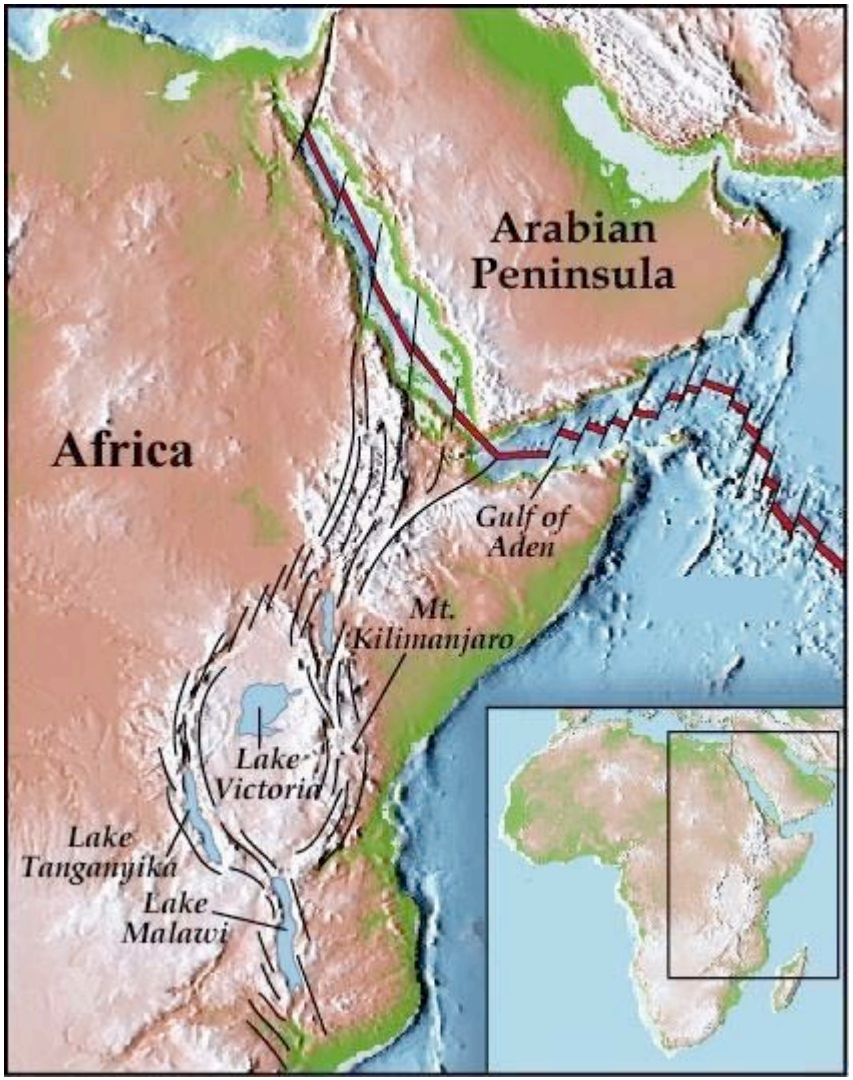
Three Stages of Divergent Plate Boundary Development



Marshak, EARTH (Norton, 2005)

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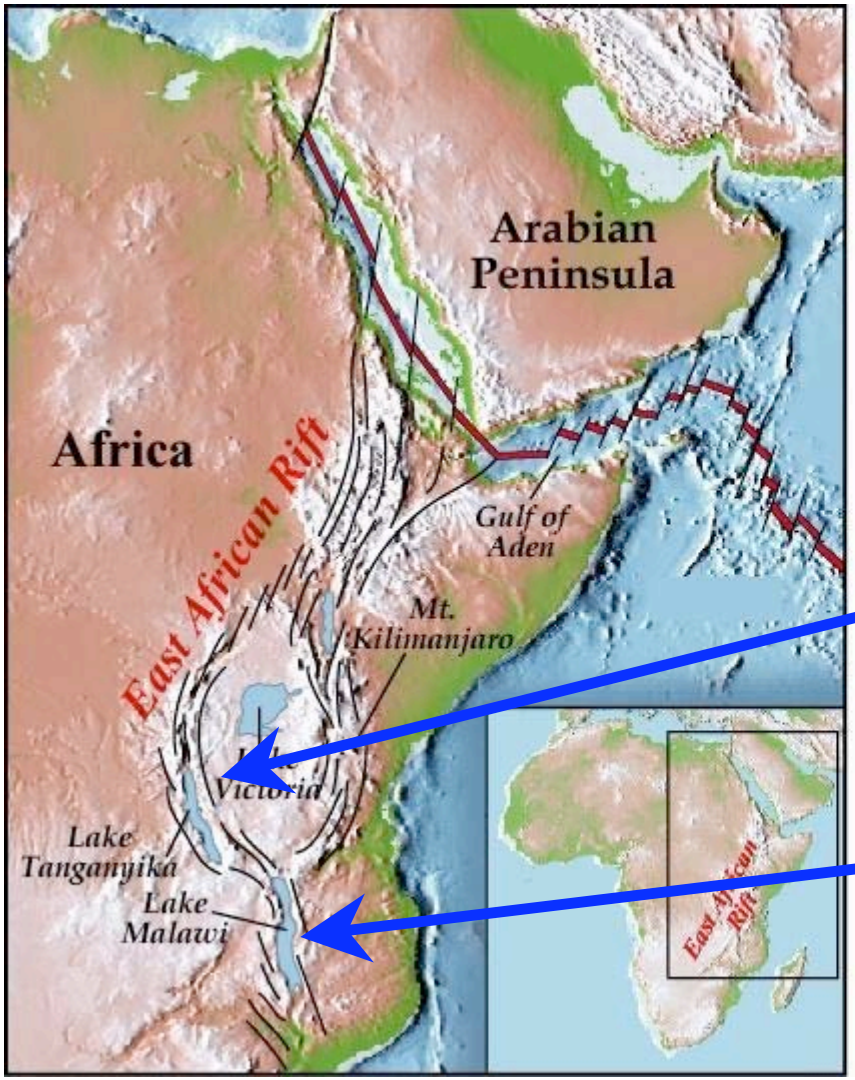
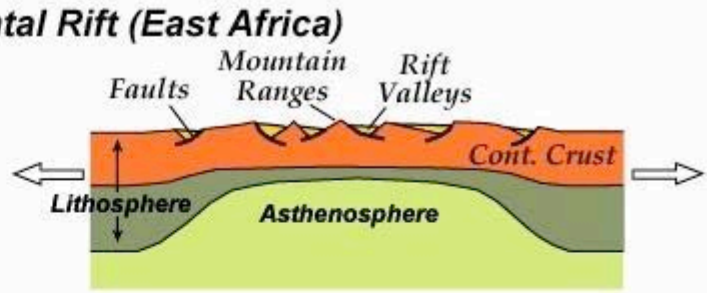
Three Stages of Divergent Plate Boundary Development





World's 2nd Deepest Lake

World's 4th Deepest Lake

Marshak, EARTH (Norton, 2005)

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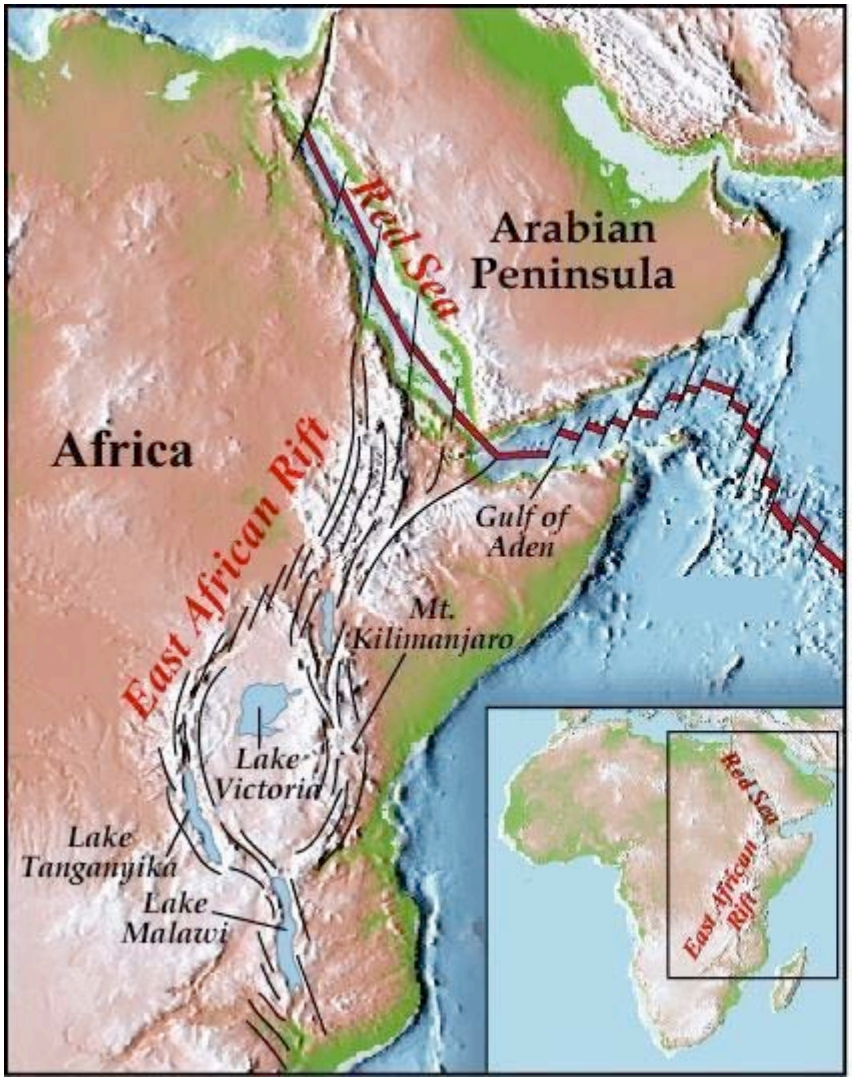
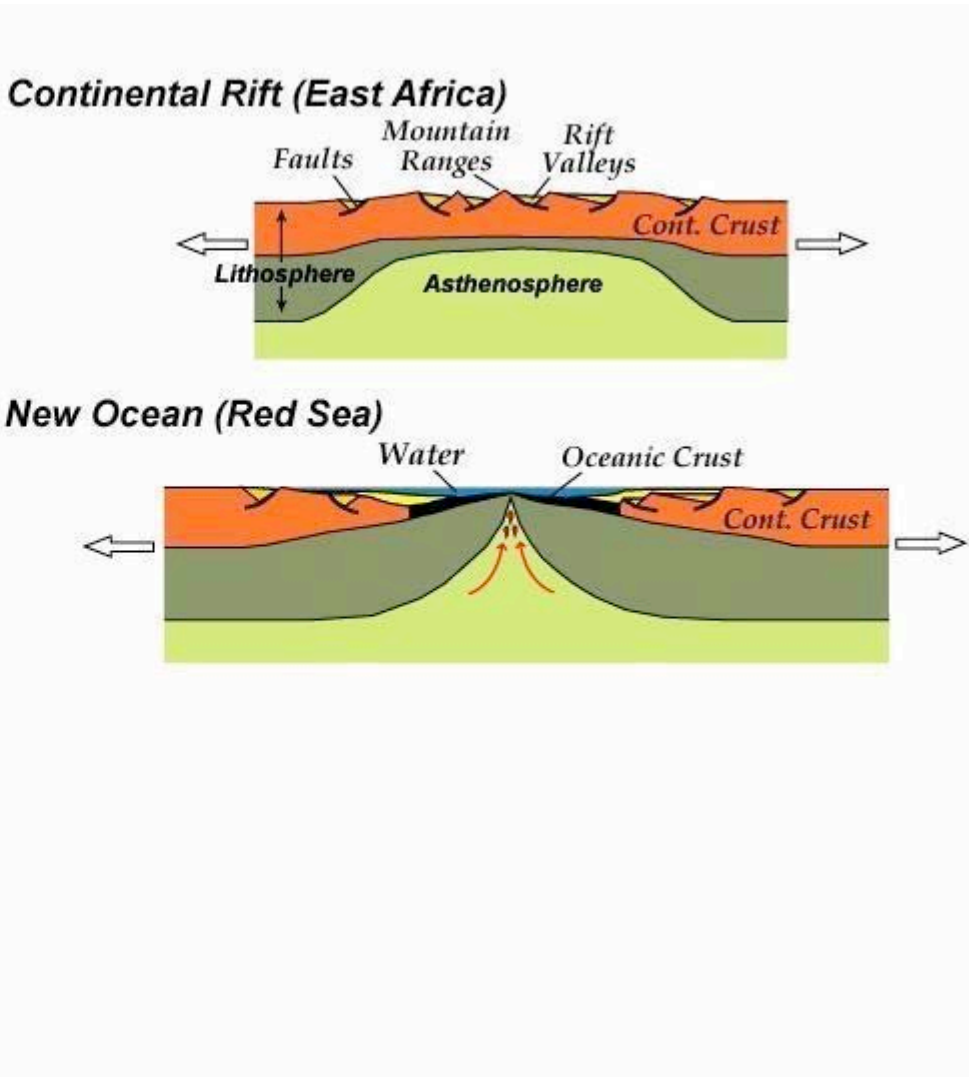
Three Stages of Divergent Plate Boundary Development





Marshak, EARTH (Norton, 2005)

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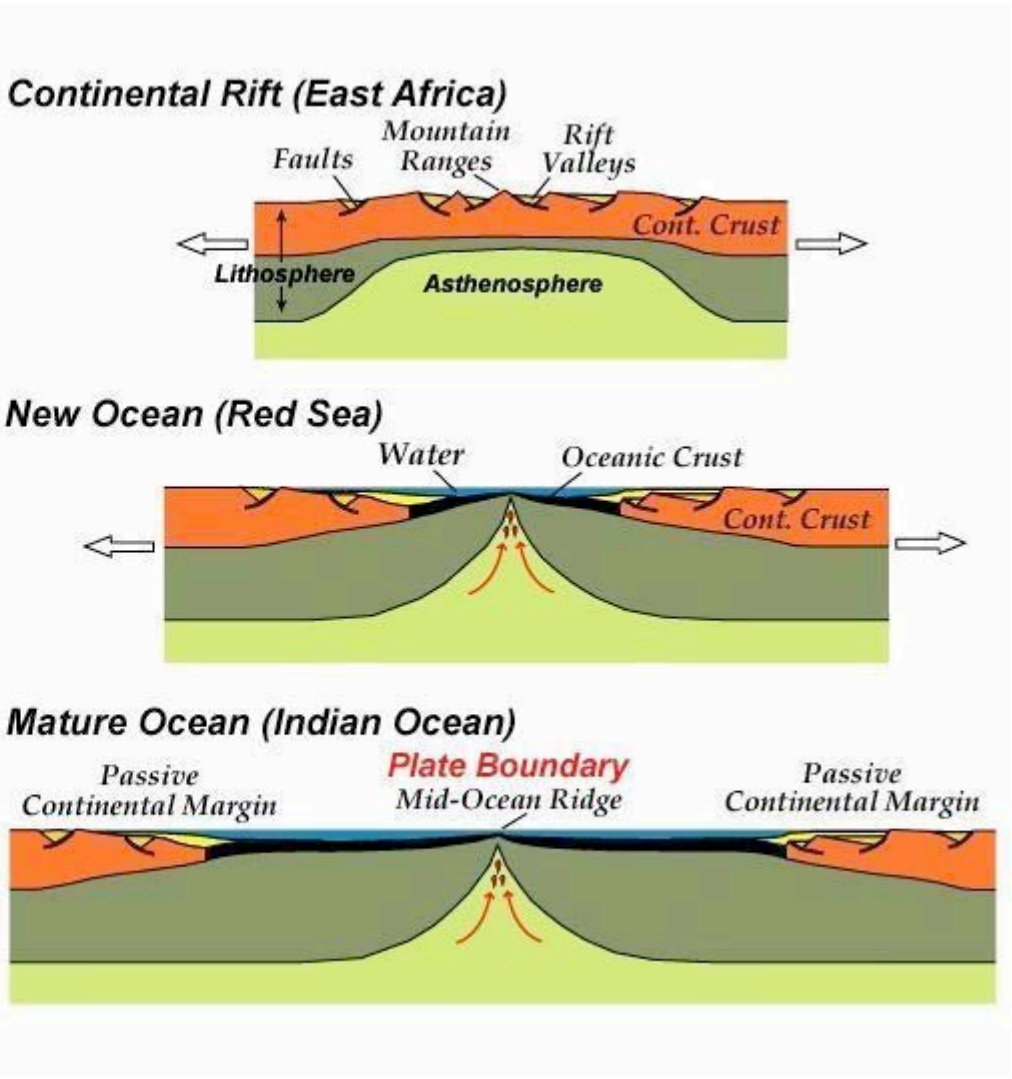
Three Stages of Divergent Plate Boundary Development



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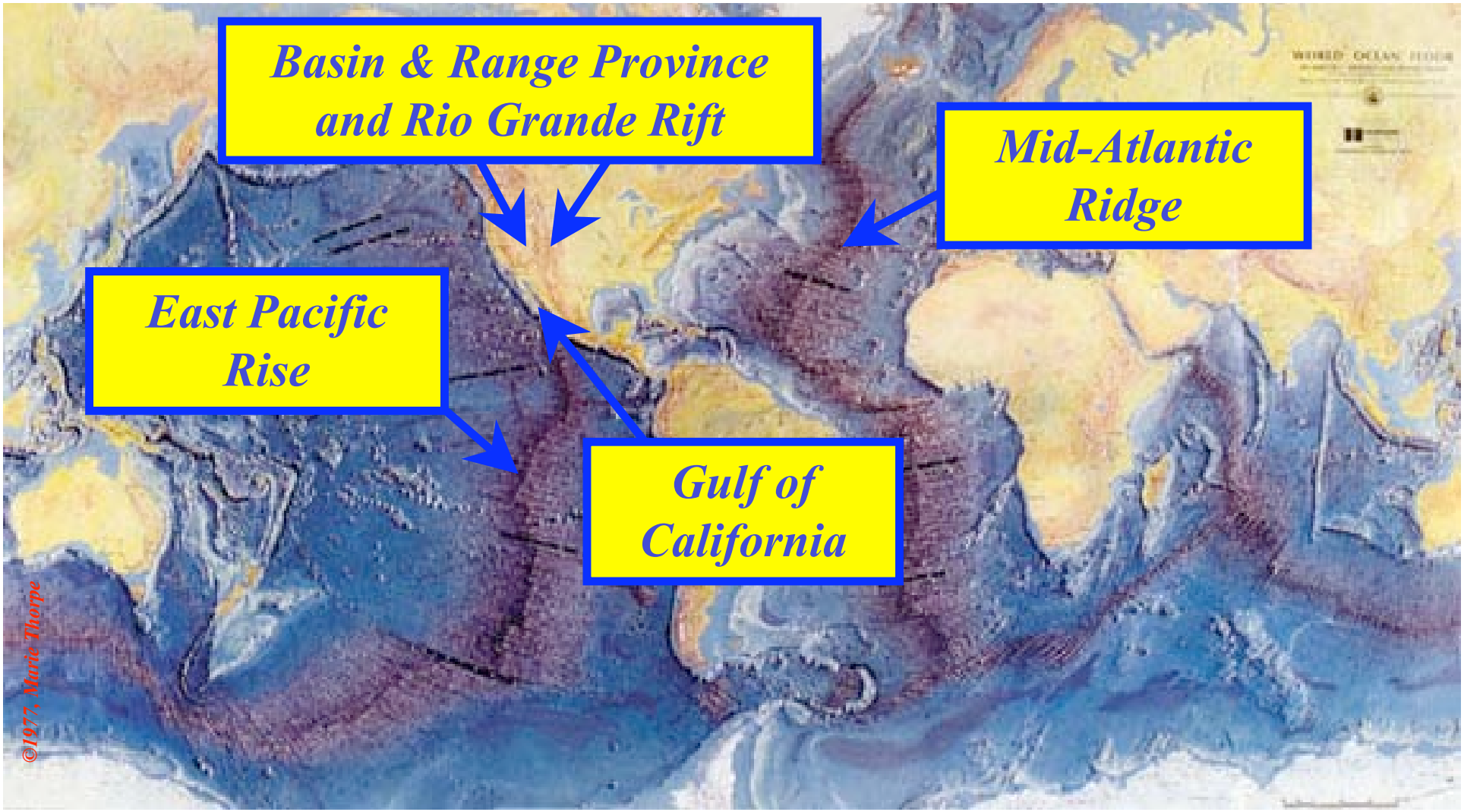
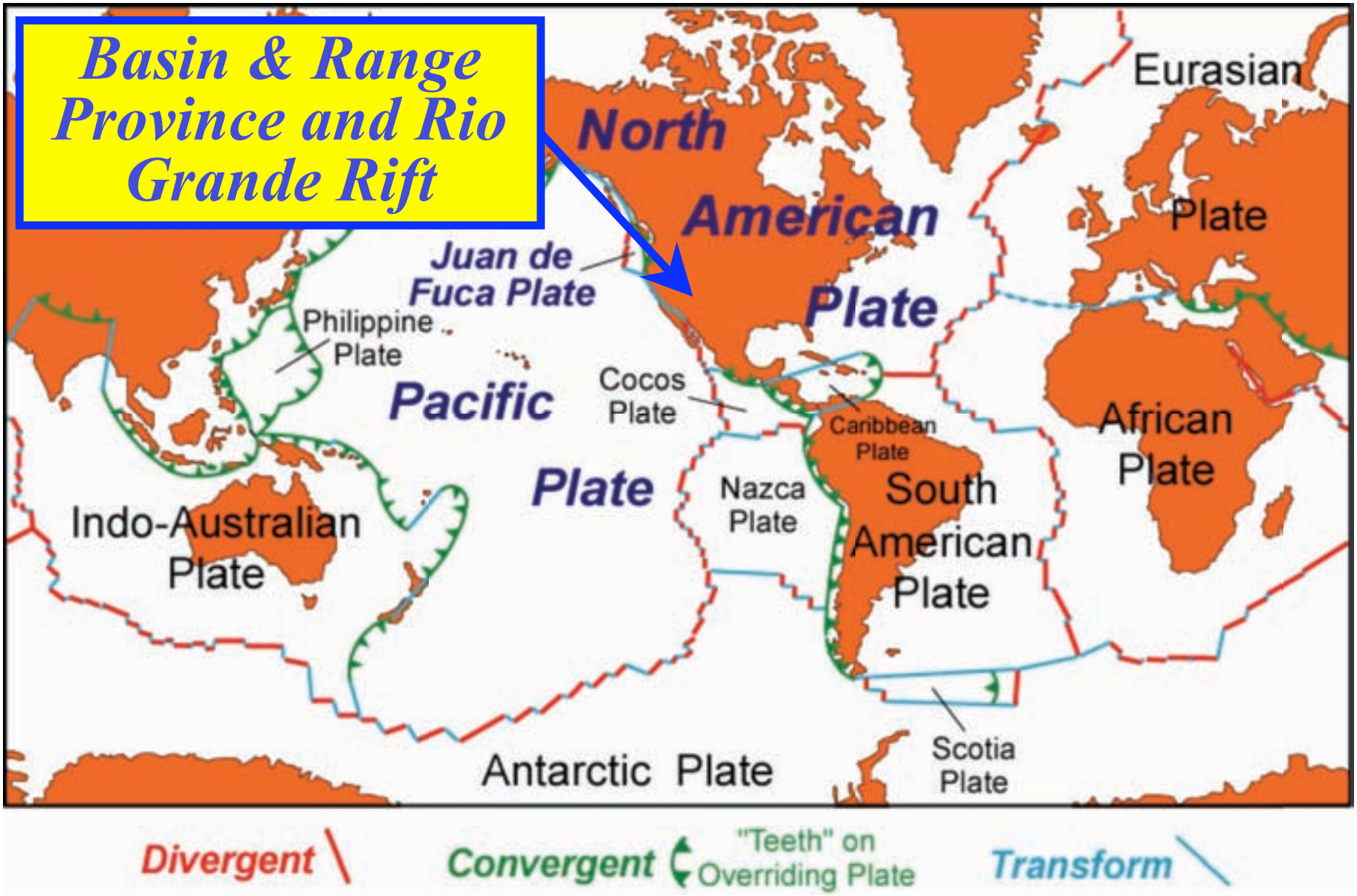
A Continental Rift might be Viewed as the On-land Continuation of a Mid-Ocean Ridge



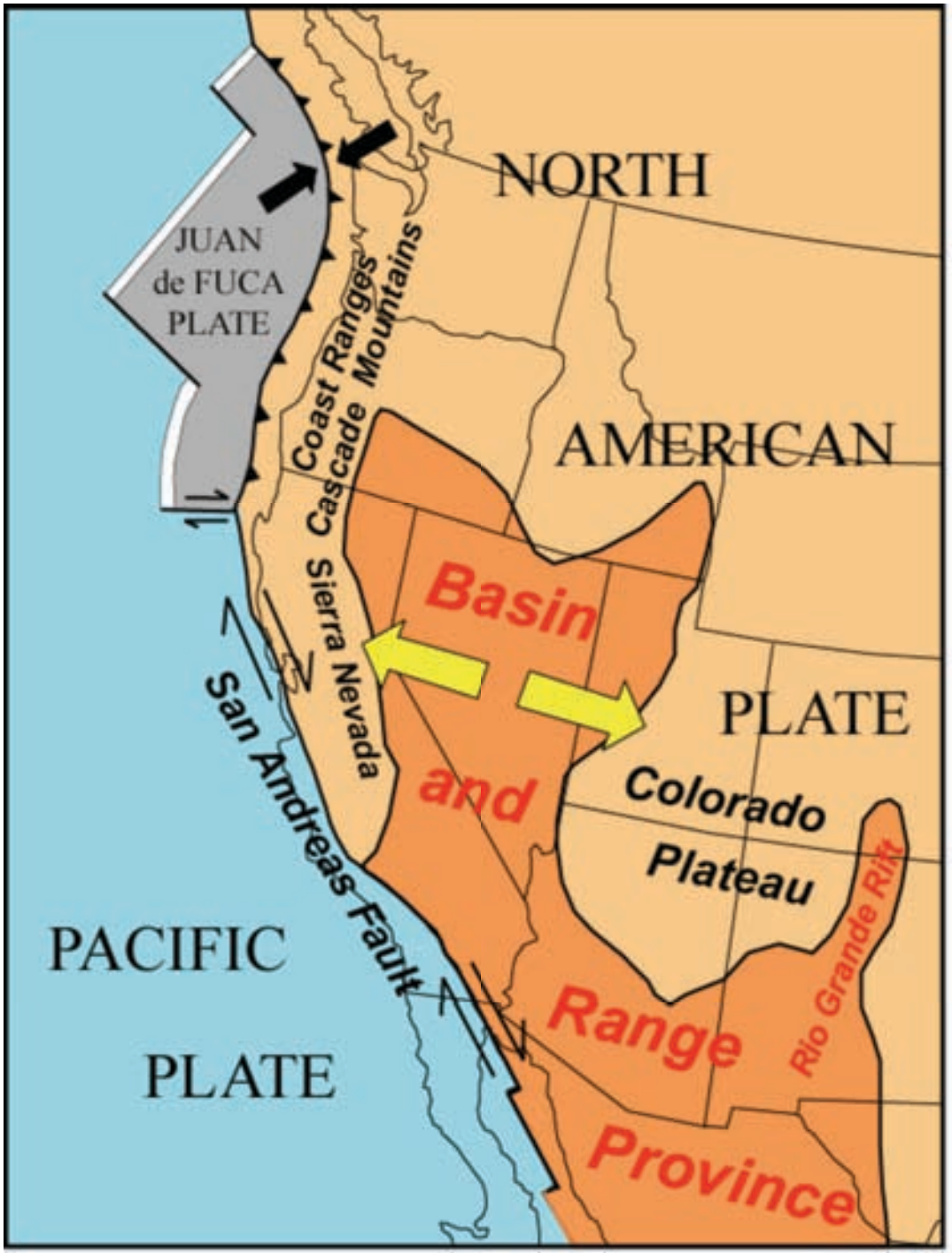
Continental Rift features formed by processes at Divergent Plate Boundaries



- **Basin & Range Province and Rio Grande Rift:**
  - Active Continental Rifts
  - High Elevation

- **Colorado Plateau:**
  - More coherent block
  - Also at High Elevation

- **Much of western U. S. is Hot and Ripping Apart!**
  - Elevates the topography
  - Forms “Basins” and "Ranges”



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Western U. S. is High and Ripping Apart

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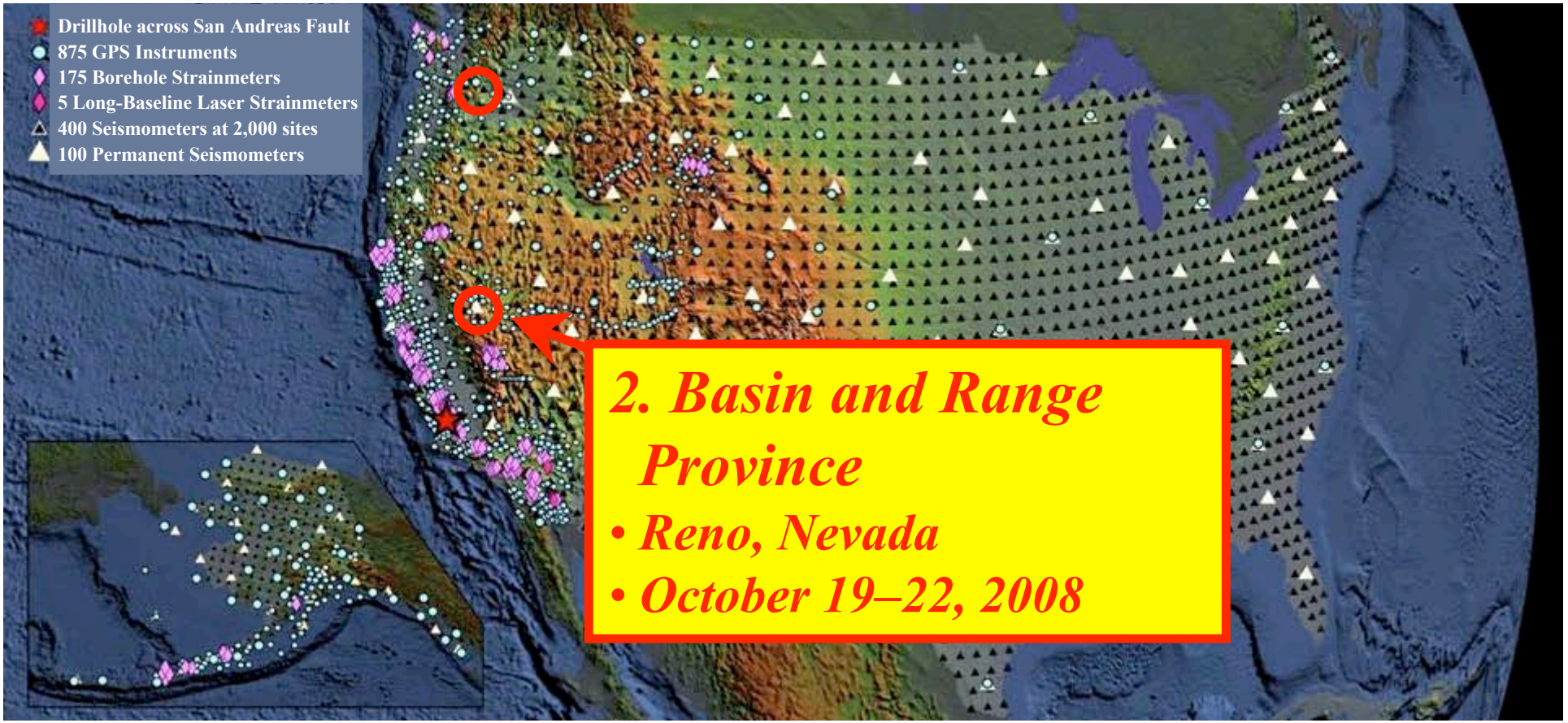
Informal Education Workshops

For Interpretive Professionals in Parks and Museums



www.earthscope.org/eno/parks

EarthScope Workshop for Interpretive Professionals in the Basin and Range Province

University of Nevada – Reno
October, 2008

Plate Boundary Observatory GPS Station

Slide Mountain, Nevada

Brian Wernicke, Cal Tech

Ellen Bishop

EarthScope Workshop for Interpretive Professionals in the Basin and Range Province

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October, 2008

Plate Boundary Observatory GPS Station

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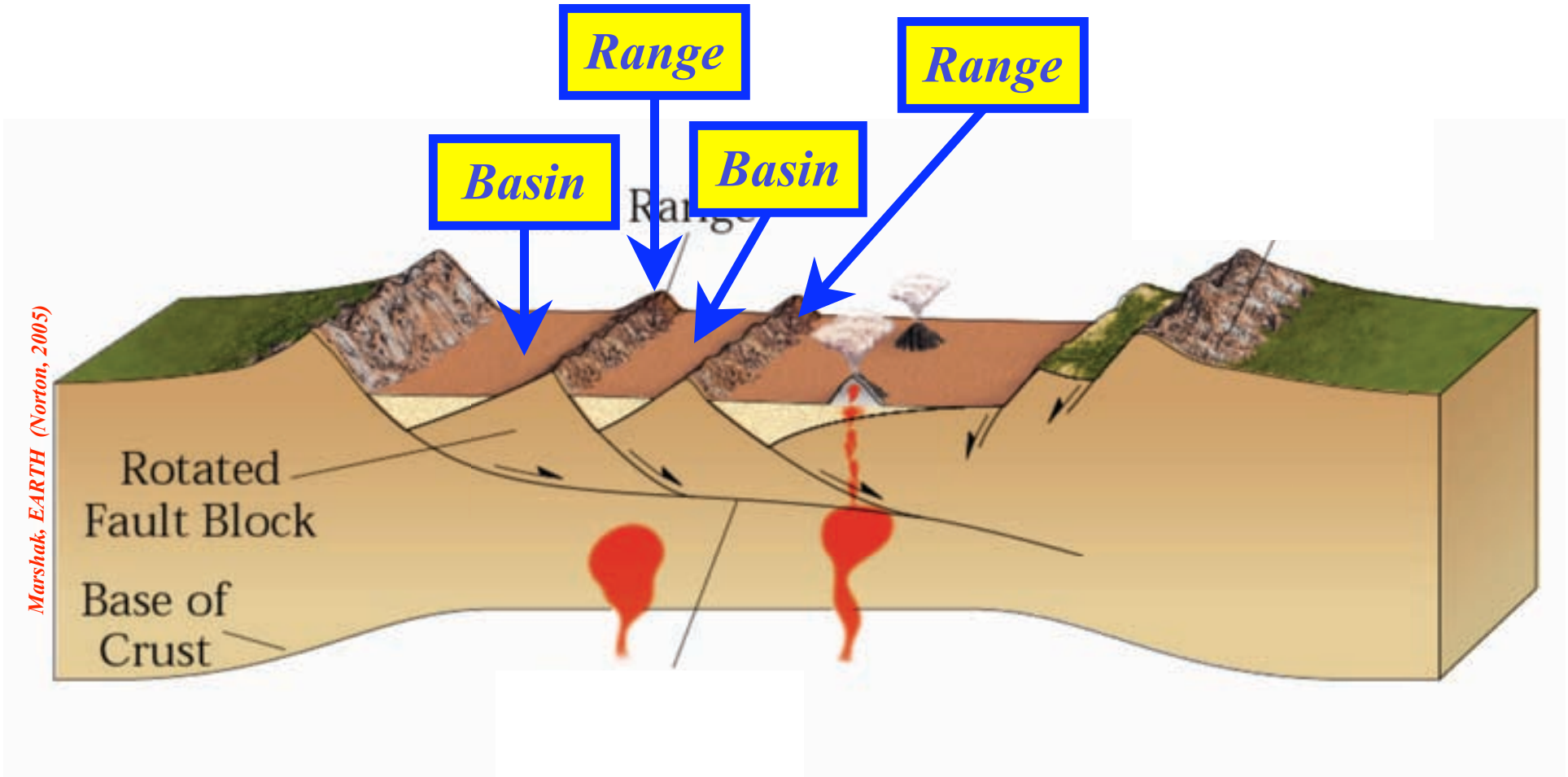
Bob Roney

EarthScope Workshop for Interpretive Professionals in the Basin and Range Province, 2008

EarthScope Workshop for Interpretive Professionals in the Basin and Range Province, 2008

BASIN AND RANGE PROVINCE



Interpretive Presentation:
Basin – Range Tectonic Development

EarthScope Workshop for Interpretive Professionals in the Basin and Range Province, 2008

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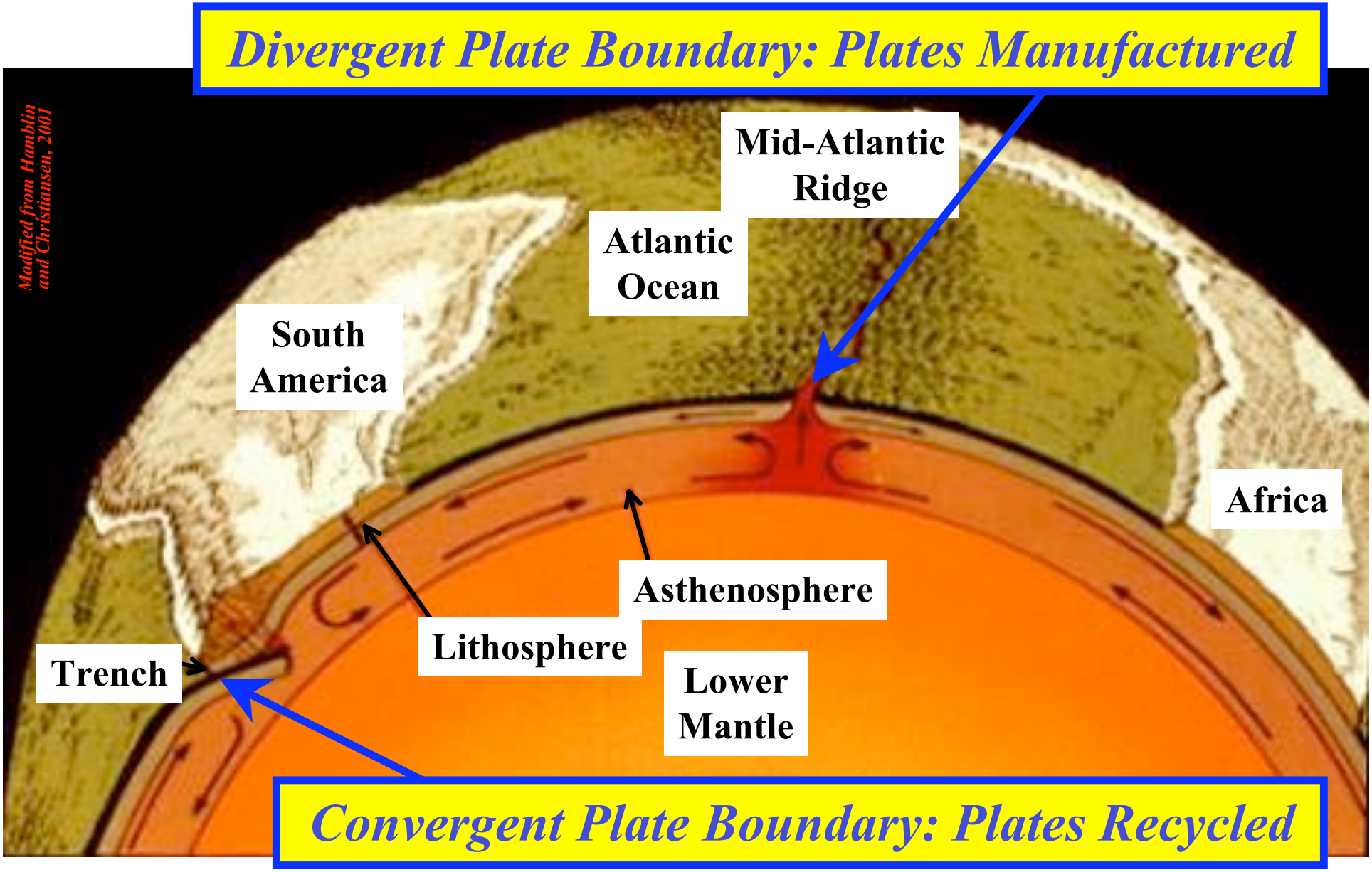
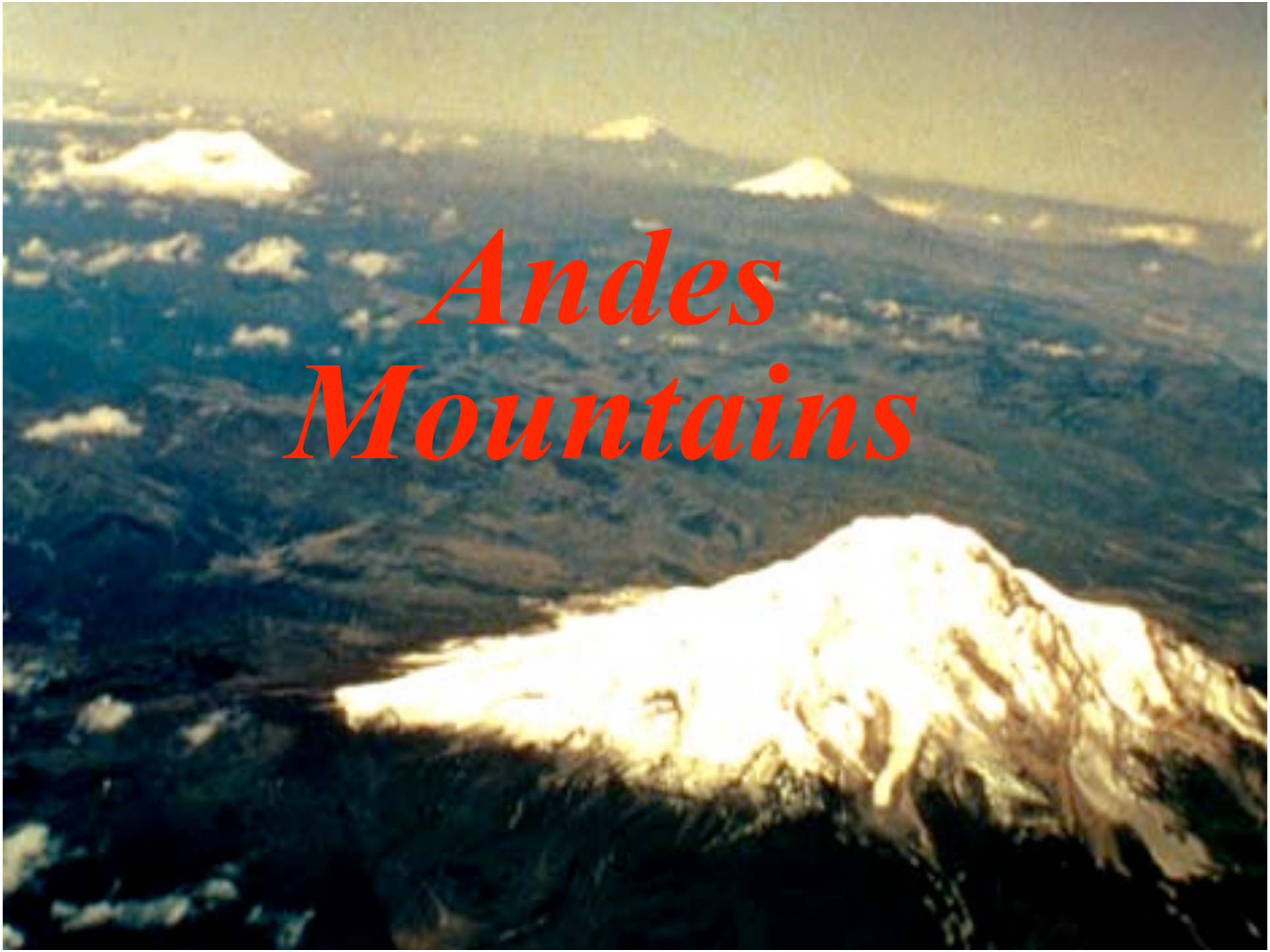
Interpretive Presentation:
Basin – Range Tectonic Development

EarthScope Workshop for Interpretive Professionals in the Basin and Range Province, 2008

Giant Re-Cycling Machine!! ☺

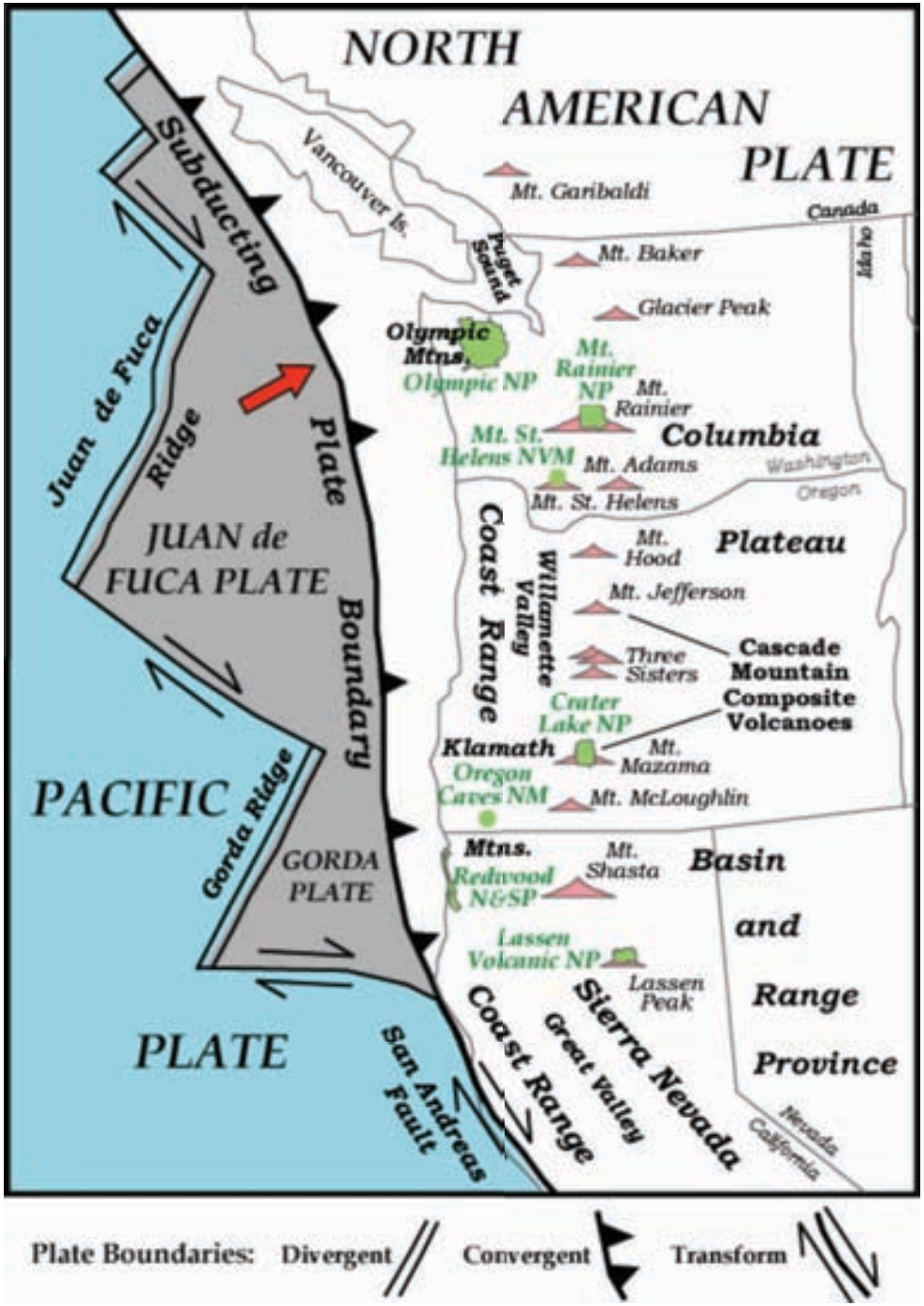



Andes
Mountains

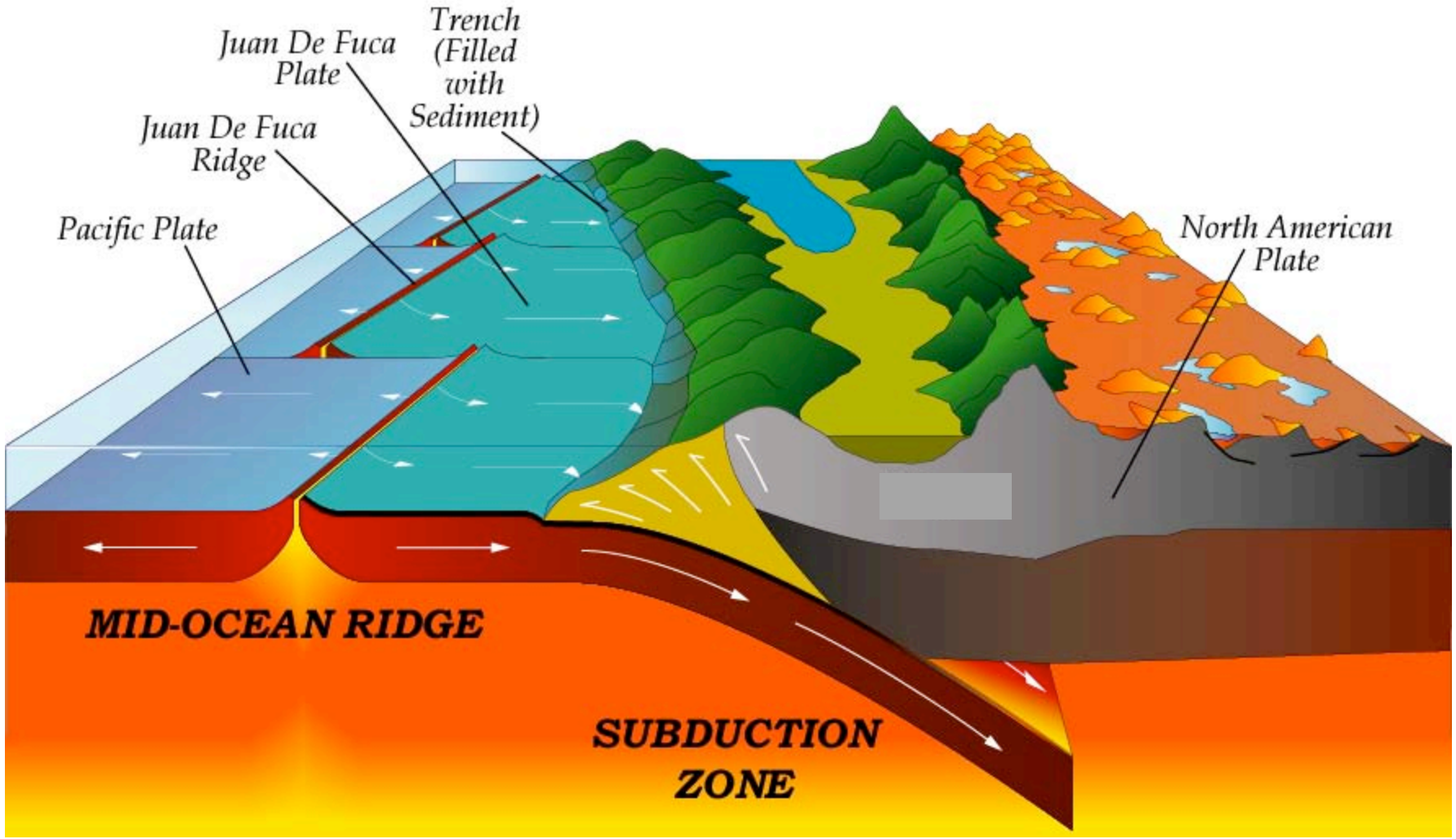
Convergent Plate Boundary

Parks in the Pacific Northwest Display Convergent Plate Boundary Motion

Some Park Lands in the Cascadia Subduction Zone



Subducting Juan de Fuca Plate forms two parallel mountain ranges in the Pacific Northwest.



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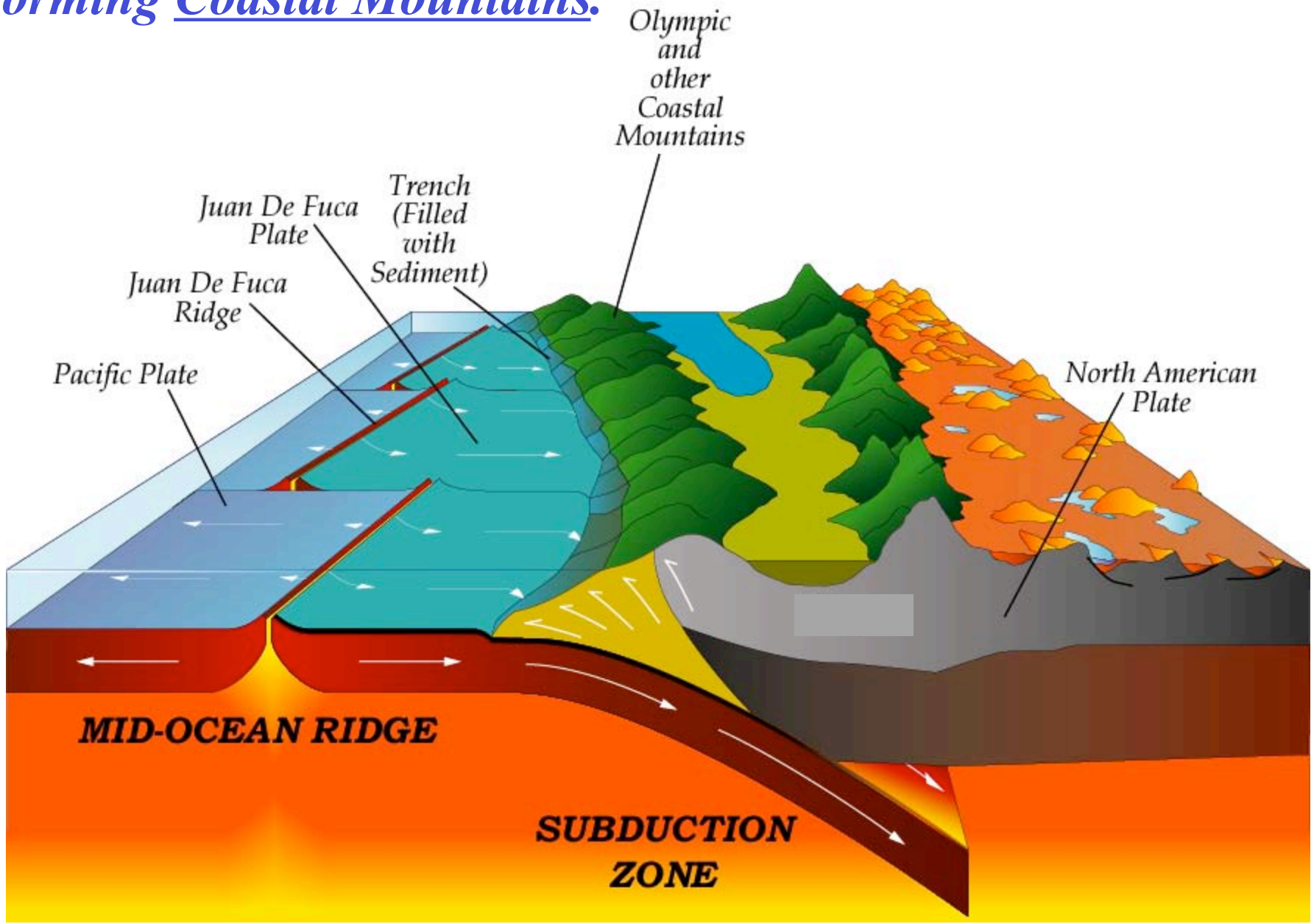
Bernard Garcia

Oceanic sediment and basalt scraped off subducting plate, forming Coastal Mountains.



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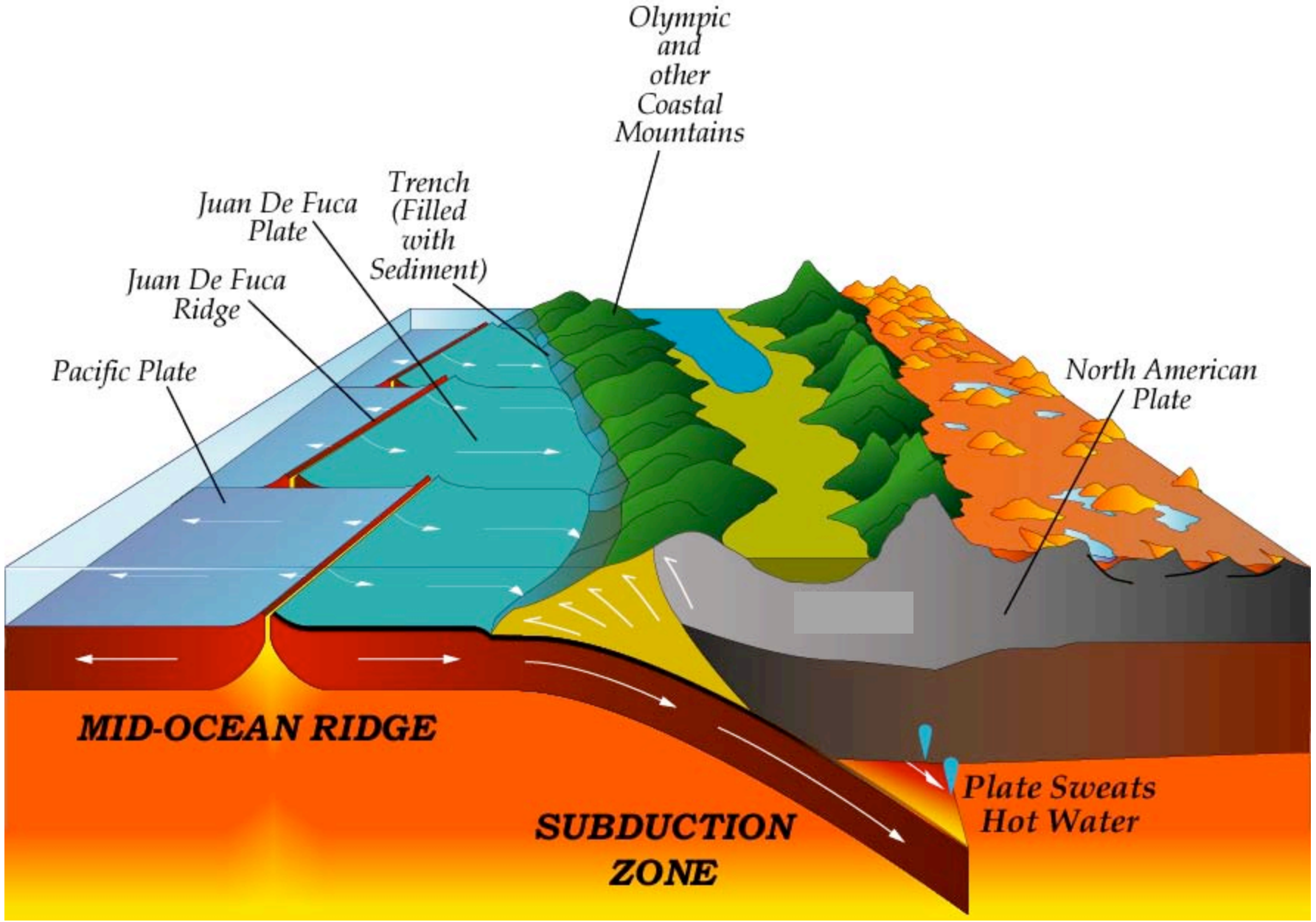
Subducting plate dehydrates, forming Cascade Volcanoes.



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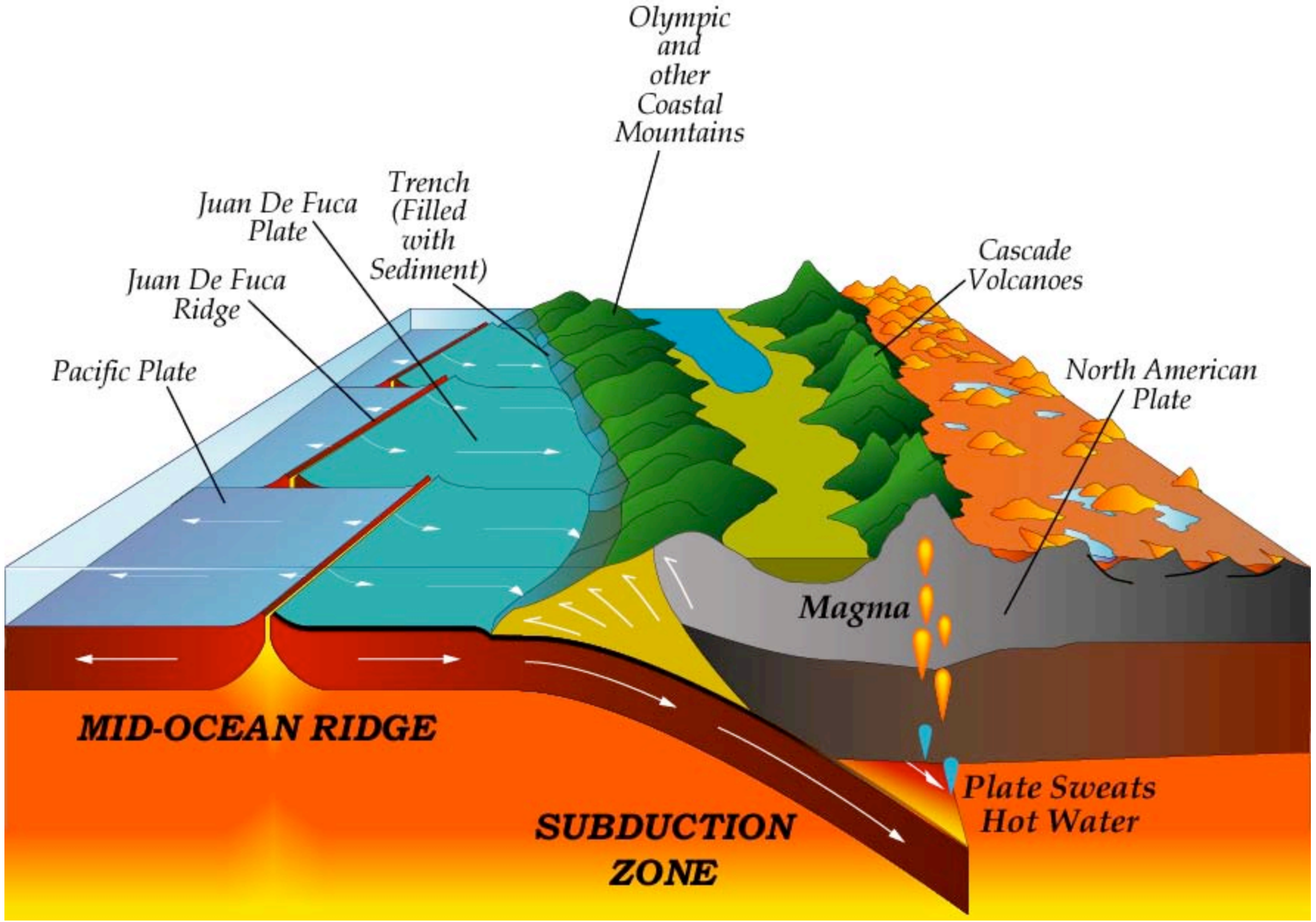

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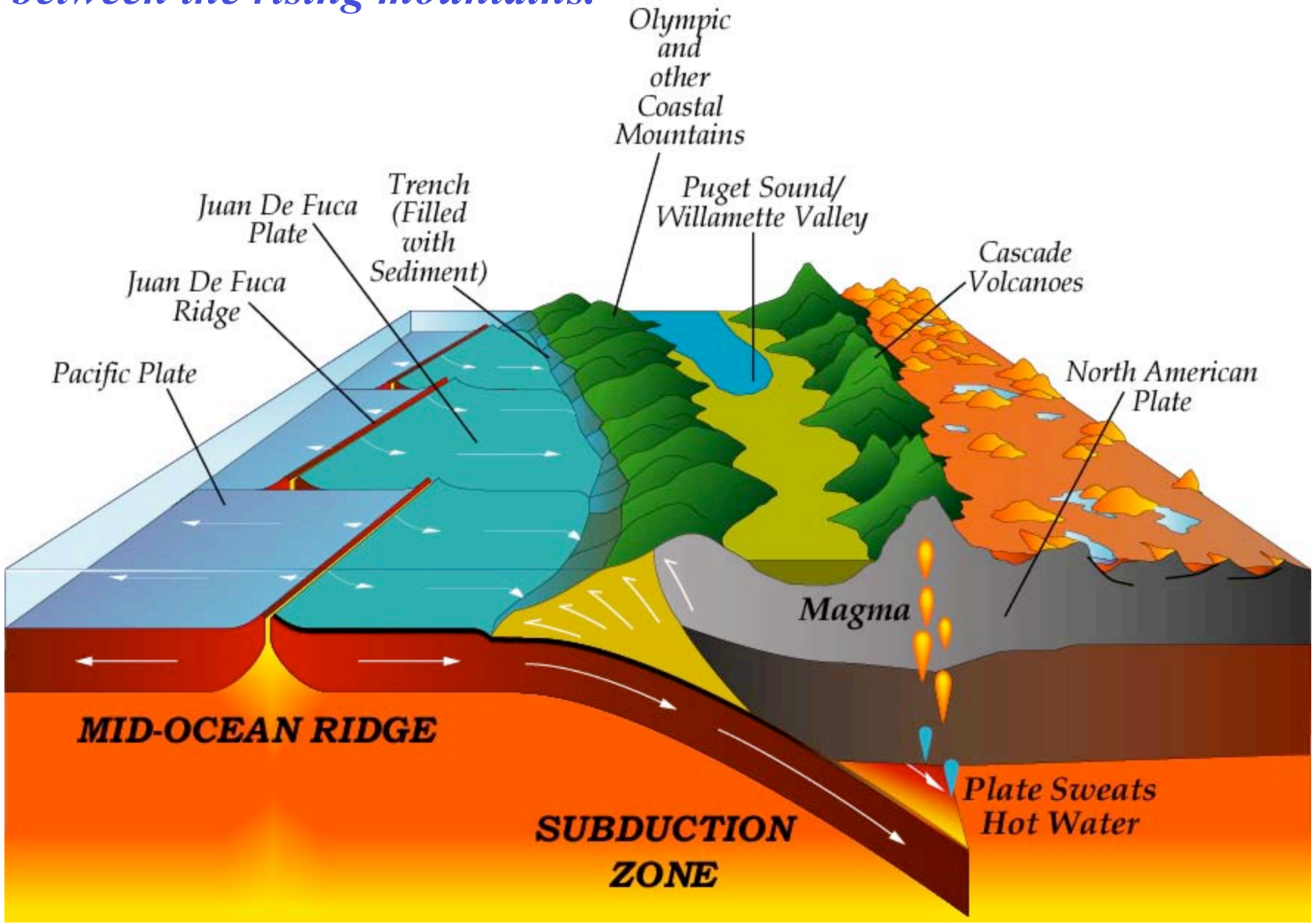
***Puget Sound* and the *Willamette Valley* are low-lying regions between the rising mountains.**



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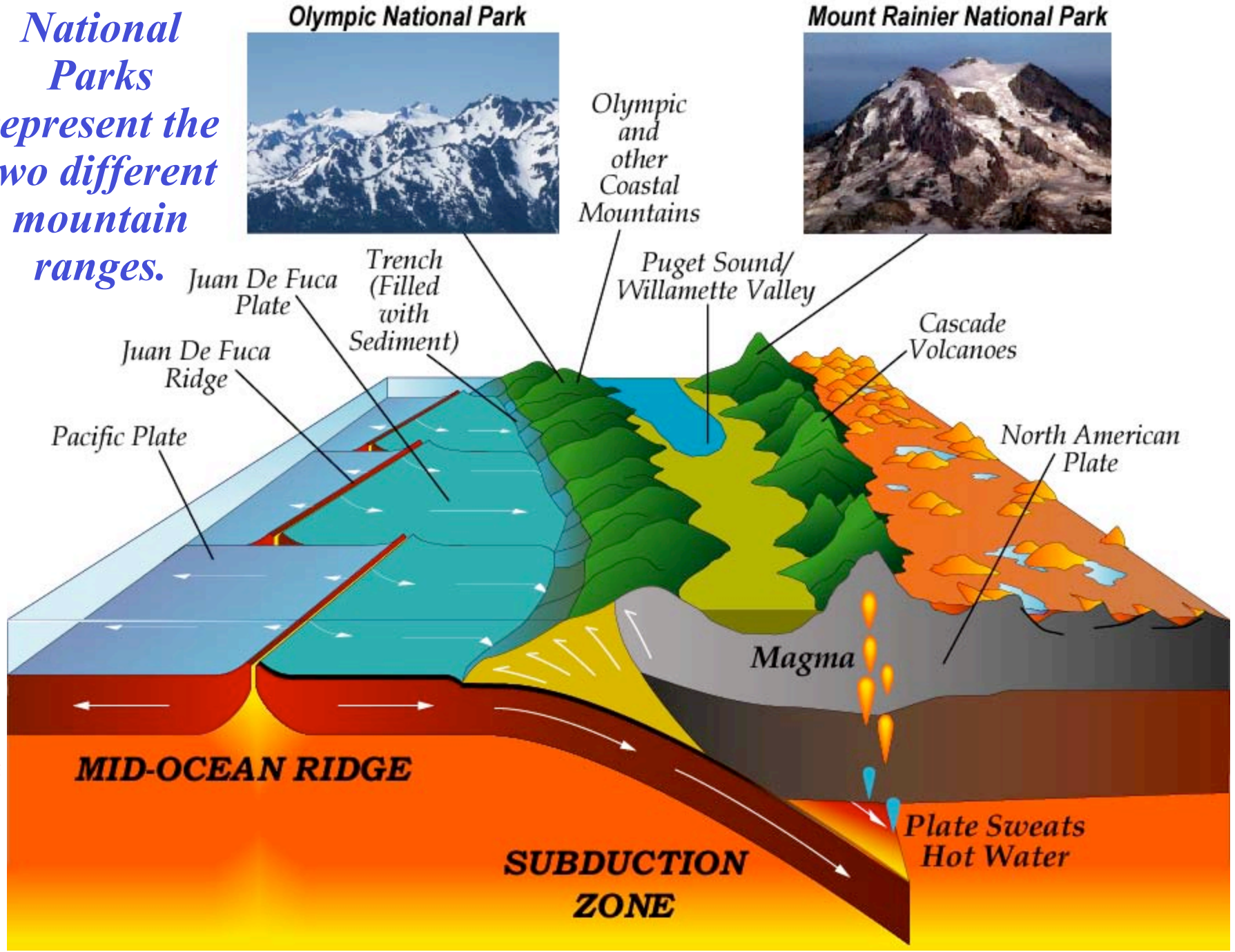
National Parks represent the two different mountain ranges.



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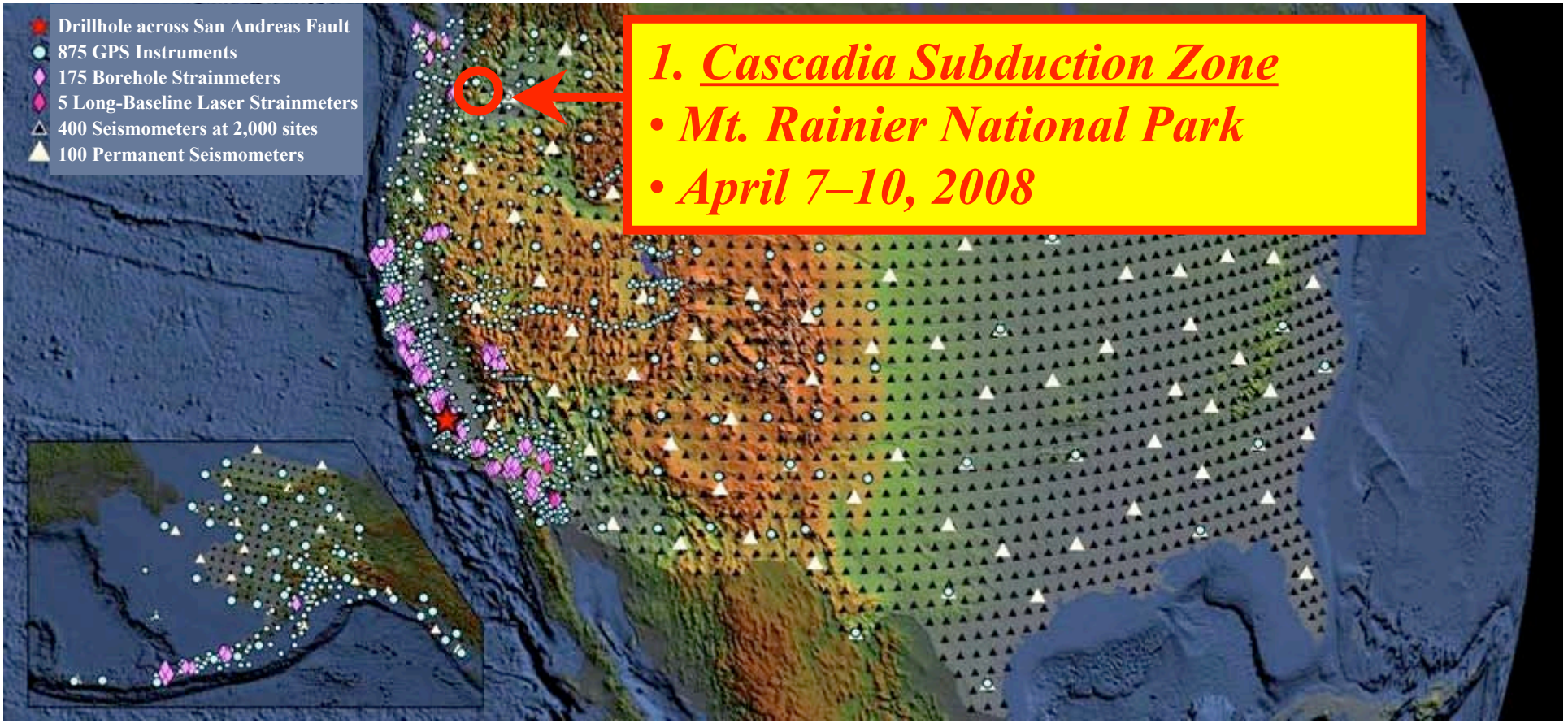
Bernard Garcia

Informal Education Workshops

For Interpretive Professionals in Parks and Museums



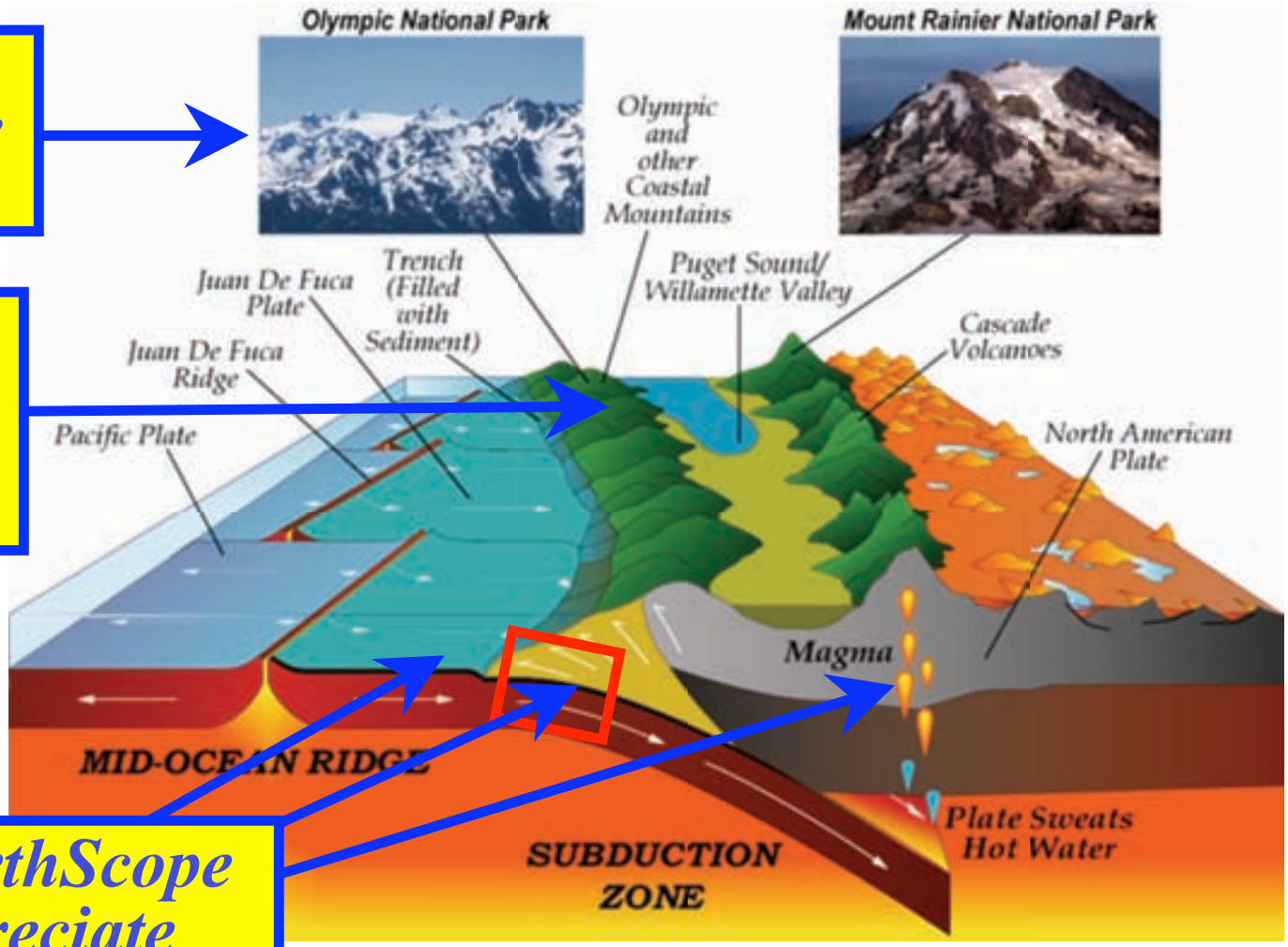
www.earthscope.org/eno/parks

Cascadia Subduction Zone

We can <u>see</u> what's on the surface.

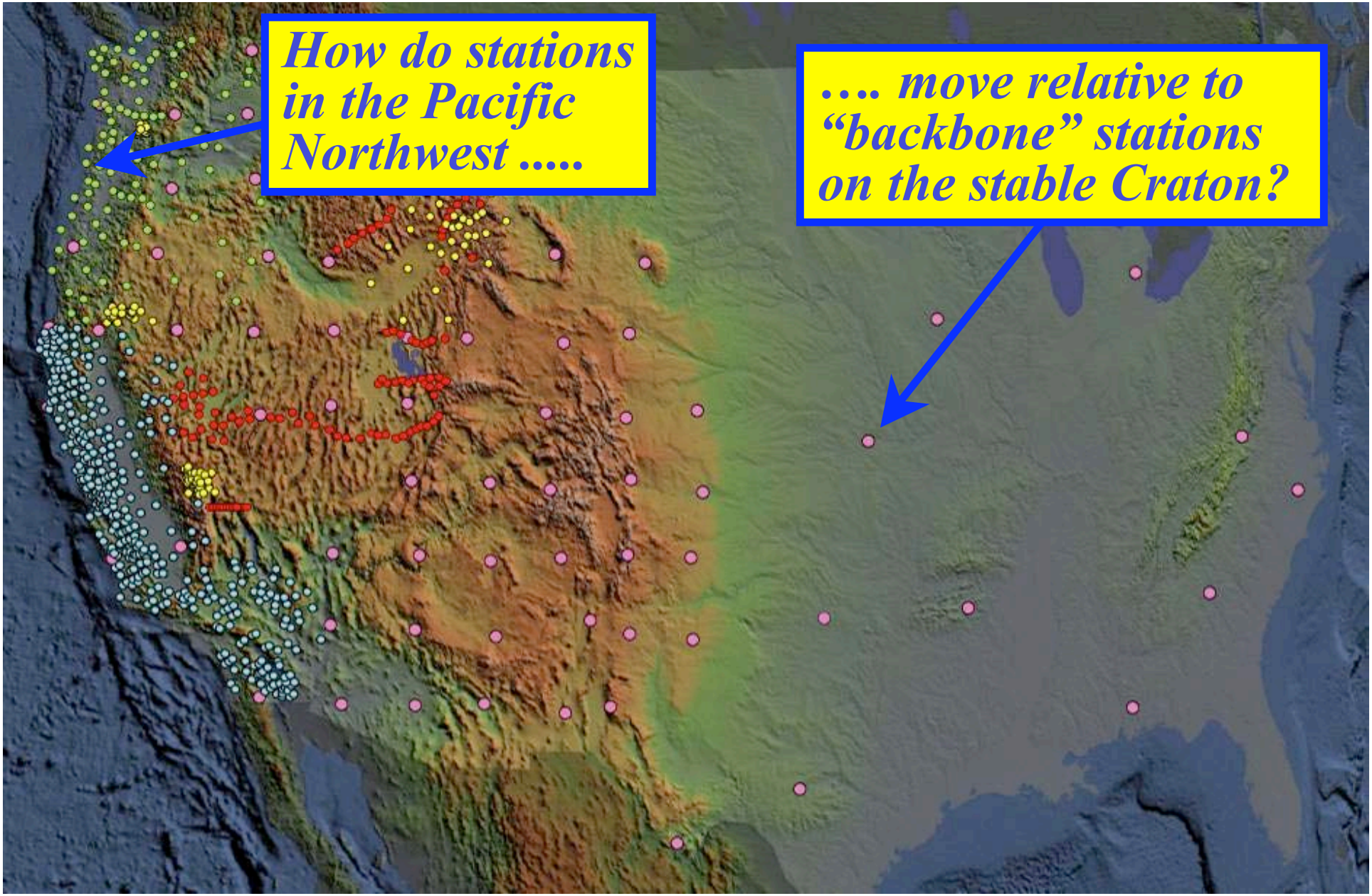
How does the surface change as a response to subduction?

How does EarthScope help us appreciate earthquakes, tsunamis, and volcanic eruptions?



EarthScope GPS Stations

Backbone Network
Subduction Cluster Volcanic Cluster
Transform Cluster Extension Cluster



Introduction to GPS

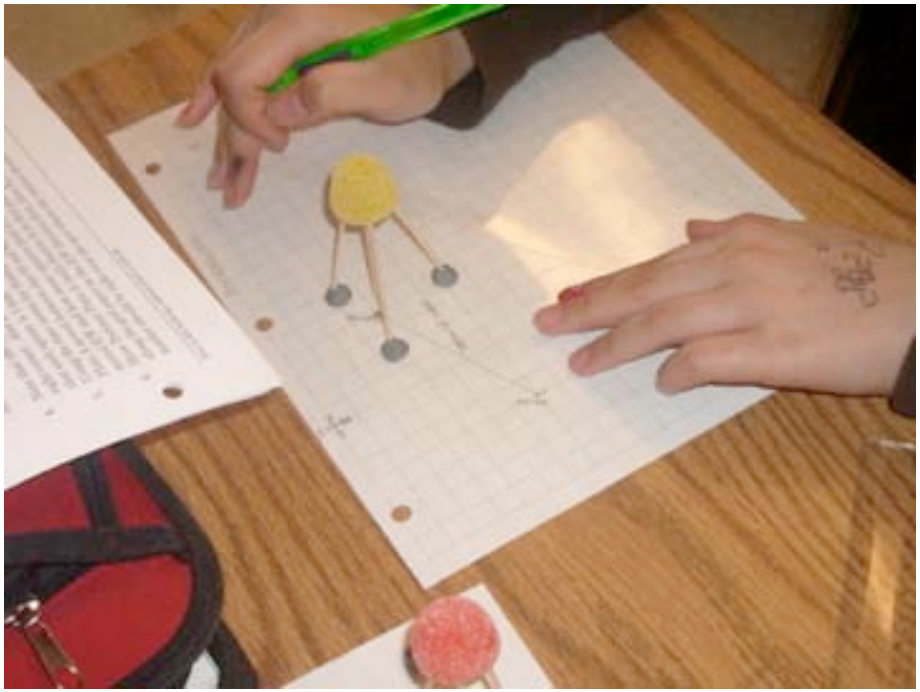
- Building a GPS Monument ☺

(From UNAVCO - GPS Workshop)

Newport, Oregon
GPS Station

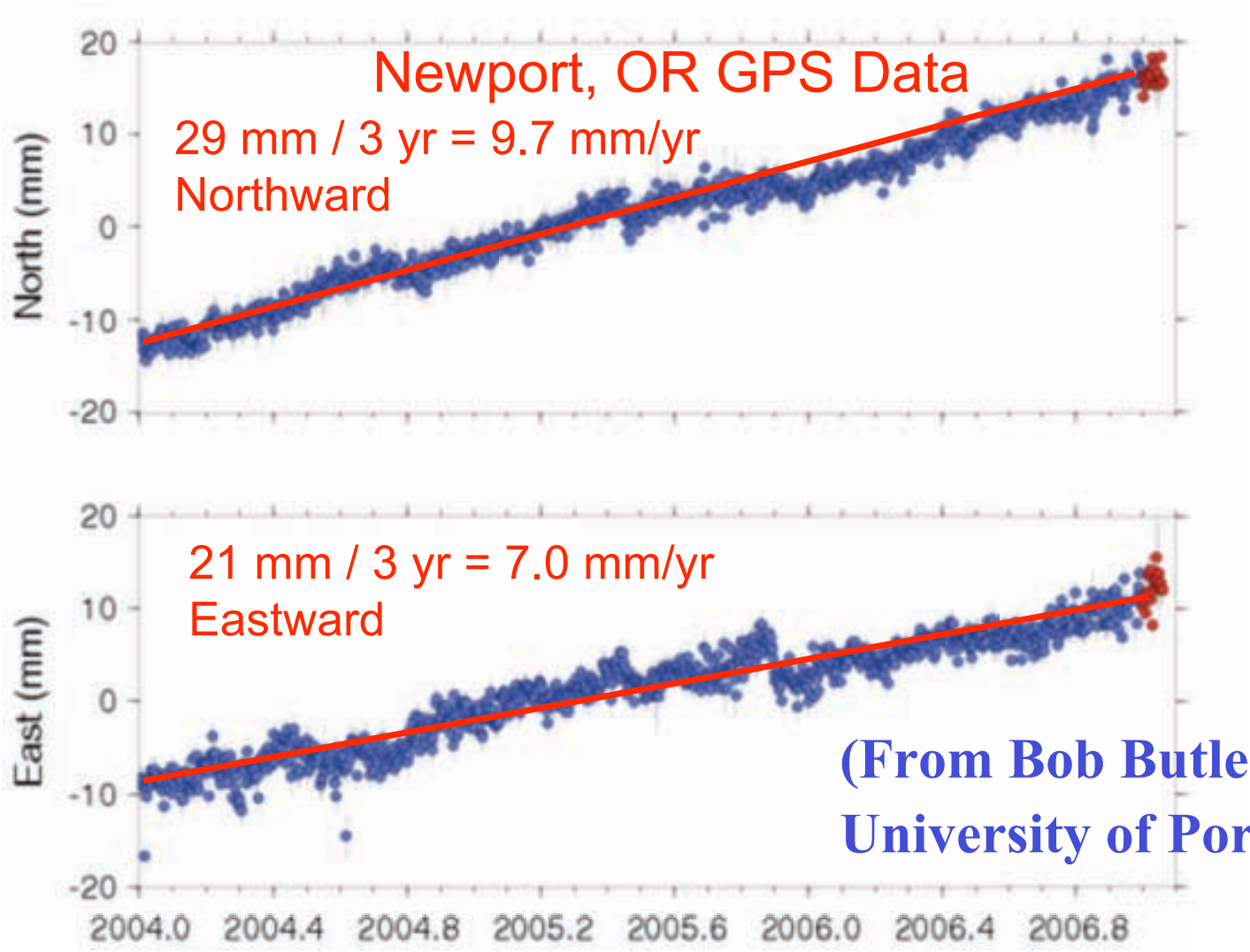
Introduction to GPS

- **Moving GPS Stations** ☺
  - **Using data from actual GPS Stations, move the GPS monuments using grid paper and transparencies**



(From UNAVCO - GPS Workshop)

Newport, Oregon GPS Data



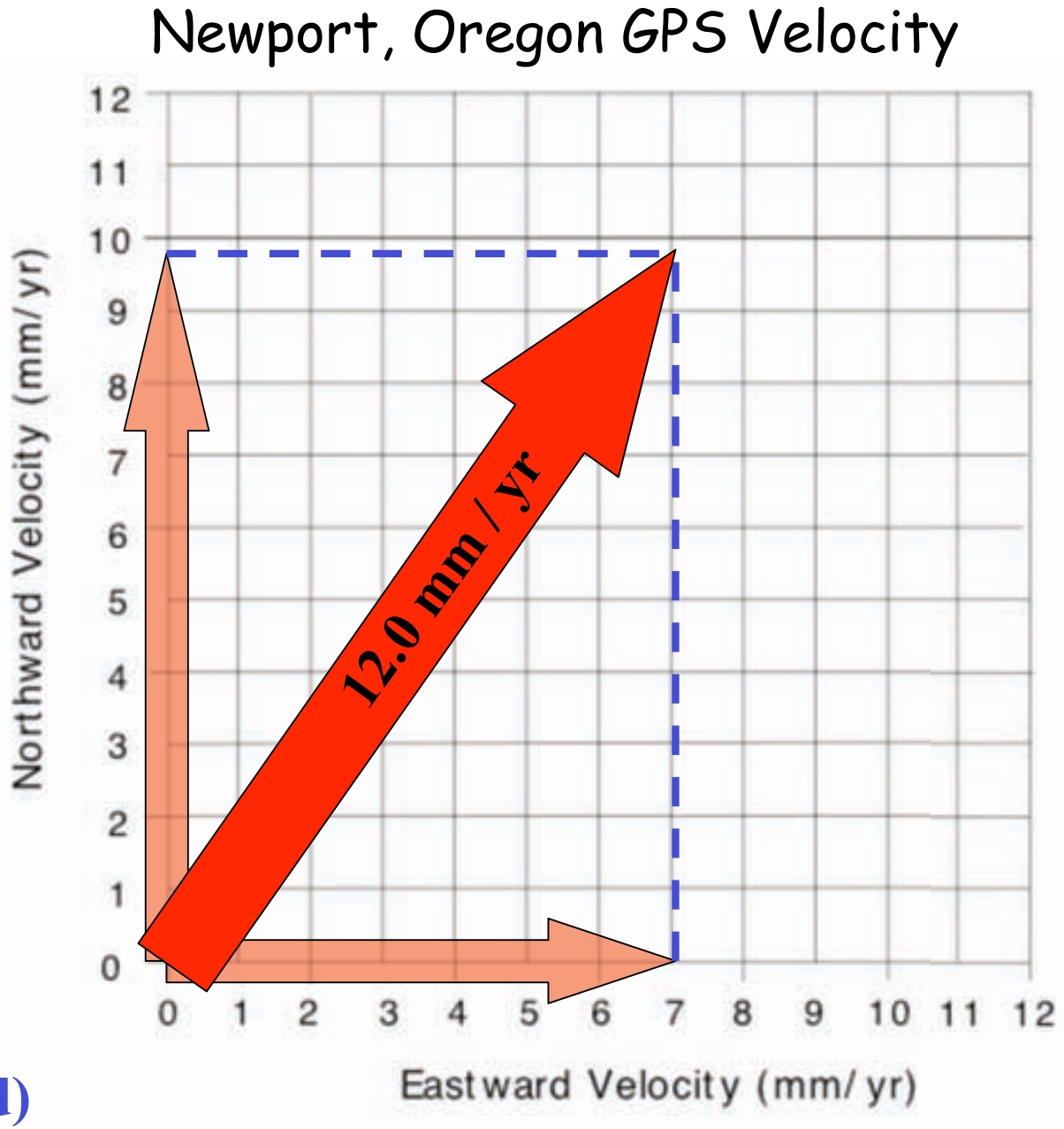
(From Bob Butler, University of Portland)

Can download data to spreadsheet and determine best-fit slopes = Rates of north and east motion

Graphically add the north and east velocities.

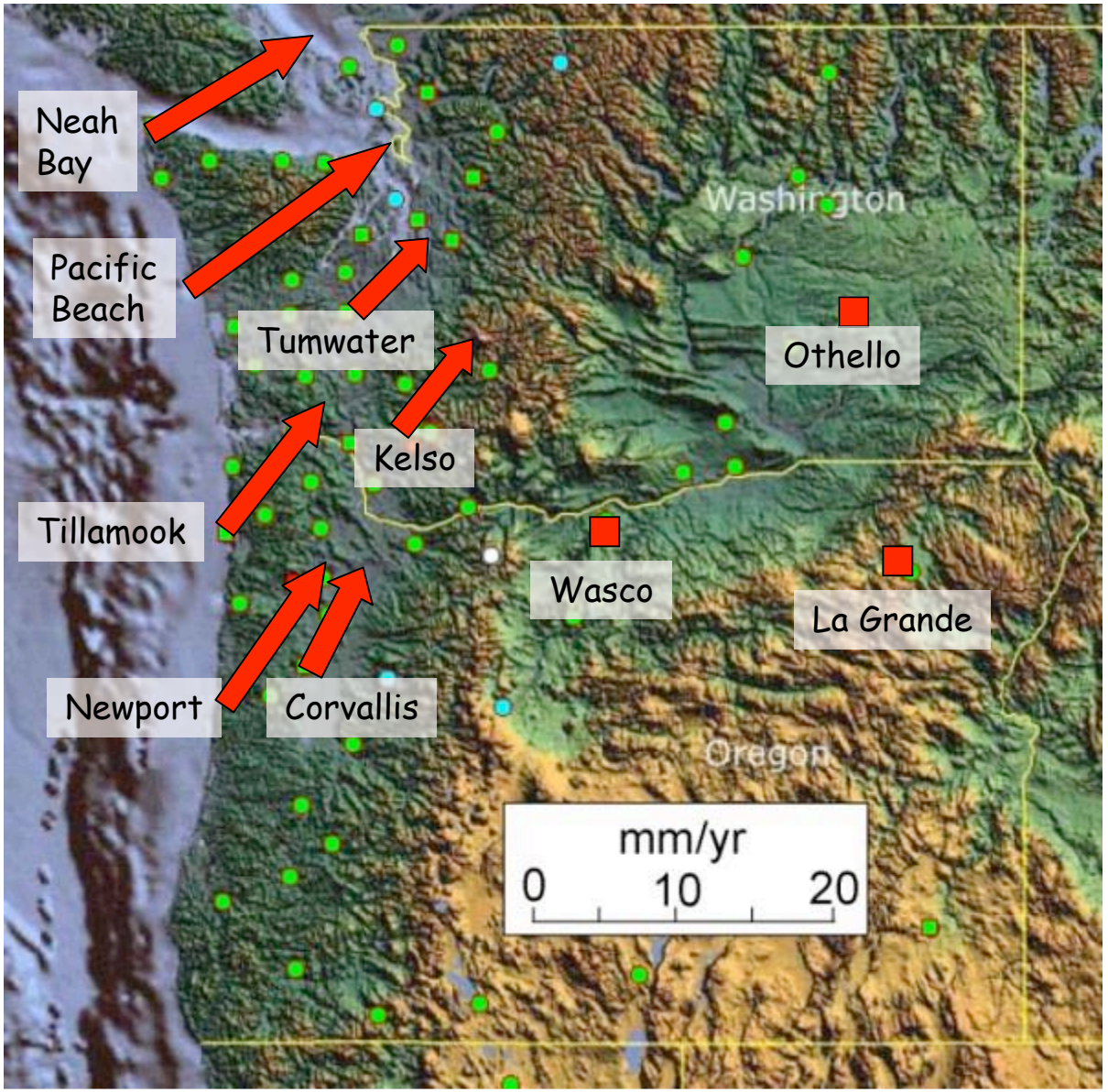
- Don't even THINK of using the word "vector" ☺

(From Bob Butler, University of Portland)



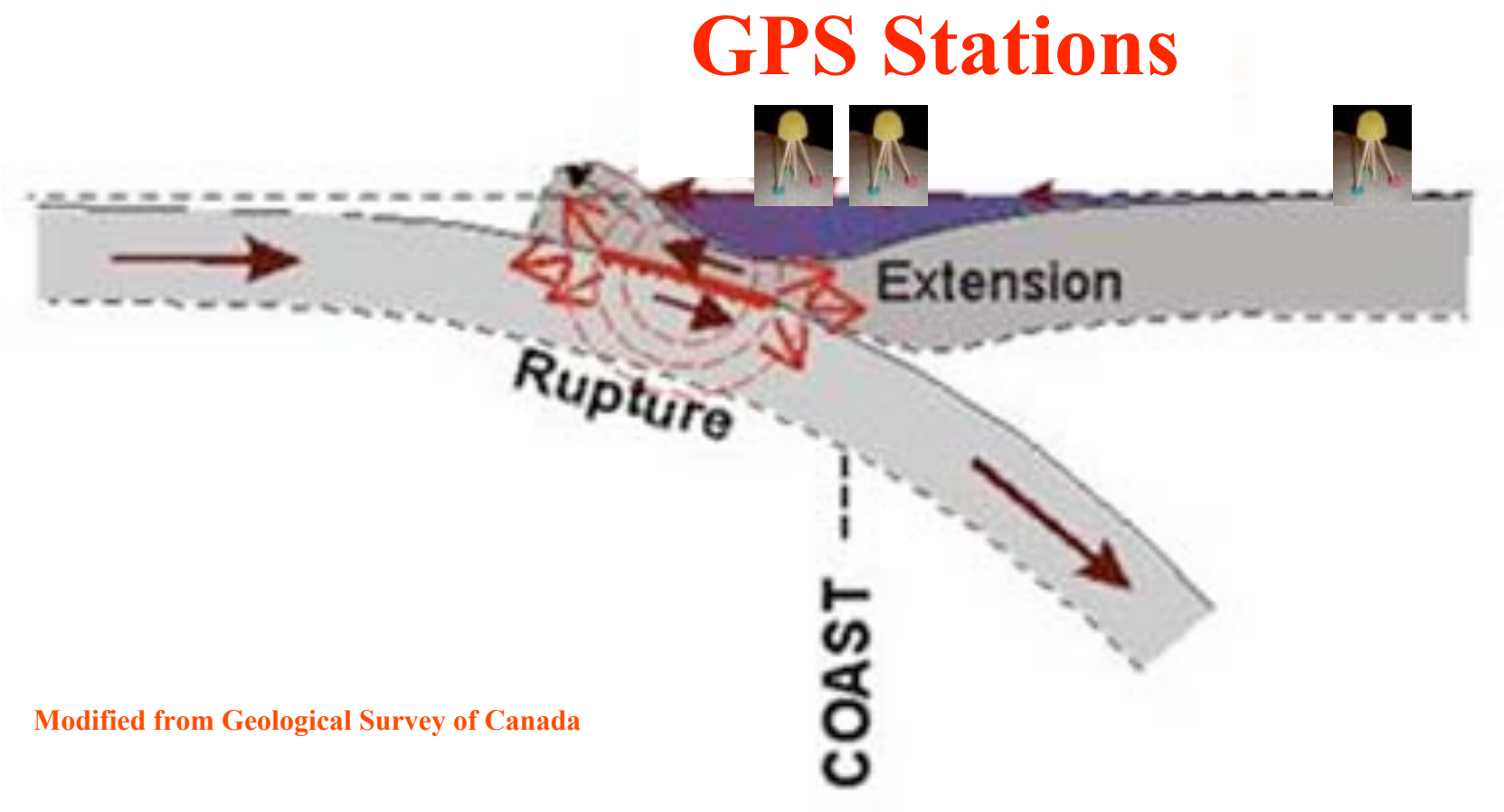
Compression of Pacific Northwest Continental Margin

- **Newport and other stations in western OR/WA moving NNE (with respect to "stable North America").**
- **Cascadia subduction zone boundary is "locked and loading" as it stores elastic energy that will be released in the next great Cascadia megathrust earthquake.**



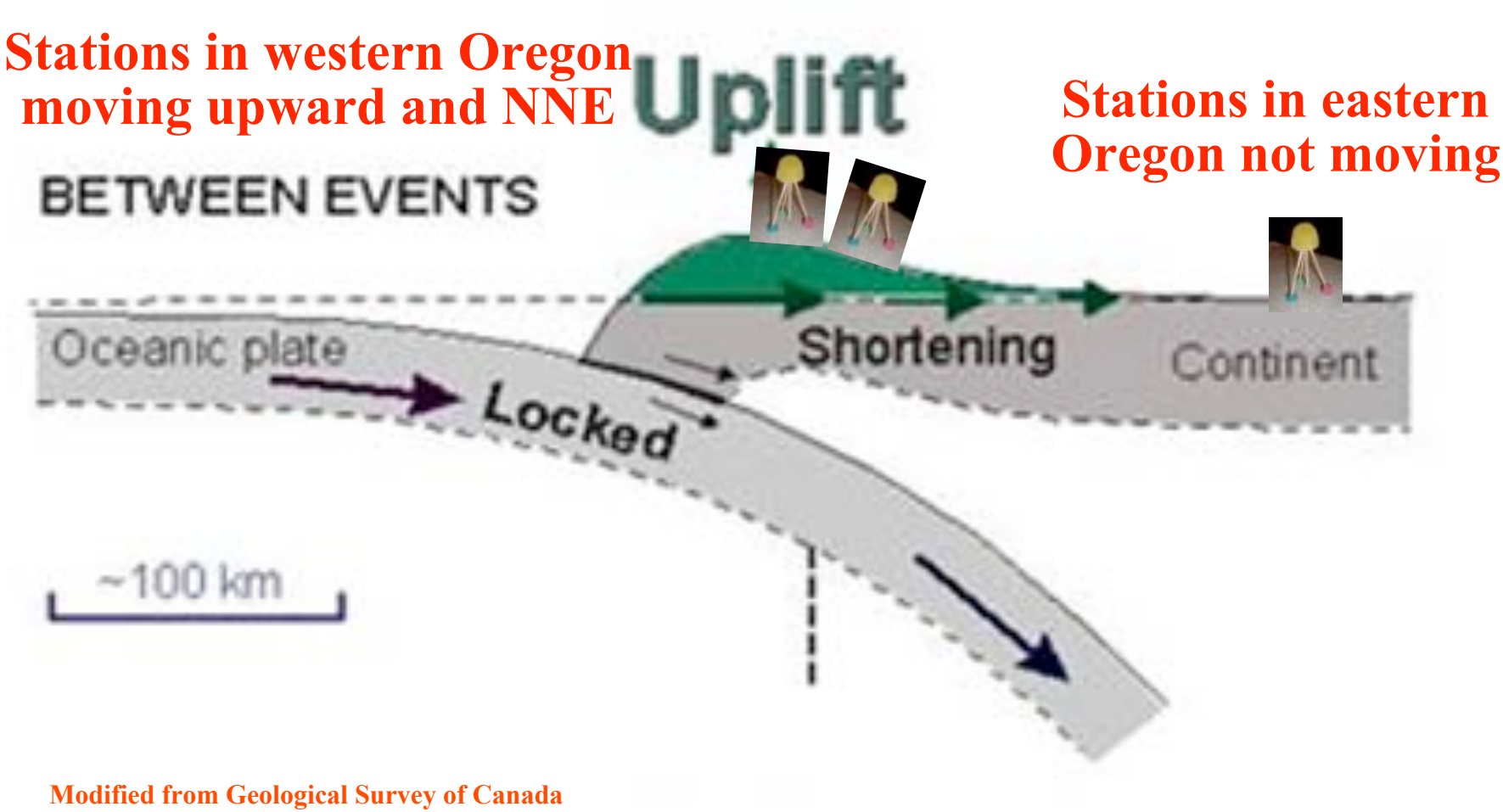
(Modified from Bob Butler, University of Portland)

GPS Stations Monitor Ground Motion



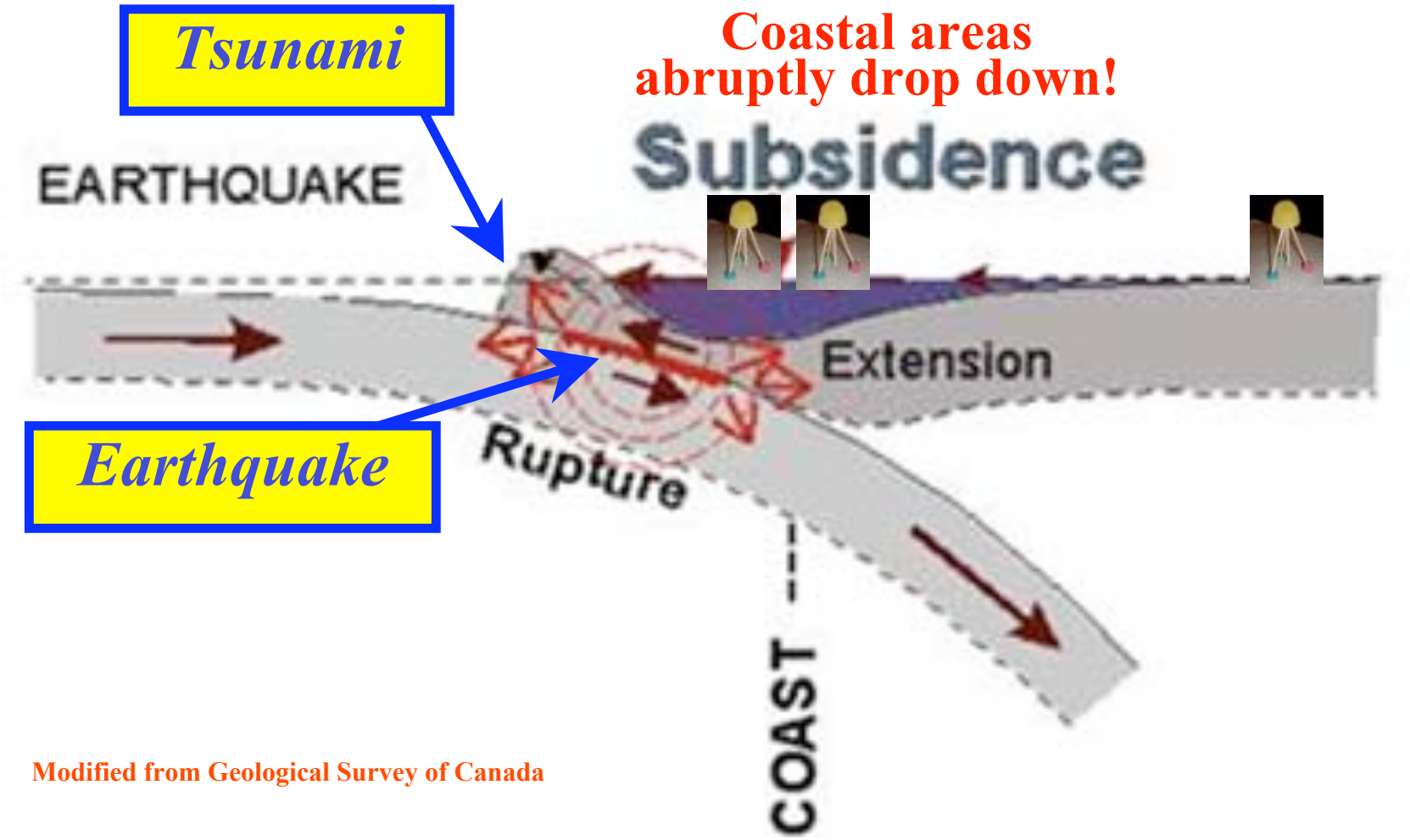
Modified from Geological Survey of Canada

"Locked" Subduction Zone



Modified from Geological Survey of Canada

Suddenly Unlocks!!



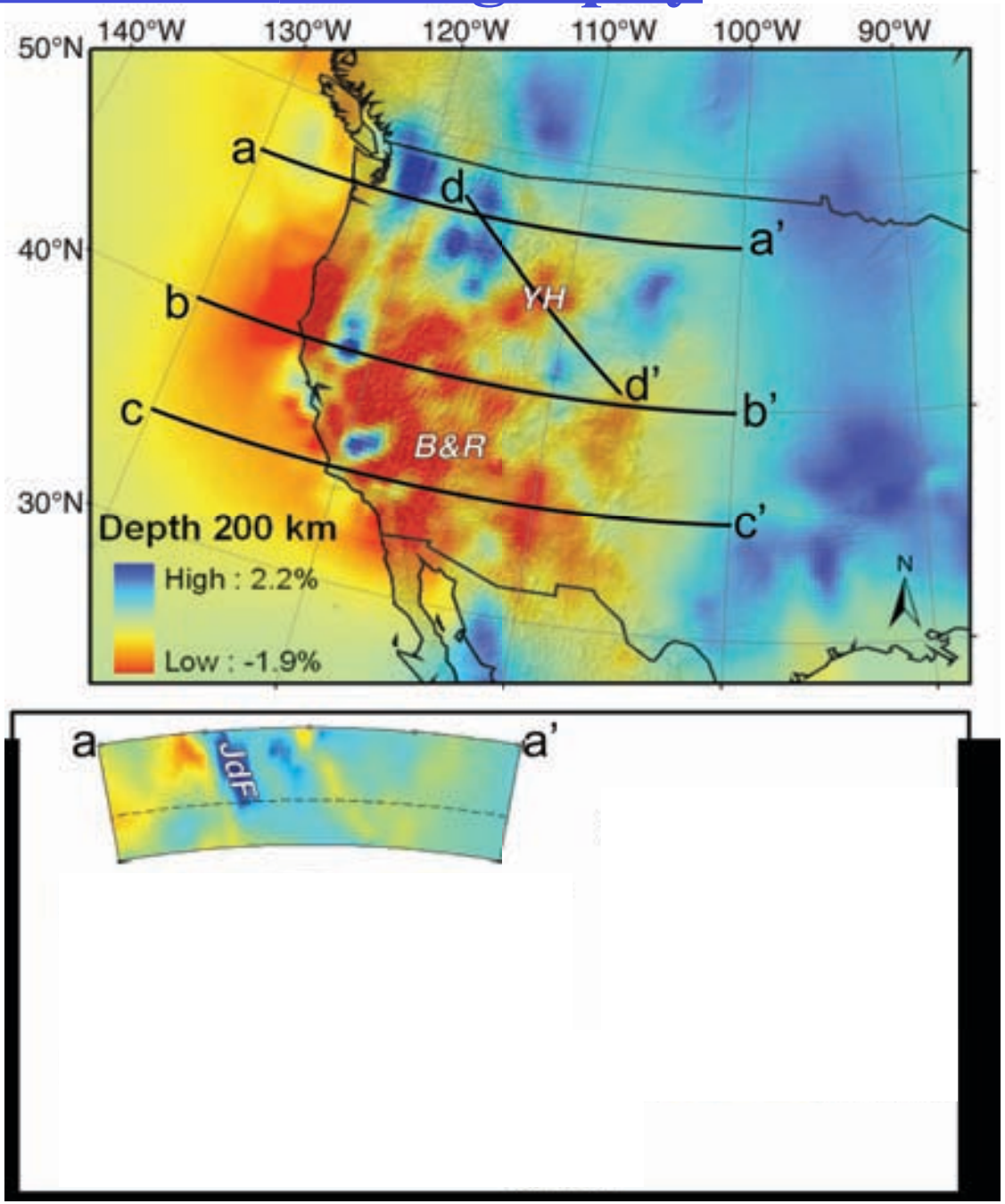
Modified from Geological Survey of Canada

Teachers, park rangers, students, and the public "get it."

P-Wave Seismic Tomography

P-Wave "Community Velocity Model" based partly on USArray through November 2007

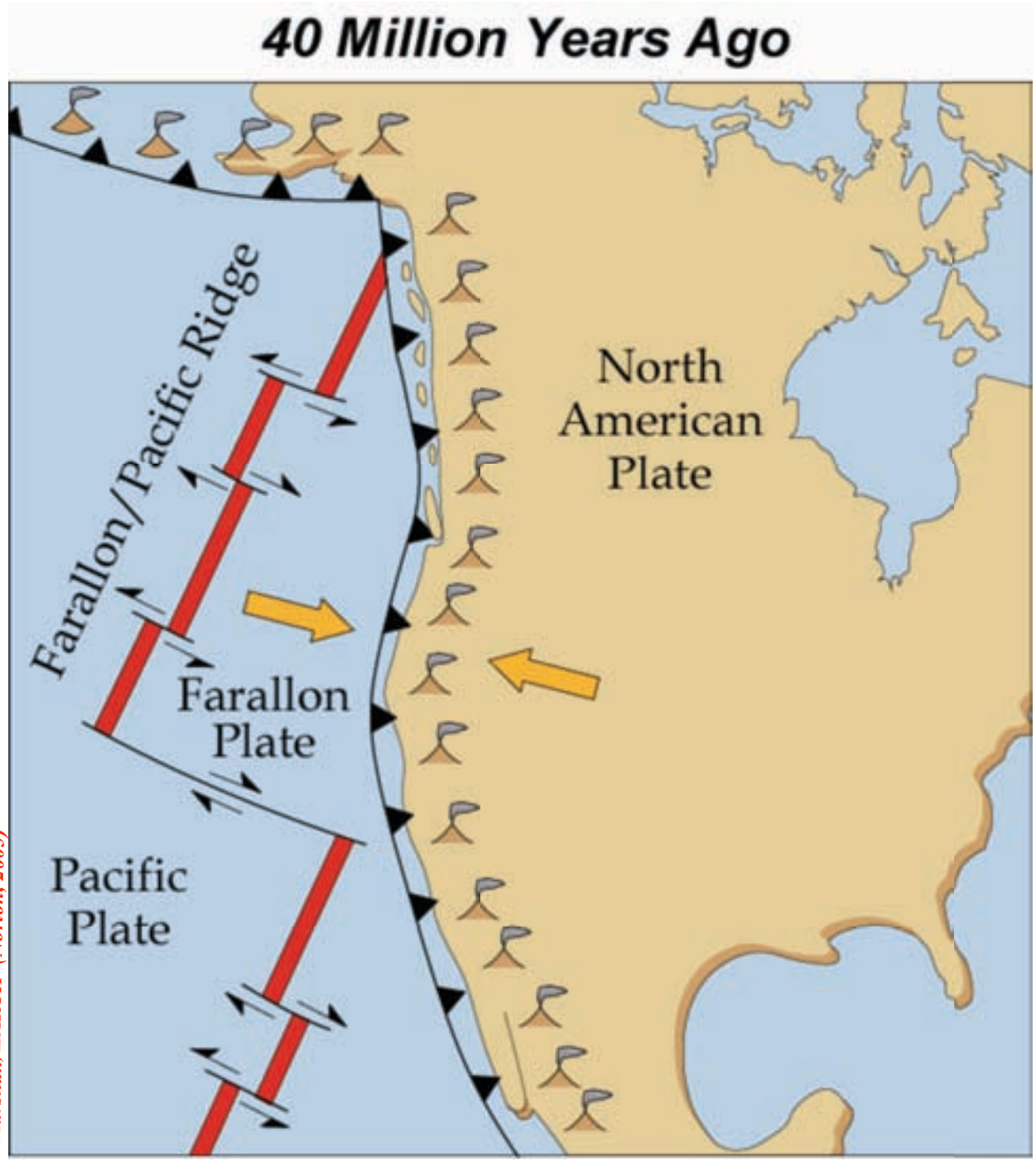
- **High Velocity → Subducted Juan de Fuca and Farallon lithosphere**



Burdick et al., 2008

PLATE TECTONIC DEVELOPMENT OF THE WESTERN UNITED STATES

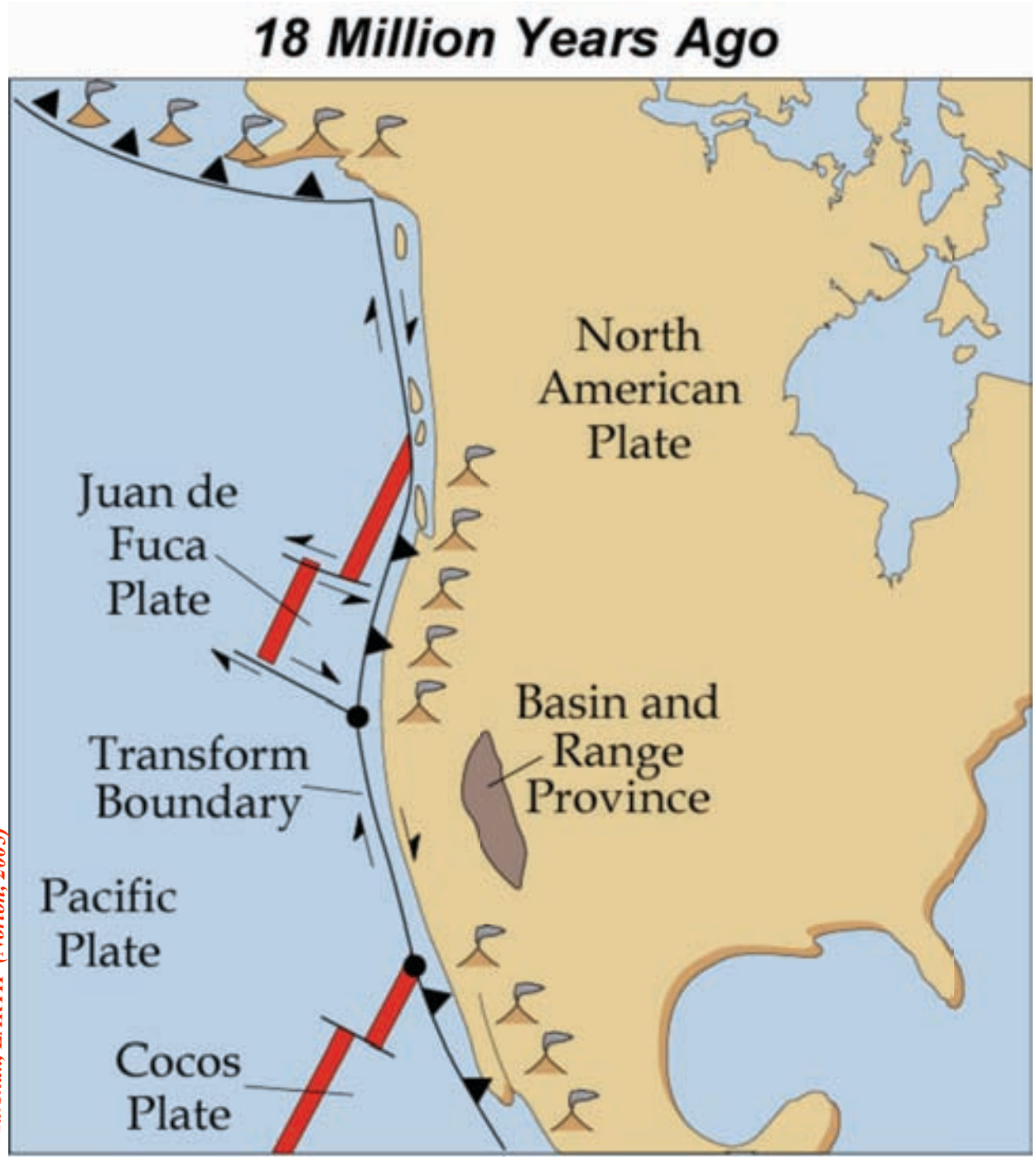
In the past the entire West Coast was a subducting plate boundary. A volcanic arc extended all the way from Alaska to Mexico.



Marshak, EARTH (Norton, 2005)

PLATE TECTONIC DEVELOPMENT OF THE WESTERN UNITED STATES

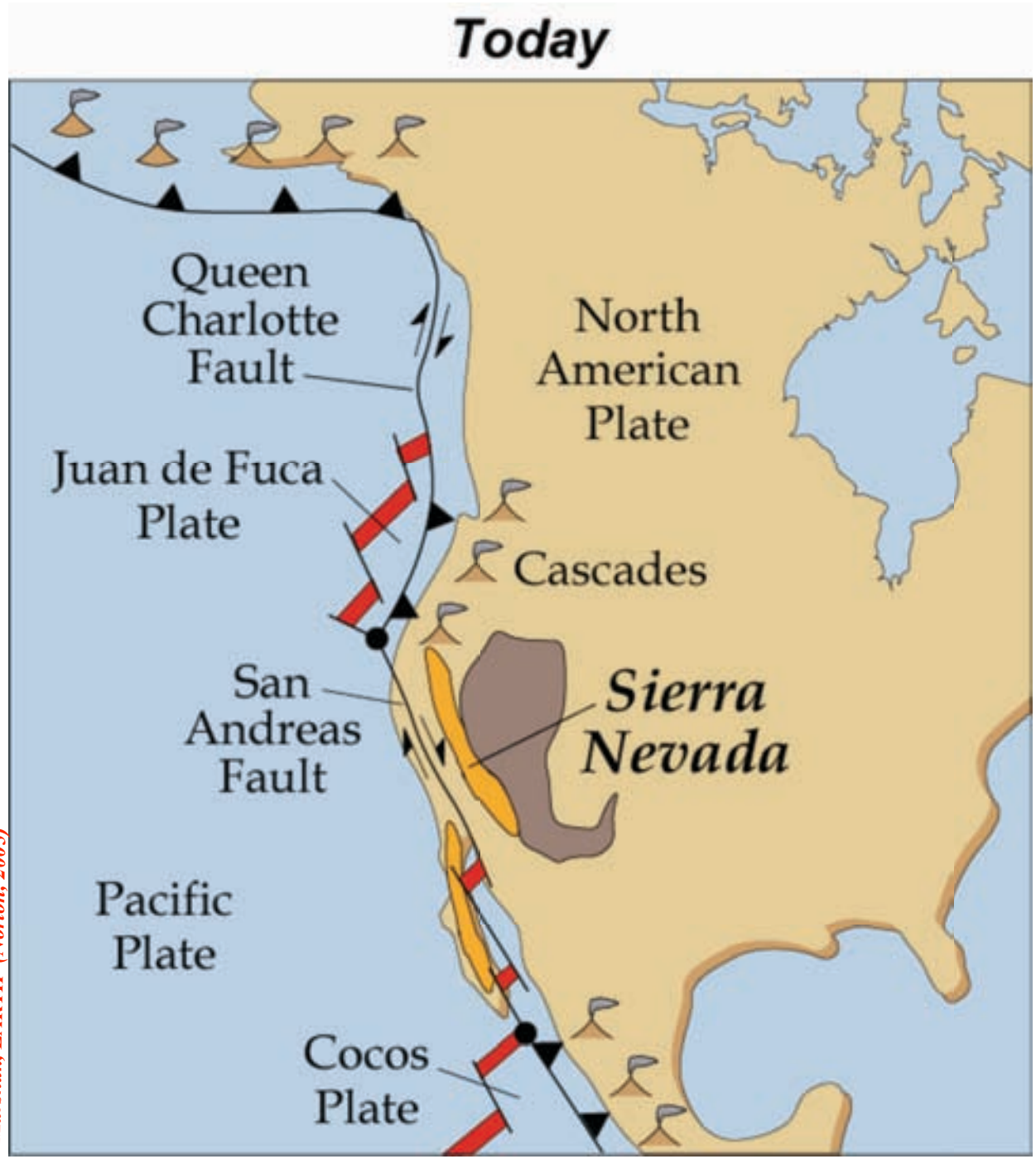
The Farallon Plate was completely subducted in the California region, leaving only fragments know as the Juan de Fuca and Cocos plates. Where the Pacific and North American plates touched, subduction ceased and a transform boundary developed.



Marshak, EARTH (Norton, 2005)

PLATE TECTONIC DEVELOPMENT OF THE WESTERN UNITED STATES

The Sierra Nevada are the eroded remnants of the once-extensive volcanic arc.



Marshak, EARTH (Norton, 2005)

Seismic Tomography → "CatScan" of the Earth

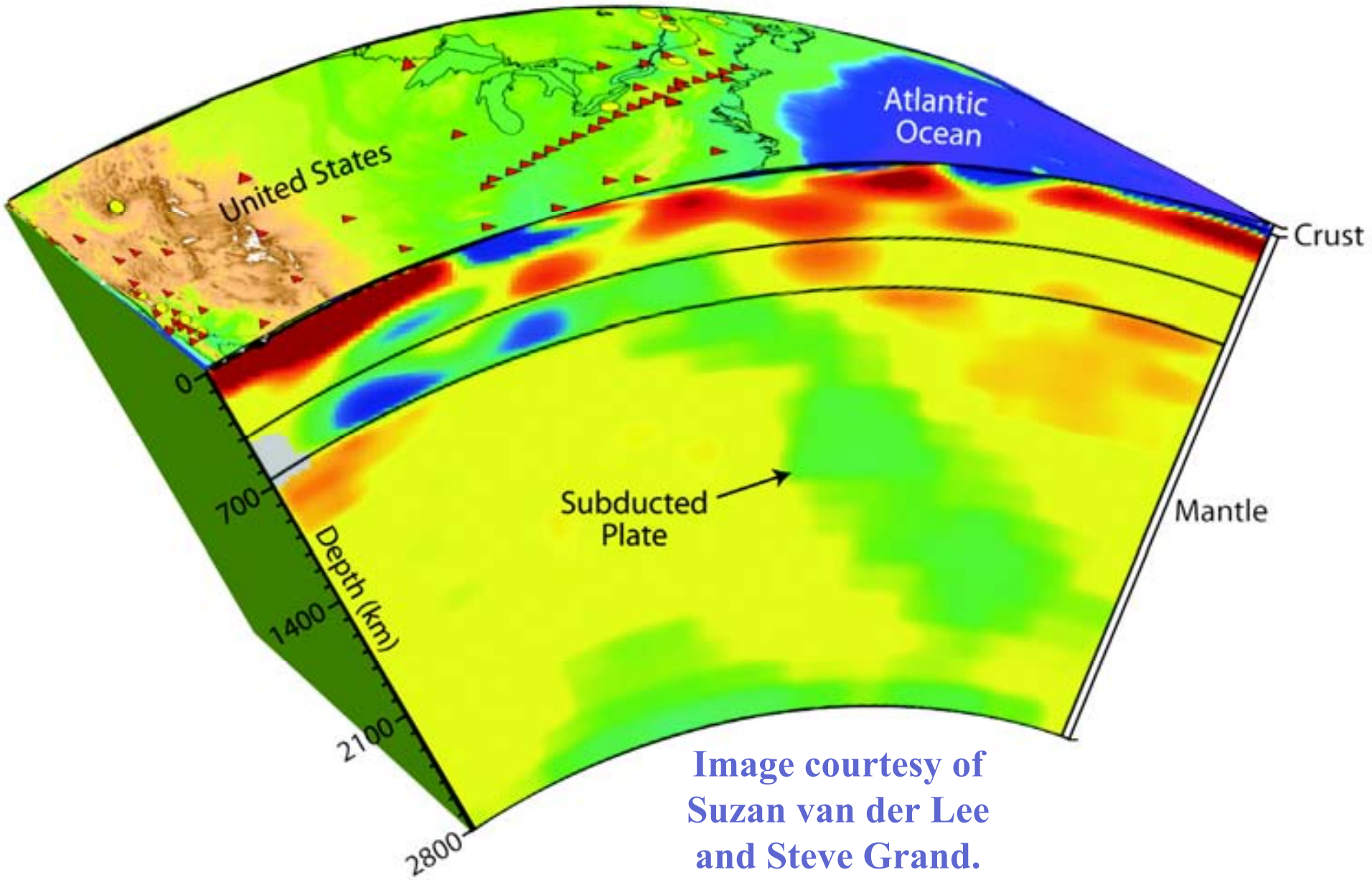


Image courtesy of Suzan van der Lee and Steve Grand.

P-Wave Seismic Tomography

P-Wave "Community Velocity Model" based partly on USArray through November 2007

- **High Velocity → Subducted Juan de Fuca and Farallon lithosphere**

- **Low Velocity → Yellowstone Hotspot, Basin and Range rifting and Colorado Plateau**

Burdick et al., 2008

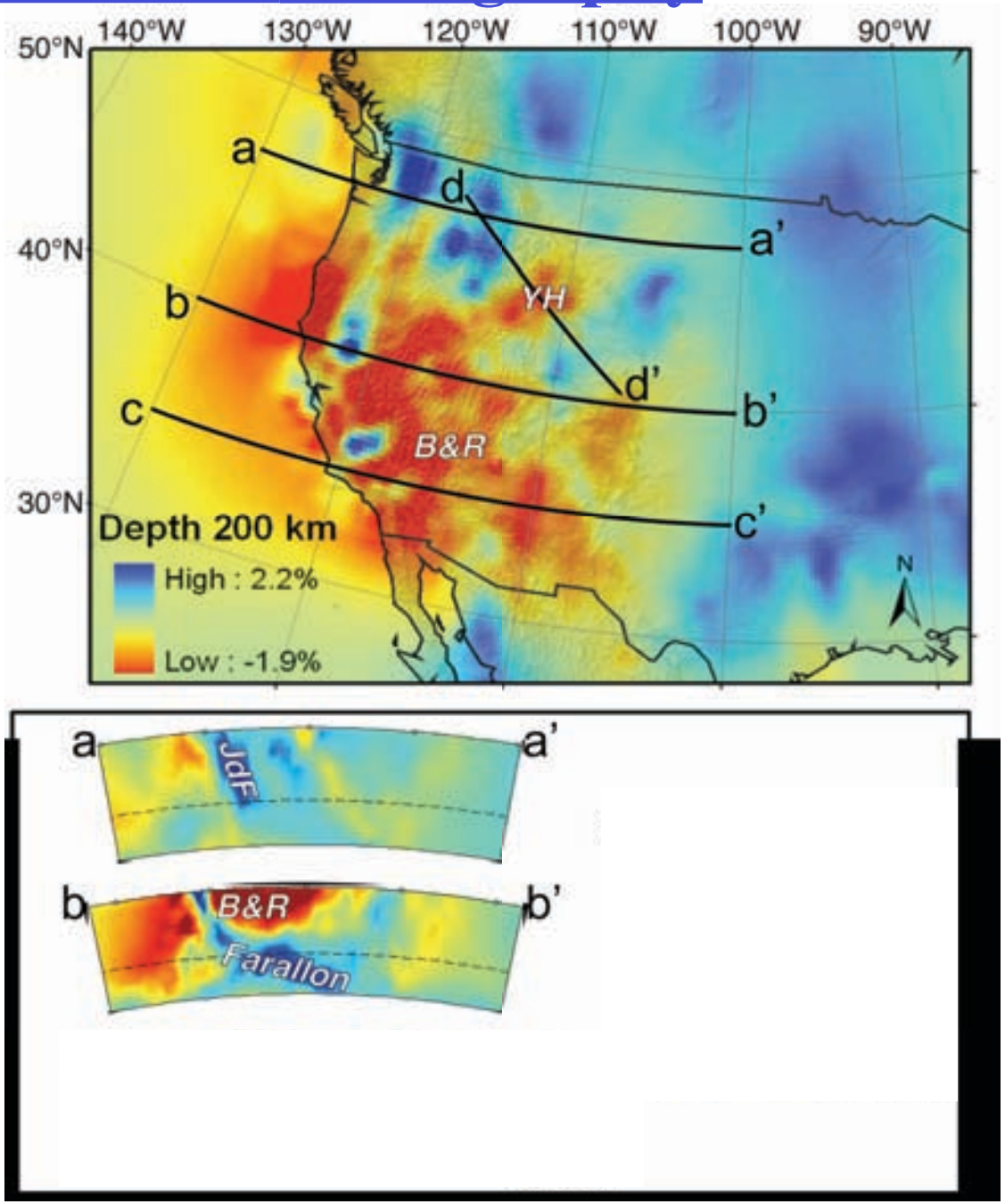
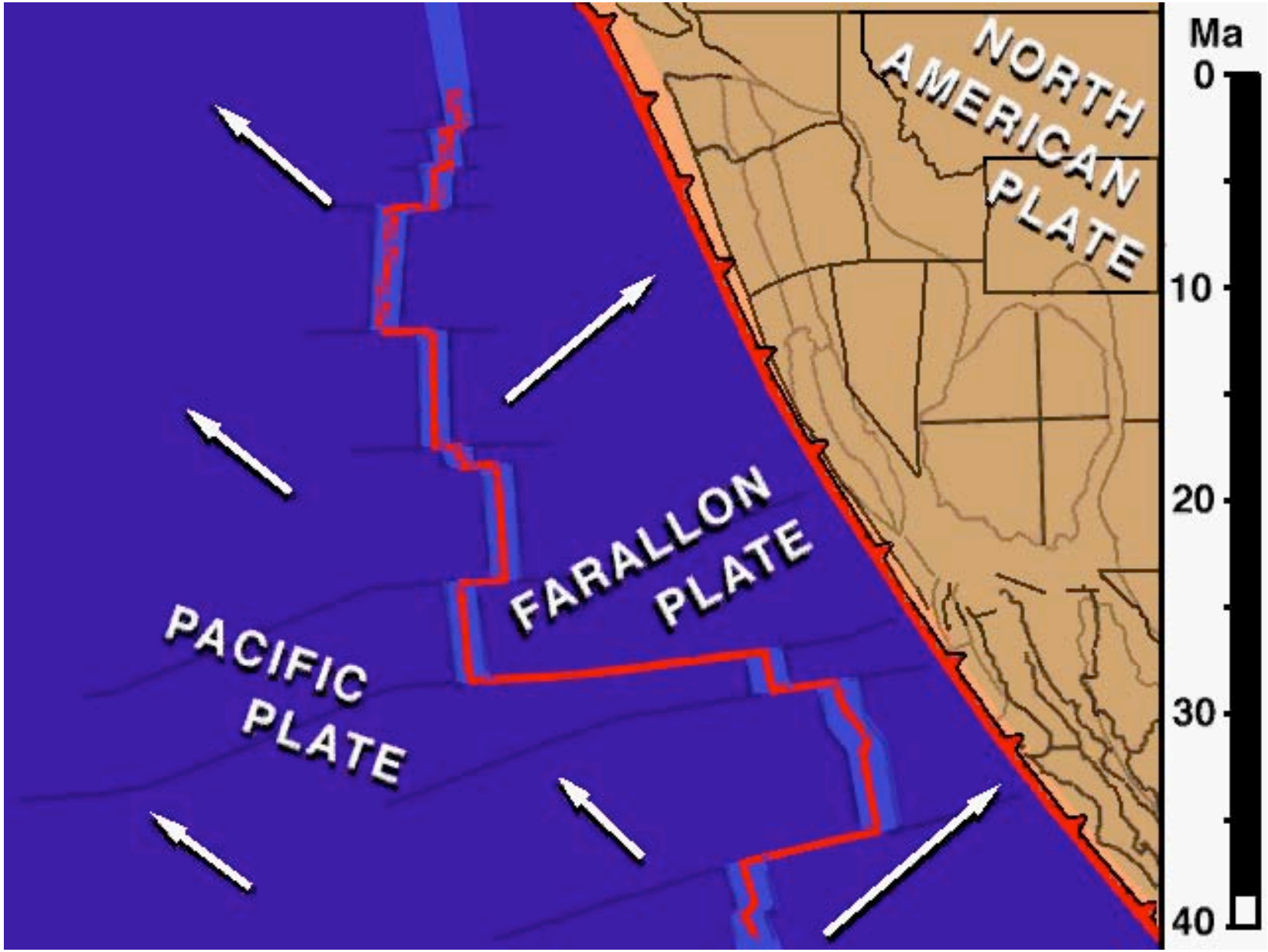


Plate Tectonic Evolution of U. S.

40 Million Years to Present

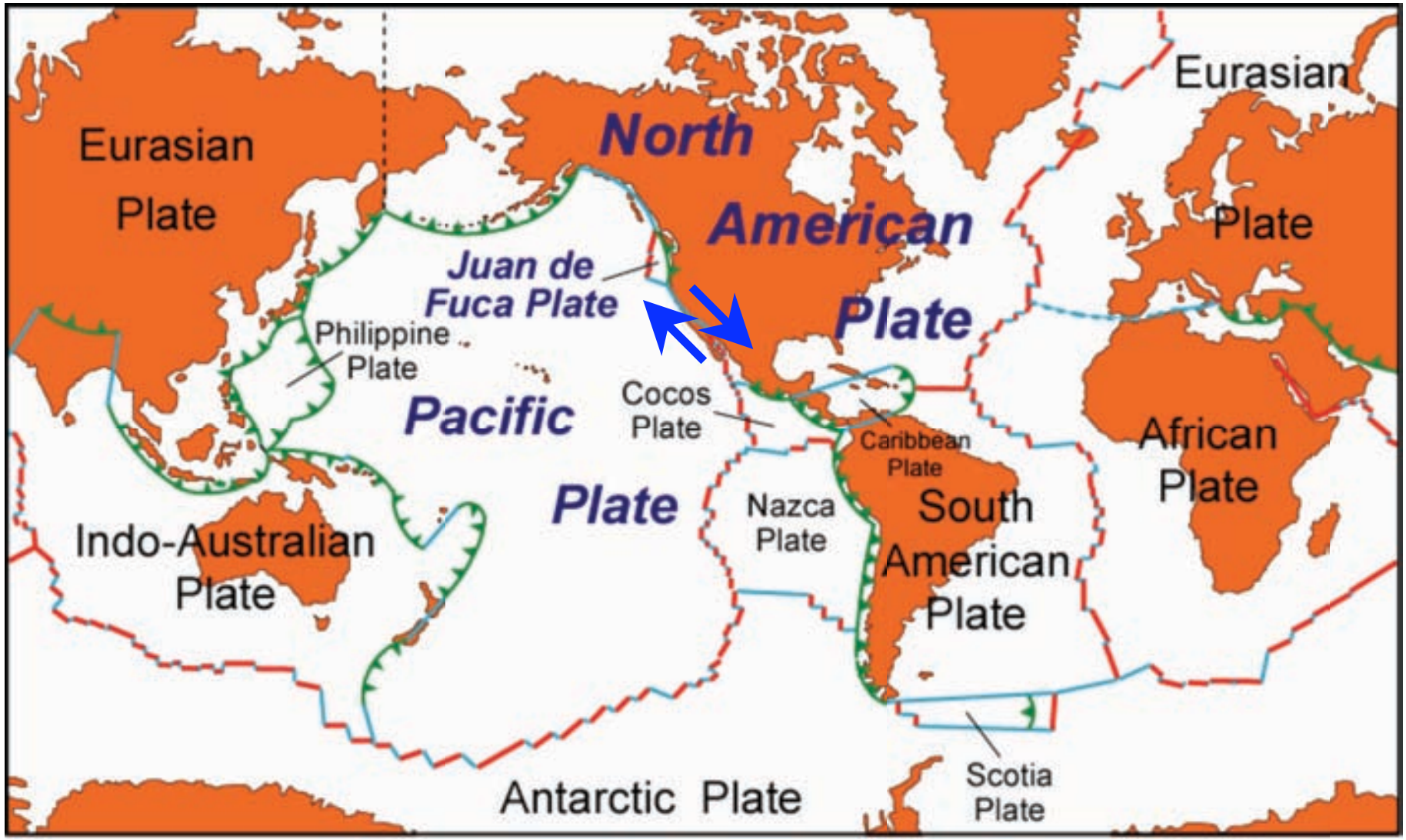
Tanya Atwater, UC-Santa Barbara



Robert J. Lillie

Transform Plate Boundary

Transform Plate Boundary



San Andreas Fault

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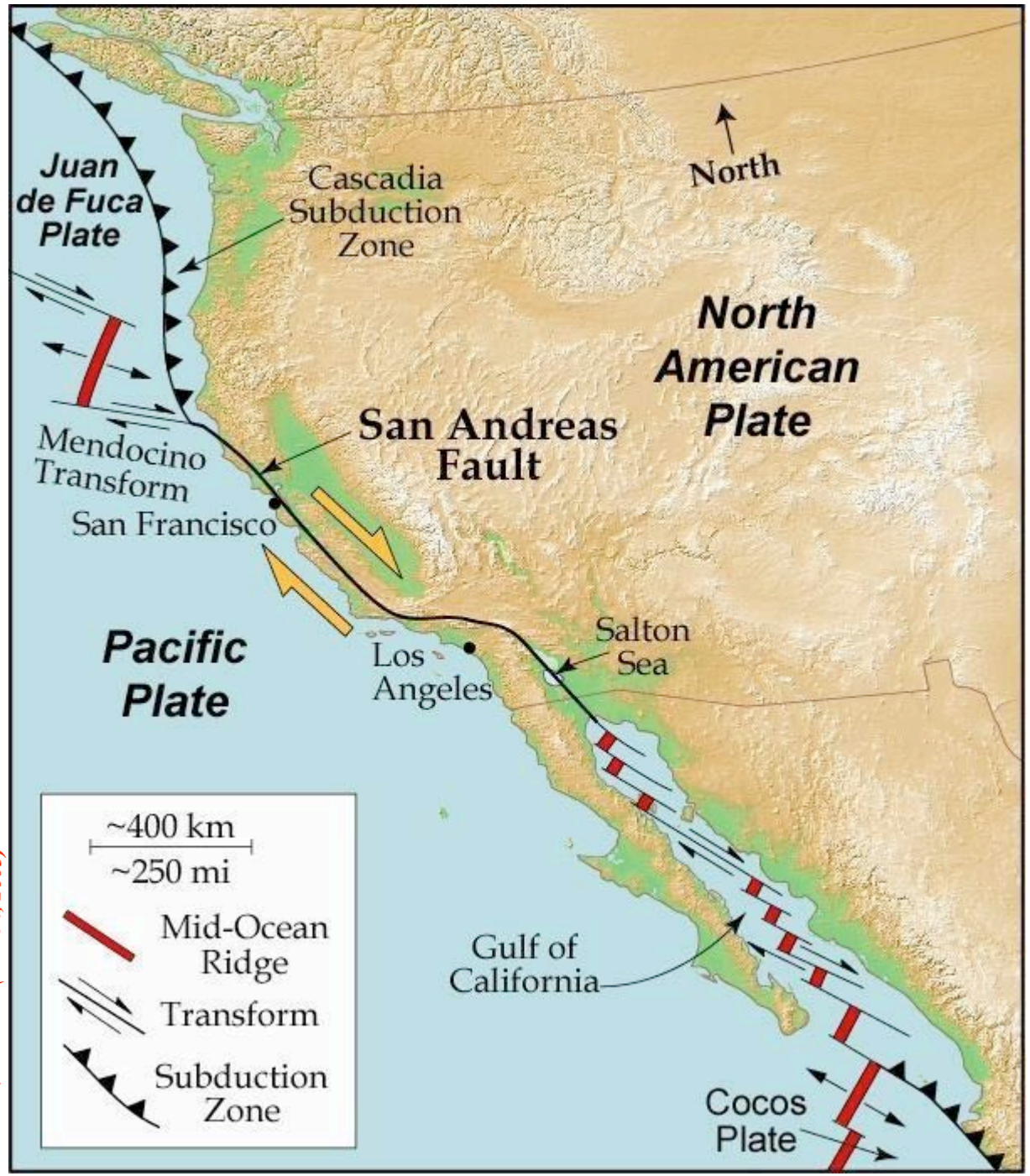
Transform Plate Boundary

The Pacific Plate slides past the North American Plate along the <u>San Andreas Fault</u> in California.



Marshak, EARTH (Norton, 2005)

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SAN ANDREAS FAULT

R. E. Wallace, U. S. Geological Survey

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SAN ANDREAS FAULT

R. E. Wallace, U. S. Geological Survey

Parks and Plates
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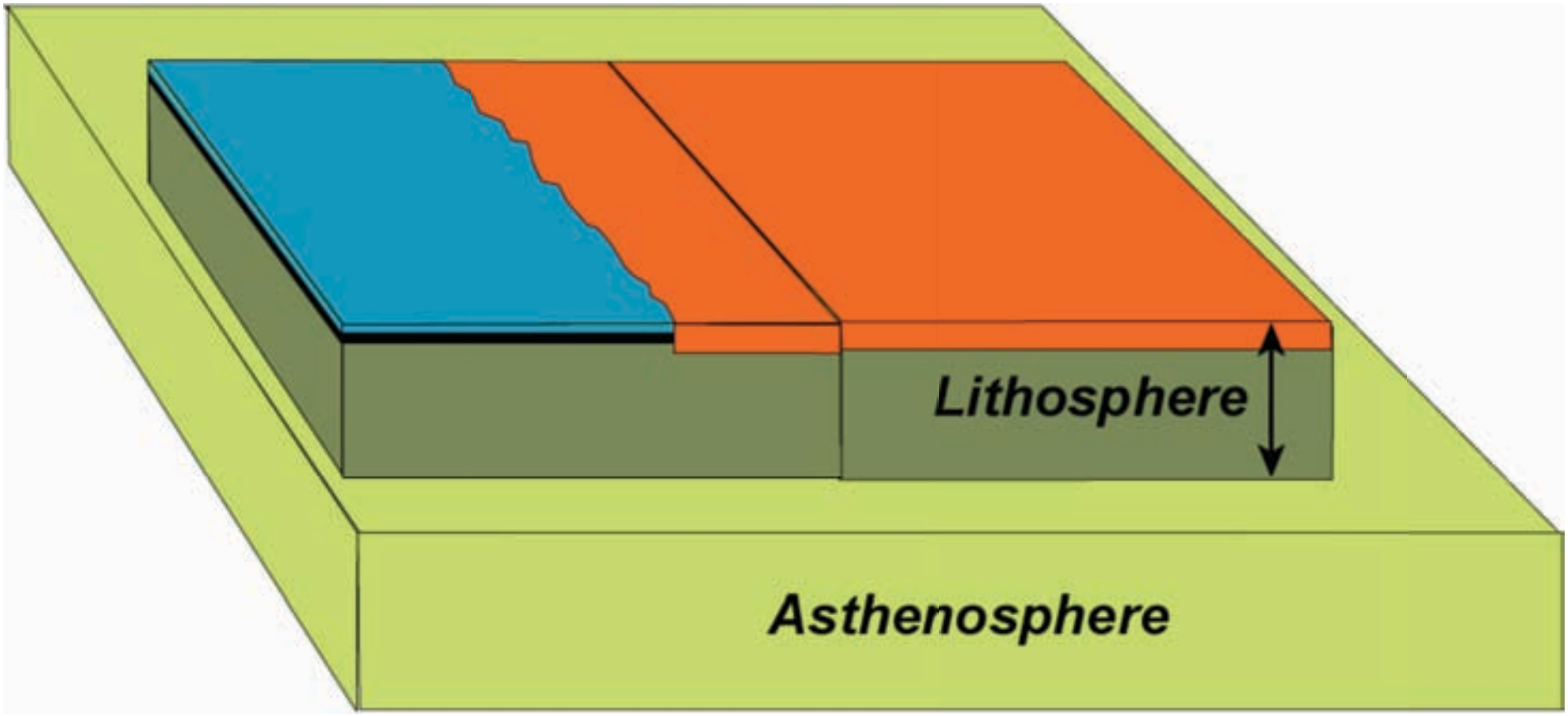
Geology Interpretive Workshop – Golden Gate NRA and Point Reyes NS, California, August 30-31, 2005

Geology Interpretive Workshop – Golden Gate NRA and Point Reyes NS, California, August 30-31, 2005

Features Developed along TRANSFORM PLATE BOUNDARY

A transform boundary is a nearly-vertical break between two plates of lithosphere.



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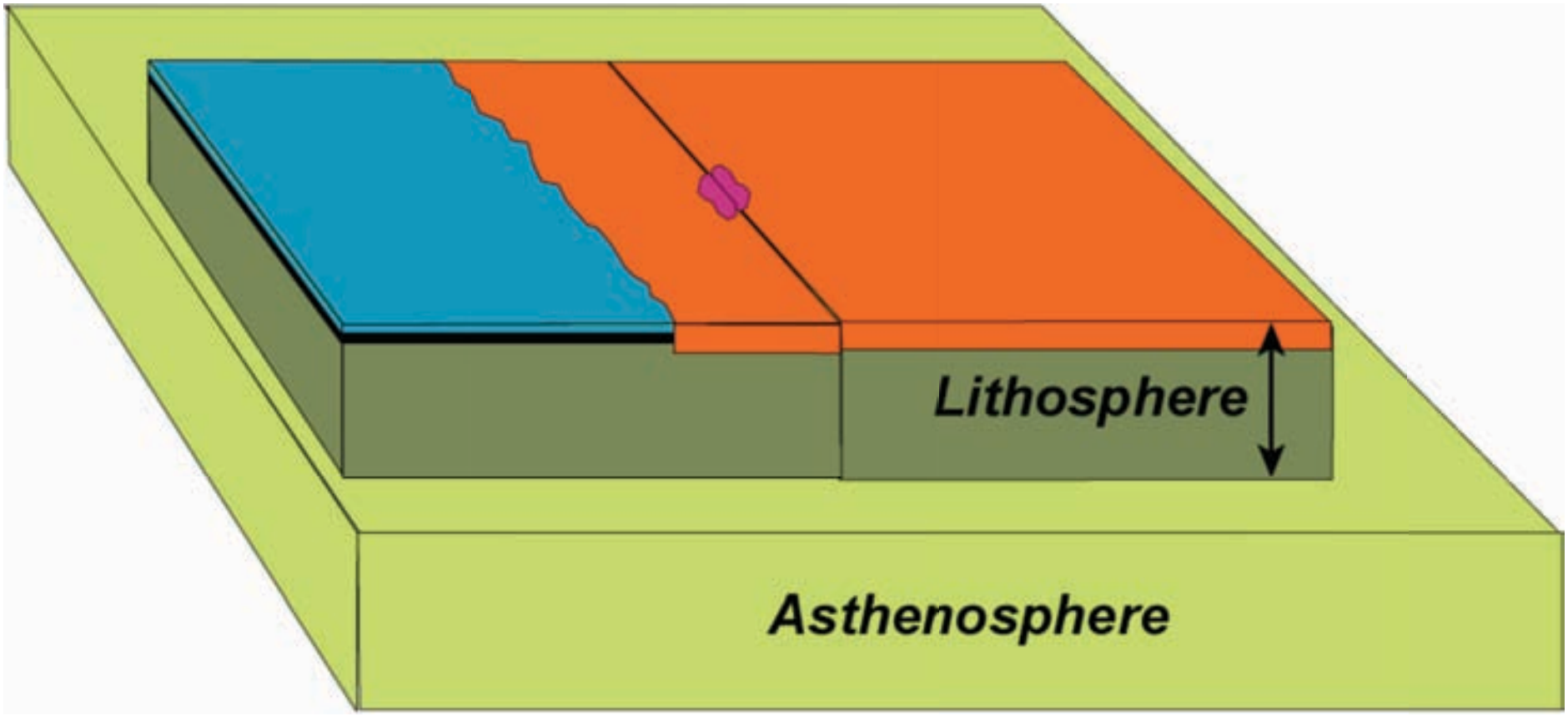
Features Developed along TRANSFORM PLATE BOUNDARY

A mass of rock formed on the plate before it broke in two may be cut by the transform boundary.



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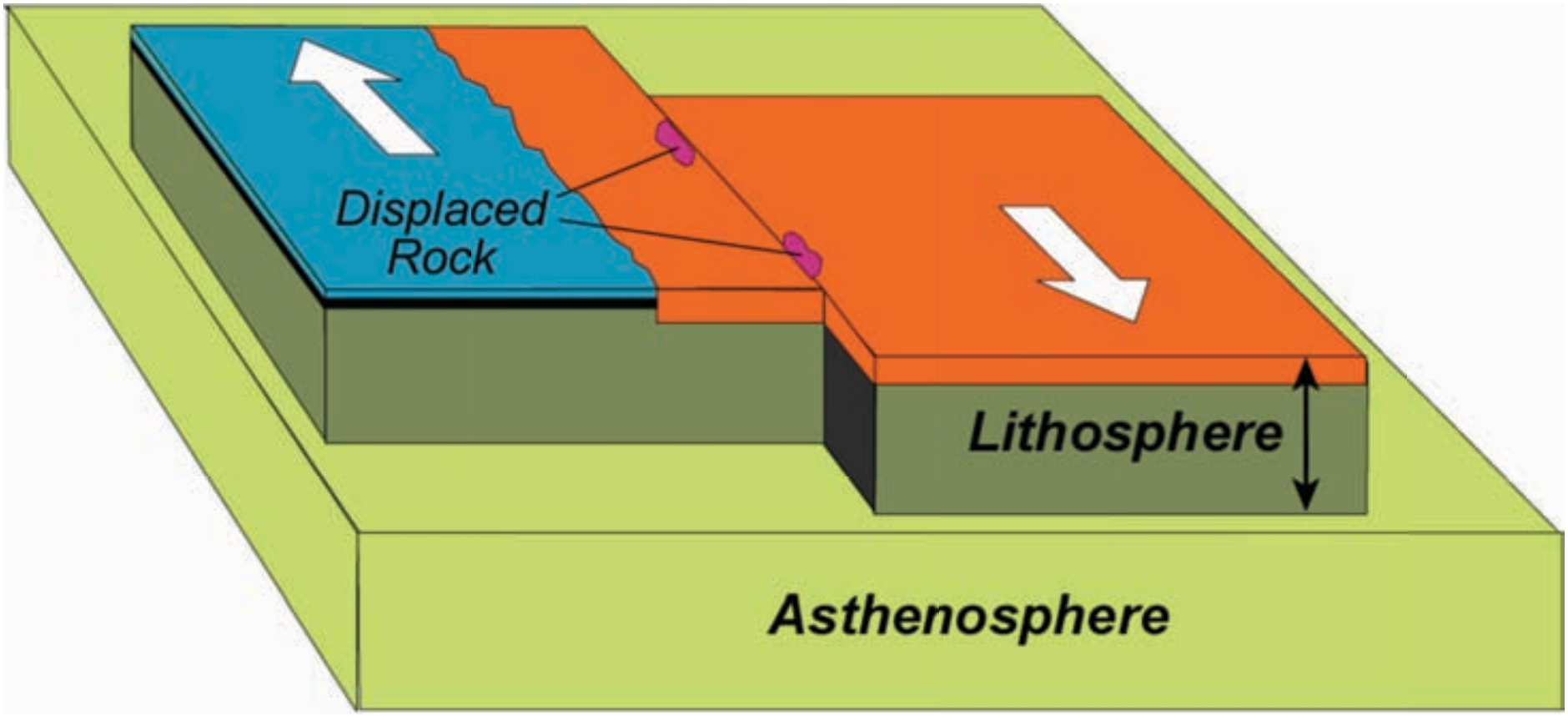
Features Developed along TRANSFORM PLATE BOUNDARY

The distance between the displaced fragments is a clue to the amount of plate motion since the rock mass formed.



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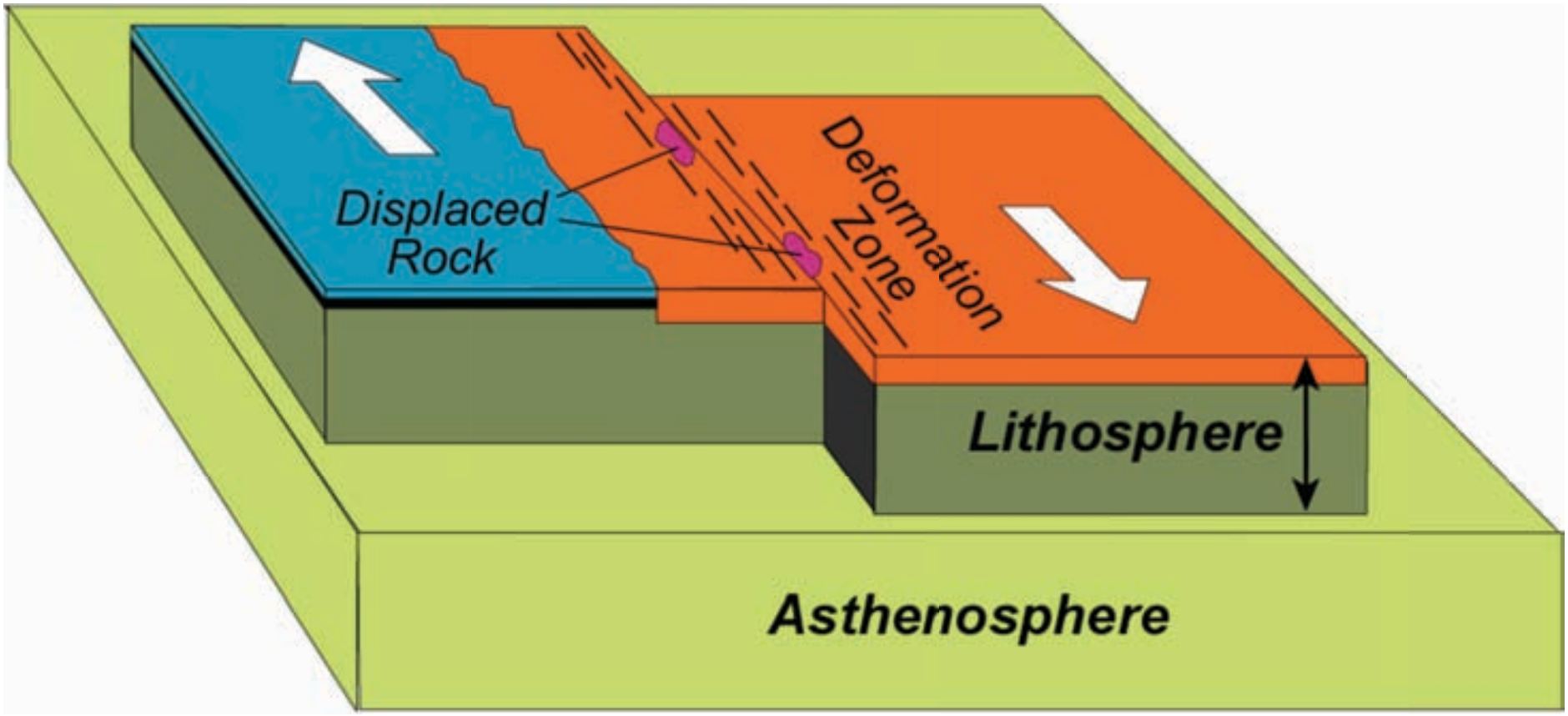
Features Developed along TRANSFORM PLATE BOUNDARY

The transform plate boundary is a broad zone of deformation between the two plates.



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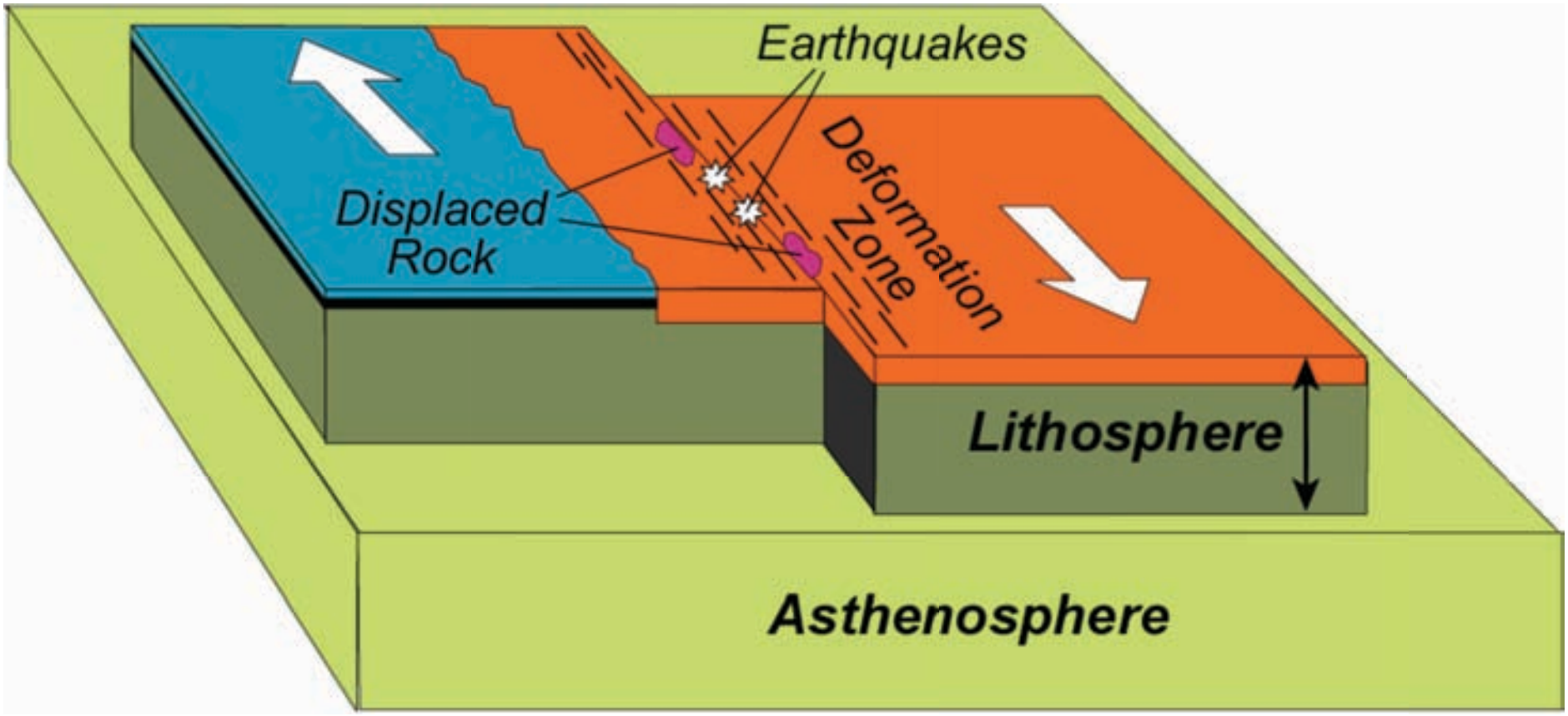
Features Developed along TRANSFORM PLATE BOUNDARY

Earthquakes occur as the plates stick together for some time, then suddenly let go.



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Creating the SAN ANDREAS FAULT with a Deck of Cards

Pretend your left hand is the Pacific Plate, your right hand the North American Plate.

Robert J. Lillie

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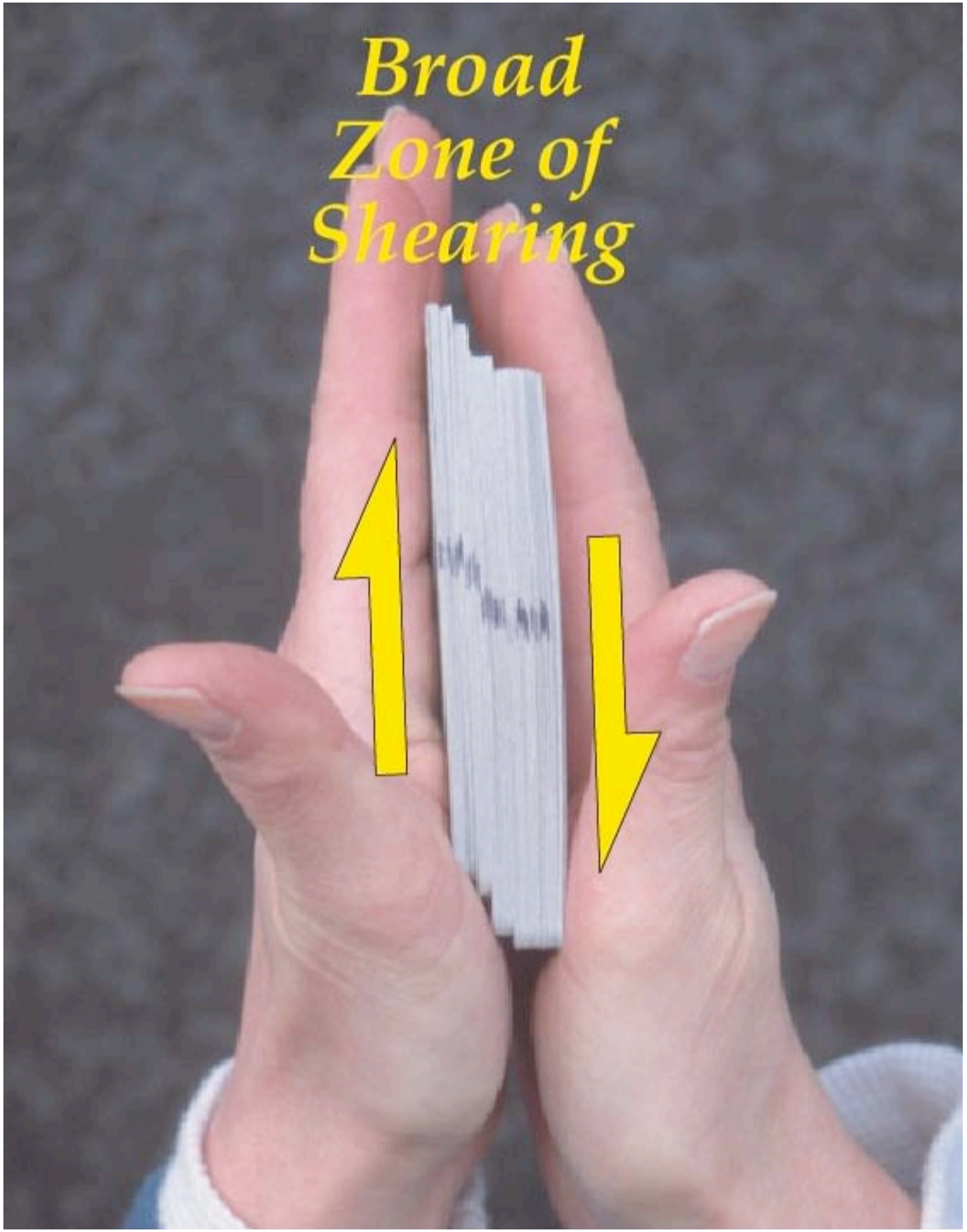
Creating the SAN ANDREAS FAULT with a Deck of Cards

The TRANSFORM PLATE BOUNDARY is a broad zone of shearing between the two plates.



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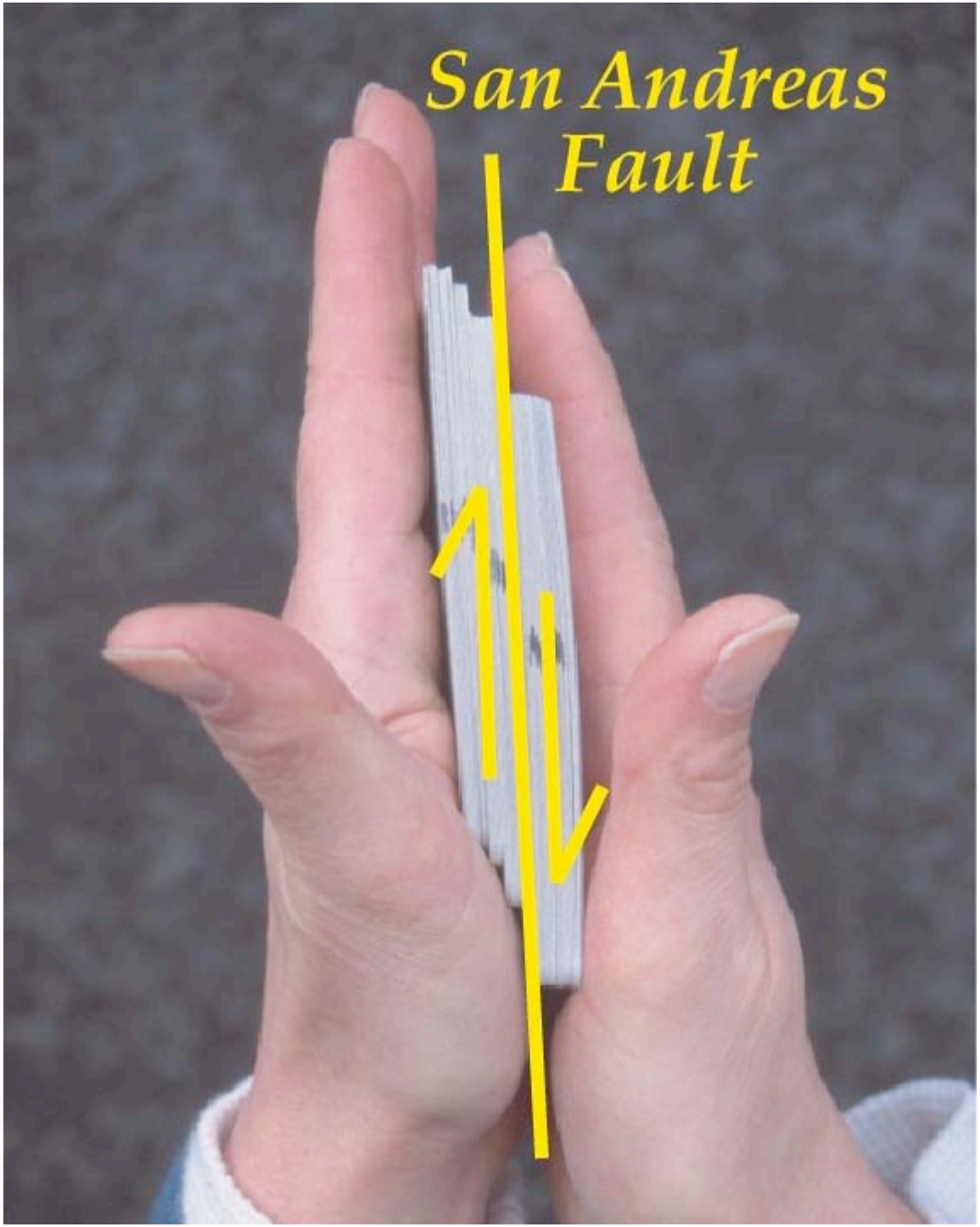
Creating the SAN ANDREAS FAULT with a Deck of Cards

One card face eventually takes over, simulating the predominance of movement along the San Andreas Fault.



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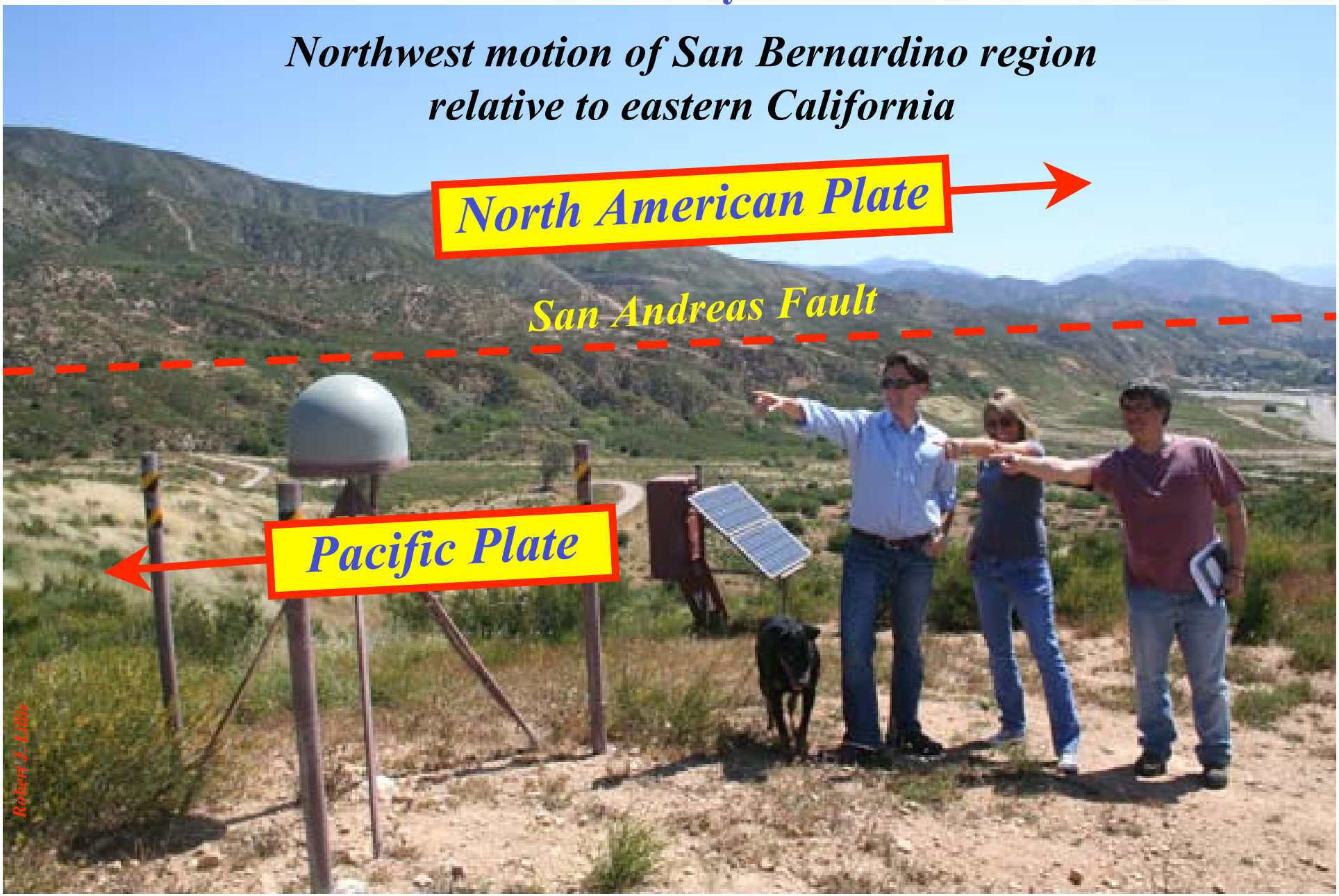
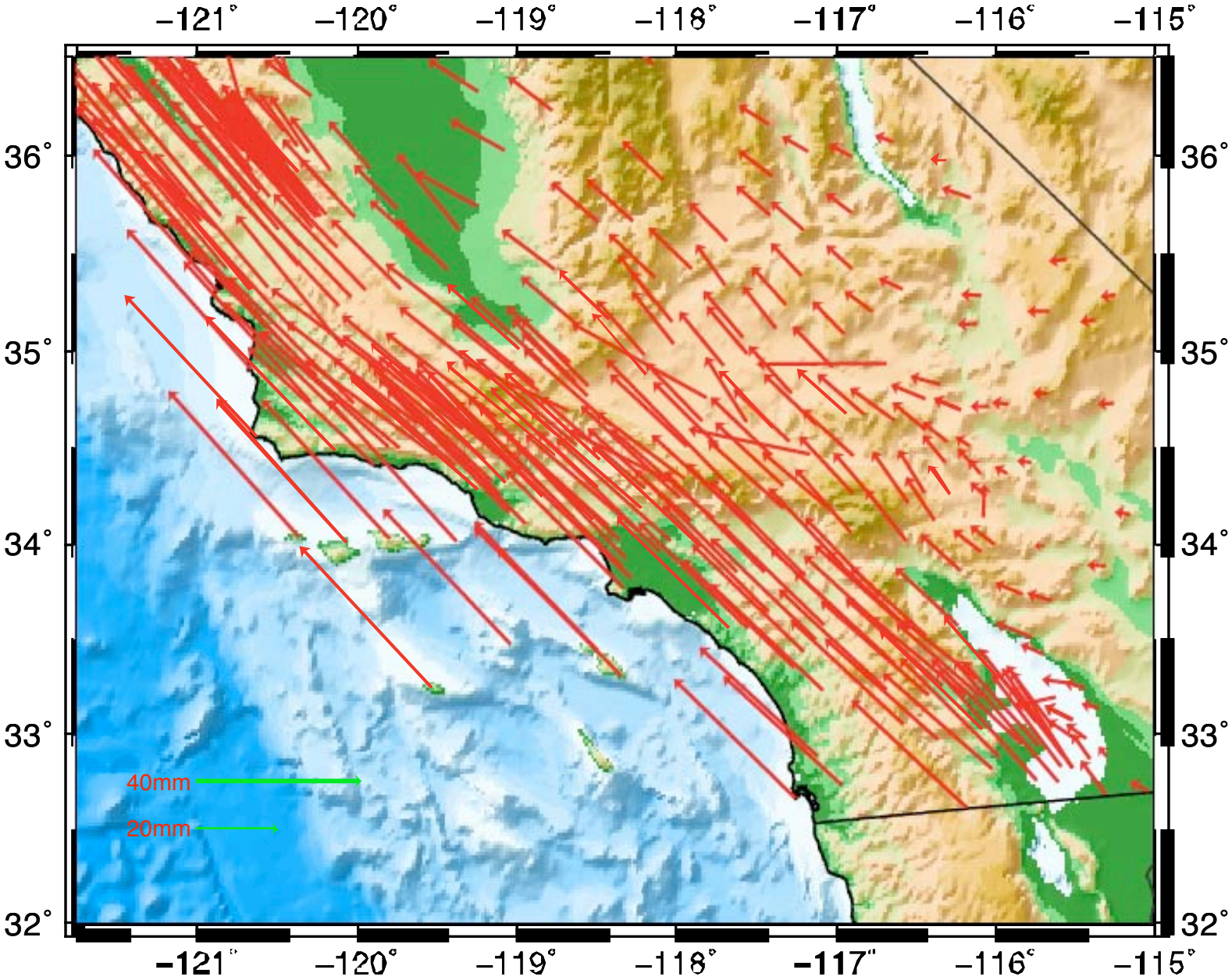
GSP Station
California State University at San Bernardino

GSP Station
California State University at San Bernardino



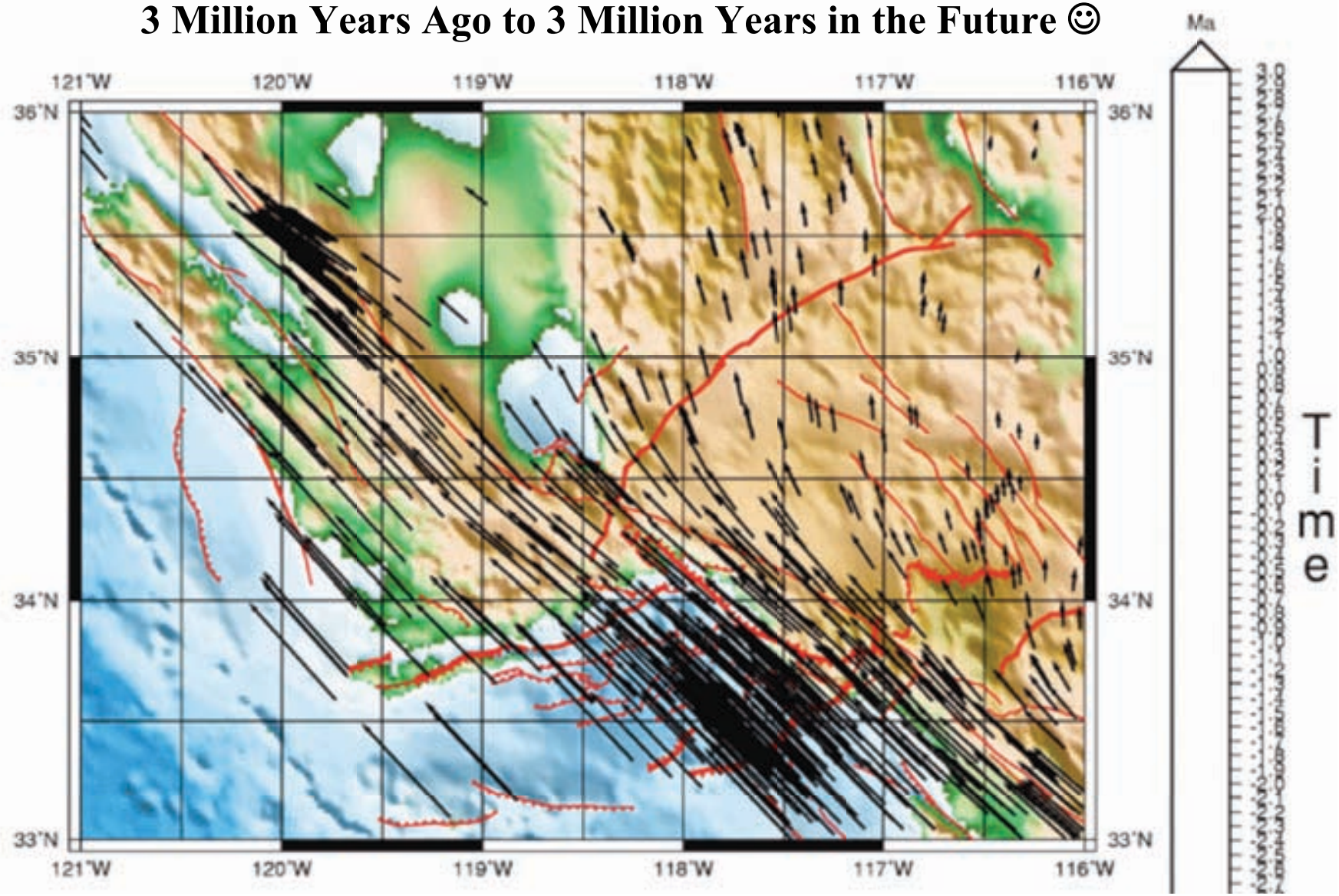
Southern California GPS Vectors

(Relative to Stable North America)



GPS Motions in Southern California

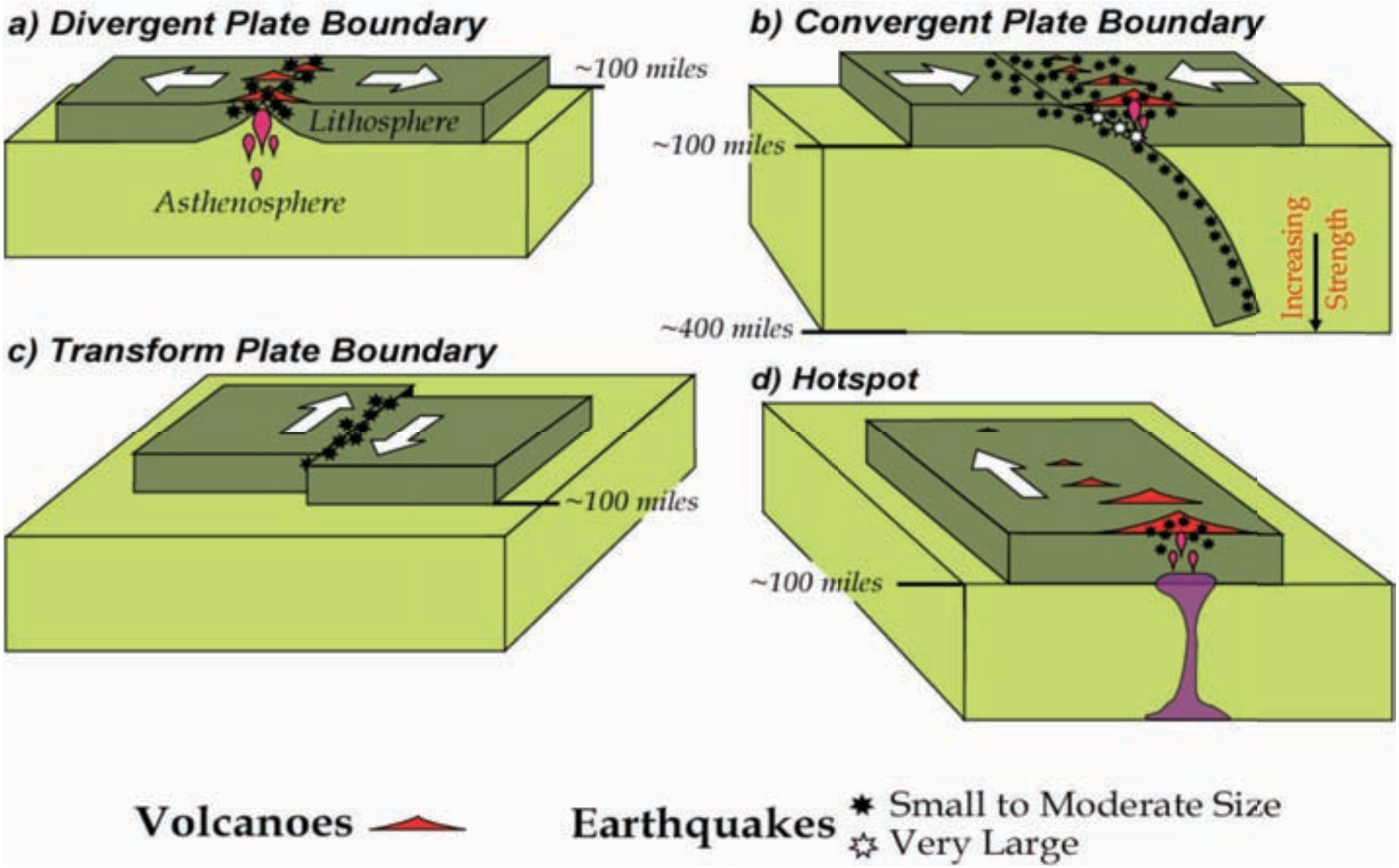
3 Million Years Ago to 3 Million Years in the Future ☺



Animation by Bill Holt

http://rock.geo.sunysb.edu/~holt/Education/vel6Ma.html

Types of Plate Boundaries



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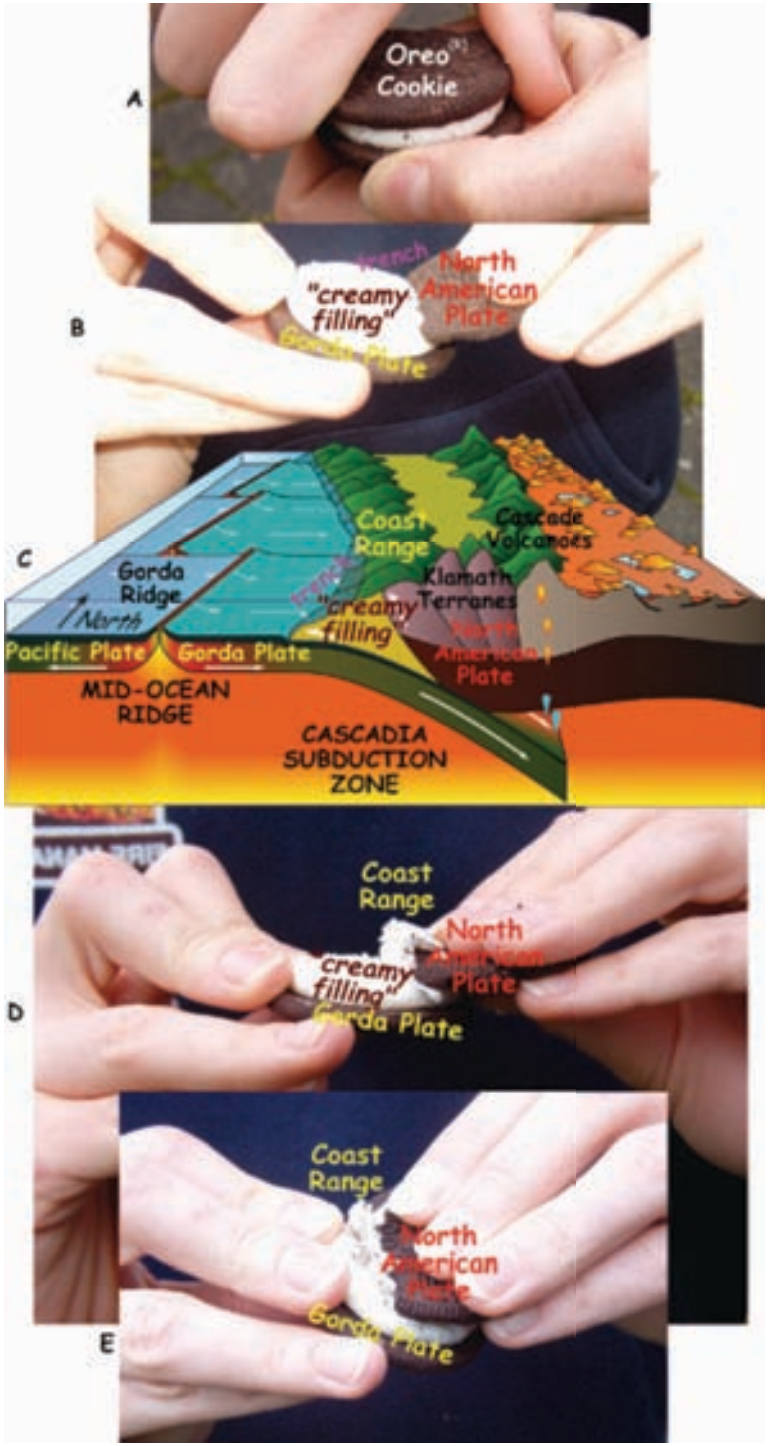
Engaging the Public on the Geology of National Parks and other Special Places

1. Geology on a Basic Level

2. Results of Latest Research

- **Climate Change:**
  - **Example of how outreach efforts are now paying off in terms of public awareness and action**
- **Volcanic Activity**
- **Earthquakes**
- **Landscape Development**

→EarthScope!!!!! ☺



Golden Gate National Recreation Area, California

PAIRing People with Parks

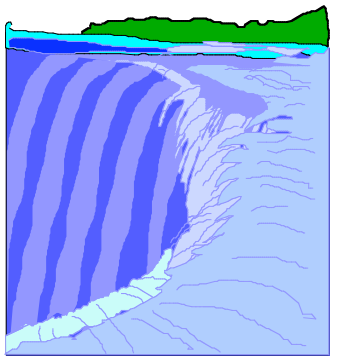
Park Visitors

P *Presentation Technique*

A *Audience Characteristics*

I *Interpretation Methods*

R *Resource Information*



National Park

(Adopted from Allyson Mathis, Grand Canyon National Park)

PAIRing People with Parks

Park Visitors

P

Presentation Technique

A

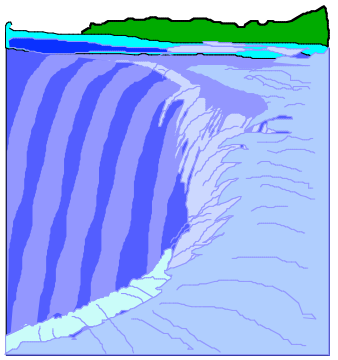
Audience Characteristics

I

Interpretation Methods

R

Resource Information



National Park

Won't work if any link is missing!

(Adopted from Allyson Mathis, Grand Canyon National Park)

Group Presentations

Groups of 4-6:

Skit?

Interpreter/Audience?

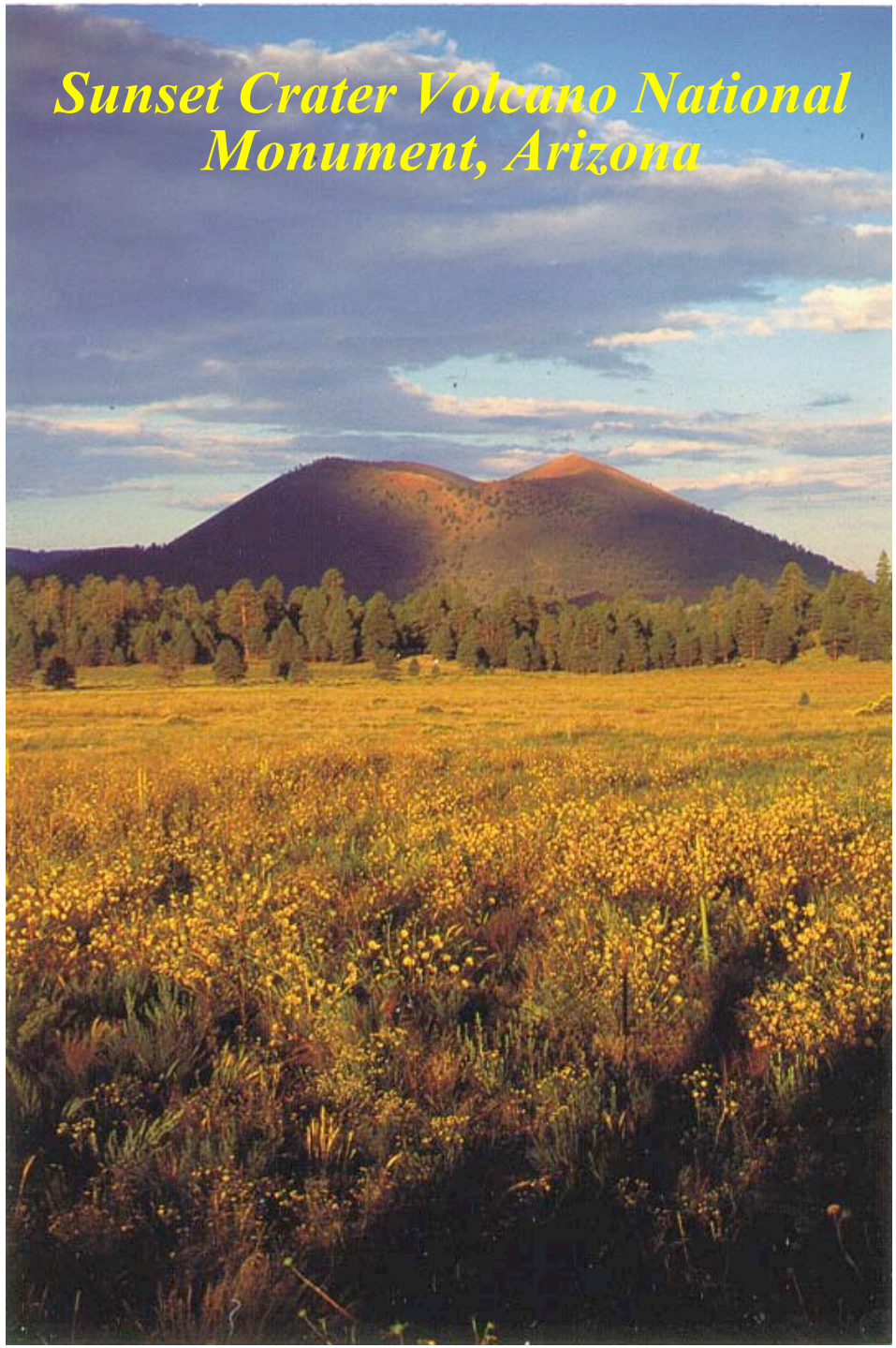
Theme Statement:

Complete Sentence.

Answers "So what?"

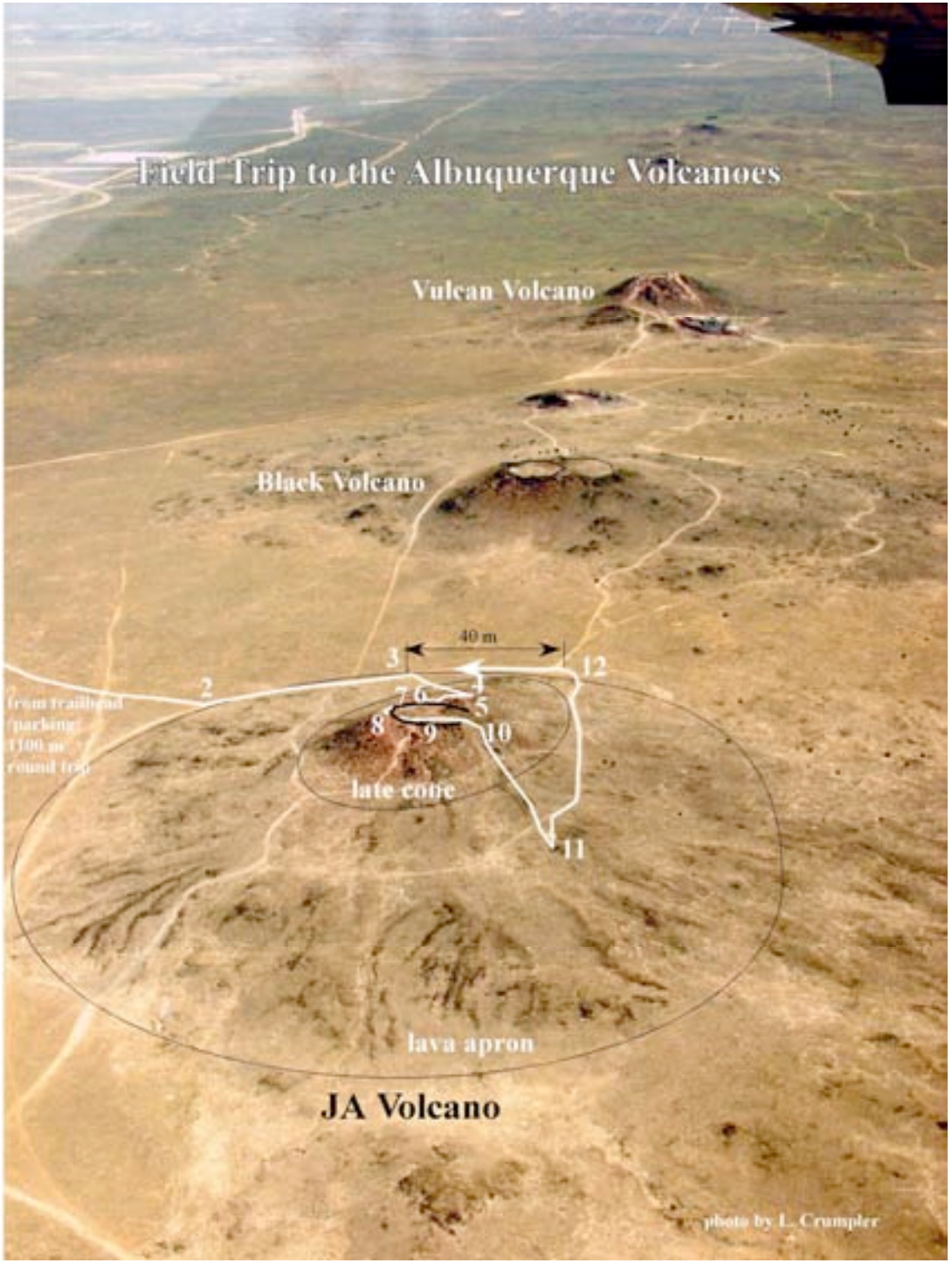
Elements of PAIRing:

1. Presentation Technique
   Where? What?
2. Who is the Audience?
3. 10-15 Minute Interpretative Presentation
4. Resource Information incorporates EarthScope



Field Trip to the Albuquerque Volcanoes: A Field Guide to the Physical Volcanology of a Fissure-type Eruption

Larry Crumpler
Jayne Aubele
New Mexico Museum of Natural History and Science



Introductions

1. Who? Where from? Why this workshop?

2. What's your favorite park - other than your own ☺ - and why?

Participant Organizations

1. Arizona State Univeristy, Tempe, AZ
2. Pecos National Historical Park, Pecos, NM
3. New Mexico Dept of Cultural Affairs, Bernalillo, NM
4. Canyonlands National Park, Moab, UT
5. Southern California Earthquake Center, Los Angeles, CA
6. Red River Community House, Red River, NM
7. Glen Canyon National Recreation Area, Page, AZ
9. Rio Grande Nature Center State Park, Albuquerque, NM
10. Four Corners School of Outdoor Education, Flora Vista, NM
11. National Mus of Nuclear Sci and History. Albuquerque, NM
12. Great Sand Dunes National Park and Pres, Mosca, CO
13. Hueco Tanks State Park and Historic Site, El Paso, TX
14. Smithsonian Institution, Napa, CA
15. Lafayette College, Easton, PA
16. Glen Canyon National Recreation Area, Page, AZ
17. Chinle Unified School District #24, Chinle, AZ
18. Doyon/Aramark JV (DNP&P), Colorado Springs, CO
19. National Park Service, Mountainair, NM
20. NM Museum of Natural History & Science, Albuquerque, NM
21. Great Sand Dunes National Park and Pres, Mosca, CO
22. Public Lands Interpretive Association, Flagstaff, AZ
23. San Bernardino County Museum, Redlands, CA
24. Edinboro University of Pennsylvania, Edinboro, PA
25. Asombro Institute for Science Education, Las Cruces, NM
26. Rough Rock Community School, Chinle, AZ
27. Salinas Pueblo Missions Nat. Mon., Mountainair, NM
28. Rough Rock Community School, Chinle, AZ
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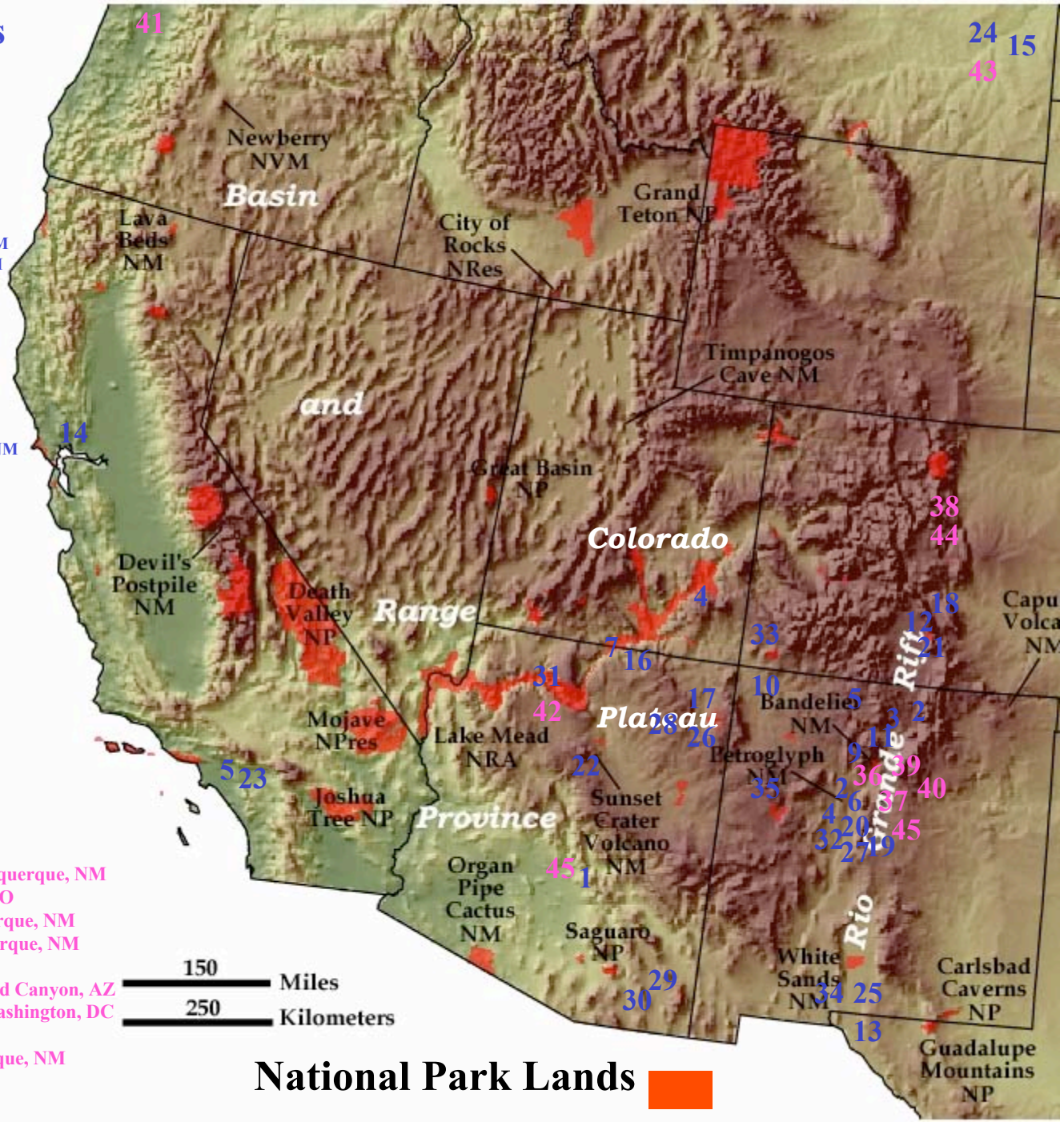
31. Grand Canyon National Park, Grand Canyon, AZ
32. National Park Service, Albuquerque, NM
33. Four Corners School of Outdoor Education, Cortez, CO
34. Asombro Institute for Science Education, Las Cruces, NM
35. Bureau of Land Management, Grants, NM

Instructors

36. Rick Aster, New Mexico Tech, Socorro, NM
37. Jayne Aubele, New Mex Mus Nat Hist and Sci, Albuquerque, NM
38. Henry Berglund, University of Colorado, Boulder, CO
39. Laurie Crossey, University of New Mexico, Albuquerque, NM
40. Karl Karlstrom, University of New Mexico, Albuquerque, NM
41. Bob Lillie, Oregon State University, Corvallis, OR
42. Allyson Mathis, Grand Canyon National Park, Grand Canyon, AZ
43. Patrick McQuillan, Incorp Res Instit for Seismol, Washington, DC
44. Shelley Olds, UNAVCO, Inc., Boulder, CO
45. Mousumi Roy, University of New Mexico, Albuquerque, NM
46. Steve Semken, Arizona State University, Tempe, AZ



Colorado Plateau - Rio Grande Rift
Interpretive Workshop, Oct. 26-28, 2009

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