



**NSDL/NSTA Web Seminar:**

**Hotspots, Plumes and LIPS:  
Everything's Coming up Igneous!**



Tuesday, October 2, 2007



## Today's NSDL Experts



Dr. Chris Massell Symons, Researcher at the Scripps Institution of Oceanography



Dr. Anthony Koppers, Associate Professor of Marine Geology and Geophysics at Oregon State University



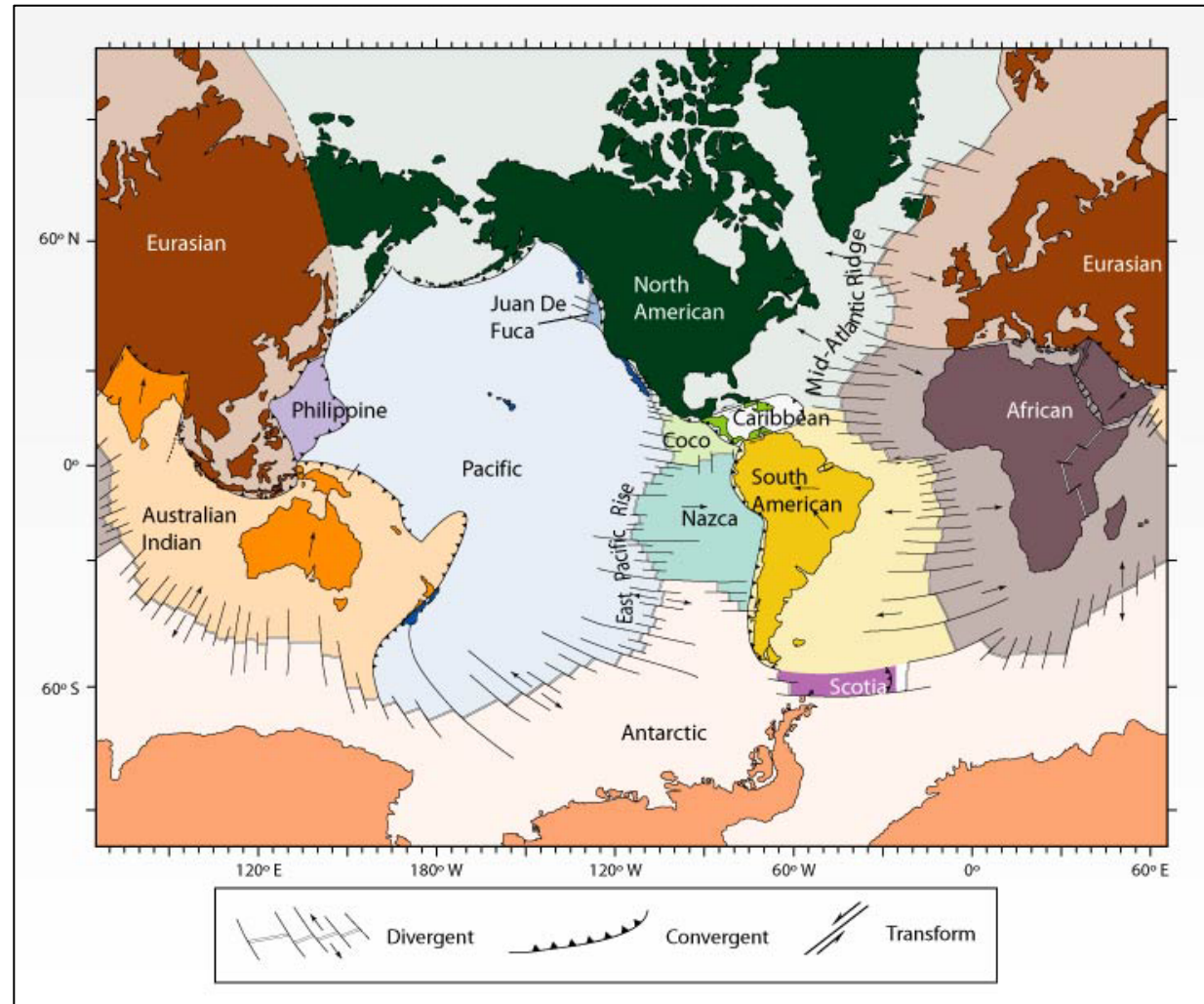
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# The Earth's surface is broken into plates

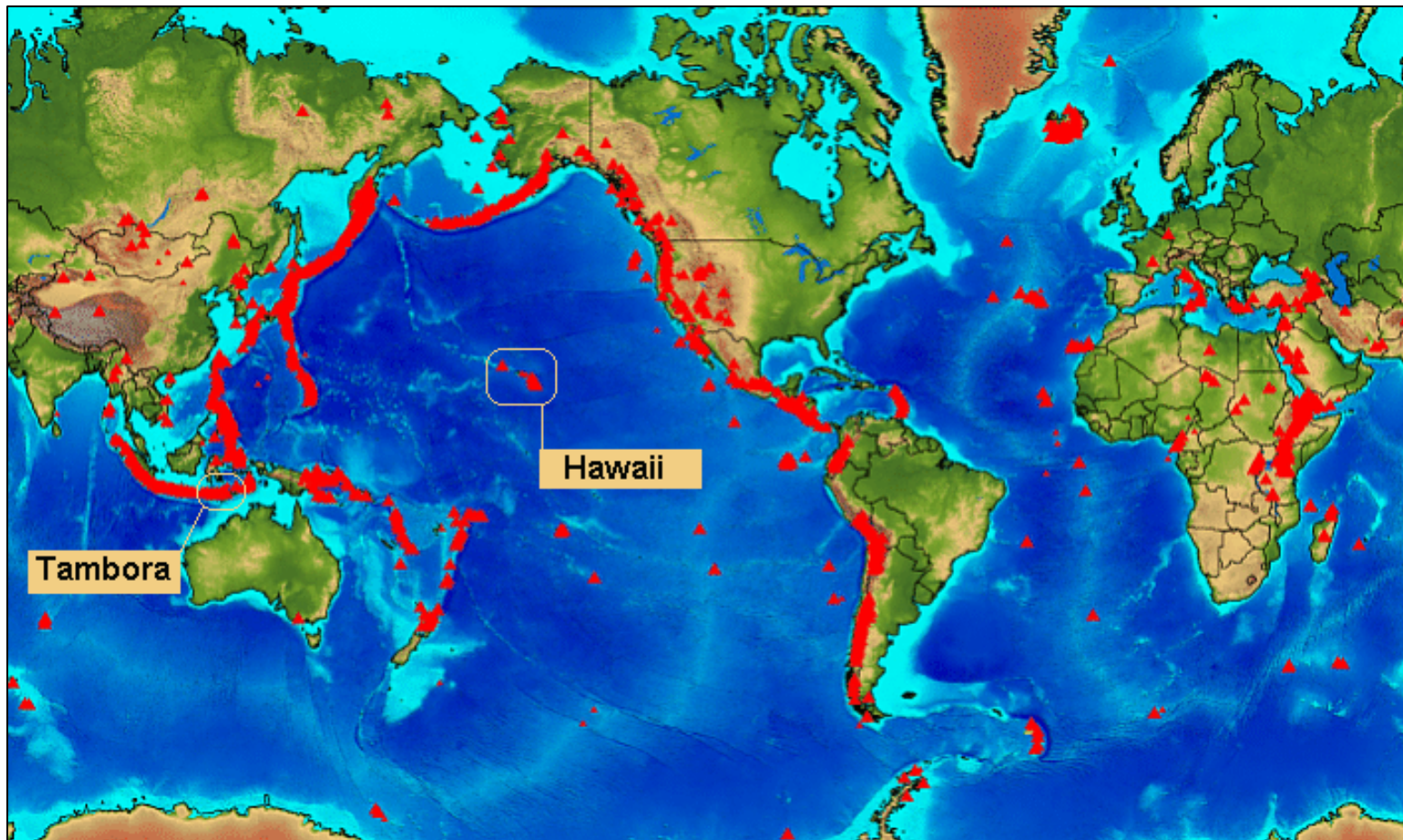
Stamp a place on the map where you expect the most volcanism





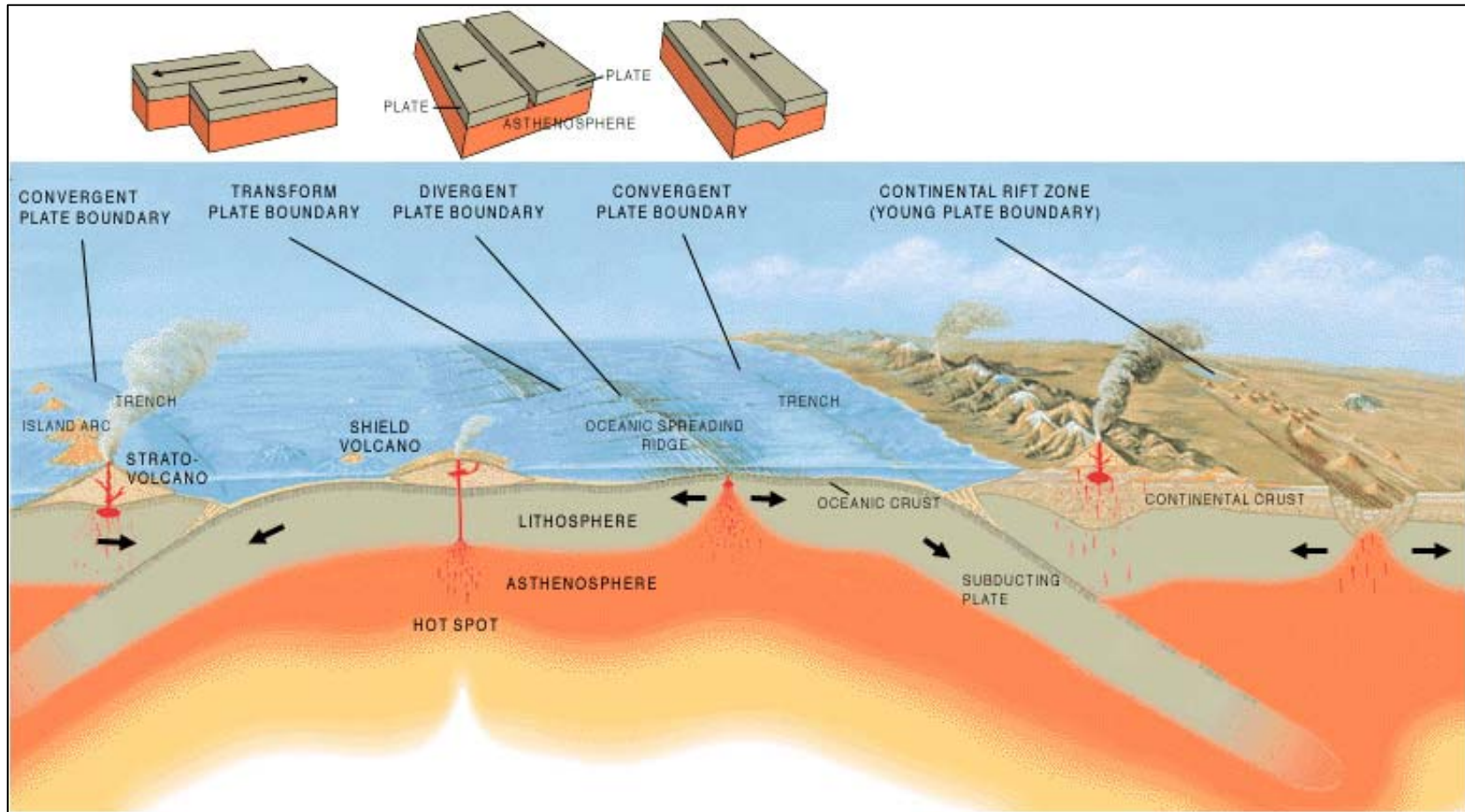


# Volcanism



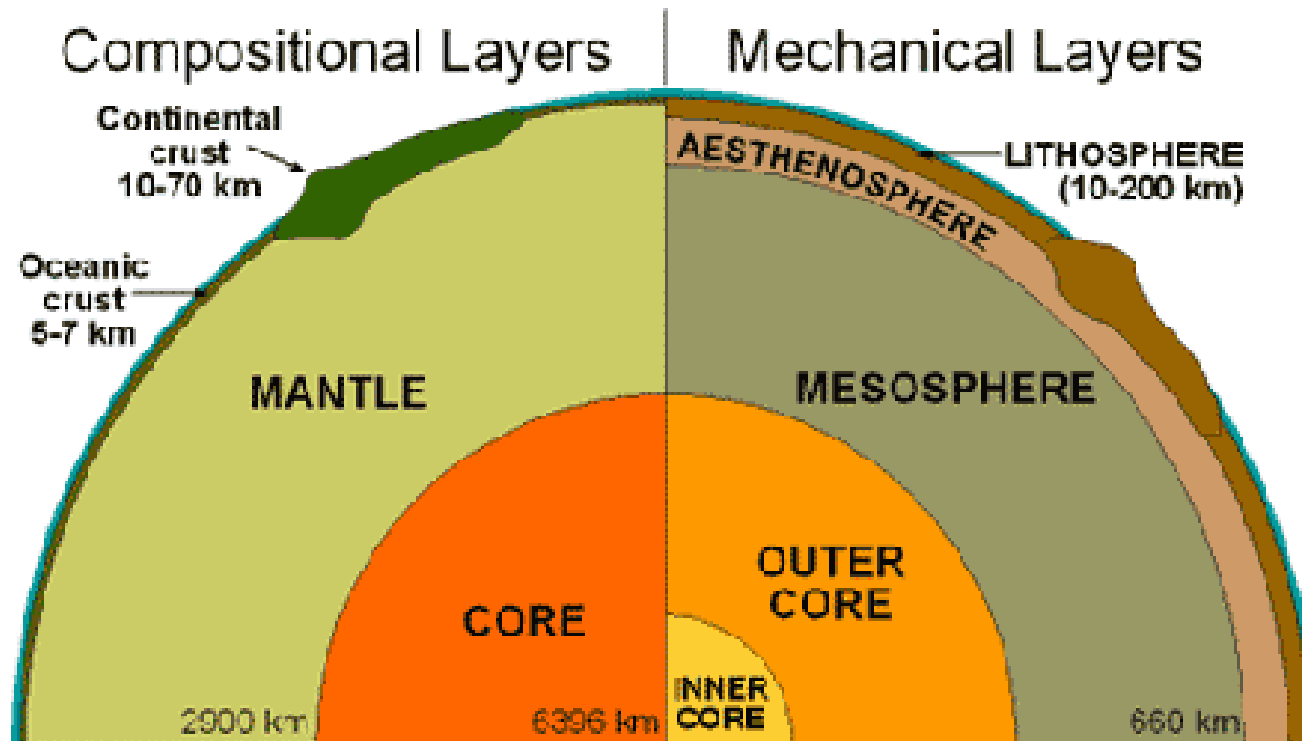


# Rigid lithospheric plates “float” on partially molten asthenosphere



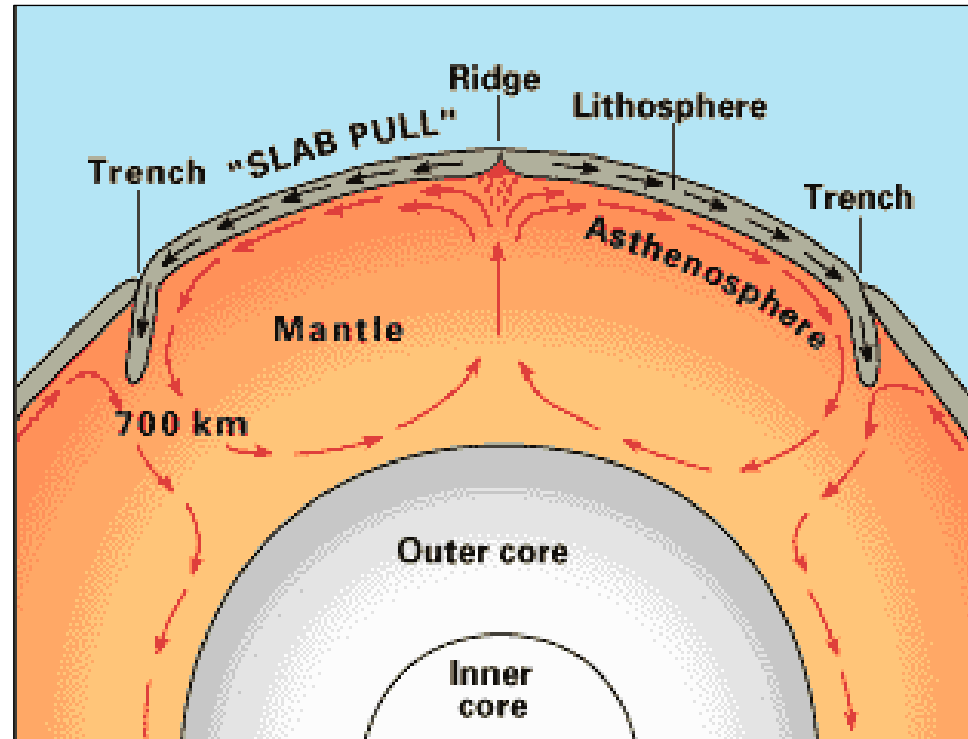
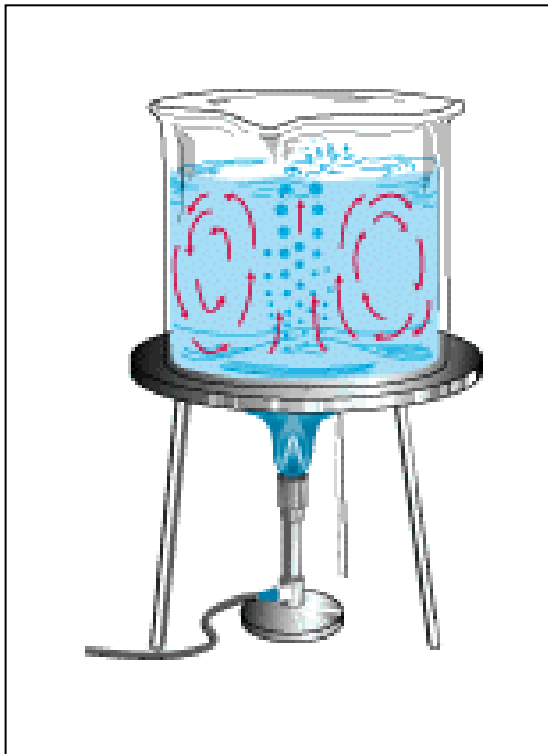


# Inside the Earth





# Mantle convection - the driving force for plate tectonics

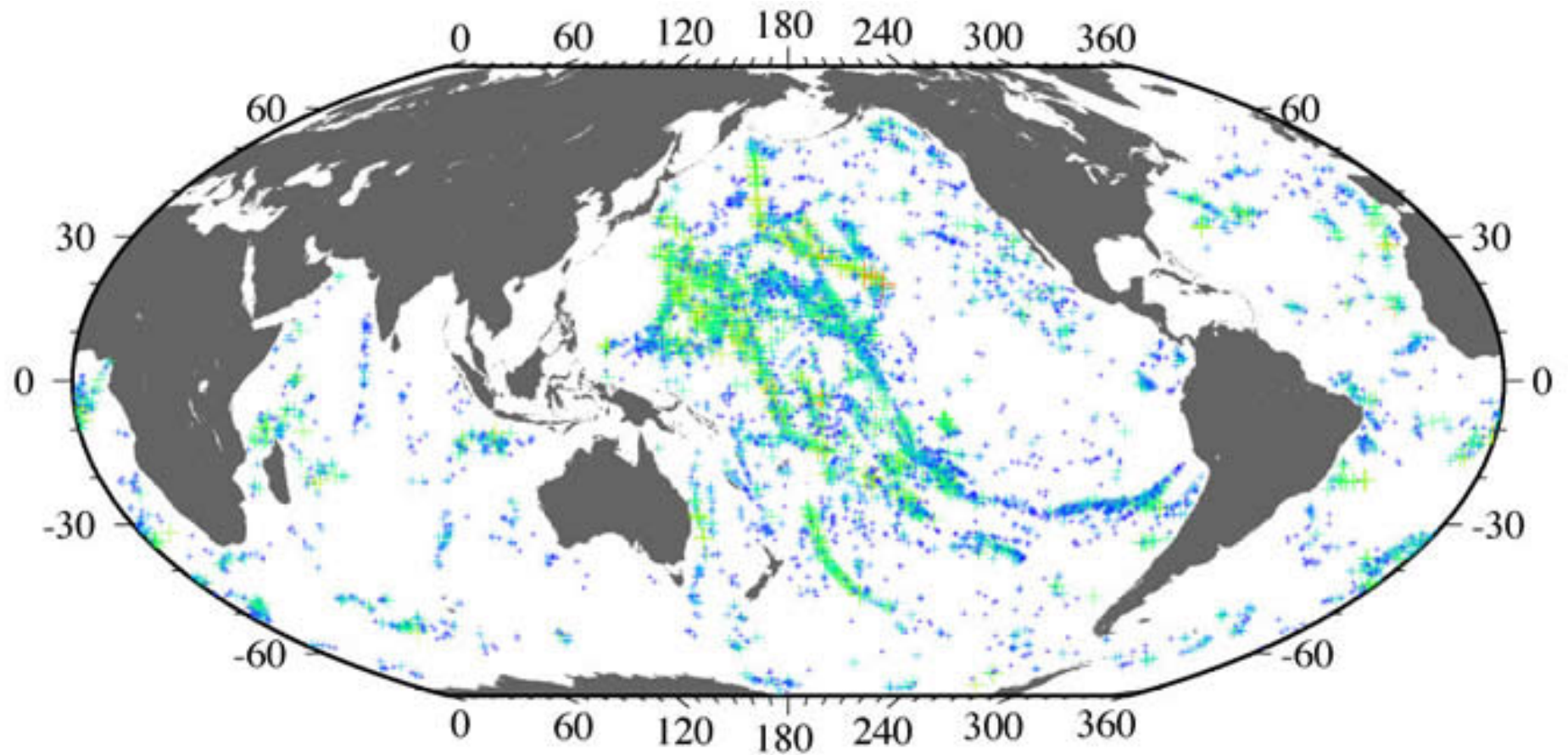


What causes the lighter material to rise?  
Write your answers on the chat





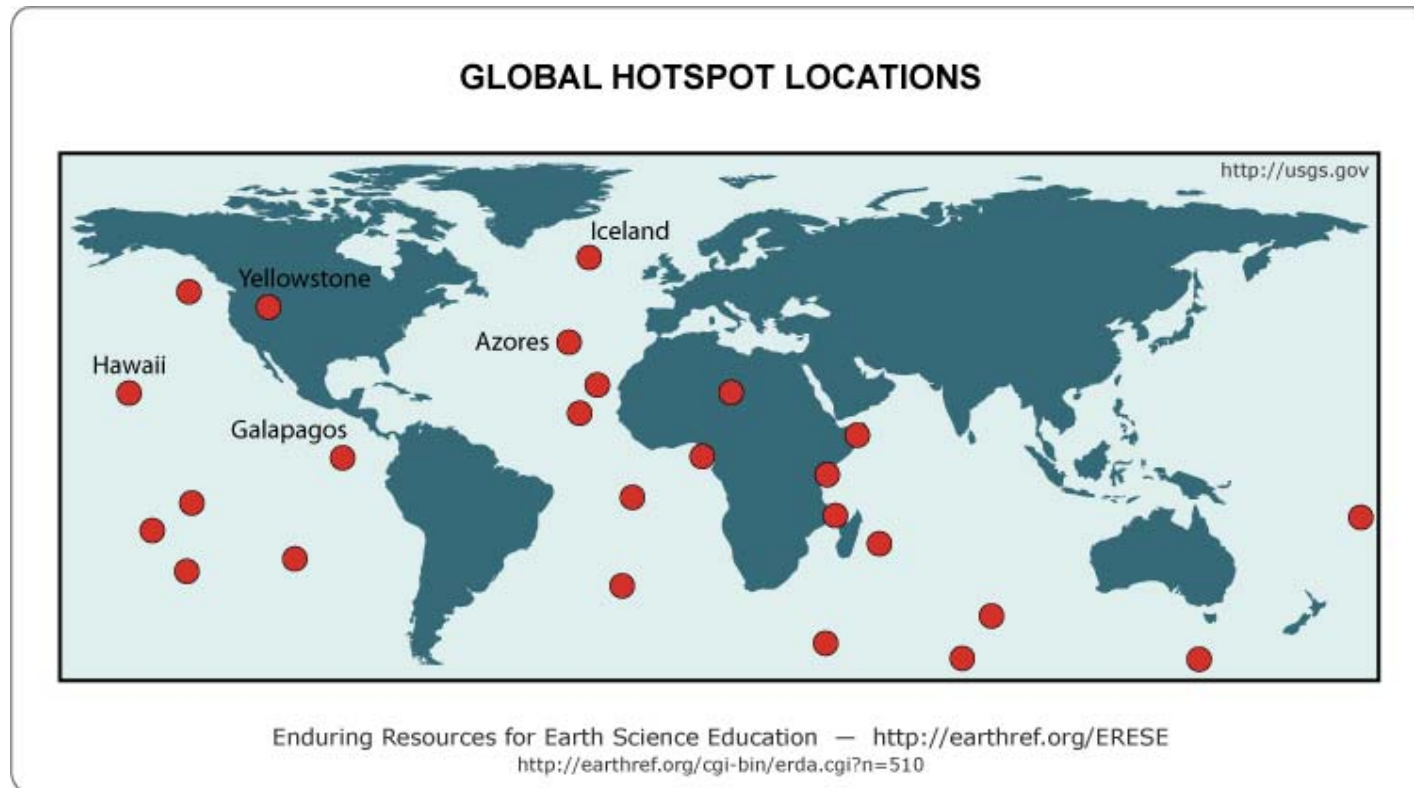
# Global Distribution of Seamounts







# Active hotspots associated with seamount trails



● = Present-day location of some select active hotspots

# Poll Question!

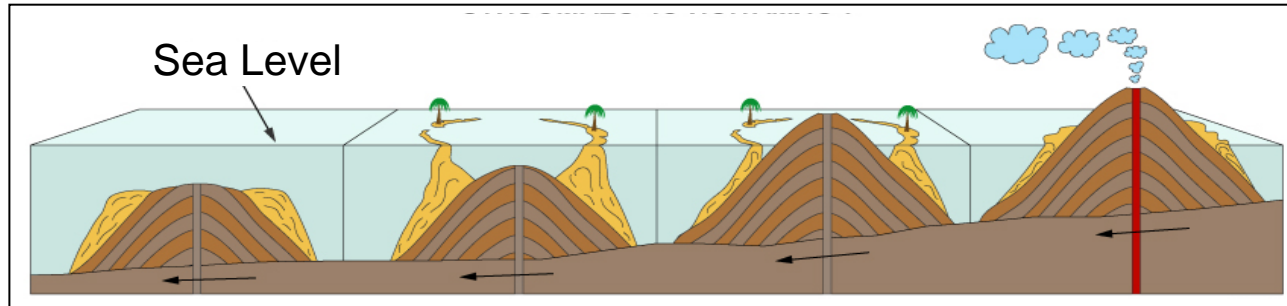


Approximately how long has the Hawaii hotspot been active?

- a. 8,000 years
- b. 8 million years ago
- c. ~80 million years ago
- d. ~180 million years ago

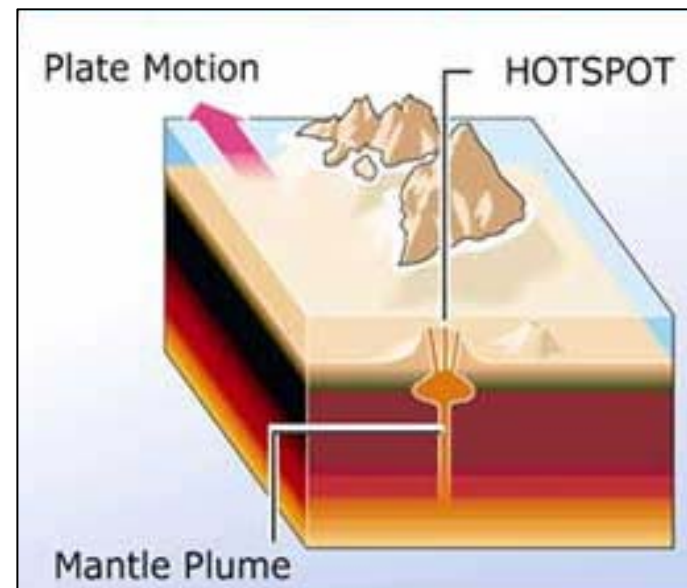


We can observe the evolution of a seamount chain above the seafloor.....



What is the source of the magma **below** the seafloor?

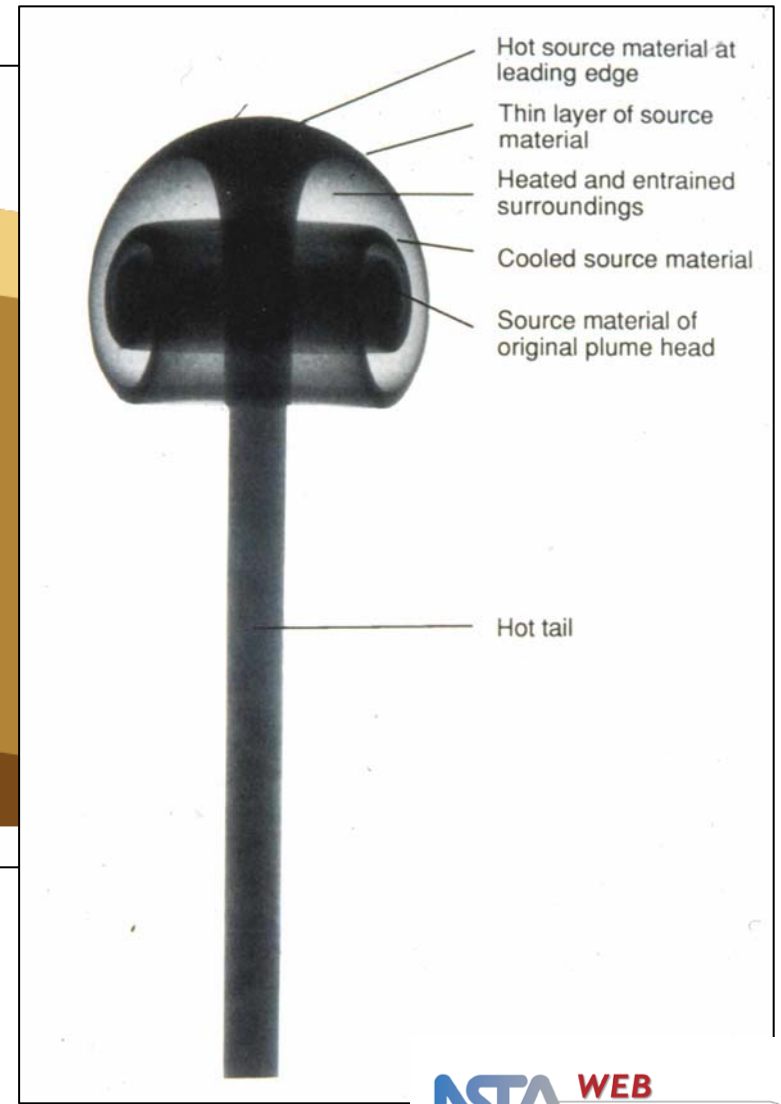
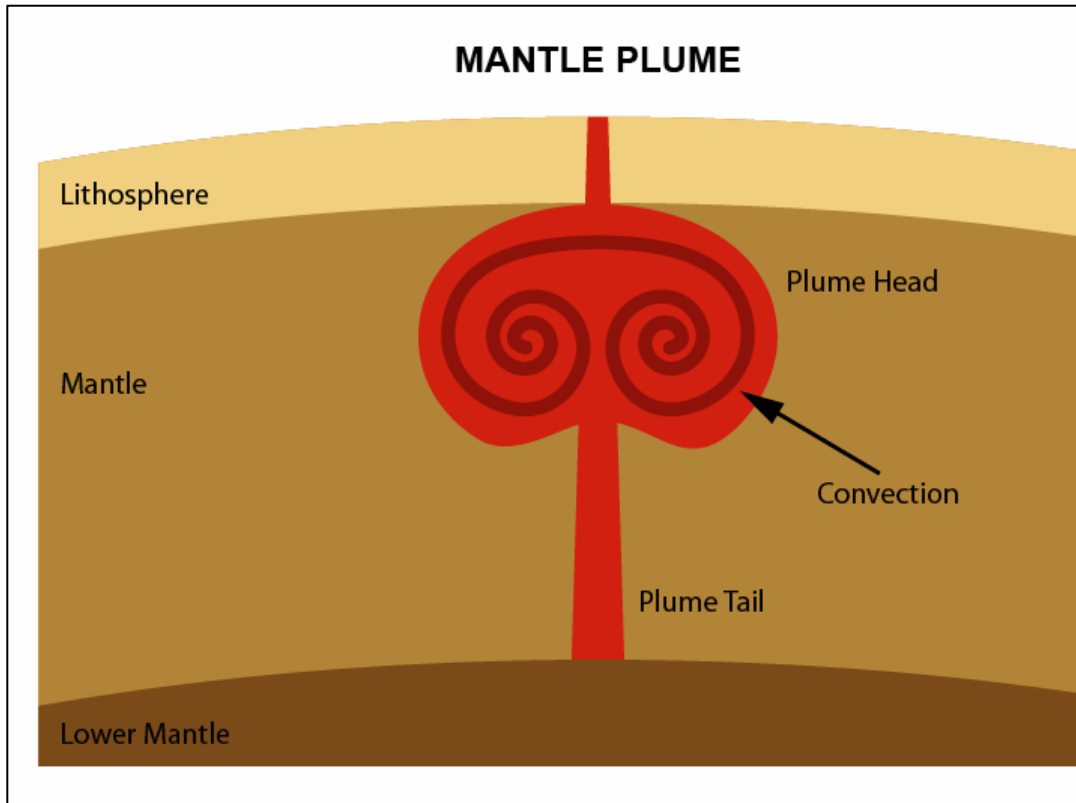
The Mantle?	The Core?



Stamp your answer



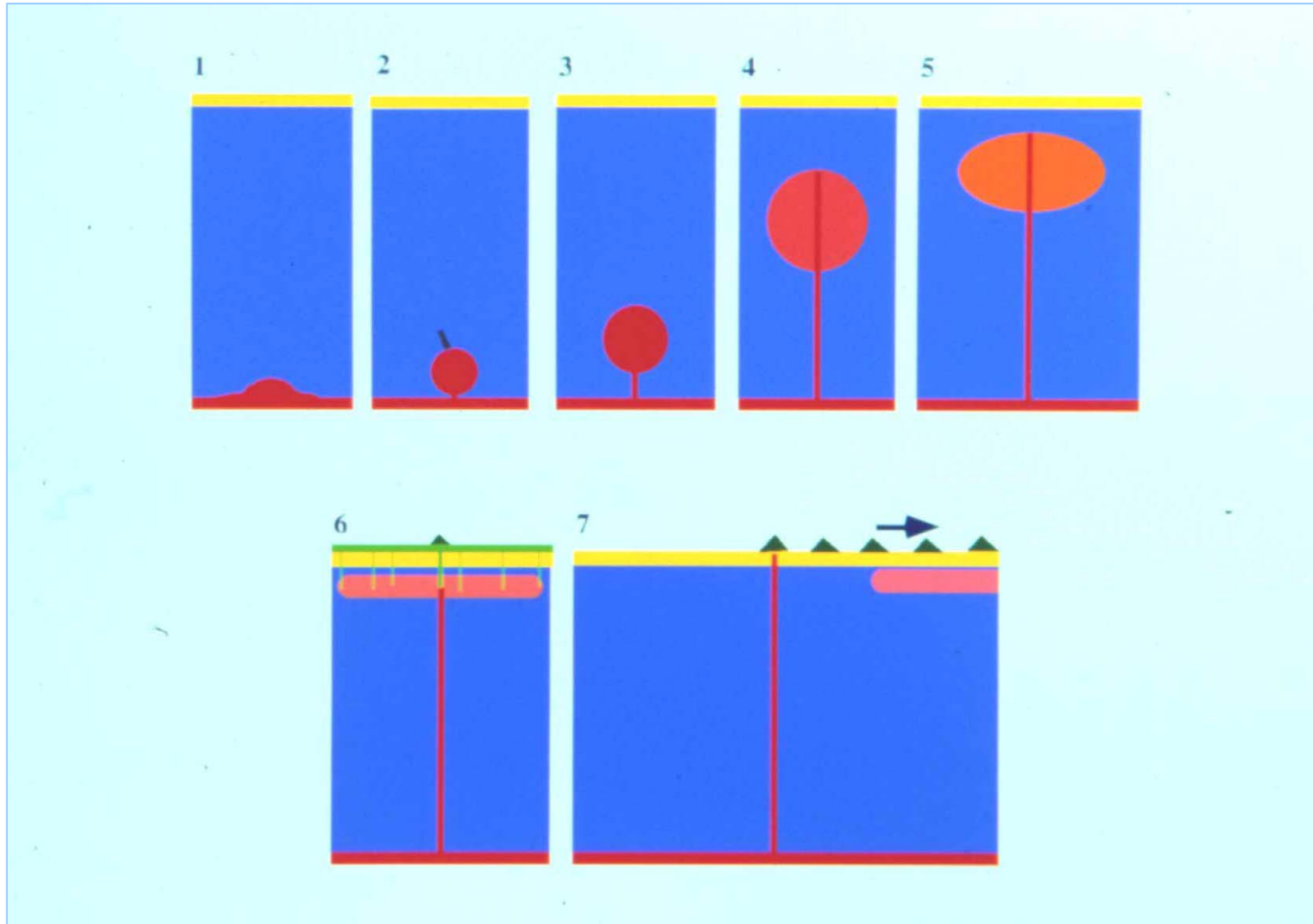
# Mantle Plumes







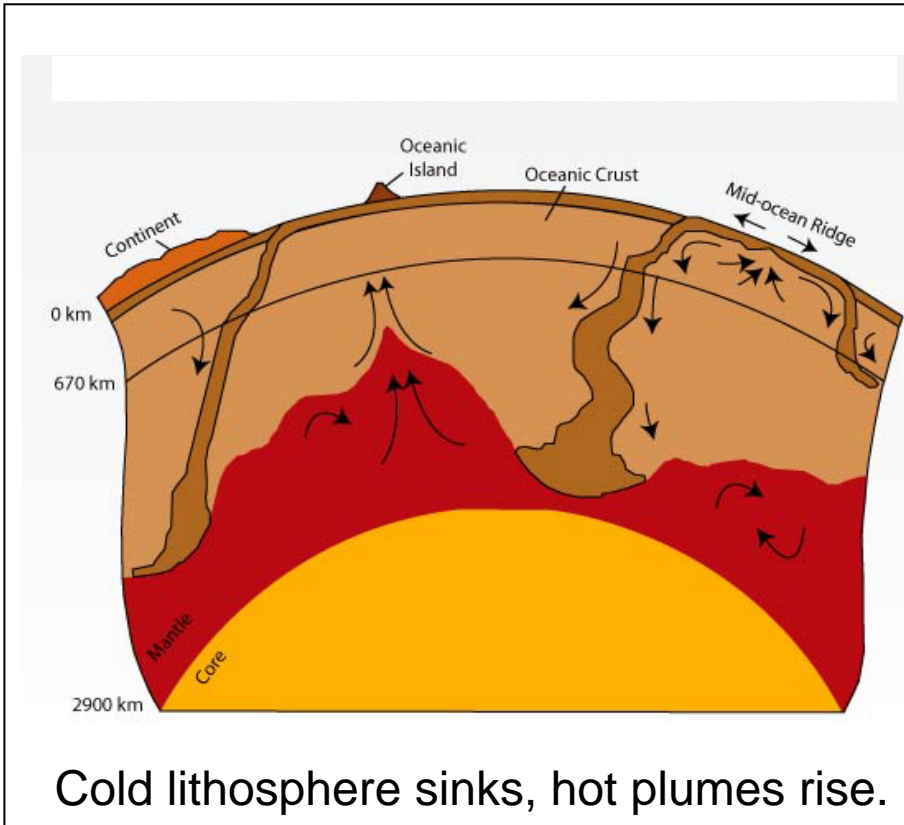
# Lifecycle of a Mantle Plume



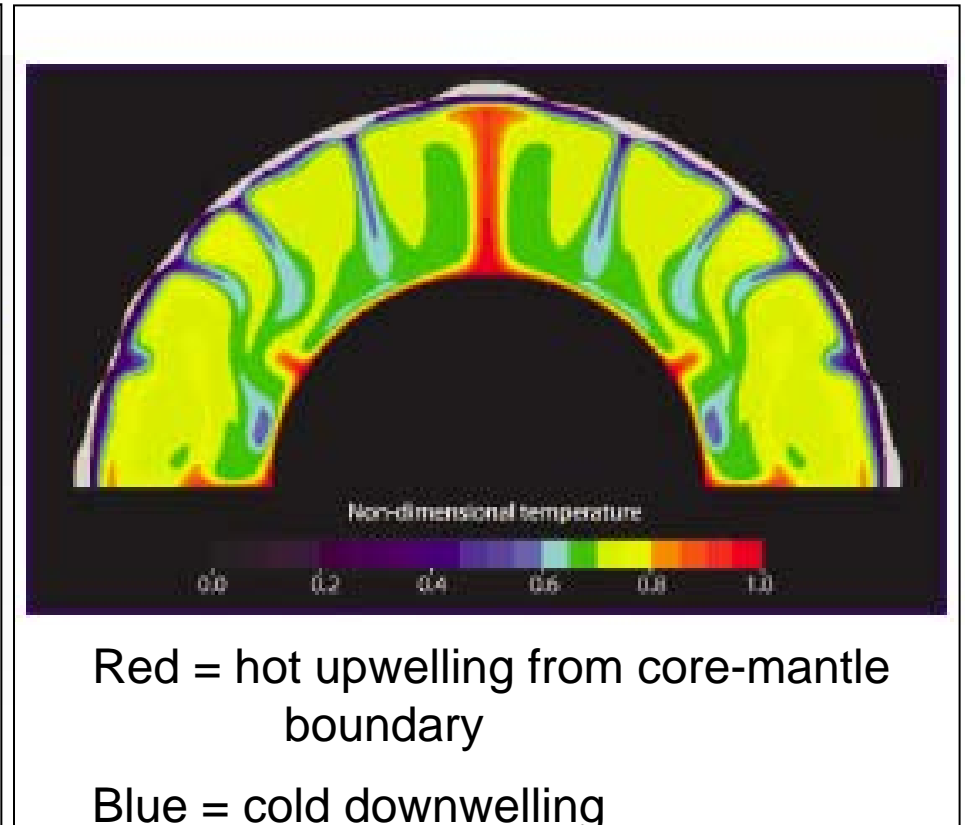


# Mantle convection and hotspot formation

## Cross-sections of the Earth



**Cartoon Schematic**



**Computer Model**

Which is not related to a hotspot? Stamp your answer



Iceland



Yellowstone



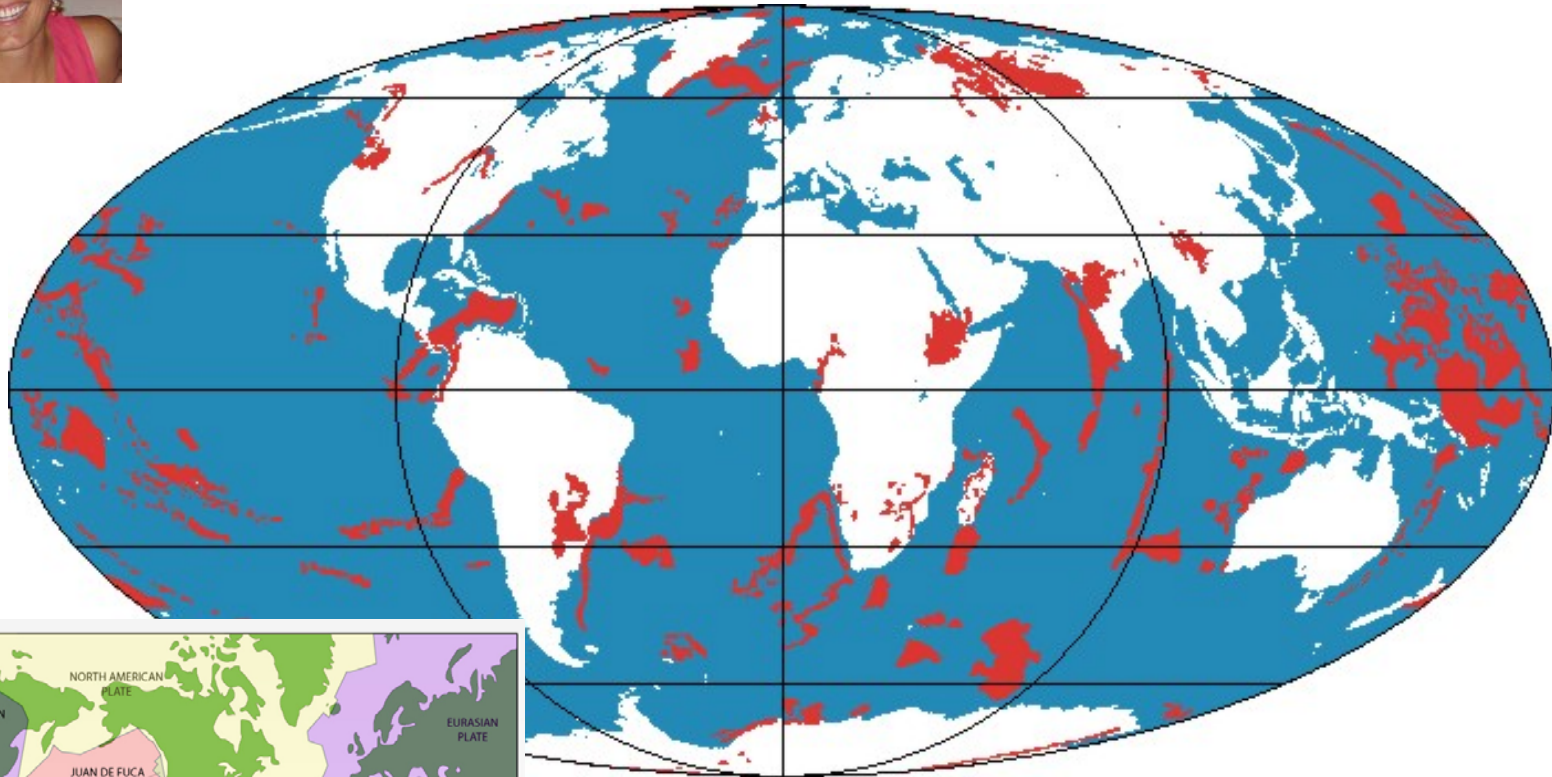
Hawaii



Mt. St. Helens

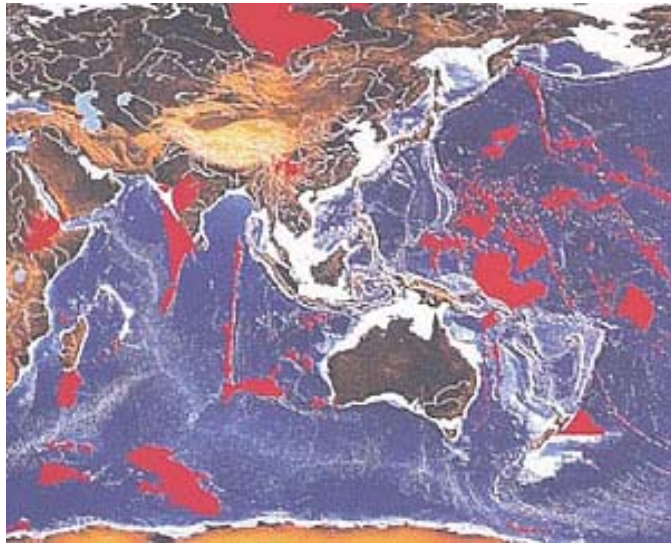


# Large Igneous Provinces aka, “LIPS”



LIPS are NOT restricted to plate boundaries.

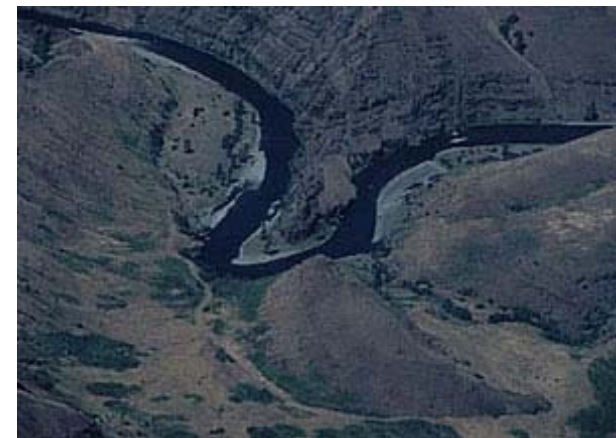




Red = LIPs emplaced since 250 Ma



Deccan Traps, India

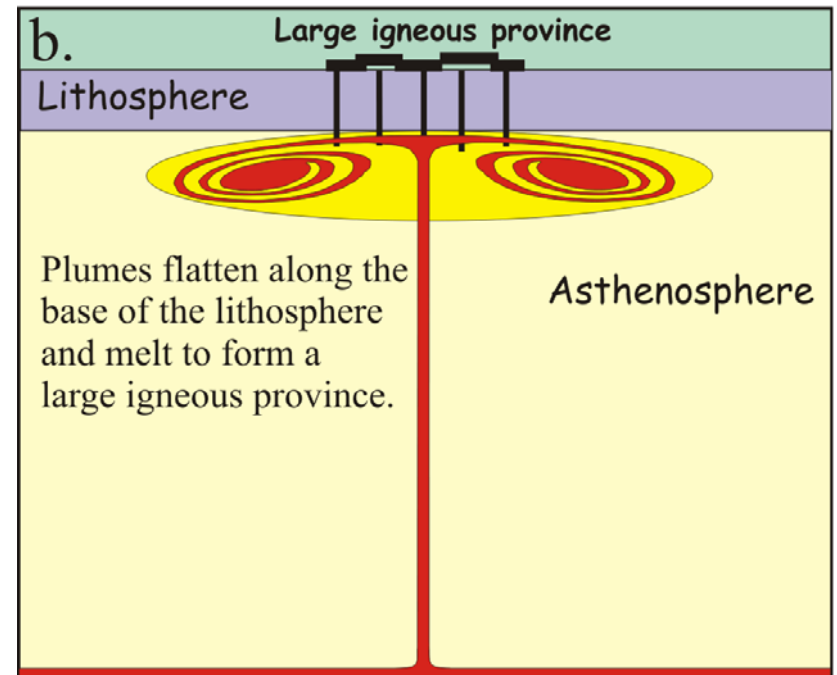
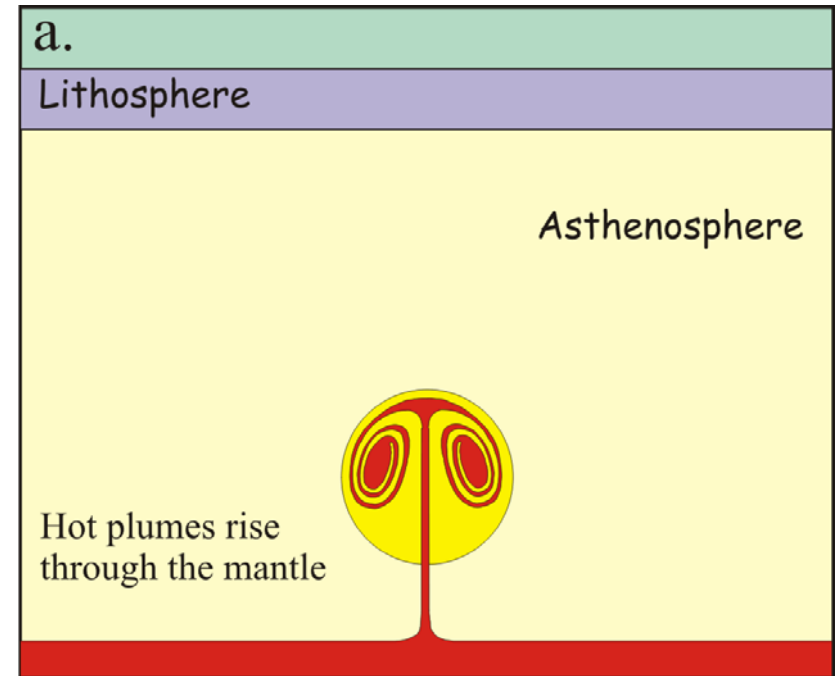
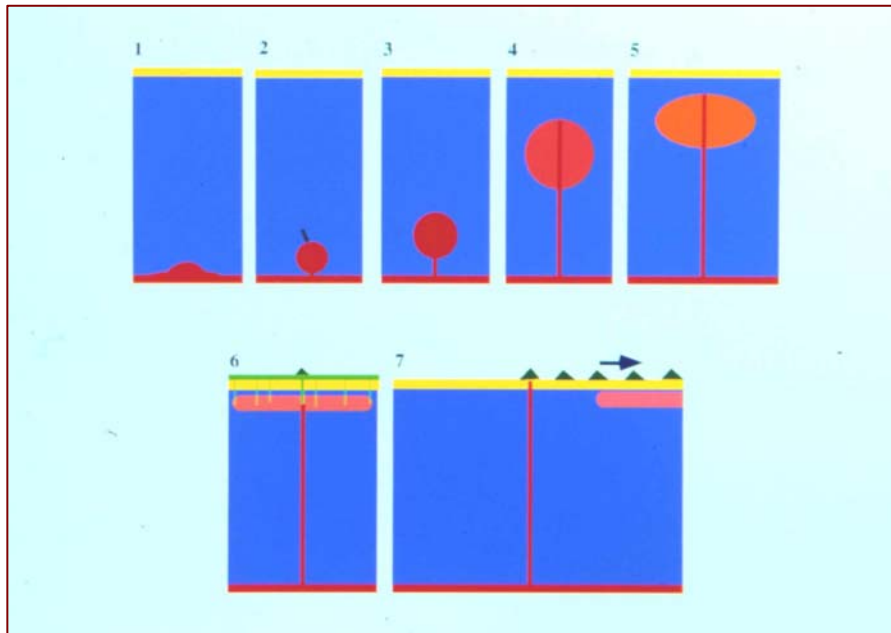


Columbia River Basin Flood Basalts with source at Yellowstone

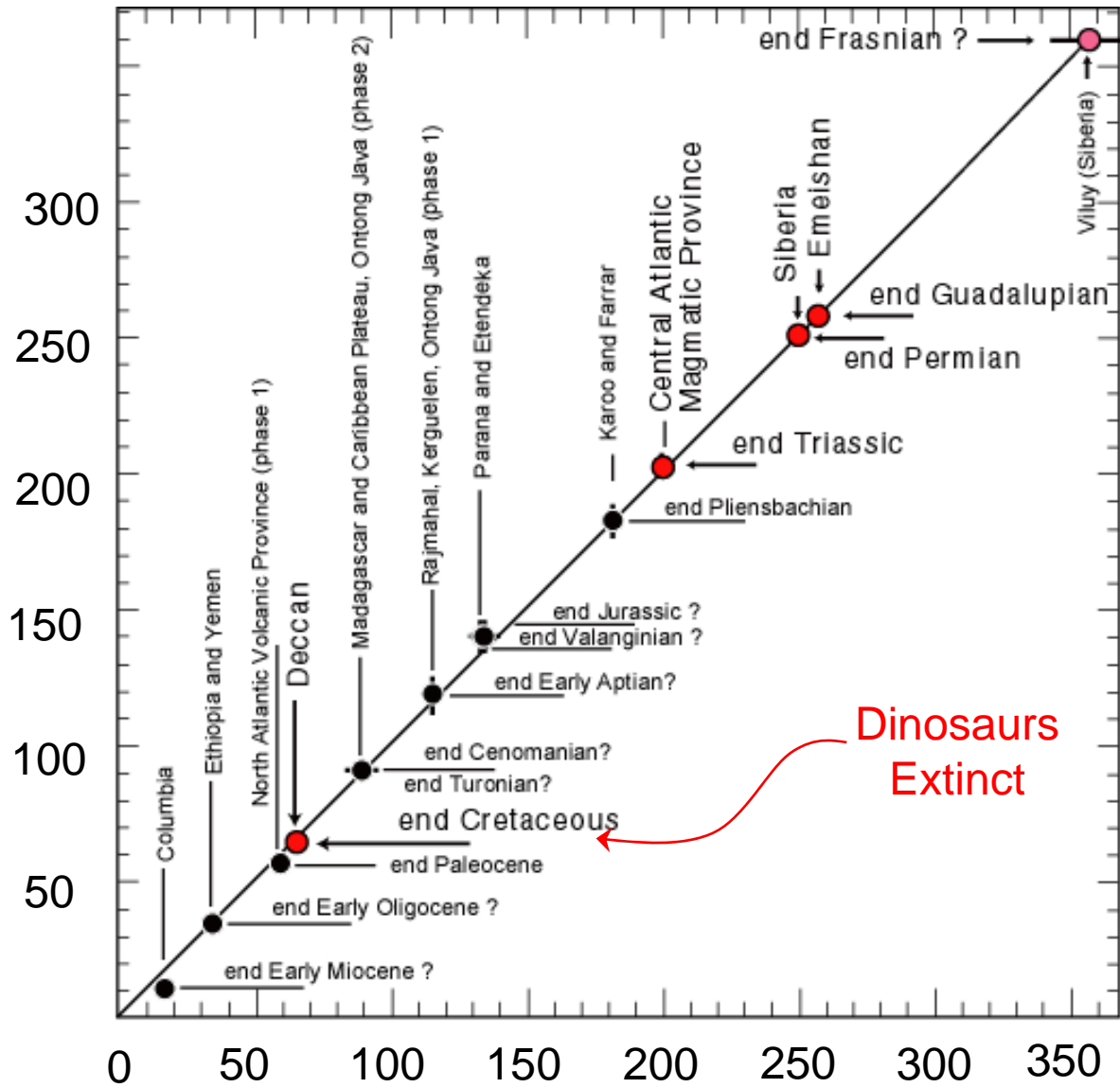


How do you  
get a LIP?

Recall the lifecycle  
of a plume:



Ages of Mass Extinctions (million of years before present)



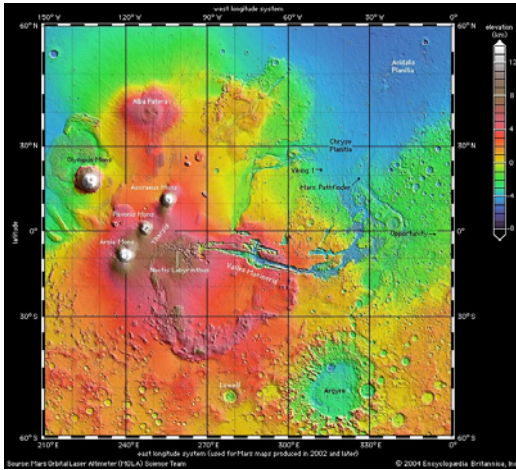
LIPS and Major Extinctions

Age of LIPS (million of years before present)

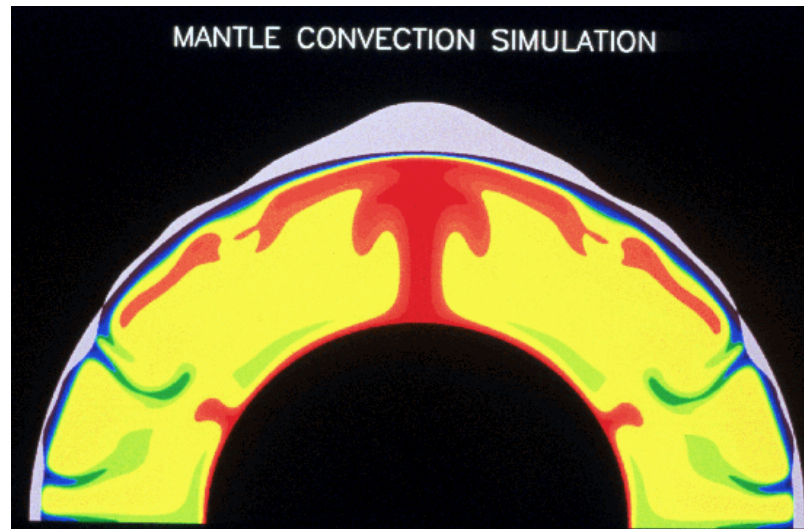




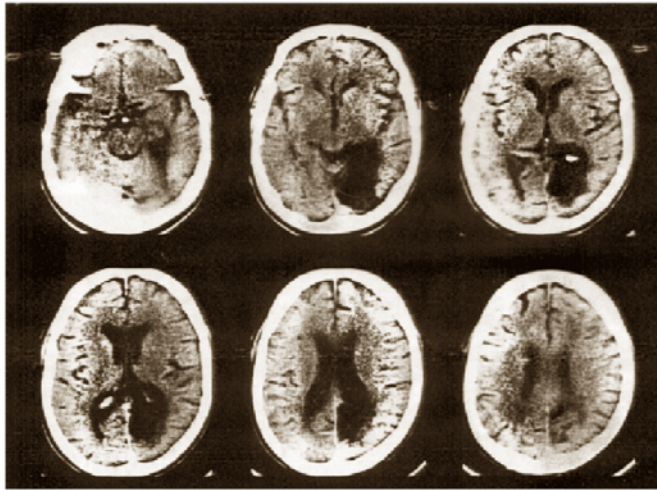
# Upwelling on Mars



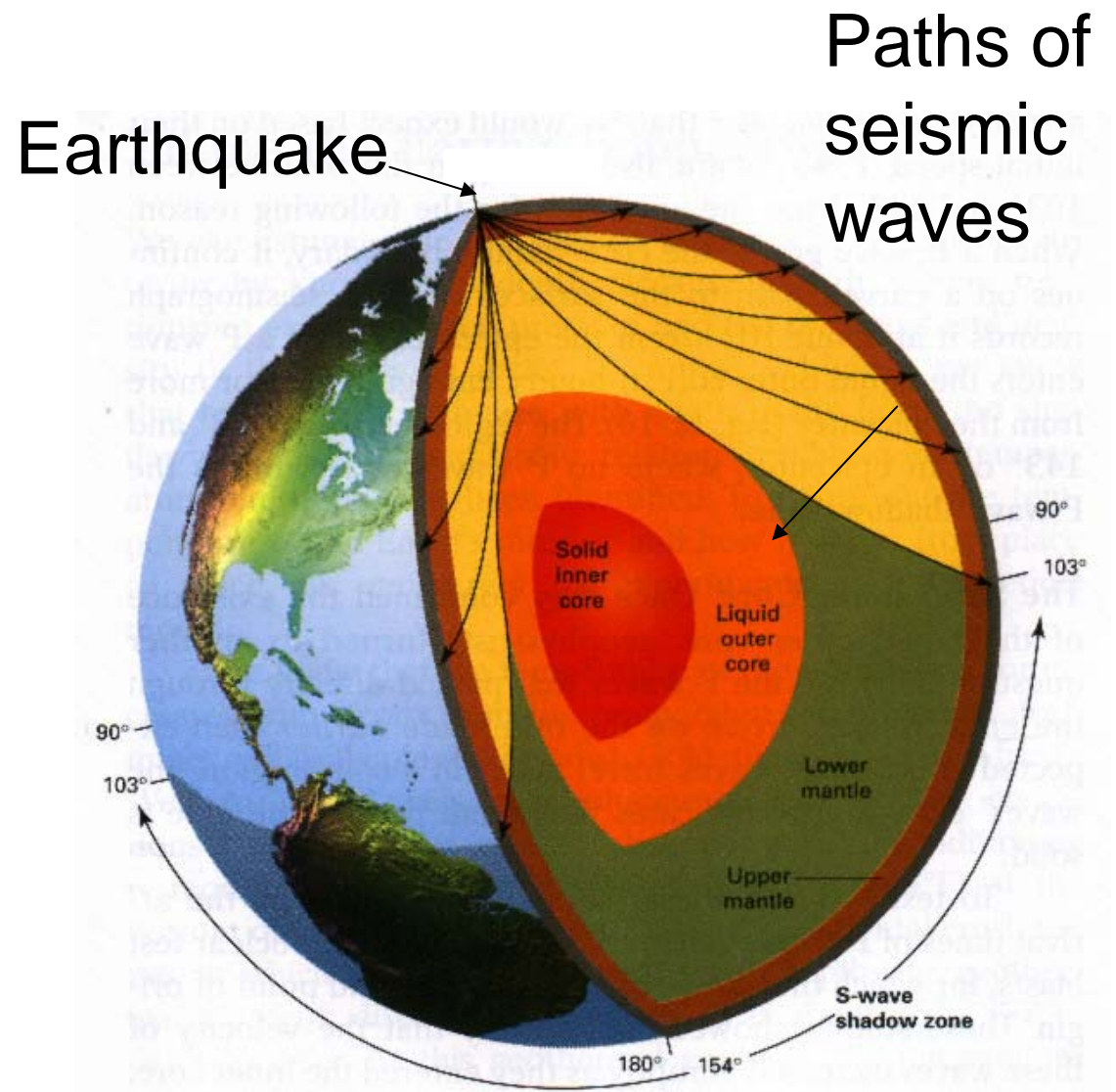
Olympus Mons  
~79,000 feet high  
340 miles  
diameter







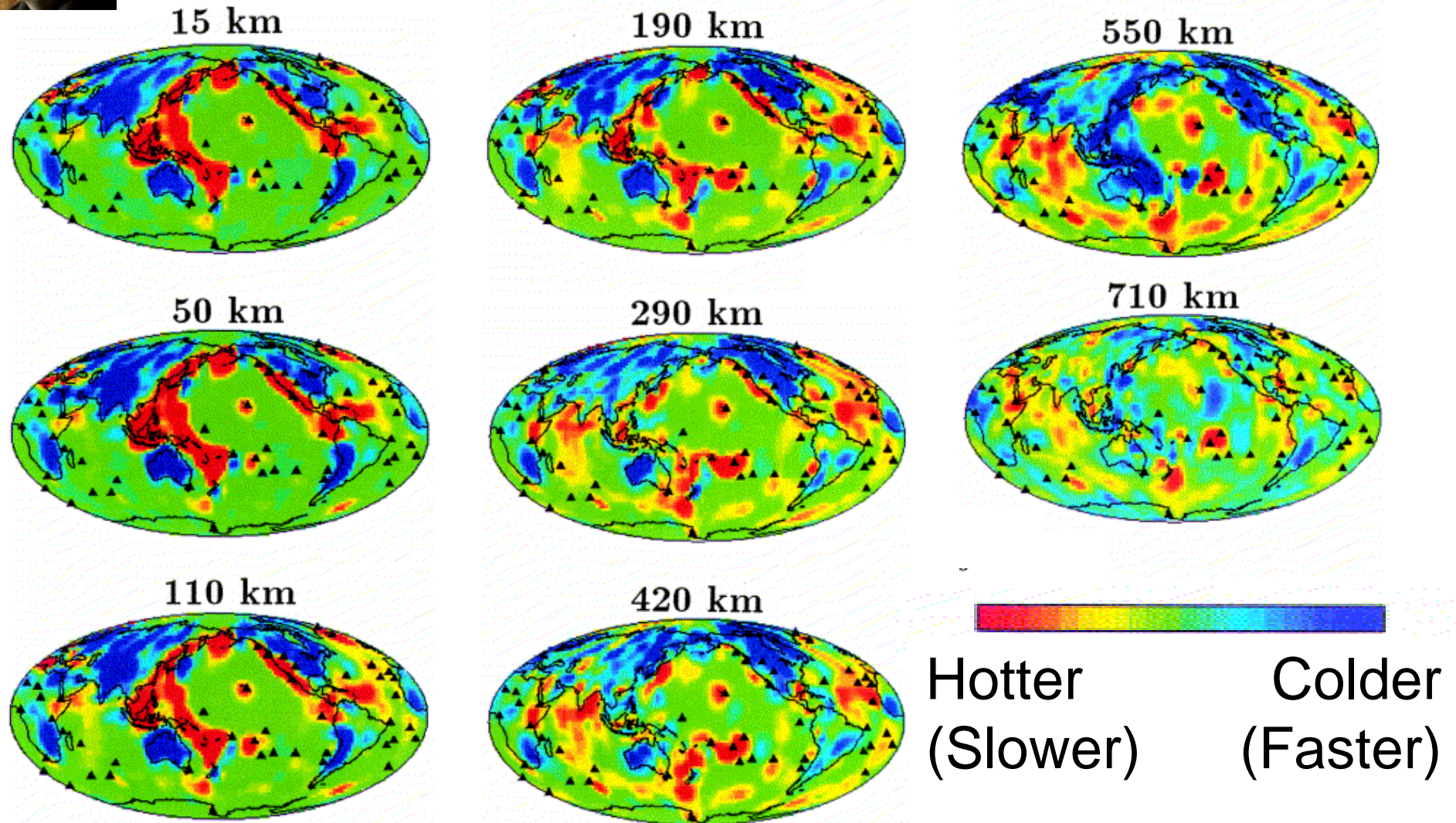
“CAT” Scan of Brain  
Layered X-Rays



An “ultrasound” of the earth = seismic tomography



# Seismic Tomography



▲ = Hotspots on surface





# Enduring Resources for Earth Science Education

<http://earthref.org/ERESE>



## Enduring Resources for Earth Sciences Education (ERESE)

Promoting, creating and publishing of Enduring Resources for Earth Science Education in a collaboration between middle and high school teachers and Earth scientists.

### RESEARCHABLE HYPOTHESES

Searching by Question

The predefined ERESE questions will guide you through some important Earth science questions and concepts, helping you in your search for lesson materials and other scientific materials in the EarthRef.org and SIOExplorer scientific databases.

### RESOURCE MATRICES

Searching by Topic

Each ERESE resource matrix contains objects and materials for a certain Earth science concept or subject. You can directly browse the available matrices and select the objects you need for your lesson plan or project based on content type and expert level.

### Important Links

#### Seamount Catalog

View and Download Maps from over more than 1,800 Undersea Mountains. Find Data Files to make your own Maps, or discover Data collected during Seagoing Expeditions studying the Geology and Biology of Seamounts.

#### Geochemical Reservoir Database

Findout about the Composition of the Earth and the Solar System. You can answer Questions about the Major and Trace Element Composition of the Earth's Mantle, Core and Crust. Or you can find out about the Isotope Composition of Rivers, Seawater or any Rock Type.

#### SIOExplorer

Search the Collection of Shipboard Data collected during more than 900 Scientific Expeditions of the Scripps Institution of Oceanography.

### Your Own Contributions

To upload your Own files, please select an option below and continue by clicking the Upload button.

Upload new file

If you already are an EarthRef.org user you don't have to register again, otherwise click the Register button

### News

■ A two week learning segment on **Hotspot Volcanoes** has been implemented through a collaborative effort between Melanie McWilliams, a high school Earth and Planetary Science teacher at **Chula Vista High School** in California, and Jamie A. Russell, a masters student at the **Scripps Institution of Oceanography**. Utilizing data collected during Jamie's research, the students were taught about the hotspot theory and how hotspot volcanoes are important to understanding other Earth science concepts. The segment begins with five lessons, one for each day of the week and culminates with a group project for the students. [Read more ...](#)

■ Three scientists from the **Scripps Institution of Oceanography** and the **University of Hawaii** are traveling to Antarctica to study the geological history of Earth's magnetic field. This scientific endeavor, project **G-182** (spelled 'golf-1-8-2') of the **US Antarctic Program** will begin on November 16, 2006 with a flight from Christchurch/New Zealand to McMurdo in Antarctica. We will provide you with regular updates of the 2006/2007 expedition, but above all, you will be able to contact us and ask questions or get more information, because McMurdo station has high-speed internet access. So, we are looking forward to share our adventures with you or to chat to you over the internet! [Expedition home page ...](#)

### Workshops

■ **Second ERESE Workshop, Scripps Institution of Oceanography, La Jolla, 17-30 July, 2005**

■ **First ERESE Workshop, Scripps Institution of Oceanography, La Jolla, 11-24 July 2004**

### Events

■ **ALIA Expedition to the Samoan Islands and Vailulu'u, April 2005**

■ **Hawaiian Volcano Field Trip, University of California, September 2006**

■ **Hotspot Lessons for a High School Earth Science Class**



<http://nsdl.org>





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- M00002 Complex Seafloor Spreading
- M00003 Geological Time Scale
- M00004 The Earth's Magnetic Field
- M00005 Plate Motion on the Earth
- M00006 Magnetic Reversals
- M00007 The Formation of Oceanic Crust
- M00008 The Formation of Seamounts
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- M00010 Biomediation of Lavas
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- M00050 The Forces Causing Plate Tectonics

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### Detailed File Information

**Global Map of Tectonic Plate Locations**

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File Name	m00001.i3.global.map.tectonic.plate.locations.jpg
Data Type	map
Computer Program	Adobe Illustrator CS
File Size	138 kb - 1 file
Expert Level	Middle School (Grade 6-8)
Contributor	<a href="#">Marcus Keller</a>
Source	No source

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**Description**  
This map shows the world's tectonic plates and their respective plate interactions (convergent, divergent, transform). Trenches form at convergent boundaries while ridge crests are associated with divergent boundaries.

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# ERESE Lessons and Projects

## Daily Lessons & Activities

### Day 1: Relative Dating

Lesson | Activities

- The initial lesson focuses on the concept of relative dating. Relative dating of island chains was a fundamental step toward the development of the hotspot theory utilized over 100 years before the hotspot theory was introduced.

### Day 2: Hotspot Theory

Lesson | Activity | Age vs. Distance Diagram | Instructions

- This lesson introduces the hotspot theory. The lesson covers the hotspot theory and how hotspot island and seamount chains form due to plate motion.

### Day 3: Mantle Plumes

Lesson

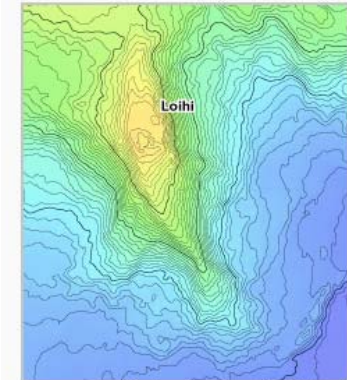
- This lesson introduces the theory of mantle plumes and how they support the theory.

### Day 4: Samoa

Lesson | Activity | Age vs. Distance Diagram | Instructions

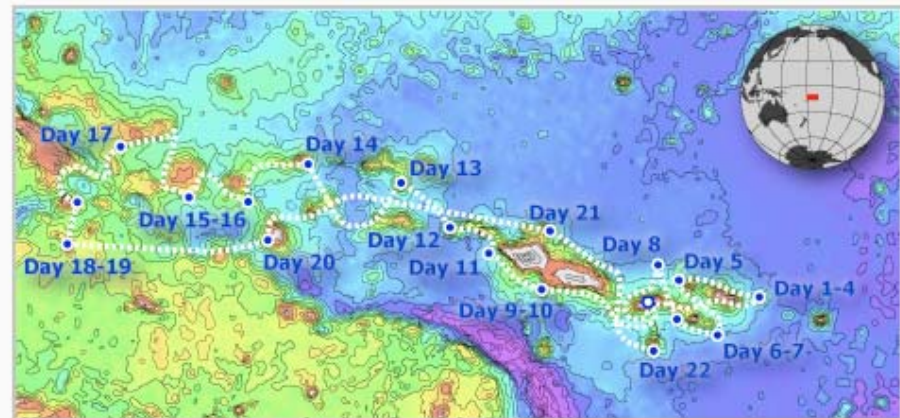
- This lesson discusses the similarities and differences between the Samoa and Hawaii island chains in the Pacific and how they are thought to be formed.

### Day 5: Conducting Research



Loihi a.k.a. the Hawaiian Hotspot

## Cruise Status



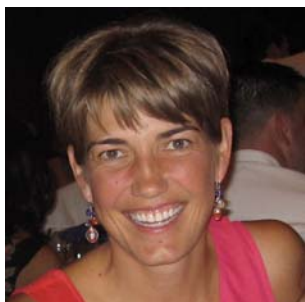
### Day 22 -- 25 April 2005 -- Our Final Full Day at Sea

The last target for the ALIA cruise was set today and we are cruising for Papatua seamount to put a final dredge there. Preparations for packing up our rocks, data and personal belongings is starting up already, so that we can make a smooth transition for the next science crew to come onboard.



<http://nsdl.org>





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**THANK  
YOU!**



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