The Dynamic Earth and Hawaiian Islands

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soest

School of Ocean and Earth Science and Technology

AT THE UNIVERSITY OF HAWAI'I AT MĀNOA

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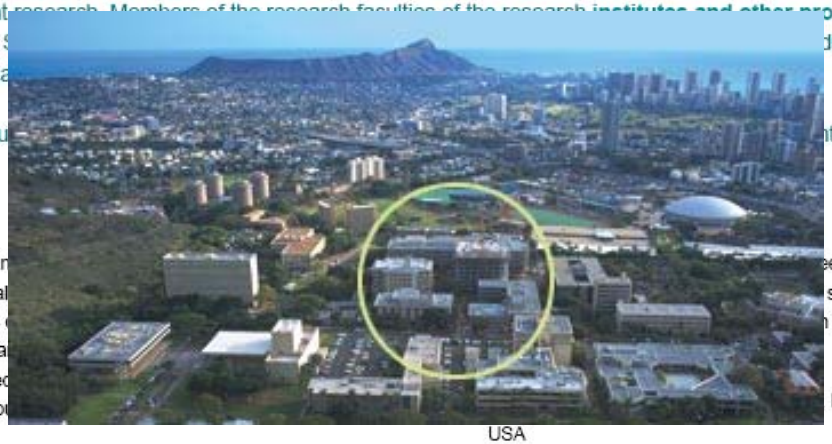

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Education Outreach Program

Funded by National Science Foundation

Sponsored by SOEST

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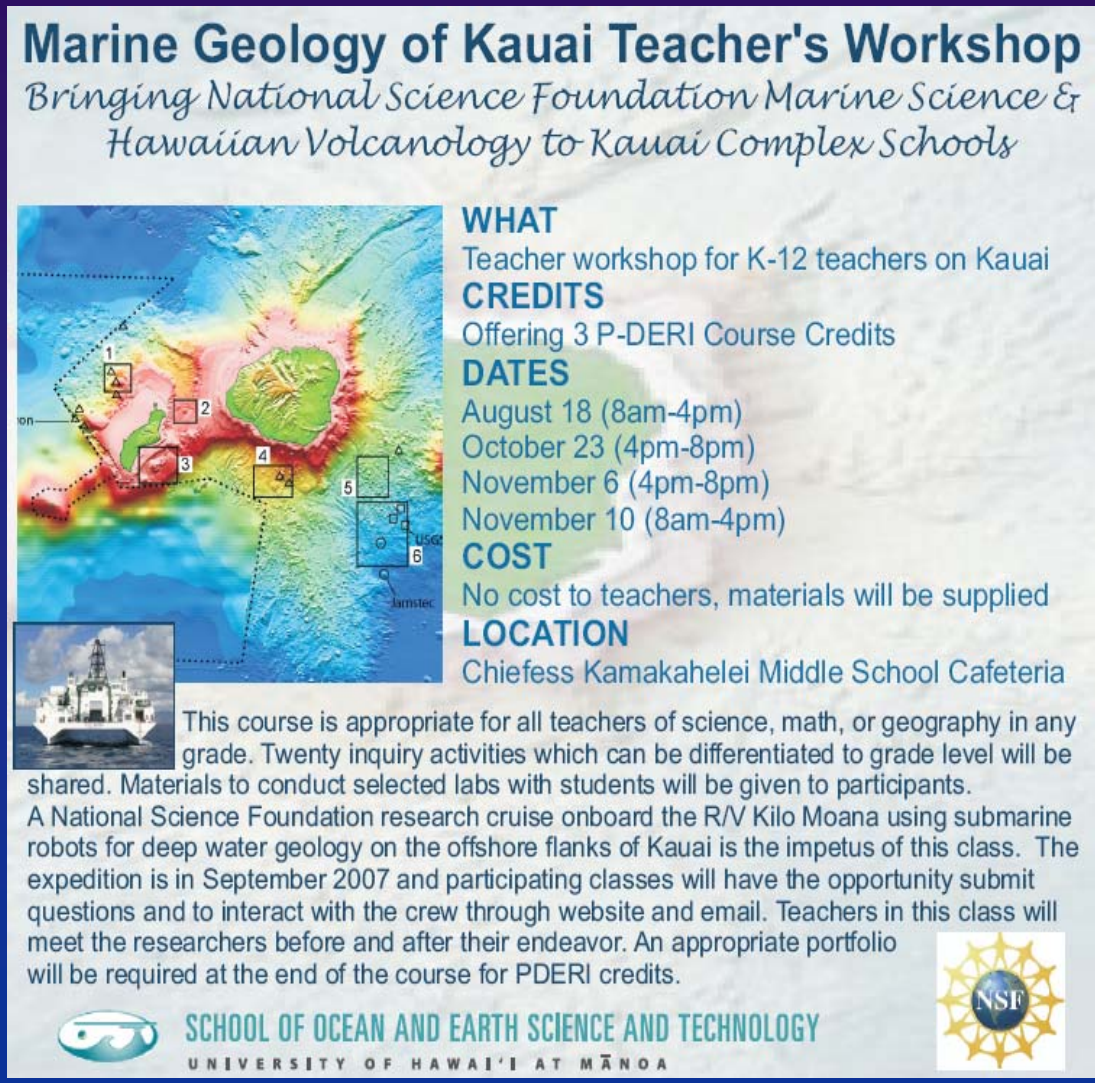
Garrett Ito (co-investigator)
Todd Bianco (Ph.D. student)

Coordinator:
Linda Sciaroni



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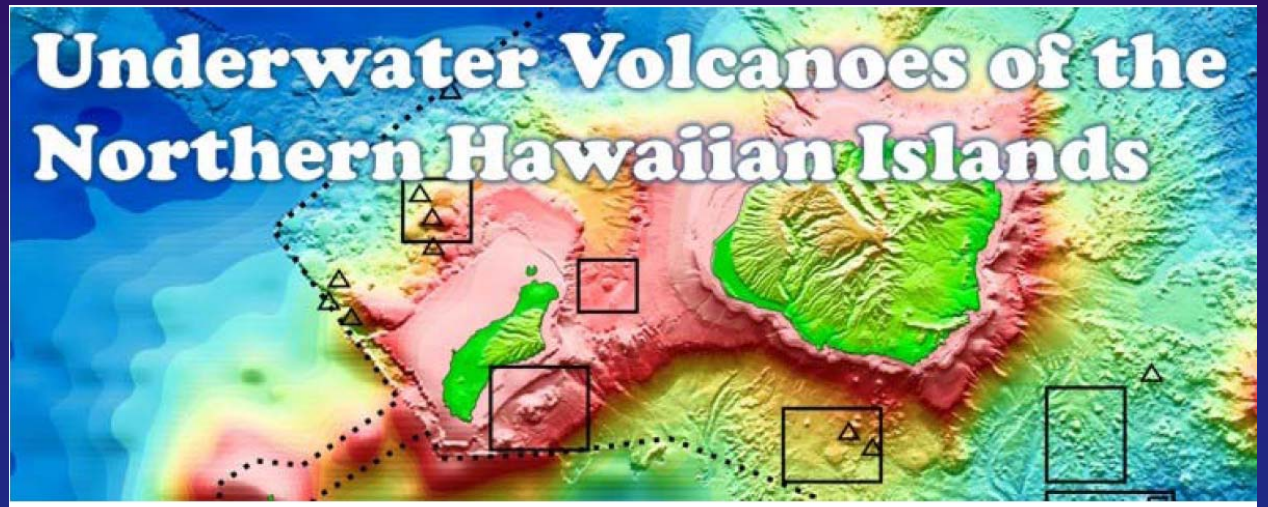

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2007	30						

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	28	29	30	31			
2007							

Mahalo For Participating !

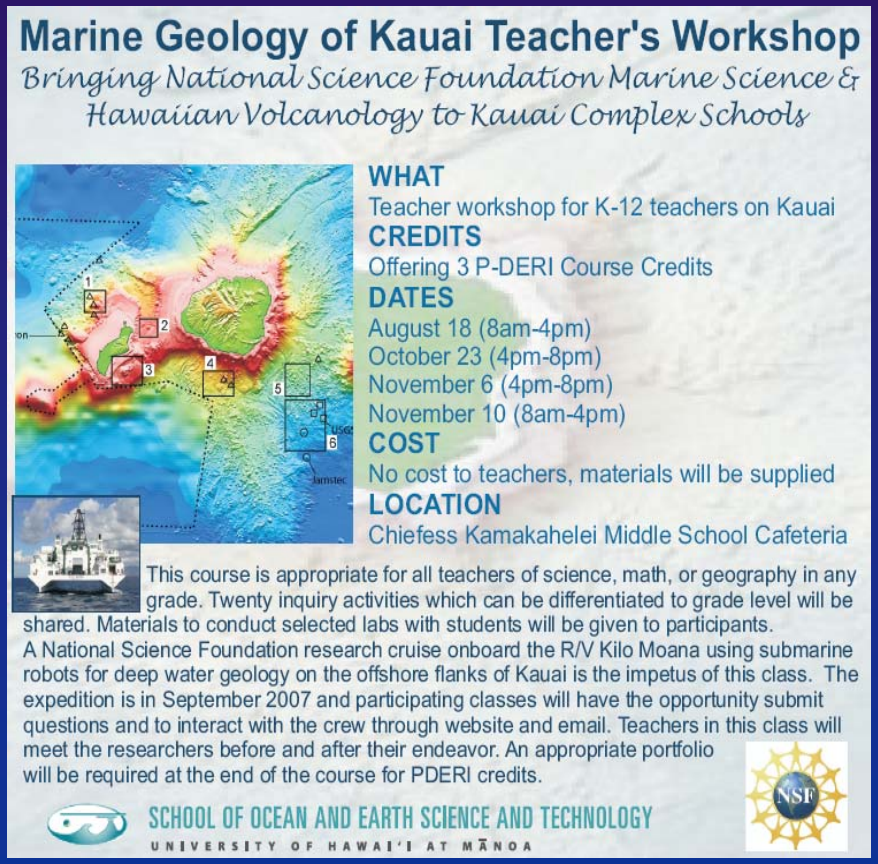
Hawaii needs continually improving science education to meet future challenges:

-Energy

-Global warming & sea level rise

-Sustainable relationship with the atmosphere, land, & sea

-Awareness & response to natural hazards



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Background nuggets:

-Plate tectonics

-Mantle convection

-Formation of ocean islands

Exercise

-Exploring the landforms & evolution of the islands

Message: *Science is about CURIOSITY: keen eye for questions, & passion for answering them*

Plate Tectonics

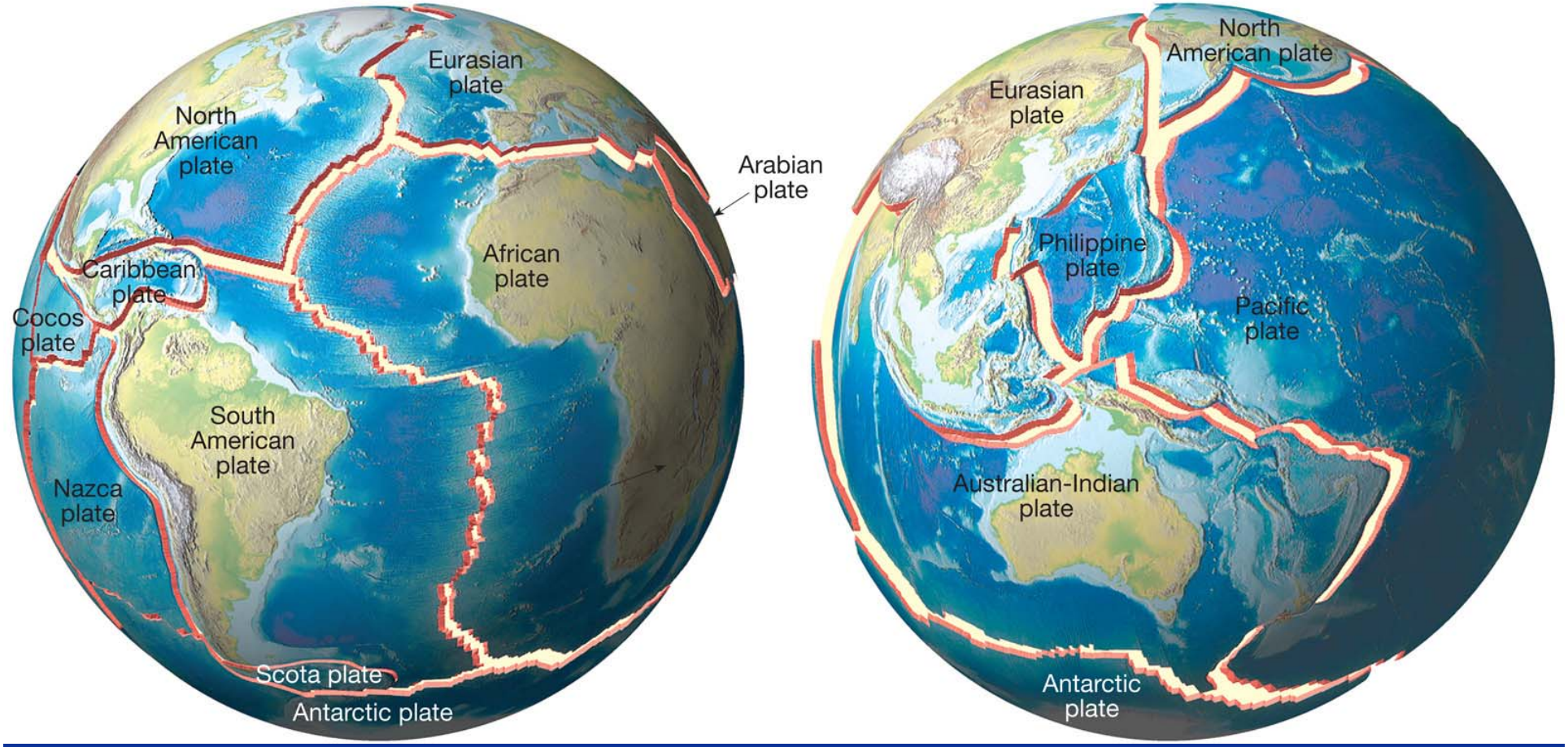
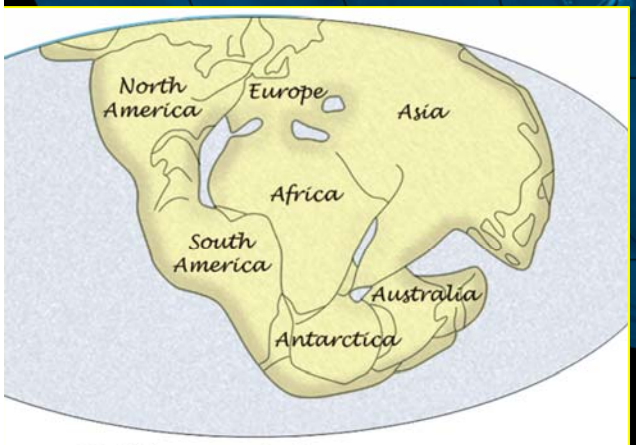


Plate Tectonics:
CLUE (1)- Continent jigsaw puzzle

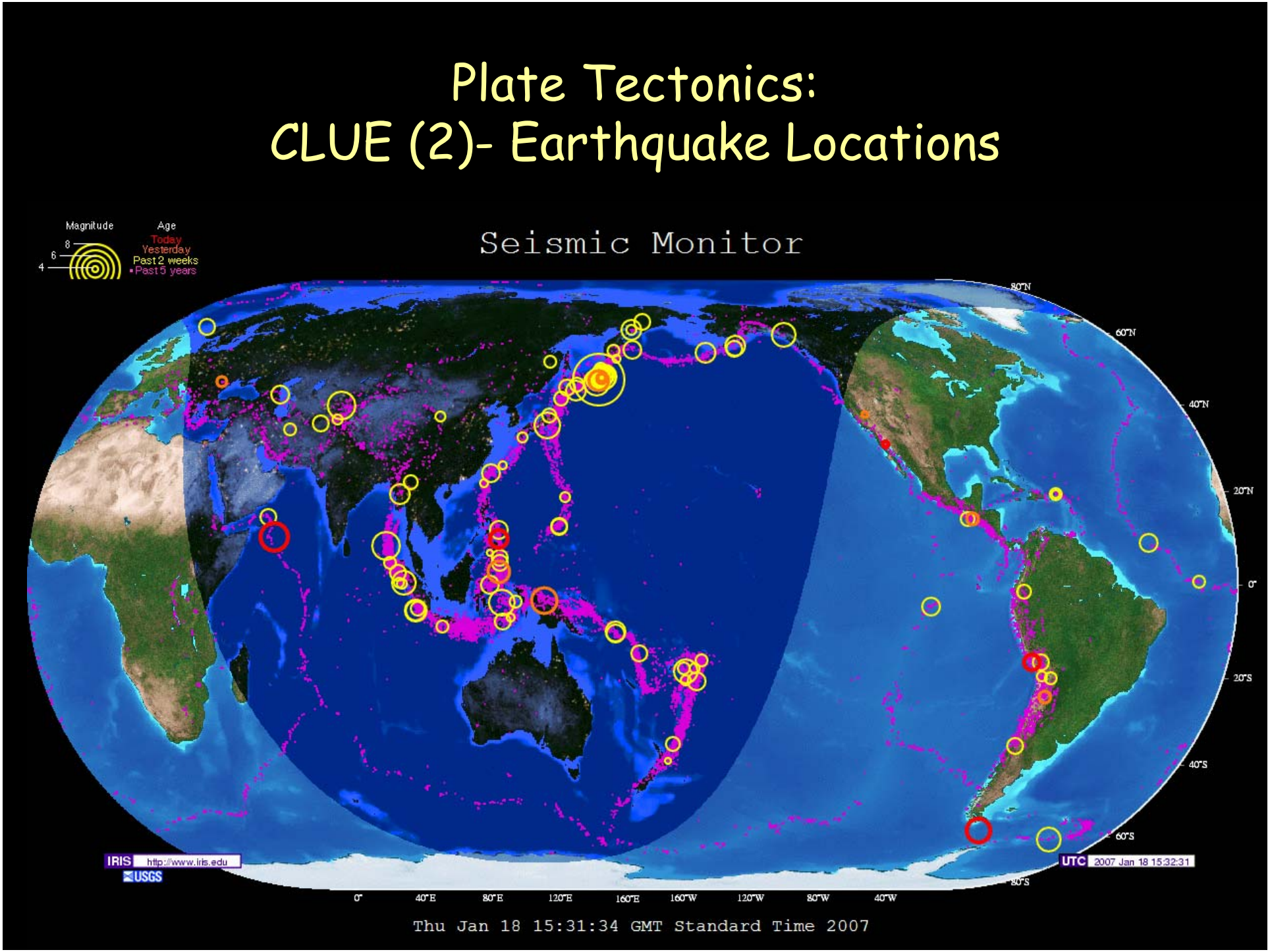
Present Day

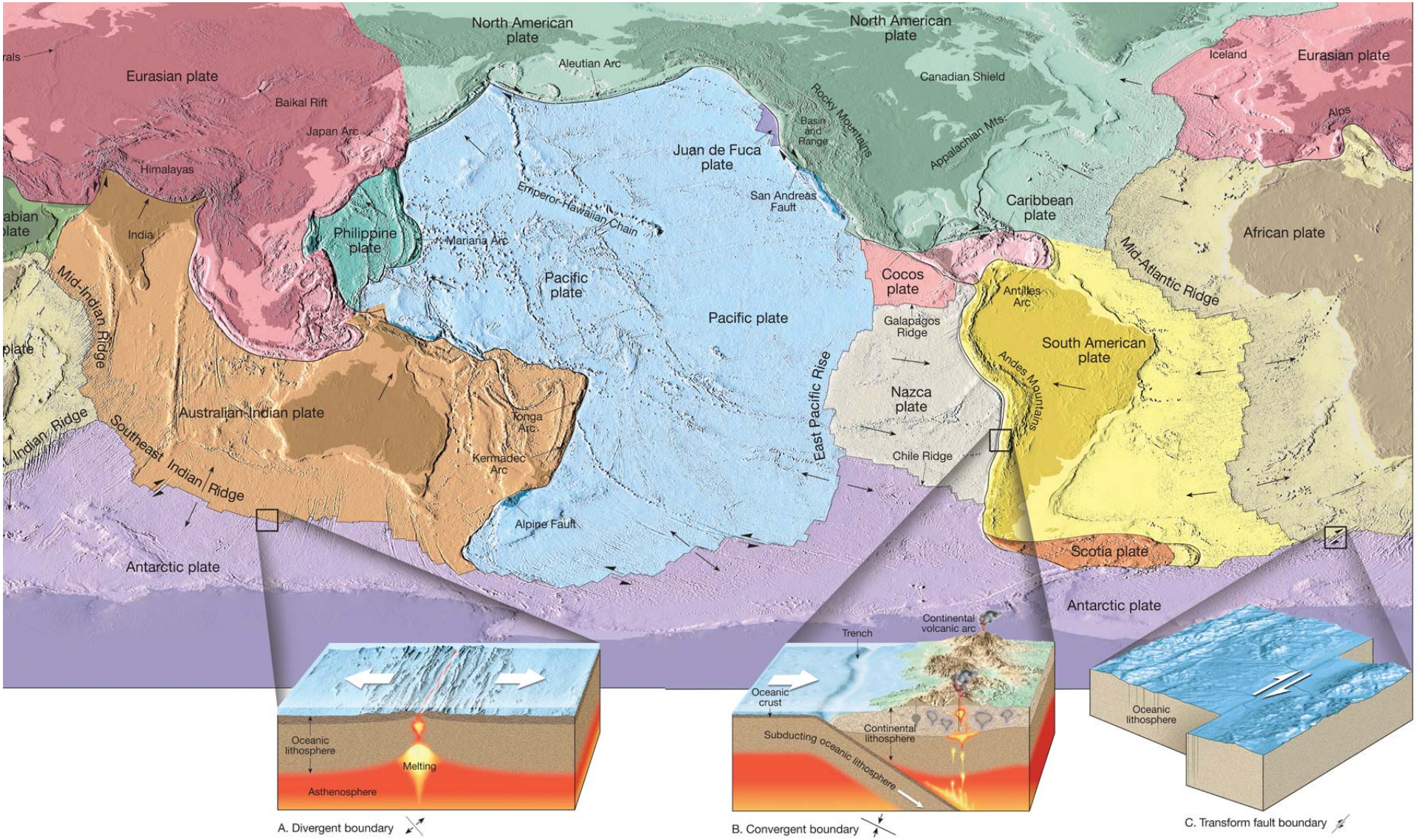
Pangaea (240 Myr ago)



B. Wegener's Pangaea

Plate Tectonics:
CLUE (2)- Earthquake Locations





(1) Divergent: mid-ocean ridges

(2) Convergent: subduction zones

(3) Transform faults

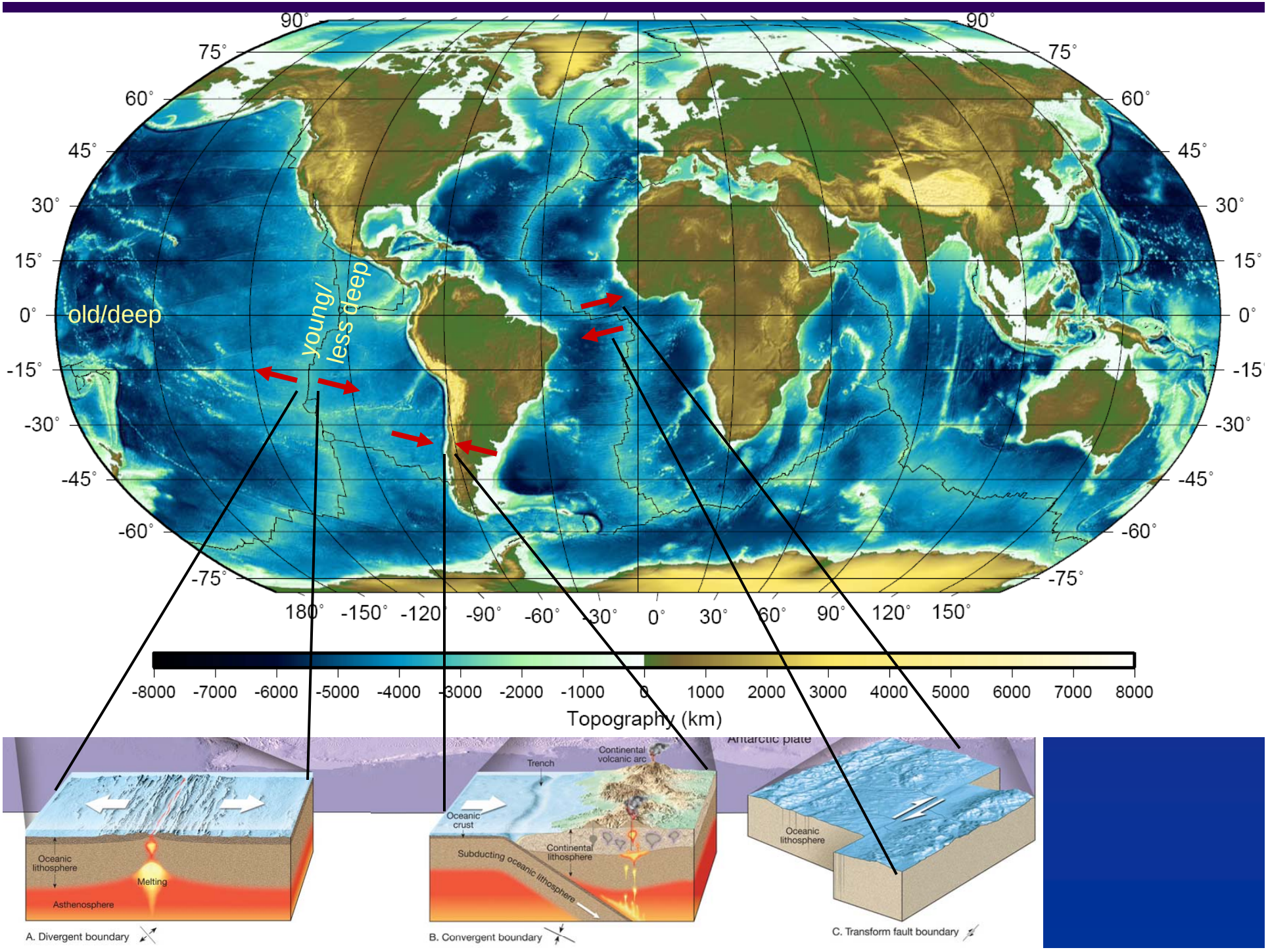
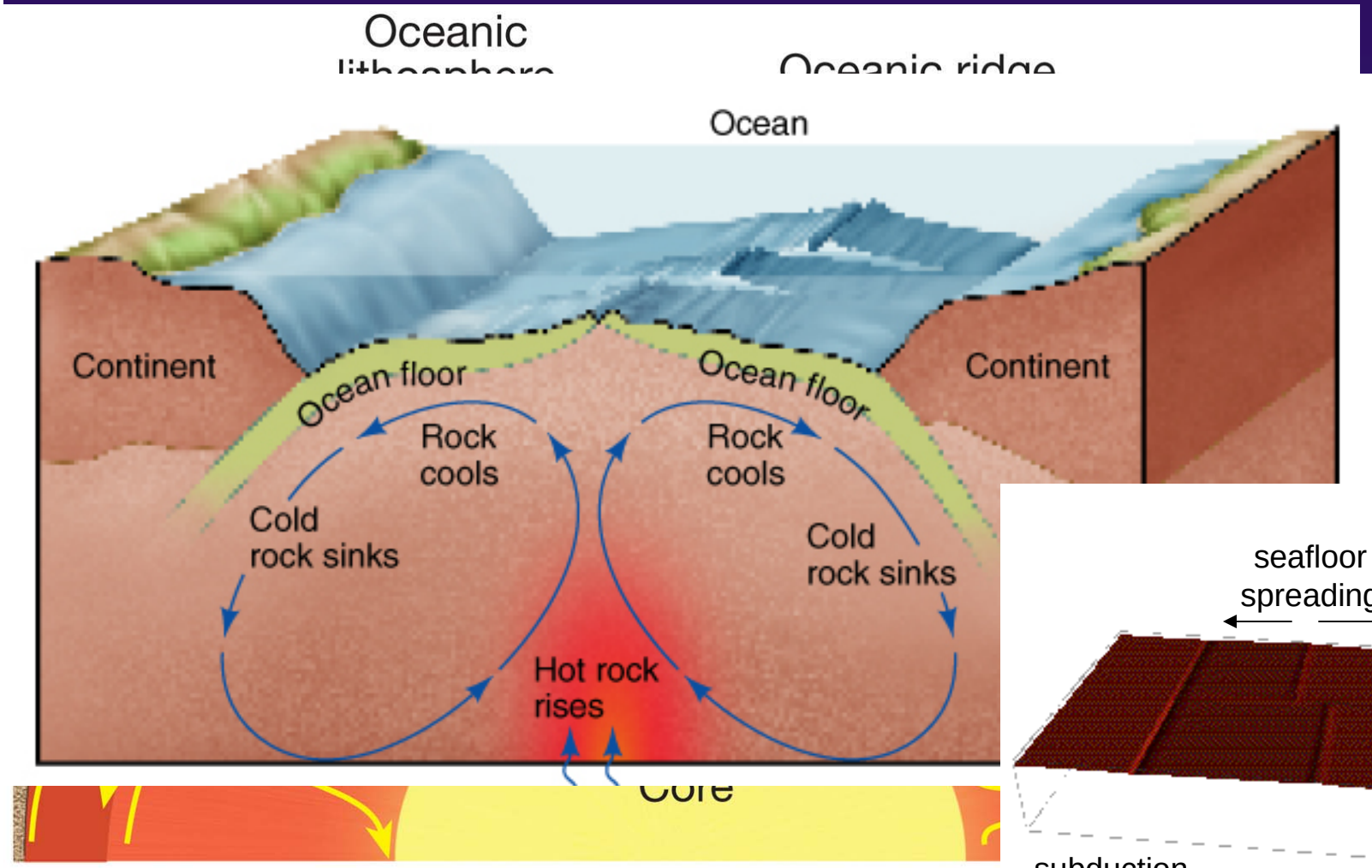
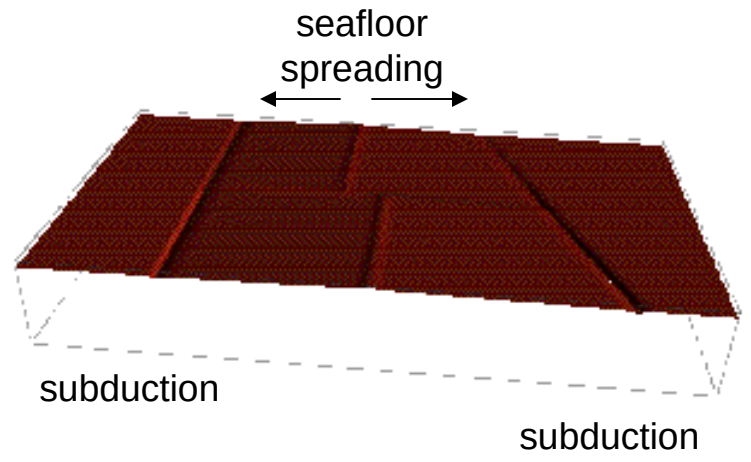
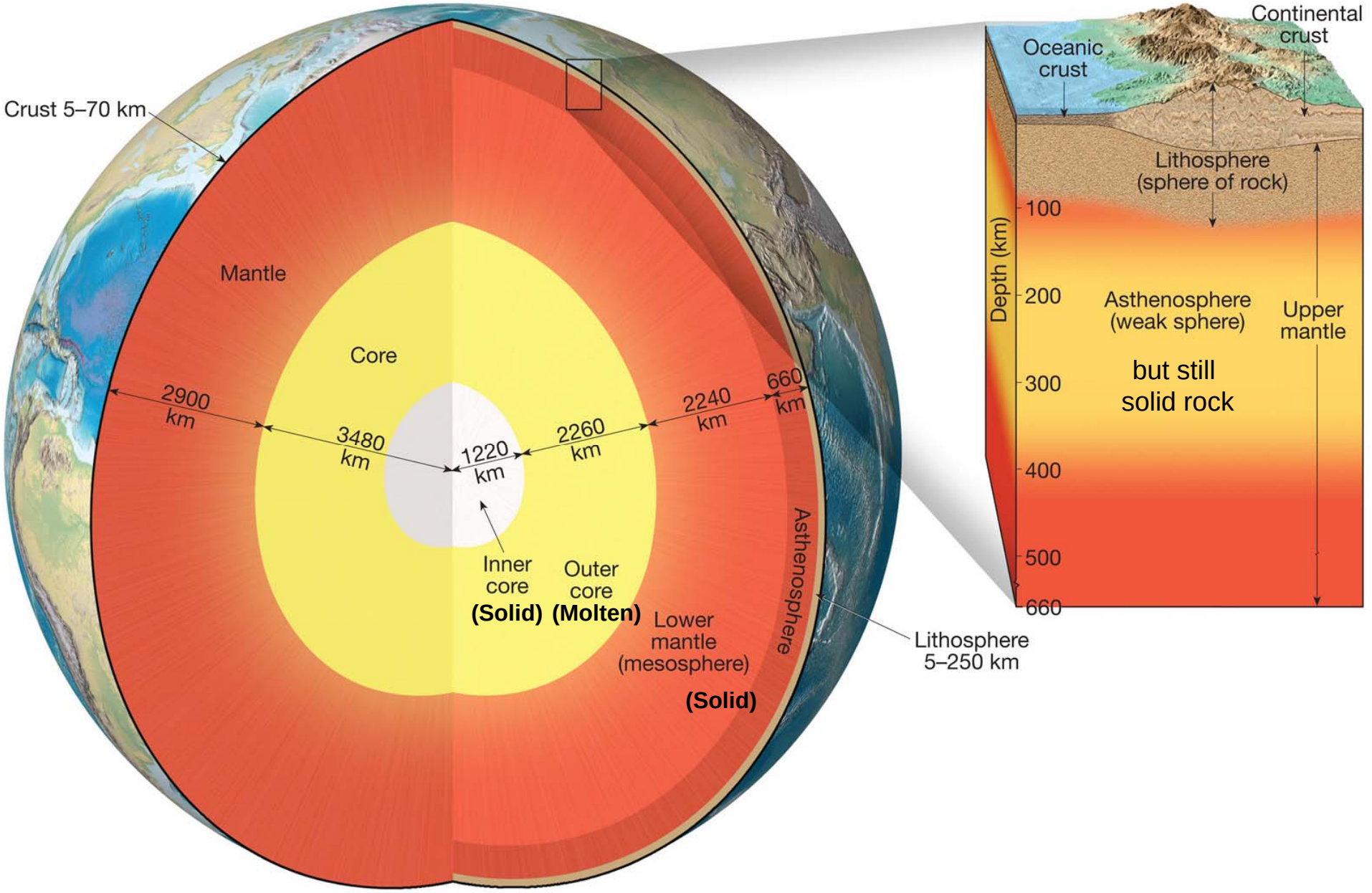

old/deep
young/
less deep
Topography (km)
Oceanic lithosphere
Melting
Asthenosphere
A. Divergent boundary
Trench
Continental volcanic arc
Oceanic crust
Continental lithosphere
Subducting oceanic lithosphere
B. Convergent boundary
Oceanic lithosphere
C. Transform fault boundary

Plate Tectonics is the Surface Expression of Mantle Convection



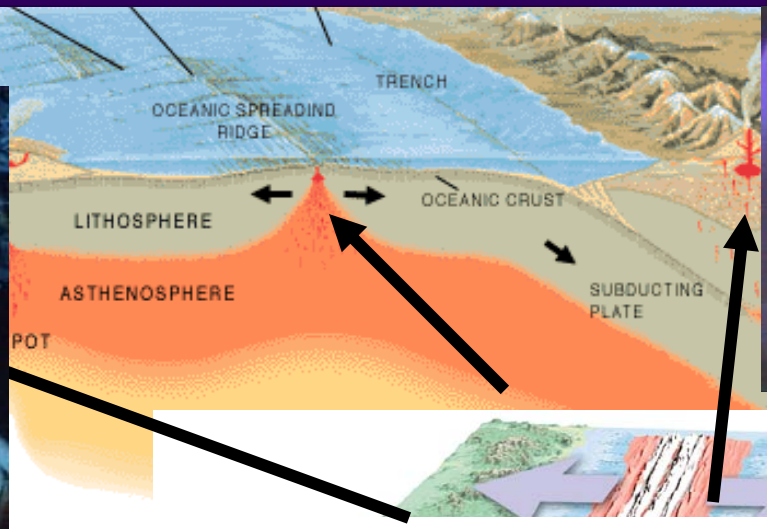


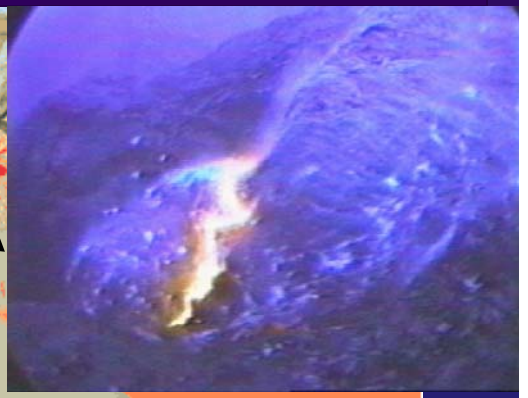
Mantle is half the volume of Earth



Mantle Convection and Oceanic Volcanism

Three Main Origins of Volcanism



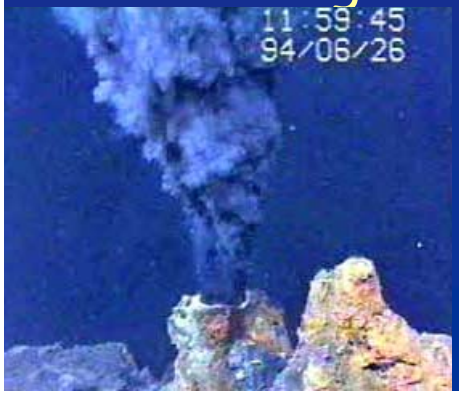


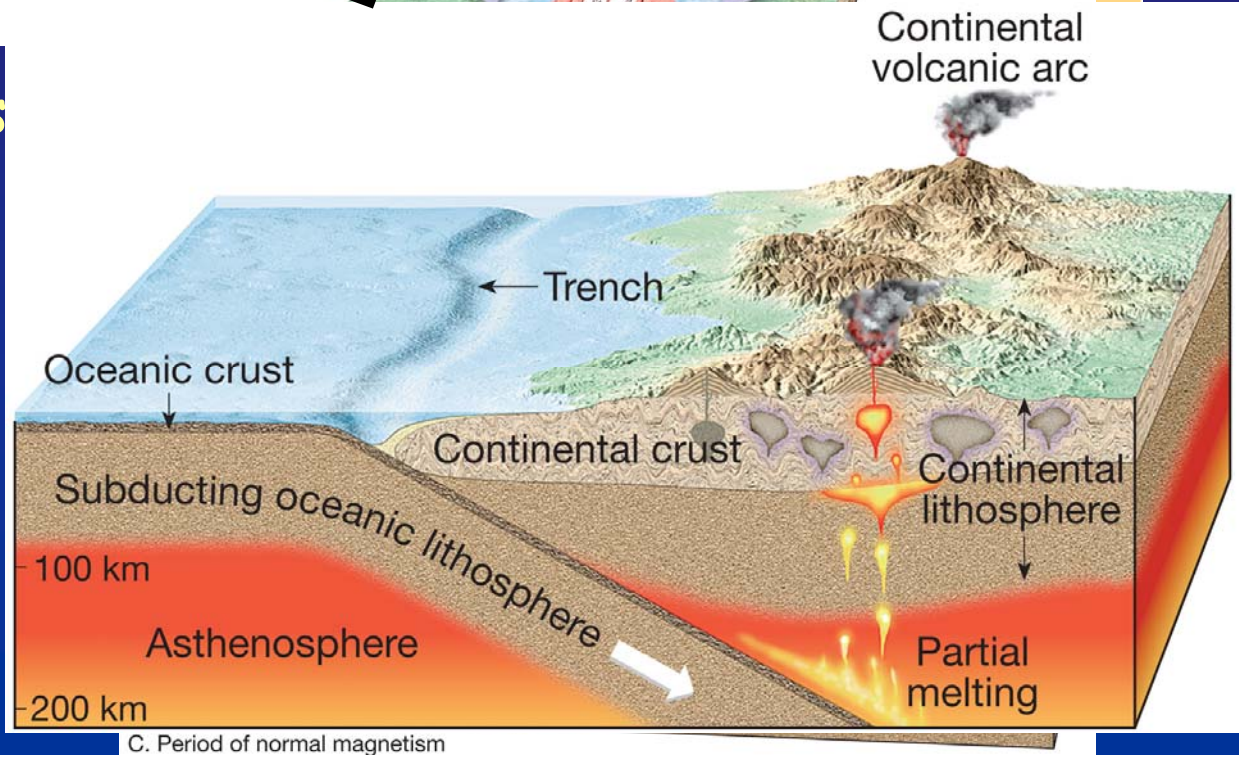
Are volcanism behind subduction zones.

Mid-ocean ridge volcanism creates the seafloor.

60% of Earth's surface!

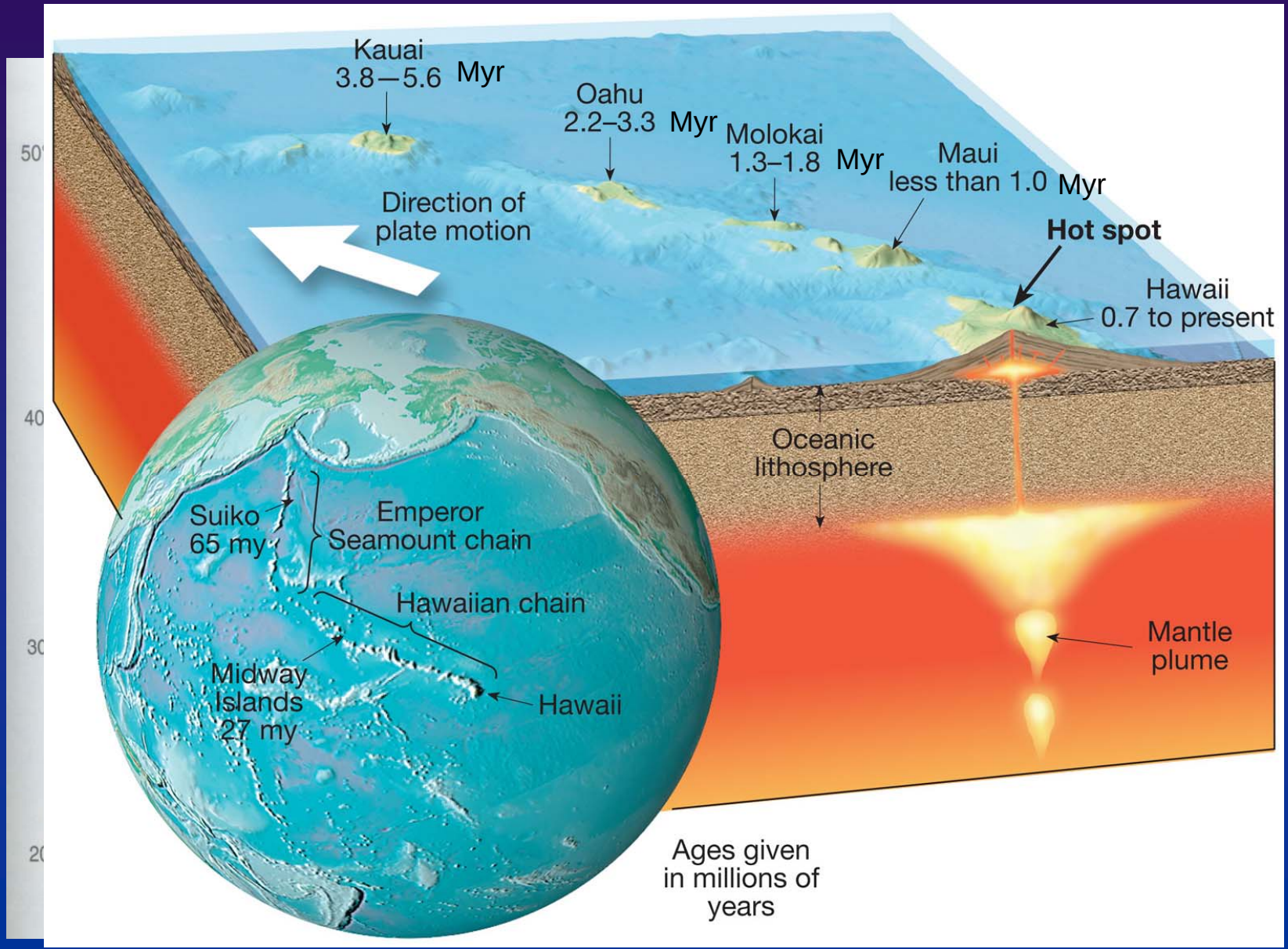
Pacific Ring of Fire



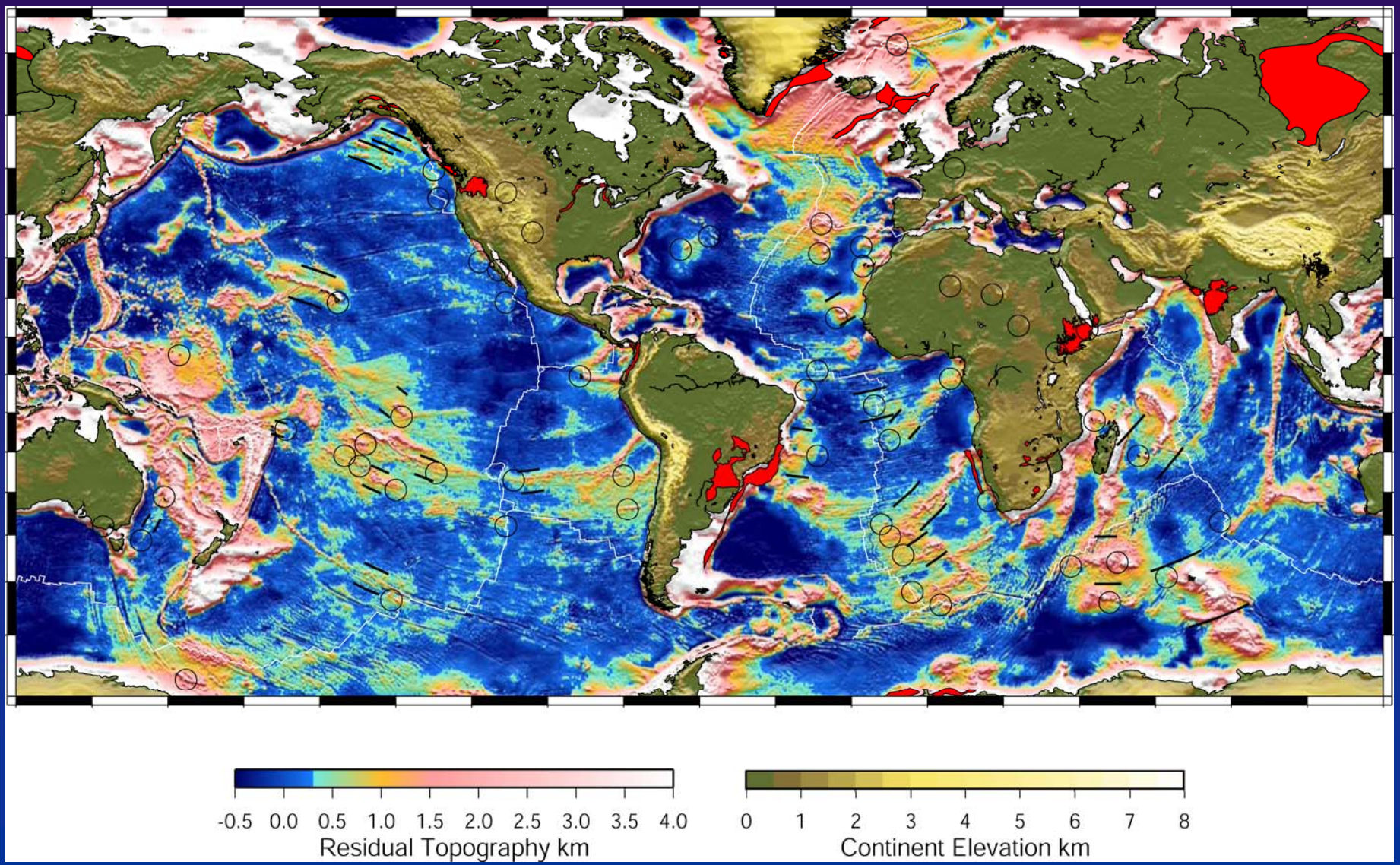


C. Period of normal magnetism

Hotspot Volcanism

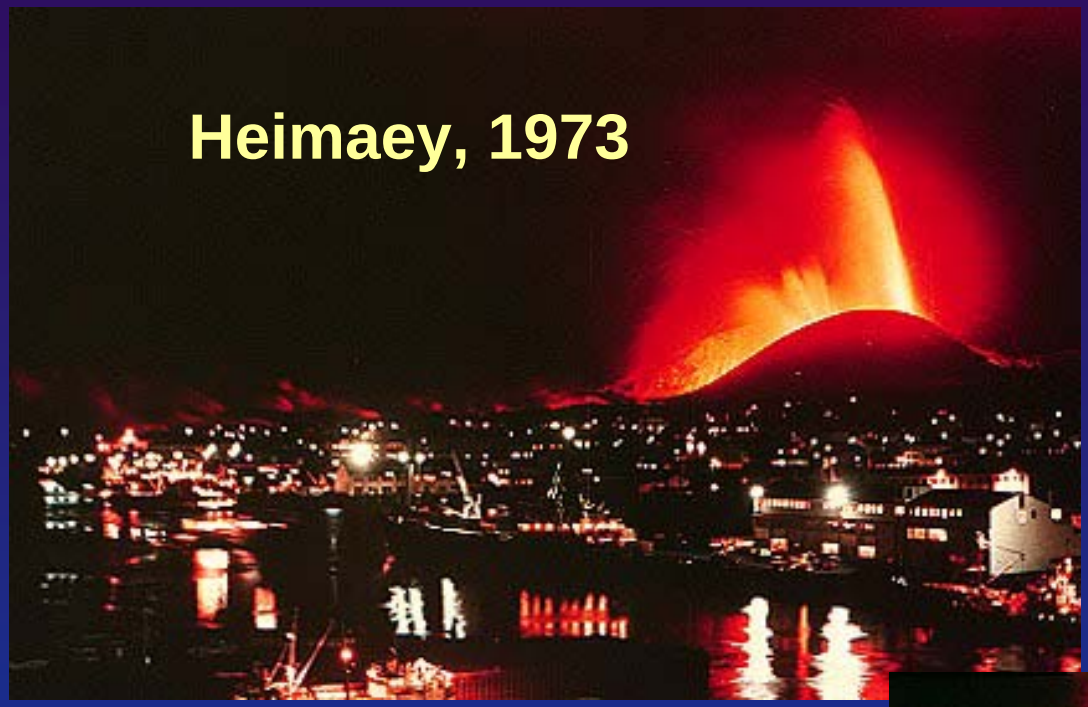


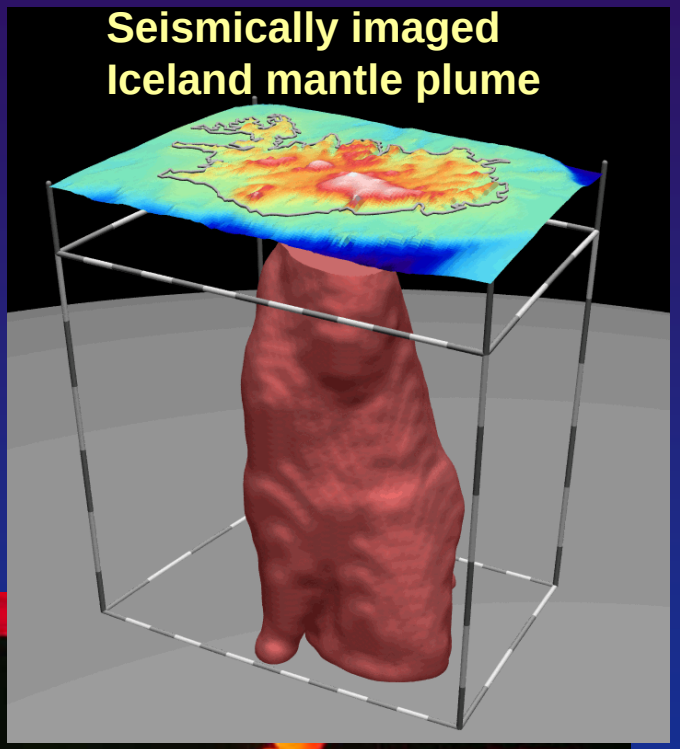
Hotspot Volcanism

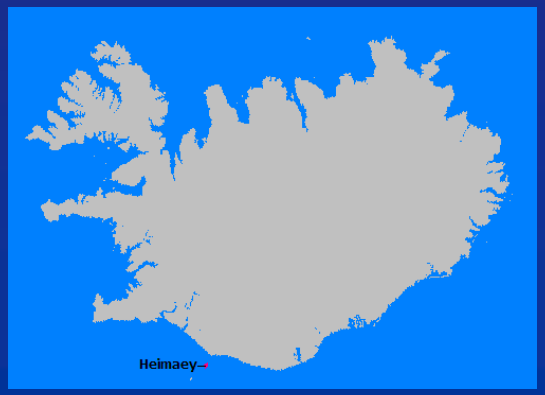


Hotspot Volcanism: Its HOT!

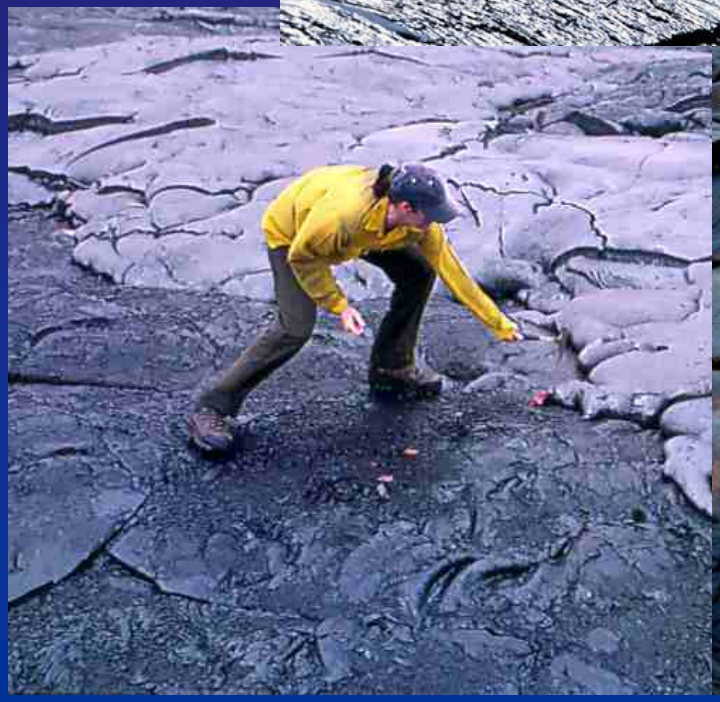
Hotspot Volcanism: Its HOT!





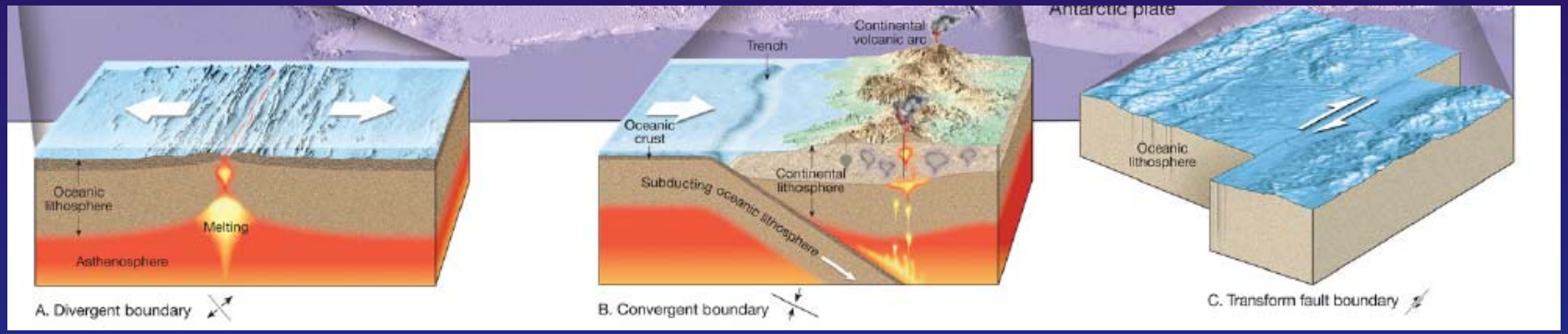


Hotspot Volcanism: Its FUN!



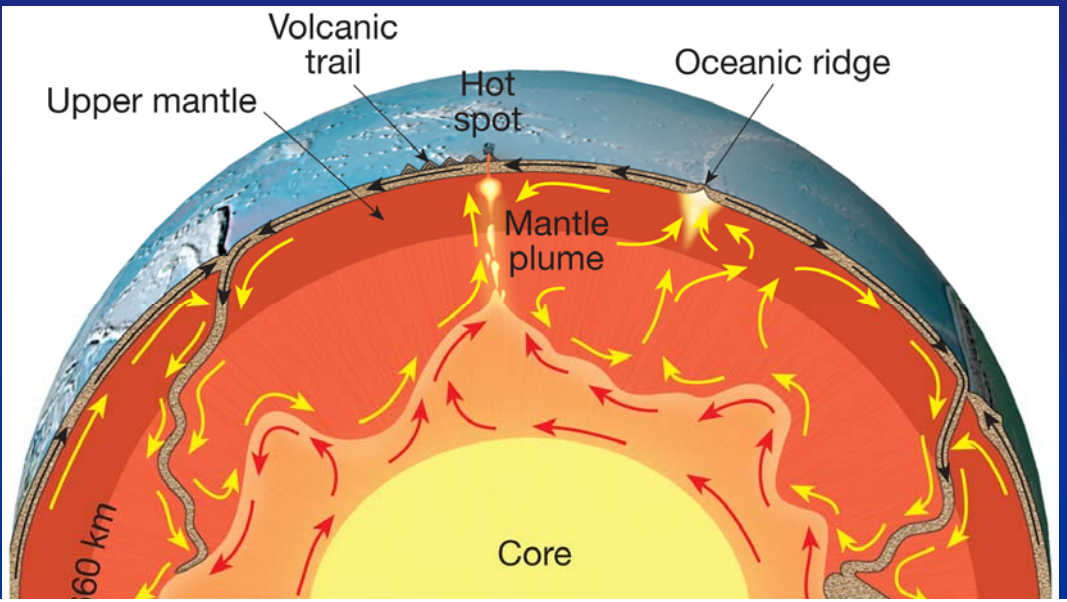
Summary: Dynamic Earth

Plate Tectonics: describes motion of Earth's cracked outer shell
(1) Divergent (mid-ocean ridges)
(2) Convergent (subduction zones)
(3) Transform (strike-slip faults)

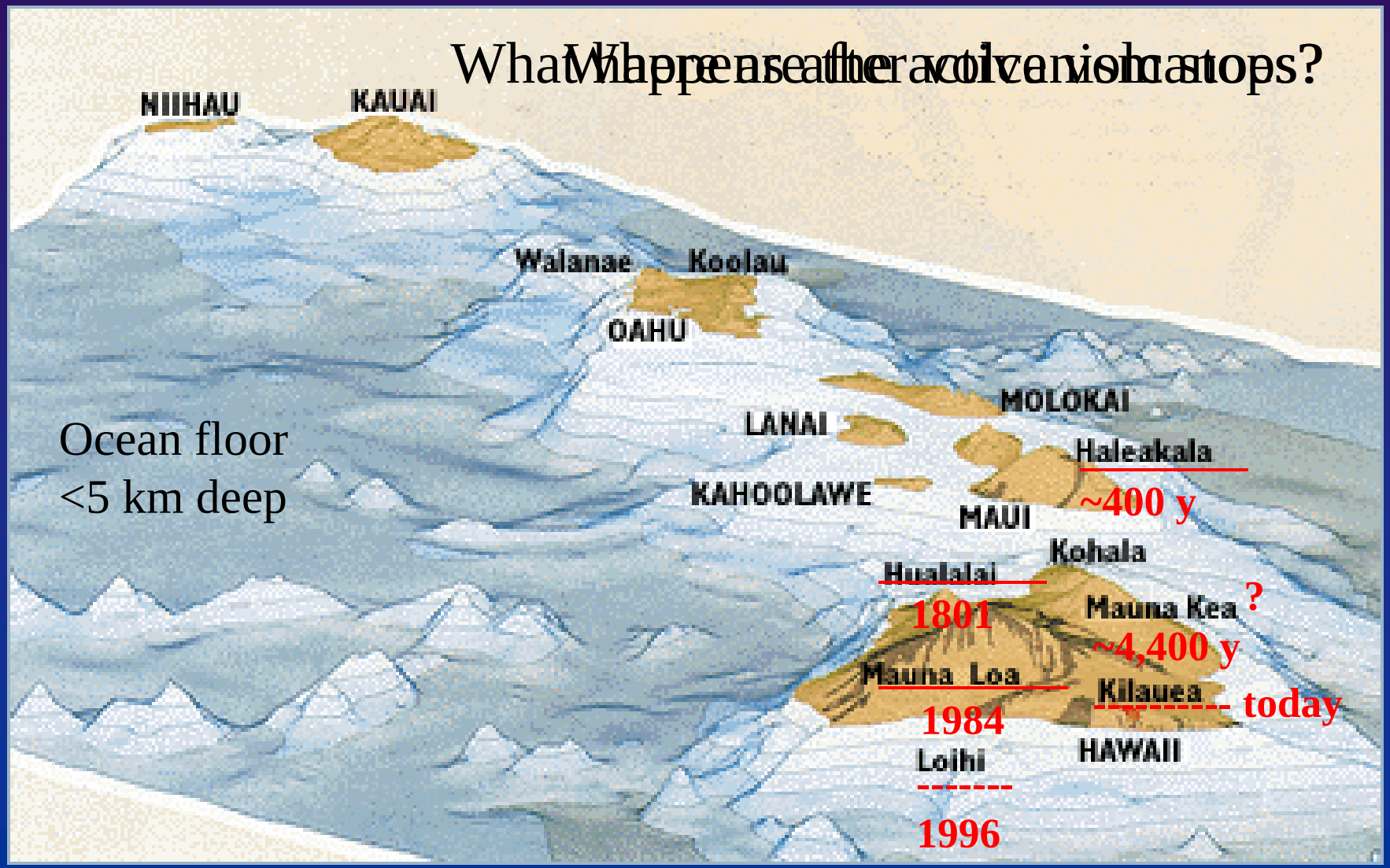


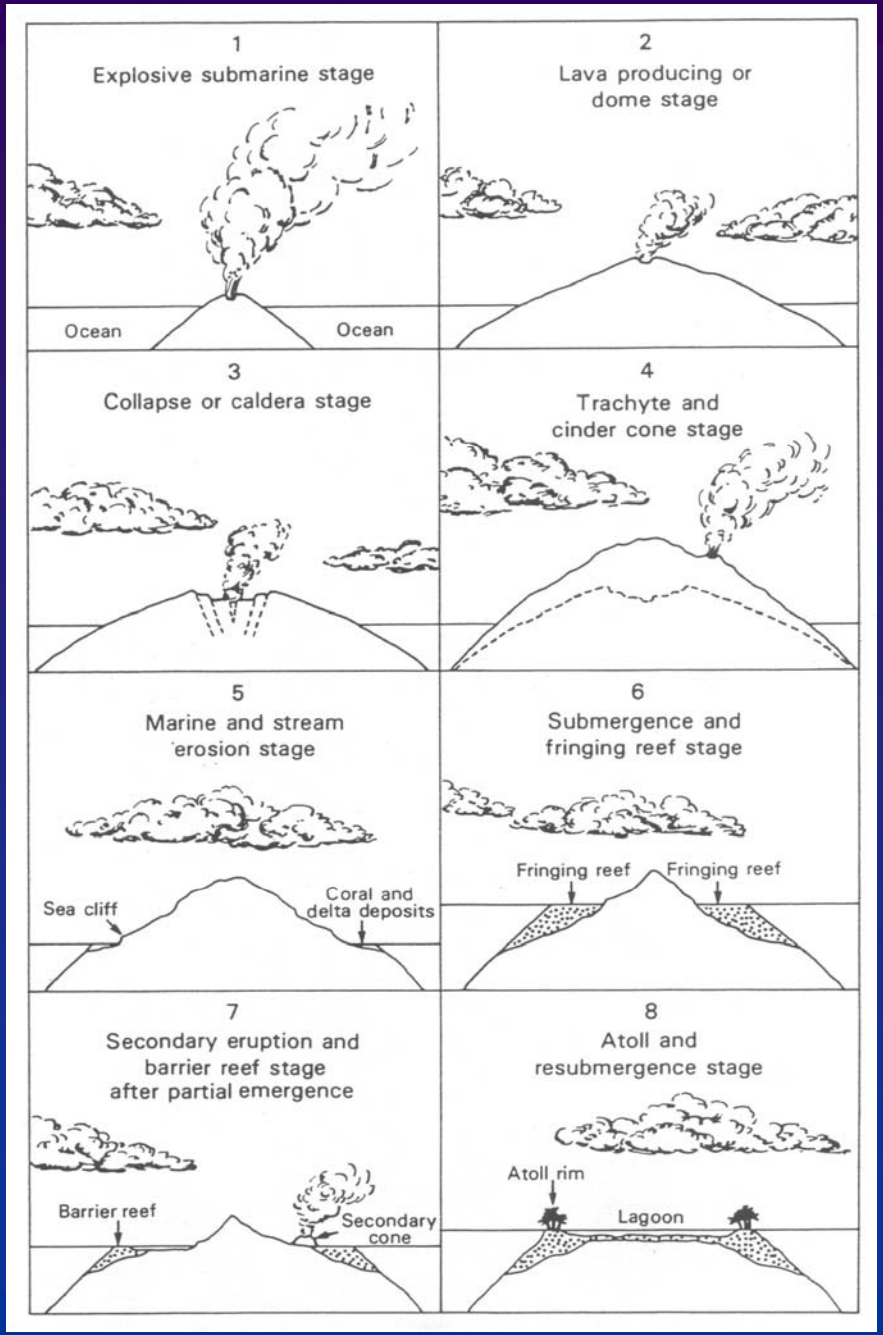
Part of Mantle Convection: Motion of the surface and interior of the Earth

Three Main Types of Volcanism
(1) Mid-ocean ridge (divergent boundaries)
(2) Arc volcanism (near subduction zones)
(3) Hotspot volcanism (Hawaii)



Evolution of Hawaiian Volcanoes





Life stages of Hawaiian volcanoes according to Stearns (1946)

He didn't have evidence about the earliest, submarine history

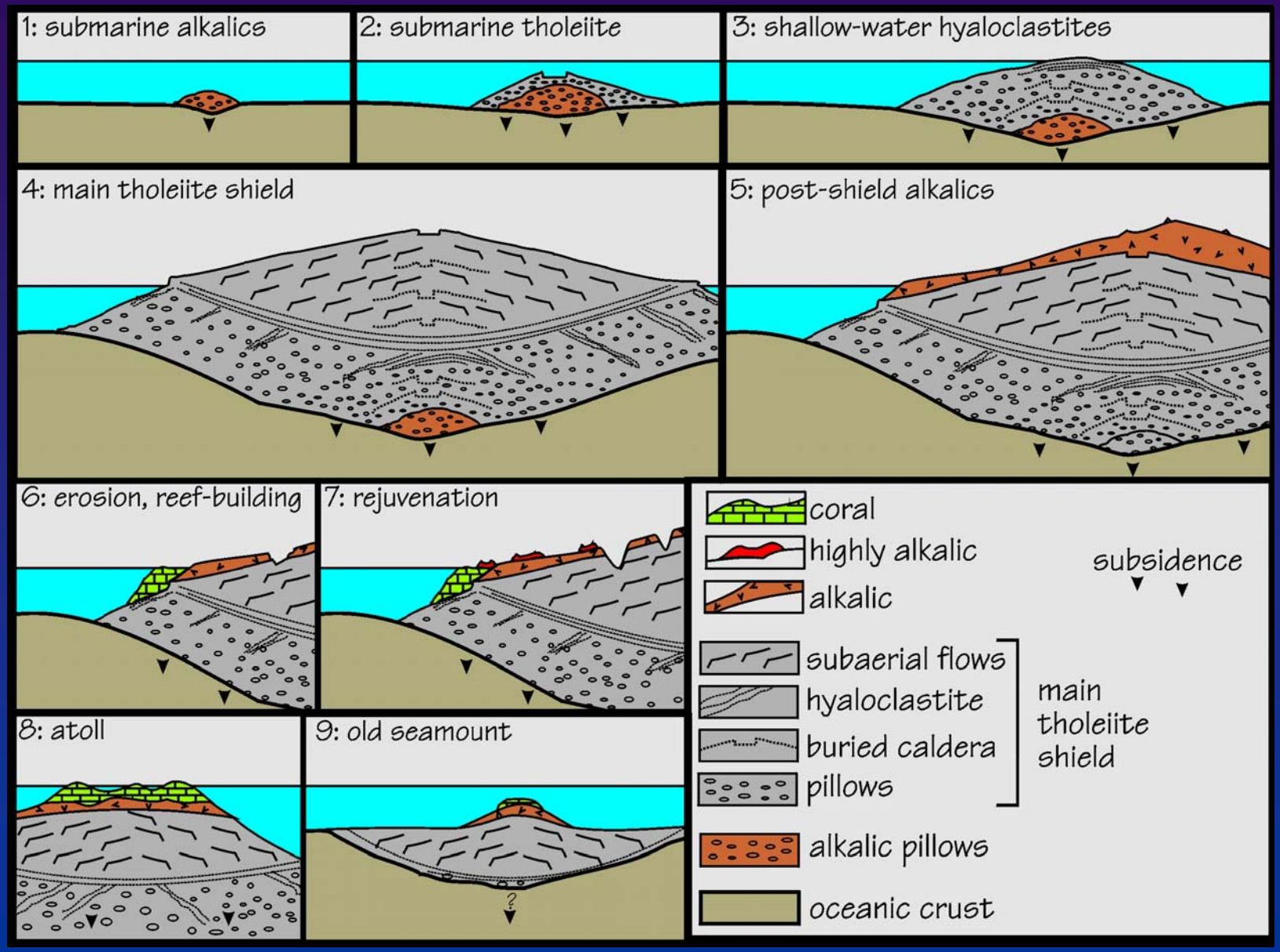
He thought caldera collapse was a singlular event that happened late in the shield (or dome-building) stage

He correctly identified the characteristics of three primary constructional phases of Hawaiian volcanism that have come to be known as

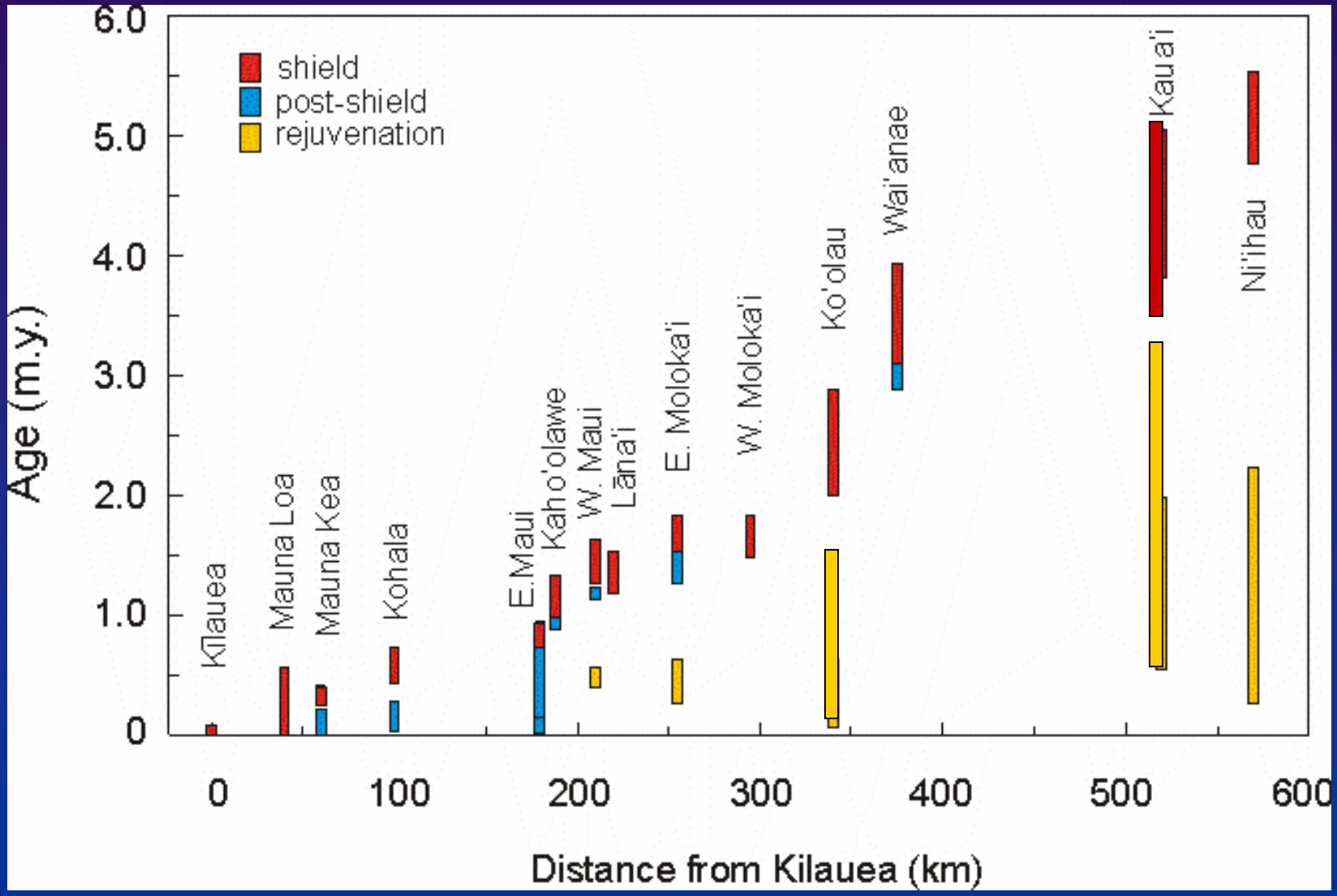
1. Shield Stage (his 2 & 3)
2. Postshield Stage (his 4)
3. Rejuvenation Stage (his 7)

And he had a whole lot of other things right, as well

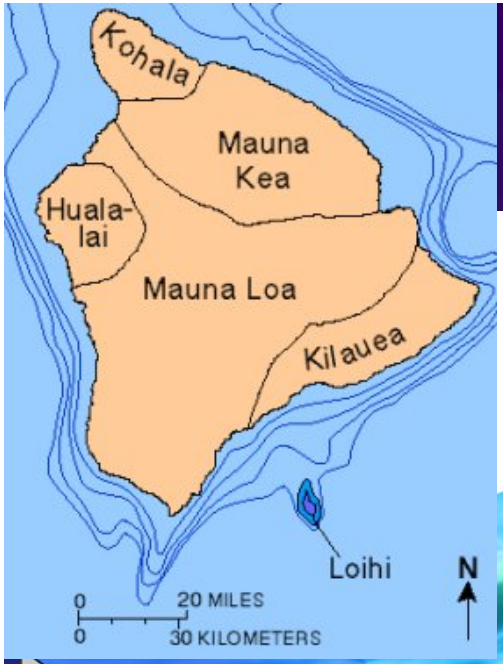
Evolution of Hawaiian Volcanoes

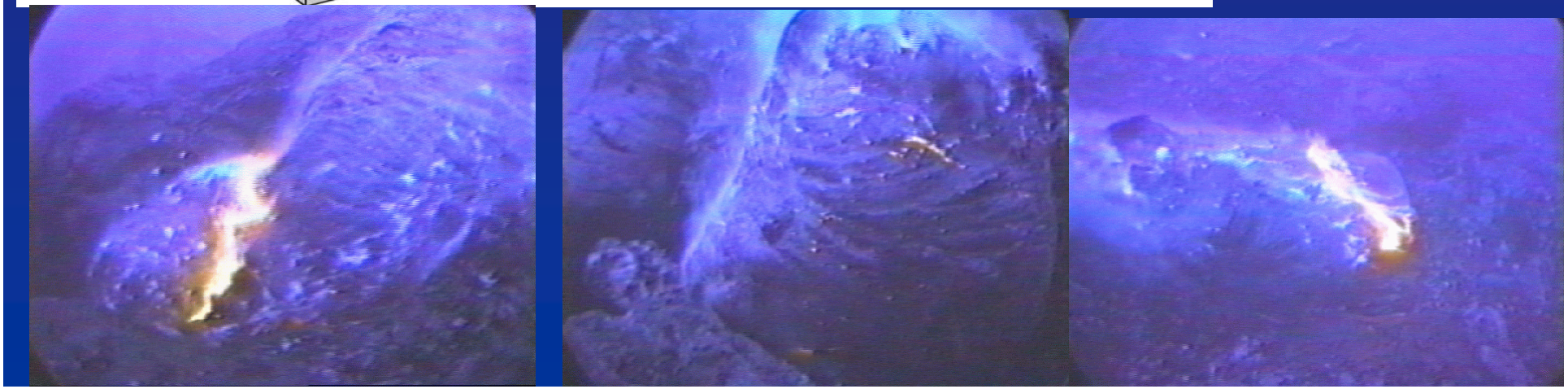


Evolution of Hawaiian Volcanoes

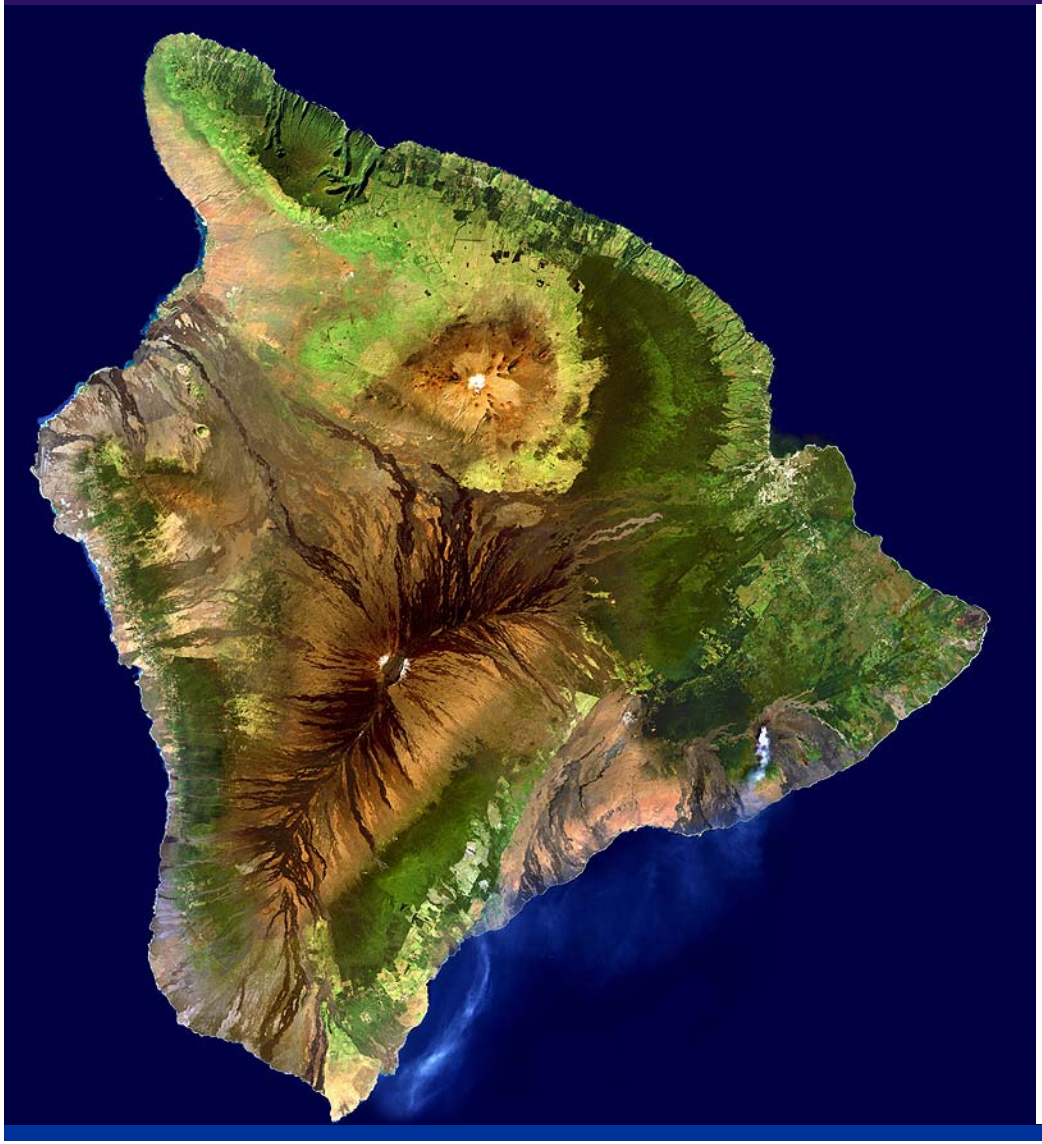


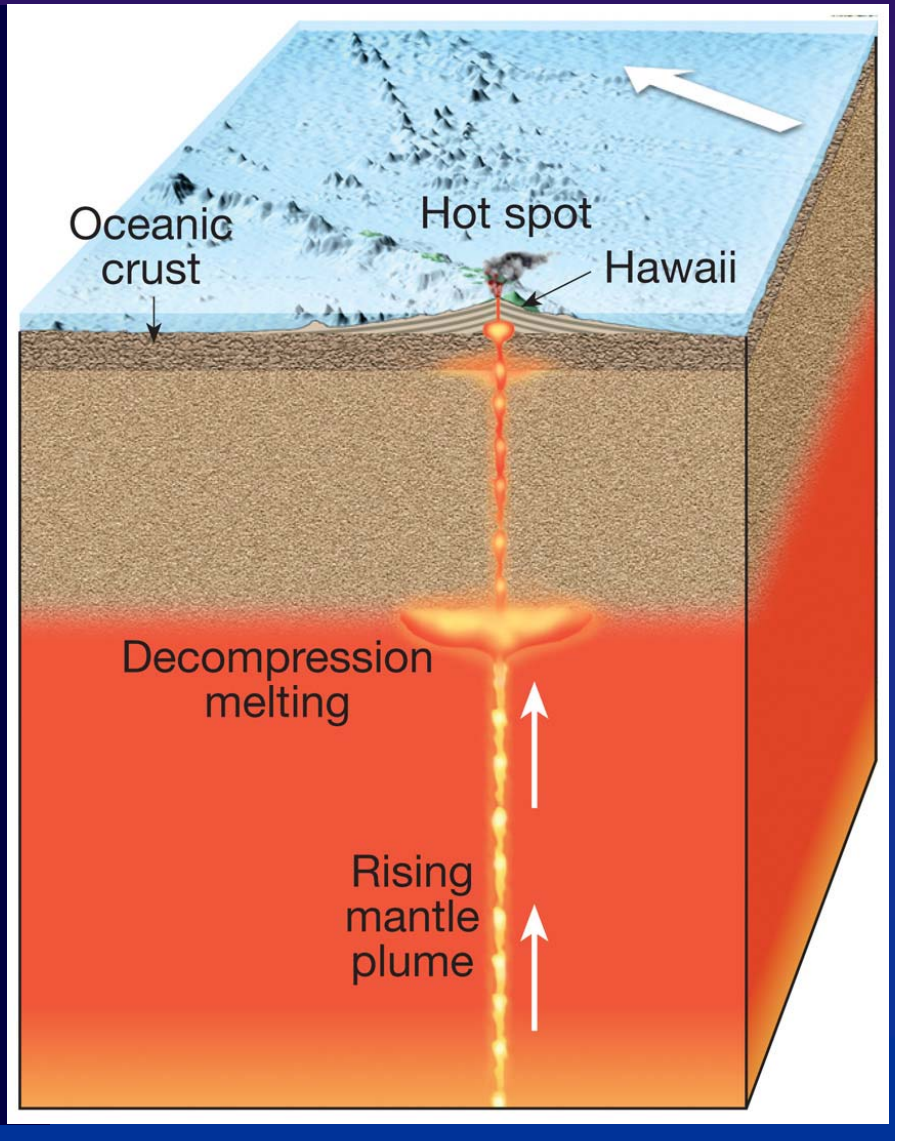
Submarine pre-shield phase: Loihi Seamount

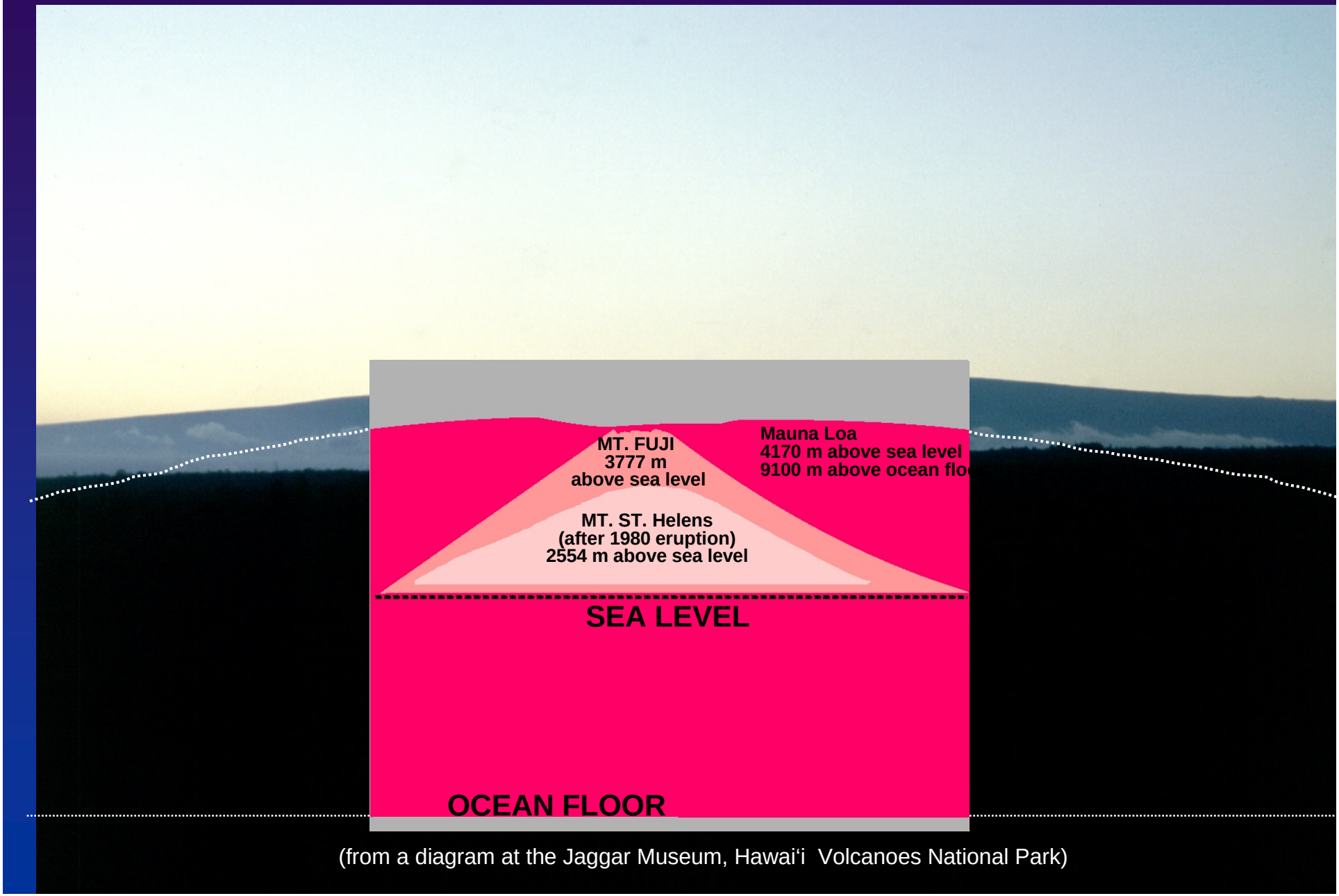




Shield Building Phase is Biggest!





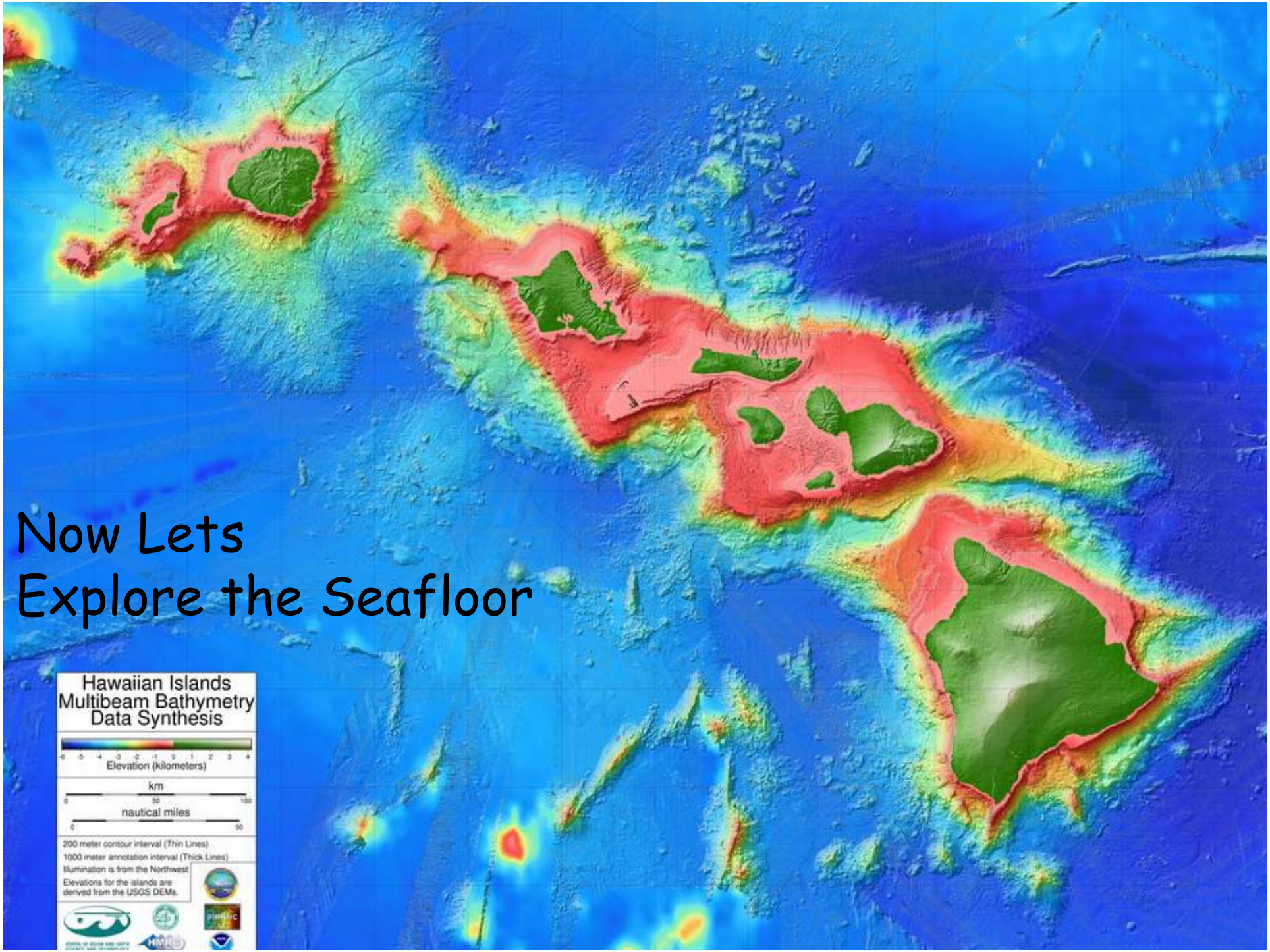


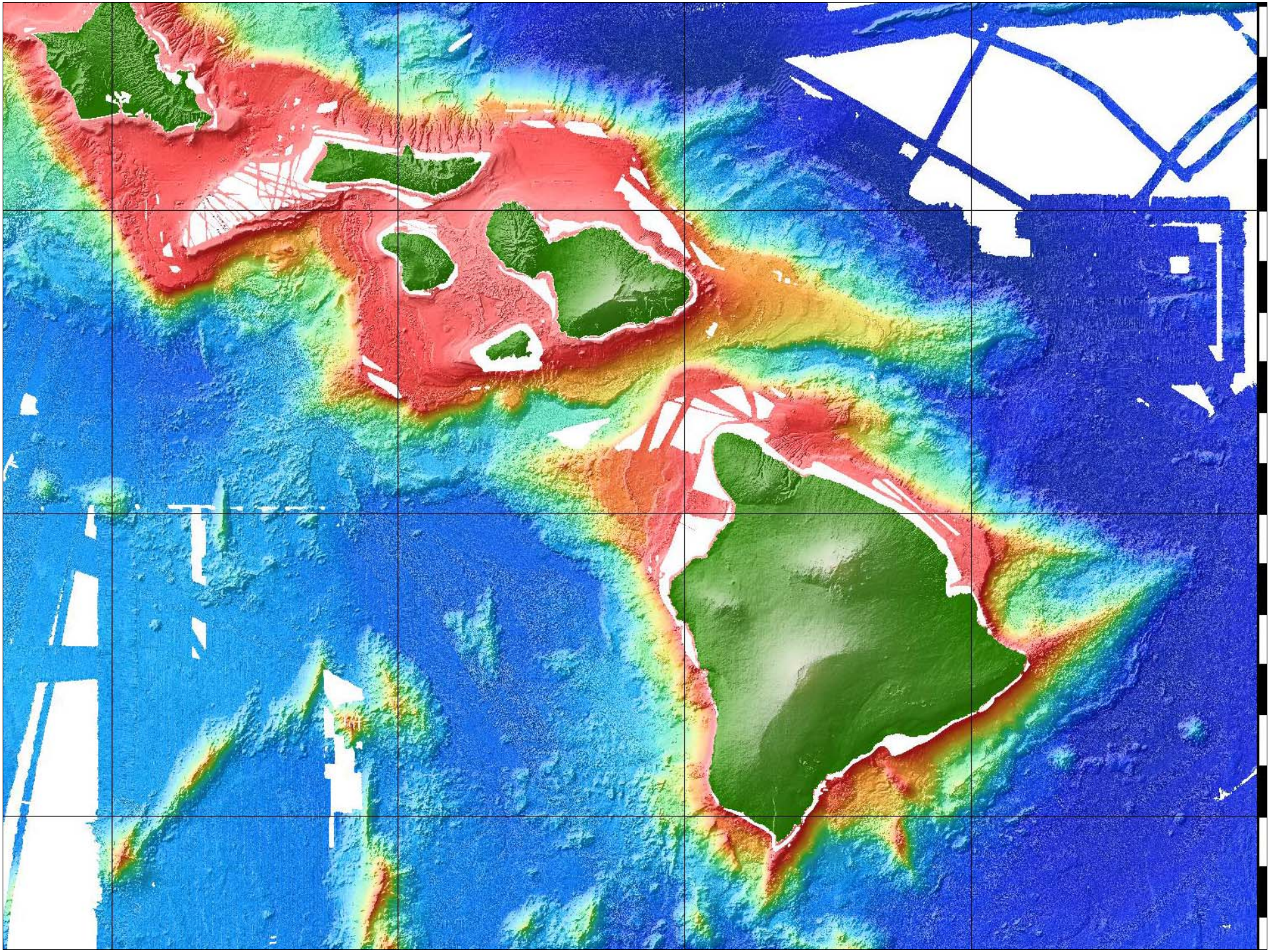
(from a diagram at the Jaggar Museum, Hawai‘i Volcanoes National Park)

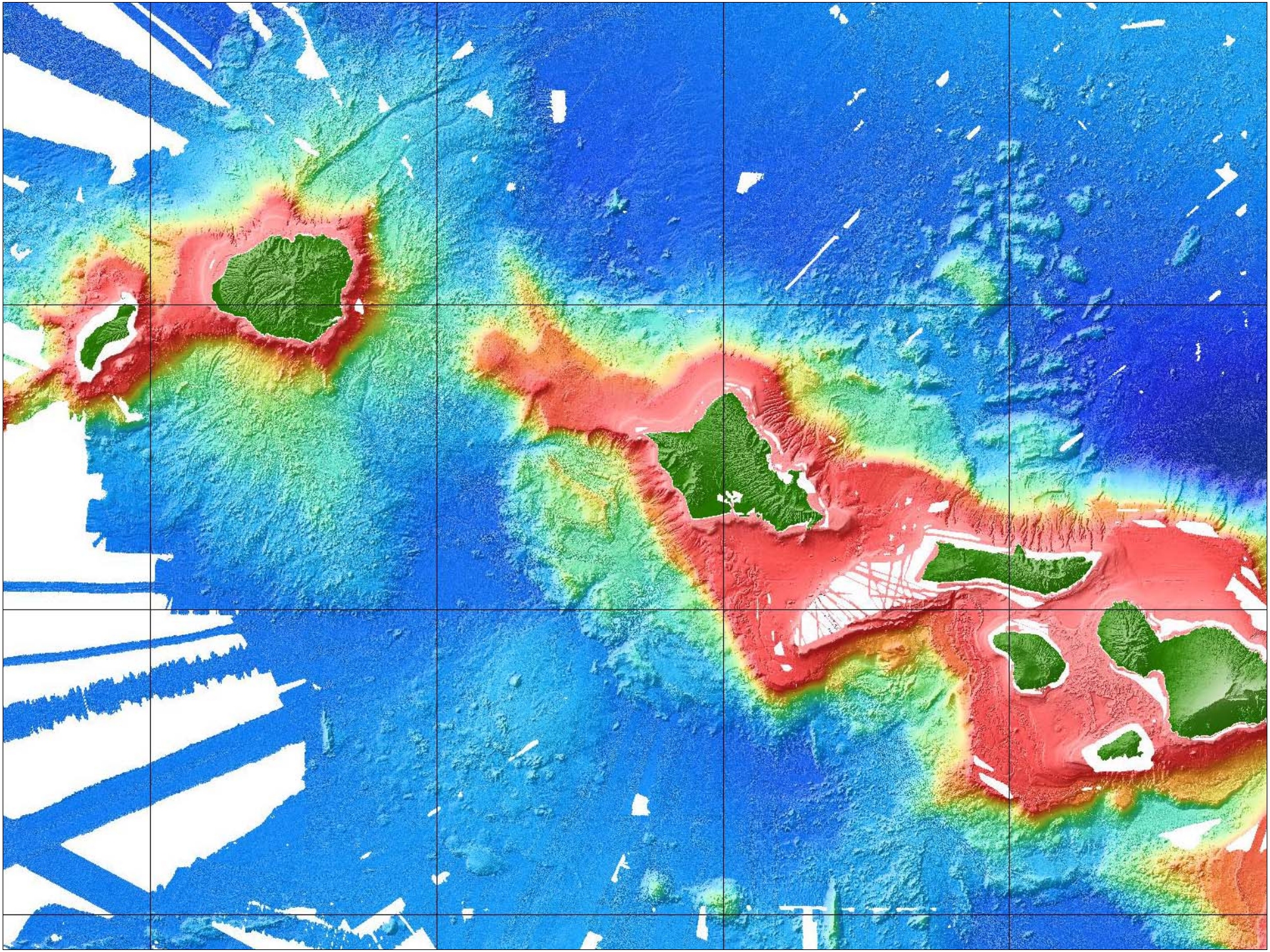
Post-shield Alkalic: Mauna Kea

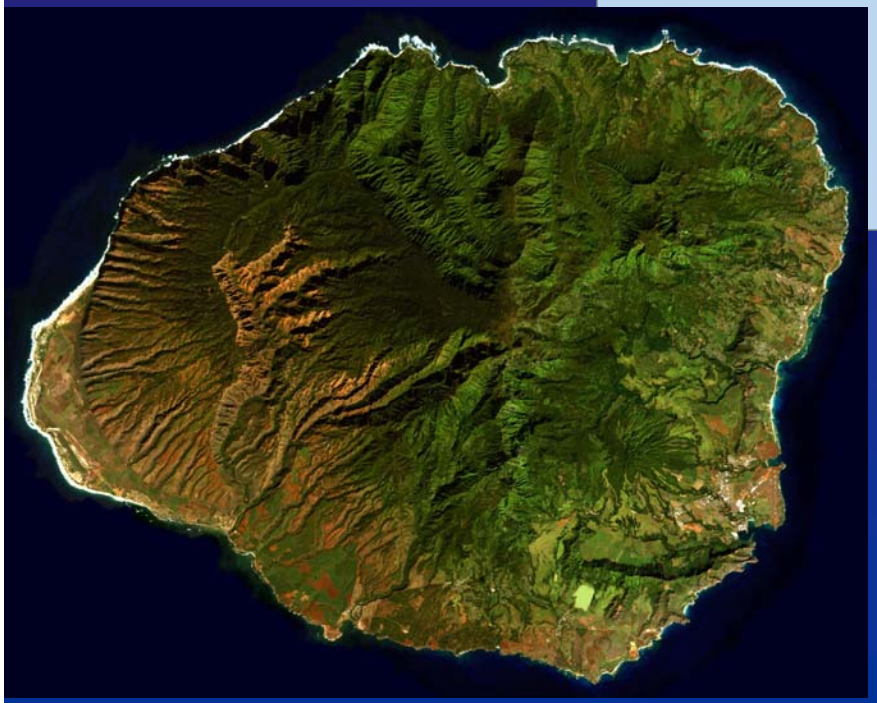
Hotspot Volcanism is…
BEAUTIFUL!

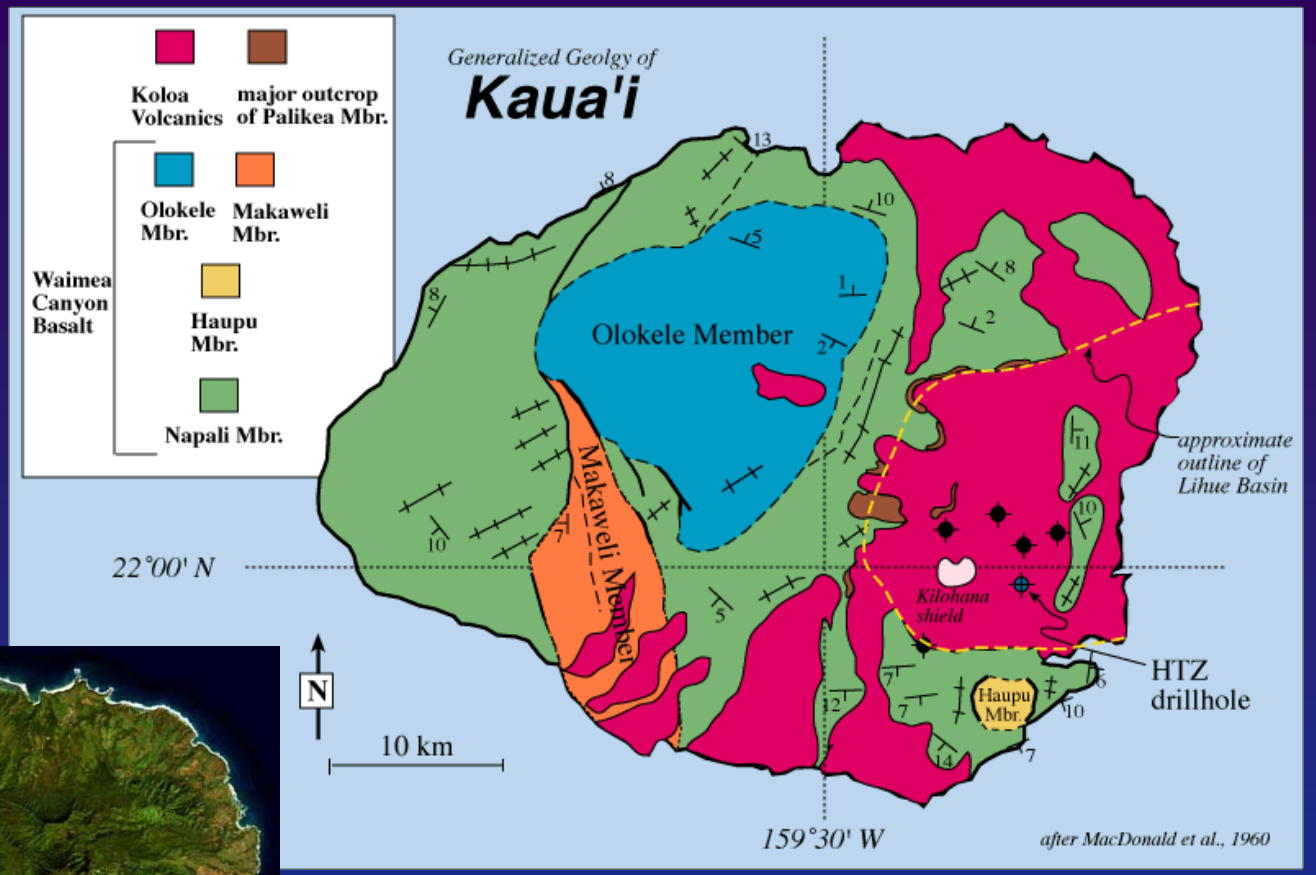

Rejuvenated Volcanism
Kalihi Vents
Nu`uanu Vents
Tantalus Vents
Punchbowl Crater
Rocky Hill Craters
U.H.
Diamond Head Crater
8 28 '98


Now Lets
Explore the Seafloor
Hawaiian Islands
Multibeam Bathymetry
Data Synthesis
-6 -5 -4 -3 -2 -1 0 1 2 3 4
Elevation (kilometers)
km
0 50 100
nautical miles
0 50
200 meter contour interval (Thin Lines)
1000 meter annotation interval (Thick Lines)
Illumination is from the Northwest
Elevations for the islands are
derived from the USGS DEMs.

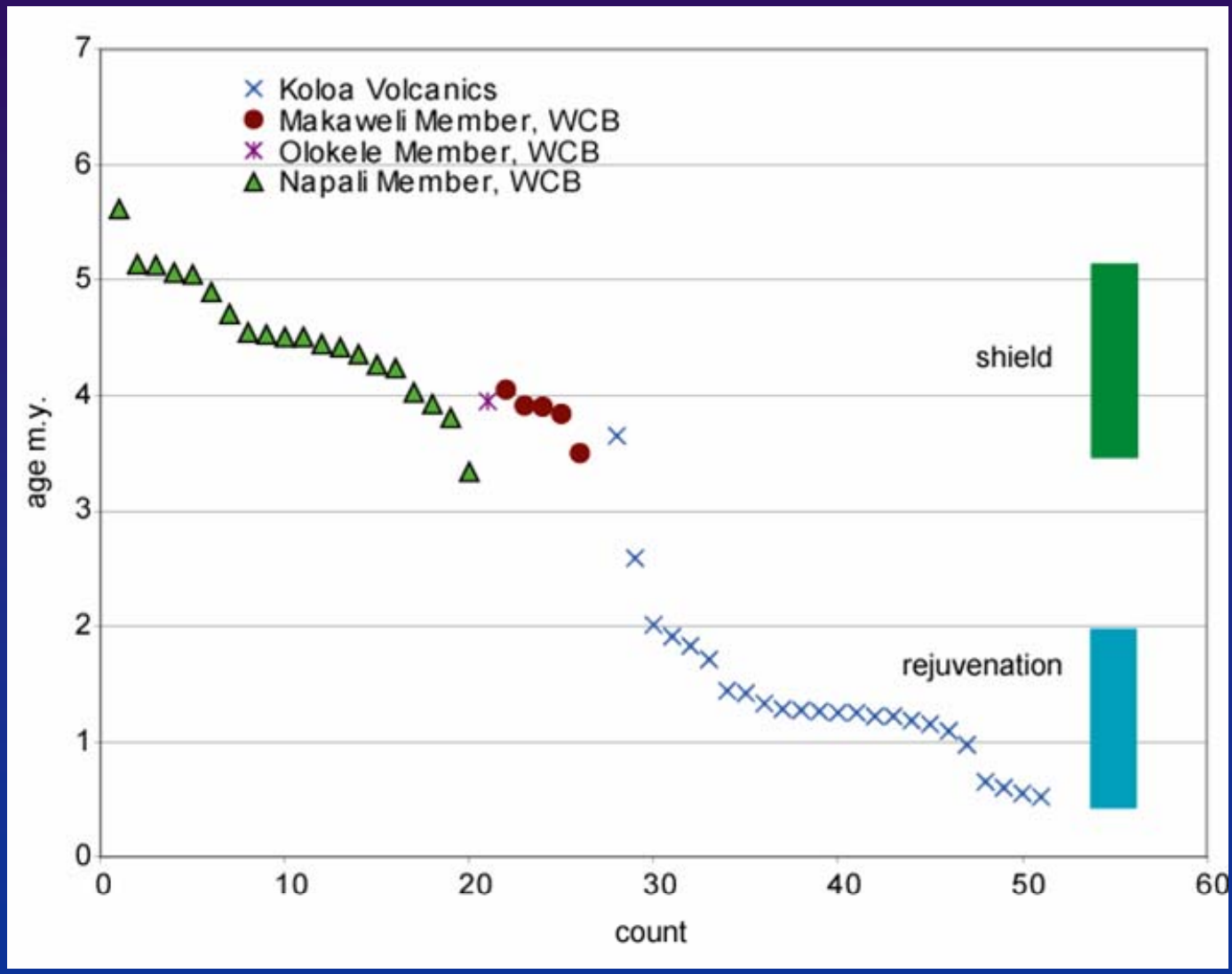






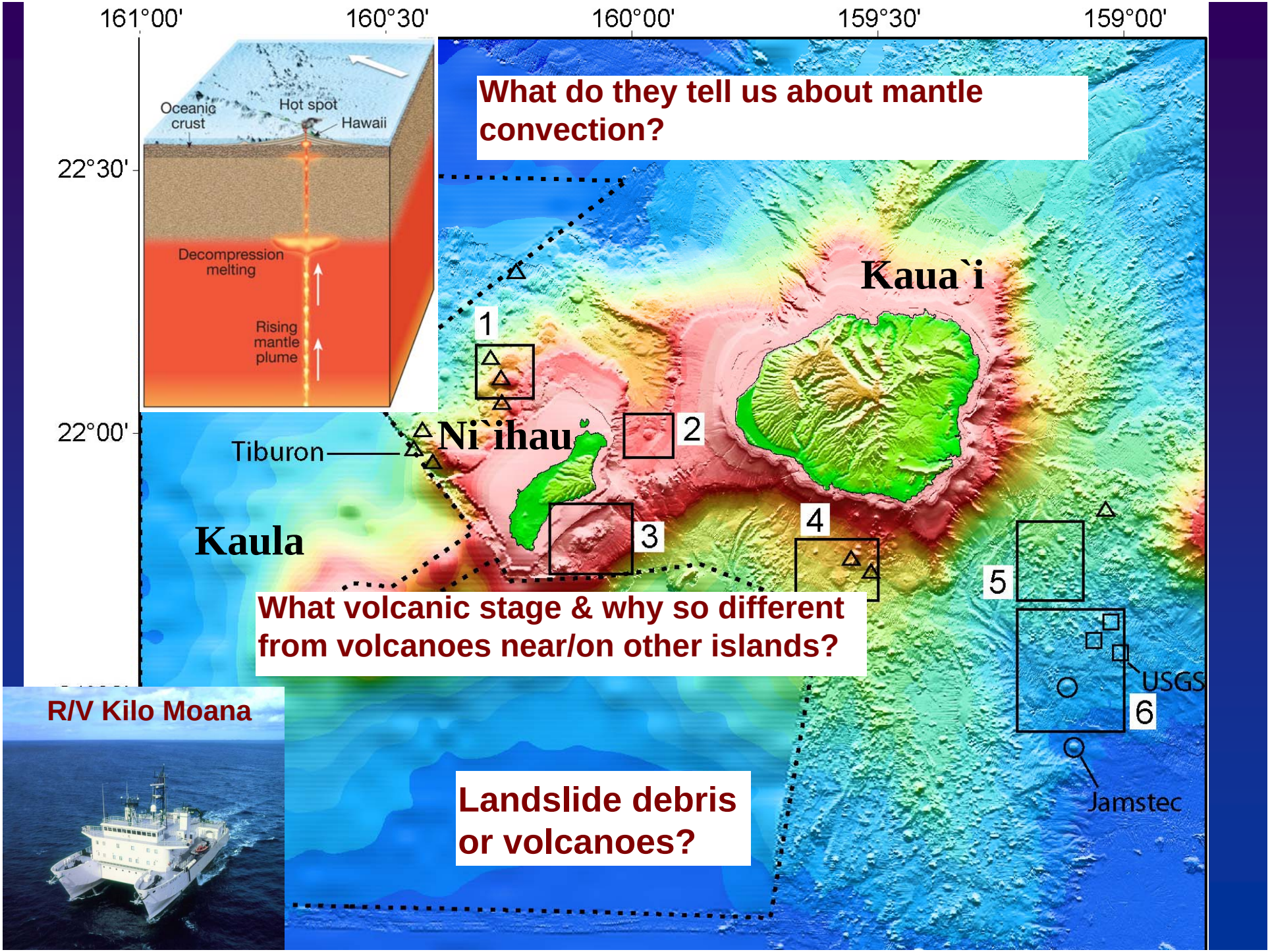

Generalized Geolgy of
Kaua'i
Koloa Volcanics
major outcrop of Palikea Mbr.
Olokele Mbr.
Makaweli Mbr.
Waimea Canyon Basalt
Haupu Mbr.
Napali Mbr.
Olokele Member
Makaweli Member
approximate outline of Lihue Basin
Kilohana shield
HTZ drillhole
Haupu Mbr.
22°00' N
159°30' W
N
10 km
after MacDonald et al., 1960

Ages

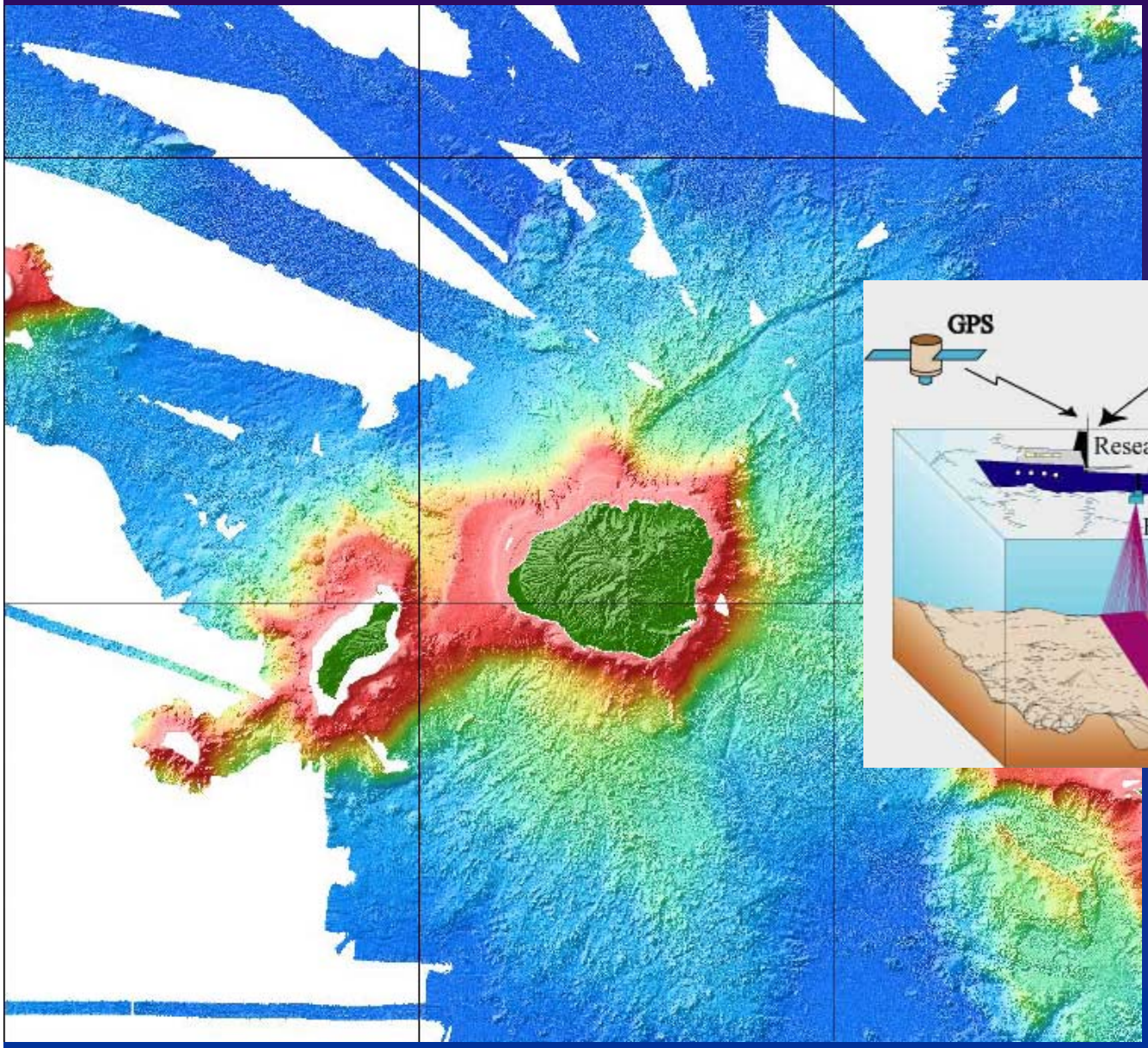


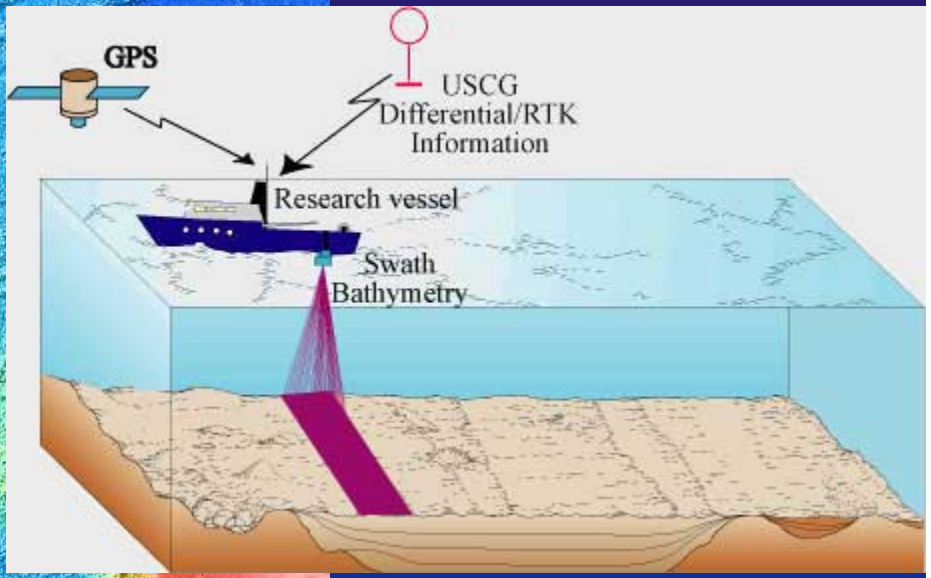
Waimea Canyon Basalt

Koloa Volcanics

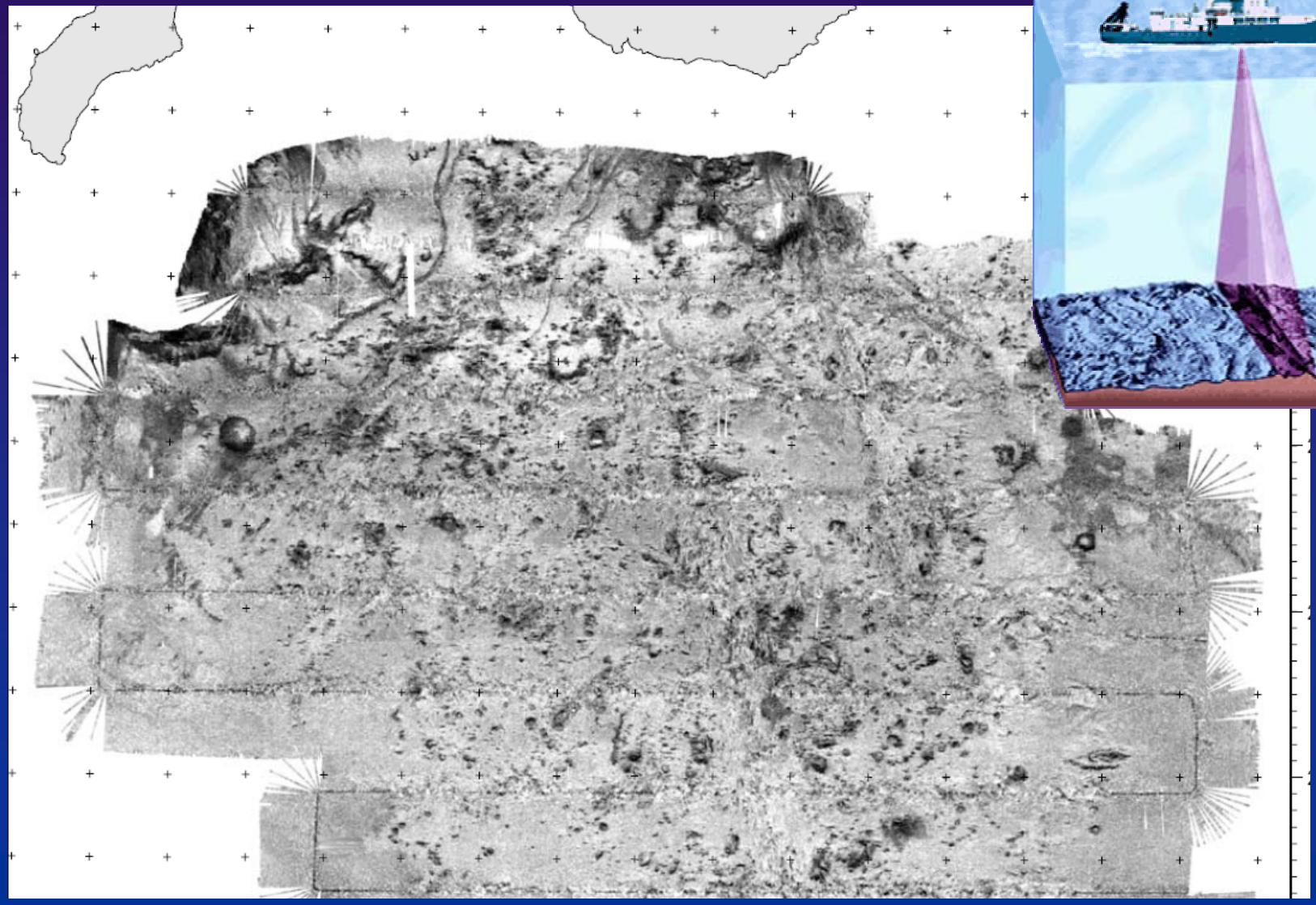

161°00'
160°30'
160°00'
159°30'
159°00'
22°30'
22°00'
Oceanic crust
Hot spot
Hawaii
Decompression melting
Rising mantle plume
What do they tell us about mantle convection?
Kaua`i
Ni`ihau
Tiburon
Kaula
1
2
3
4
5
6
What volcanic stage & why so different from volcanoes near/on other islands?
USGS
Jamstec
R/V Kilo Moana
Landslide debris or volcanoes?

Exploration Tools: (1) Swath Bathymetry





Exploration Tools: (2) Side Scan Sonar Measures "Hardness" of Seafloor



Exploration Tools:
(3) Photos, Movies, and Rock Samples Using...

Jason2 Remotely Operated Vehicle

Cruise Dates: Sept 9-Oct 7, 2007

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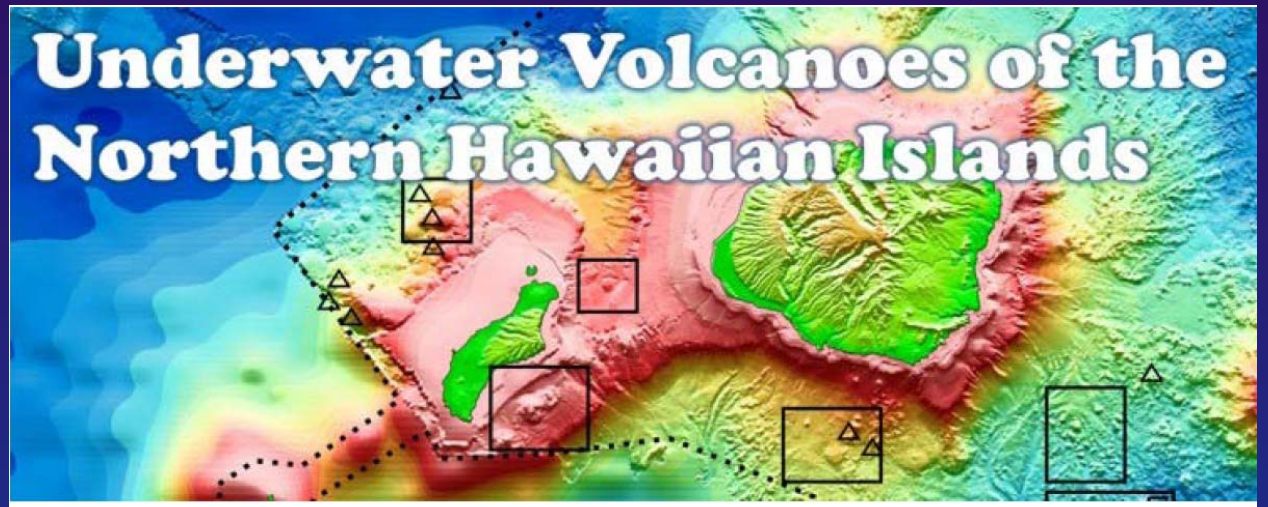

Home

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Contact Us

Aloha, welcome to the website for the "Underwater Volcanoes of the Northern Hawaiian Islands".

A 28-day marine expedition on the University of Hawaii Research Vessel Kilo Moana to map the Kaua`i and Ni`ihau submarine volcanic fields. We will use multibeam bathymetry and acoustic imagery, and we will also sample many of its volcanoes using the JASON2 ROV to characterize the petrology, geochemistry and ages of these lavas.

We will be doing updates from the ship, to view them just click on the calendar to the right. We will also have information about our science objectives, the crew that will be on the ship, and the ship and all equipment we'll be using!

Daily Updates

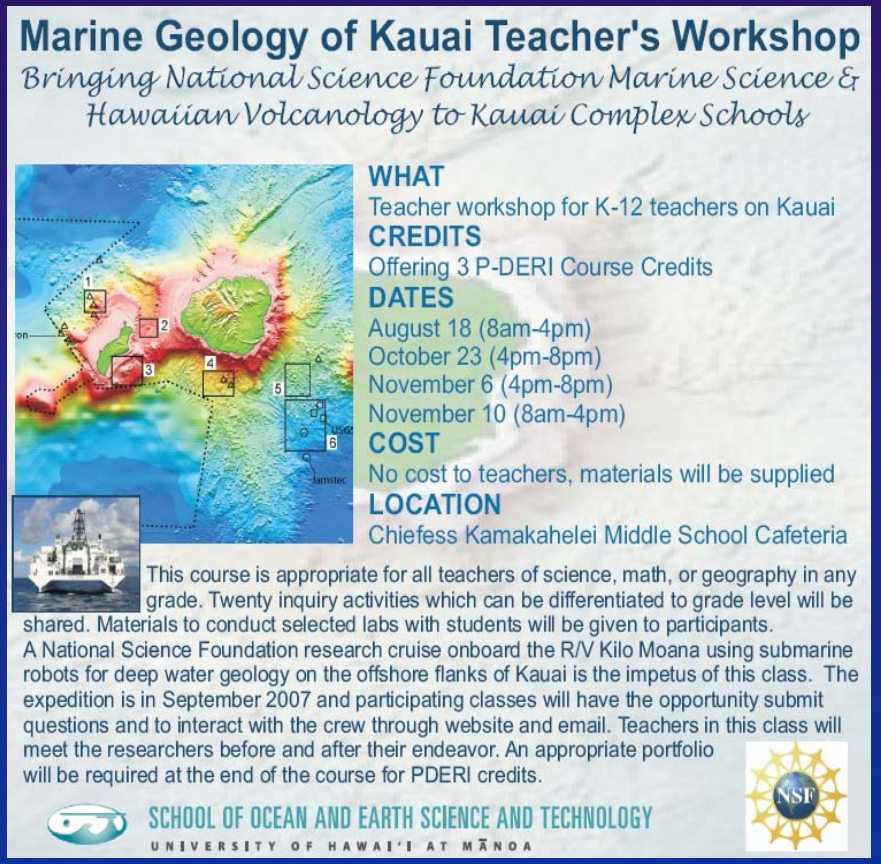
September 2007	Sun	Mon	Tue	Wed	Thu	Fri	Sat
							1
	2	3	4	5	6	7	8
	9	10	11	12	13	14	15
	16	17	18	19	20	21	22
	23	24	25	26	27	28	29
	30						

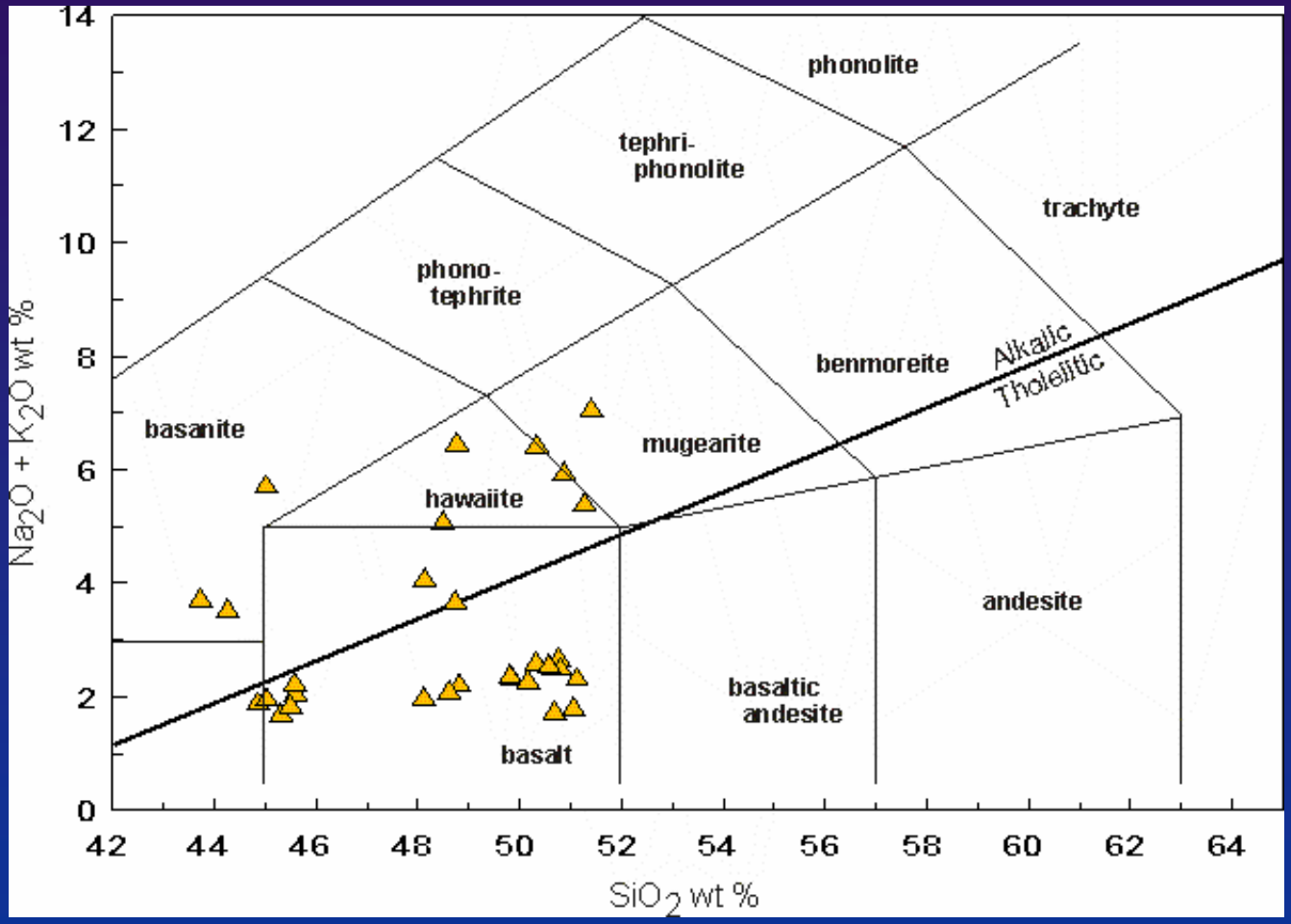
October 2007	Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5	6
	7	8	9	10	11	12	13
	14	15	16	17	18	19	20
	21	22	23	24	25	26	27
	28	29	30	31			

Mahalo For Participating !

Hawaii needs continually improving science education to meet future challenges:

Science is about CURIOSITY: a keen eye for questions & a passion for answering them

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Alkalic
Tholeiitic
basanite
mugearite
hawaiite
andesite
basaltic
andesite
basalt
$Na_2O + K_2O$ wt %
SiO_2 wt %
0
2
4
6
8
10
12
14
42
44
46
48
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56
58
60
62
64