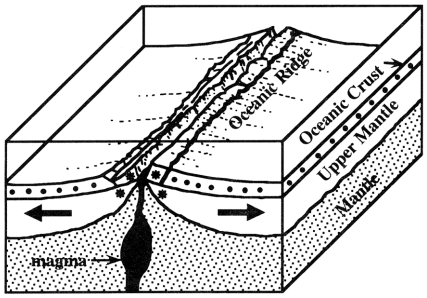
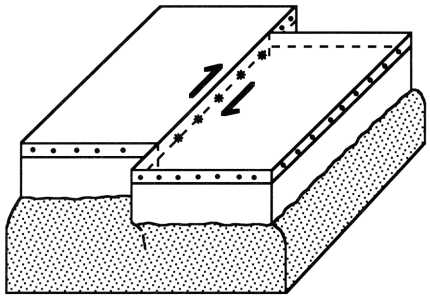
Lab 10 - Plate Tectonic Boundaries

Name _____ Section _____

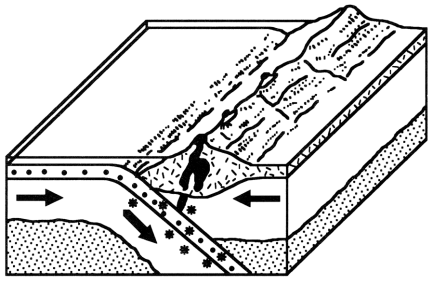
This lab will explore three types of plate tectonic boundaries illustrated below. The exercises for each type of boundary are designed to give you some insight on such concepts as: rates of plate movement and origins of tectonic features.



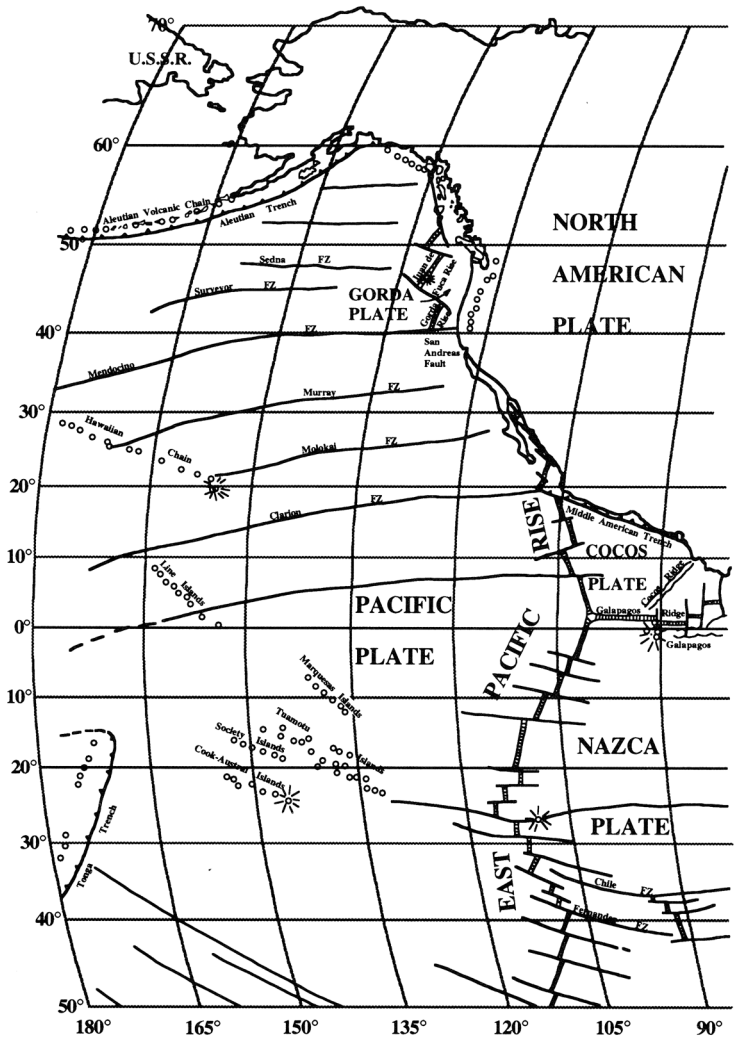
Mid-oceanic ridge divergent plate boundary.



Transform plate tectonic boundary.

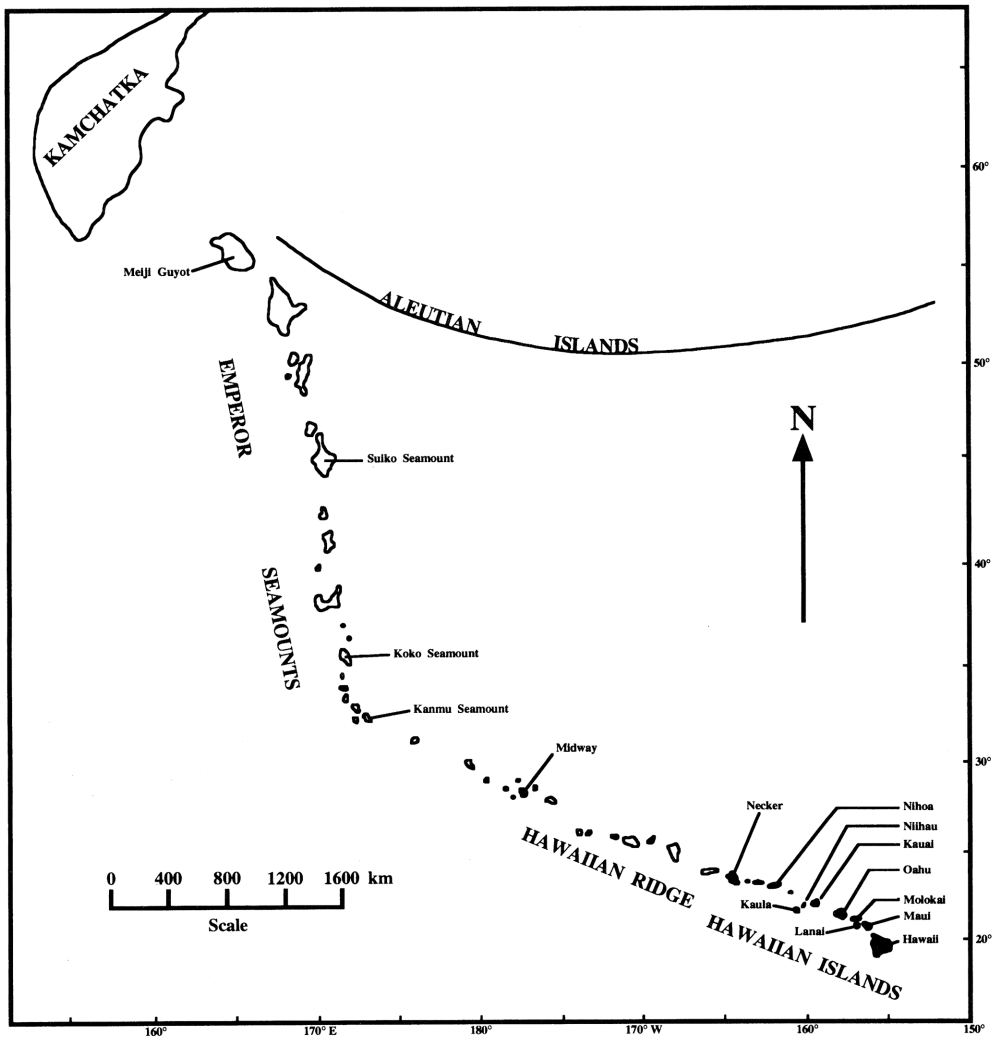


Subduction at an ocean to continent convergent plate boundary.



A portion of the Pacific Plate showing tectonic features that will be described in the lab.

Part 1 - Hawaiian Hot Spot

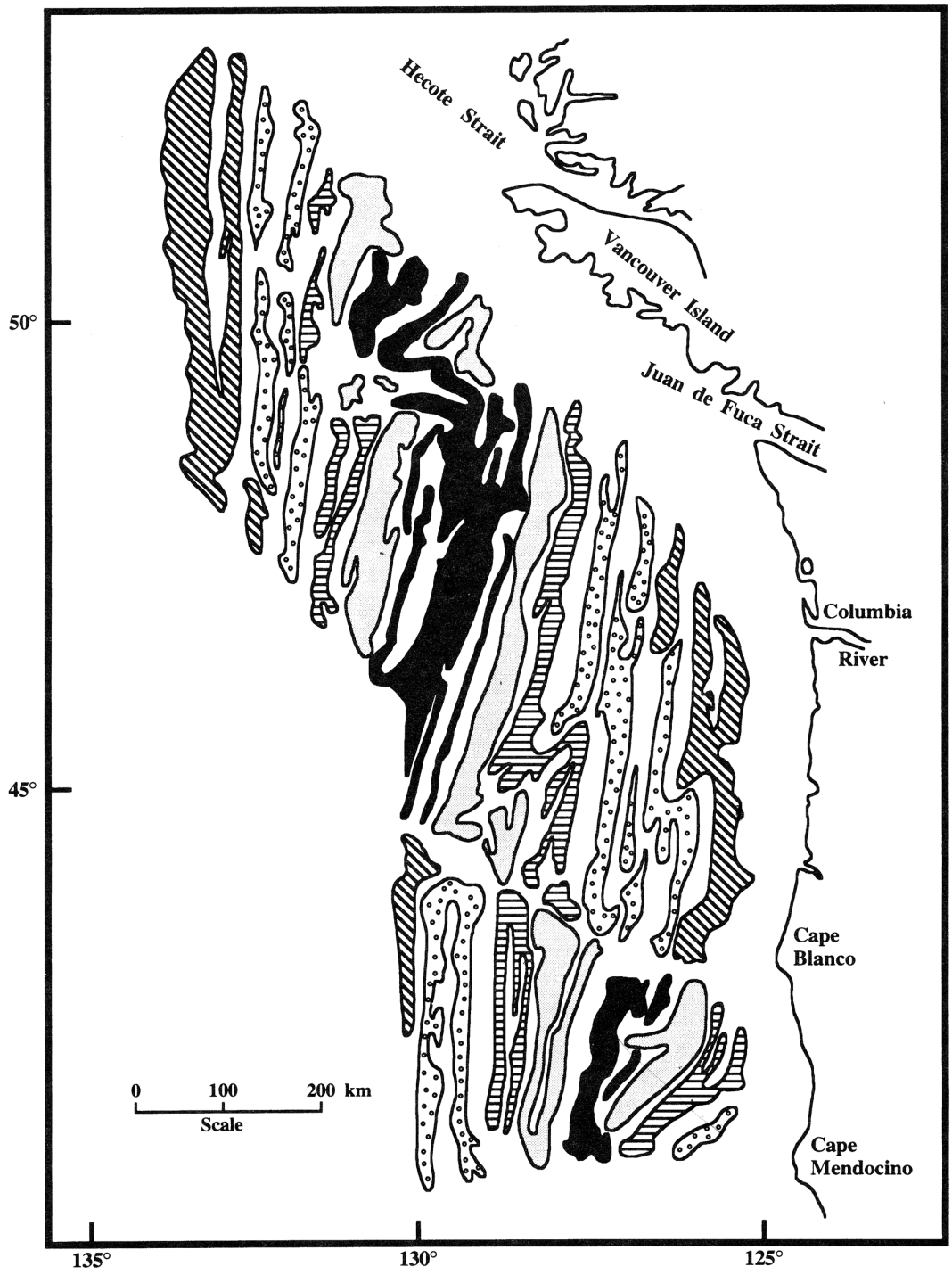


Bend in the trend of Hawaiian Island-Emperor Seamount Chain, probably caused by a change in the direction of movement of the Pacific Plate.

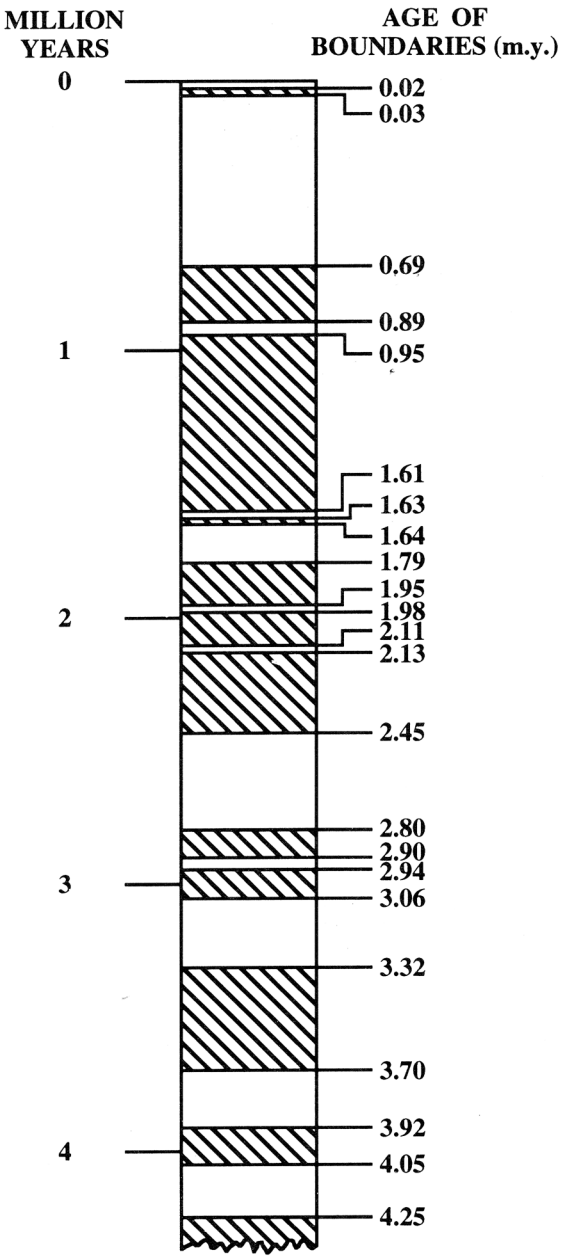
LOCATION AND AGE OF ISLANDS IN THE HAWAII-EMPEROR VOLCANIC CHAIN

Island/ Seamount	*Distance from Hawaii Island along the chain*	*Age in million years*	*Island/ Seamount*	*Distance from Hawaii Island along the chain*	*Age in million years*
1. Hawaii	0 km	0 (active)	8. Necker	1,200 km	9.5
2. Maui	200	0.84	9. Midway	2,800	17.9
3. Molokai	320	1.48	10. Kanmu	4,000	37.5
4. Ohau	400	2.55	11. Koko	4,480	45.9
5. Kauai	600	5.6	12. Suiko	6,000	41.8
6. Niihau	680	3.0	13. Meiji	7,400	67.0
7. Nihoa	920	3.0			

Part 2 - Paleomagnetism at a Mid-Oceanic Ridge

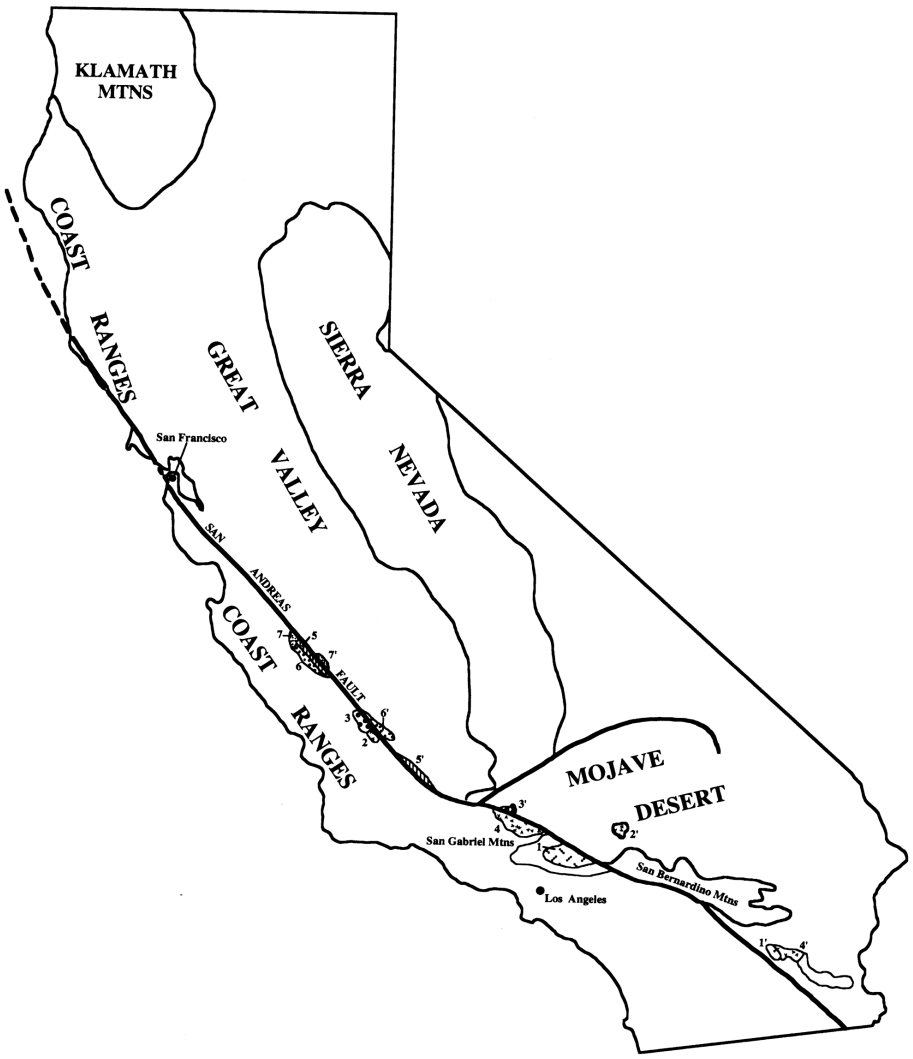


Magnetic patterns (simplified) in rocks of the Juan de Fuca Ridge and vicinity. Rocks that are black or patterned formed when the earth's magnetic field was oriented the same as today. Rocks that correlate on each side of the ridge have the same patterns. (Modified from Raff and Mason, "Magnetic Survey off the West Coast of North America, 40°N Latitude to 52°N Latitude," *Geol. Soc. America Bull.*, 1961, p. 1267-1270.)



Simplified paleomagnetic reversal time scale showing intervals of normal (unshaded) and reversed (shaded) magnetic fields.

Part 3 - Offset Along a Transform Plate Boundary

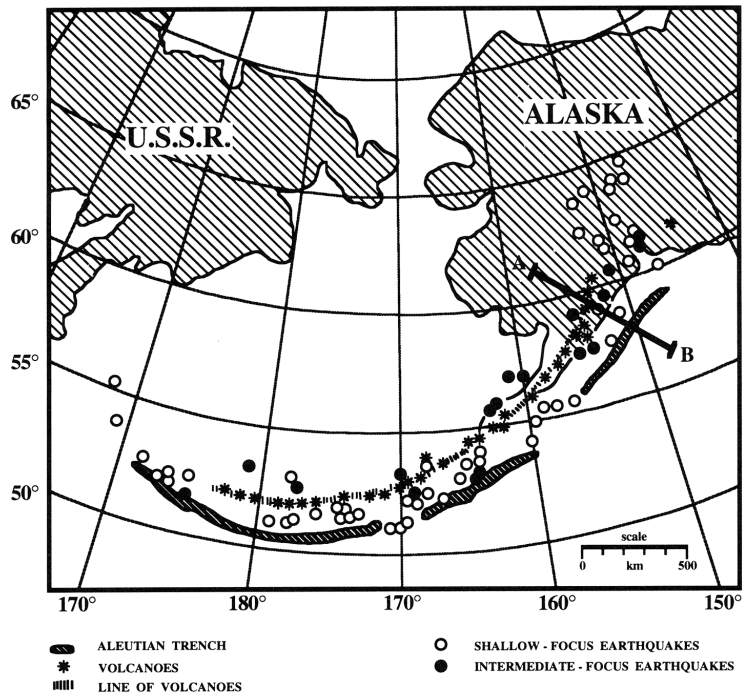


An outline map of California showing displacement of selected geologic units by the San Andreas fault.

AGES OF SOME GEOLOGIC UNITS AND THEIR OFFSETS ALONG THE SAN ANDREAS FAULTS

Rock unit	*Age (million years)*	*Offset shown in Fig. X-6*	*Measured offset distance (km)*
1. Precambrian Anorthosite	1450	1 - 1'	300
2. Triassic Volcanic Rocks	225	2 - 2'	300
3. Eocene Conglomerate	25	3 - 3'	300
4. Miocene Volcanic Rocks	5	4 - 4'	300
5. Mio-Pliocene Sed. Rocks	4	5 - 5'	240
6. Pliocene Sed. Rocks	3	6 - 6'	180
7. Pleistocene Sed. Rocks	1	7 - 7'	60

Part 4 - Subduction Boundary at the Aleutian Trench



Distribution of volcanoes and earthquake foci associated with the Aleutian Trench. (Modified from Hugo Benioff, 1954, "Orogenesis and deep crustal structure: Additional evidence from seismology," *Geol. Soc. Am. Bull.*, v. 65, p. 385-400.)

APPROXIMATE FOCAL DEPTHS OF EARTHQUAKES ASSOCIATED WITH THE ALEUTIAN TRENCH

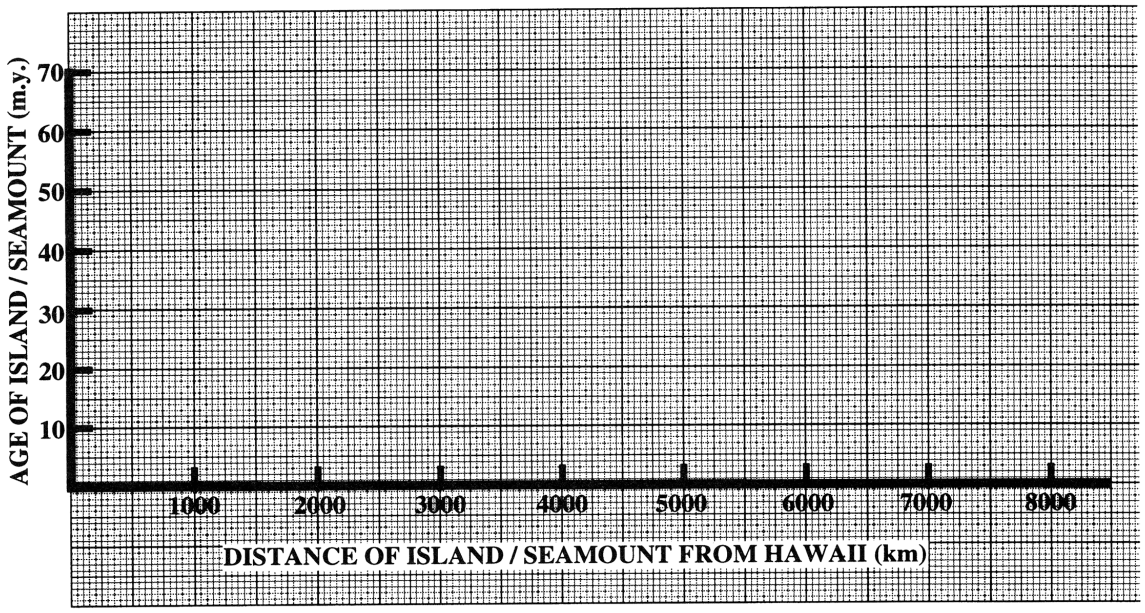
Focal depth of earthquakes (km)	*Distance from the trench (km)*
29	50
35	70
47	70
48	84
54	95
56	97
60	94
61	105
85	150
95	166
107	219
120	207
137	249
162	277
175	303

Lab 9 - Plate Tectonic Boundaries - Homework

Name _____ Section _____

Part 1 - Hawaiian Hot Spot

For better visualization of the Pacific plate motion, plot the age of each volcanic island /seamount versus its distance from Hawaii. Use a scale of 1 cm = 400 km.



1. Calculate the rate of movement of the Pacific Plate (in millimeters per year) between the island of Hawaii and the Kanmu Seamount. Please show all of your work.

2. Calculate the rate of movement of the Pacific Plate (in millimeters per year) between the the Kanmu Seamount and the Meiji Guyot. Please show all of your work.

3. Indicate with large arrows on the map on page 3 the direction of movement of the Pacific Plate both above and below the 'bend'.

Part 2 - Paleomagnetism at a Mid-Oceanic Ridge

4. Using the Mid-Oceanic Rigde Map on page 4 and the Paleomagnetic Time Scale on Page 5, calculate the rate of sea floor spreading for the northern portion of the map on page 4 (in millimeters per year). Please show all of your work.

5. Using the Mid-Oceanic Rigde Map on page 4 and the Paleomagnetic Time Scale on Page 5, calculate the rate of sea floor spreading for the southern portion of the map on page 4 (in millimeters per year). Please show all of your work.

Part 3 - Offset Along a Transform Plate Boundary

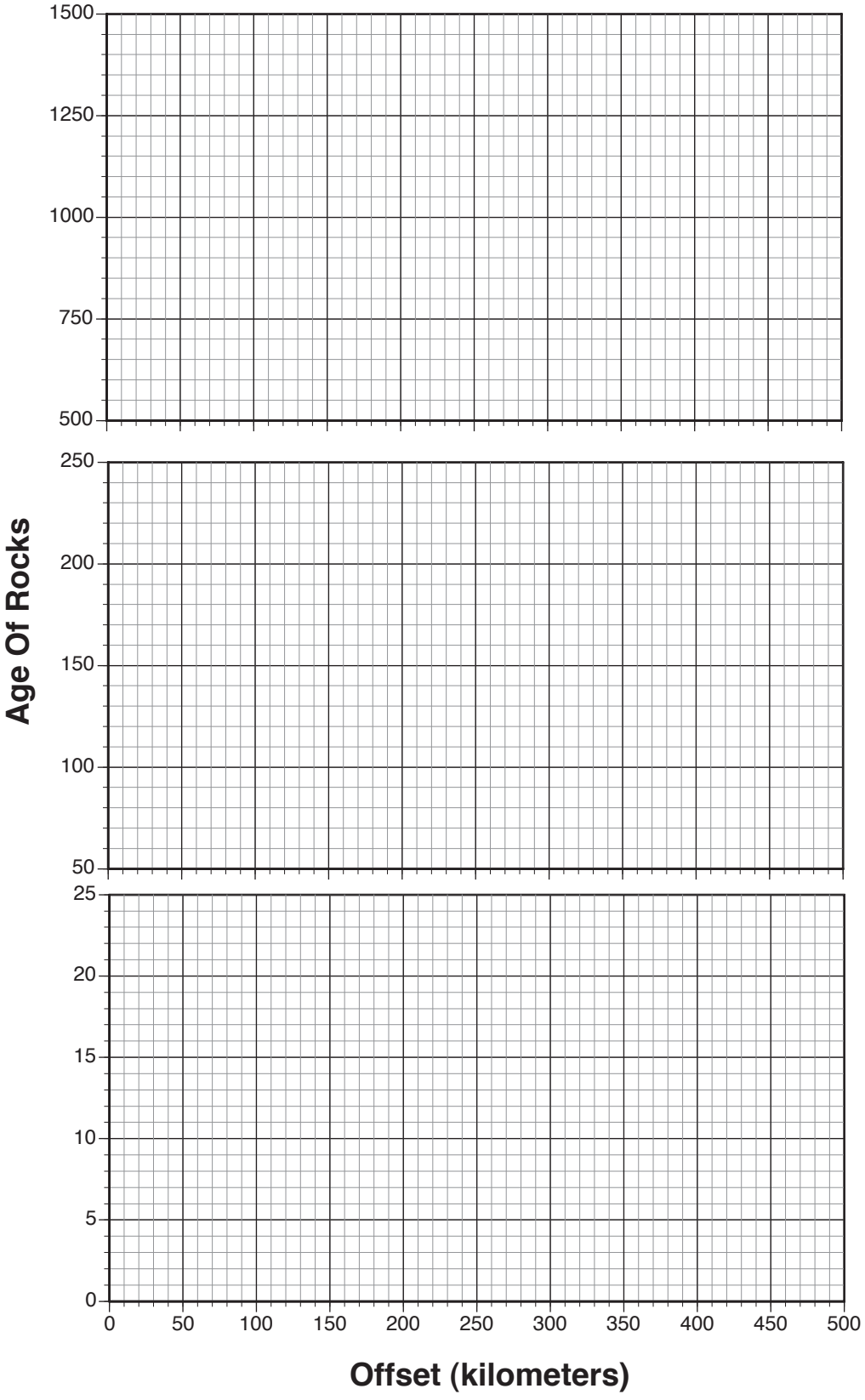
6. From the table on page 6 plot the offset distance verses the rock age on the graph on page 10.

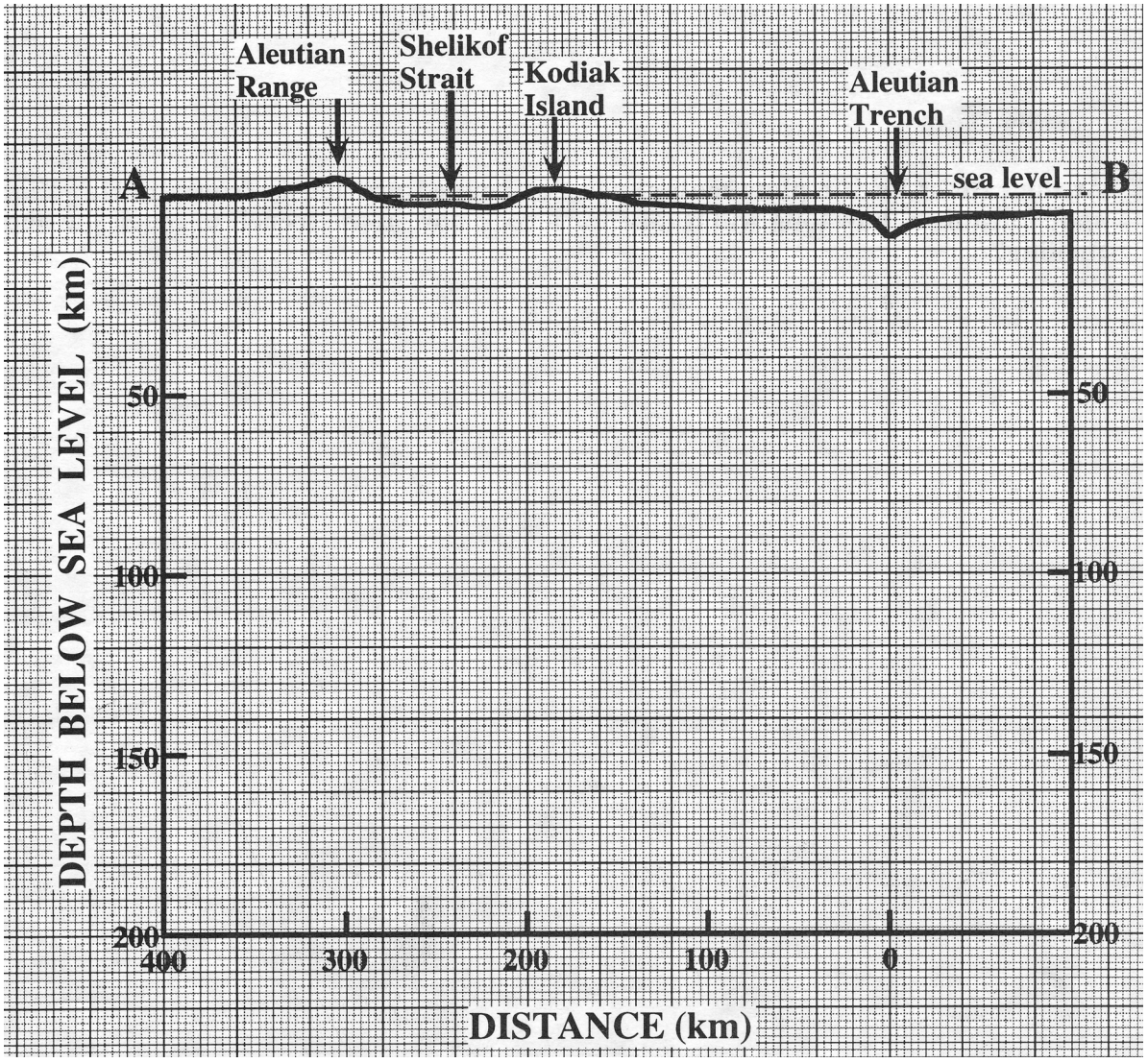
7. From the plot you just made, indicate the age of the San Andres Fault and explain how you determined this age.

Part 4 - Subduction Boundary at the Aleutian Trench

8. Using the information supplied in the table on page 7, plot the distance from the trench vs.the earthquake focal depth on the graph on page 11.

9. Can you determine a rate of subduction that is taking place along the Aleutian trench? Why or why not?


1500
1250
1000
750
500
250
200
150
100
50
25
20
15
10
5
0
Age Of Rocks
0
50
100
150
200
250
300
350
400
450
500
Offset (kilometers)


Aleutian Range
Shelikof Strait
Kodiak Island
Aleutian Trench
sea level
A
B
DEPTH BELOW SEA LEVEL (km)
50
100
150
200
400
300
200
100
0
DISTANCE (km)