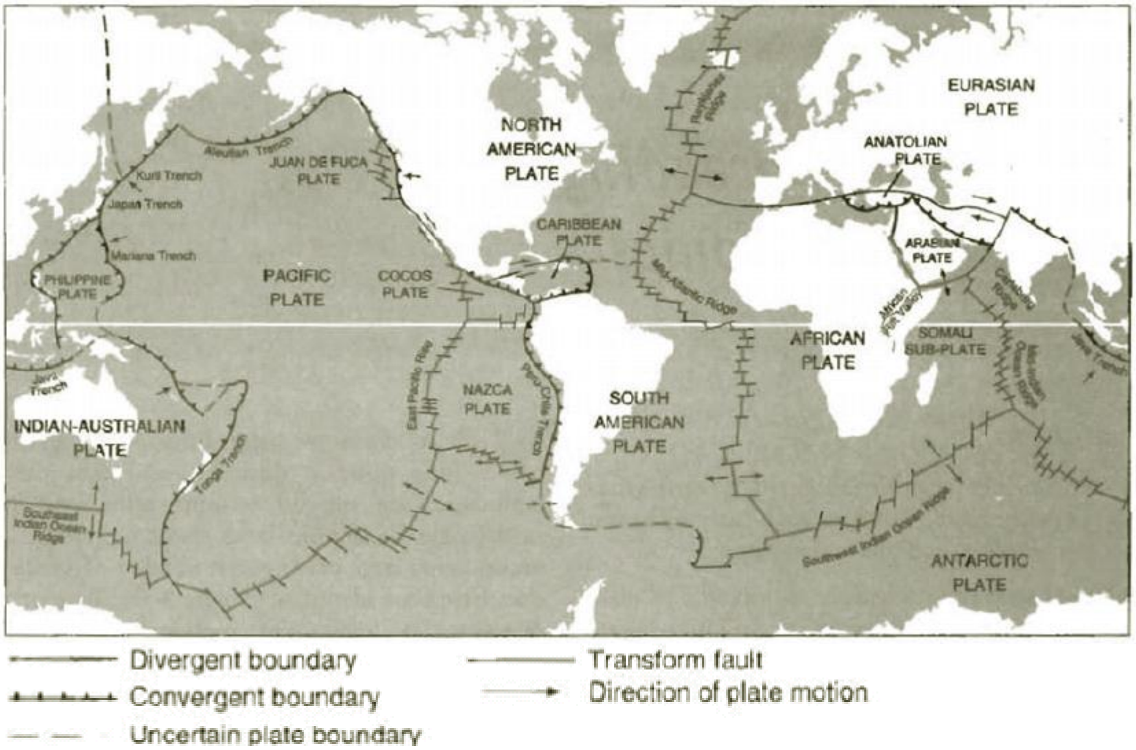
Name____



Part I Plate Boundaries

1. On the above map of Earth's lithospheric plates, a convergent boundary means
   a) plates move toward each other
   b) plates move away from each other
   c) plates slide past each other.

An oceanic convergent plate boundary is associated with what prominent geographic feature? ______________________________

List the names of 4 of these features at ΔΔΔΔ in the Pacific Ocean.

a.__________________________________ b._____________________________

c.__________________________________ d._____________________________

The saw-toothed symbol parallels the west coast of South America and the Andes Mountain Range. Describe what happens to the eastern edge of the Nazca Plate as it approaches the South American Plate.

____

____

____

A continental margin with an offshore subduction zone/trench is called a (circle)

Passive Margin **Active Margin**

2. Note the east margin of the North American Plate and the South American Plate. Where are their eastern margins located?
_______________________________________. Where are the western margins of the African and Eurasian Plate boundary?

____.

The Mid -Atlantic Ridge is called a *Divergent Plate Boundary*. *Why?*

3a. With respect to lithospheric plates, how does the Atlantic Ocean differ from the Pacific Ocean?

____

____

3b. With respect to continental margins, how is the Atlantic Ocean distinct from the Pacific Ocean?

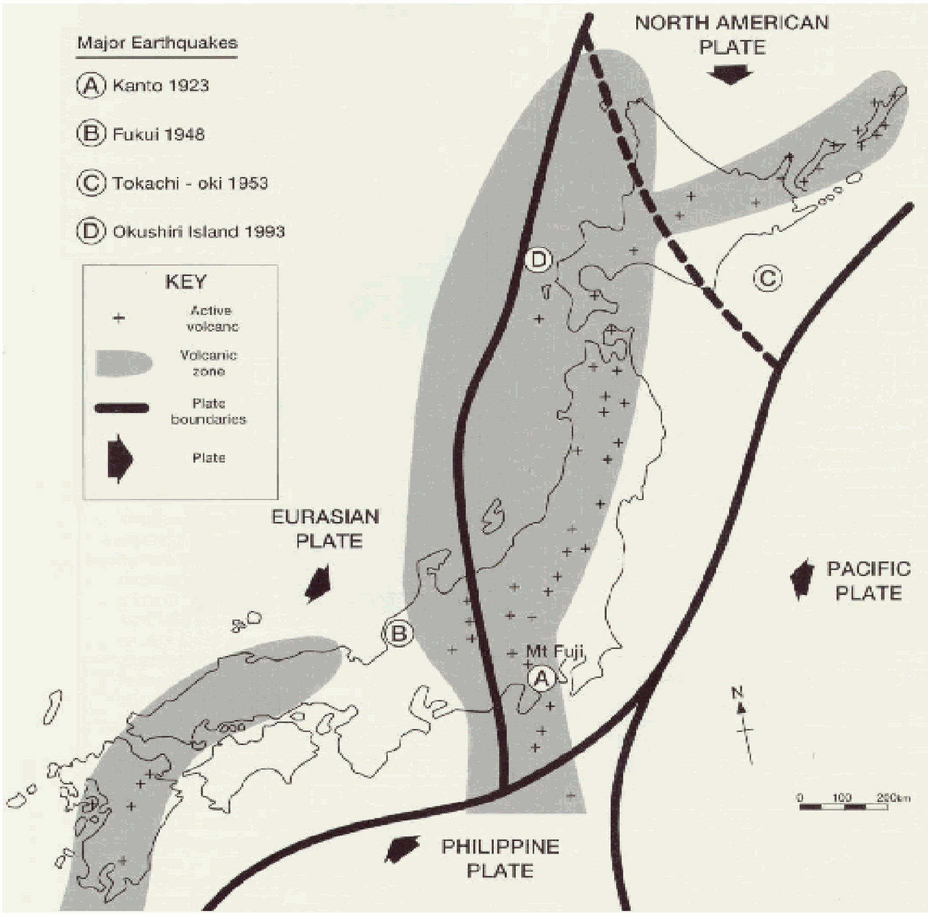
____

____

____

❋ Hint: What is the difference between a passive and an active continental margin? See profiles Lab I

4a. Japan is an island arc produced by the subduction of the _________________plate into the Japan Trench. Draw sawteeth along the Japan Trench, teeth point landward.



4b. List the 4 lithospheric plates of Japan's complex tectonic geography

1_________________________ 2 _________________________________

3_________________________ 4_________________________________

4c. What geologic hazard(s) are associated with these convergent boundaries?

5a. What is the name of the subduction zone/trench closest to Miami, Florida.

____ What two plates converge here?

____

6. Name the type of plate boundary (**divergent, convergent, transform**) between the Pacific Plate and North American Plate at the following locations:

Southern California____

Northern California-Oregon-Washington____________________________________

Aleutian Islands Alaska____

Part II. Seafloor Spreading

Your instructor has lithospheric plate/divergent boundary models. Working in groups of three or more, assemble a model so that Plate A (continental lithosphere) and Plate B (continental lithosphere) are joined as one continent—this configuration is the *15 million years ago when there was one continent* position. (Seafloor tabs will be fully inserted trailing out the underside).

You have a single continent made up of two plates. You are now ready to watch divergence in action. Fifteen million years ago the continent began to rift.

One person should hold the model base horizontally at the two ends where it says “hold here”. A second person should pull Plate A and Plate B horizontally away from each other, keeping them about the same level as the model base. The numbers on the plates are the age of the rocks.

a. Starting at 15 Myr ago, pull the plates apart until you reach the configuration for 13 Myr ago. The age of the rocks is marked in millions of years on the oceanic crust.

b. In your model, how many continents were present 13 Myr ago? ________________________

How many plates were there? ____

Remember that one continent can be made up of more than one plate and that one plate can have both continental and oceanic parts.

c. At each time step in the table below as you proceed spreading your model, fill in a description of the land masses and oceans from the following list
- Two continents with a narrow land bridge
- One continent with narrow sea inlets and a land-locked basin
- Two continents separated by an ocean
- Two continents separated by a narrow ocean
- One continent with no seas

Time (Myr ago)	Description of Model
15	
13	
10	
0	

Land organisms can migrate from one continent to another as long as there is some sort of connection or land bridge between the continents.

d) On your model of diverging continents, when did species of organisms roaming the continent become isolated into two separate populations? ______________________________________

2) Use the age of the rocks on your model (the numbers) and the map scale on Plate A to determine how fast Plate A was moving relative to Plate B in kilometers/million years or millimeters/year[1]. This number is your full spreading rate. Show your calculations.

Hint: Measure the distance from 0 to 15 in centimeters; multiply by 2 for the full spreading rate (i.e. the measurement from 15 to 15 when the model is open all the way to 0). Then convert centimeters on the map to kilometers on the ground using the conversion factor 1 cm = 50 km, measured off the map scale (i.e. multiply centimeters by 50).

Full spreading rate_______________________________________ (show calculations below)

3) Next calculate how fast Plate A or Plate B was moving relative to the spreading center in km/Myr or mm/yr. This number is the half spreading rate. Show your calculations.

Rate of Plate A (or B): ____

4) The slowest half spreading rates are about 20 mm/yr and the fastest ones are about 120 mm/yr. Was your spreading rate reasonable (i.e., did it fall within this range)?

YES / NO

5) Study the relationship between the age of the rocks and their distance from the spreading center. What general pattern do you see?

____

____

____

____

____

[1] Note that kilometers/million years (km/Myr) = millimeters/year (mm/yr) since there are 1,000,000 mm in a km

6) Note the African Rift Valley. (page 1) This is understood to be a young spreading center. How will the geography of Africa have altered 15 million years from the present?

____

____

____

7) Locate Madagascar on the map. Within the context of a discussion of seafloor spreading and continental drift what might you suggest about Madagascar's tectonic history?

____

____

Part III Rocks forming Continental Crust & Rocks forming Oceanic Crust

Examine the oceanic and continental crustal samples with special attention to their volume and mass. Note the sample number and rock name. Use the balance to measure the mass of one sample of each type of crust and include that information in the table below. Make sure the units are in grams (g). Measure the volume as follows: 1) add enough water in a beaker to cover the rock (be precise and note the water level), 2) place a rock in the beaker and read off the water level, 3) the difference between the two water levels is the volume of rock (1 ml water = 1 cm^3). Each student should measure a different pair of rocks. Calculate the density for each sample and enter that information also in the table below.

1)

Hint: Density is mass divided by volume.

Type of crust	**Sample Number**	**Rock name**	**Mass (g)**	**Volume (cm^3)**	**Density (g/cm^3)**
Oceanic					
Continental					

2) The density of oceanic rocks is higher or lower than that of continental rocks? (circle)

Higher Density Lower Density

Continued →

Part IV Locating Features of Earth's Oceans

Use the map on page 1 of this lab and the map your instructor will provide for in-lab use. A copy of the classroom map is included for you on last two pages of this lab.

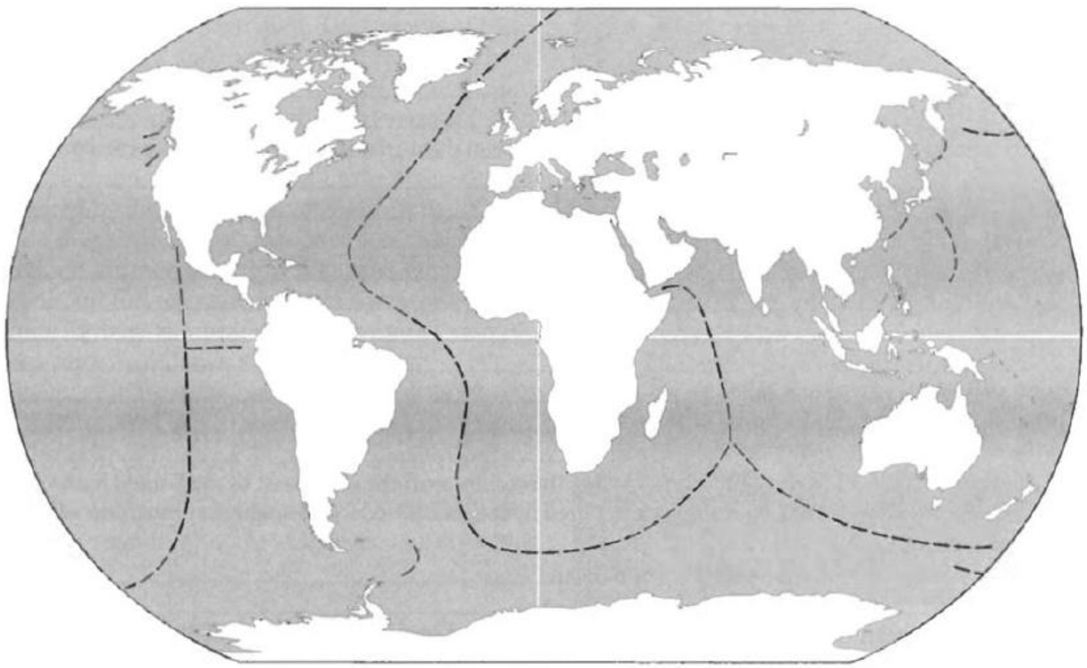


Figure 8: Worksheet for location of geographic features of the sea floor. The mid-ocean ridge system is indicated by the dashed lines.

Pacific Ocean		Atlantic Ocean		Indian Ocean	
P1	East Pacific Rise	A1	Argentine Abyssal Plain	I1	Carlsberg Ridge
P2	Mendocino Fracture Zone	A2	Mid -Atlantic Ridge	I2	Seychelles Islands
P3	Galapagos Islands	A3	Bermuda Rise	I3	Arabian Sea
P4	Mariana Trench	A4	Walvis Ridge	I4	Kerguelen Island
P5	Peru-Chili Trench	A5	Puerto Rico Trench	I5	Madagascar
P6	Sea of Okhotsk	A6	Scotia Sea or Ridge	I6	Red Sea
P7	Bering Sea	A7	Falkland Islands	I7	Persian Gulf
P8	Kermadec-Tonga Trench	A8	Iceland	I8	Ninety East Ridge (90º E Ridge)
P9	Emperor Sea Mount Chain	A9	Canary Islands	I9	Java Trench
P10	Island of Hawaii	A10	Labrador Sea		
P11	Aleutian Trench				
P12	Nazca Plate				
P13	Juan de Fuca Plate				
P14	Great Barrier Reef				

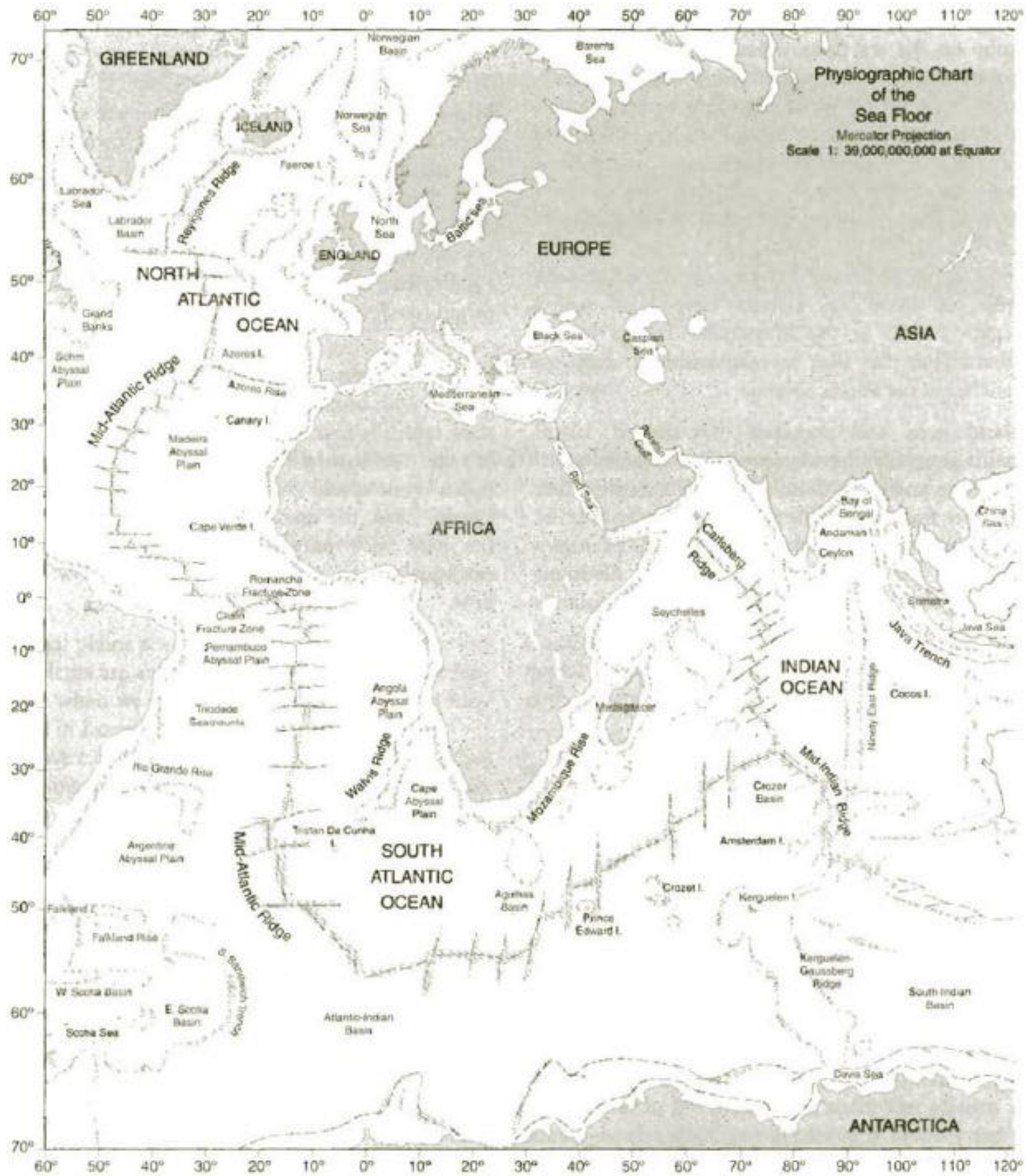
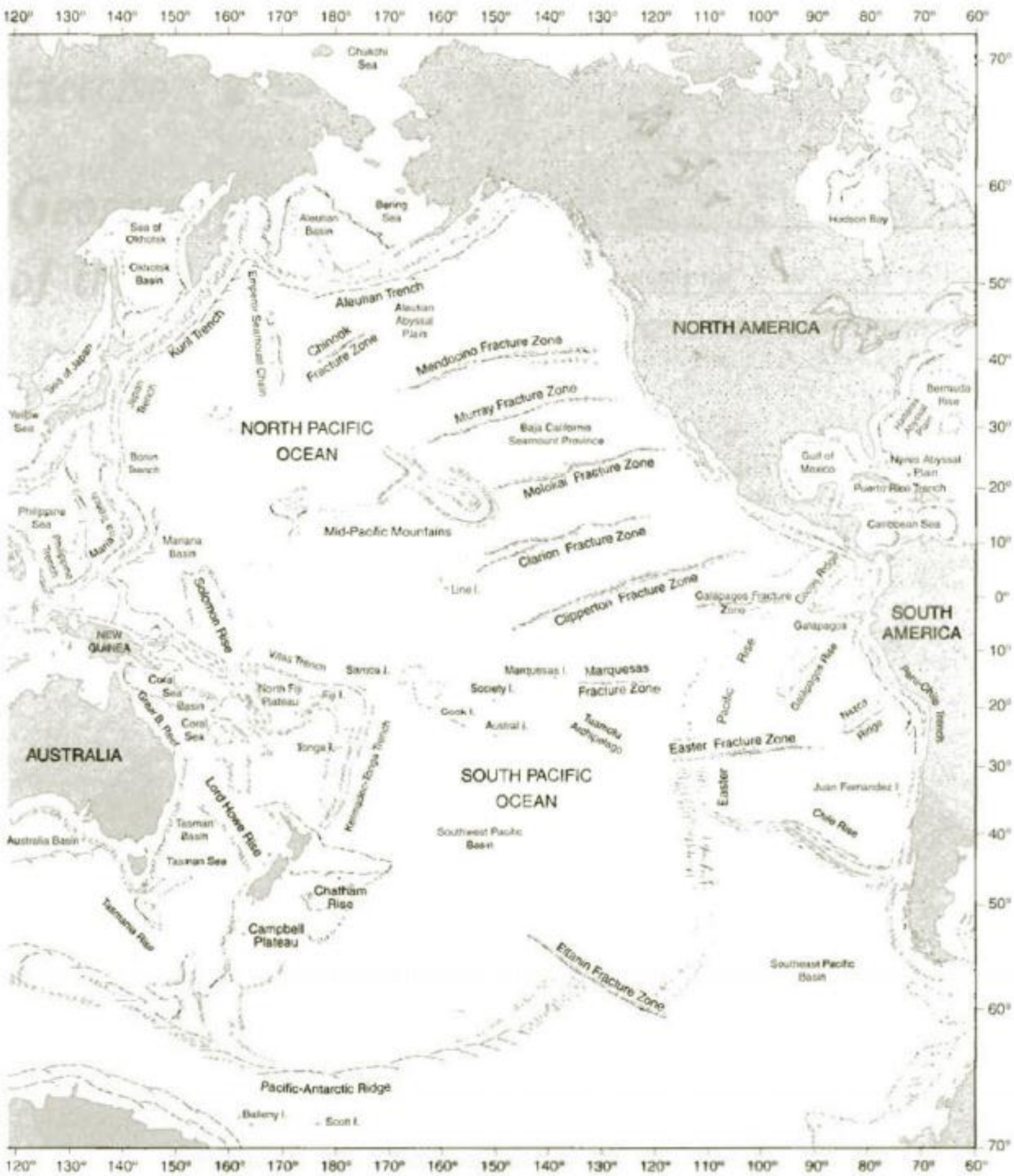


Figure 9: The ocean basins and their major features (also on next page).



NORTH AMERICA
NORTH PACIFIC
OCEAN
SOUTH PACIFIC
OCEAN
SOUTH
AMERICA
AUSTRALIA
NEW
GUINEA
Chukchi
Sea
Bering
Sea
Aleutian
Basin
Sea of
Okhotsk
Okhotsk
Basin
Aleutian Trench
Aleutian
Abyssal
Plain
Kuril Trench
Sea of Japan
Emperor Seamount Chain
Chinook
Fracture Zone
Mendocino Fracture Zone
Murray Fracture Zone
Baja California
Seamount Province
Molokai Fracture Zone
Clarion Fracture Zone
Clipperton Fracture Zone
Mid-Pacific Mountains
Line I.
Mariana
Basin
Philippine
Sea
Japan
Trench
Bonin
Trench
Solomon Rise
Hudson Bay
Gulf of
Mexico
Puerto Rico Trench
Caribbean Sea
Bermuda
Rise
Nares Abyssal
Plain
Galapagos Fracture
Zone
Galapagos
Galapagos Rise
Nazca
Ridge
Peru-Chile Trench
Samoa I.
North Fiji
Plateau
Fiji I.
Tonga I.
Kermadec-Tonga Trench
Coral
Sea
Coral
Sea
Basin
Great B. Reef
Marquesas I.
Marquesas
Fracture Zone
Society I.
Cook I.
Austral I.
Tuamotu
Archipelago
Easter Fracture Zone
Pacific
Rise
Easter
Juan Fernandez I.
Chile Rise
Lord Howe Rise
Tasman
Basin
Tasman Sea
Australia Basin
Chatham
Rise
Campbell
Plateau
Southwest Pacific
Basin
Eltanin Fracture Zone
Southeast Pacific
Basin
Pacific-Antarctic Ridge
Balleny I.
Scott I.
120° 130° 140° 150° 160° 170° 180° 170° 160° 150° 140° 130° 120° 110° 100° 90° 80° 70° 60°
70° 60° 50° 40° 30° 20° 10° 0° 10° 20° 30° 40° 50° 60° 70°