

Interpreting Tectonic and Bathymetric Maps.

The purpose of this lab is to provide experience interpreting the bathymetry of the seafloor in terms of tectonic and geologic settings and processes. Use the maps of the seafloor provided by the instructor. Because these seafloor maps show only bathymetry and topography, you may need to consult some of the other maps around the room to find place and plate names.

Atlantic Ocean

1. Name at least one place that the mid-Atlantic Ridge is exposed above sea level.
2. In addition to the deep, broad abyssal plain northeast of the Falkland Islands, where are the deepest areas of the Atlantic Ocean? What is the tectonic setting of these places? Be careful, on the most detailed bathymetric map (titled “Measured and Estimated Seafloor Topography”), deep bathymetry is shown by a purple color, not a blue color.
3. Is the east coast of South America at a plate boundary or in the middle of a plate? How do you know? Figure this out by looking at the detailed bathymetric map, not by looking at a map that shows the plate boundaries.
4. How does the shape of the Mid-Atlantic Ridge relate to the shape of the continental margins on either side? Why do you think this relationship in shape exists?
5. Are the Falkland Islands (just east of South America) part of the South American Plate? Why or why not? Don't look at a map that shows the plate boundaries.

Indian Ocean

1. India and Australia are both part of the Indo-Australian Plate. What features are found along the northeast boundary of the Indo-Australian Plate (concentrate on the portion northwest of Australia)? What kind of tectonic boundary is this?
2. Are the islands of Indonesia considered part of the Eurasian Plate or part of the Indo-Australian Plate? Why?

3. What features are found along the southwest boundary of the Indo-Australian Plate? What kind of tectonic boundary is this?

4. Based on your answers to 1-3 above, which direction is the Indo-Australian Plate moving? How did you come to this conclusion?

Pacific Ocean

1. What features do you find along the western boundaries of the Pacific Plate?

2. What features do you find along the southeastern boundary of the Pacific Plate?

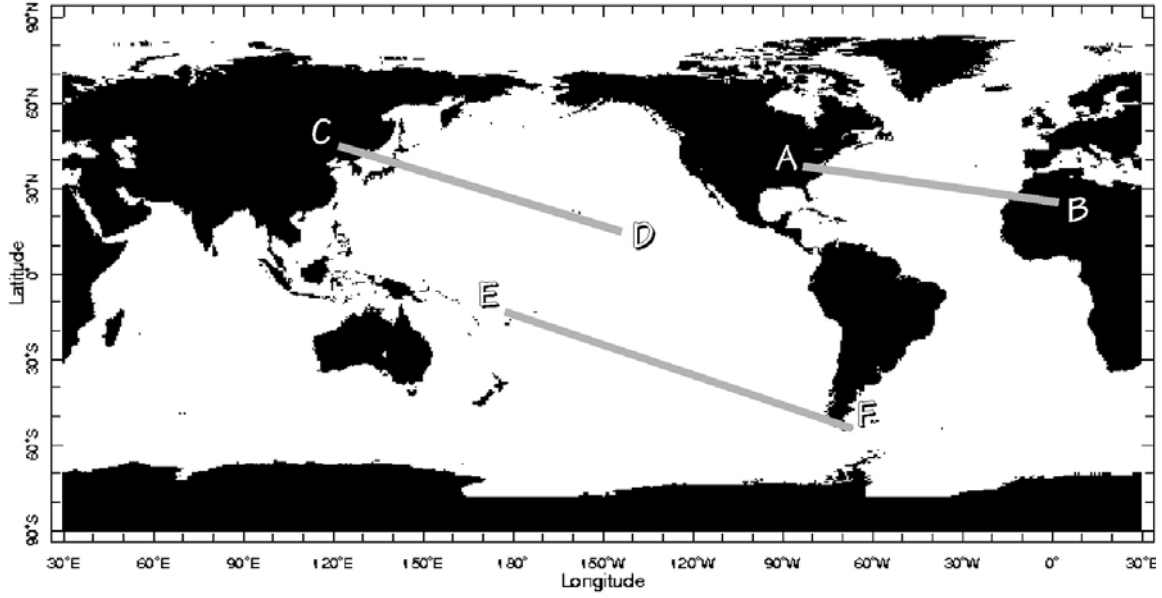
3. Based on the answers above, which way is the Pacific Plate moving? How did you come to this conclusion?

4. Notice the bend in the Hawaiian-Emperor Seamount Chain. How might this bend have formed? The age of the rocks right at the bend are 43 million years old.

5. Where in the Pacific Basin would you expect to find the oldest oceanic crust? Why?

6. Note that the Marshall Islands and the Louisville Ridge seem to connect with one another. What do you think happened to the “missing” islands?

7. Notice the chain of islands extending north from New Zealand. Why might you expect to find active volcanoes on these islands? What kind of volcanoes would you expect them to be?



Cross Sections

Use the bathymetric/topographic maps to draw cross-sections along the lines indicated in the map above. In your cross sections, be sure to include and label the following features if present:

- | | | | |
|---------------|---|------------------|--------------------|
| Lithosphere | Reasonably accurate topography and bathymetry | Hot spots | Convergent margins |
| Asthenosphere | Sea level | Trenches | Divergent margins |
| Crust | Sites of active volcanism | mid-ocean ridges | Transform margins |

Please note that cross-section C-D goes right through Hawaii.

A _____ B

C _____ D

E



F

ArcReader GIS questions

Basically, I want you to play around with the maps on the ArcReader computer program to better understand the relationship between seafloor bathymetry, earthquakes, and tectonics. The questions below are designed to get you exploring the maps a little bit. I encourage you to explore and play around on your own by zooming in and out of areas of interest turning the layers on and off to see the relationship between the plate boundaries, seafloor bathymetry and earthquakes.

The file is called TectLab.pmf. It is in a folder called Tectonics.

1. Turn on the Big_eq layer. This time, the earthquakes are color coded by the depth at which they occur. Go to the View>Bookmark>Tonga. This is a convergent margin. Is there any regularity or pattern by which the depth of the earthquakes occur? If so, what is it?
2. Go to the View>Bookmark>Andes. This is a convergent margin. Is there any regularity or pattern by which the depth of the earthquakes occur? If so, what is it?
3. Is there any similarity between the Andes and Tonga? What do you think causes this pattern?
4. Draw a cross section of a convergent margin and show where these earthquakes are occurring.
5. Zoom in on the western portion of North America and the eastern Pacific Basin. Which two plates are we closest to here in Monterey?
6. What kind of plate boundary separates these two plates here near Monterey?
7. Based on the evidence from the plate boundaries on this map, where would you predict is the closest place you could drive to see an explosive volcano?
8. Based on the evidence from the plate boundaries on this map, where would you predict is the closest place you could sail to see a non-explosive volcano?

Monterey Bay Area

These questions refer to the Monterey Bay National Marine Sanctuary map (MBNMS map) put out in 1999 by the Monterey Bay Sanctuary Foundation.

1. Find the San Andreas Fault (SAF).
 - a. In the northern part of the MBNMS map, which bay marks the course of the SAF?
 - b. As accurately as possible, draw the SAF on the image on the following page.
 - c. In the southern portion of the MBNMS map, which highway follows the SAF most closely?
 - d. How can one recognize the location of the SAF on the MBNMS map? In other words, what kinds of features are most common in the vicinity of the fault?
 - e. What kind of fault is the SAF?

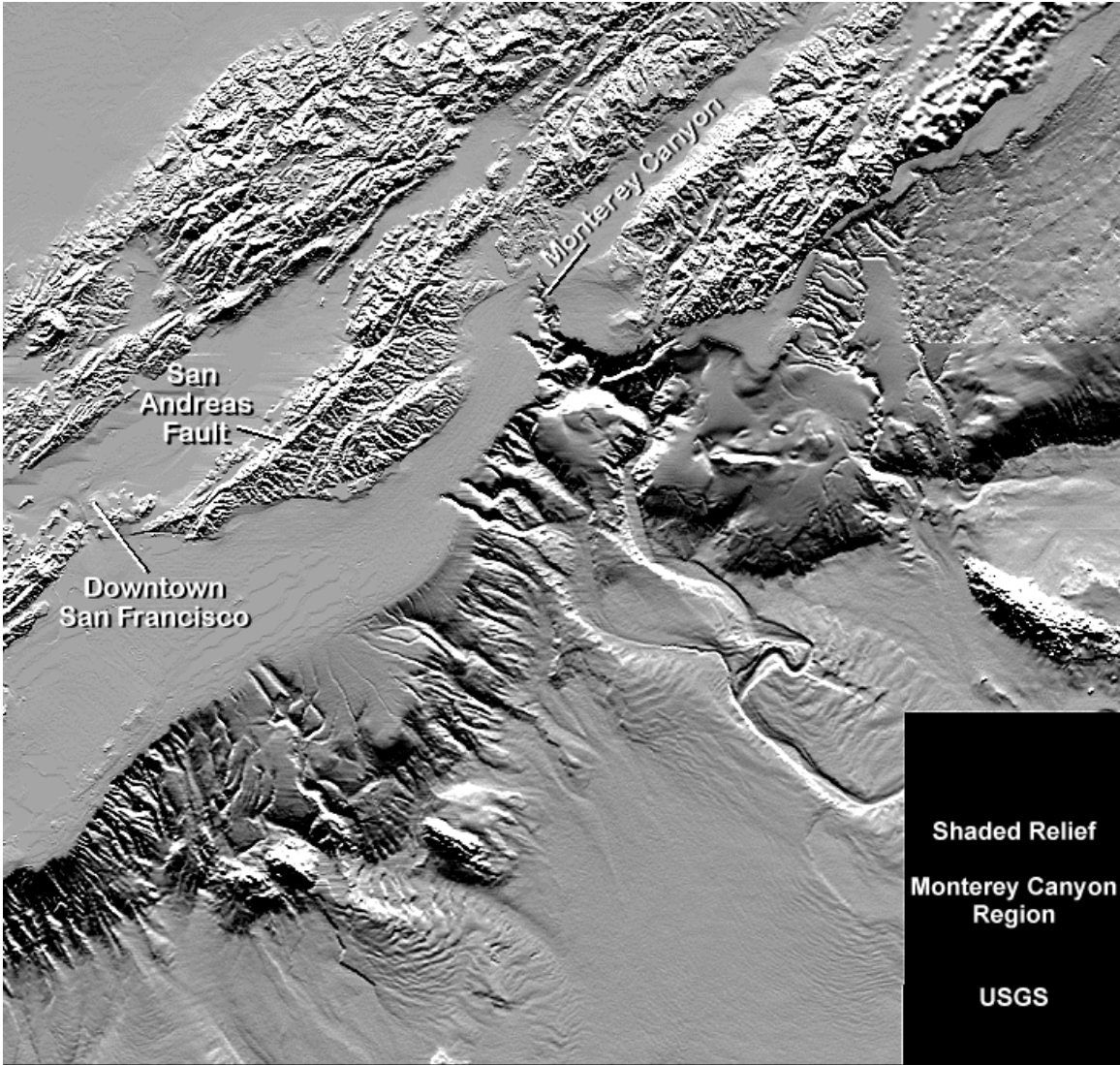
2. Note the light blue lines labeled with numbers in the offshore portion of the MBNMS map. These lines are called *contours* and represent depth. In what unit is the depth recorded on this map? The *contour interval* is the vertical distance between contour lines. What is the contour interval on the MBNMS map? ...close to shore?and far from shore?

3. The MBNMS map shows several seafloor features exceptionally well. These include examples of the continental shelf, continental slope, continental rise, submarine canyons, and seamounts. Please label examples of each of these on the image on the following page.

4. What sort of material comprises the feature called the Monterey Fan in the southwestern region of the MBNMS map?

5. How deep is the Monterey Canyon near the intersection with the Carmel Canyon, in meters? In feet? (3.28 feet = 1 meter.)

6. Have your instructor point out the San Gregorio Fault for you. What sea-floor features are associated with the San Gregorio Fault? Please draw the San Gregorio Fault on the image on the following page.



San
Andreas
Fault

Downtown
San Francisco

Monterey Canyon

Shaded Relief
Monterey Canyon
Region

USGS