

Investigating the continental margins of North America using GeoMapApp.

This exercise is designed to familiarize you with the features of continental margins. Through the analysis of color-coded bathymetric maps, bathymetric profiles, and readings about scientific investigations along the coast of North America, you will gain a better understanding of the processes responsible for the modern topography of the seafloor in the immediate surroundings of continental masses.

Introduction

After reviewing the classification of continental margins (*not* plate margins) in your textbook, answer the following questions:

1. What are continental margins?
2. How many types of continental margins (*not* plate margins) are discussed in the textbook and course notes?
3. In terms of topographic features, what is the difference between passive and active continental margins?

The Southern Coast of Alaska

- Launch GeoMapApp (www.geomapapp.org) and select the Mercator projection.
- Magnify the area between approximately (176°W, 62°N) and (132°W, 50°N). You should see the southern coast of Alaska.
- Construct three or four topographic profiles with starting points on land (or island) between 151 and 159°W longitude. You can choose the profile locations yourself, or you can use the points listed below. Important things to keep in mind:
 - start the profile on land (or island), close to the shoreline (you must see the 0 m elevation in the profile);
 - don't extend too far or not far enough from the coast (you want to show the features of the continental margins from the coast to the deep ocean floor);
 - create profiles perpendicular (90°) to the coastline (don't worry if the profiles aren't parallel); and
 - print or save each profile (not the map) before you move on to the next one.

Suggested starting points:

- 159.3°W, 56.3°N
- 157°W, 57.3°N
- 155°W, 58.3°N

4. Using the colors indicated below, mark the location of the features in the list that are present along the profile, then save your work for later submission. (**Note:** Not all of them are necessarily there.) Please mark above or below the profile line.

Continental shelfred
Shelf edgea purple dot
Continental slope.....yellow
Continental risegreen
Trenchblue

Ocean floororange

5. What type of continental margin is this? Justify your answer.

You will now add the location of earthquakes foci and active volcanoes to the map.

- Click on “Portals” on the menu at the top of the screen and select “Earthquake Locations, Epicenter Depths, and Magnitudes.” A series of colored dots will appear on the map. Notice the legend on the upper right corner of the screen.
 - Click on “Datasets” on the menu at the top of the screen and select “Volcanoes and Seamounts,” then “Location and Aster Satellite Images of Major Volcanoes.” A series of gray dots will appear on the map, marking the position of major volcanoes. You can change the dot color by going to the “Toolbox” (right side of the screen) and clicking on “Configure” and then “Symbol Color.”
6. Carefully observe the distribution of volcanoes, earthquake foci, and earthquake depths. Do these data support your classification of this continental margin? Justify your answer.

The East Coast

- Zoom out until you see the entire world map, then magnify the area between approximately 86°W, 43°N and 60°W, 32°N. You should see the East Coast in the central part of the map.
- Construct three or four topographic profiles with starting points on land. Stay in the area north of Cape Hatteras and south of Cape Cod. You can choose the profile locations yourself, or you can use the points listed below. Follow the instructions provided for the Alaskan margin. Make sure you extend your profile to the ocean floor (about 4,000 m water depth), or you won't see all of the important features.

Suggested starting points:

- 76°W, 37.3°N
- 74.5°W, 39.8°N
- 72°W, 41.6°N

7. Using the same colors indicated above, mark the location of the features in the list that are present along the profile, then save your work for later submission. (**Note:** Not all of them are necessarily there.) Please mark above or below the profile line.
8. What type of continental margin is this? Justify your answer.
9. Add the distribution of earthquakes and volcanoes to your map. Do these data support your classification of this continental margin? Justify your answer.

Continental margins can be characterized by the presence of numerous deep sea canyons that cut through the continental slope; some are particularly deep and long and encroach on the continental shelf. Several of these larger canyons are visible along the Atlantic continental margin of North America.

- Zoom into the area between approximately 77°W, 41°N and 67°W, 35°N and locate one area where two or more of these canyons are found next to each other. Enlarge this area and save or print the map. (**Note:** The southern part of the map seems to have better resolution when magnified, so you may want to look there first.)

- On the map, draw red lines parallel to the canyons' axes. Use the yellow line to identify one canyon that will be the subject of further investigation. Add the map to the other figures to be submitted.
- Magnify the canyon you selected at the previous point until it occupies most of the screen (Figure 1, see below).
- Make sure the GeoMapApp program doesn't occupy the entire screen; if it does, reduce the window size.
- Activate the grid command (Figure 2, see below) and two new windows will open. In the "Global Grids" window, set the vertical exaggeration to five and click on three-dimensional (Figure 3, see below).
- You can rotate the image vertically and horizontally using the commands on the lower left of the screen (Figure 4, see below). Do so to get a good idea of the canyon characteristics; when you have a good point of view, render the image.
- Save or print the image. Carefully observe the figure; on the continental rise, you should see a layer of sediments deposited around the main channel. Use a yellow line to mark the edges of this deposit.

10. What is the name of this feature, and what is its origin? Justify your answer.

The Floridian East Coast

Zoom out until you see the entire continent of North America, then magnify the area around Florida, between approximately 92°W, 35°N and 64°W, 22°N. Figure 5 (see below) shows the names of the main bathymetric features in this area.

11. Look at the continental shelf to the east of Florida. Where is the continental shelf widest? How wide? (Use the profile tool in GeoMapApp to estimate the width.)
 12. Where is the continental shelf narrowest? How narrow?
 13. Print the map and draw a yellow line marking the position of the shelf break. Mark the position of the Blake Escarpment with a green line, and circle the Blake Spur in blue.
- Draw a bathymetric profile from approximately 81.6°W, 28°N to 73°W, 30°N and save or print it.
14. On the profile, where are the shelf edge (break) and the Blake Plateau located? (Read the distance on the horizontal axis.)
 15. In your profile, what are the width and average depth of the Blake Plateau? What is the depth of the sea floor to the east of the plateau?
- Go to the U.S. Geological Survey's GLORIA Mapping Program. Scroll down and read about the oceanography of the Blake Plateau and Blake Escarpment.
16. What processes are responsible for the formation of the plateau?
 17. Name the current that scours the Blake Plateau, preventing sediment deposition. Where does it originate? Is it a warm or cold water current? (You will have to search the web to answer the second part of this question; start at <http://oceancurrents.rsmas.miami.edu/atlantic/antilles.html>).

18. Along the Blake Escarpment, where is the steepest region located and what process is responsible for the presence of this cliff?
19. In the southern part of the Blake Plateau, immediately north of the Bahamas Islands, there is a series of canyons. What is their origin?
20. Which of the following processes is ultimately responsible for the formation of the Blake Escarpment?
21. Geologic evidence indicates that until about 100 million years ago the Blake Plateau was a shallow water area. What process most likely moved the plateau to its modern depth?

The Gulf Coast

- Go back to GeoMapApp and zoom out until you can see the Gulf of Mexico.
 - Zoom into the area between 99°W, 30°N and 86°W, 24°N. The seafloor in the northern part of the map is marked by the presence of numerous crater-like depressions that give it a lunar-like appearance.
 - Construct a series of two or more bathymetric profiles from the land to the deeper part of the Gulf, perpendicular to the shoreline.
22. Save or print the profiles, and mark the area where the depressions are found.
 23. Based on the profiles, on what part of the continental margin are the depressions located (shelf, slope, raise, trench)? Justify your answer.
 24. Draw two or three additional profiles across the depressions (you may want to magnify the area where they are located). What are their average diameter and depth?

In 2002, a National Oceanic and Atmospheric Administration expedition to this area investigated the characteristics of one of these depressions called the *Brine Pool*. Go to the 2002 Gulf of Mexico exploration, read the “Brine Pools” section (<http://oceanexplorer.noaa.gov/explorations/02mexico/background/brinepool/brinepool.html>), and answer the following questions:

25. What are brine lakes or pools?
26. How did these depressions form?
27. What is the origin of the salt layers found in the Gulf of Mexico under more recent marine sediments?

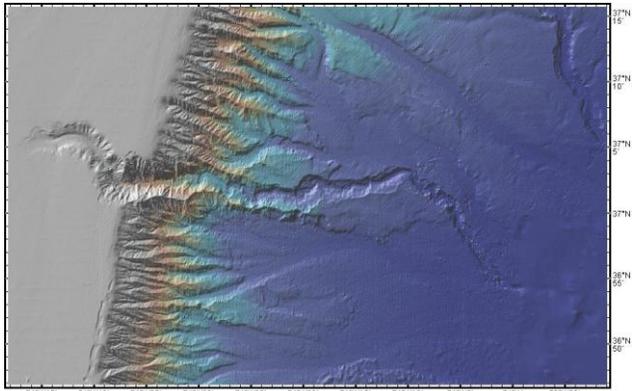


Figure 1

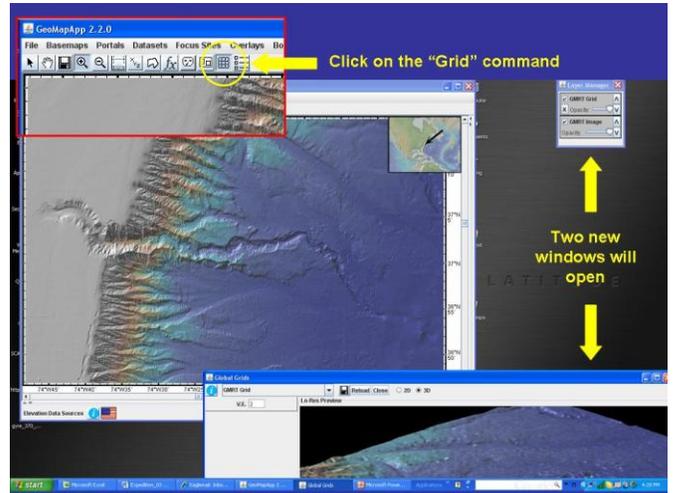


Figure 2

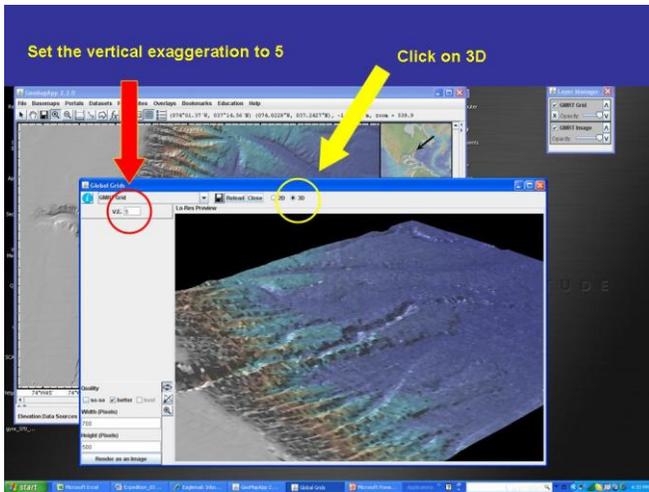


Figure 3

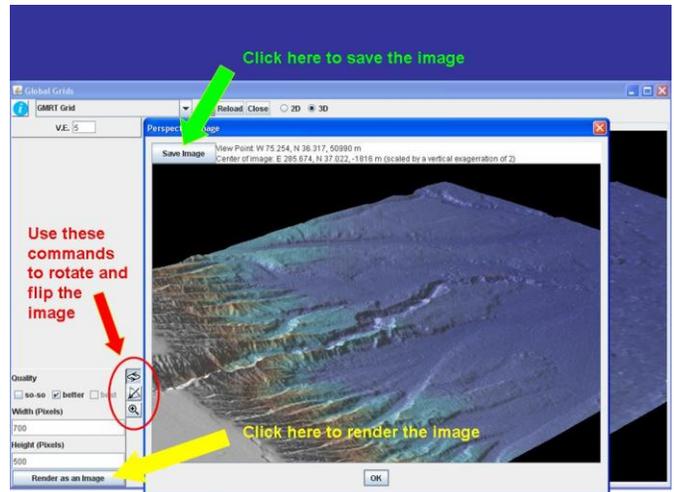


Figure 4

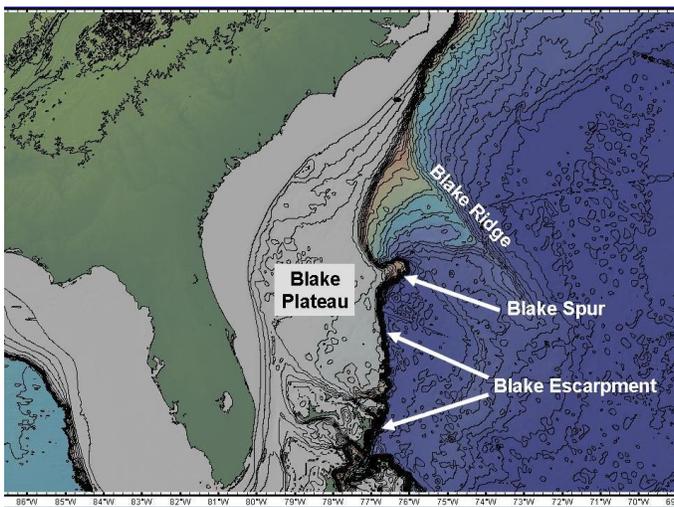


Figure 5