Oceanography 2 Lab More about Maps, Charts, and Navigation

There are two main objectives to this lab: first, to learn to locate oneself at sea by sighting on features of known location, and second, to recognize the shape of underwater features using contoured bathymetric maps.

Part 1. Chart location by triangulation.

The best way to locate oneself at sea is by taking fixes on points of known location on land. Obviously, this only works if it is clear and land is visible. As discussed in lab 1, compass directions are given in degrees from 0° (true north) to 90° (east), to 180° (south), to 270°, to 360° (back to true north). The compass rose on the Monterey chart shows all of the compass directions. First we will practice determining bearings (a direction from one point to another as expressed as an angle from north) from one known point to another. Then we will plot two or three bearings from an unknown point. The intersection of these bearings is the location of the observer. Note that any two bearings can be thought of as imaginary lines of known orientation on the map. These lines will intersect at a single, unique, point on the map, which is your location. Note that this is the very same way that satellite systems, such as GPS (Global Positioning System), work, except that signals use the satellites to sight on rather than physical objects within the line of sight.

Please note, all of these exercises require you to draw very light lines on the Monterey chart. Please erase these lines, and a few others, after you are done. Remember, pens are forbidden near the charts for the duration of this exercise and will be confiscated if found.

Example: plotting a bearing from an unknown point towards an on-land object of known location.

Question: Plot a bearing of 63° towards the Moss Landing stacks and a bearing of 187° towards Pt Pinos. What is the latitude and longitude of your location?

Answer:
1) Align one side of the parallel rulers on the compass rose through 63°. Put the other ruler on the Moss Landing stacks. Draw a **very light** line along the ruler that goes through the Moss Landing Stacks. Your location is somewhere along this line.
2) Align one side of the parallel rulers on the compass rose through 187°. Put the other ruler on Pt Pinos (use the letter “o” in “horn” as an exact location). Draw a **very light** line through Pt Pinos.
3) The location where the two lines intersect is your location. What is the latitude and longitude of your location? Note that a third bearing could provide a test to confirm your location. Answer = 121°55’W, 36°45’N.

Problems.

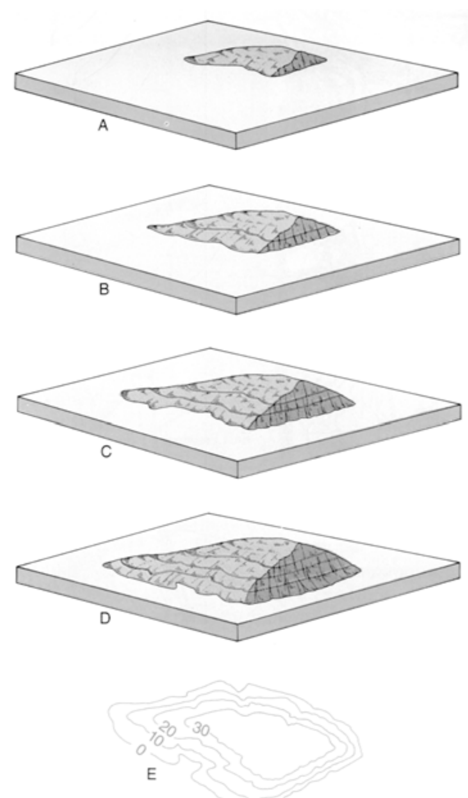
1. Out at sea in Monterey Bay, you obtain bearings of 33° on the radio towers between Twin Lakes and Soquel Pt. You also obtain a bearing of 96° the stacks at Moss Landing. What is the latitude and longitude of your location?

2. A little while later, you obtain bearings of 12° on the lighthouse at Pt Santa Cruz and 135° on Pt Pinos. Where are you now? Which direction have you been sailing?

Part 2. Contoured Bathymetric and Topographic Maps.

Maps that show the shape of the Earth's surface are called bathymetric maps (underwater) and topographic maps (on land). Both of these kinds of maps use *contour lines* to accurately represent the shape of the Earth's surface on a flat piece of paper. Contour lines are lines of equal elevation that enable one to visualize the topography or bathymetry of the Earth's surface. Contour lines are a method to visualize shapes in three dimensions.

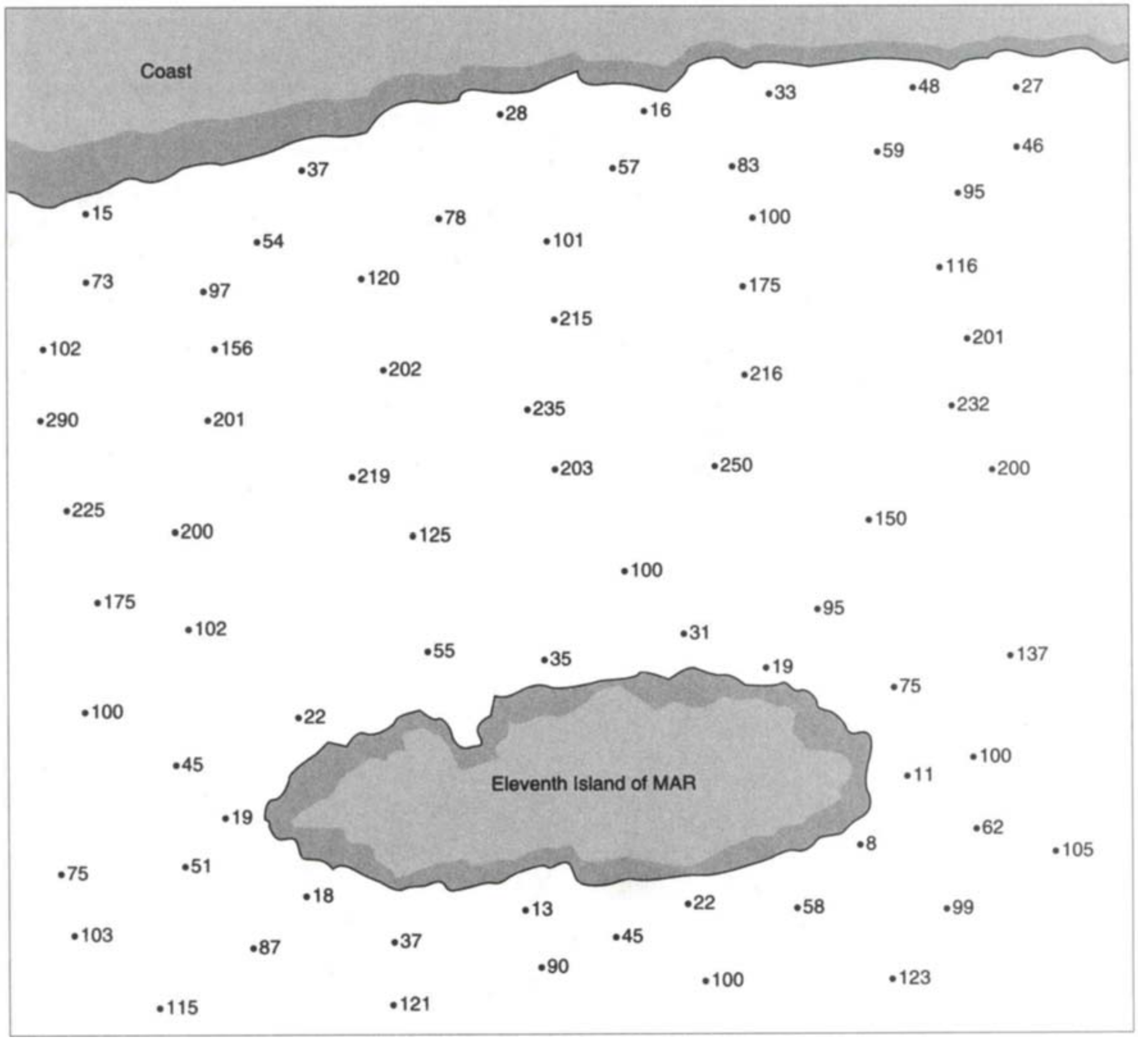
In the example to the right, the contour lines in E represent distance above sea level. Thus, it is a topographic map. Each of the contour lines in E (0 through30) represents a horizontal surface that can be thought of the line to which water would rise during a flood, as shown in A-D.



See the lab books distributed about the room for more information.

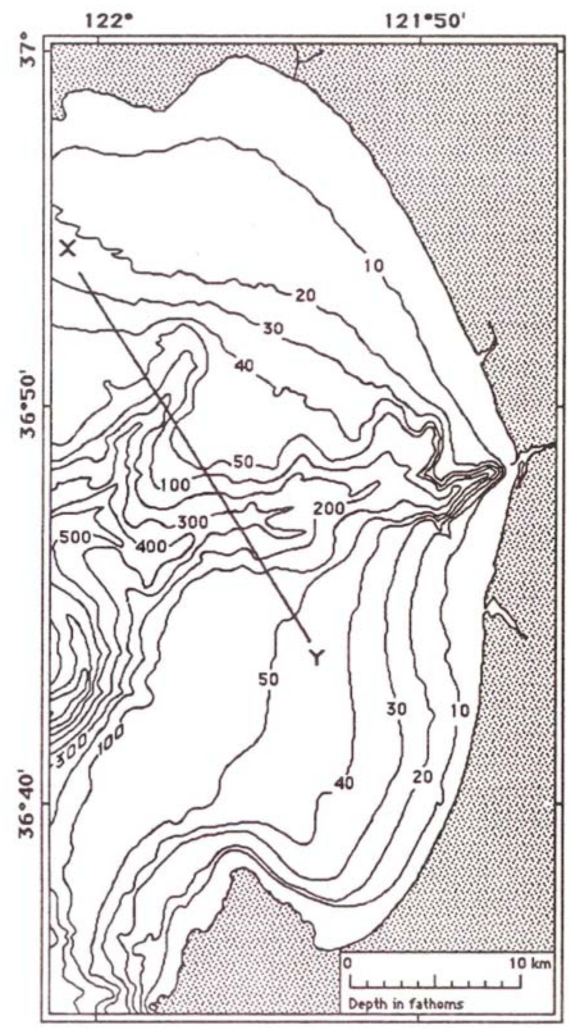
Some of the basic points:
-The difference in elevation between contour lines is called the *contour interval* and is usually measured in feet, meters, or fathoms.
-Contour lines never cross or divide.
-Contour lines are very close together when representing a steep slope or cliff.
-Contour lines are far apart when representing flat terrain (see diagram to right).
-Hills and knobs are shown as closed contours.
-Closed depressions are shown by closed contours with hatch marks on the down hill side (see lab books).

The following map has soundings given in meters. Complete the map by drawing in the contour lines. Use a 40 meter contour interval. Start with the 40m contour line and follow the shape of the beach as a guide. Label your contour lines with their appropriate depth.



Now color your map using the colored pencils provided to make your contour map look like the color bathymetric maps to the right of the chalkboard. Use the following color scheme:
Blue: >200 meters
Green: 160-200 meters
Yellow: 120-160 meters
Orange: 80-120 meters
Red: <80 meters

Follow the directions given on the following page to construct a profile of the Monterey Canyon using the data given in the bathymetric map below.



MONTEREY BAY, CALIFORNIA

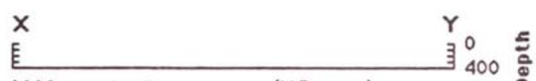
In this exercise you'll learn to construct profiles and will observe the impact of vertical exaggeration.

If this is your first experience with making profiles, you should **first review the step-by-step instructions on the following page.**

On the grid below, make a profile of the line labelled X-Y on the map. This grid is set up so that the vertical exaggeration is 18.5 times.

X-Y PROFILE (V.E. = 18.5)

Now try to make a profile of the same area, this time on a grid set up with a vertical exaggeration of just 2 times.



X-Y PROFILE (V.E. = 2 x)

Which profile was easier to plot?

Which shows the features most clearly?

You can think of the colorful global bathymetric maps to the right of the chalkboard as contour maps as well. The only difference is that they show terrain at different elevations as different colors.

Step-by-step Profile Construction

• The line along which the profile is to be drawn is placed on the map. In practice, a strip of paper is placed along the line of profile (A-B). >>>

• A mark is made at each point where a contour crosses the line of profile, and the depth of that contour is written on the strip of paper. The ends of the profile are also marked on the paper strip.

• Another sheet of paper is prepared with horizontal lines spaced at equal intervals corresponding to the contour interval (10 m in this example). This grid can be drawn at any convenient scale. The full range of depths on the map, from the shallowest feature to the deepest, is entered on the left side of the graph.

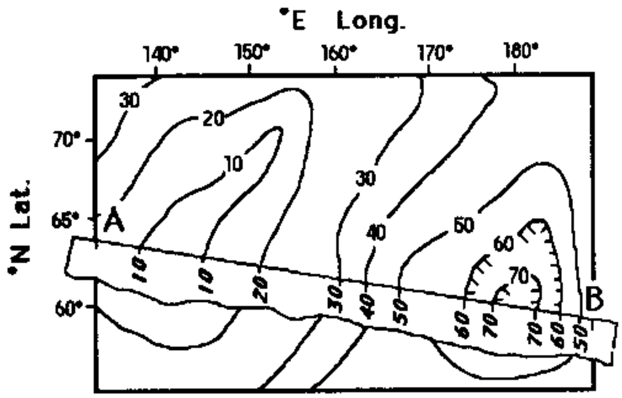
• The paper strip is placed along the top line of the profile graph and the marks, with their depth values, are transferred along the top line.

• A grid is then constructed by extending dotted lines straight down the page from each marked depth to the horizontal line that corresponds to that depth. Place a dot at the point where they intersect.

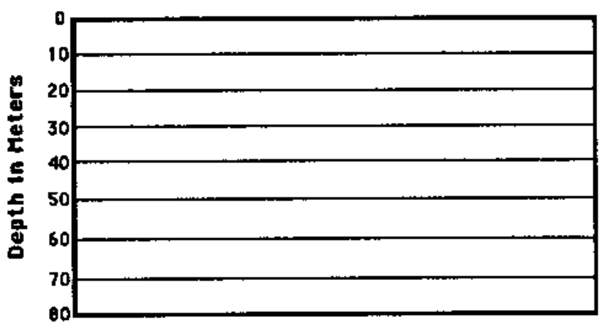
• These points are then connected with a smooth curve, resulting in a profile of the features on the chart. Note that there are no sharp angles.

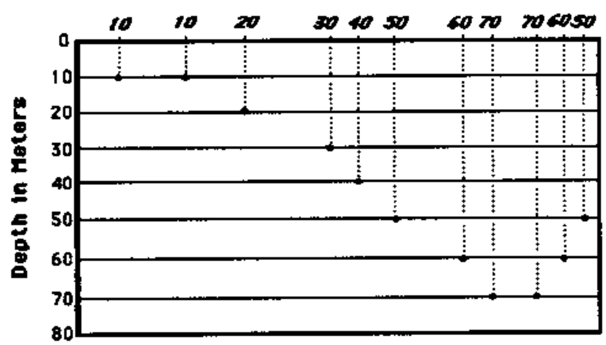
• Where two adjacent marks represent the same depth (see the 1 0 m and the 70 m marks >>>) the profile line extends slightly above or below the depth line, depending on the trend of adjacent slopes. Use your judgment how far above or below, but it may not cross the next contour depth.

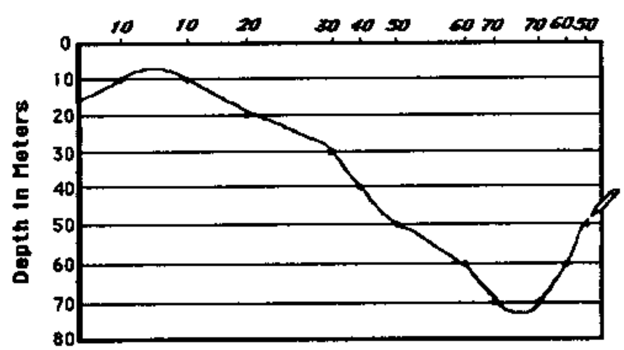
• Now you can easily see that the feature on the left of the chart is a `hill, the feature on the right a basin.`



Bathymetric Chart
Contour Interval 10 m







Profile

Now that you have some practice with topographic and bathymetric maps. Use the Crater Lake topographic map to answer the following questions. Look at the backside of the Crater Lake map to help you imagine what the topography looks like. Note that the main difference between topographic maps and bathymetric maps (or charts) is elevation is given as depth on bathymetric maps so that the highest elevations have the lowest numbers (because they have the shallowest depth).

1. Where is the highest point on the map?

2. Where is the lowest point on the map (hint: think about rivers; they flow downhill)?

3. Where are the steepest slopes on the map?

4. Where is topography that is essentially flat?

5. In what direction is the photograph on the back of the map taken?

6. In the space given below, draw a *bathymetric map* of the following items. Use a contour interval of your choice. Be sure to label the contour lines in your drawings.

a. a ridge trending in a northwest direction

b. a conical shaped seamount

c. a steep valley.

d. a very broad valley.