

LAB ACTIVITY

Earthquakes and Subduction Boundaries

The vast majority of earthquakes occur at plate boundaries. The deepest earthquakes occur at subduction boundaries where lithosphere is plunging down into the mantle. Deep focus earthquakes are defined as those with foci (plural of *focus*) occurring deeper than 300 kilometers. Shallow earthquakes have foci less than 70 kilometers deep, while intermediate focus earthquakes occur at depths between 70 and 300 kilometers.

The behavior of the subducting plate is determined by the age of the rocks comprising the plate. Older crust is cooler, and therefore denser, than younger crust. Older, cooler, denser crust subducts faster and at a steeper angle than younger, warmer, less dense crust.

In this lab activity, you will plot and compare actual earthquake foci data from two areas where subduction is currently occurring. One of the areas includes the Tonga Islands in the southwest Pacific Ocean. The other area is along the coastline of Chile.

Lab Skills and Objectives

- To construct profiles across two subduction zones
- To compare and contrast the behavior of two subducting plates

Materials

- graph paper
- maps

Procedure

1. Look at both sets of earthquake data in Data Table A. Determine the number of shallow focus earthquakes (<70 kilometers) for both areas. Record your values on a copy of Data Table B.
2. Repeat Step 1 for intermediate focus and deep focus earthquakes.
3. Add the numbers in both columns of Data Table B. Your total should equal the *Total Number of Quakes*.
4. On the graph paper, draw a set of axes to plot longitude versus focal depth, as shown in Figure 15.17. Plot the data for Tonga from Data Table A. Do not connect the dots. Instead draw a best-fit line for the points. A *best-fit* line is a single line that shows the trend of the data without having to pass through the points. Assume the line you have drawn is the upper surface of a subducting plate.
5. Construct a second graph for the Chile data. You will want to change the values

Data Table A

Tonga Data		Chile Data	
Longitude (°W)	Focus Depth (km)	Longitude (°W)	Focus Depth (km)
176.2	270	67.5	180
173.8	35	66.9	175
175.8	115	68.3	130
174.9	40	69.3	60
175.7	260	62.3	480
175.9	190	70.8	35
175.4	250	61.7	540
174.7	35	68.4	120
176.0	160	69.8	30
175.7	205	66.5	220
173.9	60	69.8	55
177.7	580	67.3	185
174.9	50	67.7	120
178.5	505	69.5	75
177.9	565	68.3	110
179.2	650	67.9	140
178.7	600	69.1	95
173.8	50	69.2	35
178.3	540	63.8	345
177.0	350	68.6	125
174.6	40	66.7	210
178.8	580	68.1	145
176.8	340	66.7	200
177.4	420	65.2	285
173.8	60	67.5	170
178.0	520	69.7	50
177.7	560	68.2	160
174.1	30	67.1	230
177.7	465	66.2	230
179.2	670	66.3	215
178.8	590	68.6	180
178.1	510	66.4	235
175.1	40	68.5	140
178.2	550	65.5	290
176.0	220	68.1	130
178.6	615		
174.8	35		
178.2	595		
179.1	675		
177.8	460		
177.0	380		

on the longitude axis to match the range of longitudes found in Data Table B. Plot the Chile data and draw a best-fit line.

6. Answer the questions in *Analysis and Conclusions*.

Analysis and Conclusions

1. Locate the Tonga and the Chile areas using the maps showing plate boundaries.

What plate is subducting in each location? Under which plates are those plates subducting?

2. Locate the East Pacific Rise on the map on

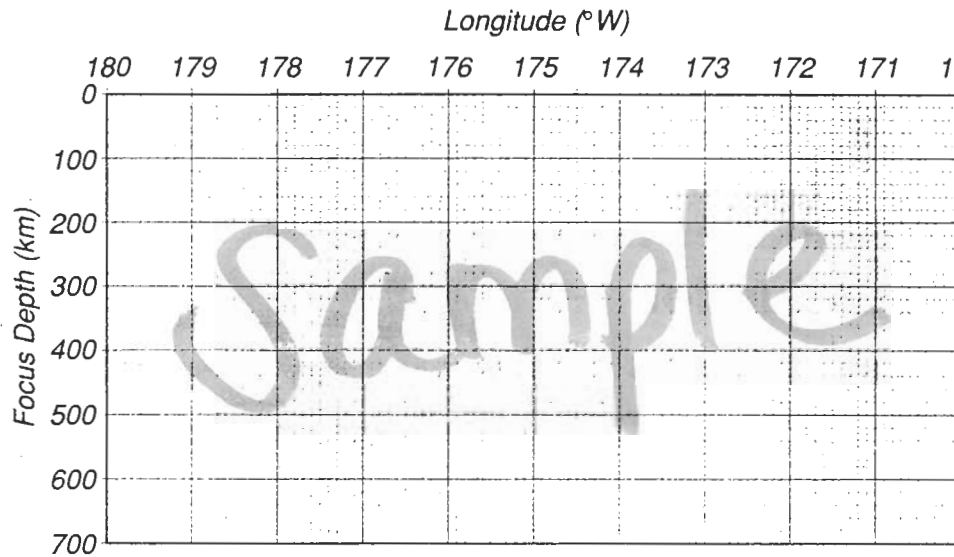
(a) Compare the distance of the Tonga area from the East Pacific Rise with the distance of the Chile area from the East Pacific Rise.

(b) Mid-ocean ridges are the source of oceanic crust. If the East Pacific Rise is the source of the subducting crust in both areas, how do the ages of the two subducting plates compare?

3. Look at your values in Data Table B. Compare the focus depth of the majority of the earthquakes at Tonga with those at Chile.

4. Now look at the profiles you have drawn for the two areas. (a) For which area is the subducting plate moving westward? (b) Which plate is subducting at a steeper angle? (c) What does this mean about the type of plate beneath which each plate is being subducted? Explain your answer fully.

15.17 Longitude versus focus depth, Tonga area



Data Table B

Earthquake Type	Focus Depth (km)	Tonga Total	Chile Total
Shallow	< 70		
Intermediate	70–300		
Deep	> 300		
Total Number of Quakes		41	35

5. For the Chile data, the deepest earthquake occurred at longitude 61.7°W and at a depth of 540 kilometers. If the rocks at this location started subducting (left the surface) 10 million years ago and the distance down the subducting plate to the present location is 1000 kilometers, what is the rate of descent, in centimeters per year, of the subducting plate? Show your work.

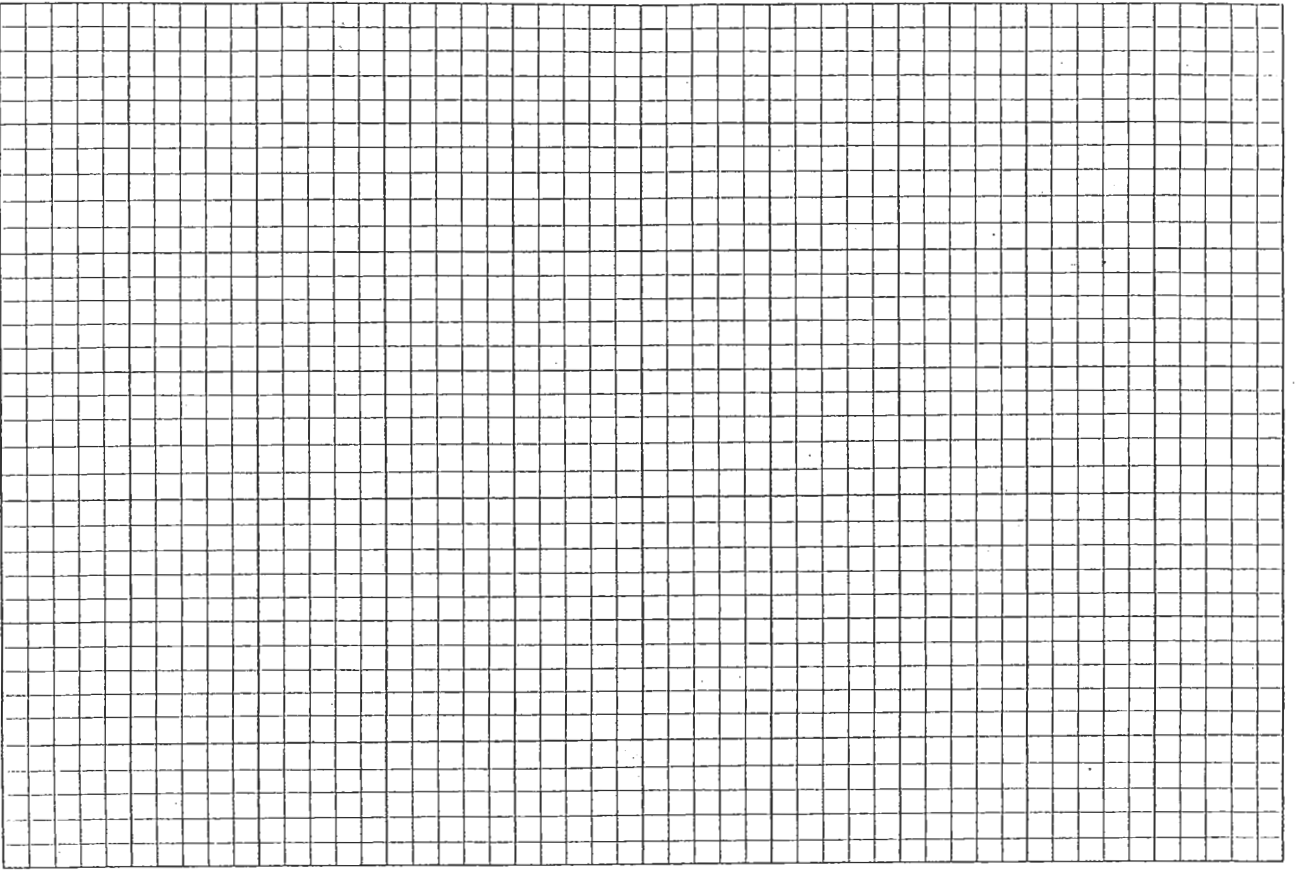
6. Would you expect the subduction rate at Tonga to be more or less than the Chilean rate? Why?

7. Summarize the differences between the subducting plate at Tonga and the subducting plate at Chile by comparing their (a) distance from assumed source of lithosphere, (b) age (c) angle of descent, (d) rate of descent, and (e) number of deep focus earthquakes.

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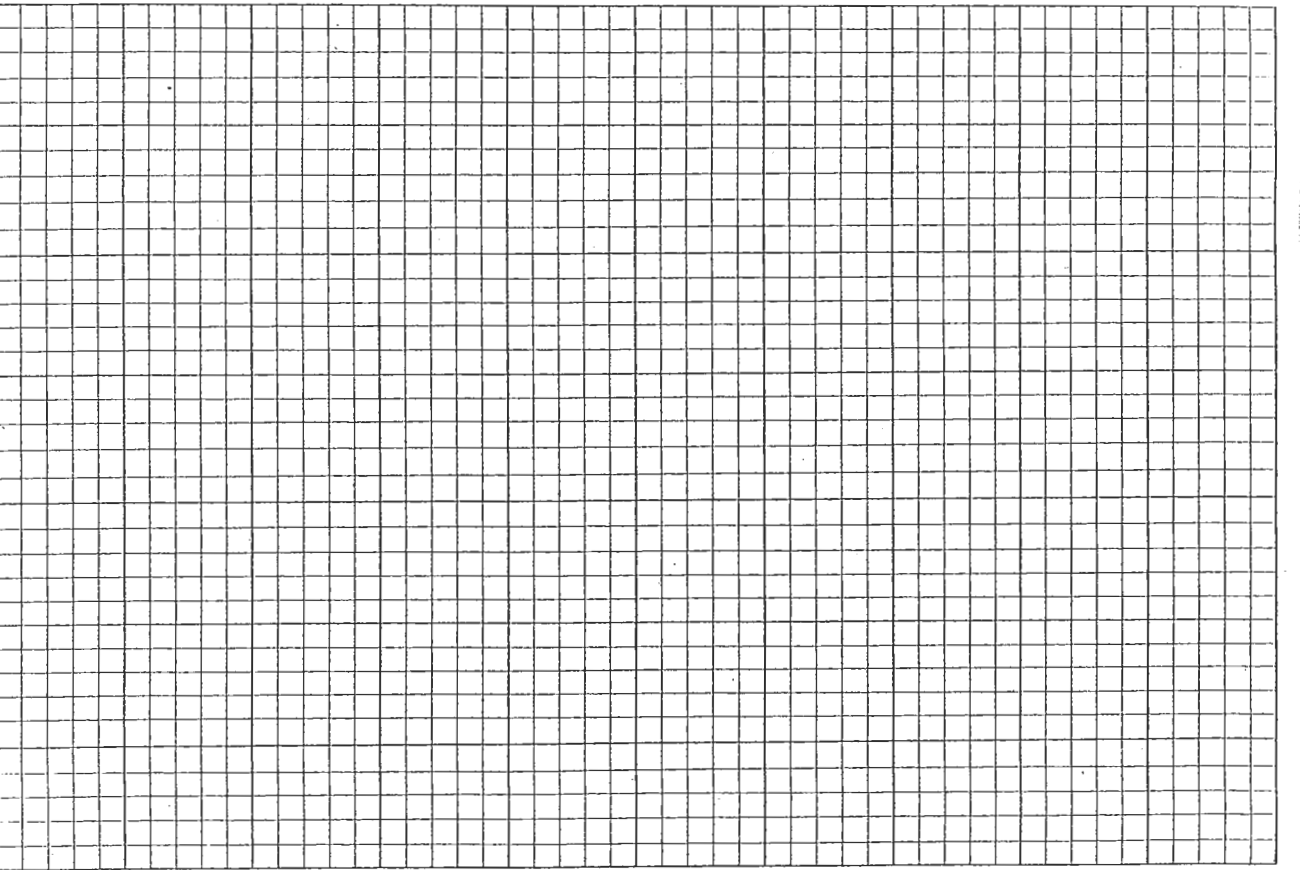
Answers to Analysis and Conclusions Questions:

5 DIVISIONS PER INCH
DENTAL BOARD



b

5 DIVISIONS PER INCH
DENTAL BOARD



b