



Name \_\_\_\_\_

Boundary lab

Per \_\_\_\_\_ Date \_\_\_\_\_

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.

Procedure:

1. **Look at Earthquake Depth Data Table (On next page). Determine the number of shallow (<70), intermediate (70-300) and deep (>300) earthquakes and record them all on the summary table, for both the Tonga and Chile Trench.**
2. **Add the numbers in both columns of Summary Table. The total should equal the Total number of Quakes.**

Summary Table			
Earthquake Type	Focus Depth	Tonga	Chile
Shallow	Less than 70 km		
Intermediate	70 km – 300 km		
Deep	More than 300 km		
Total number of Earthquakes			

3. On the graph below plot the data for Tonga trench from the table. **DO NOT CONNECT THE DOTS.** Instead draw a **Best-fit line** for the points. A **Best-fit line** is a line that does not go through the points but shows a trend of data.

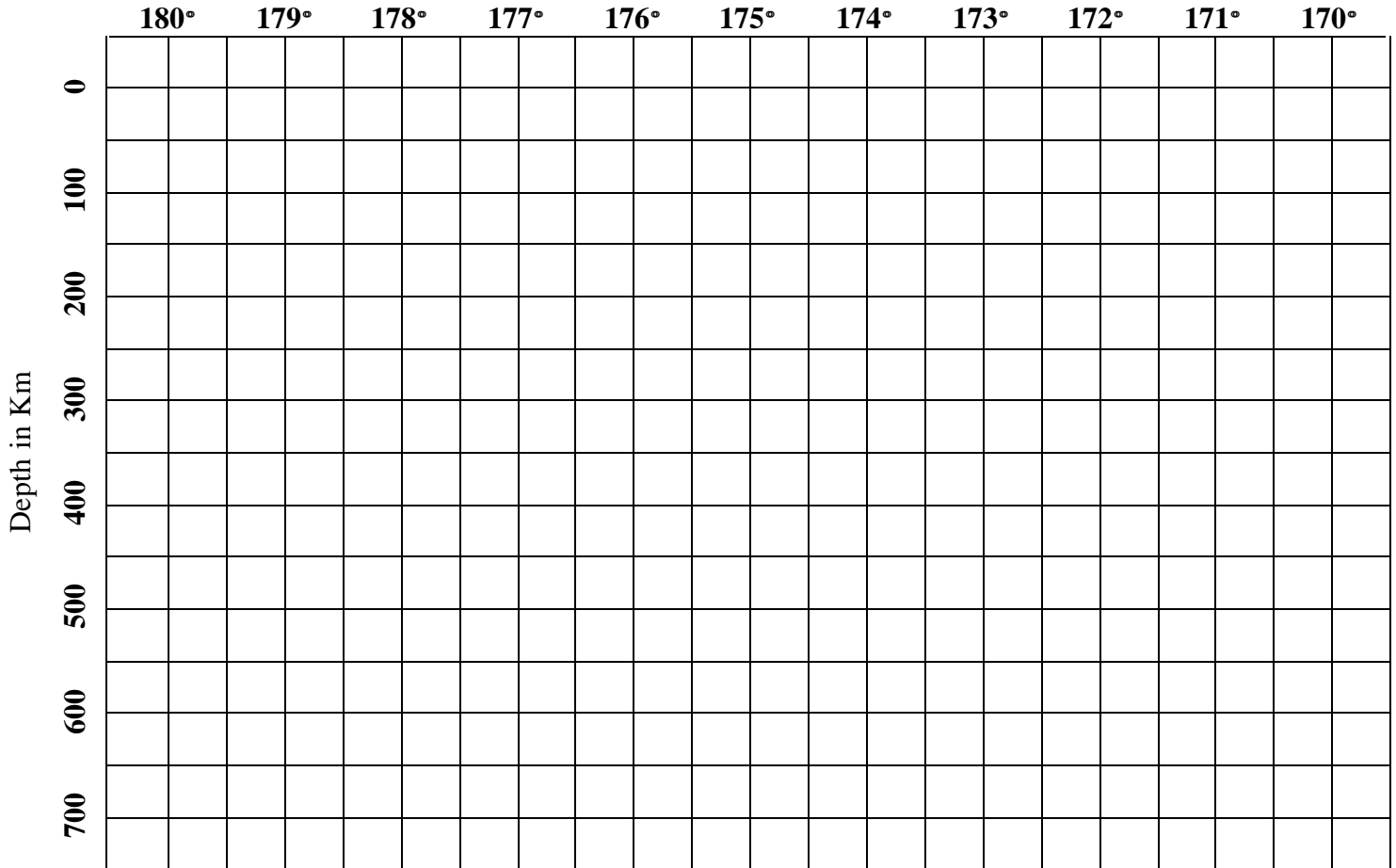
- ✓ Assume the line is the upper surface of a subducting plate.
- ✓ Label the approximate location of the Tonga trench on the graph
- ✓ Using your Reference tables, indicate the name of the two converging plate
- ✓ Using your Reference tables, indicate the relative movement of each plate using arrows
- ✓ Using your Reference tables, indicate the type of crust that makes up each plate.

4. Make a 2<sup>nd</sup> graph for the Chile trench. Plot the Chile data... and again draw your best-fit line.

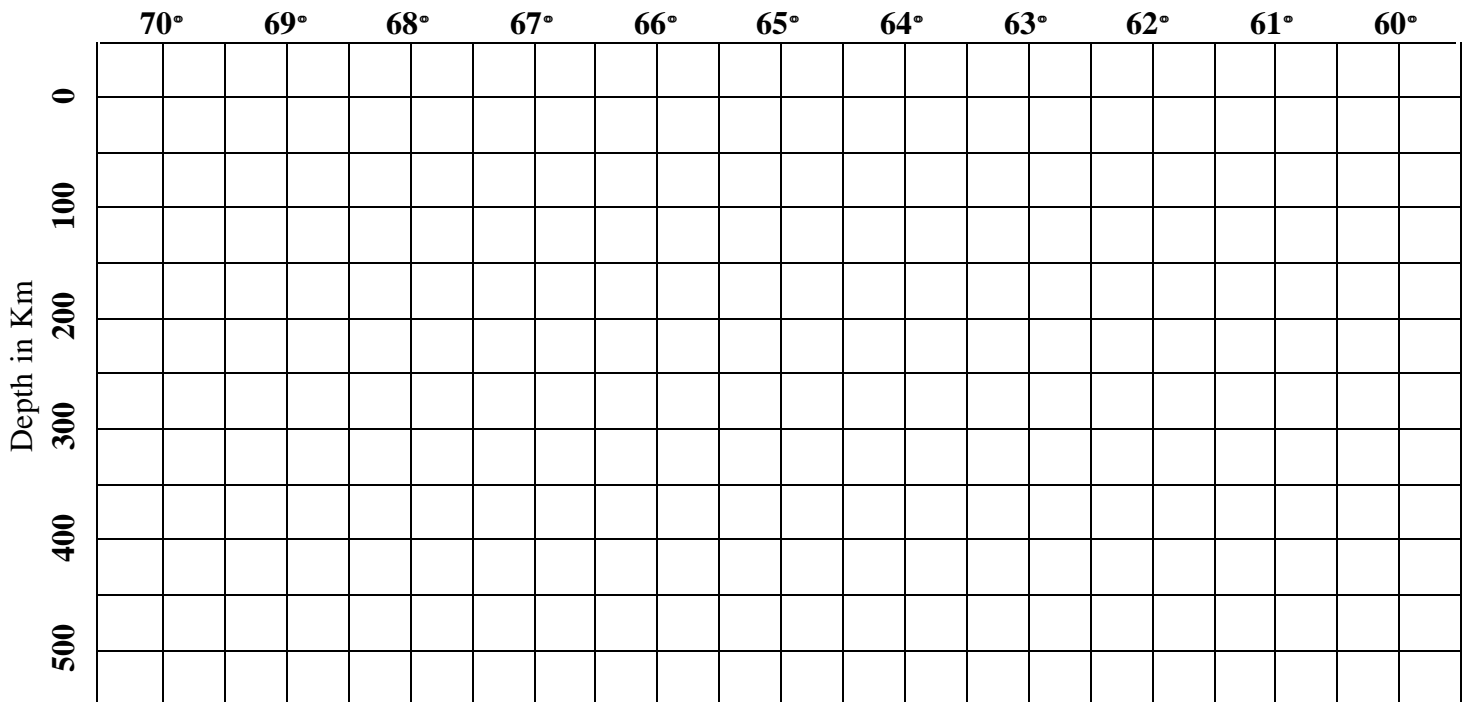
- ✓ Assume the line is the upper surface of a subducting plate.
- ✓ Label the approximate location of the Chile trench on the graph
- ✓ Using your Reference tables, indicate the name of the two converging plate
- ✓ Using your Reference tables, indicate the relative movement of each plate using arrows
- ✓ Using your Reference tables, indicate the type of crust that makes up each plate.

<b>Earthquake Depth Data</b>			
<b>Tonga trench</b>		<b>Chile Trench</b>	
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		

# Tonga Trench



# Chile trench

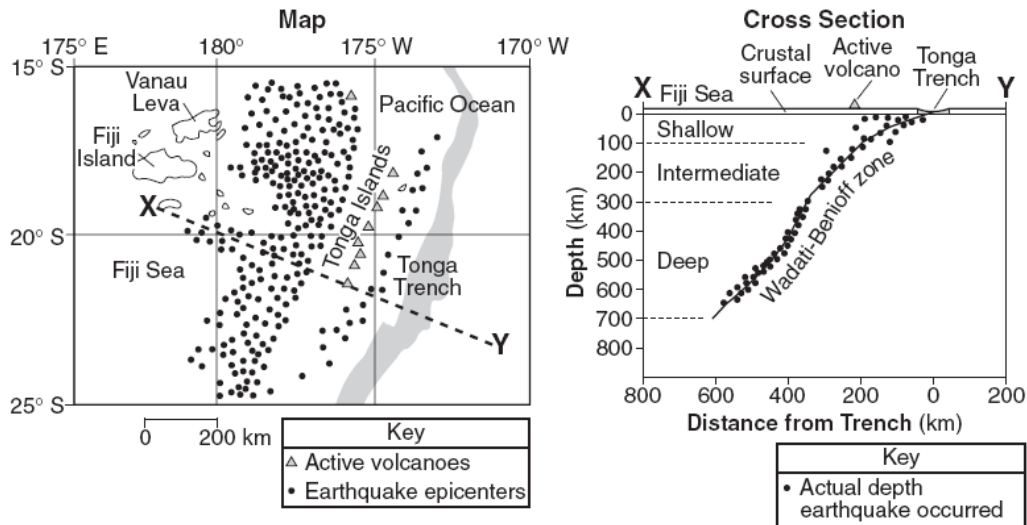


## Discussion Questions

### Questions 1-5 use the diagram below

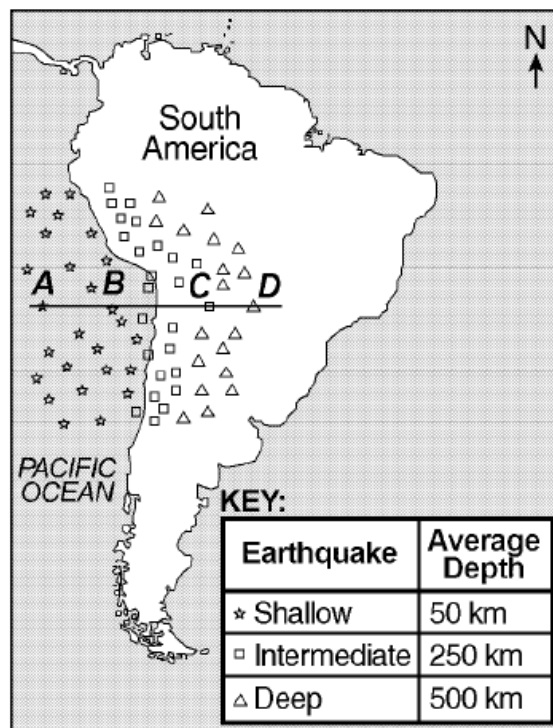
The map represents a portion of Earth's surface in the Pacific Ocean. The positions of islands, earthquake epicenters, active volcanoes, and the Tonga Trench are shown. Lines of latitude and longitude have been included.

The cross section shows earthquakes that occurred beneath line XY on the map. Depth beneath Earth's surface is indicated by the scale along the left side of the cross section, as are the range of depths for shallow, intermediate, and deep earthquakes. Distance from the trench is indicated by the scale along the bottom of the cross section.



### Questions 5-10 use this diagram

The map below shows the depths of selected earthquakes along the crustal plate boundary near the west coast of South America. Letters *A*, *B*, *C*, and *D* are epicenter locations along a west-to-east line at the surface. The relative depth of each earthquake is indicated.



1. What 2 tectonic plates are converging at the Tonga Trench?

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2. What are the 2 types of plates converging at the Tonga Trench?  
(oceanic/oceanic, oceanic/continental, continental/continental)

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3. When 2 oceanic plates converge, which plate is subducted and why?

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4. Which tectonic plate is being subducted at the Tonga Trench?

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5. According to the cross section on Diagram 1 and your plotted data, where did the greatest number of earthquakes occur?

- a. at sea level
- b. between sea level and a depth of 100 km.
- c. at a depth between 100 and 300 km.
- d. at a depth between 300 and 600 km.

6. What 2 tectonic plates are converging at the Peru-Chile Trench?

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7. What are the 2 types of plates converging at the Peru-Chile Trench?  
(oceanic/oceanic, oceanic/continental, continental/continental)

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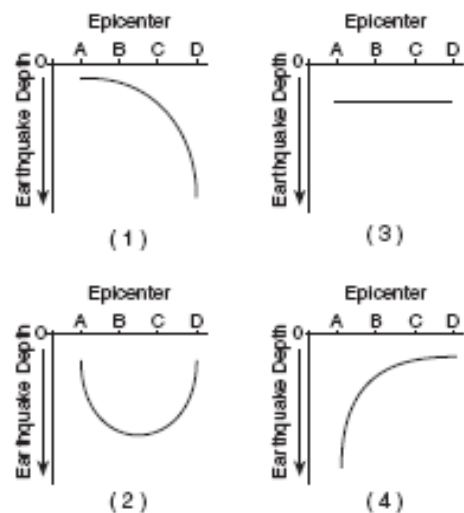
8. Using the cross-section of South America (Diagram 2) and the data from the Peru-Chile Trench, describe the pattern of earthquake depths from west to east.

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9. Based on your answer to Question 8, what appears to happen as the oceanic plate to the west collides with the continental plate to the east.

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10. Using Diagram 2, which graph best shows the depth of earthquakes beneath epicenters A, B, C, D?



11. Look at your data. Compare the depth of the majority of the earthquakes at the Tonga Trench and the Chile Trench.

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12. Collision of which 2 types of plates create the deepest Quakes?  
(oceanic/oceanic, oceanic/continental, continental/continental)

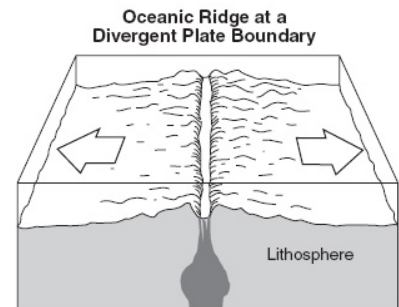
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Plate Boundary Chart – using your ESRT determine the type of boundary

Location	Divergent	Convergent	Transform
Mid-Atlantic Ridge			
Aleutian Trench			
East Pacific Ridge			
San Andreas Fault			
Iceland Hot Spot			
Tonga Trench			
Southeast Indian Ridge			

13. What type of plate boundary creates new crust?  
Hint: Look at diagram

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14. Using page 5 of your reference table, where do we usually find divergent boundaries?

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15. Oceanic trenches are associated with what type of plate boundary?

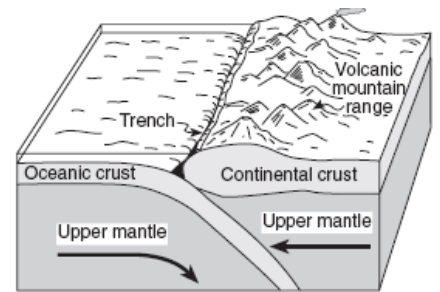
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16. Are convergent plate boundaries creating or destroying crust?

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17. What surface feature has most likely formed on the west coast of South America as a result of the collision of the South American and Nazca Plate?  
Hint: Look at diagram

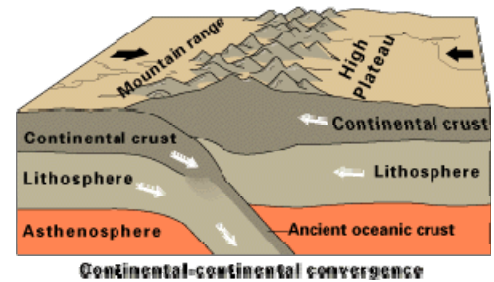
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18. When 2 continental plates converge, what surface feature is most likely formed because both plates resist subduction? Hint: Look at diagram. Where is this happening today?

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19. What 2 plates are involved in the relative movement of the San Andreas Fault?

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20. What is the relative movement of the plates along the San Andreas Fault?

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21. At Transform Plate Boundaries, do you think the earthquake depths are shallow, intermediate, or deep and why?

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