Name: _____   Period: _____ Date: _____

LAB: EARTHQUAKE DEPTHS AT SUBDUCTION ZONES
by Charles Burrows

BACKGROUND:

A **convergent boundary** is a boundary between two plates that are moving toward each other, or converging. Two broad classifications for convergent boundaries are subduction boundaries and collision boundaries.

When an oceanic plate plunges beneath another plate, the oceanic plate is said to be subducting beneath the **overriding plate**. The boundary between the plates is called a **subduction boundary**. One important feature of a subduction boundary is a long, deep trench called a **deep-sea trench** that forms along the boundary. Such trenches are the deepest parts of the ocean floor.

Subduction boundaries can occur at the convergence of two oceanic plates or at the convergence of an oceanic plate with a continental plate.

When two oceanic plates converge, the deep-sea trench that forms is accompanied by the formation of a chain of volcanic islands called a **volcanic island arc** on the overriding plate. For example, as the Pacific Plate subducts under the Philippine Plate, the Pacific Plate is pulled down to form the Mariana Trench. The leading edge of the overriding Philippine Plate is marked by a chain of volcanic islands, the Mariana Islands.

When an oceanic plate converges with a continental plate, the denser oceanic plate subducts beneath the less-dense continental plate. A **mountain chain and volcanoes form inland** on the overriding continental plate. For example, off the west coast of South America, the Nazca Plate is subducting under the South American Plate. The Peru-Chile Trench has formed between the plates. The Andes Mountains and active volcanoes have formed along the western edge of the South American continent.

The density of the rock that makes up a subducting plate is one of the factors that determines how the plate behaves. The greater the density, the faster the plate subducts into the mantle and the steeper the angle of subduction. Older crust is cooler and therefore denser than younger crust, so it subducts faster and at a steeper angle along a subduction zone. Most earthquakes occur at tectonic plate boundaries. An earthquake can be classified by the depth of its **focus** (where it originates). Deep-focus earthquakes have foci at more than 300 km, shallow-focus earthquakes have a focus at less than 70 km, and intermediate-focus earthquakes have foci between 70 km and 300 km.

PROCEDURE:

1. Complete the following table by counting the number of each **type** of earthquake:

EARTHQUAKE CLASSIFICATION	PERU-CHILE TRENCH AREA	TONGA TRENCH AREA
Shallow-focus (less than 70km)		
Intermediate-focus (70km-300km)		
Deep-focus (more than 300km)		
TOTAL #:		

2. Use the table above to calculate the **percentages** in the following table (**% = (# ÷ total) X 100**) :

EARTHQUAKE CLASSIFICATION	PERU-CHILE TRENCH AREA	TONGA TRENCH AREA
Shallow-focus (less than 70km)		
Intermediate-focus (70km-300km)		
Deep-focus (more than 300km)		
TOTAL %:	**100%**	**100%**

3. **Plot** the given earthquake depth data on the corresponding two graphs. *DO NOT CONNECT THE DOTS!*

4. Draw a **best-fit line** for each graph. A best-fit line is a smooth line that shows the trend of the data. The line should *not* connect all data points. The best-fit line should roughly divide the number of data points in half.

5. Use your reference tables to complete the following table:

	NAME OF SUBDUCTING PLATE	**NAME OF OVERRIDING PLATE**
PERU-CHILE TRENCH		
TONGA TRENCH		

6. Name the **ridge** where rising magma is cooling and solidifying, creating brand new (very young) oceanic crust, where the Pacific Plate and the Nazca Plate touch. Which trench (Peru-Chile or Tonga) is farthest from this ridge?

7. Complete each of the following relationship statements by writing *increases*, *decreases,* or *stays the same*:

a) As distance from a ridge increases, the **age of the seafloor** _____.

b) As distance from a ridge increases, the **age of the subducting rock material** _____.

c) As distance from a ridge increases, the **temperature** of a plate _____.

d) As distance from a ridge increases, the **density** of a plate _____.

e) As distance from a ridge increases, the **greatest depth** of earthquakes at a subduction zone _____.

f) As distance from a ridge increases, the steepness of a subducting plate _____.

g) As distance from a ridge increases, the **speed** of a subducting plate _____.

h) As you go in a straight line from the Peru-Chile Trench, across the East Pacific Ridge to the Tonga Trench, the age

of the seafloor _____ then _____.

8. Circle the **type of convergent boundary** associated with each trench area:

PERU-CHILE TRENCH AREA	**TONGA TRENCH AREA**
OCEANIC-OCEANIC *or* **OCEANIC-CONTINENTAL**	**OCEANIC-OCEANIC** *or* **OCEANIC-CONTINENTAL**

9. Which trench is associated with a volcanic island arc? Use a world map to find the name of these islands.

10. Which trench is associated with a chain of volcanic mountains on the land? Use a world map to find the name of this mountain range.

11. Sketch the plate boundary associated with each trench on the blank areas of your graphs as follows:
  o Sketch the outlines of the overriding and subducting plates. (Make the continental crust thicker! Include the ocean!)
  o Draw arrows within the sketched outlines of each plate showing the directions that the plates are moving relative to each other on either side of each trench.
  o Label the *names* of the following: **the trench**, **the subducting plate** and **the overriding plate**.
  o Draw and name the volcanic island arc and the chain of volcanic mountains where they belong.
  o Label earthquake focus depths along the tops of the subducting plates using these symbols:
                              s = shallow   **i** = intermediate   **d** = deep
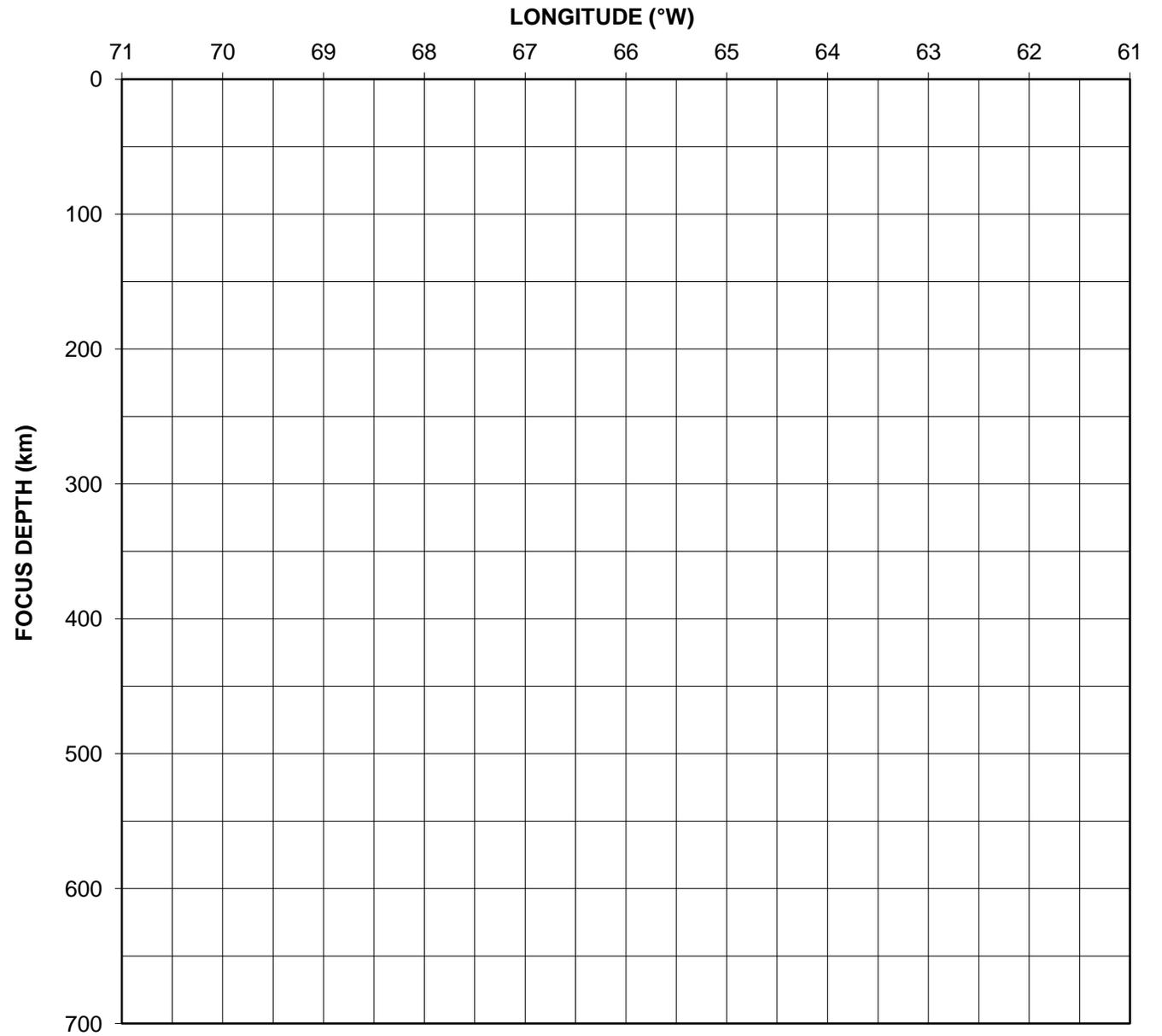 o Make sure your name is printed clearly on both graphs!

12. If you measured the depth of earthquake foci from just west of Washington State (in the Pacific Ocean) to the eastern edge of the Cascade Mountains (The Cascades), what **trend** would your notice? **WHY**? (Name the plates involved **and** what's happening there.)

13. There are probably dormant _____ in The Cascades because the _____

Plate is subducting beneath the _____ Plate causing rock to melt and rise to the surface.

PERU-CHILE TRENCH AREA

LONGITUDE (°W)	FOCUS DEPTH (km)
70	30
71	35
69	35
69.5	50
70	55
69.5	60
69.5	75
69	95
68.5	110
67.5	120
68.5	120
68.8	125
68	130
68.5	130
68	140
68.5	140
68	145
68	160
67.5	170
67	175
67.5	180
68.5	180
67.5	185
66.5	200
66.5	210
66.5	215
66.5	220
66	230
67	230
66.5	235
65	285
65.5	290
64	345
62.5	480
61.5	540

PERU-CHILE TRENCH AREA

LONGITUDE (°W)

(Empty grid plot: LONGITUDE axis from 71 to 61 (°W), FOCUS DEPTH axis from 0 to 700 km)

TONGA TRENCH AREA

LONGITUDE (°W)	FOCUS DEPTH (km)
174	30
174.5	35
174	35
175	35
174.5	40
175	40
175	50
174	50
174	60
174	60
175.5	115
175	140
176	160
176	190
175.5	205
176	220
175.5	250
176	260
176	270
177	340
177	350
177	380
177.5	420
178	460
177.5	465
178.5	505
178	510
178	520
178.5	540
178	550
178	560
178	565
179	580
178	580
179	590
178	595
178.5	600
178.5	615
179	650
179	670
179	675

TONGA TRENCH AREA

LONGITUDE (°W)

FOCUS DEPTH (km)