# Earthquakes and subduction zones lab report

Earthquakes and Subduction Zones Lab Amy Paret Mrs. Igo 9th Grade Periods 3 and 4 Even Date: 2/14/13 Background Research: This lab uses earthquake data to construct profiles of two convergent boundaries: the Tonga Trench and the Peru-Chile Trench. Where two tectonic plates converge, if one or both of the plates is an oceanic lithosphere, a subduction zone will form. When crust is formed at a mid-ocean ridge, it is hot and buoyant meaning it has a low density. As it spreads away from the ridge and cools and contracts, or becomes denser, it is able to sink into the hotter underlying mantle.

When two oceanic plates collide, the younger of the two plates, because it is less dense will ride over the edge of the older plate. The density of the rock that makes up the subducting plate determines the way in which a plate behaves. A plate with a greater density subducts into the mantle faster and at a steeper angle than a plate with a lower density. The age of the crust involved in the subduction also affects the rate at which it subducts. Older crust is cooler and denser therefore it suducts at a steeper angle and faster than new crust at a subduction zone.

The three key features associated with a subduction zone are a deep ocean trench, a volcanic arc on the overriding plate parallel to the trench, and a plane of earthquakes, shallow near the trench and descending beneath and beyond the volcanic arc. Most earthquakes occur at tectonic plate boundaries. The largest earthquakes are associated with subduction zones because they have long continuous fault lines. The depth of its focus can classify an earthquake. Earthquake depth range is divided into three zones: shallow, intermediate, and deep.

Shallow earthquakes are between 0 to 70 km deep, intermediate earthquakes are between 70 to 300 km deep, and deep focus earthquakes have foci at more than 300 km. Terms Introduced and Defined: – Subduction zone: the place where two lithospheric plates come together, one riding over the other – Density: mass per unit volume – Earthquake: the result of a sudden release of energy in the Earth's crust that creates seismic waves. – Subduction: the process in which one plate is pushed downward beneath another plate into the underlying mantle when plates move towards each other Plate boundaries: found at the edge of the lithospheric plates and are of three types, convergent, divergent and transform – Deep ocean trench: a portion of the Earth's crust in which a tectonic plate is being sub-ducted (pushed down) below another plate – Shallow earthquake: more damaging than deeper earthquakes due to there being less rock to absorb the shaking – Deep focus earthquakes: occur within the subducting oceanic plates as they move beneath the continental plates Hypothesis:

The East Pacific Rise Material at the two convergent boundaries: the Tonga Trench and the Peru-Chile Trench is older than the crust created at the East Pacific Rise but the Tonga Trench material is older than the Peru-Chili Trench material. Materials: – Earthquakes and Subduction Zones Lab – Sharpened pencil with eraser – Graphing Paper – Ruler – Calculator Procedure: 1. Take out a sharpened pencil, ruler, blank sheet of graph paper, and a calculator. 2. Pick up the earthquakes and subduction zones lab from your teacher. 3. Read the background information. 4.

Read the hypothesis information. 5. View Figure 1 at the top of the Lab. 6. Form a hypothesis about the relative ages of the East Pacific Rise material at the two convergent boudaries: the Tonga Trench and the Peru-Chile Trench. 7. View table 1. 8. Divide your graph paper into two sections. 9. Label the left section Tonga Trench and the right section Peru-Chili Trench 10. Draw a vertical line (y-axis) and a horizontal line (x-axis) on each section of the graph paper. 11. Label both vertical lines (y-axes) Focus Depth (km). 12. Label both horizontal lines (x-axes) Longitude (°W). 13.

On both sections of the graph paper (Tonga Trench and Peru-Chile Trench) create a scale for the vertial axis (focus depth) ranging from 0-700 km. Going by intervals of 50 km, label zero at the top of the y-axis and 700 at the bottom of the y-axis. 14. On the left section of the graph paper (Tonga Trench) create a scale for the horizontal axis (longitude) ranging from 173-180 °W. Going by intervals of 1°W, label the right end of the x-axis 173 and the left end of the x-axis 180. 15. On the right section of the graph paper (Peru-Chile Trench) create a scale for the horizonal axis (longitude) ranging from 61-71 °W.

Going by intervals of 1°W, label the right end of the x-axis 61 and the left end of the x-axis 71. 16. Plot the earthquake data from the region associated with the Tonga Trench from Table 1 on the left section of the graph paper, using a dot to represent each data point. 17. Plot the earthquake data from the region associated with the Peru-Chile Trench from Table 1 on the right section of the graph paper, using a dot to represent each data point. 18. Draw a best-fit line for the Tonga Trench data. A best fit line is a smooth line that shows the trend of the data; the line does not have to pass through the data points. 19.

Draw a best fit line for the Peru-Chili Trench. 20. On the left side of the graph (Tonga Trench) label the Pacific Plate (right side of the line of best fit) and the Indian Australian Plate (left side of the line of best fit) 21. Draw an arrow to show the direction of motion of the Pacific Plate (subducting under the Indian Australian Plate) 22. On the right side of the graph (Peru-Chile Trench) label the Nazca Plate (left side of the line of best fit) and the South American Plate (right side of the line of best fit) 23. Draw an arrow to show the direction of motion of the Nazca Plate (subducting under the South American Plate) 24.

Complete analyze questions # 1-5 (4 & 5 completed in steps 20-23) 25. Check and analyze your hypothesis 26. Answer conclude and apply questions # 1-2 Preparing a Lab Report: The lab report is to be written in the same format as any scientific publication. There is to be 5 minumum sections and they should be labeled: Introduction, Methods, Results, Discussion, and Literature Cited. The report must be composed on a word processor, printed, double spaced, Times New Roman, 12 pt. font. The metric system should be used throughout the report. All parts of the report should be written using complete sentences in paragraph format.

The first section of your lab report should be labeled with the word " Introduction. " This section can be used to educate the reader so he or she can understand the rest of the report. A hypothesis is proposed to explain an observation. It should be a statement, not a question. The next section is labeled " Methods. " This section should provide enough information for readers to repeat the experiment if they desire. It should include the specific procedures and materials needed to carry out the lab. The next section should be labeled “ Results. ” Put all results, statistical analyses, graphs, and tables in this section.

Use sentences and paragraphs to describe general trends and summarize the tables and graphs. The next section should be labeled “ Discussion. ” In this section discuss whether you accept or reject your hypotheses and explain why. If you reject a hypothesis, state an alternative. Explain why your results came out the way they did. If your results did not come out as they expected, explain why and what should have happened. In addition, explain what your results mean. The last section is “ Literature Cited. ” Everything mentioned in a scientific publication should be varifiable.

This helps readers that have questions and it ensures that the information presented is accurate. The literature cited section contains a list of publications that you cited in the report. Instructions on Using a Table, Setting Up, and Preparing a Graph: To begin take a blank sheet of graph paper. View Table 1, which includes the Longitude and Focus depths of the earthquakes at the Tonga Trench and Peru-Chile Trench. Divide the graph paper into two sections labeling the left side Tonga Trench and the right side Peru-Chile Trench. Draw a vertical line (y-axis) and horizontal line (x-axis) on each section of the graph paper.

Label both vertical lines (y-axes) Focus Depth (km) and label both horizontal lines (x-axes) Longitude (°W). On both sections of the graph paper (Tonga Trench and Peru Chile Trench), create a scale for the vertical axes (focus depth) ranging from 0-700 km. Going by intervals of 50, label zero at the top of the y-axis and 700 at the bottom of the y-axis. On the left section of the graph paper (Tonga Trench) create a scale for the horizontal axis (longitude) ranging from 173-180 °W. Going by intervals of 1, label the right end of the x-axis 173 and the left end of the x-axis 180.

On the right section of the graph paper (Peru-Chile Trench) create a scale for the horizontal axis (longitude) ranging from 61-71 °W. Going by intervals of 1, label the right end of the x-axis 61 and the left end of the x-axis 71. Plot the earthquake data from the region associated with Tonga Trench on the left section of the graph paper, and plot the earthquake data from the region associated with the Peru-Chili Trench on the right section of the graph paper, using a dot to represent each point. Data and Results: Pacific Plate Pacific Plate Indian-Australian Plate Indian-Australian Plate South American Plate

South American Plate Nazca Plate Nazca Plate Analysis and Synthesis: 1. Question: How far is the Tonga Trench from the East Pacific Rise? Note that one degree longitude equals about 100 km. If the seafloor spreads at 3 cm/year, how long would it take material on the plate to travel this distance? Answer: The Tonga Trench is 6, 500 km from the East Pacific Rise. If the seafloor spreads at 3 cm/year, it would take material 216. 67 million years to travel this distance. Work: 65°W = 65 x 100 km = 6, 500 km. 6, 500 km x 100, 000 cm = 650, 000, 000 cm 650, 000, 000 cm / 3 cm/year = 216, 666, 667 years 2.

Question: What is the depth of the deepest earthquake in the Tonga data set? Estimate the rate of descent of the East Pacific Rise material at the Tonga Trench in centimeters per year. Answer: The depth of the deepest earthquake in the Tonga data set is 675 km. The rate of descent of the East

Pacific Rise material at the Tonga Trench in centimeters per year is 0. 312 cm/year. Work: 675 km x 100, 000 cm = 67, 500, 000 R = 67, 500, 000 cm / 216, 666, 667 years R = 0. 312 cm/year 3. Question: Estimate the rate of descent of East Pacific Rise material into the Peru-Chile Trench in centimeters per year. Answer: 5°W = 45 x 100 km = 4, 500 km 4, 500 km x 100, 000 cm = 45, 000, 000 cm 450, 000, 000 km / 3 cm/year = 150, 000, 000 years 540 km x 100, 000 cm = 54, 000, 000 cm R = 54, 000, 000 cm/ 150, 000, 000 years R = 0. 36 cm/year Interpret and Explain Data The data represents the focus depths and longitudes (°W) of the earthquakes that occur at the Peru-Chile Trench subduction zone, and the Tonga Trench subduction zone. On the Tonga Trench as longitude (°W) increases, or moves further from the prime meridian, the focus depth also increases, or becomes deeper. This creates a steeper slope, and the line appears to be moving upwards.

On the Peru-Chile Trench as longitude (°W) increases, or moves further from the prime meridian, decreases, or becomes shallower. This creates a smoother slope that appears to be moving downwards. On the Tonga Trench graph, the best-fit line is an estimate of the location of the boundary between the Pacific Plate and the Indian-Australian Plate. The Pacific Plate is subducting, or moving under the Indian-Australian Plate as this plate overrides the Pacific Plate. On the Peru-Chile Trench graph, the best-fit line is an estimate of the location of the boundary between the Nazca Plate and the South American Plate.

The Nazca Plate is subducting, or moving under the South American Plate as this plate overrides the Nazca Plate. The Peru-Chile Trench and Tonga Trench have similar earthquake focus depths (km), but the longitude (°W) of these earthquakes is different. Summary of Data As two tectonic plates converge, if one or both of the plates is an oceanic lithosphere, a subduction zone will form. The Tonga Trench has a steeper profile than the Peru-Chile Trench. This is because older crust is cooler and denser than younger crust therefore it subducts at a steeper angle.

The Tonga Trench has the steeper and older material. As observed from the charts, the Tonga Trench has a steeper profile than the Peru-Chile Trench. This means that the crust at the Tonga Trench is older and denser than the crust at the Peru-Chile Trench, therefore it subducts faster and at a steeper angle. The density of the rock that makes up the subducting plate determines they way in that a plate behaves. A plate with a greater density subducts into the mantle faster and at a steeper angle than a plate with a lower density.

The age of the crust involved in the subduction also affects the rate at which it subducts. Older crust is cooler and denser therefore it subducts at a steeper angle and faster than new crust at a subduction zone. Conclusion: Check Your Hypothesis: My data supports my hypothesis. I predicted that the East Pacific Rise material at the two convergent boundaries: the Tonga Trench and the Peru-Chile Trench is older than the crust created at the East Pacific Rise but the Tonga Trench material is older than the Peru-Chile Trench.

This is true because the Tonga Trench and Peru-Chile Trench will have older material, as they are further away from where the crust is created. In addition, it is true that Tonga Trench has older material than the Peru-Chile Trench because it has a steeper slope, which means it is older and denser. Errors and Fixes: In this lab report, I researched more on my background information to enhance my understanding of the topic. In addition, I explained and analyzed my data to make it easier to understand the trends and what the data actually means.

I also provided instructions on using a table of data, setting up, and preparing a graph, and preparing a lab report. The errors I had in my lab report were with the math work on the first three analyze questions, the direction in which the plates subducted, and my hypothesis did not clearly state an answer to my question. I revised these errors by paying attention in class as the math problems were reviewed as this gave me a better understanding of how to solve the problems correctly.

In addition, I had the direction of which the Pacific Plate moves against the Indian-Australian plate as moving upward, but since the plate is being subducted under the Indian-Australian plate I changed the direction to downwards. Lastly, I revised my hypothesis by correctly stating the question asked which was to compare the relative ages of the East Pacific Rise material at the two convergent boundaries: the Tonga Trench and the Peru-Chile Trench. In my original hypothesis, I only stated the relative age of the East Pacific Rise material.