



UNC
WORLD VIEW

NC GLOBAL DISTINCTION

Faculty Curriculum Development Grant Proposal Cover Sheet

Individual Project

Community College: Guilford Technical Community College

Applicant Information

Department: Sciences

Phone: 336-334-4822 ext. 50003

Email: jasawyer1@gtcc.edu

Name of College VP of Instruction: Dr. Beth Pitonzo

Which course will this project create a global module for? GEL-111 Geology

World region module will focus on (choose 1 or 2 regions unless you choose "A combination of World Regions").

Africa

Asia

Europe and the European Union

Latin America

Middle East and Muslim civilizations

A combination of World Regions

How many students enroll in these courses per academic year? ~600

Jennifer A Whisman
Geology Instructor
Guilford Technical Community College

Course to be Globalized: GEL-111 Geology

Description of the course:

This course introduces basic landforms and geological processes. Topics include rocks, minerals, volcanoes, fluvial processes, geological history, plate tectonics, glaciers, and coastal dynamics. Upon completion, students should be able to describe basic geological processes that shape the earth. *This course has been approved for transfer under the CAA as a general education course in Natural Science. This is a Universal General Education Transfer Component (UGETC) course.*

Description of the Module:

Students will learn about Plate Tectonics, the unifying theory of Geology, through exploring Japan. Plate Tectonics explains that the crust of the Earth is divided into large slabs of rock that move slowly about, ripping apart, grinding against, or slipping underneath one another. This movement creates dramatic mountain landscapes, causes devastating earthquakes, and violent volcanic eruptions. Throughout the semester, students will learn about the types of plate boundaries that occur in Japan and the hazards associated with each. Emphasis will be placed on the 1995 Kobe earthquake, and the 9.0 magnitude earthquake that shook Japan in 2011 and the tsunami that followed. In addition, students will examine the history of geologic disasters in Japan, how they have shaped Japanese culture, and how the Japanese respond to disasters. Students will also contrast geologic explanations and myths surrounding the formation of Mt. Fuji to explore the scientific method and to introduce plate tectonics.

Global Learning Outcomes:

Upon completion of this module, students will be able to:

- 1) Apply the scientific method to geologic and mythical explanations of the formation of Mt. Fuji to understand the nature of scientific inquiry.
- 2) Examine the frequency of earthquakes and volcanic eruptions in Japan and reflect upon the impacts these disasters have had on Japanese culture and society.
- 3) Locate the epicenter of the 1995 Kobe earthquake by reading seismograms and using the method of triangulation.
- 4) Determine the types of volcanoes in Japan and their likely eruption styles using topographic profiles.
- 5) Design a culturally competent disaster mitigation plan to include disaster education, warning systems, appropriate locations for evacuation routes and shelters, and cultural considerations in tsunami-prone regions of Japan.

Possible Global Learning Activities:

1) Title: Scientific Method and Japanese Mythology

Objective: Students will be able to articulate the steps of the scientific method and to apply those steps to scientific information. Students will be able to determine whether questions about the formation of Mt. Fuji and earthquakes can be answered with science or if they fall under the realm of legends and mythology.

Procedure: This exercise will take place in the first or second week of the semester during a unit on the Scientific Process. Students will learn about how science works, including what science can and cannot do, the types of questions that science can address, and the types of questions science can and cannot answer. The unit begins by asking the class a series of true/false questions, each followed by discussion. For example, the class might be asked if the following statement is **true or false**: “Science can prove anything, solve any problem or answer any question.” This may be done through a PowerPoint presentation or as a clicker/poll exercise (e.g. Kahoot, PollEverywhere, etc.). The instructor then lists and explains the steps of the scientific method. For most students, the scientific method has already been learned in previous college courses and in high school, so this is generally a quick review. Next, the instructor reads or shows a video of *The Bamboo Cutter’s Daughter*, one of Japan’s oldest written texts. This story explains how the fires of Mt. Fuji were ignited when the Emperor of Japan, who had fallen in love with a Moon goddess, sent her a message by burning it upon the highest point in the land. As a class, students discuss the aspects of the story that are untestable, and therefore not scientific. The story of *The Bamboo Cutter’s Daughter* is then contrasted with the geologic explanation of the formation of Mt. Fuji, and the class discusses how geologists might have derived the explanation, as well as how it may be tested using the scientific method.

Follow-up assignment and assessment:

Working in small groups, students will be given a mythical story explaining a geologic phenomenon. Students will determine the aspects of the myth that are not testable, and therefore are not scientific. They will then research the geologic explanation for the phenomenon. Students will present the following to the class: their myth and why it is not scientific, the geologic explanation, and how the scientific method could be used to test the geologic explanation. Presentations should be about 5 minutes long.

Resources:

Appendix A: True/False questions

F. Hadland Davis. *Myths and Legends of Japan*. Forgotten Books. 2017

Geology News and Information: www.Geology.com

Ozaki, Yei Theodora. *Japanese Fairy Tales*. AL Burt Company, 1908.

NOTE: The Bamboo Cutter and the Moon Child is in this book, but the story can also be found online.

Smits, Gregory. Shaking up Japan: Edo society and the 1855 catfish picture prints. *Journal of Social History* 39: 1045-1078.

United States Geological Survey: www.usgs.gov

Website: www.kahoot.it

Website: www.polleverywhere.com

2) Title: Plate Tectonics of Japan and Cultural Response to Disasters

Objective: Students will learn about the complex nature of Japan's plate boundaries, and reflect upon how frequent geologic disasters have affected Japanese culture and society.

Procedure: This unit begins alongside, or just after, teaching the details of the six types of plate boundaries. Open Google Earth, and download and open the KMZ file *Tectonic Plate Boundaries*. Show students Japan in Google Earth with the plate boundaries visible. Ask them to identify trenches in the image. Point out that Japan borders/is very near the Japan Trench, the Nankai Trough, Ryukyu Trench, Kuril Trench, and the Izu-Bonin Trench. Students are lead through a discussion of the types of geologic hazards associated with subduction zones (which are marked by trenches). Students should recall that earthquakes, tsunamis and volcanic eruptions are all associated with subduction. In Google Earth, turn on layers in the "Gallery" section to show the locations of volcanoes and recent earthquakes. Point out the high concentration of volcanoes and earthquakes in Japan. Indeed, Japan is the most seismically active country in the world. Also, point out Mount Fuji and the location of the 9.1 magnitude Tohoku earthquake that rocked Japan on March 11, 2011.

Show the video [Japan—Overview of Earthquakes and Tectonics](#). After the video, lead the students through a discussion of the other types of tectonic boundaries (transform and continental-continental convergent boundaries) and their associated hazards explained in the video. In addition, discuss the Kobe earthquake in 1995, which killed more than 5,500 people near Kobe and displaced 250,000, and the 2011 Tohoku earthquake and tsunami that claimed nearly 20,000 lives and displaced more than 300,000. Finally, discuss the timing of historic earthquakes and tsunamis in Japan, focusing on how these records may have helped to predict the 2011 Tohoku earthquake and tsunami.

Historic records of earthquakes and tsunamis go back nearly 1300 years in Japan. They include an interesting outlier: about 300 years ago, Japan experienced a nuisance tsunami without a major earthquake preceding the event. By this time, the Japanese had long known that tsunamis followed earthquakes by this time. Recent research suggests that this orphan tsunami was probably generated by plate movement along the Cascadia Range in the Pacific Northwest of North America, which would have caused a devastating earthquake in the vicinity of Seattle, Washington and a tsunami that impacted the entire Pacific Ocean. Discuss how lessons from Japan should be applied to the Cascadia subduction zone, suggesting this is an area that may expect a major tsunami in the geologically near future.

Follow-up assignment and assessment:

Students will read *Disaster and the Japanese Spirit*, by Alexander N. Meshcheryakov and *Japan: How a Quake Changed a Culture*, by Michael Fitzpatrick. Students will reflect on the complex geology of Japan and how associated natural disasters may have shaped Japanese culture. They will then write a personal response to the 2011 earthquake in Japan, and their own experiences and responses to natural disasters.

Resources:

About Japan Editors. *Natural Disasters*. About Japan: A teacher's resource. Website:
http://aboutjapan.japansociety.org/natural_disasters_1#sthash.LdAKDA2O.dpbs

Fitzpatrick, Michael. Japan: How a Quake Changed a Culture. 10/09/2011. Website:
<https://www.pri.org/stories/2011-10-09/japan-how-quake-changed-culture>

Google Earth: <https://www.google.com/earth/>

History of Geology. *Historic Tsunamis of Japan* by David Bressan, 2011 (website)
<http://historyofgeology.fieldofscience.com/2011/03/historic-tsunamis-in-japan.html>

Japan—Overview of Earthquakes and Tectonics. IRIS Earthquake Science. 2017 (video)
<https://www.youtube.com/watch?v=5BHnf1wGD9w>

Meshcheryakov, Alexander. *Disaster and the Japanese Spirit*. 3/31/2016. Website:
<https://www.nippon.com/en/column/g00353/>

Numo Report: *Tectonic Setting and Evolution of Japan*. NUMO-TR-04-04.
https://www.numo.or.jp/en/reports/pdf/Level3_SF_Final-06.pdf

Tectonic Plate Boundaries KMZ file: <https://earthquake.usgs.gov/learn/plate-boundaries.kmz>

3) Title: Topographic Maps

Objective: Students will create topographic maps and profiles of Japanese volcanoes. These profiles are compared to images of composite, shield, and scoria cone volcanoes to determine the types present in Japan, and to predict their associated hazards.

Procedure: This unit should take place during mid-semester, after students have learned about volcanoes and volcanic hazards. Students should already be familiar with stratovolcanoes, cinder cones/scoria cones and shield volcanoes. They should also be familiar with the general shapes of these types of volcanoes, their associated types of lava, eruption styles and volcanic hazards. To begin this unit, introduce students to the basics of topographic maps by examining a map of your school or town. Students should be introduced to the terms *contour line*, *index contours*, *spot elevations*, and *benchmarks*, shown examples, and asked to identify these features on their maps. Students will be asked to locate landmarks, determine elevations, and the direction of water flow from topographic information on the map. To close, students are asked to brainstorm uses for topographic maps in geology, followed by discussion of the uses they determine. Students should be shown geologic maps and hazards maps (flood zones, lahar and pyroclastic flow maps and tsunami impact zones)

Follow-up assignment and assessment:

The follow-up assignment will occur in lab. Students are asked to complete three topographic maps of Japanese volcanoes using spot elevations provided by their instructor (see appendix B). Maps have been provided for Mt. Omuro (a cinder-cone), Mt. Washiba (a shield volcano), and Mt. Fuji (a stratovolcano). After completing the maps, students will create topographic profiles of each mountain and will compare them to typical stratovolcanoes, cinder cones and shield volcanoes to identify the volcanoes on their

maps. Students should then reflect on the types of volcanic hazards associated with each type of volcano to explain the threat each mountain poses on inhabitants of the surrounding countryside.

Resources:

Appendix B: Student Activity--Topographic Maps and Volcanoes in Japan

Perry-Castañeda Library Map Collection: <https://legacy.lib.utexas.edu/maps/>

Google Earth: <https://www.google.com/earth/>

Google Maps: <https://www.google.com/maps>

Volcanoes and Volcanic Eruptions-Facts and Information: www.Geology.com/volcanoes

Volcano Discovery Website: www.volcanodiscovery.com/honshu.html

4) Title: Earthquake Lab

Objective: Students will analyze seismograms of the 1995 Kobe earthquake in Japan to determine the magnitude and location of the epicenter. Students will determine the tsunami risk associated with the earthquake based upon its magnitude, location, and plate tectonic theory.

Procedure: Students will have already learned the basics of plate tectonics and the causes of earthquakes and tsunamis. In this lesson, students will learn how to determine the epicenter and Richter magnitude of an earthquake. To determine the epicenter, students must be able to identify the time that p-waves and s-waves arrive at a seismic station from a seismograph. Using the s-p interval, or, the amount of time between the arrival of the s and p waves, students can determine the distance of the earthquake's epicenter to the seismic station from seismograph and a time-distance chart. Once the distance is known, a circle with a radius equal to the distance from the seismic station to the epicenter is drawn around the seismic station. The epicenter is located at some point along the circumference of the circle. This procedure must be followed for two additional seismic stations to triangulate the location of the earthquake's epicenter. The epicenter is located at the point where the three circles from each station intersect. Once the epicenter has been located, the Richter magnitude can be determined by plotting the distance from the epicenter and the amplitude of the highest s-waves on a nomogram chart, and connecting those points. The Richter magnitude is found at the intersection of the drawn line and the middle scale on the chart.

Follow-up assignment and assessment:

This assignment will be completed as a Lab exercise. Students will be given seismographs of the 1995 Kobe earthquake obtained from three seismic stations, which have been plotted on a map of Asia and the Sea of Japan. In addition, students will have a distance-travel chart and a nomogram. Students will be instructed to determine the location of the epicenter and magnitude of the earthquake. Follow-up questions will ask students to determine if the earthquake would have been felt by the people living nearby, the amount of damage expected, and if the earthquake would have likely caused landslides and/or tsunamis. Upon completion of the lab, students will be told that the earthquake they analyzed

was the 1995 Kobe earthquake. Students will research the Kobe earthquake and reflect on the impact this event had on the people of Japan.

Resources:

Appendix C: Japan Seismology Lab

United States Geological Survey: www.USGS.gov

UPSeis. How do I locate that earthquake's epicenter? www.geo.mtu.edu/UPSeis/locating.html

5) Title: Natural Disasters Project-Geologic Hazard Mitigation

Objective: Working in small groups, students will use their knowledge of plate tectonics, earthquakes, volcanoes and topography to create a geologic hazards mitigation plan for a coastal city in Japan. Students will determine areas in likely need of evacuation, appropriate evacuation routes, rendezvous points and appropriate shelter areas. Students will present their recommendations to a panel of reviewers (their classmates).

Procedure: This activity will serve as a final project. Working in groups of 3-4, students will use Google Earth to find a coastal town in Japan with a nearby volcano. Students will use Google Earth, Google Maps, and the Perry-Costañeda Library Map Collection to locate topographic and hazards maps of the town and surrounding countryside. Students should research their location and determine the population, population density and population dynamics (average age, diversity, etc.) of their town. Students will research nearby volcanoes and their associated hazards, and create a topographic profile to determine the type(s) of volcano(es) located nearby. Finally, students will research historic volcanic eruptions, earthquake and tsunami records to determine the most likely geologic hazards their town might face. Students will then recommend steps the town and citizens should take to prevent loss of life and property as part of a Geologic Disasters Mitigation Plan. Plans must include procedures to be followed in case of an eruption or tsunami (note, the response should be different for each). Areas to be evacuated, evacuation routes, rendezvous points and appropriate shelter locations (at least one shelter/10,000 people) should be identified, keeping in mind that these may vary between types of disasters. Students should include how they will educate the public about the plan ahead of, warn and communicate during, and support the public after the disaster. Students should research disaster mitigation practices already in place in Japan as a starting point. In addition, students will research societal impacts of past disasters on the Japanese and how Japan has responded. These findings will be presented to their peers for feedback.

Follow-up assignment and assessment: Each student will individually research typical western attitudes and responses to disasters and contrast them with those of the Japanese. Students will individually write a short essay reflecting on the cultural competence of their Disaster Mitigation Plan and make suggestions for improvement.

In addition, students will reflect upon one of the disaster mitigation plans created by their classmates. Upon reviewing a plan, each student will offer suggestions for improvement, paying special attention to the chosen evacuation areas, evacuation routes, and shelter locations. Students assigned to review the

same plan will then work together as a review panel to suggest a minimum of two additional shelter locations and rendezvous points.

Resources:

Japan—Overview of Earthquakes and Tectonics. IRIS Earthquake Science. 2017 (video)

<https://www.youtube.com/watch?v=5BHnf1wGD9w>

John C. Scott. Concept Paper: *Importance of Cultural Competency in Disaster Management*. Consensus Building Meeting for the Cultural Competence for Disaster Preparedness and Crisis Response Project. 2007.

Perry-Castañeda Library Map Collection: <https://legacy.lib.utexas.edu/maps/>

Google Earth: <https://www.google.com/earth/>

Google Maps: <https://www.google.com/maps>

Starrs, Roy. *When the Tsunami Came to Shore: Cultural and Disaster in Japan*. Brill NV 2014.

Bestor, Theodore C, 2013. Disasters, natural and unnatural: reflections on March 11, 2011 and its aftermath. *Journal of Asian Studies* vol. 72: 763-782.

Appendix A: True/False Questions

Science is concerned with understanding how nature and the physical world work.

Science can prove anything, solve any problem or answer any question.

Any study done carefully and based on observation is scientific.

Science can be done poorly.

Anything done scientifically can be relied upon to be accurate and reliable.

Different scientists may get different solutions to the same problem.

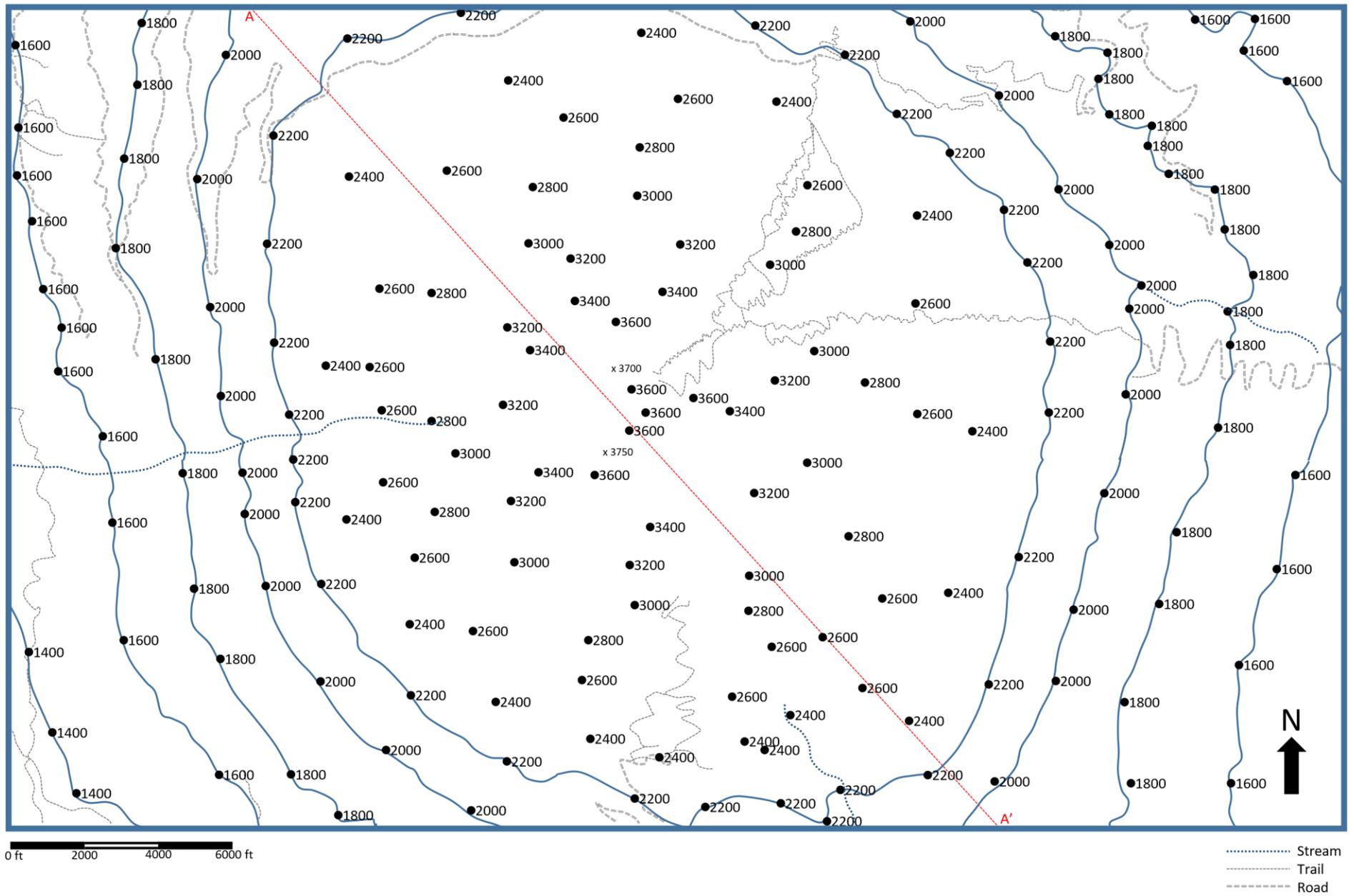
Knowledge of what science is, what it can and cannot do, and how it works, is important for all people.

Appendix B: Student Activity—Topographic Maps and Volcanoes in Japan

Topographic Maps and Volcanoes in Japan

1. Complete the maps in Figures 1, 2 and 3 by drawing index contour lines through the spot elevations. Remember contour lines:
 - do not cross, split or merge.
 - form a “v”-shape pointing upstream where crossing over rivers.
 - Should be drawn so that higher elevations are on one side and lower elevations are on the other.
2. Use the vertical sections for each volcano to draw profiles through lines A – A', B - B' and C – C'.
3. Recall the shapes and sizes (profiles) of stratovolcanoes, cinder cones and shield volcanoes, and compare each to the completed topographic maps and profiles. Label each map with the corresponding volcano from the options below:
 - I. Mount Washiba (shield volcano)
 - II. Mount Omuro (cinder cone)
 - III. Mount Fuji (stratovolcano)
4. Use Google Earth and Google Maps to find each volcano. Examine the surrounding countryside and determine the locations of nearby population centers and landmarks. Provide the following information in the space below each topographic profile:
 - a) Name and elevation of the nearest town
 - b) Description of landmarks and population density in the surrounding countryside
 - c) Which volcanic hazards would be most likely if the volcano were to erupt?
 - d) What can the people living at the base of each volcano do to prepare.
5. Identify each volcano as active, dormant or extinct. You may find information about these volcanoes on the following website: www.volcanodiscovery.com/honshu.html

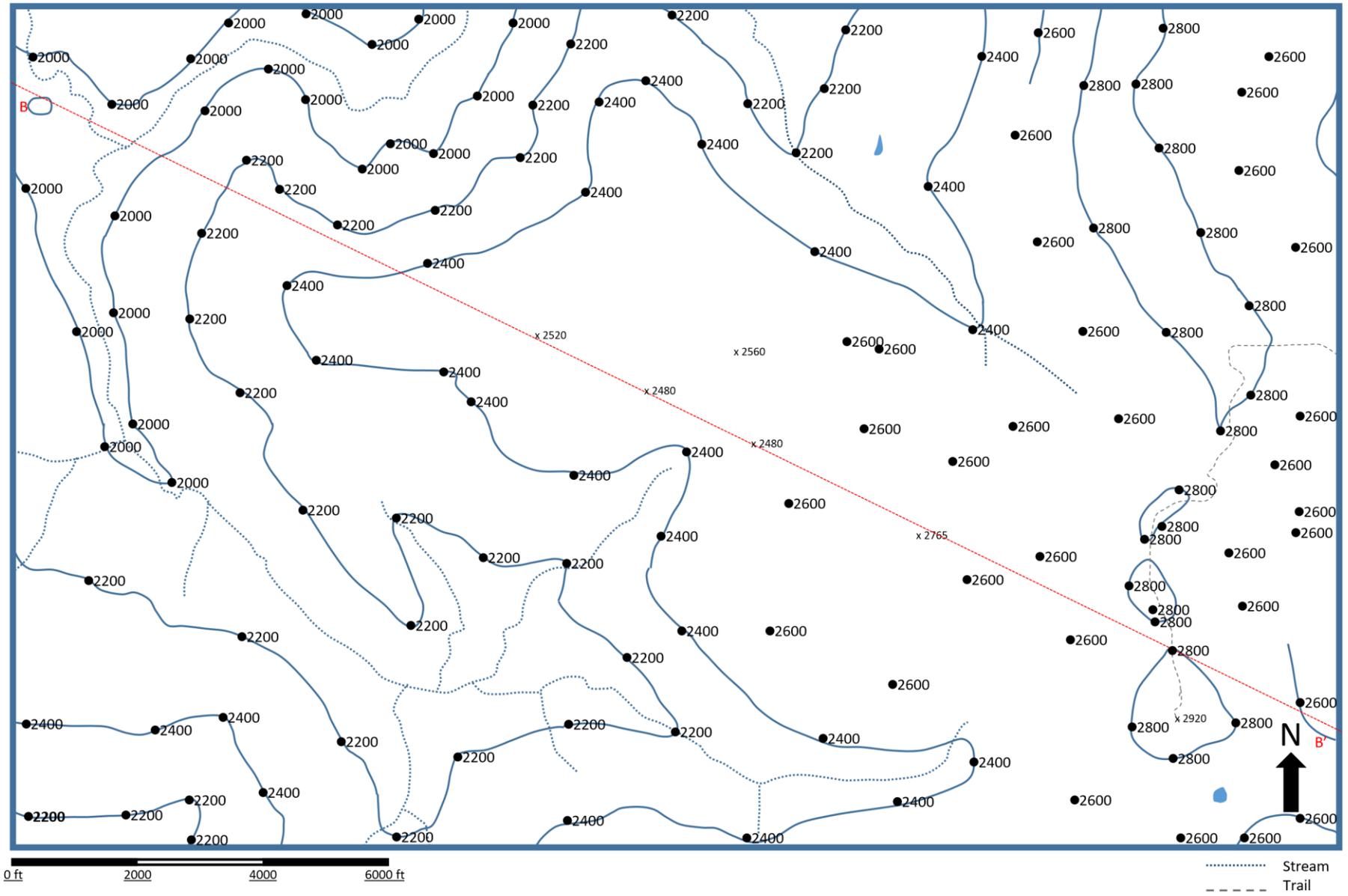
Figure 1: Volcano A Mount _____



Profile: Volcano A



Figure 2: Volcano B Mount _____

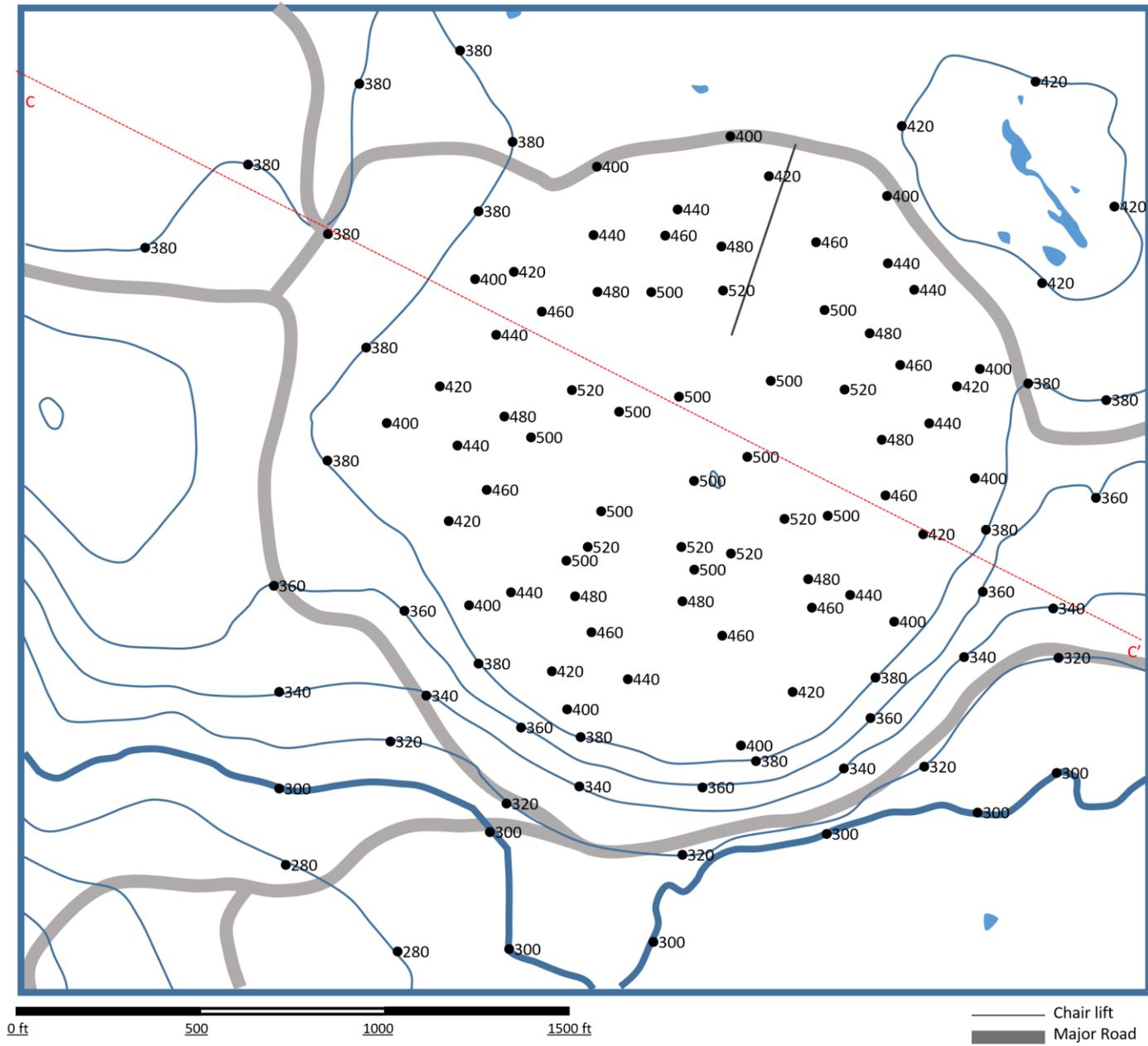


Profile: Volcano B



Figure 3: Volcano C

Mount _____



Profile: Volcano C



Appendix C: Japan Seismology Lab

Japanese Seismology Lab



Reading the Seismograms (Figure 1)

1. What time in H:M:S did the P-waves arrive at seismic station A?
2. What time in H:M:S did the S-waves arrive at seismic station A?
3. What is the S-P interval in H:M:S at Seismic station A?
4. What time in H:M:S did the P-waves arrive at seismic station B?
5. What time in H:M:S did the S-waves arrive at seismic station B?
6. What is the S-P interval in H:M:S at Seismic station B?
7. What time in H:M:S did the P-waves arrive at seismic station C?
8. What time in H:M:S did the S-waves arrive at seismic station C?
9. What is the S-P interval in H:M:S at Seismic station C?

Determination of Earthquake's Epicenter (Figure 2 and 4)

10. What is the distance between seismic station A and the earthquake's epicenter?
11. What is the distance between seismic station B and the earthquake's epicenter?
12. What is the distance between seismic station C and the earthquake's epicenter?
13. A) Use the method of triangulation to determine the location of the earthquake's epicenter, and mark it with a star. B) Would this earthquake likely have caused a tsunami? C) Landslides?

Determination of Earthquake's Time (T_0) (Figure 2)

14. Use the arrival time for the P-waves at location A and determine when the earthquake happened. Do the same procedure for the other 2 locations.
15. Do you get the same results for T_0 at all three seismic stations. Explain why these results might be different.

Determination of Earthquake's Magnitude (Figure 3)

16. A) Determine the earthquake's magnitude with the information from all three seismic stations. B) Do you get the same results? Explain why these results might be different. C) Was this earthquake strong enough to have caused damage near the epicenter?
17. What happen with the P-waves and S-waves when they reach the ocean?
18. Which seismic station is closest to the earthquake's epicenter? Can we figure out which seismic station is the closest or the furthest by just looking at the three seismograms, instead of looking at the map?
19. The seismograms in Figure 1 are from an infamous earthquake that occurred in Japan sometime in the past 50 years. Using your results, determine which earthquake inspired this lab exercise.
20. Write a couple paragraphs explaining why this earthquake was important in the history of Japan, and how has it impacted Japanese society.

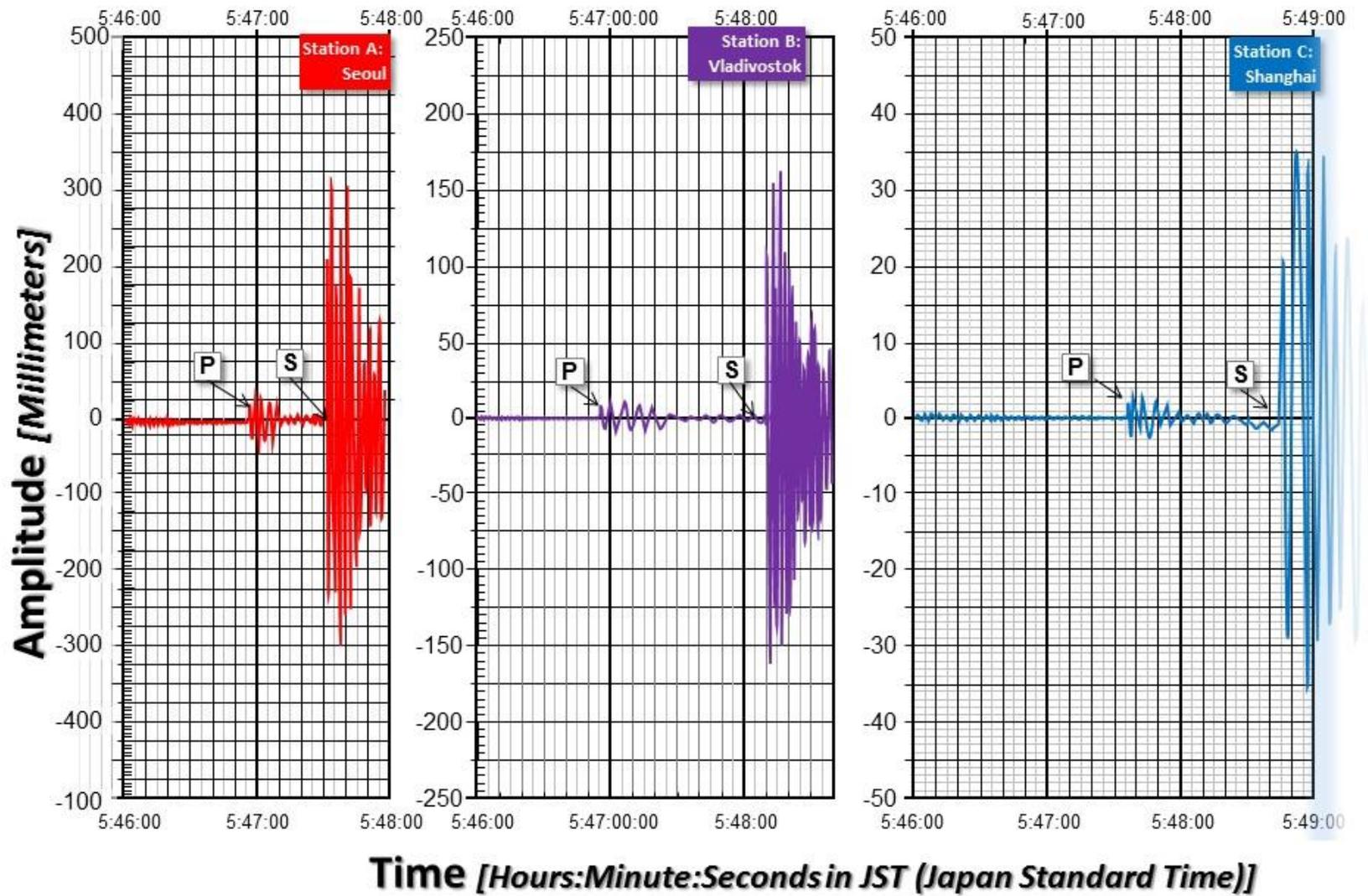


Figure 1: The seismograms of the three seismic stations

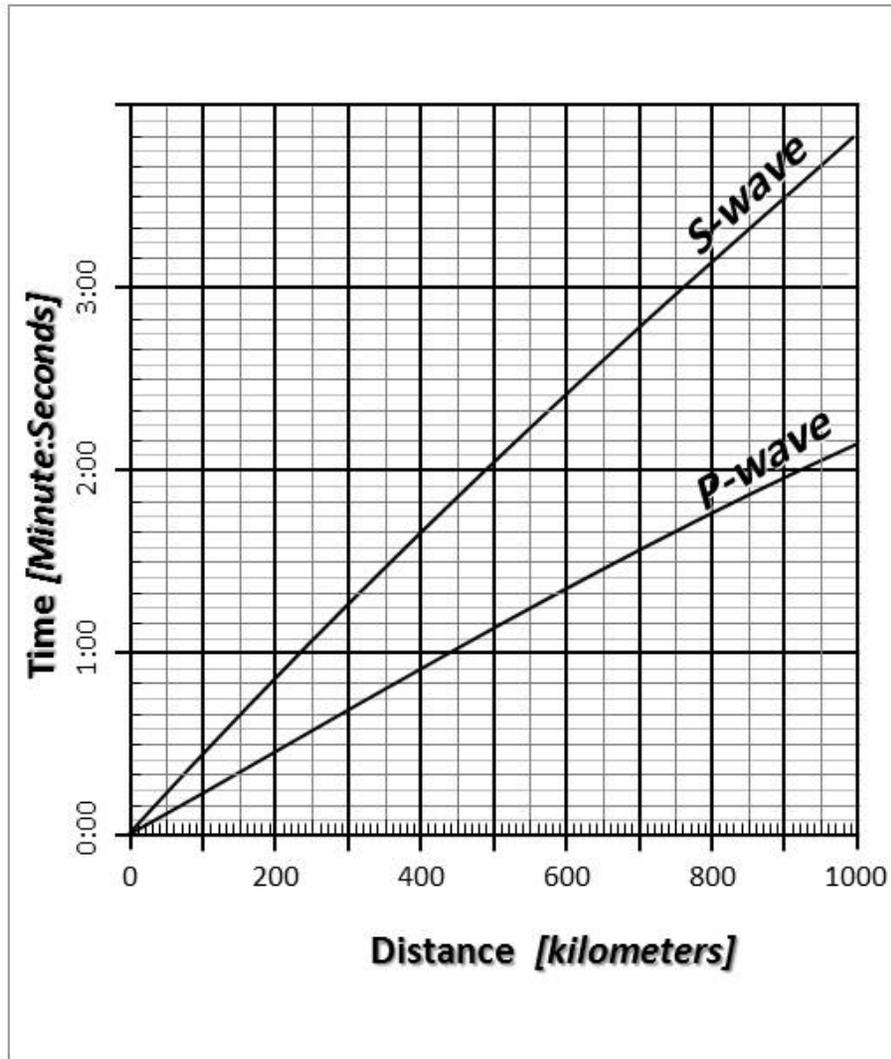


Figure 2: Time-travel chart

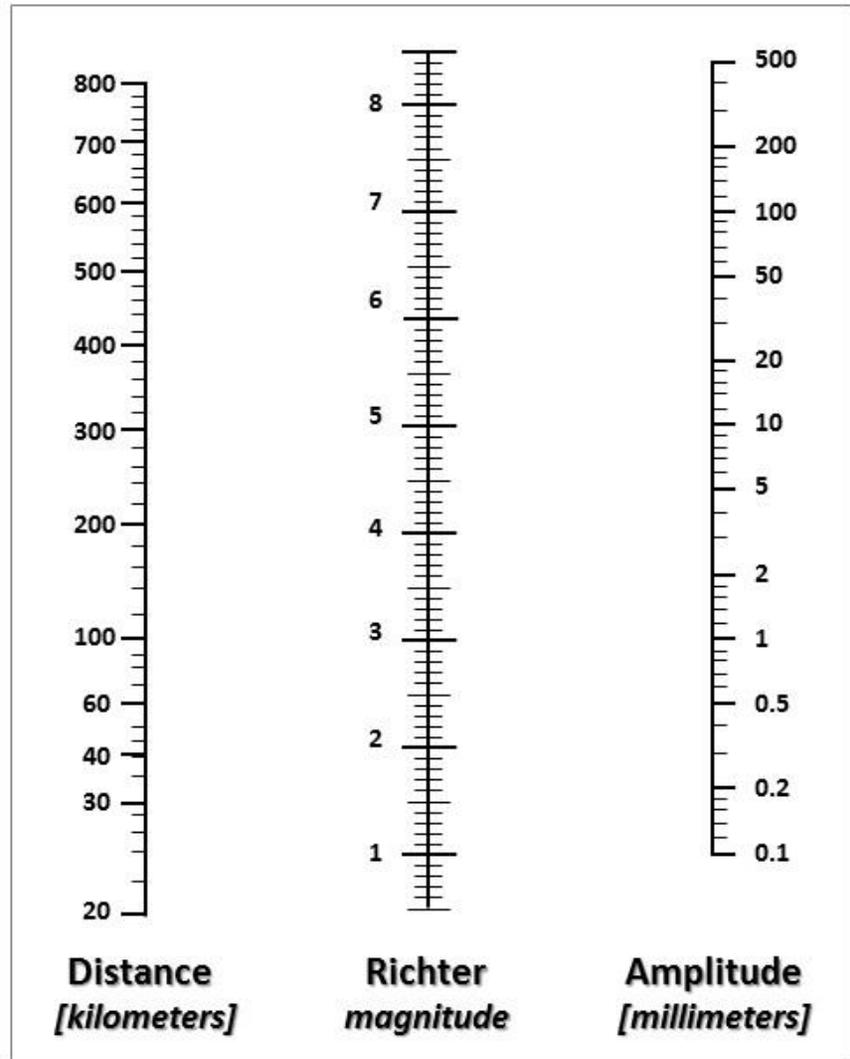


Figure 3: Nomogram

