EENS 3050	Natural Disasters
Tulane University	Prof. Stephen A. Nelson

Homework III. Volcanological Exercises

This page last updated on 16-Feb-2018

1. In your work as an insurance company executive you have been reassigned to head up the Tacoma, Washington office of Denyallclaims Insurance Co. Although Tacoma is located about 50 miles from the volcanic mountain, Mount Rainier, other executives in Denyallclaims have assured you that the volcano has not erupted for a long time and there is no risk associated with the volcano. In fact, the current manager of the office, has offered to sell you his home in the suburb of Orting, Washington, for what seems to be a good price. You decide to check things out for yourself, and go to the internet to search for hazards associated with Mt. Rainier, Washington. One good site is - https://pubs.usgs.gov/fs/2008/3062/

   The following are questions you (and your professor) want answered.

   a. When was the last time Mt. Rainier had an eruption? **(1 point)**

   b. Are there any types of volcanic hazards associated with Mt. Rainier that could affect you in the future if you were living in the area of Tacoma or its suburbs? If so, what types of hazards have affected the Tacoma area in the past? **(1 point)**

   c. Considering that the summit area of Mt. Rainier is covered to a large extent by glacial ice, would residents of the Tacoma area be threatened in any way by a small eruption from the volcano that only sent a few lava flows down the flanks, none reaching more than 1 km from the summit? If so, why, and if not, why not? **(2 points)**

   d. Among the things you should be able find is a USGS hazards map for the area around Mount Rainier. What hazards exist in Orting, Washington where the Denyallclaims manager has offered to sell the house? How often do events represented by this hazard occur? **(1 point)**

   e. Find a site on the internet that discusses hazards in Orting, Washington (hint: use the search terms **Orting** and **hazards**). Describe the location of Orting in terms of its topography and location relative to rivers, and discuss why this location could be particularly at risk (use the map you found in part d to help you with this) **(1 point)**

   f. What steps have been taken in Orting to reduce risk? **(1 point)**

2. Use the internet to answer the following questions (Note that you might have to find more than one article on the internet to answer both questions):

   a. What possible volcanic event could occur in the Canary Islands (off the northwest

coast of Africa) that could have a disastrous effect on the east coast of the United States? (Try the key words - Canary - Islands - disaster) Describe the possible event and the possible effects it would have on the United States. **(2 points)**

b. How much warning would U.S. east coast cities have to prepare for the event if it occurred? (**1 point)**

3. Go the following web site: http://www.agiweb.org/geotimes/may00/featurestory.html read the article entitled: "*Mount St. Helens 20 Years Later: What we have learned*"**.** Then answer the following questions.

   a. Give a summary of the sequence of events that occurred at Mount St. Helens beginning at about 8:32 AM on May 18, 1980 and ending on May 19. **(2 points)**

   b. Which one of these events was the main cause of human fatalities? **(1 point)**

   c. What three important lessons were learned form the eruption (summarize in your own words? **(2 points)**

   d. What is probably the most far-reaching scientific finding from the eruption? Why is this important? **(1 point)**

   e. Were scientists aware of the fact that Mount St. Helens could have a devastating eruption in the years prior to the 1980 event? **(1 point)**

   f. What factor(s) most strongly influence awareness of and increased funding levels for volcanic hazards studies (and natural hazards studies in general)? **(1 point)**

4. Some volcanic eruptions have occurred within the last several million years that are larger and more destructive than anything a human being has ever witnessed, or at least lived to write about. These volcanoes erupt over 1000 km^3 of magma, mostly in the form of Plinian tephra falls and pyroclastic flows (ignimbrites) and result in the formation of large collapsed areas, called calderas. Three of these volcanic centers have erupted within what is now the United States in the last 1.2 million years. These are - Long Valley Caldera, Yellowstone Caldera, and Valles Caldera. This exercise asks you to learn about one of these large rhyolitic eruptive centers, Long Valley Caldera. A Good starting point can be foudn at - http://pubs.usgs.gov/fs/2014/3056/pdf/fs2014-3056.pdf

   a. When did Long Valley Caldera form? **(1 point)**

   b. How much magma was erupted from the Long Valley system during the Caldera forming eruption? **1 point)**

   c. How far east is ash from this eruption still found today? **(1 point)**

   d. Is there any indication that the Long Valley magma system is still active? If so, what evidence is there that the system is still active and that volcanic activity is likely to continue into the near future? **1 point)**

5. Volcanoes that produce gigantic eruptions like those that occurred at Long Valley Caldera and Yellowstone (discussed in class) have recently been termed supervolcanoes. Eruptions

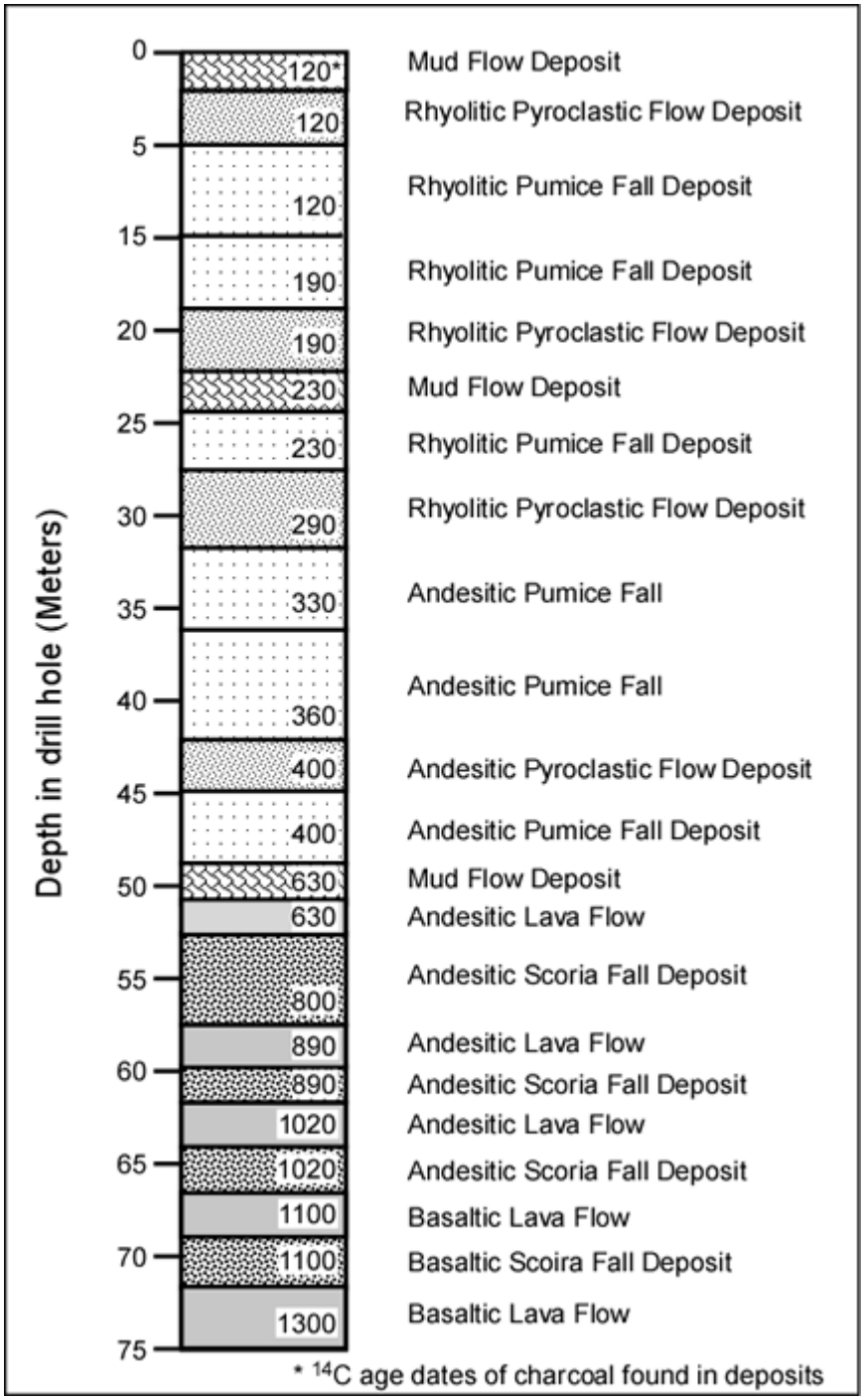
of supervolcanoes have the potential of producing world-wide catastrophic disasters. Use the internet to determine if there have been any supervolcano eruptions that produced over 2,000 km^3 of erupted material in the last **100,000** years that could have been large enough to affect humans on a global scale. If you can find one, where is it, when did the eruption occur, and what were the likely effects on human populations? **(2 points)**

6. Having decided to keep your job as Regional manager for Denyallclaims Insurance Company in the San Francisco Bay area (and keep your home in Mill Valley), the executives at the main office assign you a new task. A company is requesting insurance coverage on a ski resort they are planning to build in a South American country bordering on the Pacific Ocean. The ski resort will be built at the base of a conical mountain peak where a valley cut into the side of the mountain empties onto a broad flat plain. You are asked to evaluate the risk of building in this locality. Since you suspect that the mountain is a stratovolcano, you decide to go check it out for yourself.

   Upon arrival at the site, you find that there are few rocks or deposits exposed on the valley floor that might give you a hint as to what has been happening at this mountain in the recent past. There are rumors among the people living nearby that the mountain has erupted a couple of times in the past few hundred years, but, they claim that this is nothing to worry about, as it has been a long time since the volcano erupted and the locals consider it to be an extinct volcano. Because you have taken a course on natural disasters, you realize that relying on local rumors may cost you your job, your Mill Valley house, and maybe even your spouse, you decide to acquire more information.

   You find a local geological consulting firm that is capable of drilling a hole 75 meters deep into the valley floor. The company will take core samples of the entire drill hole, and, if they encounter any charcoal within the samples, provide you with ^{14}C age dates of any charcoal they find. When finished, they provide you with a chart, shown on the next page, that shows the depth within the drill hole, a description of the deposits found in the drill hole, and the ^{14}C age of the charcoal they found in the layers (shown as numbers within the layers). Because a ^{14}C age date on charcoal is the date when the original tree or twig died due to exposure to hot volcanic material, it gives a fairly precise date on the eruption which caused the formation of the charcoal. The drill hole data gives a fairly complete picture of the events that have occurred at this particular locality. Other eruptions may have occurred, but they did not leave deposits in this valley.
   From your text and lecture notes you should have learned that pyroclastic flow deposits result from Plinian and Pelean eruptions (very explosive), and scoria fall deposits and lava flows result from Strombolian eruptions (less explosive). Mud flows can form during an eruption or during periods of heavy rains not associated with eruptions. Viscosity and gas content of magmas are the two properties most responsible for explosive volcanic eruptions and both of these properties generally increase with increasing SiO_2 content of the magma.

   From this information, you want to answer the following questions for your report to corporate headquarters.



a. Describe in general how the history of the volcano, as determined in this particular valley, has changed through time as revealed by the deposits found with depth in the drill hole. In particular note how the SiO_2 content of the magmas has changed with time and whether or not this is reflected in the explosivity of the eruptions as revealed by the deposits. (**2 points**)

b. Note that the drill hole data shows two distinct periods of eruptive style of the volcano as exhibited by the deposits. How would you characterize these different periods and when did the change occur? (**2 points**)

c. The average eruption rate, R, (number of eruptions/year) can be obtained by dividing the number of eruptions by the time over which the eruptions occurred*. The average eruption frequency (number of years between eruptions) is then 1/R. What is the average eruption rate and average eruption frequency for (i) the entire sequence represented by the layers represented in the drill hole and (ii) the two different eruptive periods? (Note that in counting eruptions, it is likely that two deposits of different type that have the same ^{14}C age date, probably represent a single eruption) (**3 points**).

*Note that in considering the time periods for this exercise, you should use the range from the first eruption of the period to the beginning of the next period. For example the time range for the entire sequence should be 1300 minus 0, the time range for the first eruptive period should be1300 minus the date of the beginning of the next period, and time range for the second eruptive period should be the date of the beginning of the second eruptive period minus 0).

d. What are the three most likely volcanic hazards expected in this valley? (**1 point**).

e. Based on the above information, provide a one paragraph statement to Denyallclaims corporate headquarters that explains the hazard(s) and evaulates the risk of building a ski resort at this locality? (**3 points**)

Return to EENS 3050 Homepage