LAB: *Mount Rainier: Volcanic Hazards*

Name _____

Physical Geology **Mr. Ling**

Purpose: to investigate the eruptive history, volcanic hazards, and safety measures that can be taken in the event of an eruption of Mount Rainier, Washington.

Materials:

1. U.S. Geological Survey Open File Report *"Volcano Hazards from Mount Rainier, Washington, Revised1998"*
2. *PLATE I*
3. *PLATE II*

Procedure: Answer the following questions using the above U.S.G.S. background materials.

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1. List two aspects of Mount Rainier which create a uniquely significant hazard.

2. In assessing future hazards, what are the primary data gathered by the U.S.G.S.?

3. Why is it that the best data only covers approximately the last 10,000 years?

4. A) List five hazards that occur only during an eruption.

   B) List three hazards that can occur during both eruptions and dormant periods (at any time).

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5. Why would a modern lahar of the same size as a previous one be expected to spread farther and faster?

6. What is the primary hazard at Alder Lake?

7. What are the two hazards that could affect great numbers of people far from the volcano?

8. What is the greatest volcano hazard in the Cascade Range?

9. Tephra (sometimes called “ejecta”) is a collective term for all the clastic materials ejected from a volcano and transported through the air, including volcanic dust, ash, cinders, lapilli, scoria, pumice, bombs and blocks.

   A) How thick can these deposits get near the volcano?

   B) List two hazards from large tephra fragments.

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   C) List nine hazards from fine tephra.

10. A) Have pumice-producing eruptions occurred at regular intervals in the past?

    B) Is it possible to predict when the next one will occur?

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11. A. How far can ballistic projectiles travel from the vent?

    B. How large can they get?

12. What is a pyroclastic flow?

13. What is a pyroclastic surge?

14. What is the difference between a pyroclastic flow and a pyroclastic surge?

15. A. How fast can pyroclastic flows and surges move?

    B. What are the typical temperatures encountered within one?

16. What are the impacts on structures and living things?

17. What is the most likely reason for the lack of abundant evidence of past pyroclastic flows and surges on Mount Rainier?

18. What type of lava is usually produced by Mount Rainier?

19. Lava flows typically occur after the explosive eruptive activity declines. Describe an andesitic lava flow in terms of viscosity, speed of flow, and direct danger to living things.

20. What is the greatest hazard related to future lava flows at Mount Rainier?

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21. List three impacts volcanic gases can have on organisms.

22. State two volcanic environments where vulcanologists collect gas samples.

23. Explain two ways that a debris avalanche can occur.

24. Why are non-magmatic debris avalanches especially dangerous?

25. Describe a worst-case debris avalanche with regard to maximums of distance traveled, velocity, and thickness.

26. What effect can a debris avalanche have on a tributary valley, and why is this hazardous?

27. What is a *lahar*?

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28. Describe the effects of lahars on structures and lakes.

29. What's a cohesive lahar, and why are they called cohesive?

30. What's a non-cohesive lahar, and what triggers them?

31. List four sources of water for lahar formation.

32. How large an area did the Osceola Mudflow (lahar) cover?

33. List the four primary circumstances conducive to future debris avalanches and lahars at Mt. Rainier.

34. What is a *lateral blast*?

35. Do you think a lateral blast tends to be more, or less, destructive than a typical vertical blast?

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36. How far did the 1980 Mount St. Helens lateral blast extend?

37. What circumstances can allow vulcanologists to predict a lateral blast?

38. What circumstances can lead to an unpredictable lateral blast?

39. Describe a *glacial outburst flood*.

40. Glacial outburst floods are not related to volcanic activity. What environmental factors are correlated with them?

41. List five types of data that can be considered warning signals of a potential eruption.

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42. How precise are predictions regarding the probability, type and scale of volcanic eruptions?

43. How can land use planning help protect people from volcanic hazards?

44. Everyone living in a volcano hazard zone for debris avalanches and lahars should assemble a Red Cross Emergency Kit for their car trunk, including a map showing the best routes to high ground. Once an event occurs, what should such people be primarily concerned with?

45. Are areas outside the hazard zone boundaries volcanically hazard-free?

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46. Why does the lateral blast hazard zone extend farthest to the northwest of Mt. Rainier?

47. A single lateral blast would not affect the entire zone shown on PLATE II, Map C, but rather, would affect how large a sector around the volcano?

48. Using PLATE I, name at least three lakes that could be a source of flood waters if they were to receive lahar sedimentation.

49. According to PLATE II, Map A, which Cascade volcano contributes the most to probable tephra fallout?

50. Using PLATE II, Map C, name 15 communities that could be affected by a Case M lahar.

Text from PLATE I

Note on lower Nisqually below Alder Dam:
Inundation area shown downstream from Alder Dam is a sub−case of the Case I lahar. Inundation could result from dam failure caused by lahar impact, displacement by the lahar of some of the water impounded by the reservoir, or possible continuation of the lahar past the dam site. Some part of a Case I lahar may be impounded in the reservoir. Thus, without dam failure, lahar−related inundation downstream from Alder Dam would most probably affect less area than shown.

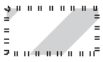
Note: Downstream risk associated with this inundation area includes the potential for dam failure from nonvolcanic causes, including seismically induced failure. Inundation area is mapped at a 1:24,000 scale (by the City of Tacoma Department of Public Utilities, 1997, Nisqually River; Alder and Lagrande Dam failure flood inundation maps).

EXPLANATION

Inundation Zone for Case I Lahars: Areas that could be affected by cohesive lahars that originate as enormous avalanches of weak, chemically altered rock from the volcano. Case I lahars can occur with or without eruptive activity. The average time interval between Case I lahars on Mount Rainier is about 500 to 1000 years.

Inundation Zone for Case II Lahars: Areas that could be affected by relatively large non−cohesive lahars, which most commonly are caused by the melting of snow and glacier ice by hot rock fragments during an eruption, but which can also have a non−eruptive origin. Because the average time interval between Case II lahars from Mount Rainier is near the lower end of the 100− to 500−year range, making these flows analogous to the so−called "100−year flood" commonly considered in engineering practice.

Inundation Zone for Case III Lahars: Areas that could be affected by moderately large debris avalanches or small non−cohesive lahars, all of non−eruptive origin. The average time interval between Case III lahars at Mount Rainier is about 1 to 100 years.



Pyroclastic−Flow Hazard Zone: Areas that could be affected by pyroclastic flows, pyroclastic surges, lava flows, and ballistic projectiles in future eruptions. During any single eruption, some drainages may be unaffected by any of these phenomena, while other drainages are affected by some or all phenomena. The average time interval between eruptions of Mount Rainier is about 100 to 1000 years.

Post−Lahar Sedimentation

Water body

Stream

Spot Elevation, text is elevation in meters

Case II inundation area in lower Puyallup River includes the entire area possibly subject to inundation by such a flow. Actual inundation areas will probably be more limited and will be strongly influenced by the existing and future network of levees and road and rail embankments.

Text from PLATE II

Inundation areas downstream from Mossyrock Reservoir are approximate because of the variety and magnitude of reservoir effects on the flow. Significant attenuation or amplification is possible.

Inundation area from post-lahar sedimentation in the Duwamish and lower Green River systems is based on published topographic information. Actual inundation will probably be more limited than shown and will be strongly influenced by the existing and future network of levees and road and rail embankments.

Area shown in diagonal lines north of Auburn is at significantly reduced (but not eliminated) risk of inundation by a Case I lahar. This area will also be at significant risk from Case II lahars or post-lahar sedimentation if (1) lahars or post-lahar sedimentation significantly reduce the available storage of Mud Mountain Reservoir; (2) aggradation of the lower White River valley south of Auburn by lahars or post-lahar sedimentation from the Puyallup valley causes the White and Puyallup Rivers to drain northward into the Green and Duwamish River valleys.

EXPLANATION

Inundation Zone for Case M Lahars: Areas that could be affected by an enormous debris avalanche and associated cohesive lahars, similar in magnitude to the Osceola Mudflow, the largest lahar to occur at Mount Rainier in the past 10,000 years.

Lateral-Blast Hazard Zone: Areas that could be affected by a lateral blast similar to that which occurred at Mount St. Helens in 1980. Any single blast would affect a sector of no more than 180 degrees. Lateral blasts at Mount Rainier are infrequent; only one occurred during the past 10,000 years and it was associated with the Osceola Mudflow. The Mount Rainier blast was much smaller than the 1980 blast at Mount St. Helens.