

## 2020 Camas Invite GeoLogic Mapping

This test is fairly long, so be efficient with your time (I would suggest having each person start from opposite ends of the test to ensure complete coverage). It will be helpful to have a scientific calculator (non-graphing) for a few problems, but answers will not require significant figures. Please round answers as requested in each question. Show work the best you can for any math questions by writing out key equations used.

Example for how to write an inverse trig function:  $\arcsin(x)$  or  $\sin^{-1}(x)$ .

Be sure to use parentheses and brackets as necessary for clarity.

You might need a ruler or straight edge for some problems.

**Note:** The above is an artifact of the intro for the Scilympiad version of this test.

### Earth Structure and History:

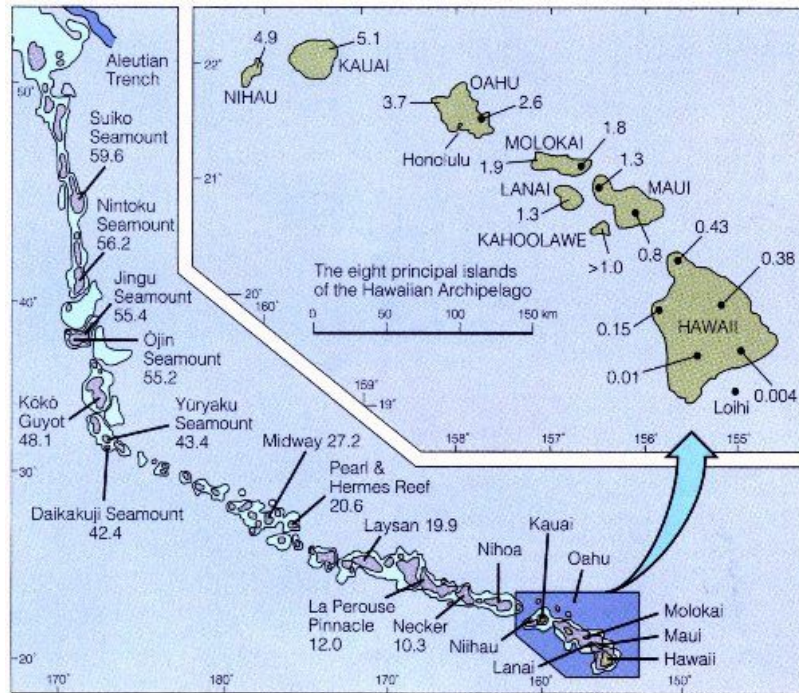
1. How old is the Earth? (1)
  - a. 4.5 million yrs
  - b. 9 million yrs
  - c. 4.5 billion yrs
  - d. 9 billion yrs
2. List the chemical layers of the earth and provide an approximate composition of each (6)
3. List the physical layers of the Earth and describe their states (10)

4. We know a lot about the Earth's interior because of seismic waves. Use knowledge of these waves to describe how we know the outer core is liquid and the inner core is solid. (5)

**Plate Tectonics:**

5. What are five pieces of evidence for plate tectonics? (5)

Use the following map to answer questions 6-10:



6. How were Emperor seamounts and the Hawaiian islands formed? Explain in detail. (4pts)

7. What direction was the Pacific plate moving 60 million years ago? (1)

8. Around 43 million years ago, the plate direction changed to what? (1)

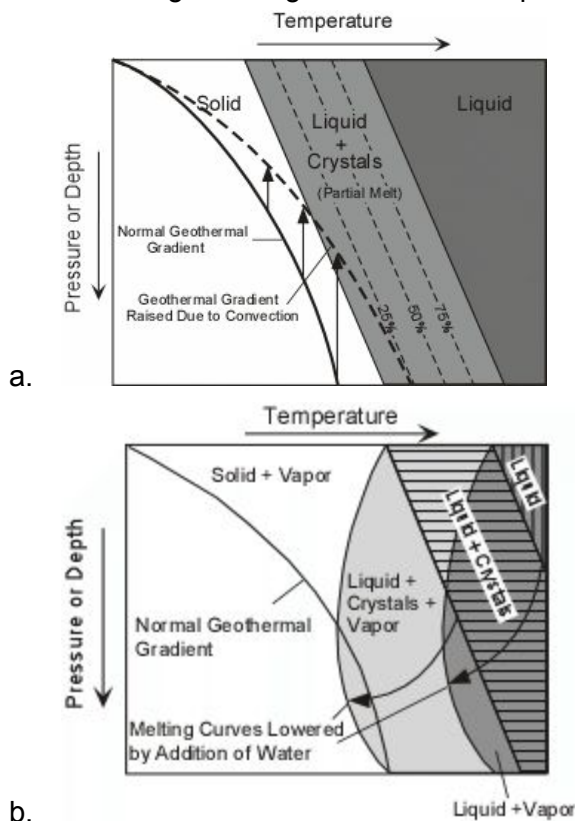
9. Using Hawaii and Oahu, calculate the average speed of the Pacific plate in centimeters per year (note that the ages of the volcanoes are in millions of years on the map). (3pts)

10. Is this relatively fast, slow, or average compared to other parts of the oceanic crust? (1pt)

11. Is continental crust denser or less dense than oceanic crust? How does this affect what happens when two plates converge? Based on this, is continental crust generally older or younger than oceanic crust? (4 pts.)

### Rock Formation:

Use the following two diagrams to answer questions 12-15:



12. What kind of partial melting is shown in graph A? (1)

13. What kind of partial melting is shown in graph B? (1)

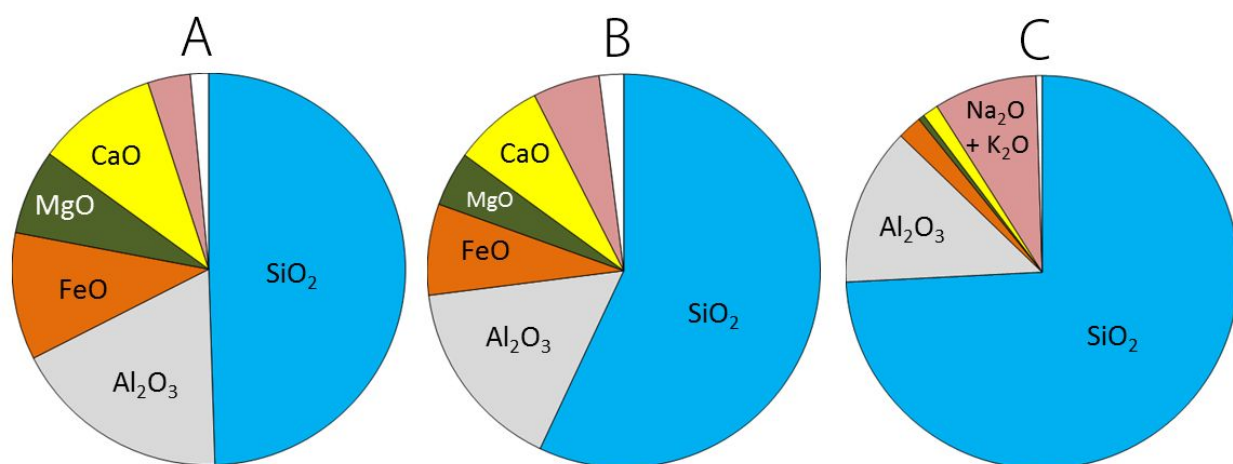
14. Which kind of melting occurs at mid oceanic ridges? (1)

- a. A
- b. B

15. Which kind of melting occurs at an oceanic/continental convergent boundary (1)

- a. A
- b. B

Use the following pie charts to answer questions 16-20:



16. Identify which of the above is most like the composition of andesite? (1)

- a. A
- b. B
- c. C

17. Identify which of the above is most like the composition of basalt? (1)

- a. A
- b. B
- c. C

18. Identify which of the above is most like the composition of rhyolite? (1)

- a. A
- b. B
- c. C

19. **TB4:** Magma in a shield volcano is most likely to have a composition like which of the above? (1)

- a. A
- b. B
- c. C

20. Magma in a composite volcano is most likely to have a composition like which of the above? (1)

- a. A
- b. B
- c. C

21. Which one of the following minerals does not contain silica tetrahedra? (1)

- a. Clay
- b. Quartz
- c. Calcite
- d. Olivine
- e. Feldspar

22. If a basalt were heated up until it melted thoroughly (no crystals left) and then was cooled very very slowly you would most likely get: (1)

- a. Gabbro
- b. andesite porphyry
- c. Obsidian
- d. Granite
- e. Diorite

23. Which mineral below is extremely unlikely to occur in a basaltic rock? (1)

- a. Pyroxene
- b. Plagioclase
- c. Olivine
- d. Amphibole
- e. Quartz

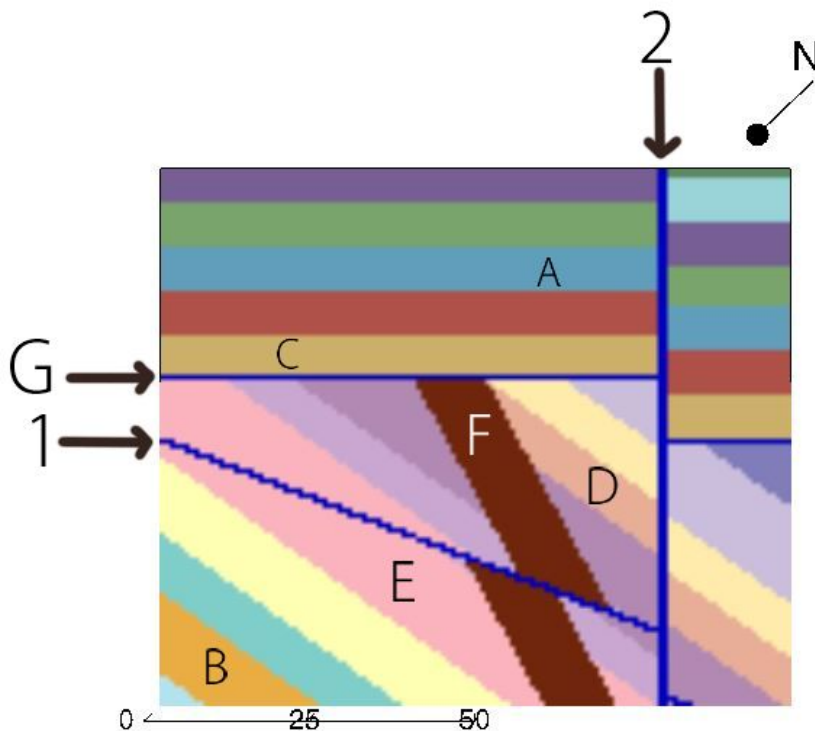
24. A very dense, very fine-grained metamorphic rock suggests metamorphism primarily as a result of (1)

- a. high pressure and high temperature
- b. high pressure and lower temperature
- c. low pressure and low temperature
- d. low pressure and high temperature
- e. migration of chemical fluids

25. The best evidence that a rock has a metamorphic origin is: (1)
- a. finding mica in the rock
  - b. presence of different-colored layers in the rock
  - c. a foliated texture
  - d. finding garnets in the rock
  - e. finding phenocrysts in the rock
26. Many granites are thought to originate by
- a. deep burial, melting, and recycling of continental material (especially sedimentary rocks) where two lithospheric plates are colliding
  - b. melting of the tops of downgoing lithospheric slabs (in trenches) together with contamination by continental material as the melt rises through the crust
  - c. partial melting of the upper mantle
  - d. settling out of quartz and feldspar from peridotite
  - e. metamorphism of andesitic rocks

**Geological Principles:**

Use the following block diagram to answer questions 27-30:



Note: The letter N is specifying North and is not pointing at anything in the diagram.

27. Determine the order of events (A B C D E F G 1 2) and explain using Steno's three laws as necessary. Assume that no beds were overturned. (10)

28. What kind of unconformities exist and between which layers? (2)

29. What kind of fault is fault 1? (1)

30. What kind of igneous intrusion is F? (1)

31. Explain uniformitarianism and provide one piece of evidence for it. (3)

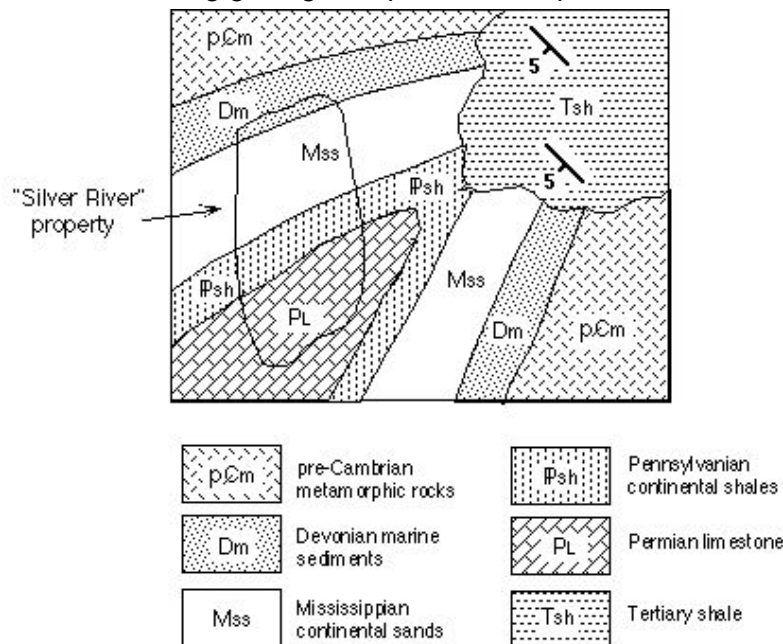
32. Explain catastrophism and provide one piece of evidence for it. (3)



33. Based on current geologic knowledge of the Earth and its history, which of the above is correct? (or both?) Explain. (3)

### Geologic Map Interpretation:

Use the following geologic map to answer questions 34-39:



34. Which of the beds is the oldest? (1)

- pCm
- Tsh
- Psh
- Mss
- PL
- None of the above

35. Which of the beds is the youngest? (1)

- pCm
- Tsh
- Psh
- Mss
- PL
- None of the above

36. Name the two kinds of unconformities that exist in the above map and which layers they are between. (4)

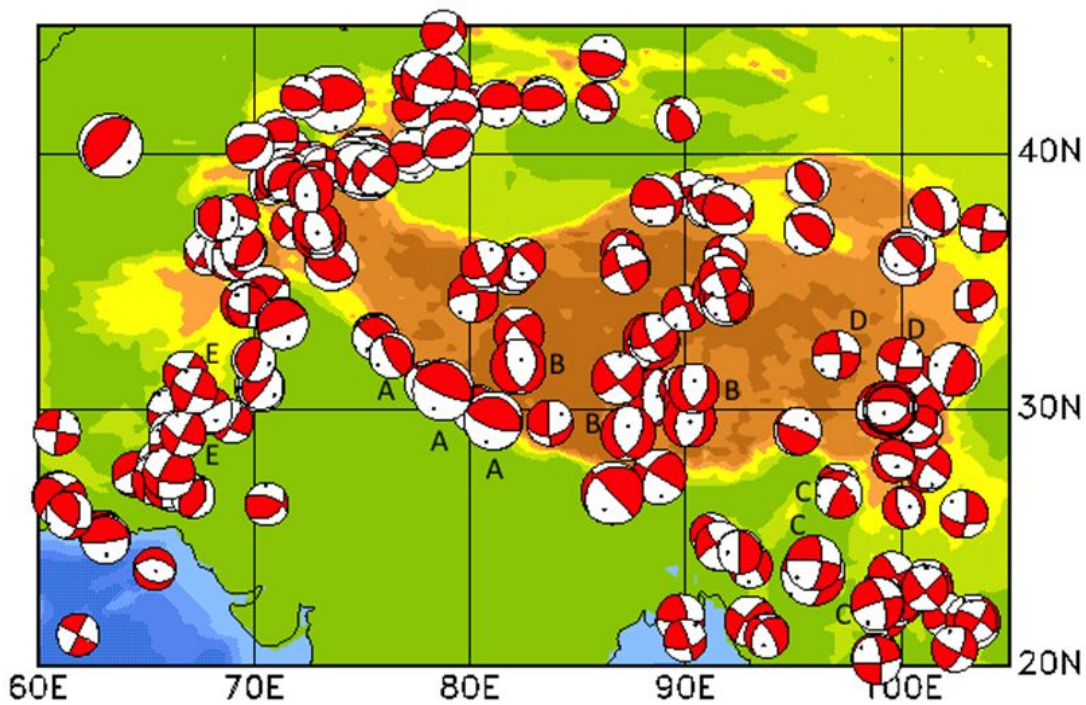
37. What kind of geologic structure is present? (1)

38. What direction does the structure plunge? (1)

39. Do you think the Silver River property labeled in the map would be a good place to find oil? Explain the likelihood by describing possible source and reservoir rocks, and traps. (5)

## Faults:

Use the following map to answer questions 40-47:



40. What kind of faults are those labelled A? (1)

- a. Normal
- b. Thrust
- c. Reverse
- d. Strike slip

41. What kind of faults are those labelled B? (1)

- a. Normal
- b. Thrust
- c. Reverse
- d. Strike slip

42. What kind of faults are those labelled C? (1)

- a. Normal
- b. Thrust
- c. Reverse
- d. Strike slip

43. What kind of faults are those labelled D? (1)

- a. Normal
- b. Thrust
- c. Reverse
- d. Strike slip

44. What kind of faults are those labelled E? (1)

- a. Normal
- b. Thrust
- c. Reverse
- d. Strike slip

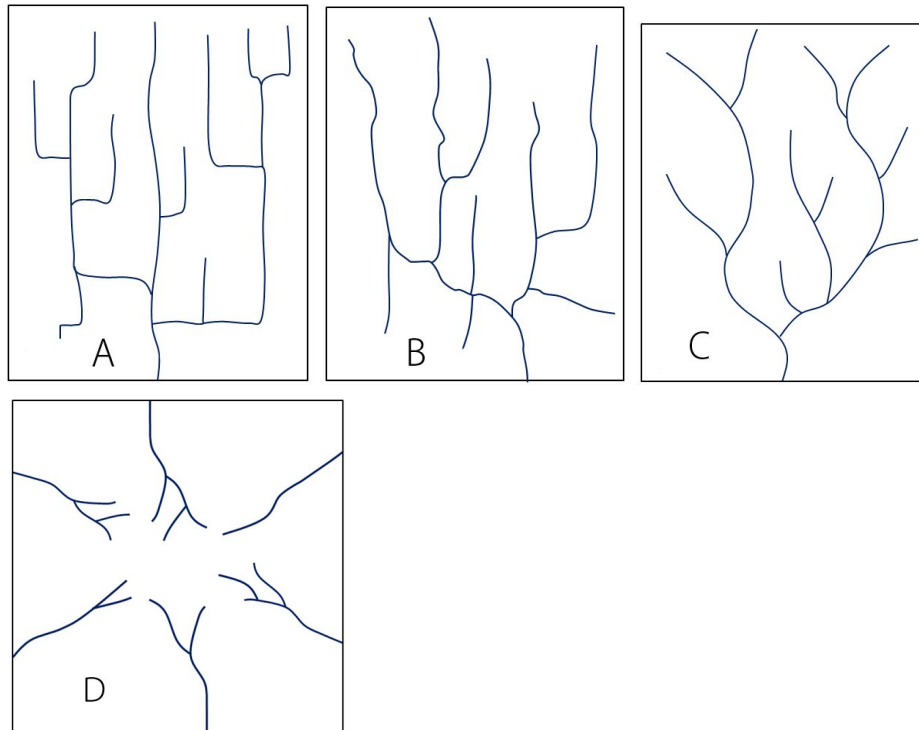
45. **TB3**: What is the strike direction for Group A? Describe the dip qualitatively (i.e. steep, shallow, near 45 degrees ...). What is the most likely fault plane? Explain. (4)

46. What kind of plate boundary most likely exists near faults labelled A? (1)

47. Explain why the different types of faulting occur in this region. (5)

**Erosional patterns:**

Use the following diagrams to answer questions 48-52:



48. What kind of stream drainage pattern is A and what kind of geology does it correspond to? (2)

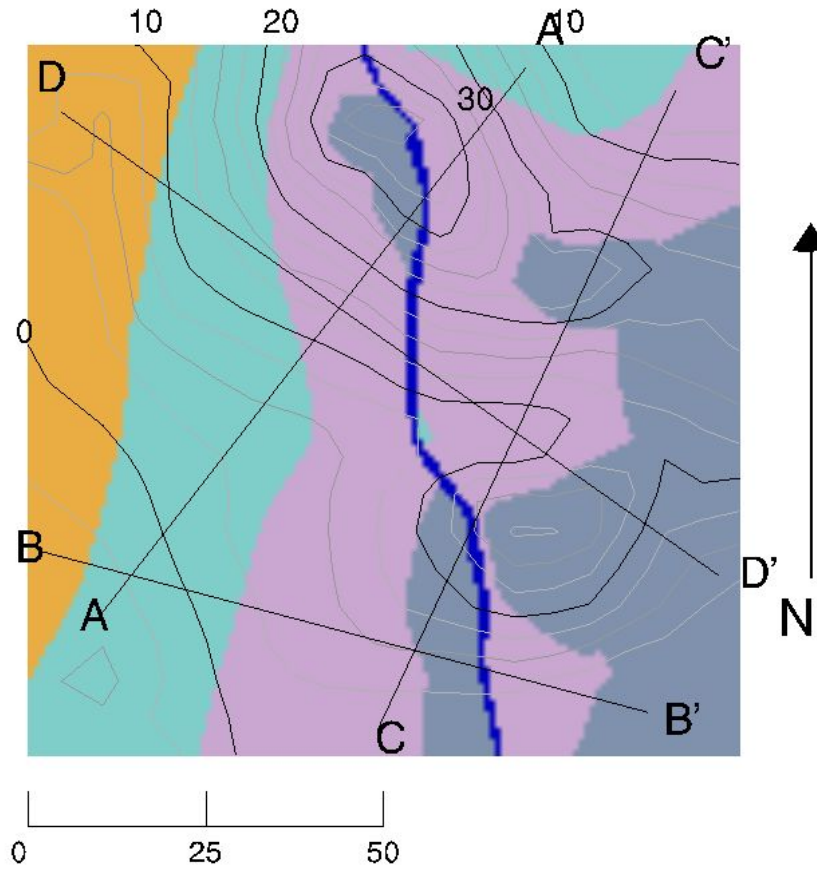
49. What kind of stream drainage pattern is B and what geology does it correspond to? (2)

50. What kind of stream drainage pattern is C and what geology does it correspond to? (2)

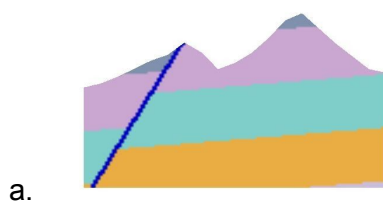
51. What kind of stream drainage pattern is D and what geology does it correspond to? (2)

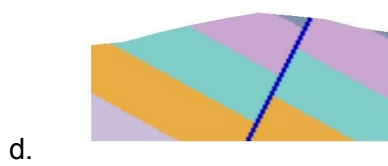
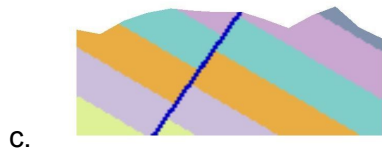
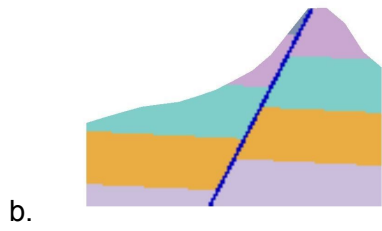
52. The Great Basin region probably has which of the above stream patterns? Why? (2)

Use the following Topographic map and profiles to answer questions 53-57:



Here are the unlabeled profiles of the above lines:





53. Which profile corresponds to A-A'? (1)

- a. A
- b. B
- c. C
- d. D

54. Which profile corresponds to B-B'? (1)

- a. A
- b. B
- c. C
- d. D

55. Which profile corresponds to C-C'? (1)

- a. A
- b. B
- c. C
- d. D

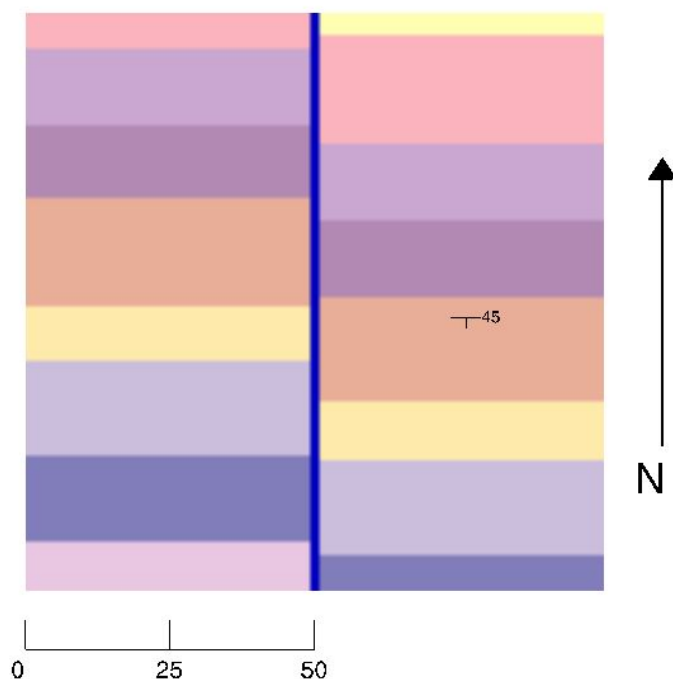
56. Which profile corresponds to D-D'? (1)

- a. A
- b. B
- c. C
- d. D

57. What kind of fault exists in the above map? (1)

- a. Normal
- b. Thrust
- c. Reverse
- d. Right lateral strike-slip
- e. Left lateral strike-slip

Use the geologic map below to answer questions 58-59:



58. What kind of fault is shown in the diagram above? (note, meters) (1)

- a. Normal
- b. Thrust
- c. Reverse
- d. Right lateral strike-slip
- e. Left lateral strike-slip



59. **TB2:** Calculate the thickness of the orange bed (assume the ground is flat) (3)

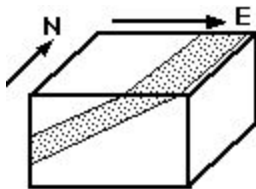
60. Calculate the thickness of a bed (to the nearest meter) given the following:

The distance between the lower and upper contacts is 30 meters measured perpendicular to the strike.

The true dip is 38 degrees.

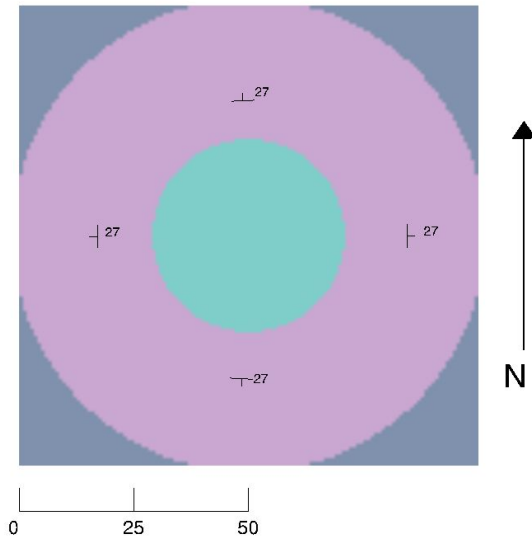
The slope has a grade of 15 degrees.

61. Given the following block diagram, what directions are the strike and dip? (1)



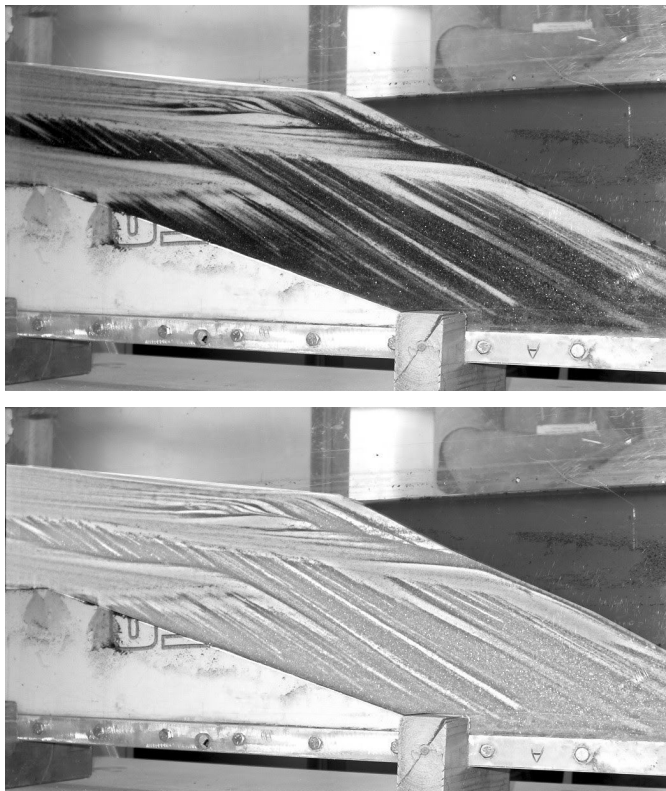
- a. E-W, N
- b. E-W, S
- c. N-S, E
- d. N-S, W
- e. N, S

62. Identify the structure in the map below and describe how you know what it is: (2)



### Depositional Environments:

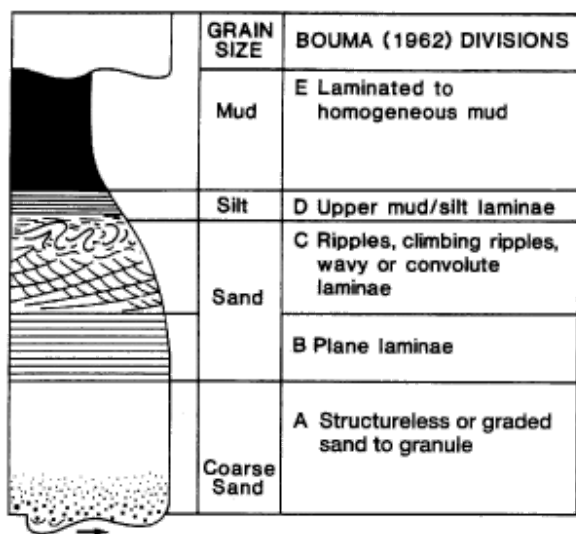
Pictured below is a cross section of a model fluvial-dominated delta depositional sequence. Use the images to answer questions 63-64:



63. Based on the depositional sequence, how many transgressions and regressions have occurred at this location? (4)

64. At what water level do topset beds form? (2)

Use the following diagram to answer questions 65-67:

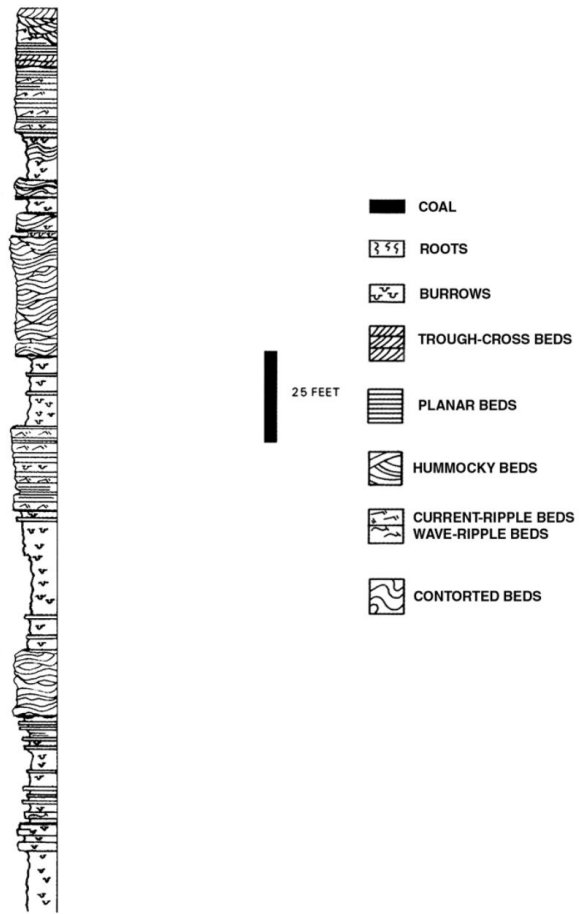


65. The above depositional sequence is characteristic of what sedimentary process? (1)

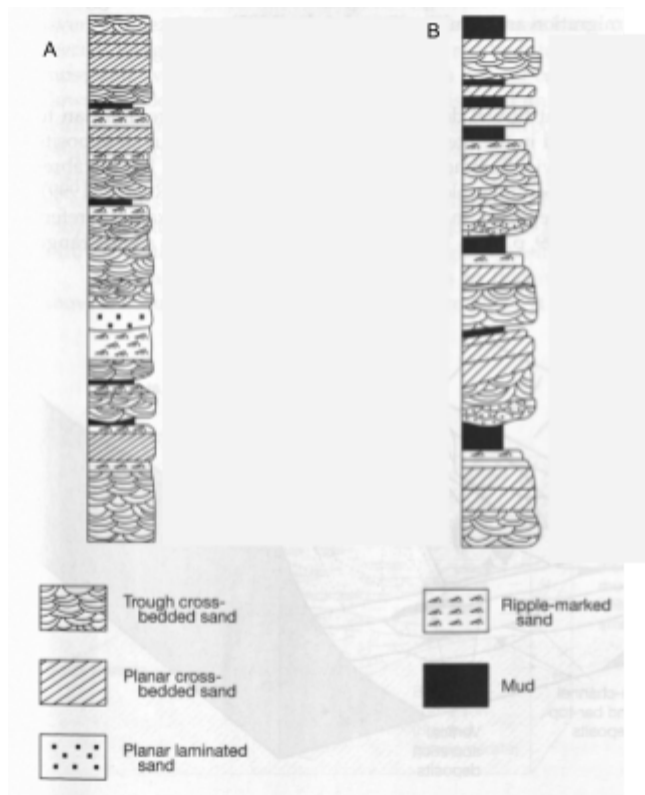
66. Describe how normal graded bedding forms (3)

67. List one event that can trigger the sedimentary process that produces the sequence above (1)

69. How are hummocky beds formed? (1)



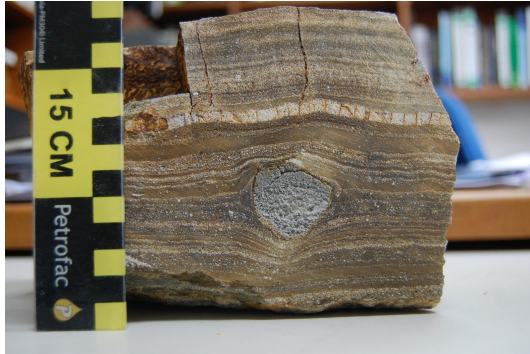
Use the following diagram for questions 70-71:



70. The two cross sections above represent a standard depositional sequence from a braided river and a meandering river. Which column represents each river? (2)

71. How does the depositional environment of planar cross beds differ from the depositional environment of trough cross beds? (1)

Use the following image for questions 72-73:



72. **TB1**: What is the name of this sedimentary feature? (1)

73. What causes this feature to form? (2)

74. Rank the following sedimentary structures in order of flow velocity of the depositional environment in which they form, from lowest flow velocity to highest: (5)

Antidunes  
Ripples  
Dunes  
Varves  
Cross bedding

Use the following image for questions 75-76:



75. What sedimentary structure is visible in the sample above? (1)

76. Suggest an environment where this sample could have formed (be specific about energy of the environment) (1)