

NCSO GEOLOGICAL MAPPING EVENT 2019**QUESTIONS**

(NOTE: Questions are worth one point each unless otherwise marked. 65 points total)

I. TECTONIC PLATES (SEE FIGURE I)

1. What tectonic plate is Phoenix, Arizona part of?
 - A. North American
 - B. Nazca
 - C. Eurasian
 - D. Scotia
 - E. None of these

2. Which of these is the closest plate boundary to Phoenix? It is the boundary with the _____.
 - A. Caribbean Plate
 - B. Scotia Plate
 - C. Pacific Plate
 - D. Arabian Plate
 - E. Cocos Plate

3. (2 pts) Why is Iceland located on two plates?
 - A. It is on a divergent plate boundary.
 - B. It is on a convergent plate boundary.
 - C. It is on a transform plate boundary.
 - D. It is on a subduction zone boundary.
 - E. It is on a fossil plate boundary.

4. Which of these areas of active volcanoes is NOT part of the "Ring of Fire"
 - A. The Aleutians Islands.
 - B. The Andes.
 - C. Philippines.
 - D. The Hawaiian Islands.
 - E. New Zealand.

5. Which of these plates does not include continental crust?
 - A. African
 - B. Indian
 - C. South American
 - D. Pacific
 - E. Australian

6. Which of these areas is/are likely to suffer from the effects of tsunamis?
 - A. The Hawaiian Islands
 - B. The Aleutian Islands
 - C. The west coast of South America
 - D. Indonesia
 - E. All of these

7. Which of these areas is the least likely to suffer from landslides?
- A. Western California
 - B. Western North Carolina
 - C. Western South America
 - D. Eastern North Carolina
 - E. Northern India and Nepal

II. NORTHWEST DURHAM QUADRANGLE, NORTH CAROLINA (FIGURE II)

This diagram is taken from the Geological Map of the Northwest Durham 7.5-minute quadrangle. Unit **Zadlt** is “andesitic to dacitic lavas and tuffs” of Late Proterozoic age; Unit **Trcs/si1** is “pink to tan arkosic sandstone and siltstone of Triassic age”; and unit **Jd** is “black to greenish black diabase/basalt, locally containing olivine.”

8. What type of diagram is this?
- A. sedimentary facies isopach map
 - B. geological cross section
 - C. stratigraphic column
 - D. Mercator projection
 - E. Fence correlation diagram
9. (2 pts) What is the nature of the contact between unit **Zadlt** and **Trcs/si1**?
- A. unconformity
 - B. conformable sedimentary beds
 - C. conformable sequence of lava flow
 - D. intrusive
 - E. fault
10. (2 pts) What is the nature of the contact between unit **Jd** and **Trcs/si1**?
- A. unconformity
 - B. conformable sedimentary beds
 - C. conformable sequence of lava flow
 - D. intrusive
 - E. fault
11. What is the nature of the contact between unit **Jd** and **Zadlt**?
- A. unconformity
 - B. conformable sedimentary beds
 - C. conformable sequence of lava flow
 - D. intrusive
 - E. fault

12. (2 pts) What is the nature of unit **Jd** at the location marked **X**?
- A. a thrust fault
 - B. a recumbent dike
 - C. a metamorphic isograd
 - D. a lava flow
 - E. a sill

III. BLACK HILLS, SOUTH DAKOTA (FIGURE III A & B)

13. In which rock type are Wind Cave National Park and Jewel Cave National Monument?
- A. Wind Cave – schist; Jewel Cave – sandstone
 - B. Wind Cave – limestone; Jewel Cave – sandstone
 - C. Wind Cave – limestone; Jewel Cave – granite
 - D. Wind Cave – sandstone; Jewel Cave – granite
 - E. Wind Cave – limestone; Jewel Cave – limestone
14. Which is the oldest rock type depicted?
- A. sandstone
 - B. granite
 - C. schist
 - D. limestone
 - E. something else
15. Beds of Dakota sandstone near Rapid City dip in which direction?
- A. north
 - B. east
 - C. south
 - D. west
 - E. northwest
16. The overall structure of this area is best described as a/an:
- A. syncline
 - B. thrust fault
 - C. dome
 - D. basin
 - E. plunging syncline
17. (2 pts) Examine the picture of Mount Rushmore. Given the information of the geological block diagram, what rock type are the presidents' heads, and what type are the dark-colored rocks indicated by the white X beneath George Washington?
- A. Heads – granite; Dark rocks – schist
 - B. Heads – granite; Dark rocks – limestone
 - C. Heads – schist; Dark rocks – sandstone
 - D. Heads – limestone; Dark rocks – granite
 - E. Heads – sandstone; Dark rocks – schist

18. (2 pts) The dark rocks indicated by the X are _____ than the light rocks of the heads. The dark rocks represent a/an _____ surrounded by the light rocks.

- A. younger; window
- B. older; xenolith
- C. younger; protolith
- D. older; protolith
- E. younger; lava flow

IV. FANTASY QUADRANGLE (FIGURE IV)

There are different sorts of geologic contacts. Given the following choices, for each contact described below (**questions 19-25**) in the Fantasy Quadrangle, select the correct response:

- A. Conformable sedimentary contact
- B. Unconformity (any type of unconformable contact)
- C. Intrusive contact
- D. Fault contact
- E. None of these

19. The contact between the Monteith granite and the D. H. Hill limestone

20. The contact between the Reynolds Formation and the D. H. Hill limestone

21. The contact between the Monteith granite and the diabase

22. The contact between the Withers sandstone and the Jordan Formation

23. The contact between the alluvium and the Jordan Formation

24. The contact between the Avent Ferry quartzite and the Western Formation

25. The contact between the Monteith granite and the Reynolds Formation (Even though it is not visible on the map)

26. What is the feature indicated by the heavy black dashed line?

- A. Axis (hinge line) of a recumbent nappe.
- B. Axis (hinge line) of a plunging anticline
- C. Normal fault
- D. Strike-slip fault
- E. Axis (hinge line) of a plunging syncline

27. (2 pts) What is the feature B-B'?
- A. Normal fault
 - B. Reverse fault
 - C. Thrust fault
 - D. Strike-slip fault (either type)
 - E. Subduction zone
28. (2 pts) When did A-A' form?
- A. After the alluvium was deposited
 - B. Before the alluvium but after the diabase
 - C. Before the diabase but after the Monteith granite
 - D. Before the Monteith granite but after the Western Formation
 - E. None of these is correct
29. (3 pts) Which of the following is the correct sequence (oldest to most recent; i.e. first to last)?
- A. Carter Rhyolite, Diabase, Monteith Granite, Avent Ferry Quartzite, Alluvium, Withers Sandstone
 - B. Avent Ferry Quartzite, Monteith Granite, Carter Rhyolite, Withers Sandstone, Diabase, Alluvium
 - C. Withers Sandstone, Alluvium, Carter Rhyolite, Monteith Granite, Avent Ferry Quartzite, Diabase
 - D. Avent Ferry Quartzite, Carter Rhyolite, Withers Sandstone, Monteith Granite, Diabase, Alluvium
 - E. Monteith Granite, Withers Sandstone, Diabase, Carter Rhyolite, Avent Ferry Quartzite, Alluvium

V. EAST MESA QUADRANGLE, NEW MEXICO (FIGURE V)

30. (2 pts) In this map, note the (parallel) relationship between most of the geological contacts and the topographic contour lines. (Ignore the purple lines.) What does this tell you?
- A. The rocks are metamorphic
 - B. The rocks are dipping downstream to the west
 - C. The rocks are in horizontal layers
 - D. The rocks are folded gently
 - E. The youngest rocks are in the valleys
31. (3 pts) What is the correct sequence of these rock units, from the oldest to the youngest?
- A. Kds, Js, Jeu, Kdo, Jz
 - B. Jeu, Js, Jz, Kds, Kdo
 - C. Js, Kds, Jeu, Jz, Kdo
 - D. Kdo, Kds, Jeu, Jz, Js
 - E. Kdo, Kds, Jz, Js, Jeu

VI. APEX QUADRANGLE, NORTH CAROLINA (FIGURE VI)

These are two contoured Schmidt equal-area stereonet plots for poles to foliation (A) and poles to bedding (B) in the Apex Quadrangle, North Carolina.

32. (2 pts) What is the general or average attitude/orientation represented in A?
- A. Vertical/steeply dipping
 - B. Horizontal/gently dipping
 - C. Striking NE-SW and dipping NE
 - D. Striking NE-SW and dipping SW
 - E. Striking NW-SE and dipping SW
33. (2 pts) What is the general or average attitude/orientation represented in B?
- A. Vertical/steeply dipping
 - B. Horizontal/gently dipping
 - C. Striking NE-SW and dipping NE
 - D. Striking NE-SW and dipping SW
 - E. Striking NW-SE and dipping SW

VII. MINOR CANYON (FIGURE VII)

34. (2 pts) Prior to the deposition of the Larsonton Formation, which of these units was the youngest (most recent) to form?
- A. Leet Junction Fm.
 - B. Tarburg Fm.
 - C. Birkland Fm.
 - D. Granite
 - E. Dike
35. (2 pts) Which unit is most likely to contain pebbles eroded from the Dike?
- A. Larsonton Fm.
 - B. Foster City Fm.
 - C. Birkland Fm.
 - D. Lutgrad Fm.
 - E. Granite
36. (3 pts) What is one way to tell that the Tarburg Formation is older than the Hamlinville Formation?
- A. The Minor Canyon River flows through it.
 - B. The granite cuts through the Hamlinville Formation.
 - C. The dike does not cut through the Tarburg Formation.
 - D. The Tarburg Formation is tilted; the Hamlinville Formation is horizontal.
 - E. Trees are growing on the Hamlinville Formation but not on the Tarburg Formation.

VIII. OTHER QUESTIONS (no figures)

37. A special type of compass used by geologists is known as a/an _____
Compass.

- A. Rietveldt
- B. McKinley
- C. Ashburn
- D. Brunton
- E. Suunto

38. This type of compass is unique in part because it

- A. Includes a mirror and an inclinometer.
- B. Does not need to be corrected for the Earth's magnetic declination.
- C. Only works in the Northern Hemisphere.
- D. Has an all-digital display.
- E. Comes with a built-in GPS unit.

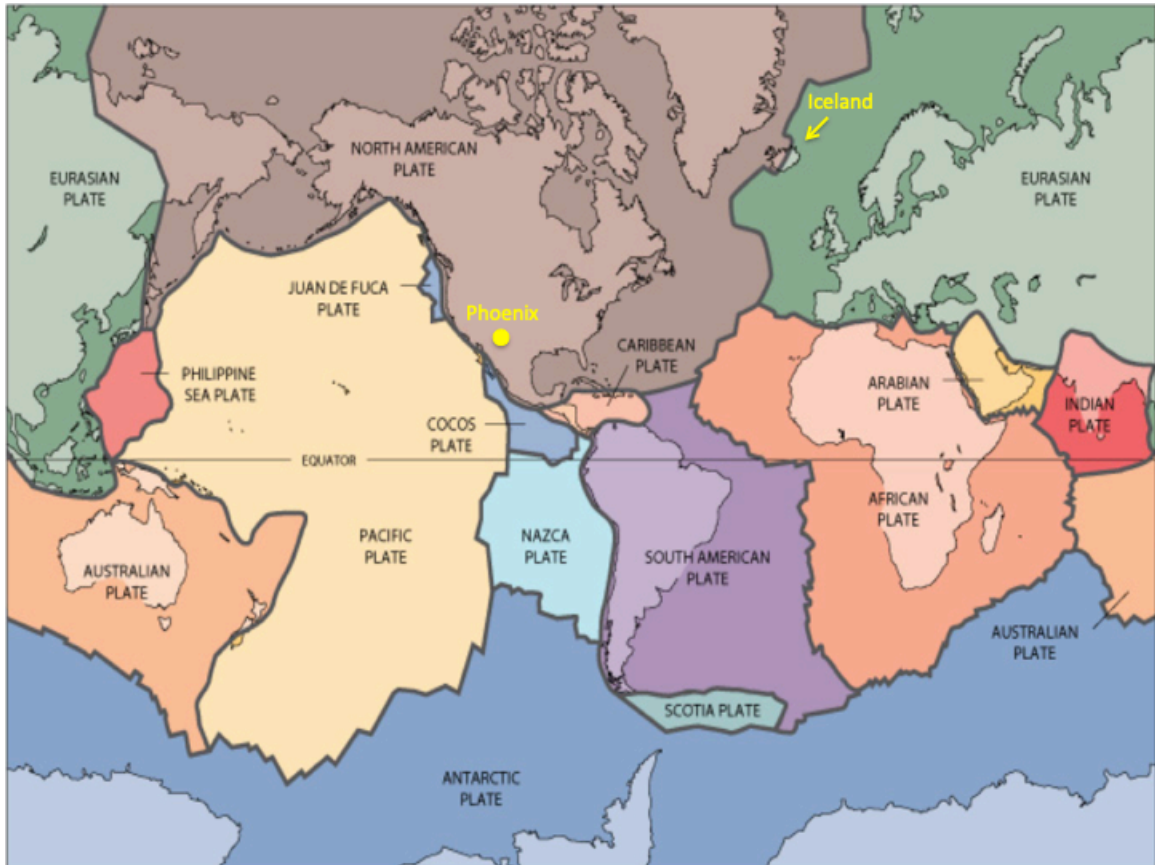
39. (4 pts) What are **two ways** to distinguish a syncline from an anticline? (*This question is Tiebreaker #1*)

40. (4 pts) There is a rock set in plaster at the front of the room. Use your inclinometer or compass to measure the dip of the rock sample, or simply estimate it. Examine the rock sample in the box, but do not pick it up. Note the north arrow. What is the correct strike and dip of the bedding in this rock? (*This question is Tiebreaker #2*)

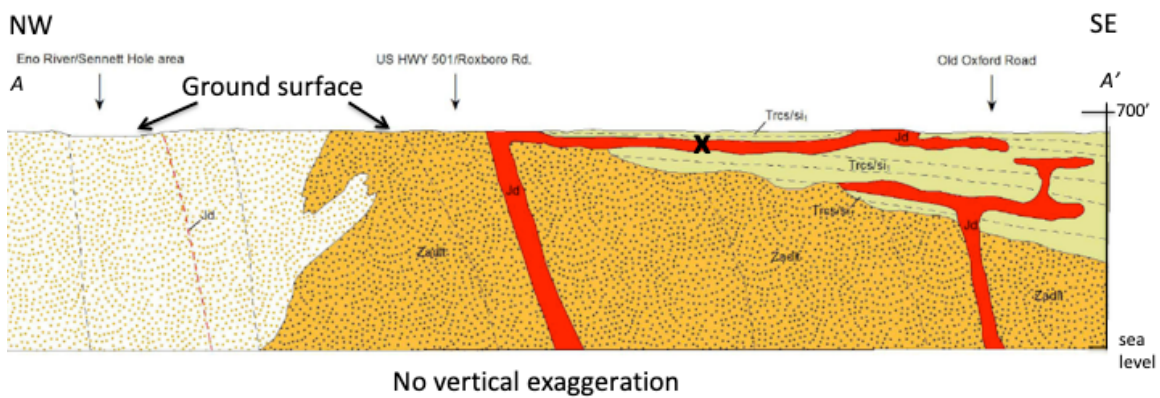
Strike: _____

Dip: _____

I. TECTONIC PLATES



II. NORTHWEST DURHAM QUADRANGLE, NORTH CAROLINA



III. BLACK HILLS, SOUTH DAKOTA

A.



GEOLOGICAL BLOCK DIAGRAM OF THE
BLACK HILLS AREA, SOUTH DAKOTA



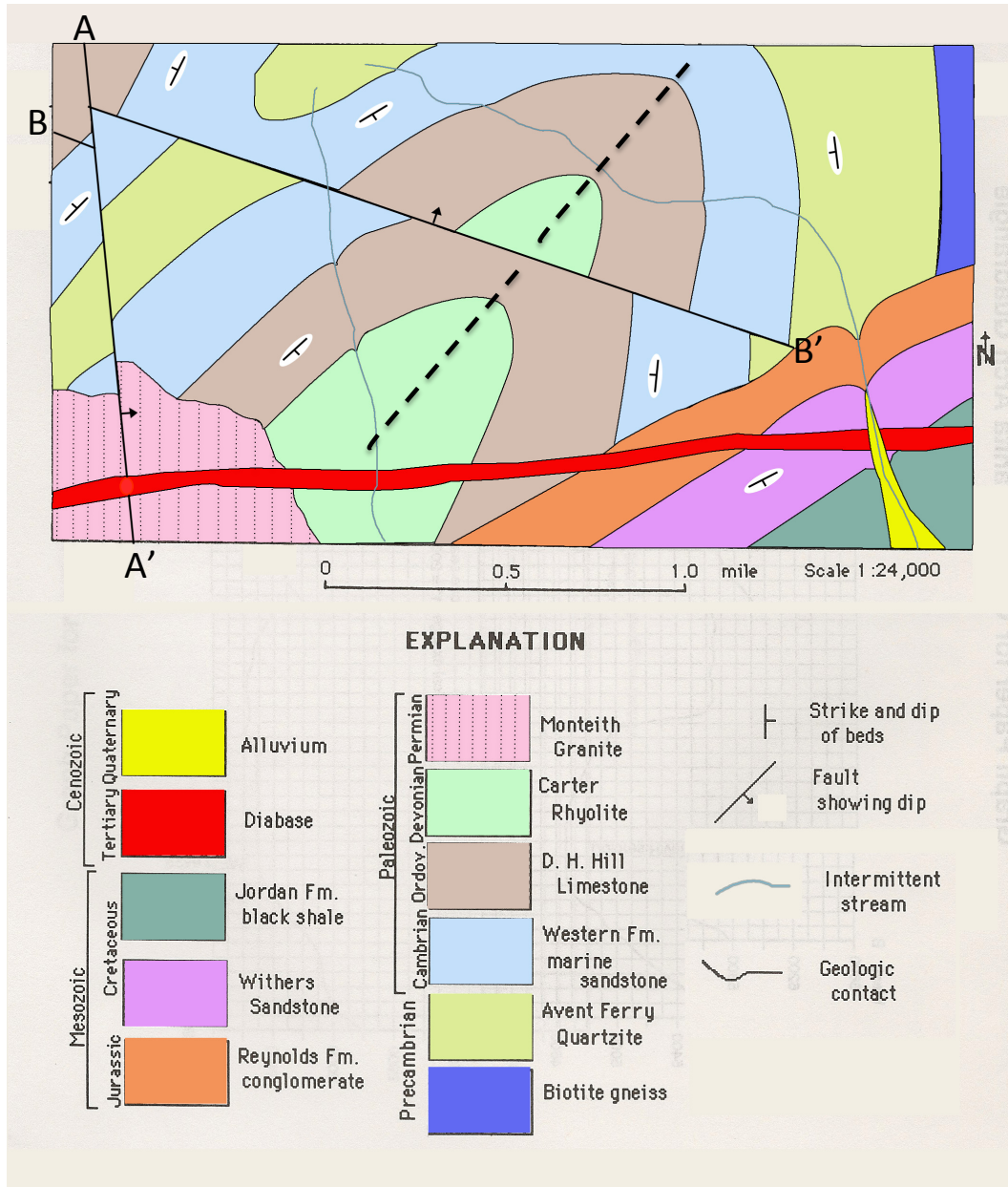
B.

Mount Rushmore

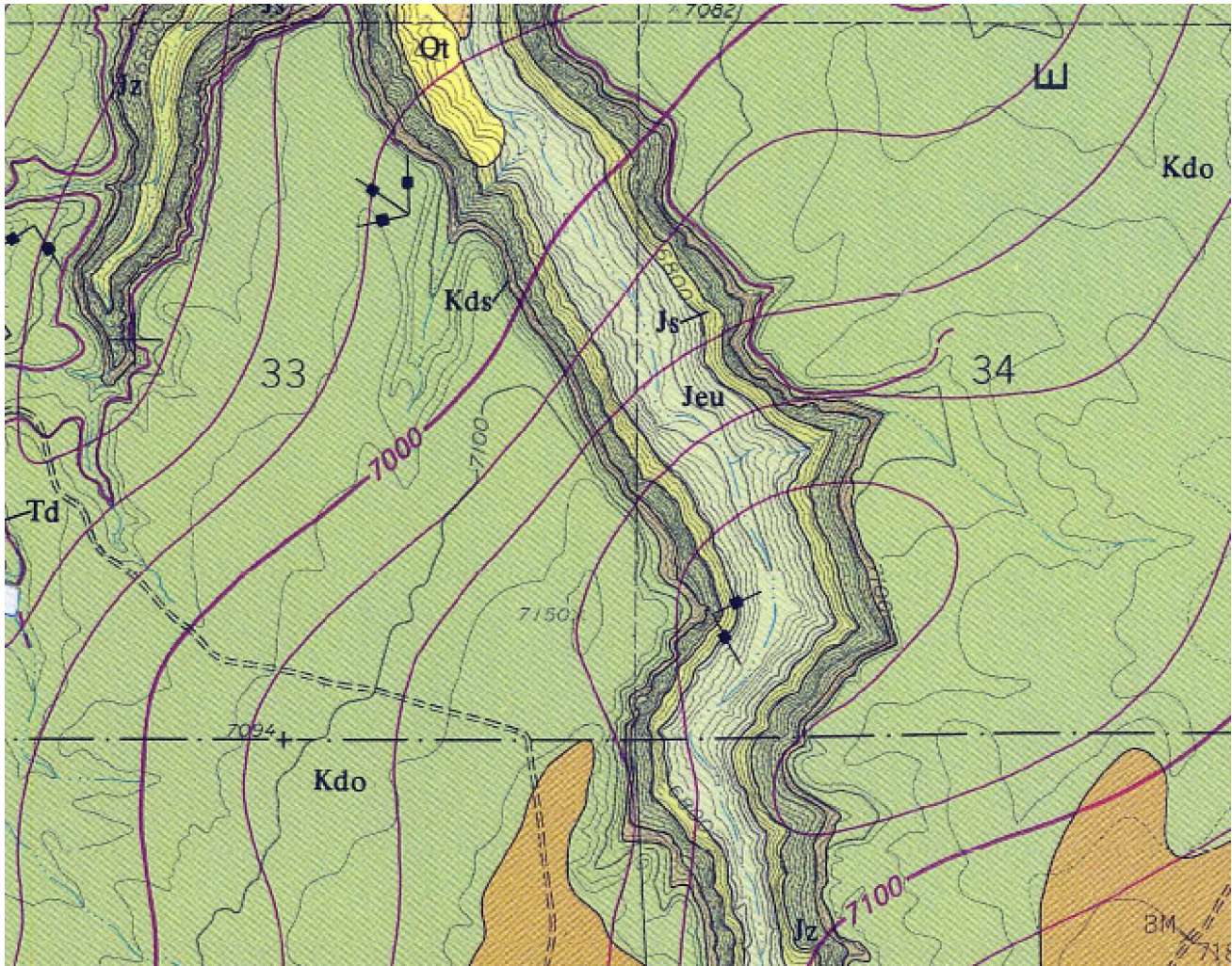


Left to Right: Washington, Jefferson, T. Roosevelt, Lincoln

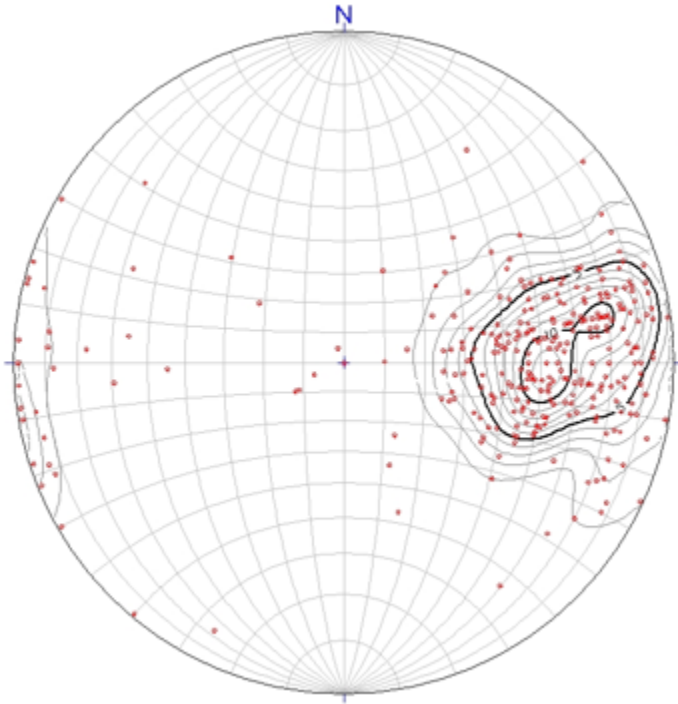
IV. FANTASY QUADRANGLE



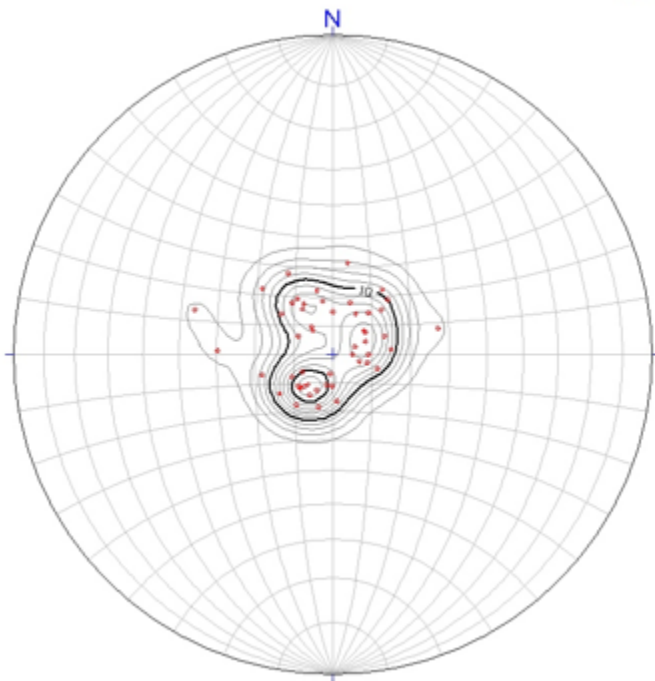
V. EAST MESA QUADRANGLE, NEW MEXICO



VI. APEX QUADRANGLE, NORTH CAROLINA

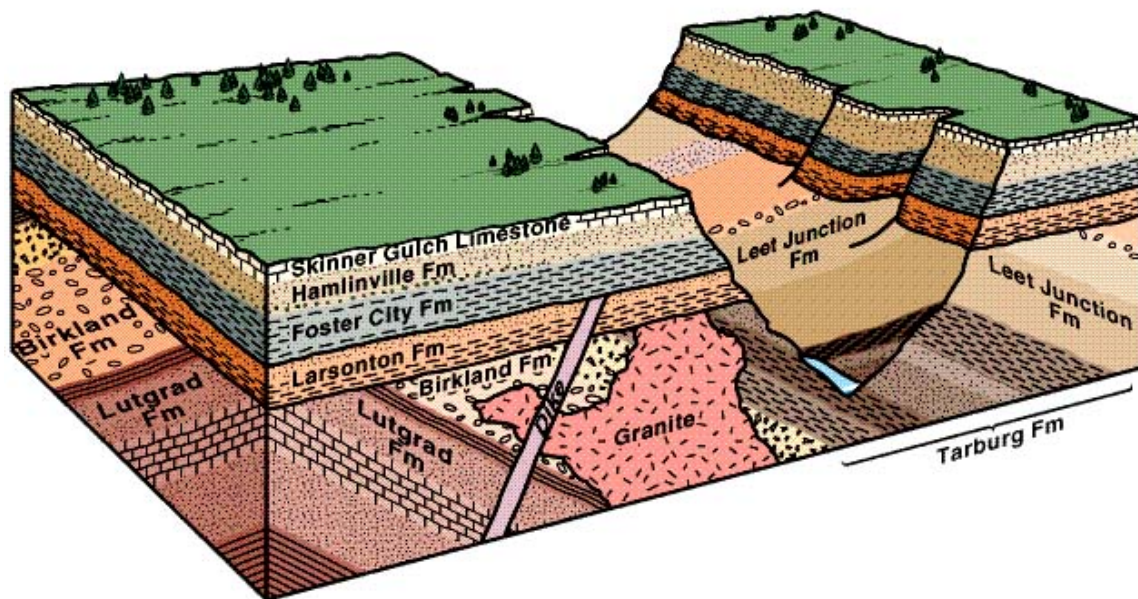


A. Proterozoic Rocks



B. Triassic Rocks

VII. MINOR CANYON



NCSO GEOLOGICAL MAPPING EVENT 2019**QUESTIONS**

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CIRCLE THE CORRECT ANSWER**I. TECTONIC PLATES (SEE FIGURE I)**

- | | | | | | |
|------------|---|---|---|---|---|
| 1. | A | B | C | D | E |
| 2. | A | B | C | D | E |
| 3. (2 pts) | A | B | C | D | E |
| 4. | A | B | C | D | E |
| 5. | A | B | C | D | E |
| 6. | A | B | C | D | E |
| 7. | A | B | C | D | E |

II. NORTHWEST DURHAM QUADRANGLE, NORTH CAROLINA (FIGURE II)

- | | | | | | |
|-------------|---|---|---|---|---|
| 8. | A | B | C | D | E |
| 9. (2 pts) | A | B | C | D | E |
| 10. (2 pts) | A | B | C | D | E |
| 11. | A | B | C | D | E |
| 12. (2 pts) | A | B | C | D | E |

III. BLACK HILLS, SOUTH DAKOTA (FIGURE III A & B)

- | | | | | | |
|-------------|---|---|---|---|---|
| 13. | A | B | C | D | E |
| 14. | A | B | C | D | E |
| 15. | A | B | C | D | E |
| 16. | A | B | C | D | E |
| 17. (2 pts) | A | B | C | D | E |
| 18. (2 pts) | A | B | C | D | E |

IV. FANTASY QUADRANGLE (FIGURE IV)

19. A B C D E

20. A B C D E

21. A B C D E

22. A B C D E

23. A B C D E

24. A B C D E

25. A B C D E

26. A B C D E

27. (2 pts) A B C D E

28. (2 pts) A B C D E

29. (3 pts) A B C D E

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30. (2 pts) A B C D E

31. (3 pts) A B C D E

VI. APEX QUADRANGLE, NORTH CAROLINA (FIGURE VI)

32. (2 pts) A B C D E

33. (2 pts) A B C D E

VII. MINOR CANYON (FIGURE VII)

34. (2 pts) A B C D E
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VIII. OTHER QUESTIONS (no figures)

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I. Scotia
J. None of these
2. Which of these is the closest plate boundary to Phoenix? It is the boundary with the _____.
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H. Pacific Plate
I. Arabian Plate
J. Cocos Plate
3. (2 pts) Why is Iceland located on two plates?
F. It is on a divergent plate boundary.
G. It is on a convergent plate boundary.
H. It is on a transform plate boundary.
I. It is on a subduction zone boundary.
J. It is on a fossil plate boundary.
4. Which of these areas of active volcanoes is NOT part of the "Ring of Fire"
F. The Aleutians Islands.
G. The Andes.
H. Philippines.
I. The Hawaiian Islands.
J. New Zealand.
5. Which of these plates does not include continental crust?
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H. The west coast of South America
I. Indonesia
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7. Which of these areas is the least likely to suffer from landslides?
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 - J. a sill

III. BLACK HILLS, SOUTH DAKOTA (FIGURE III A & B)

13. In which rock type are Wind Cave National Park and Jewel Cave National Monument?

- F. Wind Cave – schist; Jewel Cave – sandstone
- G. Wind Cave – limestone; Jewel Cave – sandstone
- H. Wind Cave – limestone; Jewel Cave – granite
- I. Wind Cave – sandstone; Jewel Cave – granite
- J. Wind Cave – limestone; Jewel Cave – limestone

14. Which is the oldest rock type depicted?

- F. sandstone
- G. granite
- H. schist
- I. limestone
- J. something else

15. Beds of Dakota sandstone near Rapid City dip in which direction?

- F. north
- G. east
- H. south
- I. west
- J. northwest

16. The overall structure of this area is best described as a/an:

- F. syncline
- G. thrust fault
- H. dome
- I. basin
- J. plunging syncline

17. (2 pts) Examine the picture of Mount Rushmore. Given the information of the geological block diagram, what rock type are the presidents' heads, and what type are the dark-colored rocks indicated by the white X beneath George Washington?

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18. (2 pts) The dark rocks indicated by the X are _____ than the light rocks of the heads. The dark rocks represent a/an _____ surrounded by the light rocks.

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- G. older; xenolith
- H. younger; protolith
- I. older; protolith
- J. younger; lava flow

IV. FANTASY QUADRANGLE (FIGURE IV)

There are different sorts of geologic contacts. Given the following choices, for each contact described below (**questions 19-25**) in the Fantasy Quadrangle, select the correct response:

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- G. Unconformity (any type of unconformable contact)
- H. Intrusive contact
- I. Fault contact
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19. The contact between the Monteith granite and the D. H. Hill limestone **C**

20. The contact between the Reynolds Formation and the D. H. Hill limestone **B**

21. The contact between the Monteith granite and the diabase **C**

22. The contact between the Withers sandstone and the Jordan Formation **A**

23. The contact between the alluvium and the Jordan Formation **B**

24. The contact between the Avent Ferry quartzite and the Western Formation **A**

25. The contact between the Monteith granite and the Reynolds Formation (Even though it is not visible on the map) **B**

26. What is the feature indicated by the heavy black dashed line?

- F. Axis (hinge line) of a recumbent nappe.
- G. Axis (hinge line) of a plunging anticline
- H. Normal fault
- I. Strike-slip fault
- J. Axis (hinge line) of a plunging syncline

27. (2 pts) What is the feature B-B'?

- F. Normal fault
- G. Reverse fault
- H. Thrust fault
- I. Strike-slip fault (either type)
- J. Subduction zone

28. (2 pts) When did A-A' form?

- F. After the alluvium was deposited
- G. Before the alluvium but after the diabase
- H. Before the diabase but after the Monteith granite
- I. Before the Monteith granite but after the Western Formation
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29. (3 pts) Which of the following is the correct sequence (oldest to most recent; i.e. first to last)?

- F. Carter Rhyolite, Diabase, Monteith Granite, Avent Ferry Quartzite, Alluvium, Withers Sandstone
- G. Avent Ferry Quartzite, Monteith Granite, Carter Rhyolite, Withers Sandstone, Diabase, Alluvium
- H. Withers Sandstone, Alluvium, Carter Rhyolite, Monteith Granite, Avent Ferry Quartzite, Diabase
- I. Avent Ferry Quartzite, Carter Rhyolite, Monteith Granite, Withers Sandstone, Diabase, Alluvium
- J. Monteith Granite, Withers Sandstone, Diabase, Carter Rhyolite, Avent Ferry Quartzite, Alluvium

V. EAST MESA QUADRANGLE, NEW MEXICO (FIGURE V)

30. (2 pts) In this map, note the (parallel) relationship between most of the geological contacts and the topographic contour lines. (Ignore the purple lines.) What does this tell you?

- F. The rocks are metamorphic
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- I. The rocks are folded gently
- J. The youngest rocks are in the valleys

31. (3 pts) What is the correct sequence of these rock units, from the oldest to the youngest?

- F. Kds, Js, Jeu, Kdo, Jz
- G. Jeu, Js, Jz, Kds, Kdo
- H. Js, Kds, Jeu, Jz, Kdo
- I. Kdo, Kds, Jeu, Jz, Js
- J. Kdo, Kds, Jz, Js, Jeu

VI. APEX QUADRANGLE, NORTH CAROLINA (FIGURE VI)

These are two contoured Schmidt equal-area stereonet plots for poles to foliation (A) and poles to bedding (B) in the Apex Quadrangle, North Carolina.

32. (2 pts) What is the general or average attitude/orientation represented in A?

- F. Vertical/steeply dipping
- G. Horizontal/gently dipping
- H. Striking NE-SW and dipping NE
- I. Striking NE-SW and dipping SW
- J. Striking NW-SE and dipping SW

33. (2 pts) What is the general or average attitude/orientation represented in B?

- F. Vertical/steeply dipping
- G. Horizontal/gently dipping
- H. Striking NE-SW and dipping NE
- I. Striking NE-SW and dipping SW
- J. Striking NW-SE and dipping SW

VII. MINOR CANYON (FIGURE VII)

34. (2 pts) Prior to the deposition of the Larsonton Formation, which of these units was the youngest (most recent) to form?

- F. Leet Junction Fm.
- G. Tarburg Fm.
- H. Birkland Fm.
- I. Granite
- J. Dike

35. (2 pts) Which unit is most likely to contain pebbles eroded from the Dike?

- F. Larsonton Fm.
- G. Foster City Fm.
- H. Birkland Fm.
- I. Lutgrad Fm.
- J. Granite

36. (3 pts) What is one way to tell that the Tarburg Formation is older than the Hamlinville Formation?

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VIII. OTHER QUESTIONS (no figures)

37. A special type of compass used by geologists is known as a/an _____ Compass.

- F. Rietveldt
- G. McKinley
- H. Ashburn
- I. Brunton
- J. Suunto

38. This type of compass is unique in part because it

- F. Includes a mirror and an inclinometer.
- G. Does not need to be corrected for the Earth's magnetic declination.
- H. Only works in the Northern Hemisphere.
- I. Has an all-digital display.
- J. Comes with a built-in GPS unit.

39. (4 pts) What are **two ways** to distinguish a syncline from an anticline **on a geological map**? (*This question is Tiebreaker #1*)

A syncline has the **youngest beds/layers in the middle** (closest to the axis or hinge) and they get older as you go out; an anticline has the **oldest beds/layers in the middle** and they get younger outward.

In a syncline, the beds **dip toward** the middle; in an anticline the beds **dip away** from the middle.

(They may say an anticline is an “upfold” and a syncline is a “downfold.” That’s okay, but not as good as answers above. A cross-section diagram is really no good, because the question is asking about **map view**)

40. (4 pts) There is a rock set in plaster at the front of the room. Use your inclinometer or compass to measure the dip of the rock sample, or simply estimate it. Examine the rock sample in the box, but do not pick it up. Note the north arrow. What is the correct strike and dip of the bedding in this rock? (*This question is Tiebreaker #2*)

BOX #1 - Strike: N33W

Dip: 67NE

BOX #2 - Strike: N40W

Dip: 70NE

BOX #3 - Strike: N40W

Dip: 70NE

BOX #4 - Strike: N45W

Dip: 70NE

Accept answers within +/- five degrees for strike and for dip. There are alternative ways of answering this question; for example using azimuth. Box #1 could be answered with **327,67** or 327, 67NE or 147, 67NE