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Department of Geoscience

Assessment Exam – Part II

Feb 13, 2007

Please answer these questions as completely as possible and write clearly.
Unless explicitly stated, please only choose one response per multiple-choice question.

Thank you for taking the time to help us improve our department and achieve our common goal of graduating high-quality geoscientists, informed teachers, and responsible citizens of Earth.

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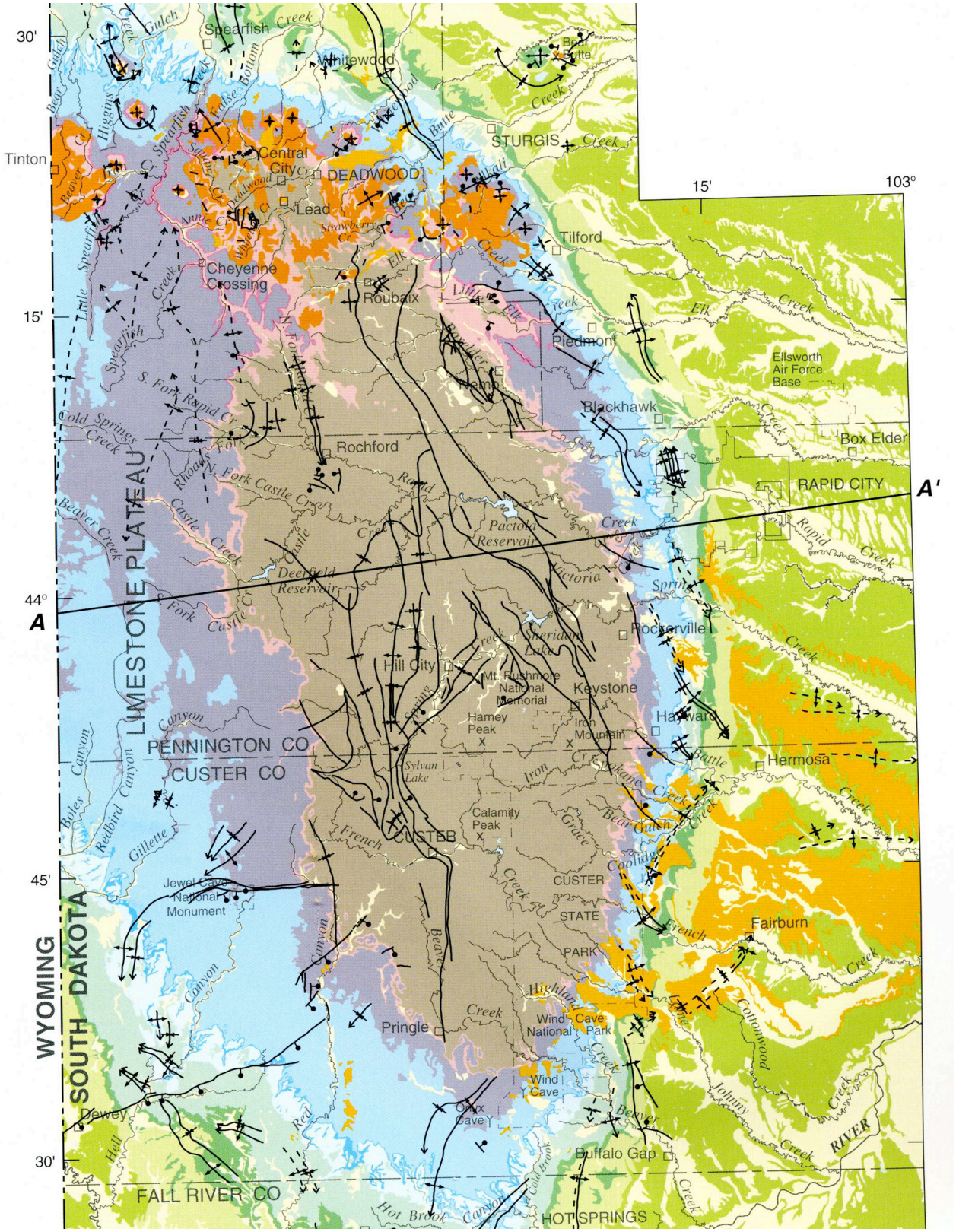
Section B. Geology of the Black Hills Region

In this section, you will get an opportunity to demonstrate the various skills that geologists utilize in order to communicate with each other (geologic maps and cross-sections) and use your geologic knowledge to interpret the geologic history of a region and create hypotheses related to the region's development.



Stratigraphic units	Map units
QTac	Alluvium and colluvium, undifferentiated
Tw	Mudstones and interbedded lenticular sand
Tui	Undifferentiated intrusive igneous rocks
Kps	Pierre Shale to Skull Creek Shale, undifferentiated
Kik	Siliciclastic sands with mudstones
Ju	Mudstones with lenticular sands and some gypsum units
TrPs	Dominated by mudrock, silt, with some sand
Pmk	Thin bedded, laminated dolostone
Po	Opeche Shale
PPm	Quartz arenite sandstone with interbedded carbonates
MDme	Thick dolomite
Ou	Dolostones
O€d	Red sandstones with basal conglomerate
pCu	Undifferentiated igneous and metamorphic rocks

1. Ignoring Quaternary deposits, where are the oldest rocks in this structure generally located?
   a. To the North
   b. In the center
   c. To the West
   d. On the outer edge
   e. In the Southeast

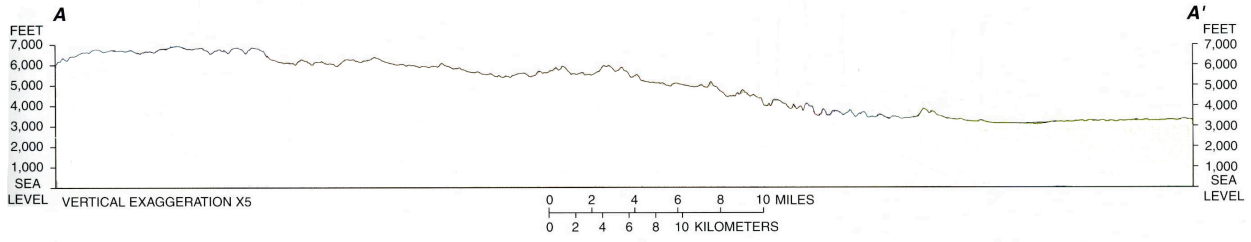
2. Starting from the center of the structure and moving outward in any direction, describe the general age relationship of the rock units.
   a. Rocks get progressively younger from the West to the East.
   b. Rocks get progressively younger from the center outward.
   c. There is no age relationship.
   d. Rocks get progressively older from the West to the East.
   e. Rocks get progressively older from the center outward.

3. How does the dip of bedding compare across the structure?
   a. Beds dip most steeply in the North.
   b. Beds dip at a consistent angle toward the West.
   c. Beds are flat-lying in all directions.
   d. Beds dip more steeply in the East than the West.
   e. Beds dip more steeply in the West than the East.

4. Which of the following best describes the general structure of this region?
   a. Anticline
   b. Syncline
   c. Dome
   d. Basin
   e. Monocline

5. A more detailed description of the structure of this region would include which of the following descriptors? *(Circle all that apply.)*
   a. Doubly plunging syncline
   b. Doubly plunging anticline
   c. Antiformal Syncline
   d. Synformal Anticline
   e. Overturned Anticline
   f. Overturned Monocline
   g. Overturned Syncline
   h. Asymmetric Dome
   i. Asymmetric Basin
   j. Symmetric Dome
   k. Symmetric Basin

6. Using the topographic profile given below, create a simplified geologic cross section along A-A'. (Feel free to group similar beds together so long as the structure is clear.)



7. List two stratigraphic units as named in the legend that you expect might be aquifers.
   a.

   b.

8. List two stratigraphic units as named in the legend that you expect might be confining units.
   a.

   b.

9. When determining whether a rock unit is an aquifer or a confining unit, which of the following are important to consider? *(Circle all that apply.)*
   a. Porosity
   b. Permeability
   c. Hardness
   d. Density
   e. Chemical composition
   f. Grain size
   g. Grain shape & sorting

10. Like many places in North America, the Black Hills are considered sacred by Native Americans of the Great Plains (specifically, the Black Hills to the Lakota and Cheyenne are the equivalent of Vatican City to Catholics). Imagine that you show up to do some mapping at Bear Butte at a time that coincides with a native ceremonial event (Bear Butte is known as the "shrine of vision"). How do you handle the interaction and what might you learn from such an exchange?

There is no one right answer to this question.

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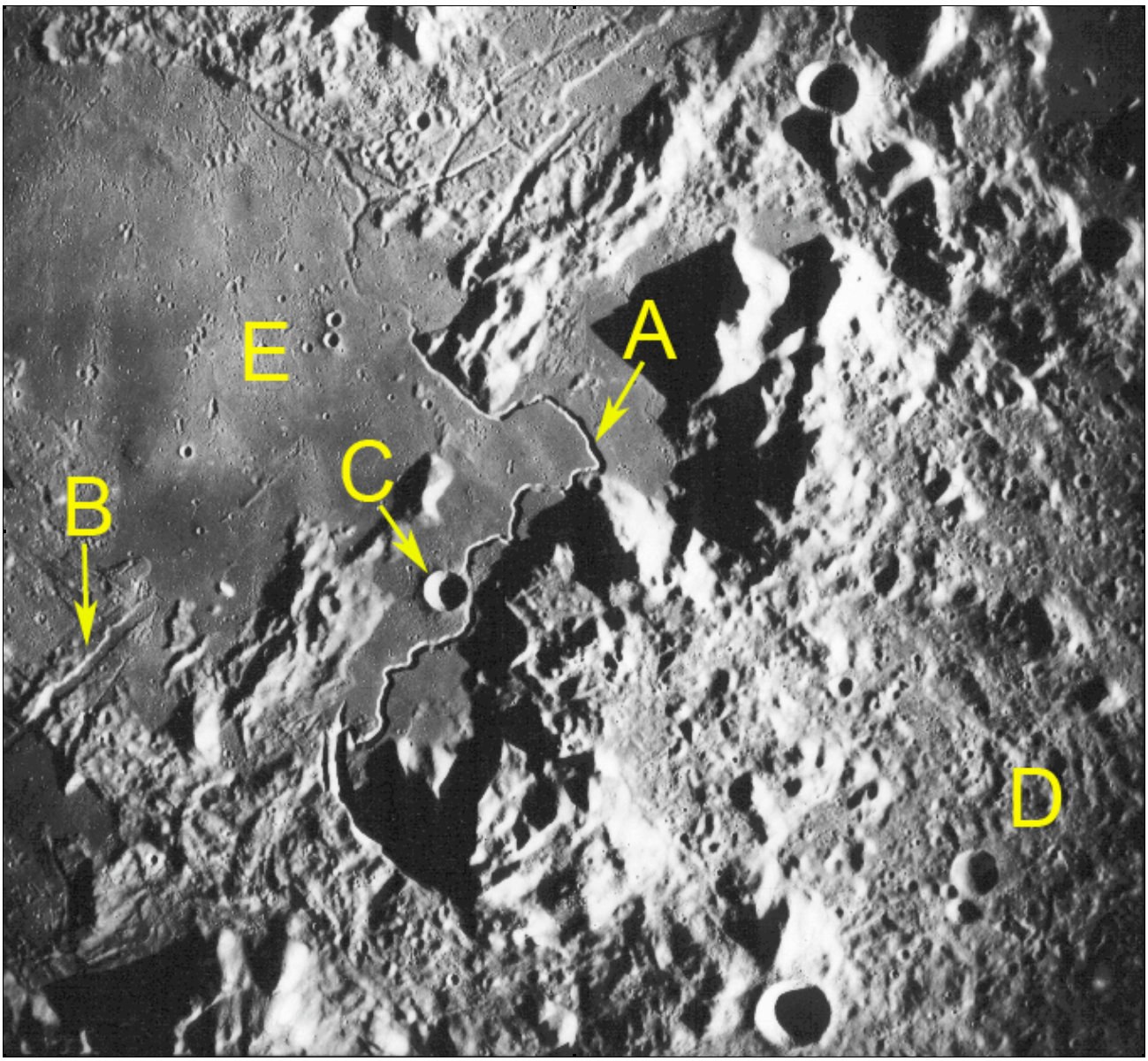
Section C. Planetary Geology

One of the Geoscience Department's primary learning objectives for our students is to develop a student's ability to interpret the geology and geologic history of an unknown area. What better unknown area to examine than that of another planetary body? In essence, we are dropping you into a new field area (the Moon) to see how well we have prepared you to apply your geologic knowledge and skills in a less familiar environment.

This is a photo of the Apollo 15 landing site at Hadley Rille, the Moon:



11. What might the sinuous feature A be?
    a. A river
    b. A lava tube
    c. A highway system
    d. A compressional ridge
    e. An extensional valley

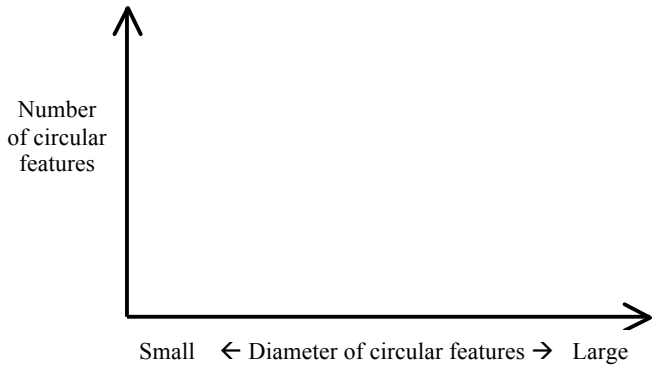
12. What might the linear feature B be?
    a. A river
    b. A lava tube
    c. A highway system
    d. A compressional ridge
    e. An extensional valley

13. Which planetary processes have acted on this region over its history? *(Circle all that apply.)*
    a. Volcanism
    b. Impact cratering
    c. Wind erosion
    d. Structural deformation
    e. Water erosion
    f. Bioerosion

14. What might the circular feature C be and how might it have formed?

15. Examine surface E. What is the general relationship between the size of the circular features and the number of circular features?

16. On the graph below, plot the general relationship between the number and size of the circular features that you observe on surface E.



17. Which surface is older, E or D?

18. On what evidence did you base your answer to Question #17? *(Circle all that apply.)*
    a. The absence of volcanics on surface E.
    b. The presence of mountains on surface D.
    c. More circular features on surface E than surface D.
    d. More circular features on surface D than surface E.
    e. Recent fluvial activity on surface A.
    f. Cross-cutting relationships.

19. List events A through E in order of occurrence from oldest to most recent.
    a. B, D, E, A, C
    b. E, A, D, B, C
    c. D, B, A, C, E
    d. D, B, E, A, C
    e. B, D, C, E, A

20. What are the fundamental geologic principles you used to determine your response to Question #19? *(Circle all that apply.)*
    a. Fossil succession
    b. Cross-cutting relationships
    c. Intrusions
    d. Original Horizontality
    e. Principle of Continuity
    f. Principle of Superposition

21. One constant throughout all of human existence on planet Earth has been the human endeavor to explore every inch of the Earth, from the highest peaks to the deep ocean floor, from Death Valley to Antarctica. In the last 50 years, humans have achieved the ability of exploring beyond our planet into the solar system. Today NASA is poised to establish a human colony on the Moon. At the same time, the global citizens of Earth are faced with a number of environmental challenges including global warming, species extinction, pollution, dwindling natural resources, and land use management issues. Which of these two issues (human base on Moon or environmental concerns) would you prefer your tax money be spent on? Frame a case to garner public support for your position.

There is no one right answer to this question. Your task is to choose a position that you might take and support it using scientific evidence, logic, and well-reasoned arguments. We are <u>not</u> asking for your opinion.

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Section D. Whole Planet Remote Sensing

To understand the dynamics and history of any given region, geologists must work at many different spatial scales from the atomic level through hand samples into the field and even on a planetary scale. A responsible geologist needs to place their regional work into a planetary context and, as geology extends throughout the solar system, geologists start with data about an entire planet's surface and work toward understanding specific regions.

In this section, please refer to the attached maps of the entire lunar surface. Each map is oriented in the same manner so you can directly compare one map to another. North is to the top for all maps.

22. Study the lunar albedo images. You'll notice two general regions on the Moon, "Dark areas" and "Light areas." Use the table below to describe the defining characteristics of these two different regions.

	Defining Characteristics	Average Elevation (km)	Average wt % Iron
Dark Areas			
Light Areas			

In addition to the data gathered from these maps, the Dark areas are characterized by high gravity anomalies, high Magnesium content and low Aluminum content. The Light areas show no gravity anomalies and have low Magnesium content and high Aluminum content.

23. Which general rock type would you expect to find in the DARK AREAS?

igneous	sedimentary	metamorphic

24. Which rock name best represents the rock that you would expect to find in the DARK AREAS?

granite	granodiorite	sandstone	quartz arenite	schist	gneiss
basalt	rhyolite	limestone	siltstone	slate	phyllite
peridotite	andesite	mudstone	feldspathic sandstone	hornfels	granofels
anorthosite	gabbro	pebble conglomerate	lithic sandstone	mylonite	marble
diorite	monzonite	quartz sandstone	dolostone	pelite	quartzite
quartz syenite	granitoid	skeletal grainstone	skeletal wackestone	breccia	shale

25. Explain why you think this type of rock is present in the DARK AREA.

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26. Which general rock type would you expect to find in the LIGHT AREAS?

igneous	sedimentary	metamorphic

27. Which rock name best represents the rock that you would expect to find in the LIGHT AREAS?

granite	granodiorite	sandstone	quartz arenite	schist	gneiss
basalt	rhyolite	limestone	siltstone	slate	phyllite
peridotite	andesite	mudstone	feldspathic sandstone	hornfels	granofels
anorthosite	gabbro	pebble conglomerate	lithic sandstone	mylonite	marble
diorite	monzonite	quartz sandstone	dolostone	pelite	quartzite
quartz syenite	granitoid	skeletal grainstone	skeletal wackestone	breccia	shale

28. Explain why you think this type of rock is present in the LIGHT AREA.

29. Compared to the Earth, what have been the prevalent geologic processes that have acted on the Moon throughout its history? *(Circle all that apply.)*

g. Volcanism
h. Impact cratering
i. Wind erosion
j. Structural deformation
k. Water erosion
l. Bioerosion

30. From the list below, choose the primary reason why the Moon's evolution has been so different from the Earth's. (Choose only one response.)

a. The Moon was formed further away from the Sun than the Earth.
b. The Moon was formed from part of the Earth during a large impact event.
c. The Moon has more Iron relative to its total mass than the Earth does.
d. The Moon never had an atmosphere.
e. The Moon is a satellite and not a planet.
f. The Moon is much smaller than the Earth and cooled off faster.
g. The Moon has experienced a much higher rate of impact cratering than the Earth.

Great job! Thank you