Name _____

COSMORPHOLOGY - May 2012

Geologic mapping

Goals:

- To recognize the similarities and differences in the processes affecting the outer planet satellites, and in the resulting landforms.
- To demonstrate how observations of a planet can be used to produce geologic maps. This includes the identification of rock units and placement of units in a time sequence.

This activity is based on Exercises Thirteen and Fifteen from NASA's Activities in Planetary Geology for the Physical and Earth Sciences (EG-1998-03-1089-HQ).

For descriptions, be complete, clear, and brief. Describe as if the reader cannot see the picture.

QUESTIONS

Ganymede

1. Examine figure 1a, which shows part of the Sippar Sulcus region of Ganymede, and compare to the geologic map of the area (figure 1b). Notice that the surface of Ganymede can be divided into two principal geologic units, bright terrain and dark terrain. The dark terrain is believed to be a mixture of ice and rock, while the bright terrain is probably composed mostly of ice. List and describe the many characteristics of the bright and dark terrains. Be as detailed as possible. Include factors such as brightness, number of craters, general surface appearance, and other characteristics that are apparent.
   A. Bright terrain:

   B. Dark terrain:

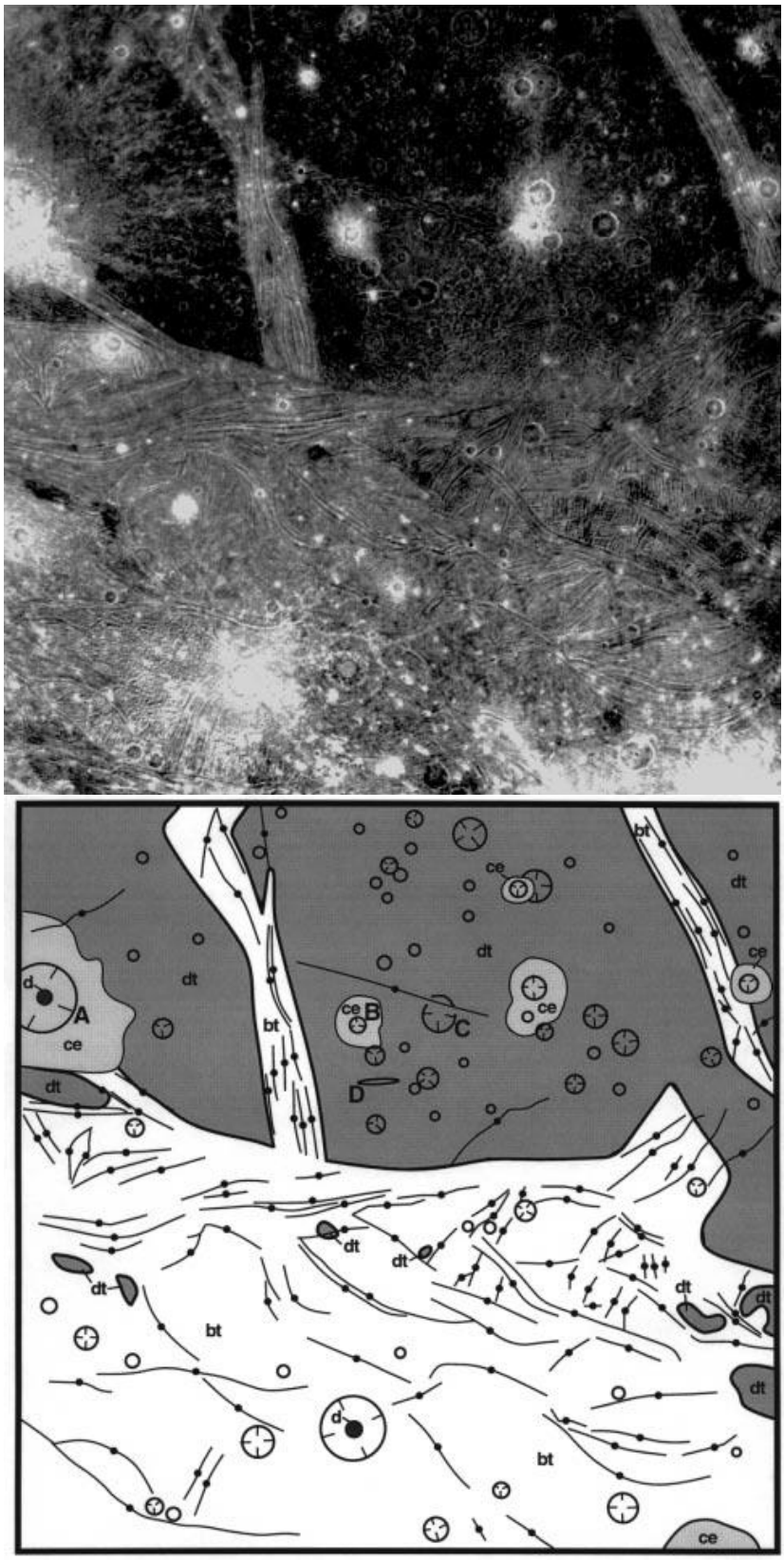

Figure 1: a) Voyager 2 image of Ganymede (FDS 20636.02) at a resolution of 1.5 km/pixel, showing part of Sippar Sulcus in lower half. North is to the top and the image is approximately 800 km across. b) corresponding geological map.

2.

A. Which of Ganymede's two principal terrain types is older? How can you tell?

B. What is the age of the ejecta for the crater marked "A" relative to the bright and dark terrain? How can you tell?

3. Many researchers believe that the bright terrain of Ganymede was shaped by tectonism. What is some evidence that this is true?

Enceladus

4. Now make a geological map of Enceladus. Use as a gude the map of Ganymede in figure 1. Tape a piece of acetate over the photograph of Enceladus (figure 2). Trace the outline of the satellite. You will find that it is simple to trace the satellite's limb, but the terminator is not as clearly defined. Next, outline the most prominent craters on the satellite, you will have to decide which craters should be included.
5. Locate and describe two impact craters that are unusual looking in different ways.

6. Grooves on Enceladus are probably tectonic features; map their locations. This symbol (✓) is one way of mapping a groove. Draw a thin line along each groove you see, and place a dot near the center of each line to indicate it is a groove.

7. Where do grooves (and the ridges between them) occur on Enceladus?

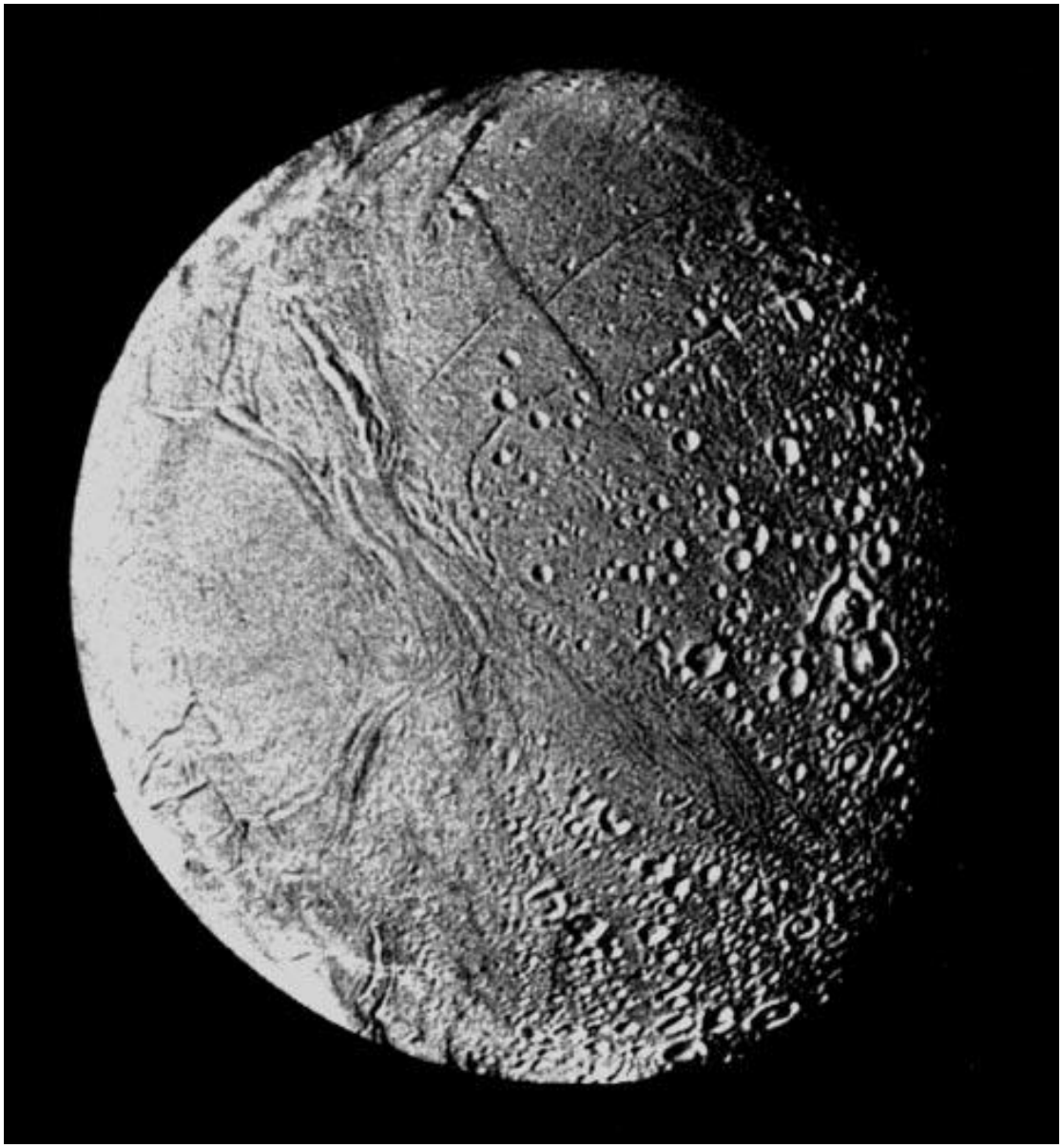

Figure 2: Photomosaic of Enceladus constructed from Voyager 2 images with resolutions of about 2 km/pixel. the satellite has a diameter of approximately 500 km. (Jet Propulsion Laboratory photomosaic P-23956 BW.)

8. The surface of Enceladus can be divided into three difference types of terrain. Think about the features you have mapped so far, and decide on how to divide the surface into three terrains. Decide on names that describe your units. (For example, "cratered terrain.") List the names of your three units. Following each name, describe the characteristics of each unit as you defined it in making your map.

   A.

B.

C.

9. On your map, draw boundaries around the different units. There might be only one patch of each unit, or there could be more than one patch. To complete you map, label the units with the descriptive names you have given them.

10.
    A. Which of the three units is the oldest? How can you tell?

    B. Which is the youngest? How can you tell?

Moon

11. Examine figure 3, an observatory photograph of the near side of the Moon. Visually separate the different areas of the Moon into terrains. List the characteristics of each terrain.

Figure 3: Near side of the Moon. North is to the top.

12. Which terrain do you think is the oldest? The youngest? Why?

Figure 3 shows that the surface of the Moon is not the same everywhere. The terrains, however, are not units in the strictest sense. Rather, each terrain is made up of many different units; close inspection of Figure 3 shows small areas having distinctive characteristics and that, when observed on high resolution photographs or on the ground, are seen to be distinct rock units.

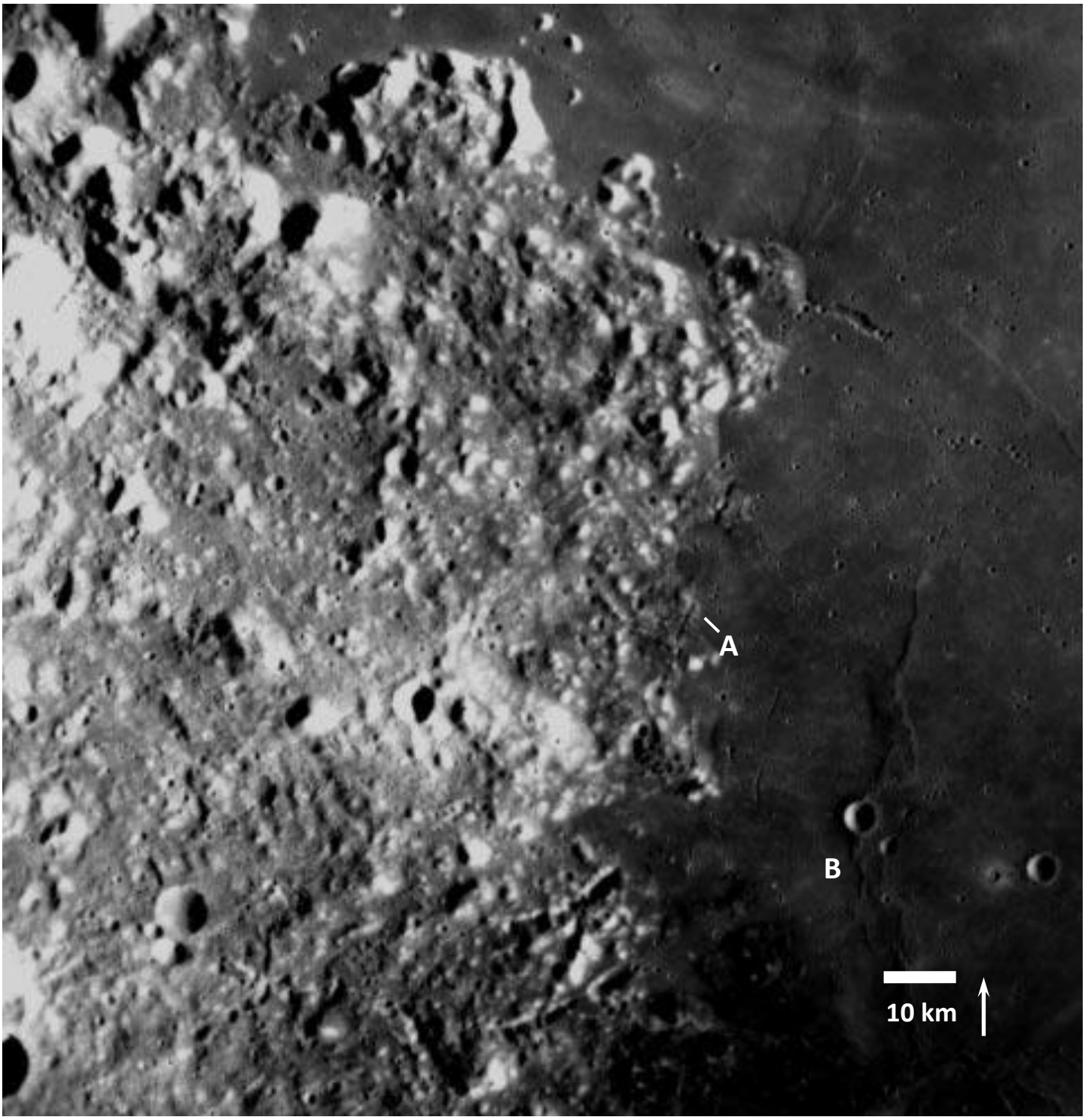

Figure 4: Apollo 15 photograph of the moon. North is to the top. The small crater above the letter B is 3.8 kilometers in diameter. Apollo metric AS15 0583.

13. Examine figure 4. This photo shows in greater detail the boundary between two of the terrains you identified previously. Tape a piece of acetate or tracing paper over the photo. Mark the four corners as reference points in case the sheet shifts while you are working on it and also to allow for overlaying with other maps for comparison. Draw the contact between the rough highlands and the smooth plains. Note the feature indicated by the A on the photo. This is a graben caused by tectonic activity. The feature marked B on the photo is a ridge caused by tectonic activity. Trace these features on your map. Fill in the unit descriptions in the space provided below. Label the units on your map.

Unit Name	Observation	Interpretation

14. What is the age relation between the graben and the highlands? (Is the graben older or younger than the highlands?) How can you tell?

15. What is the age relation between the highlands and the smooth plains? What observations did you use to decide?

16. What is the age relation between the ridge and the smooth plains? How can you tell?

17. What is the age relation between the ridge and the large crater on it? How can you tell?

18. Place the geologic units and structural features identified above in their correct sequence in the stratigraphic chart below. List the oldest at the bottom and the youngest at the top.

	Geologic Unit	Structural Features
Youngest		
Oldest		

19.

A. If the geologic map of Ganymede (Figure 1b) could be printed in color, what colors would you use for the units? Why?

B. What colors would you use for your map of Enceladus? Why?

C. What colors would you use for your map of the moon? Why?

20. What do you think are the most important factors to consider when choosing colors? Why?