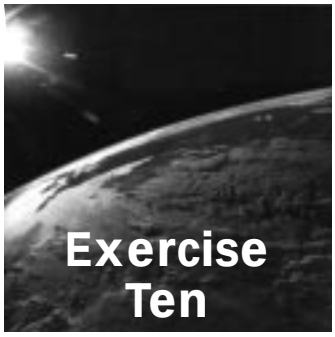

Name _____

Landform Mapping: The Terrestrial Planets

Purpose

To examine and compare global-scale surfaces of the terrestrial planets.

Materials

Clear acetate, overhead projector markers, metric ruler, compass.

Introduction

At a global scale, only the largest planetary **landforms** and regions are visible and can be identified. Such landforms include large volcanoes, canyons, impact craters, plains regions, mountains, and highlands (topographically "high standing" regions). Although the Moon and planets formed at the same time (about 4.5 billion years ago) their surfaces differ in age. This difference is due to variation in the levels of geologic activity on each body since their formation. The four main geologic processes (**volcanism, tectonism, gradation,** and **impact cratering**) have worked to alter the original surfaces. In comparing planetary surfaces, relative ages are usually determined from impact craters. In general, older surfaces show more craters, larger craters, and more degraded craters than younger surfaces.

Questions

Moon

Examine Figure 10.1. Place a piece of clear acetate over the photo. Trace the outline of the Moon. Divide the Moon by its two major regions—highlands (light) and plains (dark)—by outlining the light-toned and dark-toned areas. On the Moon, the plains are called "maria" (which means "seas" in Latin) for their fanciful resemblance to oceans.

1. Describe the characteristics of each region.

2. Which of the two regions appears to be most heavily cratered?

3. Which region on the Moon is older—the plains or the highlands?

4. Some large, young craters have bright ejecta deposits that form a star-like pattern of rays around them. Trace two such craters and their deposits onto your acetate map. Are these craters older or younger than the plains?

Mercury

5. Examine Figure 10.2. What landforms and regions do you observe on Mercury?

6. Based on the number of craters, do you think the surface of Mercury is older, younger, or about the same age as the plains on the Moon?

Mars

Examine Figure 10.3. Mars has a thin atmosphere, seasonal dust storms and polar ice caps (notice the bright south polar ice cap near the bottom of the figure). At one time, Mars had liquid water on its surface, although today Mars is too cold to have liquid water and only has ice. The darker spots within the bright region of the upper left of the image (marked A–D) are large volcanoes. Images sent back from surface landers and other remotely acquired data show that the lighter toned areas are relatively dusty and the darker toned areas are sandy or bare rock. Near the center of the image is Valles Marineris (marked E), a large canyon system of probable tectonic origin.

7. List similarities and differences in the features found on Mars compared to those on the Moon and Mercury.

8. Why is the surface of Mars different from the Moon? (List reasons that support your answer.)

9. Based on the number of impact craters, do you think the surface of Mars seen here is older, younger, or about the same age as the highlands on the Moon?

10. Based on the number of impact craters, which part of Mars is older, the northern or the southern region?

Venus

Although the atmosphere of Mars is relatively cloud free, the thick cloud cover on Venus completely hides the surface from viewing by cameras. Using **radar,** which can penetrate through clouds, the Magellan spacecraft sent back radar images of the surface of Venus. In general, these radar images show rough topography (such as mountains, **rift zones,** crater rims and **ejecta**) as bright, and smoother material (plains) as dark. A volcano (A), a crater (B), and a canyon (C) have been labeled on the image.

11. Which planet looks more like Venus at the global scale: Mercury or Mars?

12. Compare Valles Marineris on Mars to Artemis Corona (the canyon marked C) on Venus. How are their morphologies the same? How are they different?

13. Based on the number of craters, do you think the surface of Venus is older, younger, or about the same age as the highlands on the Moon?

Earth

Figure 10.5 shows a digital representation of the Earth, shown as it might look from space if it had no clouds and no oceans. In this way, Earth's landforms can be compared to those of other planets.

14. **a.** List some major landforms on Earth that are comparable to what you have seen on the other planets.

b. List some different types of landforms you can see.

15. List some similarities and differences between the landforms of the Earth and:

    a. Moon

    b. Mercury

    c. Mars

    d. Venus

16. Based on the number of craters, the number of geologic processes evident and the different types of landforms seen on the images, list the five surfaces you have examined in order :

    a. From oldest to youngest.

    b. From least complex to most complex.

17. Examine the table on the next page. Using a compass, draw circles showing the relative sizes of Mercury, Venus, Mars, the Moon, and Earth in the sketch area below. Let the diameter of Earth equal 6 cm.

Sketch area

	Mercury	Venus	Earth	Moon	Mars
Mean Distance from Sun (millions of km)	57.9	108.2	149.6	384,400 km from Earth	227.9
Equatorial Diameter (km)	4880	12,104	12,756	3476	6787
Equatorial Diameter (Earth diameters)	0.38	0.95	1.000	0.272	0.53
Mass (relative to Earth)	0.055	0.815	1.000	0.0123	0.108
Volume (relative to Earth)	0.06	0.88	1.000	0.0203	0.15
Density (g/cm^3)	5.4	5.2	5.5	3.34	3.9

*18. Before the initial reconnaissance of the solar system by spacecraft was completed, it was traditionally believed that the geological complexity of surface features on a solar system body would be related to the size of the body, larger planets being more geologically complex. Is this true of the terrestrial planets? Support your answer.

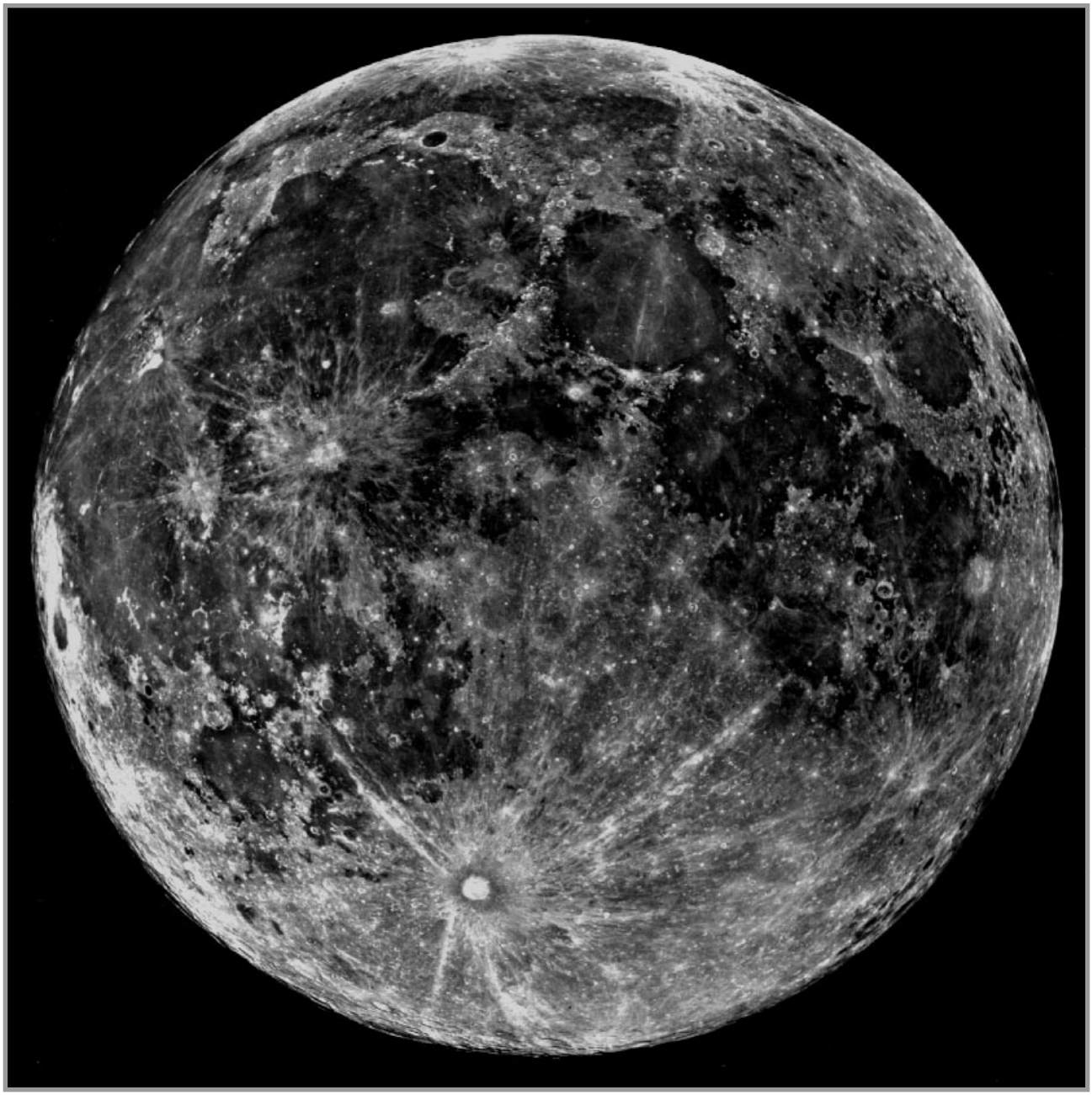

Figure 10.1. *Photograph of the Moon. North is to the top. (Courtesy of Ewen A. Whitaker, University of Arizona.)*

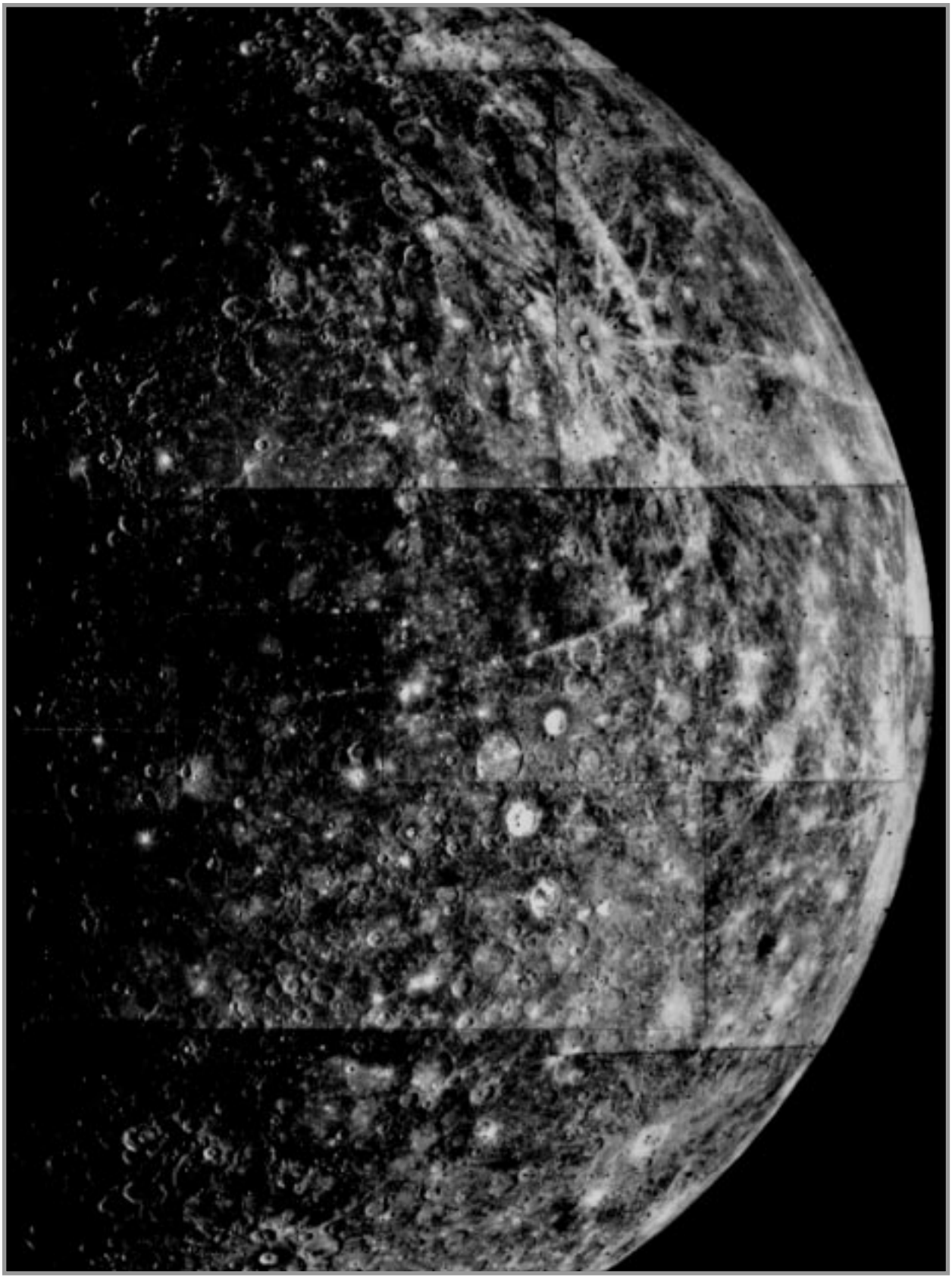

Figure 10.2. *Mariner 10 mosaic of Mercury. North is to the top. (NASA P-14580.)*

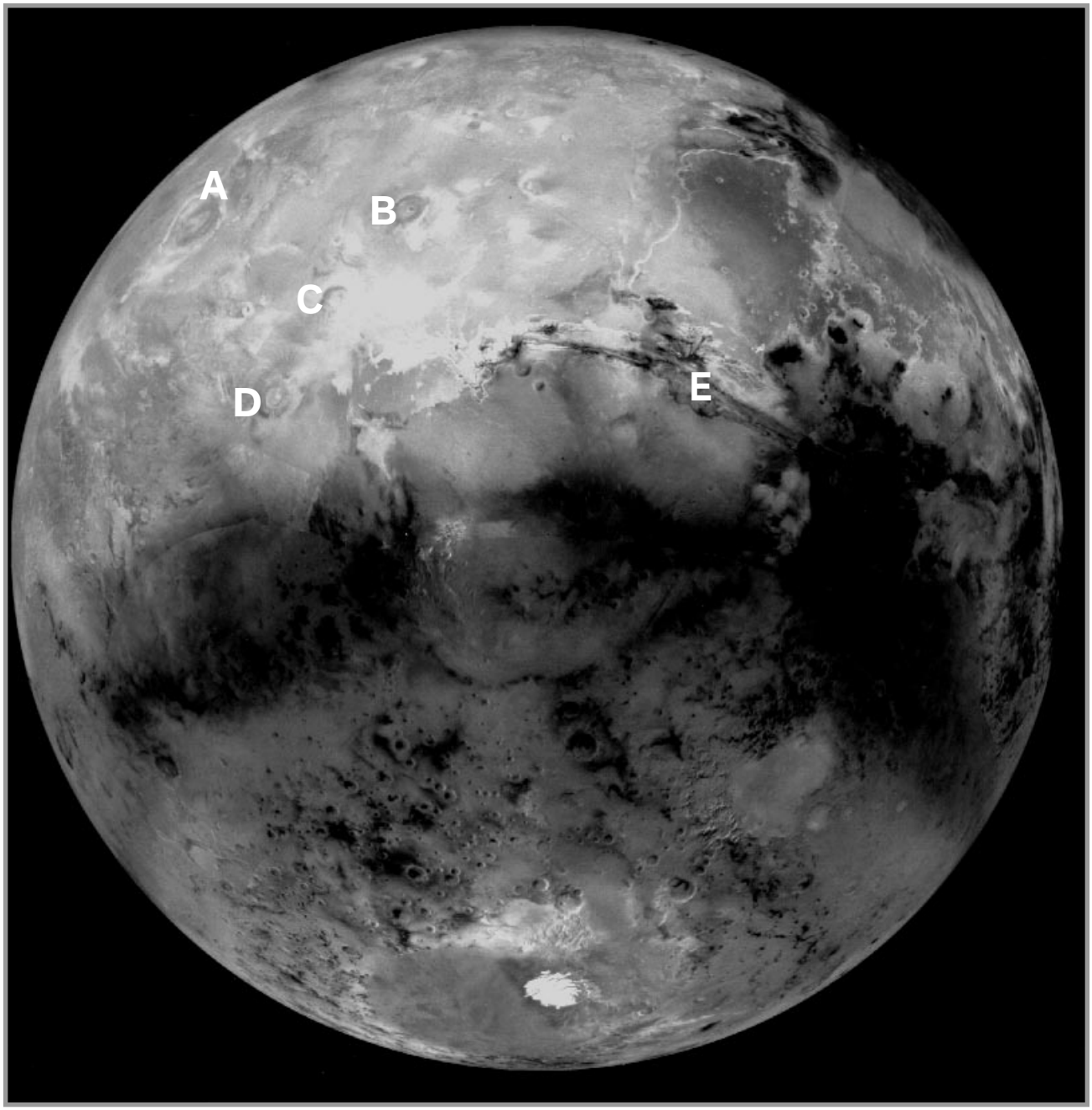

Figure 10.3. *Viking Orbiter global mosaic of Mars, centered at -30°, 90°. North is to the top. (Courtesy U.S. Geological Survey, Flagstaff, Arizona.)*

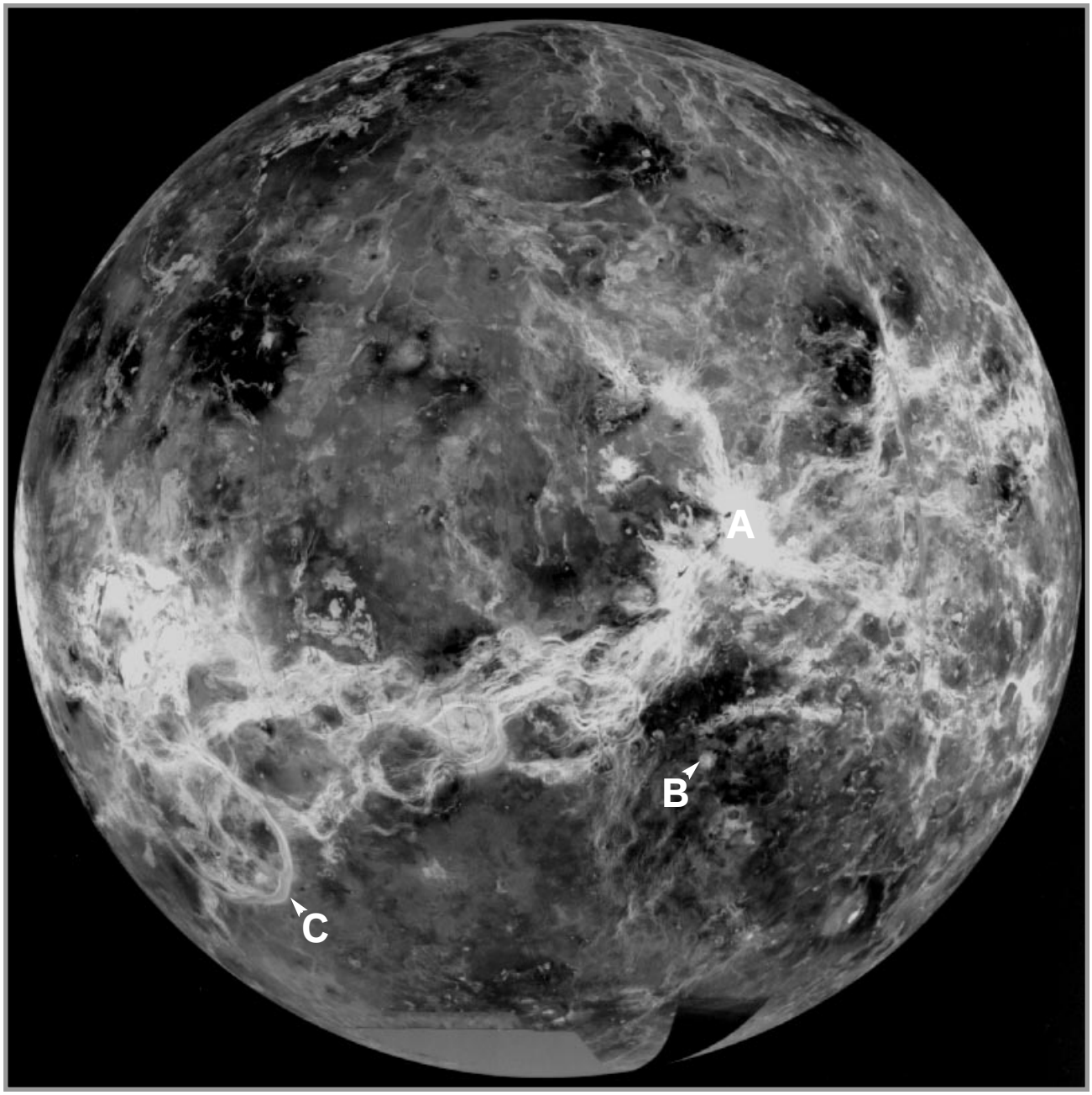

Figure 10.4. *Magellan radar mosaic of Venus. North is to the top. The smooth gray and black sections at the bottom of the figure are portions of the south pole that were not imaged by the spacecraft. (NASA P-39225.)*

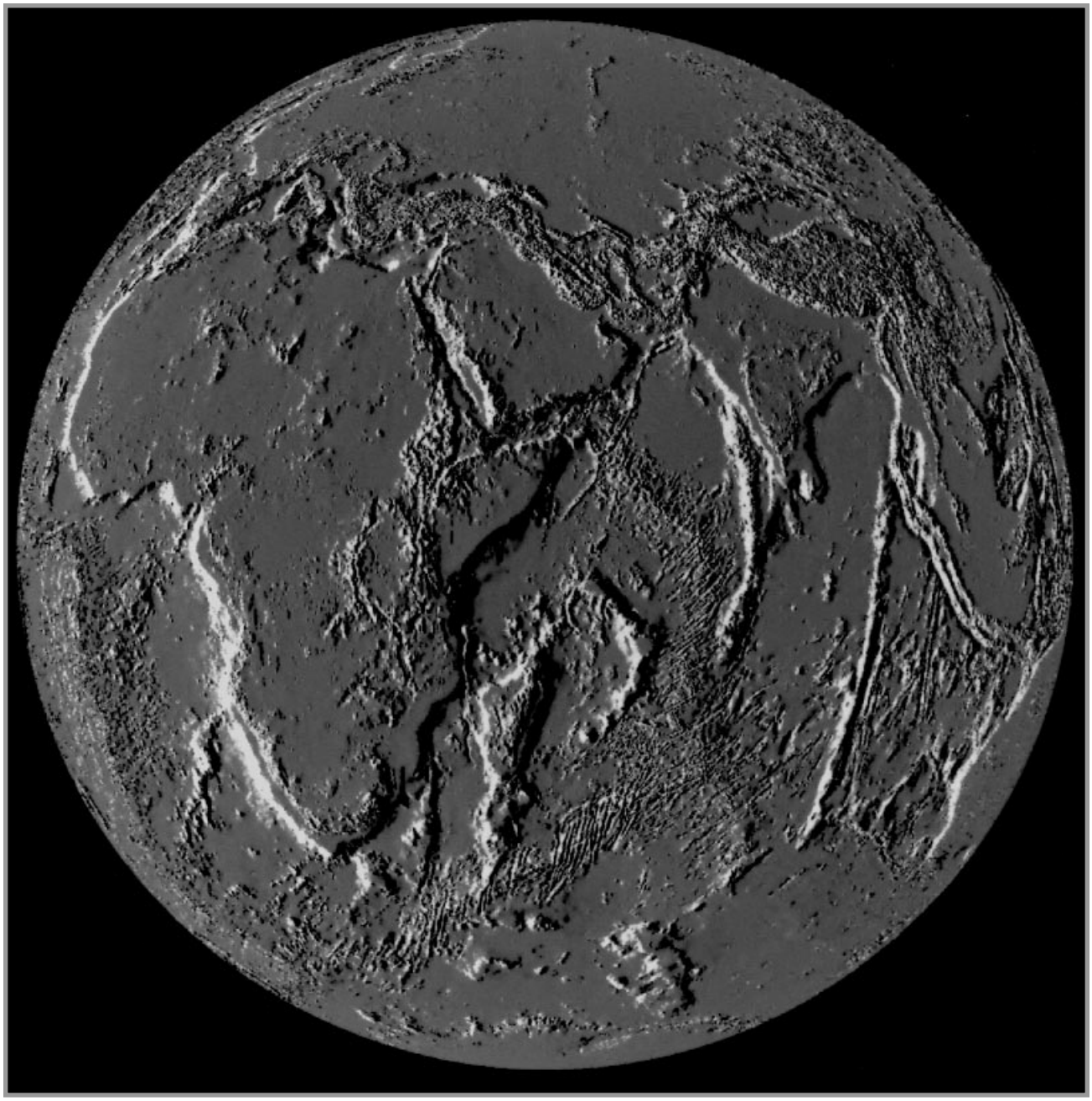

Figure 10.5. *Global representation of the Earth in which higher standing topography is shown as brighter, centered at 0°, 50°. North is to the top. (Courtesy U.S. Geological Survey, Flagstaff, Arizona.)*