SUPERFICIES
Y
PROCESOS GEOLOGICOS

MATERIAL COMPLEMENTARIO DEL CURSO DE PLANETOLOGIA 2013

(no sustituye al curso teórico)

http://www.astronomia.edu.uy/depto/planetologia/2013.html

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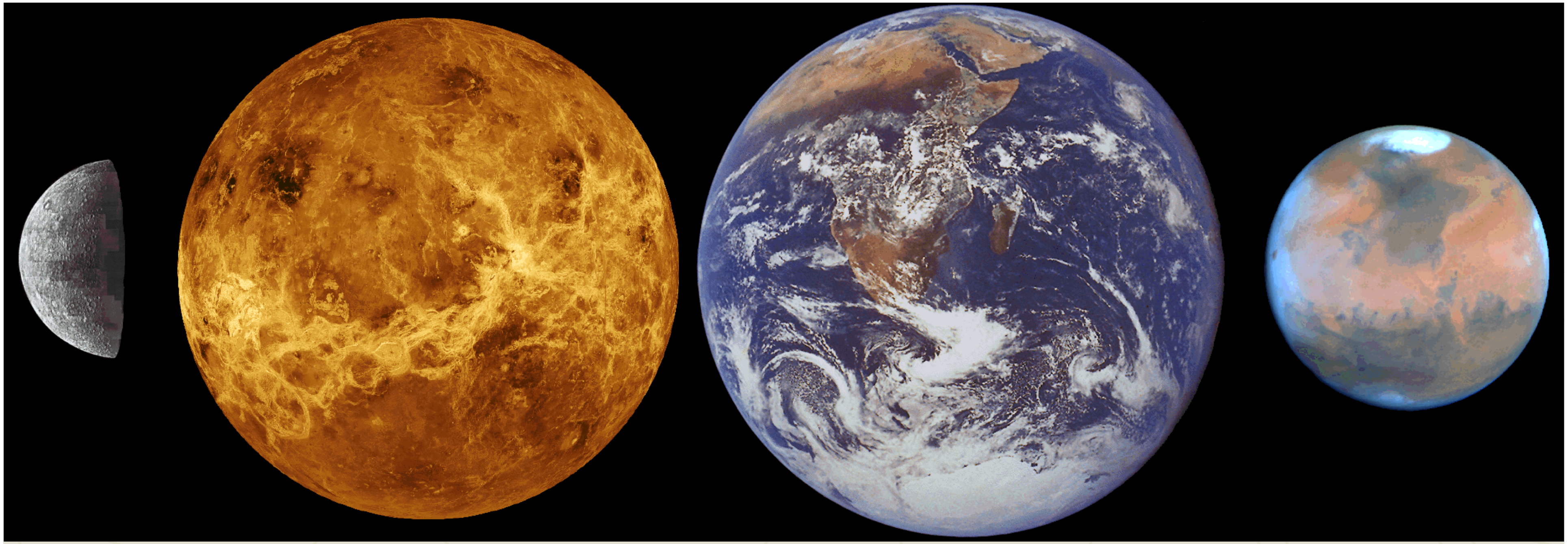
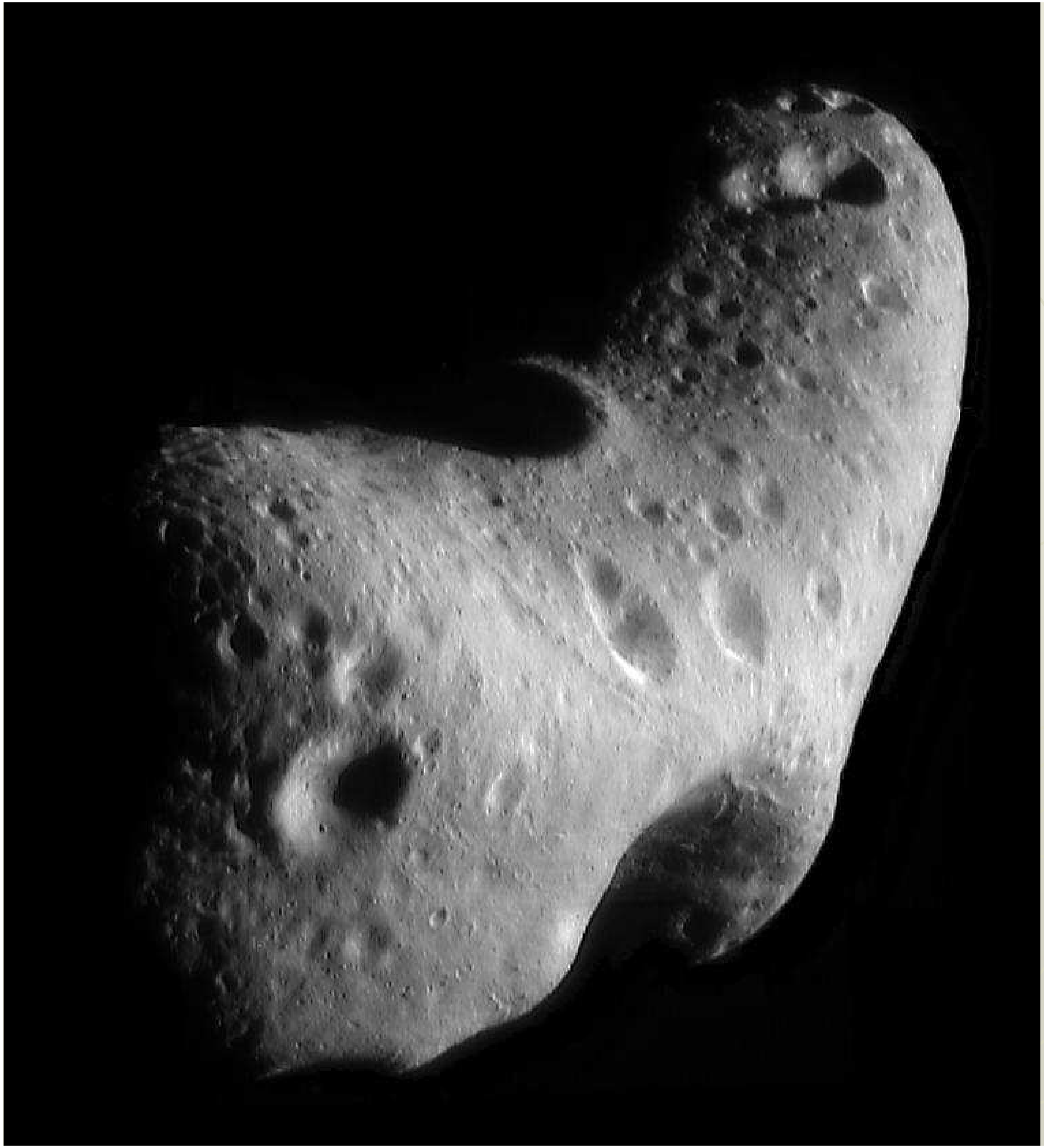



Io
Europa
Earth's Moon
Ganymede
Callisto



Eros

Temperaturas de equilibrio en el sistema solar:

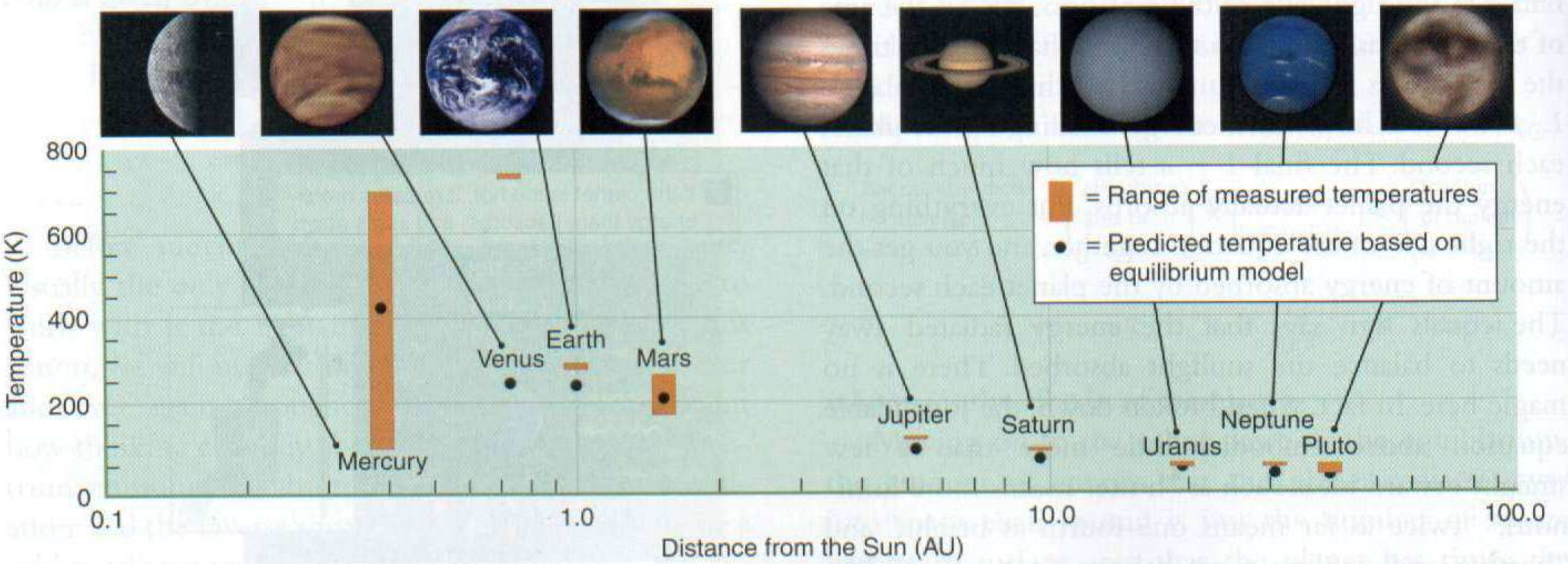


Figure 4.27 *Predicted temperatures for the planets, based on the equilibrium between absorbed sunlight and thermal radiation into space, are compared with ranges of observed surface temperatures. Some predictions are correct. Interestingly, others are not.*

Dependen básicamente de la distancia al Sol y del Albedo.

espectro observado = emisión + reflexión

determinación de radio

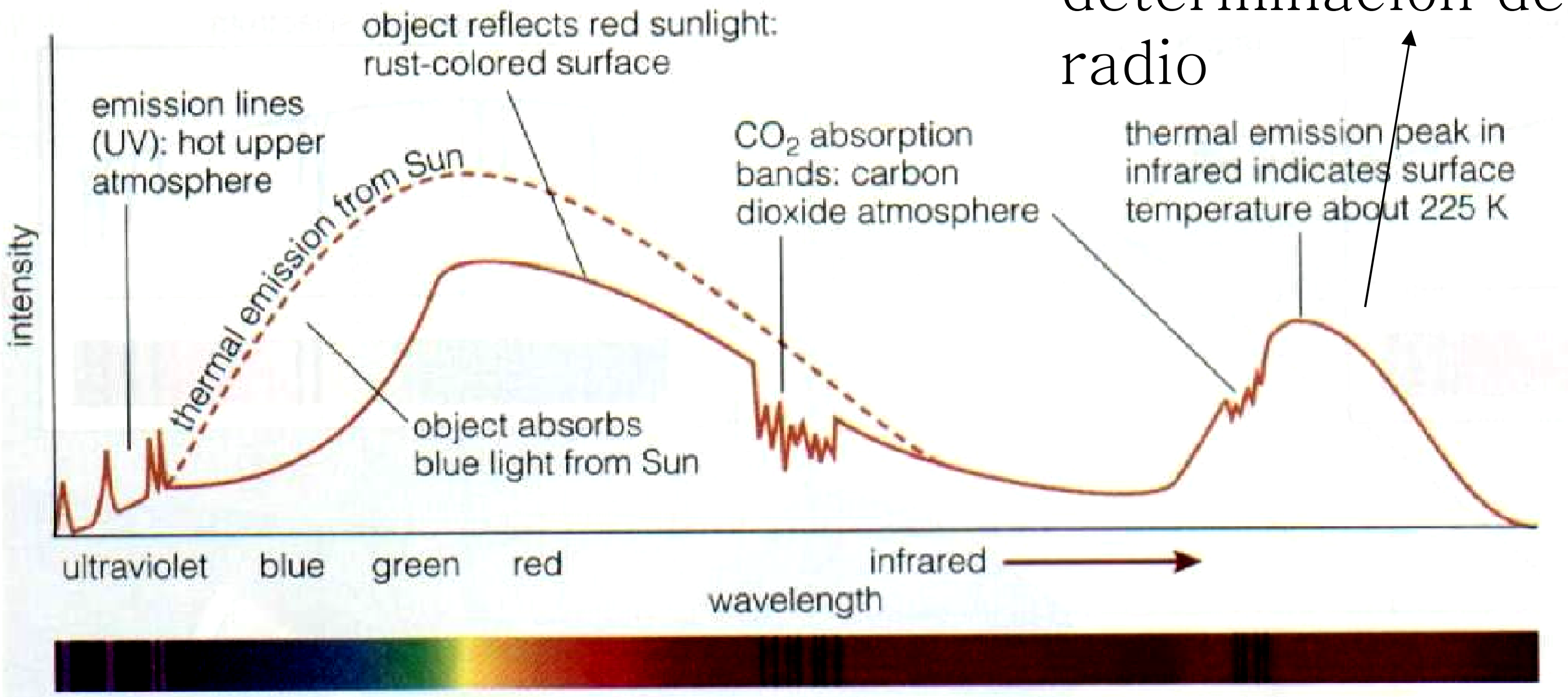


FIGURE 7.14 The spectrum of Figure 7.6, with interpretation. We can conclude that the object looks red in color because it absorbs more blue light than red light from the Sun. The absorption lines tell us that the object has a carbon dioxide atmosphere, and the emission lines tell us that its upper atmosphere is hot. The hump in the infrared (near the right of the diagram) tells us the object has a surface temperature of about 225 K. It is a spectrum of the planet Mars.

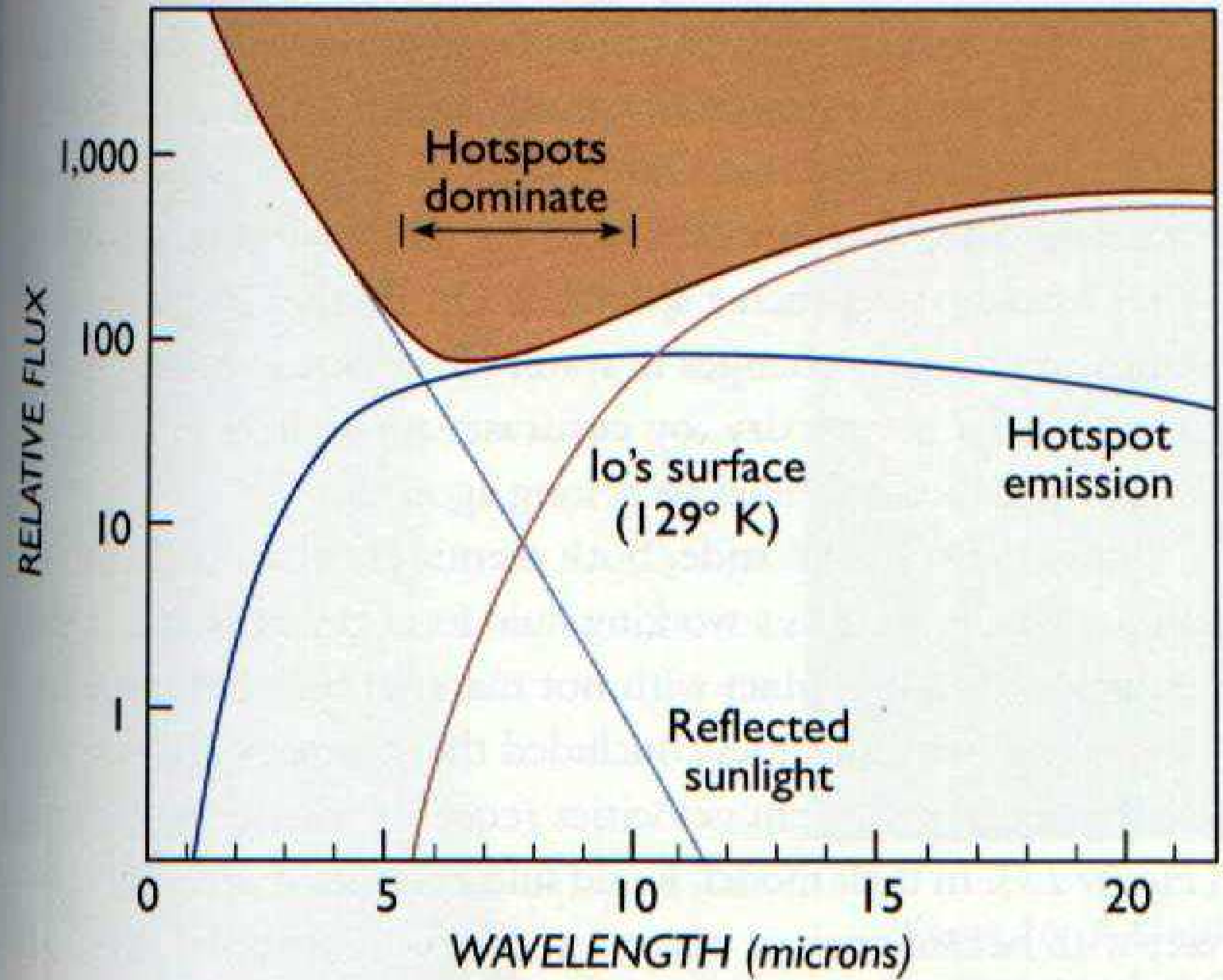
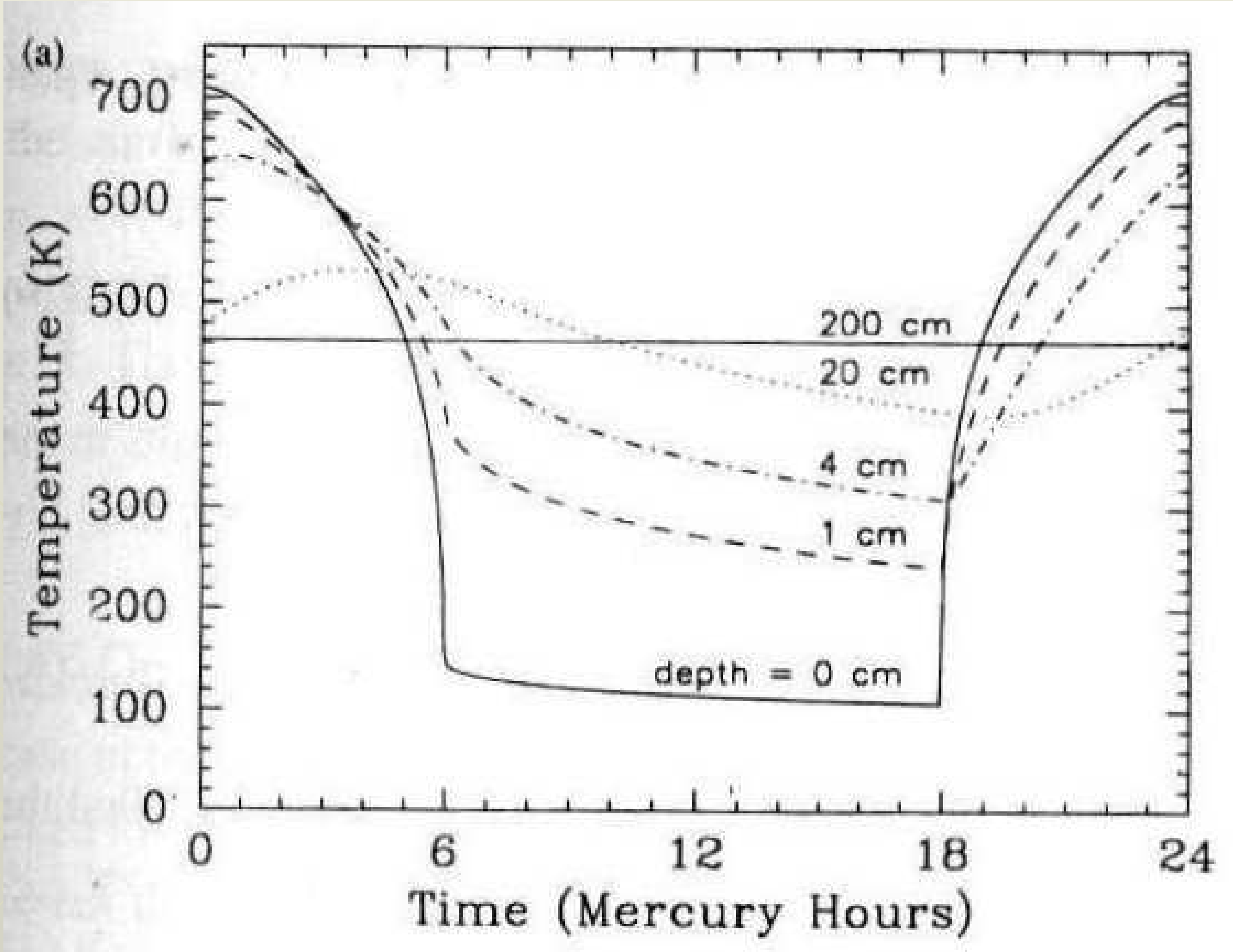


Figure 11. **Io's spectral signature involves contributions from three major components, but hotspot emissions dominate from 6 to 10 microns. Observations in this range can be used to monitor the hotspots from Earth as they rotate into and out of view.**



(a)
Temperature (K)
0
100
200
300
400
500
600
700
200 cm
20 cm
4 cm
1 cm
depth = 0 cm
0
6
12
18
24
Time (Mercury Hours)

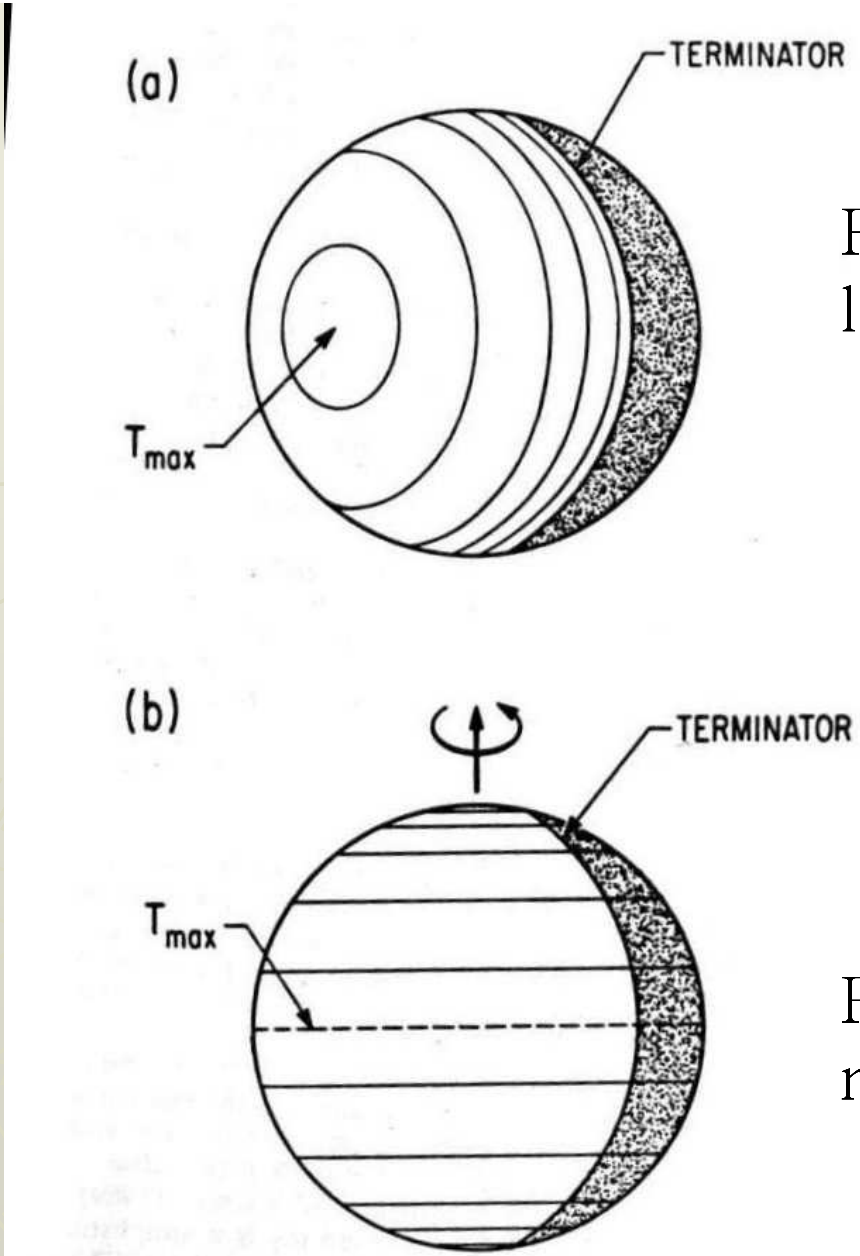
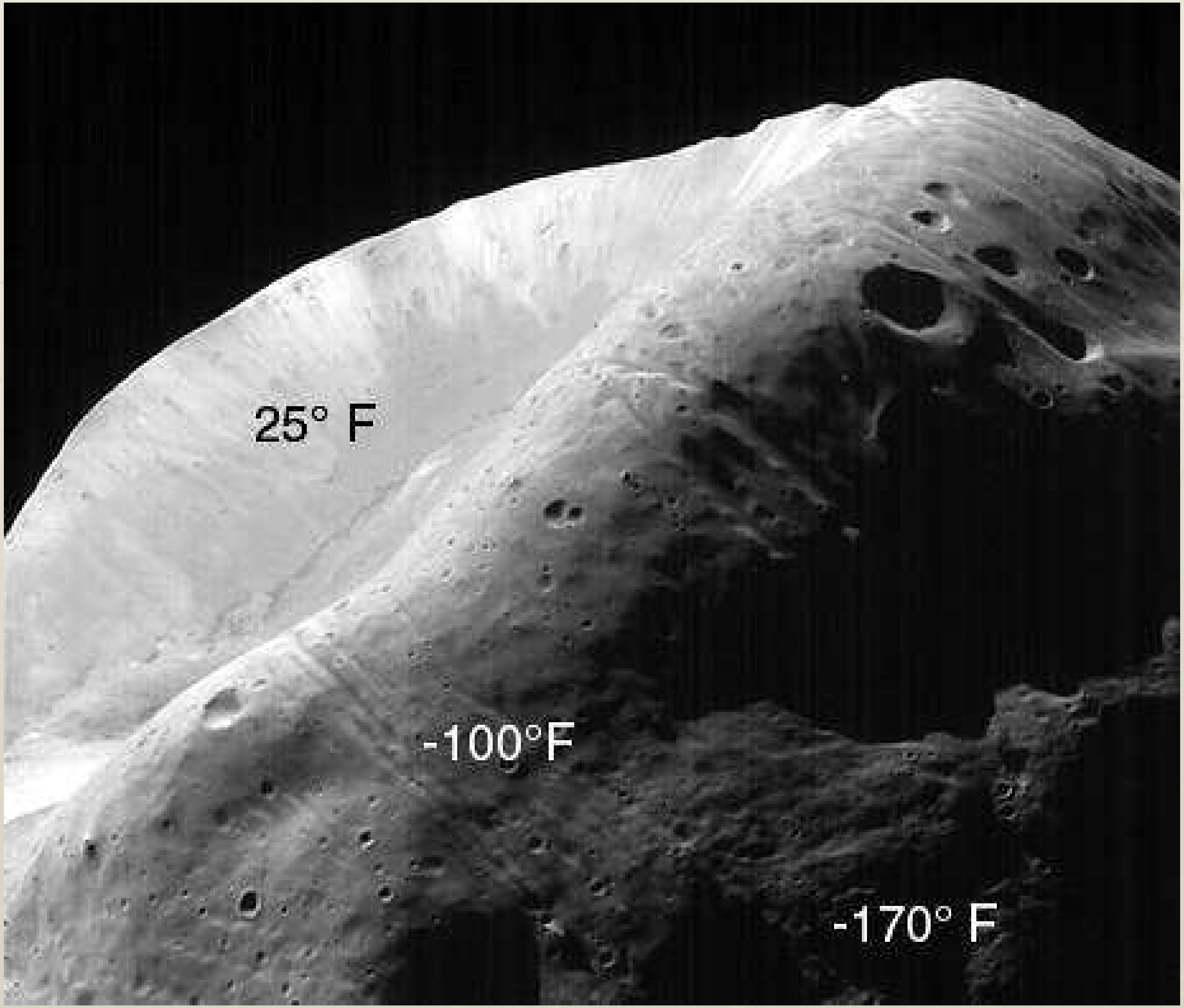


Figure A44 Illustration of the two endmember thermal models. (a) The standard thermal (non-rotating) model, with the temperature dependent only on the solar incidence angle. (b) The fast-rotating (isothermal latitude) model, with the temperature dependent only on the distance from the equator.

Planeta de rotación lenta

Planeta de rotación rápida


25° F
-100°F
-170° F

Minerales

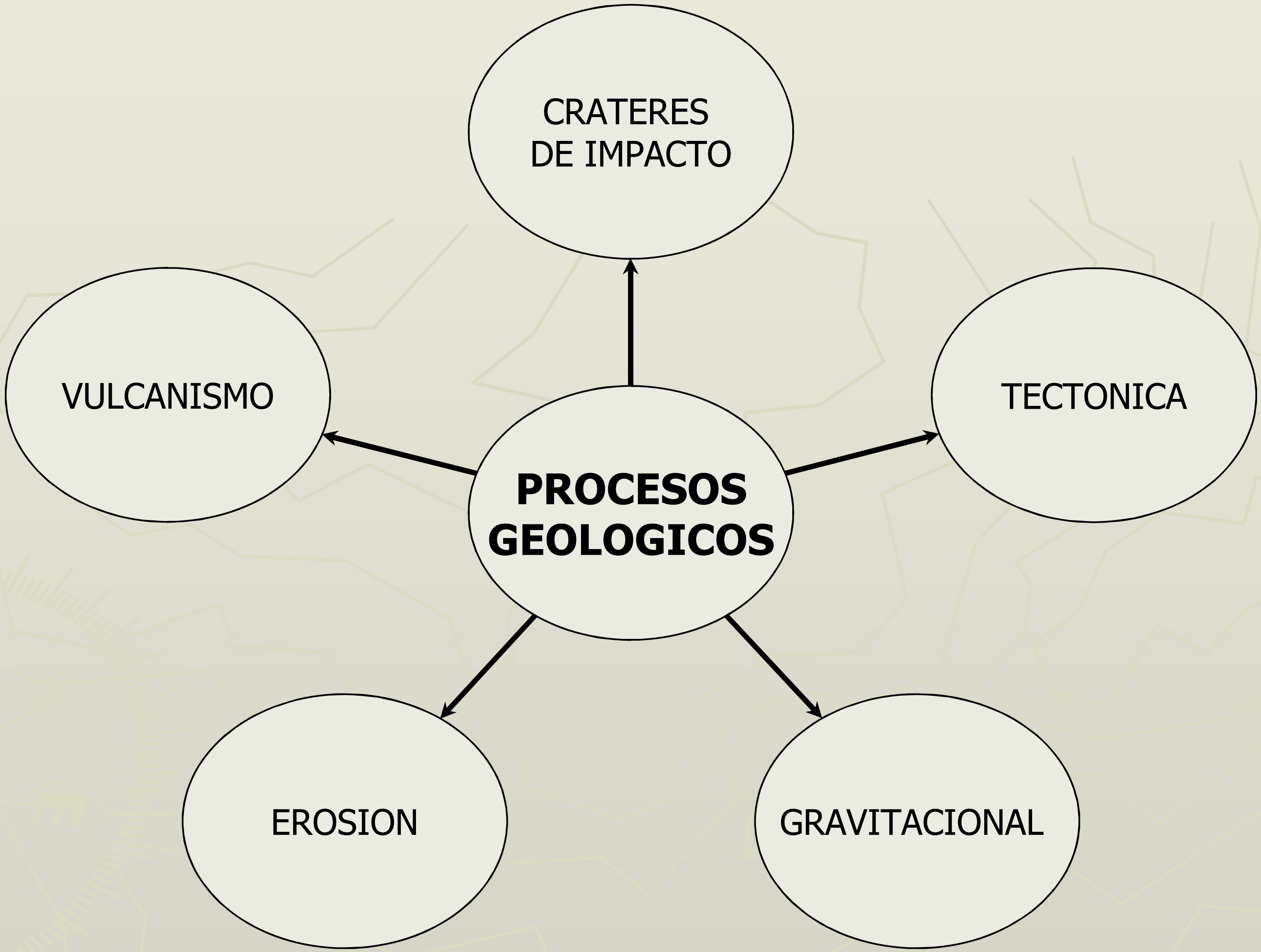
que constituyen

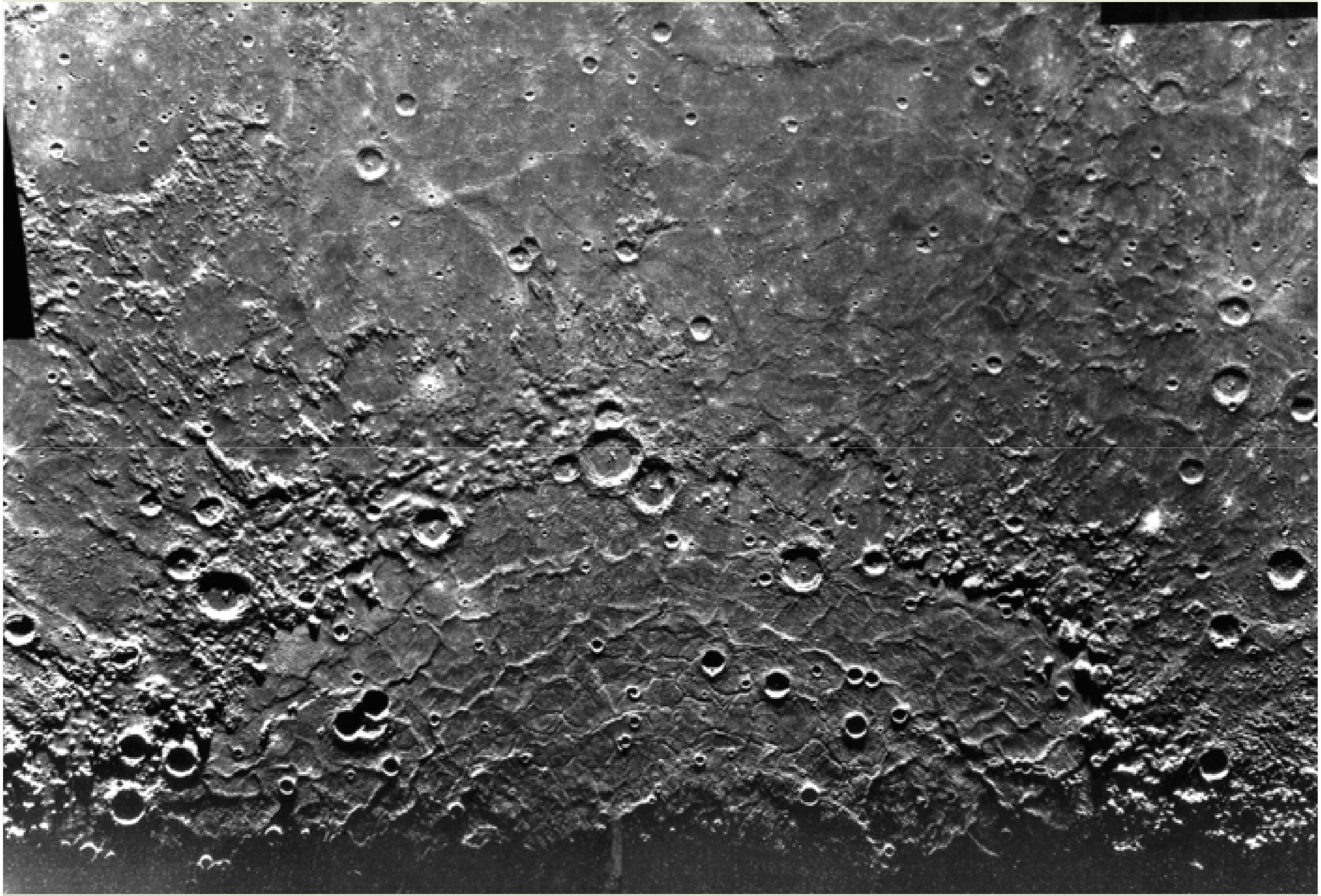
Rocas

primitivas, ígneas, metamórficas, sedimentarias, breccias

que sufren

Procesos Geológicos


CRATERES
DE IMPACTO
VULCANISMO
TECTONICA
PROCESOS
GEOLOGICOS
EROSION
GRAVITACIONAL



MERCURIO

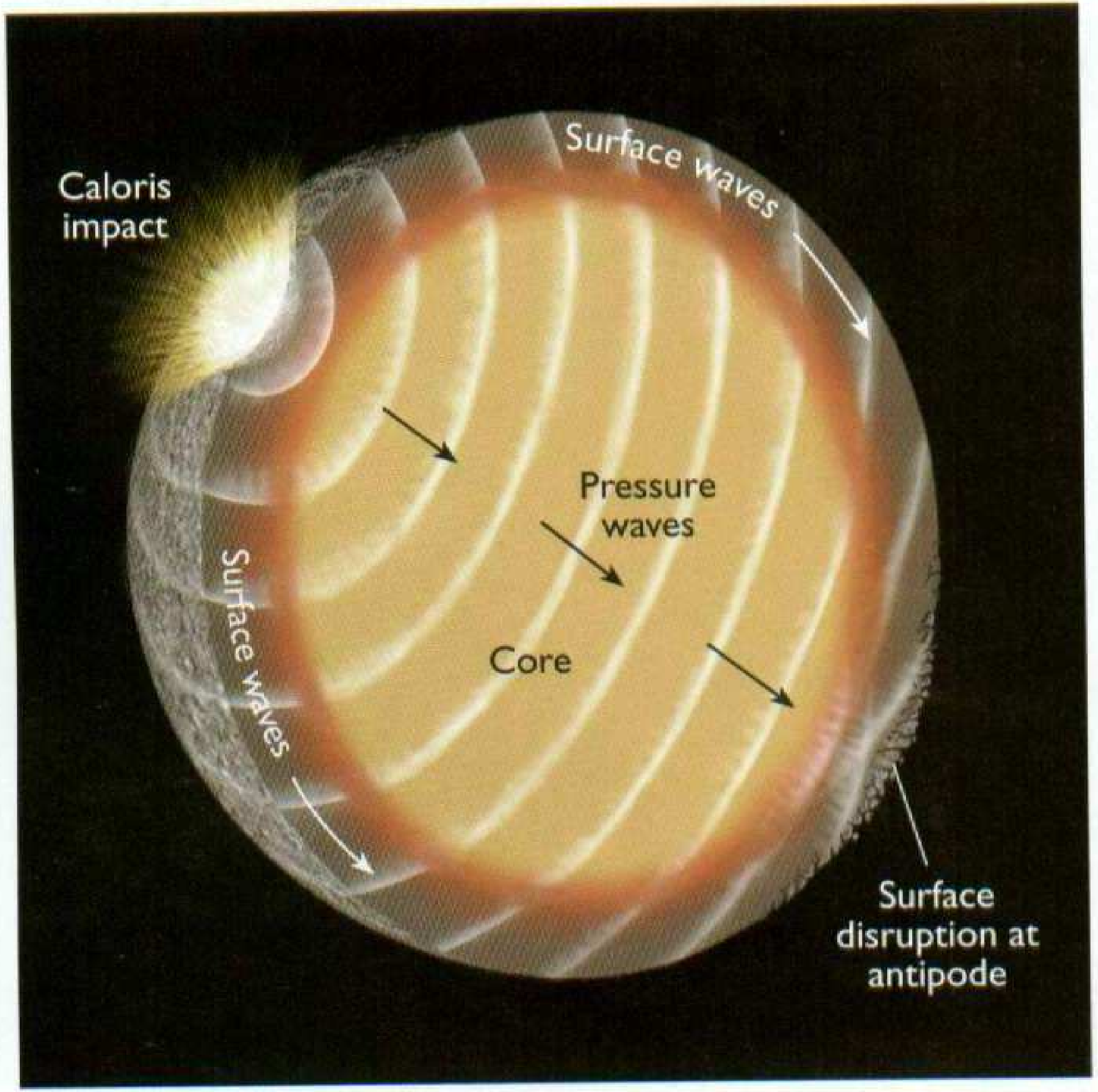
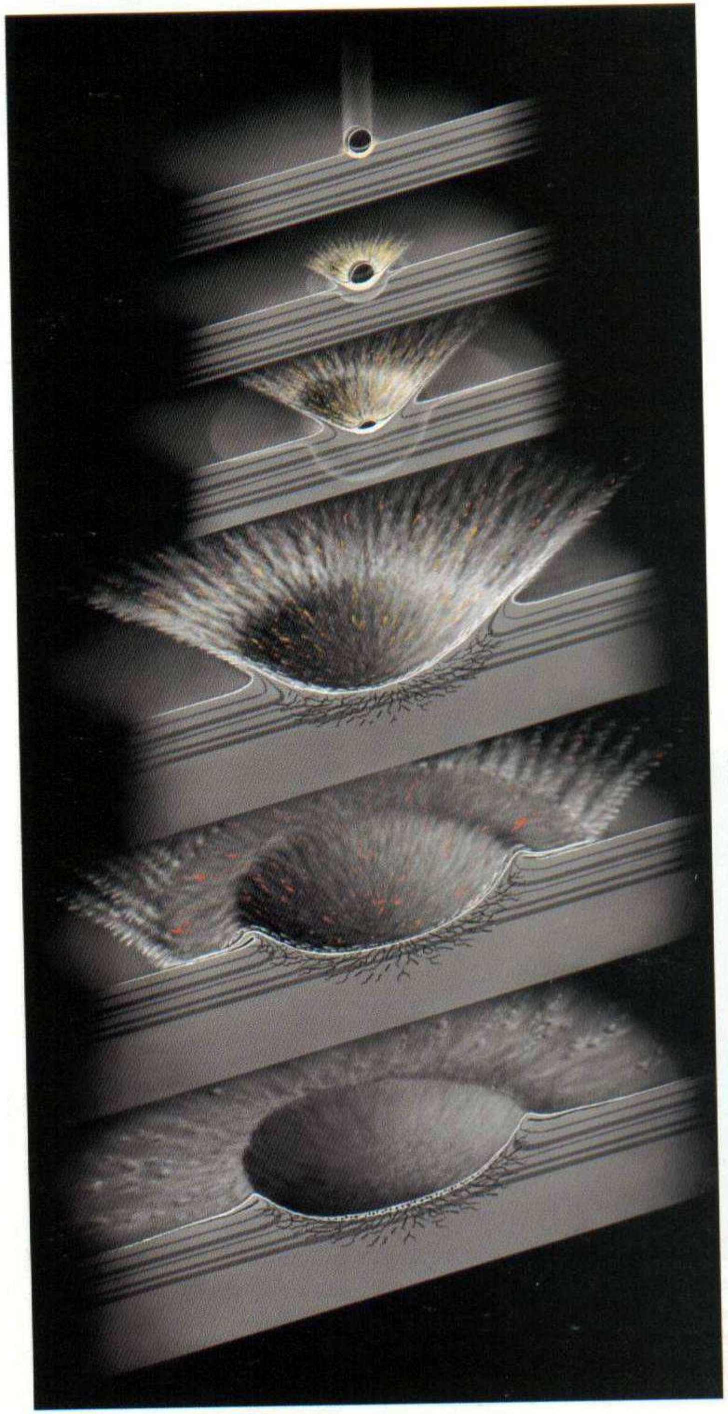
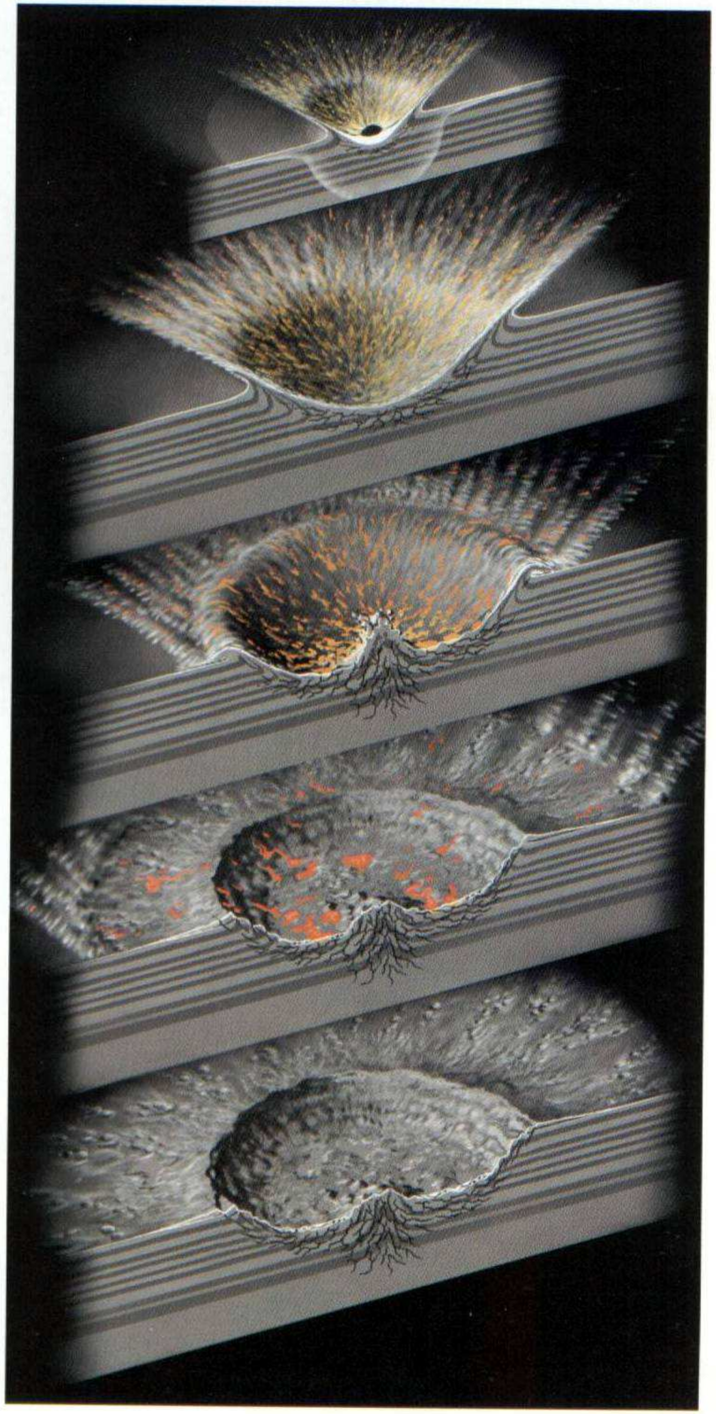


Figure 11. The gigantic impact that created Caloris basin 3.85 billion years ago sent intense seismic waves around and throughout the planet. These came to a focus at the antipodal point, where the ground shook and heaved violently.





DENSIDAD DE CRATERES

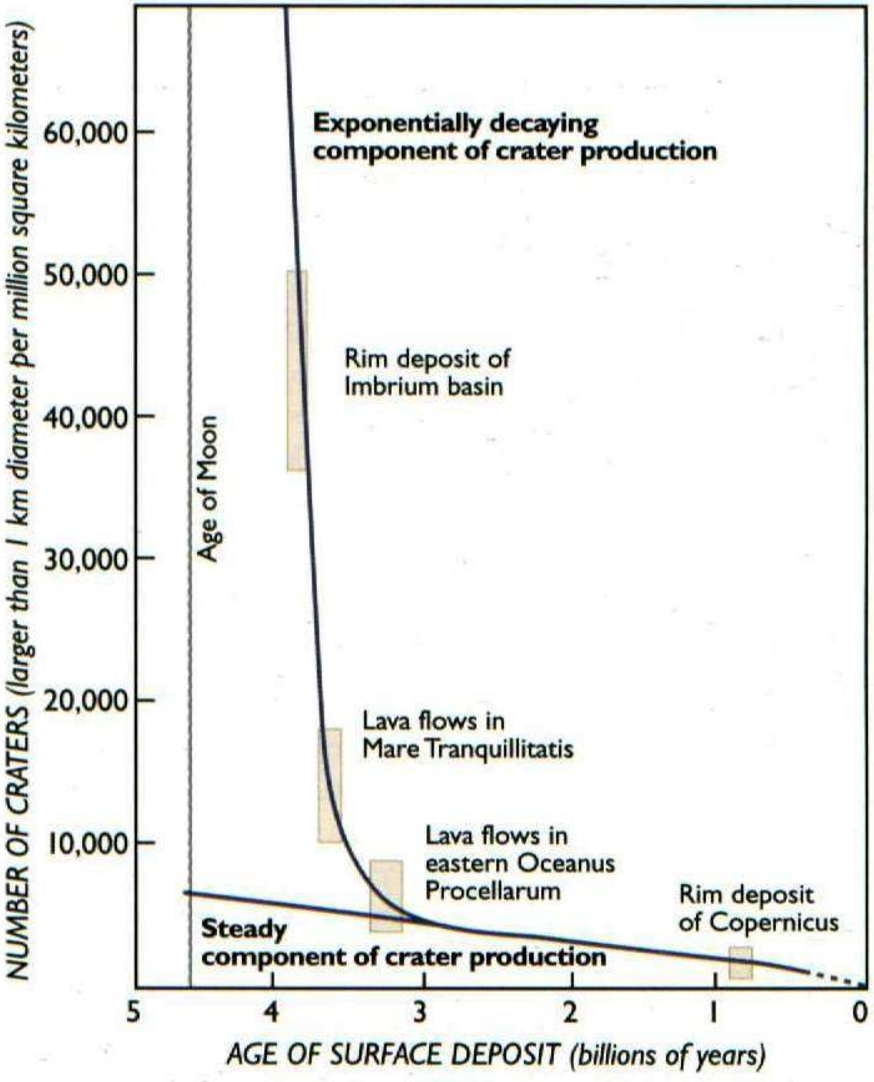
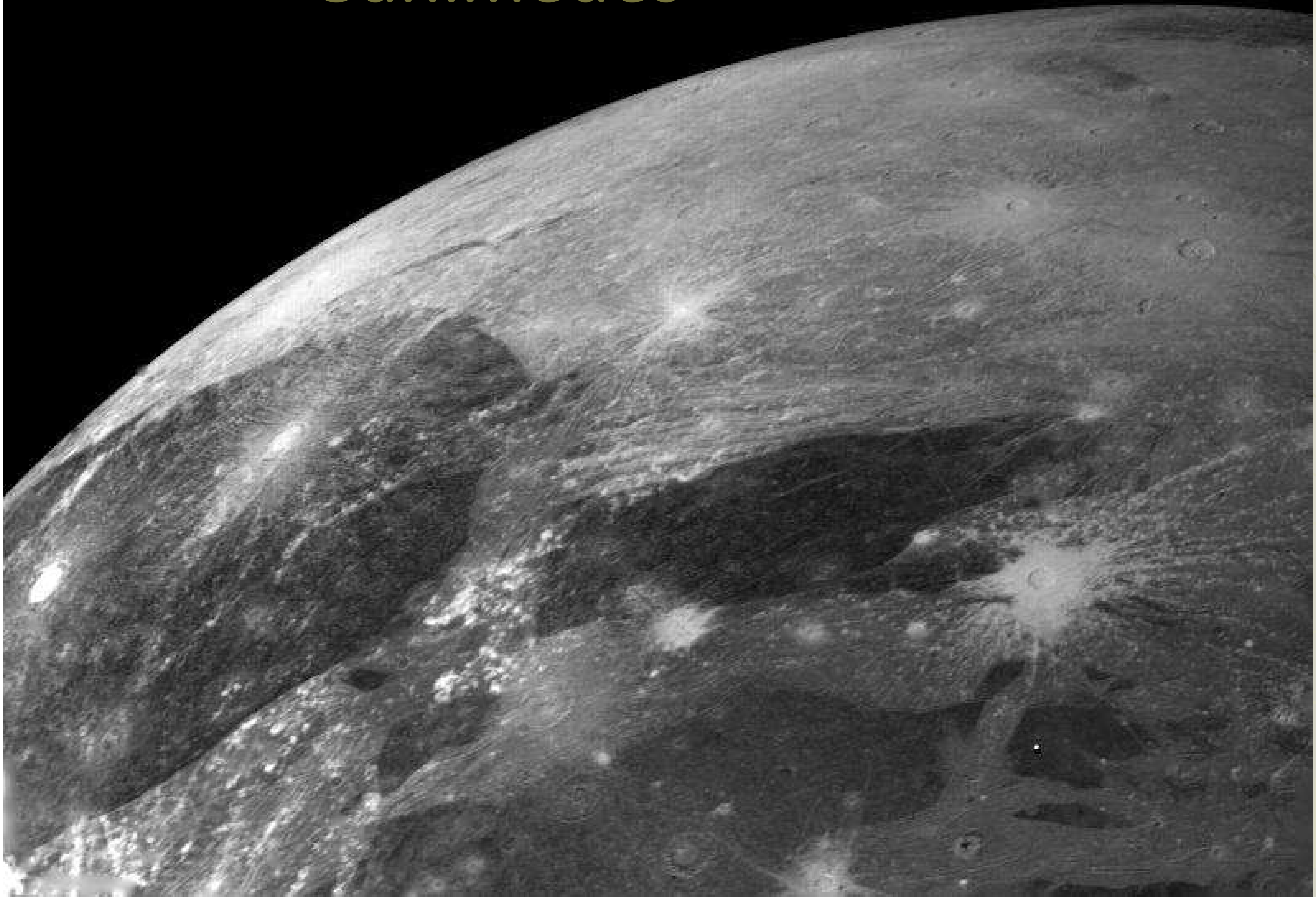


Figure 12. Lunar surfaces of different ages exhibit different crater densities. The rapid cratering rate during the late heavy bombardment fell off dramatically between 3.9 and 3.3 billion years ago, giving way to a slower, steady rate of crater production. This dramatic falloff is reflected in the varying ages and crater densities determined at Apollo landing sites (small rectangles, whose dimensions correspond to uncertainties).

Ganimedes



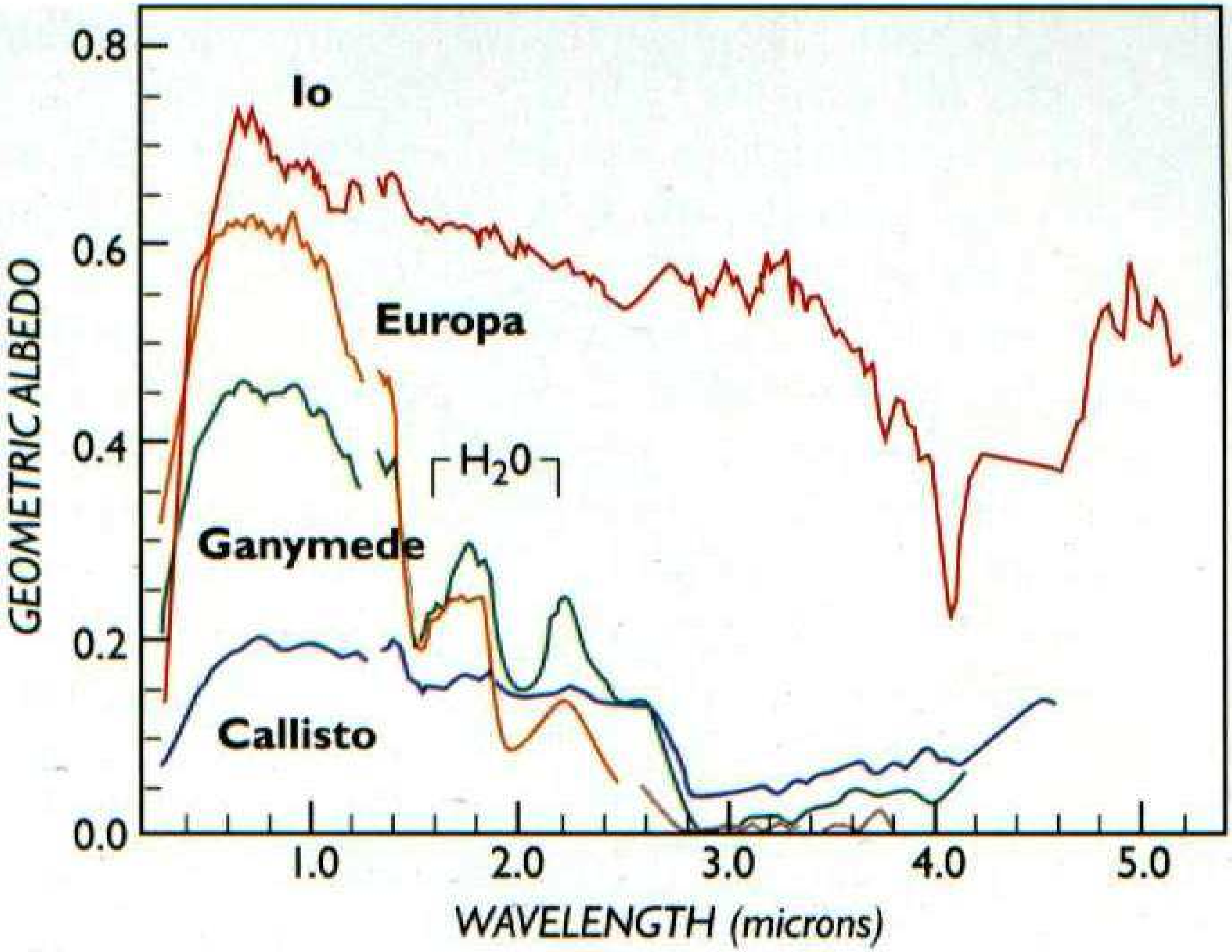
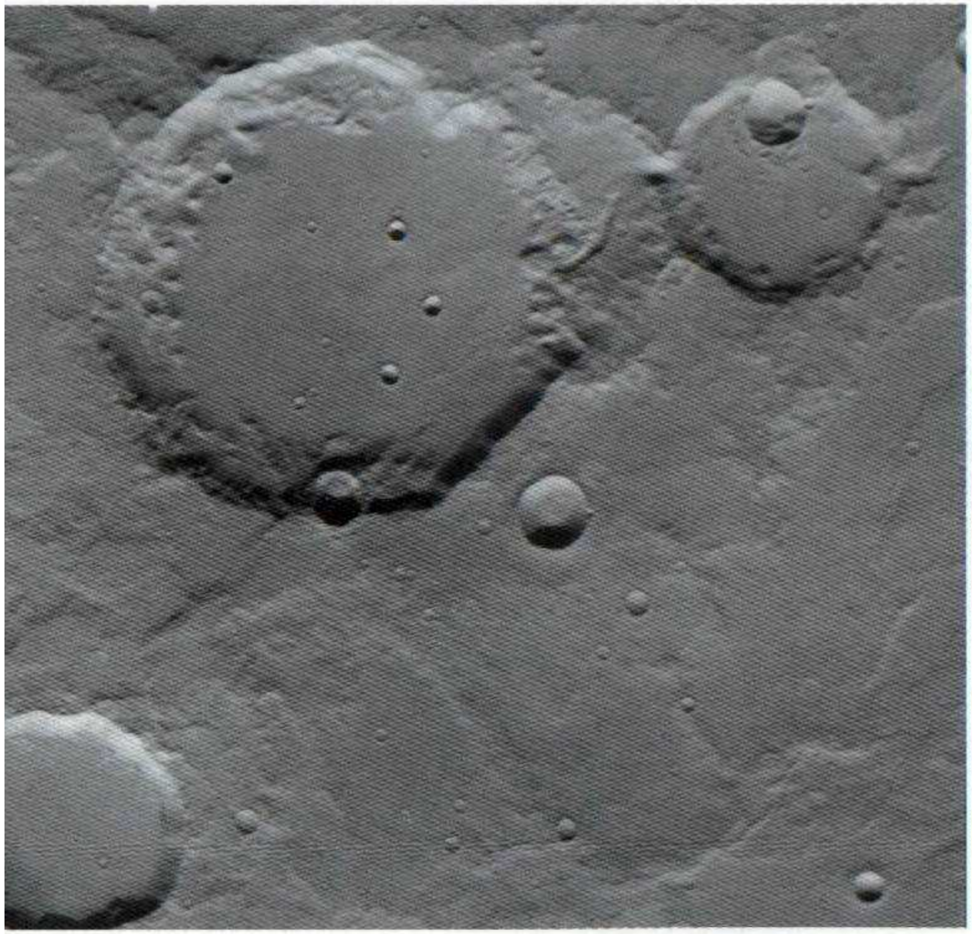
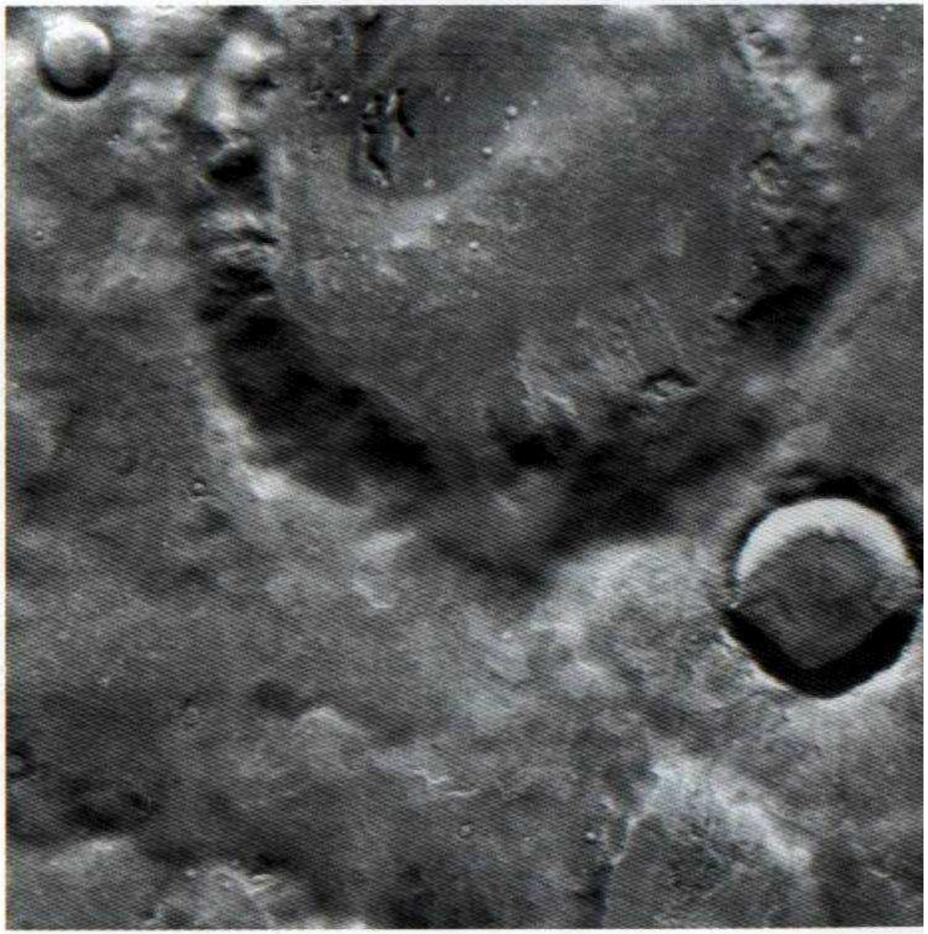
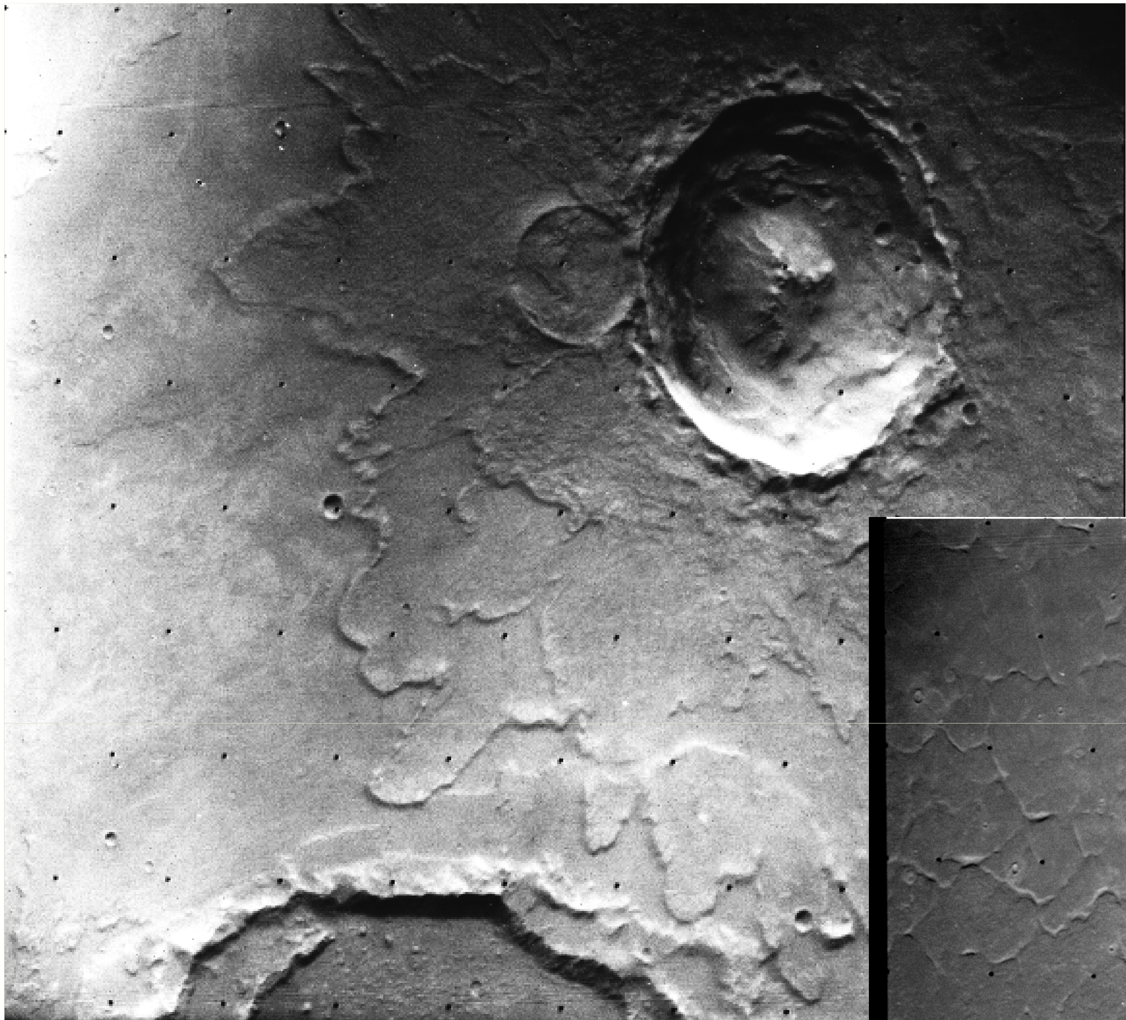
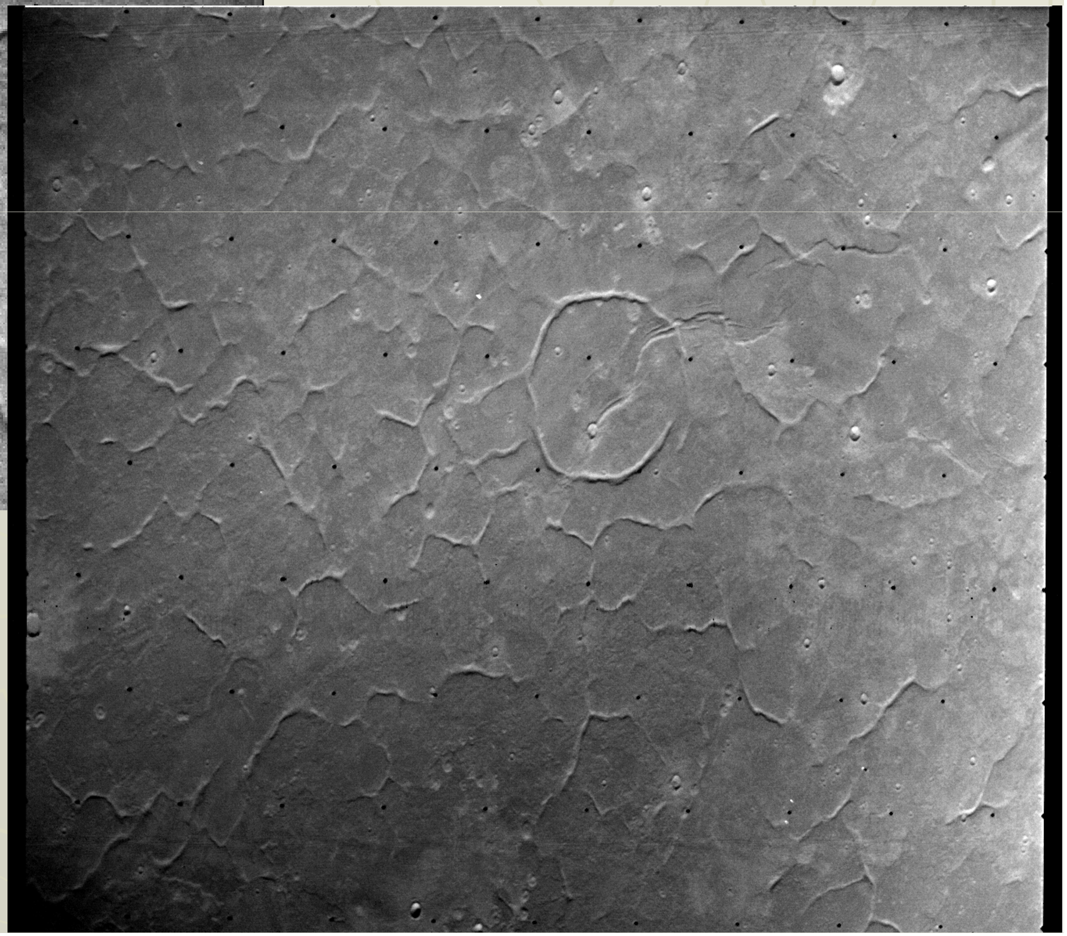


Figure 4. Studies of Jupiter's largest satellites from Earth show that they have distinctive spectral signatures. Absorptions in the near-infrared reveal the presence of water ice on the surfaces of Europa, Ganymede, and Callisto — but not Io.

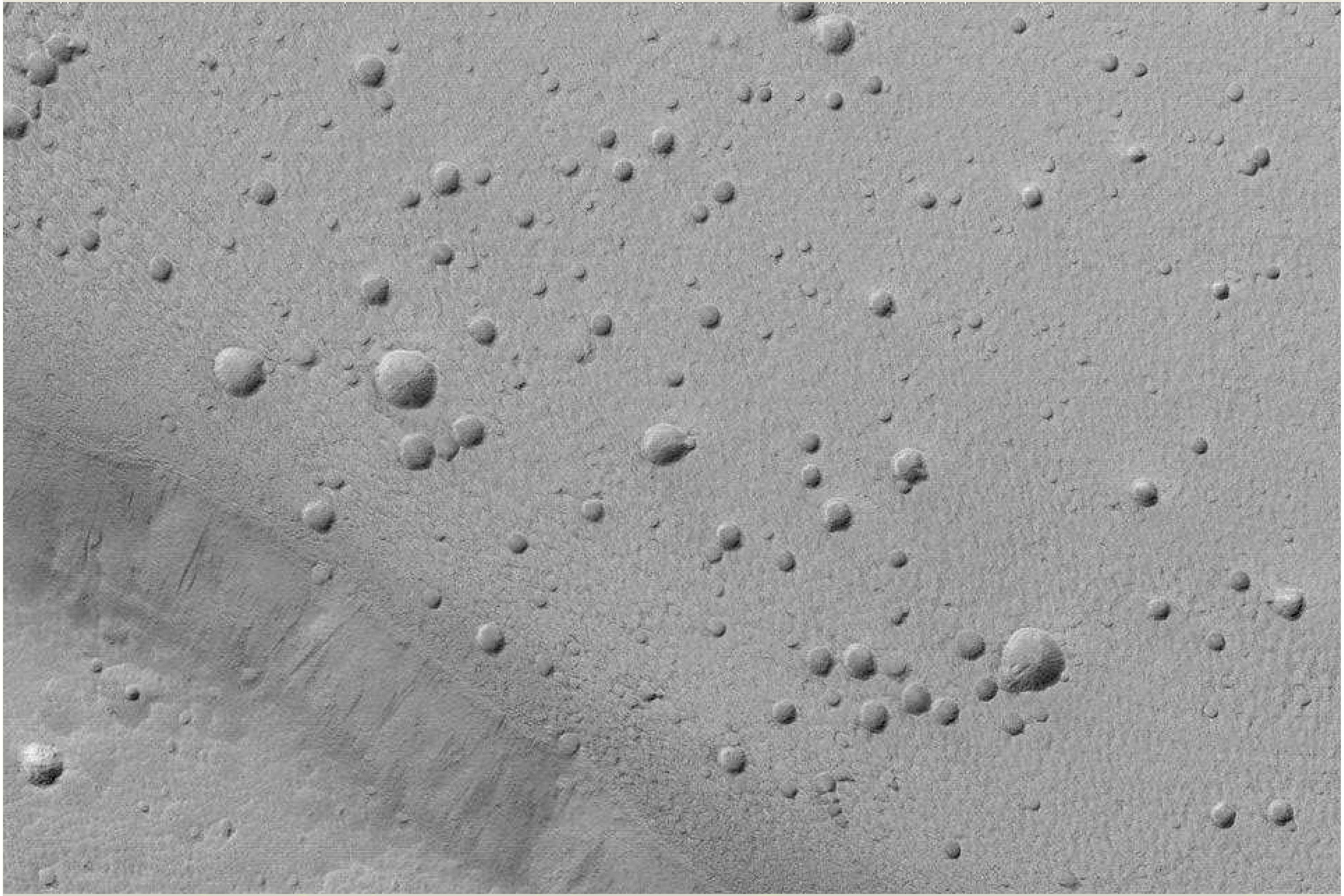
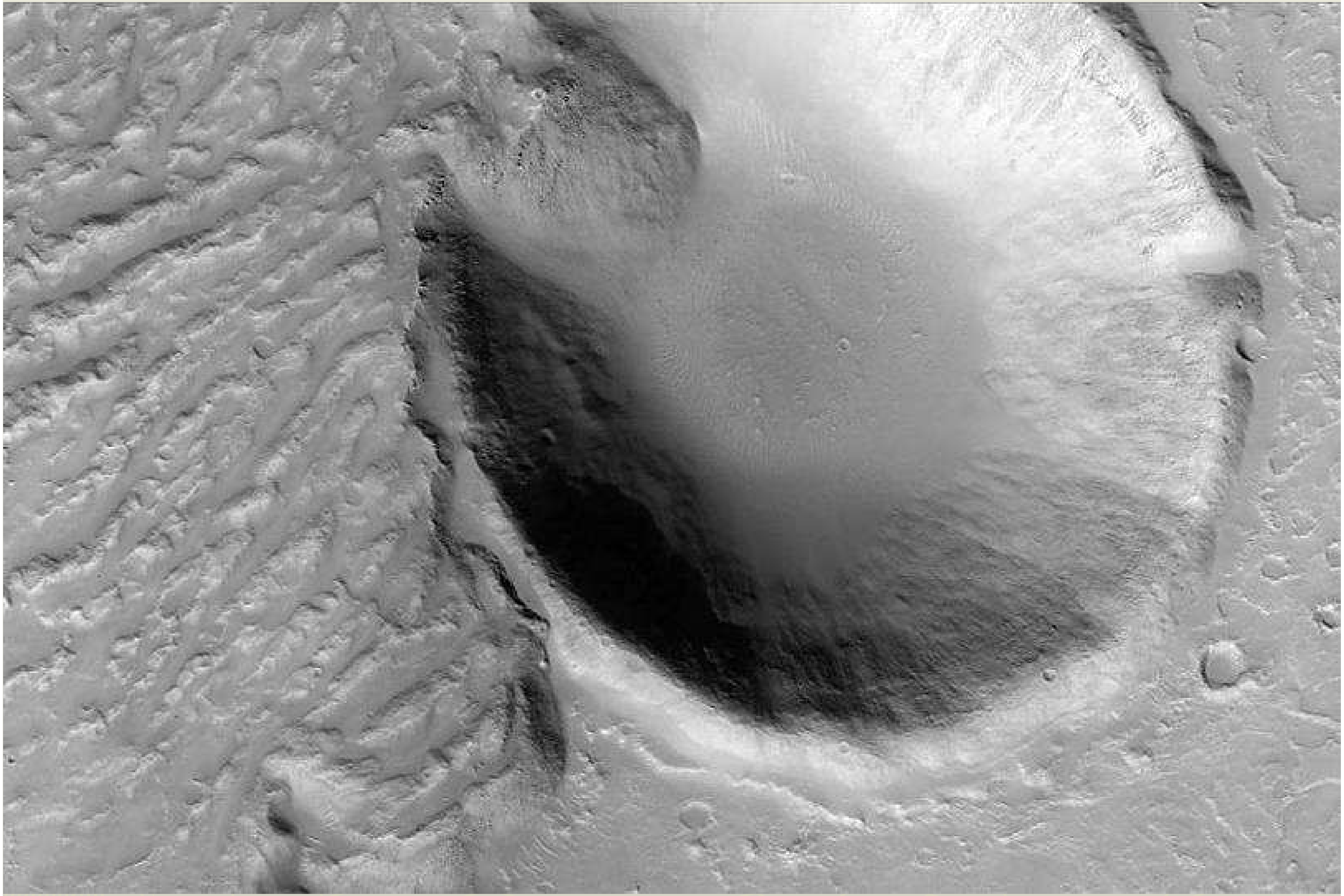


Figura 11.C Una dolina de Florida que creció rápidamente durante tres días, tragándose parte de una piscina comunitaria, así como varios comercios, casas y automóviles.



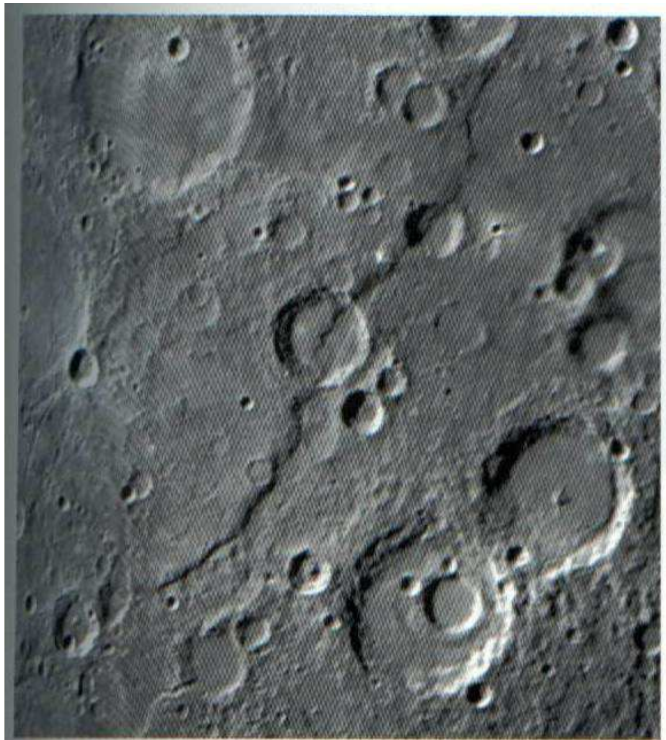
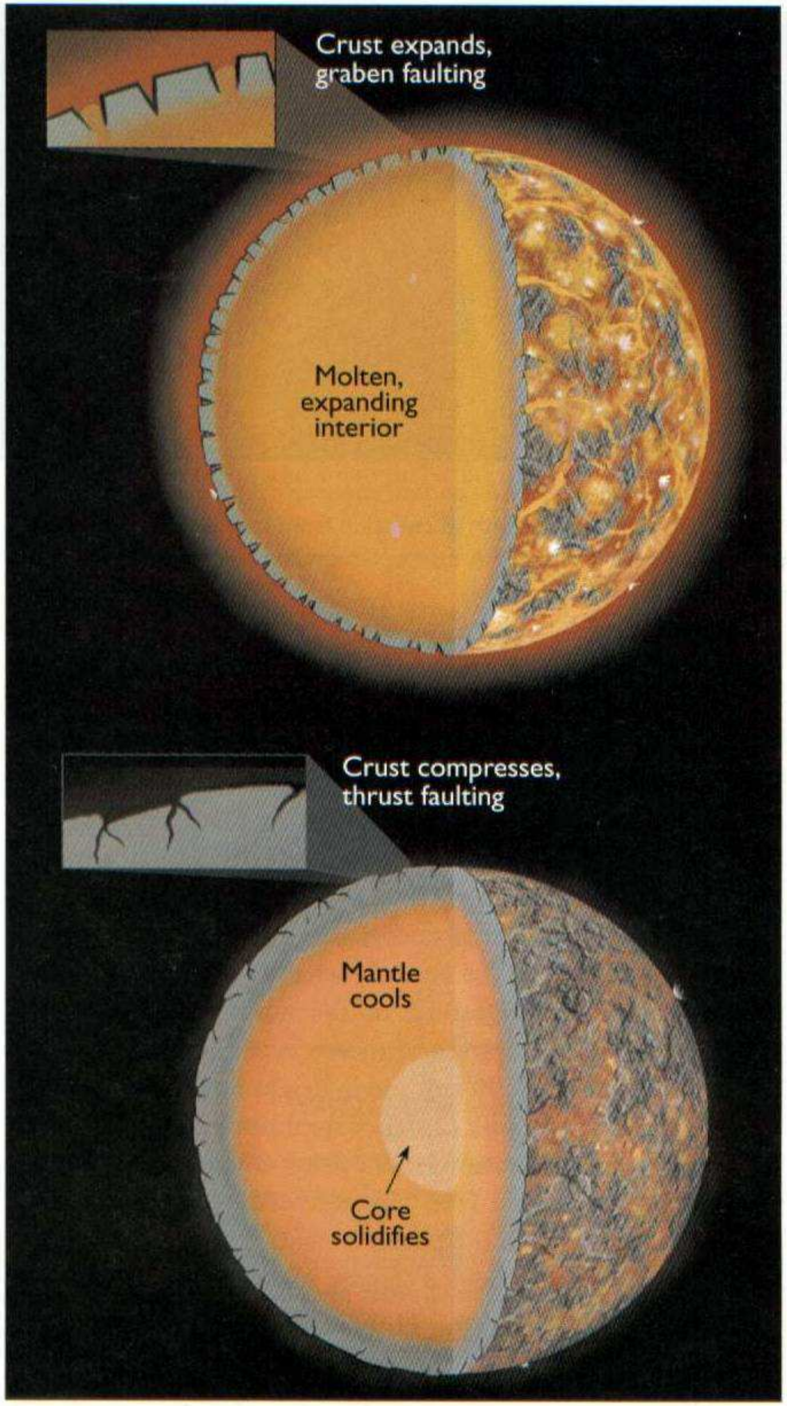


Figure 12. Discovery Rupes, one of the longest lobate scarps on Mercury, extends 500 km and is up to 2 km high in some places. It transects two craters, and the foreshortening seen in their floors argues that Discovery is a thrust fault caused by compressional stress in the crust.

Pole-Aitken basin, on the Moon's far side, is 2,600 km across.) The cataclysmic Caloris impact occurred about 3.85 billion years ago when an object roughly 150 km across struck Mercury with the energy equivalent of a trillion 1-megaton hydrogen bombs. It was an event with global consequences for the young planet, and its manifestations are not limited to the region around the basin.

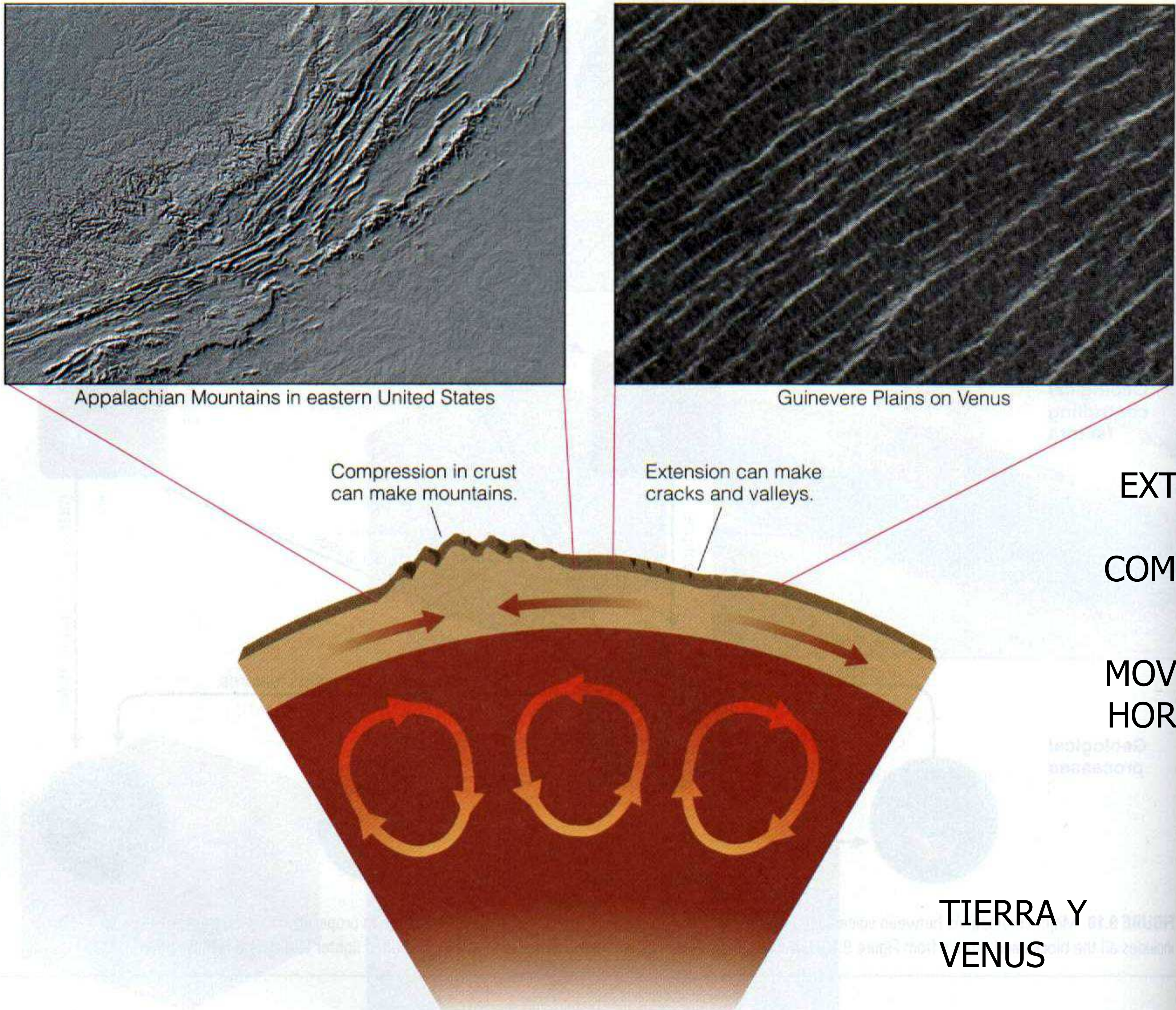
For example, at the basin's *antipode* (the spot on Mercury 180° from the impact site) is an unusual tract of terrain unlike any other in the solar system. Roughly the size of France and Germany combined, it consists of numerous hills and depressions that crosscut the preexisting landforms (*Figure 10*). The



EXTENSION
Y
COMPRESION
POR

MOVIMIENTO
RADIAL

LUNA,
MERCURIO,
MARTE



EXTENSION
Y
COMPRESION
POR

MOVIMIENTO
HORIZONTAL

TIERRA Y
VENUS

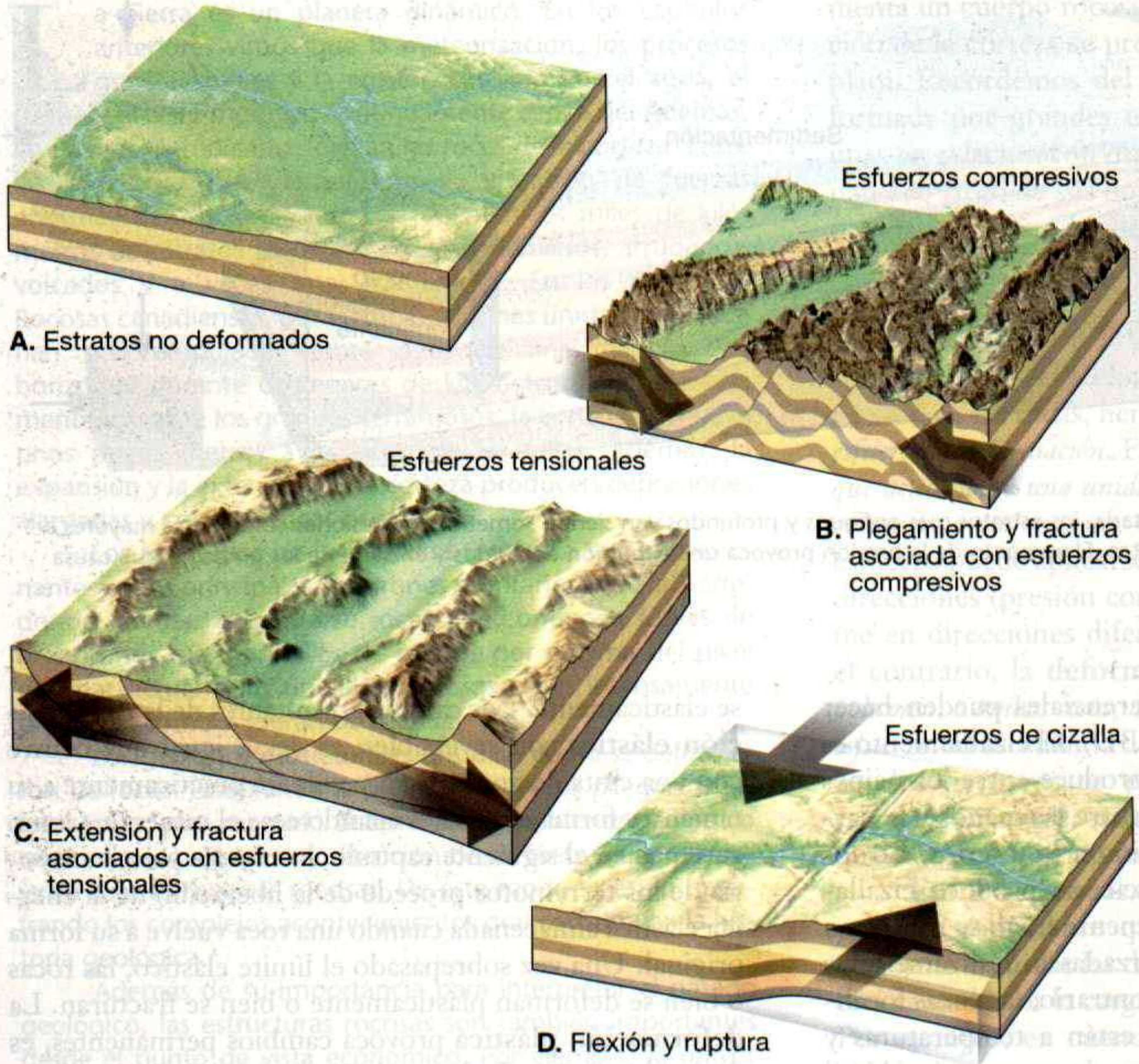


Figura 15.3 Diagramas simplificados que muestran varios estadios de deformación de: **A.** Estratos horizontales. **B.** Los esfuerzos compresionales tienden a acortar un cuerpo rocoso, a menudo mediante plegamiento. **C.** Los esfuerzos tensionales actúan alargando, o separando una unidad rocosa. **D.** Los esfuerzos de cizalla actúan desplazando las rocas, doblándolas y rompiéndolas.

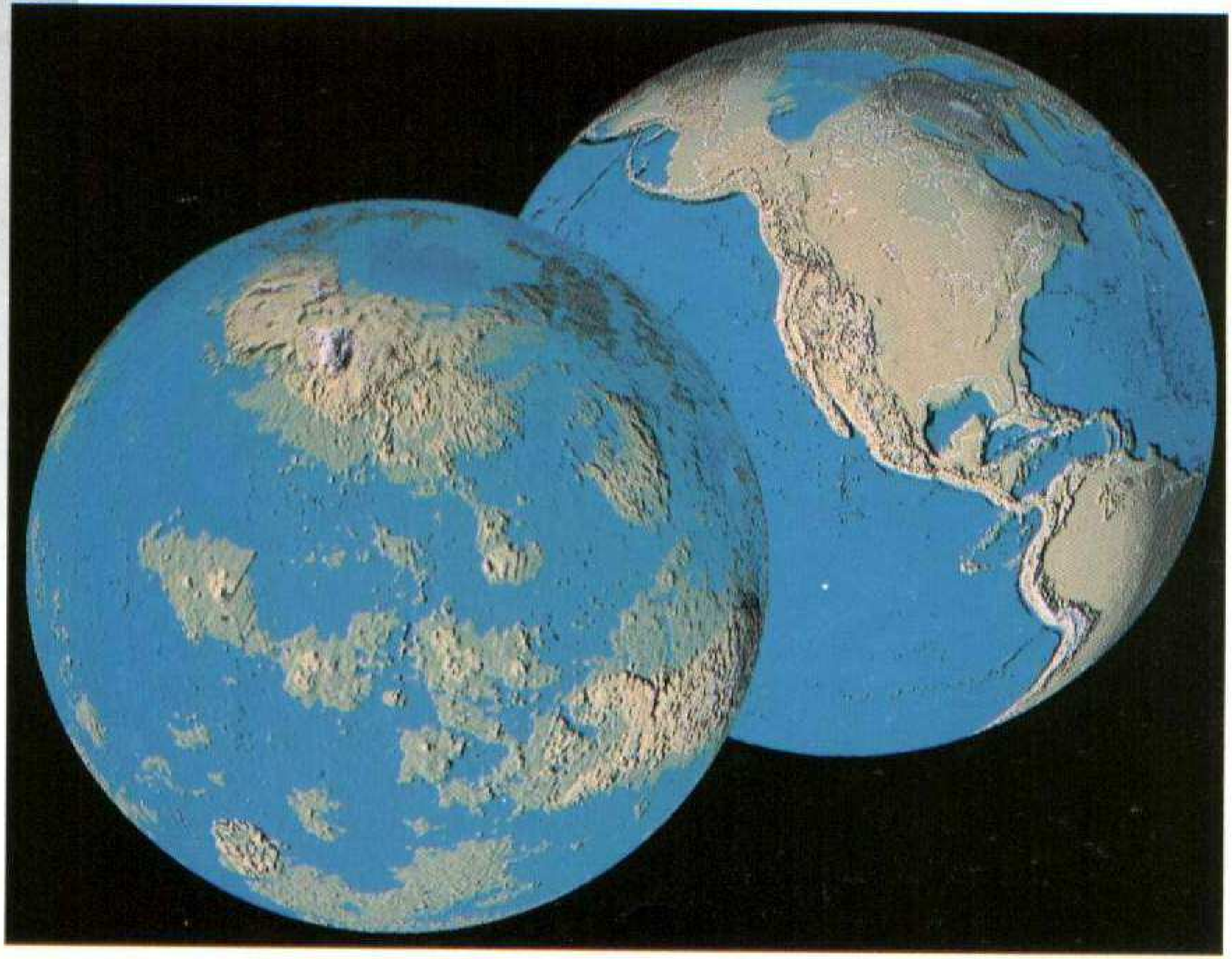
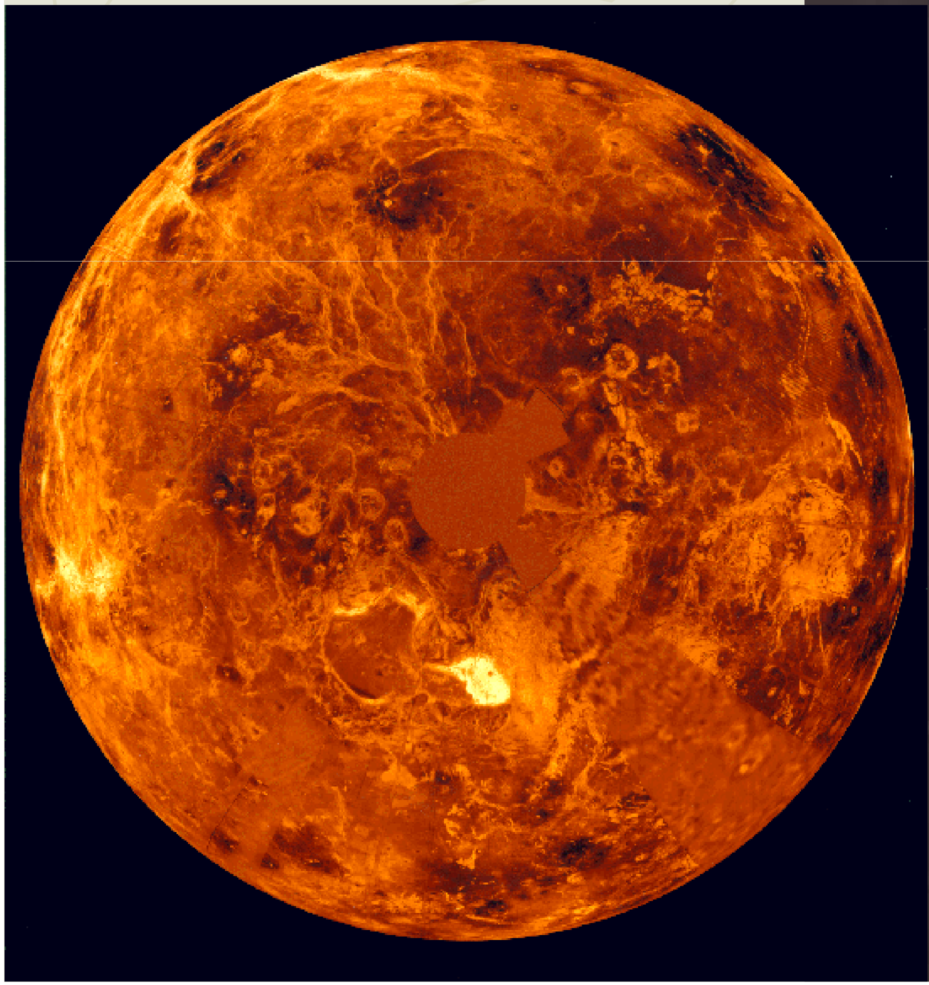


Figure 1. Even before Magellan's arrival, scientists realized that the landscape of Venus (left) was dominated by vast plains and lowlands, with few landmasses comparable to Earth's continents (right).

VENUS Y TIERRA

Venus



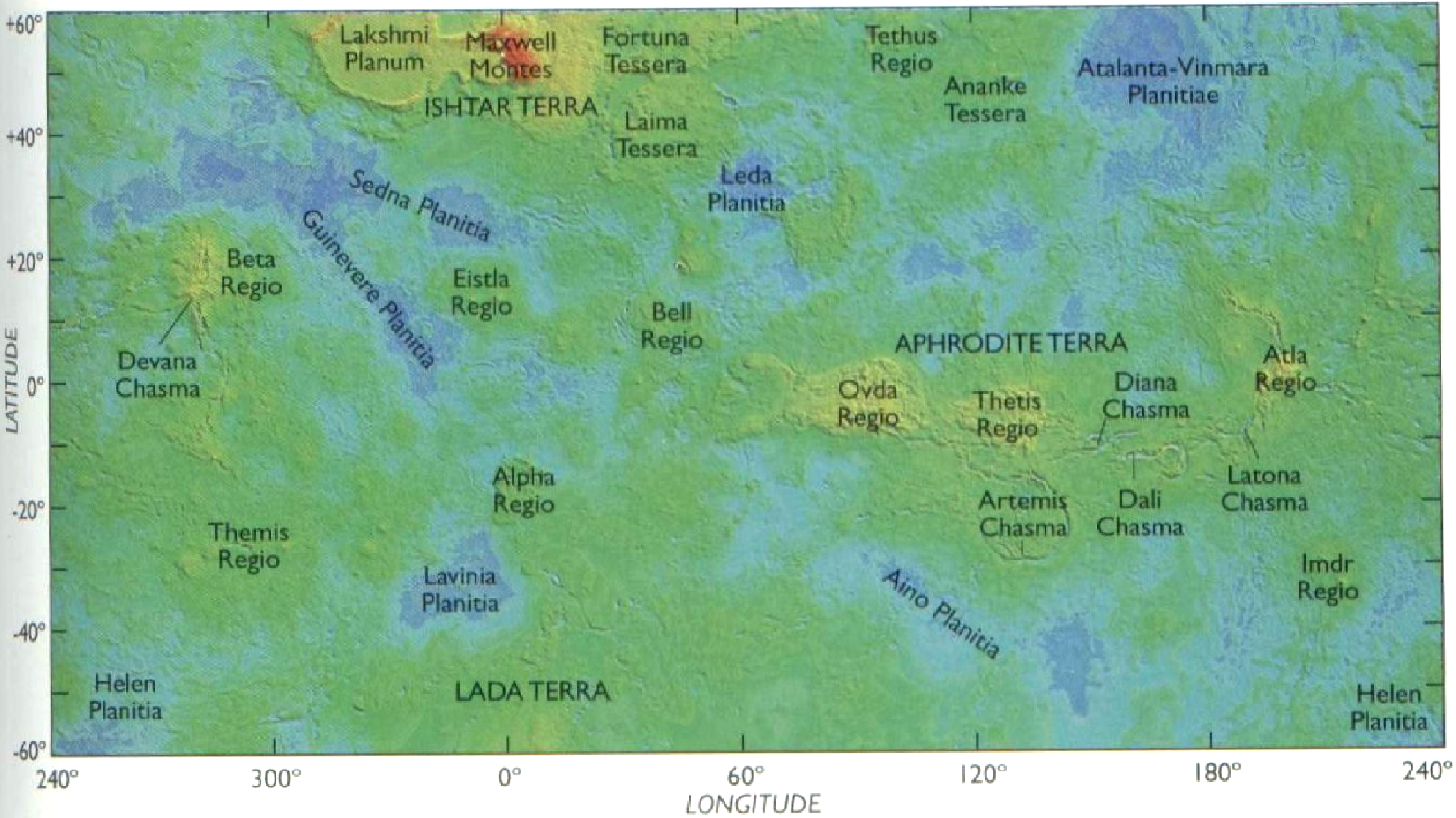


Figure 9. It took Magellan's radar altimeter 24 months to map 98 percent of Venus. In this Mercator-projected view, red corresponds to the highest elevations, blue to the lowest. Maxwell Montes, the planet's highest mountains, rise 12 km above the mean elevation. Even though Venus exhibits a range of elevations comparable to that of Earth, the two planets have distinct topographies. Earth has many high-standing continents and low-lying ocean floors, whereas about 60 percent of Venus's terrain lies within 500 m of the mean planetary radius (its equivilent of sea level). The scorpion-shaped feature extending along the equator between 70° and 210° east longitude is Aphrodite Terra, a continentlike highland that contains several spectacular volcanoes at its eastern end: Maat Mons, Ozza Mons, and Sapas Mons.

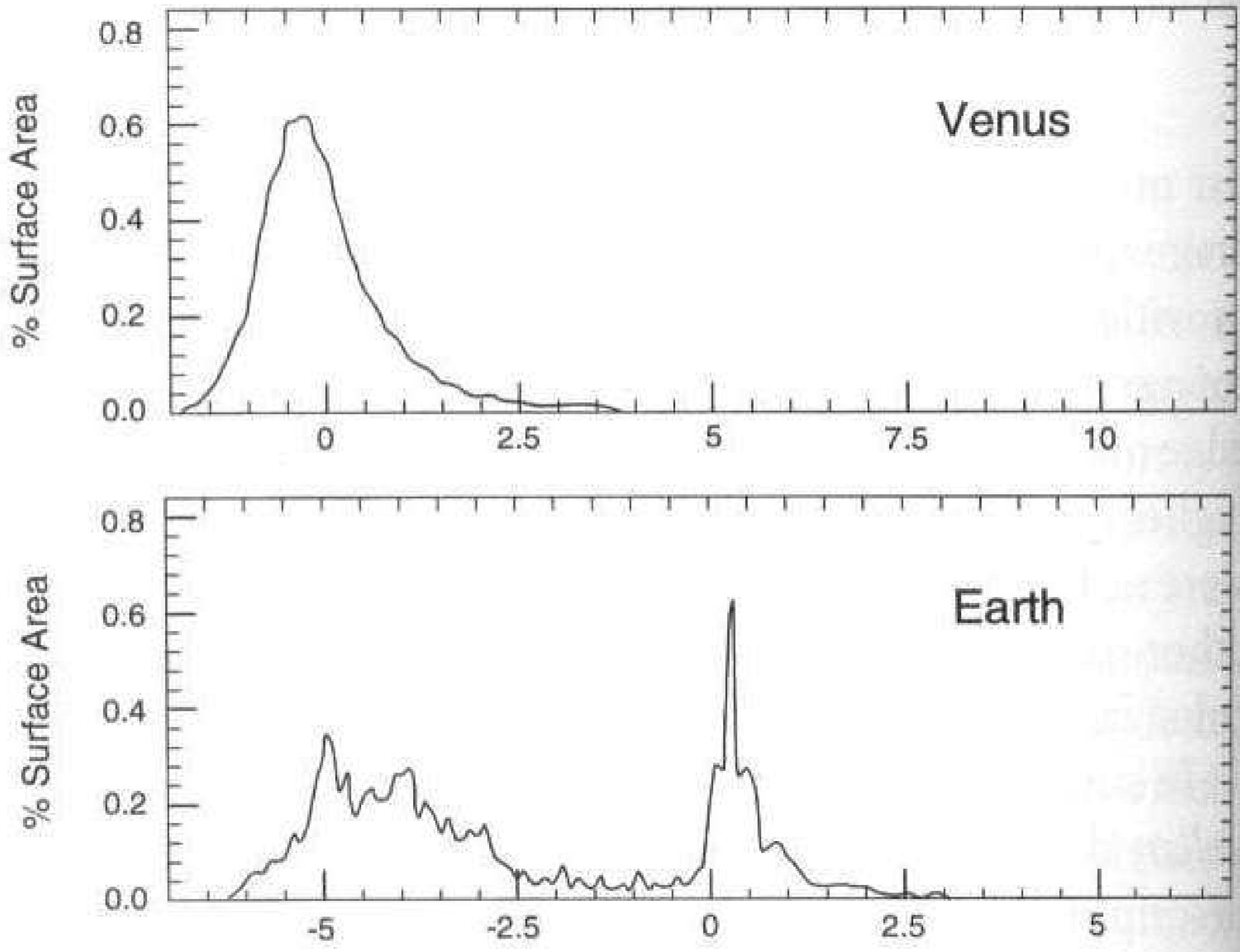


FIGURE 5 Altitude frequency distribution of topography for Venus and Earth shown as hypsometric curves [representing the percentage of surface area at different elevations relative to mean sea level on Earth or mean planetary radius (MPR) on Venus].

MARTE

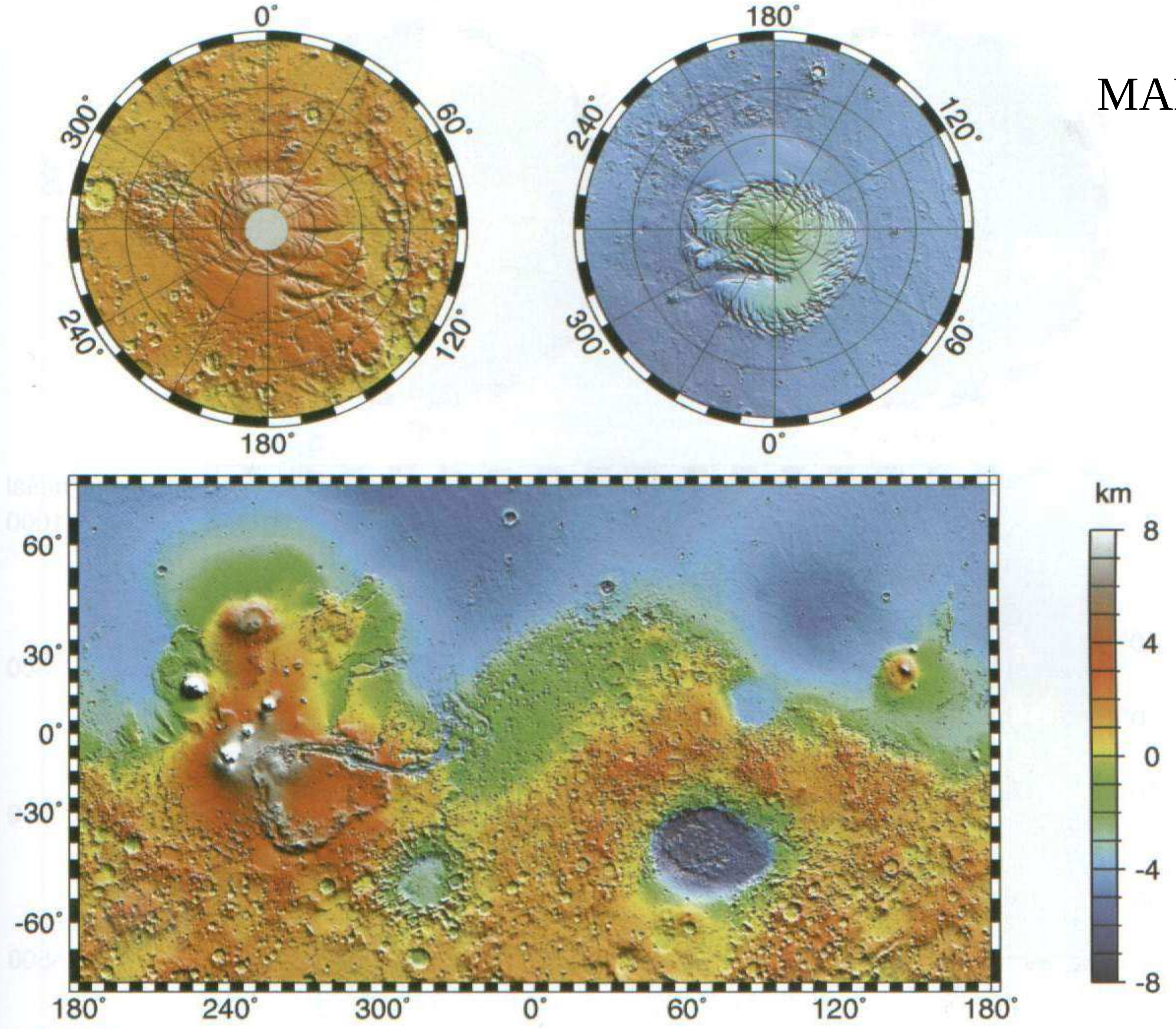


FIGURE 6.20a

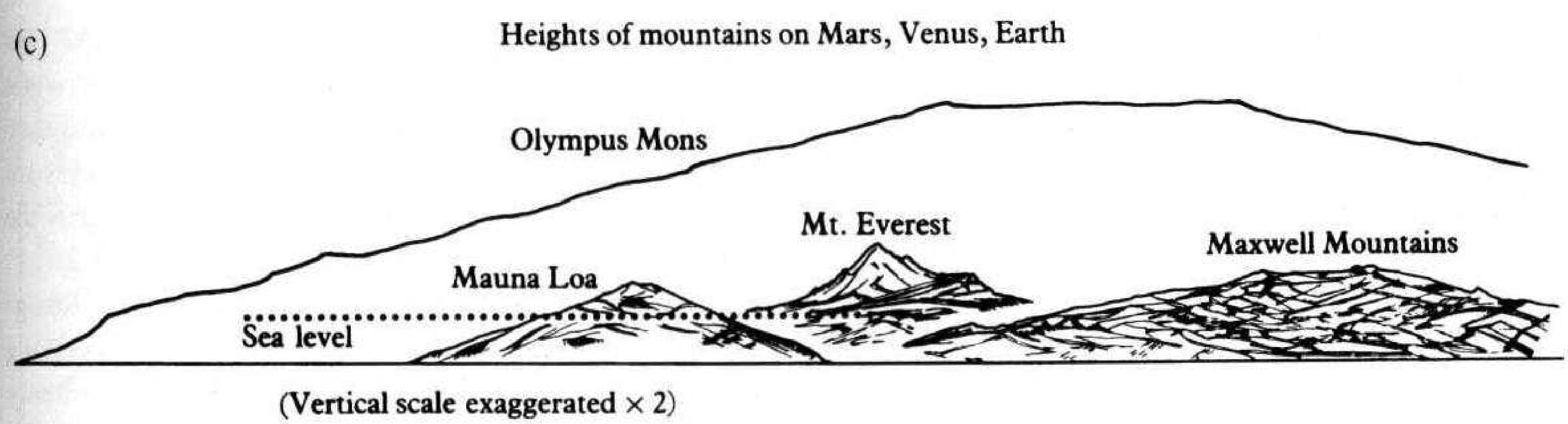
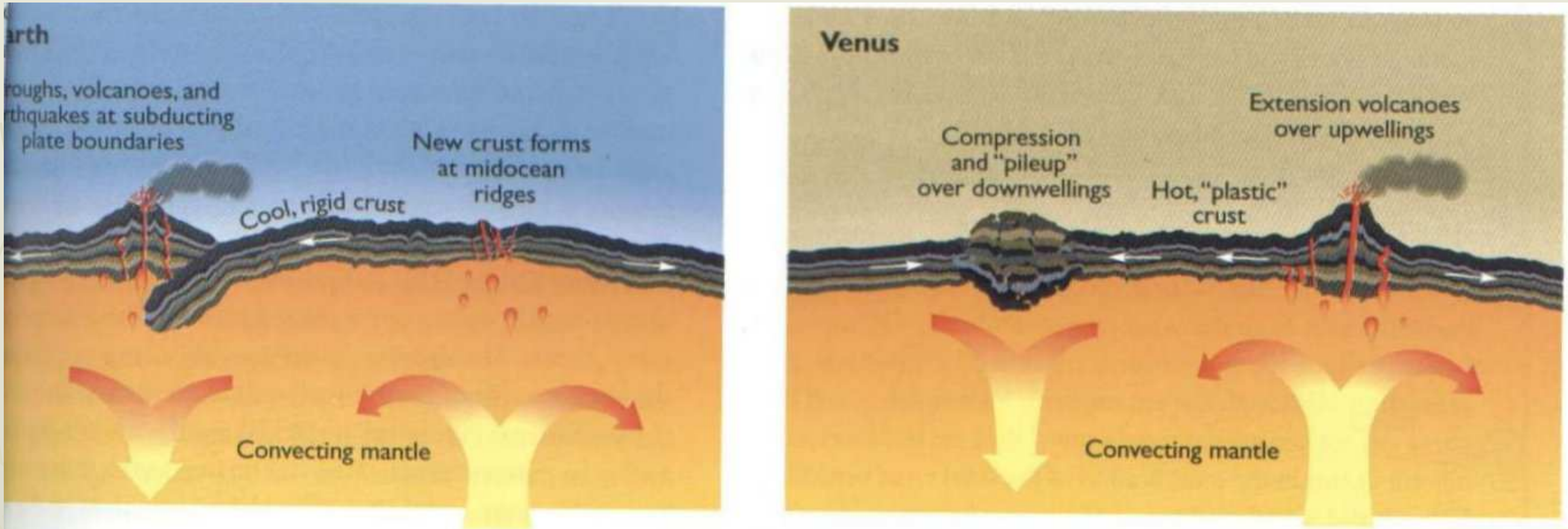


FIGURE 5.16 Continued. (c) A comparison of the the volcanoes/mountains on Mars (Olympus Mons), Earth (Mauna Loa and Mount Everest) and Venus (Maxwell Mountains). (Morrison and Owen 1996)

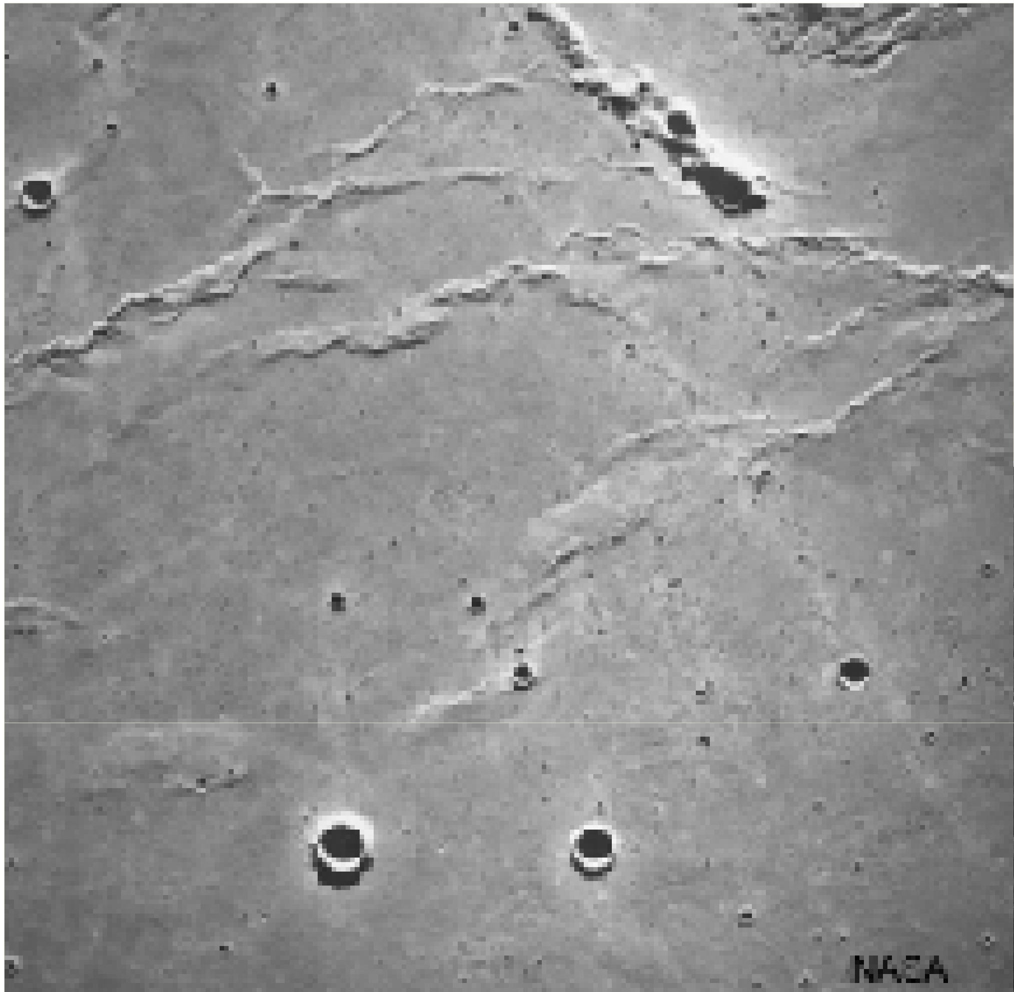
- Equilibrio isostatico: habiendo equilibrio isostatico la gravedad local no es superior en las proximidades de las montañas.

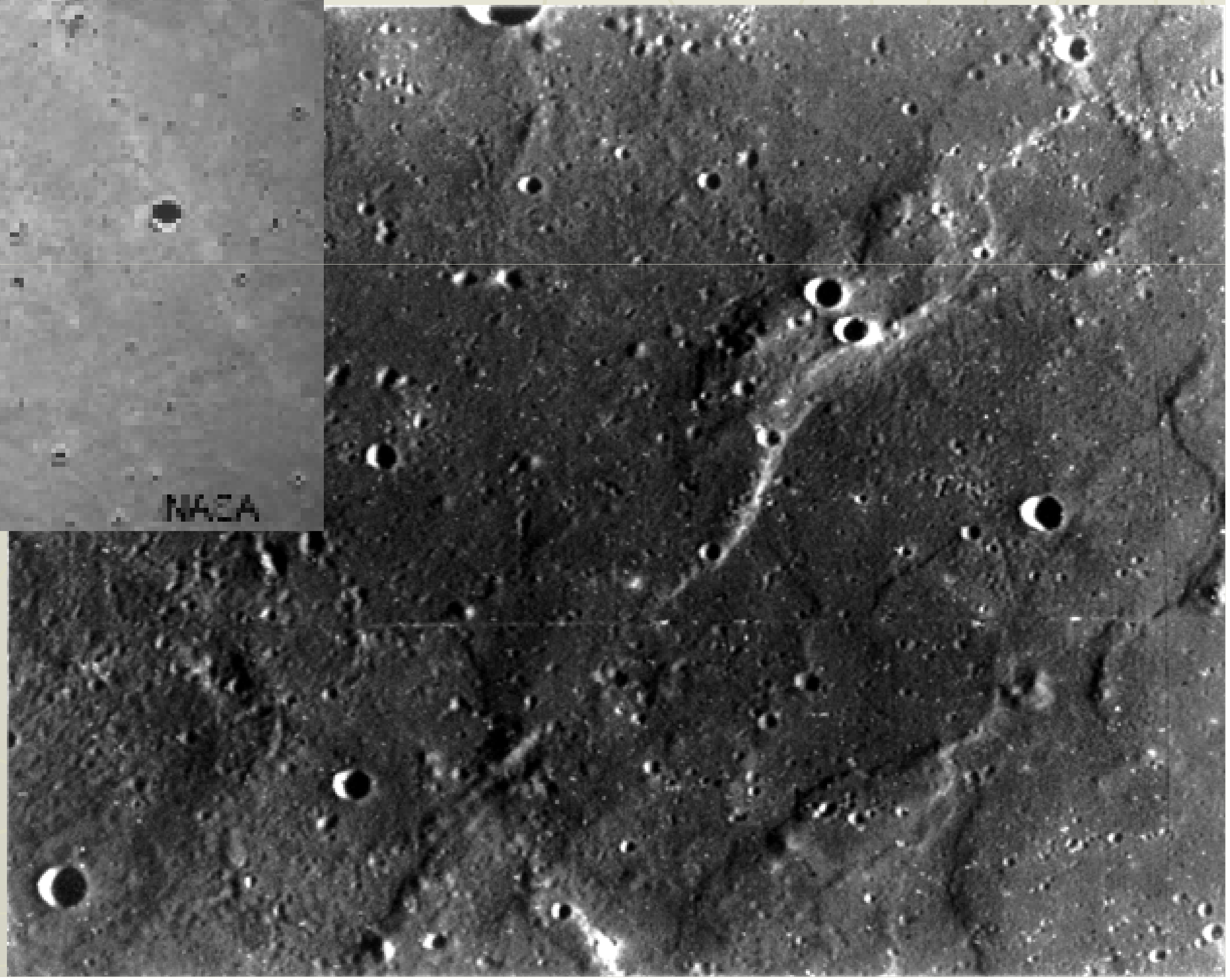


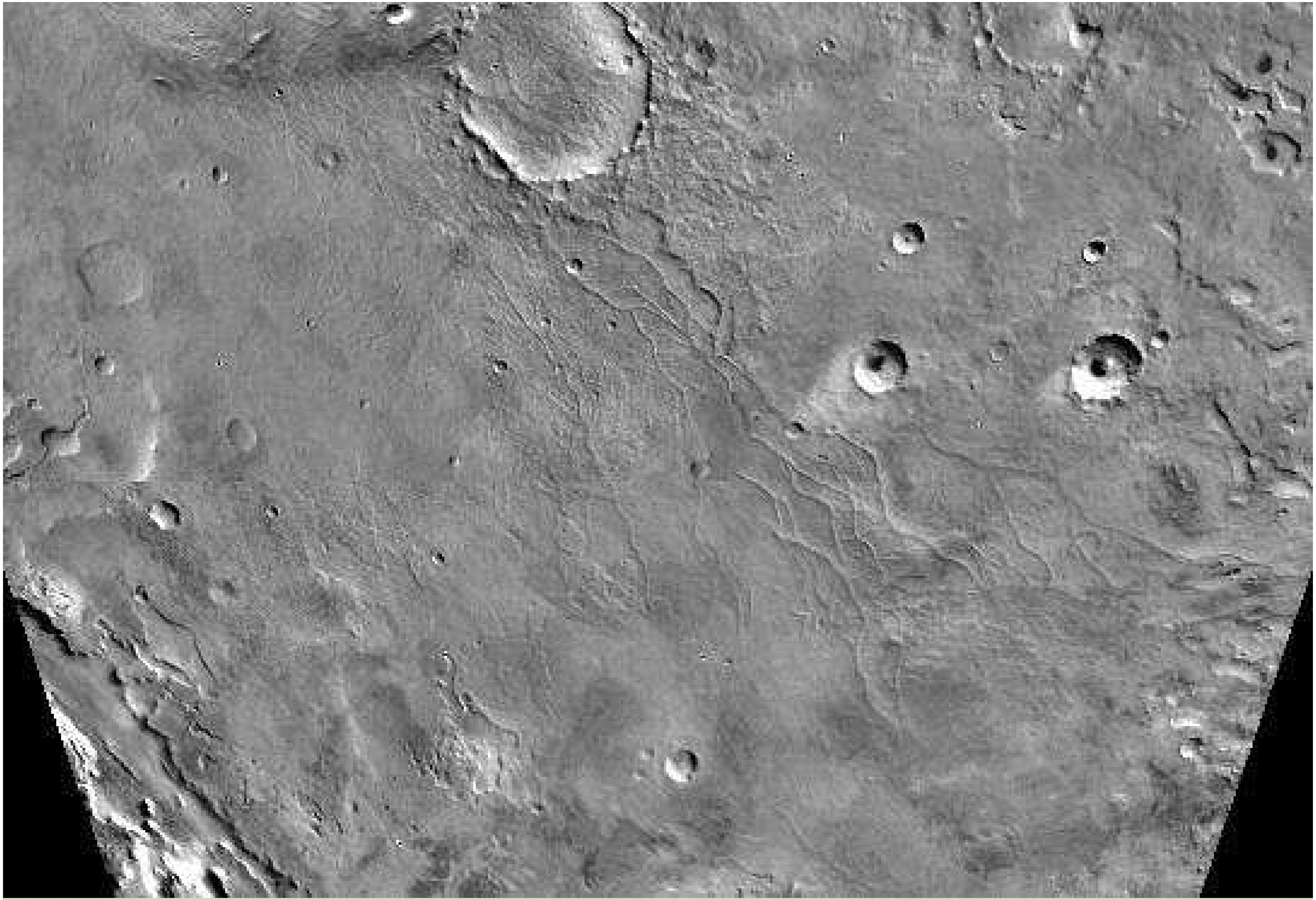
[redacted]

Figure 16. In contrast to plate tectonism on Earth (left panel) Venus may pile up old crust over convective downwellings in the mantle and produce new crust over upwellings (right). At present Venus is a one-plate planet whose internal heat escapes to space largely by conduction.

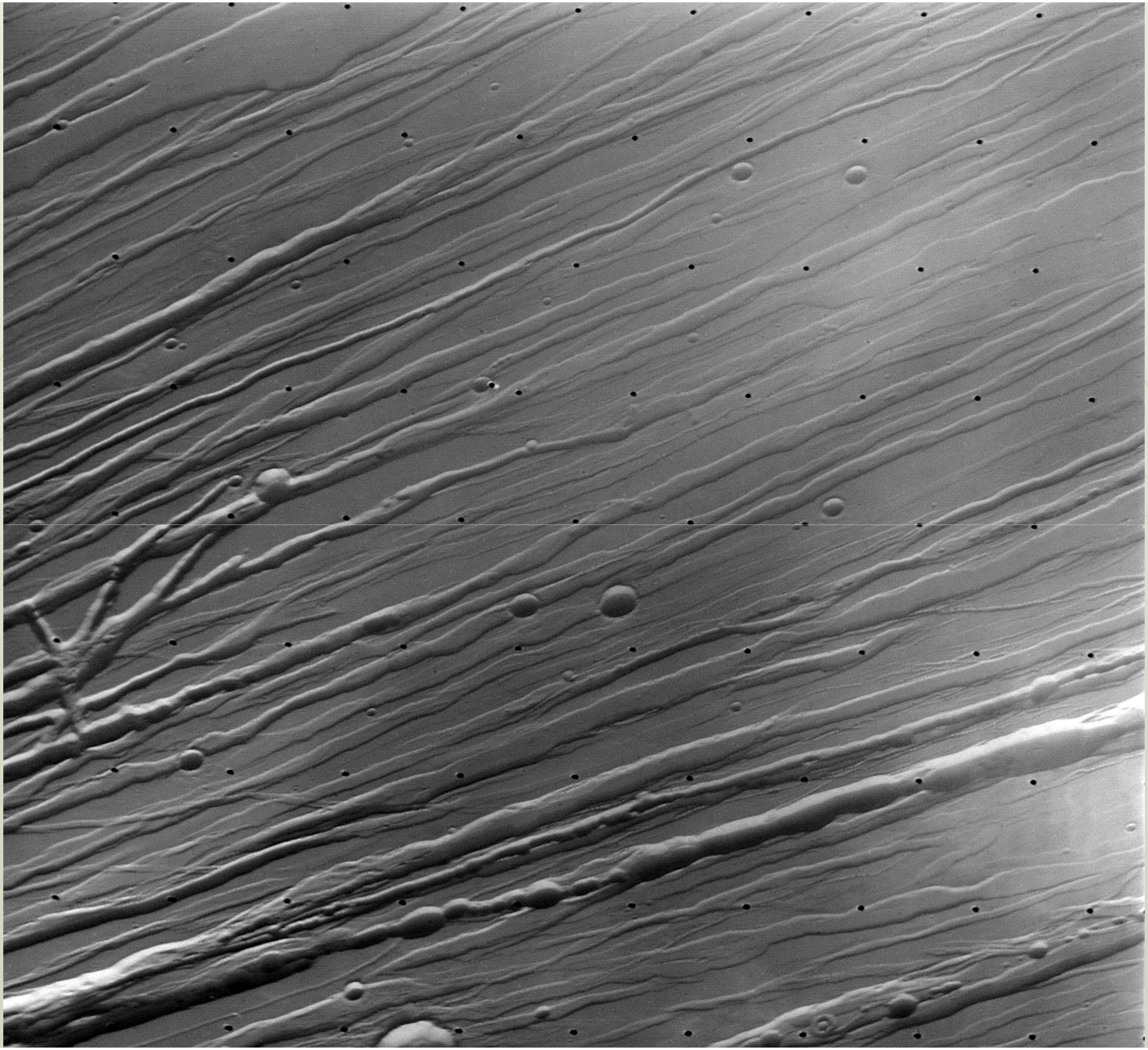
Wrinkle ridges en Luna y Mercurio

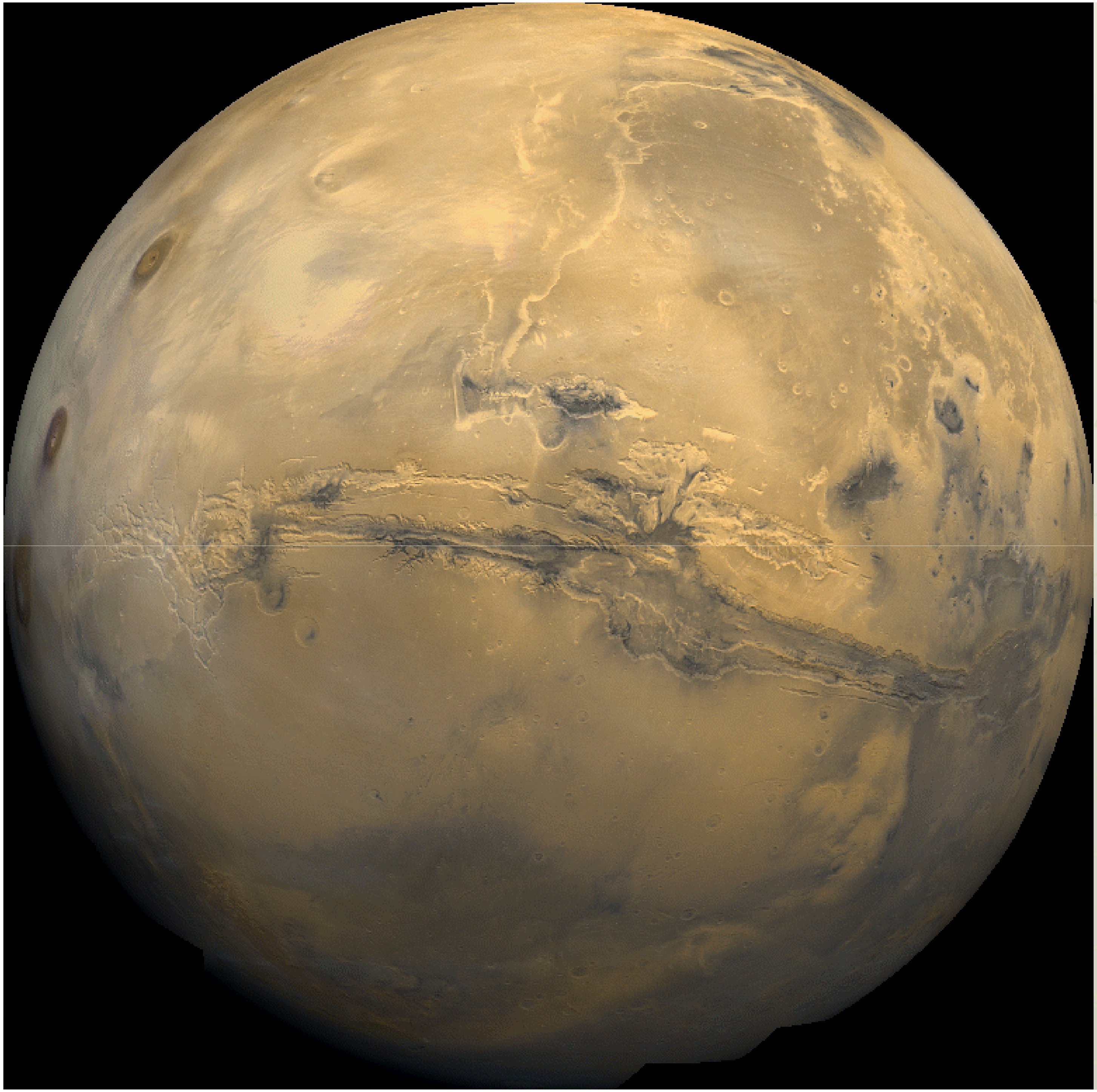


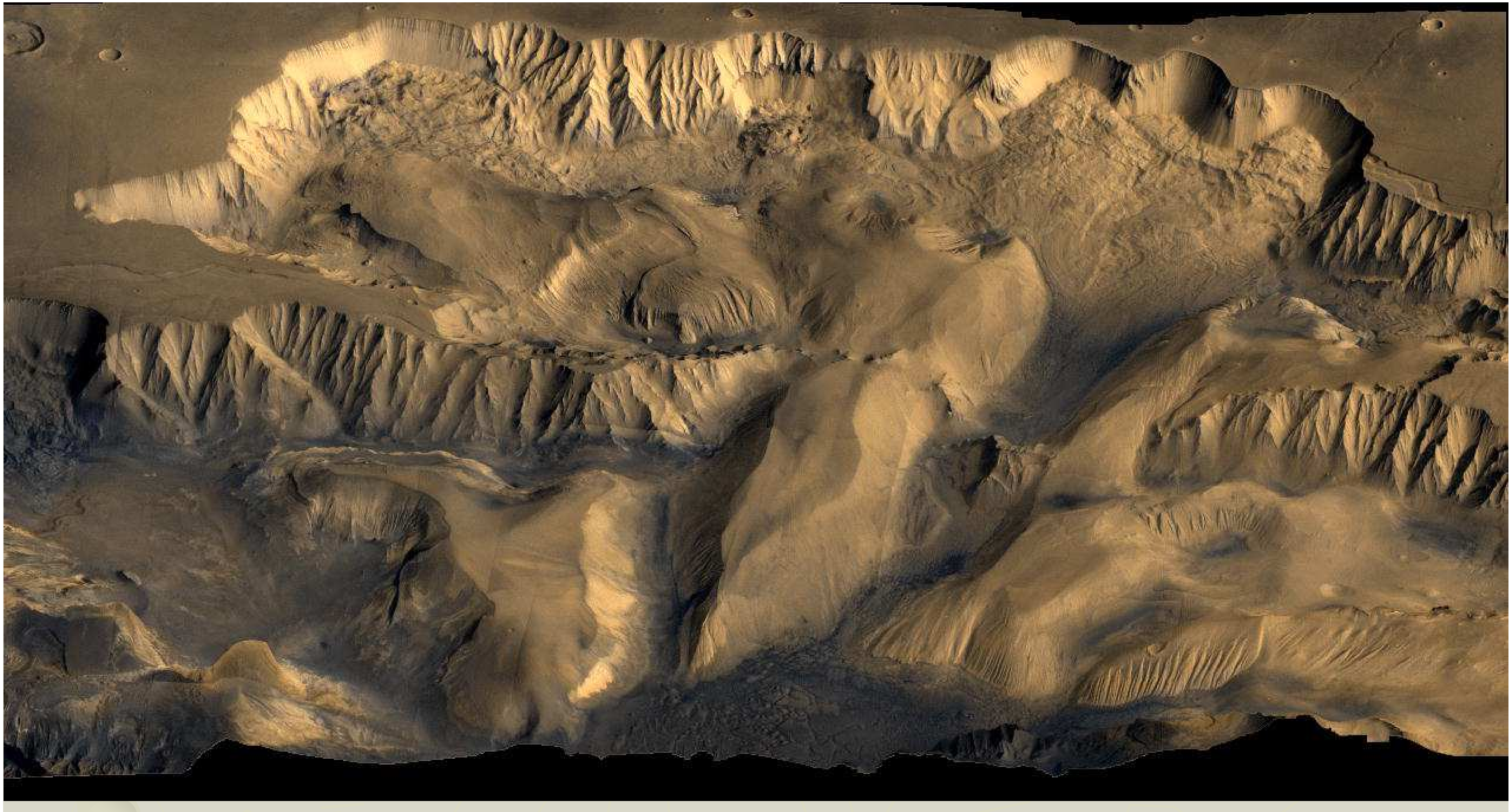


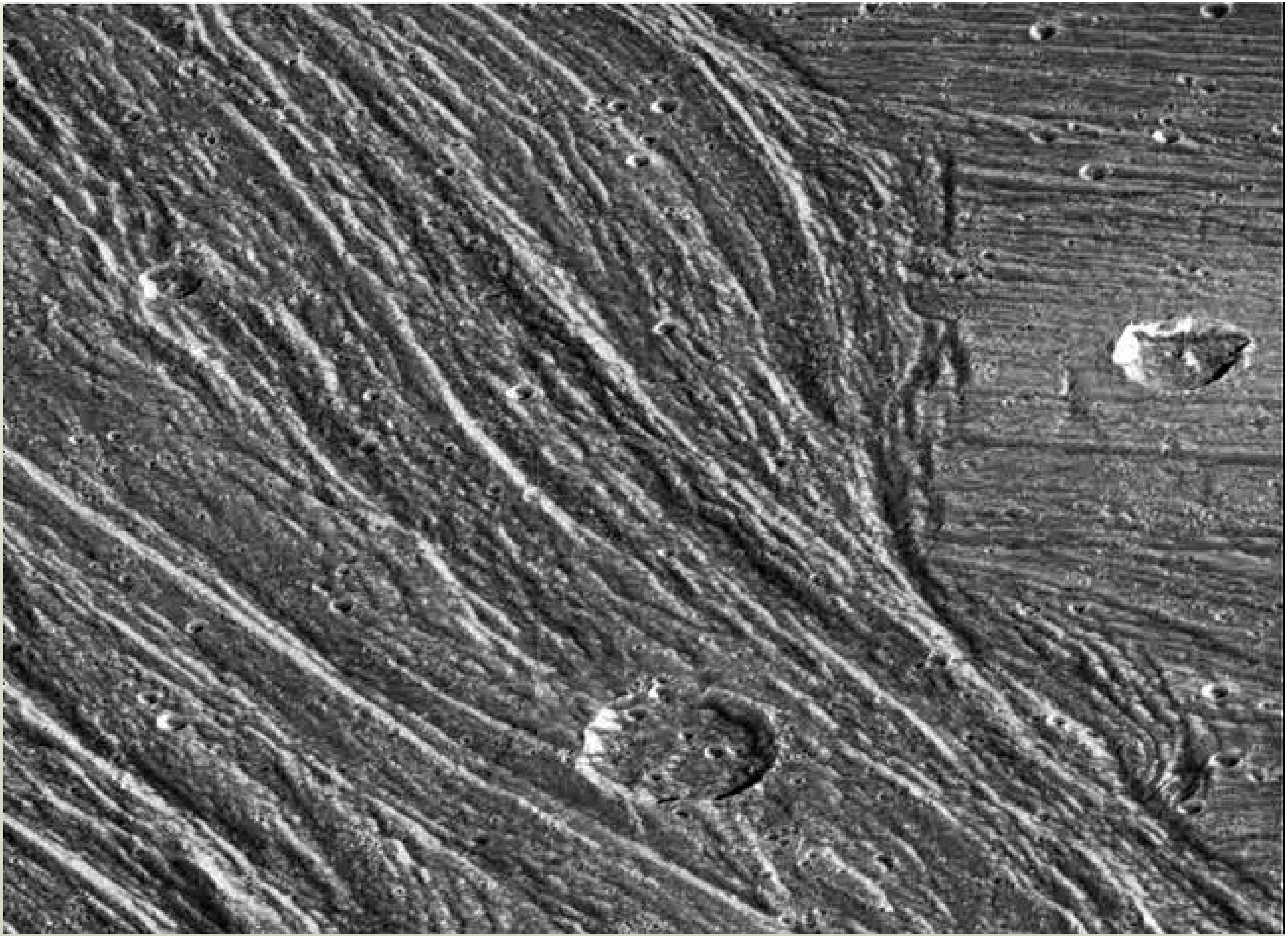


Wrinkle ridges en Marte









Ganymedes

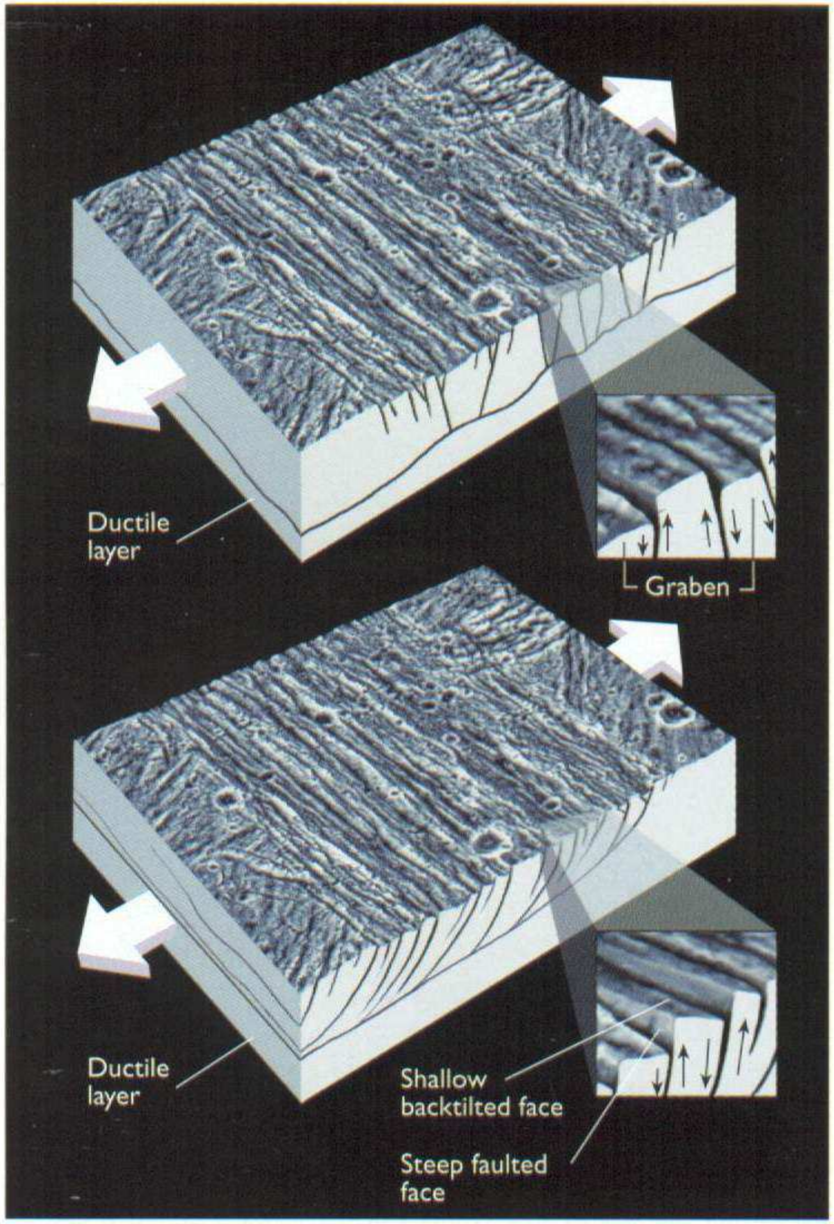
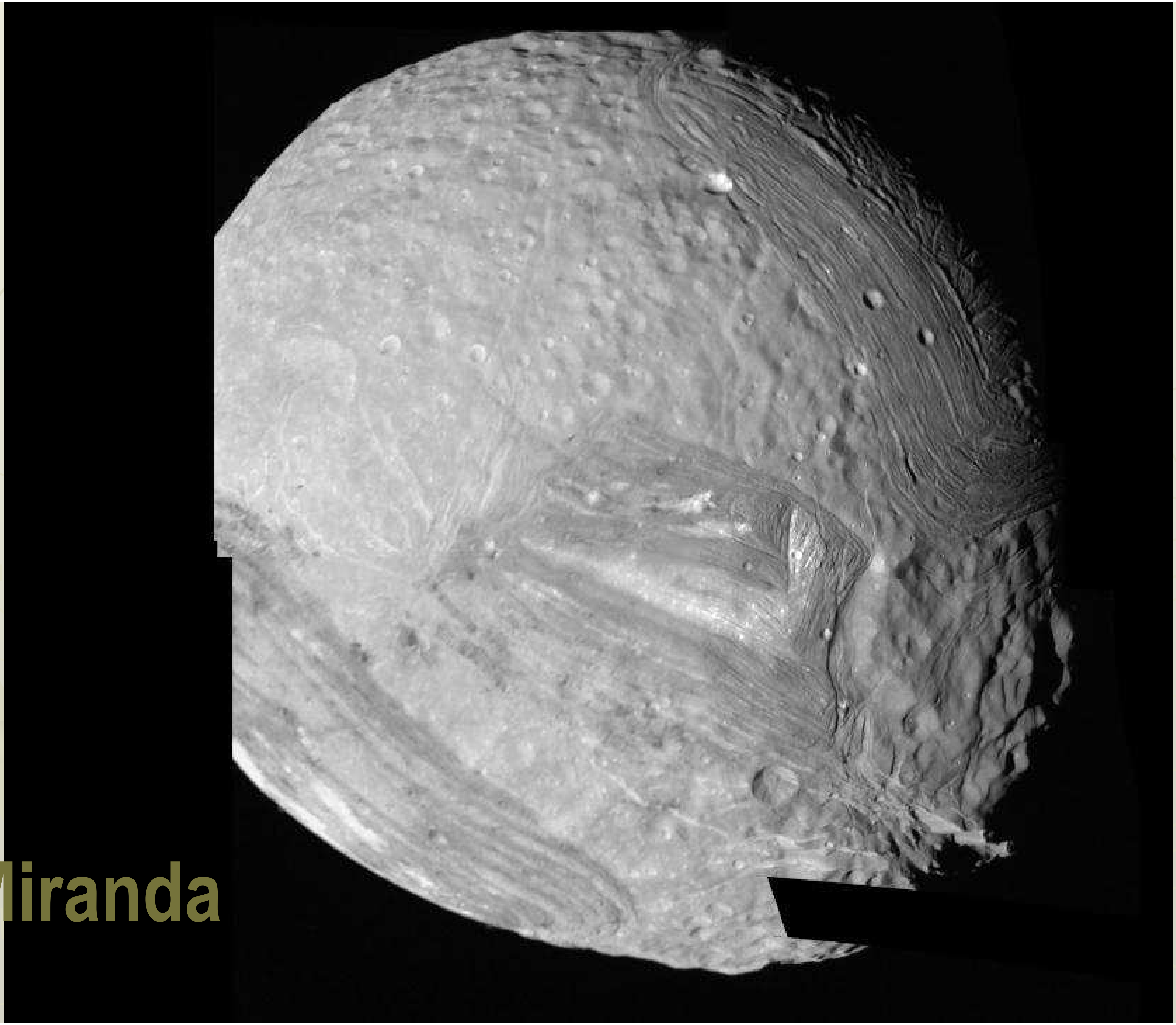
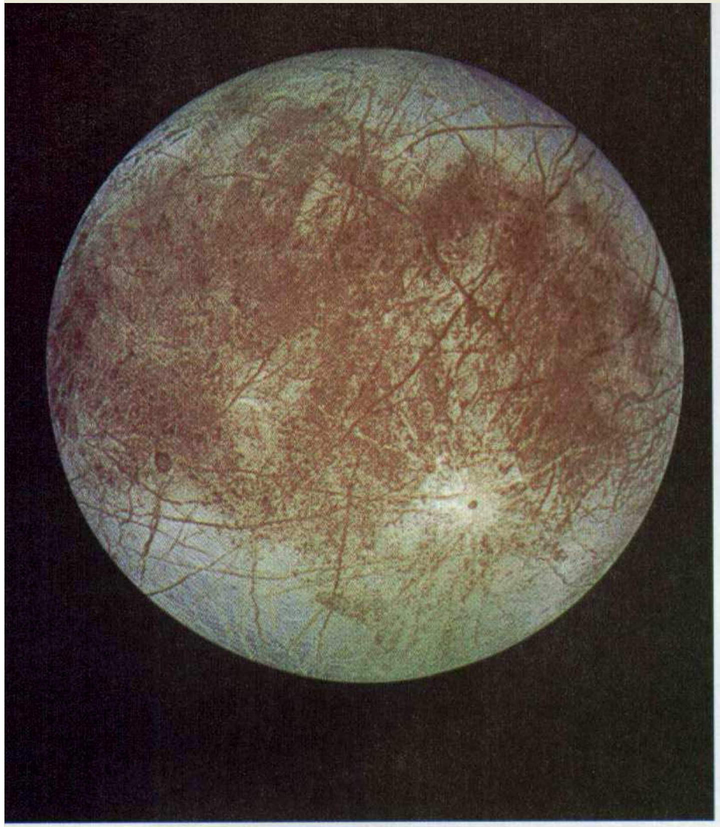


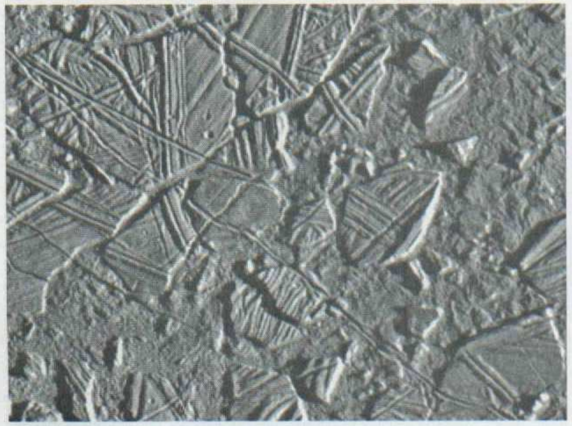
Figure 8. Ganymede's grooved terrain might consist of sets of parallel graben (upper panel), which form when a brittle layer is pulled apart atop a ductile substrate such as warm ice. Another possible faulting style is tilt blocks (lower panel). These result when parallel normal faults face the same direction, producing mountains inclined like toppled dominoes.



Miranda



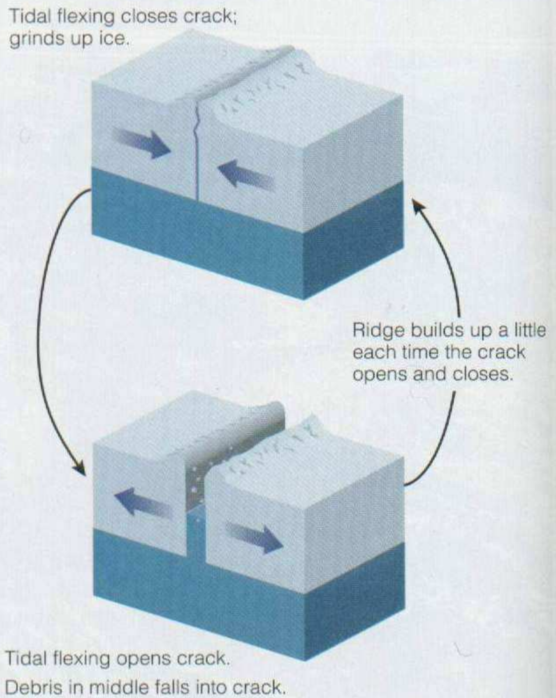
a Europa's icy crust is criss-crossed with cracks.



b Some regions show jumbled crust with icebergs, apparently frozen in slush.

FIGURE 11.20 Europa is one of the most intriguing moons in the solar system.

c Close-up photos show that surface cracks have a double-ridged pattern.



d A possible mechanism for making the double-ridged surface cracks.

Europa

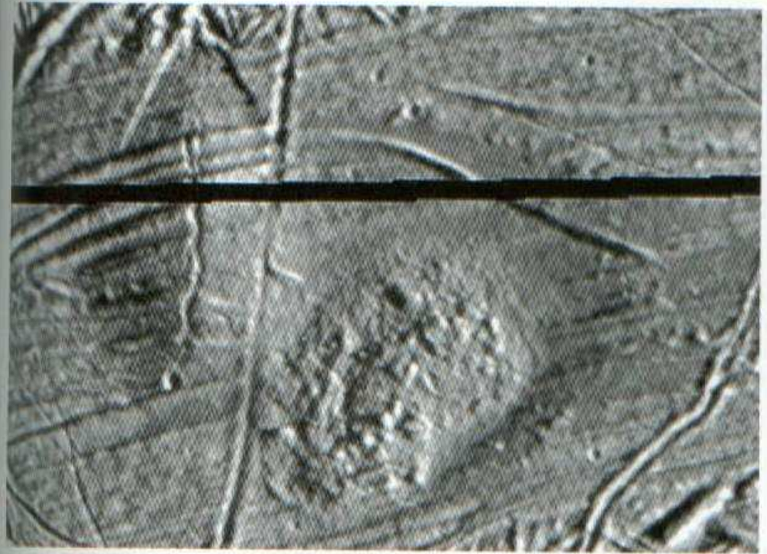


Figure 6 (above). These dome-shaped structures near Conamara Chaos may be manifestations of subsurface upwelling, perhaps the consequence of diapirs or mantle convention. The feature at left has a medial fracture; the one at right has been disrupted by extrusion from below or some other process. Illumination is from the right (east), and the area shown is about 14 by 20 km. The black line is an image artifact.

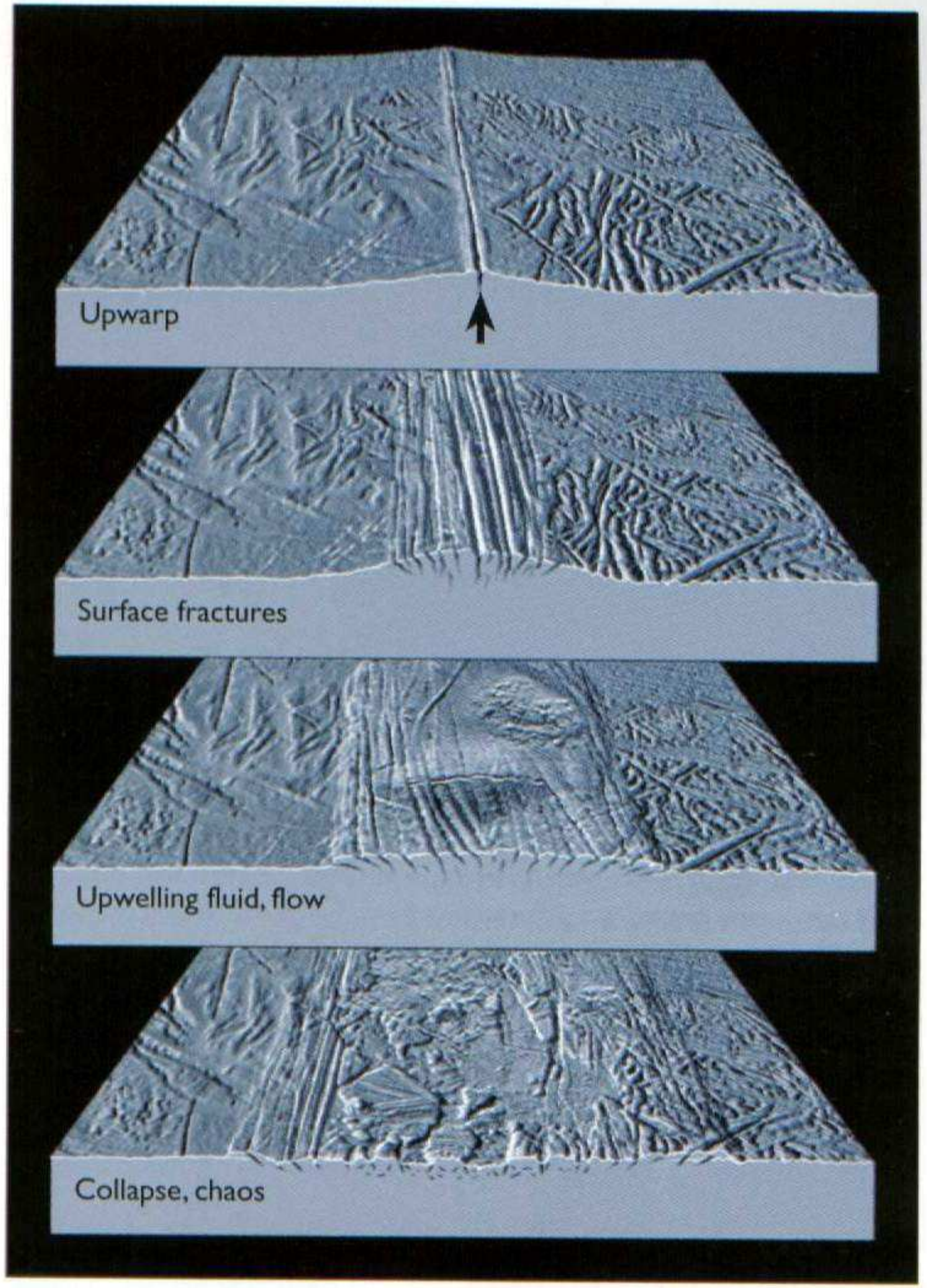
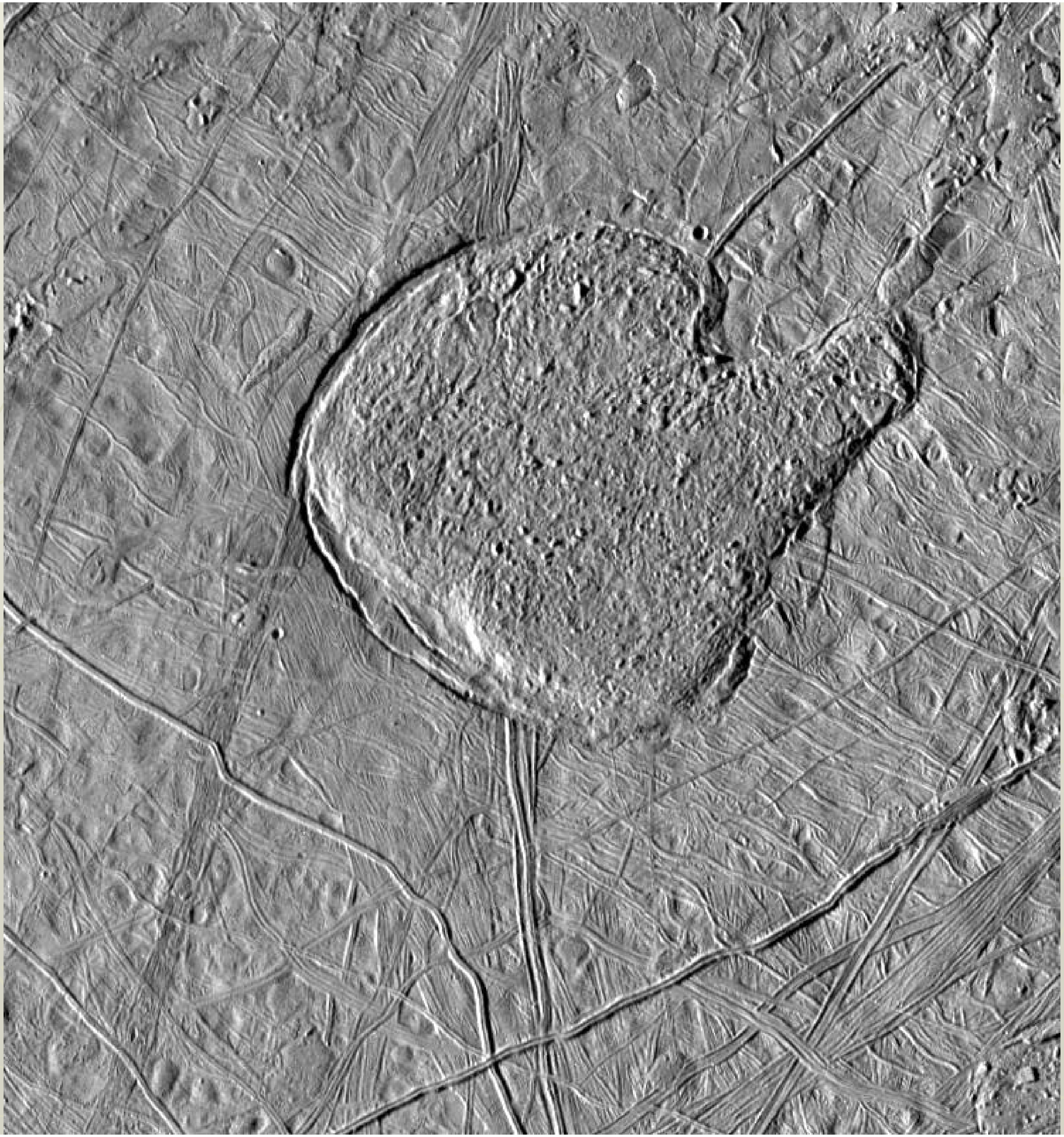
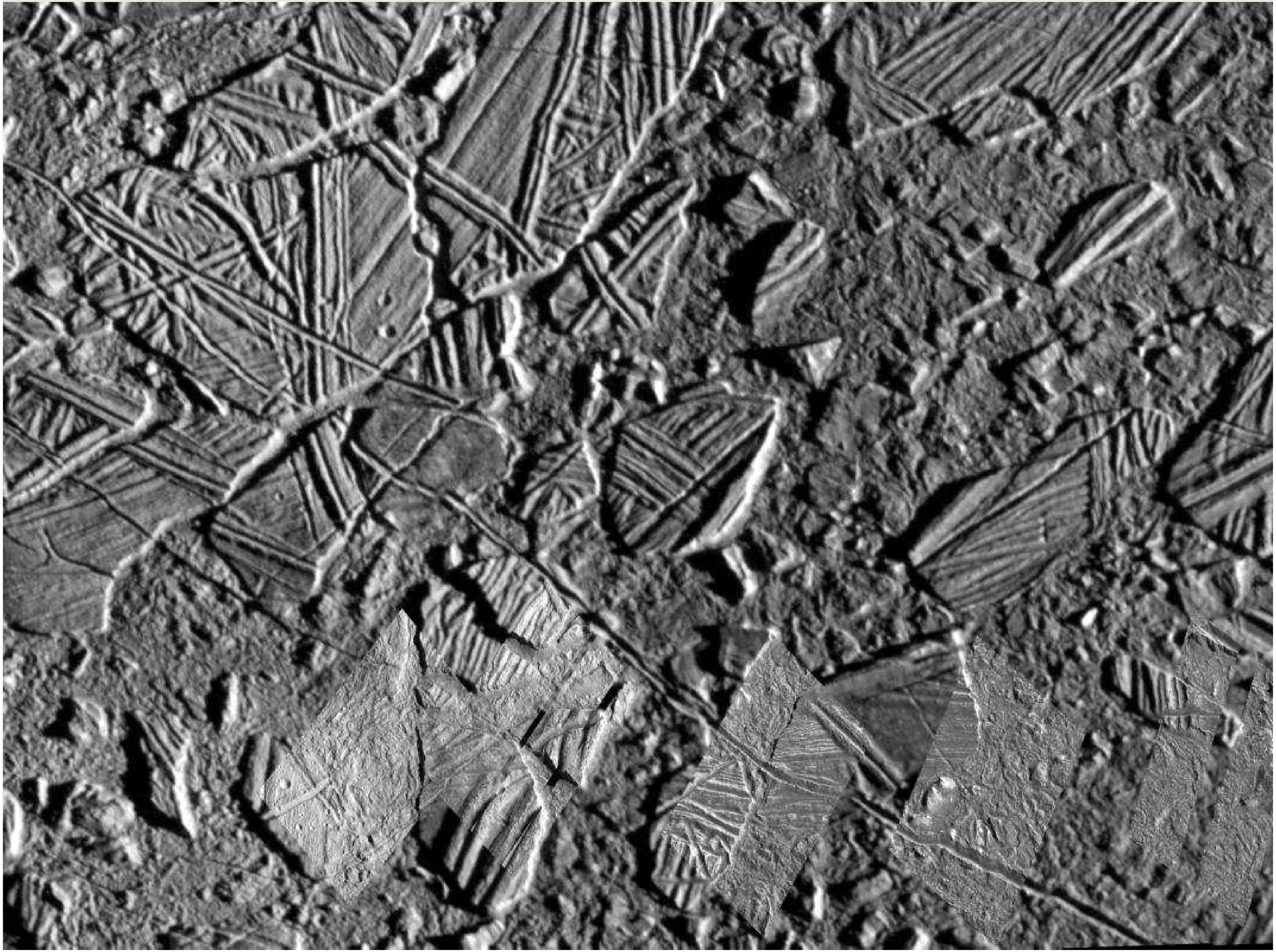


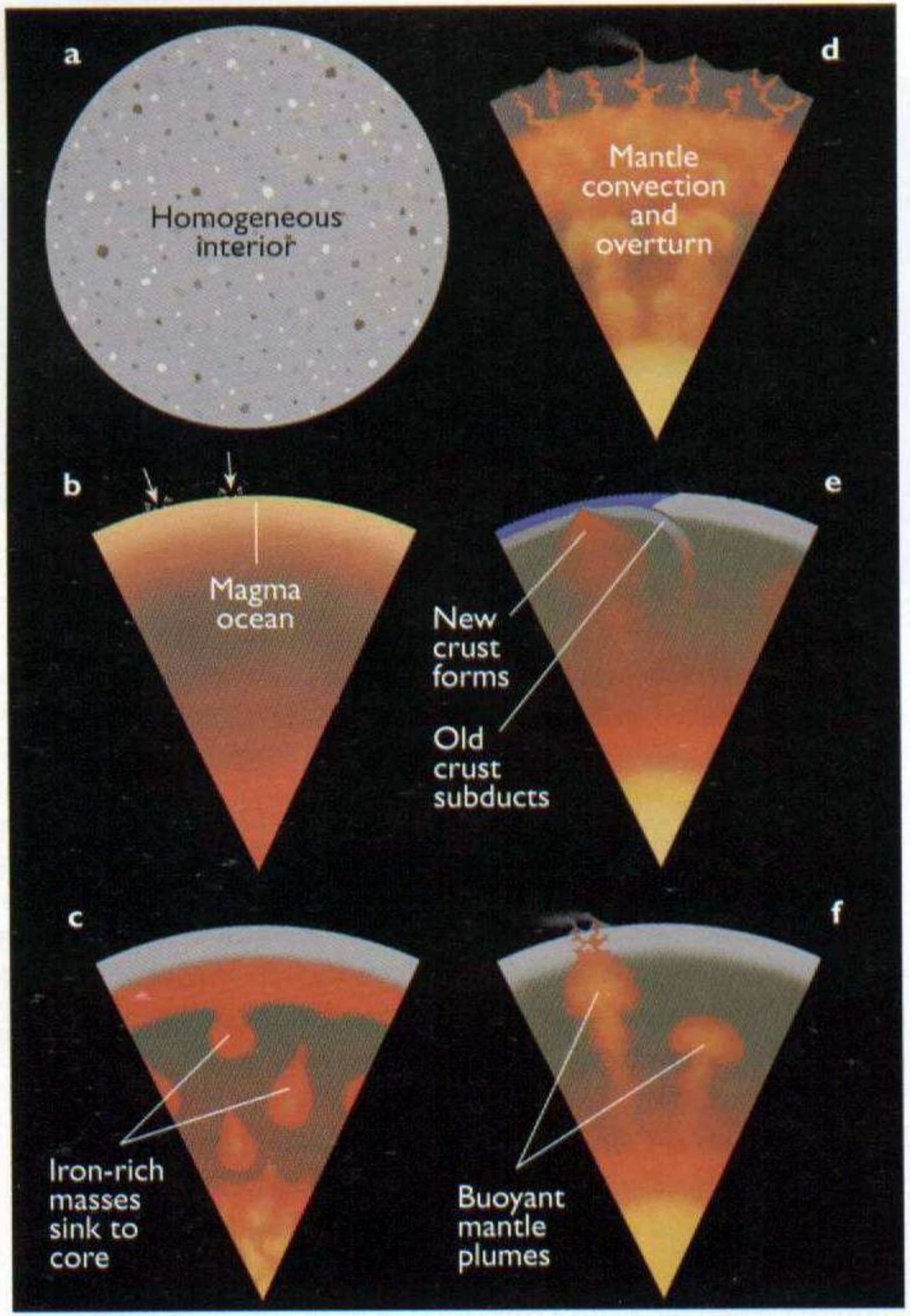
Figure 7 (right). Geologists don't yet understand what causes the deformation of Europa's crust, but one or more of these processes may be involved.

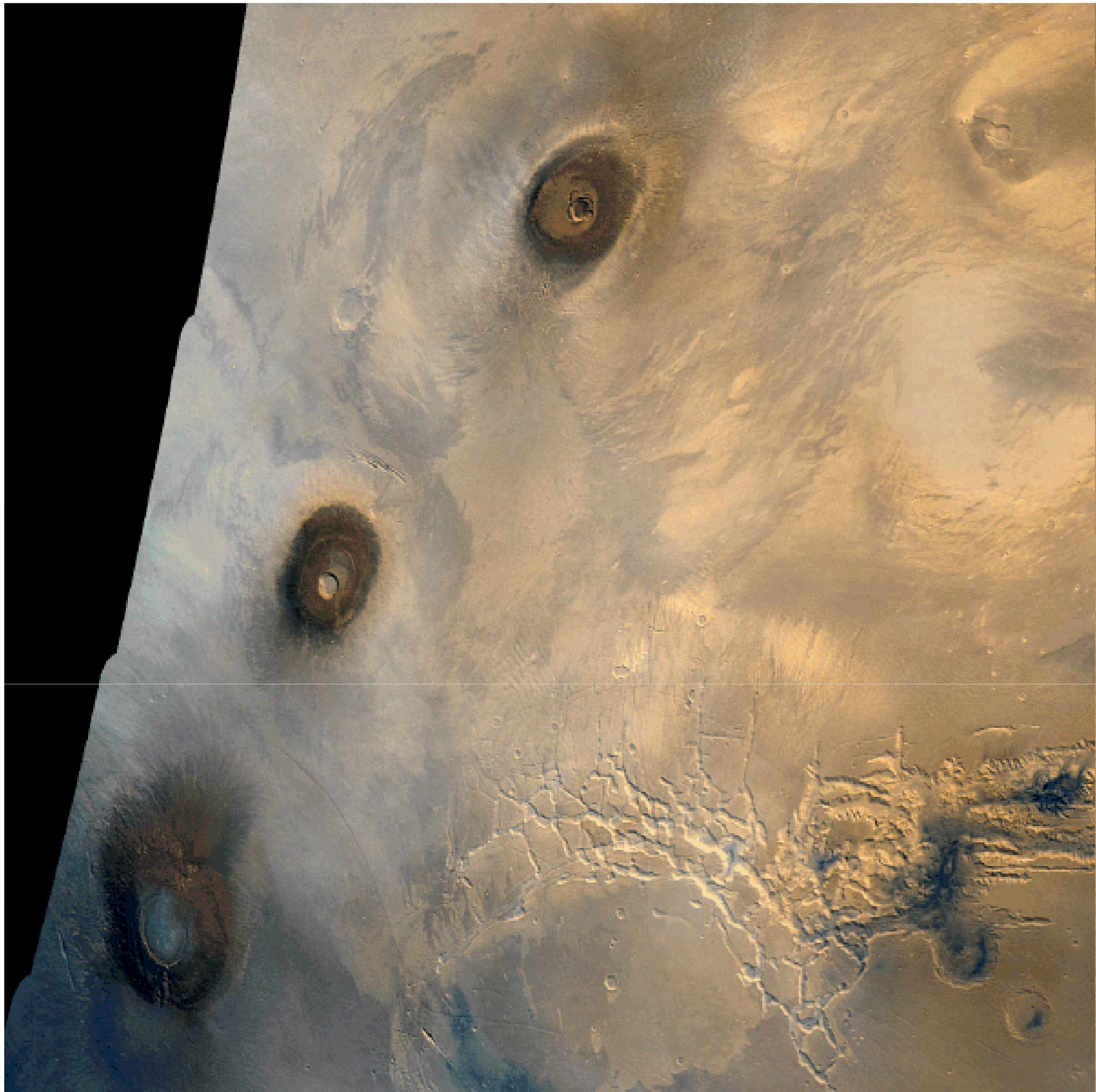
Figure 8 (lower right). The anti-Jovian hemisphere of Europa bears a dark, wedge-shaped zone (left panel, arrowed), which is in some ways analogous to sea-floor spreading on Earth. Extensional forces caused breaks within the crust, which later were filled in with low-albedo material. Running through the dark wedge are parallel ridges that display bilateral symmetry, just as our mid-ocean ridges do. When the dark material is removed by computer, the fractured plates (color-coded for clarity) can be reassembled to show how they might have appeared prior to the extensional episode (right panel).

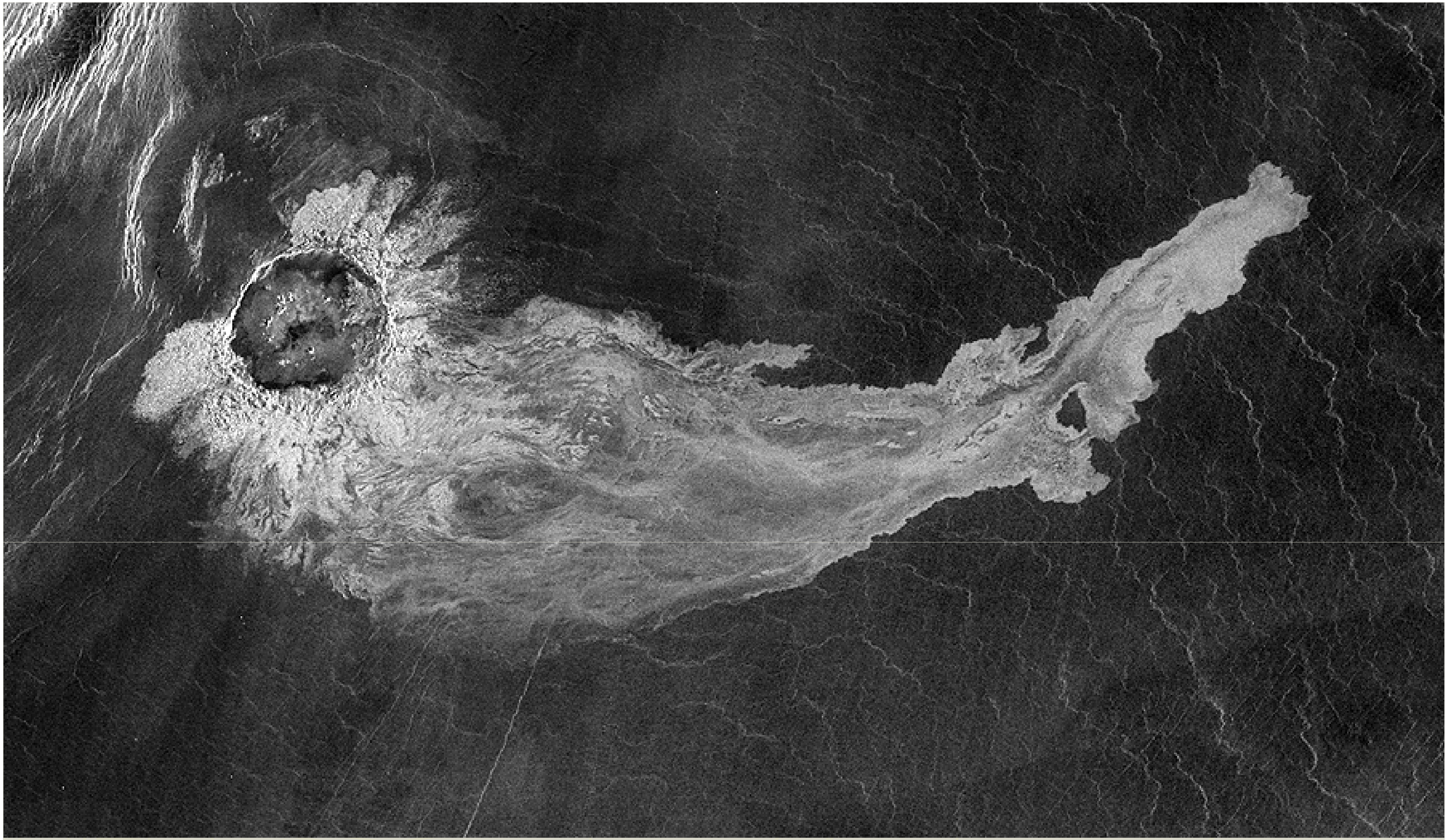
Europa



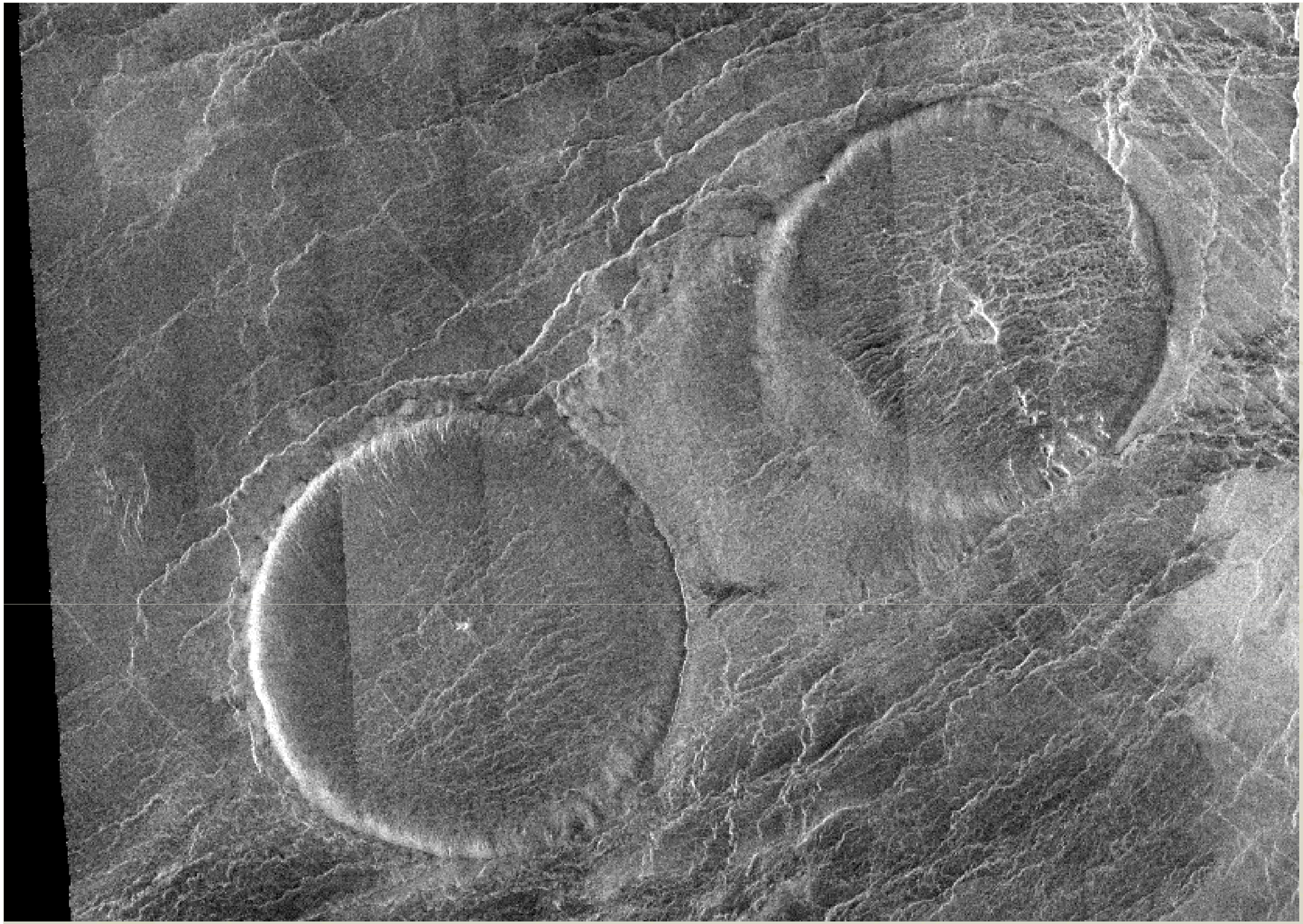



a
Homogeneous interior
b
Magma ocean
c
Iron-rich masses sink to core
d
Mantle convection and overturn
e
New crust forms
Old crust subducts
f
Buoyant mantle plumes

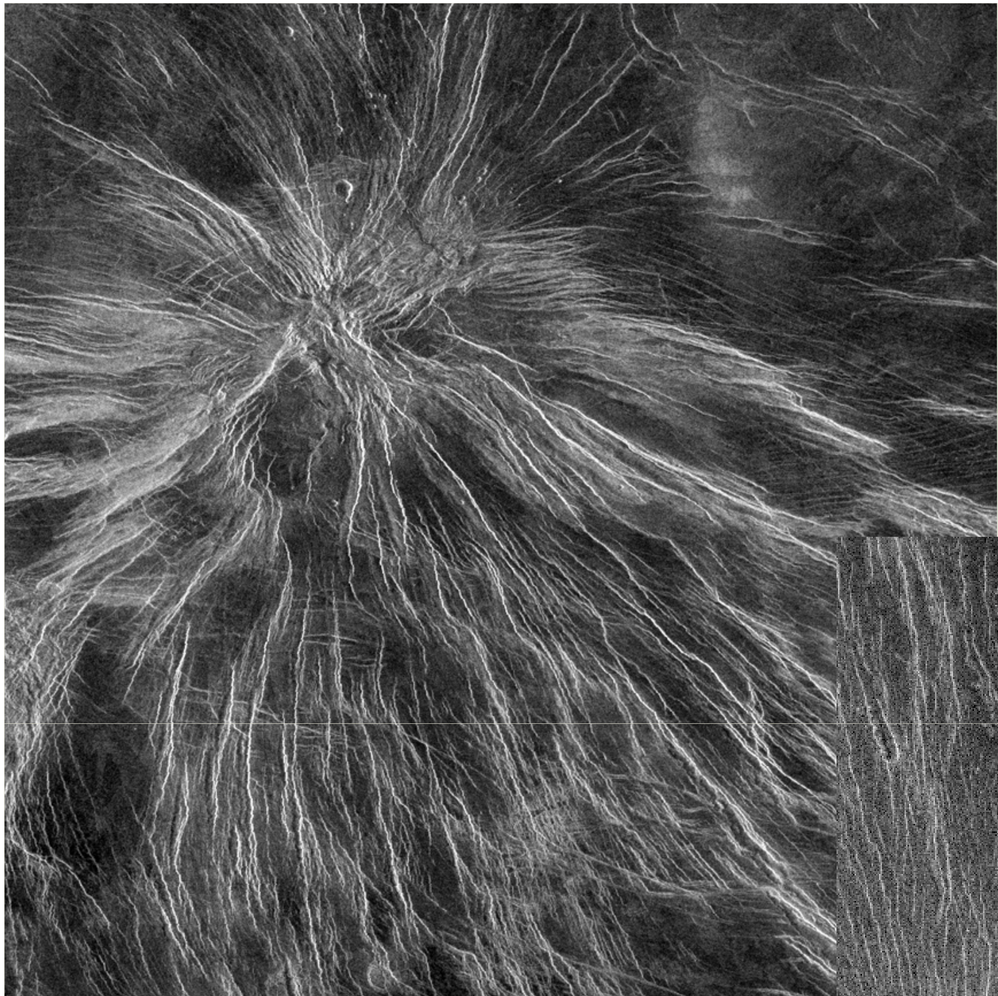


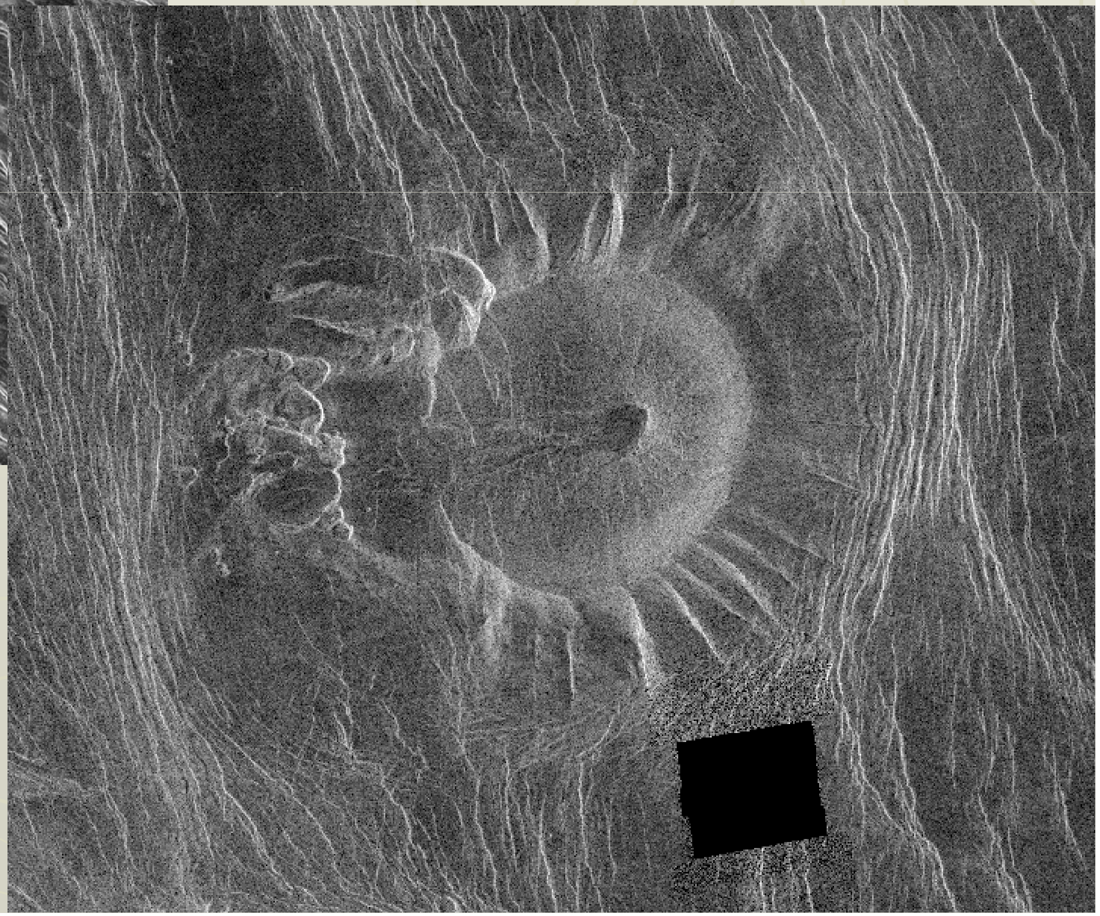


- Existen canales de lava hasta de 6800km .
- Miles de **VOLCANES** tipo escudo.
- Más de 1500 con diámetros mayores a 20 kms

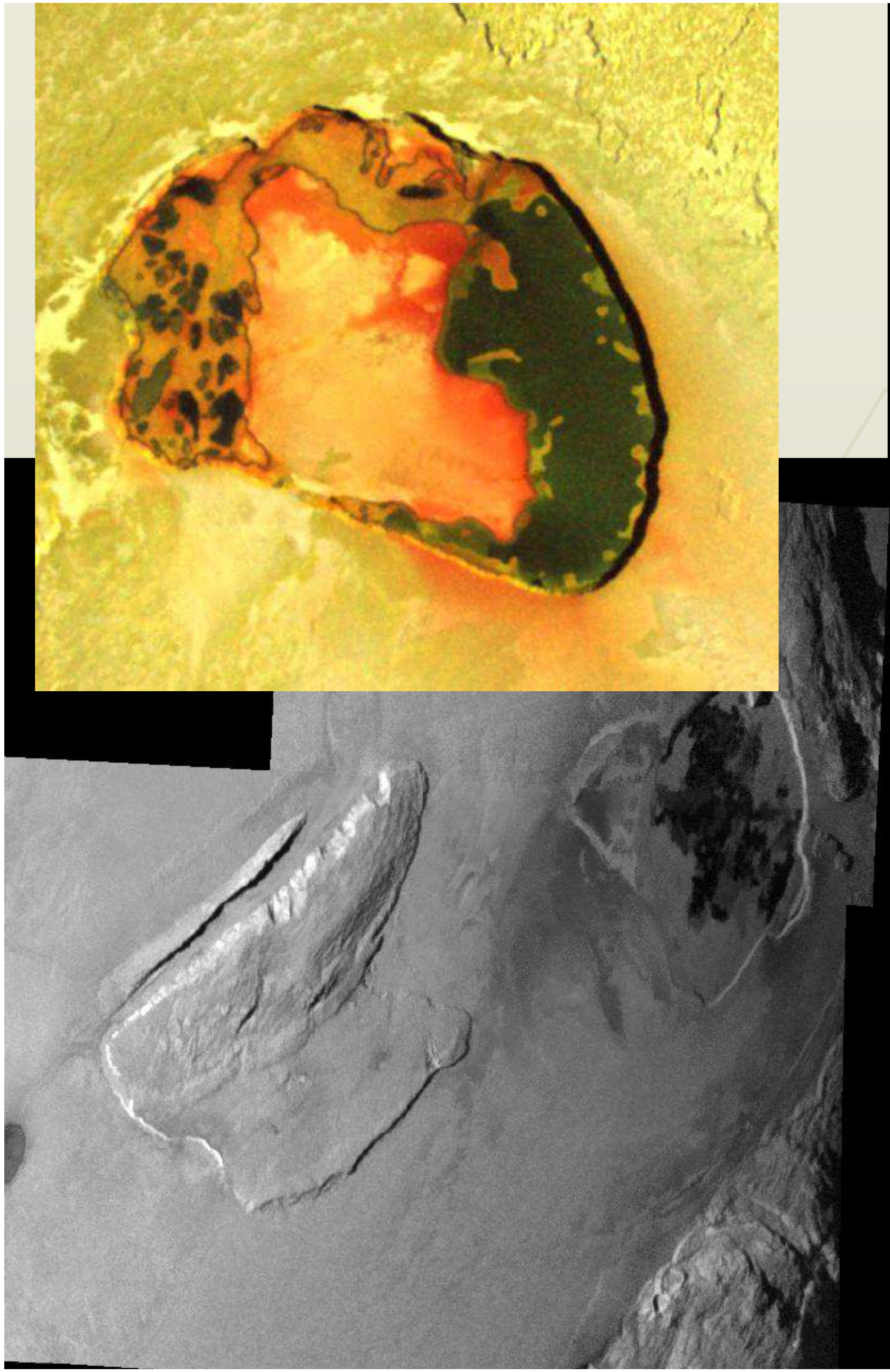


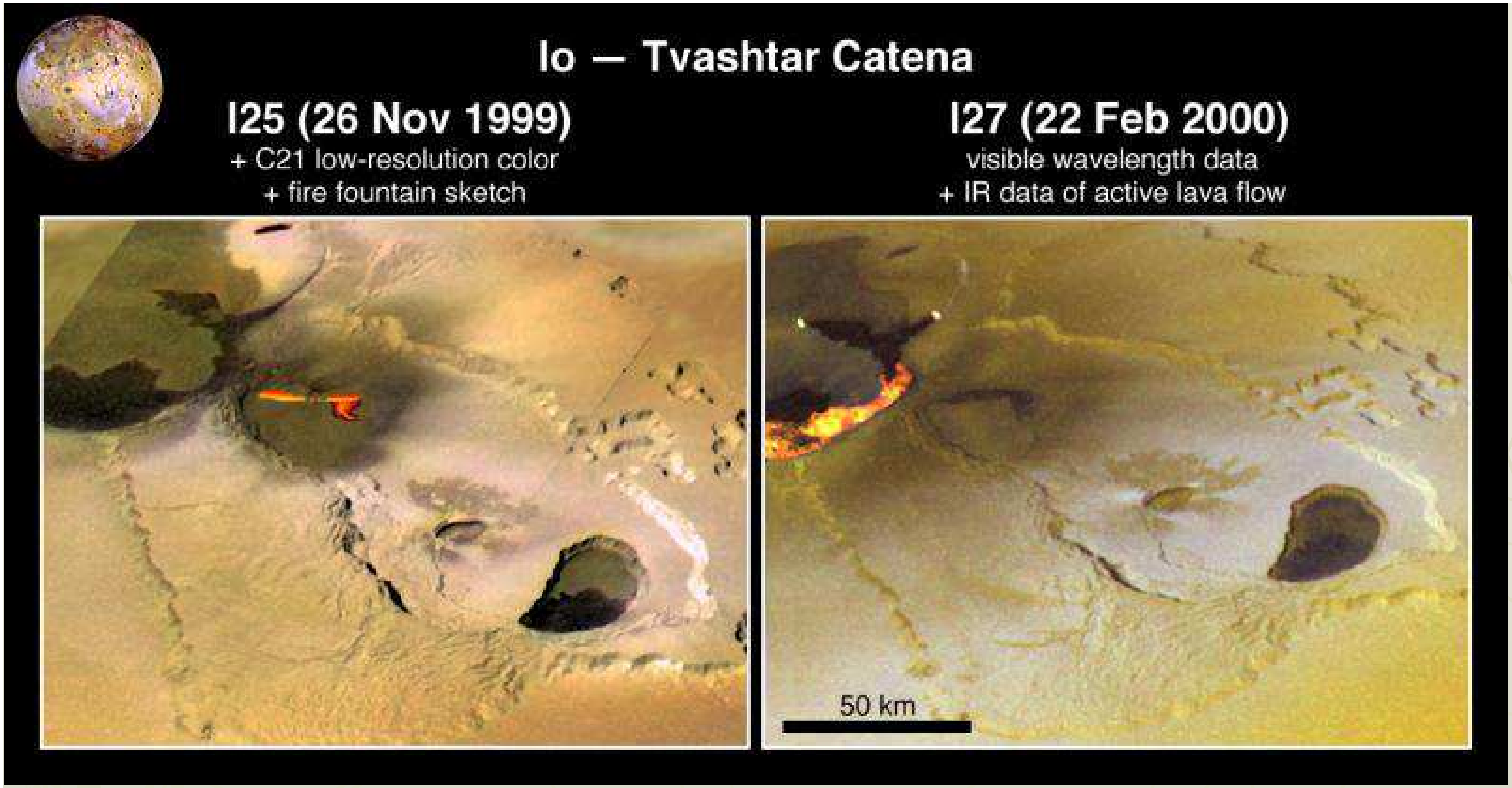
► **Domos Circulares** (panqueques) de 35 km de diámetro y casi 1km de alto: producto de lavas muy viscosas.



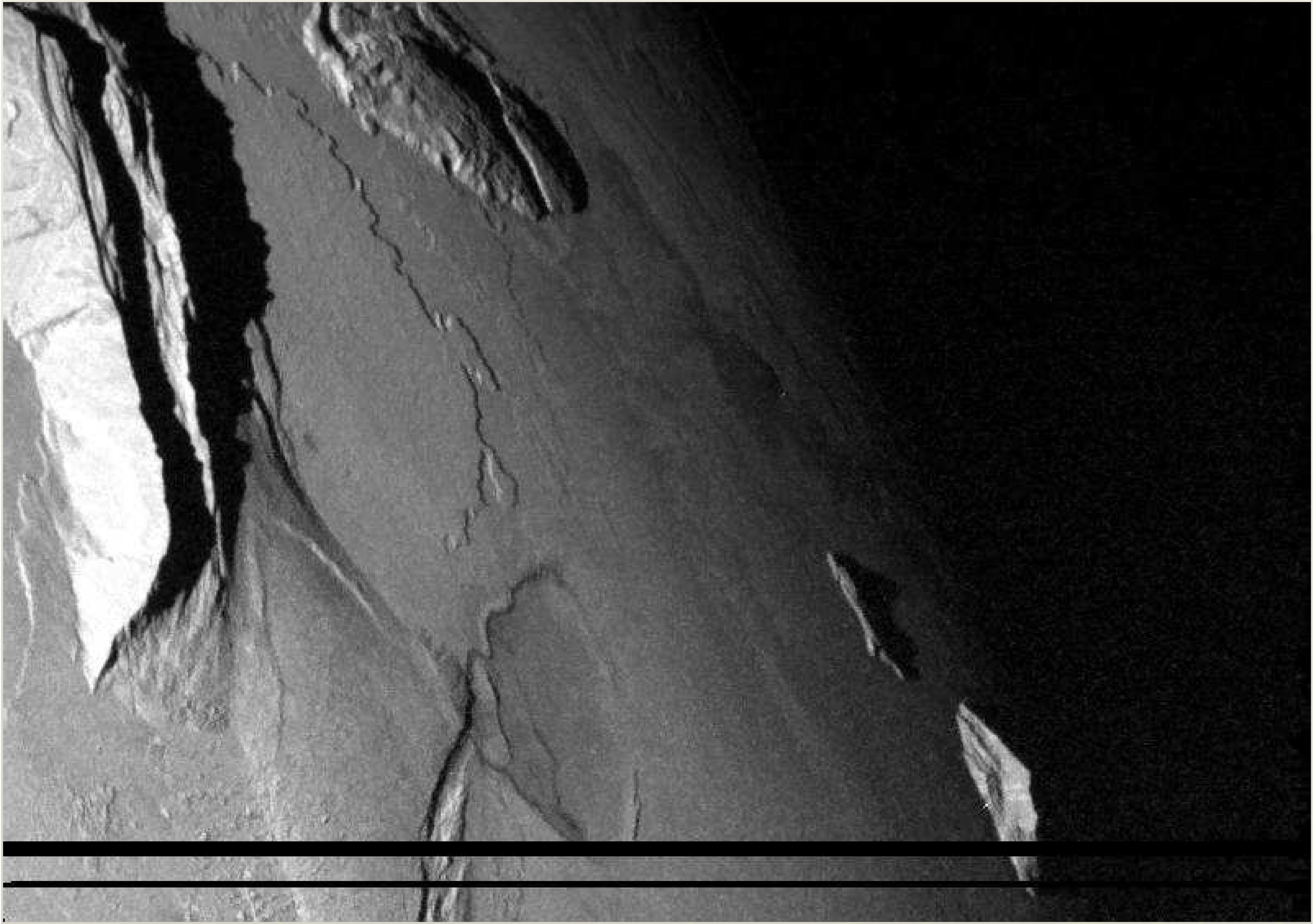


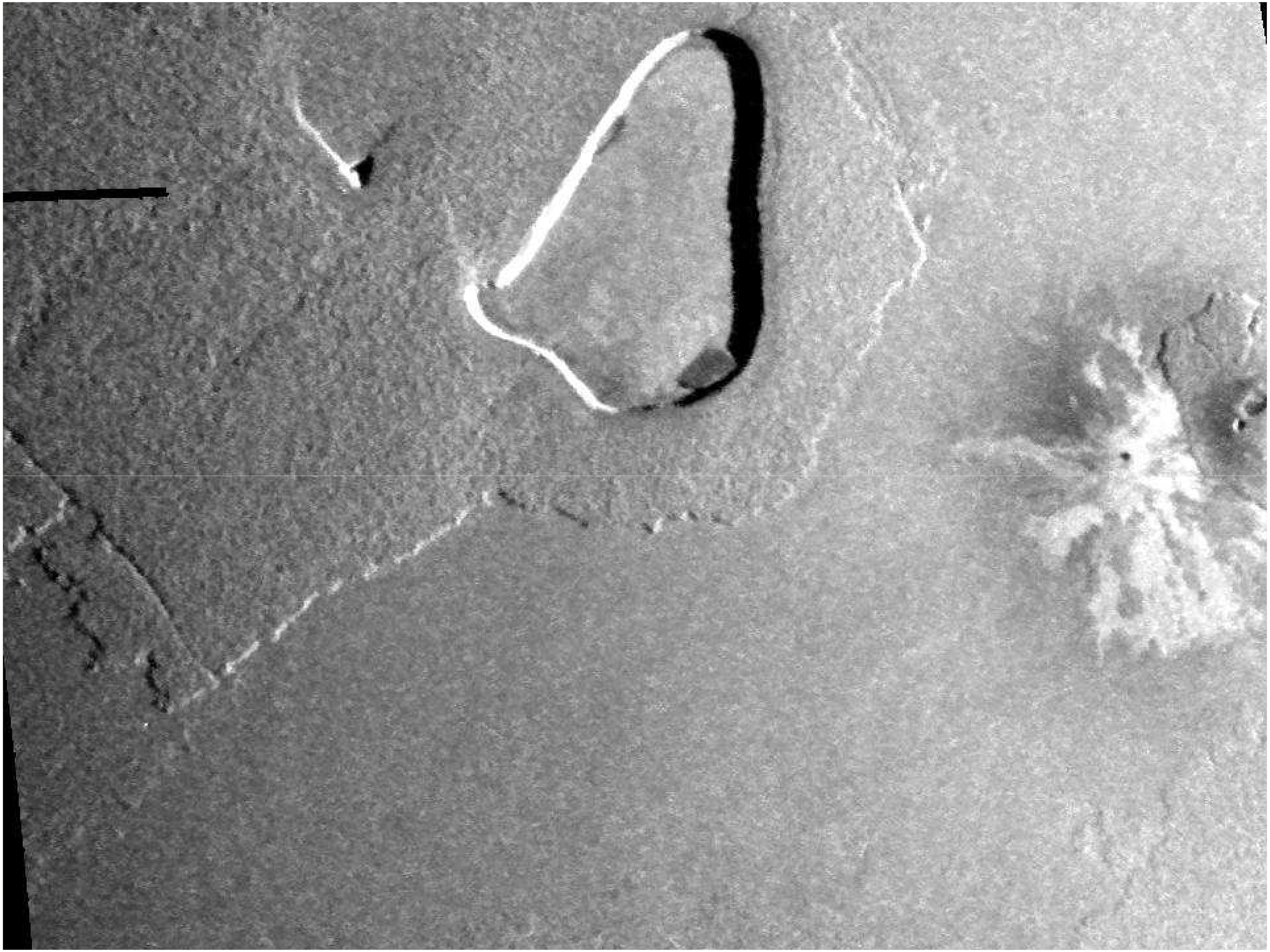
Io





Io: Tiene una superficie muy joven y un vulcanismo importante, que es consecuencia de la tectónica. Sin embargo, no hay evidencias de tectónica de placas, como fallas o cinturones plegados.





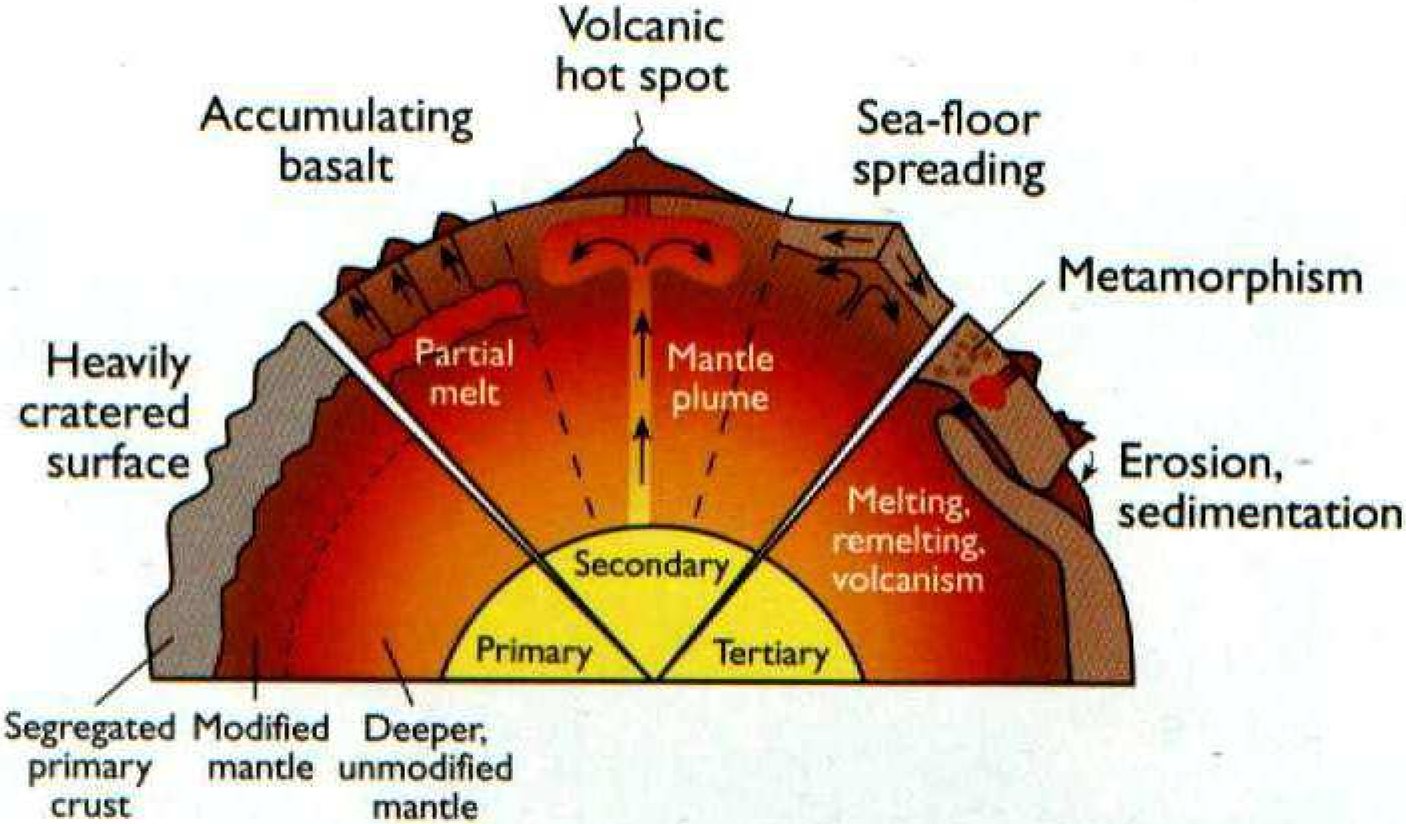


Figure 5. Various mechanisms lead to the formation of a planet's primary, secondary, and tertiary crusts. Primary crust, created early in planetary history, is still preserved in places like the lunar highlands. Partial melting of the mantle and volcanic activity lead to the formation of secondary crusts, largely of basaltic composition. Tertiary crust results from the recycling of primary and secondary crust, as is typified by Earth's continents and (perhaps) the tessera terrain of Venus.

TIPOS DE CORTEZA HOY

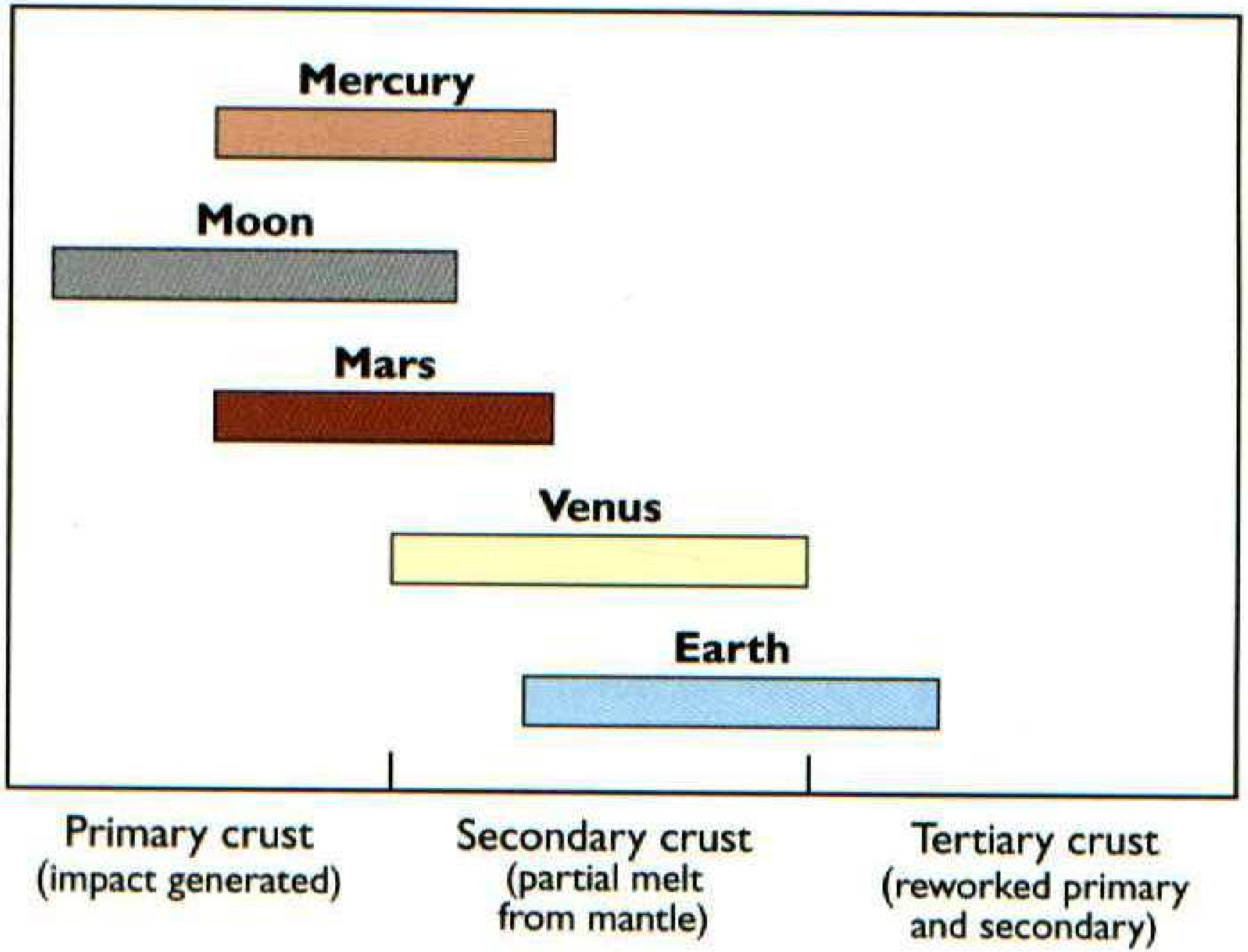


Figure 20. The types of crust now exposed on the terrestrial planetary bodies vary widely, from the largely primary crusts of the Moon to the heavily modified tertiary crust represented by Earth's continents.

EDAD DE LAS SUPERFICIES

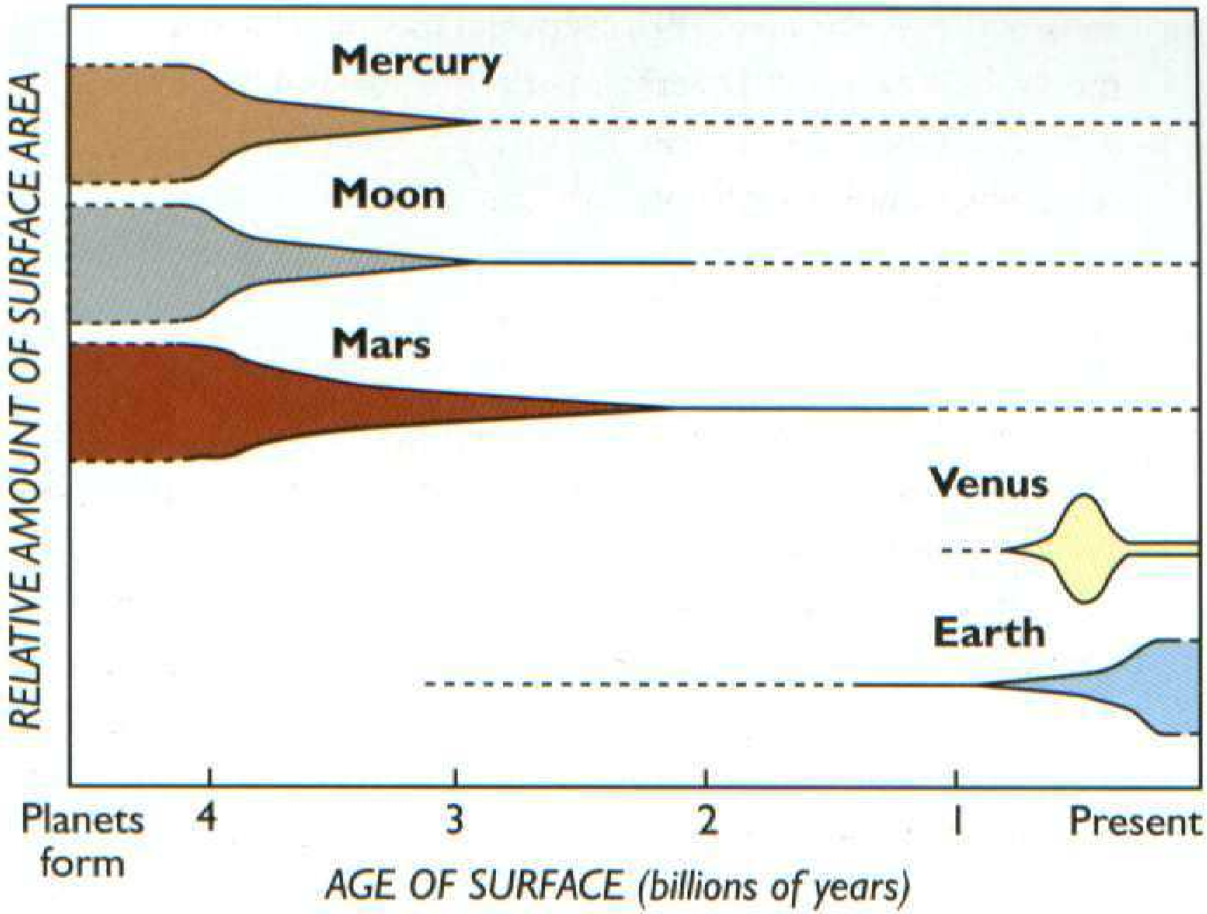
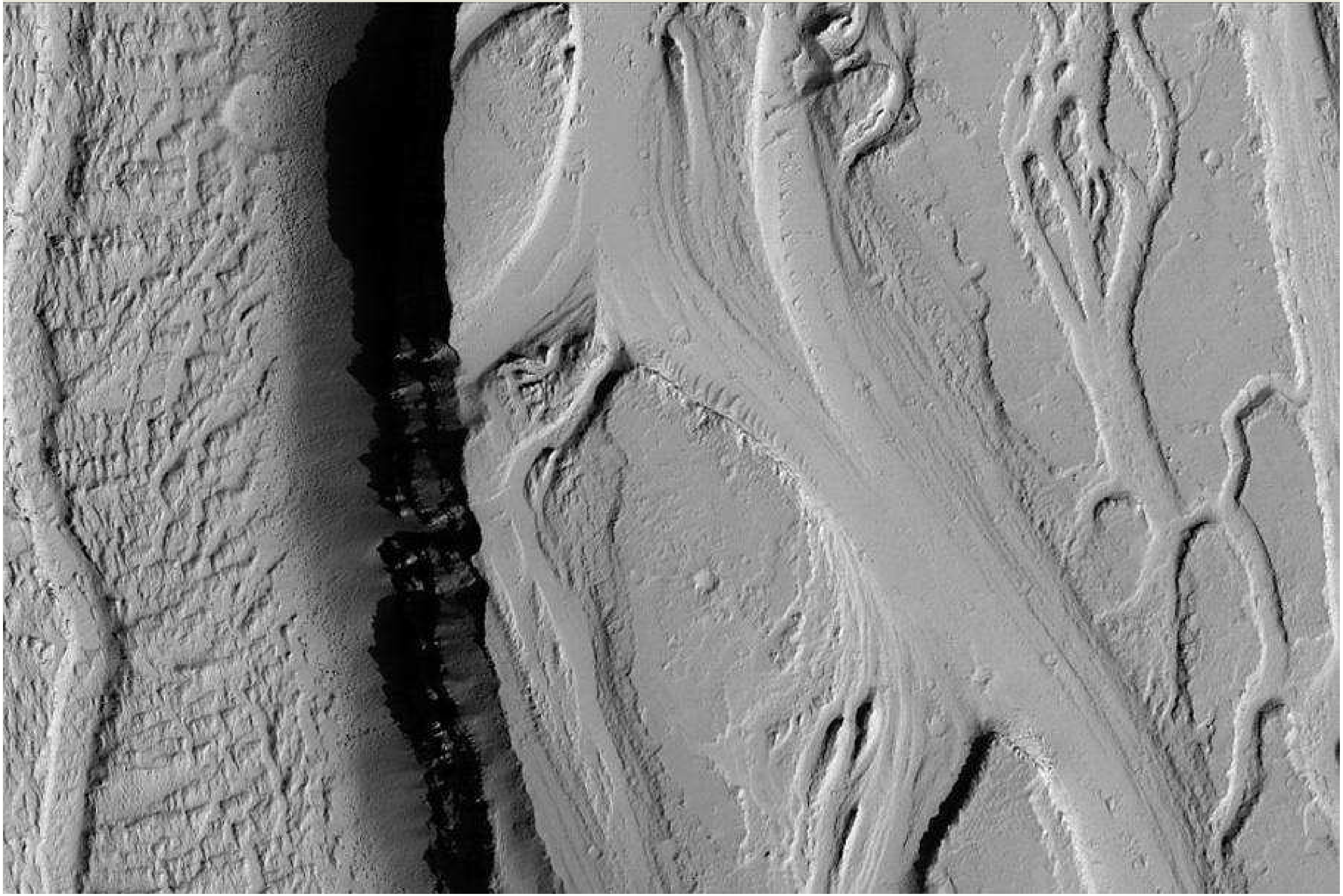


Figure 18. The ages of the terrestrial planets' current surfaces, with colored shading representing the total surface area of each body. Most regions on the Moon, Mars, and Mercury are several billions of years old, though volcanic activity continued for some time on Mars. Two-thirds of Earth's surface (its ocean basins) formed within the last 200 million years. As on Earth, most of Venus's surface formed relatively recently, apparently due to processes very different from terrestrial plate tectonism.



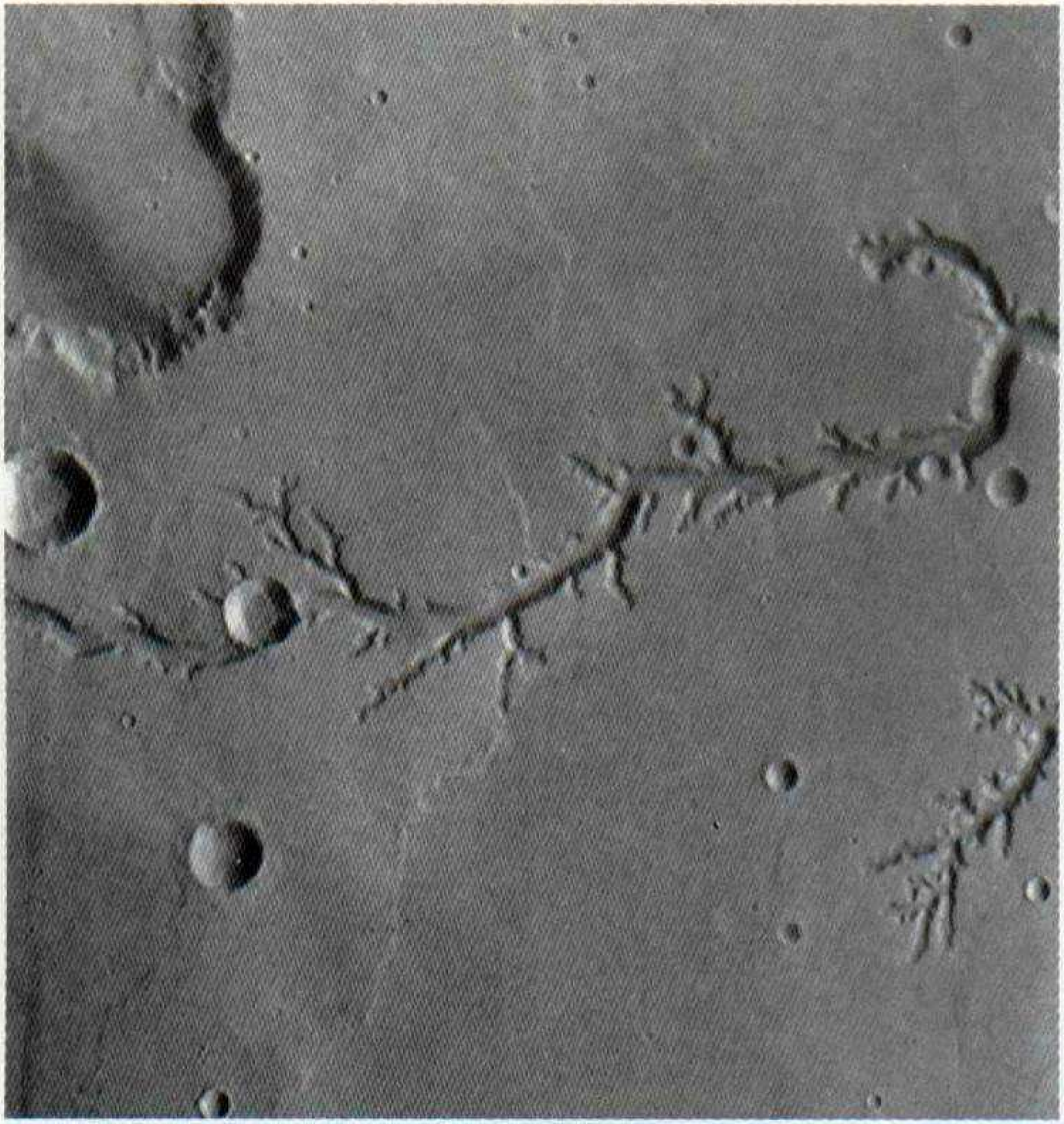
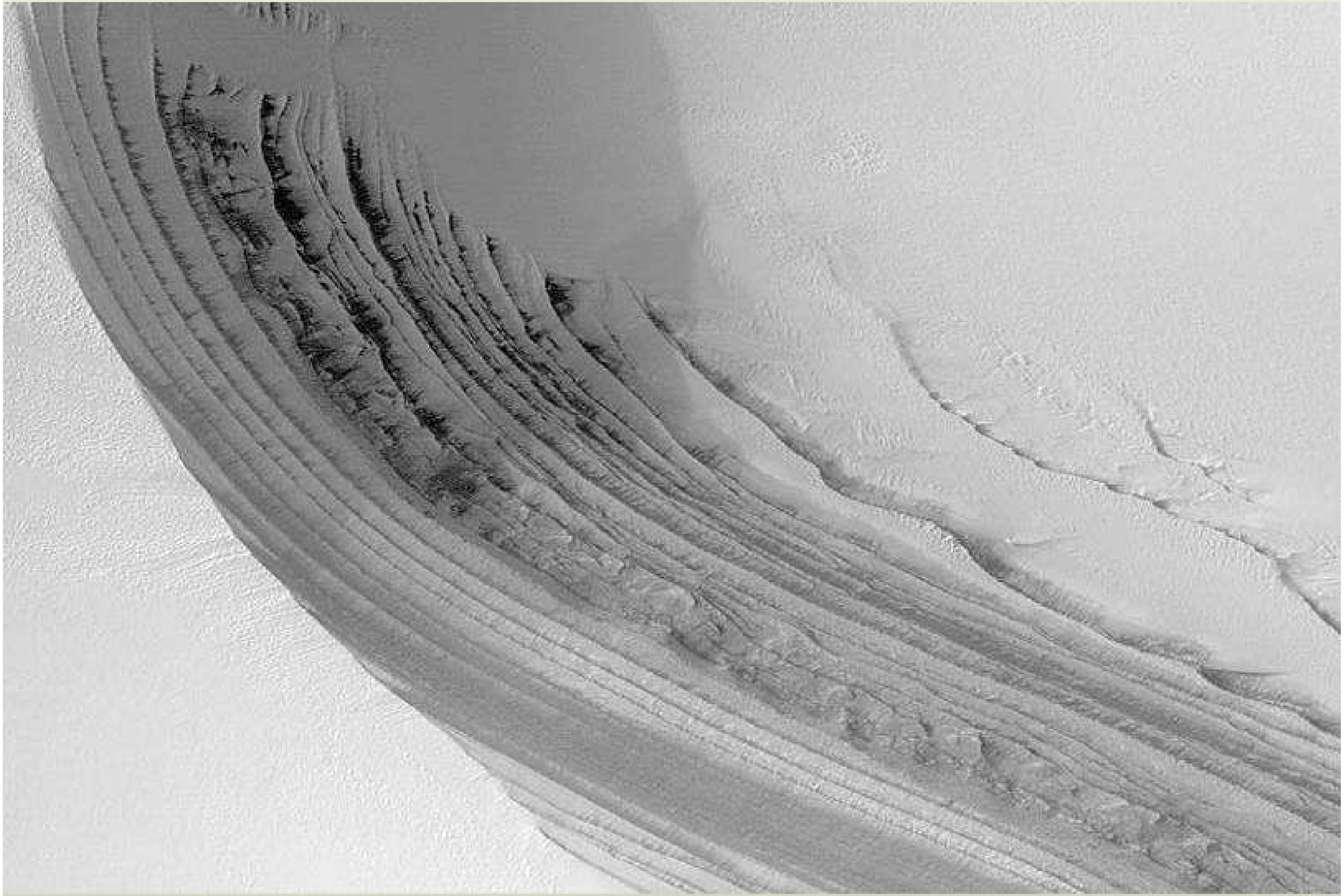
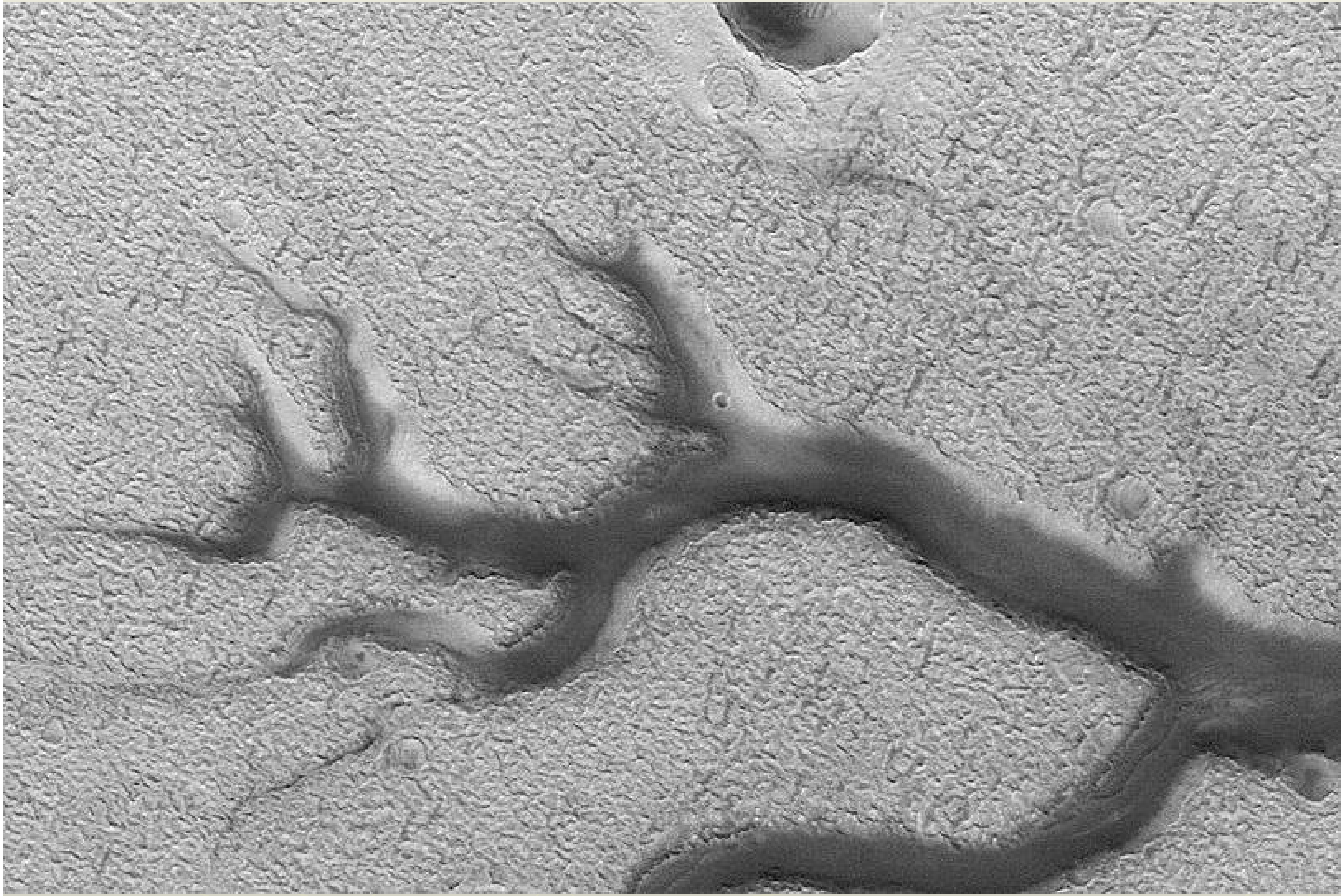
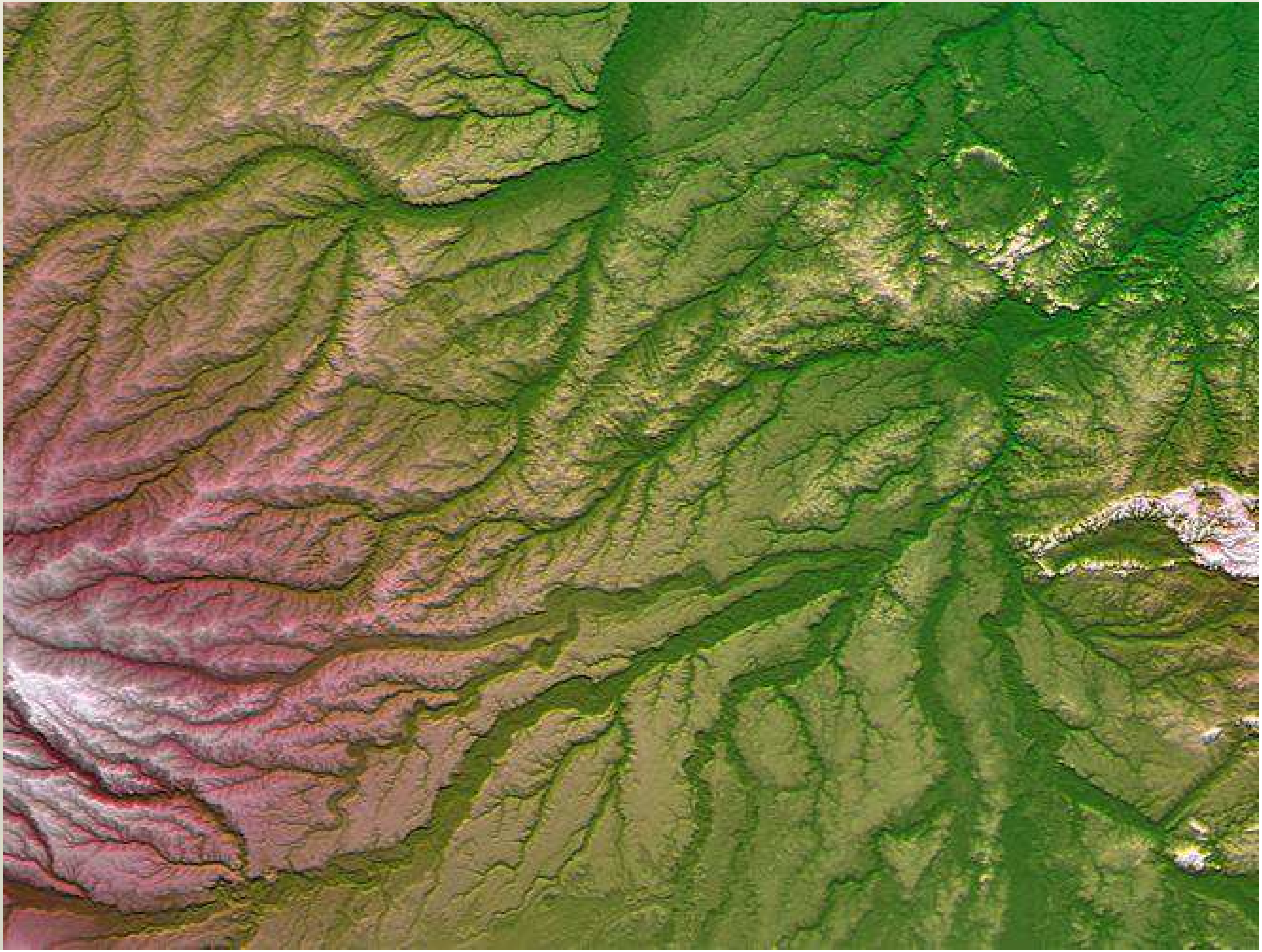


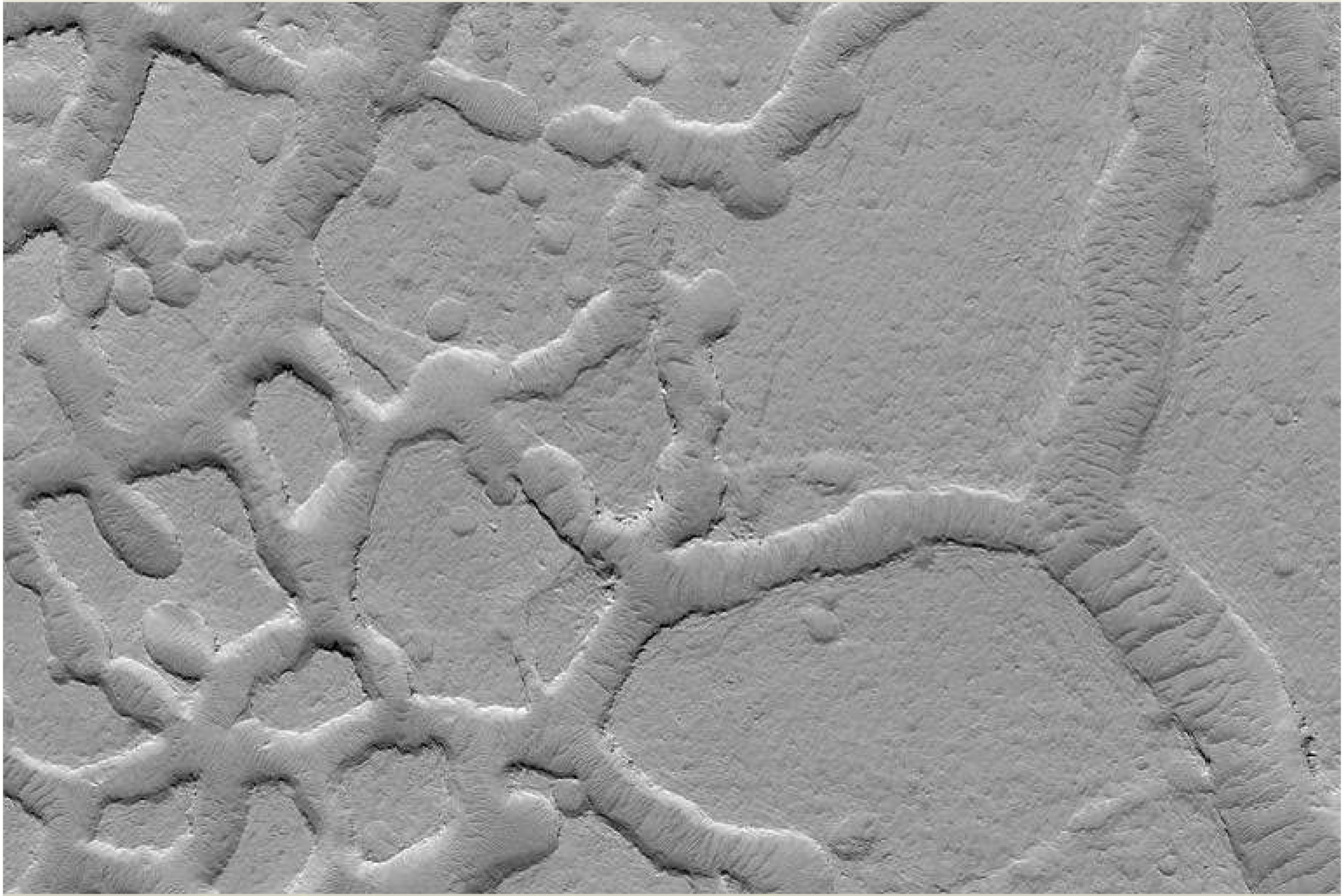
Figure 20. All the tributaries of Nirgal Vallis, a branching valley network, have blunt ends, and there is no indication of any erosion between them. These characteristics suggest erosion by groundwater-fed streams rather than surface runoff. The picture is 60 km across.

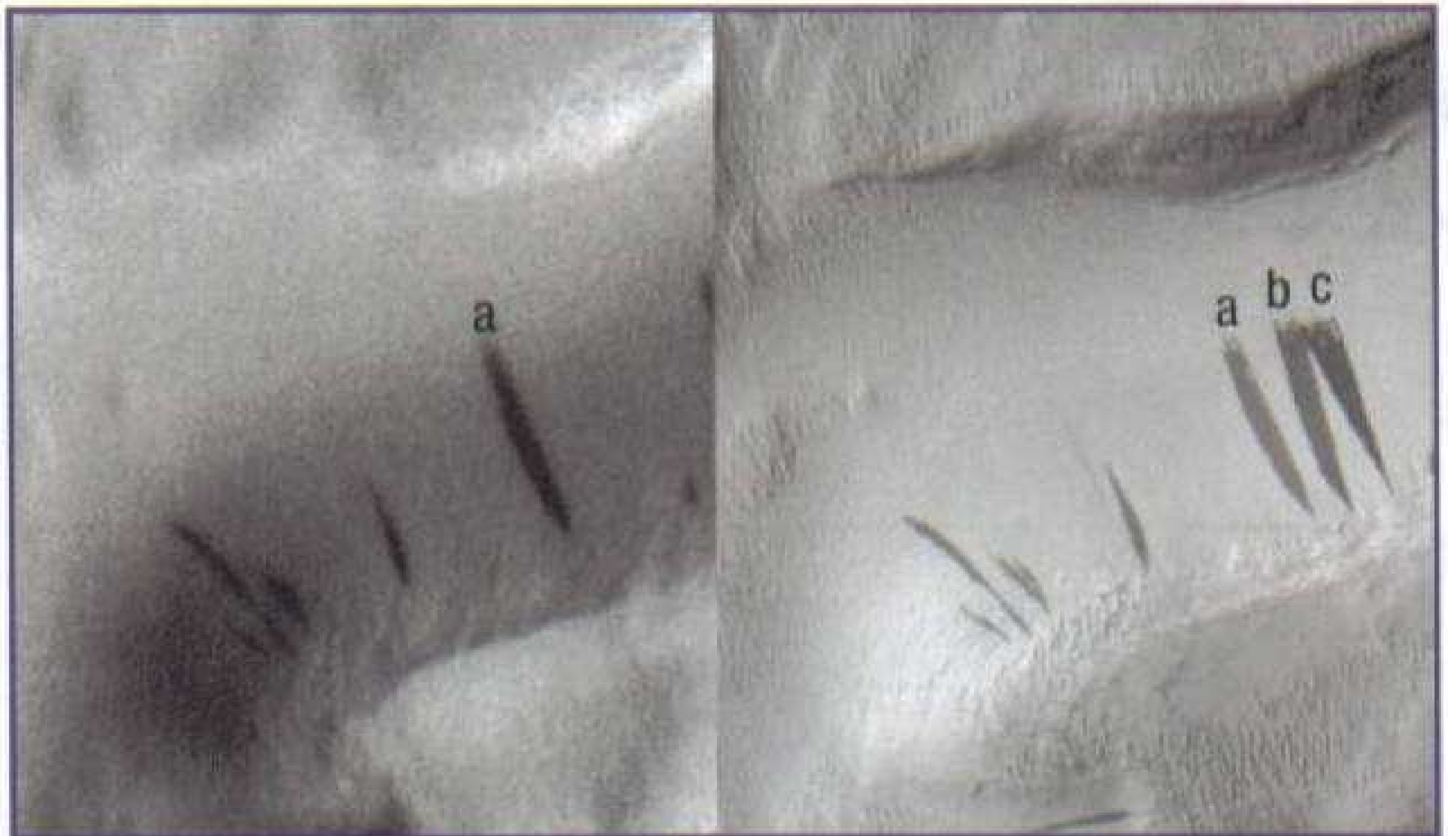




Agua superficial







3: Two Mars Orbiter Camera narrow-angle images of the same area (about 2.8 km across) illustrating the extremely recent formation of dark streaks (b and c) in walls of Mangala Valles at 6.5°S by 208.3°E. Left image: sp237303, aquired on 18 June, 1998. Right image: e0202379, aquired on 26 March 2002. (Karl Mitchell, from raw MOC image data using USGS ISIS software)

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