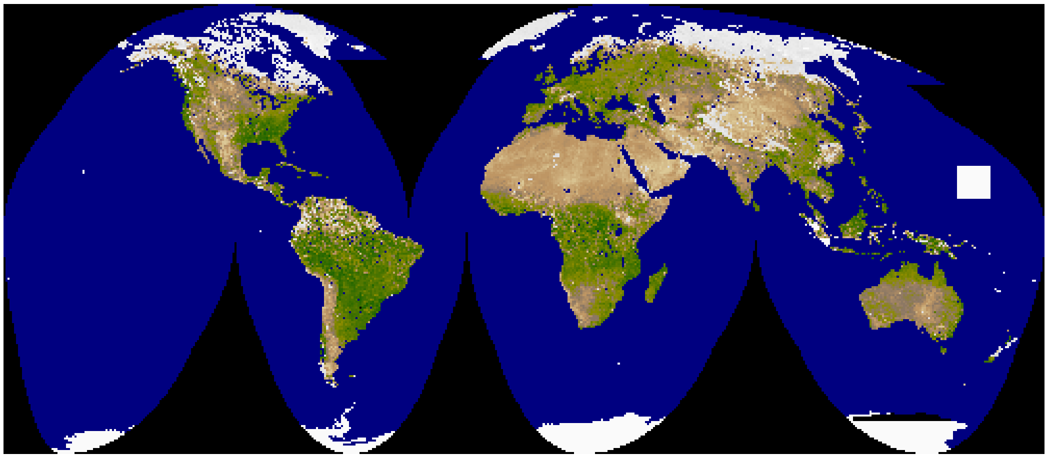
Typhoon Odessa, Western Pacific Ocean, Earth



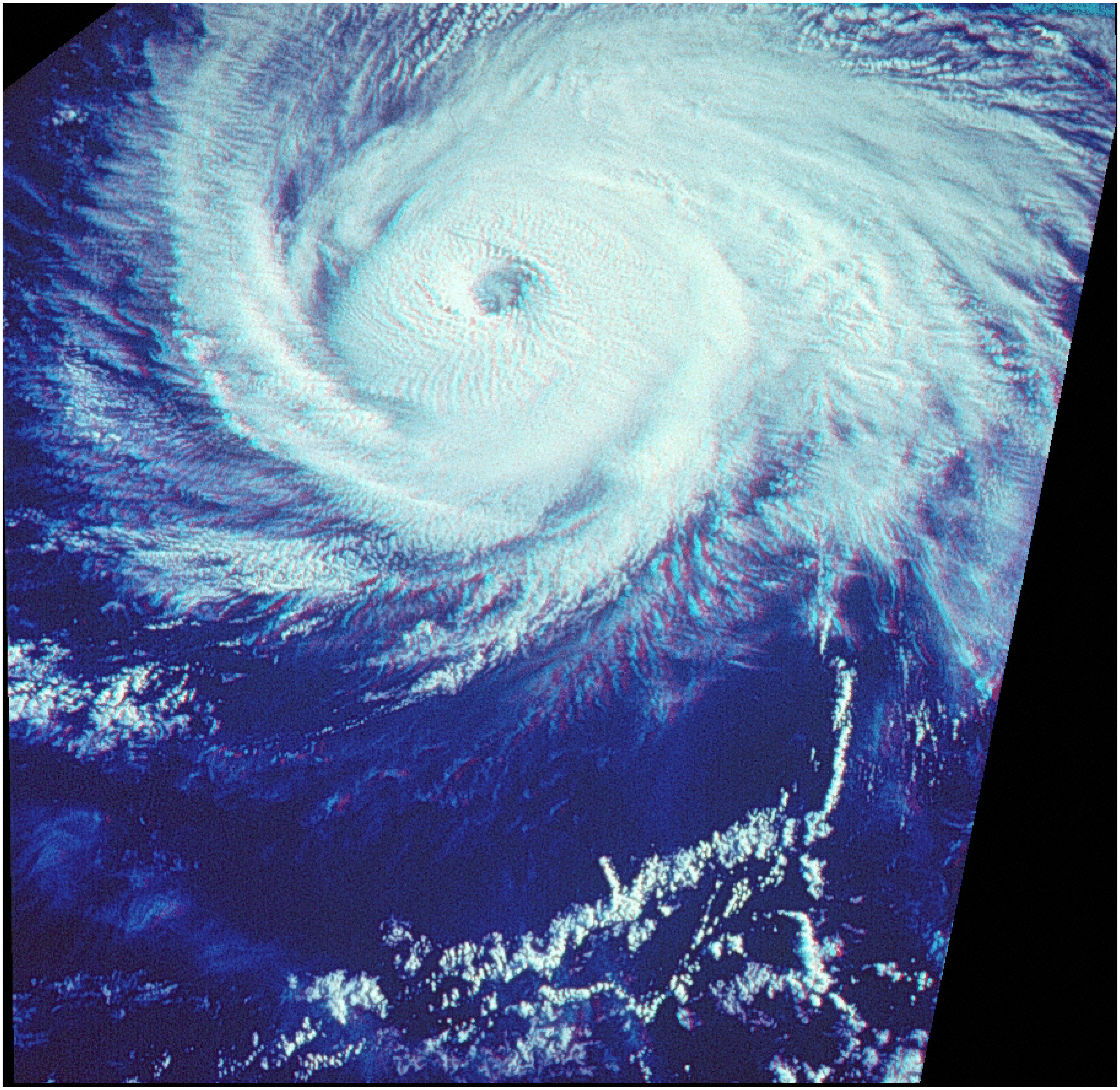
Hurricanes (which are called typhoons when they occur in the western Pacific) are among the most powerful and most organized atmospheric systems on Earth. They form in tropical regions, where warm ocean waters trigger local thunderstorm activity. Under the right circumstances, regional wind currents and the Earth's rotation can organize these storm systems (called waves) into large spiral systems. When sustained winds reach 119 kilometers per hour, a hurricane is born.

When observed by shuttle astronauts in August 1985, Typhoon Odessa was a mature and powerful storm with a tightly formed eye wall. Hurricane circulation (counterclockwise in the northern hemisphere) forms a cylindrical wall of thunderstorms up to 100 kilometers wide near the center called the eye wall, which is the site of the most damaging winds. These storms create powerful updrafts that pull warm surface air into the hurricane, further feeding storm activity.

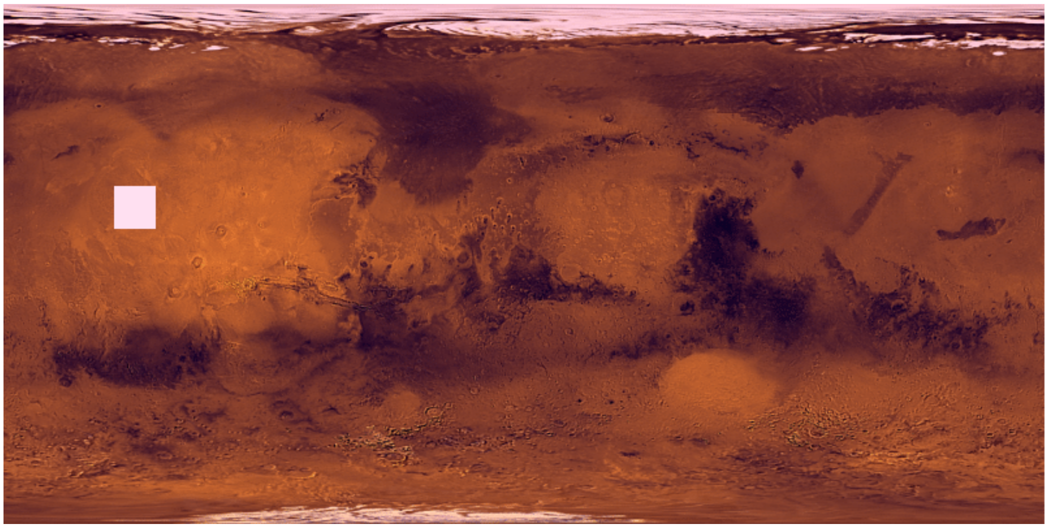
When the rising thunderclouds of the eye wall encounter the tropopause (at 13,500 meters) they are no longer buoyant and spread laterally. Some air flows downward into the center, dissipating clouds and forming the eye (seen in a close-up image). Most of the air flows outward, however, forming a circular cloud deck over the hurricane called the cirroform anvil.

Hurricanes can affect an area 600 kilometers wide. The general circulation in a hurricane is part of the mechanism that redistributes tropical heat from the ocean to the atmosphere and from the equator to the poles.

http://www.lpi.usra.edu/resources/stereo_atlas/HTDOCS/HURR.HTM



Olympus Mons, Tharsis Montes, Mars

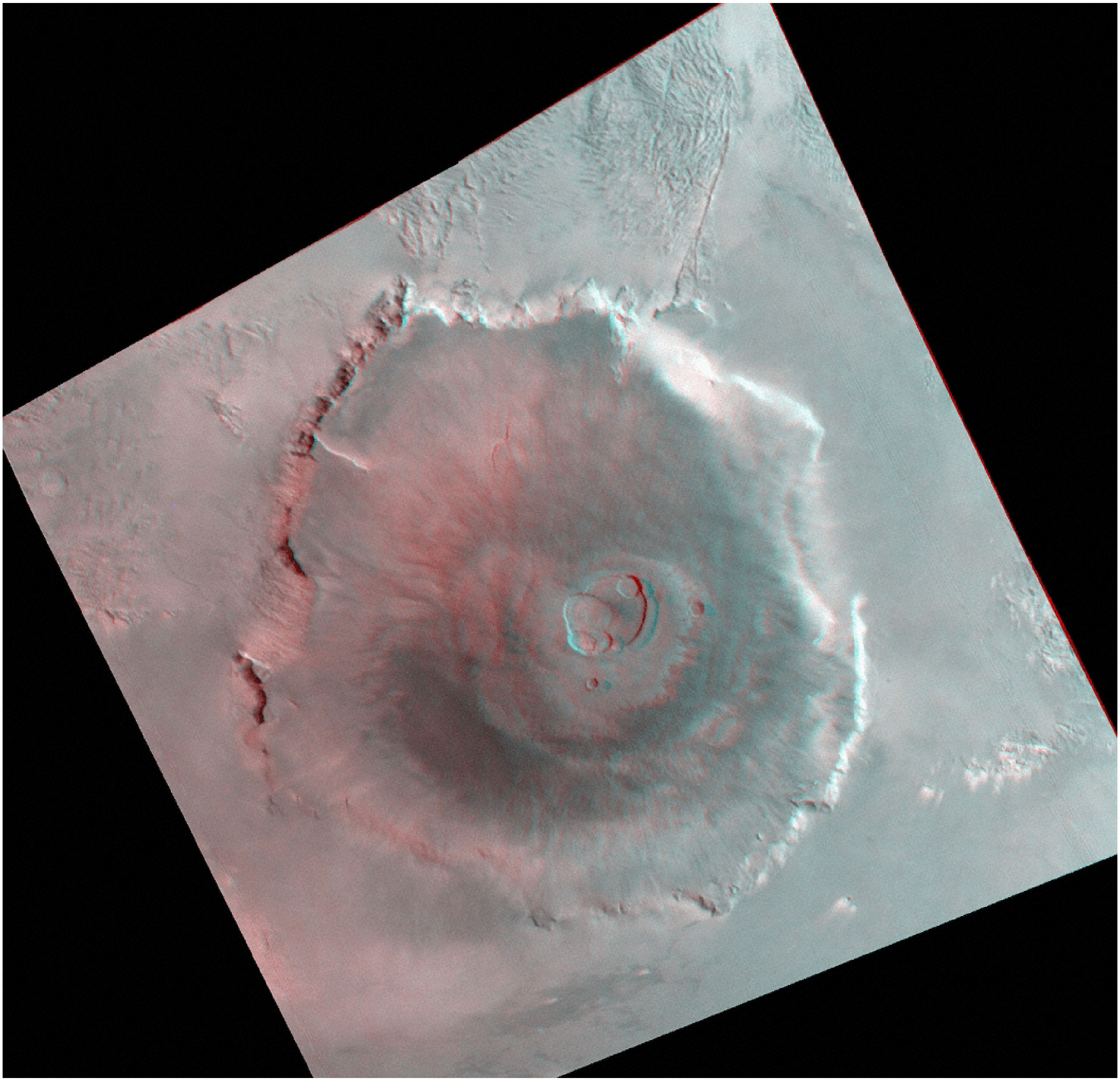


This Viking 3-D view features Olympus Mons, which is the largest of the more than 12 large volcanos in the Tharsis Montes volcanic province. Measuring 600 kilometers across and 21 kilometers high, Olympus Mons is also probably the largest volcano in the solar system. In contrast, the largest volcano on Earth, Mauna Loa, is 120 kilometers across and 9 kilometers high.

Olympus Mons is a classic broad shield volcano, with slopes averaging 4° and ranging up to 10°. The large complex summit caldera (shown in a close-up image) is 65 by 85 kilometers wide. The general characteristics of Olympus Mons resemble those of the great Hawai'ian volcanos and suggest that its lavas may be basaltic or basaltic andesite in composition. Volcanism in the Tharsis region has occurred throughout much of the history of Mars. The initial time of formation of Olympus Mons is not known. Some of the lava flows on Olympus Mons probably formed in the last 200 million years and are among the youngest features on Mars.

A nearly continuous scarp 2 to 10 kilometers high (shown in a close-up image) formed at the base of Olympus Mons. Beyond the scarp and surrounding the volcano on nearly all sides lie a series of quasicircular ridged deposits called aureoles (shown in a close-up image). The scarp and the aureole may be related.

http://www.lpi.usra.edu/resources/stereo_atlas/HTDOCS/OLYM.HTM



Inverness Corona, Miranda, Uranus

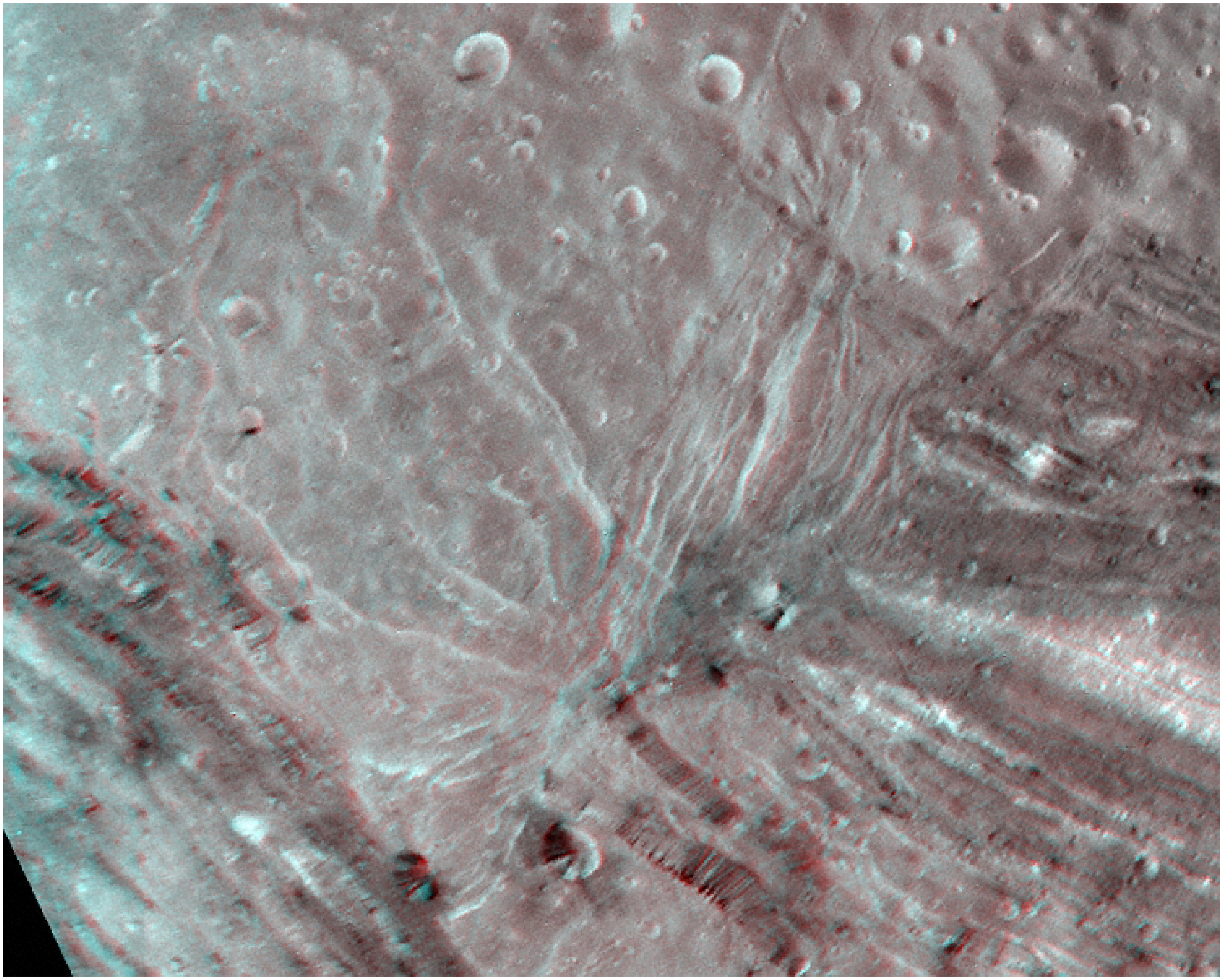
This Voyager 2 stereo view of the small icy Uranian satellite Miranda was obtained in 1986 and is probably the best stereo view of an icy satellite obtained during this mission. Despite its tiny size, only 470 kilometers across, Miranda has had a surprisingly diverse and complex geologic history.

Most of the interesting geologic features on Miranda are concentrated in three oval- to square-shaped regions called coronae. Coronae can be up to 300 kilometers across and consist of a central zone of chaotic ridges surrounded by a zone of concentric ridges and fractures. Ridges appear to be extensional faults in some areas and volcanic extrusions in other areas. These volcanic ridges may be composed of ammonia-water. One fault scarp (not shown here) is nearly 10 kilometers high.

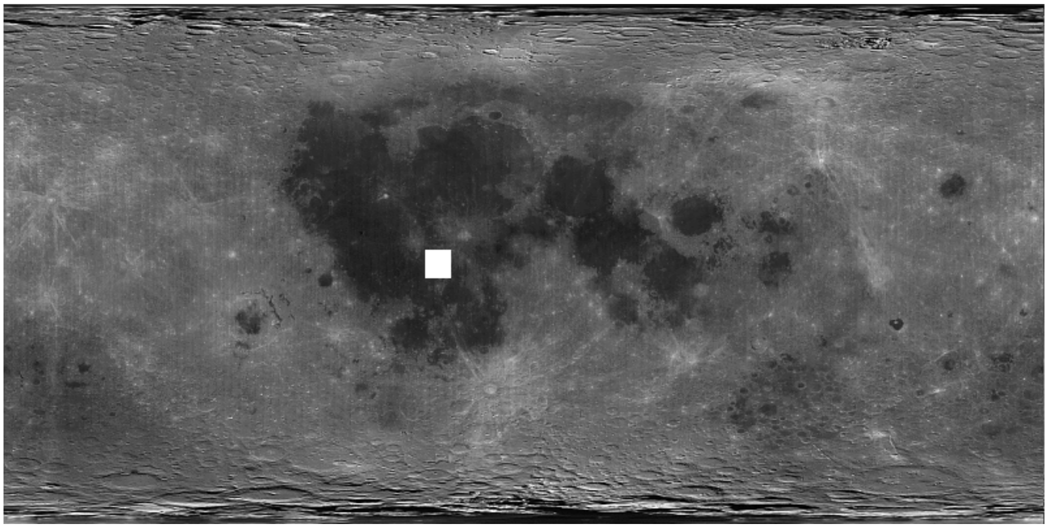
The concentric pattern of volcanism and tectonism within coronae suggest that they formed over plumes of material rising from the core of Miranda. These plumes spread out as they neared the surface, fracturing the crust and triggering local volcanism.

The geologic complexity of Miranda is puzzling because it should have been cold and quiescent (inactive) since shortly after its formation. The heat required to melt large parts of the interior may have been provided by tidal interactions with neighboring satellites and Uranus itself. Similar tidal heating powers the volcanos on Jupiter's moon Io (such as Prometheus) and may be responsible for the resurfacing of Ariel.

http://www.lpi.usra.edu/resources/stereo_atlas/HTDOCS/MIRA.HTM



Apollo 12 – Astronaut, Oceanus Procellarum, Moon

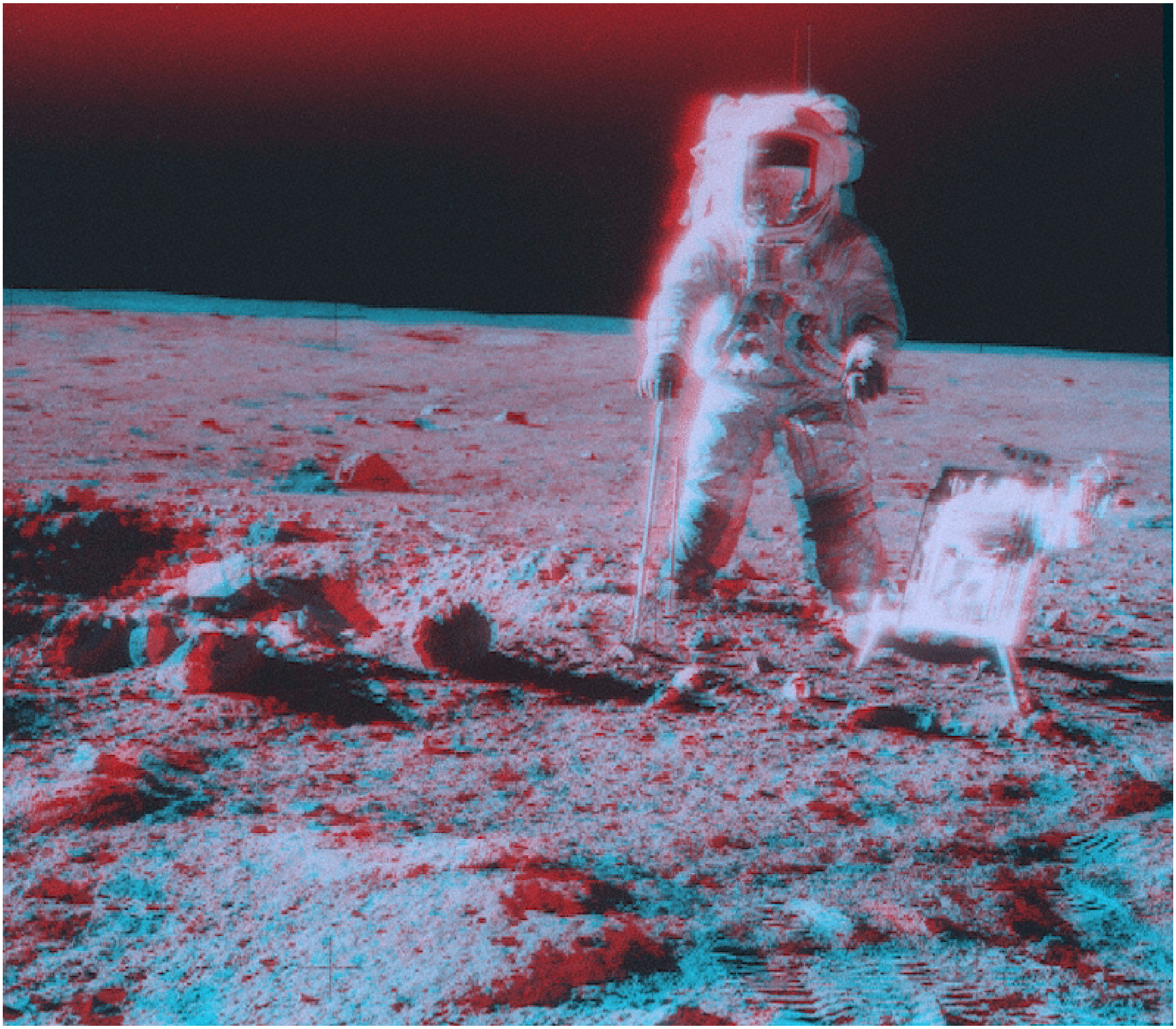


This 3-D view (obtained by Charles Conrad) features Apollo 12 astronaut Alan Bean performing scientific tasks on the Moon. Bean is holding a drill core tube used for extracting deep soil samples. The large square object at right is a tool carrier.

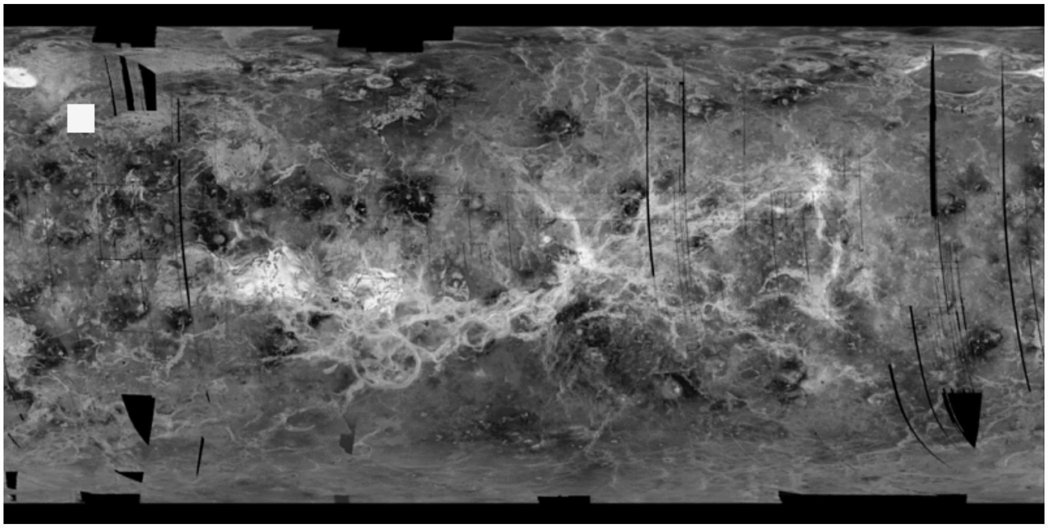
Apollo 12 landed in November 1969 in eastern Oceanus Procellarum, a basaltic lava plain that formed roughly 3.1 billion years ago. A small crater and several small boulders are visible at left.

Image numbers AS12-49-7318 and AS12-49-7319.

http://www.lpi.usra.edu/resources/stereo_atlas/HTDOCS/A2AS.HTM



Ridge Belt, Ishtar Terra, Venus

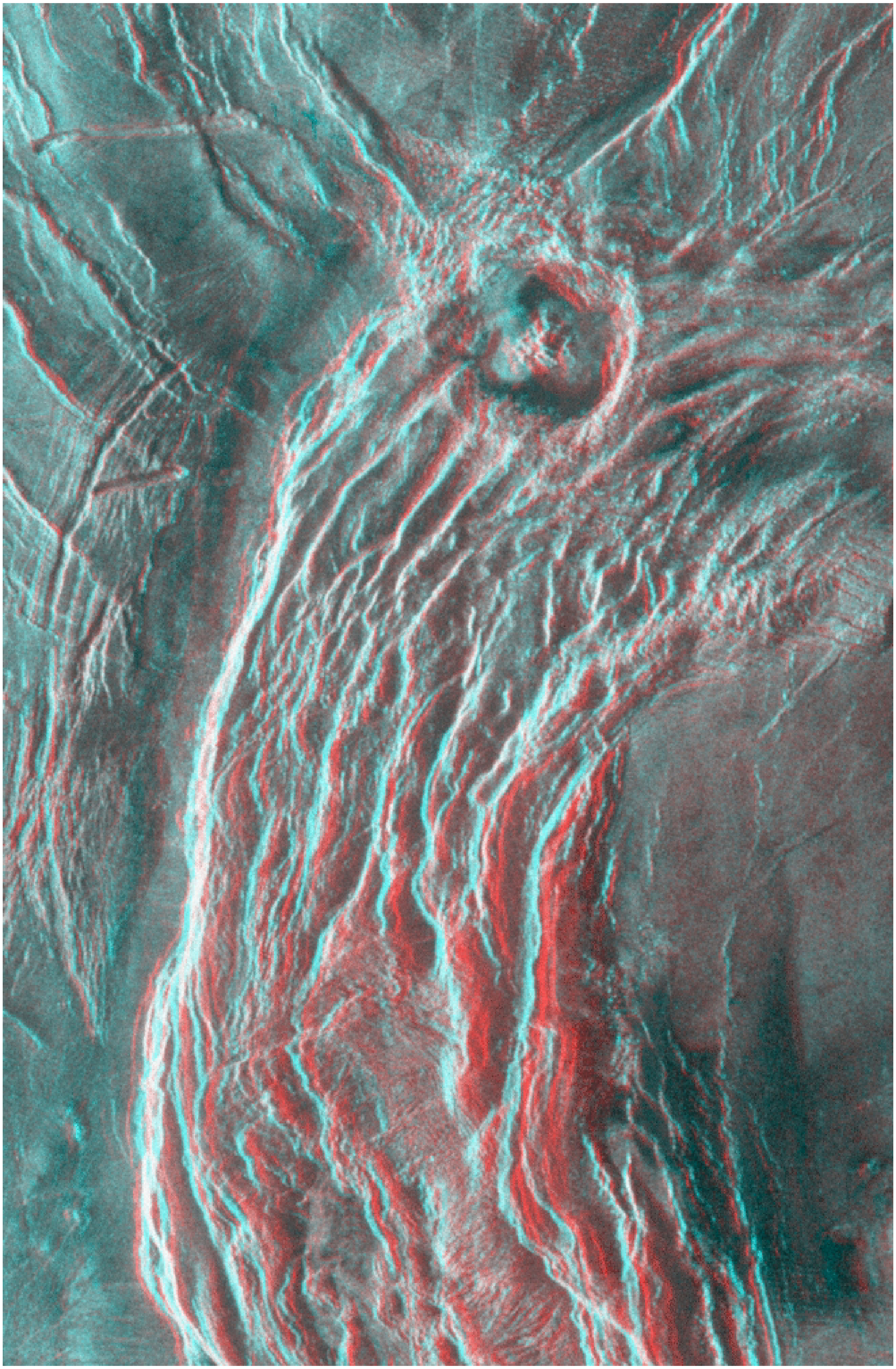


This Magellan stereo view of Venus shows a belt of prominent ridges near Laima Tessera. These ridges form a gentle topographic rise. They are part of a 600-kilometer-long, 100-kilometer-wide belt of closely spaced parallel ridges. The ridges are probably the traces of compression thrust faults, folds, or a combination of both. The origin of this compression is not well understood.

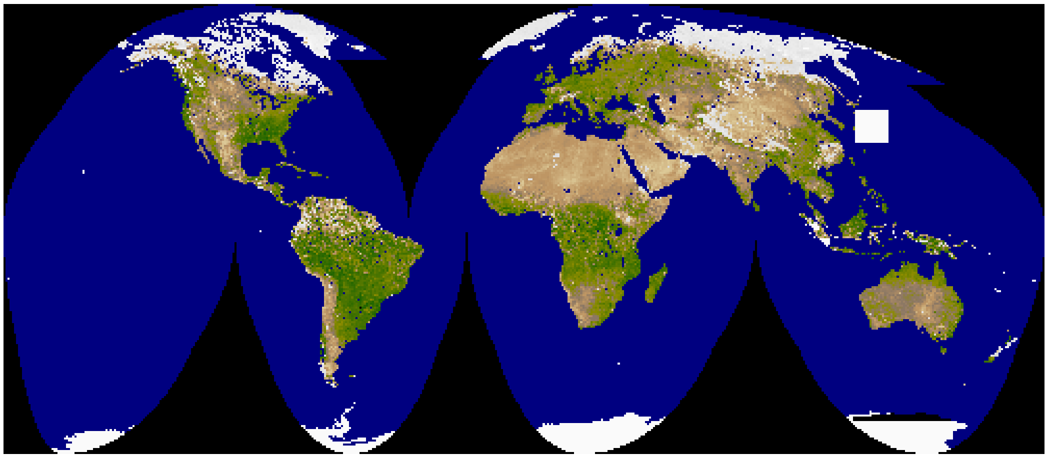
A set of narrow extensional graben (left) formed parallel to the ridge belt. Several ridges also extend westward perpendicular to the fold belt. These features probably formed in response to the stresses associated with formation of the ridge belt.

The 32-kilometer-wide impact crater (Geopert-Meyer) is typical of craters on Venus. A central peak and several terraces can be seen.

http://www.lpi.usra.edu/resources/stereo_atlas/HTDOCS/VCR1.HTM



Mount Fuji, Honshu, Japan, Earth



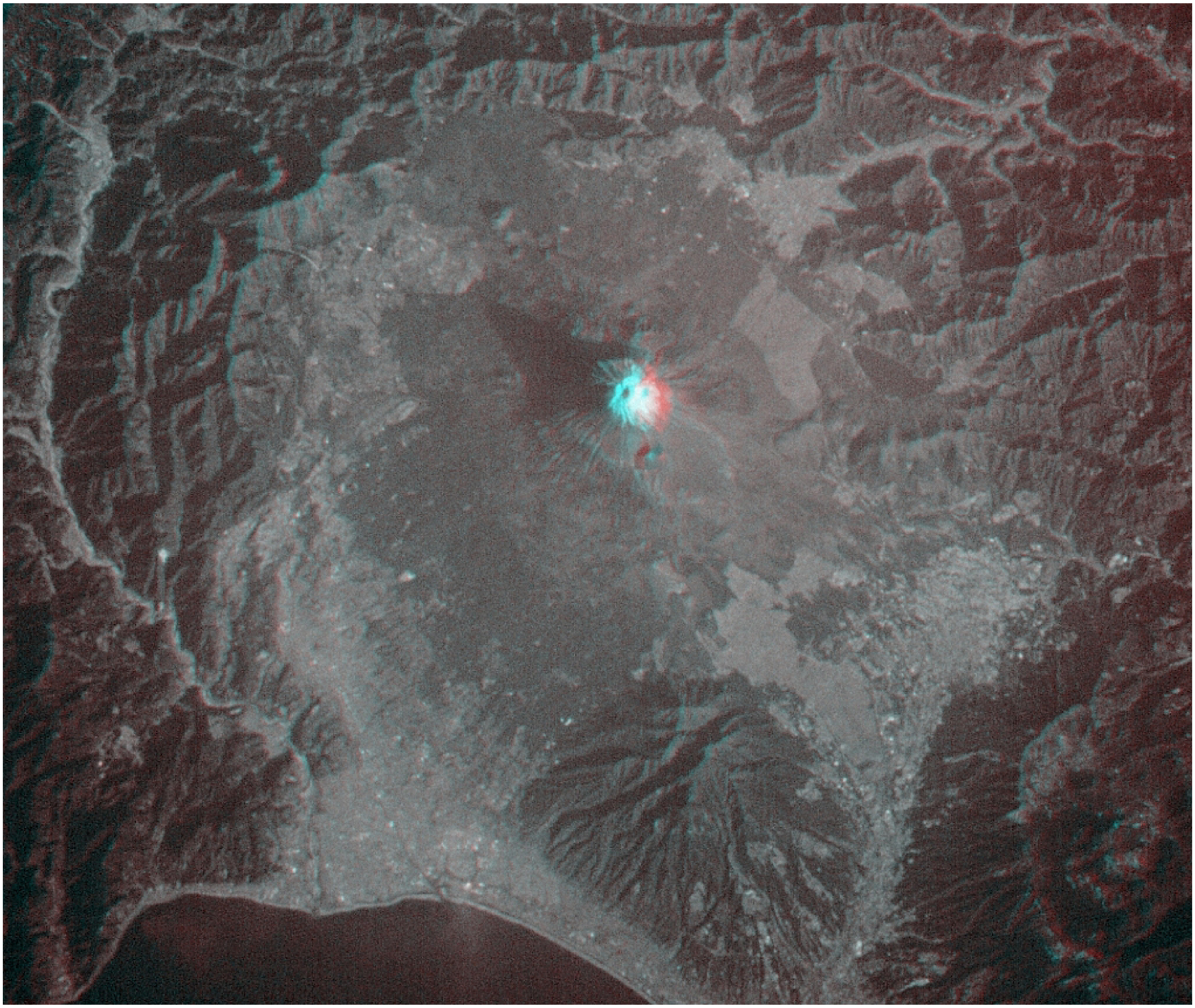
Mount Fuji (Fujiyama), on the island on Honshu, Japan, is a classic stratovolcano. This volcano reaches 3776 meters above sea level and is noted for its steeply sloping (35° near the summit) and symmetric profile. It is often called one of the most beautiful mountains in the world. Mount Fuji has a prominent summit crater and is constructed from innumerable basaltic lava flows, each a few meters thick. Mount Fuji last erupted in 1707.

The area near Mount Fuji has been volcanically active for a long time. Mount Fuji was built on top of the Pleistocene stratovolcano Komitake. The main eruptive phases that formed Fuji occurred 80,000 to 10,000 years ago, followed by another phase starting roughly 5000 years ago and continuing to the present. To the southeast of Mount Fuji is Hakone volcano, an extinct triple volcano that last erupted 5000 years ago.

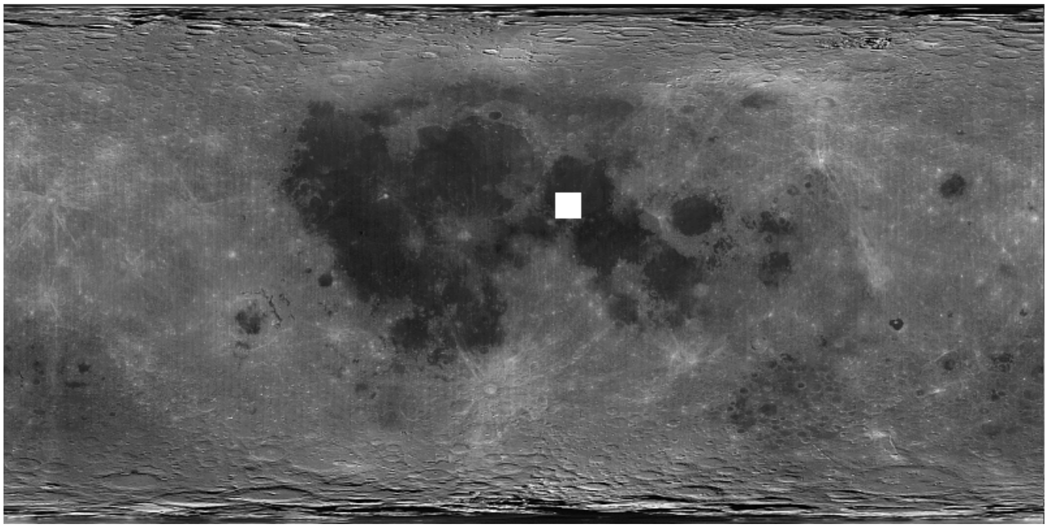
Mount Fuji is located on the Pacific Ring of Fire. Japan is a block of continental crust that was tectonically deformed in the Mesozoic era and broke away from the Asian continent in the Cenozoic era. Volcanism and tectonism continue today and trigger large earthquakes such as those that occurred in Tokyo (1923) and Kobe (1995). This activity results from the thrusting or subduction of the Pacific crustal plate beneath Japan (see Kurile-Kamchatka Trench). Melting of the descending crustal slab triggers volcanism in the overlying crust, in this case Japan. Mount Fuji and the surrounding volcanic complexes formed near the intersection of the Japan and Bonin subduction zones.

The steep, gullied, and forested hills surrounding Mount Fuji are characteristic of the terrain of Japan. These hills are too steep for agriculture and illustrate the difficulties posed for this densely populated island nation.

http://www.lpi.usra.edu/resources/stereo_atlas/HTDOCS/FUJI.HTM



Montes Haemus, Mare Serenitatis, Moon



This Apollo stereo view of the Serenitatis Basin illustrates the geologic diversity of the Moon. This region, known as Sulpicius Gallus, contains a variety of impact, volcanic, and tectonic features. Most noticeable is the boundary between the rugged highlands (the Montes Haemus) and the smooth basalt seen in Mare Serenitatis.

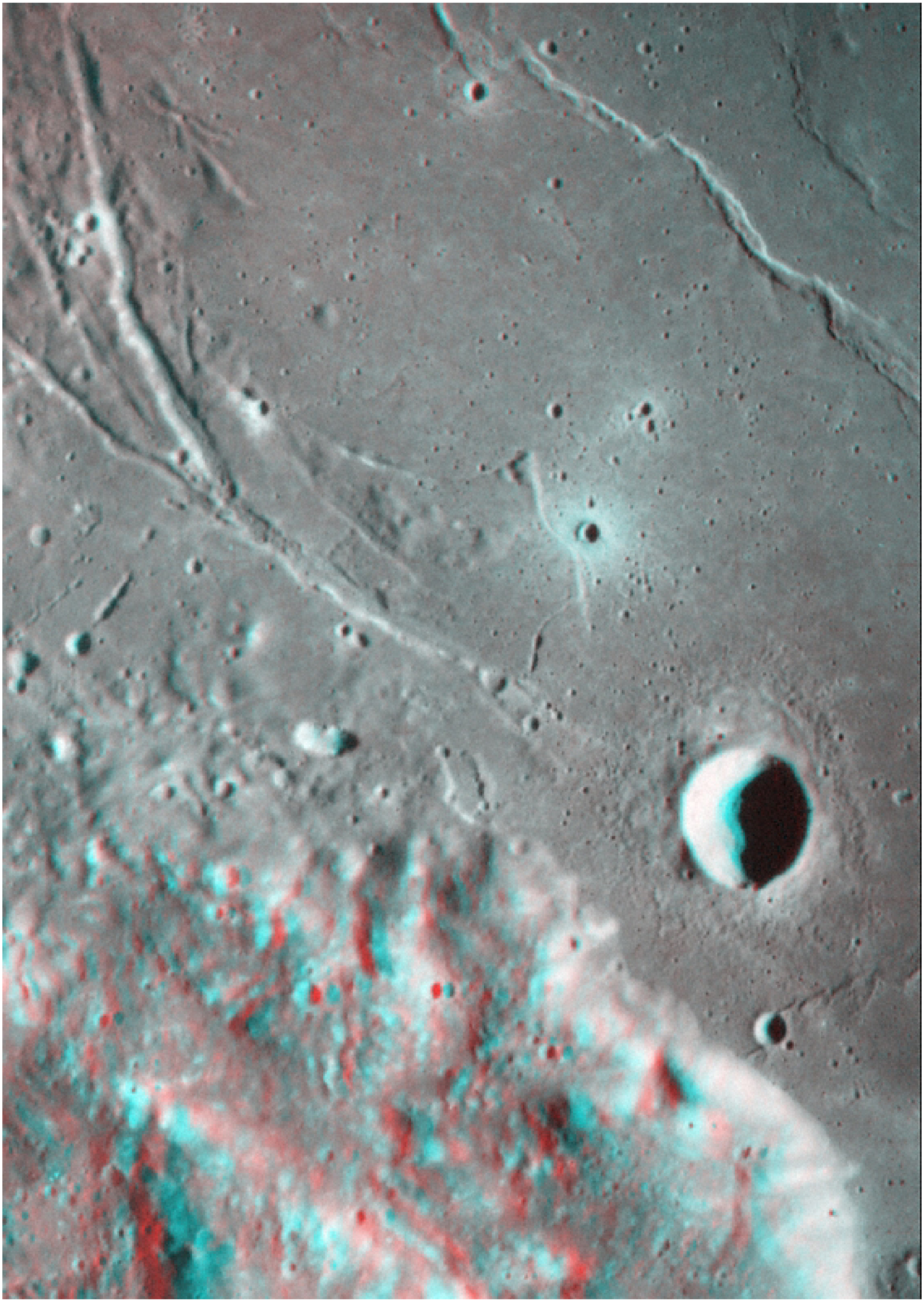
The Montes Haemus (more commonly referred to as the Haemus Mountains) are part of the prominent 740-kilometer-wide outer ring of the Serenitatis Basin. This basin formed 3.87 billion years ago when an asteroid 50 to 100 kilometers across slammed into the Moon. The Haemus Mountains are 2 to 3 kilometers high, but were probably 5 kilometers high before the basin was flooded by lava flows.

The Serenitatis Basin and most of its central structures were flooded by vast outpourings of basaltic lava after the basin formed (approximately 3.7 to 3.8 billion years ago). Several small volcanic pits can be seen along the edge of the mountains. These may have been source vents for some of the lava flows.

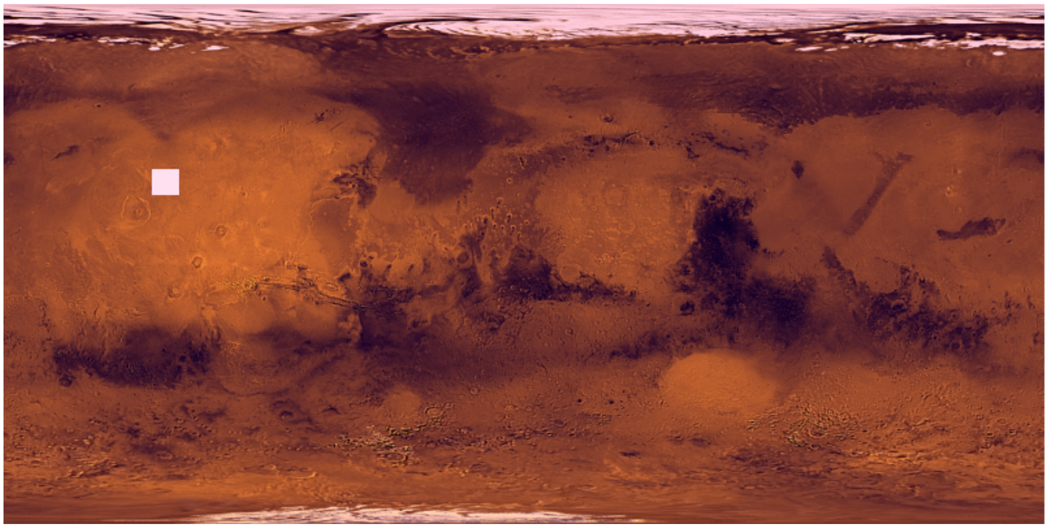
The great weight of the lava deposits caused the center of the basin to sag downward. This placed tensional stress on the outer part of the basin floor, forming a series of concentric fractures and graben called the Fossae Sulpicius Gallus. In contrast, concentric wrinkle ridges formed in response to compressional stresses closer to the center of the basin. They may have formed over buried basin ring structures.

Small impact craters have formed over the past 3 to 4 billion years. The largest of these, Sulpicius Gallus, is a simple bowl-shaped crater 12 kilometers across and 2.2 kilometers deep.

http://www.lpi.usra.edu/resources/stereo_atlas/HTDOCS/LSER.HTM



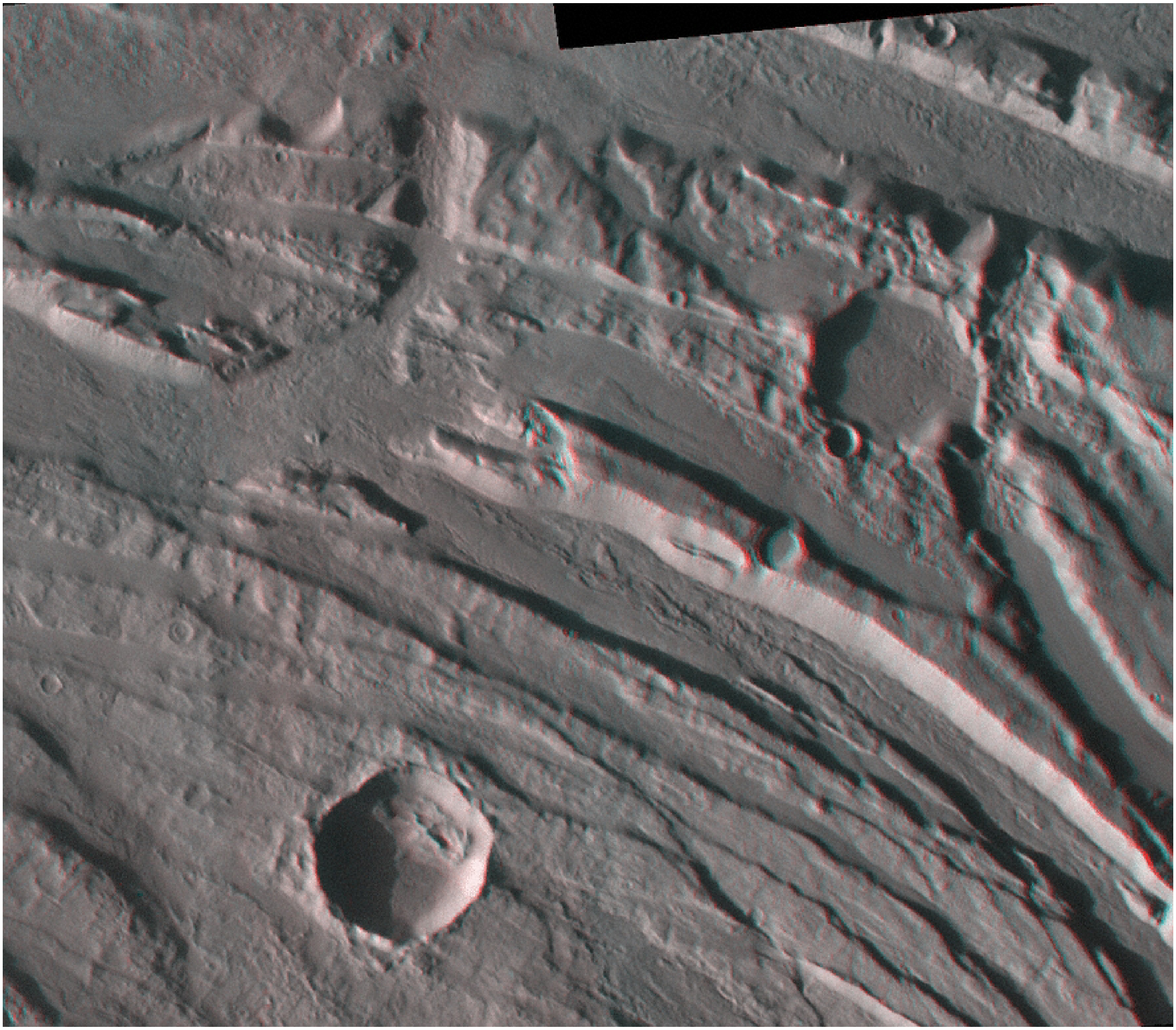
Acheron Fossae, Arcadia Planitia, Mars



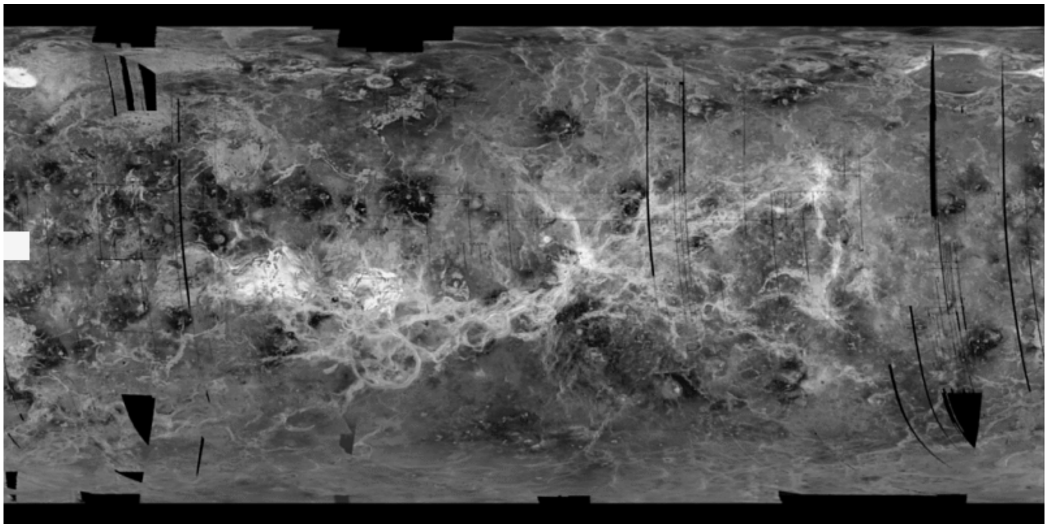
Acheron Fossae is a classic set of parallel fault-bounded valleys, or graben. Graben form when the crust is stretched and fractured. When two parallel faults form, the block of crust between them may drop down, forming a graben. The ridge between two faults is called a horst. The graben in this scene are typically 3 to 5 kilometers wide.

Acheron Fossae is located on the northern edge of the Tharsis plateau. It is part of a radial network of extensional fractures centered on Tharsis that formed when the plateau was uplifted. The uplift caused the crust over the plateau to fracture. A concentric set of fractures (shown at Thaumasia Fossae) formed later when the plateau became too massive and began to spread laterally.

http://www.lpi.usra.edu/resources/stereo_atlas/HTDOCS/ACHE.HTM



Carmenta Farra (Pancake Domes), Eistla Regio, Venus

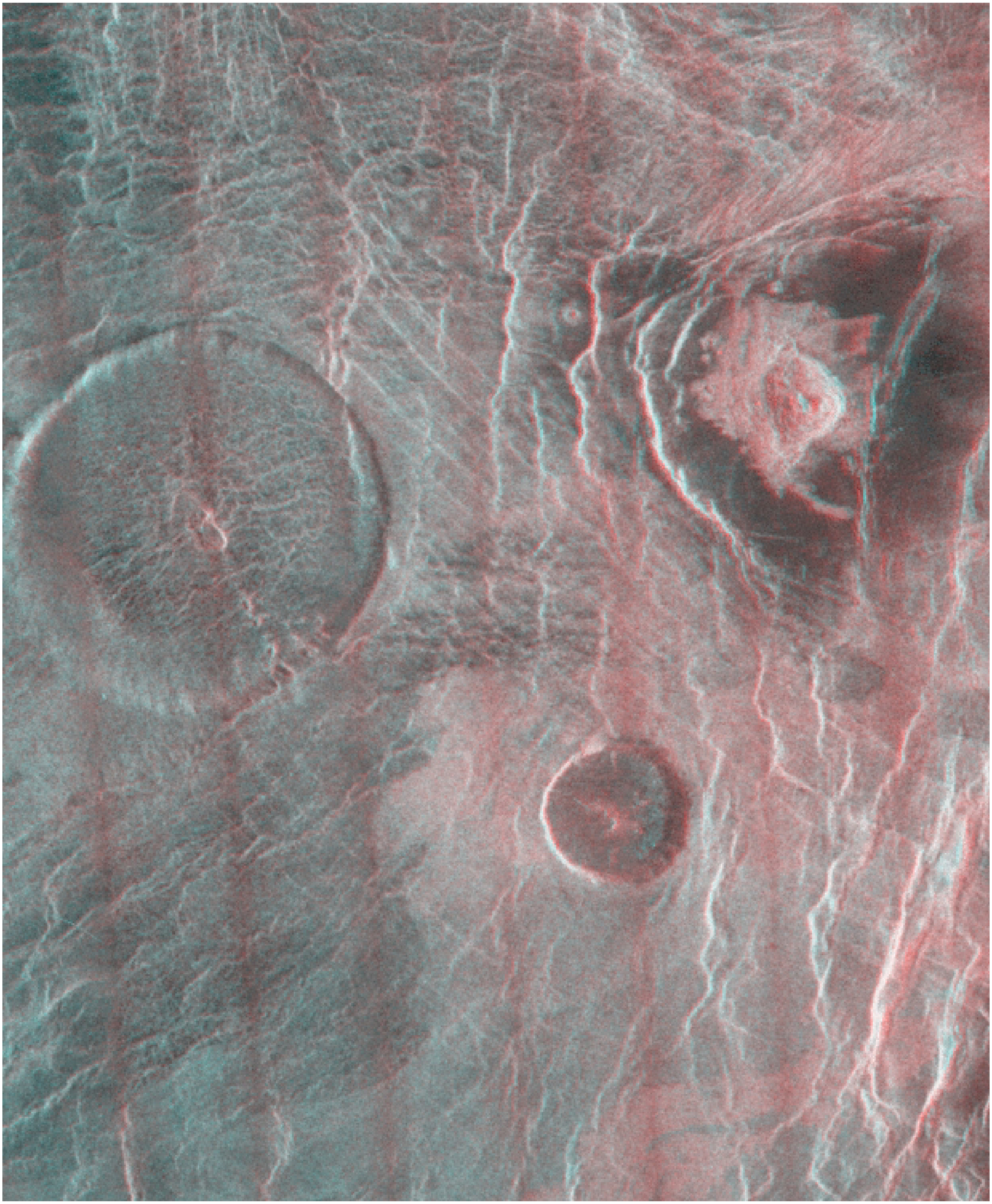


Among the unusual volcanic features observed on Venus by Magellan are these circular, flat-topped volcanic domes, called pancake domes. The largest of the domes in this scene is 65 kilometers across and roughly 1 kilometer high. This group of pancake domes is called Carmenta Farra.

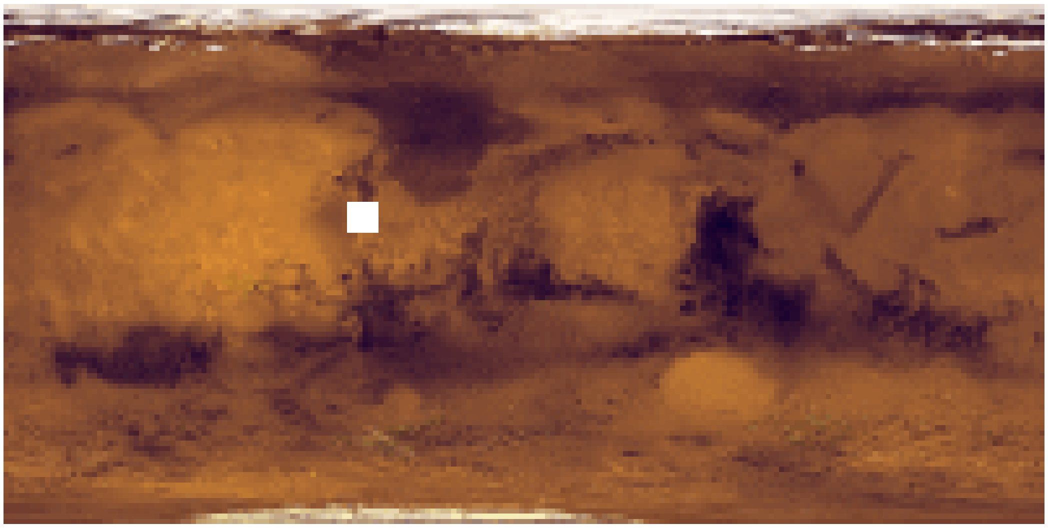
A small crater can be found near the center of each dome. This may be the source vent for the extrusion. The center of the largest dome appears to be depressed below the elevation of the margin of the dome. Although the volcano may have once had a flat top, the weight of the volcano pushes down on the crust. The resulting collapse produces the observed depression in the center of the crater.

Although the composition of the these domes is not known, their unusual morphology suggests that they may have a different composition than shield volcanos (like Kunapipi) on Venus. The unusual thickness of these flows indicates they are stickier or more viscous than ordinary basalt. On Earth, thicker lava flows, such as those found at Mono Craters, are usually associated with lavas richer in silica, such as dacite or rhyolite. Whether this is true on Venus as well is not known. These domes could also be explained by basalt erupting at unusually slow rates.

http://www.lpi.usra.edu/resources/stereo_atlas/HTDOCS/VPAN.HTM



Vedra Valles, Lunae Planum, Mars

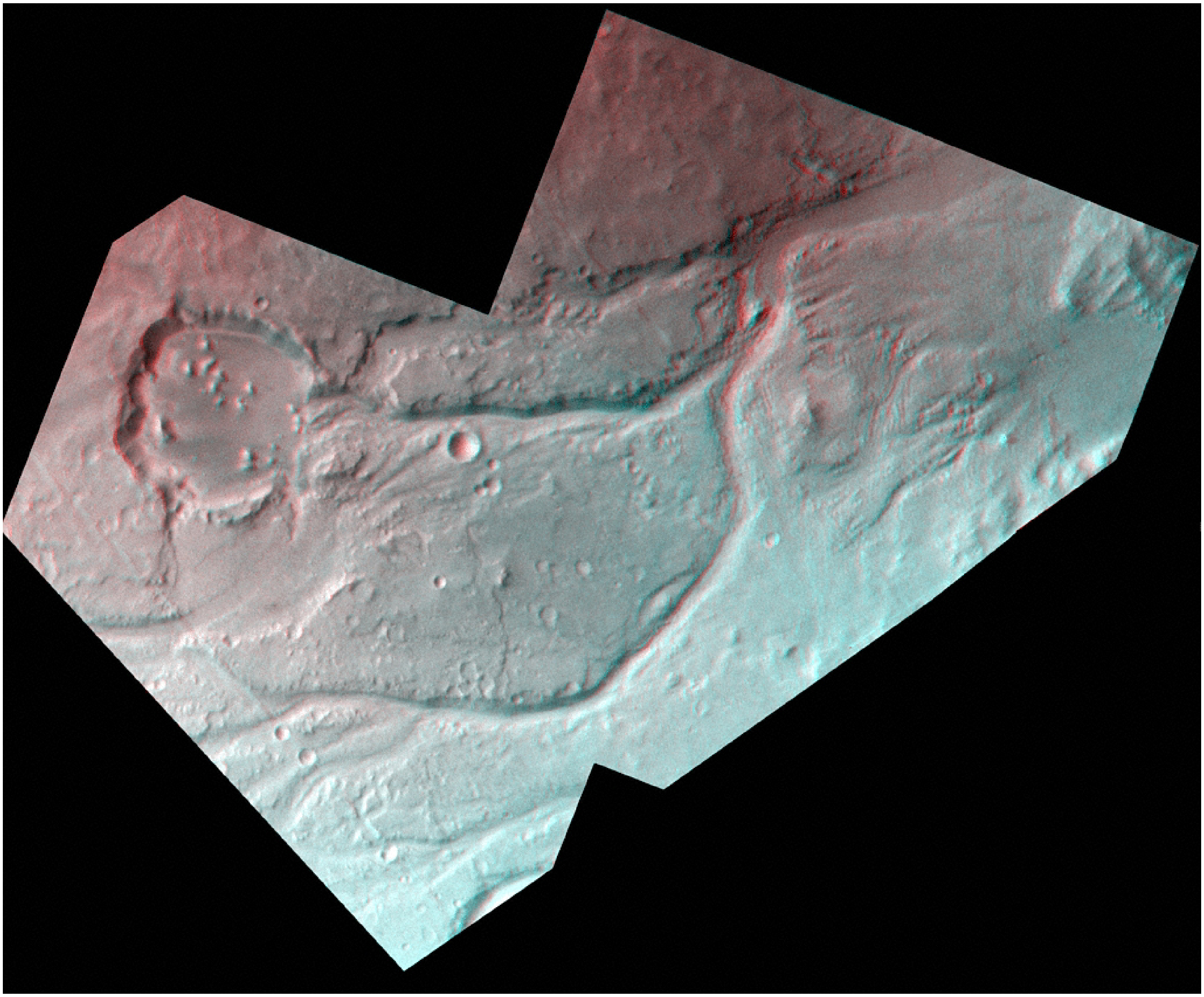


This Viking 3-D view shows Vedra Valles, a group of now dry outwash channels that once flowed eastward into the giant Chryse Basin on Mars. Similar channels, including Ares Vallis, surround Chryse. These channels were carved by running water in a period when Mars was capable of sustaining liquid water on its surface. The Viking 1 landing site is located roughly 400 kilometers east of Vedra Valles.

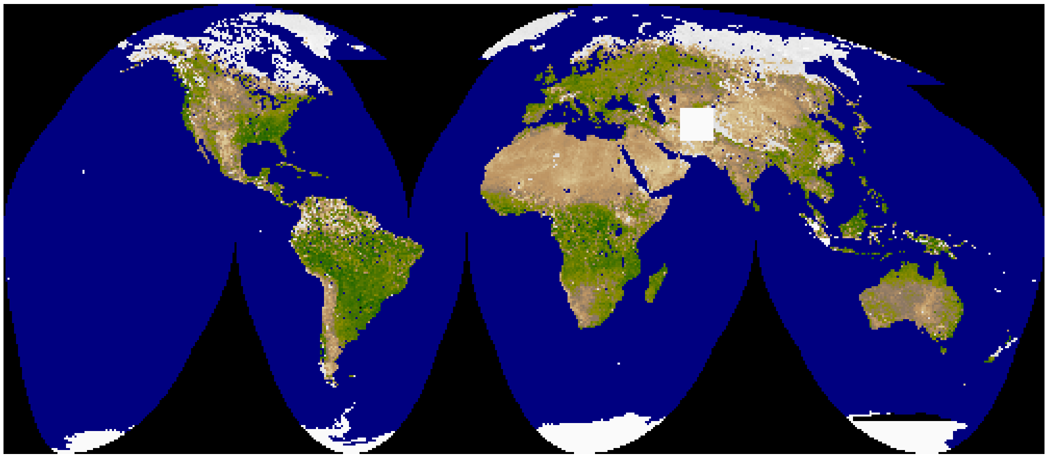
The waters that carved Vedra Valles originated 1200 kilometers to the south in Juventae Chasma, which is part of the Valles Marineris canyon system. Many of these waters flowed into nearby Maja Vallis, but some were diverted into Vedra Valles. The deep channels seen here were carved through the rim of the Chryse basin.

These channels are estimated to be 200 to 300 meters deep. A sequence of channels can be identified. Older channels were abandoned and new channels cut. Water from one set of channels breached a 12-kilometer-wide impact crater (center left), forming a large lake. A series of impressive cataracts mark the breach. The smooth floor may be lake sediment.

http://www.lpi.usra.edu/resources/stereo_atlas/HTDOCS/VEDR.HTM



Darya-Ye Sut, Afghanistan, Earth



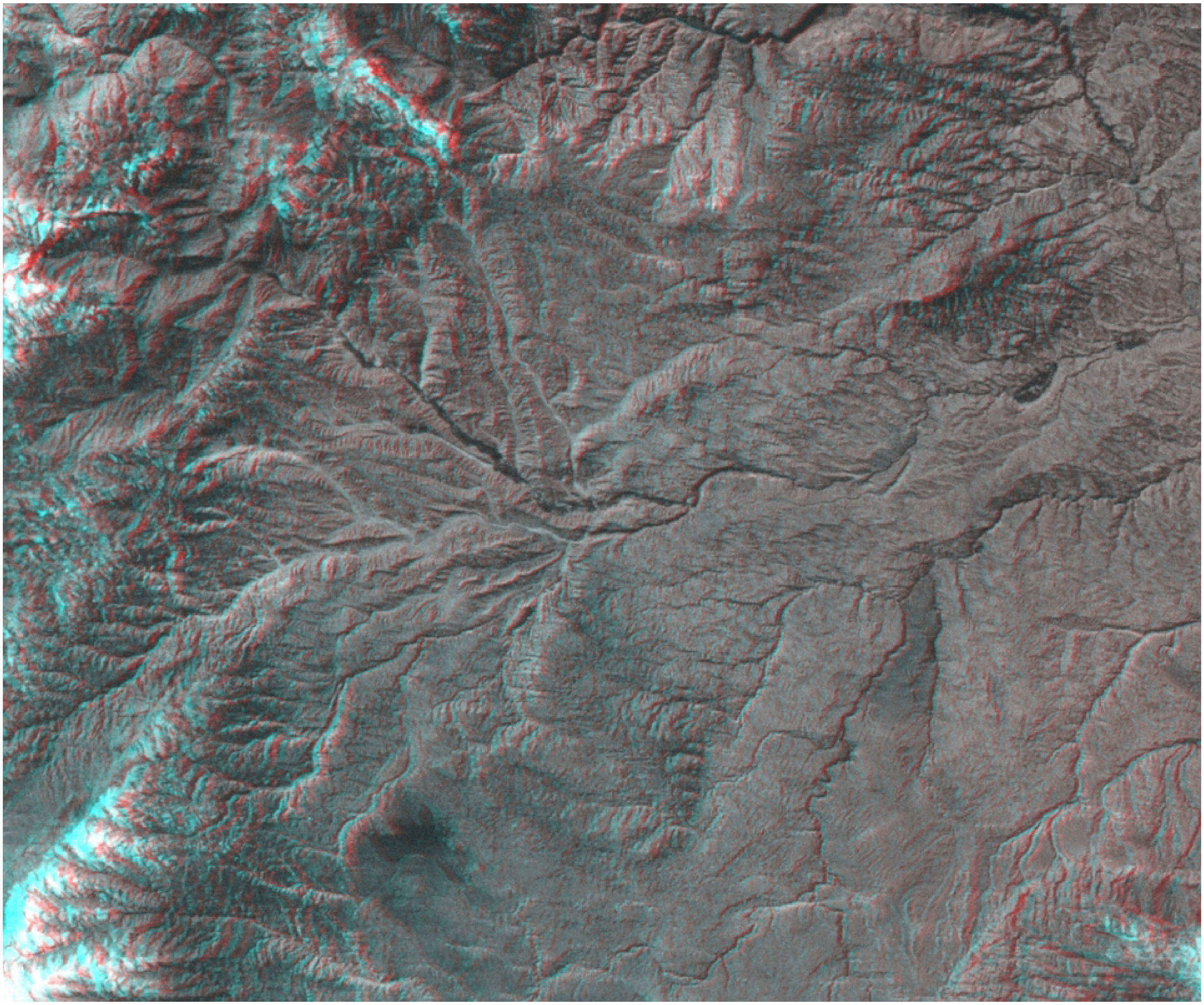
The fan-shaped river system in the center of the scene is the Darya-Ye Sut. This river lies on the northern flank of the Hindu Kush mountain range of northern Afghanistan and empties into the Amu Darya, which in turn flows to the Aral Sea. The different drainage patterns in this area are created as water erodes rocks of different hardness and slope.

The Darya-Ye Sut has developed a parallel drainage pattern, with streams flowing in one or two general directions. This pattern formed in erosion-resistant but fractured Neogene to Pleistocene sandstones, conglomerates, and siltstones. Parallel drainage patterns tend to develop on steep slopes or on rocks that have been fractured in one or two particular directions. This drainage pattern bears a resemblance to some channel networks on Mars, such as the Warrego Valles.

Dendritic drainage patterns, like those to the north (right), formed on less-resistant Cretaceous limestones and on shallower slopes. Unlike the rocks to the south, there is no dominant fracture pattern in the rocks in this area.

The 800-kilometer-long Hindu Kush range reaches elevations of 7000 meters or more. The Hindu Kush formed during the collision between the Indian and the Eurasian plates. The collision also formed the Himalayan Mountains, and the Kirthar and Sulaiman Ranges of Pakistan. Some of the numerous faults in this tectonically active area control the locations of rivers in the area.

http://www.lpi.usra.edu/resources/stereo_atlas/HTDOCS/AFGA.HTM



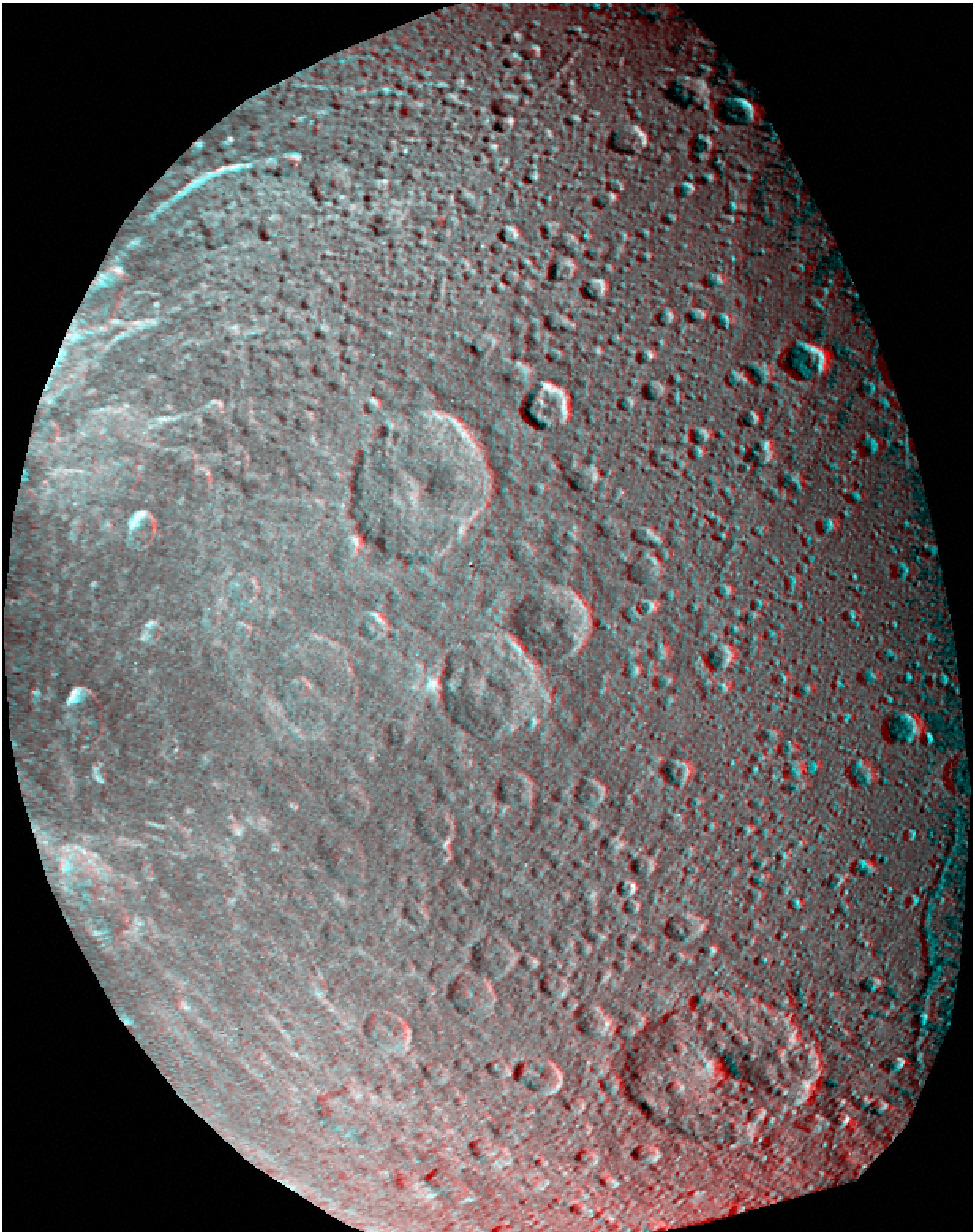
Aeneas Region, Dione, Saturn

This Voyager 2 stereo image shows a large portion of Saturn's small icy satellite Dione. Although somewhat similar in appearance to Rhea, Dione has had a more complex geologic history than Rhea.

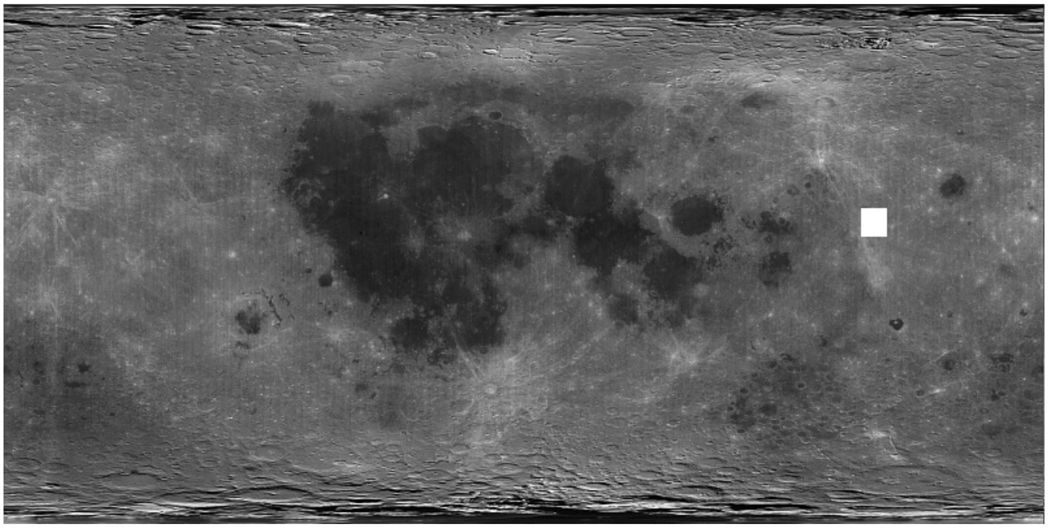
Heavily cratered terrains (right) are the oldest surfaces on Dione. These surfaces resemble Rhea. This terrain is crossed by a network of bright lineaments, a few of which are visible at upper right. These appear to be extensional fractures formed when the interior of Dione expanded by a few percent, stretching and fracturing the outer crust.

Areas of relatively smooth and lightly cratered plains occur to the east (left in this view) of the cratered plains. These plains have apparently been covered by lava flows, although some impact craters have also formed on this terrain. The composition of these flows is not known, but they may have been composed of water or ammonia-water mixtures. Enceladus, an even smaller satellite of Saturn, has been even more heavily resurfaced by icy lava flows. These flows may be composed of ammonia-water mixtures.

http://www.lpi.usra.edu/resources/stereo_atlas/HTDOCS/DION.HTM



King Crater (Overview), Farside Terra, Moon



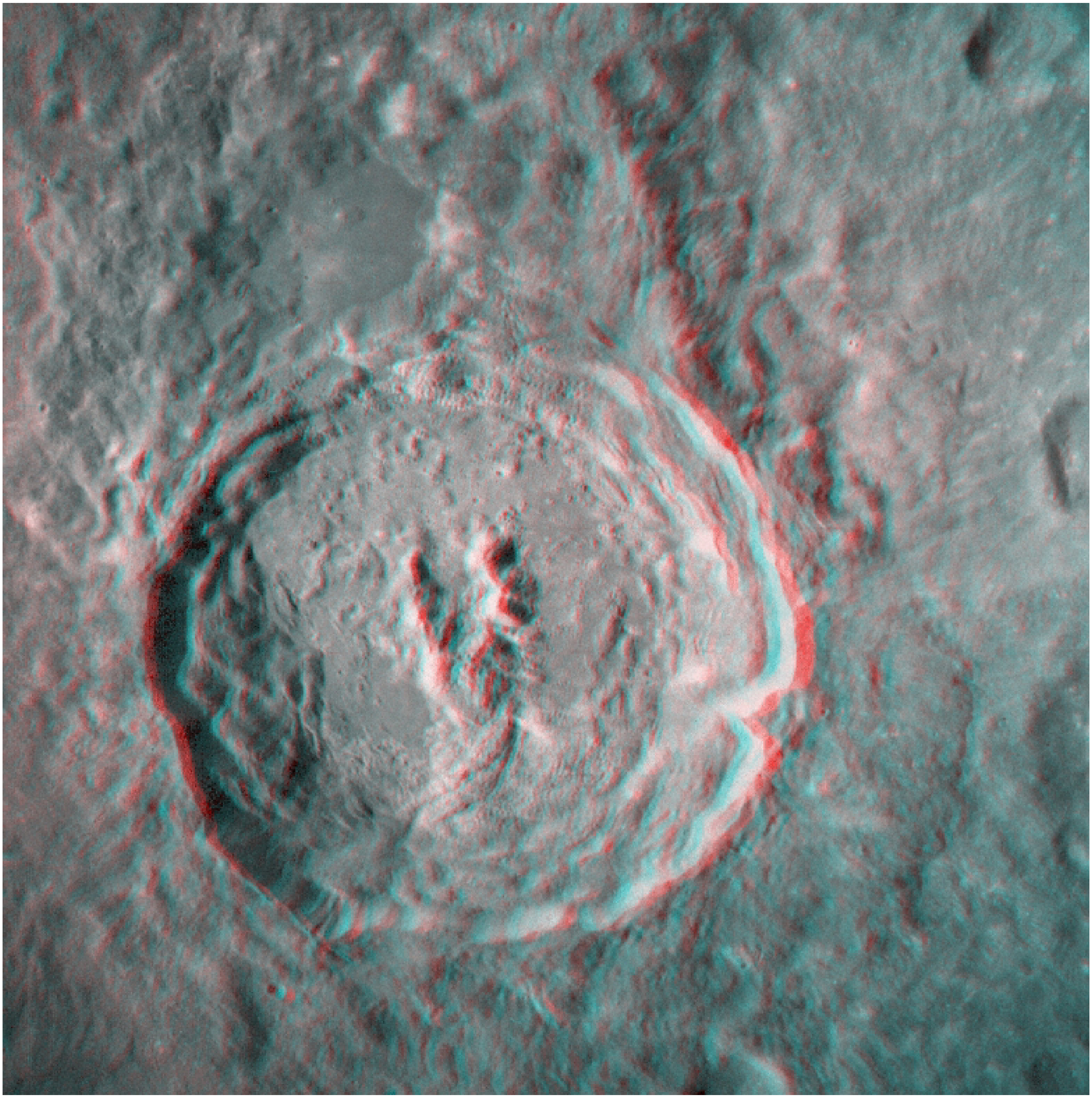
This Apollo stereo view shows the large impact crater King, formed by the impact of an asteroid (or comet) onto the lunar surface. King is 76 kilometers across and 5 to 5.5 kilometers deep.

King is a classic complex crater. The central peak of such a large crater can be conical in shape or may be a cluster of peaks. In King, the central peak complex is a massif 20 kilometers wide and 1.5 to 2.5 kilometers high. A large notch or gap occurs in the northern side. Slumping along the interior of the crater rim has formed a series of step-like terraces 3 to 4 kilometers wide. Terraces form when crater walls become too steep, causing the crater rim to slump.

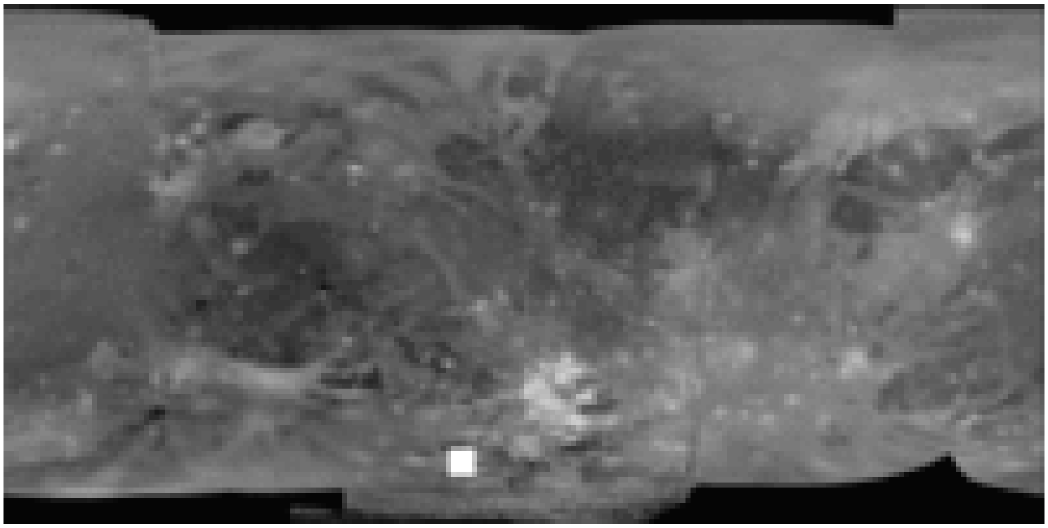
In larger craters, the tremendous heat and pressures of impact melt large quantities of rock. This melted rock pooled in the bottom of King Crater, forming a melt sheet that slowly solidifies. Melt was also blasted out with the ejecta. Several large pools of impact melt can also be seen in a depression north of King. The largest of these pools is directly north of the crater and is 20 kilometers across.

Additional detail can be seen in close-up views of the central peak region and ejecta deposits.

http://www.lpi.usra.edu/resources/stereo_atlas/HTDOCS/LKIN.HTM



Isis, Ganymede, Jupiter



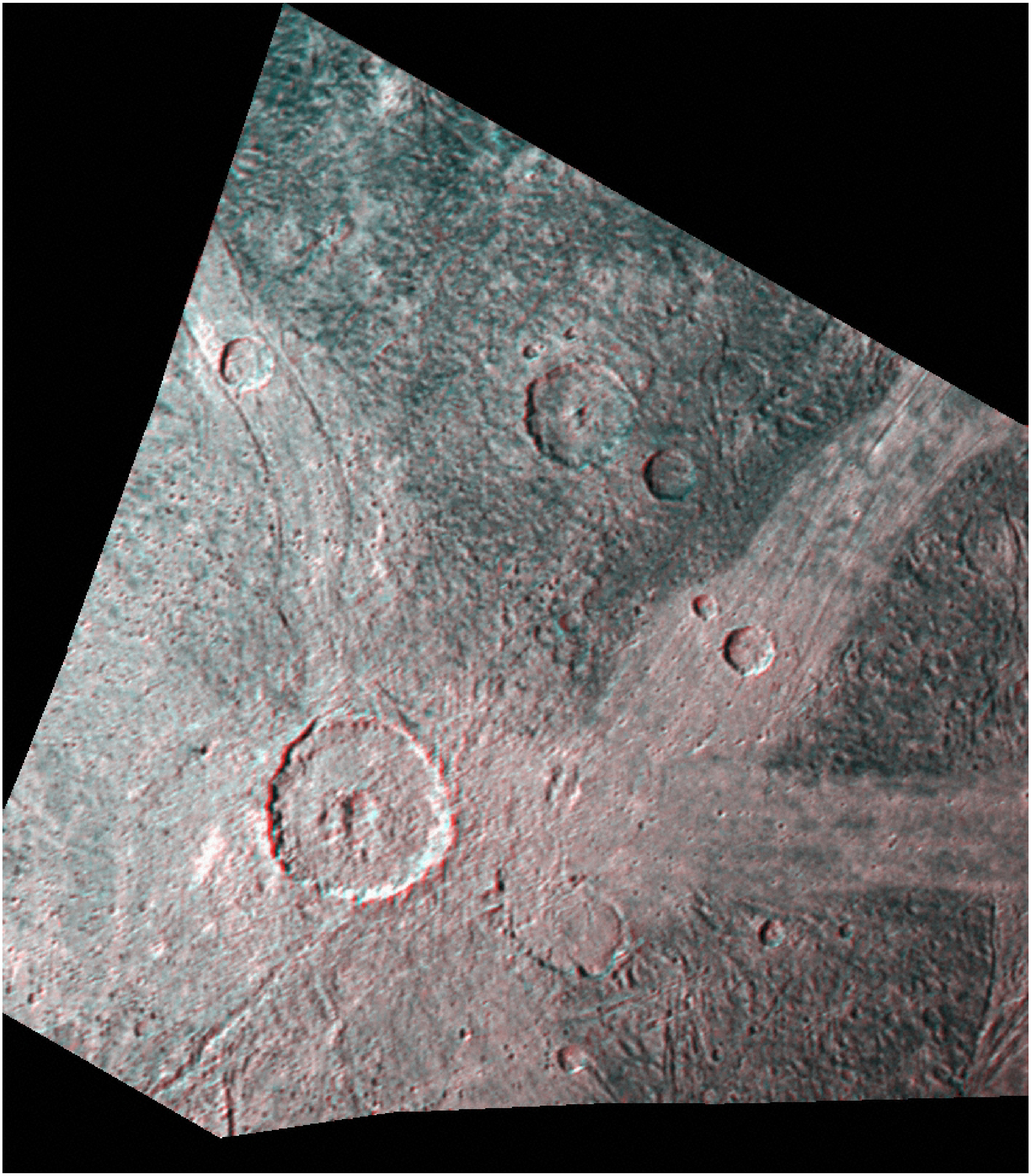
This Voyager 2 stereo image of Jupiter's large icy moon Ganymede features the central pit crater Isis, as well as the two main geologic terrain types seen on Ganymede. Isis is 75 kilometers wide and roughly 2 kilometers deep. Central pit craters are seen in abundance only on the large icy satellites Ganymede and Callisto and are sometimes observed on Mars (at Ophir Planum).

Central pit craters differ from complex (or central peak) craters on the Moon, Mars, and Venus, because the conical central peak has been replaced by a small rimmed depression. The origin of central pits is not understood. Central peaks form when the floor of the crater rebounds upward during crater formation. The subsurface geology on Ganymede and Callisto (and parts of Mars) may differ from that of the Moon, preventing or destroying a central peak as it forms.

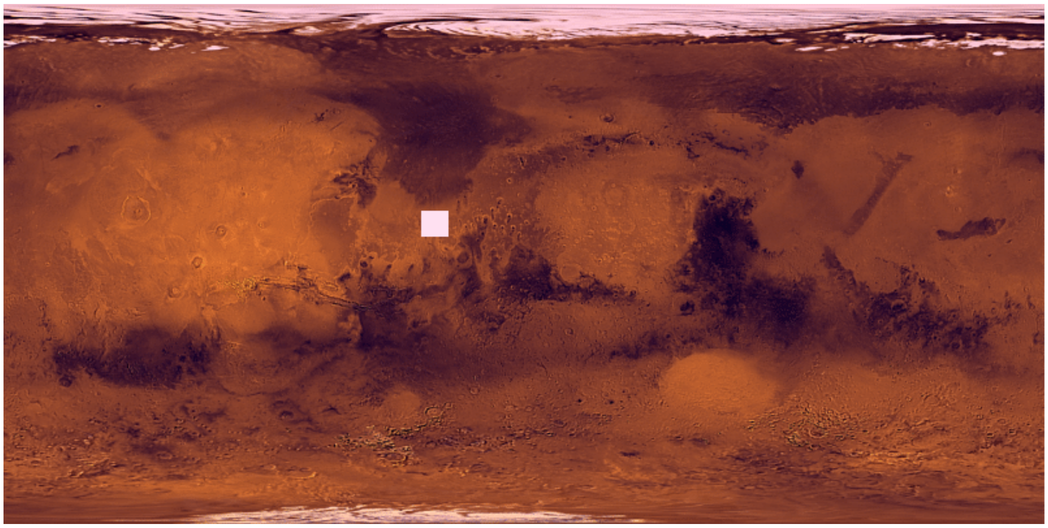
Ganymede is roughly evenly divided between dark terrain (the triangular-shaped regions) and swaths of bright terrain. Dark terrain is older and more heavily cratered than bright terrain. Bright terrain probably formed in extensional graben, which have been partially filled with bright material. This bright material may be lava flows composed of water. In some areas, bright terrain is depressed roughly 500 meters below the elevation of dark terrain.

Topographic relief on Ganymede, including the largest impact basins, rarely exceeds 2 kilometers. In contrast, the largest impact basins on the Moon are 12 kilometers deep. The low relief on Ganymede is probably related to the ice-rich composition of Ganymede's outer layers. Ice is much weaker than ordinary rock and cannot support high topography.

http://www.lpi.usra.edu/resources/stereo_atlas/HTDOCS/ISIS.HTM



Mars Pathfinder Landing Site (Sojourner), Ares Vallis, Mars



This 3-D view of the surface of Mars was obtained by Mars Pathfinder, which landed on Mars on July 4, 1997. Visible in this scene is the microrover Sojourner, shortly after it rolled onto the martian surface. Sojourner is 63 centimeters long. The ramp used by the rover to move onto the surface is visible in the foreground.

Also visible are a variety of rocks, including "Barnacle Bill," adjacent to Sojourner. Barnacle Bill was the first rock analyzed by the rover. The largest rock in the scene is "Yogi," which is 1 to 2 meters across.

The Mars Pathfinder landing site is at the mouth of Ares Vallis, a large outflow channel that emptied into the Chryse Basin. (See the Ares Vallis 3-D page for more images and information on Ares Vallis.) Vast floodwaters poured over this site several billion years ago.

(The apparent offsets within the scene, including one of the rover wheels, are artifacts created when the mosaic was assembled shortly after landing.)

http://www.lpi.usra.edu/resources/stereo_atlas/HTDOCS/MPF1.HTM