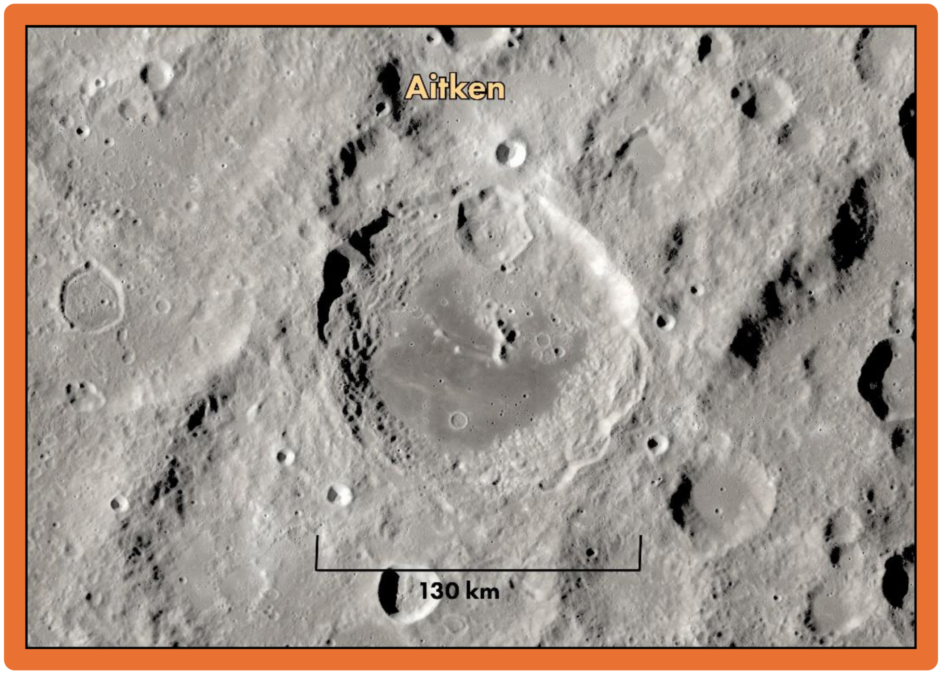
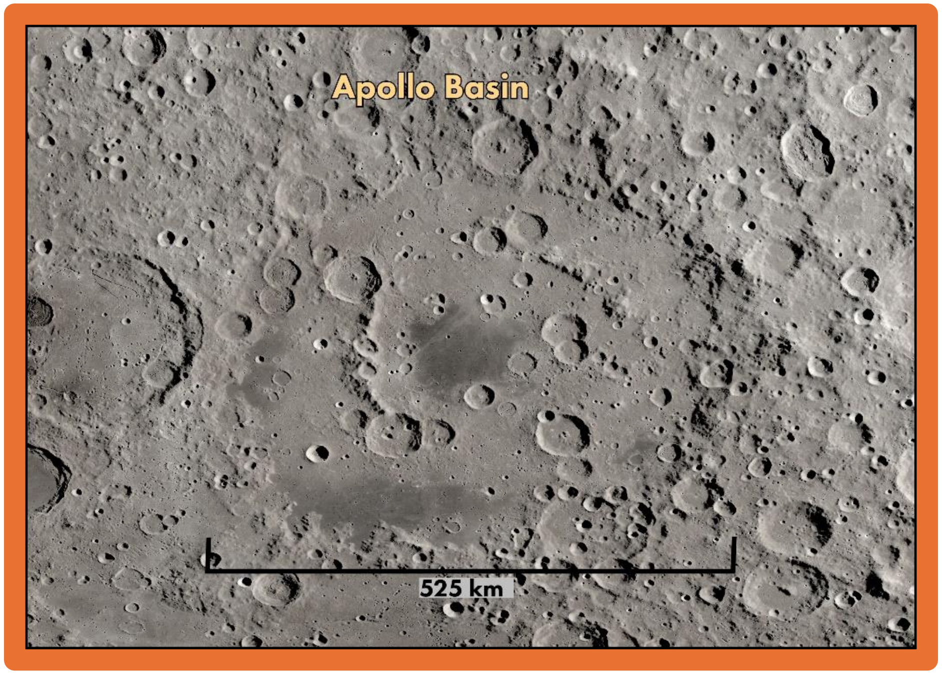

Aitken
130 km


Apollo Basin
525 km

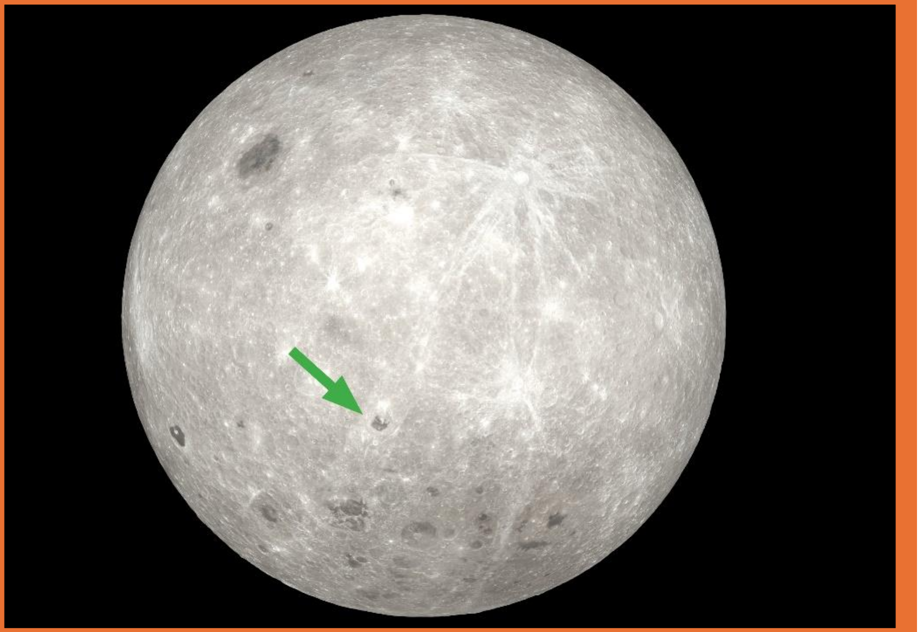
Aitken

Description: Aitken is a complex crater that lies along the northern rim of the South Pole–Aitken Basin. The central peak of Aitken crater towers approximately 1 km above the crater floor. Aitken dates to the Imbrian period (~3.85 to 3.2 billion years ago), which is characterized by extensive volcanism and the formation of mare, contributing to mare emplacement on its floor. Aitken's mare patch contains high albedo swirls in its southern area.

Orbital Observations: Descriptions of mare color and albedo in Aitken will reveal the interior composition and possible buried magnetized sources. Of particular interest are the swirl boundaries—are they sharp or gradational, and do they follow topography?

Morphology and stratigraphy of crater rims, along with the color and albedo of material on crater peaks and floors, will inform impact mechanics, material transport, and crustal layering.

Part of the "Lunar Fifteen"*; Image credit: NASA/GSFC/ASU*



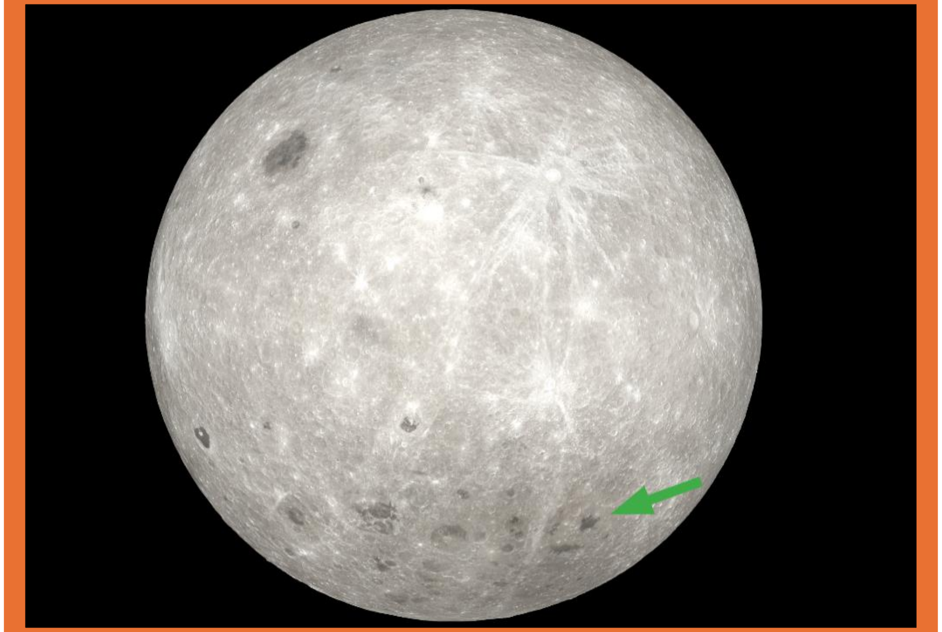
Apollo Basin

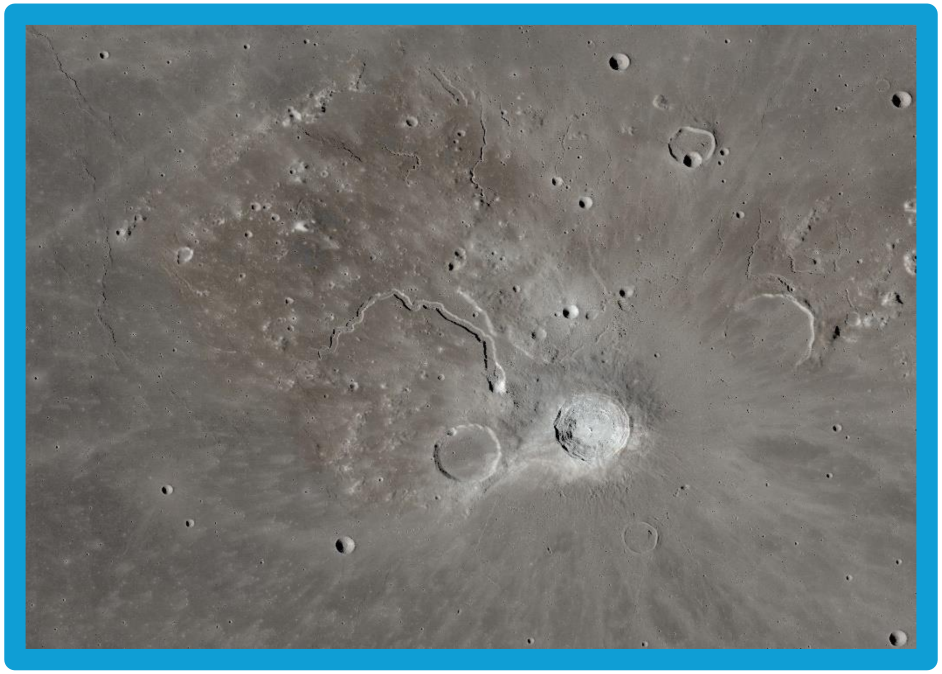
Description: Apollo Basin is a double-ringed impact basin located in the northern region of the South Pole-Aitken (SPA) Basin. It is characterized by blocky and mountainous terrain. Volcanic resurfacing postdated impact formation, which is evident by mare infill on its floor. The impact that formed the basin was powerful enough to excavate layers from the Moon's upper mantle, deposited earlier by the SPA Basin impact. Instruments have detected mafic signatures consistent with SPA Basin ejecta, indicating that SPA-derived materials may be present in Apollo Basin and making it a compelling target for future scientific exploration.

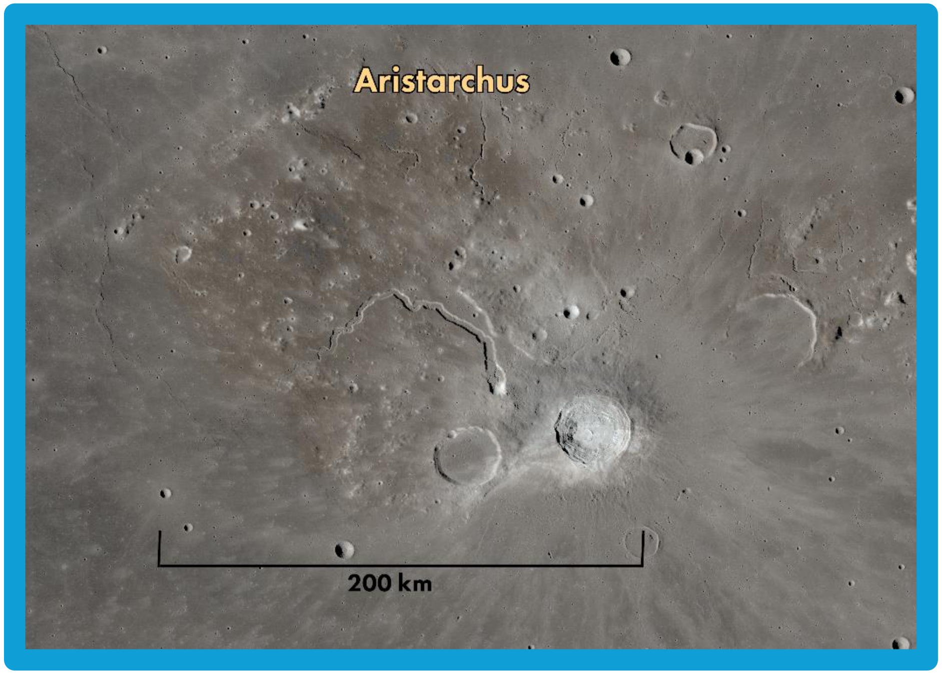
Orbital Observations: Descriptions of mare color and albedo can help piece together its volcanic history, specifically where resurfacing buried older crustal or mantle materials.

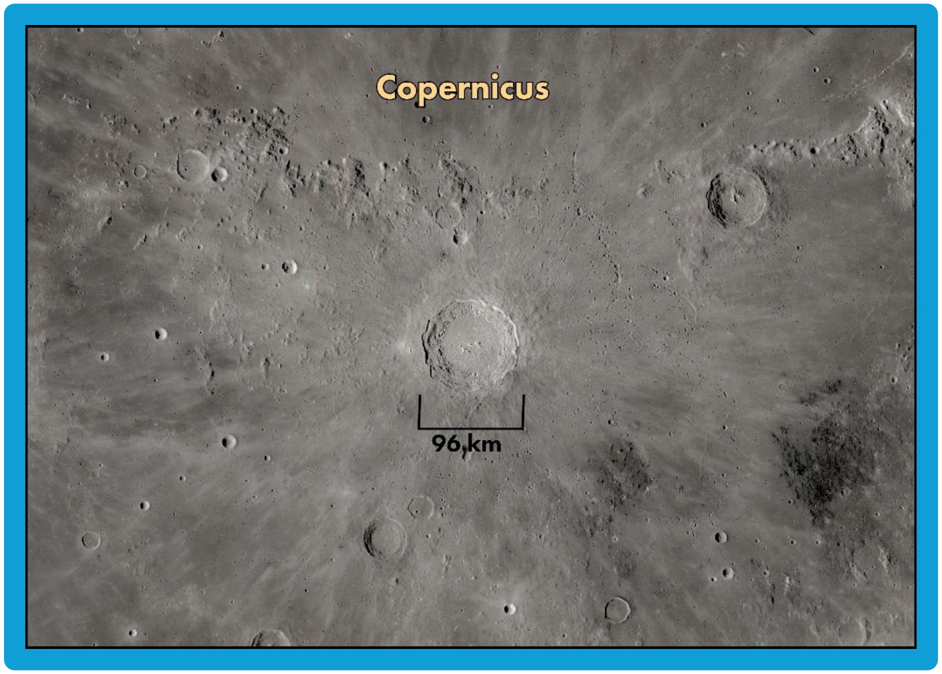
Descriptions of ring stratigraphy, and color and albedo differences, help constrain excavation depth, crustal composition, and thermal conditions of basin formation.

Part of the "Lunar Fifteen"*; Image credit: NASA/GSFC/ASU*






Aristarchus
200 km

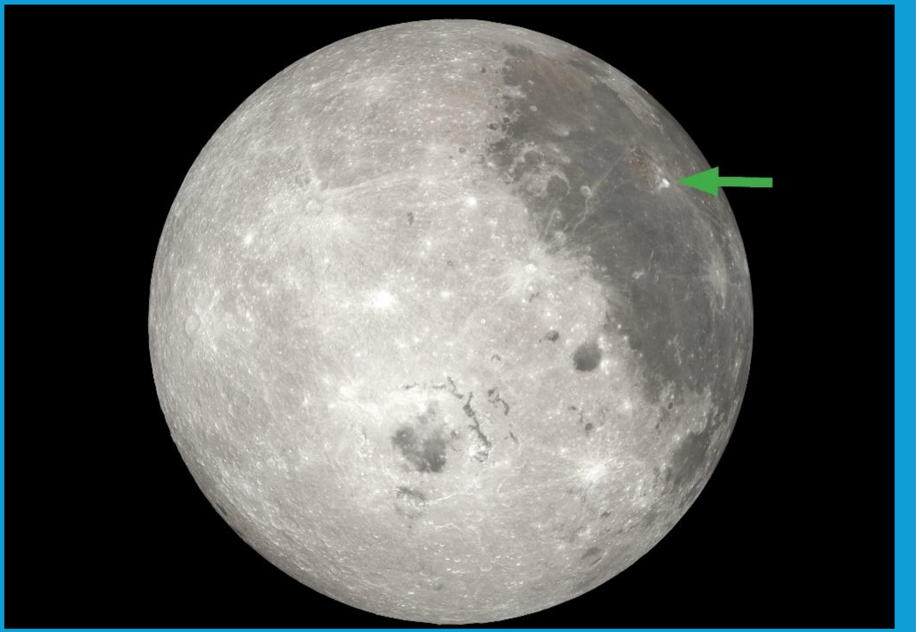

Copernicus
96 km

Aristarchus Region

Description: Aristarchus is a young, bright impact crater on the nearside. It has terraced walls, a central peak, and impact melt deposits, exposing both mare and highland materials. The crater is ~42 km in diameter and sits on the Aristarchus Plateau, which spans ~240 km. The plateau is an elevated crustal block that preserves a mix of ancient volcanic and tectonic features. It contains the largest and thickest known deposit of volcanic glass on the Moon, and its geologic diversity makes it one of the most scientifically valuable regions. The region also includes Vallis Schröteri, the largest sinuous rille on the Moon, formed by ancient lava flows. This rille is part of a wider system, with some segments created by collapsed lava tubes.

Orbital Observations: Descriptions of color and albedo variations across the Aristarchus region will help constrain the origin of its various landforms. Within the crater, the exposure of both mare and highland materials within a single crater is also of high interest.

Part of the "Lunar Fifteen"*; Image credit: NASA/GSFC/ASU*



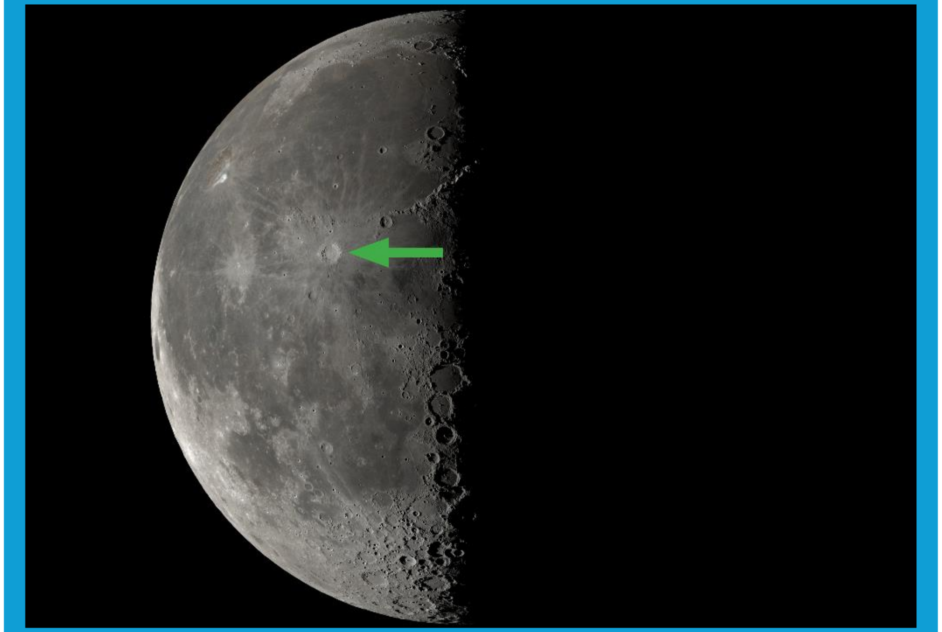
Copernicus Crater

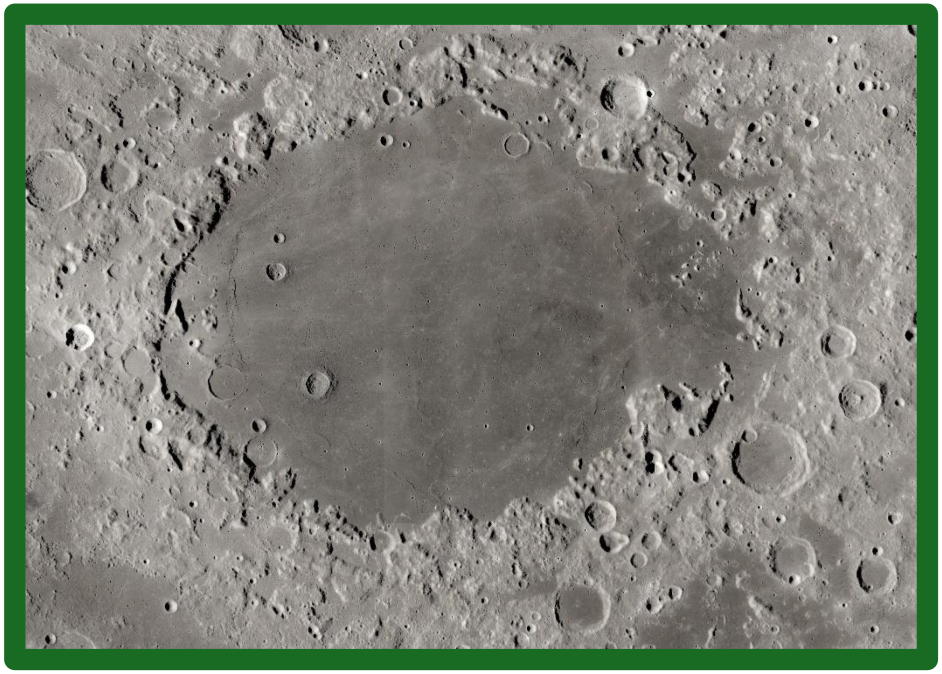
Description: Copernicus is a 96-km-diameter, rayed crater featuring multiple central peaks. It formed during the Copernican period, which spans from about 1.1 billion years ago to the present. The crater is surrounded by a hummocky ejecta blanket, created by the uneven dispersal of material during the impact. Copernicus provides clues as to how the crust responds to an impact to produce a central peak formation and an extensive ejecta system.

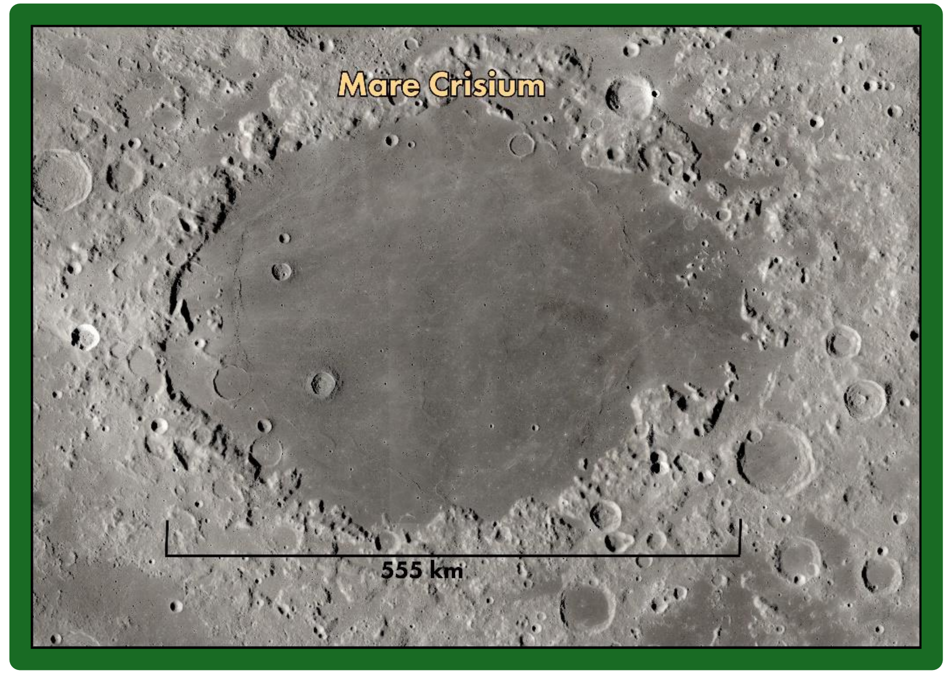
The Apollo 12 landing site in Oceanus Procellarum lies on a ray from Copernicus crater, approximately 350 km away from the crater rim. This provided scientists with an opportunity to establish chronological boundaries between the mare basalts of Oceanus Procellarum and the ejecta material from Copernicus.

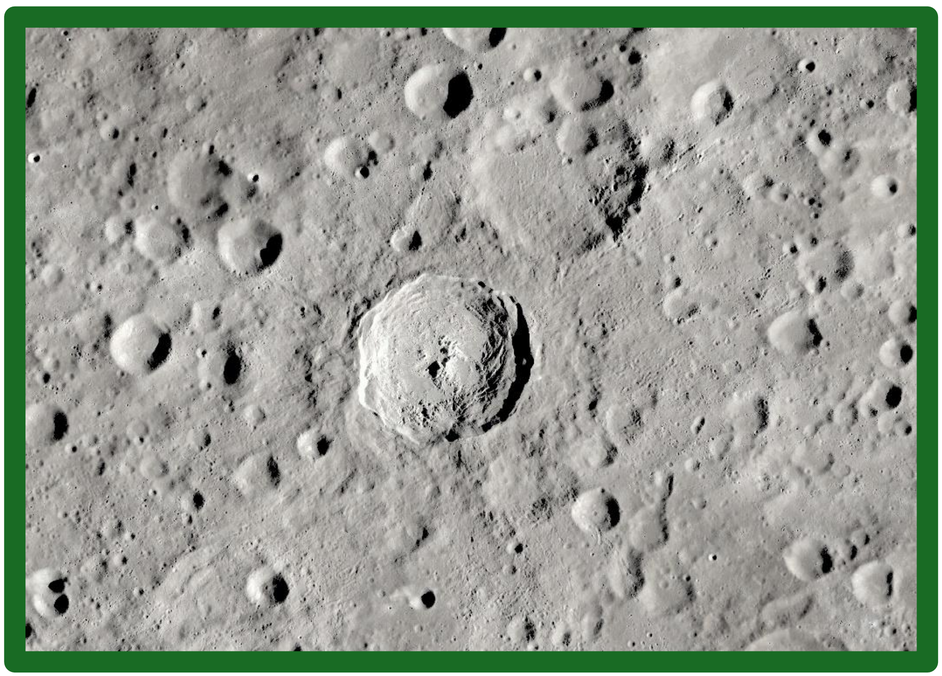
Orbital Observations: Descriptions of the crater's interior morphology, ray system, and their crosscutting relationships with surrounding terrain, aids in refining lunar stratigraphy and crater chronology studies.

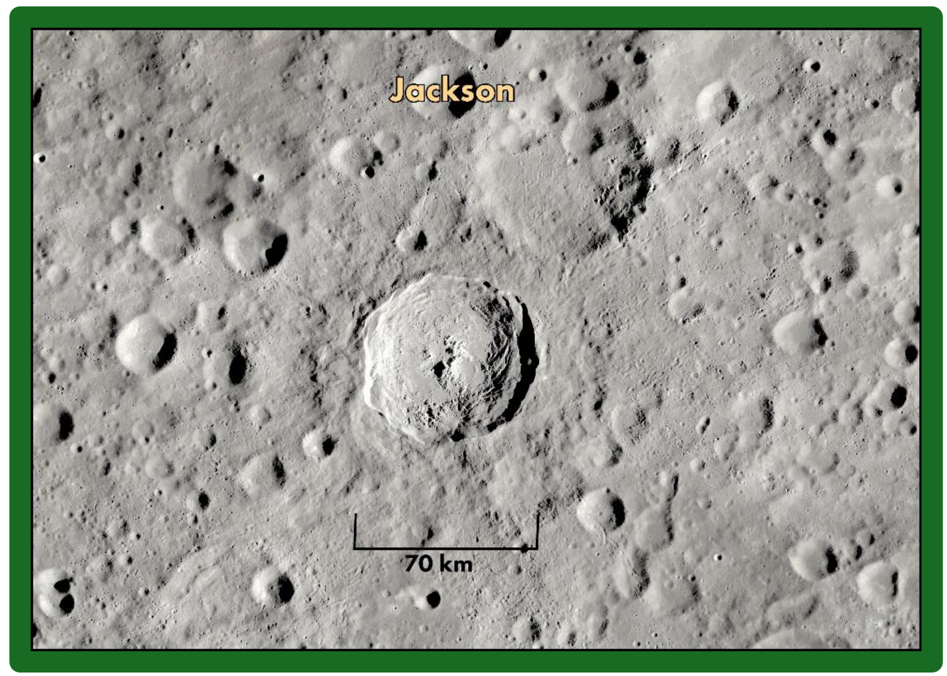
Part of the "Lunar Fifteen"*; Image credit: NASA/GSFC/ASU*






Mare Crisium
555 km




Jackson
70 km

Mare Crisium

Description: Mare Crisium is a lunar mare formed by basaltic lava flows that filled the ancient Crisium Basin and provides clues about the effects of large impact events on lunar mare formation. The mare basalts vary in composition, with some enriched in elements such as titanium and calcium. Lunar Reconnaissance Orbiter spectral data show that in western Crisium Basin, the mare basalts are mixed with feldspathic ejecta from craters like Proclus, making it hard to distinguish between mature highland materials and mixed mare basalts. Mare Crisium also has wrinkle ridges, which may be linked to thrust faulting. There may also be volcanic cones and pyroclastic deposits.

Orbital Observations: Descriptions of color and albedo variations across the mare basalts and their boundary preservation can help constrain their composition and therefore their volcanic histories, including eruption styles and formation rates. Observing the morphology of wrinkle ridges, particularly where they cross-cut different mare basalts, supports interpretations of structural relationships and the timing of crustal deformation.

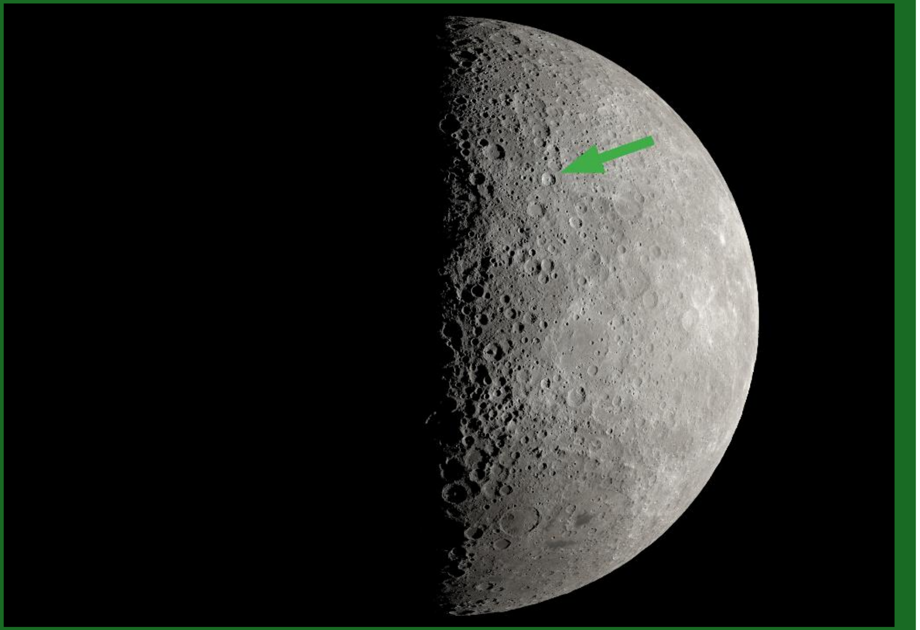
Part of the "Lunar Fifteen"*; Image credit: NASA/GSFC/ASU*

Jackson Crater

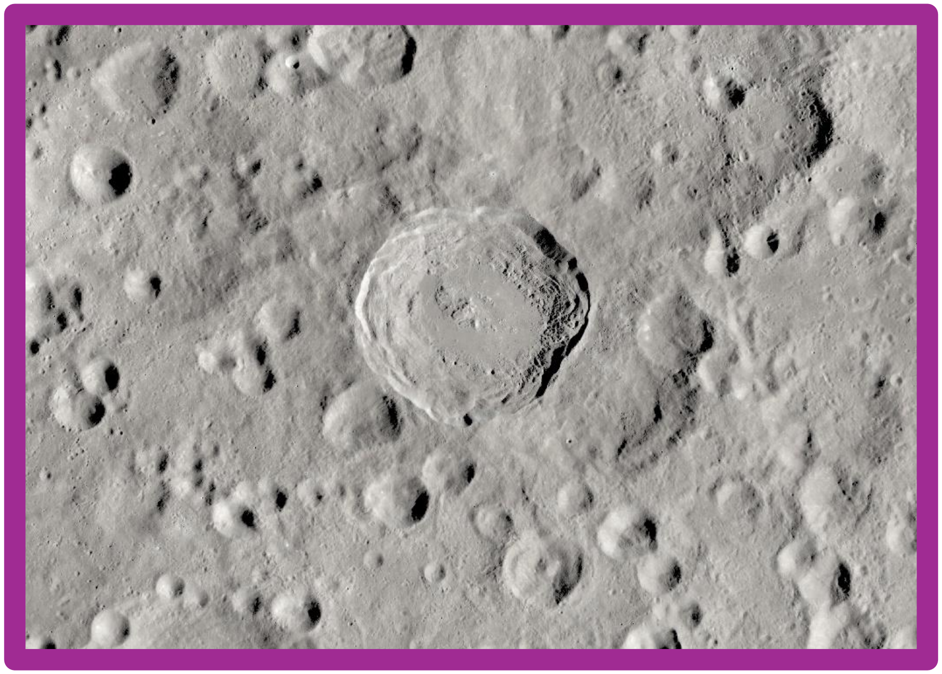
Description: Jackson is a complex crater on the lunar far side, marked by prominent rays that indicate its young age. You can think of Jackson as Tycho crater's twin. The impact that formed Jackson exposed deep material, and the central peak brings up rock from several km below the surface. Although its crater is not large (~70 km), Jackson's ray system is vast, measuring over 1,200 km in diameter. Thin sheets of impact melt cover terraces and crater walls, often fractured into brittle, puzzle-like pieces. Flow fronts appear frozen in motion, and boulders line the slopes and crater floor. These boulders will eventually slump downslope and become buried, while small impacts will gradually erode and soften Jackson's sharp features.

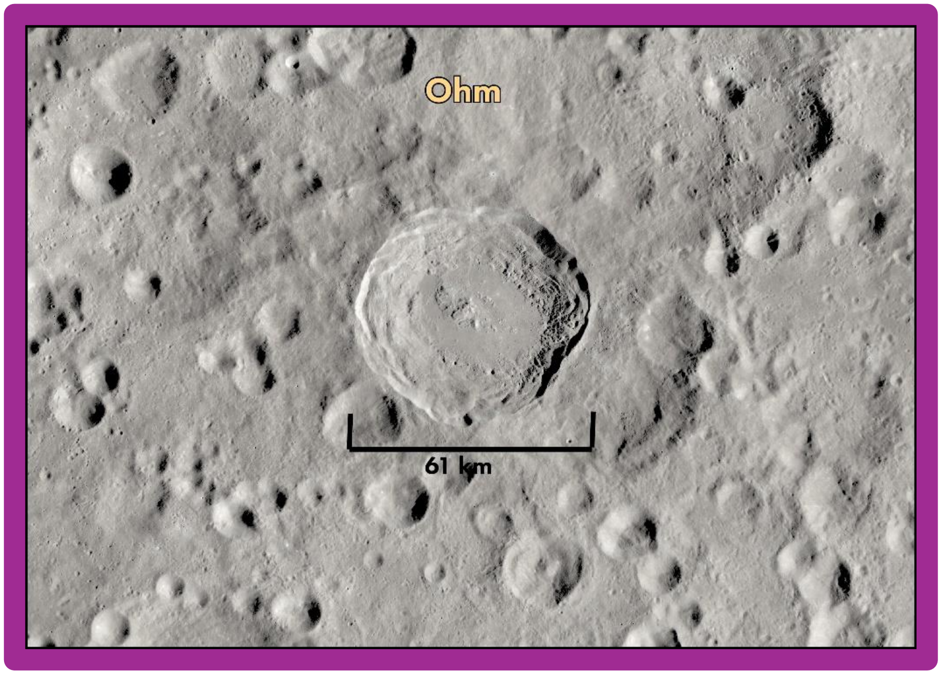
Orbital Observations: Descriptions of the morphology of Jackson's features give insight into how complex craters form and how impacts deliver, modify, redistribute, and mix material on the lunar surface. Jackson also serves as a target for understanding ray systems on the Moon. Observations of its rays (color, albedo, extent, and crosscutting relationships) help reveal clues to material transport and space weathering.

Part of the "Lunar Fifteen"*; Image credit: NASA/GSFC/ASU*




Moscoviense Basin
275 km



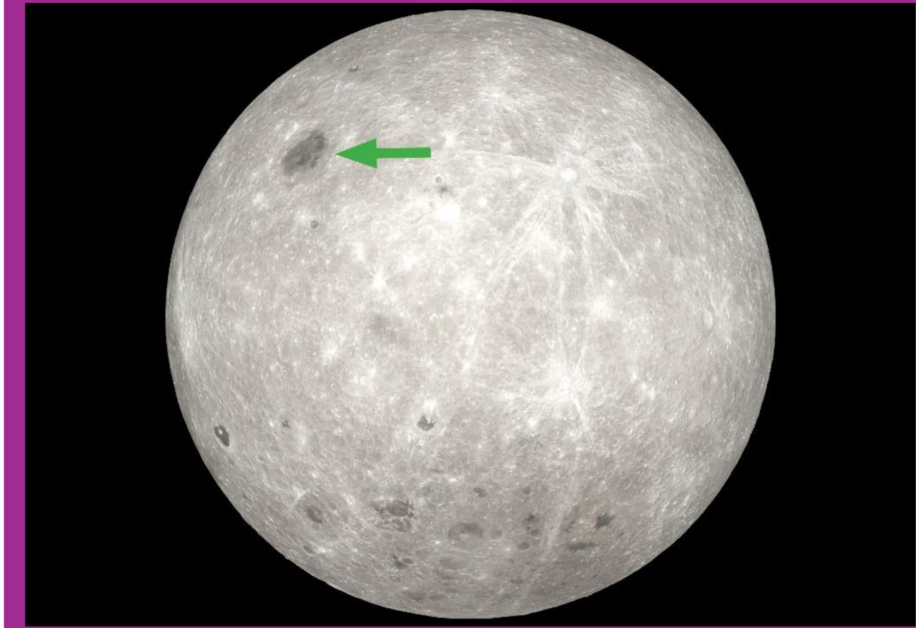

Ohm
61 km

Moscoviense Basin

Description: Moscoviense Basin is a multi-ringed impact structure located on the Moon's far side, within the Feldspathic Highlands Terrane (FHT), which contains remnants of the Moon's oldest crust. The basin measures ~450 km in diameter and is filled by Mare Moscoviense (~275 km in diameter), the largest mare deposit on the far side. Heavily degraded and dating to the Nectarian period (~3.92 - 3.85 billion years ago), it contains craters of various ages and morphologies, reflecting a long and complex history of impacts and volcanic resurfacing. The mare likely formed through multiple basaltic eruptions, as indicated by their color and albedo variations and craters nearly buried by younger flows. Lunar swirls have also been detected by orbital instruments.

Orbital Observations: Color and albedo observations of the swirls (including whether their boundaries appear sharp or gradational) contribute to future landing site selection, as swirls are of high interest for lunar science exploration. Descriptions of Moscoviense's ring stratigraphy and color and albedo differences help constrain excavation depth and crustal composition.

Part of the "Lunar Fifteen"*; Image credit: NASA/GSFC/ASU*



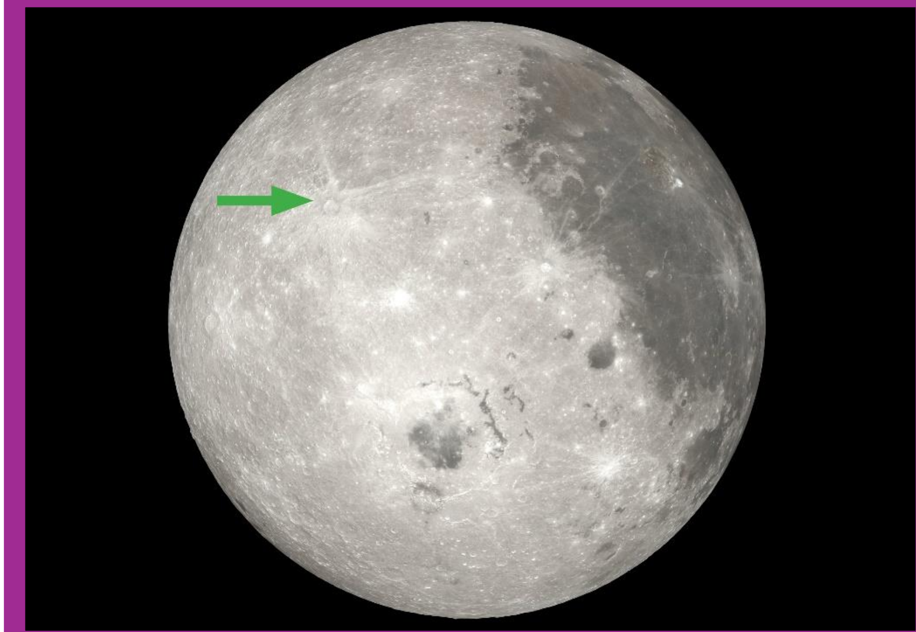
Ohm Crater

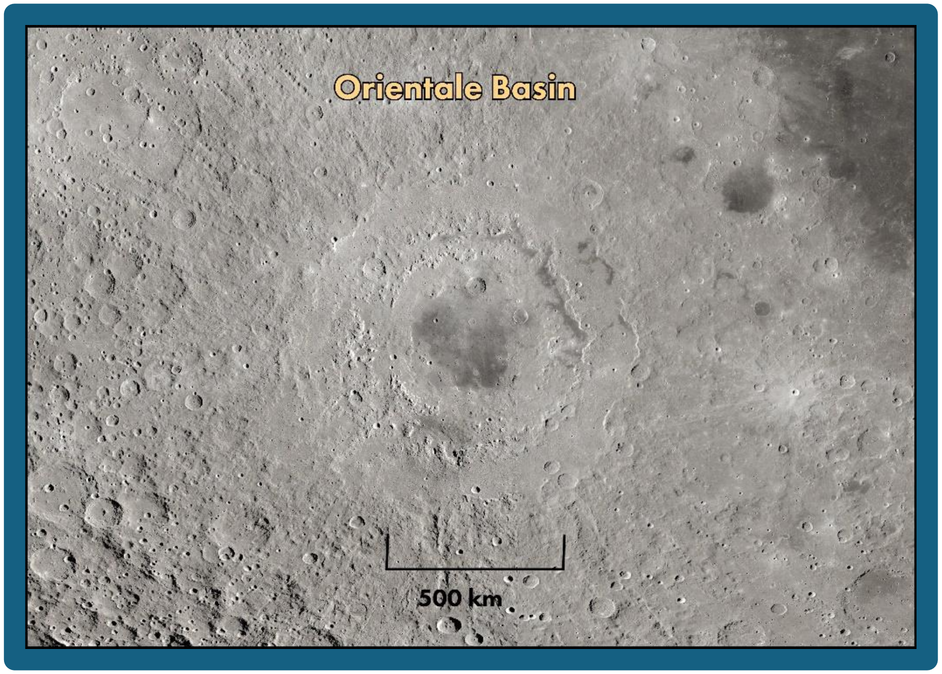
Description: Ohm is a young (Copernican-aged) crater that shows evidence of extensive impact melting. Its central peak appears to be surrounded by impact melt deposits. Geologic features on the crater floor include lava channels, lava ponds, and dome-like structures. Ohm's bright ejecta tells us about material transport (how rock and debris were ejected and redistributed during the impact), and its wall terraces show mass wasting (the slow, long-term downslope movement of material after the impact). Severely fractured solidified impact melt near the crater wall likely indicates that the impact melt pond was either not thick enough or not uniformly thick enough to completely cover the underlying crater floor feature.

Ohm is a proxy for studying small and young impact crater ray systems, particularly their extent, which is of high interest.

Orbital Observations: Descriptions of ray visibility, including their color, albedo, and reach, along with detailed observations of the crater's walls and central mounds, can provide valuable insight into impact processes.

Part of the "Lunar Fifteen"*; Image credit: NASA/GSFC/ASU*




Orientale Basin
500 km

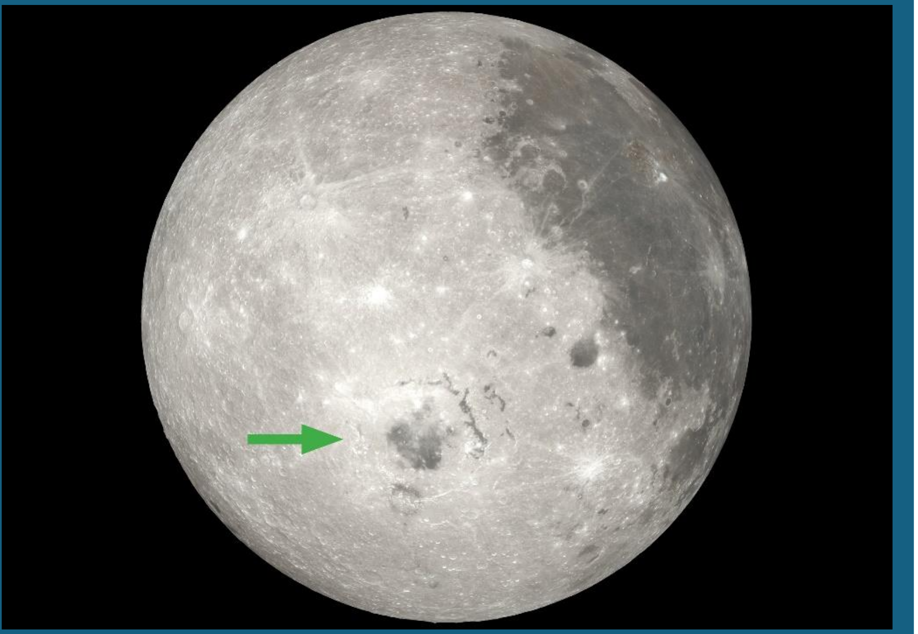

Mare Serenitatis

Orientale Basin

Description: Orientale Basin (the "Grand Canyon of the Moon") is a three-ringed impact basin. It's the Moon's best example of large impact basin formation and has never been seen in sunlight by human eyes. Its nickname is based on how well preserved its stratigraphy is. In order of geologic processes, this region formed through an impact basin event (complemented by impact melt), and then mare volcanism. The basalts of Mare Orientale, which partially infill the central depression of the basin, may preserve buried impact melt deposits, effectively making it a time capsule that records impact melt thickness, differentiation, and stratigraphy of the lunar interior. The basin's rings and features like Maunder Crater provide a window to the Moon's crustal composition and preserve stratigraphic relationships.

Orbital Observations: Descriptions of stratigraphic relationships within the rings and craters provide valuable insight into the formation processes of large basins across the solar system. Orientale's Dark Annular Ring, with its distinctive "kiss" shape, is of high interest, as data show that it has a different mineral signature than the mare patches in the rest of the basin. Observations of its boundaries, stratigraphy, and uniformity could yield important clues about its formation.

Part of the "Lunar Fifteen"*; Image credit: NASA/GSFC/ASU*

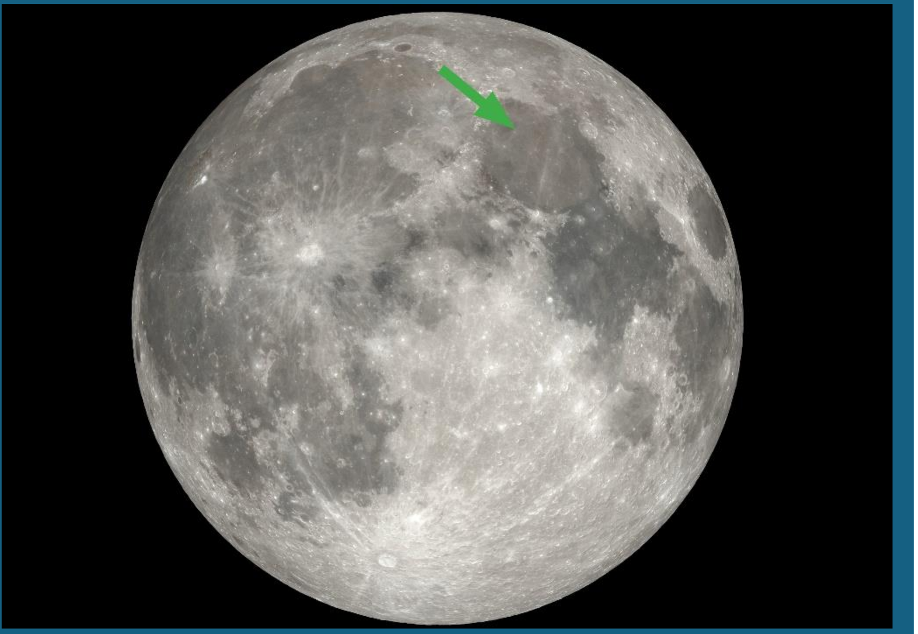


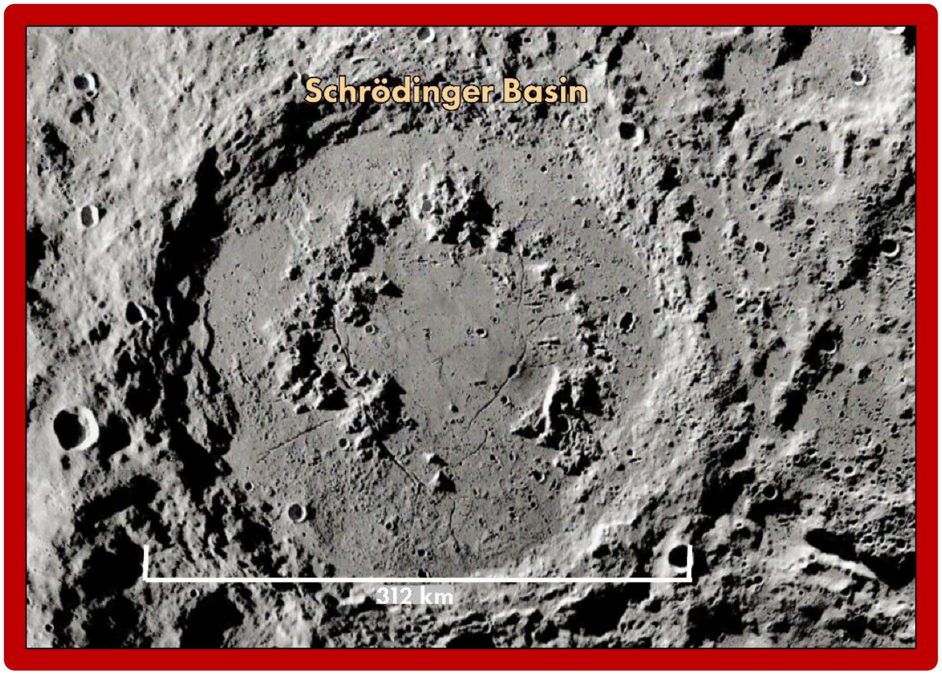
Mare Serenitatis

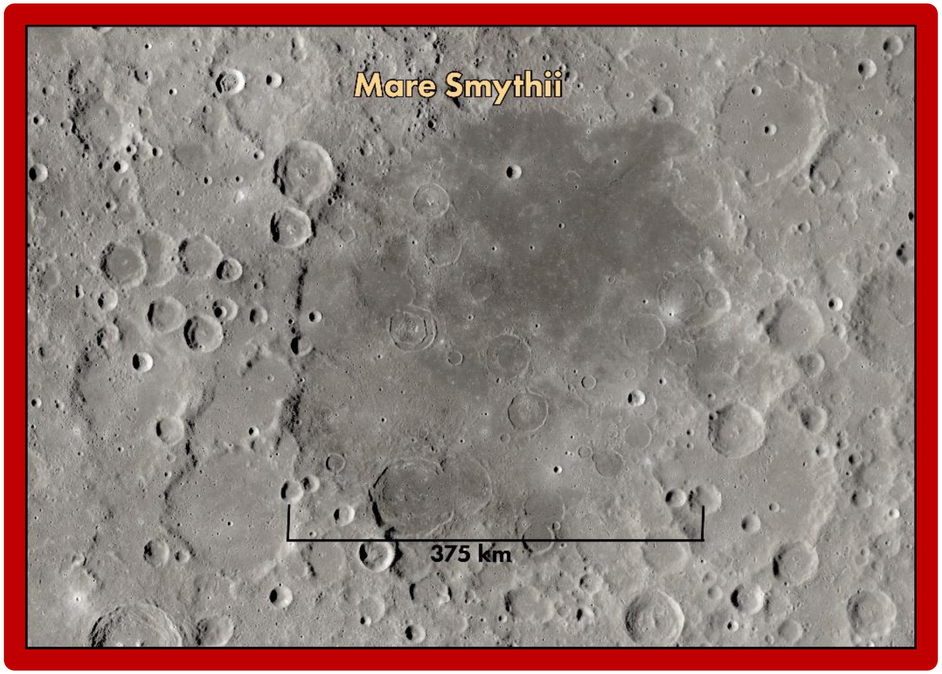
Description: Mare Serenitatis is a large multi-ring impact basin formed during the late Nectarian period (~3.92 - 3.85 billion years ago). Its structure includes at least three concentric rings, partially preserved in surface ridge patterns and supported by gravity data, which together help reconstruct the basin's formation and the lunar crust's response to massive impacts. Following the basin-forming impact, multiple volcanic episodes flooded the basin with basaltic lavas and subsequent tectonic deformation produced the wrinkle ridges seen today. The basin contains one of the Moon's most prominent mass concentrations or mascons (a gravitational anomaly created by mantle uplift and dense basaltic infill). Although mascons aren't visible to human eyes, understanding them is helpful for geologic context and for interpreting morphologic terrain expressions on the surface. Other features include rilles, wrinkle ridges, high-albedo rays that overprint the mare, and lunar pits.

Orbital Observations: Descriptions of color and albedo variations of mare basalts provide insight into compositional differences across the region, help determine the relative ages of lava flows, and improve our understanding of regional volcanic evolution and material mixing. Characterizing the system of wrinkle ridges (their size, extent, and crosscutting relationships) supports studies of lithospheric response to mascon-related tectonic uplift.

Part of the "Lunar Fifteen"*; Image credit: NASA/GSFC/ASU*




Schrödinger Basin
312 km


Mare Smythii
375 km

Schrödinger Basin

Description: Schrödinger Basin is the second youngest impact basin on the Moon. Its peak ring spans ~150 km in diameter and stands between 1-2.5 km above the basin floor. The impact excavated deep crustal material, including potential melt from the earlier South Pole–Aitken Basin (SPA) impact. Science investigations at Schrödinger could help assess the Late Heavy Bombardment hypothesis and constrain the timing of basin formation by determining the age of SPA. The basin hosts volcanic and tectonic features on its floor, including mare, a pyroclastic vent, and a system of extensional grabens. As one of the Moon's youngest giant impact basins, its fractured floors provide insights into how impact stresses influence volcanic responses.

Orbital Observations: Descriptions of any color and albedo variations might help reconstruct the history of geologic surface processes. The basin's combination of rings, grabens, mare, and pyroclastic deposits records a history of impact, tectonic, and volcanic processes. Observing these features and their crosscutting relationships can help reconstruct the sequence of events that shaped the basin. Schrödinger is a strong candidate for future lunar science exploration.

Part of the "Lunar Fifteen"*; Image credit: NASA/GSFC/ASU*

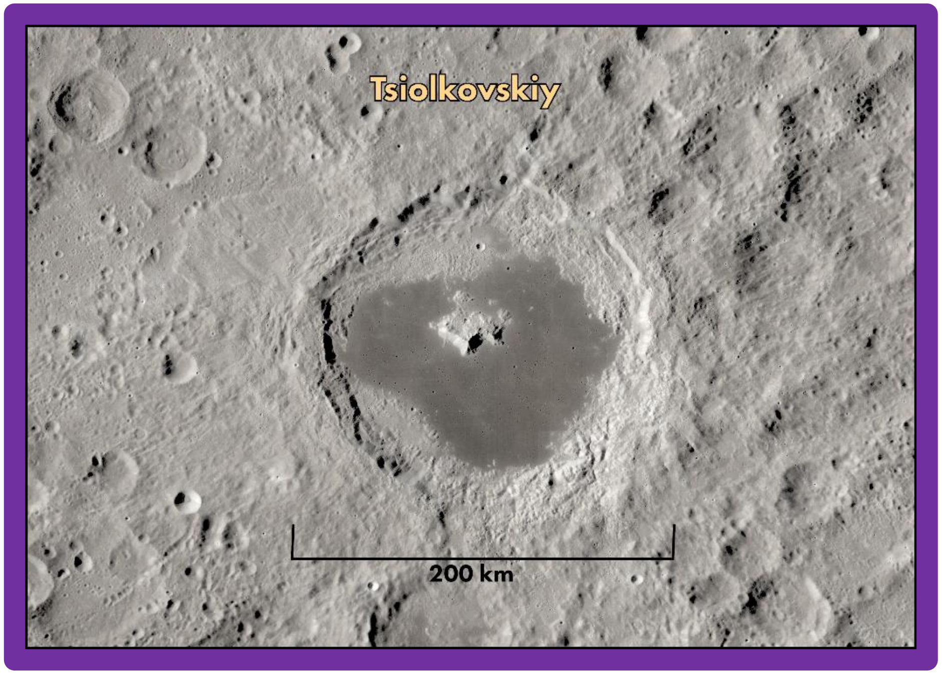
Mare Smythii

Description: Smythii Basin (infilled by Mare Smythii) is the fifth oldest impact structure on the Moon. It has inner and outer rings composed of massifs, a scarp within the inner ring, and several large craters on the basin floor that have been modified by intrusions. It also has an ancient cryptomare deposit along its eastern margin and mare basalts overlain by pyroclastic eruptions; these features provide evidence of the basin's age and complex geological history. Higher albedo patterns in the mare could potentially be swirls. The basin preserves exposed impact melt deposits on its floor, which are relatively rare on the Moon and are valuable for dating ancient impact events. The impact melts are overlain by younger mare basalts, showing that the basin was resurfaced by multiple lava flooding events after the initial impact.

Orbital Observations: Descriptions of swirl color, albedo, boundary sharpness, crater infill, and thickness help determine the origin of cryptomare and volcanic deposits. Descriptions of morphology and terrain expression on different sides aid in reconstructing the impact history.

Part of the "Lunar Fifteen"*; Image credit: NASA/GSFC/ASU*


Mare Tranquillitatis


Tsiolkovskiy
200 km

Mare Tranquillitatis

Description: Mare Tranquillitatis is a basaltic lava plain with a wide variety of volcanic landforms including lunar pits, mare domes, rilles, and distinctive wrinkle ridges. In Mare Tranquillitatis, the presence of over 200 mare domes (small shield volcanoes) offers opportunities for volcanic history observations. Apollo 11 landed in Mare Tranquillitatis, where they collected samples indicating that these mare basalts are rich in titanium in comparison to terrestrial basalts. The complex geologic history of Mare Tranquillitatis reflects multiple phases of tectonism, including early subsidence and basin loading, a later global stress field, and more recent global contraction. These three phases have been studied by comparing newer, distinct features with older, degraded ones such as wrinkle ridges.

Orbital Observations: Descriptions of any differences in the color, albedo, and morphology of mare domes in Mare Tranquillitatis help constrain variability in their formation processes and volcanic history.

Descriptions of the distribution and structure of wrinkle ridges and other tectonic features help determine the timing and origin of compressional tectonism in the region.

Part of the "Lunar Fifteen"*; Image credit: NASA/GSFC/ASU*

Tsiolkovskiy Crater

Description: Tsiolkovskiy is a large, complex crater with a dark, flat, partially mare-filled floor, and a central peak. Its rim is characterized by impact melt and ejecta deposits. On the northwest side is a runout landslide, which originated from the northwest rim and flowed into the floor of Fermi crater, likely triggered by an oblique impact. This landslide is the largest of its kind on the Moon and on a dry, rocky, airless body in general, making it a feature of interest for studying the mechanics of rapid mass-wasting events.

Orbital Observations:

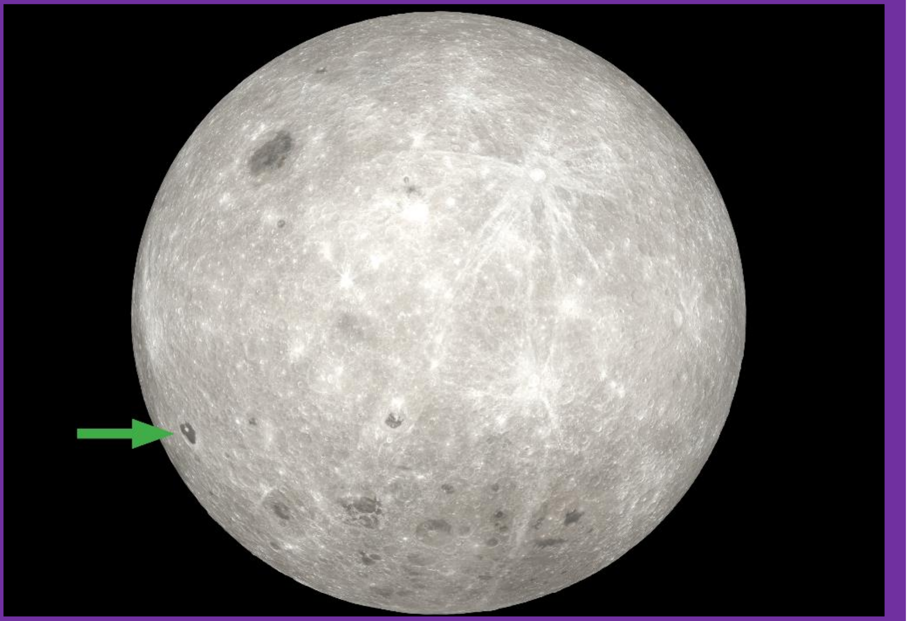
Observations of:

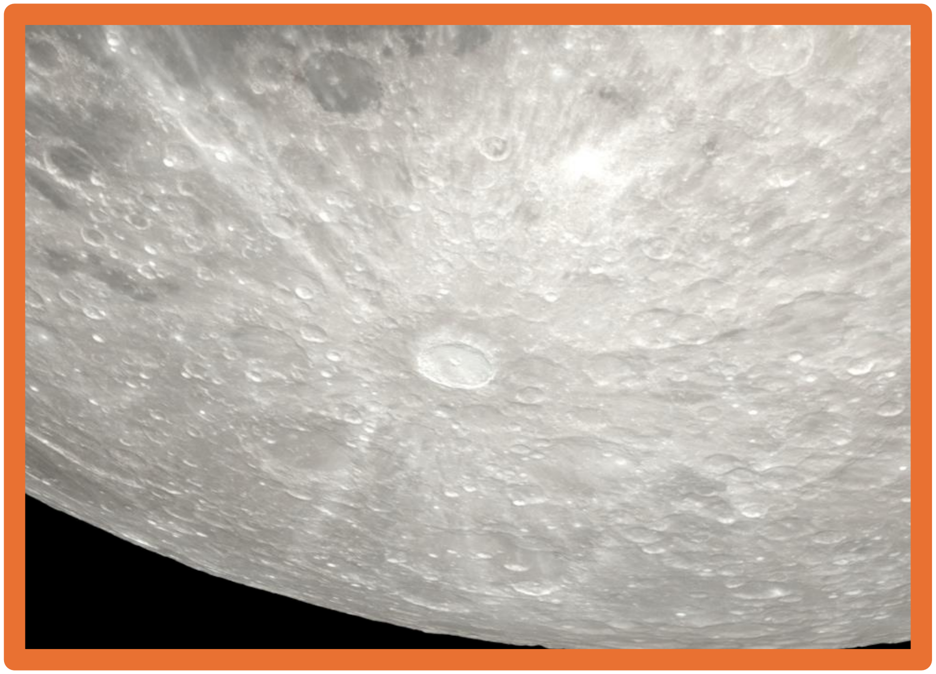
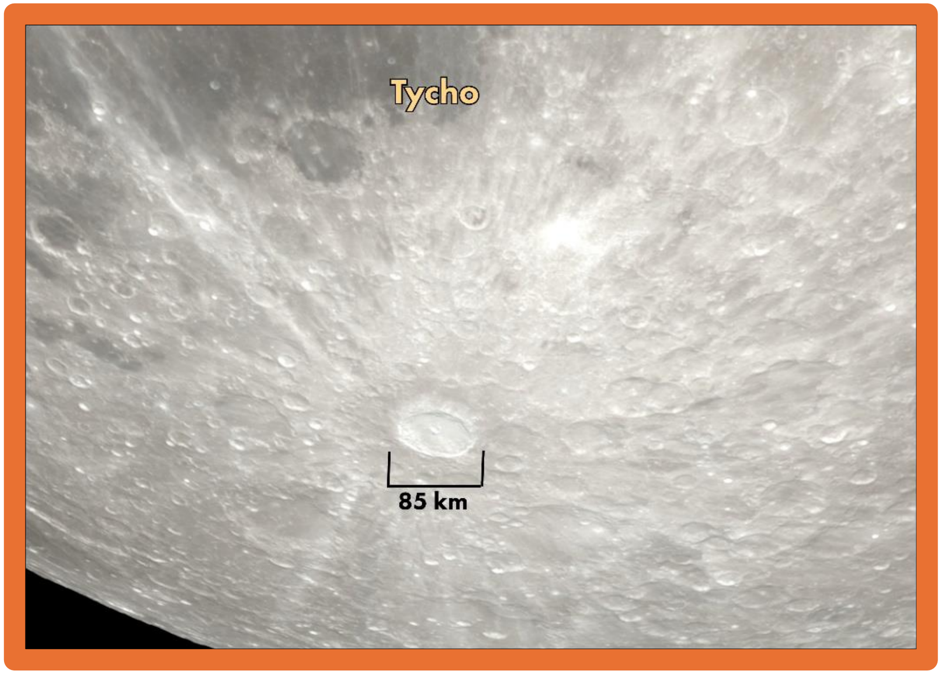
--Morphology of the landslide helps reveal how impacts modify, redistribute, and mix surface materials.

--Crater rim morphology and stratigraphy, textures of crater floors, walls, and central peak provide clues to the composition and structure of the lunar crust.

--Color and albedo of the mare basalts give insight into their origin and stratigraphy.

Part of the "Lunar Fifteen"*; Image credit: NASA/GSFC/ASU*





Tycho
85 km

Tycho Crater

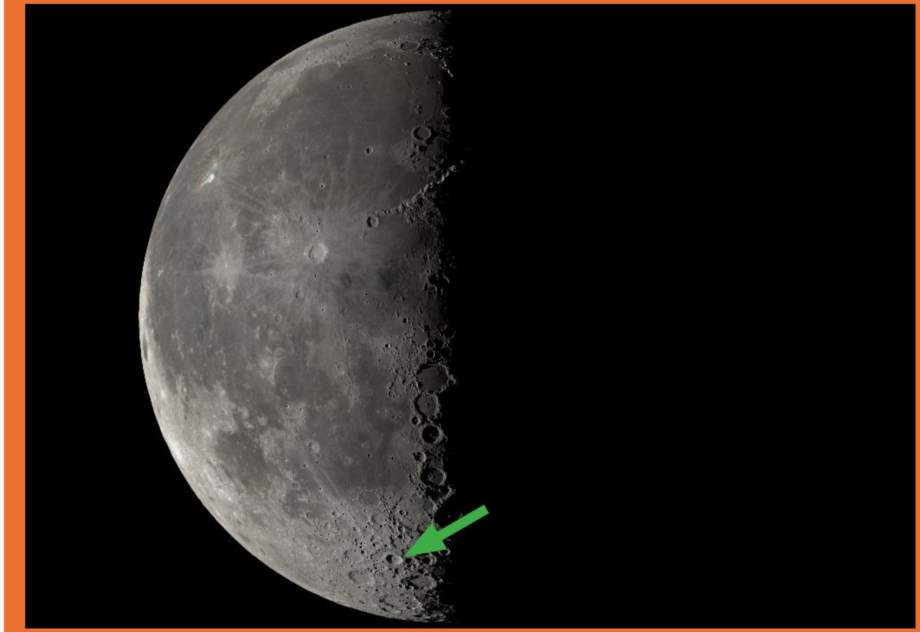
Description: Tycho, an 85-km diameter rayed crater, has a central peak, flow fractures, and impact melt deposits. This fresh and well-preserved crater provides important information about the most recent period of geologic history on the Moon. Tycho is famous for its extensive ray system, which reaches the Moon's South Pole and intersects future Artemis III Candidate Landing Regions.

The central peak has steep slopes, and debris accumulation on these slopes indicates ongoing mass wasting. Tycho's peak also has patches of impact melt, distinguished by their darker color and characteristic cooling fractures.

Orbital Observations: Descriptions of the color and albedo of the ray system and its crosscutting relationships with the surrounding terrain aid in building out the stratigraphy of the Moon.

Descriptions of Tycho's interior (crater walls, floor, peak), specifically of any color and albedo differences and morphological patterns, support studies that focus on the spatial distribution of impact melt within Tycho.

Part of the "Lunar Fifteen"*; Image credit: NASA/GSFC/ASU*



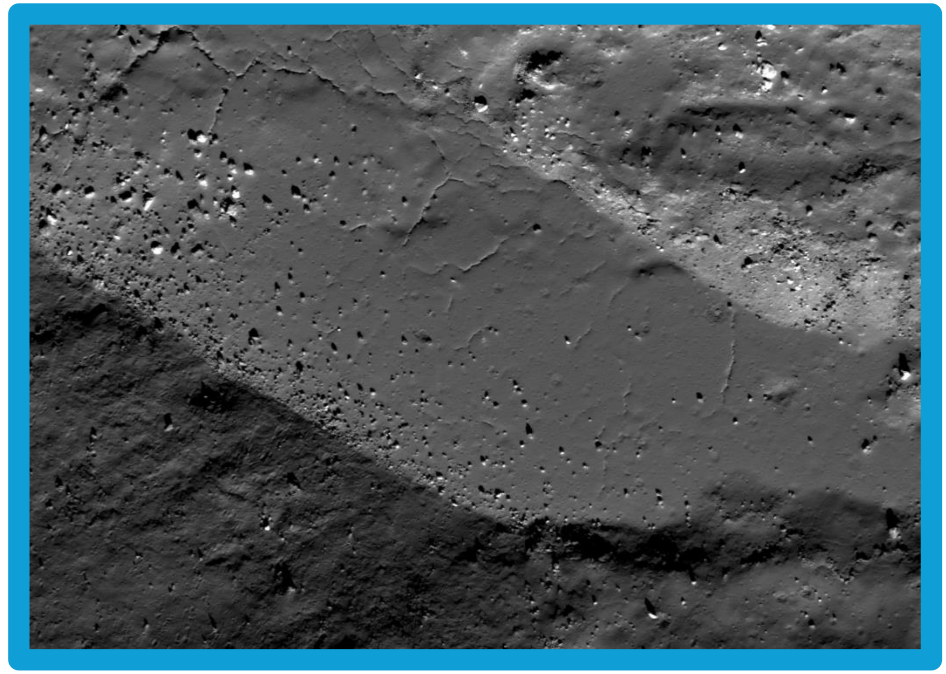
Shackleton Crater

Description: Shackleton Crater is an ancient, unusually well-preserved crater whose interior receives almost no direct sunlight. It is located at the lunar South Pole.

Science Goals: Unlike Earth, the Moon's orbit is barely tilted relative to the Sun. As a result, there are regions at the North and South Pole that never receive sunlight. Thanks to data collected by the Lunar Reconnaissance Orbiter, we know there is water ice in the darkest craters at the poles. By studying the lunar polar regions, we can better understand the locations and characteristics of this valuable resource.

Challenges: Because these permanently shadowed regions are incredibly cold, we would have to determine the survivability of the mechanical instruments (not to mention the design of an astronaut's spacesuit). How cold is cold? Temperatures in these areas can be more than 410°F (210°C) below zero. Think about how cold your bare hands feel when making a snowball – and that's a balmy 32°F (0°C)!

Image credit: NASA's Scientific Visualization Studio



Impact Melt Inside Thales Crater

Description: Thales is a young, 32-km diameter crater located at 61.8°N, 50.3°S. The interior of Thales has many different features including terraces formed by slumping and impact melt. This image shows the dynamic nature of Thales, with smooth impact melt emplaced at the time of impact, which then fractured and was subsequently sprinkled with boulders from a neighboring slope.

Impact melt is instant lava, formed when lunar rock is melted when the tremendous energy of an impact is released in a moment. After the initial impact, the melt can end up anywhere in the crater.

The cracks in the impact melt of Thales probably formed as the melt cooled and solidified. With the cooling of the material comes a change in volume, which could open the cracks. Or, the cracks may have formed over time as the crater floor slowly changed shape, and the impact melt material cracked to compensate.

Image credit: NASA/GSFC/ASU

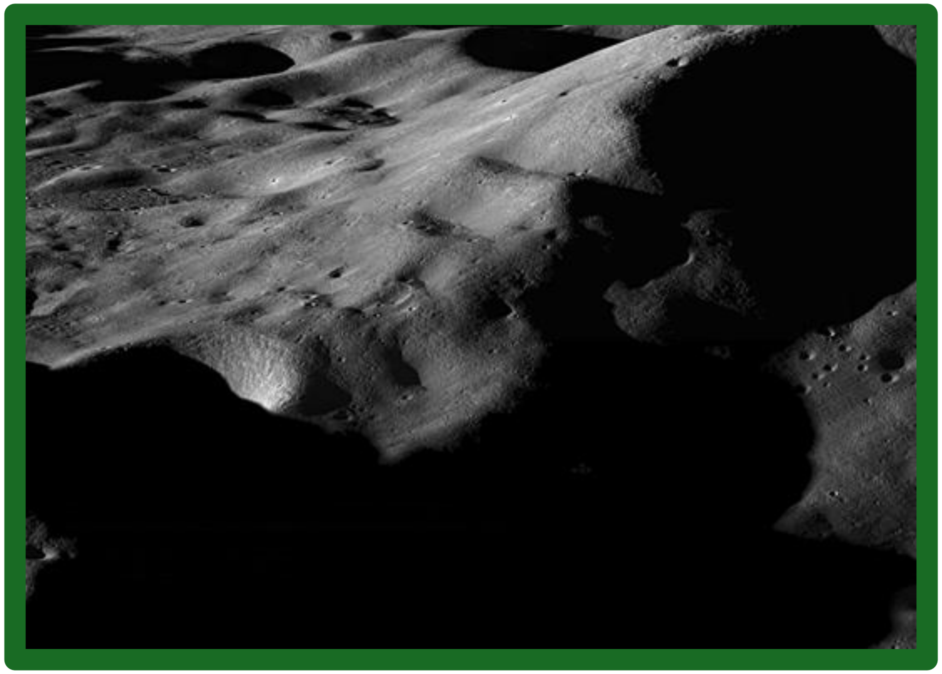
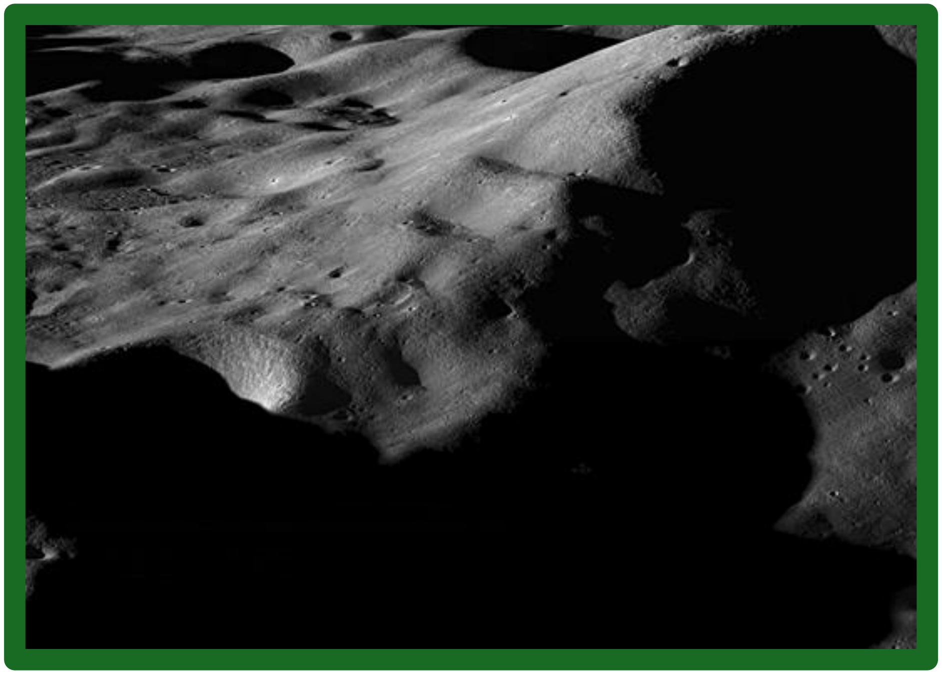
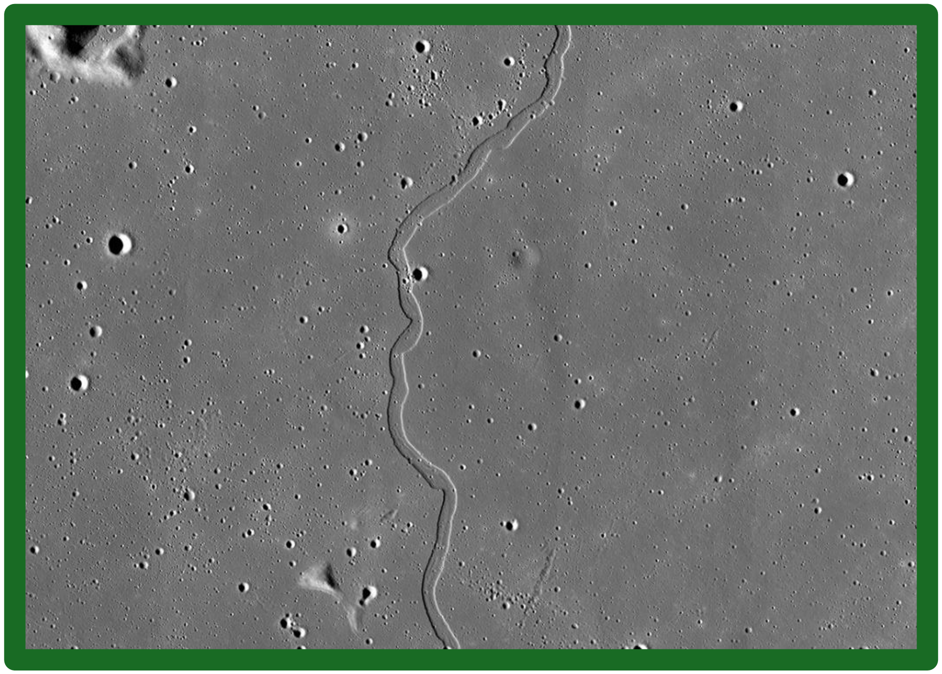
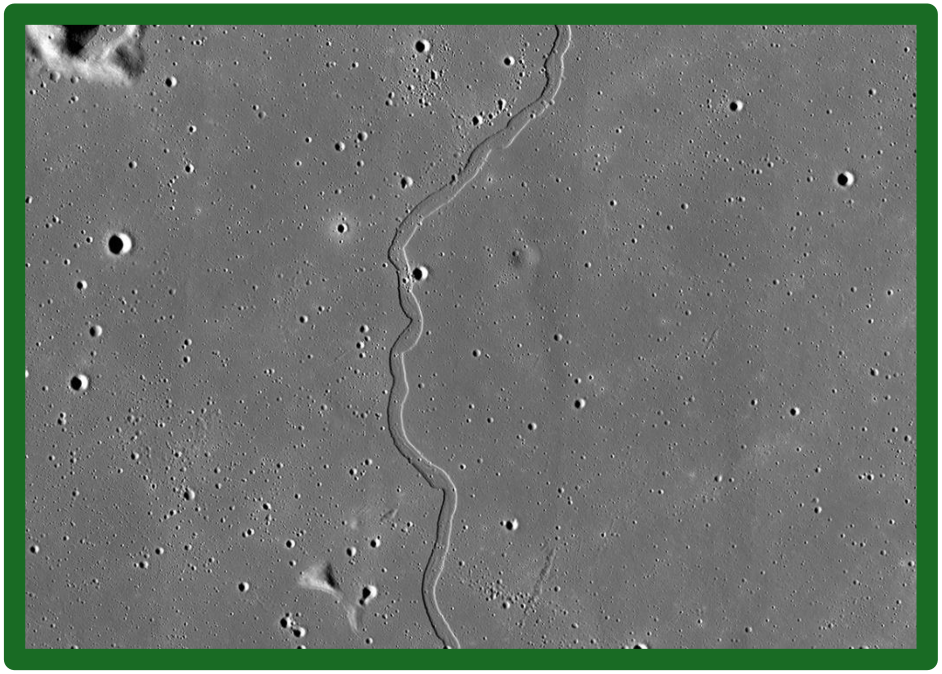
Forked Wrinkle Ridge

Description: A forked wrinkle ridge (located southeast of Copernicus crater) branches into two segments. North is up and solar illumination is from the east; the crater just to the west of the fork is approximately 1 km in diameter.

Wrinkle ridges are common compressional landforms on the Moon. These large ridges mainly formed because of contraction from load-induced subsidence after the emplacement of basaltic lavas in the maria – as the dense lavas cooled, their weight caused the terrain to sag, faulting and folding the basalts into wrinkle-like landforms. Wrinkle ridges are characterized by linear topographic highs with complex surface expressions involving a broad arch and a sharp ridge. The faults that created the ridges are thought to extend to depths between hundreds of m to several km beneath the surface.

The wrinkle ridge in this image splits into two ridges. Here, these two segments exhibit an uncommonly broad, flat arch without a sharp superimposed ridge. The unusual morphology of the segments indicates how the underlying fault, or multiple faults, offset the underlying basalt layers.

Image credit: NASA/GSFC/ASU

View Over Northern Rim of Cabeus Crater

Description: View looking across the north rim of Cabeus Crater at the lunar South Pole. Future astronauts may see a similar view as they descend to the surface for a polar landing. Cabeus Crater is relatively old, 100 km in diameter, and contains significant areas of permanent shadow. Such regions are of great interest because some may harbor significant deposits of water ice.

The large mountain (or massif) at the upper right is a portion of the ancient rim of the South Pole-Aitken basin. It rises some 6,000 m (19,685 ft) above the surrounding plains, and more than 9,200 m (30,184 ft) above the floor of Cabeus Crater – taller than any mountain on Earth.

On the Moon, mountains are formed in only minutes as huge amounts of energy are released when asteroids and comets slam into the surface at velocities greater than 16 km/sec (more than 10x faster than a speeding bullet). In contrast, mountains on Earth typically form over millions of years during slow-motion collisions of tectonic plates.

Image credit: NASA/GSFC/ASU

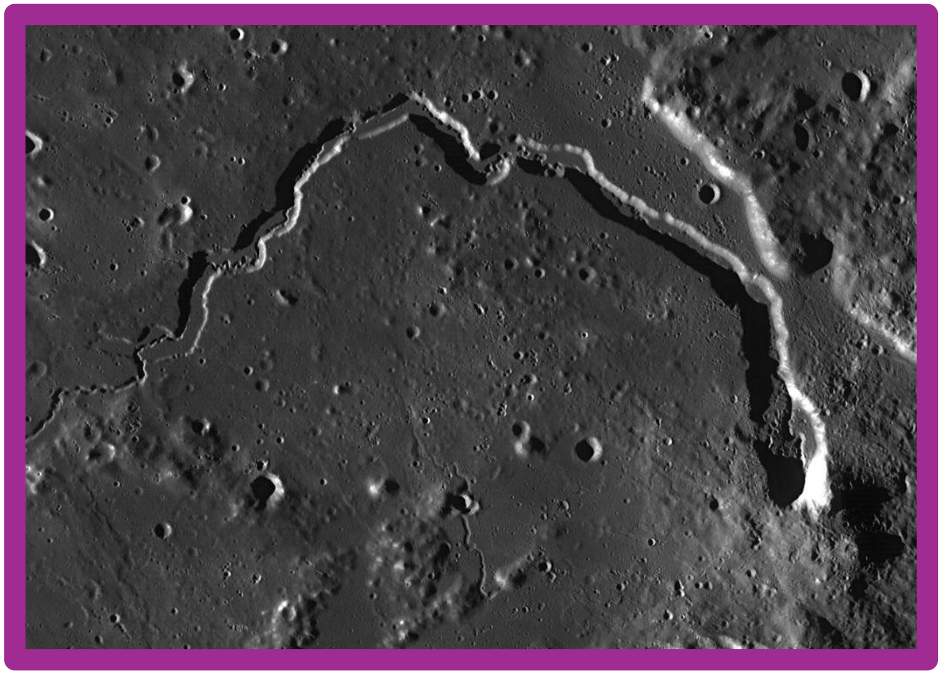
Rima Sharp

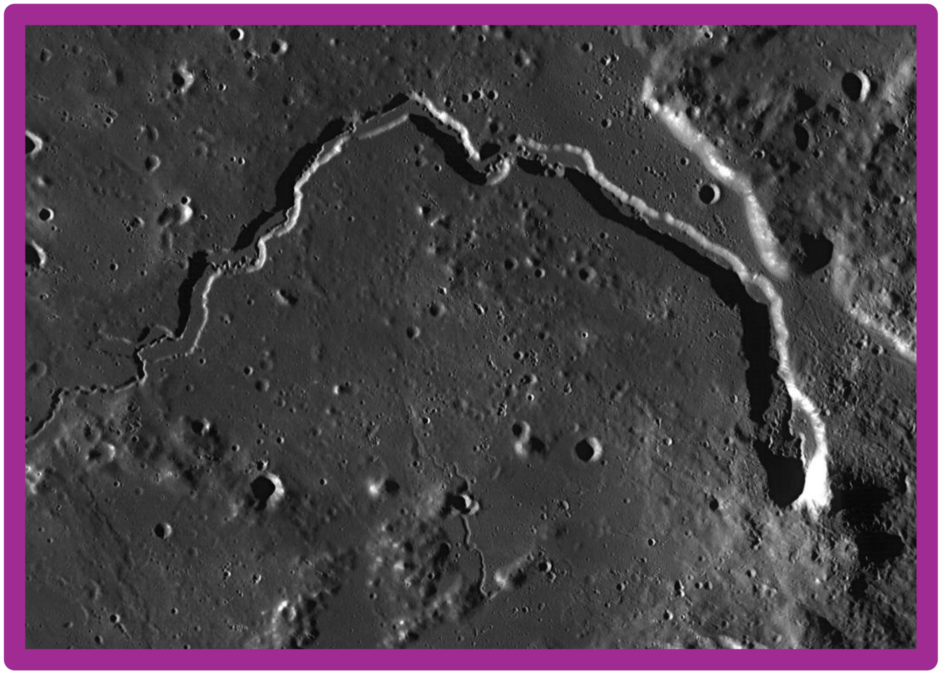
Description: Rima Sharp is one of the longest sinuous rilles on the Moon, with a total rille length of ~276 km.

Sinuous rilles are channels that have the appearance of a meandering river that twists and turns as it flows along. Sinuous rilles are thought to have formed as the result of surface lava flows or collapsed lava tubes. Many have crater-like structures at their point of origin. These depressions are most likely vents where the magma reached the surface from mantle source regions below.

While sinuous rilles are a common lunar landform, there are similar, though typically much shorter, volcanic features on Earth that form when magma steadily emerges from a vent and forms a channelized flow.

Image credit: NASA/GSFC/ASU





Vallis Schröteri

Description: Vallis Schröteri is located within the Aristarchus region and is the largest sinuous rille on the Moon, formed by ancient lava flows. This sinuous rille actually contains two rilles. The larger rille (155 km long) cuts through the Aristarchus Plateau, and the smaller, curvier inner rille (204 km long) cuts through the floor of the larger rille. This nested form indicates that multiple eruptive events occurred, or there was a large change in the volume of a single eruption over time. The area also hosts extensive pyroclastic deposits, rich in volcanic glass and considered a key target for future lunar resource exploration.

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Image credit: NASA/GSFC/ASU

Mons Mouton

Description: This is an illustration of Mons Mouton, a mesa-like lunar mountain that towers above the landscape carved by craters near the Moon's South Pole. The wide, relatively flat-topped mountain, about the size of the state of Delaware, was created over billions of years by lunar impacts, which sculpted it out of its surroundings. As a result, Mons Mouton stands as tall as Denali, the tallest mountain in North America, approximately 6,096 m (20,000 ft) higher than its neighboring features on the Moon's South Pole.

Because it is relatively untouched by bombardments, scientists believe Mons Mouton is much more ancient, possibly billions of years older than its surroundings. A ring of huge craters – evidence of its pulverizing past – lie around its base; some with cliff-like edges, descending into areas of permanent darkness. Its rolling hilltop is peppered with smaller rocks and pebbles as well as a lot of enticing craters that are frequently blanketed in freezing, shifting shadows.

Image credit: NASA's Scientific Visualization Studio