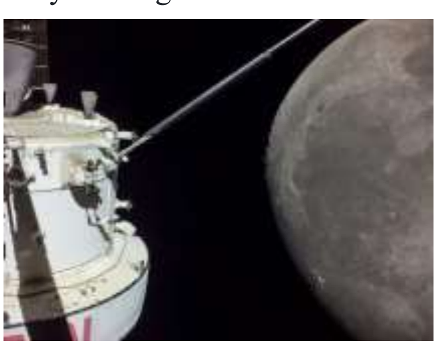
The Lunar Observer

A Publication of the Lunar Section of ALPO

January 2023

In This Issue



Artemis I and the Moon

Online readers, click on images for hyperlinks

Lunar Reflections

Wishing each of you and your loved ones a very good 2023. May it be as peaceful and prosperous as possible. Thank you to all who contributed to this issue of *The Lunar Observer*. In this issue, you will find 19 contributors who added to our lunar knowledge in essays, articles, drawings and images. In the United States and Europe, we had a very nice view of the Moon-Mars occultation in December. You will see some amazing images and drawings of this in the pages to come. Also, we are still receiving images of the November 8, 2022 total lunar eclipse. You will find another remarkable article by Guillermo Scheidereiter in his “Lunar Disclosure”. I found it very interesting as I was asked this month why look at the Moon? Rik Hill, David Teske and Alberto Anunziato take tours of lunar topography, most of which is clearly visible in small telescopes. Alberto Anunziato leads us on a bi-monthly feature on the crater Petavius. Check out the article, drawings and images of this beautiful ancient giant. As always, Tony Cook discusses both Lunar Geologic Change and his Buried Basins and Crater Project in great and interesting detail.

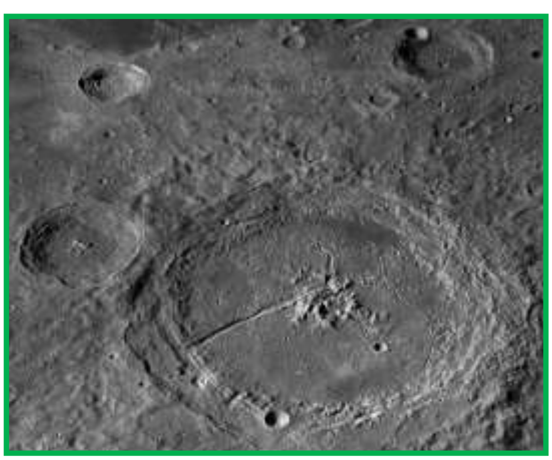
Please remember to follow the future Focus-On topics and gather observations of these features. Next up is Mare Nubium. Observations are due to Alberto and myself by February 20, 2022.

Clear skies,

-**David Teske**

Petavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2022 May 05 03:10 UT, colongitude 318.5°. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 665 nm filter, Skyris 445M camera.*

Langrenus and Petavius, *David Teske, Louisville, Mississippi, USA. 2020 September 03 07:43 UT, colongitude 97.4°. 4 inch f/15 refractor telescope, IR block filter, ZWO ASI120MMs camera. Seeing 8/10.*



Petavius, *Howard Fink, New York, New York, USA. Lunar Astronautical Chart 098 as a 3D model with wide area camera image overlay. Petavius crater with its neighbors. Upper right, 48 km Holden, lower left 58km Wrottesley, upper left 32km Petavius B.*

Lunar Topographic Studies

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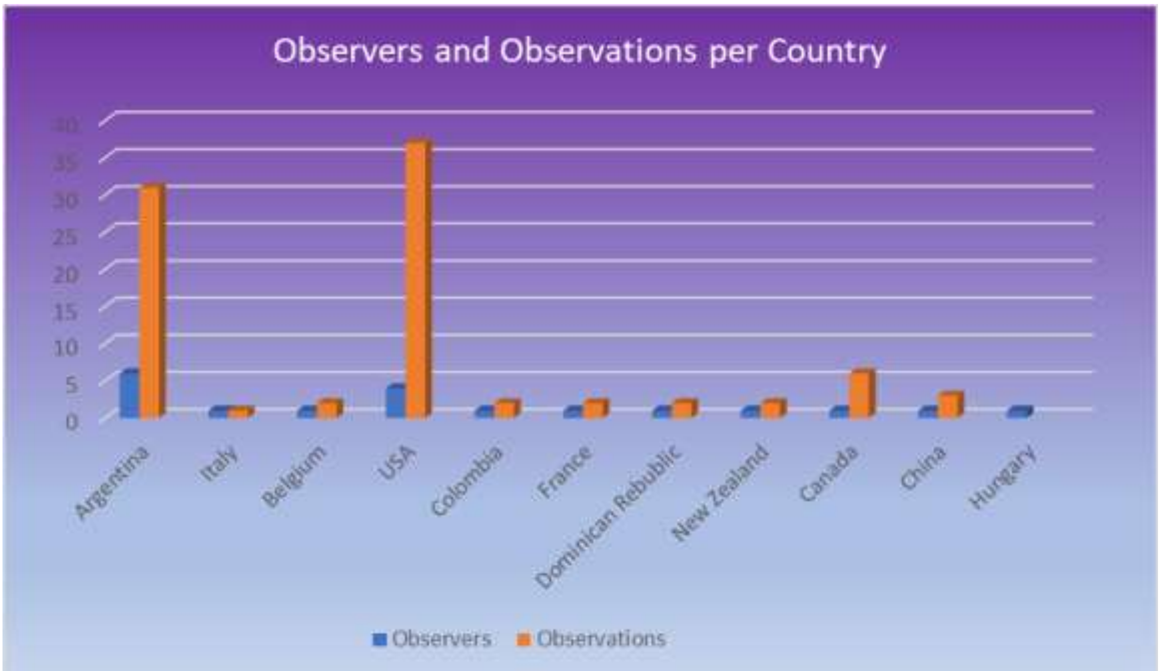
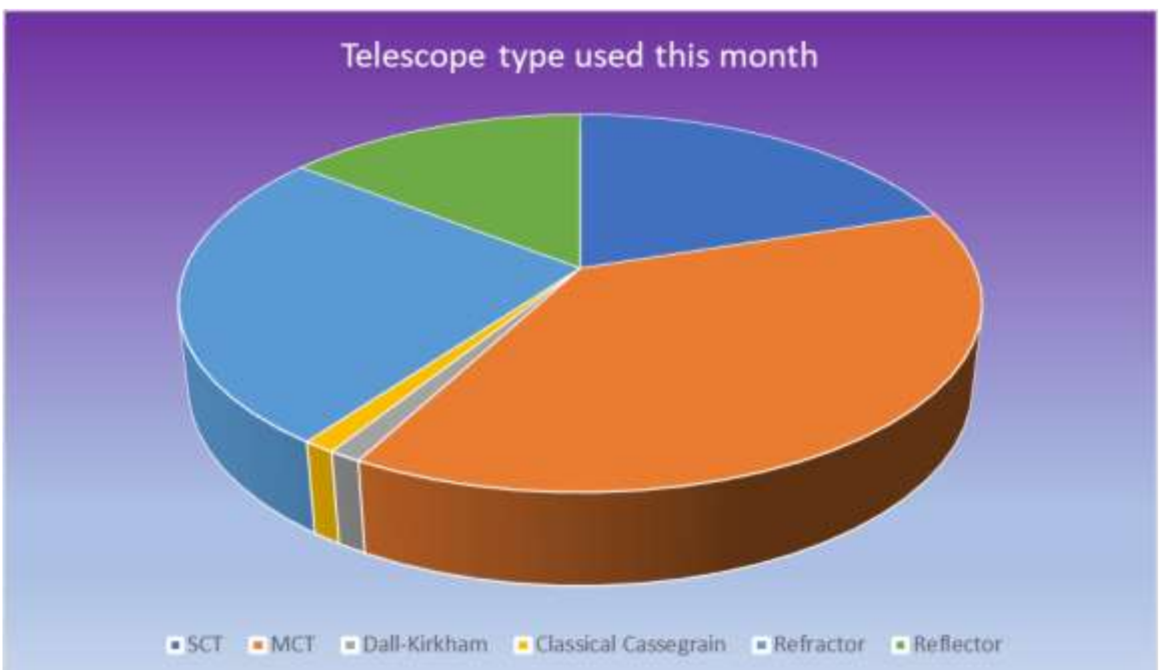
Observations Received

Name	Location and Organization	Image/Article
Alberto Anunziato	Paraná, Argentina, SLA	Images of Petavius (2), article with drawing and image *The Wrinkle Ridges of Sinus Iridum Observed with a Small Telescope The Ridge that Crosses Scheele Arc* and *Focus-On Petavius, Land of Cracks*.
Massimo Bianchi	Milan, Italy	Image of Petavius.
Leonardo Alberto Colombo	Córdoba, Argentina	Images of Copernicus, Gassendi, Tycho and Plato.
Michel Deconinck	Artignosc-sur-Verdon - Provence - France	Drawings of Petavius, Moon-Mars occultation
Jef De Wit	Hove, Belgium	Drawings of Petavius (2).
Walter Ricardo Elias	AEA, Oro Verde, Argentina	Images of Tycho (2), Aristarchus and Eratosthenes (2).
Howard Eskildsen	Ocala, Florida, USA	Image of Moon and Mars conjunction.
Howard Fink	New York, New York, USA	Images of Petavius (7).
István Zoltán Földvári	Budapest, Hungary	Drawings of Reiner Gamma, Gaudibert and Lambert.
Marcelo Guarda	Santa Fe, Argentina	Image of the Waning Gibbous Moon.
Rik Hill	Loudon Observatory, Tucson, Arizona, USA	Images of Petavius (16), article and image *Langrenus Ignored.*
Felix León	Santo Domingo, República Dominicana	Images of Petavius (2).
KC Pau	Hong Kong, China	Images of Plinius, Theophilus and Petavius.
Guillermo Scheidereiter	LIADA, Rural Area, Concordia, Entre Ríos, Argentina	Images of Anaxagoras, Aristarchus (2), Gassendi, Janssen, Mare Humorum (2), Mare Nectaris, Mersenius, Montes Recti, Philolaus, Sinus Iridum, Tycho and article with image *Lunar Disclosure.*
Gregory T. Shanos	Sarasota, Florida, USA	Images of Moon and Mars conjunction. (6), Lunar Eclipse (4) Waning Gibbous Moon and Waxing Gibbous Moon.
Fernando Surá	San Nicolás de los Arroyos, Argentina	Image of Petavius.
David Teske	Louisville, Mississippi, USA	Images of Petavius (6), article and image *Exploring the Sea of Isles and the Known Sea.*
Larry Todd	Dunedin, New Zealand	Images of Petavius (2).
Ken Vaughan	Cattle Point, Victoria, British Columbia, Canada	Images of Petavius, Moretus, Eastern Mare Imbrium, Montes Apenninus, Ptolemaeus and Archimedes.

January 2023 *The Lunar Observer* By the Numbers

This month there were 91 observations by 19 contributors in 11 countries.



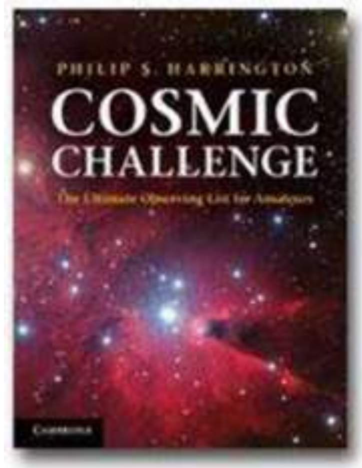


Lunar X and V Visibility 2023

Submitted by Greg Shanos

Table 4.3 Lunar X and Lunar V Visibility Timetable

	2023
Jan	29; 00:37
Feb	27; 15:02
Mar	29; 04:59
Apr	27; 18:10
May	27; 06:28
Jun	25; 18:02
Jul	25; 05:07
Aug	23; 16:07
Sep	22; 03:26
Oct	21; 15:27
Nov	20; 04:23
Dec	19; 18:16



Note: The dates and times listed are based on calculations made with the Lunar Terminator Visualization Tool (LTVT) by Jim Mosher and Henrik Bonda. This useful freeware program may be downloaded from https://github.com/fermigas/ltvt/wiki.

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Lunar Topographic Studies

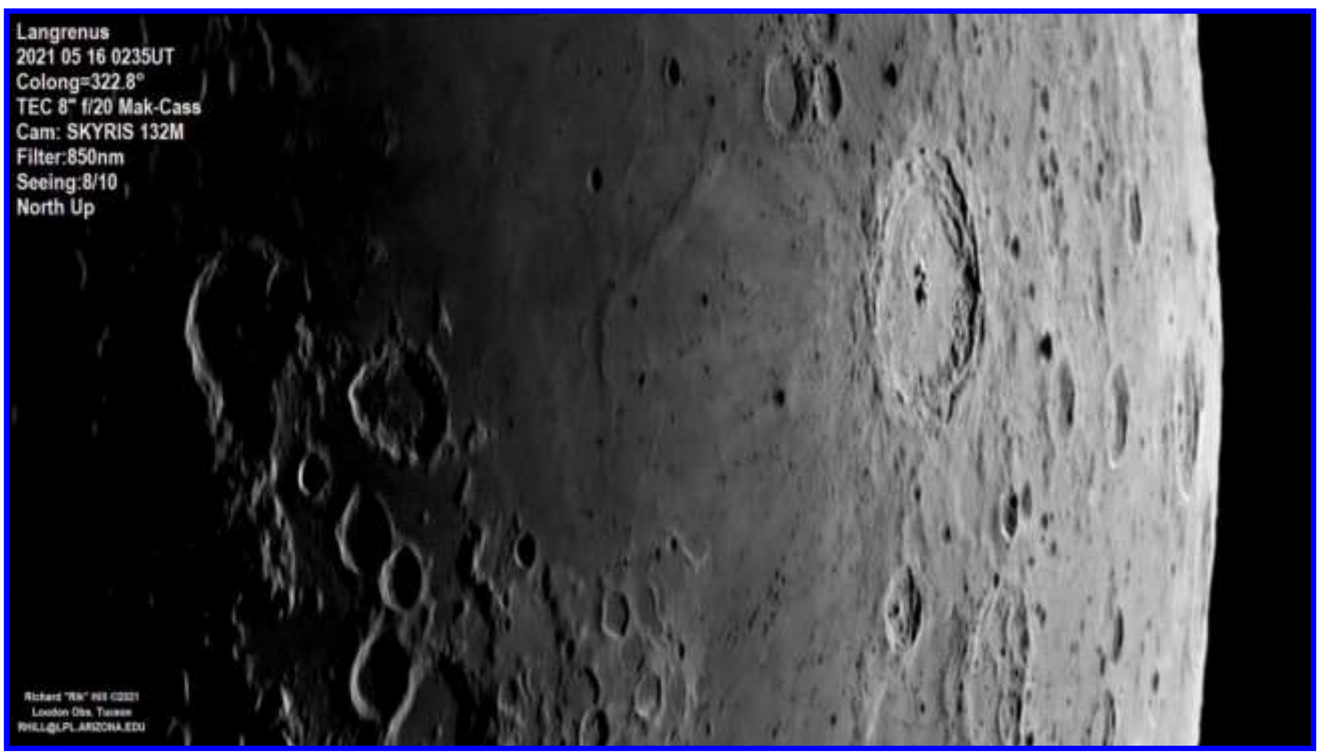
Langrenus Ignored

Rik Hill

Early in every lunation the spectacular crater Langrenus is seen on the eastern shore of Mare Fecunditatis. Here it is only a little more than 4 days past new moon and the great crater Langrenus (138 km diameter) is clearly seen even in binoculars! Unfortunately, it is usually overshadowed by its bigger brother Petavius (182 km) to the south, with the huge rima, and often overlooked. To the west (left) of Langrenus are several large wrinkle ridges or dorsum. Dorsa Mawson is the northern branch that points to two craters on the upper edge of this image, Bilharz (44 km) on the left and Atwood (31 km) on the right it makes a sudden angle heading due south. Notice the shadow filled crater west of Langrenus. This is Al-Marrakushi (8 km) and it's surrounded by 1-5 km secondary craters formed from the Langrenus impact. Take some time to look up this region on LROC Quick Map and look at all the odd shape of these craters formed from low velocity impacts! You can see some of that if you expand this image to 100% on your browser.

Moving east from Langrenus, heading for the limb, we see three craters in a row. The first is Barkla (40 km) followed by the larger Kapteyn (48 km) and the last, largest one, very foreshortened and very near the limb is la Pérouse (80 km). The isolated crater due south of Langrenus is a nicely terraced Lohse (43 km). A small crater with a clear central peak.

On the western shore of Mare Fecunditatis is a collection of craters just coming into the sunlight. The pear-shaped crater farthest west (left) is Gutenberg (70 km) with Gutenberg C (45 km) being the appendage to the south. The very odd-looking crater to the right of it is Goclenius (73 km) with Magelhaens (37 km) and Magelhaens A (19 km) just below. Watch these as the sun rises on them over the course of an evening.



Langrenus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2021 May 16 02:35 UT, colongitude 322.8°. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 850 nm filter, Skyris 132M camera. Seeing 8/10.*

Lunar Topographic Studies

The Wrinkle Ridges of Sinus Iridum Observed with a Small Telescope

Alberto Anunziato

Sinus Iridum is one of the most beautiful lunar landscapes. It is the place where the metaphor of the lunar seas is most obvious (a metaphor in our days, but one that many of the first lunar observers took as a reality, by analogy between the new world that they were observing telescopically and our world). It's not actually a bay, but rather what's left of a large impact crater, which was subsequently flooded with basaltic lava, but not completely. The best description is that of Arthur C. Clarke in his novel "Earthlight", which narrates a sports competition that takes place in our area: "Eons ago the Sinus Iridum had been a complete ring mountain--one of the largest walled-plains on the Moon. But the cataclysm which had formed the Sea of Rains had destroyed the whole of the southern wall, so that only a semicircular bay is now left. Across that bay Promontory Laplace and Promontory Heraclides stare at each other, dreaming of the day when they were linked by mountains four kilometers high. Of those lost mountains, all that now remain are a few ridges and low hillocks".

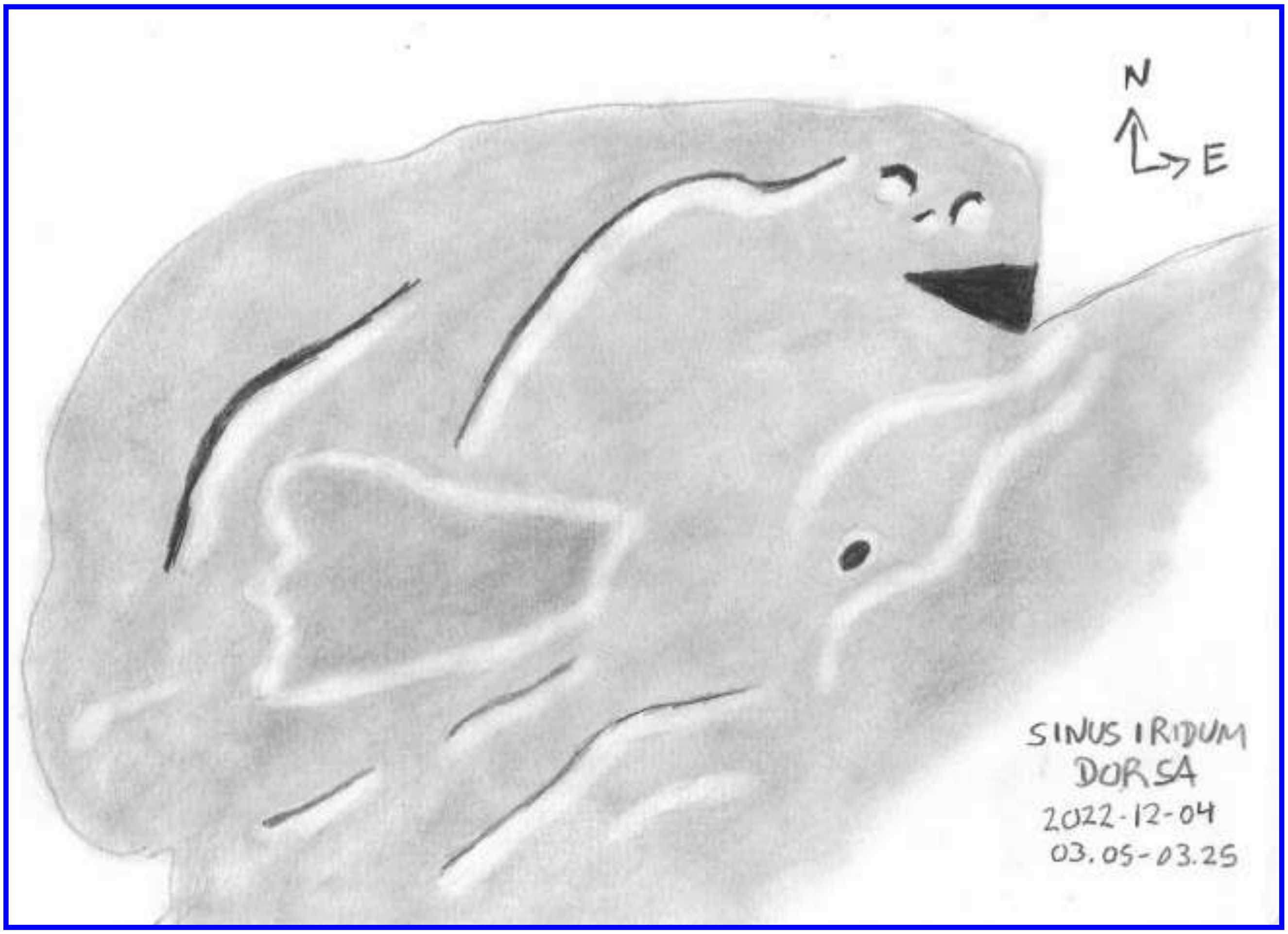


Image 1, Sinus Iridum Dorsa, *Alberto Anunziato, Paraná, Argentina. 2022 December 04 03:05 –03:25 UT. Meade EX 105 Maksutov-Cassegrain telescope, 154x.*

Lunar Topographic Studies

Almost nothing of the pre-flood topography can be seen, or even imagined, except for a few peaks near Promontorium Laplace. There are very few craters in Rainbow Bay (and with small telescopes only Laplace A is visible). And if this were not enough to preserve the illusion of a true bay, with adequate illumination, near the terminator, you can see frozen waves, as if it were an enchanted sea: They are the wrinkle ridges of Sinus Iridum, so small that they have not deserved a name, and that run from east to west, to make the resemblance to frozen waves more impressive: "On the western side of Mare Imbrium is the crescent of Sinus Iridum. A group of parallel wrinkle ridges run across the mouth of the sinus (...) They give the appearance of frozen waves of lava, much like ocean waves that were heading in toward the sinus from Imbrium" (Robert Garfinkle, Luna Cognita, Chapter 27).

My intention at the time of the observation was not to record Sinus Iridum (which exceeds my drawing skills), but to record the wrinkle ridge contained in this area, which, although not small, it is small for my small telescope. I tried to record them and then check with the Lunar Reconnaissance Orbiter Quickmap Map of Lunar Wrinkle Ridges (IMAGE 2) how many I had observed. I couldn't observe the smaller segments, but I did record most of them. The ridges observed with my small 4-inch Maksutov-Cassegrain seem simplified, if we compare IMAGE 1 with IMAGE 2, by the one indicated as number 1. What can be seen as a single ridge in IMAGE 1, the Map of Lunar Wrinkle Ridges marks it as a succession of segments, which is explained by the obvious lower resolution of IMAGE 1, but it may also be that if we enlarged IMAGE 2, we would see that visually the segments seem joined. In IMAGE 1 the segments that appear marked with the number 2 in IMAGE 2 appear more curved than they are, which is an unavoidable bias of visual observation of dorsa. In this area we would have ridges that are not very high or very extensive. I have sometimes fantasized about preparing a wrinkle ridges catalog, based on the observation of my telescope, which, due to being so small, would be limited to a few general characteristics, detected visually and later corroborated with photographic images and/or from probes in lunar orbit, starting from the aforementioned Map of Lunar Wrinkle Ridges. In the case of the ridges that we recorded, it seems that we have two types: ridges that appear as bright segments that cast shadows (an example is the dorsum marked with the number 3 in IMAGE 2) and ridges that appear only as bright segments (no shadow), like the one marked with the number 4 in IMAGE 2). If we follow Charles Wood (The Modern Moon): "Although not very high (100 to 300 meters), ridge crests are often sufficiently steep that they cast shadows, and their sunward-facing slopes are brighter than those with gentler arches", we could relate shadow with height and brightness with a steeper slope".

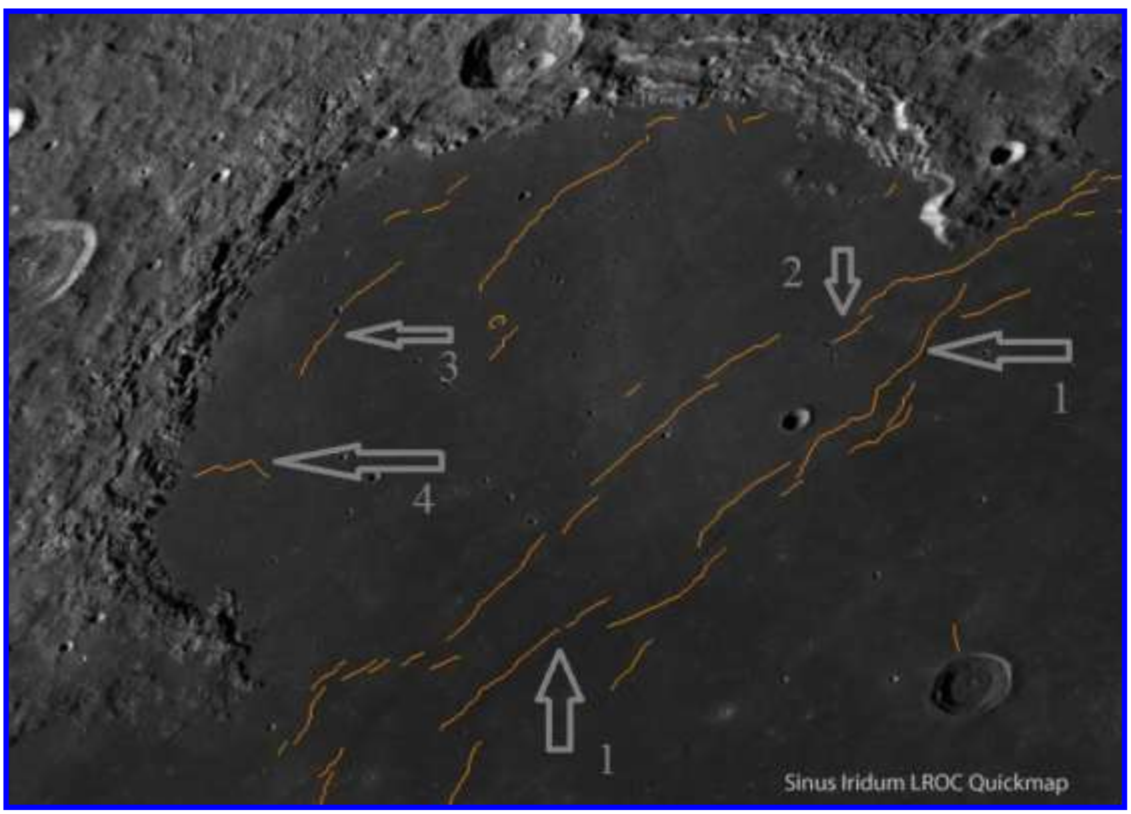


Image 2, Sinus Iridum, *LROC Quickmap.*

Let us then compare the relief of a wrinkle ridge that projects shadow (number 3, IMAGE 3) with the relief of a wrinkle ridge that does not cast a shadow (number 4, IMAGE 4). IMAGE 3 presents a steeper and higher relief than the relief from IMAGE 4, a bit gentler, just enough to appear less bright. Here we might have two tags for an eventual future catalogue: “steep crest” “gentle arch”, or something similar.

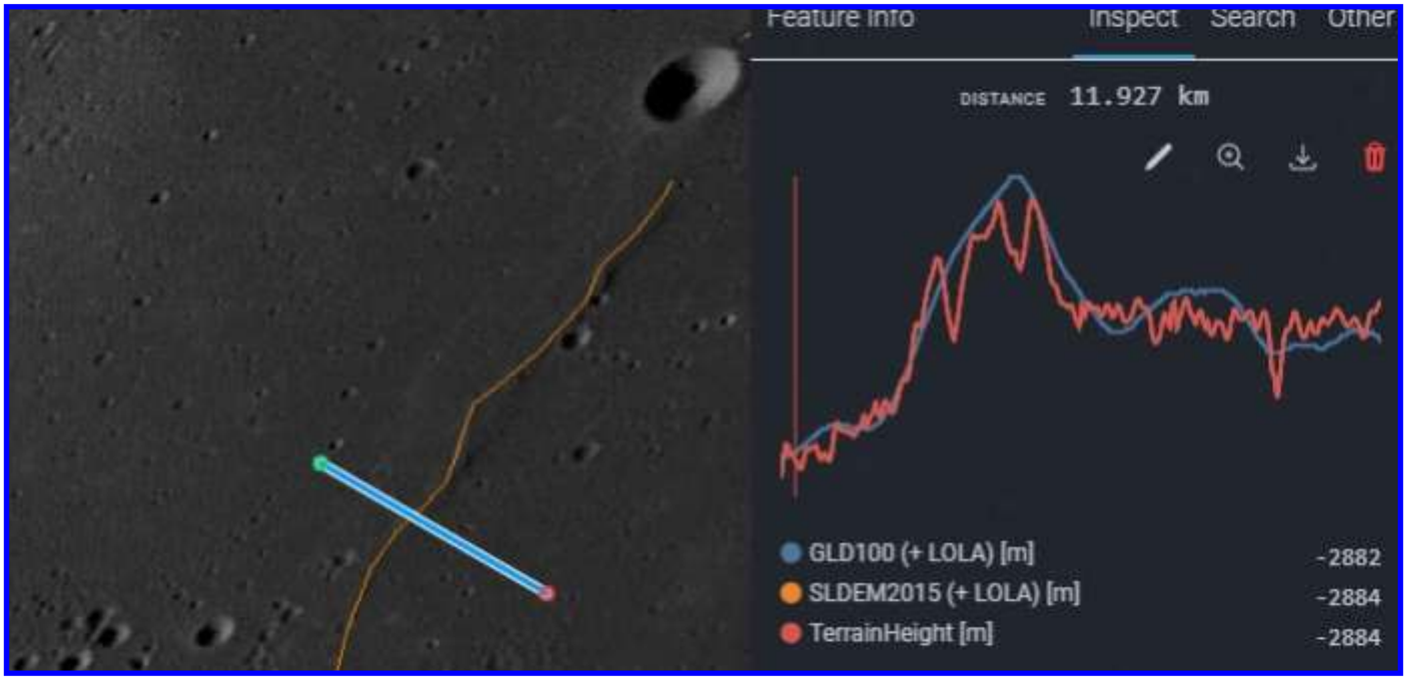


Image 3, Dorsa Sinus Iridum *(number 3, previous image), LROC Quickmap.*

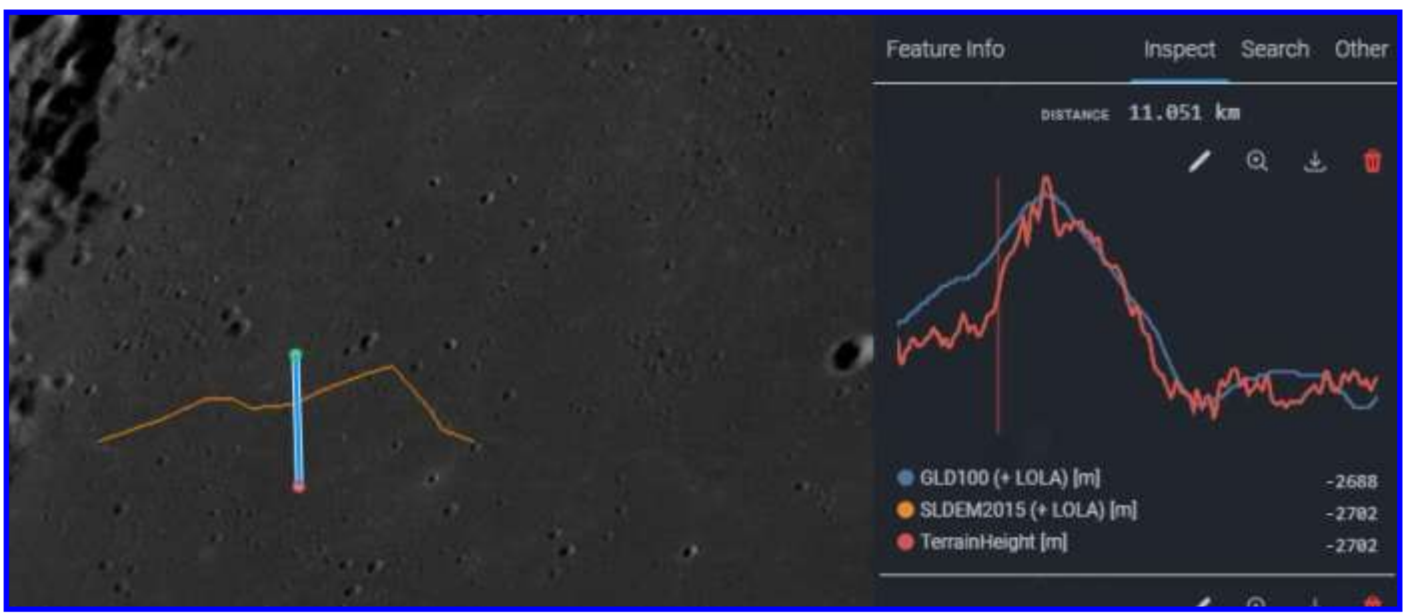


Image 4, Dorsa Sinus Iridum *(number 4, image 2), LROC Quickmap.*

Lunar Topographic Studies

Lastly, I don't know what the darker spot seen in the western sector (left) is due to, framed in bright lines, I estimate that it corresponds to differences in the types of lavas present in Sinus Iridum (easier to observe near full moon), and that, hypothetically, we could locate in IMAGE 5, in which we marked with an arrow a darker area that would correspond to what we marked (and the bright edges that I marked would be somewhat illusory, by contrast).

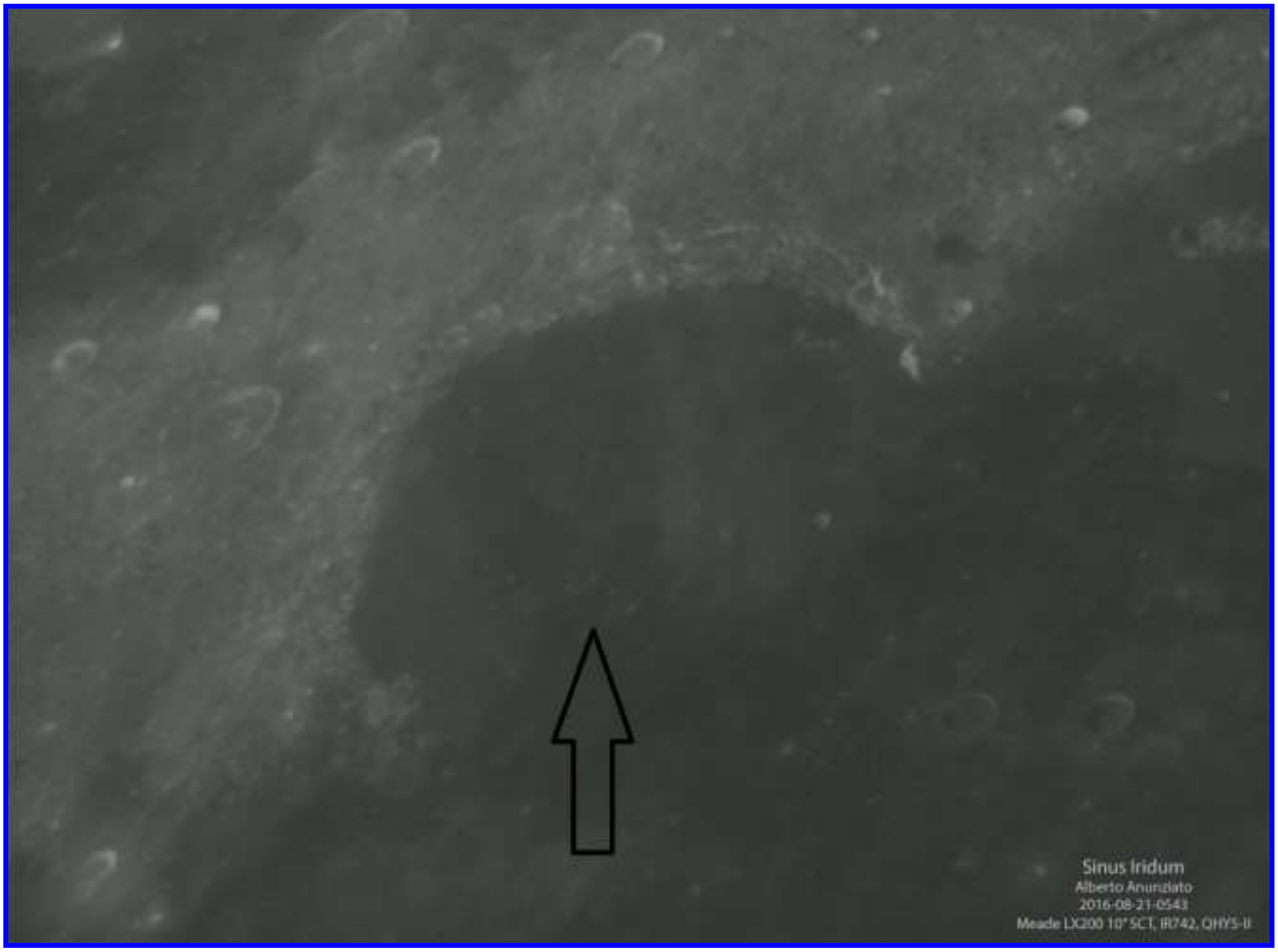


Image 5, Sinus Iridum, *Alberto Anunziato, Oro Verde, Argentina. 2016 August 21 05:43 UT. Meade LX200 10 inch Schmidt-Cassegrain telescope, Astronomik ProPlanet 742 nm IR-pass filter, QHY5-II camera.*

Lunar Topographic Studies

Lunar Disclosure

Guillermo Scheidereiter

Someone asks me for an explanation of the Moon.

With great enthusiasm, I tell him about its formation, orbital movement, composition and selenography.

-I haven't understood a single word -he tells me, stupefied.

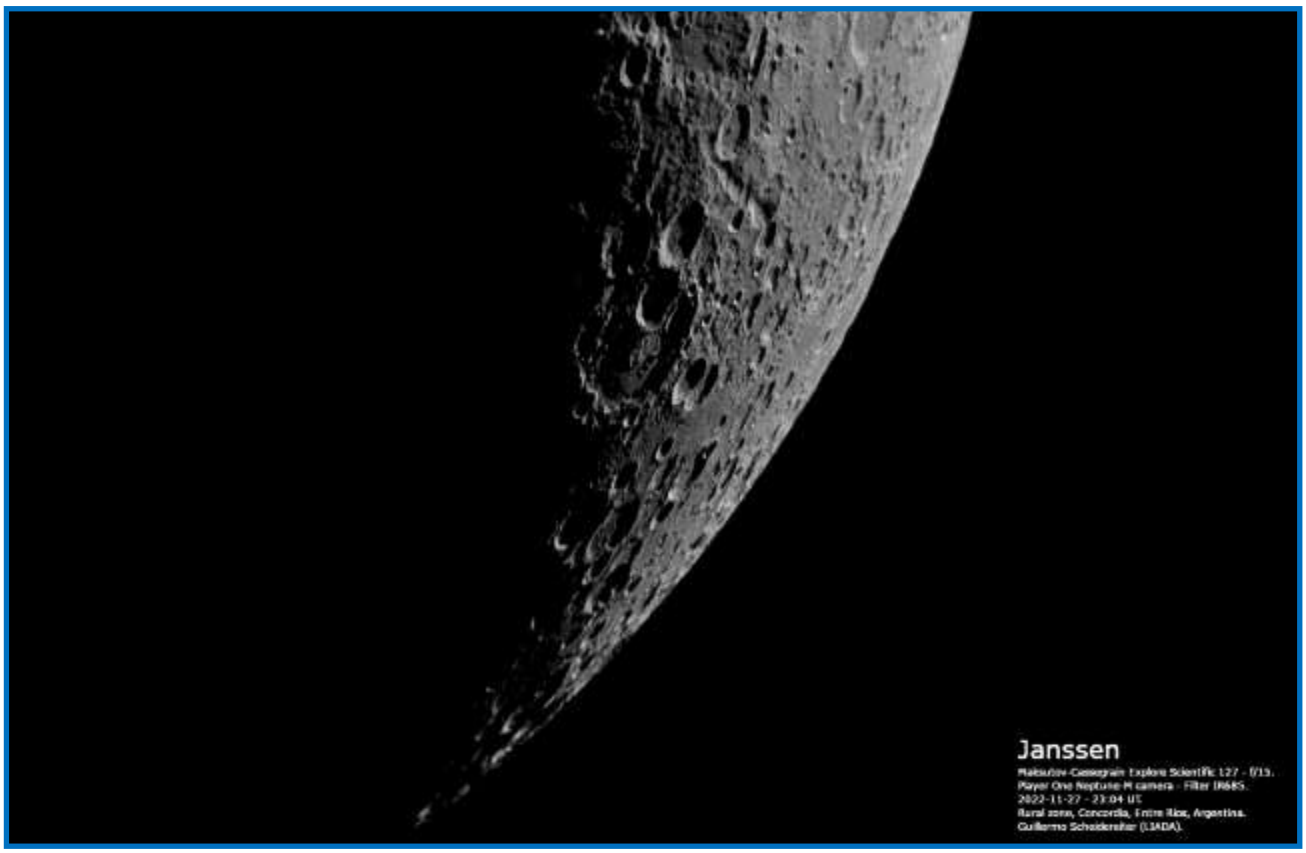
I reflect for a few moments and then, with less enthusiasm, I give a less technical explanation, preserving the formation of some crater, but explaining about their phases, turns and librations.

-I understand almost everything -my friend tells me, quite happily-. But there's something I still don't understand: that physics of cratering, those librations...

Depressed, I plunge into a long mental concentration and end up abandoning impact physics, selenography and librations forever; with true ferocity, I dedicate myself exclusively to the phases, to speak of a mere disc in the sky that revolves around the Earth, lights and shadows.

-Now yes, now I understand the Moon! -exclaimed my friend with joy.

-Yes -I answer bitterly-, but now it is no longer the Moon.



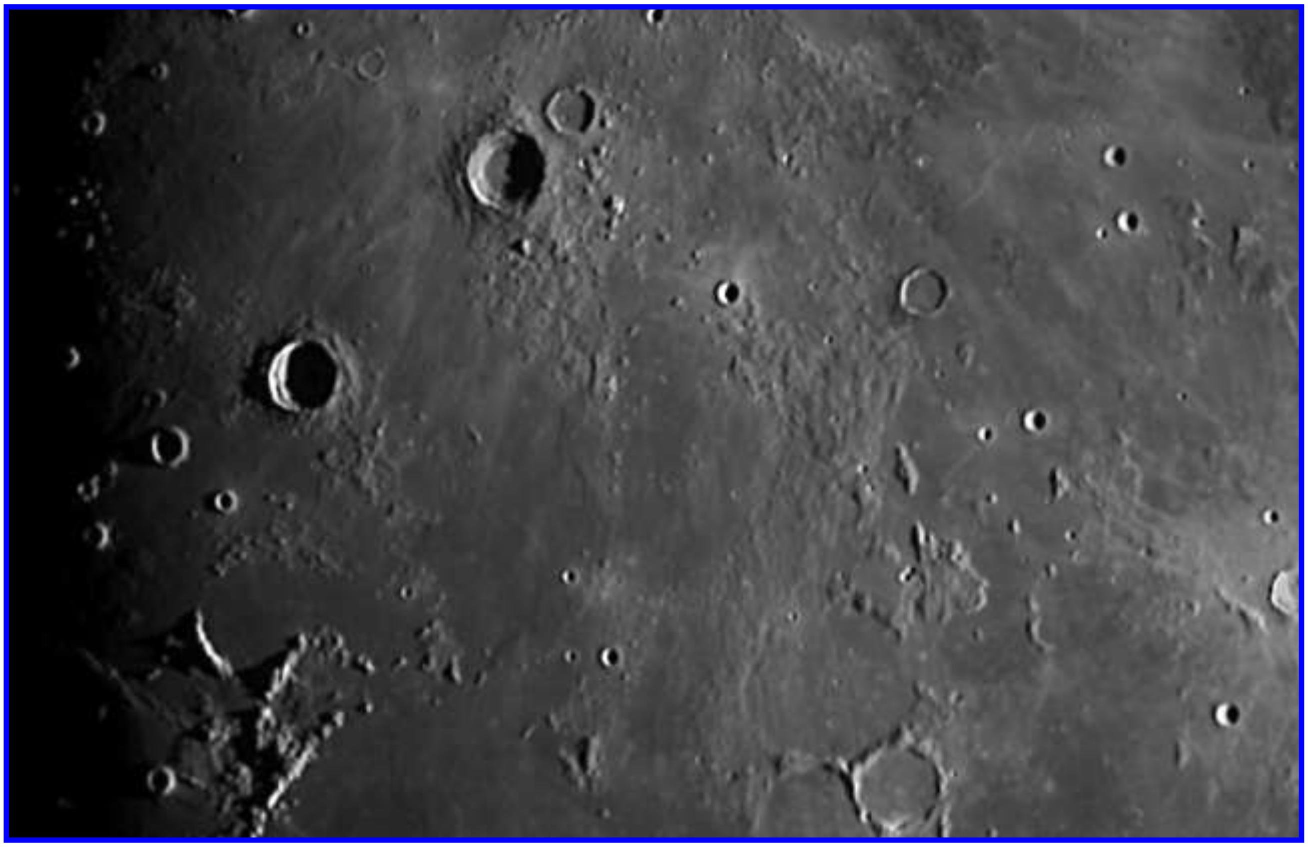
Janssen Crater, Lunar South.

Observation: Lunar Disclosure is ***completely*** inspired by "Disclosure" by the Argentine physicist and writer Dr. Ernesto Sábato, published in the essay One and the Universe, published in 1945.

Lunar Topographic Studies

Exploring the Sea of Isles and the Known Sea

David Teske



Fra Mauro Region, *David Teske, Louisville, Mississippi, USA. 2022 May 11 01:14 UT, colongitude 28.4º. 4 inch f/15 refractor telescope, IR/UV cut filter, ZWO ASI 120 mm/s camera. Seeing 8/10.*

In this image to the south of magnificent Copernicus we see the crater Reinhold (48 km) with nicely terraced walls and to its southwest (lower left), Lansberg (39 km), a similar but slightly smaller crater. These two craters are in Mare Isularum, the Sea of Isles. There seems to be a fuzzy boundary between this Mare and Mare Cognitum, the Known Sea, named such after the successful flight of Ranger 7 in 1964 when it crashed into this area sending back the first lunar close-up images of the Space Age. The western edge of Mare Cognitum is Montes Riphaeus, a range of mountains seen at the bottom right of the image. Euclides P is the large crater (64 km) at the north end of Montes Riphaeus that has its northern wall missing. To the upper left of Euclides P are the craters Lansberg C (20 km), Lansberg B (10 km) and Lansberg D (10.5 km) near the terminator. Between Lansberg D and Euclides P are two domes around 10 km in diameter. Domes like these are only seen when near terminator.

Southeast of Lansberg in a rather nondescript lunar region of Mare Insularum is a region of interesting lunar exploration. On April 20, 1967, Surveyor 3 landed. This robotic explorer made a soft landing and imaged its surroundings and used a soil mechanics surface sampler to test the lunar soil. Apollo 12 was tasked with landing near the Surveyor 3 spacecraft a couple years later. Though Apollo 11 missed its targeted landing area by a few kilometers, it was determined that Apollo 12 would have a precise landing so that future landings could be carried out.

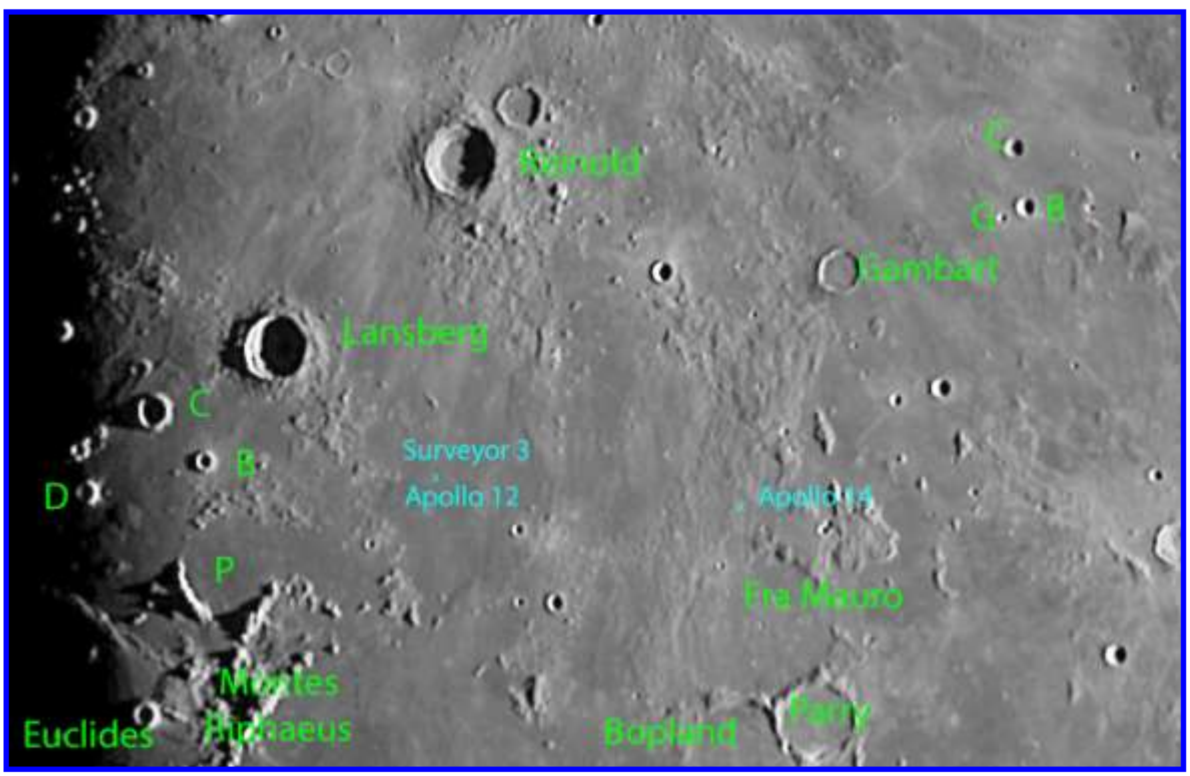
Lunar Topographic Studies

On November 19, 1969, Charles "Pete" Conrad and Alan L. Bean landed in this area while Richard F. Gordan orbited above. Upon landing on the other side of "Surveyor Crater", Conrad and Bean walked to the now defunct Surveyor 3 to examine it and to take back its camera and 33.45 kg of lunar samples along with finding evidence of the formation of Copernicus 810,000,000 years ago.

Following the Apollo 13, Apollo 14 landed not too far away from Apollo 12, this time in the Fra Mauro Formation. Fra Mauro is the very large (95 km) diameter ruined crater at the lower right of the image. Its floor has a rille running through it north to south, Parry (48 km) is adjacent to the southeast edge of Fra Mauro and has a complete wall around its hexagon shaped flooded floor and Bonpland (60 km) is straight south of Fra Mauro and has its bottom half cut off of this image. Just north of Fra Mauro in the highlands was the landing site of Apollo 14, the first mission in the lunar highlands. On February 5, 2022 Alan B. Shepard and Edgar D. Mitchell landed in the Fra Mauro highlands while Stewart A. Roosa orbited above in the command module. Shepard and Mitchell returned 94 kg of mostly lunar breccias from the lunar surface. They also returned the rock Big Bertha at 8.998 kg which a 2018 study suggests was an Earthly meteorite as it contained granite and quartz which are rare on the Moon.

North of Fra Mauro in the upper right section of the image was sits the crater Gambart (25 km) looking like a smaller version of Parry discussed above. To the northeast of Gambart sits a trio of small crisp craters, Gambart B (11 km), Gambart B (11.5 km) and Gambart C (12 km). Between them is a dome that does not show as prominently as the domes near Lansberg as it is farther from the terminator. Just to the northeast of this is the crash site of Surveyor 2, which failed to land properly on September 20, 1966.

There is a wealth of detail to see across the Moon. Mare Insularum and Mare Cognitum offer a wide variety of seas, craters, domes and rilles to explore with a small telescope. As you ponder this area, think of the various missions that have landed here in the past.



Lunar Topographic Studies

The Ridge that Crosses Scheele Arc

Alberto Anunziato

The area that IMAGE 2 tries to show is at the southern end of Oceanus Procellarum, a little further north of Gassendi. It is an area of incredible wrinkle ridge density, running east to west and north to south, there are also a large number of isolated peaks and mountain ranges, remnants of the region's ancient topography before the lava flood and an indication that its density is lower. It's a beautiful area in the terminator, it gives a certain feeling of a landscape dominated by ancient ruins, a melancholic landscape. What caught my attention was a wrinkle ridge that seemed to penetrate into an ancient crater, or the ruins of an ancient crater. Those who have the beautiful Atlas of the Moon by Antonin Rükl and Gary Seronik can get to know the area by looking at Chart 41. The area is unofficially known as Scheele Arc and would be formed either by the remains of an ancient crater or by rock formations isolated that form the image of a crater. The west and east sides are rock formations that look like a crater wall. What would be the south wall is actually part of Dorsa Ewing, the segments we observed in IMAGE 1 looked slightly bright, without details.

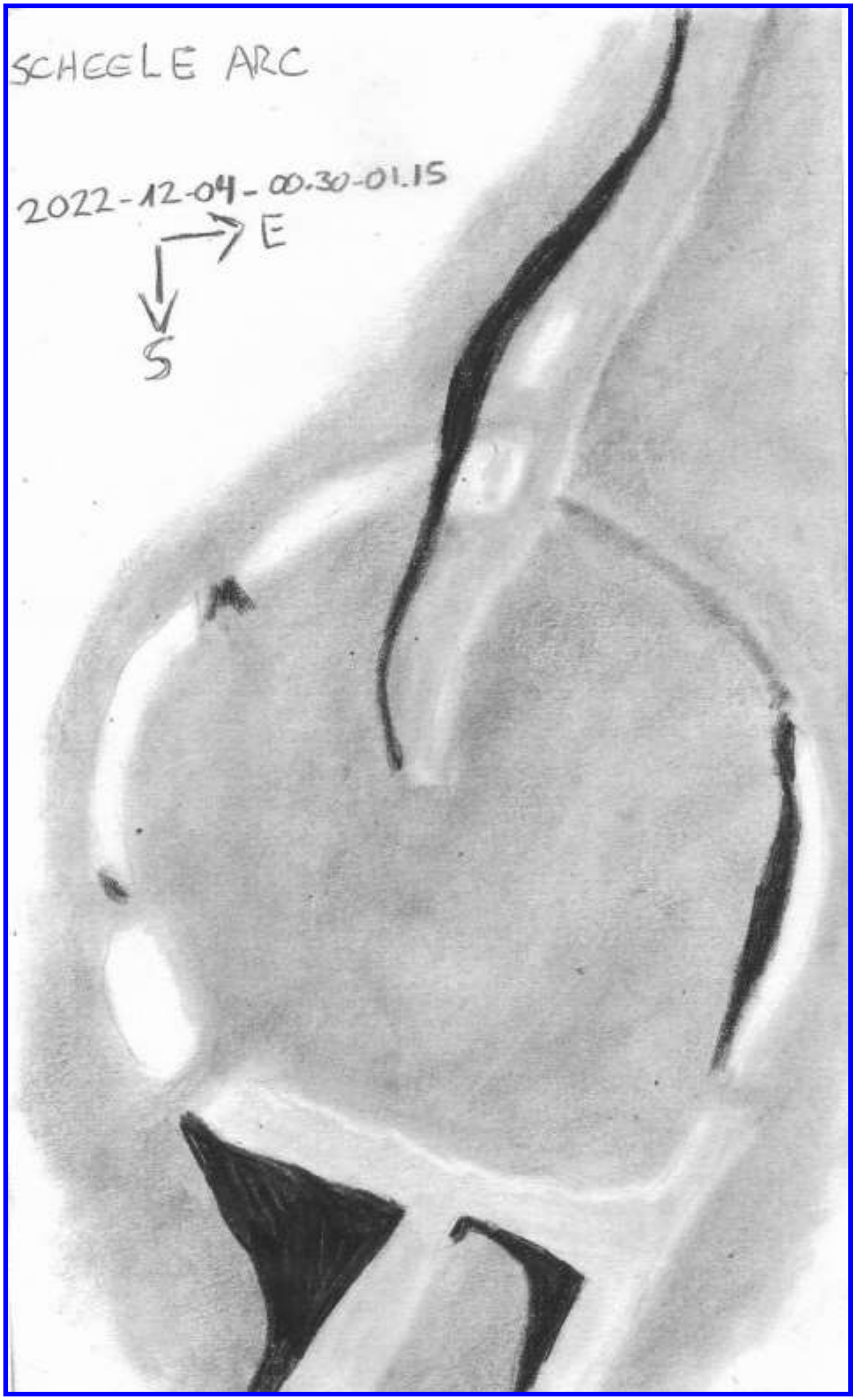


Image 1, Dorsa Scheele, *Alberto Anunziato, Paraná, Argentina. 2022 December 04 00:30 –01:15 UT. Meade EX 105 Maksutov-Cassegrain telescope, 154x.*

Lunar Topographic Studies

The northern wall has two segments, the eastern segment does not exist, but visually it was perceived as a darker segment than the floor of the area (optical illusion to mentally complete the crater shape? Submerged relief?); the western segment is a rock formation that seemed to be intersected by the dorsum or, more likely, to be integrated into it. The IMAGE 1 ridge segment is part of a larger ridge, extending to the north. The two bright areas that can be seen, and that at the time I registered as possible crests (although the low height, deducible due to the shadow, made it difficult to distinguish the crest or upper part) they actually are rocky elevations that interrupt the ridge, as we see in IMAGE 2, obtained with the Lunar Reconnaissance Orbiter Quickmap Map of Lunar Wrinkle Ridges. Here I surely perceived as a continuity what are actually separate segments, interrupted by parts of the now-defunct crater walls.

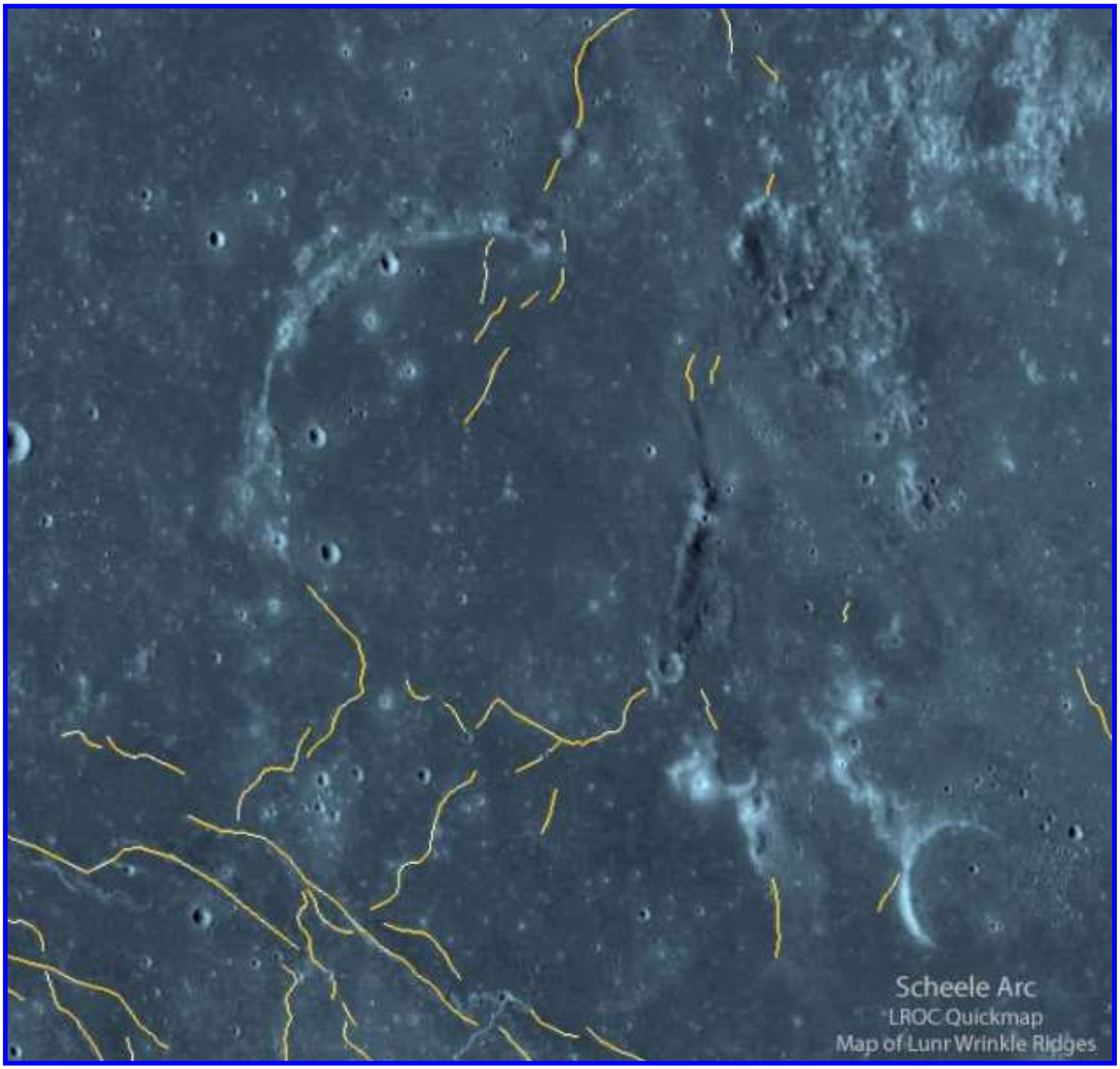


Image 2, Dorsa Scheele, *LROC Quickmap Map of Lunar Winkle Ridges.*

Lunar Topographic Studies

Focus-On: Land of Cracks: Petavius

Alberto Anunziato

Petavius is, in Elger's words: "a noble walled-plain, with a complex rampart, extending nearly 100 miles from N. to S., which encloses a very rugged convex floor, traversed by many shallow valleys, and includes a massive central mountain and one of the most remarkable clefts on the visible surface". A perfect summary, almost everything else that follows is superfluous (what a beautiful book "The Moon" is!). Another great book is "Luna Cognita" and from there we extract a more detailed description, which we will use to highlight the incredibly varied topography of our crater. Garfinkle also defines it spectacularly: "This is one of the most spectacular and complex lunar craters to observe, because of its varied terrain and the deep straight rille, Rima Petavius I, which slashes across its western floor from the central peak complex to base of the southwestern Wall".

Image 1, Petavius to Langrenus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2012 October 30 05:30 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, DMK21AU04 camera. Seeing 7/10.*

Let's start with the walls (Garfinkle): "The walls are multi-terraced and contains several peak crests on the eastern wall that reach up to about 3352 m (11,000 feet) above the crater floor". In IMAGE 2 and 3 we see the progression of the Sun rising over Petavius, the ideal moment to appreciate the profile of the highest peaks of the walls due to the long shadows they cast. In the detail of IMAGE 2 the arrows indicate what would be the highest peaks not only of the eastern wall but also of the western wall, which is more clearly perceived in the detail of IMAGE 3. What we see in detail in previous images, we see it in perspective in IMAGE 4, with another illumination, clearly the east wall is higher and more terraced than the west, which we also see in IMAGE 5, in which the difference between the terraced east wall, full of brightness in the high areas, and dark areas and the most homogeneous west wall; in the words of Garfinkle: "The western walls are noticeably lower than the eastern walls", and Elger: "The terraces, however, on the W. "(east, in the modern lunar terminology) "are much more numerous, and, with the associated valleys, render this section of the wall one of the most striking objects of its class" (IMAGE 6) and "The southern walls barely rise above the surrounding highlands", we can check it in IMAGE 7, the south is at the bottom of the image.

Image 2, Petavius, *David Teske, Louisville, Mississippi, USA. 2020 October 04 07:08 UT, colongitude 115.2°. 4 inch f/15 refractor telescope, 1.5x barlow, IR block filter, ZWO ASI120MMs camera. Seeing 7/10.*

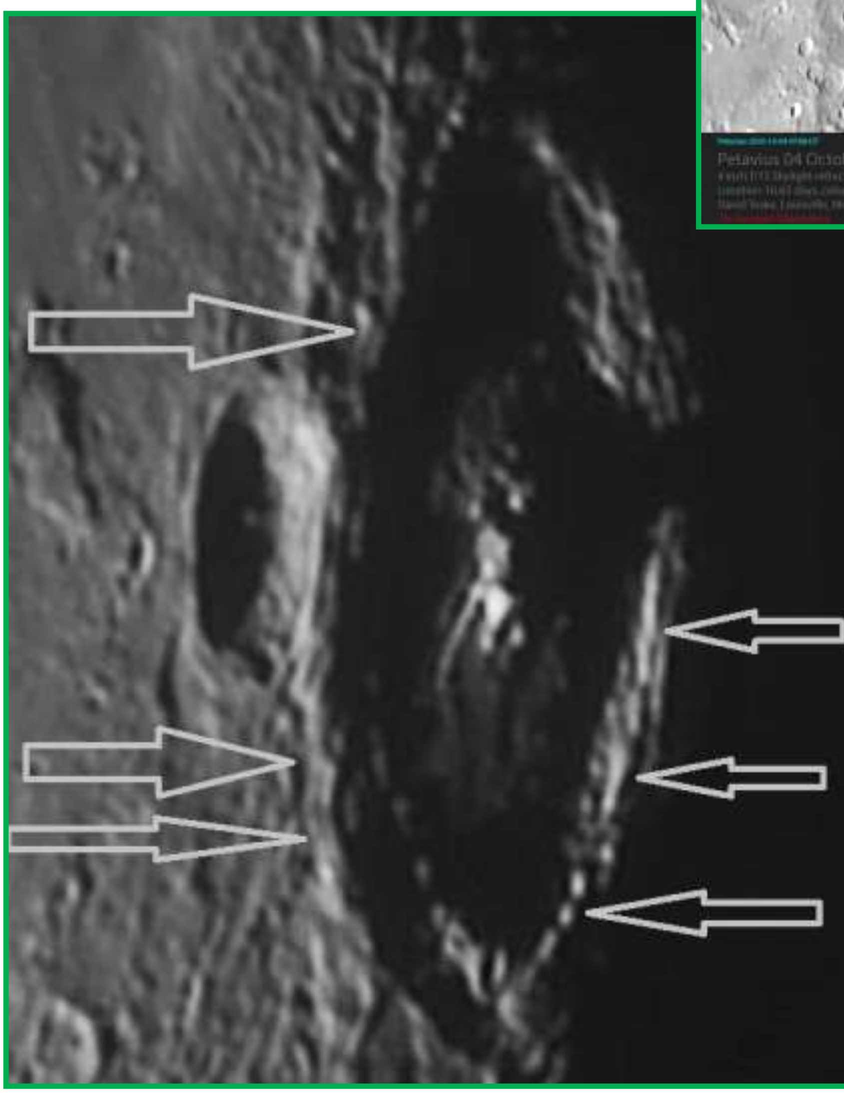


Image 2-detail, Petavius, *David Teske, Louisville, Mississippi, USA. 2020 October 04 07:08 UT, colongitude 115.2°. 4 inch f/15 refractor telescope, 1.5x barlow, IR block filter, ZWO ASI120MMs camera. Seeing 7/10.*

Image 3, Langrenus and Petavius, *David Teske, Louisville, Mississippi, USA. 2022 August 14 08:21 UT, colongitude 112.5°. 4 inch f/15 refractor telescope, IR block filter, ZWO ASI120MMs camera. Seeing 7/10.*

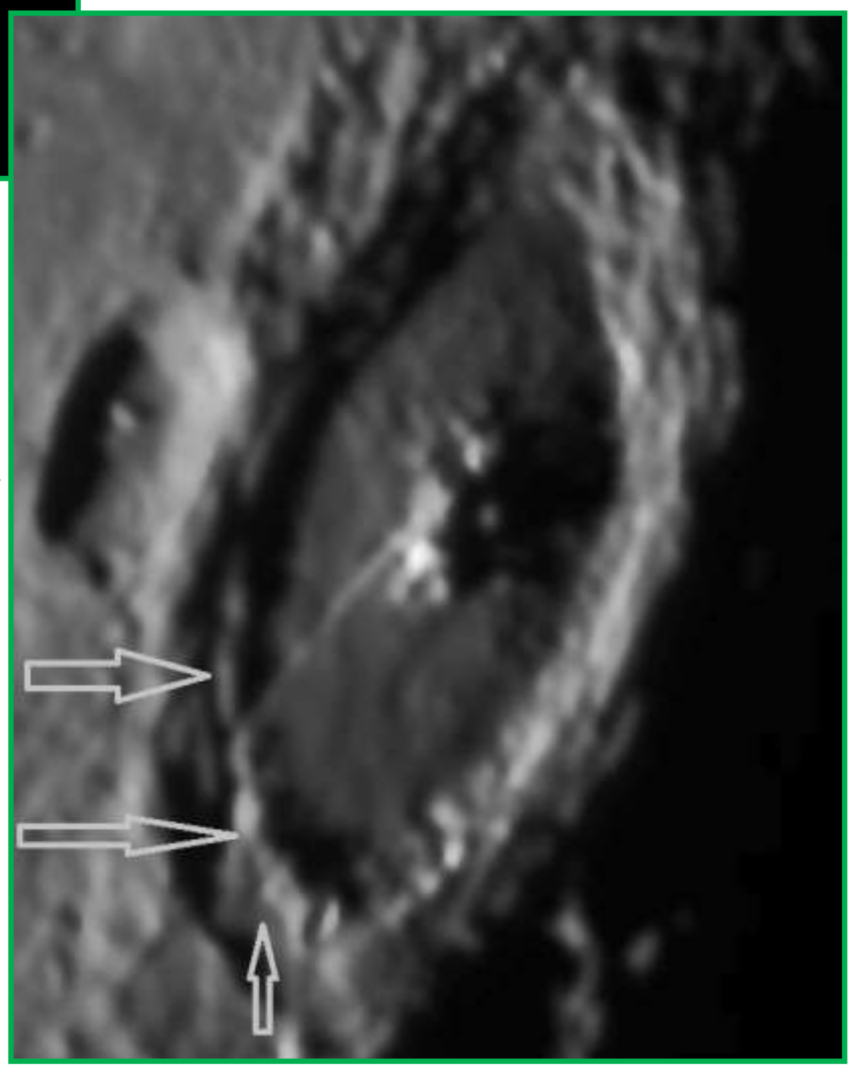


Image 3-detail, Langrenus and Petavius, *David Teske, Louisville, Mississippi, USA. 2022 August 14 08:21 UT, colongitude 112.5°. 4 inch f/15 refractor telescope, IR block filter, ZWO ASI120MMs camera. Seeing 7/10.*

Focus-On: Land of Cracks, Petavius

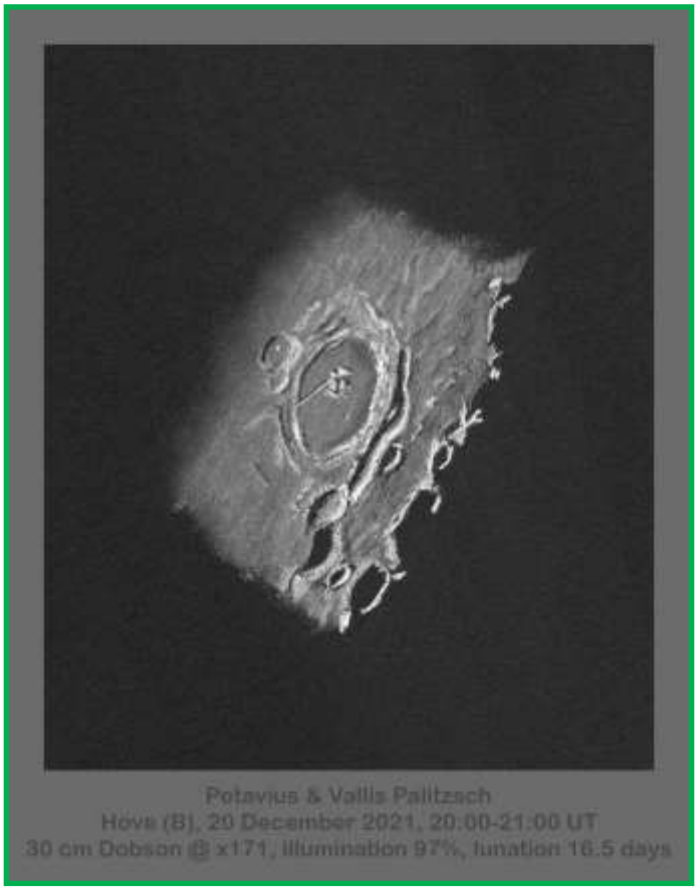


Image 4, Petavius*, Jef De Wit, Hove, Belgium. 2021 December 20 20:00-21:00 UT. 30 cm Dobsonian reflector telescope, 171x.*

Image 5, Petavius, *Alberto Anunziato, SLA, Oro Verde, Argentina. 2018 March 04 07:49 UT. Celestron CPC 1100 Schmidt-Cassegrain telescope, Canon EOS Digital Rebel XS camera.*

Focus-On: Land of Cracks, Petavius

Image 6, Petavius to Rheita, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2007 June 19 03:50 UT. Celestron 14 inch Schmidt-Cassegrain telescope, 1.6x barlow, UV/IR filter, SPC900NC camera. Seeing 6/10.*

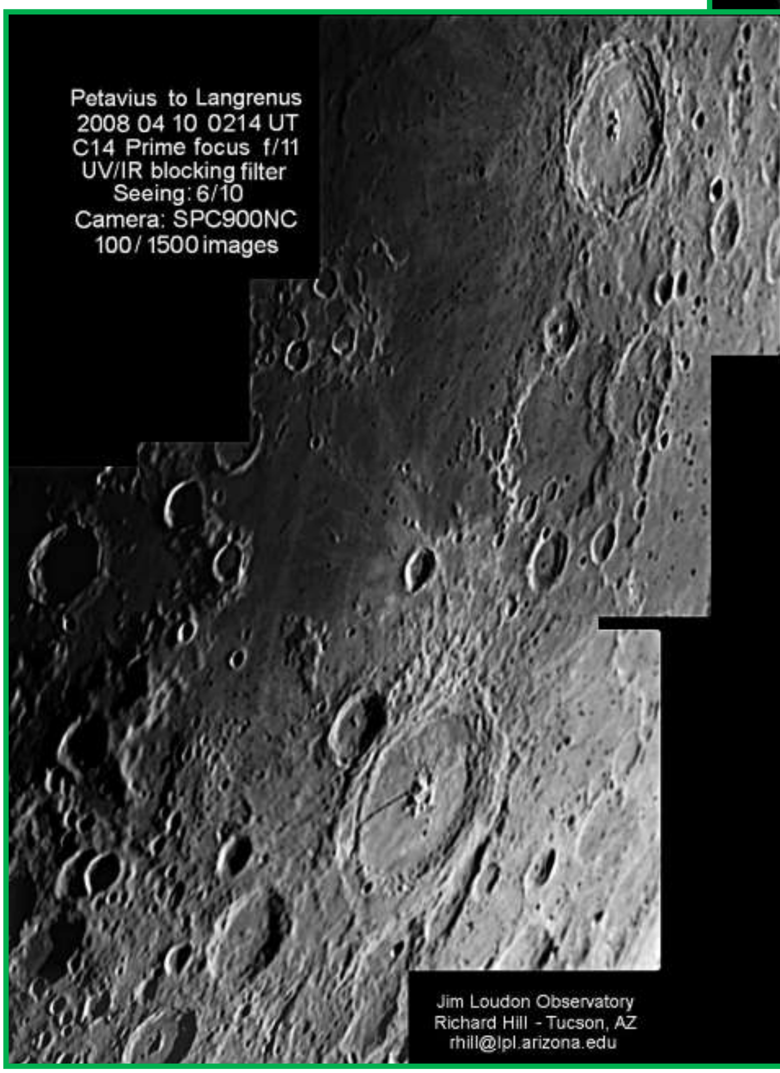


Image 7, Petavius to Langrenus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2008 April 10 02:14 UT. Celestron 14 inch Schmidt-Cassegrain telescope, UV/IR filter, SPC900NC camera. Seeing 6/10.*

Focus-On: Land of Cracks, Petavius

The east and west walls are very different from each other, so are the north and south walls, as described by Elger: "The N. border is conspicuously broken by the many valleys from the region S. of Vendelinus, which run up to and traverse it" (IMAGE 8). "On the S., also, it is intersected by gaps, and in one place interrupted by a large crater. There is a remarkable bifurcation of the border S. of Wrottesley. A lower section separates from the main rampart and, extending to a considerable distance S.E. of it, encloses a wide and comparatively level area which is crossed by two short clefts". IMAGE 9 is very illustrative, if we go to the lower area of Petavius we see Petavius C (11 km in diameter) in the center of the degraded south wall, on the left, if we go to the west wall, which borders Wrottesley, which is the huge 58 kilometer diameter crater on the left, we can see that the area described by Elger extends between Wrottesley and Snellius, the neighbor to the south.

Image 8, Petavius, *Alberto Anunziato, SLA, Paraná, Argentina, SLA. 2019 September 15 04:02 UT. 180 mm Newtonian reflector telescope, QHY5-II camera.*

Image 9, Petavius to Langrenus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2008 May 08 22:02 UT. Celestron 14 inch Schmidt-Cassegrain telescope, UV/IR filter, SPC900NC camera. Seeing 6/10.*

We continue with the description of Garfinkle: “Under low-angle illumination, the convexity of the floor can be detected. The central area of the crater floor is about 240 m (800 feet) higher than at the base of the interior walls”, which we can clearly see in IMAGE 10. In the IMAGE 3 and especially in the IMAGE 2 (and their details) we see how the central zone is the one that emerges first from the shadows, which we can take as an indication that this central zone is higher than the edges. Let's look at IMAGE 11 and IMAGE 12: we have a perspective that shows that the Petavius’s floor has been resurfaced by lava flow: there are no visible craters in the interior, with the exception of Petavius A (5 km in diameter). Another of the characteristics of the Petavius soil is that it has lighter areas and darker areas. Let's see IMAGE 13 to 16 and 8. There are dark spots on the northern edge (the largest and most noticeable), on the eastern edge, and on the southern. “Darkish, smooth spots are associated with the northern rilles, and a smooth spot at the southern end of the floor is now revealed for the first time to be associated with a shallow, pitted dome. Are the smooth patches volcanic pyroclastic (ash) deposits or mare lava flows? High Sun views show that the patches are as dark as mare lavas, but multi-spectral Clementine images show neither the blue of fresh mare material, nor the red of pyroclastics” (Wood, January 2004).

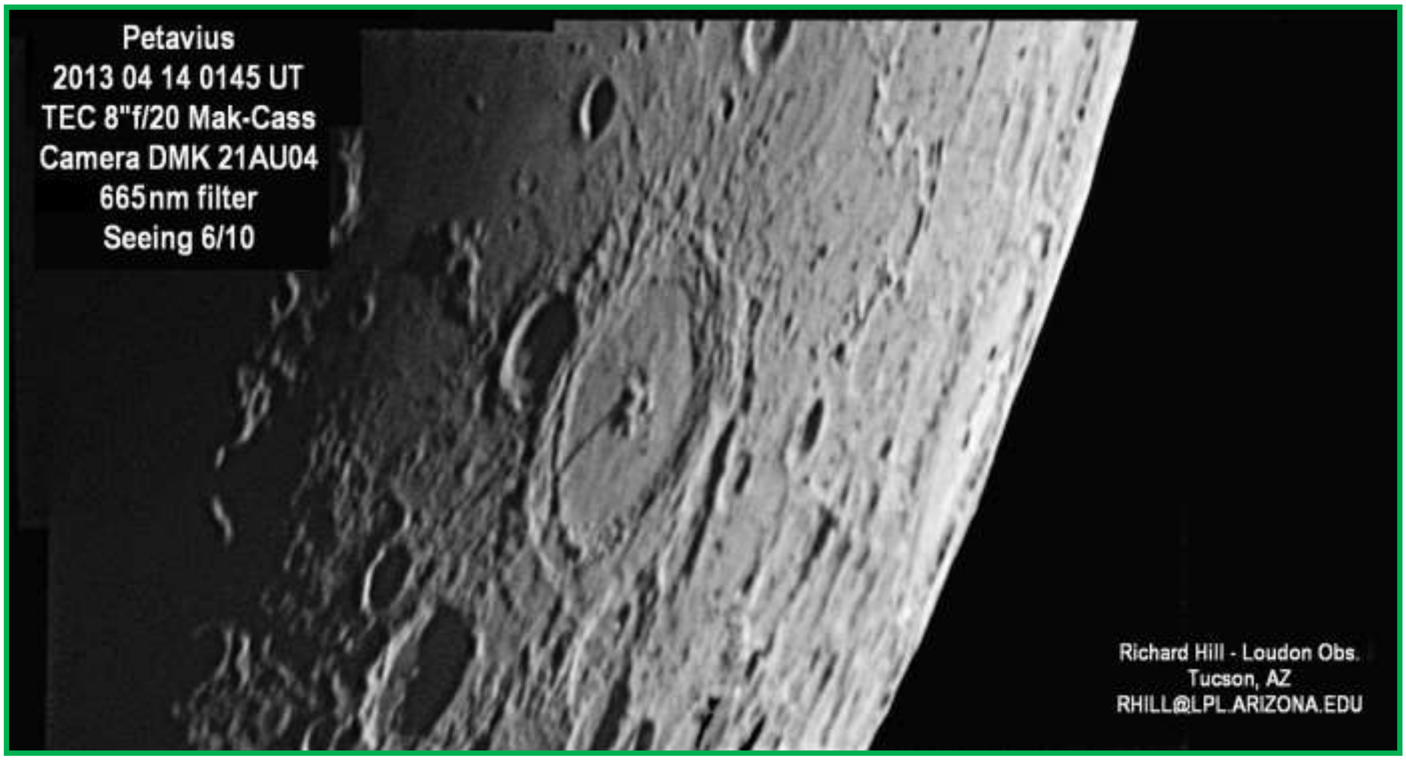


Image 10, Petavius to Langrenus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2013 April 14 01:45 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, DMK21AU04 camera. Seeing 6/10.*

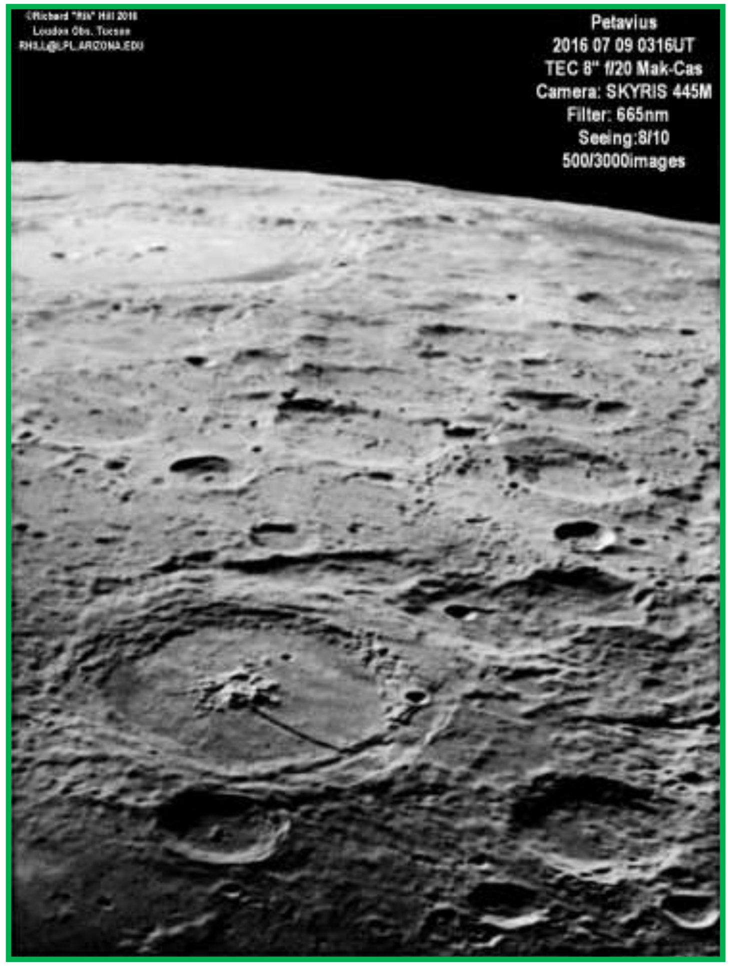


Image 11, Petavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2016 July 09 03:16 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 665 nm filter, Skyris 445M camera. Seeing 8/10. North is to the left.*

Image 12, Petavius, *Michel Deconinck, Artignosc-sur-Verdon - Provence - France . 2022 October 28 16:30 UT. Bresser 152 mm f/8 refractor telescope, 93 x. Seeing 5/10, transparency 5/6.*

Focus-On: Land of Cracks, Petavius

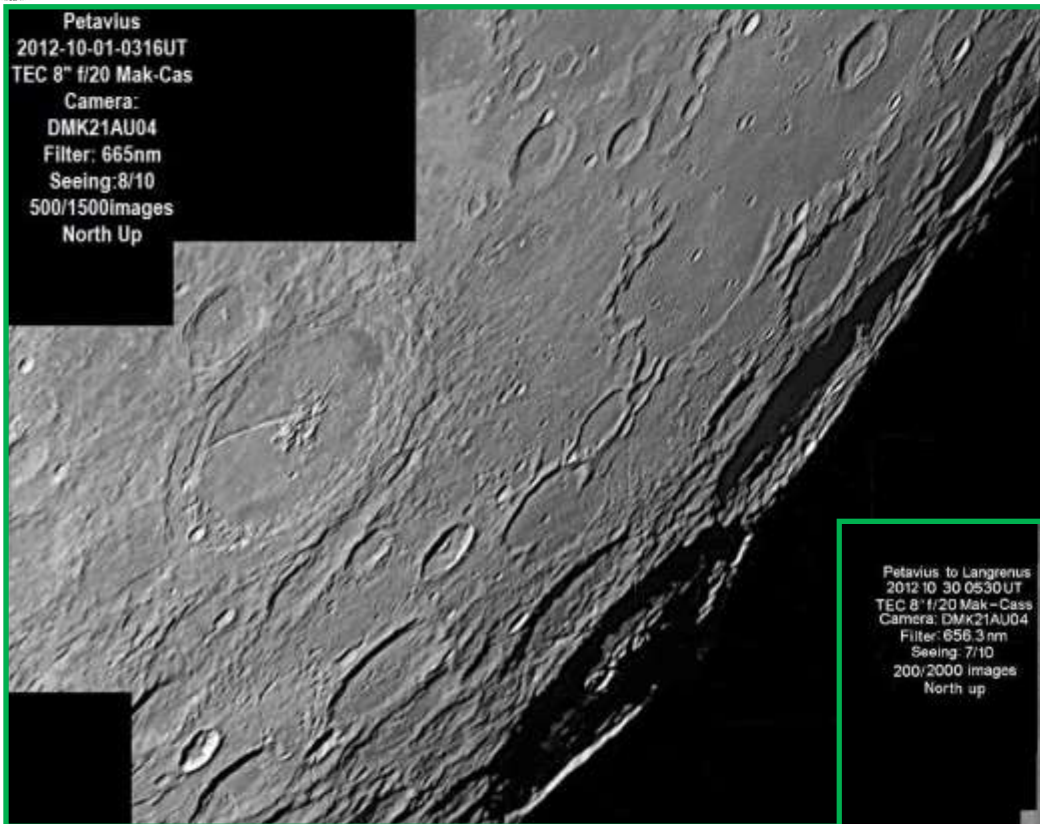


Image 13, Petavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2012 October 01 03:16 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 665 nm filter, DMK21AU04 camera. Seeing 8/10.*

Image 14, Petavius to Langrenus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2012 October 30 05:30 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, DMK21AU04 camera. Seeing 7/10.*

Focus-On: Land of Cracks, Petavius

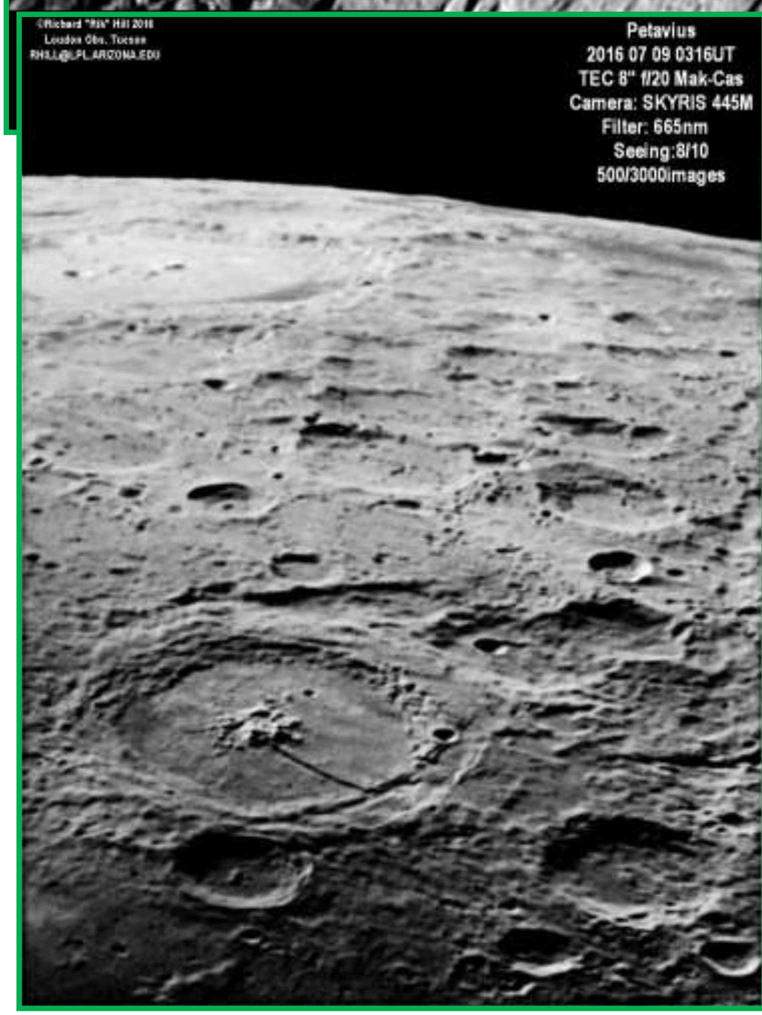


Image 15, Petavius to Langrenus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2016 April 12 03:16 UT. Questar 3.5 inch Maksutov-Cassegrain telescope, 665 nm filter, Skyris 445M camera. Seeing 8/10.*

Image 16, Petavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2016 July 09 03:16 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 665 nm filter, Skyris 445M camera. Seeing 8/10. North is to the left.*

Focus-On: Land of Cracks, Petavius

In the IMAGES 17 to 21 we clearly see what Charles Wood says regarding the association of the dark areas with cracks in the north and a dome in the south. Let's see with less frontal illumination the causes of the color differences. In IMAGE 22 we see that the north of the Petavius floor is crossed by a complicated network of rilles (DETAIL 1) and the south by numerous mounds and ridges and, touching the wall, a dome with a pit at its top (DETAIL 2). According to Charles Wood (September 2004): “At the southern end of the crater floor there is a broad and angular-edged region that could be a dome with an off-center rimless pit” (we mark it with the number 1). “If we call this a dome, what do we call the similar elevated but elongated area just to the left? ” (right in our image, marked with number 2). “The hilly areas east and to the north of the central peaks contain about a dozen rilles - some straight and others mildly sinuous. The northernmost portion of the floor is very smooth, as if it is very young lava flows. And Petavius holds the 15th largest (out of 75 tabulated) pyroclastic deposits”.

Image 17, Petavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2018 April 19 02:18 UT, colongitude 311.8°. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 610 nm filter, Skyris 445M camera. Seeing 7/10.*

Image 18, Petavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2018 September 13 01:53 UT, colongitude 306.1°. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 610 nm filter, Skyris 445M camera. Seeing 8/10.*

Image 19, Petavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2021 January 17 00:47 UT, colongitude 312.2°. Dynamax 6 inch Schmidt-Cassegrain telescope, 2x barlow, 665 nm filter, Skyris 132M camera. Seeing 7/10.*

Image 20, Petavius, *Larry Todd, Dunedin, New Zealand. 2020 June 07 10:23 UT. OMC200 telescope.*

Focus-On: Land of Cracks, Petavius

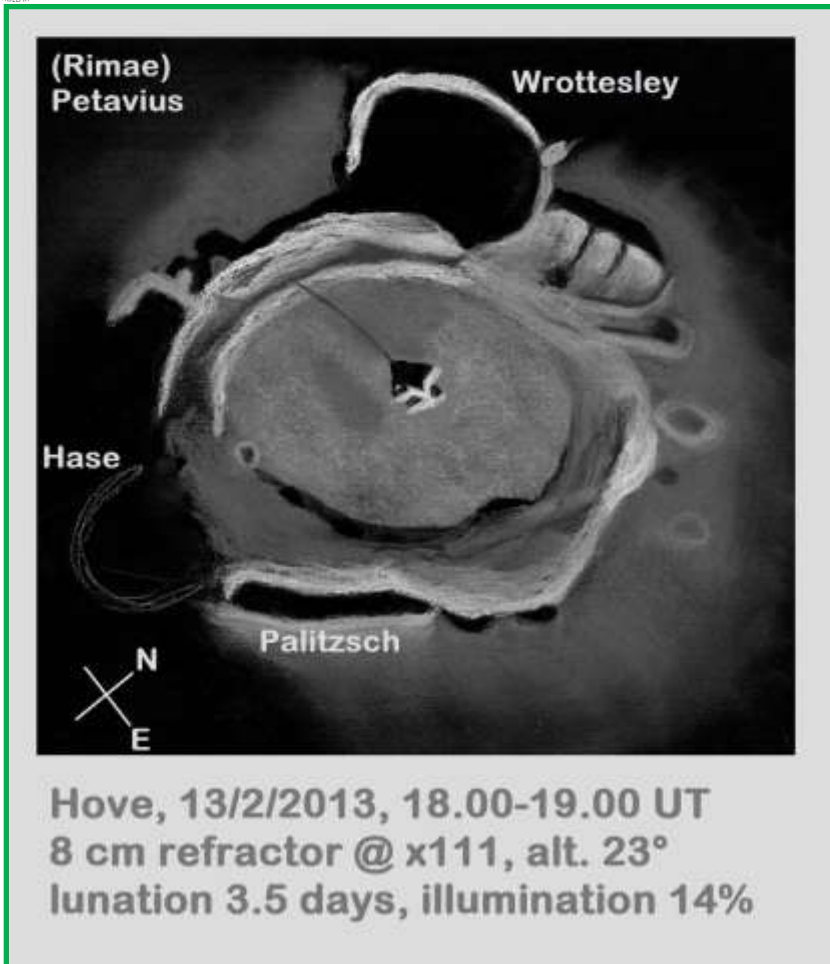


***Image 21, Petavius**, Jef De Wit, Hove, Belgium. 2013 February 13 18:00-19:00 UT. 8 cm refractor telescope, 111x.*

***Image 22, Petavius,** Massimo Bianchi, Milan, Italy. 2022 November 10 20:48 UT. Vixen VMC 260L catadrioptic telescope, UV-IR cut One Player Mars C II camera. Seeing 6/10, transparency 3/6.*

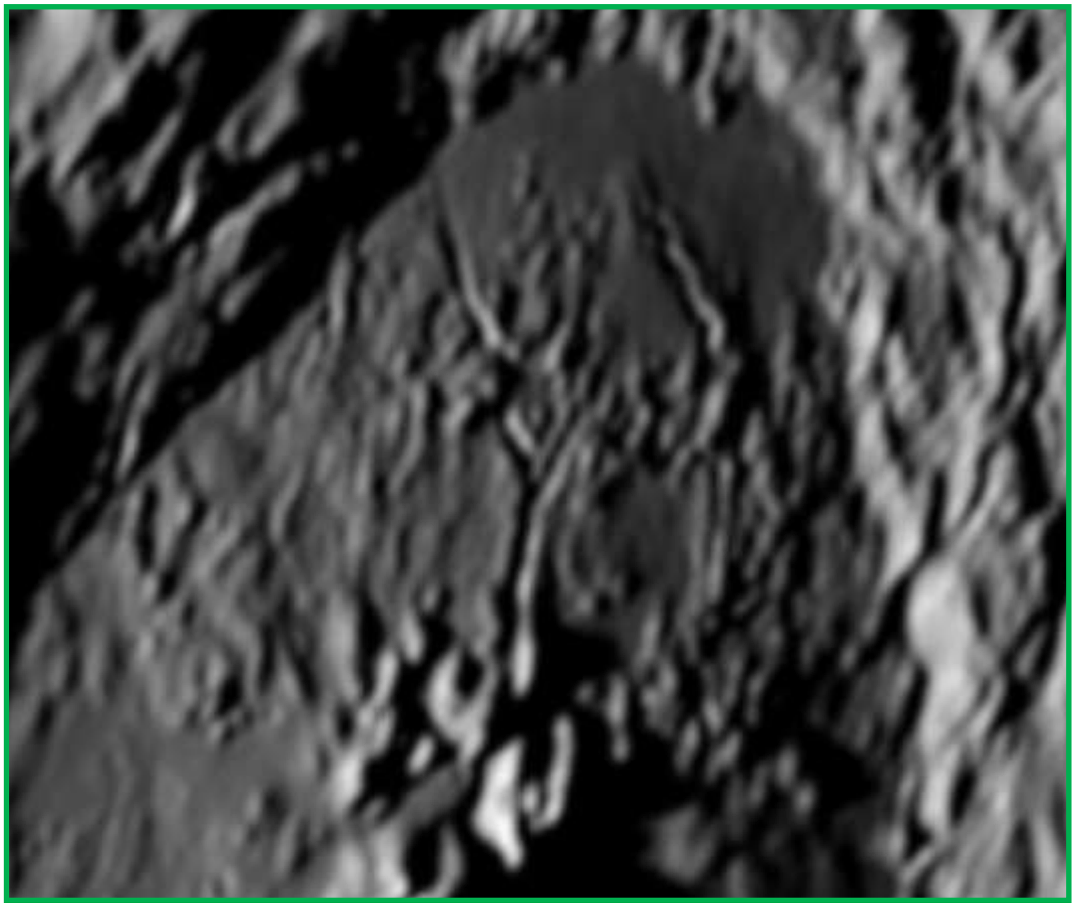


Image 22 detail 1, Petavius, *Massimo Bianchi, Milan, Italy. 2022 November 10 20:48 UT. Vixen VMC 260L catadrioptic telescope, UV-IR cut One Player Mars C II camera. Seeing 6/10, transparency 3/6.*

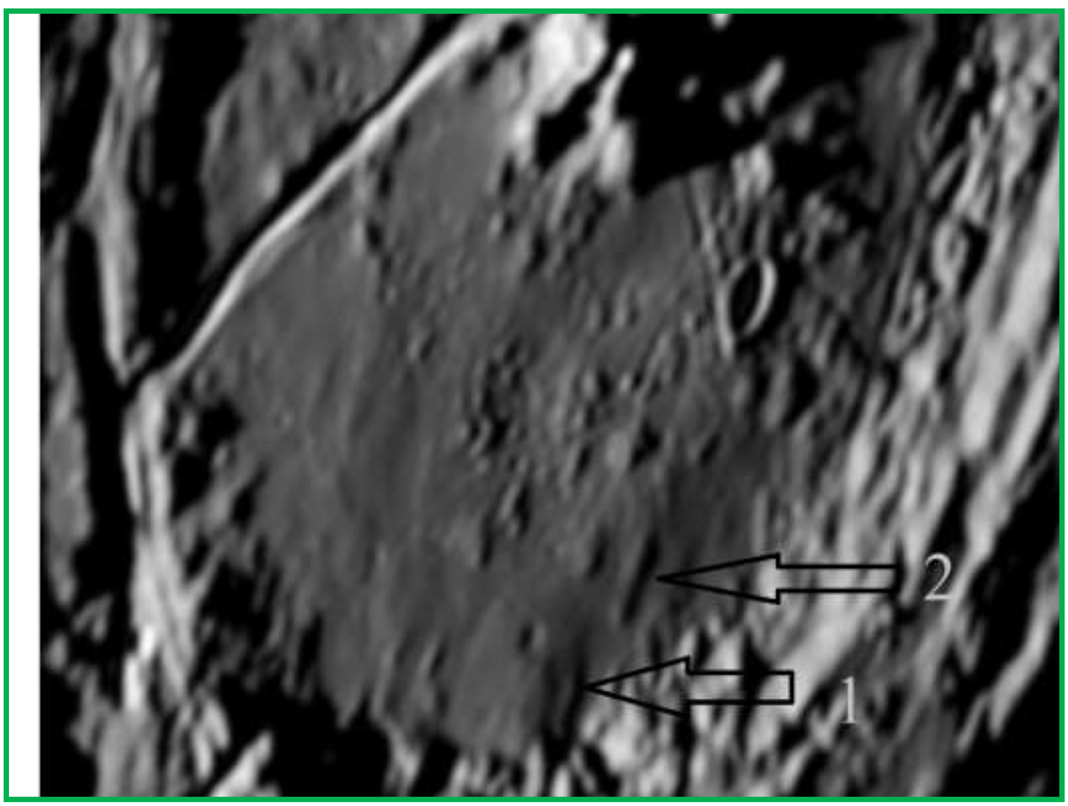


Image 22 detail 2, Petavius, *Massimo Bianchi, Milan, Italy. 2022 November 10 20:48 UT. Vixen VMC 260L catadrioptic telescope, UV-IR cut One Player Mars C II camera. Seeing 6/10, transparency 3/6.*

Image 23, Plinius, *KC Pau, Hong Kong, China. 2022 September 12 15:43 UT. 10 inch f/6 reflector telescope, 2.5x barlow, QHYCCD290M camera.*

Undoubtedly, what makes this crater unique is the splendid Rima Petavius (its official name is Rima Petavius I, to differentiate it from the other cracks in Petavius). Elger reminds us that: "The great cleft, extending from the central mountains to the S.E. wall, and perhaps beyond, was discovered by Schröter on September 16, 1788, and can be seen in a 2-inch achromatic". It is very interesting that almost two centuries have passed since the first telescopic lunar observation (1609) for an observer to recognize a feature that we can very easily observe with a small telescope, because we know it is there.

Garfinkle: "The rille is deeper near the wall than near the central peak", which we see very clearly in IMAGE 23 DETAIL, as well as we see that near the central mountains, in addition to being shallower, the rille is wider. "Near the central peak complex, the rille appears to have a levee-like ridge of material along its channel", what Elger calls "raised banks" (IMAGE 24), these "raised banks" are also seen in the central area, that in IMAGE 25 we see shining when receiving the first rays of the Sun at dawn in Petavius.

Image 23 detail, Plinius, *KC Pau, Hong Kong, China. 2022 September 12 15:43 UT. 10 inch f/6 reflector telescope, 2.5x barlow, QHYCCD290M camera.*

Image 24, Langrenus to Petavius

Image 24, Langrenus to Petavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2007 March 06 07:08 UT. Celestron 14 inch Schmidt-Cassegrain telescope, Wratten 21 filter, SPC900NC camera. Seeing 7/10.*

Image 25, Petavius to Langrenus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2008 May 08 22:02 UT. Celestron 14 inch Schmidt-Cassegrain telescope, UV/IR filter, SPC900NC camera. Seeing 6/10.*

Focus-On: Land of Cracks, Petavius

Charles Wood: “The Great Rille of Petavius is wider than any other rille in a lunar crater (I think) and is comparable to the width of some linear rilles such as the Ariadaeus (which is about twice as wide)”. In IMAGE 26 the width is noted by the density of the shadows. Charles Wood continues: “But unlike nearly all rilles its width, the Great Rille is mostly V-shaped, rather than flat-floored. Flat-floored rilles form under extensional conditions - forces pull apart the surface and parallel fractures form that the surface collapses into. I don’t think the Petavius rilles was ever like that. Often, a V-shape results from debris sliding down slope, perhaps this is what happened at the Great Rille. But I bet the story is more complicated for the size of the Great Rille is unique and its connections with the bizarre rille/ridge along the southwest crater wall are very uncertain” (Wood, December 2006).

In our images, we can see that the bottom of Rima Petavius is not flat in the section closest to the central peak, for example in IMAGE 23 and its DETAIL 23.

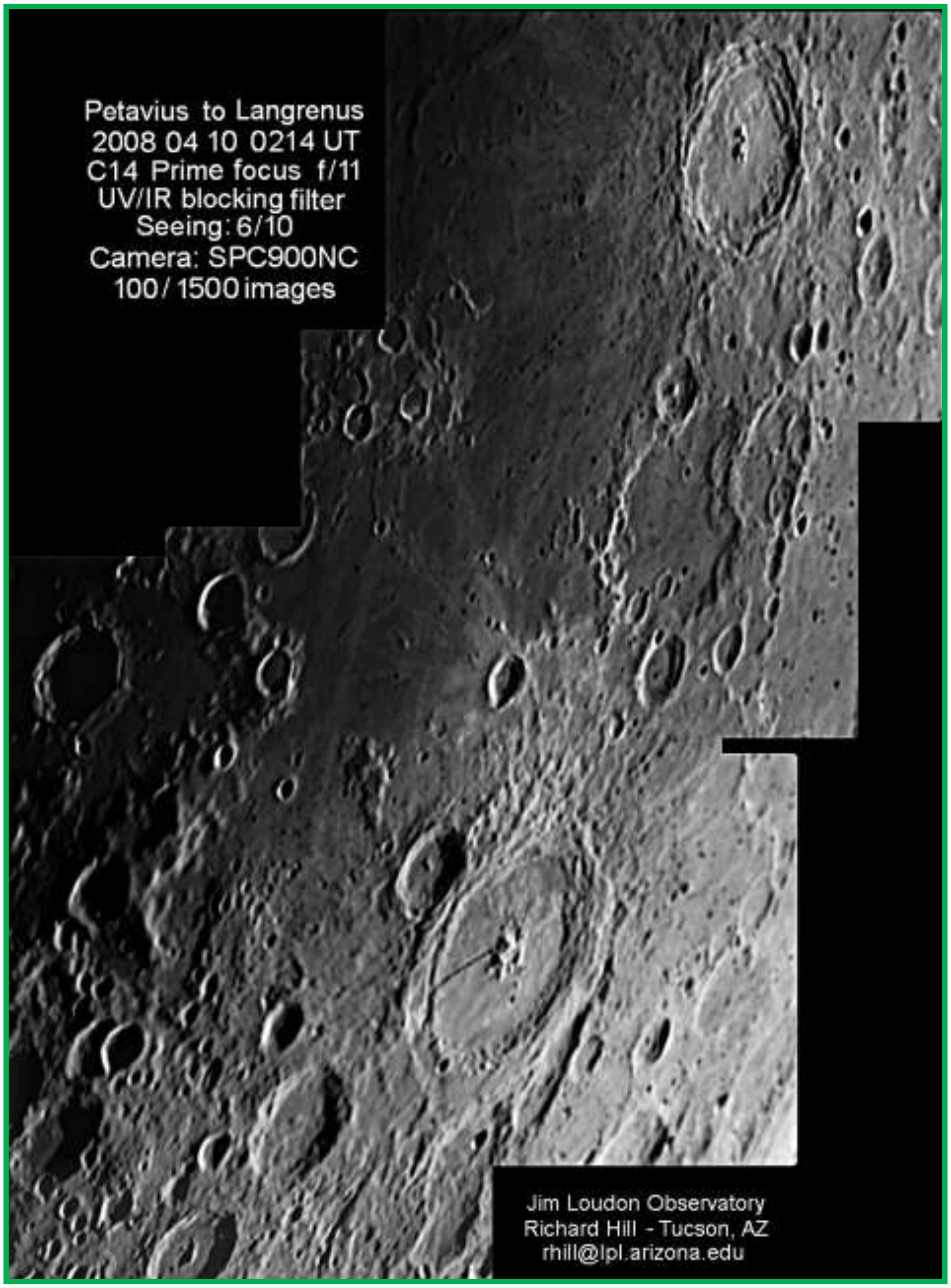
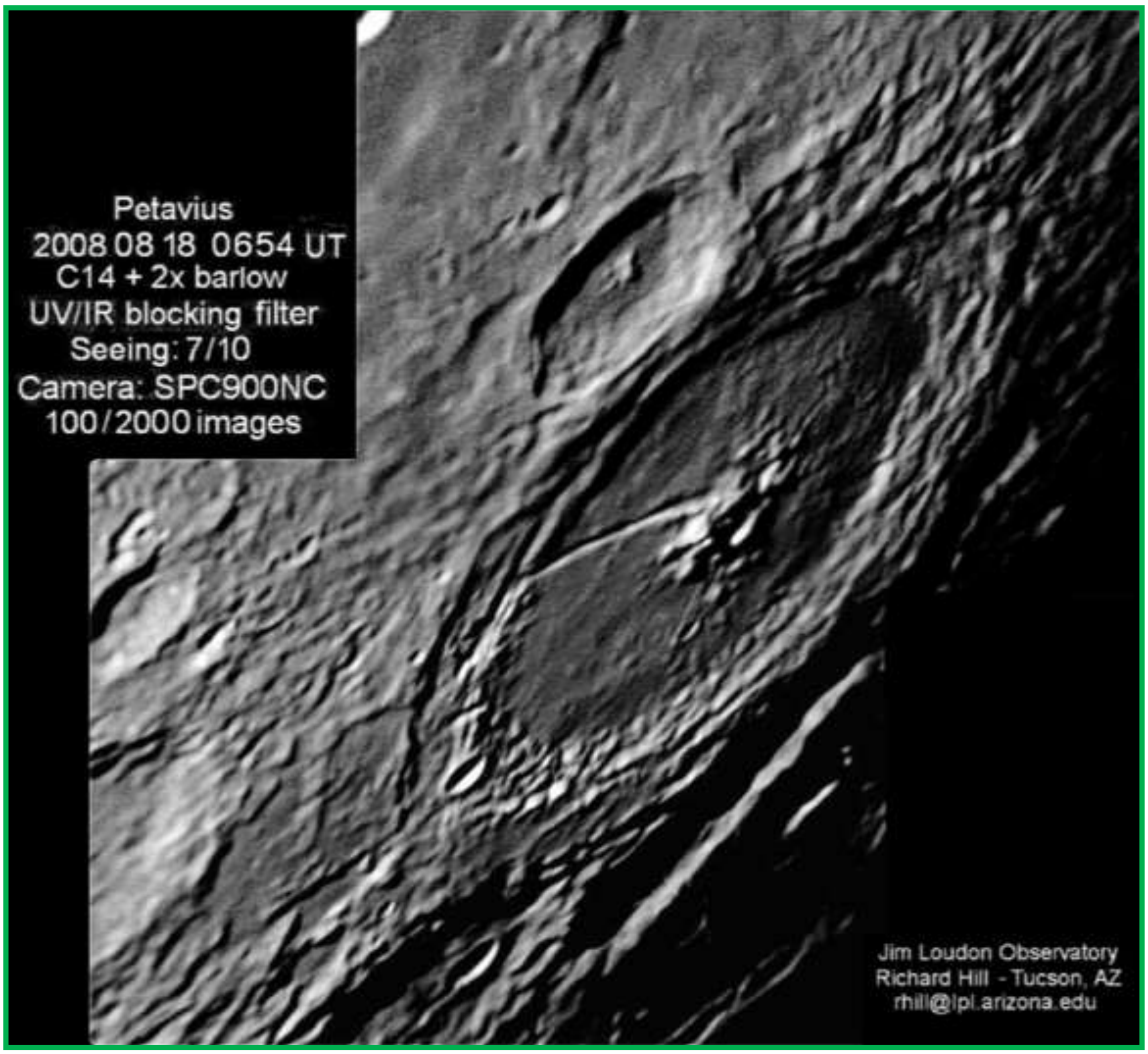


Image 26, Petavius to Langrenus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2008 April 10 02:14 UT. Celestron 14 inch Schmidt-Cassegrain telescope, UV/IR filter, SPC900NC camera. Seeing 6/10*

We naturally associate rilles with volcanism, which seems to be the case in Petavius: “Small patches of mare basalt exist in the north and south extents of the crater floor, which help cement this hypothesis. But unlike other mare filled craters, Petavius crater has only small patches of basalt. Why did Petavius crater end up with such an extensive fracture system? One hypothesis is that the fractures occurred as a result of volcanic modification. Uplift of the crater floor would occur as magma intruded beneath the floor and fracturing developed as the floor was pushed up. Because Petavius crater was not flooded completely, the fractures were never covered by basalt. The harder question is why is Petavius crater not flooded with basalt? It is possible Petavius crater did not witness the same style of eruption as elsewhere on the Moon. Or maybe the magma underneath Petavius crater was not buoyant enough to completely flood the surface. Finally, it may simply be that the magma source region was relatively small, and thus only a modest amount of basalt was erupted” (http://lroc.sese.asu.edu/posts662).

In IMAGE 27 we can see how insignificant the patches of basalt are (in which the floor is much smoother than in the rest of the internal surface of Petavius). IMAGE 28 and its detail seem to indicate that the southern edge of the Great Cleft is higher, and it is, if we turn to the Lunar Reconnaissance Orbiter Quickmap (LOLA altimeter data, IMAGE 29).

Image 27, Petavius to Langrenus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2008 August 18 06:54 UT. Celestron 14 inch Schmidt-Cassegrain telescope, 2x barlow, UV/IR filter, SPC900NC camera. Seeing 7/10.*



Focus-On: Land of Cracks, Petavius

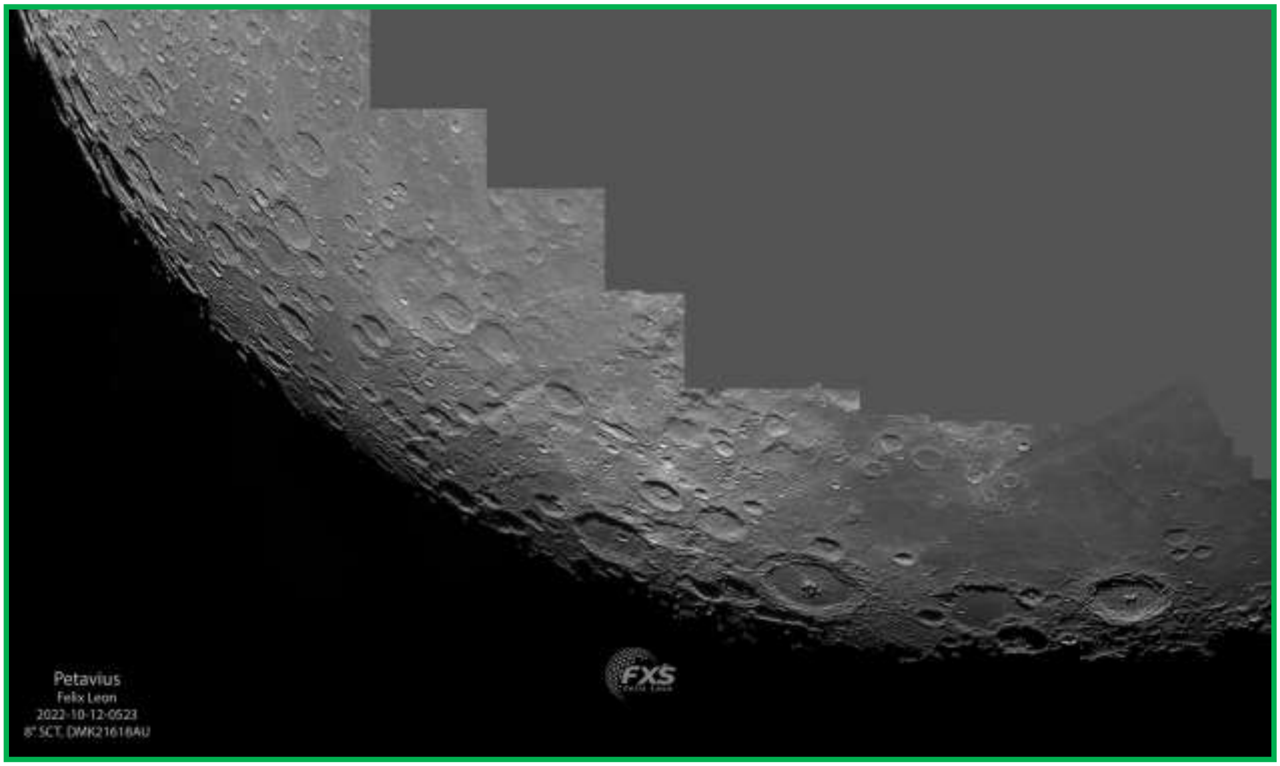
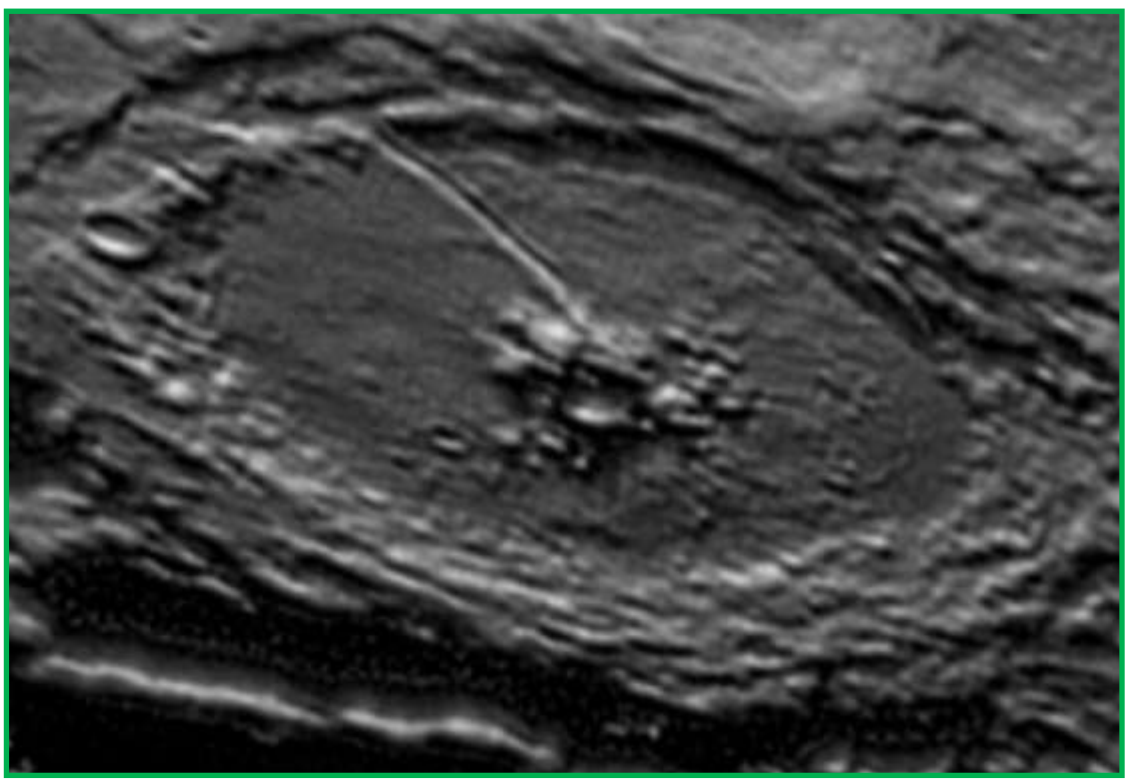


Image 28, Petavius, *Felix León, Santo Domingo, República Dominicana. 2022 October 12 05:23 UT. 8 inch Schmidt -Cassegrain telescope, DMK1618AU camera. North is to the right, west is up.*

Image 28 detail, Petavius, *Felix León, Santo Domingo, República Dominicana. 2022 October 12 05:23 UT. 8 inch Schmidt-Cassegrain telescope, DMK1618AU camera.*



Focus-On: Land of Cracks, Petavius

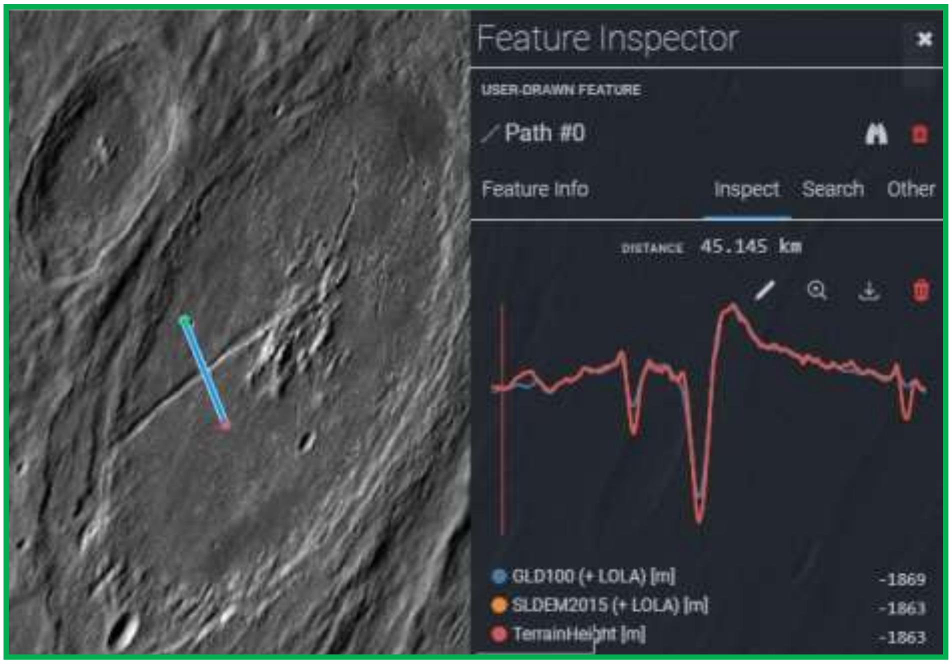
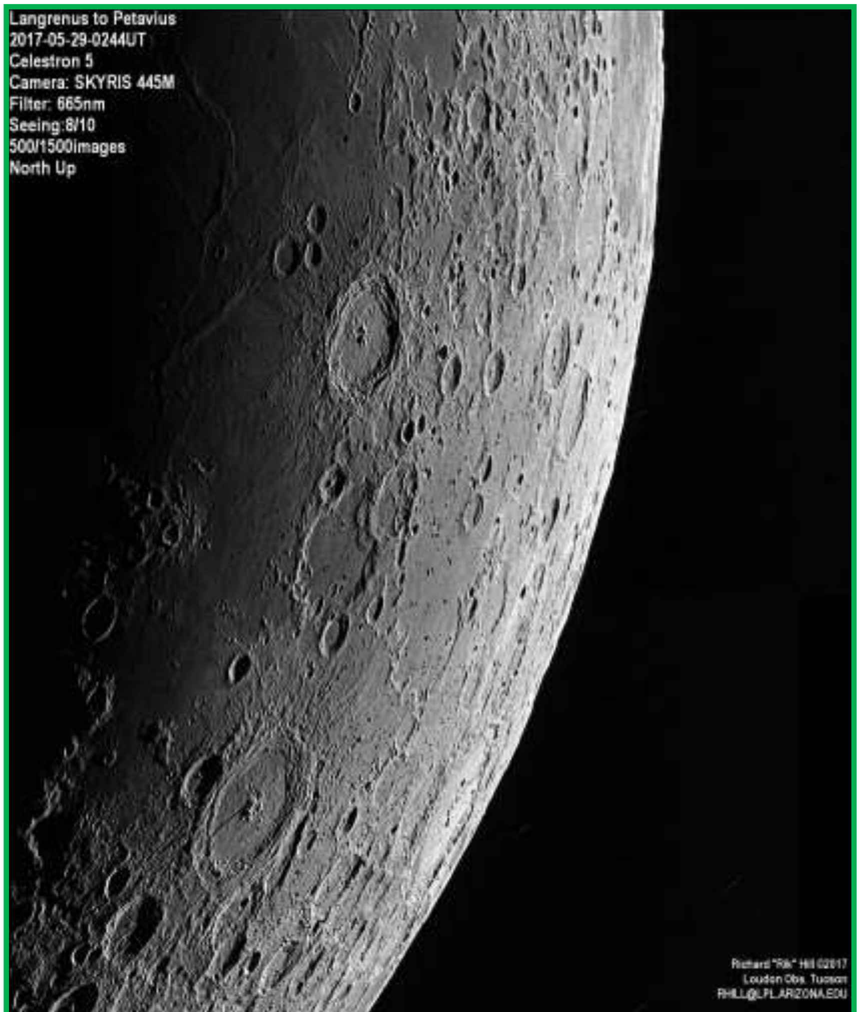


Image 29, Petavius, *LROC*



We follow Garfinkle: “The smaller Rima Petavius II (lat 24.70°S, long 60.60°E) runs north from the central peak complex”. It's not that easy to see (for example, in IMAGES 6 and 19), but we do see it in IMAGES 30, 31, and if we go back to IMAGE 22, especially DETAIL1, we see that it's actually a complex network of rilles and not just one (how difficult it would be to drive a rover through that area). In the same images we see that “Generally following the contour of the eastern wall is Rima Petavius III (lat 26.00°S, long 61.40°E). Additionally, a group of unnamed rilles can be seen on the floor leading away from Petavius and terminating at the small cone crater Petavius A (lat 26.15°S, long 61.64°E). Petavius A is about 6.26 km (3.88 miles) in diameter”.

Image 30, Petavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2017 May 29 02:44 UT. Celestron 5 inch Schmidt-Cassegrain telescope, 665 nm filter, Skyris 445M camera. Seeing 8/10.*

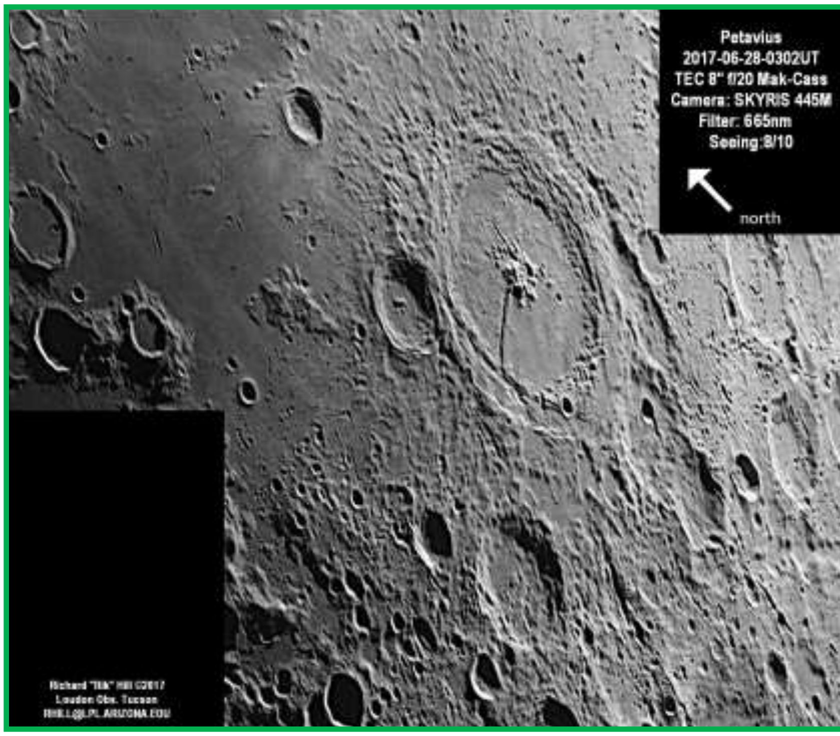


Image 31, Petavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2017 June 28 03:02 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 665 nm filter, Skyris 445M camera. Seeing 8/10.*

In the images we saw, as in IMAGE 32, we see a spectacular rille, but more similar to other in the surface of the near side (as Rima Ariadaeus): “A second bizarre rille or parallel ridges extends along the western rim of Petavius. This curved ridge pair and the straight rille intersect so they must be related in some way” (Wood, March 2006).

Image 32, Petavius, *Larry Todd, Dunedin, New Zealand. 2021 September 11 07:04 UT. OMC200 telescope.*

"The small rilles are concentrated on the northeastern side of the floor, as if to balance the one massive rille on the opposite side. This pattern of three rilles spaced about 120 degrees apart reminds me of fractures that occur on Earth where uplift occurs. Such triple junctions typically have unequal width rift arms, just as in Petavius. And we know that the floor of Petavius is domed up, consistent with the Earth analogy" (Wood, August 2006).

Petavius belongs to a relatively recent category of craters: the FFC ("Floor Fractured Craters): "a class of large craters whose original impact floor have been modified by volcanic activity and fracturing. Almost all FFC's are big and occur near the borders of maria and their enclosing basins. Once the idea that FFCs were entirely volcanic had been dismissed because of their obvious similarity to normal impact craters, the story of how they formed emerged. Schultz and his Brown University student Robert Wichman proposed the widely accepted interpretation that the appearance of FFCs is due to ponding of upward rising magma under the crater, which lifts up the original floor, causes radial and concentric fractures, and sometimes allows lava to leak onto the crater floor" (Wood, 2003).

In the Classification of Floor-Fractured Craters in Luna Cognita, Petavius is included In the Class 1, thus characterized: Craters have most characteristics found in fresh (Copernican-age) large impact craters. They have central peaks (1), ejecta blanket (2), deep floor to rim crest elevation difference (3); interior wall terraces (4); extensive wall slumps (5); fractured floor with rilles that are generally concentric with crater walls (6); rilles fracture patterns may also be radial or polygonal (7), they may have dark halo craters and mare-like patches near or on floor–wall boundary (8). Generally located on or near maria and predate last stages of local mare emplacement; large craters [50 to 300 km (31 to 186.4 miles)] in diameter; average diameter of about140 km (87 miles)".

The numbers indicate characteristics that we can see in IMAGE 33, and in more detail in IMAGE 34, the numbers coincide with the characteristics of Petavius as FFC according to Garfinkle. The IMAGE 34 was obtained by Howard Fink, it is a 3D model made from the images obtained by the Lunar Reconnaissance Orbiter (LRO) Wide Angle Camera (WAC) and the digital elevation model (DEM) of the Lunar Orbiter Laser Altimeter (LOLA) of the Kaguya probe. The works by Howard are in https://finkh.wordpress.com/ , and so he told us how he gets his images: "I have a computer program written in Mathematica that takes digital elevation models in equirectangular projection (lat, lon = x, y) and maps them on to a sphere the size of the Moon. The elevation data is turned into a 3D surface. A Wide-Angle Camera image the same dimensions as the digital elevation model is wrapped over the model. This is turned this way and that to take snapshots which are now 2D images for posting after a bit of sharpening and brightening in Photoshop".

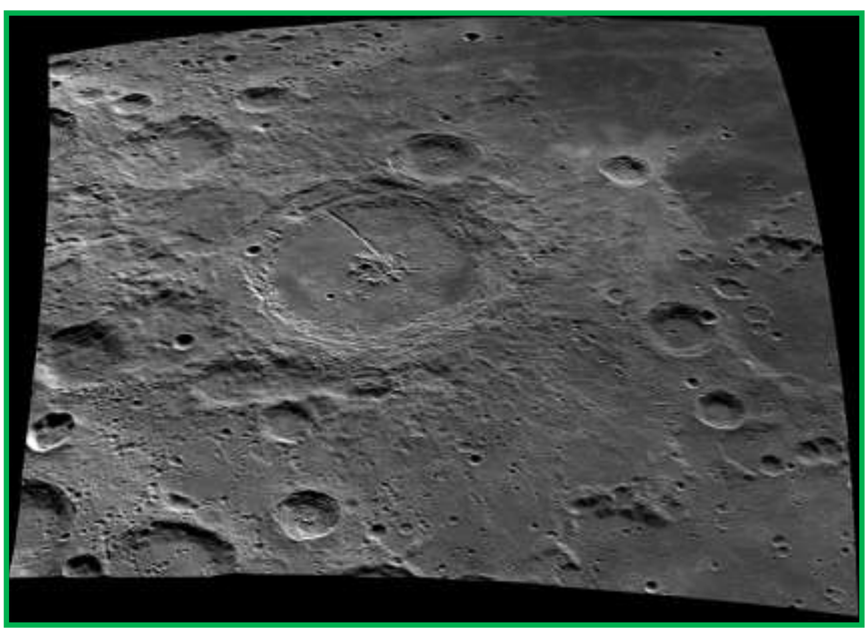
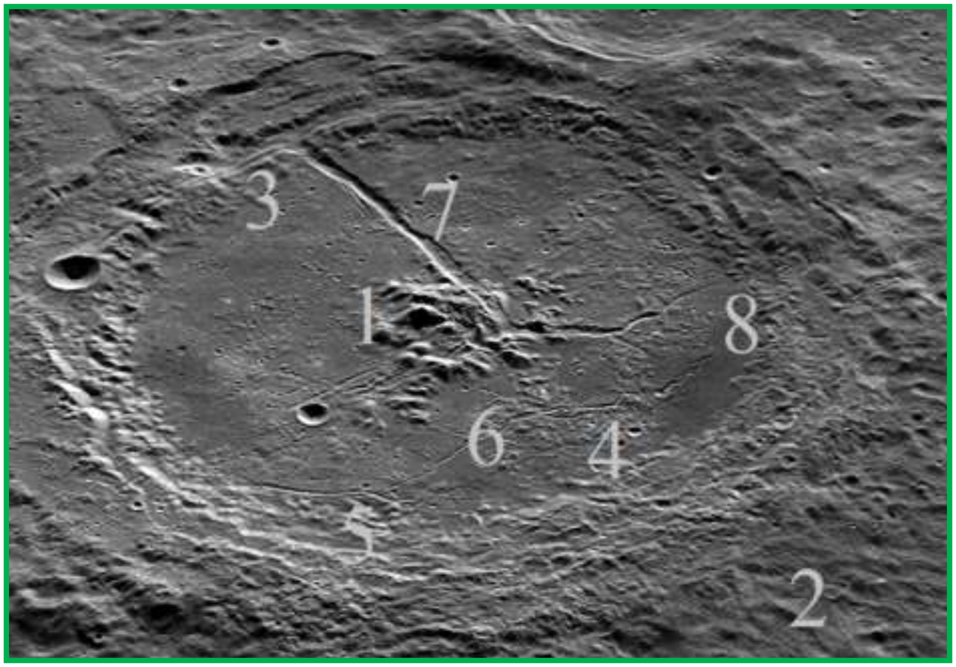


Image 33, Petavius, *Howard Fink, New York, New York, USA. Lunar Astronautical Chart 098 as a 3D model with wide area camera image overlay. 184 km Petavius in the center. The view from the east.*

Focus-On: Land of Cracks, Petavius

Image 34, Petavius, *Howard Fink, New York, New York, USA.* *[Lunar Astronautical Chart 098](#) as a 3D model with wide area camera image overlay. 184 km Petavius in the center. The view from the east, detail.*



With very oblique lighting, like the one we see in IMAGE 24, the floor of Petavius appears full of small mounds and depressions. Interesting are the depressions, or small rhymes, that can be seen on the west wall, at the southern end, between Rima Petavius I and Petavius C, which are conspicuous even with small telescopes (IMAGE 35) and that can be clearly observed in IMAGE 36

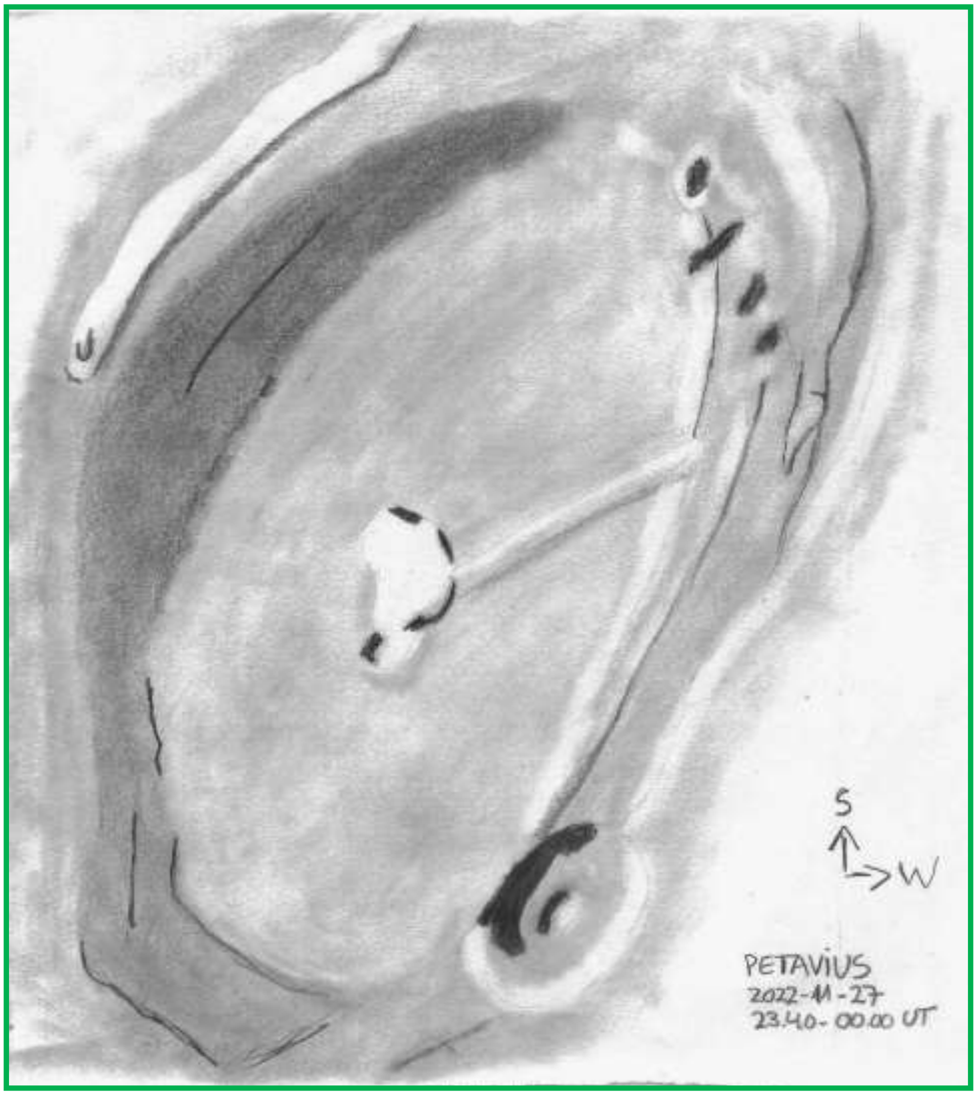


Image 35, Petavius, *Alberto Anunziato, Paraná, Argentina. 2022 November 27 23:40 –00:00 UT. Meade EX 105 Maksutov-Cassegrain telescope, 154x.*

Focus-On: Land of Cracks, Petavius

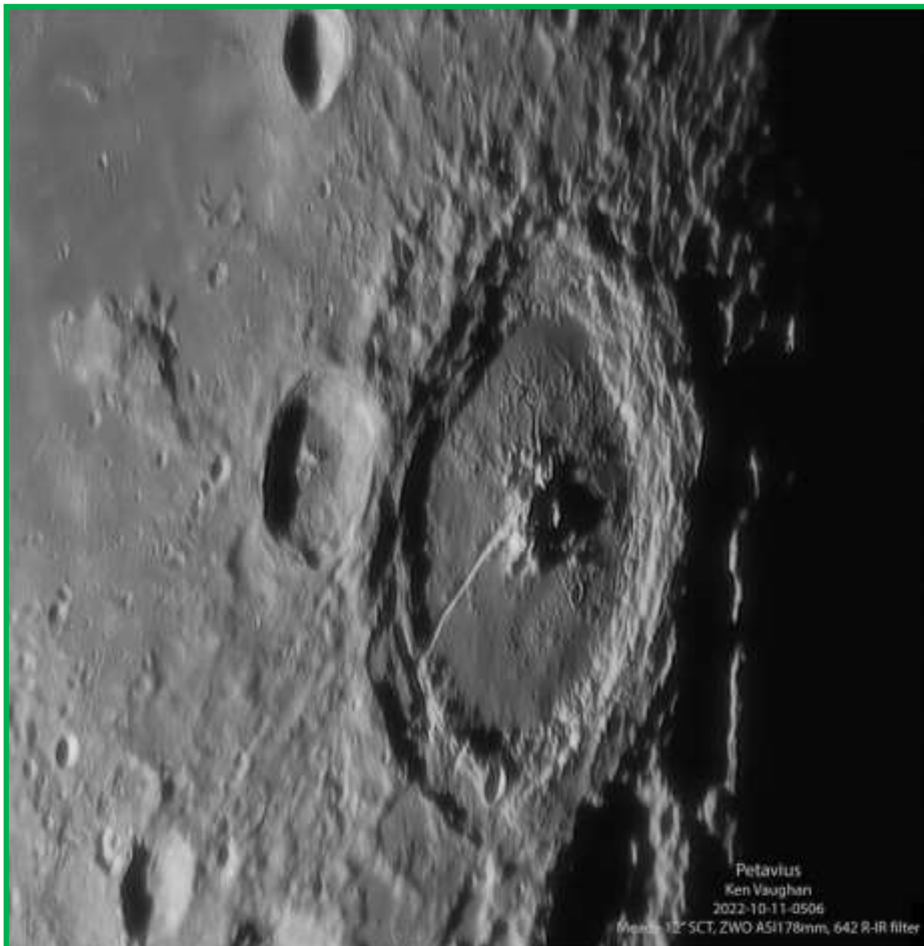


__Image 36, Petavius,__ Ken Vaughn, Cattle Point, Victoria, British Columbia, Canada. 2022 October 11 05:06 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 R-IR filter, ZWO ASI178mm camera.

Not as famous as the Great Cleft is the mountainous center of Petavius, but it is one of the most spectacular central peak complexes on the near face. Says Garfinkle: "In the center of the crater is an interesting central peak complex named Petavius α (lat 25.10°S, long 60.50°E) that rises to summit elevations over 1706 meters (5600 feet) above the floor. The central peak complex consists of three major ridges with about nine peaks and numerous impact craters on their flanks". The term "central peal complex" is very accurate, let's see what the central peaks look like in IMAGE 37, even with front illumination, when Petavius is nearly engulfed by Stevinus's bright rays, the central peak complex is more conspicuous than Rima Petavius (IMAGE 38). In IMAGE 39 to 43, with the help of oblique illumination, we see how extraordinarily complex the central peak system is, we could try to count the central peaks. A splendid panorama of the complex system of central peaks is found in IMAGE 11.

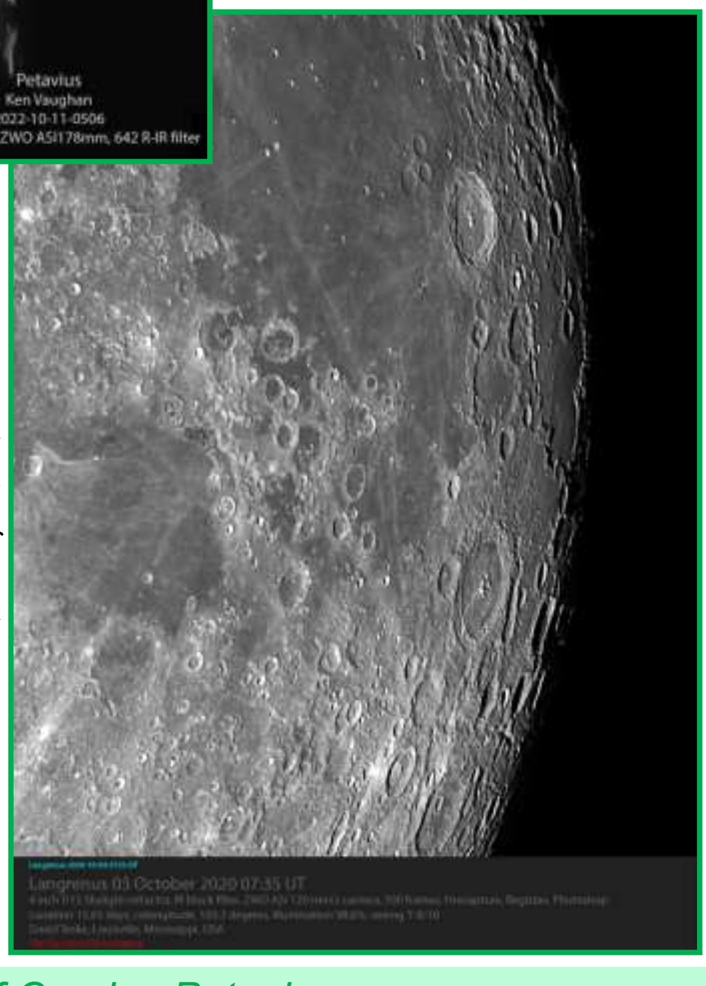


__Image 37, Langrenus and Petavius,__ David Teske, Louisville, Mississippi, USA. 2020 October 03 07:35 UT, colongitude 103.2°. 4 inch f/15 refractor telescope, IR block filter, ZWO ASI120MMs camera. Seeing 7-8/10.

Image 38, Stevinus and Petavius, *David Teske, Louisville, Mississippi, USA. 2022 February 09 02:08 UT, colongitude 359.4°. 3.54 inch Questar Maksutov-Cassegrain telescope, 2x barlow, IR block filter, ZWO ASI120MMs camera. Seeing 9/10.*

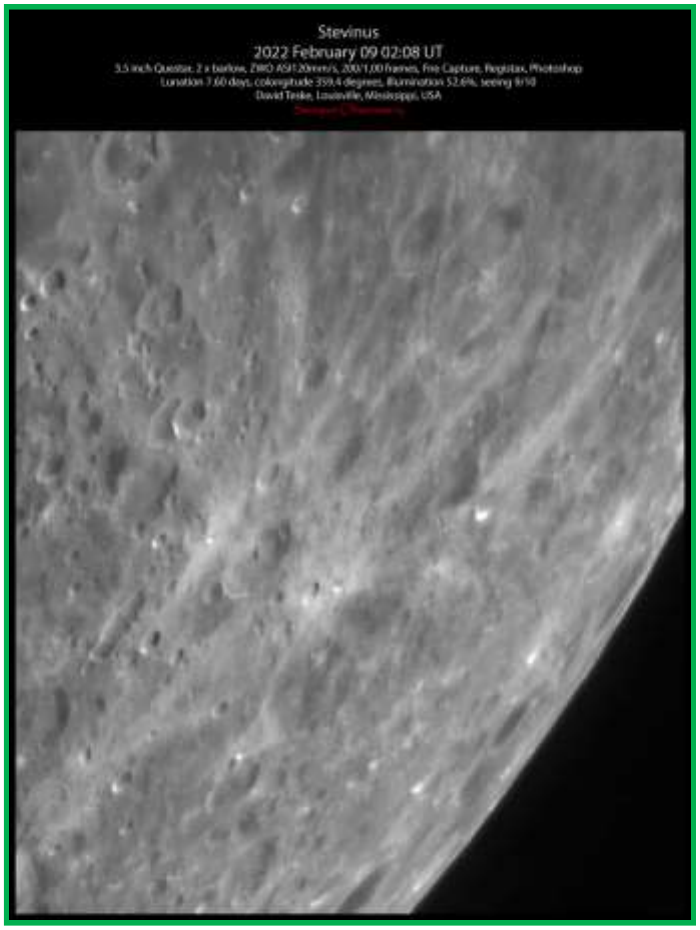


Image 39, Petavius, *Felix León, Santo Domingo, República Dominicana. 2022 October 12 05:25 UT. 8 inch Schmidt-Cassegrain telescope, DMK1618AU camera. North is right, west is up.*

Focus-On: Land of Cracks, Petavius

Image 40, Petavius, *Fernando Surá, San Nicolás de los Arroyos, Argentina. 2021 November 08 23:32 UT. 127 mm Maksutov-Cassegrain telescope, J7 cell phone camera.*

Image 41, Petavius, *Jairo Chavez, Popayán, Colombia. 2021 September 10 23:12 UT. 311 mm truss Dobsonian reflector telescope, MOTO E5 PLAY camera. North is down, west is right.*

Focus-On: Land of Cracks, Petavius

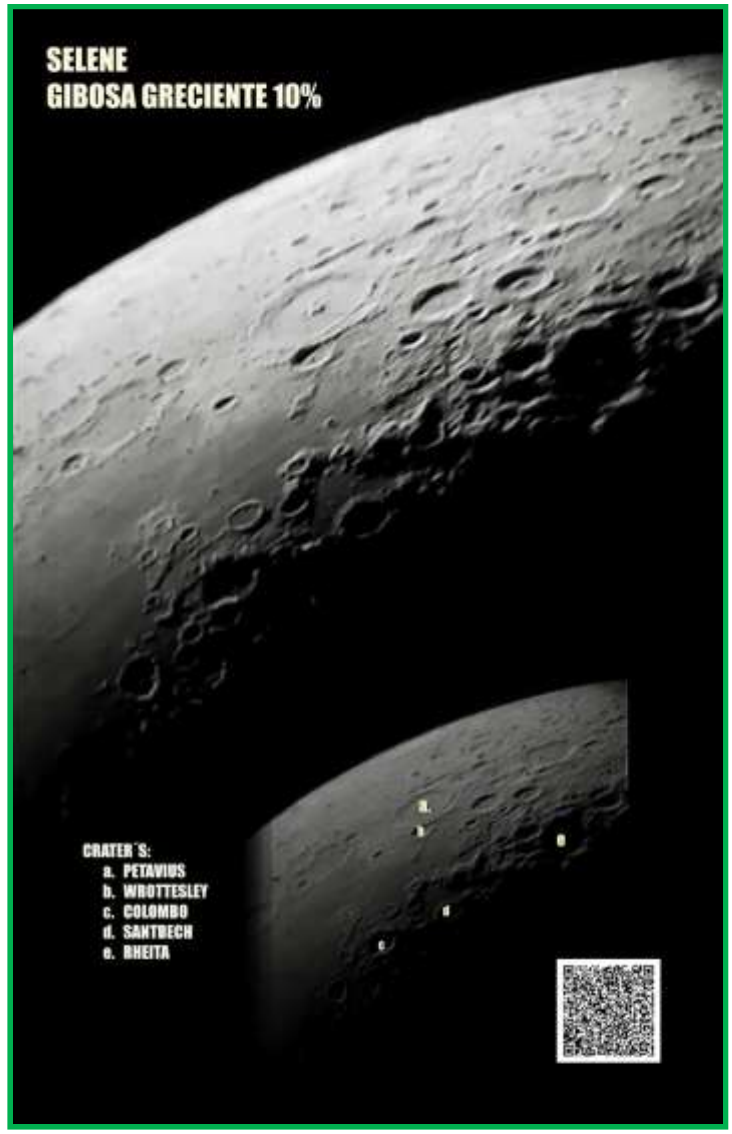
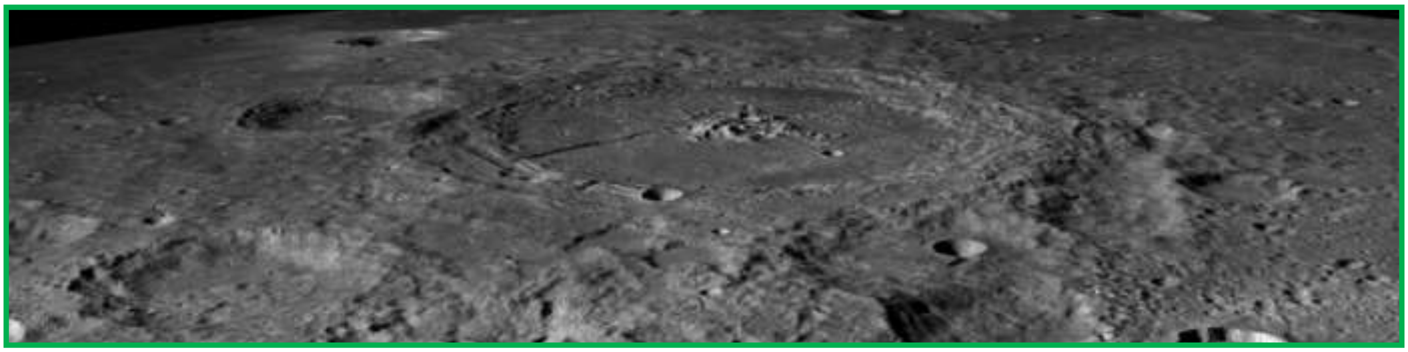


Image 42, Petavius, *Jairo Chavez, Popayán, Colombia. 2021 August 12 00:23 UT. 311 mm truss Dobsonian reflector telescope, MOTO E5 PLAY camera. North is left, west is down.*

Image 43, Petavius, *David Teske, Louisville, Mississippi, USA. 2020 January 30 00:33 UT, colongitude 325.5°. 180 mm Takahashi Mewlon Dall-Kirkham telescope, IR block filter, ZWO ASI120MMs camera. Seeing 5/10.*

Focus-On: Land of Cracks, Petavius

To finish, we go to two beautiful features near Petavius. The most interesting is Palitzsch, outside Petavius to the east, today known as Vallis Palitzsch: “This valley is actually a catena of about 10 to 12 impact craters that runs for about 150 km (93.2 miles). The valley ranges from about 10 to 40 km (6.2 to 24.8 miles) wide and about 3000 m (9842 feet) deep. The valley is narrow [17 km (10.5 miles) in diameter] at its northern end, which is the crater Petavius D (…) The western walls of the valley are mantled with mounds of ejecta materials from the Petavius formation event” (Garfinkle). In IMAGE 27 we see it emerging from the shadows, the high east wall glowing brightly, the west wall indistinguishable from Petavius's east wall. In IMAGE 4 appreciate its chain shape or, in Elger's words: “it resembles a great trough”. We already talked about Wrottesley, a 57 km diameter crater with a complex morphology, terraced walls and central peaks, “but the terraces have lost their sharpness and flow almost smoothly into each other, and instead of a single strong peak there is a straggly collection of hills” (Wood, https://www2.lpod.org/wiki/December_12,_2006.



Petavius, *Howard Fink, New York, New York, USA. Lunar Astronautical Chart 098 as a 3D model with wide area camera image overlay. 184 km Petavius in the center. A lower view of the central area of LAC 098.*

REFERENCES:

Elger, Thomas (1895): The Moon, George Philip & Son.

Garfinkle, Robert (2020), Luna Cognita, Springer, New York.

Wood, Charles A. (2003): The Modern Moon. A Personal View, Sky and Telescope (page 107).

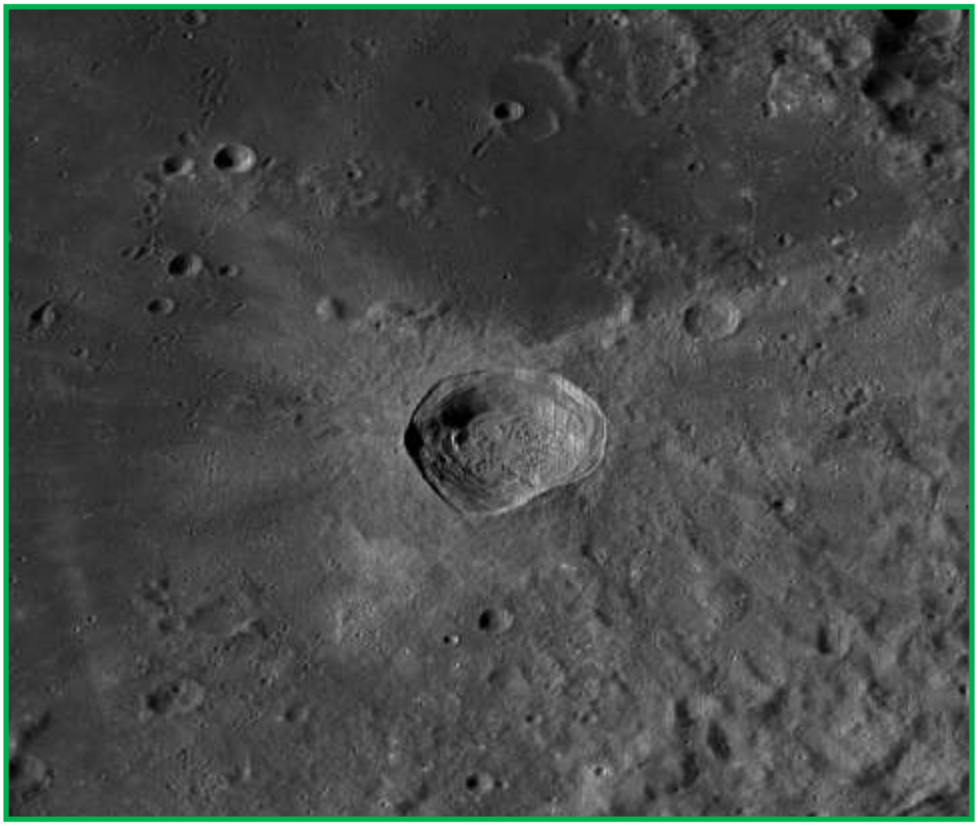
Wood, Charles (2004, January): Petavius; Rilles and volcanic spots, http://www2.lpod.org/wiki/January_7,_2004

Wood, Charles (2004, September): Petavius Naked, http://www2.lpod.org/wiki/September_27,_2004

Wood, Charles (2006, March): Moderate Sun Over a Magnificent Crater, https://www2.lpod.org/wiki/March_21,_2006

Wood, Charles (2006, August): A Bend in the Middle, http://www2.lpod.org/wiki/August_14,_2006

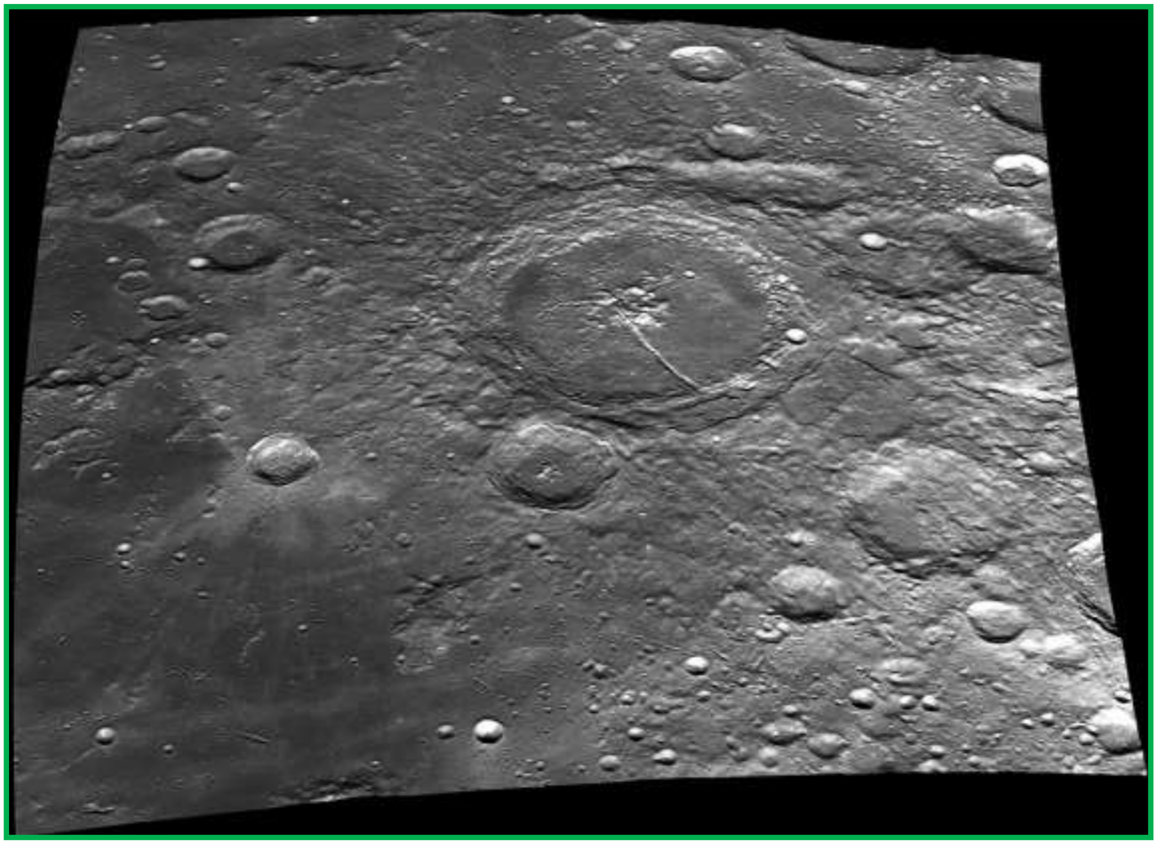
Wood, Charles (2006, December): Trenchent observations of a Trench, http://www2.lpod.org/wiki/December_12,_2006



Left, Petavius, *Howard Fink, New York, New York, USA. Lunar Astronautical Chart 098 as a 3D model with wide area camera image overlay. A closer look at Petavius B with its surrounding rays on the edge of Mare Fecunditatis. In the larger views, there appears to be sectors of rings of ray material concentric to the crater on the floor of the Mare.*

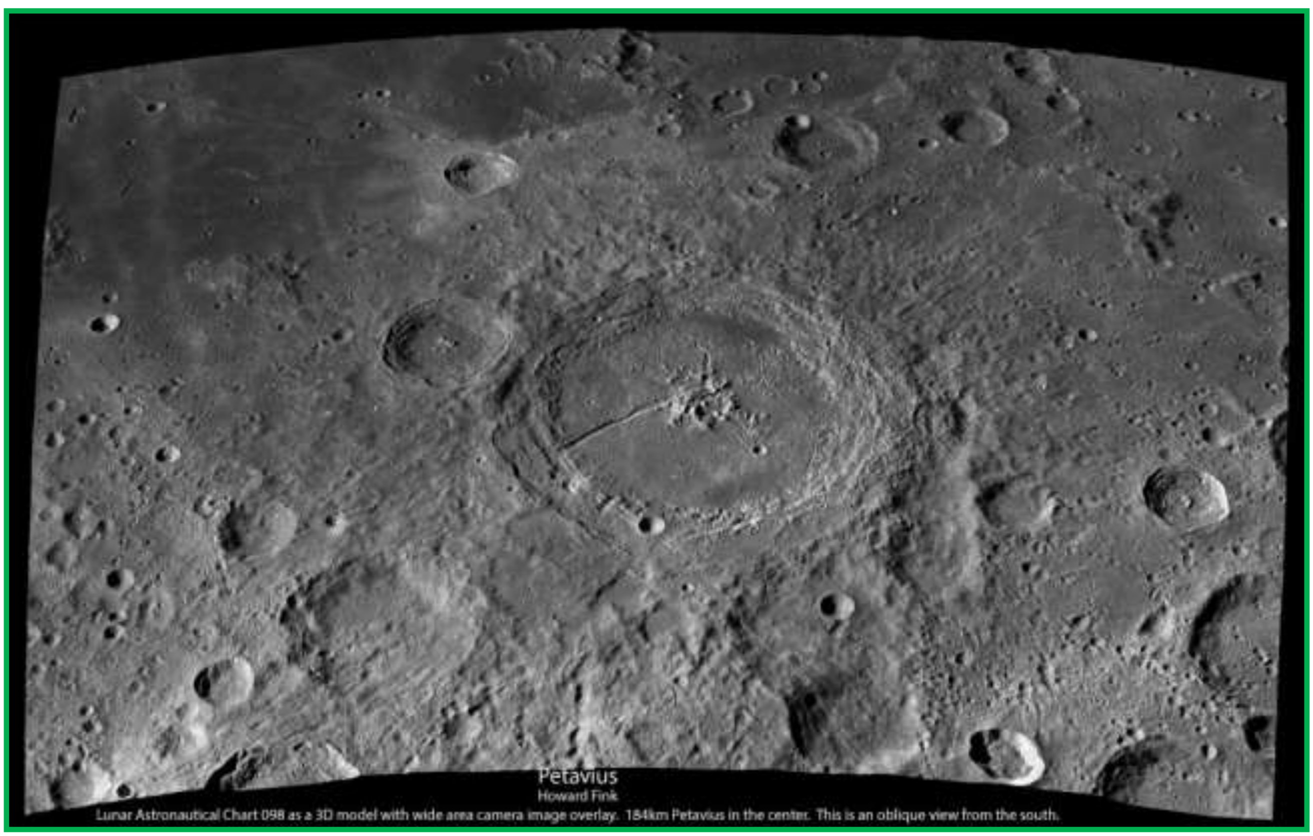
Below, Petavius, *Howard Fink, New York, New York, USA. Lunar Astronautical Chart 098 as a 3D model with wide area camera image overlay. 184 km Petavius in the center. The view from the north.*

Focus-On: Land of Cracks, Petavius



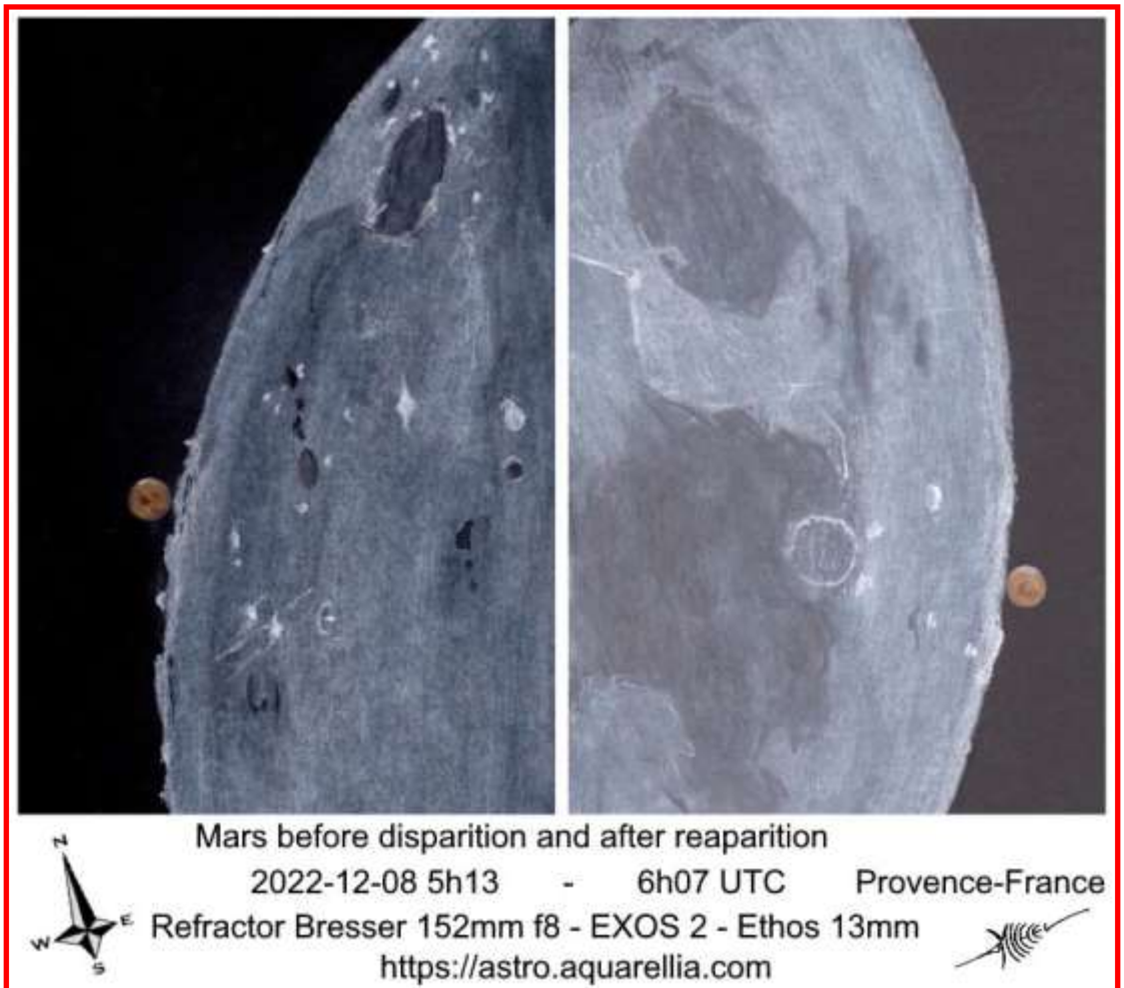
Right, Petavius, *Howard Fink, New York, New York, USA. [Lunar Astronautical Chart 098](#) as a 3D model with wide area camera image overlay. 184 km Petavius in the center. The view from the west.*

Below, Petavius, *Howard Fink, New York, New York, USA. [Lunar Astronautical Chart 098](#) as a 3D model with wide area camera image overlay. 184 km Petavius in the center. This is an oblique view from the south.*



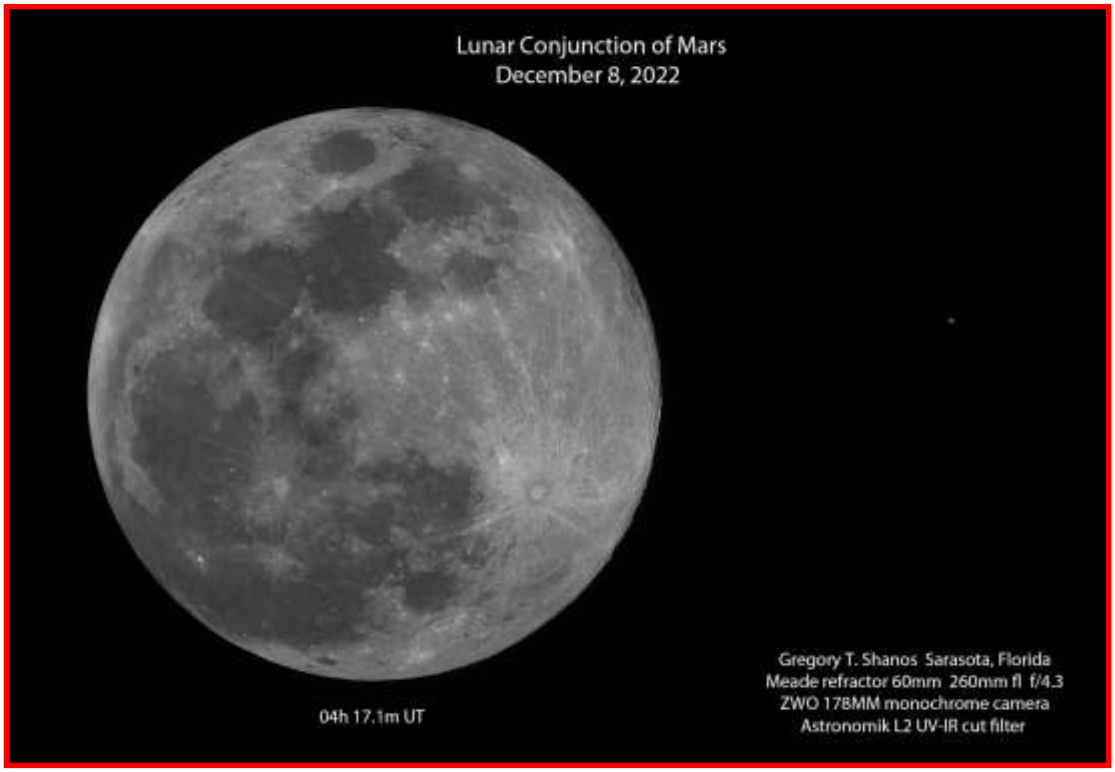
Focus-On: Land of Cracks, Petavius

Moon and Mars conjunction, *Howard Eskildsen, Ocala, Florida, USA. 9.25 inch Celestron Schmidt-Cassegrain telescope, Celestron 25 mm eyepiece, iPhone 12.*



Moon and Mars occultation, *Michel Deconinck, Artignosc-sur-Verdon - Provence - France . 2022 December 08. Bresser 152 mm f/8 refractor telescope, EXOS 2-Ethos 13 mm eyepiece.*

Moon-Mars Occultation December 08, 2022

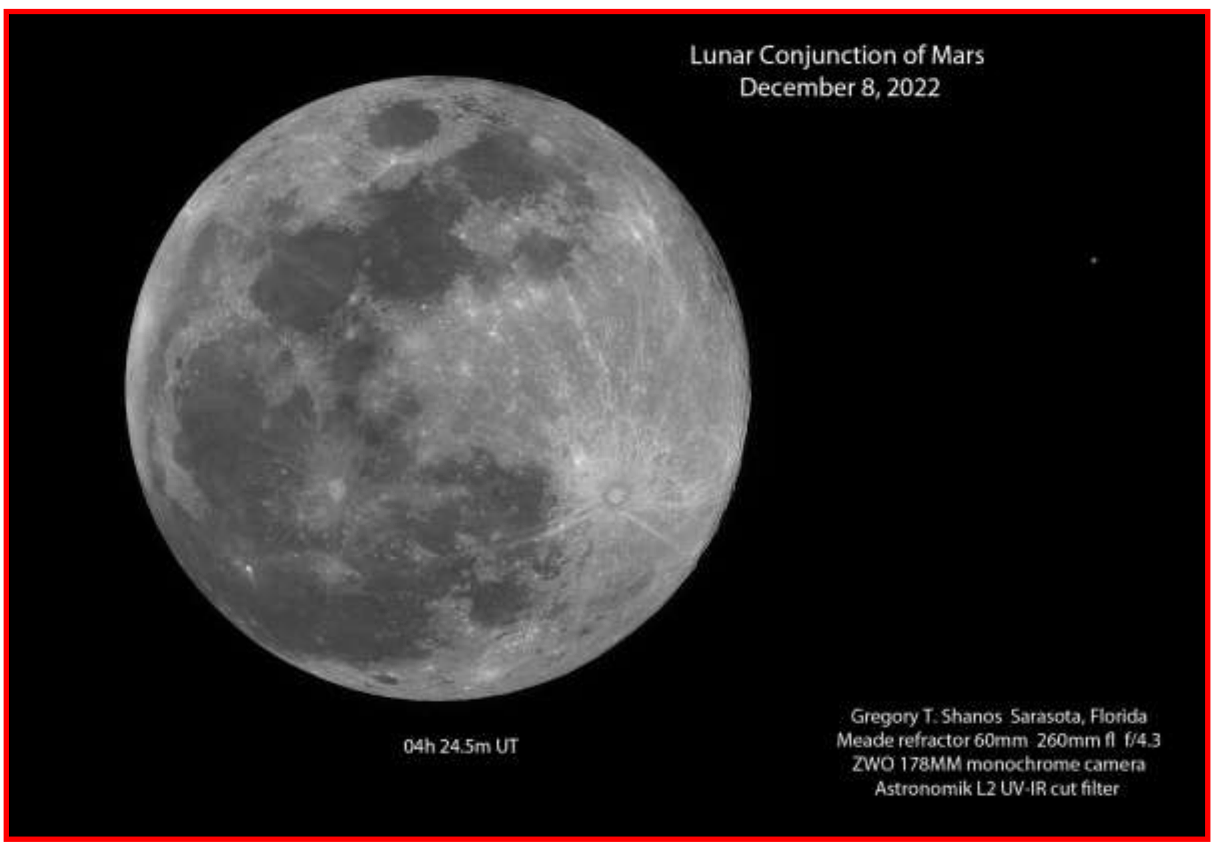


Gregory adds: *"On December 8, 2022 during its closest approach, Mars was occulted by the Moon for the northern part of the States. Unfortunately, for the southern states it was merely a conjunction. The weather was perfectly clear in Longboat Key (Sarasota), Florida on December 8, 2022 with good seeing conditions. Mars was so close to the moon that it was barely visible to the naked eye unless you knew to look. The view through binoculars was magnificent. I imaged the moon using a Meade 60mm refractor piggybacked on a Meade 2080 Schmidt-Cassegrain 8 inch telescope for tracking. The entire Moon with Mars was visible in the eyepiece of the refractor. I oriented the Moon and Mars exactly as it appeared naked eye and through binoculars. I then imaged the conjunction with a ZWO 178MM 6MP monochrome camera with a Baader CMOS optimized UV-IR cut filter (Baader 610nm R-IR filter)".*

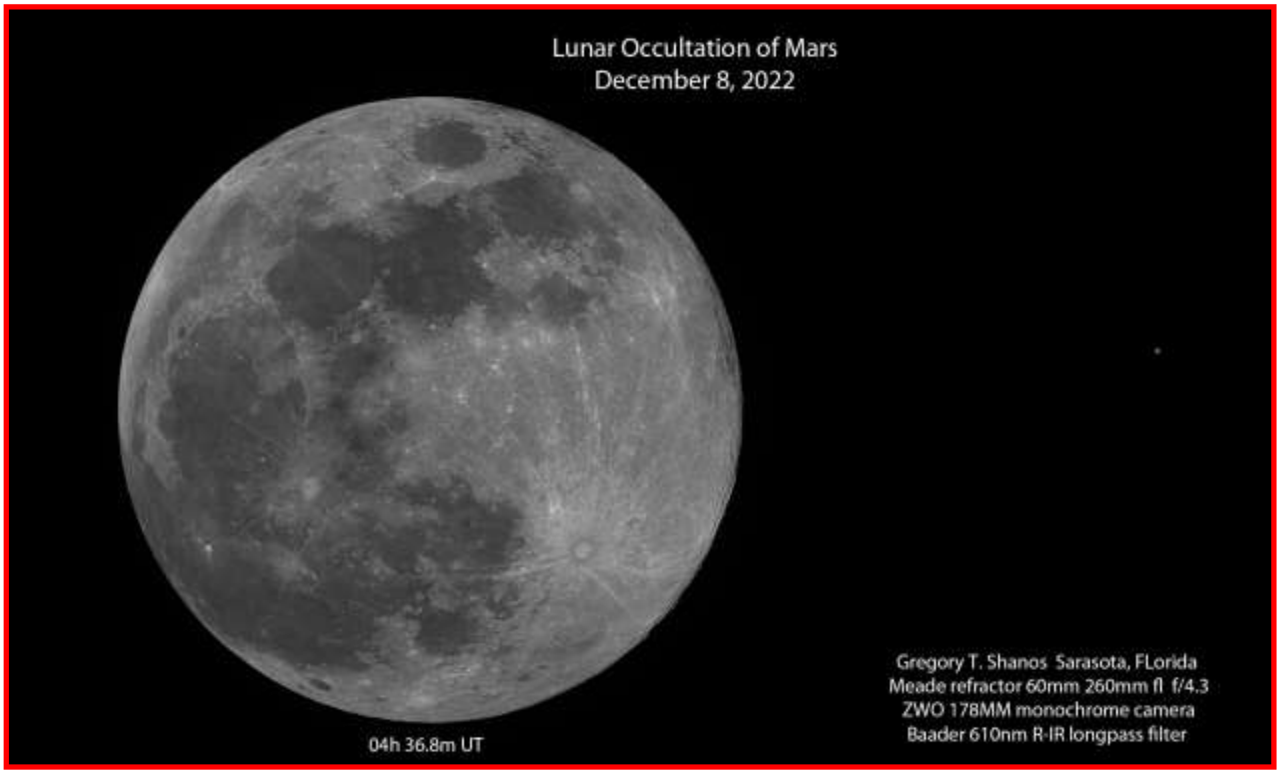
Lunar Conjunction of Mars, *Gregory T. Shanos, Sarasota, Florida, USA. 2022 December 08. Meade 60 mm refractor telescope, 260 mm fl, f/4.3, Astronomik L2 UV-IR cut filter, ZWO ASI178 mm camera. Above at 04:17.1 UT, below at 04:20.5 UT.*

Moon-Mars Occultation December 08, 2022

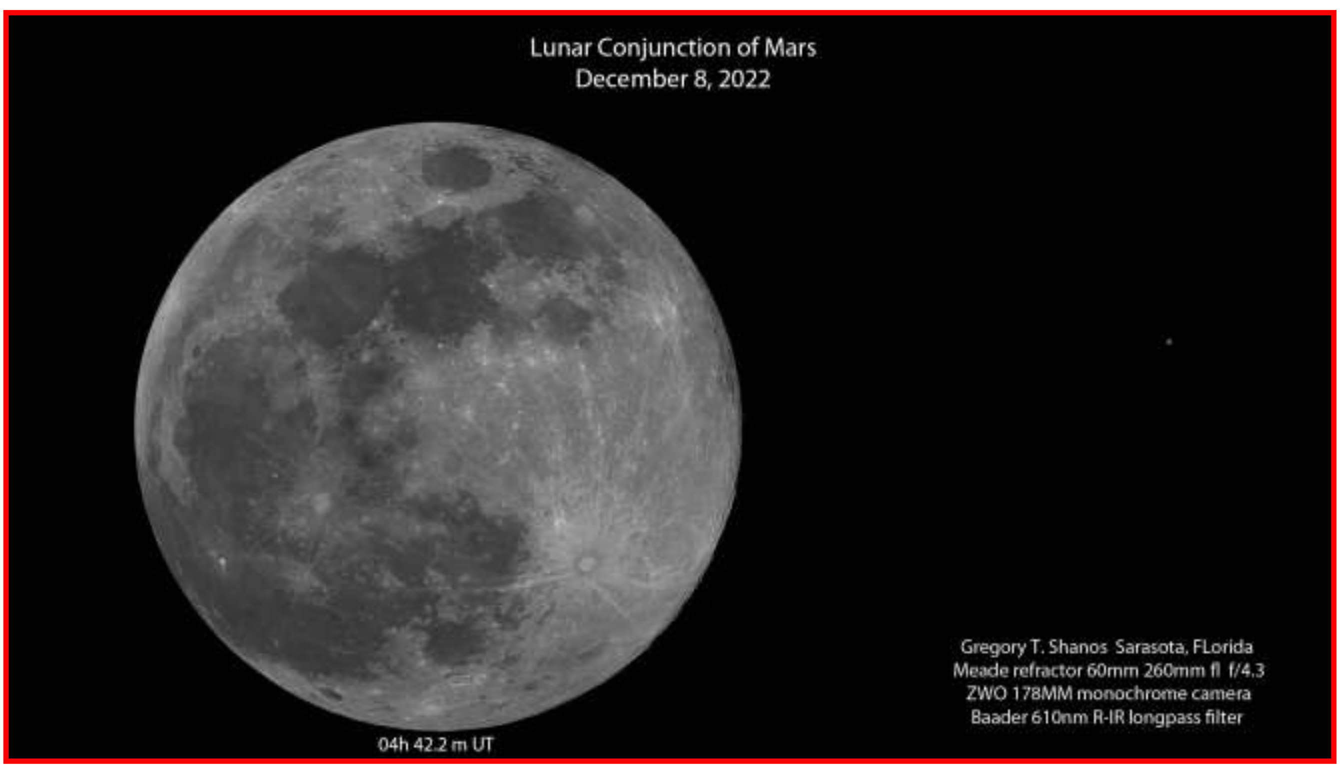
Lunar Conjunction of Mars, *Gregory T. Shanos, Sarasota, Florida, USA. 2022 December 08. Meade 60 mm refractor telescope, 260 mm fl, f/4.3, Astronomik L2 UV-IR cut filter, ZWO ASI178 mm camera. Above at 04:22.9 UT, below at 04:24.5 UT.*



Moon-Mars Occultation December 08, 2022



Lunar Conjunction of Mars, *Gregory T. Shanos, Sarasota, Florida, USA. 2022 December 08. Meade 60 mm refractor telescope, 260 mm fl, f/4.3, Baader 610nm R-IR longpass filter, ZWO ASI178 mm camera. Above at 04:36.8 UT, below at 04:42.2 UT.*



Moon-Mars Occultation December 08, 2022

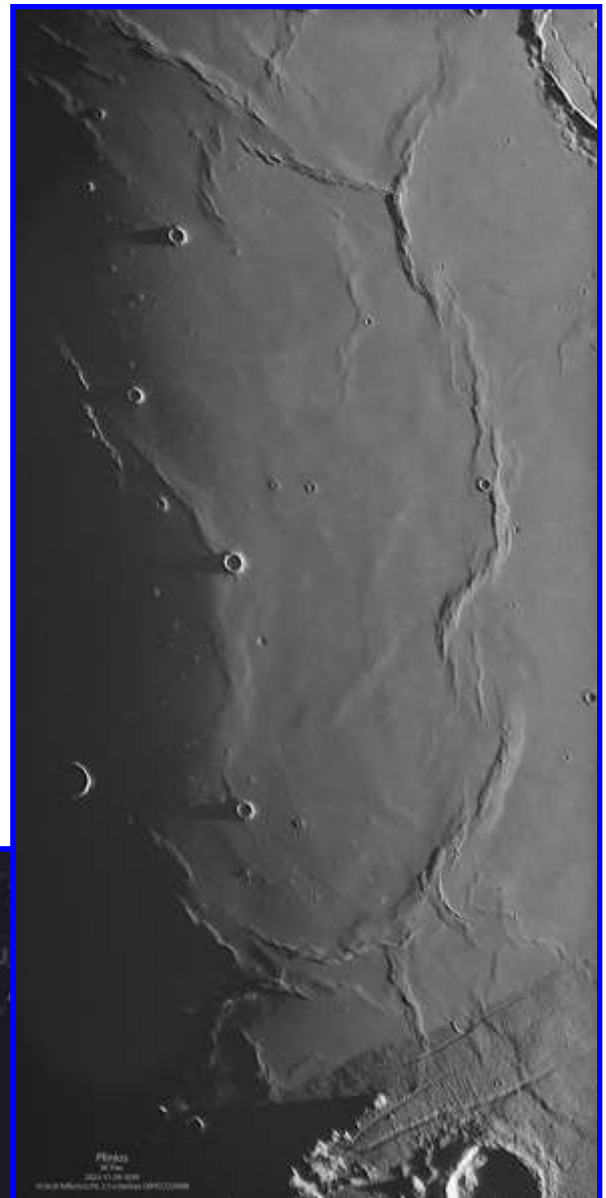
Total Lunar Eclipse, *Gregory T. Shanos, Sarasota, Florida, USA. 2022 November 08. Meade 60 mm refractor telescope, 260 mm fl, f/4.3, Astronomik L2 UV-IR cut filter, ZWO 462MC one-shot color camera. Above at 08:56.3 UT, below at 09:51.0 UT.*

Total Lunar Eclipse November 08, 2022

Total Lunar Eclipse, *Gregory T. Shanos, Sarasota, Florida, USA. 2022 November 08. Meade 60 mm refractor telescope, 260 mm fl, f/4.3, Astronomik L2 UV-IR cut filter, ZWO 462MC one-shot color camera. Above at 10:28.1 UT, below at 11:12.5 UT.*

Total Lunar Eclipse November 08, 2022

Plinius, *KC Pau, Hong Kong, China. 2022 November 29 10:39 UT. 10 inch f/6 reflector telescope, 2.5x barlow, QHYCCD290M camera.*



Tycho, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 December 16 08:42 UT. Skywatcher 150 mm reflector, 750 mm fl, QHY5-II-C camera.*

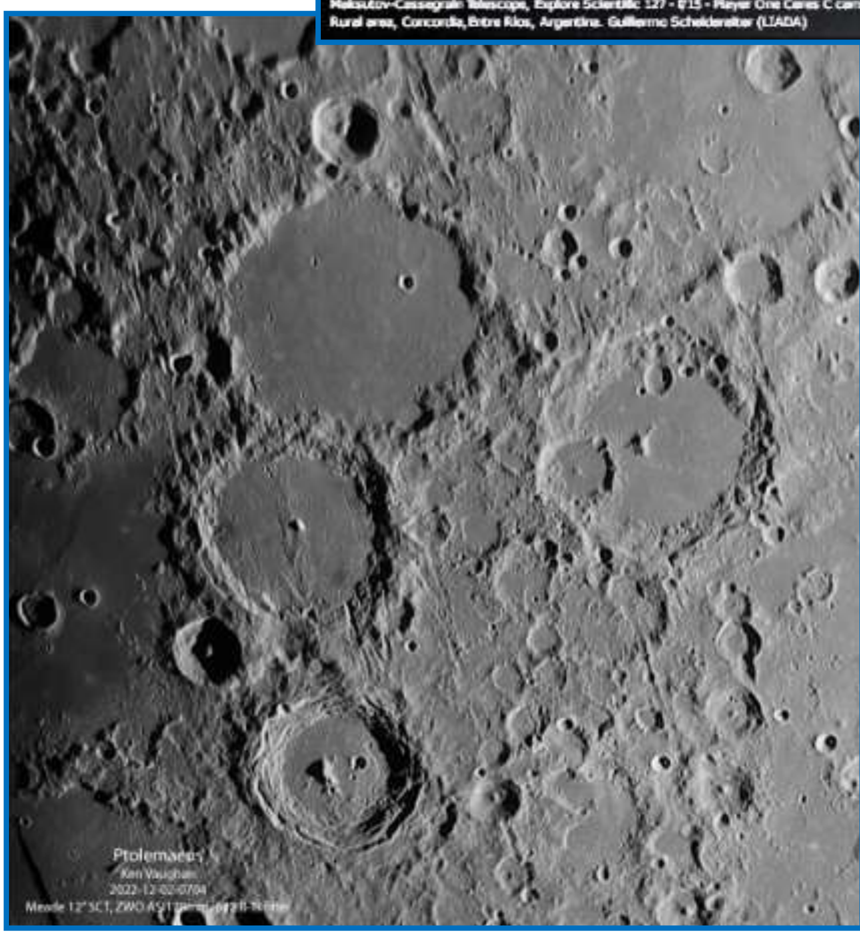
Recent Topographic Studies

Anaxagoras, Goldschmidt and Scoresby. *Guillermo Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 November 05 01:08 UT. Explore Scientific 127 mm f/15 Maksutov-Cassegrain telescope, 2x barlow, IR685 nm filter, Player One Ceres C camera.*

Tycho, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 December 16 08:41 UT. Skywatcher 150 mm reflector, 750 mm fl, QHY5-II-C camera.*

Recent Topographic Studies

Aristarchus, *Guillermo Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 November 06 01:26 UT. Explore Scientific 127 mm f/15 Maksutov-Cassegrain telescope, 2x barlow, IR850 nm filter, Player One Ceres C camera. North is left, west is down.*



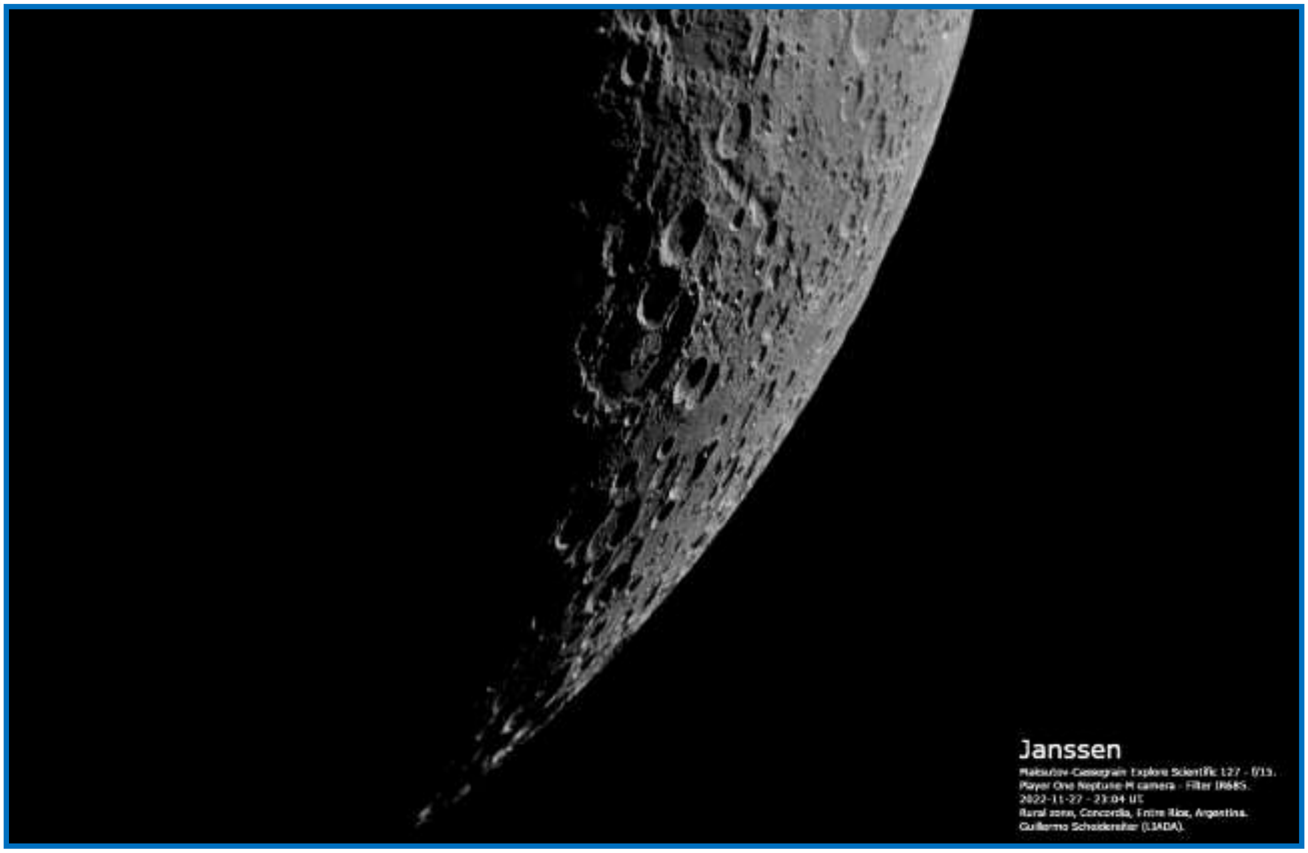
Ptolemaeus Chain, *Ken Vaughn, Cattle Point, Victoria, British Columbia, Canada. 2022 December 02 07:04 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 R-IR filter, ZWO ASI178mm camera.*

Recent Topographic Studies

Aristarchus, *Guillermo Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 November 06 01:14 UT. Explore Scientific 127 mm f/15 Maksutov-Cassegrain telescope, IR850 nm filter, Player One Ceres C camera. North is left, west is down.*

Reiner Gamma, *István Zoltán Földvári, Budapest, Hungary. 2017 September 09, 22:53-23:11 UT, colongitude 139.4°. 80 mm refractor telescope, 900 mm focal length, 150 x. Seeing 8/10, transparency 4/6.*

Recent Topographic Studies



Janssen, *Guillermo Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 November 27 23:04 UT. Explore Scientific 127 mm f/15 Maksutov-Cassegrain telescope, IR685 nm filter, Player One Neptune M camera.*

Aristarchus, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 December 16 08:45 UT. Skywatcher 150 mm reflector, 750 mm fl, QHY5-II-C camera.*

Recent Topographic Studies

Mare Humorum, *Guillermo Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 November 05 00:45 UT. Explore Scientific 127 mm f/15 Maksutov-Cassegrain telescope, IR685 nm filter, Player One Ceres C camera.*

Archimedes, *Ken Vaughn, Cattle Point, Victoria, British Columbia, Canada. 2022 December 02 03:25 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 R-IR filter, ZWO ASI178mm camera.*

Recent Topographic Studies

Mare Humorum, *Guillermo Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 November 05 01:47 UT. Explore Scientific 127 mm f/15 Maksutov -Cassegrain telescope, IR850 nm filter, Player One Ceres C camera.*

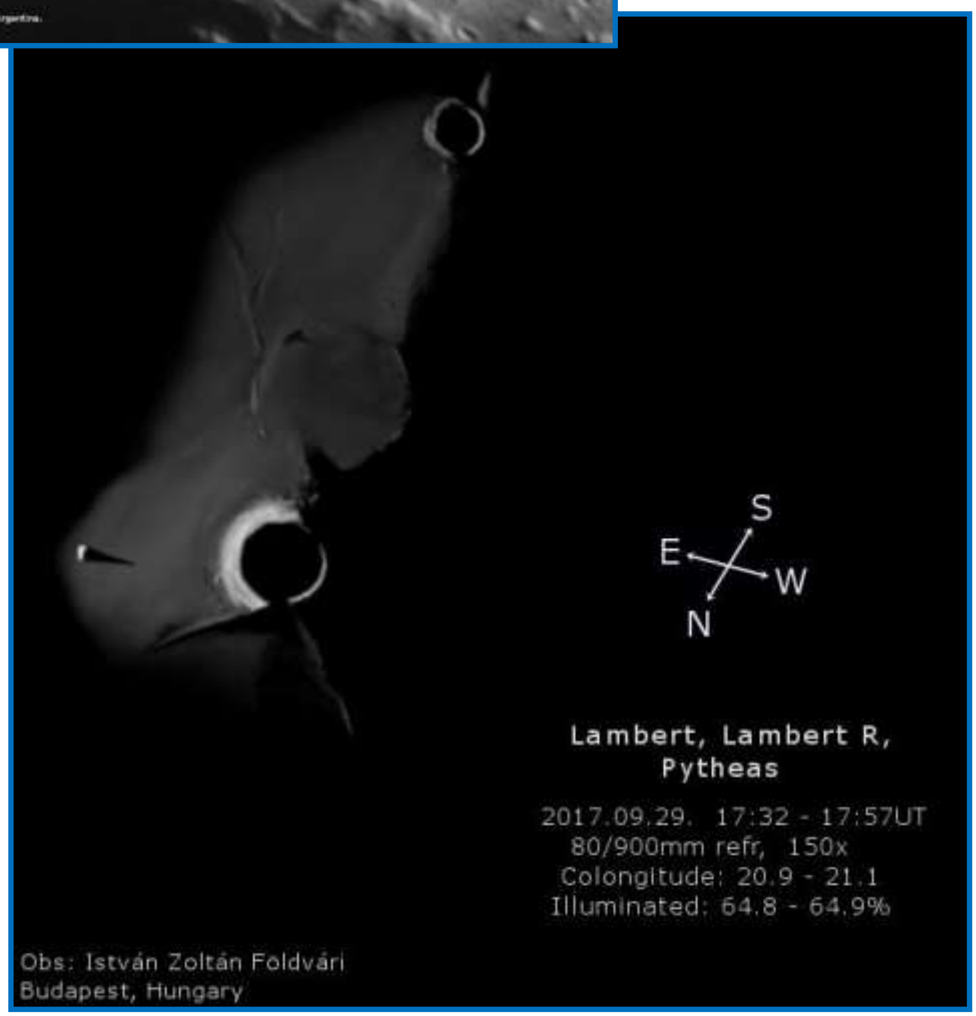
Eratosthenes, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 December 16 08:39 UT. Skywatcher 150 mm reflector, 750 mm fl, QHY5-II-C camera.*

Mare Nectaris, *Guillermo Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 November 05 00:39 UT. Explore Scientific 127 mm f/15 Maksutov-Cassegrain telescope, IR685 nm filter, Player One Ceres C camera.*

Waning Gibbous Moon, *Gregory T. Shanos, Sarasota, Florida, USA. 2022 January 19, 03:29 UT. Meade 60 mm refractor telescope, 260 mm fl, f/4.3, Astronomik L2 UV-IR cut filter, ZWO 462MC one-shot color camera.*

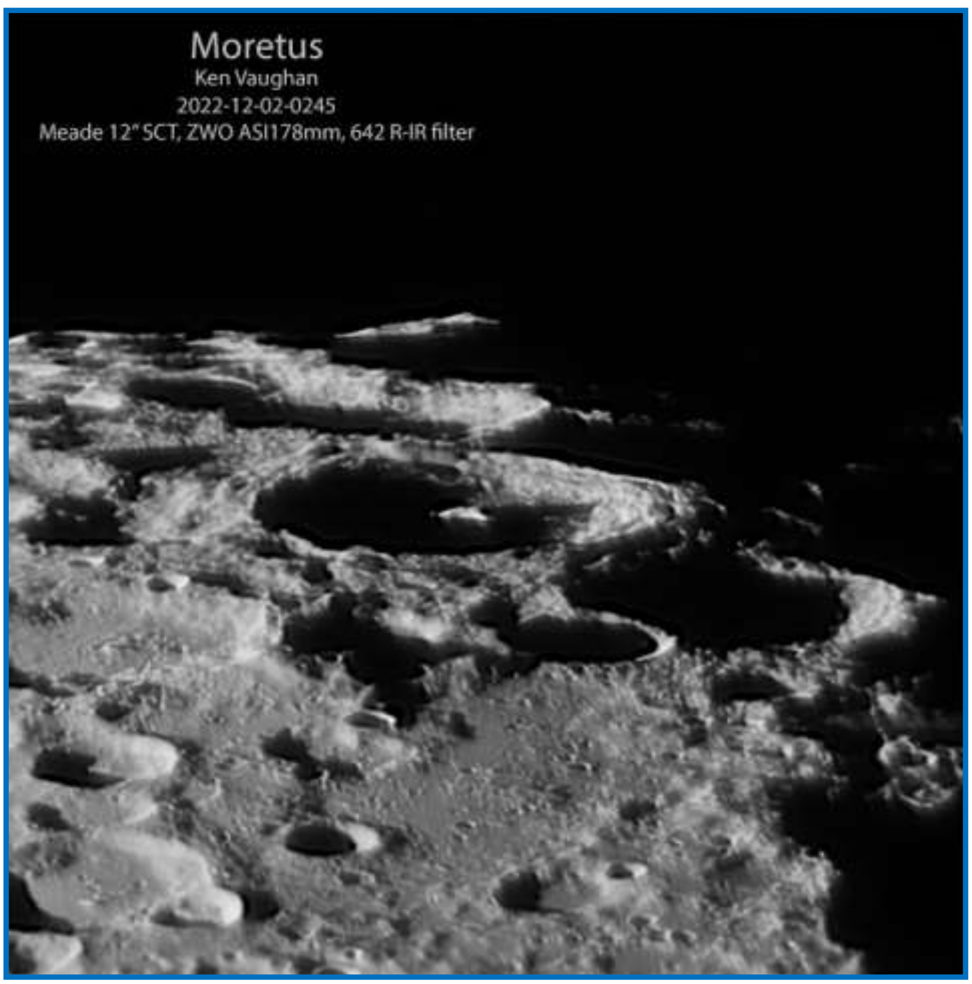
Recent Topographic Studies

Mersenius, *Guillermo Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 November 06 01:08 UT. Explore Scientific 127 mm f/15 Maksutov-Cassegrain telescope, 2x barlow, IR850 nm filter, Player One Ceres C camera.*



Lambert, Lambert R and Pytheas, *István Zoltán Földvári, Budapest, Hungary. 2017 September 29, 17:32 -17:57 UT, colongitude 20.9°-21.1°. 80 mm refractor telescope, 900 mm focal length, 150 x. Seeing 8/10, transparency 6/6.*

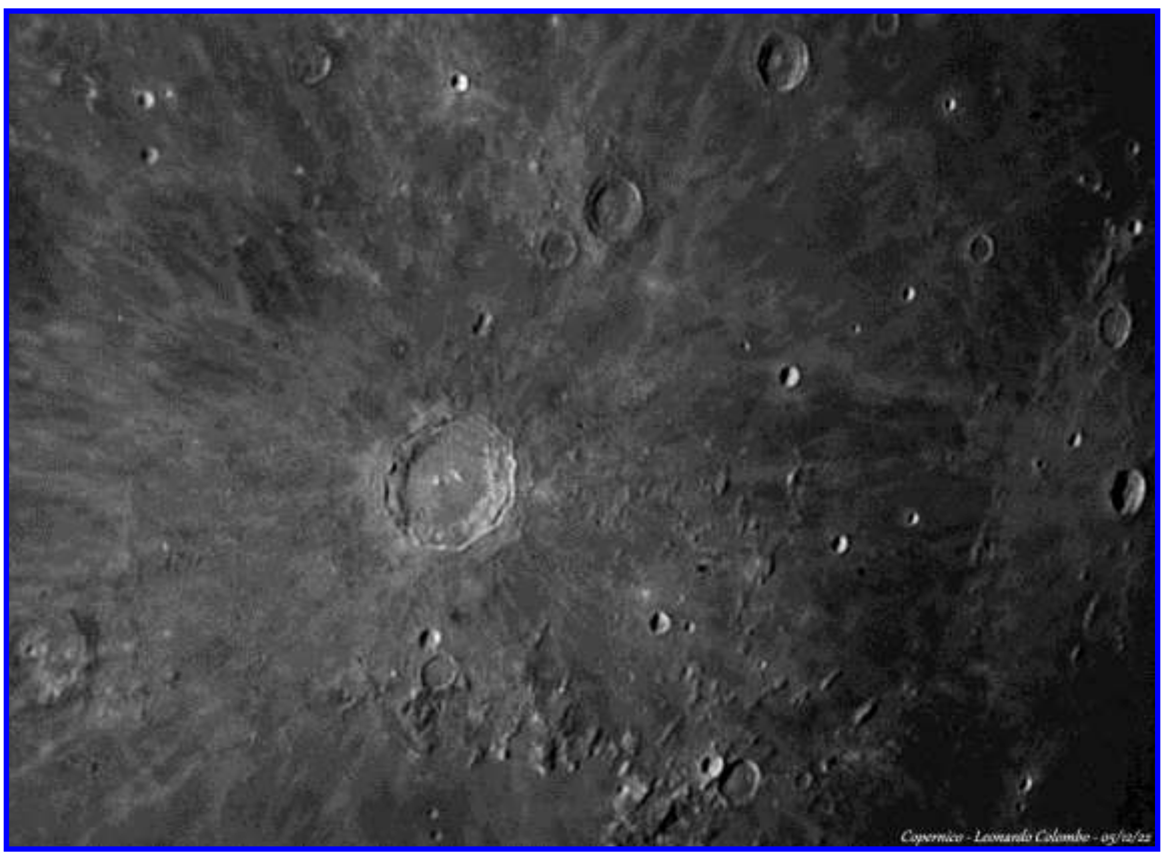
Montes Recti, *Guillermo Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 November 05 01:02 UT. Explore Scientific 127 mm f/15 Maksutov-Cassegrain telescope, 2x barlow, IR685 nm filter, Player One Ceres C camera.*



Moretus, *Ken Vaughn, Cattle Point, Victoria, British Columbia, Canada. 2022 December 02 02:45 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 R-IR filter, ZWO ASI178mm camera. North is down, west is right.*

Recent Topographic Studies

Philolaus, *Guillermo Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 November 05 01:04 UT. Explore Scientific 127 mm f/15 Maksutov-Cassegrain telescope, 2x barlow, IR685 nm filter, Player One Ceres C camera.*



Copernicus, *Leonardo Alberto Colombo, Córdoba, Argentina. 2022 December 06 03:01 UT. 102 mm Maksutov-Cassegrain telescope, IR pass 685nm filter, QHY5LII-M camera. North is down, west is right.*

Recent Topographic Studies

Sinus Iridum, *Guillermo Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 November 05 00:42 UT. Explore Scientific 127 mm f/15 Maksutov-Cassegrain telescope, IR685 nm filter, Player One Ceres C camera.*

Waxing Gibbous Moon, *Gregory T. Shanos, Sarasota, Florida, USA. 2022 December 04, 02:51 UT. Meade 60 mm refractor telescope, 260 mm fl, f/4.3, Astronomik L2 UV-IR cut filter, ZWO 462MC one-shot color camera.*

Recent Topographic Studies

Sinus Iridum, *Guillermo Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 November 05 01:50 UT. Explore Scientific 127 mm f/15 Maksutov-Cassegrain telescope, IR850 nm filter, Player One Ceres C camera.*

Montes Apenninus, *Ken Vaughn, Cattle Point, Victoria, British Columbia, Canada. 2022 December 02 03:11 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 R-IR filter, ZWO ASI178mm camera.*

Recent Topographic Studies

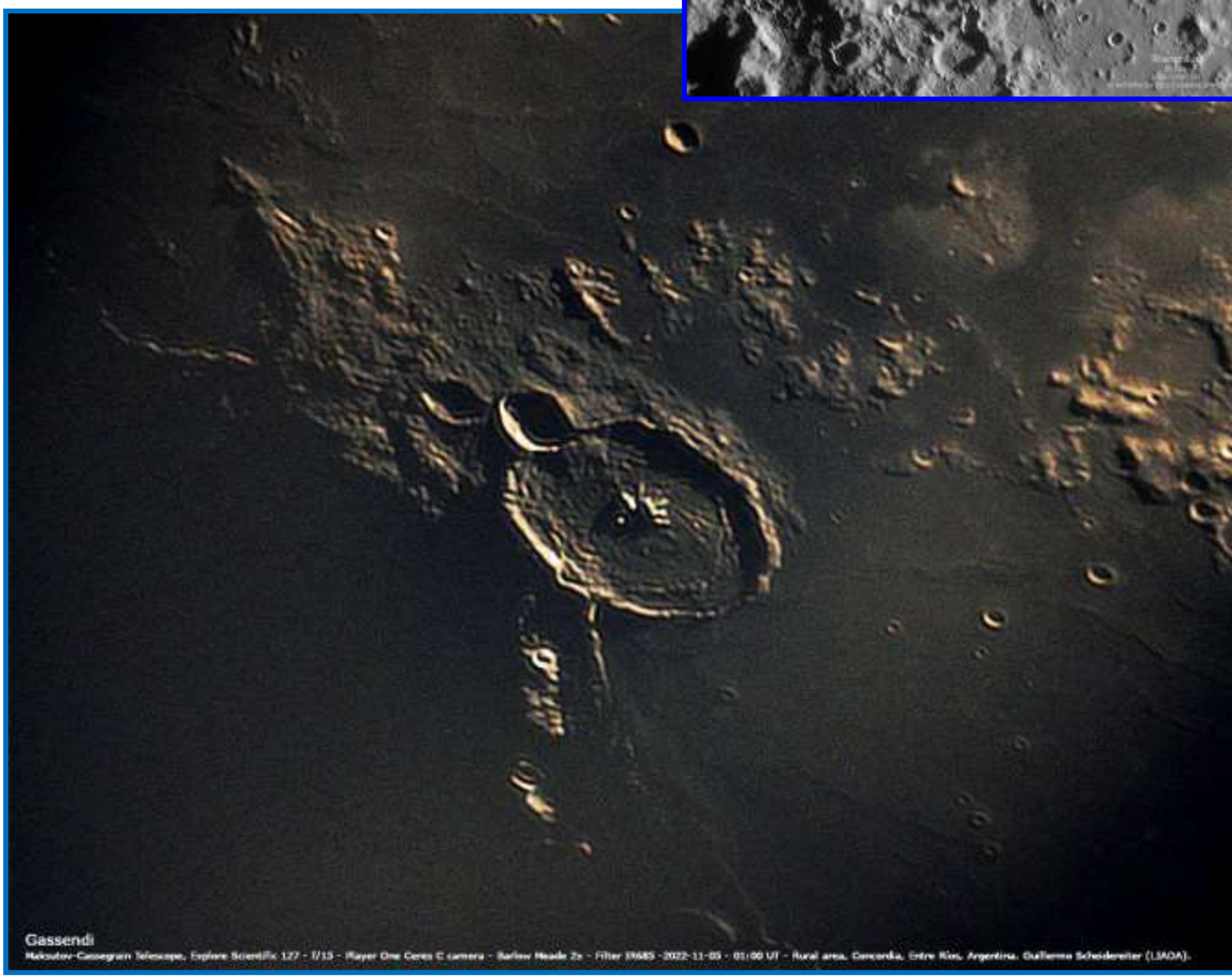
Eratosthenes, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 December 16 08:44 UT. Skywatcher 150 mm reflector, 750 mm fl, QHY5-II-C camera.*

Gassendi, *Leonardo Alberto Colombo, Córdoba, Argentina. 2022 December 06 03:03 UT. 102 mm Maksutov-Cassegrain telescope, IR pass 685nm filter, QHY5LII-M camera. North is down, west is right.*

Recent Topographic Studies

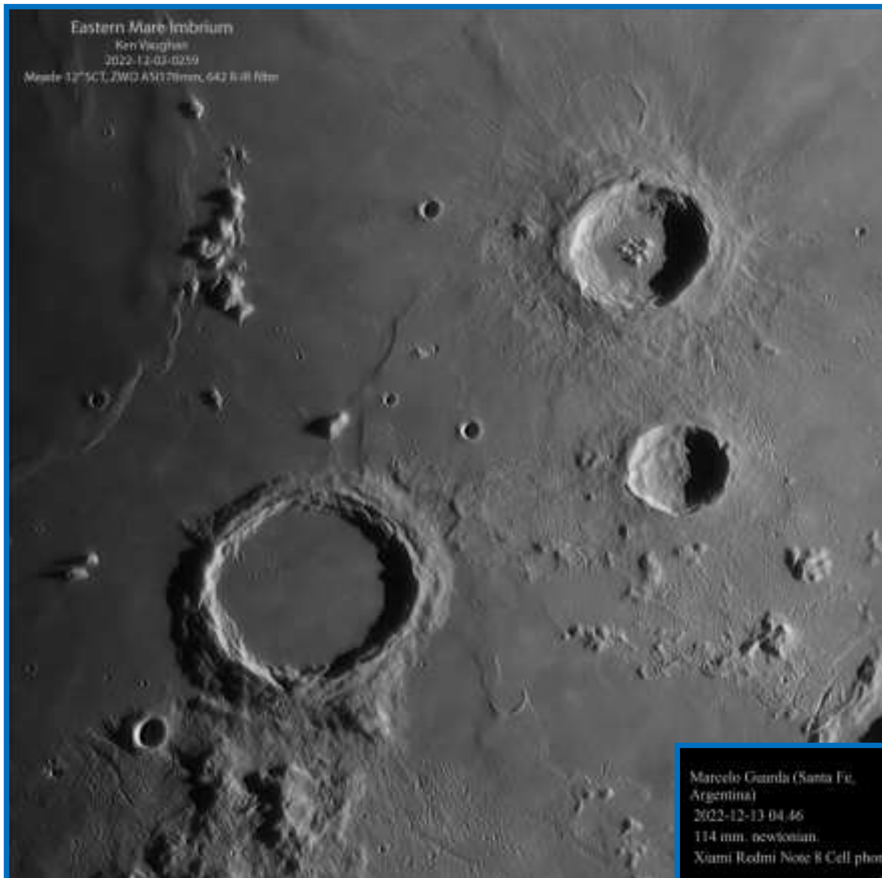
Theophilus, *KC Pau, Hong Kong, China. 2022 November 29 11:03 UT. 10 inch f/6 reflector telescope, 2.5x barlow, QHY-CCD290M camera.*

Gassendi, *Guillermo Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 November 05 01:00 UT. Explore Scientific 127 mm f/15 Maksutov-Cassegrain telescope, 2x barlow, IR685 nm filter, Player One Ceres C camera. North is upper right, west is left.*



Recent Topographic Studies

![ALPO logo]



Eastern Mare Imbrium, *Ken Vaughn, Cattle Point, Victoria, British Columbia, Canada. 2022 December 02 02:59 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 R-IR filter, ZWO ASI178mm camera.*

Waning Gibbous Moon, *Marcelo Guarda, Santa Fe, Argentina. 2012 December 13 04:46 UT. 114 mm Newtonian reflector telescope, Xiami Redmi Note 8 Cell phone camera.*

Recent Topographic Studies

Gaudibert, *István Zoltán Földvári, Budapest, Hungary. 2017 September 09, 23:30-23:51 UT, colongitude 139.7°. 80 mm refractor telescope, 900 mm focal length, 150 x. Seeing 7/10, transparency 4/6.*

Tycho, *Leonardo Alberto Colombo, Córdoba, Argentina. 2022 December 06 03:05 UT. 102 mm Maksutov-Cassegrain telescope, IR pass 685nm filter, QHY5LII-M camera. North is down, west is right.*

Recent Topographic Studies

Plato and Vallis Alpes, *Leonardo Alberto Colombo, Córdoba, Argentina. 2022 December 06 03:07 UT. 102 mm Maksutov-Cassegrain telescope, IR pass 685nm filter, QHY5LII-M camera. North is down, west is right.*

Recent Topographic Studies

Lunar Geologic Change Detection Program

Coordinator Dr. Anthony Cook- atc@aber.ac.uk
Assistant Coordinator David O. Darling -DOD121252@aol.com

2023 January

News: I have come across a couple of LTP publications, previously un known to me whilst Googling. Firstly "Transient Lunar Phenomena, Outgassing Events, and the Lunar Gravity Field: Impacts to Sustained Human Presence on the Moon" a Master's thesis by Cameron Nardini of the American Military University, published June 2022. This finds no significant statistical correlation with the lunar gravity fields – though he did find a correlation of LTP locations with past areas of volcanic activity, young age features and mare/ highland boundaries. Another publication I found was "Lunar TLP's and the Tectonic Processes of the Earth and the Moon" by Dimita Ouzounov et al. in the US again. Presented at the European Geophysical Union General Assembly in 2022. They seem to suggest that there is a causal relationship between major earthquakes (here on Earth) and LTP events on the Moon – this I am highly sceptical of, though if it's related to Moon: Earth tidal effects. One of the problems of both these studies is that they do not take into account control data when doing statistics on LTP. Only using control data, i.e. knowing what are the most favourite features on the Moon that observers look at, and when, can we attempt to remove observational bias that has blighted most past LTP studies.

LTP Reports:

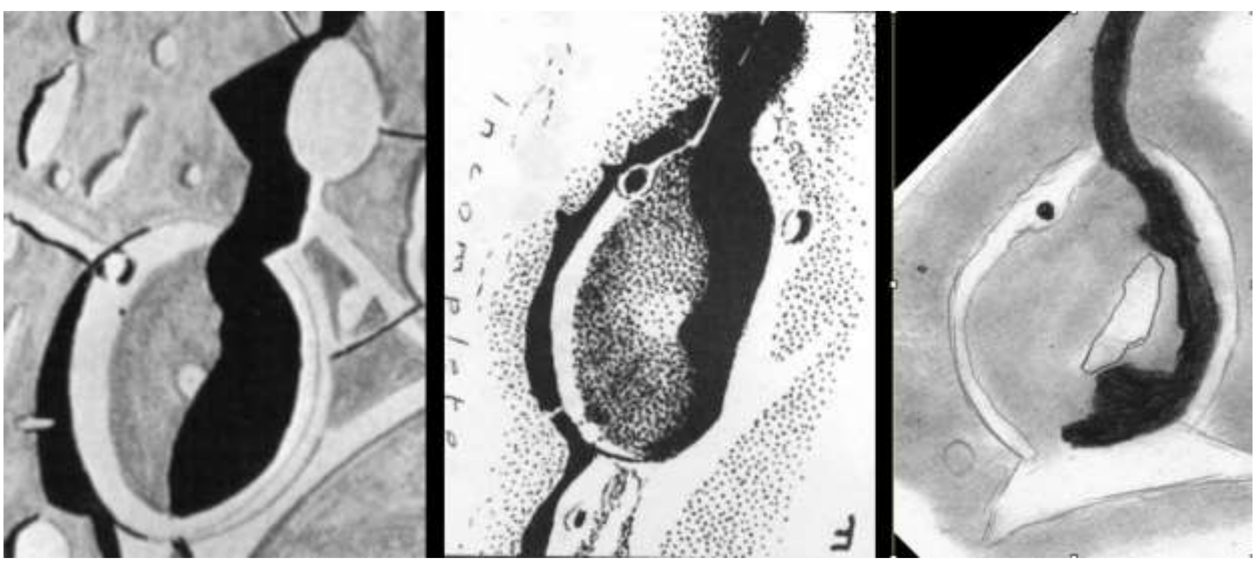


Figure 1. *Herodotus orientated with north towards the top.* ***(Left)*** *A sketch by H.P. Wilkins (BAA) from 1950 Mar 30 UT 19:00?.* ***(Center)*** *A sketch by Harold Hill (BAA) from 1966 Nov 24 UT 21:50.* ***(Right)*** *A sketch by Alberto Anunziato (SLA) made on 2022 Nov 6 UT 00:05-00:38.*

One sighting (or more of a glimpse really) of a light patch on the floor of Herodotus was made by Alberto Anunziato (SLA) on 2022 Nov 06 UT 00:05-00:38UT. He noted that he could not see the central pseudo peak, but instead observed a central patch (see Fig 1 - Right). He then goes onto say that he was not sure if this was a genuine observation, or a biased observation – based upon the written account in the repeat illumination predictions. Seeing detail on the floor of Herodotus was at the limit of his telescope (a Meade EX 105, x154). Fig 1 (Left and Center) refers to two of the LTP reports below – for Bartlett's report we have no sketch in the archive. The Fig 1 sketches have been ordered by the shadow thickness. Alberto's sighting is slightly off-center, more elongated in appearance, and unlike the Hill and Wilkins reports is more offset from the shadow too. We shall assign a weight of 1 to reflect Alberto's uncertainty.

Herodotus 1950 Mar 30 UT 19:00? Observed by Wilkins (Kent, UK, 15" reflector) "Transient c.p. (similar phen. to Bartlett's in later yrs.? see #532). NASA catalog weight=4. NASA catalog ID #523. ALPO/BAA weight=3.

Herodotus 1956 Nov 15 UT 01:05-01:30 Observed by Bartlett (Baltimore, MD, USA, 3.5" reflector x100) "Pseudo c.p. clearly seen est. I=5.5, Wratten filters showed it neutral to green, red, & yellow, but duller in blue. Floor est. 2deg, distinctly olive-green. Precise time at 0117 at col. 55.27deg" NASA catalog weight=4. NASA catalog ID #655. ALPO/BAA weight=3.

Herodotus 1966 Nov 24 UT 21:50 H. Hill (UK, 7.25" reflector, x240), seeing 4-6/10, transparency 4/5) sketched a central white diffuse patch inside the floor of the crater, with a size of about 1/7th the diameter of the crater. The eastern edge of the white patch was encroached by the shadow of the eastern rim. ALPO/BAA weight=3.

Routine Reports received for November included: Jay Albert (Lake Worth, FL, USA – ALPO) observed: Alphonsus, Aristarchus, Linne, the lunar eclipse, Maginus and Plato. Alberto Anunzatio (Argentina – SLA) observed: Aristarchus, Herodotus, Lichtenberg, Macrobius, Mare Vaporum and Pallas. Massimo Alessandro Bianchi (Italy – UAI) imaged: Plato and Sirsalis. Maurice Collins (New Zealand – ALPO/BAA/RASNZ) imaged: Copernicus, the lunar eclipse and several features. Anthony Cook (Newtown, UK – ALPO/BAA) imaged: several features in the Short-Wave IR (1.5-1.7 microns). Walter Elias (Argentina – AEA) imaged: Riccioli. Valerio Fontani (Italy – UAI) imaged Plato and Sirsalis. Les Fry (Mid Wales, UK) imaged: Clavius, Copernicus, Gassendi, Hansteen, J. Herschel, Kepler, Lacus Excellentiae, Mairan, Mare Australe, Mare Smythii, Mersenius, Palus Epidemiarum, Philolaus, Prinz, and Vallis Schroteri. Rik Hill (Tucson, AZ, USA - ALPO/BAA) imaged: the lunar eclipse. Eugenio Polito (Italy – UAI) imaged: Lichtenberg, Plato and Sirsalis. Trevor Smith (Codnor, UK – BAA) observed: Aristarchus, Mare Smythii and Plato. Gary Varney (ALPO) videoed the lunar eclipse – see this link.

Analysis of Reports Received:

Linne: On 2022 Nov 02 UT 00:40-00:50 Jay Albert (ALPO) observed this crater under similar illumination to the following report:

In 1866 Oct 16 at UT 23:00 Schmidt (Athens, Greece, 7" refractor) observed that Linne crater had disappeared and been replaced by a white patch with a small hill or craterlet. White part seems to increase in size. Cameron says probably not a LTP. The Cameron 1978 catalog ID=145 and the weight=0. The ALPO/BAA weight=1.

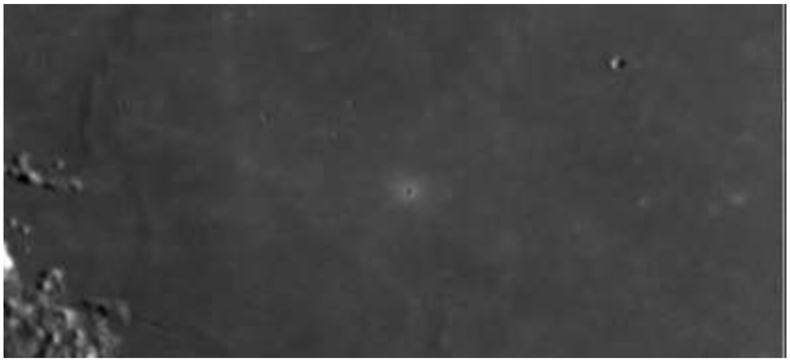


Figure 2. *Linne as imaged by Brendan Shaw on 2012 Nov 21 UT 18:34 and orientated with north towards the top.*

Jay was using an 8" Celestron NexStar Evolution SCT at x226. Transparency was 3rd magnitude, and seeing was 5-6/10. He noted that: "Linne did not disappear". Instead, it was its usual white, circular patch with the craterlet inside. The craterlet was particularly difficult to see on this night due to passing cumulus affecting the seeing, and only visible with patience. This neatly describes the appearance that Schmidt gives. Also, I came across a repeat illumination image (Fig 2), from 2012, in our archives. Again, this illustrates quite clearly what Schmidt saw was perfectly normal. We shall adjust the weight from 1 to 0 and remove it from the ALPO/BAA database of LTP. The change in size that Schmidt refers to might be his recollection of the size at different observing runs, or more likely how the apparent size gets altered by atmospheric seeing. We have covered repeat illumination of this LTP before in the 2017 Jan newsletter.

Gassendi: On 2022 Nov 05 UT 20:49 Les Fry (NAS) imaged this crater in monochrome under similar illumination and topocentric libration to the following report:

Gassendi 1968 Oct 03/04 UT 19:30-19:50 & 00:20-01:40 Observed by Rawlings (Aylesbury, UK, 6" reflector low magnification) and by Moore (Selsey, Sussex, UK, 12.5" reflector, x360) "Slight blink (Eng.) arcuate in shape, N. of c.p. (Rawlings dubious). Moore, with blink device saw none at 0020-0140h. No LTP in Gass., Ptol. or Aris. 5th or 6th.". NASA catalog weight=1. NASA catalog ID #1093. ALPO/BAA weight=1.

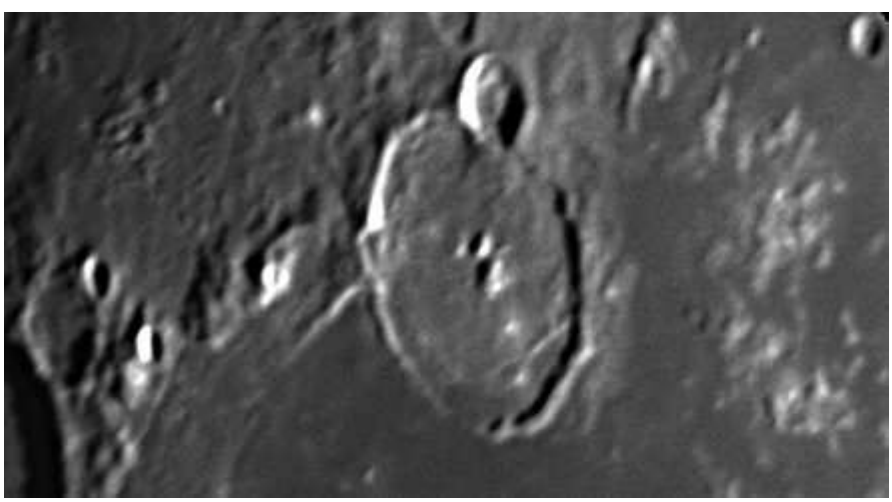


Figure 3. *A monochrome image of Gassendi, orientated with north towards the top, as imaged by Les Fry (NAS) on 2022 Nov 05 UT 20:49.*

Plato: On 2022 Nov 07 UAI observers: Massimo Alessandro Bianchi (UT 19:42 and 19:44), Valerio Fontani (UT 19:25-19:56) and Eugino Polito (UT 19:07, 19:30, 19:35 and 19:45) imaged this crater in color under similar illumination to the following report:

Plato 1788 Dec 11 UT 22:00. Bright point seen on the dark part by observers in Mannheim. Cameron 1978 catalog ID is 38 and the weight assigned is 5. ALPO/BAA weight=1.

… and under similar colongitude, according to the Lunar Schedule request website, to the following reports:

Plato 1938 Feb 14 UT 00:25 Observed by Fox (Newark, England, 6.5" reflector, x240) "Prominent gold-brown spot on E. wall with yellow glow without definite boundary, spreading over floor." NASA catalog weight=3. NASA catalog ID #431. ALPO/BAA weight=3.

On 2013 Jan 25 UT 19:05-19:15 R. Braga (Milan, Italy, 115mm refractor, x267, seeing III, transparency average) observed that Plato in general was normal in appearance, but the east rim was showing a remarkable golden (yellow-golden) hue. This was a repeat illumination observation for a W.E. Fox LTP observation from 1938 Feb 14. The observer was wondering whether they were in some way biased after reading the original report description - so uncertain over this being a LTP. In view of uncertainty ALPO/BAA weight=1.

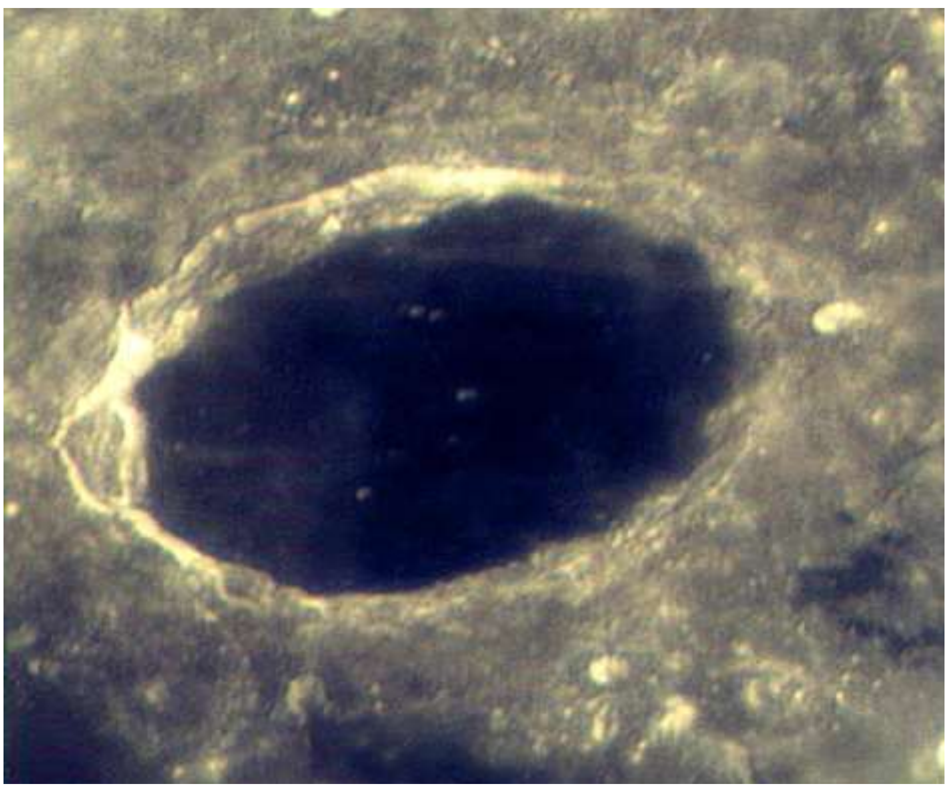


Figure 4. *Plato by Massimo Alessandro Bianchi, taken on 2022 Nov 07 UT 19:44 and orientated with north towards the top. The image has been sharpened, color normalized and then had its color saturation increased to 50% using GIMP.*

Massimo's image (Fig 4) shows a nice yellow color all over the highlands around Plato, and blue on the floor. There is no sign of a special gold color or spot on the east rim. Just as a check I decided to apply the same process to Valerio and Eugino's wider area images (See Fig 5 left and Right respectively). These do not show the yellow color that Massimo's image shows everywhere, so it must be an artifact of the camera or processing. However they do not show any gold color on the eastern rim either. So we shall leave the weights of the 1938 and 2013 reports as they are. The 1938 and 2013 reports were covered in the 2015 Feb and 2018 Jan newsletters for similar illumination observations.

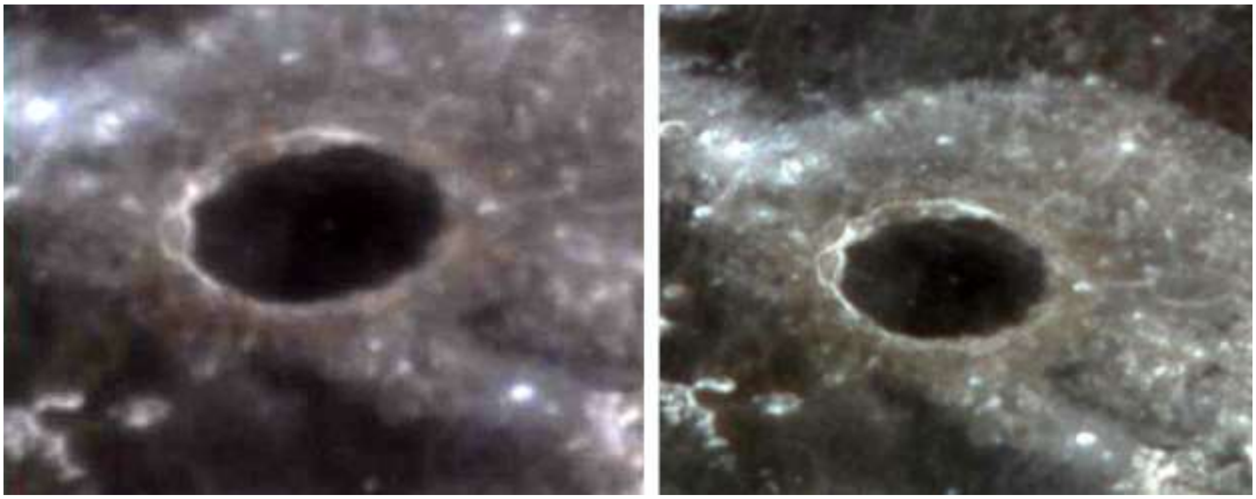


Figure 5 *Plato on 2022 Nov 07 taken by UAI observers. Images have been color normalized and then had their color saturation increased to 50% using GIMP.* ***(Left)*** *Taken by Valerio Fontani at 19:57 UT.* ***(Right)*** *Taken by Eugenio Polito at 19:30 UT.*

With regard to the 1788 report, instinct might suggest the central craterlet as the explanation. However consulting the Cameron LTP catalog cards is says the report comes from a Phil Ringsdore article in Planetarium I(3) March 1968 – which unfortunately I do not have a copy of. Furthermore it goes onto say: "*Whitish bright spot shining somewhat hazily and 4-5" in diam, 5th mag (to naked eye* – I guess she means looking through the scope*) – in bright mountainous region 1' 18"* (that's about 80 km) *S.E. of Plato (IAU) bordering M. Imbrium. Nothing similar in earthshine – details were distinct + familiar obj. recognized. It became inconspicuous at times, finally uncertain 15 m + then disappeared. Manillius + Menelaus equally visible + distinct before + after. Drawing on Oct 2, 1787 did not show any trace of white spot + never seen again*. So I think that I will leave the weight at 1 for now and even consider if the date might not be correct as there seems to be some discussion of this on the index card and the mention of earthshine would have to be on a different date as Figs 4 and 5 are well past this lunar phase stage.

Riccioli: On 2022 Nov 08 UT 00:17 Walter Elias (AEA) imaged this crater under similar illumination to the following report:

Riccioli: 1964 Jun 24 O. Brittman (Elgin, IL, USA, 3" refractor and 6" reflector, x250) - During an eclipse of the Moon the crater appeared normal until it emerged from the shadow. In the north east the dark floor was not its normal hue and two light areas appeared to join. The emerging patches became less and less bright, finally disappearing at 0345 UT when the crater returned to normal. Cameron 2006 catalog extension ID=10 and weight=2. ALPO/BAA weight=2.

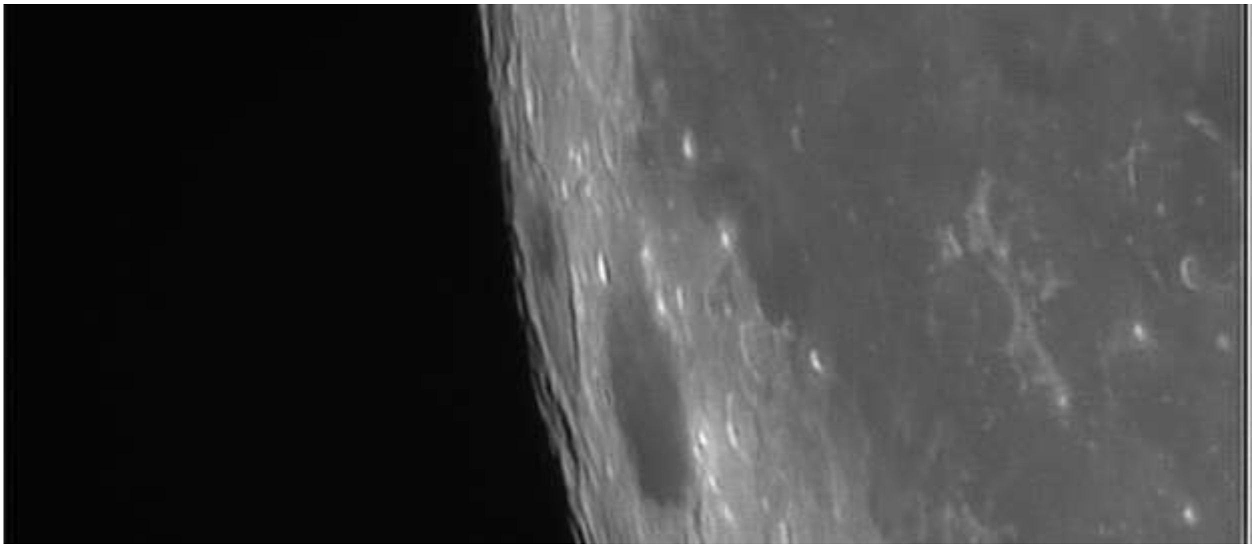


Figure 6. *Riccioli, just NW of Grimaldi, on the limb of the Moon* - *orientated with north at the top. Imaged by Walter Elias on 2022 Nov 08 UT 00:17.*

Although there was not an eclipse at this time, Walter's image (Fig 6) does at least show what the normal appearance should be like at this stage in the illumination, apart from libration effects, and so is a useful comparison image.

Lunar Eclipse: On 2022 Nov 08 UT 10:03-11:44 Maurice Collins imaged the eclipse at intervals. There are numerous repeat illumination LTP reports that we could compare his images with, but I have picked a couple below as they are repeat viewing angle (topocentric libration) as well to within ±1.0°:

On 1912 Apr 01 at UT 22:00-23:00 LeRoy (France?) during an eclipse, observed Tycho to be visible as a very bright spot standing out in the slate grey shadow. Apparently only Tycho was seen during the eclipse. The mid eclipse point was at 22:14UT. The Cameron 1978 catalog ID=236 and the weight=1. The ALPO/BAA weight=2.

On 1978 Sep 16 at UT 18:28-18:57 G. Searle (Concord, Sydney, NSW, Australia, 8" reflector, x100, x160, S=III) observed a bright star-like point on the western (IAU) edge of Mare Tranquilitatis (x100) that appeared unlike any other crater and a check of the location revealed no suitably bright crater in that region (from a map?). Changed to a higher power (x160) and it was still there, but not as conspicuous. Observer thinks that this may have been due to the Moon's low altitude (16 deg) and the seeing. At 18:35 he compared it to the brilliant crater Proclus and found the star-like point to be 75% of the brightness of Proclus. Ken Wallace (Australia) had been taking photos and observed the object at 17:37.5UT. The object gradually faded over the next 15 minutes and by 18:52UT could only be seen in averted vision at x100. By 18:57UT it was gone. The Cameron 2006 catalog ID=38 and weight=5. The ALPO/BAA weight=3.

Figure 7. *The eclipsed Moon as imaged by Maurice Collins on 2022 Nov 08 UT 10:59.*

Well as you can see from Fig 7, although the topocentric libration was the same as it was back in 1912, Tycho is not especially bright here. I therefore decided to find out more about the 1912 Apr 01 lunar eclipse. Apparently, it was partial with only the southern latitudes of the Moon in the umbra. It is therefore not surprising that Tycho was bright as it would have been near the edge of the umbra. I think we will lower the weight from 2 to 1, until I can find out more about the original observation e.g., if any photos were taken?

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For the Grant Searle report from 1978, at least this was a "total eclipse", as I remember making some naked eye sketches myself. Looking at Maurice's image (Fig 7), well there is a "star-like point" on the western shore of Mare Tranquilitatis, and it is called "Dionysius" – just a simple bright ray crater only 18 km in diameter. I am not sure how experienced Grant Searle was – if he had used a crater outline map of the Moon, or an airbrush map, it might not have been located – only a Full Moon map would give a positive identification of this bright ray crater. Grant comments that it was 75% the brightness of Proclus. Well, if you look at Fig 7, isn't this what we see for Dionysius compared to Proclus? Ken Wallace says that he took photos and mentions that the object fades – if anybody, "down under" (Australia), knows about the whereabouts of Kens photos then I would be really keen to see them. Regarding the apparent fade – there could be a number of reasons: the Moon was low down, hence more absorption, we do not know what atmospheric transparency was like, also radial density variations in the umbral shadow etc.? For safety I will lower the ALPO/BAA weight from 3 to 2 until we obtain more evidence. We have covered a repeat illumination observation of this before in the 2014 Dec newsletter.

Lichtenberg: On 2022 Nov 08 UT Eugino Polito (UAI) took a sequence of color images of this area following a request on the Lunar Schedule web site for the following:

BAA Request: An important historical LTP sketch of this crater, and its surrounds, made by Richard Baum back in 1951 seems to have the wrong UT? It is very important that we establish what the UT and date of this observation actually was. In this prediction we are seeing if his date was off by 1 day. Please email any sketches, monochrome, and especially color images to: a t c @ a b e r . a c. u k

Figure 8. *Lichtenberg.* ***(Left)*** *a close up of an image by Eugino Polito taken on 2022 Nov 08 UT 18:19. Image has cut out from a much larger image of the area, then has been color normalized and then had its color saturation increased to 50% using GIMP.* ***(Right)*** *A sketch made by Richard Baum (BAA) made, according to his log book, on 1951 Jan 21 UT 18:19-18:39.*

We covered something similar last month for a 1988 Harold Hill report of color in the same vicinity, so there might be something in those two reports? However, on this occasion, despite extensive color enhancement, Eugino's image shows no similar coloration east of the crater that was depicted in Richard Baum's 1951 report. At least the illumination seems similar, so we can now assume that the original date given in Richard Baum's observational note book of 1951 Jan 21 was actually 1951 Jan 22. I think we can remove this from the Lunar Schedule website now that we are sure about the day. Repeat illumination observations of the 1951 Baum observation have been covered before in the 2020 Jun, 2021 Apr & Jul newsletters.

Aristarchus: On 2022 Nov 08 UT 22:58-23:10 Trevor Smith (BAA) observed this crater under similar illumination to the following four reports:

Aristarchus 1956 Nov 17/18 UT 23:30-00:30 Observed by Argentiere et al. (Itatiba City, Brazil, 20, 10 and 6 cm reflectors) Crater may have been brighter than expected(?) during a lunar eclipse. NASA catalog weight=3. NASA catalog ID #658. ALPO/BAA weight=1.

On 1956 Nov 18 at UT 00:00? an unknown observer (Cameron gives an AGU meeting reference) apparently saw a LTP in Aristarchus crater. The Cameron 1978 catalog ID=657 and weight=0. The ALPO/BAA weight=1.

On 1964 Dec 19 at UT 03:13-03:14 Budine and Farrell (Binghamton, New York, USA, 4" refractor, x200, S=7, T=5) observed that Aristarchus brightened five times over 1 minute during a lunar eclipse. The Cameron 1978 catalog ID=870 and weight=5. The ALPO/BAA weight=3.

On 1964 Jun 25 at UT ~01:07 Titulaer (Utrecht, the Netherlands) observed that Aristarchus crater was very bright during an eclipse. The Cameron 1978 catalog ID=822 and weight=4. The ALPO/BAA weight=1.

Trevor was using a 16" Newtonian at x247 under Antoniadi III/IV seeing conditions. A small star like speck of light could be seen on the NW rim. However, due to the seeing it appeared to flash on and off at times, making it look artificial in appearance. Everything else in the neighborhood of Aristarchus looked normal and there were no signs of spurious color or obscurations. Trevor wonders if this is what Vreeland observed in an earlier selenographic colongitude back in 1949: *"In 1949 Apr 13 at UT 05:00 Vreeland and others (Mill Valley, CA, USA, 4.5" refractor) observed in Aristarchus a brilliant star-like point just after 3rd contact. This was not seen before or during totality. He thinks that it was a high peak catching the sunlight before the rest of the surface. It remained bright but larger as the sun hit it. The Cameron 1978 catalog ID=517 and the weight=1"*. I certainly think this is possible. Was anybody else observing at the same time as Trevor?

Concerning the repeat illumination reports above, these are all during lunar eclipses, which clearly Trevor was not able to see as it was earlier in the day when the Moon was below the horizon from the UK. The prediction software sometimes throws up Wobblies like this as it works with a ±0.5˚ tolerance in selenograhic colongitude and sub-solar latitude, not to mention the additional tolerance from the angular width of the umbra being 1.4˚. However, looking more closely at the 1956 Nov 18 observations, the official start and end of the umbral phase was between 06:03 and 07:27 UT, on that date, so quite clearly the first 1956 LTP report, during the eclipse, was probably using local time and not UT. This will be corrected. For the 1964 lunar eclipses, the June one was on 1964 Jun 24/25 UT 23:10-03:03 (U1 and U4 contacts) and the December one was on 1964 Dec 19 UT 00:59-04:15 (U1 and U4 contacts), so neither of those times needs adjusting.

General Information: For repeat illumination (and a few repeat libration) observations for the coming month - these can be found on the following web site: http://users.aber.ac.uk/atc/lunar_schedule.htm . By re-observing and submitting your observations, only this way can we fully resolve past observational puzzles. To keep yourself busy on cloudy nights, why not try "Spot the Difference" between spacecraft imagery taken on different dates? This can be found on: http://users.aber.ac.uk/atc/tlp/spot_the_difference.htm . If in the unlikely event you do ever see a LTP, firstly read the LTP checklist on http://users.aber.ac.uk/atc/alpo/ltp.htm , and if this does not explain what you are seeing, please give me a call on my cell phone: +44 (0)798 505 5681 and I will alert other observers. Note when telephoning from outside the UK you must not use the (0). When phoning from within the UK please do not use the +44! Twitter LTP alerts can be accessed on https://twitter.com/lunarnaut .

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Basin and Buried Crater Project

Coordinator Dr. Anthony Cook- atc@aber.ac.uk

This month I thought that I would include a short article, received from Dominique Hoste (See below). We will have another article of his next month on the Flamsteed-Billy basin.

If you think that you have discovered a new impact basin, or unknown buried crater, please check whether it has been found previously on the following web site, and if not email me its location and diameter so that I can update the list:
https://users.aber.ac.uk/atc/basin_and_buried_crater_project.htm.
Alternatively, if you want an observational challenge, try to see if you can image one of more of the basins or buried craters at sunrise/set and establish what colongitude range they are best depicted at.

The Smythii impact basin and looking for its impact melt by Dominique Hoste

The Smythii basin dates back to the pre-Nectarian period, and the impact occurred after an earlier Marginis basin. The rings of Smythii basin overlay/intersect those of the Marginis basin. We can distinguish three rings, seen at the topography (LROC LOLA) and gravity (GRAIL or KAGUYA mission) maps (Figs 1 to 4).

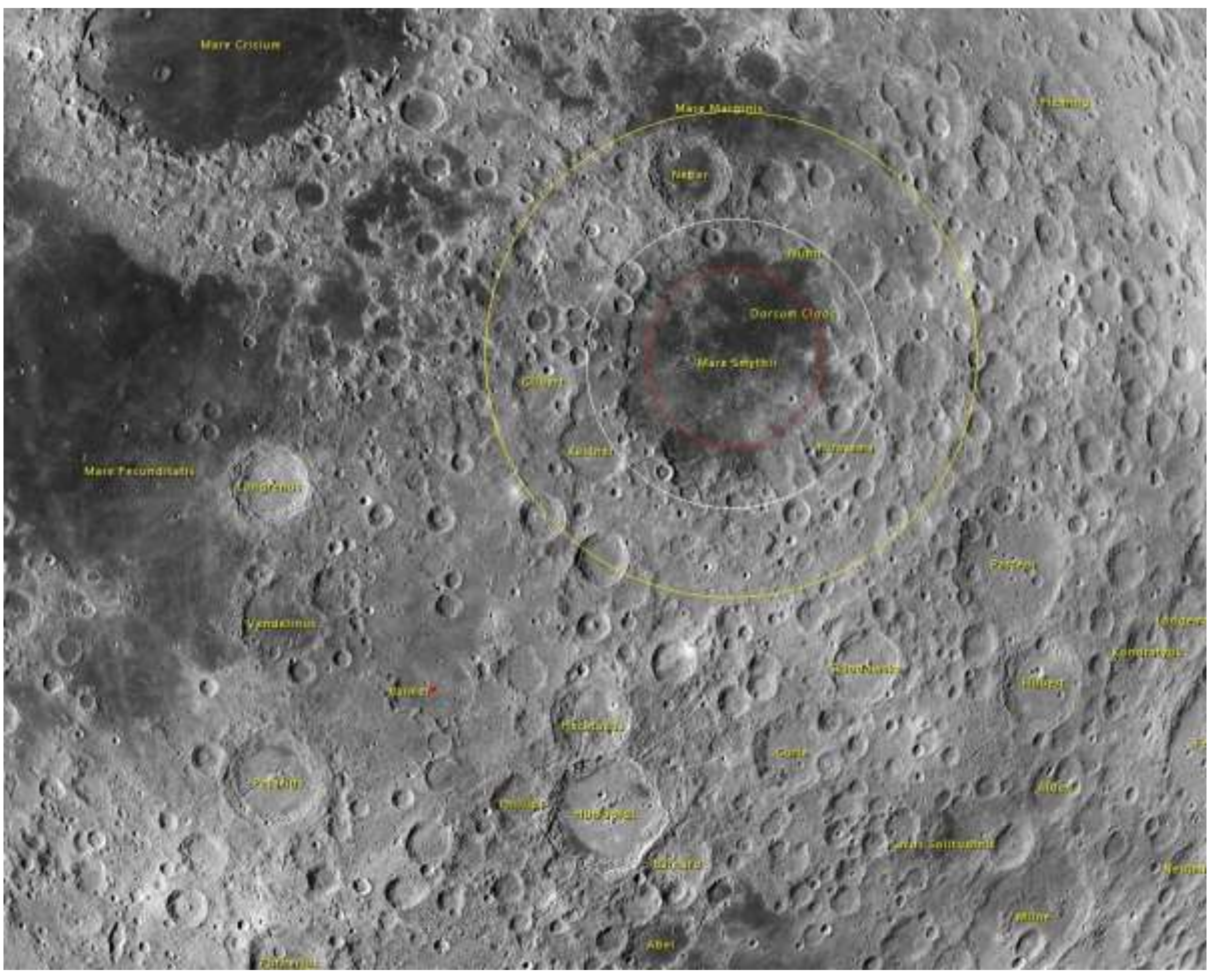

Figure 1. *The rings of the Smythii basin overlaid on a map projected image mosaic.*

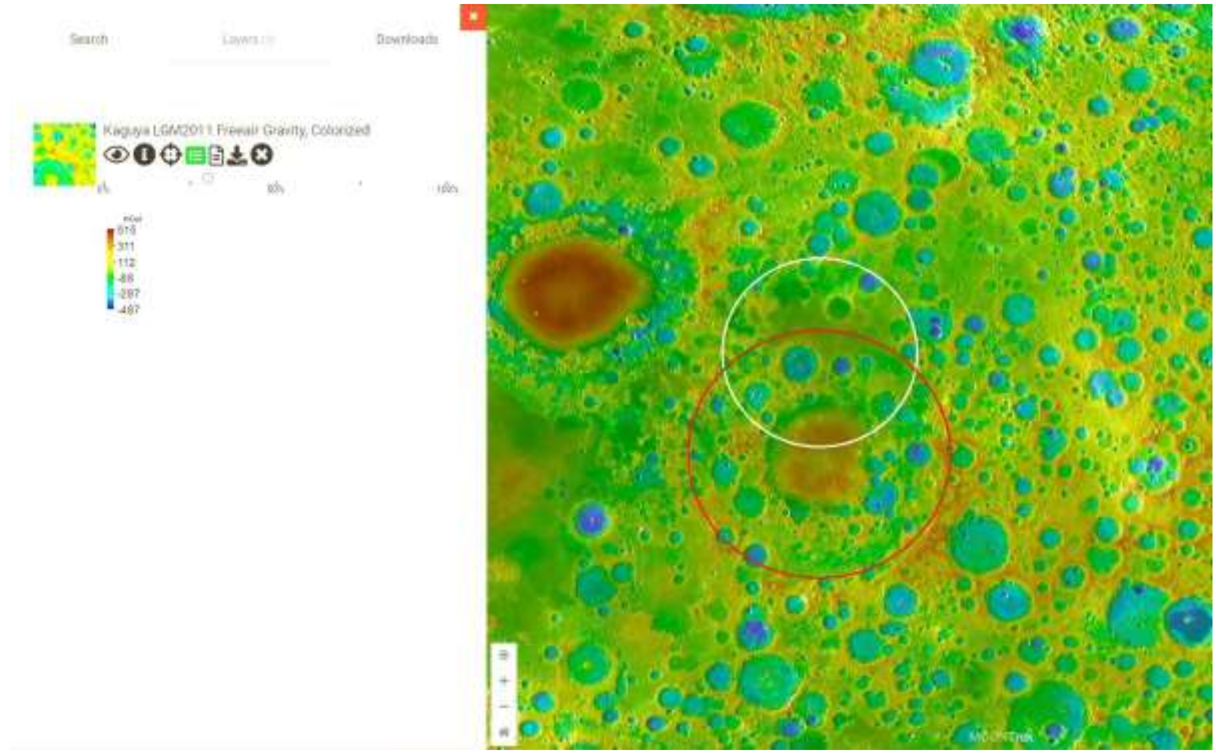

Figure 2. *The main rings of Mare Marginis and the Smythii basin – using Kaguya gravity data.*

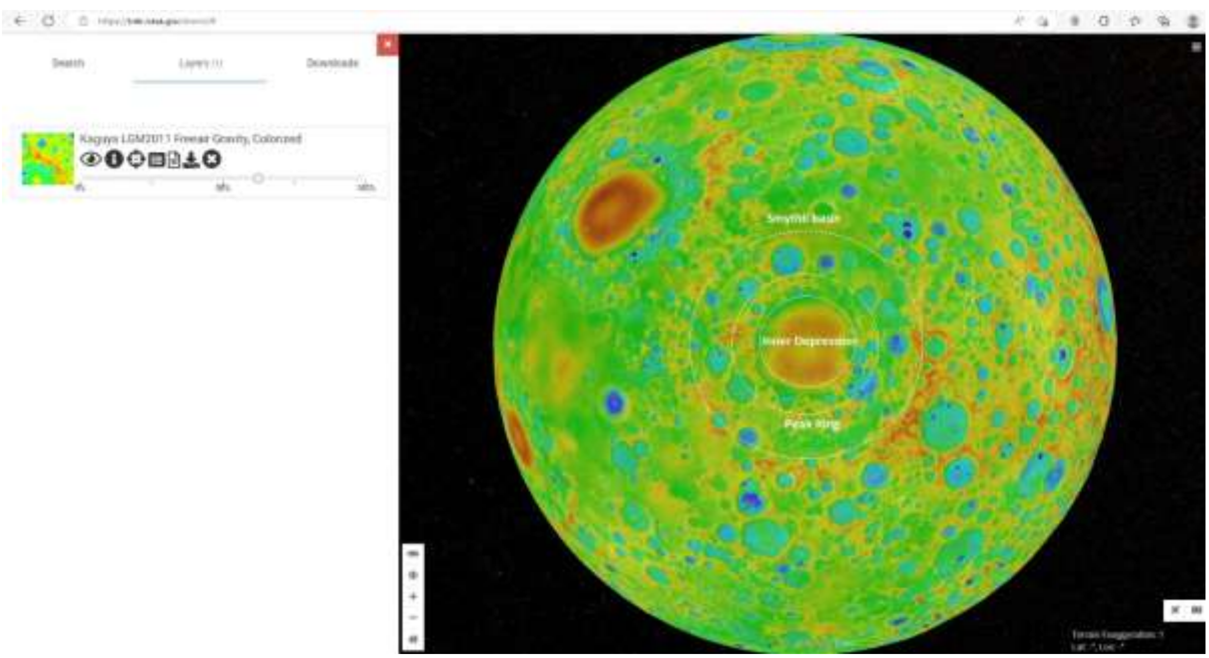

Figure 3. *The rings of the Smythii basin overlaid on Kaguya gravity data.*

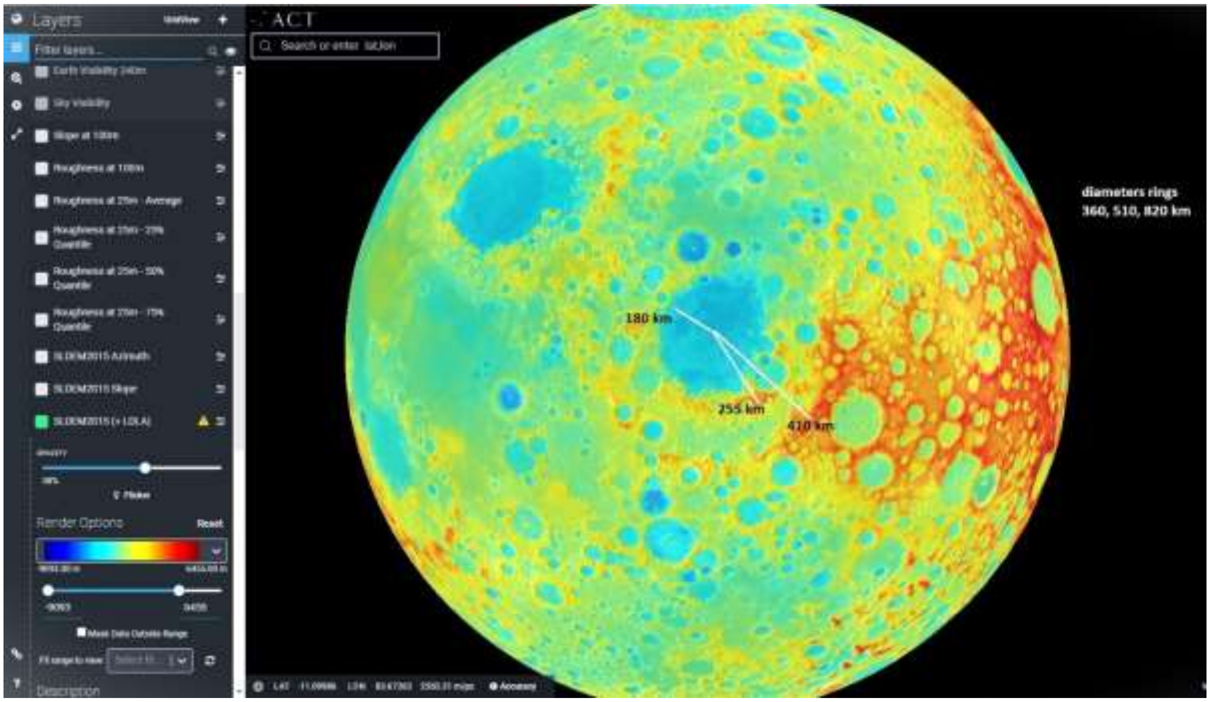

Figure 4. *The corresponding ring diameters as measured using NASA's ACT Quickmap web site. The diameter of the rings are for the central depression 360 km, for the peak ring 510 km and the basin rim 820 km. The highest gravity gradients are noted in the center of the central depression, as well as on the peak ring and on the south-eastern part of the outer ring.*

The dark basalt of Mare Smythii inundates the inner basin of Smythii. It also inundates the bottom of the Neper crater (Colored brown in Fig 5). Mare Marginis, ejecta of the Neper crater and other degraded lunar highland material overlay to the north of the Smythii basin (Colored green in Fig 5).

The basalt of Mare Smythii was originally a mixture of impact breccia, melt sheet and lava. The inner depression was subsequently overlain by many impact craters after the Smythii impact, and therefore mixtures of breccia and ejecta from these younger craters have degraded and covered the surface, making the Smythii melt no longer visible in the northern part of the central depression (Colored brown within the rectangle in Fig 5), and also causing the zone of melt and breccia to the south in the central depression to be very difficult to see as well (Blue inside the rectangle in Fig 5). This can also be seen in Fig 6, the plagioclase map: dark in the north (A), and dark-green-yellow in the south (B).

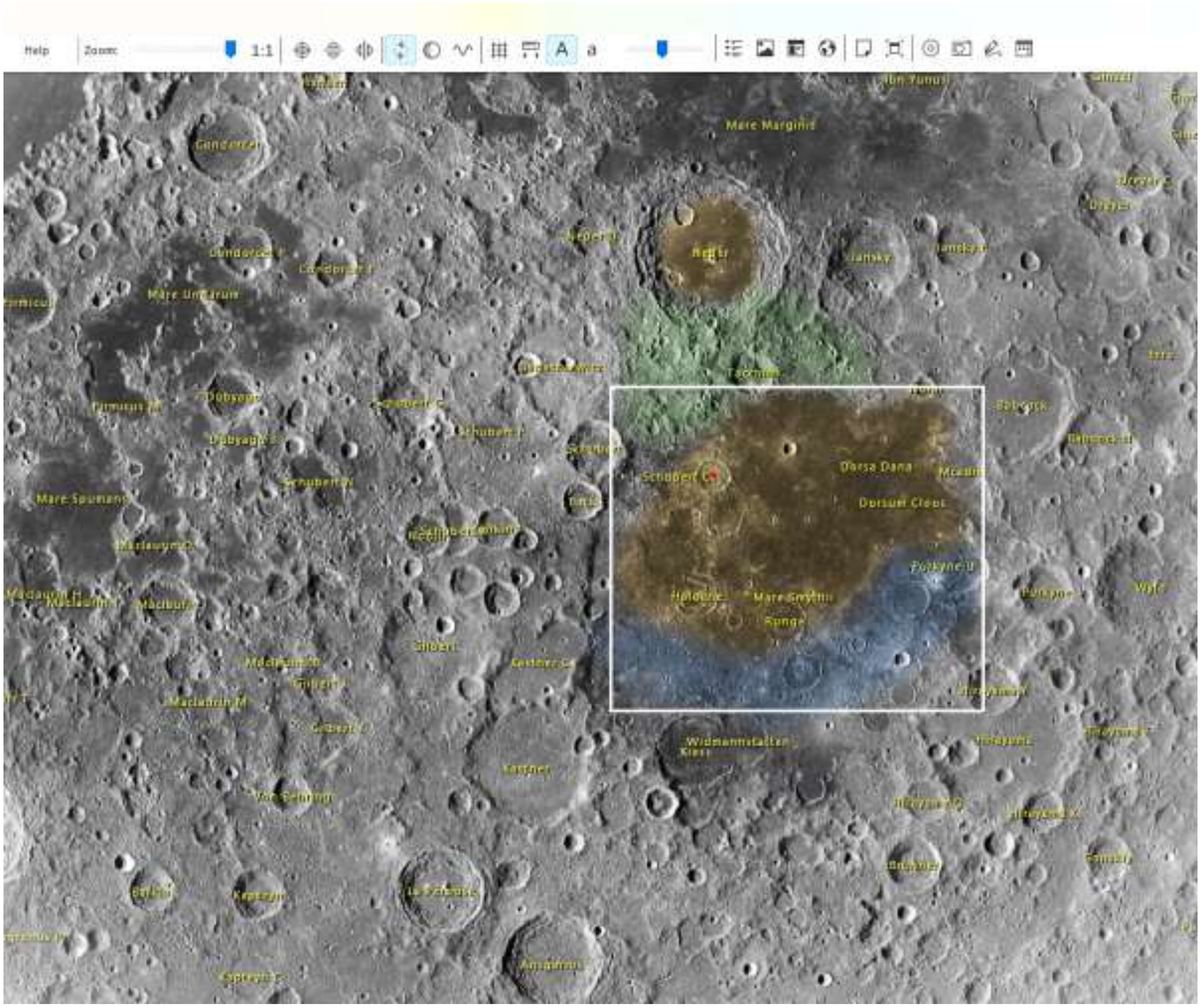

Figure 5. *The inner depression of the Smythii impact basin lies inside the rectangle. The colors depict some of the geological units in the area.*

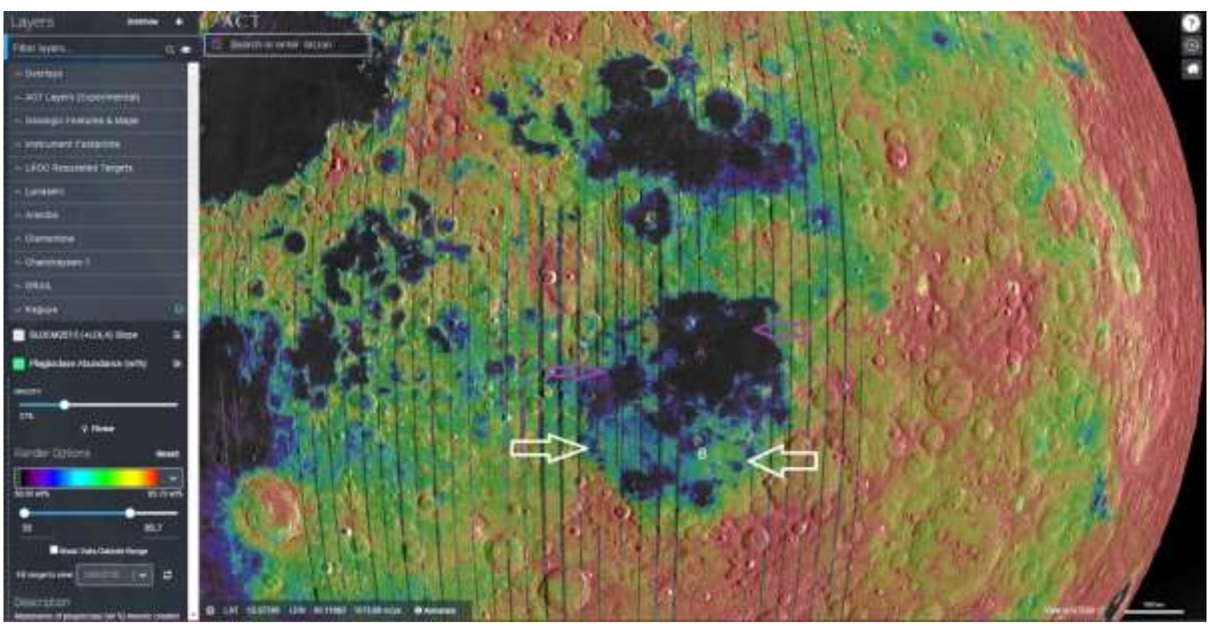

Figure 6. *Plagioclase map of the area around Mare Smythii*

Plagioclase is both common and characteristic of the Moon's highland crust. The impact of the Smythii basin occurred on the pre-existing highlands in its region. The impact here caused a melt on the highland crust in the central depression. How can we find the melt to date this impact radio- isotopically? Two craters in the northern part of the central depression, Schubert C and Haldane are important here. During their impact, when the central mountain was formed, mountains on their crater rim (as well as other mountains inside), the highland basin structure came to the surface (mantle uplift), along with the pure melt of the Smythii basin. We see this on the distribution of red color on these craters, on the plagioclase map of Kaguya mission. Schubert C is the biggest candidate for exploration. Possibly this could be a site for future lunar missions, according to the reference at the end of this article. The central mountain of Neper also shows this feature, but there is doubt about the purity of the melt there (Figs 7 & 8).

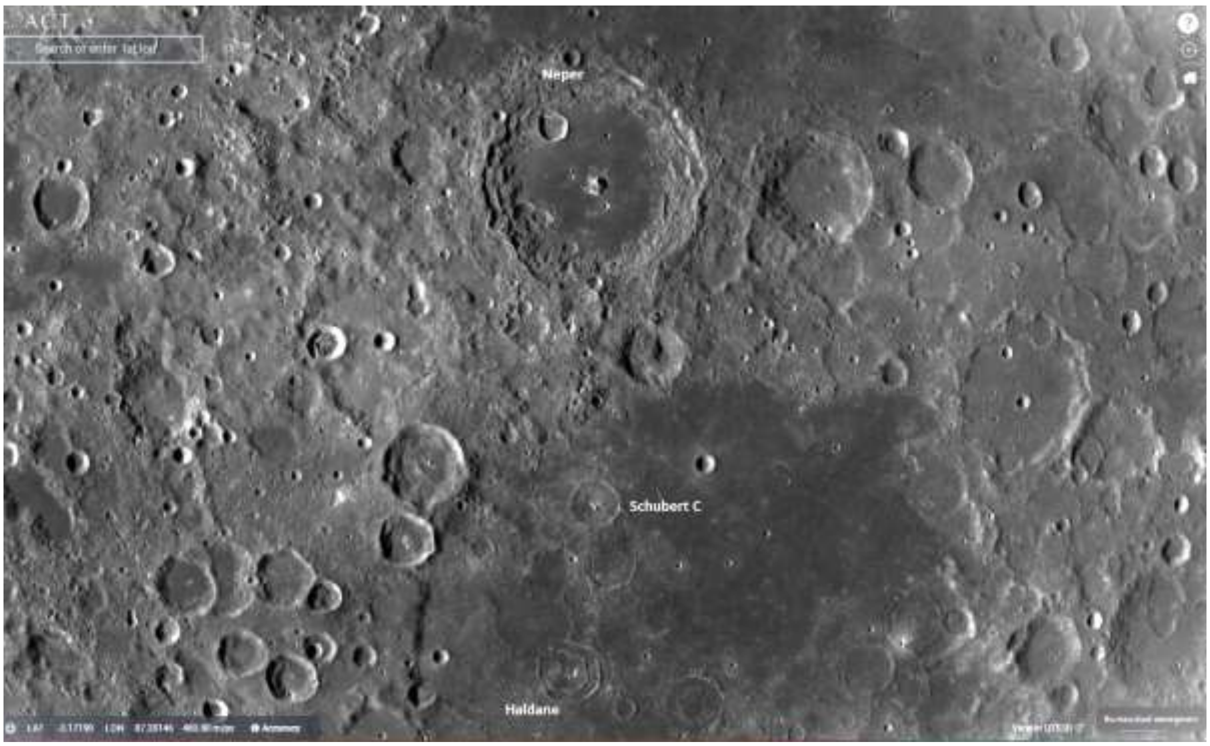

Figure 7. *Close up of important craters around Mare Smythii in a NASA Quickmap map projected image mosaic.*

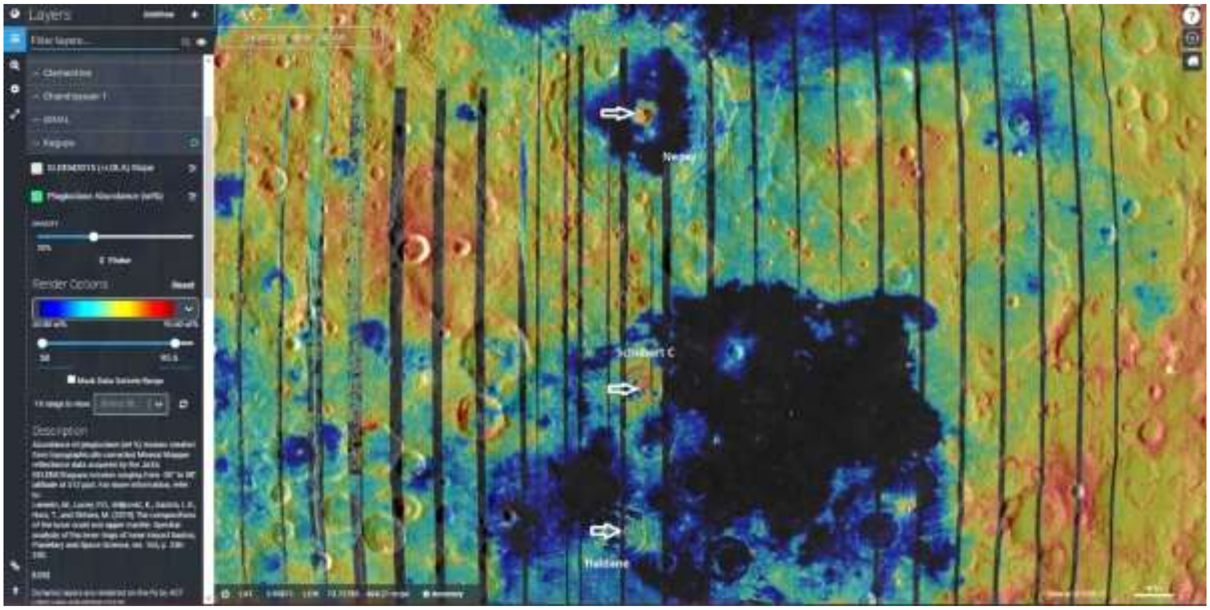

***Figure 8**. The Smythii impact basin – the arrows indicate outcrops of Mare Smythii melt in three craters mentioned in the main text.*

Determining the age of impact melt deposits is a top priority for lunar science. Establishing an accurate chronology of lunar basin impacts would also tell us a lot about the corresponding Earth impact flux, which affected profoundly the surface of our planet, as well as the habitability of early Earth.

References:

The Planetary Science Journal, 3:48 (11pp), 2022 February https://doi.org/10.3847/PSJ/ac51e2
Identifying Impact Melt from the Smythii Basin: Toward an Improved Chronology for Lunar Basin Formation Kirby D. Runyon1 , Lyle Nelson2 , and Daniel P. Moriarty III3 1 Planetary Exploration Group, Johns Hopkins APL, 11101 Johns Hopkins Road, Laurel, MD 20723, USA; kirby.runyon@jhuapl.edu 2 Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, MD, 21218, USA 3 USRA and NASA Goddard Space Flight Center, Planetary Geodynamics Laboratory, Code 698, Greenbelt, MD 20771, USA Received 2020 August 9; revised 2021 December 19; accepted 2022 January 27; published 2022 February 28.

Lunar Calendar January 2023

Date	UT	Event
0		East limb most exposed +7.4°
1	1525	Moon at ascending node
	2200	Uranus 0.7° south of Moon, occultation, Central and North America, Europe, Russia
3	2000	Mars 0.5o north of Moon, occultation Africa
6		Greatest northern declination +27.7°
6	2308	Full Moon
7	1400	Pollux 1.9° north of Moon
8	0900	Moon at apogee 406,458 km
9		South limb most exposed -6.6°
15	0210	Last Quarter Moon
16	0632	Moon at descending node
16		West limb most exposed -7.8°
20		Greatest southern declination -27.7°
21	2053	New Moon lunation 1238
21	2100	Moon at perigee 356,568 km Large Tides
22		North limb most exposed +6.5°
23	0700	Saturn 4° north of Moon
23	0800	Venus 3° north of Moon
26	0200	Jupiter 1.8° north of Moon
28		East limb most exposed +7.8°
28	1519	First Quarter Moon
29	0400	Uranus 0.9° south of Moon, occultation Japan to Greenland
31	0400	Mars 0.1° north of Moon, occultation Micronesia, Southern USA to northern South America

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lunar@alpo-astronomy.org (lunar images).

It is helpful if the filenames follow the naming convention :

FEATURE-NAME_YYYY-MM-DD-HHMM.ext

YYYY {0..9} Year

MM {0..9} Month

DD {0..9} Day

HH {0..9} Hour (UT)

MM {0..9} Minute (UT)

.ext (file type extension)

(NO spaces or special characters other than "_" or "-". Spaces within a feature name should be replaced by "-".)

As an example the following file name would be a valid filename:

Sinus-Iridum_2018-04-25-0916.jpg

(Feature Sinus Iridum, Year 2018, Month April, Day 25, UT Time 09 hr16 min)

Additional information requested for lunar images (next page) should, if possible, be included on the image. Alternatively, include the information in the submittal e-mail, and/or in the file name (in which case, the coordinator will superimpose it on the image before archiving). As always, additional commentary is always welcome and should be included in the submittal email, or attached as a separate file.

If the filename does not conform to the standard, the staff member who uploads the image into the data base will make the changes prior to uploading the image(s). However, use of the recommended format, reduces the effort to post the images significantly. Observers who submit digital versions of drawings should scan their images at a resolution of 72 dpi and save the file as a 8 1/2"“x 11” or A4 sized picture.

Finally a word to the type and size of the submitted images. It is recommended that the image type of the file submitted be jpg. Other file types (such as png, bmp or tif) may be submitted, but may be converted to jpg at the discretion of the coordinator. Use the minimum file size that retains image detail (use jpg quality settings. Most single frame images are adequately represented at 200-300 kB). However, images intended for photometric analysis should be submitted as tif or bmp files to avoid lossy compression.

Images may still be submitted directly to the coordinators (as described on the next page). However, since all images submitted through the on-line gallery will be automatically forwarded to the coordinators, it has the advantage of not changing if coordinators change.

When submitting observations to the A.L.P.O. Lunar Section

In addition to information specifically related to the observing program being addressed, the following data should be included:

Name and location of observer
Name of feature
Date and time (UT) of observation (use month name or specify mm-dd-yyyy-hhmm or yyyy-mm-dd-hhmm)
Filter (if used)
Size and type of telescope used Magnification (for sketches)
Medium employed (for photos and electronic images)
Orientation of image: (North/South - East/West)
Seeing: 0 to 10 (0-Worst 10-Best)
Transparency: 1 to 6

Resolution appropriate to the image detail is preferred-it is not necessary to reduce the size of images. *Additional commentary accompanying images is always welcome.* **Items in bold are required. Submissions lacking this basic information will be discarded.**

Digitally submitted images should be sent to:
David Teske – david.teske@alpo-astronomy.org
Alberto Anunziato–albertoanunziato@yahoo.com.ar
Wayne Bailey—wayne.bailey@alpo-astronomy.org

Hard copy submissions should be mailed to David Teske at the address on page one.

CALL FOR OBSERVATIONS:
FOCUS ON: Expedition to Mare Nubium

Focus on is a bi-monthly series of articles, which includes observations received for a specific feature or class of features. The subject for the March 2023, will be Mare Nubium. Observations at all phases and of all kinds (electronic or film based images, drawings, etc.) are welcomed and invited. Keep in mind that observations do not have to be recent ones, so search your files and/or add these features to your observing list and send your favorites to (both):

Alberto Anunziato – albertoanziato@yahoo.com-ar
David Teske – david.teske@alpo-astronomy.org

Deadline for inclusion in the Mare Nubium Focus-On article is February 20, 2023

FUTURE FOCUS ON ARTICLES:

In order to provide more lead time for contributors the following future targets have been selected:

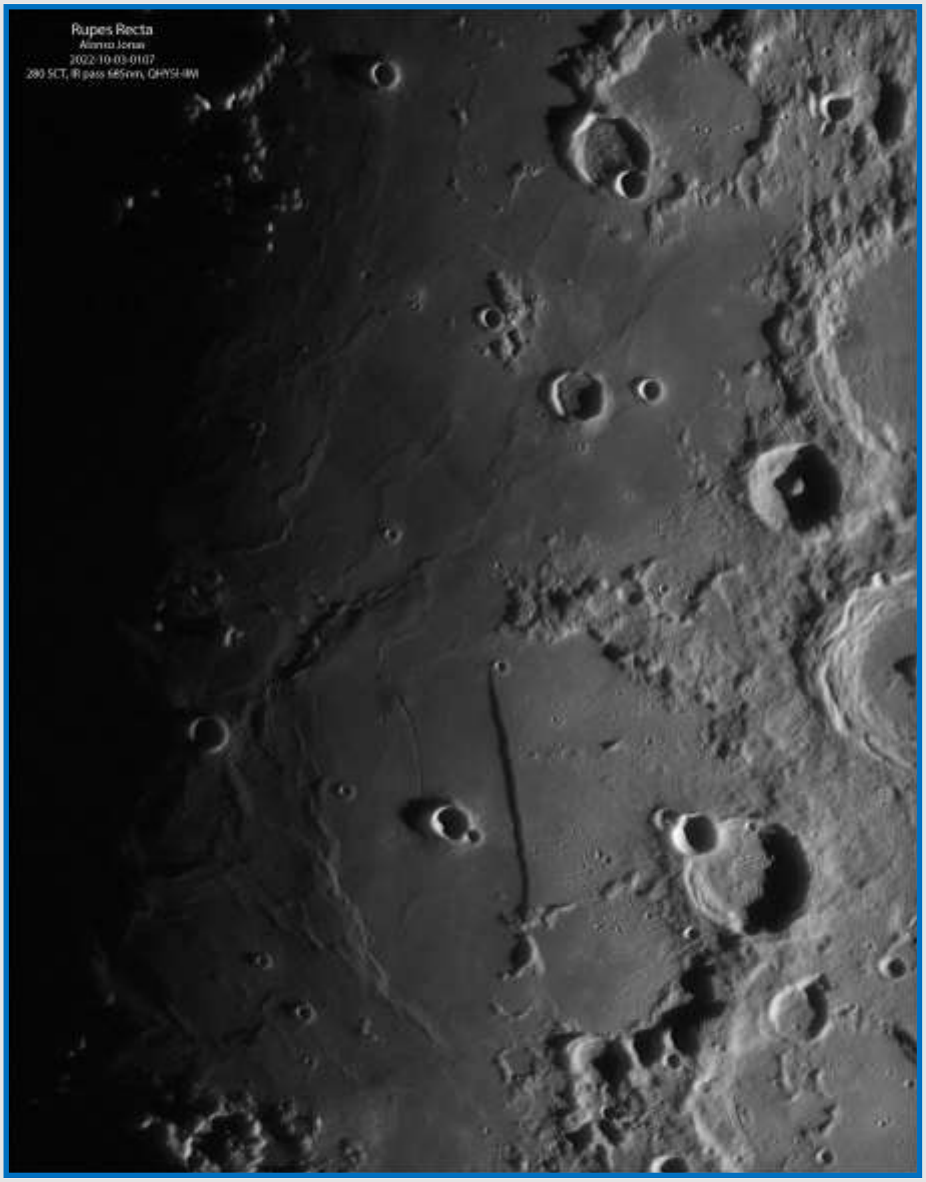
Subject	TLO Issue	Deadline
Mare Nubium	**March 2023**	**February 20, 2023**
Reiner Gamma	**May 2023**	**April 20, 2023**
Mons Rümker	**July 2023**	**June 20, 2023**
Floor-Fractured Craters	**September 2023**	**August 20, 2023**
Dorsa Smirnov	**November 2023**	**October 20, 2023**

Focus-On Announcement

Expedition to Mare Nubium

Mare Nubium is small, not very large, but it has an incredible variety of features: an impact crater beauty, not very fresh but incredibly preserved as Bullialdus, strangely shaped craters like Wolff, giants like Pitatus, almost disappeared craters like Kies or Gould, the most conspicuous concentric crater (Hesiodus A), domes, rilles, wrinkle ridges, the bright rays of distant Tycho, and one of the most beautiful features, Rupes Recta. We will share the lunar images of our observers to dream of an expedition through the sea of clouds.

MARCH 2023 ISSUE-Due February 20, 2023: MARE NUBIUM
MAY 2023 ISSUE-Due April 20th, 2023: REINER GAMMA
JULY 2023 ISSUE-Due June 20th, 2023: MONS RÜMKER

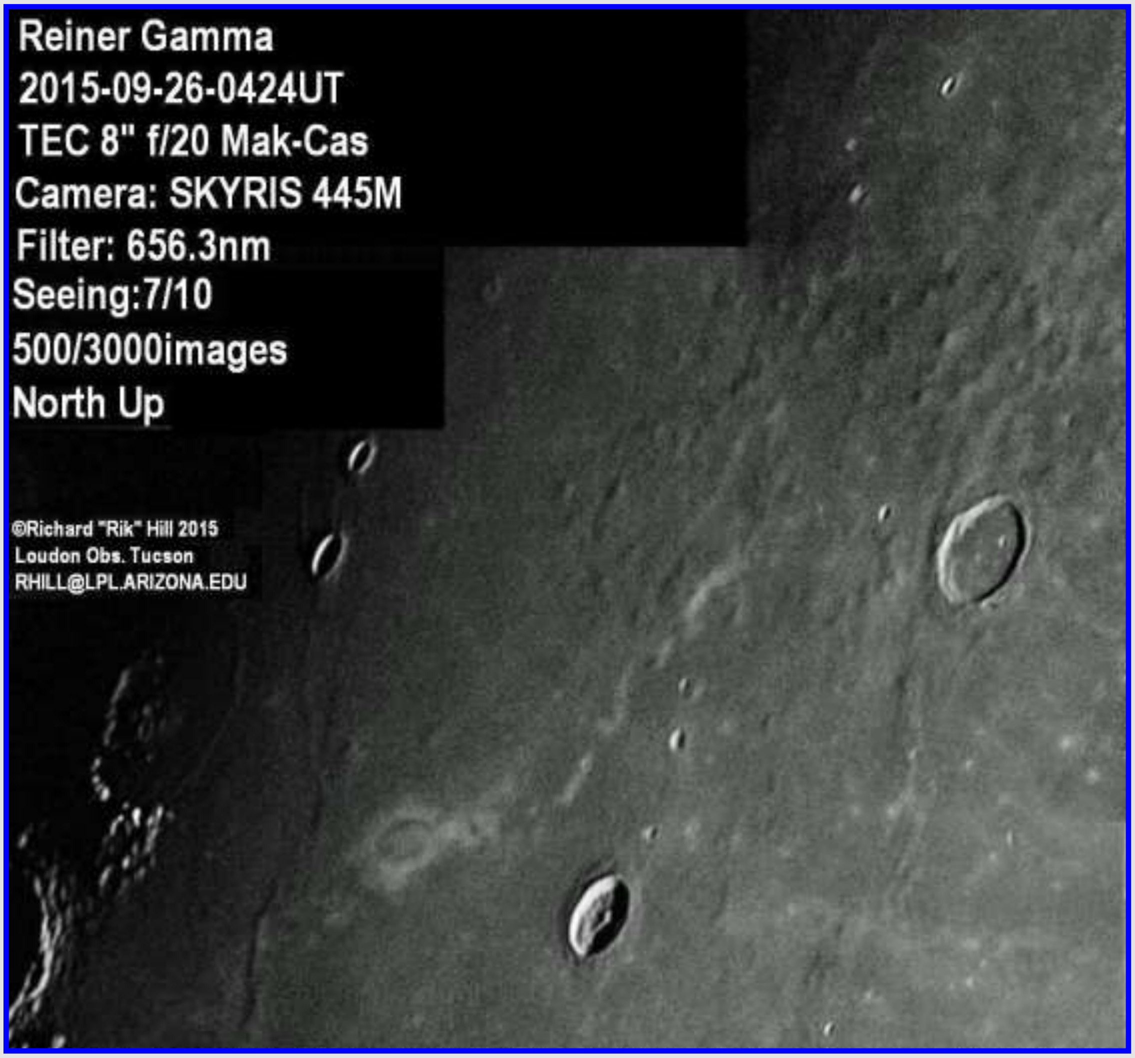


Jonás Alonso

Focus-On Announcement
Mysterious Reiner Gamma

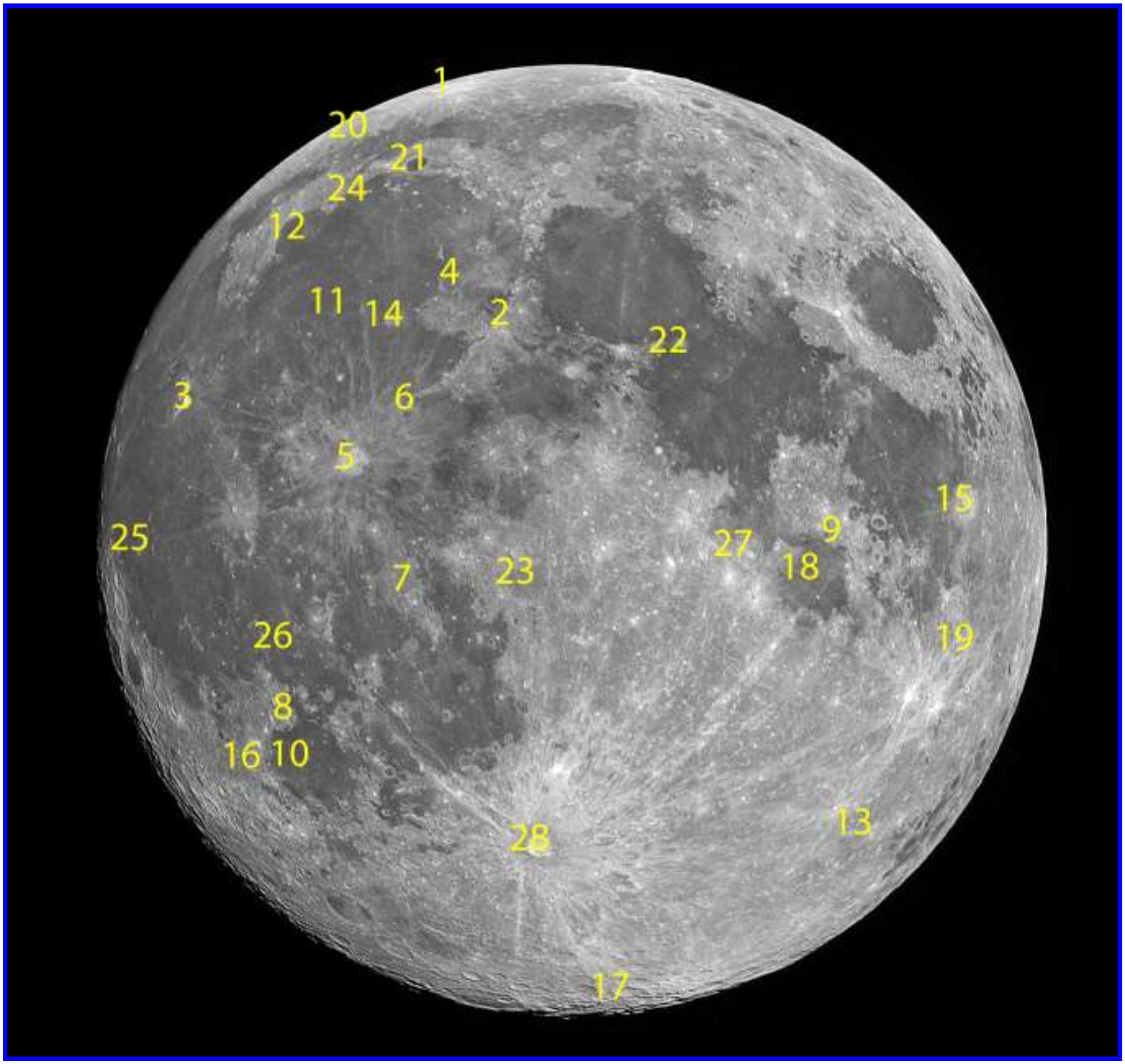
Reiner Gamma deserves the name anomaly with honors. There are other lunar swirls, but Reiner Gamma is the only one visible to us, amateurs. It shares the near side with the swirls of Mare Marginis and Mare Ingenii, which we can only partially glimpse under favorable libration conditions. There are different theories about the nature of Reiner Gamma, everyone has a transitory moment of reign, but we are not completely sure what caused our anomaly. We will ask ourselves about its nature and we will try to provide images that make us better understand the topography of the area.

MARCH 2023 ISSUE-Due February 20, 2023: MARE NUBIUM
MAY 2023 ISSUE-Due April 20th, 2023: REINER GAMMA
JULY 2023 ISSUE-Due June 20th, 2023: MONS RÜMKER
SEPTEMBER 2023 ISSUE-Due August 20th 2023: FLOOR FRACTURED CRATERS
NOVEMBER 2023 ISSUE-Due October 20th 2023: DORSA SMIRNOV



Rik Hill

Key to Images In This Issue



1. Anaxagoras
2. Apenninus, Montes
3. Aristarchus
4. Archimedes
5. Copernicus
6. Eratosthenes
7. Fra Mauro
8. Gassendi
9. Gaudibert
10. Humorum, Mare
11. Imbrium, Mare
12. Iridium, Sinus
13. Janssen
14. Lambert
15. Langrenus
16. Mersenius
17. Moretus
18. Nectaris, Mare
19. Petavius
20. Philolaus
21. Plato
22. Plinius
23. Ptolemaeus
24. Recti, Montes
25. Reiner Gamma
26. Scheele Arc
27. Theophilus
28. Tycho