The Lunar Observer

A Publication of the Lunar Section of ALPO

David Teske, editor
Coordinator, Lunar Topographic Studies Section Program

FEBRUARY 2025

In This Issue

Lunar Reflections

Greetings to all. I hope that the year is off to a good start to you. Many thanks to all who have contributed to this issue of *The Lunar Observer*. I hope that you find this issue interesting. In this issue, there are short articles in Lunar Topographic Studies by:

- Peter Benedict "Sky" Tubalinal of the Philippines was observing the Moon in early January 2025 when he saw a light transverse the Moon. He captured it with a cell phone. An you help identify theis lunar mystery?
- Alberto Anunziato as he explores two Rima Plato, some interesting topography near Manilius and the Schiller-Zucchius Basin.
- Robert Reeves took a fascinating tour of Tycho with its dark ring and bright rays with prose and images.
- David Teske took a look at the beautiful crater Theophilus and its surroundings with a small telescope.
- Greg Shanos had first light with a new (to him) telescope and captured sunrise on Sinus Iridum.

Several people contributed to the images and drawings to the Recent Topographic Studies. I was impressed with images by Ken Vaughan taken with a 12 inch SCT. The detail in his images was outstanding.

As always, Tony Cook has provided in depth studies in Lunar Geologic Change and the Buried Basin and Crater Project.

Many thanks to all who contributed, and to all interested in *The Lunar Observer*!

Our next Focus-On article features the giant cráter Clavius. Please get images, drawings and articles to Alberto Anunziato and David Teske by February 20, 2025.

Clear skies,
-David Teske

Edited by David Teske: david.teske@alpo-astronomy.org
2162 Enon Road, Louisville, Mississippi, USA
Back issues: http://www.alpo-astronomy.org/

Online readers, click on images for hyperlinks

Lunar Topographic Studies

Coordinator – David Teske - david.teske@alpo-astronomy.org
Assistant Coordinator– Alberto Anunziato albertoanunziato@yahoo.com.ar
Assistant Coordinator-Wayne Bailey– wayne.bailey@alpo-astronomy.org
Website: http://www.alpo-astronomy.org/

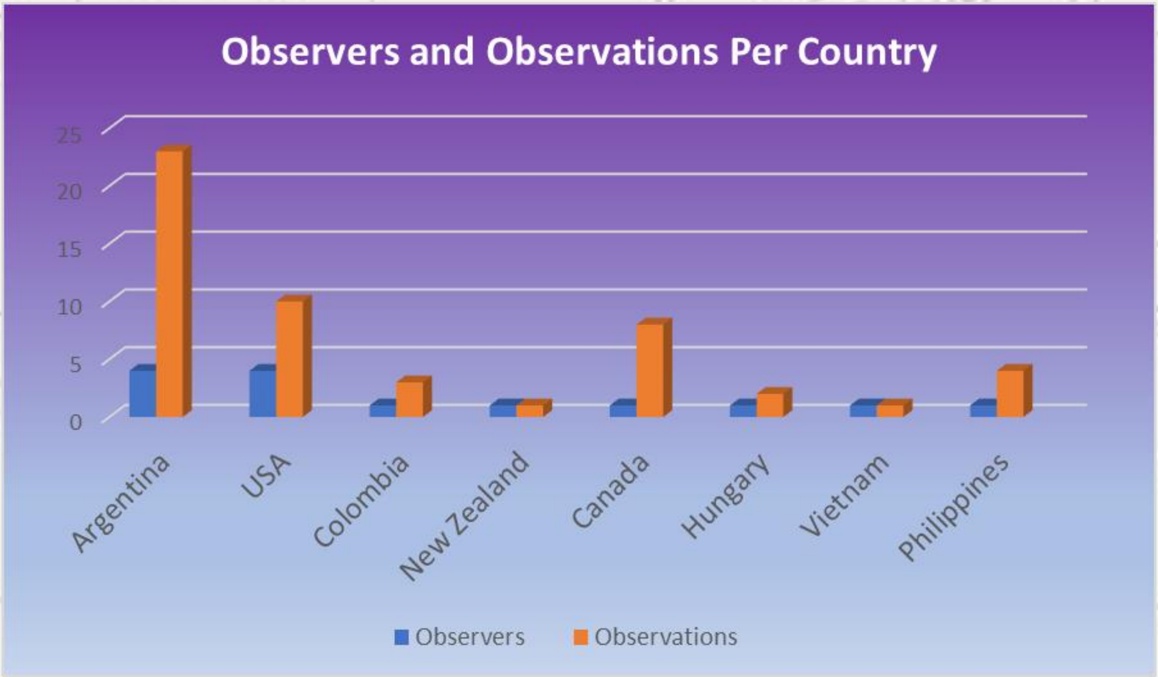
Observations Received

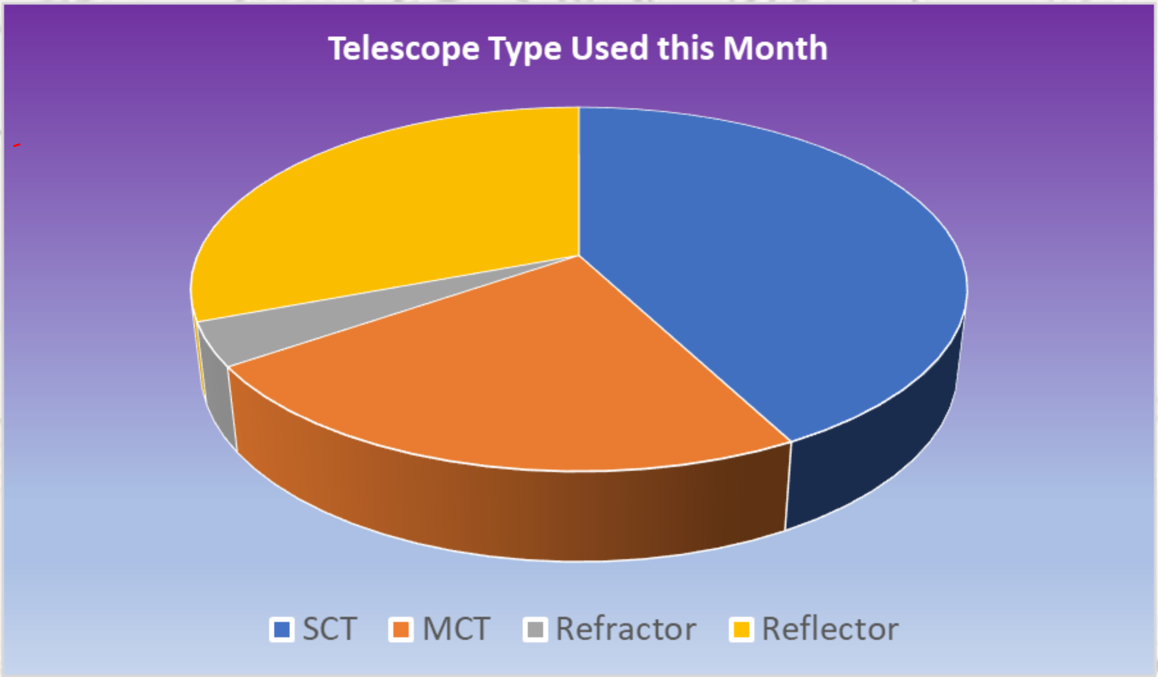
Name	Location and Organization	Image/Article
Alberto Anunziato	Paraná, Argentina	Article and drawing *An Unusual Wrinkle Ridge West of Manilius, Some Details in Rima Plato,* article and two drawings *Two Glances ant the*
Francisco Alsina Cardinalli	Oro Verde, Argentina	Images of Plato and Schiller.
Jairo Chavez	Popayán, Colombia	Images of the Waxing Gibbous Moon, the Full
Maurice Collins	Palmerstown North, New Zealand	Image of the 5 day-old Moon,
Walter Ricardo Elias	Oro Verde, Argentina, AEA	Images of Aristarchus (4), Fontana, Gassendi (2), Mars Moon conjunction, Archimedes, Cen-
Rik Hill	Loudon Observatory, Tucson, Ari-	Image of Schiller.
Attila Ete Molnar	Budapest, Hungary	Images of Newton and Philolaus.
Raúl Roberto Podestá	Formosa, Argentina	Images of Theophilus, Atlas, Langrenus, Pro-
Robert Reeves	San Antonio, Texas, USA	Article and seven images Enjoying a Donut
Gregory T. Shanos	Sarasota, Florida, USA	Article and image *A Surprise Golden Handle*
David Teske	Louisville, Mississippi, USA	Article and image: *Small Telescope Lunar Mus-*
Tien Ngo Tran	Ho Chi Minh City, Vietnam	Image of the lunar Southern Hemisphere.
Peter Benedict Tubalinal	Manila, Philippines	Images of mystery object crossing th Moon.
Ken Vaughan	Cattle Point, Victoria, British Columbia, Canada	Images of Archimedes, Deslandres, Eastern Mare Imbrium, Endymion, Ptolemaeus, Tri-

Many thanks to all contributors!

February 2025 *The Lunar Observer*
By the Numbers

This month there were 52 observations by 14 contributors in 8 countries.





Lunar X Predictions for 2024-2028

5 Year Lunar "X" and "V" Schedule * **					
	2024	2025	2026	2027	2028
Jan	18: 0830	6: 1645	25: 1630	15: 0015	4: 0830
Feb	16: 2345	5: 0800	24: 0730	13: 1530	3: 0015
Mar	17: 1400	6: 2300	25: 2145	15: 0600	3: 1500
Apr	16: 0300	5: 1300	24: 1100	13: 1930	2: 0430
					1: 1700
May	15: 1600	5: 0130	23: 2245	13: 0730	31: 0400
Jun	14: 0400	3: 1330	22: 0945	11: 1830	29: 1430
Jul	13: 1430	3: 0015	21: 2000	11: 0500	29: 0030
		1: 1100			
Aug	12: 0130	30: 2130	20: 0630	9: 1530	27: 1100
Sep	10: 1230	29: 0900	18: 1730	8: 0200	25: 2245
Oct	10: 0015	28: 2115	18: 0530	7: 1400	25: 1130
Nov	8: 1245	27: 1045	16: 1900	6: 0300	24: 0145
Dec	8: 0230	27: 0115	16: 0930	5: 1730	23: 1645

* All times are listed as the day of the month and then the hour in **UT**

** All times are approximations based on LTVT calculations. They are accurate to ± 1 hour.

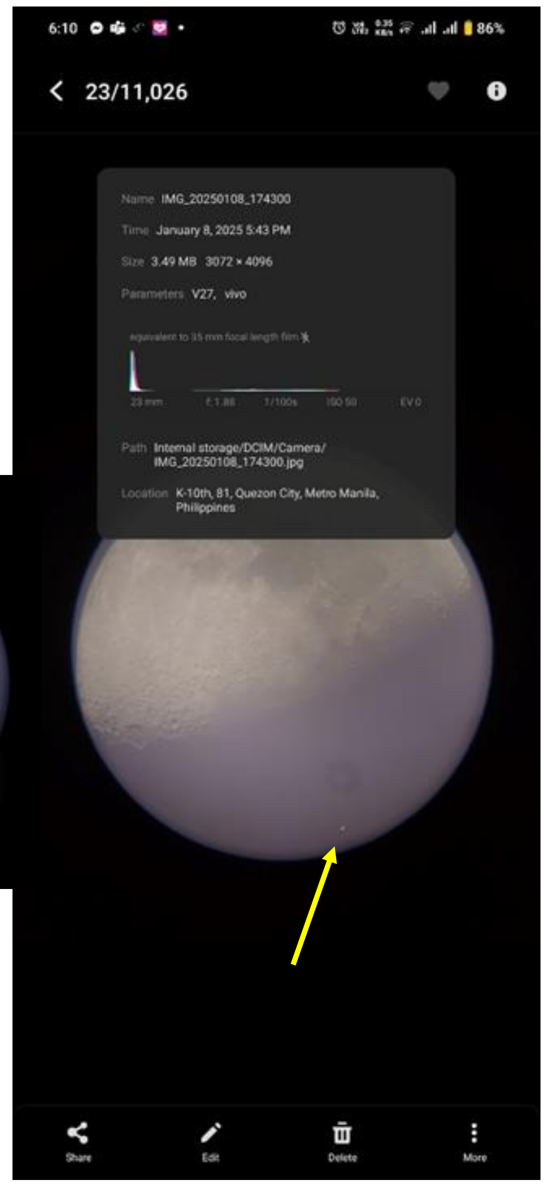
Submitted by Greg Shanos.

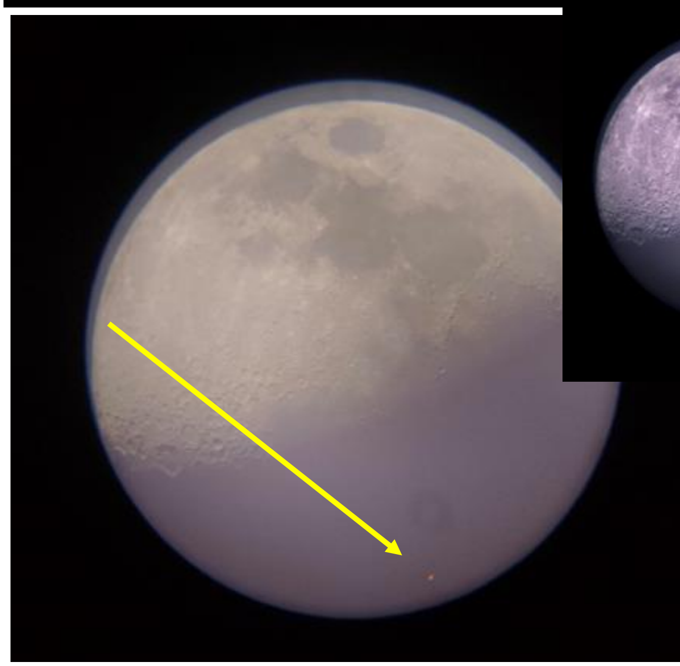
Help! A Lunar Mystery

Observed by Peter Benedict "Sky" Tubalinal

I recently received correspondence from Peter Benedict "Sky" Tubalinal of Manila, Philippines. On 2025 January 08 he was imaging the Moon with a Celestron Nexstar 8i telescope with a 25 mm ELux eyepiece. He was using a Vivo V27 5g cell phone to image the Moon. The images are presented below. Peter observed an object that on "January 8, 2025 at 5:43 pm (Philippine Time), I was imaging the Waxing Gibbous Moon when this object appeared and cruised past the Moon, and I was able to get one single shot of it before it exited the field of view. I thought it was a satellite but upon checking the Heavens Above app, no satellite transited the Moon." Other correspondence was that this object was visible for 2-3 seconds.

So, what is this moving point of light? The obvious first answer is one of the very many satellites orbiting Earth, but a satellite should transit the Moon in a fraction of a second. Readers, do you have any insights on this sort of object? Thanks for your input.





An Unusual Wrinkle Ridge West of Manilius

Alberto Anunziato

The area around Manilius is very interesting, at least for those of us who are particularly fond of selenographic features related to volcanism, which the Mare Vaporum is so rich in. While observing it for pure pleasure, I found this wrinkle ridge so originally shaped (when observing) that I seriously doubted that it was a dorsum and was some volcanic feature. The most prominent crater is Manilius D (5 km in diameter). The structure we see in IMAGE 1 has a curious, and obvious, depression in the center, which could be the intermediate zone between two segments or a depression within the same segment, separating two high zones (crests). Now, the strange thing is that these central depressions are not as easy to observe visually as they are photographically. I tried to record this feature, similar to a dorsum, as faithfully as possible.

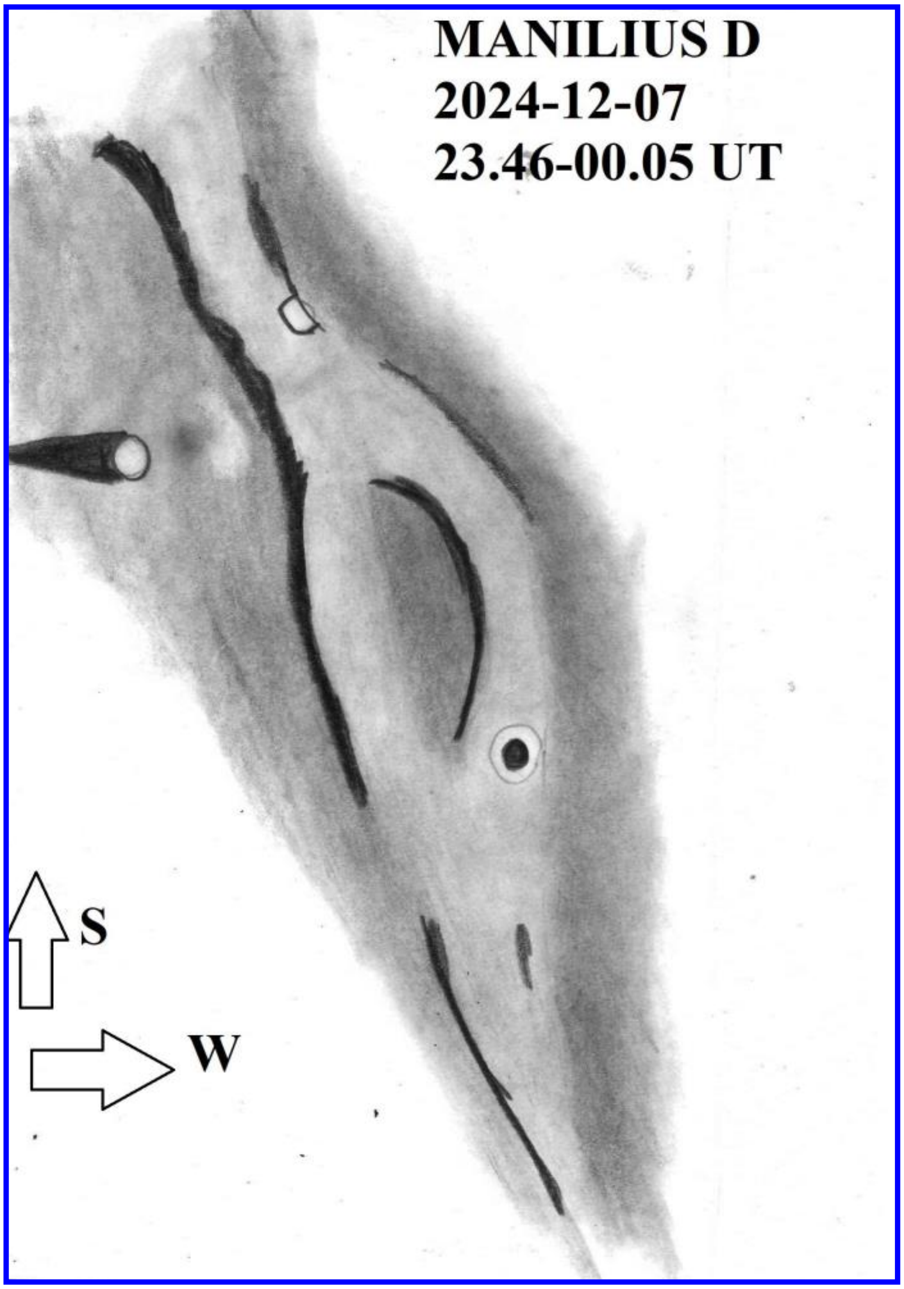


***Image 1, Manilius D,** Alberto Anunziato, Paraná, Argentina. 2024 December 7 23:46-00:05 UT. Meade EX105 Maksutov-Cassegrain telescope, 154x.*

The idea, once again, was to use my favorite tool for wrinkle ridges analysis the following day, Kwok Pau's Photographic Lunar Atlas for Moon Observers, in whose Volume 1 I found the reference area in an image with lighting very similar to that of my observation (page 351). IMAGE 2 is a combination of IMAGE 1 with Kwok's image. It is always nice to know that the visual observation coincides with the photographic one; for the most part, of course, since the latter is more detailed (obviously). Arrow 1 indicates Manilius D. Now we see that the crest (the upper topographical element, high, narrow and steep) passes along the eastern margin (in my drawing it is not visible, but it can be deduced from the pronounced shadow that it would coincide with the highest area of the arch), along the west another segment runs (arrow 2) and forms an arc with the other segment, also casting a shadow. The northern area appears much more simplified in IMAGE 1. Arrow 3 is the brightest point within the dorsum.

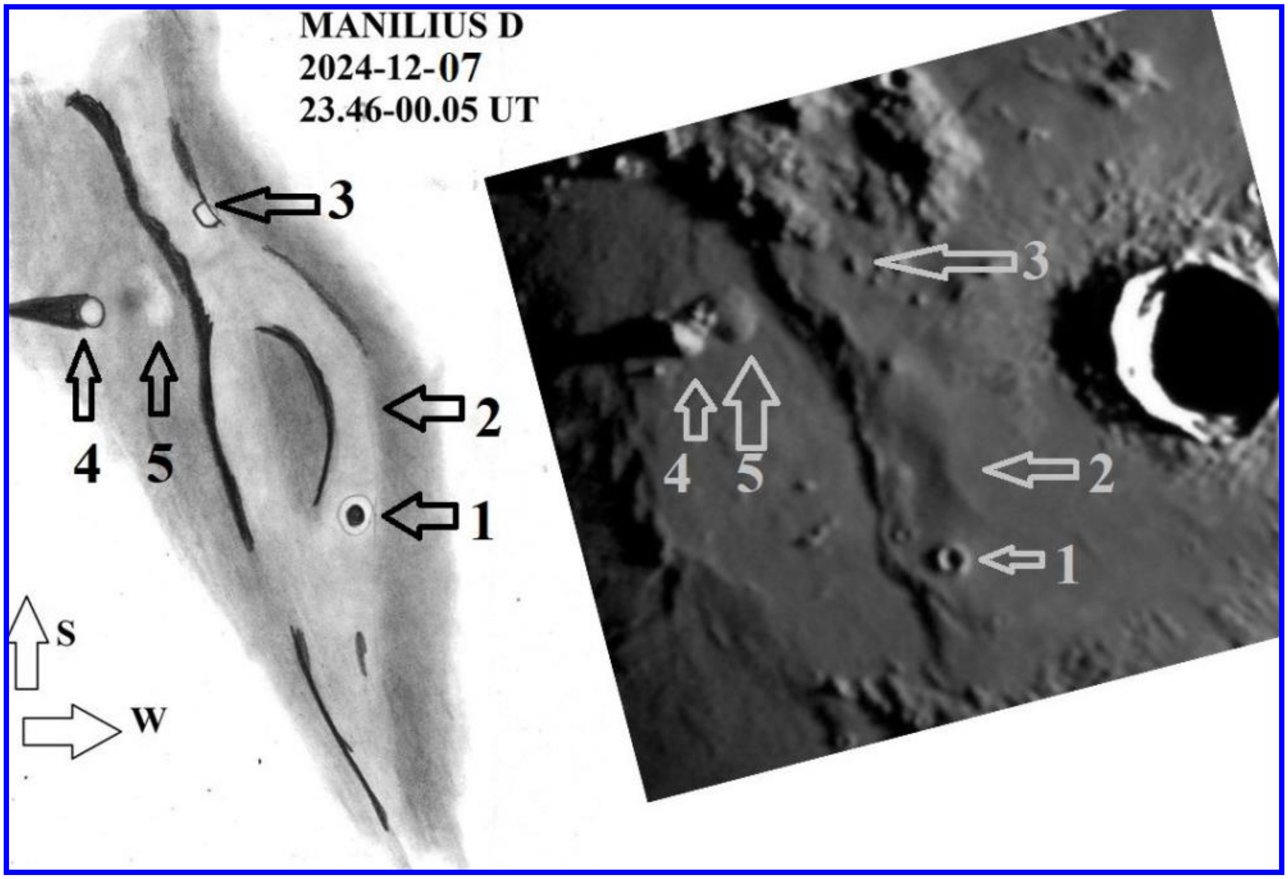
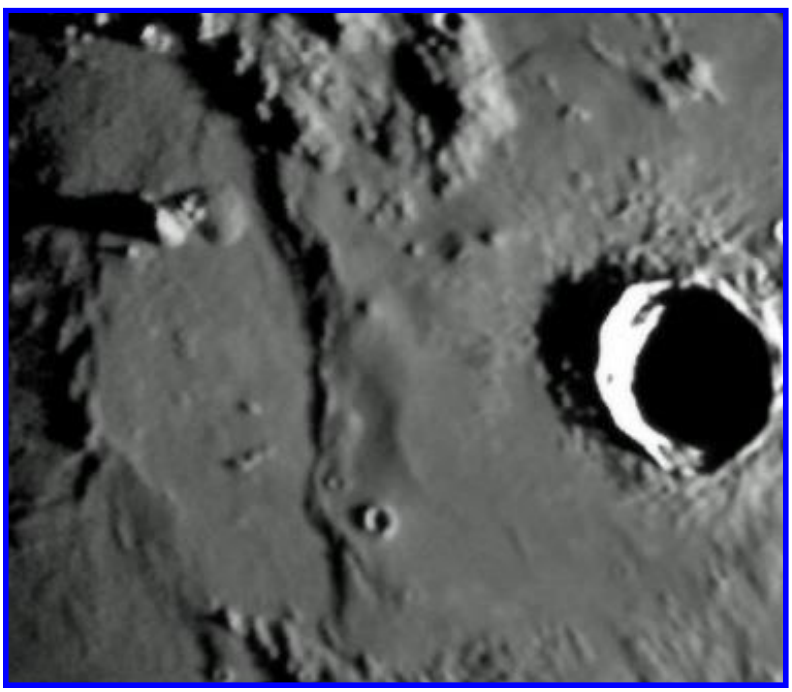


***Image 2, Manilius D,** Alberto Anunziato, Paraná, Argentina. 2024 December 7 23:46-00:05 UT. Meade EX105 Maksutov-Cassegrain telescope, 154x and Kwok Pau's Photographic Lunar Atlas for Moon Observers, Volume 1, page 351.*



Arrow 4 indicates the brightest point in IMAGE 3, which is clearly a peak that projects the usual elongated arrow-shaped shadow, while arrow 5 indicates in IMAGE 1 an area that appeared as a blurry round area, with a diffuse glow, that projected a slight crescent-shaped shadow, which in Kwok's image appears to be a fairly well-defined dome. Does anyone know it? I'll look for it. It is interesting that in a volcanic area (with a possible dome included) this strange dorsum appears. Let us remember that although the consensus on the origin of the dorsa is that they are due to compression forces, there is a minority theory that relates them to lava extrusion, this could be a good candidate for this minority theory.

***Image 3, Manilius D,** Kwok Pau's Photographic Lunar Atlas for Moon Observers, Volume 1, page 351.*

A Surprise Golden Handle

Gregory T. Shanos

On January 9, 2025 at 6:22pm local time or 23h 22m UT the moon was at 82% phase and 55 degrees above the horizon. This was the moon's position as it appeared in the sky. I recently purchased a used Orion 80mm short tube refractor from a member of my local astronomy club for only $60. This is my first light image of the moon with this instrument. To my surprise the moon's Golden Handle was visible. The interplay of light and shadow on the moon can result in some interesting phenomenon. The peaks of Montes Jura rise out of the shadows and become illuminated while simultaneously, the plains of Sinus Iridum are still in darkness. Telescope was an Orion 80mm short tube refractor 400mm at f/5 on an Orion EQ tracking tripod. A ZWO ASI178MM monochrome camera with an Optolong UV-IR cut filter and Firecapture v2.7.14 software was utilized to acquire the video. The apparatus was connected to an MSI GF65 gaming computer. Minor sharpening in Registax 6 and Photoshop CS4. Image by Gregory T. Shanos.

Some Details in Rima Plato

Alberto Anunziato

Rilles are selenographic features related to volcanism, since they were formed as lava flow. They are the one of the lunar features that I like the most, I love to observe them with the telescope, but visual observation is not beneficial, since it can reproduce the general landscape, but the details of this type of features are out of the visual range of my telescope. However, if we force photographic images from amateur observers, we can find interesting details related to the structure of the rilles. One of the reasons that make these fissures fascinating is that they are related to the future of lunar exploration, since it is likely that some of them may house lava tubes, underground structures that could house habitable bases in the future. One of the visual clues that there might be a lava tube beneath a rille is that there are alternating "closed" and "open" segments, which could be explained as follows: the lava dug an underground conduit (lava tube) whose roof collapsed in certain parts, creating a series of collapse craters. In this case, the collapse craters indicate the existence of the underground cavity that in the roofed segments would constitute a lava tube. The same would be true if there were open segments (in the form of a lava channel) and segments with a roof.

***Image** 1, Plato, Francisco Alsina Cardinalli, Oro Verde, Argentina. 2018 August 20 23:34 UT. 200 mm refractor telescope, QHY5-II camera.*

IMAGE 1 is an image of Plato from a while ago, which I had the opportunity to look at again while searching for images for the next Focus On. There are so many wonders near Plato (starting with Plato itself) that we often do not notice the system of rilles known as Rimae Plato. Because of the lighting in the image and because it is in a smooth area of the rugged terrain around Plato, Rima Plato I looks spectacular. It is a sinuous rille that runs northwest of Plato. IMAGE 2 is a detail of IMAGE 1 and obviously has much less definition because we have greatly enlarged the image. I think we should be encouraged to enlarge images in search of details, regardless of the definition (which does matter in the unenlarged image).

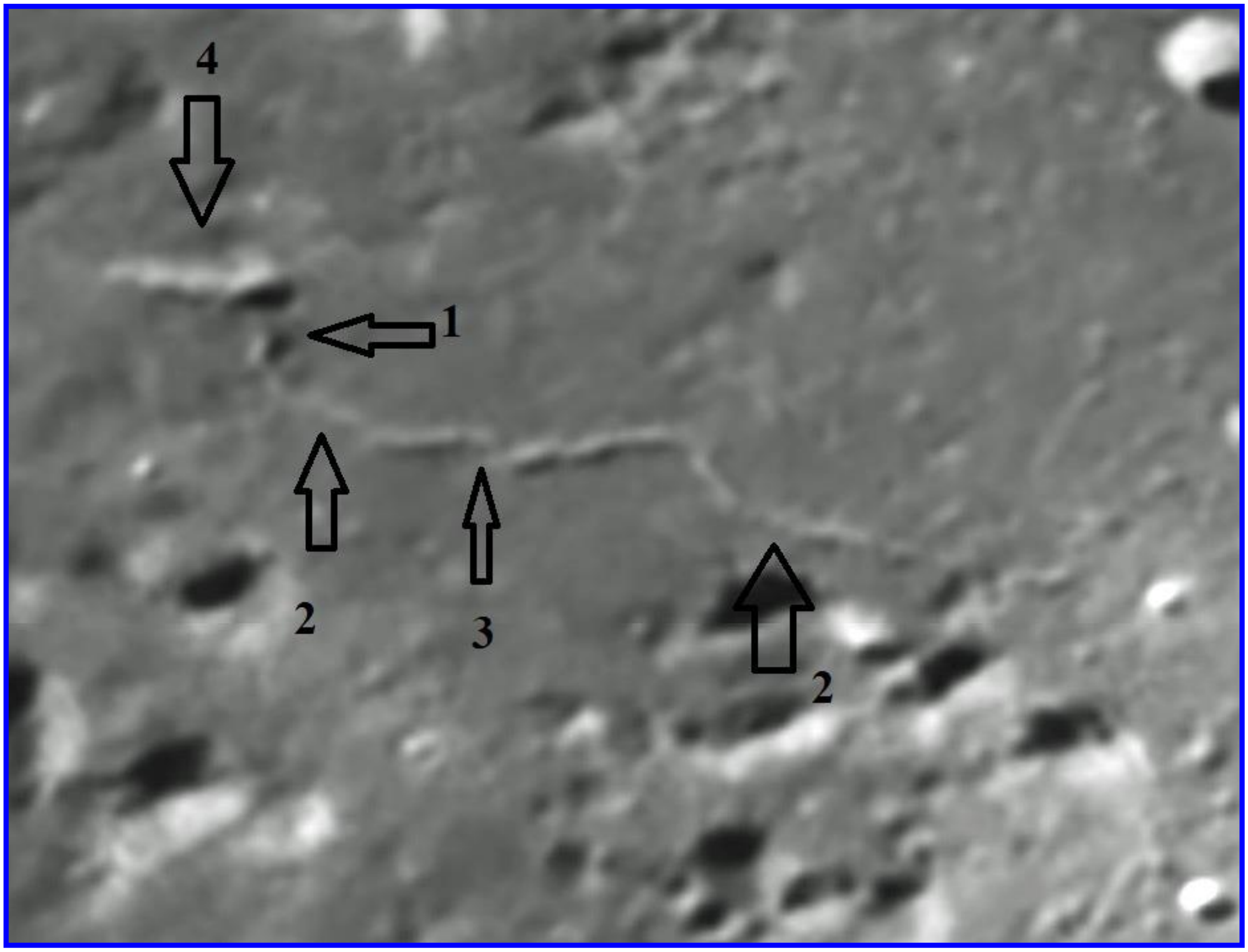


***Image** 2, Rima Plato, Francisco Alsina Cardinalli, Oro Verde, Argentina. 2018 August 20 23:34 UT. 200 mm refractor telescope, QHY5-II camera. This is a close-up of image 1.*

Rimae Plato are peculiar rilles, since they have not been formed in maria (which makes them less visible). From the Lunar Picture of the Day of February 20, 2006 (https://www.lpod.org/wiki/February_20,_2006), we extracted this stratigraphic explanation: "The large mountains in this area are part of the ejecta from the impact that formed the Imbrium basin, but the smaller hills are probably ejecta from Plato. Here is a speculative scenario. Imbrium and the Alps formed. Then came Plato and its ejecta. During a later time when Imbium's lavas were emplaced, magma rose up fractures under Plato, covering the crater's floor with dark basalt, and some of the magma leaked to the surface outside the rim, causing the eruptions of lava that made the sinuous rilles" ("Highland (Sort of) Sinuous Rilles", Charles Wood).

Returning to IMAGE 2, we mark with arrows some areas of interest. Presumably arrow 1 would indicate the collapse crater from which the lava flowed that made the groove that we know as Rima Plato I. Arrows 2 would indicate non-collapsed areas. Arrow 3 would probably indicate a kind of bridge, similar to the one that the astronauts of the Apollo 15 mission thought of crossing at Rima Hadley: "I can see what we thought was Bridge Crater, Irwin continued his commentary. This feature had been so-named because Lunar Orbiter imagery had suggested that it might be practicable to use the crater's rim to cross from one side of the rim to the other without descending into the trench. There were no plans to do this, of course, but the possibility had been studied as an option in the event that they landed on the far side of the rille, in order to gain access to St. George and The Front to achieve the primary sampling objective. But Bridge was simply a depression in the far wall. "It definitely would not have been a place to cross" (David Harland, Exploring the Moon. The Apollo Expeditions, Springer, 2009, page 116).

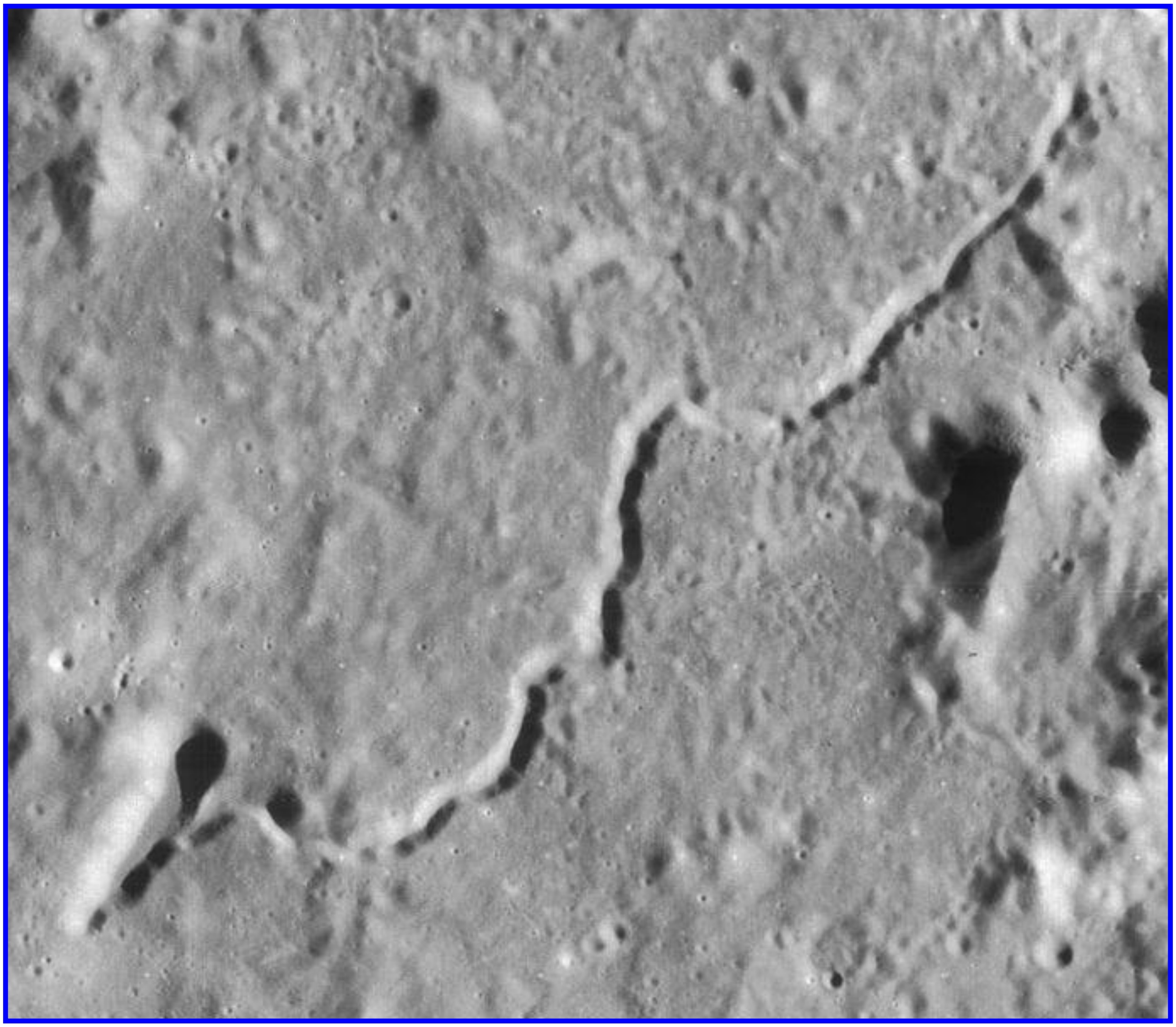


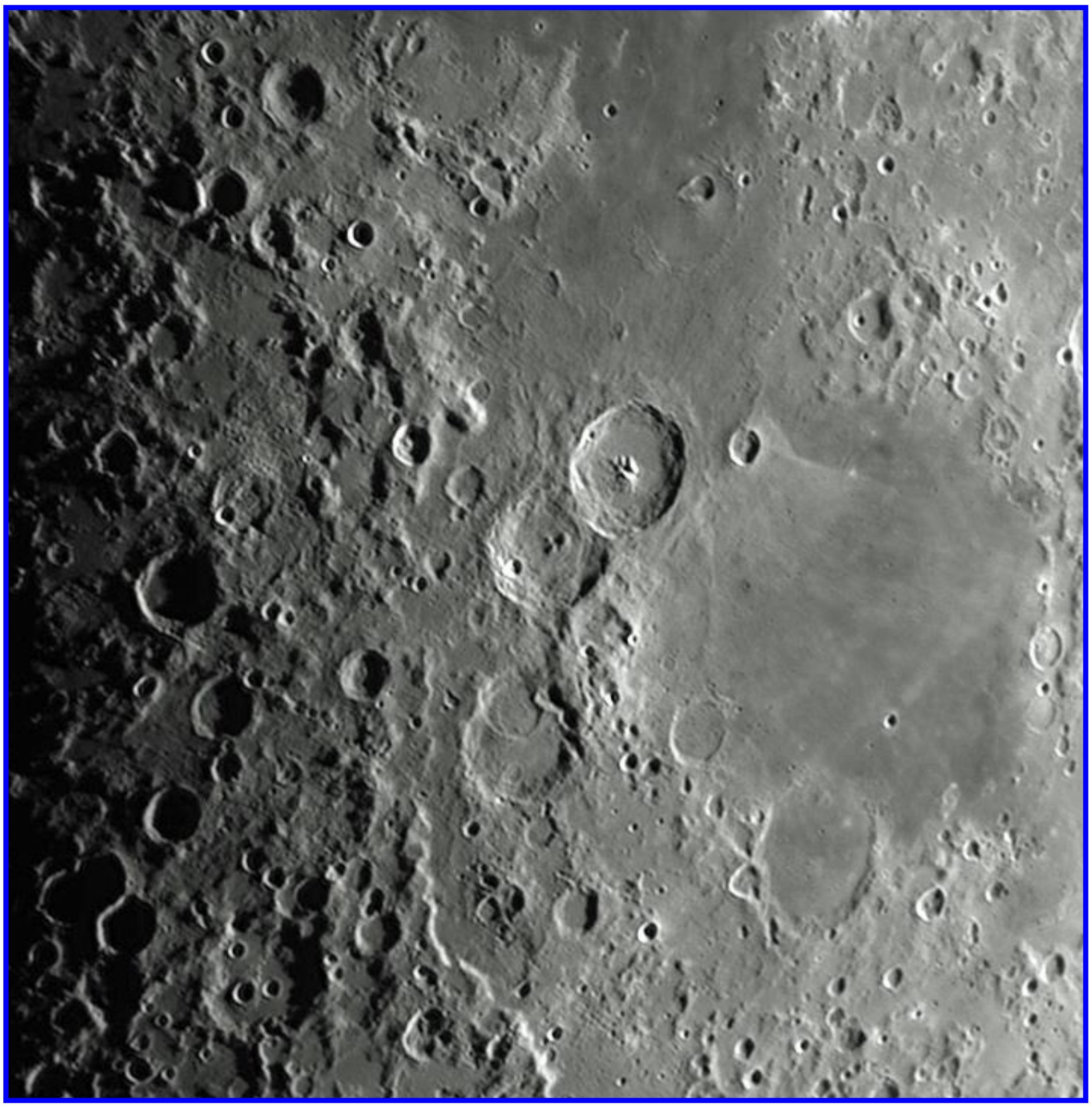
***Image 3, Rima Plato**, Lunar Orbiter 4, image 127.*

Arrow 4 indicates a kind of secondary rille that in IMAGE 2 does not seem to have a connection with the main rille, but that in other images (such as those of Lunar Orbiter, to which IMAGE 3 belongs) seems to be connected. In IMAGE2 the shadows and bright areas seem to indicate the existence of two connected craters, while in IMAGE 3 it appears as a groove similar to that of Rima Plato. We know that collapse craters are not generally overlapped like the craters that form an impact chain, so it seems that IMAGE 2 is misleading in that sense.

I find it interesting to highlight the information related to Rilles that can be obtained from amateur lunar images, it is worth continuing to observe these lunar cracks.

Small Telescope Lunar Musings
Theophilus and Mons Penck
David Teske

It is amazing just how much lunar geology can be viewed with just a small telescope. In this musing, we see the magnificent crater Theophilus (110 km) dominating the center of this image. The numbers about Theophilus are staggering. The crater walls of Theophilus rise 4.4 km above the floor of the crater, its complex central peaks rise 1.4 km above the floor and the crater rim of Theophilus rise 1.2 km above the surrounding plain. If you look to the north of the rim of Theophilus, you will see impact melt that flows into Sinus Asperitatis. The reason for this is that some very long time ago in the Eratosthenian period when an asteroid collided with the Moon to form what astronomers would call the crater Theophilus, the south rim was slightly higher. Shortly after that impact, the terraces collapsed into the lake of molten lava below. This sent waves of hot lava racing to and over the north rim, to pool on the north side as impact met. This is the way that Andrew Planck describes this in his book *What's Hot on the Moon Tonight?* Just west (left) of Theophilus stands a flat block of land that stands up above the surrounding area. This is Mons Penck, about 30 kms across. Mons Penck rises 4 km above the surrounding plains and has a steep gradient of 10-30˚. I can imagine some future lunar explorer standing on Mons Penck looking at Theophilus on their horizon. Apollo 16 did come rather close, as just west of Mons Penck is the bright crater Kant and just west of Kant about 90 km (a bit less than one Theophilus diameter) are two tiny bright craters, the North Ray and South Ray. Apollo 16 landed between these two craters in 1972.



***Theophilus,** David Teske, Louisville, Mississippi, USA. 2023 June 25 b02:29 UT, colongitude 348.2˚. 3.5 inch Maksutov-Cassegrain telescope, IR block filter, ZWO ASI120MM/S camera. Seeing 7/10.*

Lunar Topographic Studies

Small Telescope Lunar Musings: Theophilus and Mons Penck

Two Glances at the Schiller-Zucchius Basin

Alberto Anunziato

Image 1, Schiller-Zucchius Basin, *Francisco Alsina Cardinalli, Oro Verde, Argentina. 2016 December 11 03:33 UT. Meade LX200 10 inch Schmidt-Cassegrain telescope, Astronomik ProPlanet 742 nm IR pass filter.*

It is interesting to reflect on how lunar observation fluctuates between the large and the small, the full shot and the detailed shot. It began in the 17th century with the search for a map of the entire visible face. At the end of the 18th century, detailed descriptions of specific areas began, which greatly advanced selenography, but in the search for detail, the large structures ended up being lost sight of (proof of this are the maps of the end of the 19th century). With the classic paper by Grove K. Gilbert from 1893 on Mare Imbrium, the macro view regains its importance with the study of those immense craters that are the basins. How many are there on the Moon? For Paul Spudis in "The Geology of Multi-Ring Impact Basins" (Table 2.2 on page 40) there are 40, in the more detailed list of our Basin and Buried Crater Project (ALPO-BAA) there are 63, although only a part of them have been verified (https://users.aber.ac.uk/atc/ basin_and_buried_crater_project.htm).

One of the basins whose existence is agreed upon is called Schiller-Zucchius, and it is easy to find because of the peculiar elongated shape of the Schiller crater. Both the Spudis and Tony Cook lists describe this basin as a two-ring basin. There is no definitive consensus on the mechanism of formation of the rings of a basin. For a first approximation "the main rim is a megaterrace, but the inner rings are rebound features, analogous to central peaks seen in smaller craters", for a second approximation "an impact large enough to produce a basin would "fluidize" the lunar crust in the target region and that wave-like phenomena would produce rings like the ripples in a pond after a stone had been dropped into in" (Spudis, page 9).

In the image we took 8 years ago (IMAGE 1) of Schiller near the terminator, which passes through the rim of Zucchius opposite Schiller, we try to determine the rings of this basin. In IMAGE 2 we suggest what may be the edges of the two rings mentioned by Spudis (marked by red and yellow arrows). Our proposal is purely observational; we do not know with what degree of certainty the delimitation of its outer and inner rings is known.

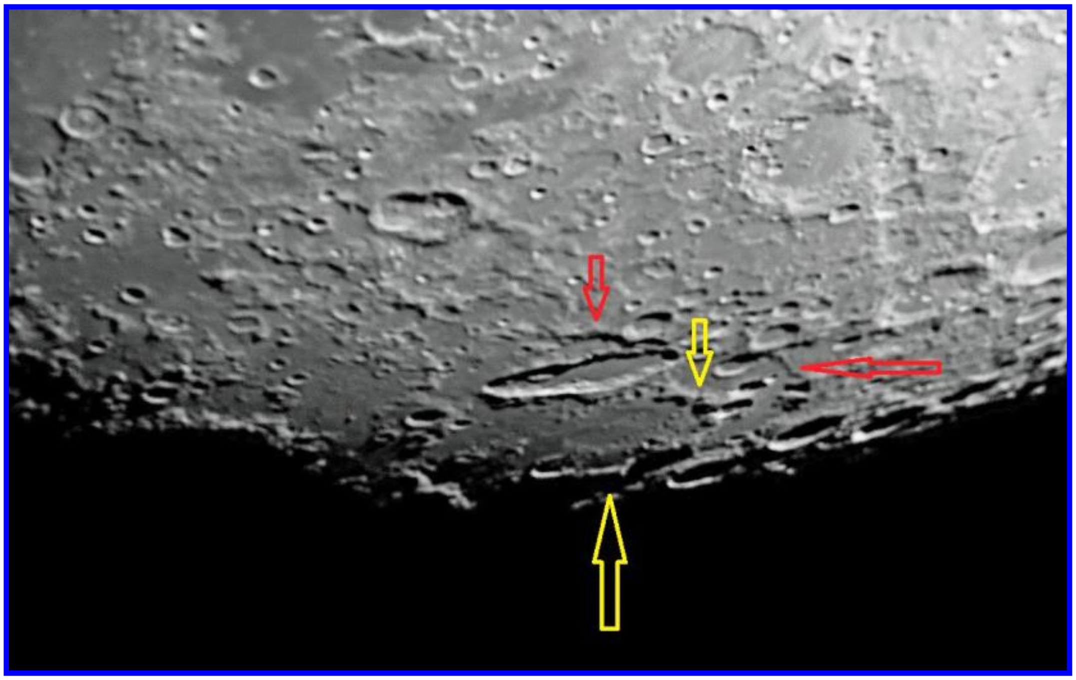
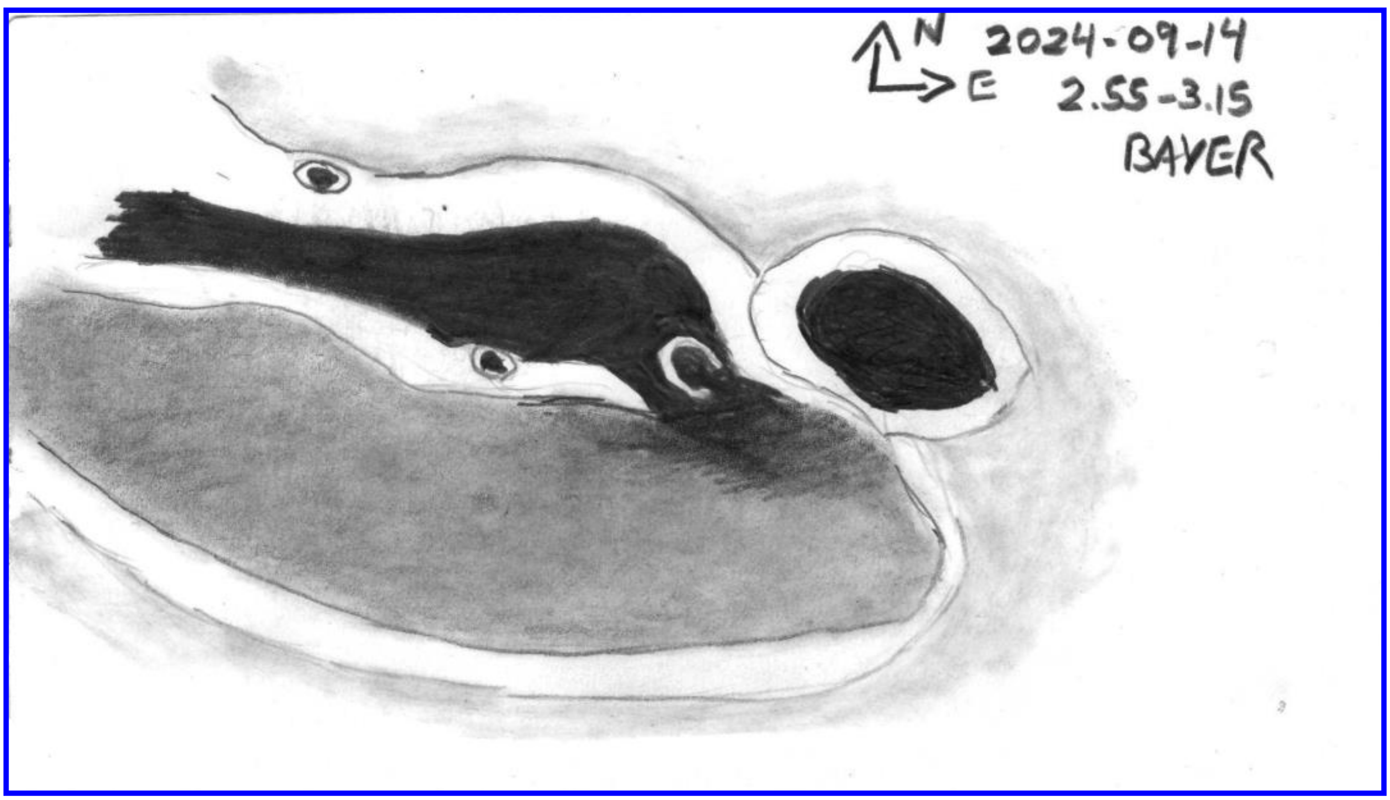


Image 2, Schiller-Zucchius Basin, *Francisco Alsina Cardinalli, Oro Verde, Argentina. 2016 December 11 03:33 UT. Meade LX200 10 inch Schmidt-Cassegrain telescope, Astronomik Pro-Planet 742 nm IR pass filter.*

Can the rings of this basin be observed visually? The difficulty in observing the rings of a basin (even with images in lunar orbit) is proverbial, but on two occasions we were able to peer into the remains of the chaotic pre-Nectarian era in which this basin was formed. IMAGE 3 documents an observation made at colongitude 40.9º. The impression at that moment, with the eye in the eyepiece, is that it was a high wall shining with the first rays of the Sun in the area. The drawing does not do justice to the wonder of that fleeting landscape. Now, is this wall part of the outer ring of the basin? Traditionally, the outer ring is seen to coincide with the northern wall of Schiller, but visually there is a very large difference between the elevation that runs from west to east and coincides with the southern wall of the Bayer crater and the northern wall of Schiller, the former being much brighter than the latter. Schiller J (9 kilometers in diameter)



I think we could say that IMAGE 4 (obtained with the Lunar Reconnaissance Orbiter Quick Map) is evidence that the outer ring of the basin is located further north of Schiller, since we see that the elevation south of Bayer is higher than the north wall of Schiller.

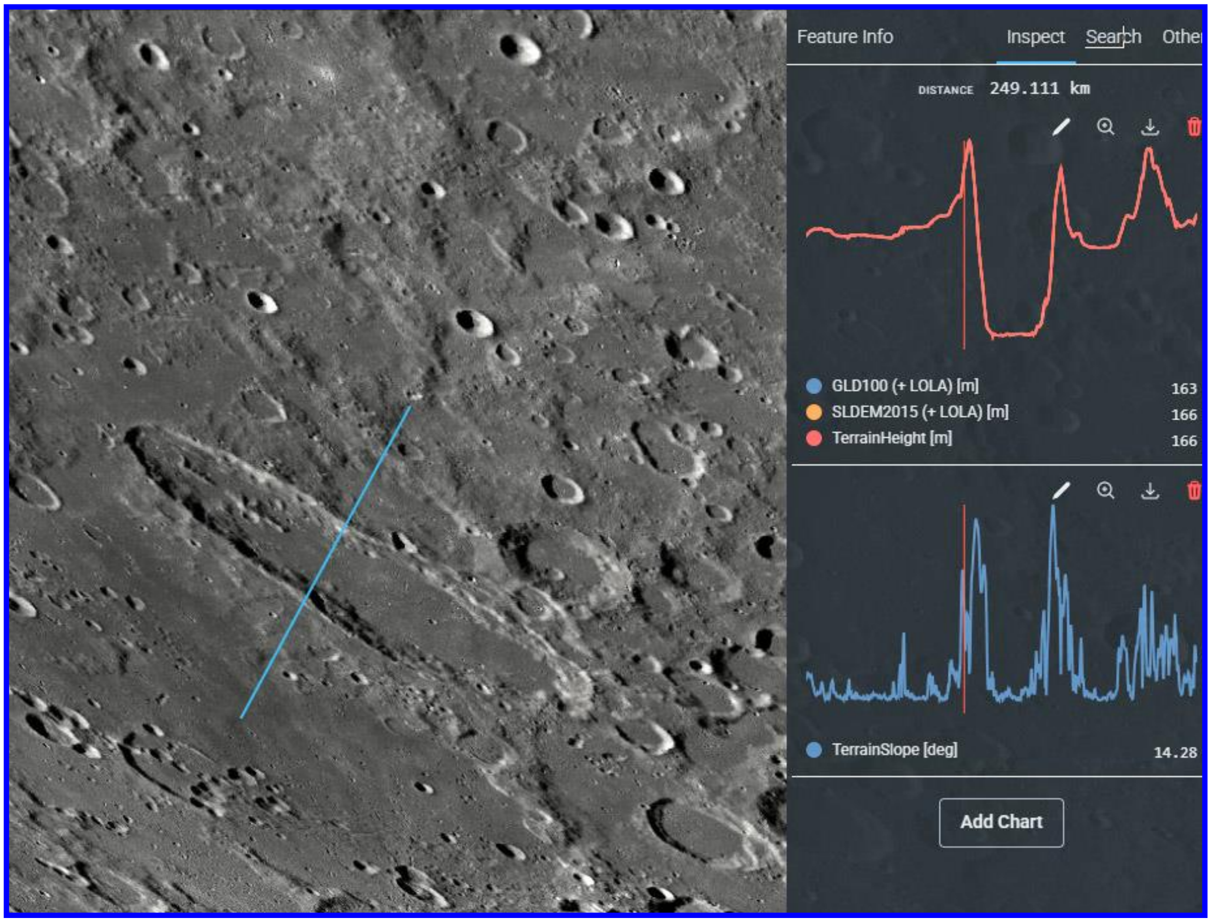


Image 4 Schiller, *Lunar Reconnaissance Mission, QuickMap.*

IMAGE 5 is the record of another observation, three months after the one illustrated in IMAGE 3. The first thing that caught our attention was the elevation on the right. In our observation notebook we noted that it appeared to be a wrinkle ridge, but lacked its typical arch-at-the-bottom and crest-at-the-top structure. My note went on to say that it was probably a mound area that, with the low resolution of my telescope, looked like some sort of unified rise, like the one found east of Cyrillus (see "The mound area east of Cyrillus" in the September 2024 issue of "The Lunar Observer"). The elevation on the left was more obvious in nature, a mountainous elevation similar to a mountain range, with a gap separating two segments. Two very different elevations in nature, if we return to IMAGE 2, we would see that the elevation on the left, the mountain-range, would be part of the inner ring, and the elevation on the right would be part of the basin rim, the outer ring. Regarding the latter, my first idea was that it was a wrinkle ridge, then I thought it might be a mound zone, then I thought it was the outer ring of the Schiller-Zucchius Basin, now I think it is the outer ring of the basin, which would consist of a mound zone related, like the one east of Cyrillus in Mare Nectaris, to the material ejected when the basin was formed, as maintained not only by Spudis in the cited work but also by the "Apollo 16 Preliminary Science Report", published by NASA in 1972, which refers to the area east of Cyrillus as a geological unit of "rock material": "The origin of this material remains uncertain: it may be ejecta from the basin, bedrock fractured during basin formation, or settlement material, but it is almost certainly related to the formation of the Nectaris Basin" (page 507). Actually, it is very likely that this elevation consists of material ejected when the basin was formed.

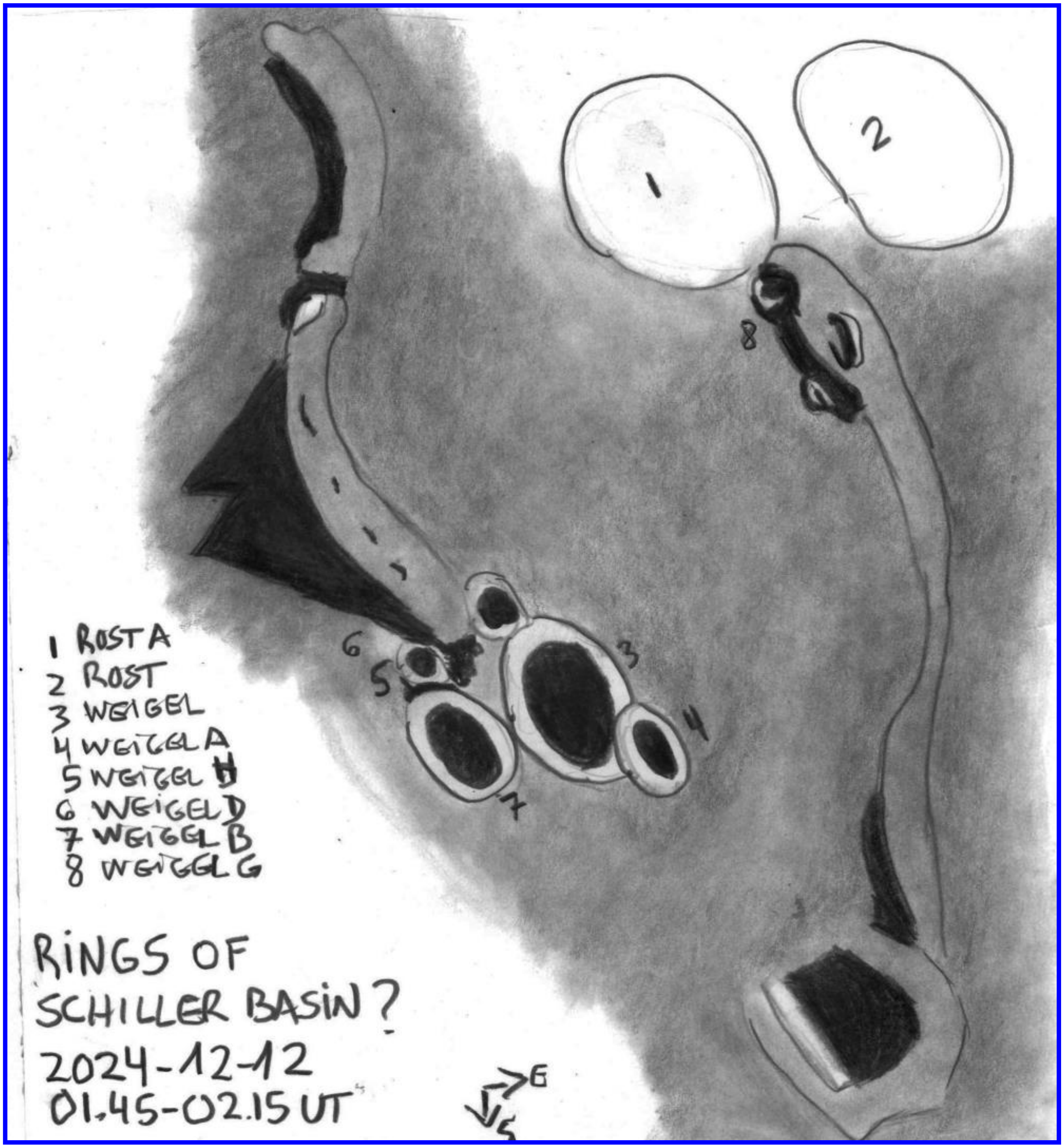


Image 5, Rings of the Schiller Basin, *Alberto Anunziato, Paraná, Argentina. 2024 December 12 01:45-02:15 UT. Meade EX105 Maksutov-Cassegrain telescope, 154x.*

Finally, I wanted to find a better image of these two elevations, and I found it (as so many other times) in the lunar images of Rik Hill on the Jim Loudon Observatory website (IMAGE 6 and 7). IMAGE 7 is a detail of our area, in which I marked with arrows some interesting areas, such as the highest area of the outer ring (arrow 1), the area of complex topography north of this ring (arrow 2) and the gorge area in the mountain range of the inner ring (arrow 3).

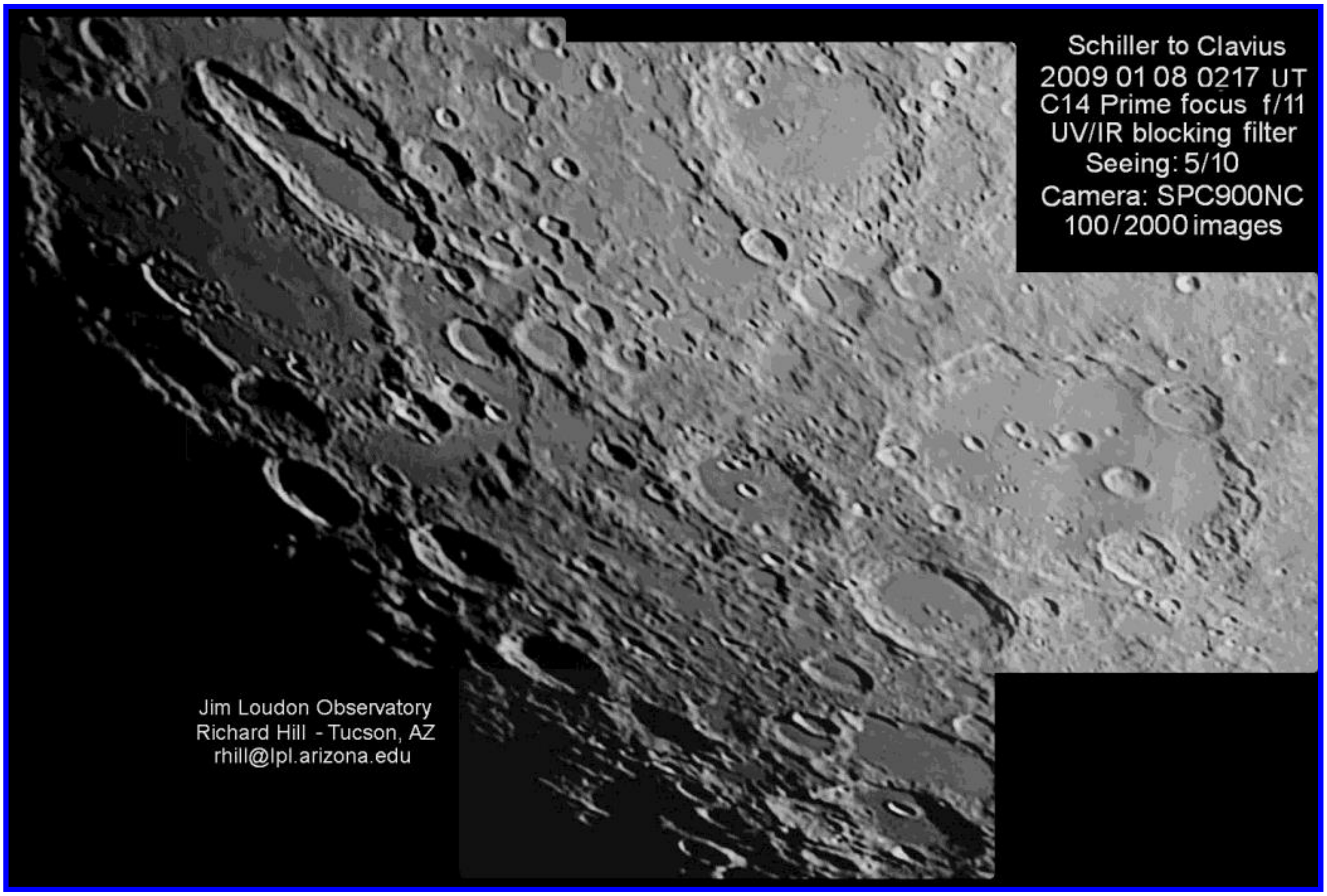
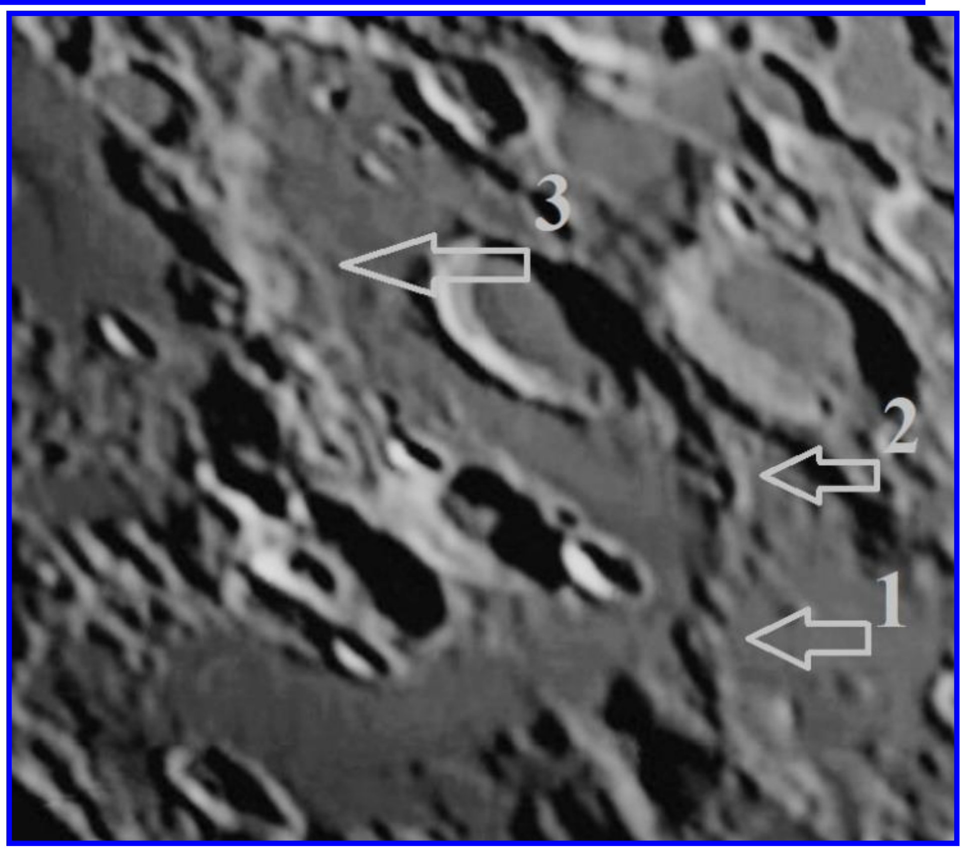


Image 7 Schiller to Clavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2009 January 08 02:17 UT. Celestron 14 inch Schmidt-Cassegrain telescope, UV/IR blocking filter, SPC900NC camera. Seeing 5/10. Right is a close-up.*



It is interesting to be able to observe with a small telescope such an old geological area, and the comparison with more precise images later helps to assess the possibilities of visual observation.

Enjoying a Doughnut While Riding the Rails to the Sea of Clouds

Robert Reeves

Tycho is one of the finest examples of a complex crater on the near side of the Moon and it possesses the largest ray system of any lunar crater. The stunning beauty of Tycho's starkly fresh appearance and its massive fan of rays steals the observing spotlight. Tycho is among the craters that create a lasting lifetime appreciation and becomes a favorite of both novice and experienced observers. So pervasive is Tycho's endearing attraction that scarcely any lunar observer can name the craters closest to Tycho. Lost in Tycho's limelight are unsung Sasserides to the north, Pictet to the east, and Street to the south.

At 85 kilometers across, Tycho spans an area equal to the largest metropolitan cities on Earth. Tycho was created by an oblique impact of a projectile arriving from the west, thus a majority of its 2200-kilometer-wide "butterfly" ray structure streams to the east and covers most of the near side southern hemisphere. One rogue ray splashes onto Mare Serenitatis 2,100 kilometers to the northeast. The bright ray system is visible to the naked eye and is reminiscent of the navel on an orange. Tycho itself is too small to be seen without telescopic aid, but the converging ray system visually pinpoints its location.

Tycho is noticeably fresher and more angular appearing than its neighboring craters. Analysis of lunar samples returned by Apollo 17 date the Tycho impact at 108 million years ago, making it the youngest major crater on the Moon. Tycho's flat floor was created by impact shock melting of lunar material. A telescopic view beyond one crater radius from Tycho reveals a territory with a rust-pitted appearance due to the hundreds of tiny secondary craters dotting the landscape.

Tycho is located among the oldest craters on the Moon, some up to four billion years old and displaying the gamut of ruin and degradation. Clavius to the south has been filled with debris thrown from subsequent impacts and additional craters have formed within its rim. Deslandres to the north is so ruined it is almost unrecognizable as a crater. To the west and east of Tycho are rounded and smoothed craters that also show their senior age. Tycho, in the middle of the geologic wreckage, remains sharp and angular among surrounding craters that are up to 40 times older.

At full Moon when the Tychonian ray system is brightest, Tycho displays two unique features not seen around other craters: a dark doughnut extending about one crater radius from Tycho's rim, and ray streamers that do not converge on Tycho's center. The dark ring gives Tycho a "black eye" appearance. Three major streamers in the Tychonian ray system are rogues that are tangential to Tycho's rim. The reason for the misplaced rays remains a mystery and is subject to much speculation.

Tycho's youth is why the dark doughnut is present, and no other crater is surrounded by a similar dark ring. Though not obvious in the low sun view, evidence of the dark ring can be seen extending about one Tycho diameter all the way around the crater's rim. Look closely and note that the territory isn't just a darker shade than that farther from Tycho, it's more featureless as well. Within the dark ring, features are softened and muted. The zone of "softness" sometimes even bisects a nearby crater with the side closest to Tycho being fuzzier than the side away from Tycho.

There are three reasons for the darker and more featureless ring around Tycho. The first is seismic shaking by the impact shock of the 8- to10-kilometer-wide asteroid the smacked into the Moon and created Tycho. The earthquake, or more correctly moonquake, created by the Tychonian impact collapsed and smoothed the geologic structure for about a 100-kilometer radius around Tycho’s present day rim. The second reason is the impact ground surge that radiated outward from Tycho’s rim washed across the region like tidal wave depositing excavated soil and debris heaved out of Tycho during its explosive formation. The third reason is the territory more than about 100 kilometers from the rim is artificially brightened by deposits of ray material, or the pulverized reflective material thrown outwards for hundreds of kilometers by the blast the created Tycho.

A curiosity is the circular ring of small secondary craters that arc around the perimeter of the softer and more muted dark doughnut. The shower of large ejecta blocks thrown by Tycho’s explosive formation ballistically arced over the dark doughnut and began impacting 100 or more kilometers beyond Tycho’s rim. None of the large blocks of ejecta fell within the donut, but hundreds of Tychonian secondary craters stream outwards beyond the doughnut. In time, half a billion years or more from now, the Tychonian rays will fade from space weathering while the dark doughnut will be churned and brightened by countless meteorite strikes, blending the two features into a homogeneous tone.

The Tychonian ray system also presents some mysteries. Crater rays are formed by pulverized glassy material blasted out by the explosion that created the crater. Thus, rays traditionally radiate from an impact point near the center of the crater. A majority of Tycho's rays do converge to a single point. However, some of Tycho's major ray streamers do not align with a central point.

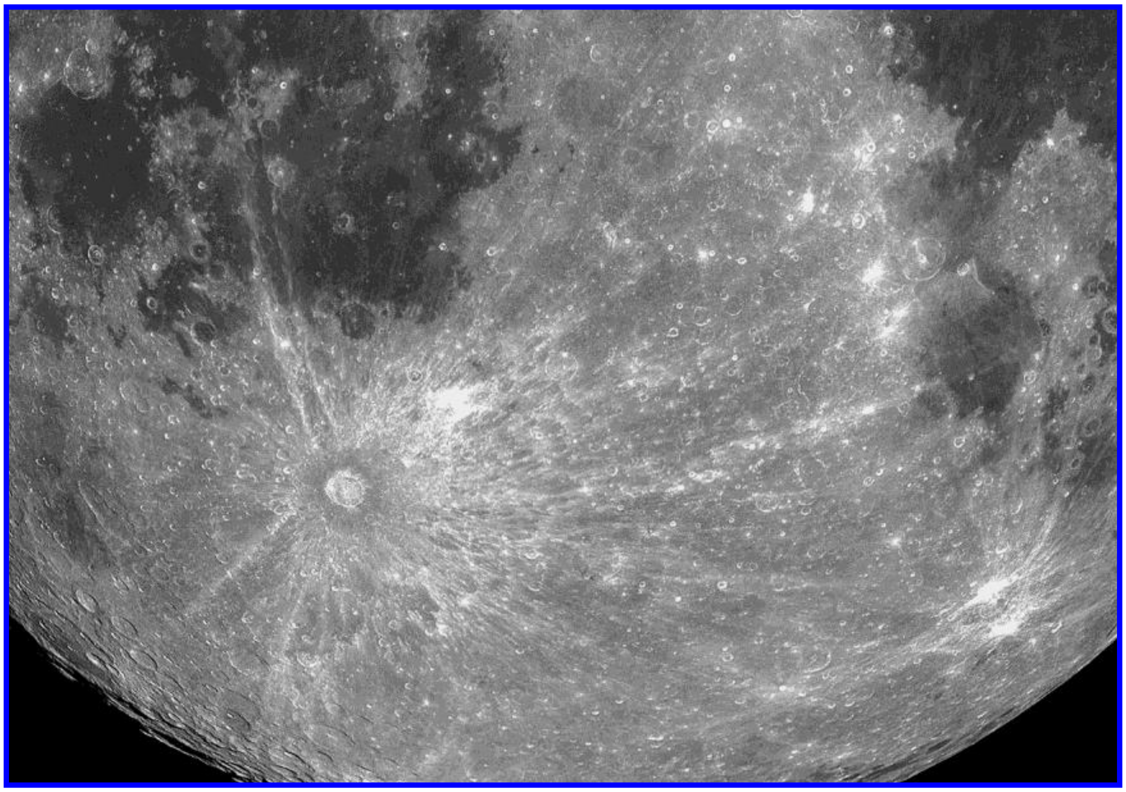
One of the more fascinating of the nicknamed lunar features is “The Railroad Tracks”. These are the unusual parallel rays streaming northwest from Tycho crater. The railroad tracks are one of the few individual lunar features, other than the maria, that can be discerned with the naked eye. Each of these rays is tangential to Tycho’s rim. Near Tycho, two prominent linear chains of secondary craters also stream tangentially northwest from opposite sides of Tycho's rim. These crater chains merge into the railroad tracks. An additional wayward ray extends southwest perpendicularly from the railroad tracks and is itself also tangential to Tycho's rim.

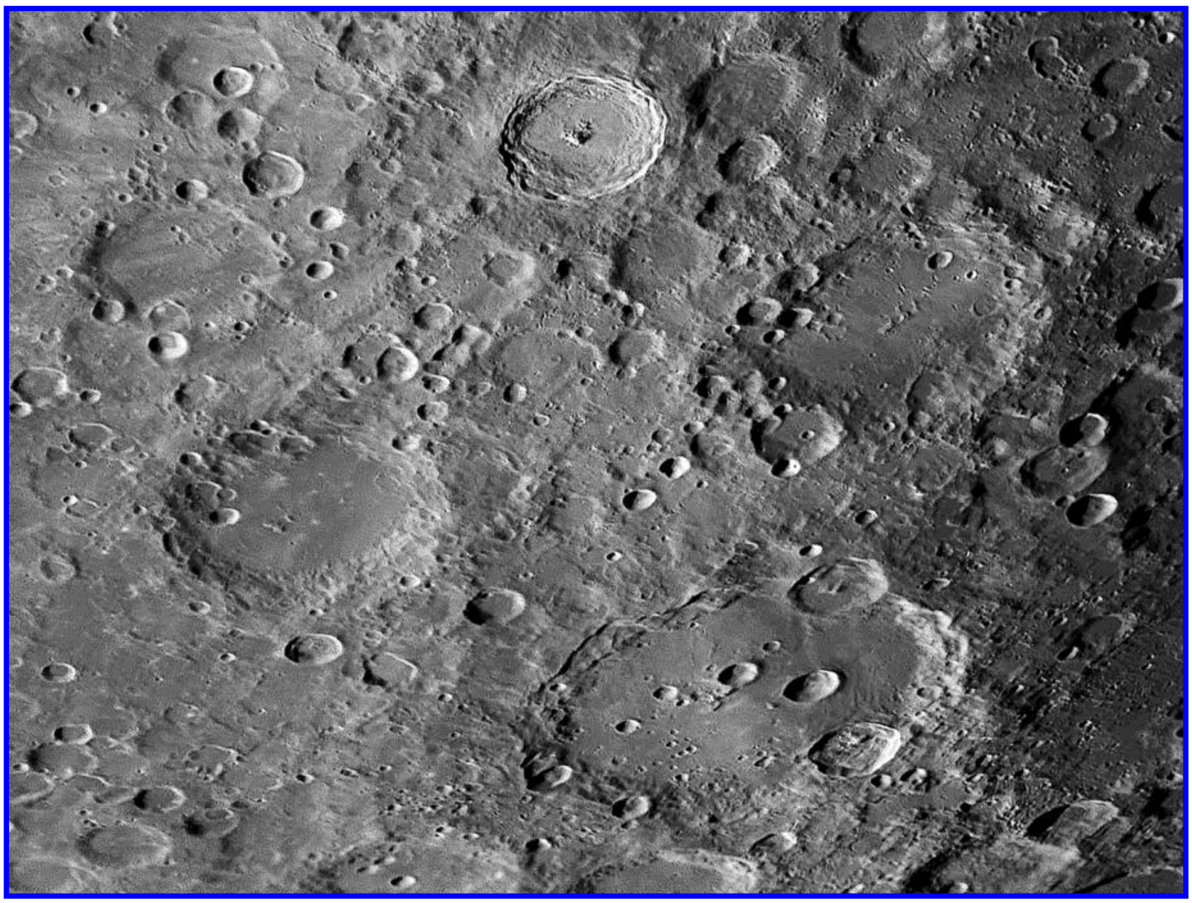
The tangential ray mystery led some respected mid-20th century lunar experts to theorize Tycho crater and portions its ray system were created by two different impact events. It is possible that Tycho was created by the impact of a "rubble pile" asteroid, or an asteroid that is not one solid mass, but many smaller gravitationally bound bodies. As the rubble pile asteroid approached, the gravity of the Earth/Moon system broke it into multiple fragments. The fragments that hit the Moon first created the offset rays, followed within seconds by the impact that blasted Tycho crater with its traditional fan of rays.

At one time, a study of the Baptistina family of asteroids suggests that projectiles from this series may have been responsible for both the Tycho impact 108 million years ago and the later Earth impact that created the Chicxulub crater in the Yucatan 65 million years ago. Since then, data gathered in 2012 by the Wild-Field Infrared Survey Explorer determined the Baptistina family of asteroids were born about 80 million years ago, ruling out any connection with the Tycho impact. Nonetheless, for a while it was fascinating to contemplate that the creation of Tycho may be related to the Yucatan event that altered the evolutionary path of life on Earth.

The mystery of Tycho’s tangential rogue rays remains, but as lunar observers, we can enjoy a doughnut while riding the railroad tracks up to Mare Nubium. Enjoy the ride and take in the view!

1 Tycho rays.jpg
Tycho's bright ray pattern splashes halfway across the Moon's visible disk. Tycho crater is too small to be seen with the naked eye, but during full Moon the fan of Tychonian rays point to the crater's location. Photos by Robert Reeves

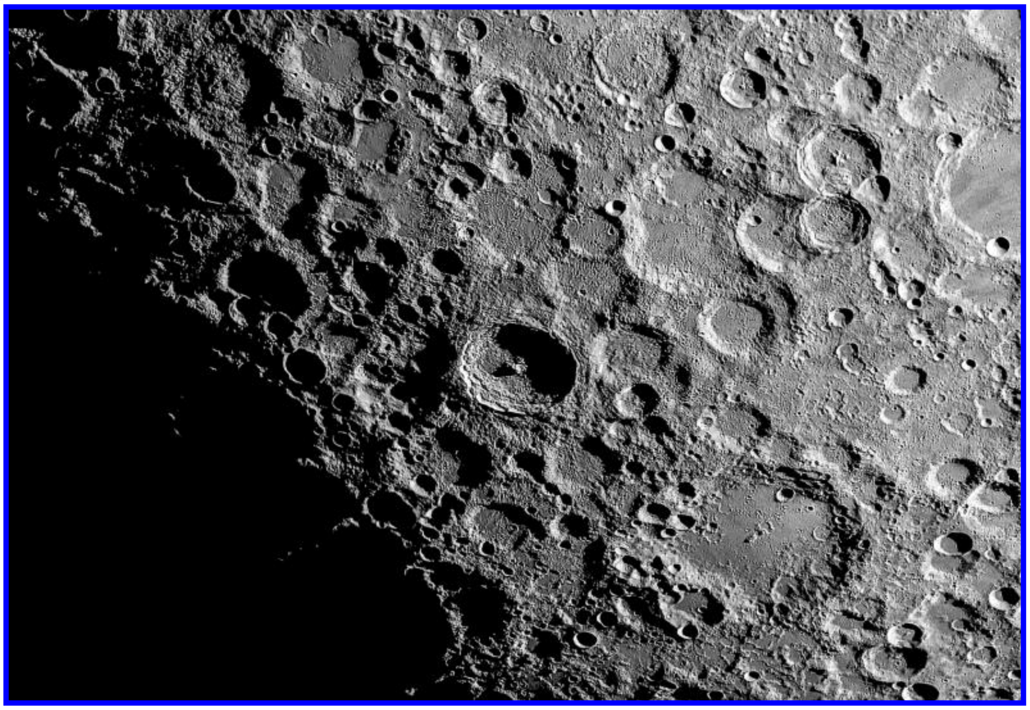




2 Tycho Longomontanus Maginus Clavious.jpg
Tycho is the youngest large crater on the Moon, but it lies on the southern highlands within a field of the oldest craters on the Moon. Massive Longomontanus to the southwest of Tycho, Maginus to the southeast, and Clavius south of Tycho are 40 times older than Tycho.

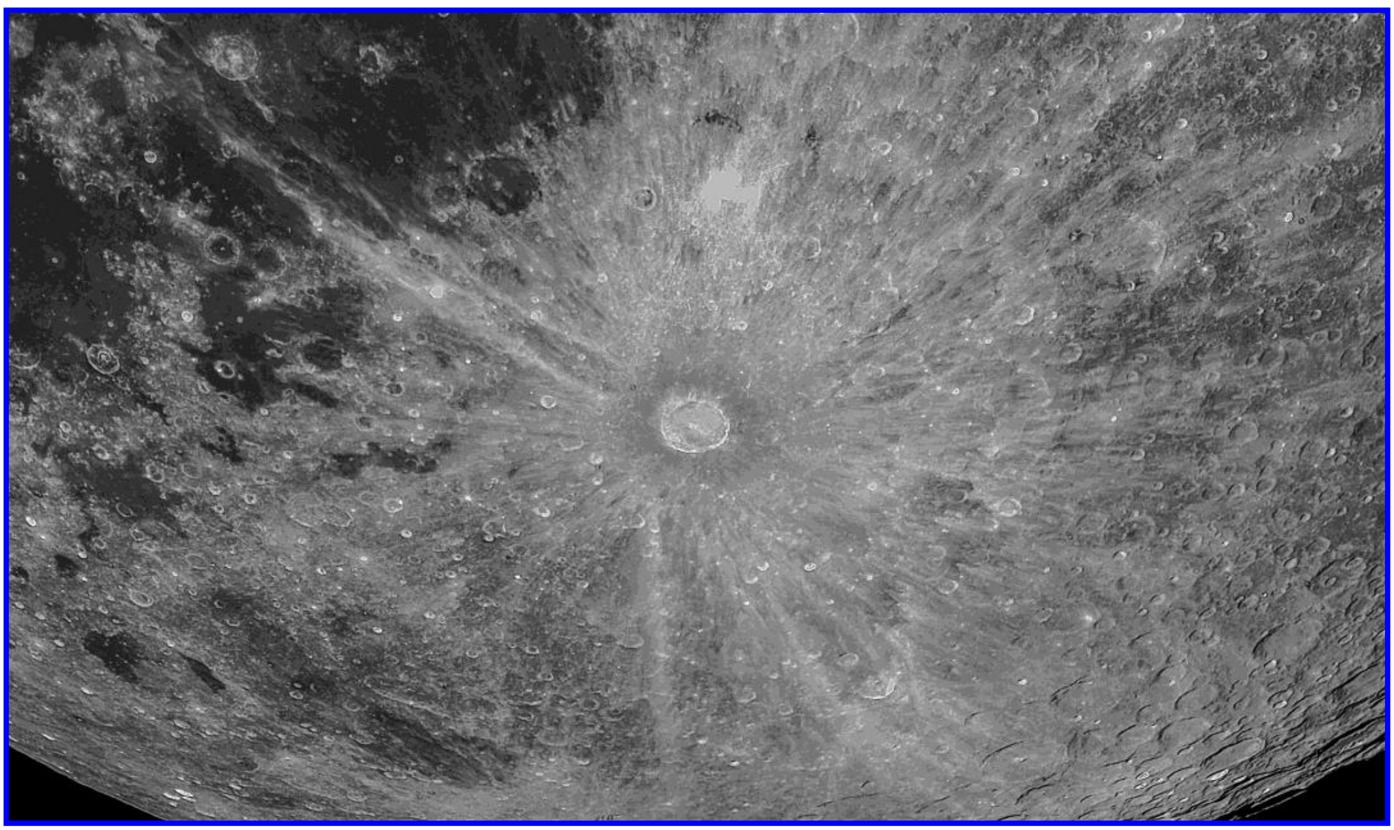
Lunar Topographic Studies

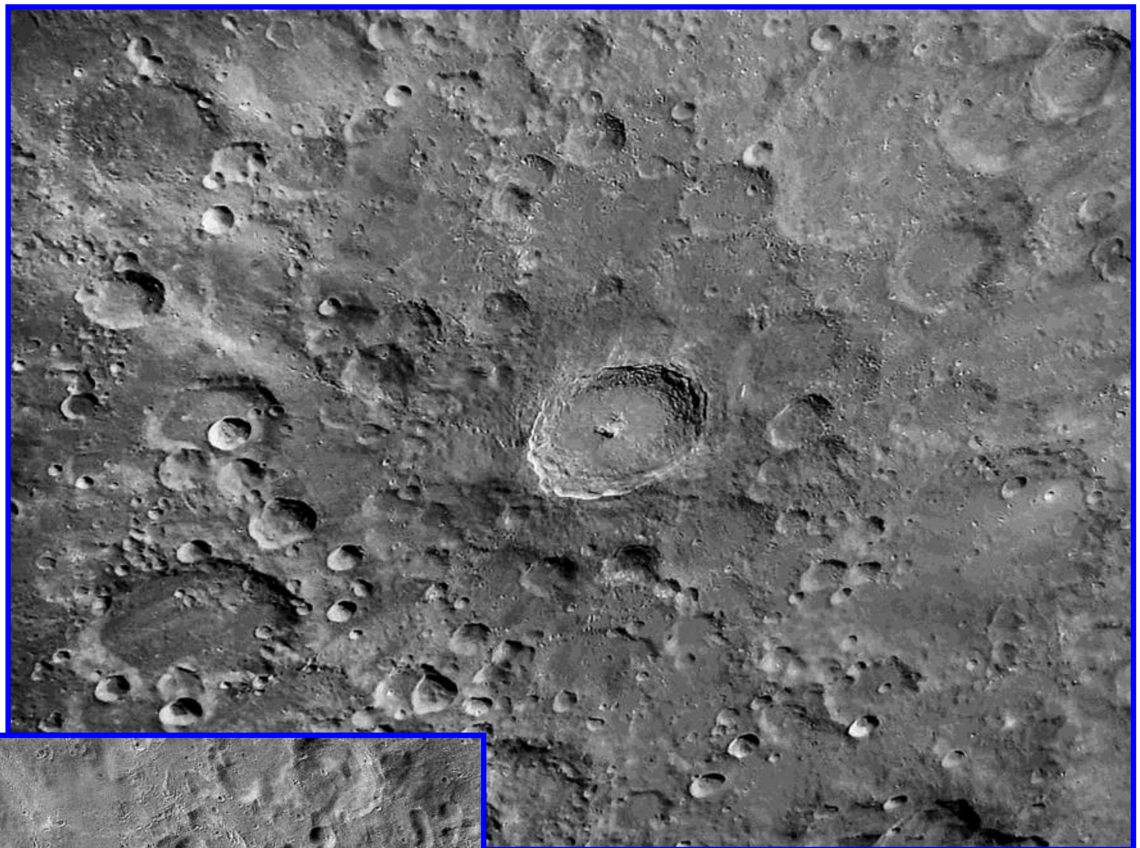
Enjoying a Donut While Riding the Rail to the Sea of Clouds



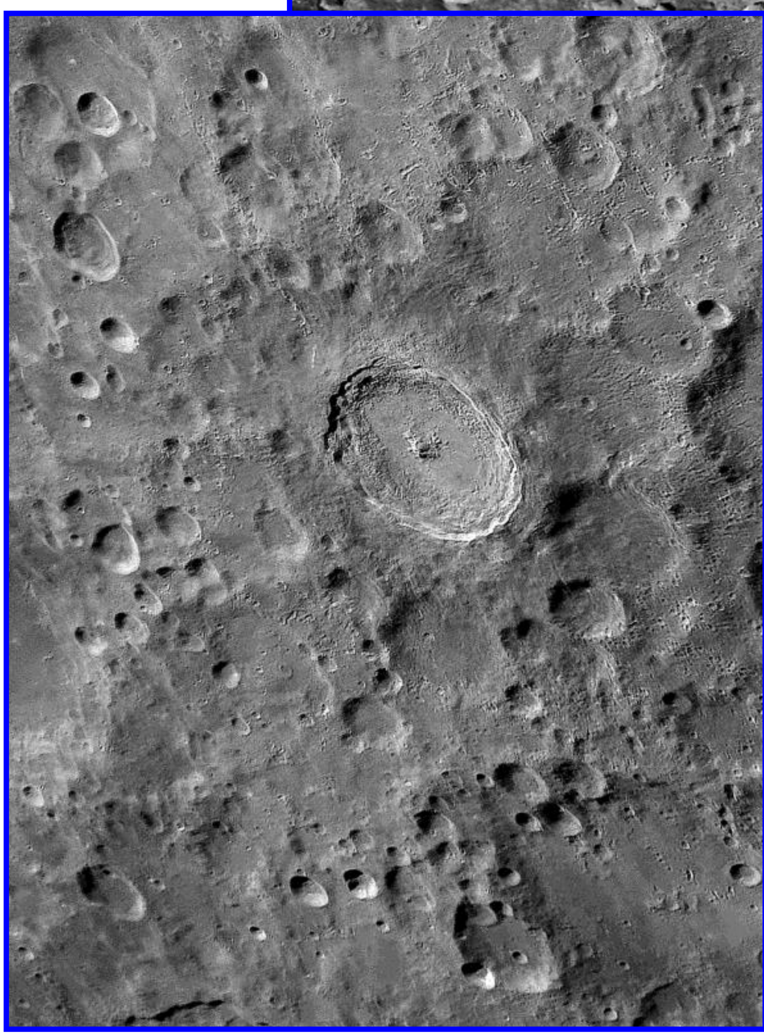
3 Tycho secondary craters.jpg
Tycho crater is the youngest and most pristine large crater on the Moon. The territory surrounding Tycho is littered with hundreds of tiny secondary craters laying atop ancient eroded and degraded craters up to 40 times older than Tycho.

4 Tycho rogue rays.jpg
Two parallel Tychonian ray streamers, unofficially known as the Railroad Tracks, extend northwest while another rogue ray extends southwest. Why these rays are tangential to Tycho's rim is unknown. A dark ring extends one crater diameter beyond Tycho's rim. Ejecta from Tycho's explosive formation hurled over this zone leaving it undisturbed, then churned and brightened the territory beyond the ring.





5 Tycho soft territory.jpg
The terrain within the Tychonian dark doughnut is noticeably smoother and features within it have been muted by the seismic shock of Tycho's explosive formation. Note that Tychonian secondary craters do not begin until the outer perimeter of the softer territory within the dark doughnut.



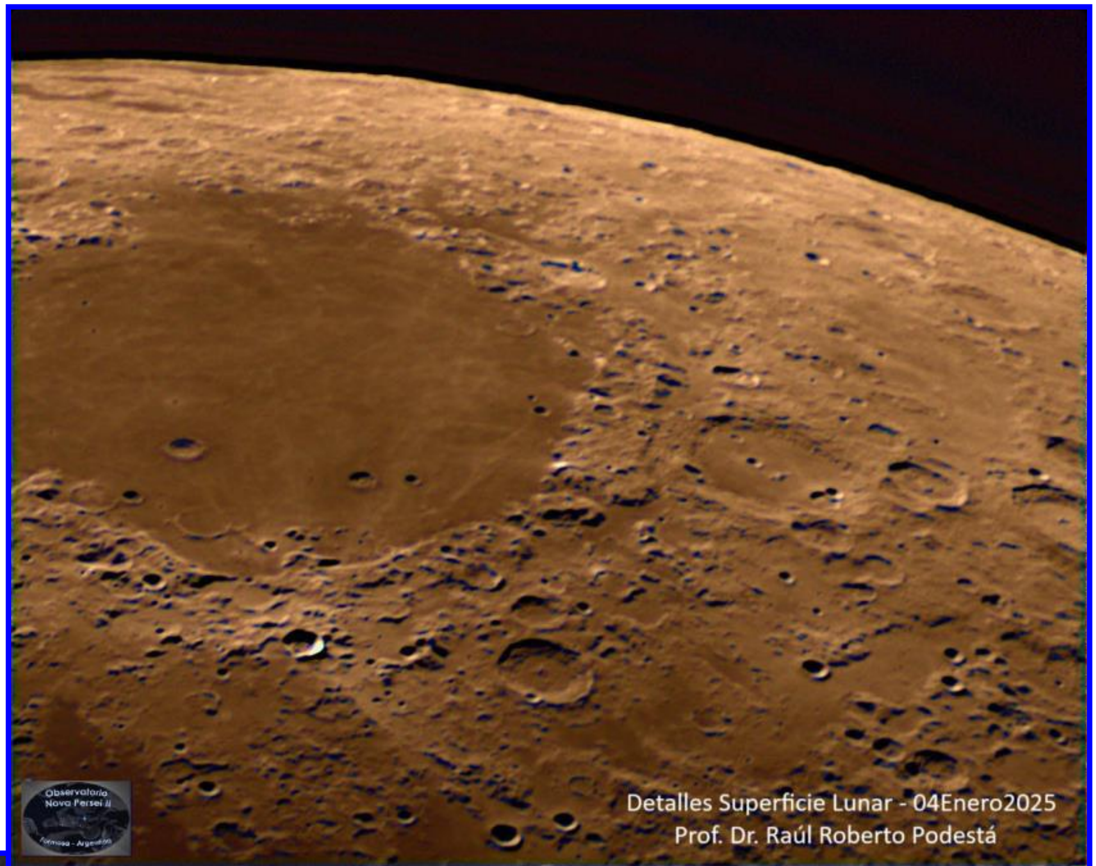
6 Tycho secondary streamers.jpg
Two linear streams of secondary craters radiate northwest from Tycho's rim. These secondary streams merge into the parallel ray streamers known as the railroad tracks.

7 Tycho railroad tracks.jpg
The curious parallel rays of the railroad tracks extending tangentially northwest from Tycho's rim stretch over 900 kilometers onto western Mare Nubium. The equally vexing and more tangential southwest rogue ray does not align with Tycho.

5 Day-Old Moon, *Maurice Collins, Palmerston North, New Zealand. 2025 January 04 08:09-08:13 UT. Celestron 8 inch Schmidt-Cassegrain telescope, QHY5III462C camera.*

Messier, *Raúl Roberto Podestá, Formosa, Argentina. 2025 January 05 00:08 UT. 127 mm Maksutov-Cassegrain telescope, UV/IR UT. ZWO ASI178M camera. North is right, west is down.*

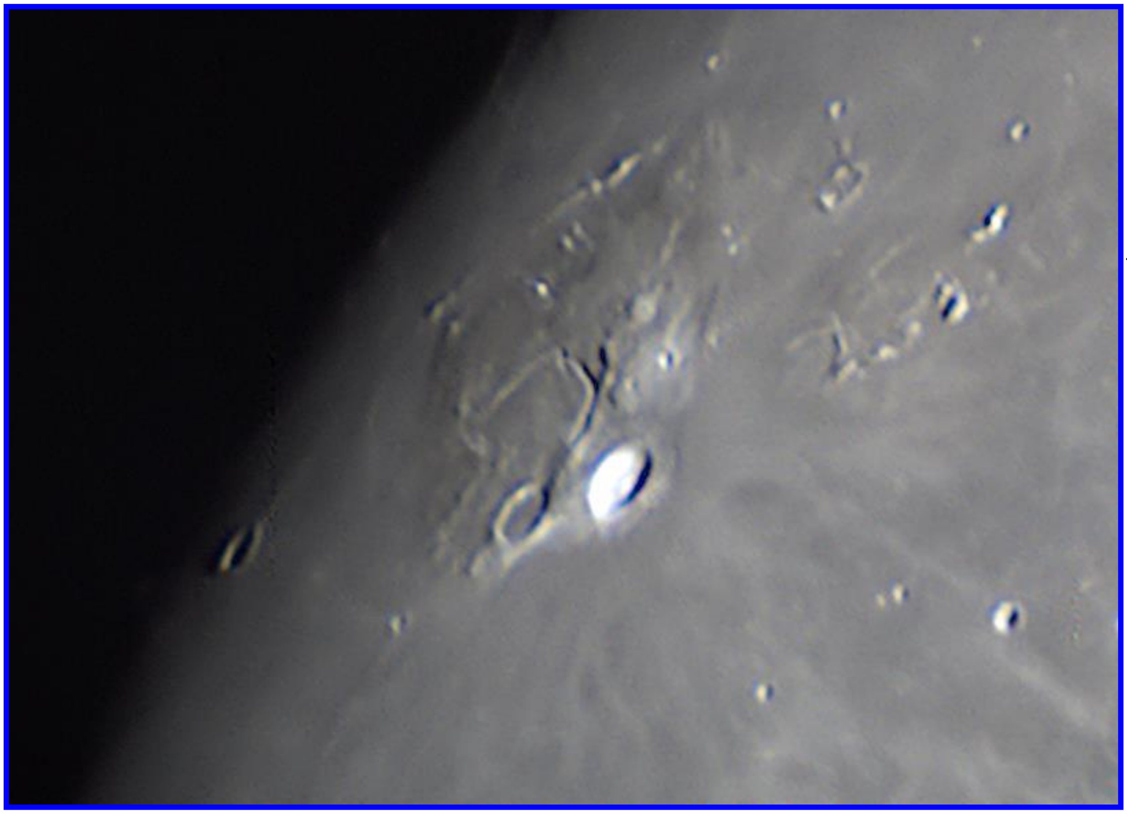
Recent Topographic Studies



***Proclus,** Raúl Roberto Podestá, Formosa, Argentina. 2025 January 05 00:05 UT. 127 mm Maksutov-Cassegrain telescope, UV/IR UT. ZWO ASI178M camera. North is right, west is down.*

***Fontana,** Walter Ricardo Elias, Oro Verde, Argentina, AEA. 2025 January 12 00:48 UT. Sky Watcher 150 mm reflector telescope, 750 mm focal length, 3x barlow, QHY5C-II camera.*

Recent Topographic Studies

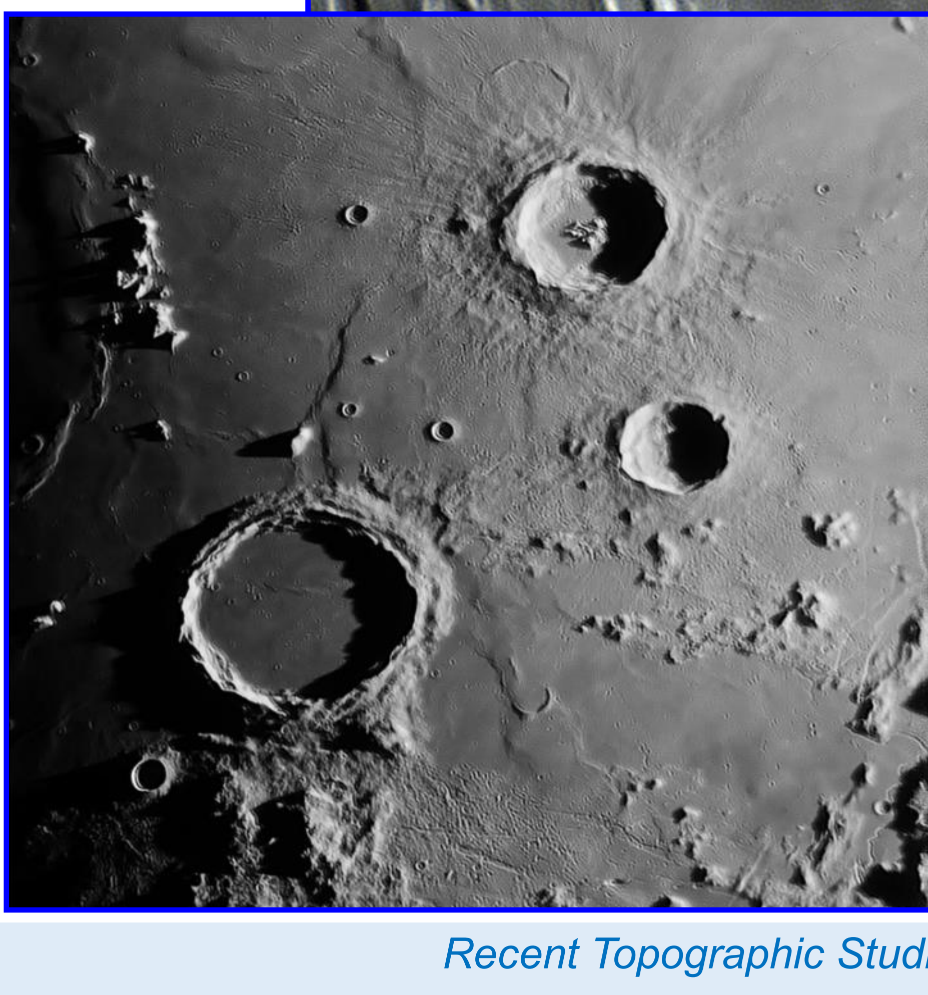


Aristarchus, *Walter Ricardo Elias, Oro Verde, Argentina, AEA. 2025 January 12 00:11 UT. Sky Watcher 150 mm reflector telescope, 750 mm focal length, 3x barlow, QHY5C-II camera.*

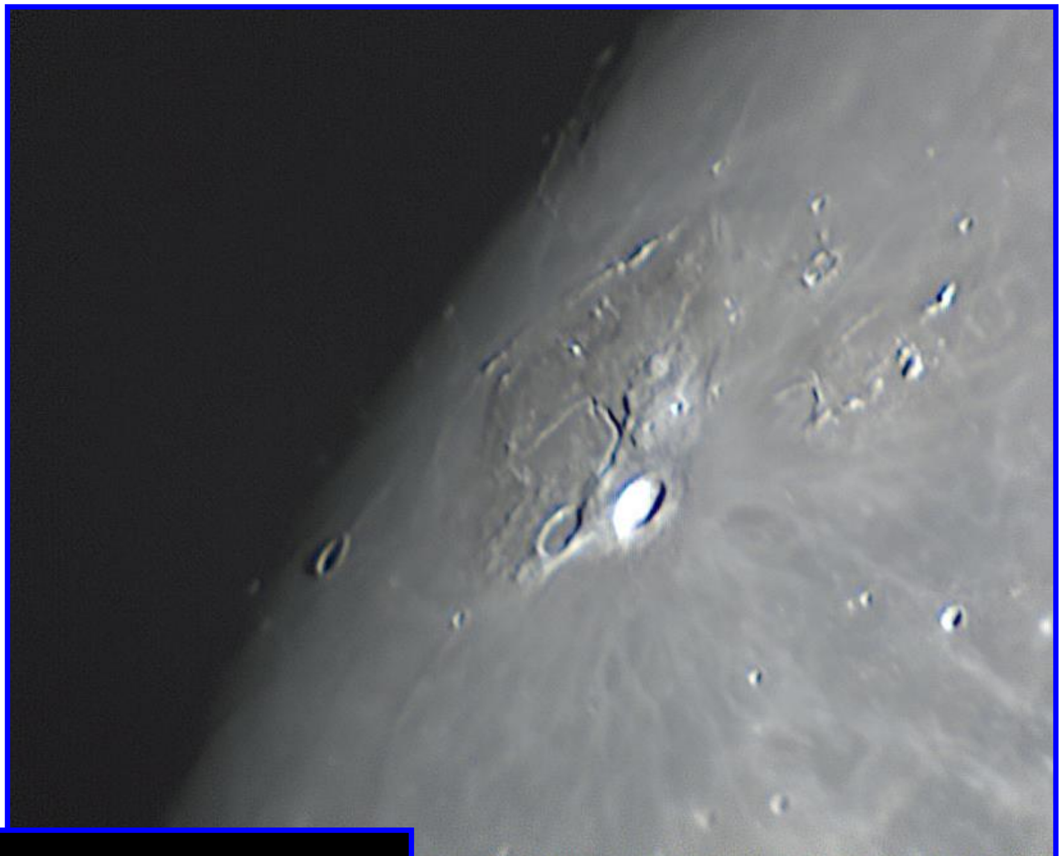
Two panels mosaic of the lunar southern hemisphere as imaged by Tien Ngo Tran of Ho Chi Minh City, Vietnam (10° 46’06” N, 106°40’33” E), on 2025 January 17thth at 10:25 UT. North is up in the image. Equipment: Vixen R130S Newtonian reflector telescope on Vixen Polaris EQ mount (manual tracking), effective focal length = 720mm, aperture = 130mm, IMC-3616UC as camera, SVBONY 685nm Ir Pass filter. Seeing condition: 3/10 (Pickering Scale).

Recent Topographic Studies

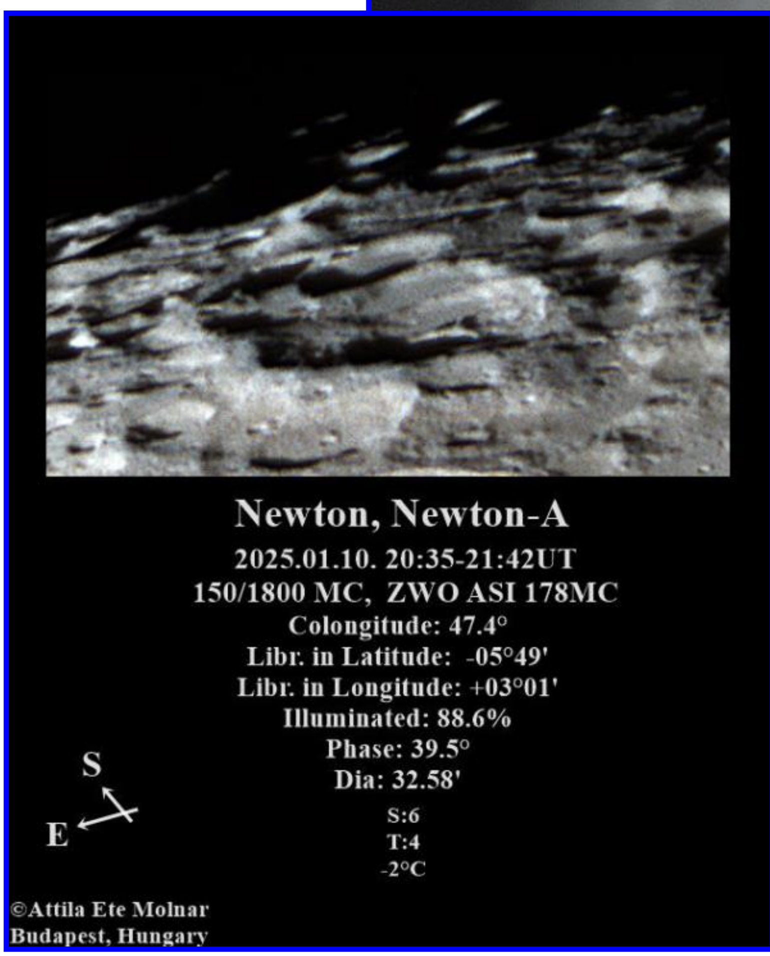
Gassendi, *Walter Ricardo Elias, Oro Verde, Argentina, AEA. 2025 January 12 00:40 UT. Sky Watcher 150 mm reflector telescope, 750 mm focal length, 3x barlow, QHY5C-II camera.*



Archimedes, *Ken Vaughan, Cattle Point, British Columbia, Canada. 2024 December 09 01:49 UT. Meade LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 R-IR filter, ZWO ASI178 MM camera.*



Aristarchus, *Walter Ricardo Elias, Oro Verde, Argentina, AEA. 2025 January 12 00:31 UT. Sky Watcher 150 mm reflector telescope, 750 mm focal length, 3x barlow, QHY5C-II camera.*

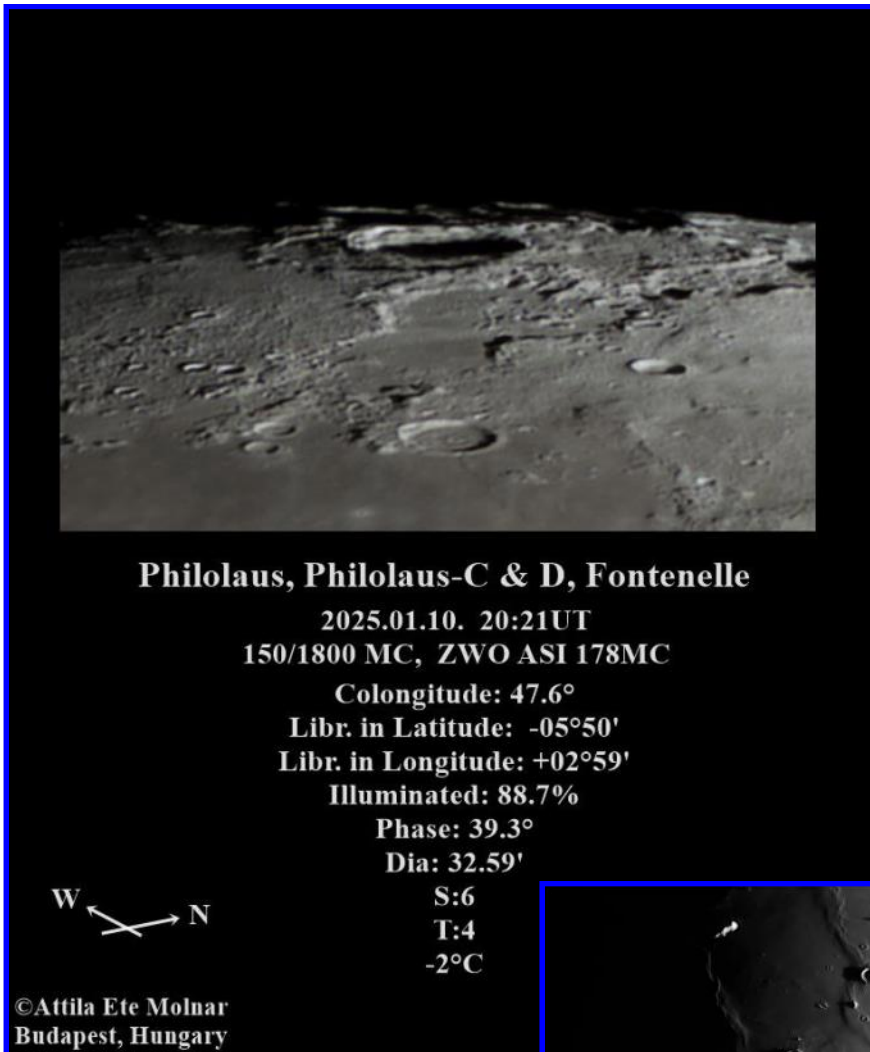


Newton and Newton A, *Attila Ete Molnar, Budapest, Hungary. 2025 January 10 20:35-21:42 UT, colongitude 47.4˚. 150 mm Maksutov-Cassegrain telescope, 1800 mm focal length, ZWO ASI178MC camera. Seeing 6/10, transparency 4/6.*

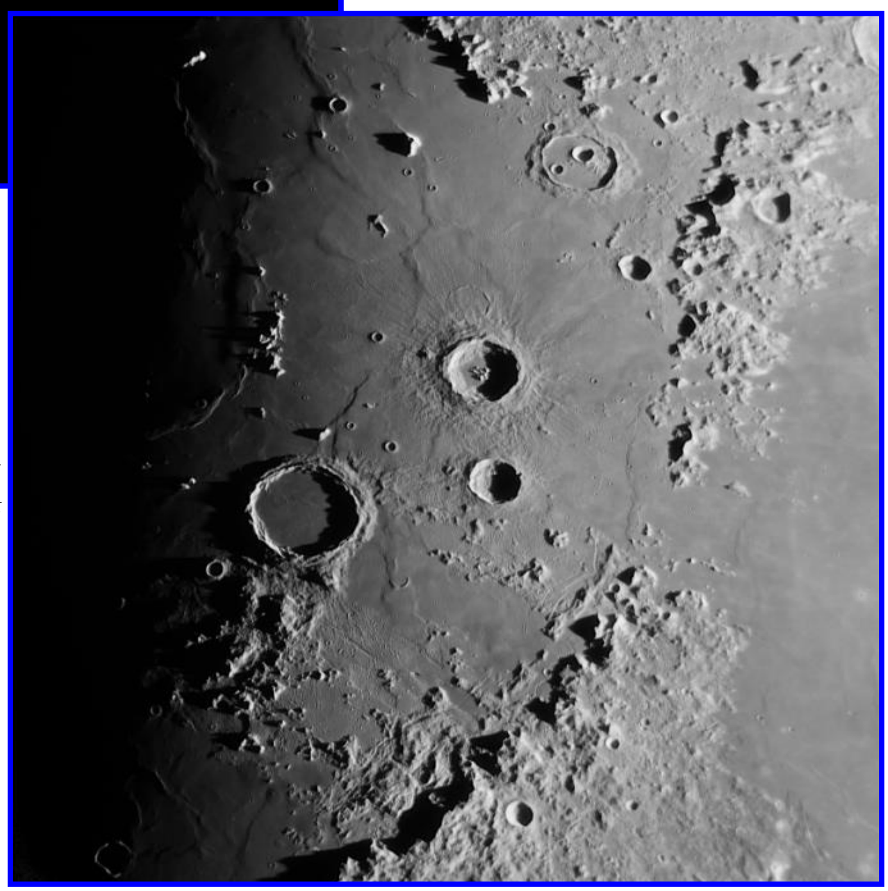
Gassendi, *Walter Ricardo Elias, Oro Verde, Argentina, AEA. 2025 January 12 00:55 UT. Sky Watcher 150 mm reflector telescope, 750 mm focal length, 3x barlow, QHY5C-II camera.*

Deslandres, *Ken Vaughan, Cattle Point, British Columbia, Canada. 2024 December 09 02:29 UT. Meade LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 R-IR filter, ZWO ASI178 MM camera.*

Recent Topographic Studies

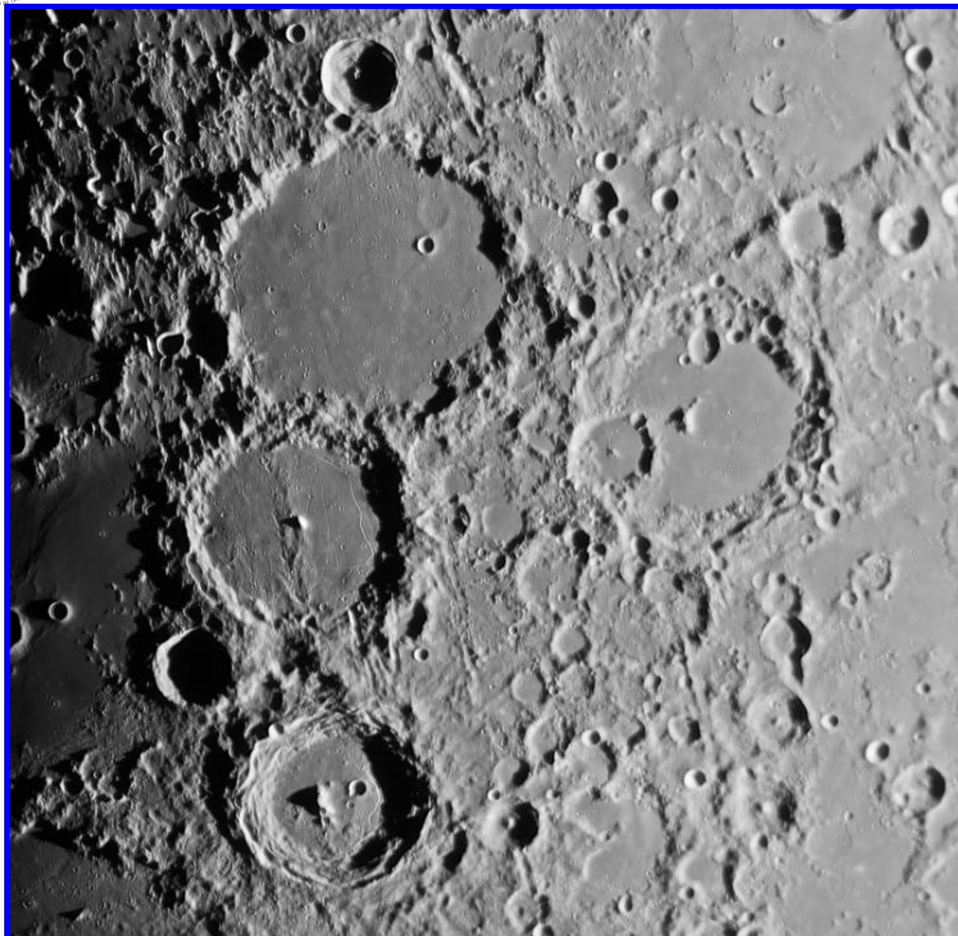


Philolaus, Philolaus C & D and Fontenelle, *Attila Ete Molnar, Budapest, Hungary. 2025 January 10 20:21 UT, colongitude 47.6˚. 150 mm Maksutov-Cassegrain telescope, 1800 mm focal length, ZWO ASI178MC camera. Seeing 6/10, transparency 4/6.*



Eastern Mare Imbrium, *Ken Vaughan, Cattle Point, British Columbia, Canada. 2024 December 09 02:20 UT. Meade LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 R-IR filter, ZWO ASI178 MM camera.*

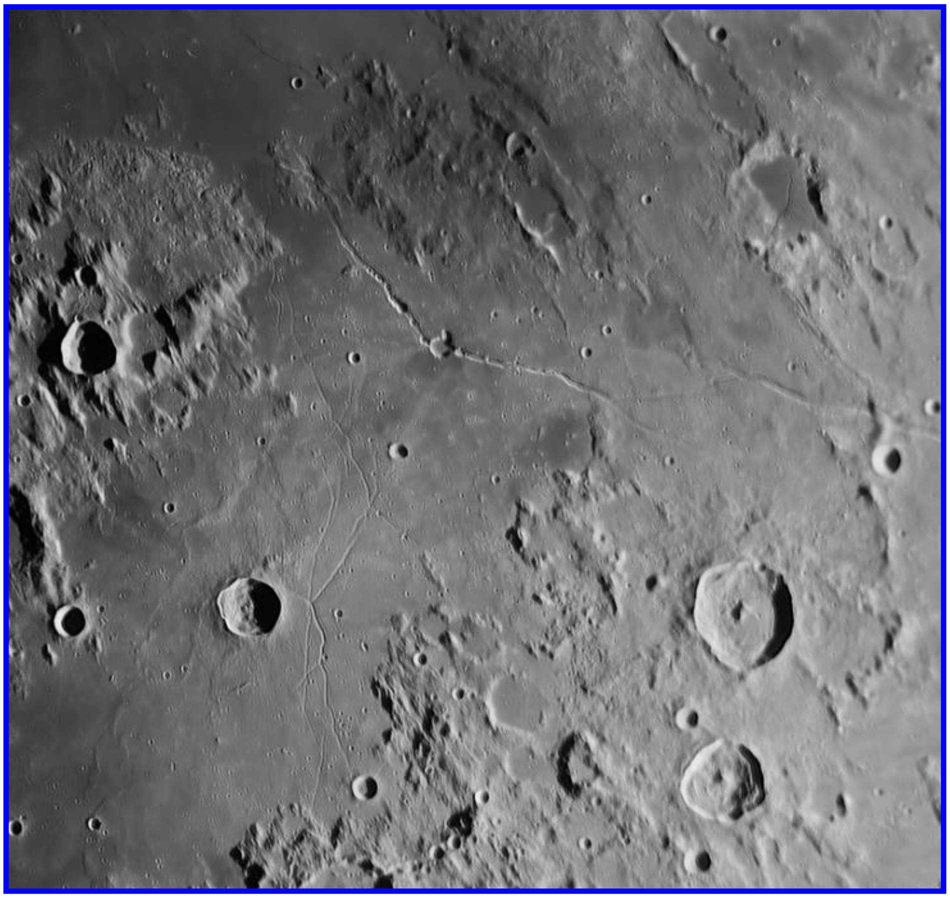
Recent Topographic Studies



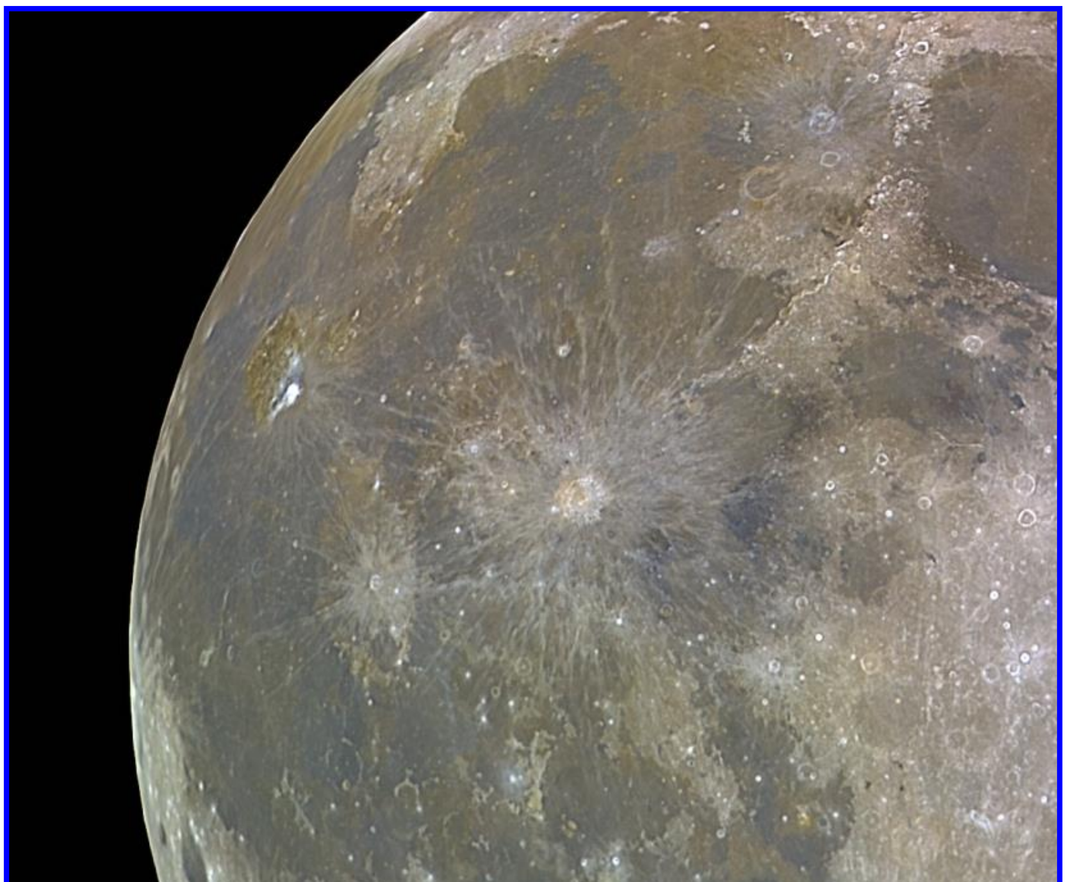
Ptolemaeus Chain, *Ken Vaughan, Cattle Point, British Columbia, Canada. 2024 December 09 02:25 UT. Meade LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 R-IR filter, ZWO ASI178 MM camera.*

Archimedes, *Walter Ricardo Elias, Oro Verde, Argentina, AEA. 2025 January 14 04:08 UT. Sky Watcher 150 mm reflector telescope, 750 mm focal length, QHY5C-II camera.*

Recent Topographic Studies

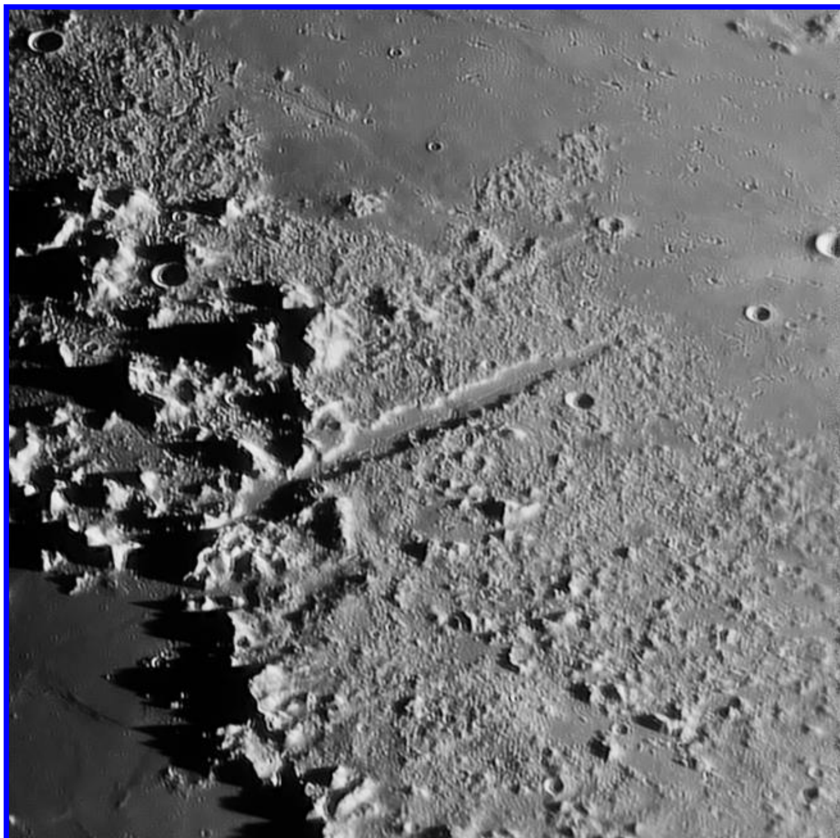


Triesnecker, *Ken Vaughan, Cattle Point, British Columbia, Canada. 2024 December 09 02:15 UT. Meade LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 R-IR filter, ZWO ASI178 MM camera.*

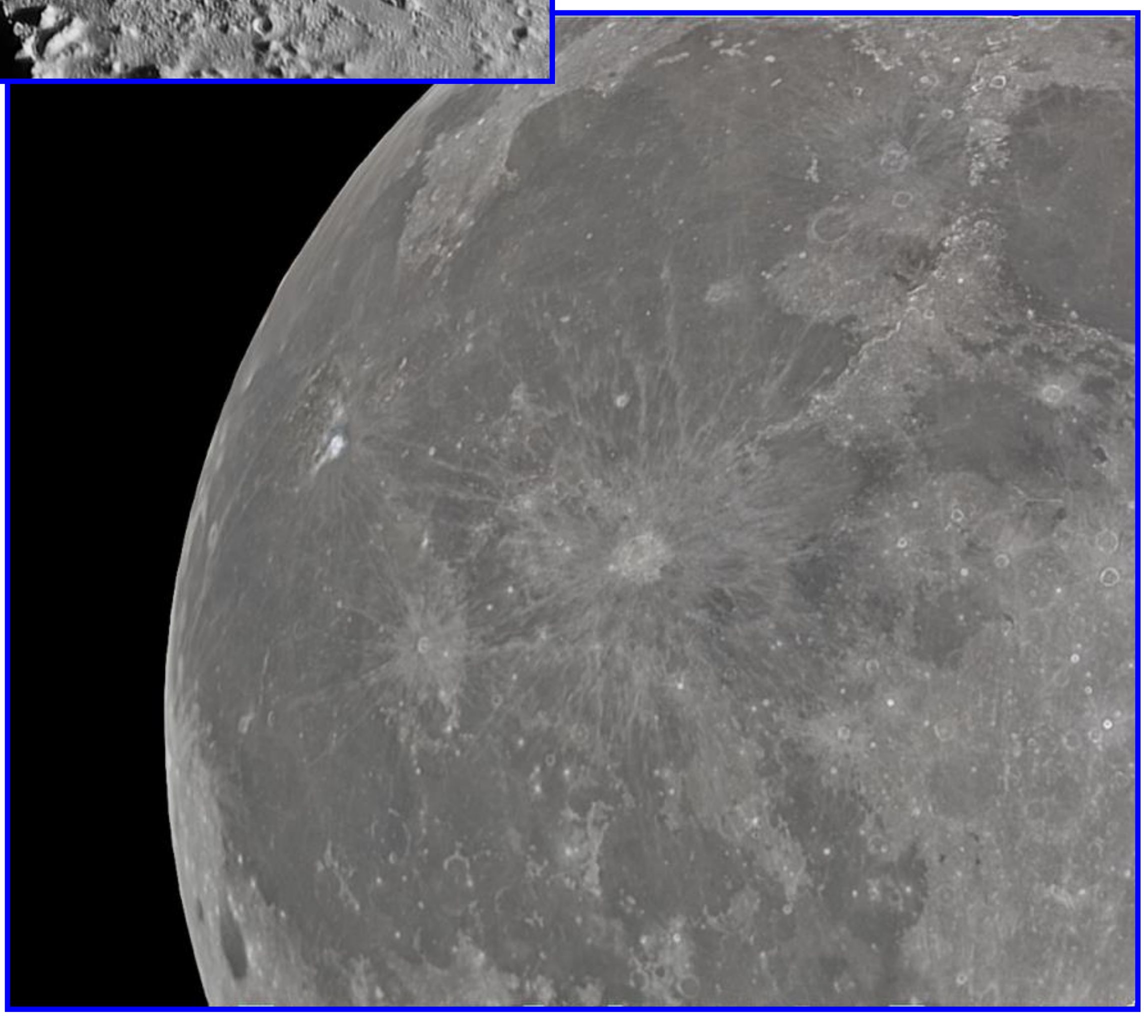


Aristarchus, Kepler and Copernicus, *Walter Ricardo Elias, Oro Verde, Argentina, AEA. 2025 January 14 03:50 UT. Sky Watcher 150 mm reflector telescope, 750 mm focal length, QHY5C-II camera.*

Recent Topographic Studies

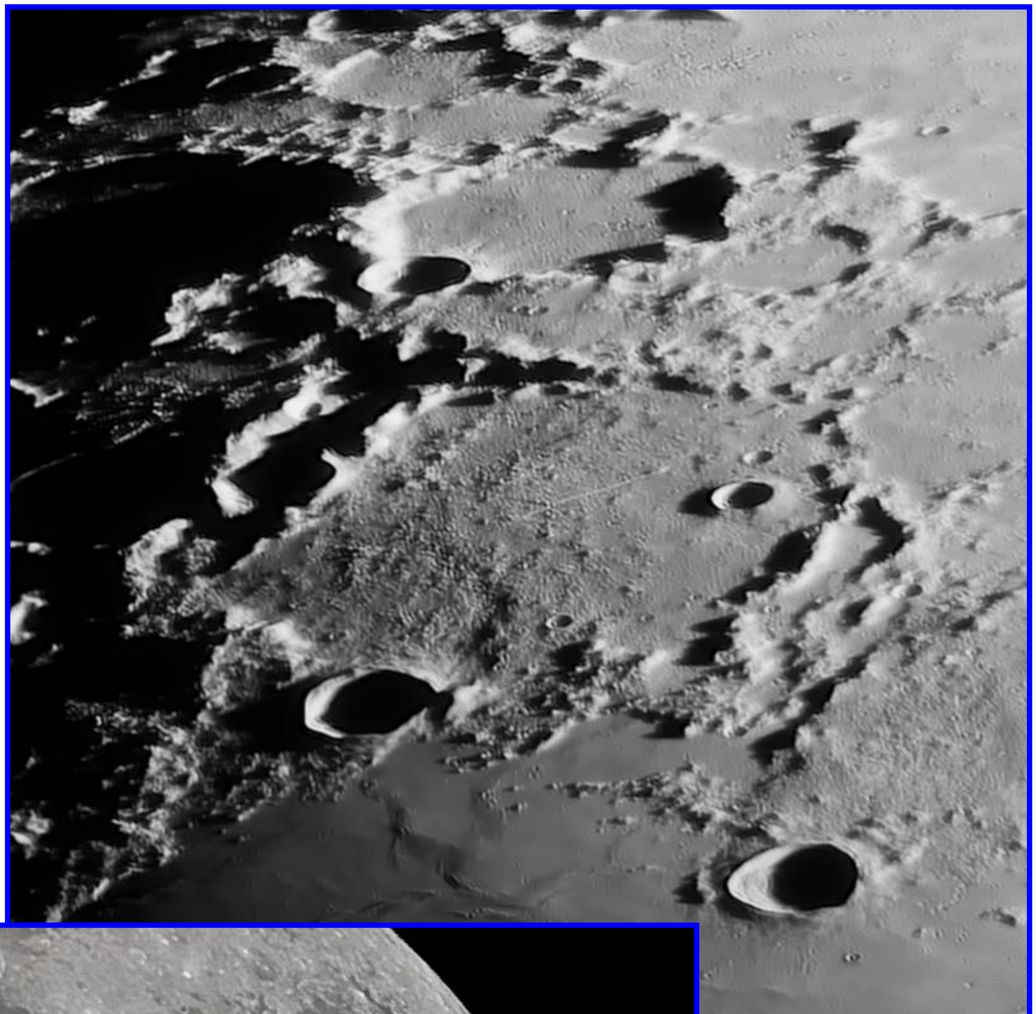


Vallis Alpes, *Ken Vaughan, Cattle Point, British Columbia, Canada. 2024 December 09 02:07 UT. Meade LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 R-IR filter, ZWO ASI178 MM camera.*



Aristarchus, Kepler and Copernicus, *Walter Ricardo Elias, Oro Verde, Argentina, AEA. 2025 January 14 03:50 UT. Sky Watcher 150 mm reflector telescope, 750 mm focal length, QHY5C-II camera.*

Recent Topographic Studies



***W. Bond,** Ken Vaughan, Cattle Point, British Columbia, Canada. 2024 December 09 02:51 UT. Meade LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 R-IR filter, ZWO ASI178 MM camera.*

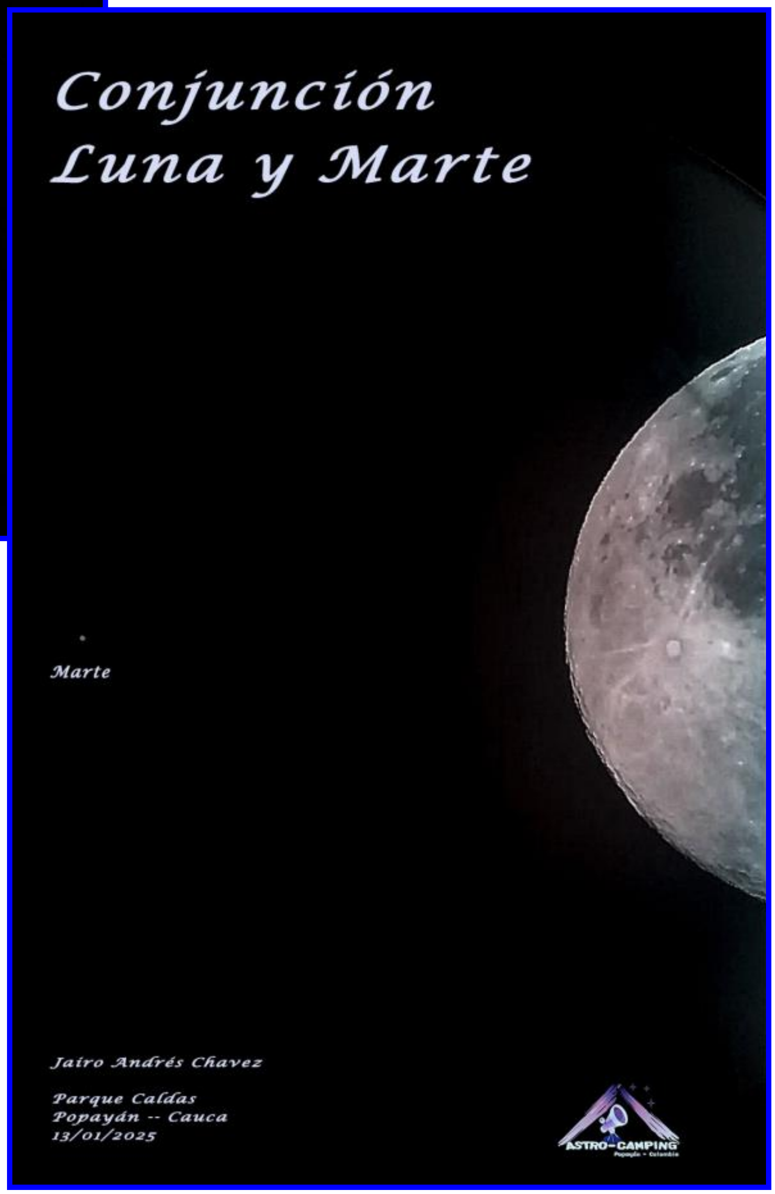
***Censorinus,** Walter Ricardo Elias, Oro Verde, Argentina, AEA. 2025 January 14 04:23 UT. Sky Watcher 150 mm reflector telescope, 750 mm focal length, QHY5C-II camera.*

Recent Topographic Studies

Endymion, Atlas and Hercules, *Ken Vaughan, Cattle Point, British Columbia, Canada. 2024 December 09 01:49 UT. Meade LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 R-IR filter, ZWO ASI178 MM camera.*

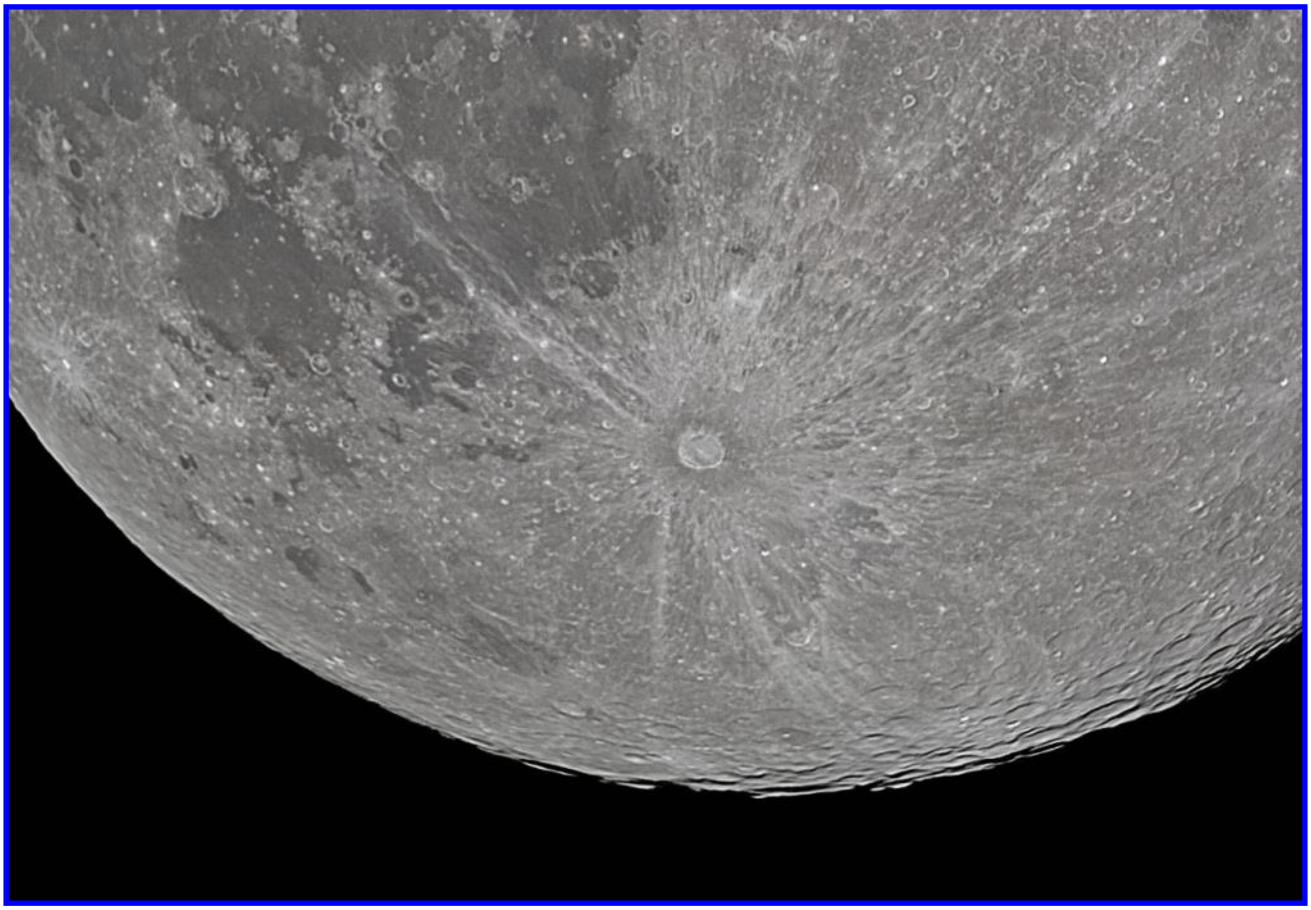
Proclus, *Walter Ricardo Elias, Oro Verde, Argentina, AEA. 2025 January 14 04:24 UT. Sky Watcher 150 mm reflector telescope, 750 mm focal length, QHY5C-II camera.*

Mars and Moon Conjunction, *Walter Ricardo Elias, Oro Verde, Argentina, AEA. 2025 January 14 02:02 UT. Sky Watcher 150 mm reflector telescope, 750 mm focal length, Canon T1 camera.*



Conjunction of the Full Moon and Mars, *Jairo Chavez, Popayán, Colombia. 2025 January 14 02:02 UT. 311 mm truss tube Dobsonian reflector telescope, MOTO E5 PLAY camera. North is to the right, west is up.*

Recent Topographic Studies

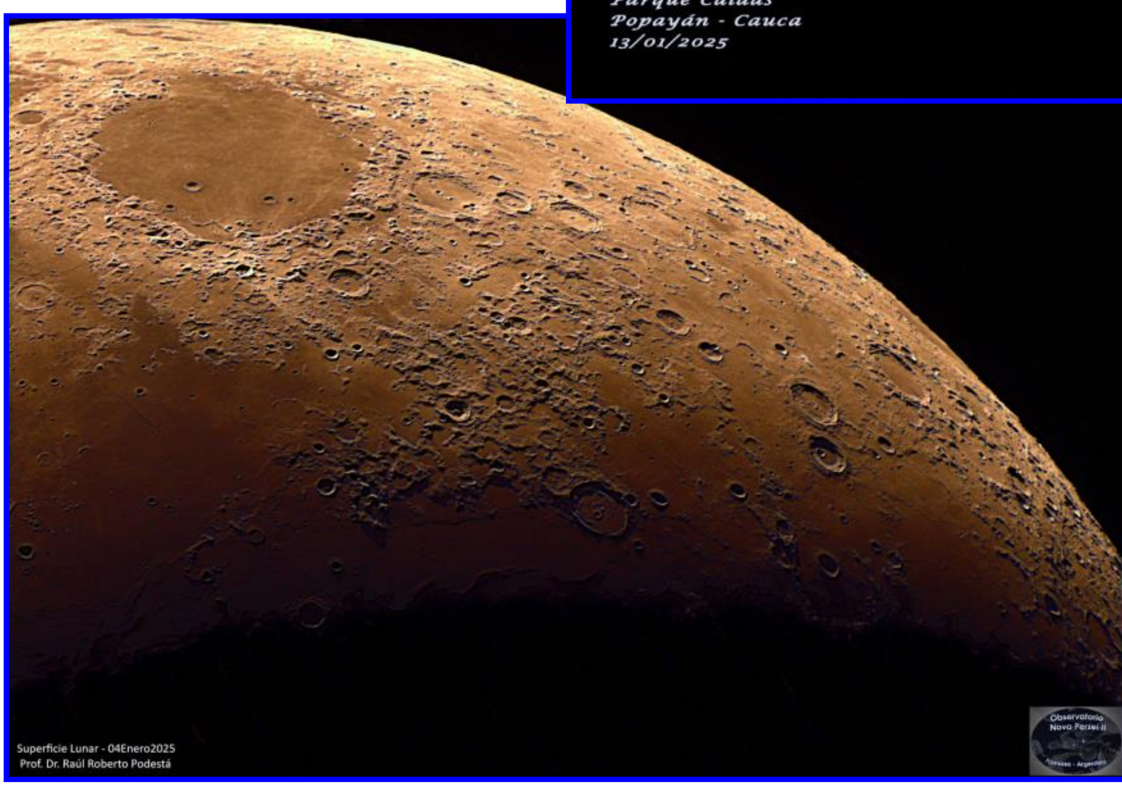


Tycho, *Walter Ricardo Elias, Oro Verde, Argentina, AEA. 2025 January 14 03:42 UT. Sky Watcher 150 mm reflector telescope, 750 mm focal length, QHY5C-II camera.*

Atlas, *Raúl Roberto Podestá, Formosa, Argentina. 2025 January 05 00:06 UT. 127 mm Maksutov-Cassegrain telescope, UV/IR UT. ZWO ASI178M camera. North is right, west is down.*

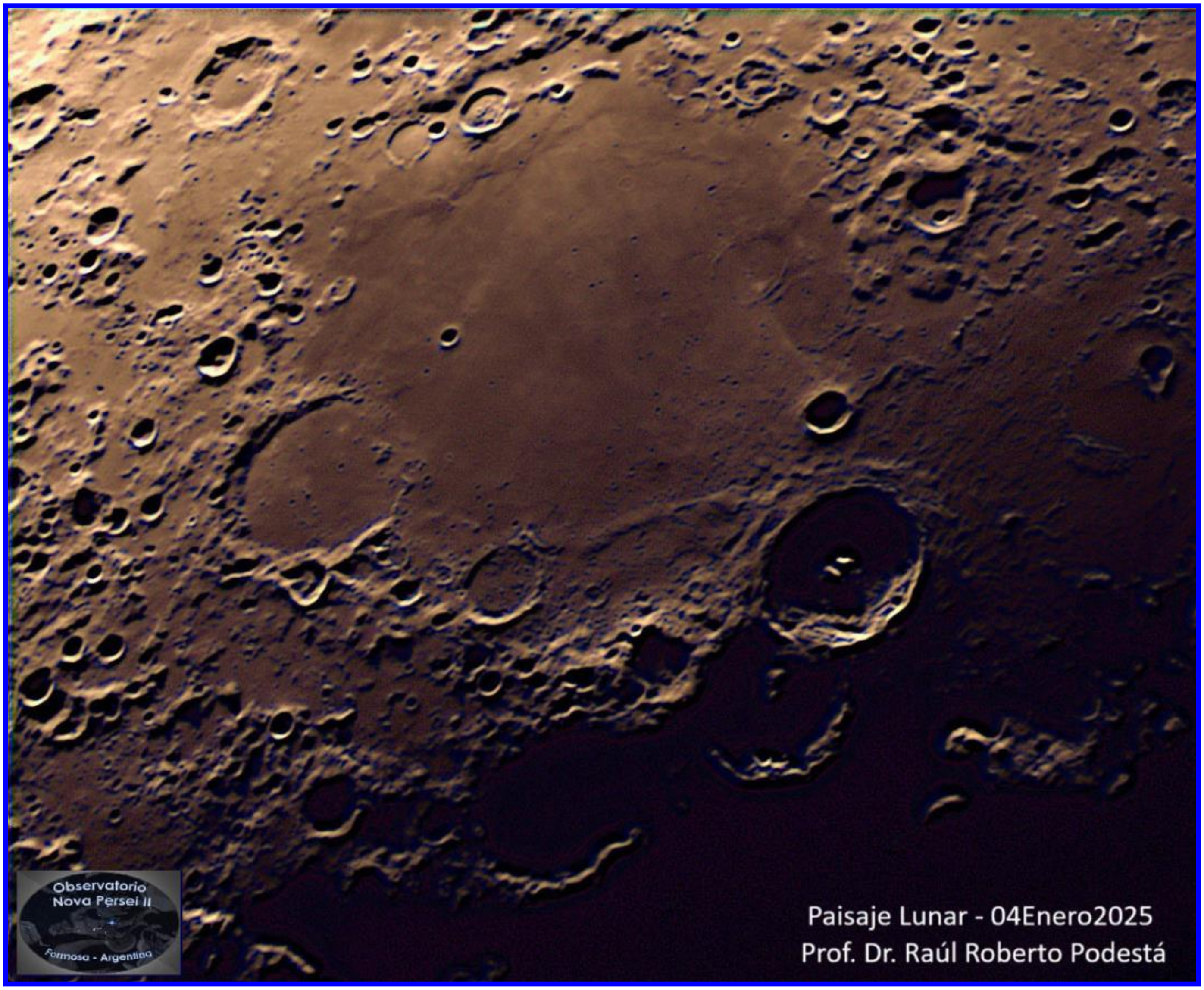
Recent Topographic Studies

Full Moon, *Jairo Chavez, Popayán, Colombia. 2025 January 14 01:56 UT. 311 mm truss tube Dobsonian reflector telescope, MOTO E5 PLAY camera. North is to the right, west is up.*



Mare Crisium, *Raúl Roberto Podestá, Formosa, Argentina. 2025 January 05 00:07 UT. 127 mm Maksutov-Cassegrain telescope, UV/IR UT. ZWO ASI178M camera.*

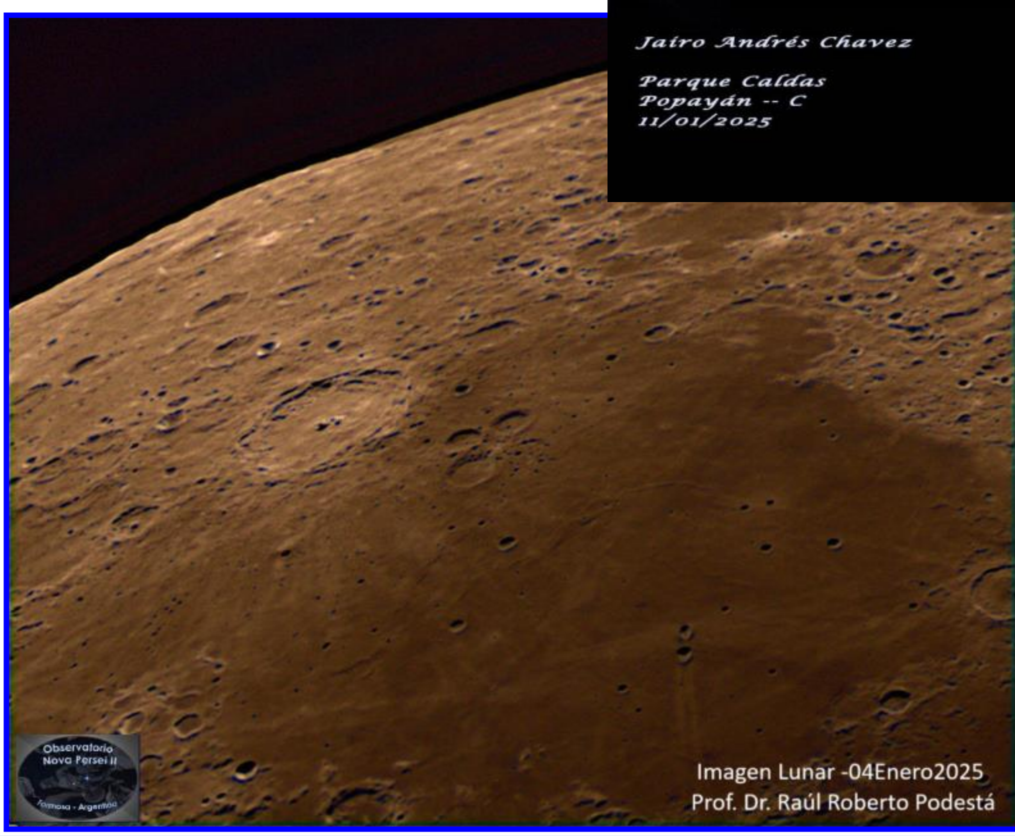
Recent Topographic Studies



Theophilus, *Raúl Roberto Podestá, Formosa, Argentina. 2025 January 05 00:02 UT. 127 mm Maksutov-Cassegrain telescope, UV/IR UT. ZWO ASI178M camera. North is right, west is down.*

Recent Topographic Studies

Waxing Gibbous Moon, 95% illuminated, Jairo Chavez, Popayán, Colombia. 2025 January 12 00:18 UT. 311 mm truss tube Dobsonian reflector telescope, MOTO E5 PLAY camera. North is to the right, west is up.



Langrenus, *Raúl Roberto Podestá, Formosa, Argentina. 2025 January 05 00:04 UT. 127 mm Maksutov-Cassegrain telescope, UV/IR UT. ZWO ASI178M camera. North is right, west is down.*

Recent Topographic Studies

Lunar Geologic Change Detection Program

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

2025 February

News: As you can see from the observations received below, the weather in December has been very unkind to us, and from what I remember was mostly cloudy, gales, wind, rain, snow etc, at least from where I live in Mid Wales, UK.

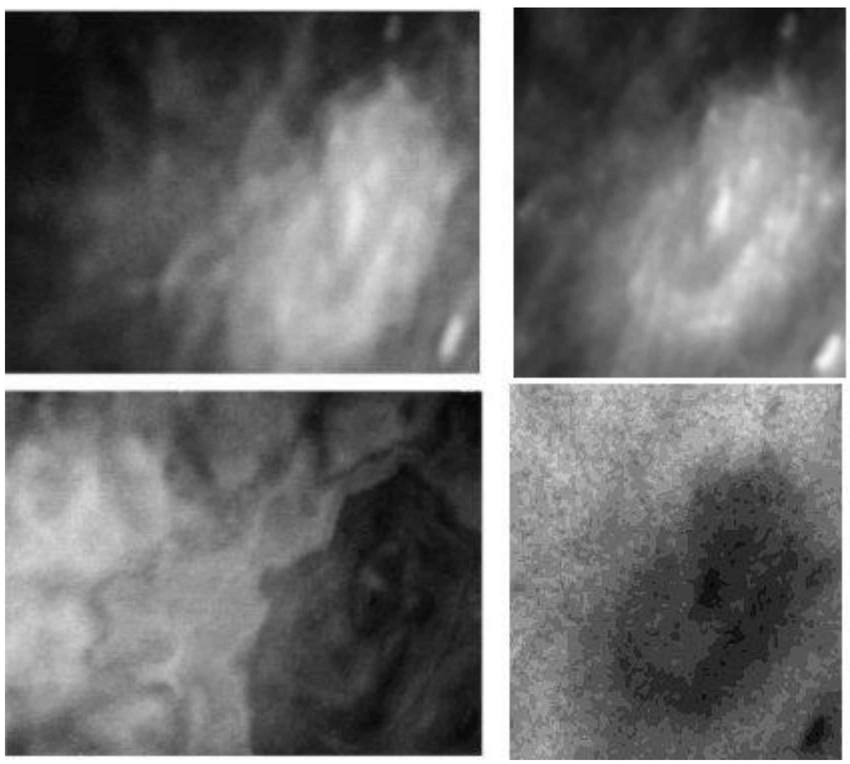


Figure 1. *Langrenus crater with north towards the top.* ***(Top Left)*** *Fig 5 A white light image from Audouin Dollfus' paper: Lunar Surface Imaging Polarimetry. III. Langrenus, Icarus 146, p 420-429, (2005).* ***(Top Right)*** *A white light image taken by Tony Cook on 2024 Jan 10 UT 19:25 from a single image frame, with no image stacking, no flat fielding, or dark current removal either.* ***(Bottom Left)*** *A degree of polarization image corresponding to the white light image immediately above – the lighter the shade the stronger the polarization.* ***(Bottom Right)*** *A degree of polarization image corresponding to the white light image immediately above.*

I attempted some more imaging of the Moon in polarized light on 2025 Dec 17th, this time at a higher resolution. I aimed at several features but wanted to show my preliminary results for the degree of polarization image for Langrenus crater (See Fig 1 – Bottom Right). I picked this crater as French astronomer Audouin Dollfus did some pioneering polarimetric imaging work in the early 1990's, and was curious to see if I could in someway replicate his results. 2024 Dec 17 was closest to the 1993 Jan 02 UT 17:41 image by Dollfus, then the others he took in Dec 1992, in terms of selenographic colongitude, but was still off by several degrees, and likewise in phase. Nevertheless, the white light images do look similar. In terms of the degree of polarization views, my image is noisier as it has not been stacked, but at least you can see that the floor of Langrenus has a lower degree of polarization compared to the highlands as it is darker. In general, agreeing with Fig 1 (Bottom Left). Clearly a lot more work needs to be done though on the calibration and processing stages and I must really utilize image stacking to reduce the noise and increase radiometric resolution. So please regard this as a cheap quick look effort. Wayne Bailly (ALPO) is also doing some work in this area and has made greater efforts and achieved more than I have managed to do so far. It seems that polarimetry may be a new imaging technique that amateurs can take up, though the processing needs to be refined and streamlined more.

LTP Reports: No further LTP reports nor lunar impact flashes have been reported.

Routine reports received for December included: Alberto Anunziato (Argentina – SLA) observed: Censorinus, Gassendi, Halley, Hyginus N, Plato, Stevinus and Torricelli B. Tony Cook (Newtown, Wales – BAA): videoed the Moon in polarized light. Rik Hill (ALPO/BAA) imaged: Endymion.

Analysis of Reports Received (December):

Torricelli B: On 2024 Dec 07 UT 23:25-23:35 Alberto Anunziato (SLA/ALPO) observed this crater under similar illumination to the following report:

On 1983 Feb 19 at 20:00UT P.W. Foley (Maidstone, Kent, UK, 12" reflector) noticed a deep steel blue color inside Torricelli B with a lighter color about 10-15 miles outside. Foley came to the conclusion that this was too visible for its size. Cameron 2006 Catalog extension ID=206 and weight=3. ALPO/BAA weight=2.

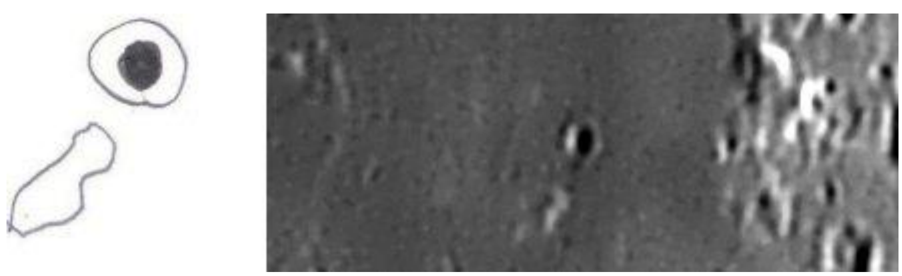


Figure 2. *Torricelli B with north towards the top.* ***(Left)*** *as sketched by Alberton Anunziato (SLA), using a Meade EX 105, on 2024 Dec 07 UT 23:25-23:35.* ***(Right)*** *A sub-section from a larger image taken by Walter Elias (AEA) on 2019 Apr 12 UT 00:20.*

Alberto commented that he could not see any color inside, nor the lighter color outside, only a small elevation SW of the crater, with normal brightness of elevated terrain (See Fig 2 – Left). Just out of curiosity, I searched the archives, for other observations made under similar illumination. Firstly, I came across an image by Walter Elias, a subsection of which is shown in Fig 2 (Right) – this is in general agreement with Alberto's visual observation. I also found a written visual description report by Trevor Smith, from 2020 Mar 01 UT 20:04-20:10UT. Here, Trevor comments that no color was seen inside the crater or just outside. Everything was normal. Checking all observations made at the time of the LTP I came across a report by Mark Sykes, made from Oxford from 20:00-22:00UT which involved examining several features, including Torricelli B – however he reported nothing unusual, despite overlapping with Peter Foley's LTP in terms of UT. In view of these modern observations that don't report color, I would consider leaving the ALPO/BAA weight at 2, however the probably simultaneous observation by Sykes in which he does simply does not comment about any color in Torricelli B or other craters he is observing that night, suggests that we should lower the weight to 1. I am not prepared to lower it to 0 though as we do not know what size instrument Sykes was using, and he does not tell us about his observing conditions.

Aristarchus: On 2024 Dec 17 UT 00:17 Tony Cook (ALPO/BAA) imaged this this region of the Moon as part of a much wider image from a polarizing camera under similar illumination to the following report:

On 1984 Feb 18 at 05:35UT Moseley (Coventry, UK, 6" reflector, x120, seeing II-III, transparency very poor to good, found that the crater was difficult to define. However, observing conditions variable. P. Moore observed that the crater was normal at 04:00UT. Moseley found the crater well defined later. Cameron 2006 catalog extension ID=242 and weight=3. ALPO/BAA weight=1.

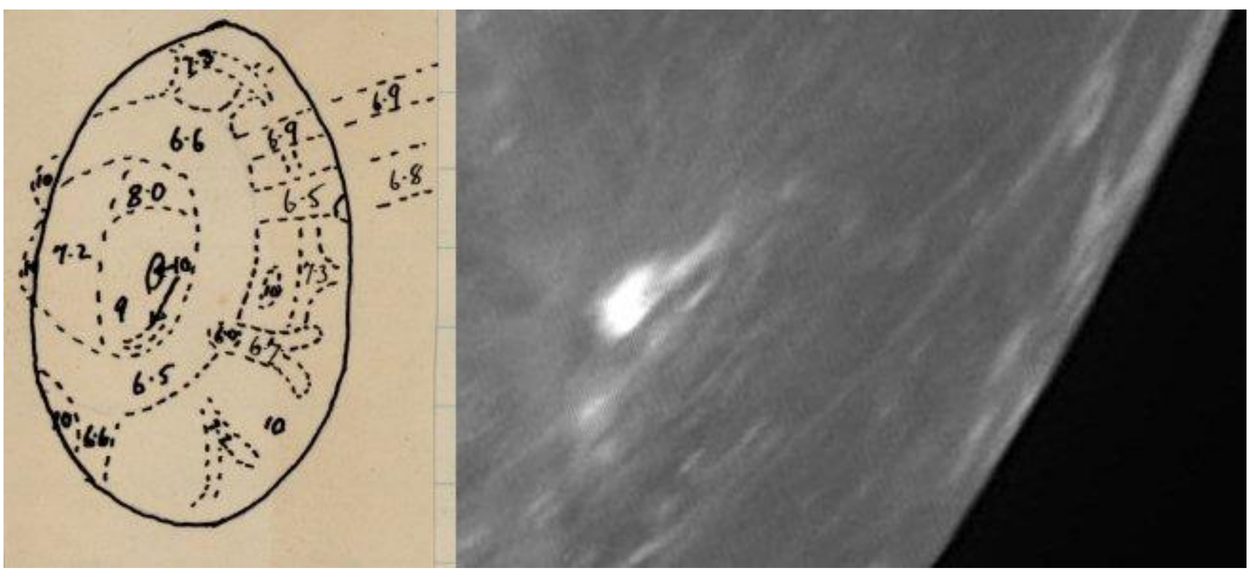


***Figure 3.** Aristarchus with north towards the bottom. **(Left)** A sketch from A.P. Lenham's observational notebook, held in the BAA archives, from 1953 Oct 23 UT 23:15-23:30. **(Right)** An image captured on 2024 Dec 17 UT 00:17 by Tony Cook (ALPO/BAA).*

Alas Fig 3 (Right) is the only view we have of Aristarchus at this repeat illumination observing window. The resolution is insufficient and the saturation hinders the revealing of the interior of the crater. So, we cannot say whether the interior is difficult to define as Moseley reported back in 1984, according to the Cameron catalog's description. However, I did a search through the BAA's archives and found a nice sketch by A.P. Lenham, that matches similar illumination. Here you can see a wealth of detail inside the crater, unlike what Cameron says that Mosely could not see. Just to be on the safe side I decided to look up Rob Moseley's original report and here is what I found for the night of 1984 Feb 18:

UT 05.05 Light cloud from S.W.

05.15 Some clearer areas developing, but transparency too poor for observation.

05.35 Transparency fair for brief moments. aristarchus bright, difficult to define, no bands visible.

impossible to comment on colour.

05.40 Cloud thickening

05:45 Sudden dramatic improvement. Whole sky clear. Trans – Fair/Good. Seeing II/III a more normal
aspect than last night. Central area bright (9) – not extending onto E. rim. N and W walls (8) with
rim at 5 to 6 o/c. (9). 4 bands seen – one at 2 o/c very dark (3/4) S wall comparatively very dull.
No colour seen, except spurious red - mainly to SE.

So, there are some similarities and some small differences between Moseley's and Lenham's descriptions, but nothing that could not be explained by libration viewing angle effects. What really stands out about Rob Moseley's comments at 05:35UT, and what has ended up in the Cameron catalog, is that Rob is clearly describing loss of detail due to poor observing conditions, whereas Winnie Cameron regards this as a LTP. We shall lower the weight from 1 to 0 and remove it from the ALPO/BAA catalog.

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. 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 .

Dr Anthony Cook, Department of Physics, Aberystwyth University, Penglais, Aberystwyth, Ceredigion, SY23 3BZ, WALES, UNITED KINGDOM. Email: atc @ aber.ac.uk

Buried Basin and Crater Project

Coordinator Dr. Anthony Cook- atc@aber.ac.uk
Assistant Coordinator Skylar Rees

This month, we have two possible hidden basins to consider. Our first is a submission from Tien Ngo Tran in Vietnam, where they have observed a potential basin candidate measuring ~255km, located to the southwest of *Mare Humorum* and west of *Lacus Excellentiae*, at approximately LON = 304°E, LAT = 34°S on the Near-side. USGS Geologic Labels suggests Nectarian terrain and basin mantling units around later Imbrian plains. ***Fig.1:*** *(above) Submitted photography and suggested basin area. (below) Corresponding location as seen in QuickMap's Lunar Globe 3D projection, with the suggested centre marked in blue.*

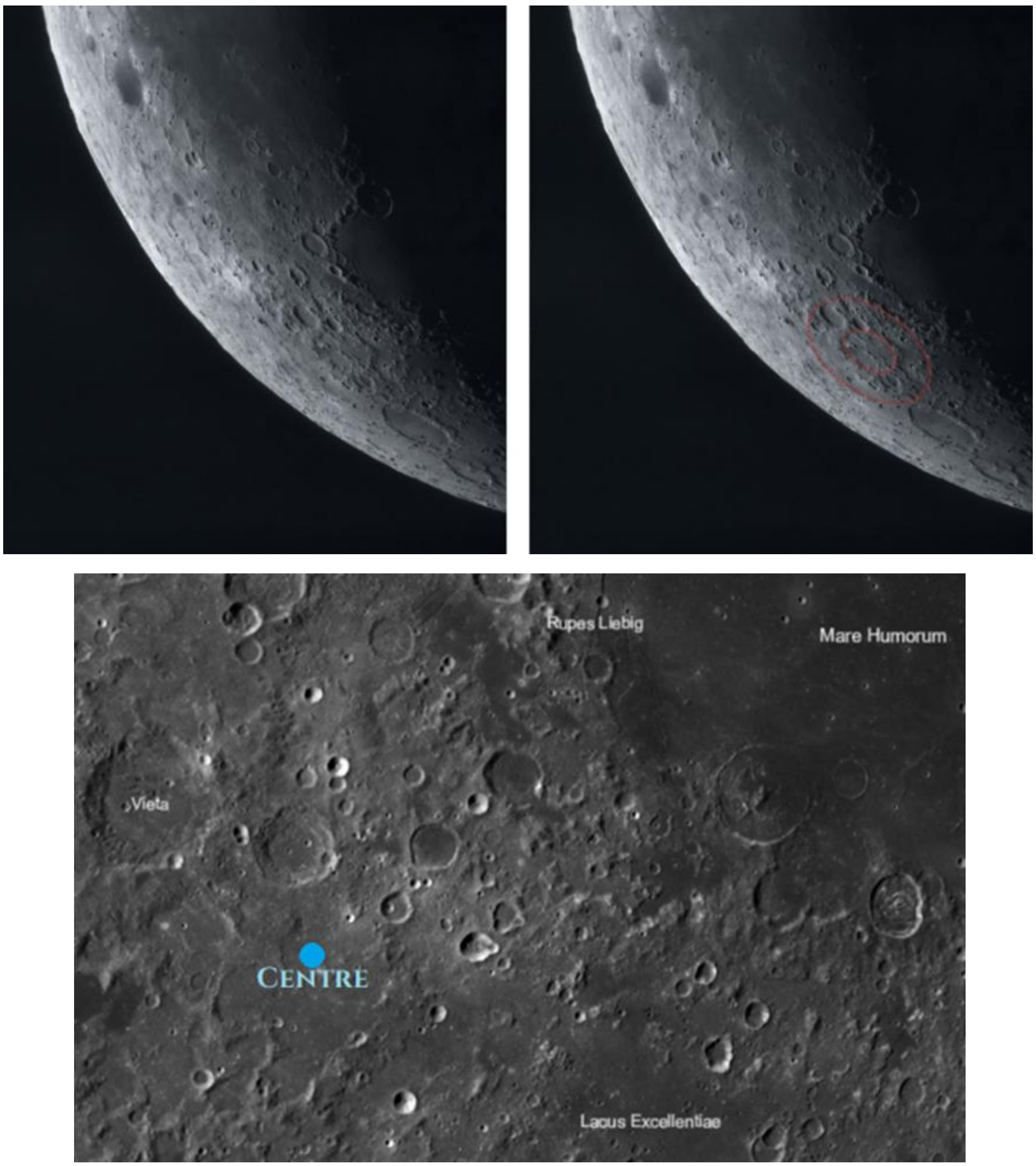


Fig.1: *(above) Submitted photography and suggested basin area. (below) Corresponding location as seen in QuickMap's Lunar Globe 3D projection, with the suggested centre marked in blue.*

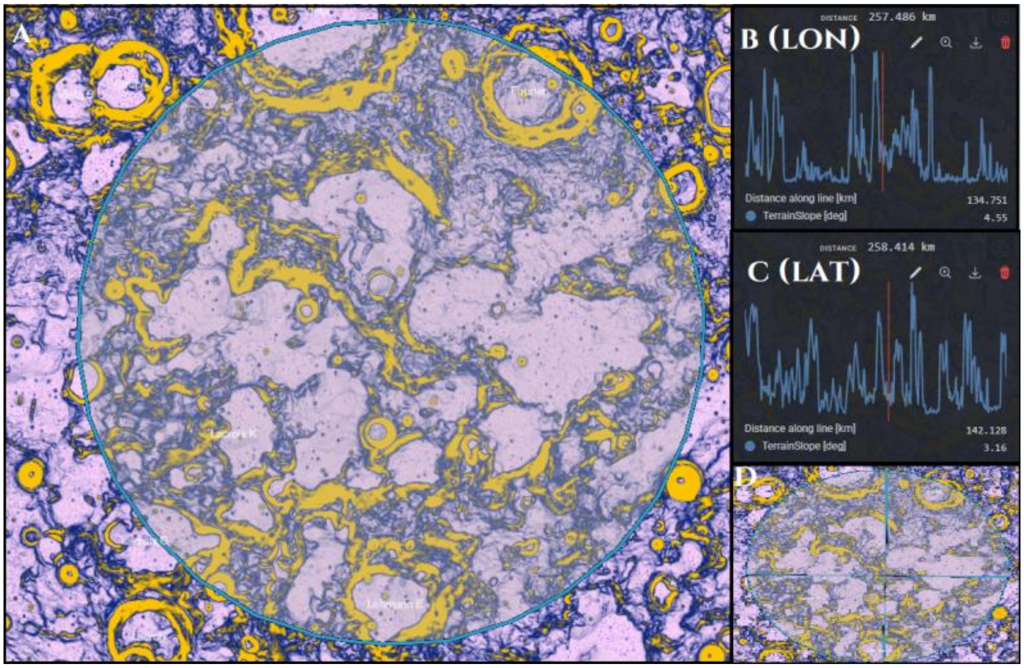


Fig.2: *TerrainHeight profile and altitude variation across the north-south and west-east plots.*

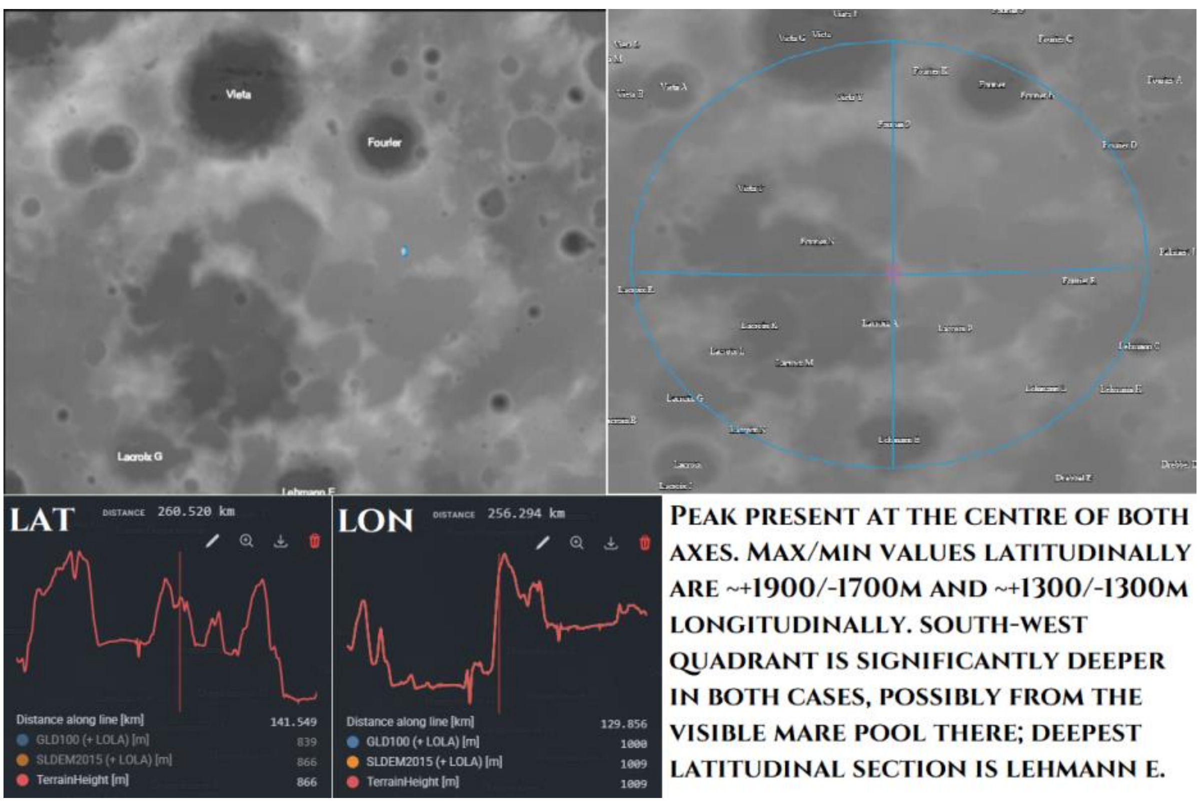


Fig.3: *(a) TerrainSlope profile. (b,c) Longitudinal and latitudinal plots. (d) Crosshair locations.*

If a basin is indeed present, it is strongly eroded – possibly by the saturation of craters nearby and magmatic influence from *Lacus Excellentiae* and *Humorum* in the Imbrian. We will assess the area with *QuickMap*'s remote sensing data as usual, primarily looking for remnants of possible arcs or a central structure to confirm.

Fig.2 above shows that this region is very slightly elliptical, with a somewhat slanted distribution between the deeper (darker) western half and lighter eastern half. This is likely, though not certainly, due to the pool of mare visible west of the blue dot in Fig.1. This lopsided height distribution is clear from the longitudinal graph, with an average relative depth of around 1km west of the central spike – present also at the latitudinal graph, which suggests some kind of central fixture – and a plateau of around 1km altitude east of it. Attributing the peaks to rings is somewhat complicated here due to the number of secondary crater rims intersecting, though the easternmost peak on the latitudinal graph does not appear to correlate with any rim and may be the outer ring of a large impact structure. The outline of an ovoid enclosure can also be faintly seen.

Fig.3 above also suggests a central aberration (possibly an impact spot) surrounded by otherwise flat segments of terrain. On the longitudinal profile, this central spot is the highest variation in slope (around 20°), which implies that some feature is present – either a strong depression or uplift. The central spike in Fig.2 implies an uplift is more likely, though not physically obvious. Fig.3(b)'s pattern on the whole suggests at least a ring to the west and a potentially reduced ring to the east, given the interstices are comparatively flat. The latitudinal profile is much more mixed and harder to infer from, though the western side of the graph (i.e. north) also shows an enclosing ~20° spike with a weaker (~15°) spike to the eastern side (i.e. south). Overall, it is still ambiguous how to interpret these spikes, though a central fixture is supported further.

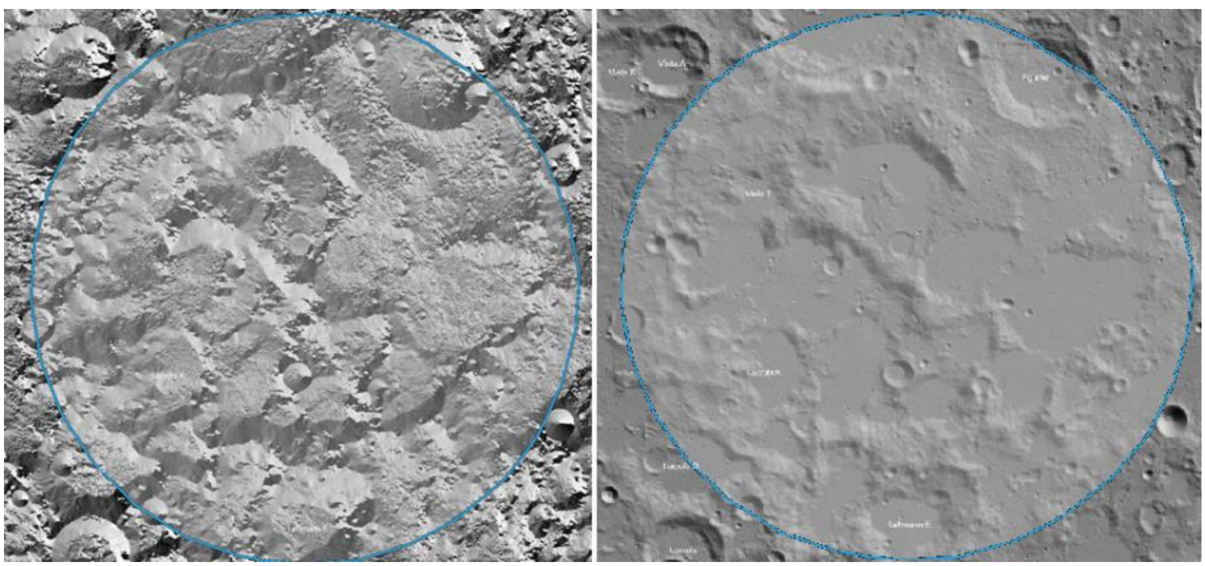


Fig.4: *(a) TerrainAzimuth filter view. (b) TerrainHillshade filter view.*

TerrainAzimuth (Fig.4a) highlights a visible semicircle of smoother and brighter material, evident if one traces immediately north of the centre and moves in an anticlockwise motion, like a crescent; this could imply the outline of a ring. The eastern half appears much coarser and eroded, which is supported by TerrainHillshade – as well as highlighting an interesting "bar" of connected terrain seemingly originating northwest of the centre. It is possible that the northern part of this "semicircle" is a secondary impact, though the trend anticlockwise from there does not appear to be. Beyond this point, evidence of another ring is not obvious. We may tentatively say that at ~250km, with only one ring and no obvious peak ring, this may be a protobasin.

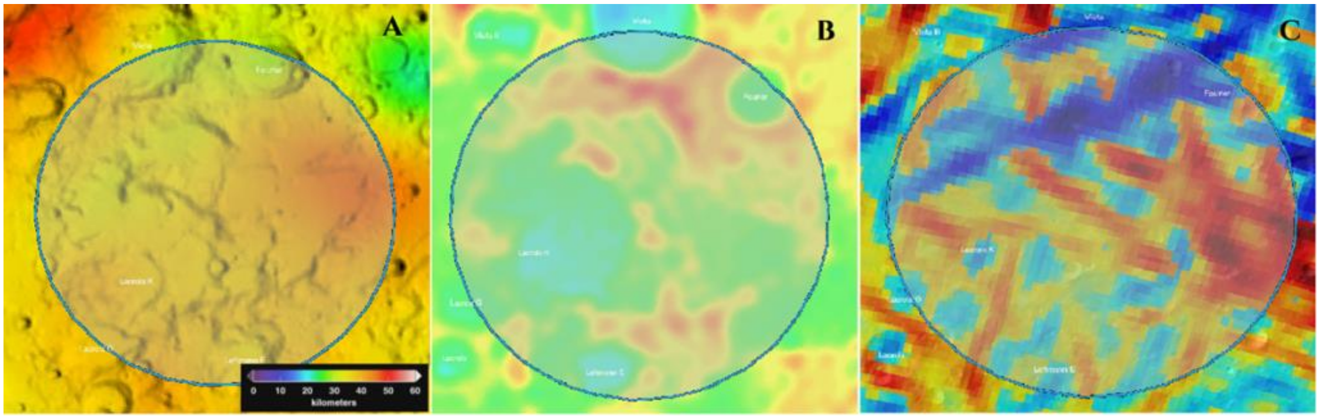


Fig.5: *(a) GRAIL Crustal Thickness. (b) Free Air Bouguer Anomaly. (c) Bouguer Gradient.*

Gravitationally, this picture is more mixed. Crustal Thickness (Fig.5a) is around 35-40km, which combined with the somewhat shallow excavation of only around 1km, is not typical for impact basins on the Nearside – especially in the presence of nearby mare from *Excellentiae, Humorum* and the patches near *Lacroix K* (west) and *Lehmann E* (south). There are some potential explanations for this. If the impact site was oblique – as it does appear this structure is not perfectly circular – a shallower impact site occurs due to a less direct transfer of energy between the impactor and the surface, which in turn means the crust will be thicker as less damage has been done. Another would be if dense geological products like basalt form in response to impact melting, perhaps encouraged by the proximity to lava flows from *Excellentiae* and *Humorum*; this would also explain the patches of isolated mare visible in blue at Fig.5b (Free Air Anomaly). It is simply unclear. Regardless, Free Air Gravity Anomaly does highlight positive anomalies to the north and south as arcing fragments; these could belong to the former rim, while Bouguer Gradient (5c) suggests a positive arc to the east – although there is a rather chaotic pattern in general, which could either suggest subsurface instability or simply no correlation in the area. Unfortunately, apart from the fragmented hints at a rim, there is no obvious gravitational evidence for a large-scale impact structure.

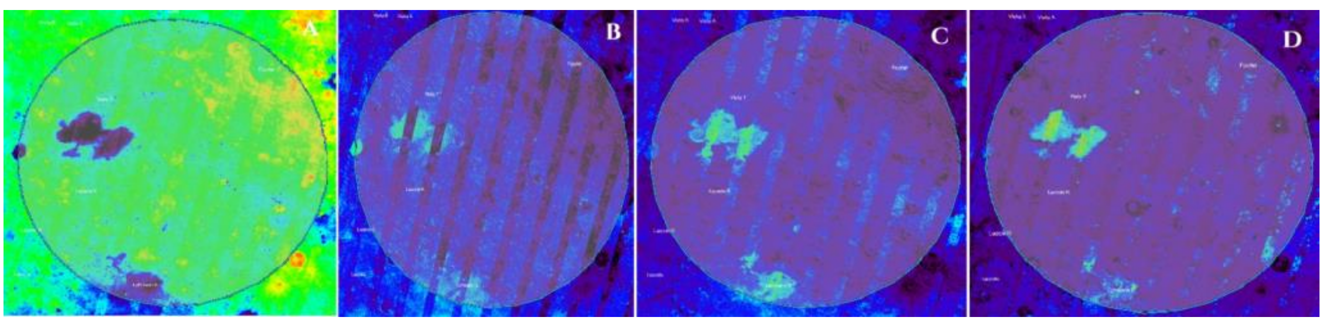


Fig.6: *Kaguya mineralogy. (a) Plagioclase %. (b) Orthopyroxene %. (c) Clinopyroxene %. (d) Olivine %.*

Geological data (Fig.6) does not suggest that either plagioclase depletion (~80%) or orthopyroxene, clinopyroxene and olivine formation play a major role in this area beyond the isolated pools of mare; from this it seems more likely that this impactor was either oblique, and/or particularly unenergetic so to cause only minimal disruption.

The results are ambiguous overall. This impact structure does appear to be oblique, or at minimum acircular, which may explain its relatively shallow excavation depth and less extensive damage to either the crustal thickness or original highland plagioclase. If it is from an oblique impact, it is less likely – though not impossible – to have imparted enough energy to the surface to form multiple rings through extensive propagation. Many sources of evidence suggest fragments of at least one ring and the initial rim, such as the spikes in TerrainSlope, the semicircular "smooth" band in TerrainAzimuth and the positive anomalies in Free Air Gravity and Bouguer Gradient to the north and east. Nevertheless, these arcs remain difficult to observe and do not show up as concentrations of Plagioclase % as would be expected if rings formed from the upwell and seismic propagation of an impact. It also likely that a raised central feature is present, based on elevated altitude and slope there; it is not obvious if this is a peak ring, central peak, or both (protobasin), but it is unlikely to be a multiring basin while a centrally raised feature remains. The presence of Nectarian terrain and basin mantling units by the USGS Geologic Map in the region is further support, although the Imbrian light plains (thought to be ejecta from large impacts like *Imbrium* and *Orientale*) have obscured much of the visible signs.

Prandtl-Schrödinger: A possible hidden protobasin?

We also report a possible hidden protobasin between *Prandtl* and *Schrödinger*, located southeast of *Planck* on the Farside at approximately LON = 147.5° E, LAT = 67° S (Fig.7a). These structures appears to be separated from *Planck*'s outer ring by a sandbar-like division of high-albedo material (Fig.7c), which *QuickMap* confirms is not a lobate scarp despite visual similarity. In Fig.7b, we switch to *QuickMap*'s First Person View mode to reveal a fairly diffuse and uniform terrain, with a very slight topographic depression. *Planck L* and *Planck K* to the southwest and east respectively here serve as a good juxtaposing comparison to the likely-eroded walls of this structure. In light of this possible erosion, in Fig.1e an attempt is made to identify the rings and overall extent of the structure from any radial fragments not evidently part of another crater. It must be stressed that not all blue rings here are believed to be legitimate – but rather where some arc fragments suggest some annular structure (in red). Equidistant Cylindrical projection was necessary in this diagram due to *QuickMap* producing an obscuring translucent layer over the plotted rings on the Lunar Globe projection. A possible transient crater or perhaps a secondary crater coincident with the centre (as shown in Fig.7d, spanning ~17km across) and up to the third blue ring can be asserted for a diameter of ~145km. Nevertheless, ambiguous arc remnants beyond ~145km prompt further investigation with the *QuickMap* filters.

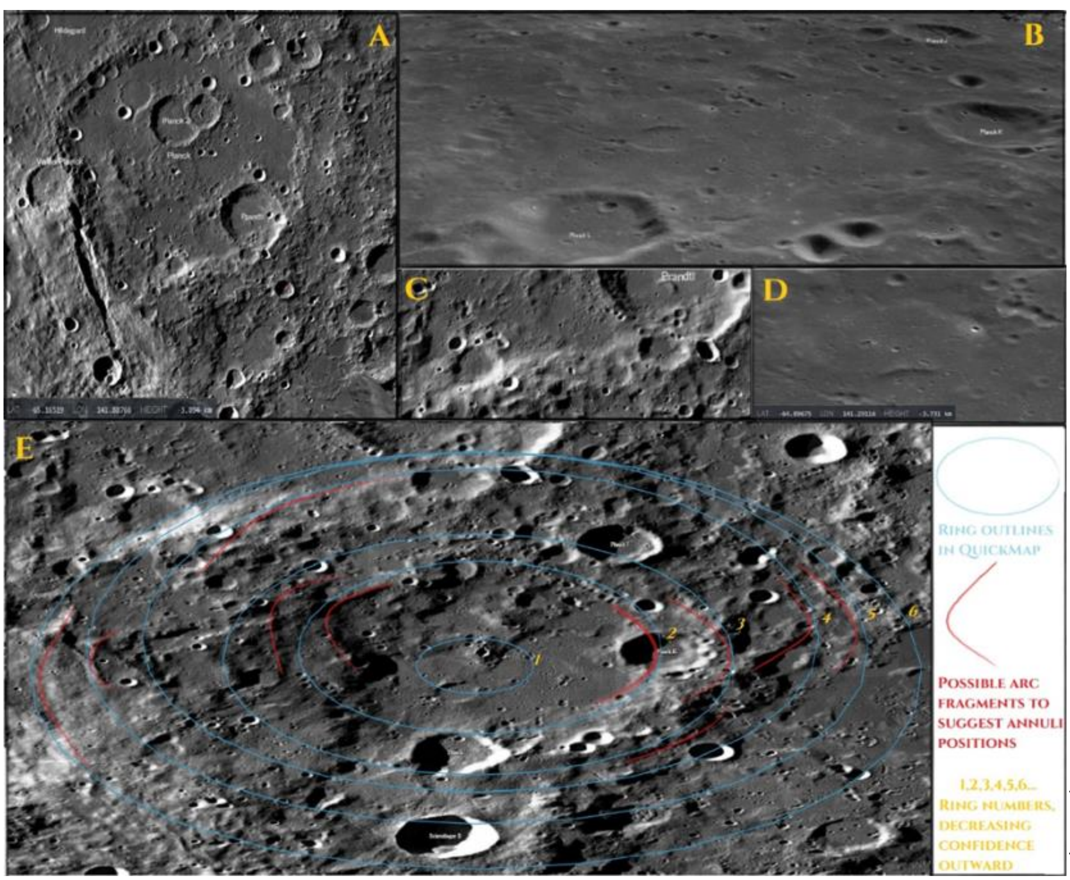


Fig.7: *QuickMap Lunar 3D Globe mosaic views. (a) The potential protobasin's position relative to Planck, to the southeast. (b) First Person View: angular view of locally depressed terrain in the inner ring. (c) The "sandbar" division between Planck/Prandtl and the new terrain. (d) Possible transient crater (50m diameter scale).(e) Equidistant Cylindrical projection, attempting to reconstruct rings from arc fragments.*

The TerrainHeight filter, as plotted in Fig.8 below, supports an impact interpretation through both axes demonstrating a "peaks and central trough" distribution. While both latitudinal and longitudinal profiles align initially, the longitudinal graph appears to be "cut short" around 175km eastward; it is possible that another impact could have broken away this side of the structure. Regardless, four of the five points align in both directions and is visibly supported the darker (greater depth) gradient to the east; a similar dark patch similarly reaffirms the area of confidence posited in Fig.1e. This structure reaches a central depth of 3900m in absolute height, which adjusted for the lunar datum radius of 1737.4km, gives a depth of 2162.6m. To quantify this, the known *Apollo* basin is around -3700m in relative height; the known proto-basin *Antoniadi* is closer to 2250m in depth. On that basis, this structure certainly resembles a protobasin closer. Based on the (intact) latitudinal profile and taking the difference between points 1 and 5 – interpreted as the rim edges – this structure is estimated as ~180km in rim-to-rim diameter, which is comparable to values assigned to other protobasins by Liu *et al* (2022) [1] like *Antoniadi* (~140km) or *Compton* (~175km). However, this cannot be confidently classified as it lacks a central peak, a peak ring or protobasin-like mix,confidently classified as it lacks a central peak, peak ring or protobasin-like mix.

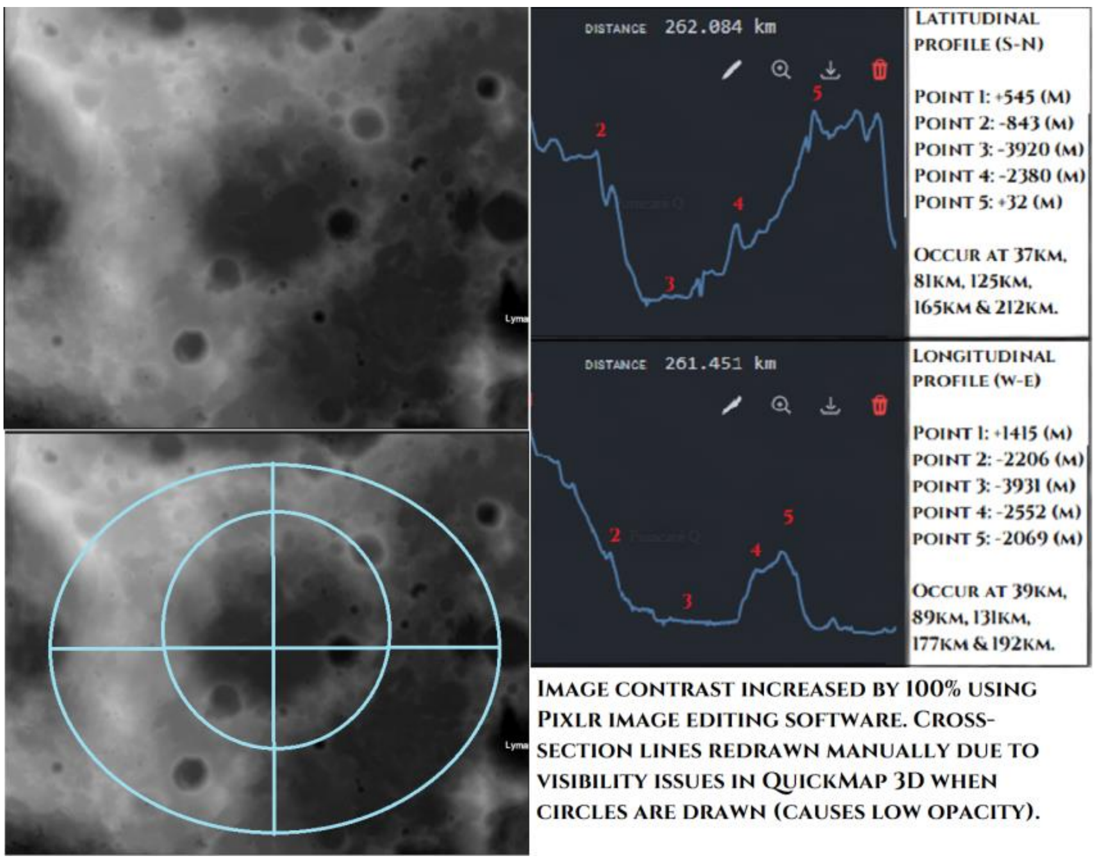


Fig. 8: *TerrainHeight filter visualisation of height/depth variation. All units are in Absolute Height by default.*

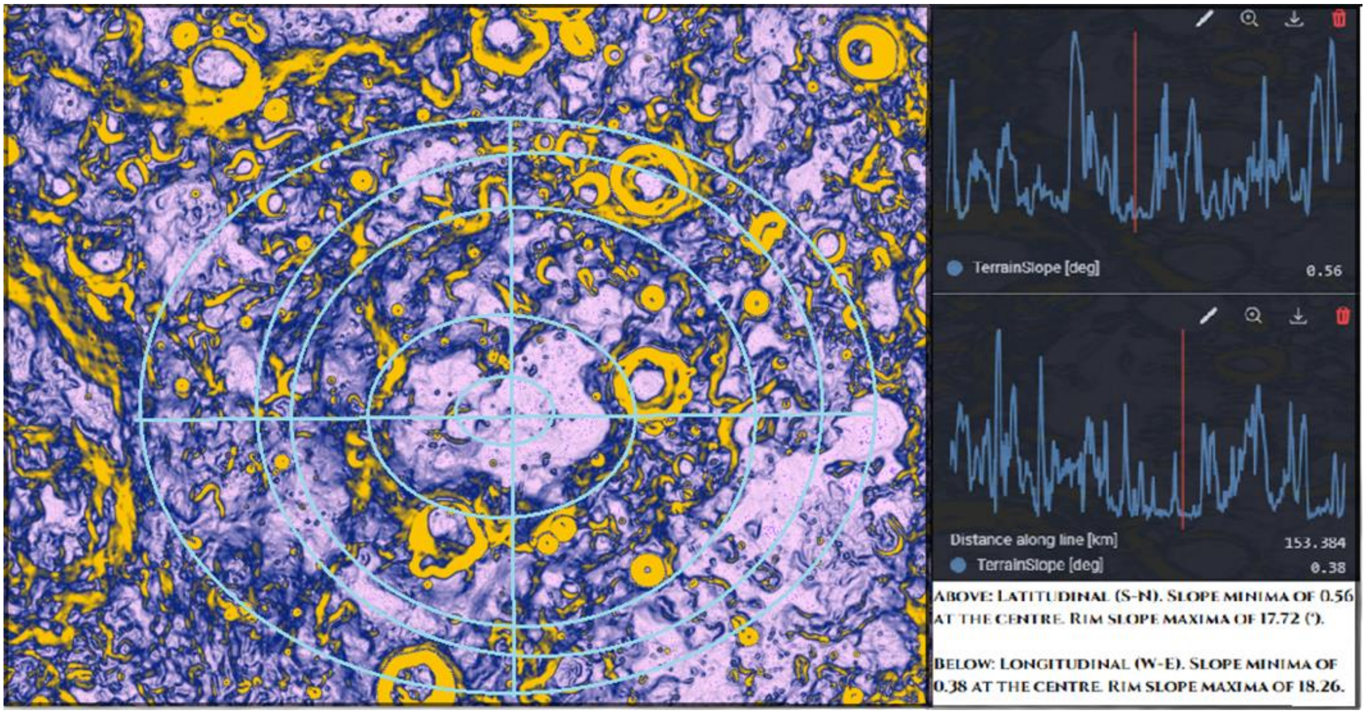


Fig.9: *TerrainSlope filter visualisation of depth variation in terms of angular change.*

TerrainSlope (Fig.9) also supports the peaks and troughs designated in Fig.8; there is virtually no change at the centre, while at least two further peaks either side are observed that can be tentatively interpreted as at least one ring and outer rim.

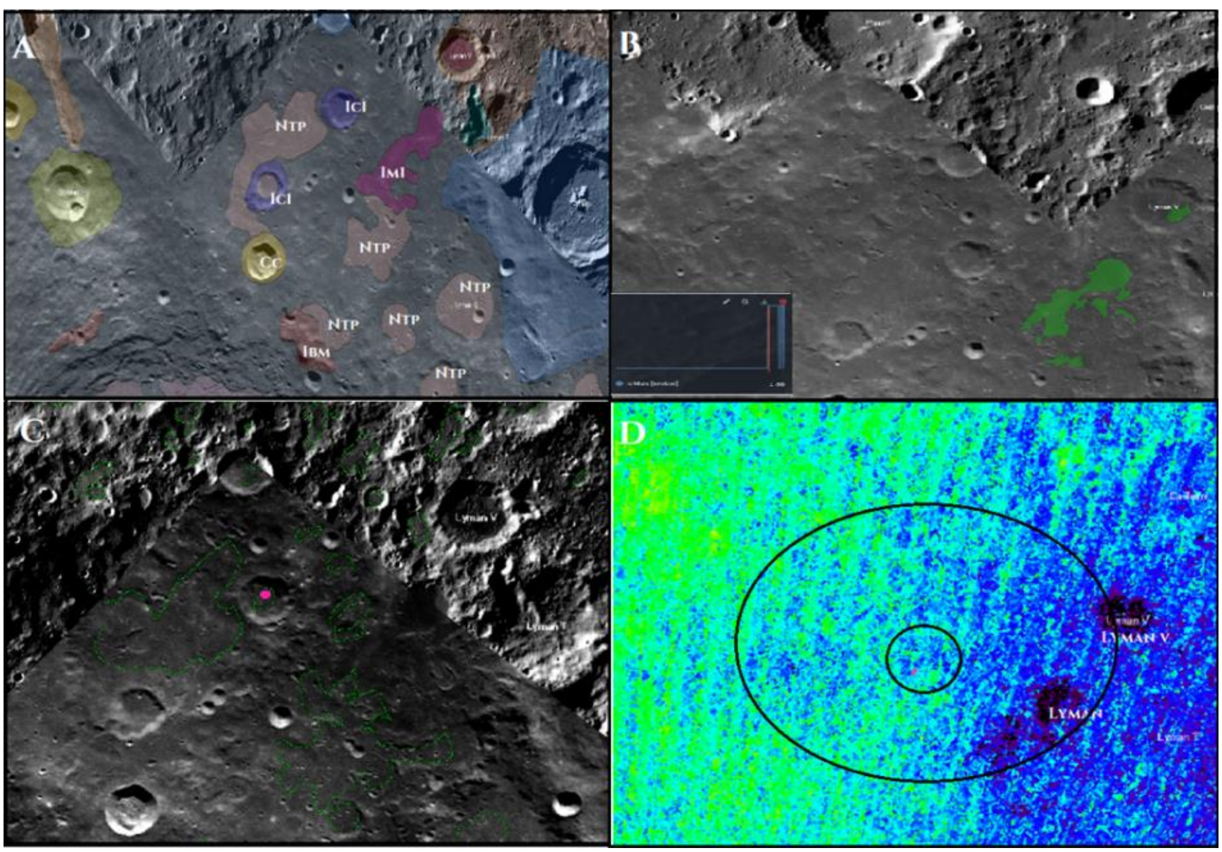


Fig.10: *Geological information. (a) USGS Geologic Map. (b) Mare patches on the east side; "is Mare" Boolean confirms onset. (c) Global Light Plains map. (d) Plagioclase %.*

Moving to the geological interpretation of this zone, the USGS Geologic Map (Fig.10a) designates the central area as being of Nectarian origin (Ntp), alongside a southeastern patch. Notably, there is an Imbrian mantling deposit to the east which appears to be a small patch of mare (Fig.10b). As mare does not appear elsewhere (as confirmed by the "is Mare" yes = 1, no = 0 graph), it is possible that the longitudinal erosion witnessed in Fig.2 is a result of this mare degrading the eastern side of the structure. This is partly supported by the presence of light plains (Fig.10c) – these represent fine-grained, higher-albedo terrain though to be related to the ejecta of massive basin-forming impacts like *Orientale*, *Imbrium*, or most likely in this case of the *South Pole Aitken* it lies within [2]. Light Plains in this definition are not native to the basin, but would have contributed to obscuring and infilling. Plagioclase distributions (Fig.4d) are more mixed; the western flank appears to have retained more plagioclase than to the east, in the direction of the light plains and isolated pools of mare near *Lyman* and *Lyman V*. It is admittedly unclear from this if the eastern half of this area is more eroded, although the corresponding area in TerrainHeight (Fig.8) does suggest greater depth here.

Lastly, we consider if gravity data from GRAIL supports this as a large-scale impact structure. The crustal thickness (Fig.11a-c) is around 30km at the centre; this is a fairly common value for Farside impacts, though the settling of light plains may have slightly contributed. Thickness dramatically lowers to around 10km on the east more than is explicable by the small mare patch alone, although this could have contributed to erosion of eastern structures (e.g. rings); being within the South Pole Aitken may also be a contributing factor. Nevertheless, the Bouguer Free Air Gravity – a marker of how much mass is absent or additional relative to surface expectation – demonstrates that the centre is depleted by around -240mGal, surrounded by a green ring of slightly higher anomaly (-80mGal) and a bull's-eye effect of positive anomaly (+40mGal). From there, the western hemisphere is significantly enhanced (~+240mGal) while the eastern edge remains slightly deficient (-80mGal). This is reflected in the Bouguer Anomaly Gradient (Fig.11f), which also highlights the western outer rim. The cause of this hemispheric difference is unclear – possibly mare from the east and ejecta to the west – but the structural configuration of this area is at least supported by distinct rings.

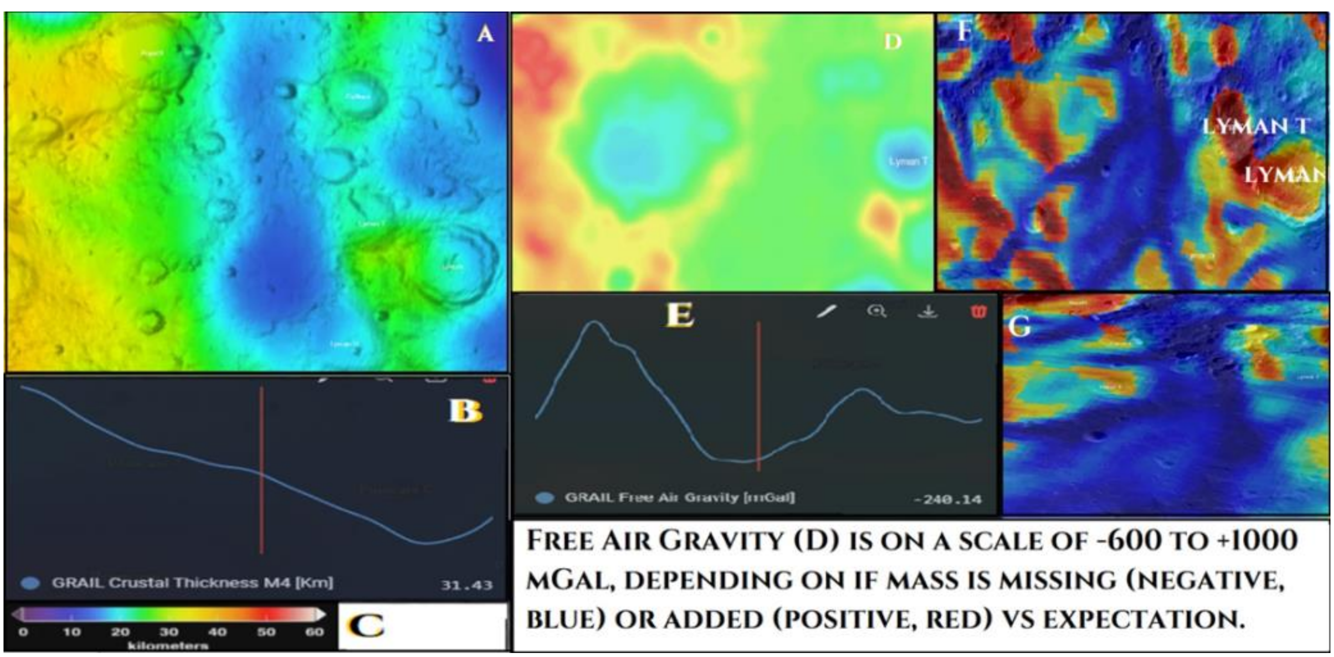


Fig 11: *Gravity (GRAIL) data. (a-c) Colour map, central value and scale bar for Crustal Thickness. (d-e) Colour map and central value for Bouguer Free Air Gravity. (f) Gradient for Bouguer Gravity. (g) First Person View at a different angle for Gradient, highlighting the unmarked, flat, circular region at 5a and 5f.*

The evidence presented does suggest a previously overlooked impact that just narrowly missed the southeastern edge of the *Planck* basin, most likely sometime in the Nectarian based on USGS mapping. Its relative depth and diameter are a close fit to other known protobasins, and the presence of at least one ring is supported. The eroded eastern side means the less ambiguous evidence only comes from the better-preserved western side and latitudinal profile. Even with annular remnants and central concentrations present in topographic and gravitational data, there is no immediately obvious central feature like a peak ring or central peak that would definitively show its morphological class; likewise, it is much larger than expected for a crater and somewhat small for a multiring basin, making a protobasin with a collapsed central feature most likely. Please send in any additional observations from *QuickMap* (as this is on the Farside), and we will append *Prandtl-Schrödinger* to the current basin list.

[1] Liu, J. et al. (2022). "Characterization and interpretation of the global lunar impact basins based on remote sensing". *Icarus*, 358(114952). DOI: https://doi.org/10.1016/j.icarus.2022.114952.

[2] Meyer, H. et al. (2019). "The Global Distribution of Lunar Light Plains From the Lunar Reconnaissance Orbiter Camera". *JGR Planets,* 125(1). DOI: https://doi.org/10.1029/2019JE006073.

Lunar Calendar February 2025

Date	Time	Event
1	0500	Saturn 1.1˚ south of Moon, occultation Asia
1	2000	Venus 2˚ north of Moon
1	2206	Moon at ascending node
1	2300	Neptune 1.4˚ south of Moon, occultation Alaska., Russia
2	0300	Moon at perigee 367457 km
5	0802	First Quarter Moon
6	0700	Moon 0.5˚ north of Pleiades
7	0400	Jupiter 5˚south of Moon
8		South limb most
8		Greatest northern declination +28.4˚
9	2000	Mars 0.8˚ south of Moon, occultation NE USA to China
10		East limb most exposed +5.1˚
12	1353	Full Moon
15	0653	Moon at descending node
17	1300	Spica 0.3˚ north of Moon, occultation Pacific Ocean
18	0100	Moon at apogee 404882 km
20	1732	Last Quarter Moon
21	0900	Antares 0.4˚ north of Moon, occultation Easter Island to South
23		North limb most exposed +6.8˚
23		Greatest southern declination -28.7˚
24		West limb most exposed +6.8˚
25	1000	Pluto 1.0˚ north of Moon, occultation Antarctica
28	0045	New Moon lunation 1264

AN INVITATION TO JOIN THE A.L.P.O.

The Lunar Observer is a publication of the Association of Lunar and Planetary Observers that is available for access and participation by non- members free of charge, but there is more to the A.L.P.O. than a monthly lunar newsletter. If you are a non-member you are invited to join our organization for its many other advantages.

We have sections devoted to the observation of all types of bodies found in our solar system. Section coordinators collect and study members' observations, correspond with observers, encourage beginners, and contribute reports to our Journal at appropriate intervals.

Our quarterly journal, *The Journal of the Association of Lunar and Planetary Observers-The Strolling Astronomer*, contains the results of the many observing programs which we sponsor including the drawings and images produced by individual amateurs. Additional information about the A.L.P.O. and its Journal is on-line at: **http://www.alpo-astronomy.org.** I invite you to spend a few minutes browsing the Section Pages to learn more about the fine work being done by your fellow amateur astronomers.
To learn more about membership in the A.L.P.O. go to: **http://www.alpo- astronomy.org/main/member.html** which now also provides links so that you can enroll and pay your membership dues online.

CONTRIBUTION GUIDELINES

While it is a great honor to put together The Lunar Observer, we are now overwhelmed by our success with some issues in excess of 200 pages.

The increased time it requires for me to perform this job (as a volunteer) pulls me away from my own family and other obligations. Thus, the following rules are being implemented to improve content flow on my end and provide you with the criteria needed to make the "TLO" even more professional in appearance and subject matter.

1. **Review your image(s) at your location before submitting it/them, then brighten or darken it/them as needed and if required, using whatever tools you have at hand. Images deemed unsuitable (including blurry, out-of-focus or "clouded-out" images) will either be returned for your attention or simply not used.**
2. **Images in jpeg format are preferred but others are also acceptable.**
3. **Crop your images to avoid jagged edges.**
4. **Orient the image so it makes the most sense. North at the top (with Mare Crisium at the upper right) is preferred but not required. To our many wonderful southern hemisphere contributors, please orient as you wish (probably south at top).**
5. **Be very limited on end-of-the-month submissions.**
6. **CHOOSE ONLY YOUR BEST IMAGES and limit the number to no more than eight (8) per each issue of the TLO. (obviously, if there is an article you are writing or contributing to this does not apply).**
7. **The image filename should be submitted with the object name spelled correctly, then the year-month-day-hour-minutes-Your Name or initials So, my image of Copernicus should have a file name of:**

Copernicus_2023-08-31-2134-DTe
means
Copernicus, 2023 August 31, 21:34 UT by David Teske

If we all do this going forward, it should make putting this all together faster and easier. Many of you already do this. Thank you for your contributions and your help. We have a premier lunar resource for the planet.

Please send images/drawings/text to drteske@yahoo.com or lunar@alpo-astronomy.org

Below are two sample captions. Both at least attempt to follow the above-stated guidelines

Meton Region as imaged by Massimo Dionisi of Sassari, Italy (10°43'26" N, 8° 33'9" E), on 2024 January 30, at 00:03 UT. Equipment details: Sky Watcher 250 mm, f/4.8 reflector telescope, Tecnosky ADC, Celestron X-cel LX 3x Barlow lens, effective focal length = 4,750 mm, 685 nm IR pass filter, Neptune-M camera, Skywatcher EQ6-R Pro mount. Seeing conditions = III-to-IV (Antoniadi scale). Software details: SharpCap 4.0 acquisition (mono), AutoStakkert! 3.1.4 ELAB, Registax Wavelets.

Lunar craters Hausen and Bailly D as imaged by István Zoltán Földvári of Budapest, Hungary on 2020 April 07, at 21:03-21:17 UT. Colongitude 86.5°. Equipment details: 70 mm refractor telescope, f/l = 500 mm, Vixen Lanthanum LV 4mm eyepiece, 125x, Baader Contrast Booster Filter. Sky seeing = 7 out of 10, sky transparency = 6 out of 6.

drteske@yahoo.com

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: Clavius

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 2025, will be Clavius. 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 Clavius Focus-On article is February 20, 2025

FUTURE FOCUS ON ARTICLES:

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

Subject	TLO Issue	Deadline
Clavius	**March 2025**	**February 2025**
Volcanic Features	**May 2025**	**April 20, 2025**
Rupes Recta	**July 2025**	**June 20, 2025**
Mare Humorum	**September 2025**	**August 20, 2025**

Focus On Announcement:
Lunar Base Clavius

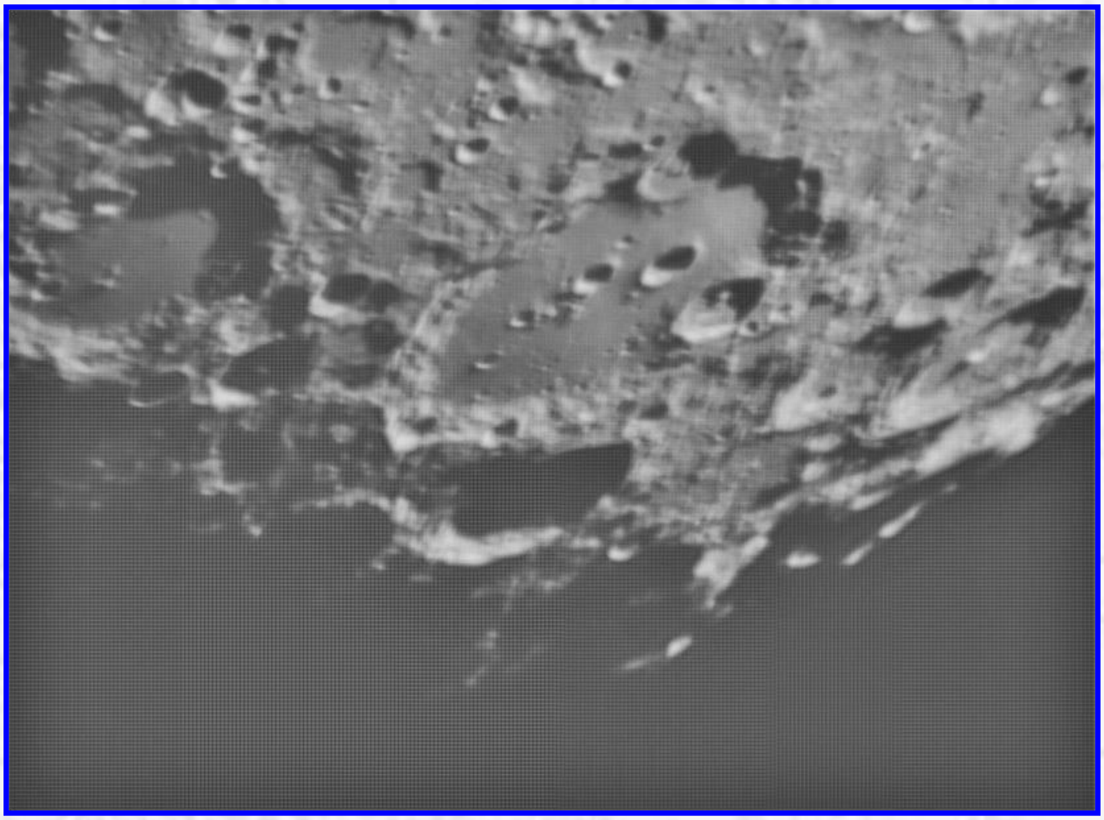
Clavius has literary and cinematic reminiscences, at least for those of us who dream of 2001: A Space Odyssey, in which a gigantic underground base was located in this crater. Due to its size and peculiar structure, it is a very recognizable place among the somewhat monotonous southern lands. In this Focus On we will have the opportunity to study a giant from the most remote times of the Moon, the Nectarian period. In addition, Clavius may be a place of importance in the future of lunar exploration, since in 2020 the presence of water (or rather the trace of hydrated minerals) was detected in this crater. Will the literary Clavius Base become a reality?

MARCH 2025 ISSUE-Due February 20 2025: CLAVIUS

MAY 2025 ISSUE-Due April 20 2025: VOLCANIC FEATURES

JULY 2025 ISSUE-Due June 20, 2025: RUPES RECTA

SEPTEMBER 2025 ISSUE-Due August 20, 2025: MARE HUMORUM



Fernando Sura

Focus On Announcement:
Volcanic Features: An Inventory of Past Chaos

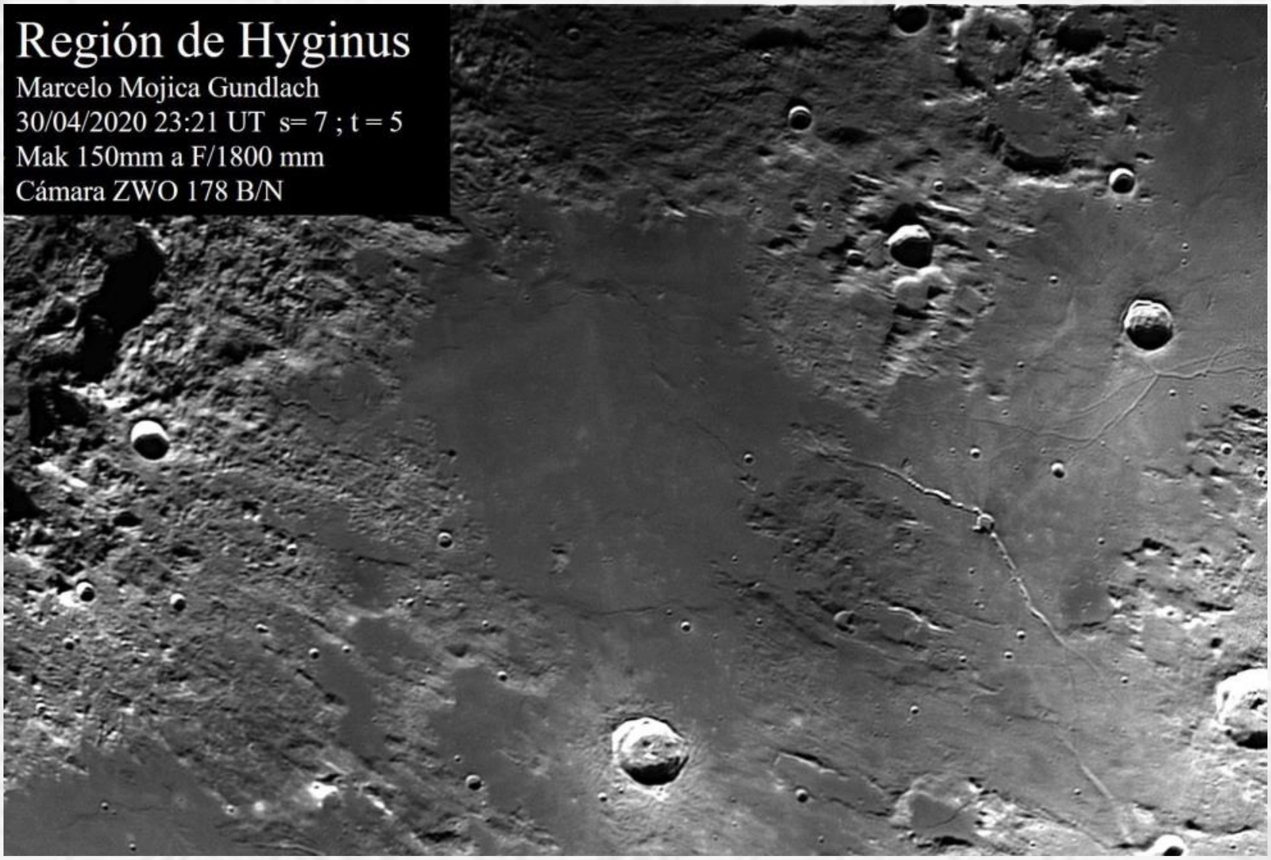
There was a (geological) time when the Moon was a real chaos, a new chaos, after the chaos of the great meteorite impacts that formed the basins. A volcanic chaos. We invite our observer friends to send their favorite images of the entire selenographic spectrum of volcanic features, from maria (including cryptomaria) to the smallest and most elusive, such as domes, passing through rilles, faults, volcanic craters, dark mantle deposits, fractured floor craters, including those of possible volcanic origin, such as wrinkle ridges and irregular mare patches. **We also invite you to share the reasons why you have sent images of your favorite volcanic features, to give a more personal touch to our Focus On.**

MARCH 2025 ISSUE-Due February 20 2025: CLAVIUS

MAY 2025 ISSUE-Due April 20 2025: VOLCANIC FEATURES

JULY 2025 ISSUE-Due June 20, 2025: RUPES RECTA

SEPTEMBER 2025 ISSUE-Due August 20, 2025: MARE HUMORUM



Marcelo Mojica Gundlach

Key to Lunar Images In This Issue

1. Alpes, Vallis
2. Archimedes
3. Aristarchus
4. Atlas
5. Censorinus
6. Crisium, Mare
7. Deslandres
8. Endymion
9. Fontana
10. Gassendi
11. Imbrium, Mare
12. Iridium, Sinus
13. Langrenus
14. Manilius
15. Messier
16. Newton
17. Philolaus
18. Plato
19. Proclus
20. Ptolemaeus
21. Schiller
22. Theophilus
23. Triesnecker
24. Tycho
25. W. Bond