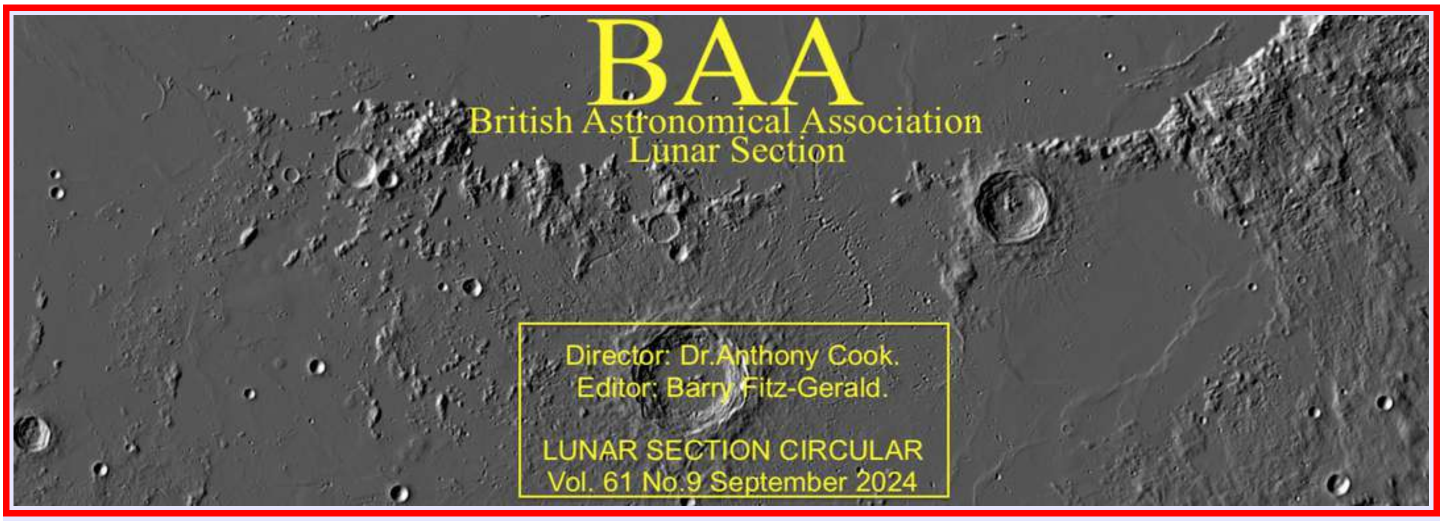
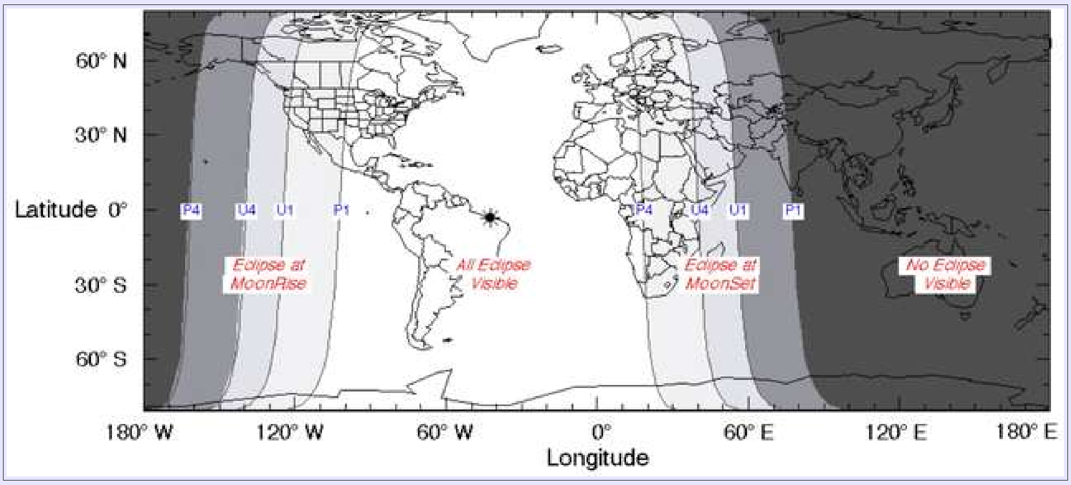
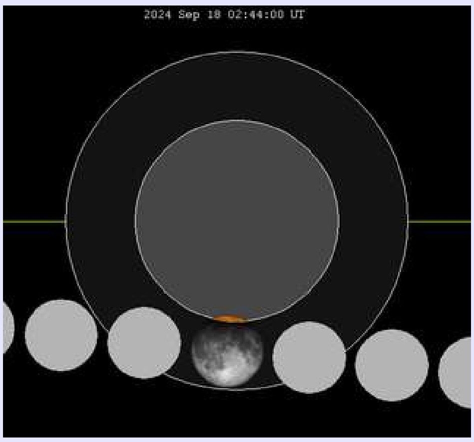


FROM THE DIRECTOR



The visibility of the partial lunar eclipse from different parts of the world – from NASA GSFC eclipse web site

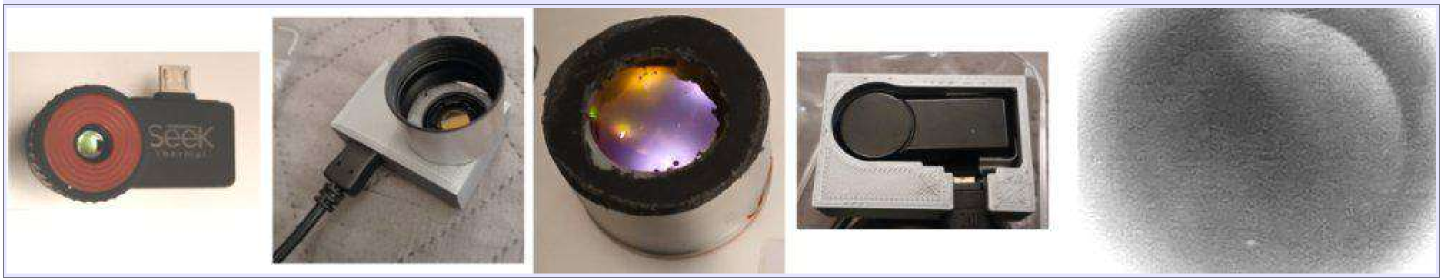
The 18th September sees a partial lunar eclipse, and it's visible from the UK. The bad news is that it is only 8% covered at most and in the early hours of the morning. So, you will have to weigh up the pros and cons of observing a relatively minor event, at anti-social hours, with the fact that from the UK we have had very few opportunities to observe lunar eclipses in the last few years. Knowing our luck, it will probably be cloudy. The penumbral phase (P1) of the eclipse starts at 00:41UT, first contact (U1) of the umbra is at 02:13UT, mid eclipse occurs at 02:44UT, the umbral phase (U4) ends at 03:14 and the penumbral shadow has left (P4) at 04:47UT.



The partial lunar eclipse of 18/09/2024 partial lunar eclipse – (from Wikipedia)

In the past amateur astronomers have tried to time when the umbral shadow was in contact with craters in its passage across the lunar surface – this was used to estimate the size of the umbra. People also estimated the darkness of the shadow on the Dajon scale (0=very dark, 1=dark grey or brown with details in shadow difficult to see, 2=dark red interior with lighter edges to the umbra, 3=brick red often with a bright or yellow edge, 4=very bright umbra, copper red or orange in colour, often with a bluish edge), but this could be problematic with such a small portion of the lunar surface being covered. Likewise looking for impact flashes in the umbra, or occultations on the limb will likely be thwarted again by the small size of the shadow and the glare from the rest of the Moon. On the plus side of things, you can attempt a time sequence of images and try subtracting the ones of the eclipse from ones of the Full Moon prior to, or after the eclipse. Although this can be affected by atmospheric transparency, and you have to register (maybe even rotate) the before and after images together, if you do it right with image processing software, you are left with an image of the penumbra and umbral shadows alone.

A few of us may have thermal imaging cameras that you can attach to a phone, for inspecting electrical wiring, plumbing, or measuring body temperature. If you are lucky to have one and also have a Newtonian (i.e. no glass to look through as glass is opaque in the thermal IR) then by purchasing a short focal length (as short as you can find) low cost laser cutter lens (its designed for thermal IR optics) on the web – if you place this in front of the lens of your thermal IR camera attachment, and place this into the eyepiece holder, then you can obtain thermal images of the Moon and see what effect the umbra has on cooling the lunar surface. I have done this in the past, using an OTG enabled USB cable between the thermal imaging camera and the mobile phone, and electrical insulation tape wrapped around the lens and the camera to hold this in place in an empty eyepiece draw tube. A more refined way to do this is to 3D print a holder for the camera and glue an empty eyepiece tube onto to this with the laser cutter lens held in by a plastic flange.



A Seek Compact Pro mobile phone thermal imaging camera adapted to fit onto a Newtonian scope using laser cutter lens eyepiece projection. (Right) A thermal IR image of the total lunar eclipse from 2007 Mar 03 taken through a 20cm Newtonian, using a different, less sensitive thermal IR camera – the bright hot spot is Tycho crater as it retains its heat inside the earth's shadow, longer than the surrounding surface.

Whatever happens, please send in any images of sketches that you obtain and we shall see what we can learn from these.

Tony

……..§………

Lunar Occultations September 2024 by Tim Haymes.

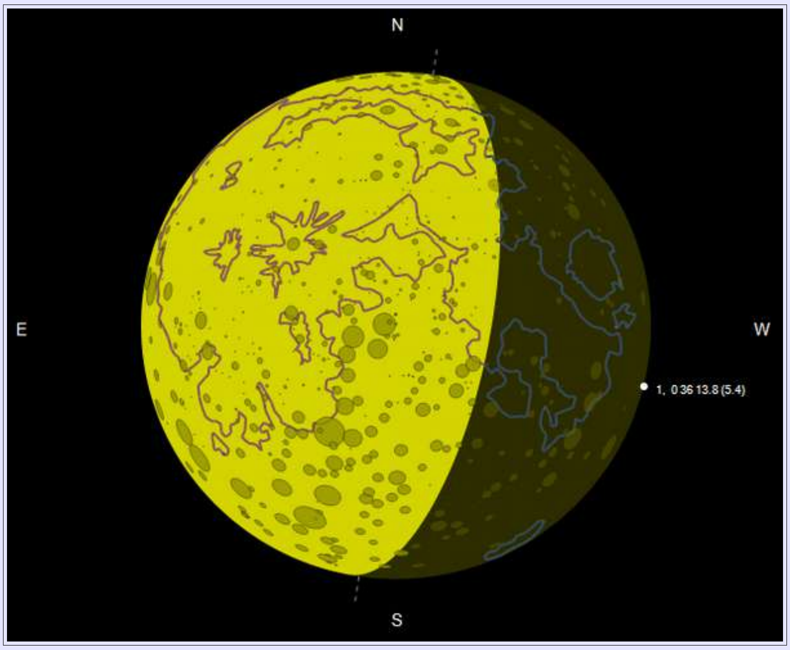
Occultation of Saturn
As I write, reports of the Saturn Occultation on morning of August 21st, are drifting in.
I failed to observe the D and R through thin cloud. A BAA Forum topic was started by Alex Pratt (Leeds) and there are some accounts at this link:
https://britastro.org/forums/topic/interesting-lunar-occultations-in-august-2024

Pleiades passage. Morning of August 26.
Reports will be included in the October LS. This Sept LSC had an earlier publication dead-line.

Observing Prospects for September
Penumbral Eclipse Sept 18, 0100 to 0400 UT (approx). The Moon passes through the Earth's penumbral shadow reaching the Umbra between 0220 and 0300UT. It is a shallow eclipse. No stars are occulted in the Umbral shadow, but I hope it will be quite pretty.

Chi Tauri Sept 23, 0035UT
Is possibly the best RD event this month, at a good altitude. The star is double, named STF 528 (Struve) m1 5.4: m2 8.5 in PA 025. Separation 19 arcsec. Time difference +24sec, so the fainter companion appears after the main star. Well worth watching or timing.

Position of the Reappearance of chi Tauri, CA 87S



Lambda Cnc Sept 27, 0201UT
A bright B9 spectral star (bluish-white) reappearing at CA 71N. Nothing of note about the star.
Peter Anderson (Taylor Range, AU) – one of our contributors-, has the most recent record in Occult in 2021 Apr 20. That was also a DR event timed with Stopwatch and Radio time signal. Residual 0.04. No remarkable circumstance noted.

The observation records in Occult4 since about 1980AD are mostly complete (at least for me).

Occultation predictions for 2024 September (Times at other locations will +/- a few minutes)
Oxford: E. Longitude -001 18 47, Latitude 51 55 40

Filter: Moon above 10deg alt. Mag. brighter than r8, Sun Alt below -5

day yy	mmm	d	Time h	m	s	Ph		Star No	Sp D*	Mag v	Mag r	% ill	Elon	Sun Alt	Moon Alt	Az	CA o	Notes
24	Sep	15	20	19	55.9	D		3175	G8	4.7	4.3	92+	148		16	153	49S	kappa Cap
24	Sep	15	22	57	52.8	D		164637	K2	7.5	6.8	93+	149		20	192	47N	
24	Sep	15	23	21	14.4	D		3191	cA5	7.4	7.3	93+	149		19	197	35S	
24	Sep	16	21	46	6.8	D		3327	K2	6.8	6.1	98+	163		24	159	42S	
24	Sep	17	0	45	51.3	D		3339	M0	6.7	5.8	98+	164		24	207	87S	
24	Sep	17	2	22	40.0	D		3347	A9	6.2	6.1	98+	165		15	230	55N	70 Aqr
24	Sep	18	03	11	39.0	DB		3496	F8	7.3	7.0	100			22	233	49N	Penumbral Ecl.
24	Sep	18	20	22	39.1	R		50	dG5	5.8	5.3	99-	169		17	110	55N	44 Psc
24	Sep	19	1	22	7.5	R		69	G4	7.5	7.0	99-	167		41	192	85N	
24	Sep	19	21	45	33.1	R		205	F0	7.4	7.3	95-	154		27	111	44S	
24	Sep	20	1	31	51.1	R		92457	cK5	8.2		94-	152		49	178	82S	
24	Sep	20	3	8	7.4	R		222	G5	7.0	6.5	94-	152		46	212	85S	
24	Sep	20	3	43	26.5	R	X	2178	F8	8.0	7.7	94-	152		42	222	23S	
24	Sep	20	23	20	47.3	R		347	K0	7.9	7.4	88-	139		39	116	61S	
24	Sep	21	4	43	33.1	R		371	G5	6.2	5.7	87-	137	-11	48	229	71N	27 Ari
24	Sep	21	21	14	42.2	R		472	cA1	4.9	4.9	80-	127		16	76	87S	zeta Ari
24	Sep	22	1	43	39.3	R		493	A0	6.9	6.9	78-	125		54	137	68S	
24	Sep	22	3	51	32.0	R		501	pK0	6.2		78-	124		61	191	34N	66 Ari
24	Sep	23	0	36	13.8	R		647	WB9	5.4	5.4	68-	112		41	100	87S	chi tau
24	Sep	23	0	36	37.1	R	X	5643	SF8	8.5	8.2	68-	112		41	100	88S	
24	Sep	23	1	47	3.5	R		655	PF5	7.9	7.6	68-	111		51	116	68S	
24	Sep	24	1	45	31.5	R		812	SF8	8.0		57-	98		44	100	31S	
24	Sep	24	3	48	20.2	R		77224	cF8	7.4	7.1	57-	97		60	134	18S	
24	Sep	24	23	59	0.0	R		78291	K0	7.7	7.0	47-	87		20	69	89N	
24	Sep	25	0	52	50.7	R		979	A0	8.1	8.1	47-	86		27	79	89N	
24	Sep	25	3	18	52.2	R		996	cA2	6.9	6.8	46-	85		49	107	70N	
24	Sep	25	4	47	4.2	R		78483	A2	8.0	7.9	45-	85	-12	60	134	78S	
24	Sep	25	5	1	32.1	R		78496	K0	7.5	6.9	45-	85	-9	62	140	54S	
24	Sep	25	23	58	26.3	R		79304	K2	8.1	7.3	37-	75		11	61	66S	
24	Sep	27	1	11	39.9	R		80089	G5	7.2	6.7	27-	63		12	66	38N	
24	Sep	27	1	50	48.1	R		80105	A0	7.9	7.9	27-	62		17	73	56S	
24	Sep	27	2	1	6.7	R		1251	B9	5.9	5.9	27-	62		18	75	71N	Lambda Cnc
24	Sep	27	3	57	7.5	R		80165	F2	7.5	7.3	26-	61		36	96	41N	
24	Sep	27	4	28	35.2	R		80173	K0	8.3	7.8	26-	61		40	103	47S	

D* : The D column indicates a Double Star in the Washington Double Star Catalogue. The characters w,S,c etc indicate the type of double explained in Occult4.

New doubles are being discovered in occultation recordings, particular close doubles. The separations are usually small and in the range 30-300 mas. Please send double star occultation reports to the LS. High frame-rate recordings are desirable when possible.

Contact the Occultation Subsection to request predictions for your location and instrument.

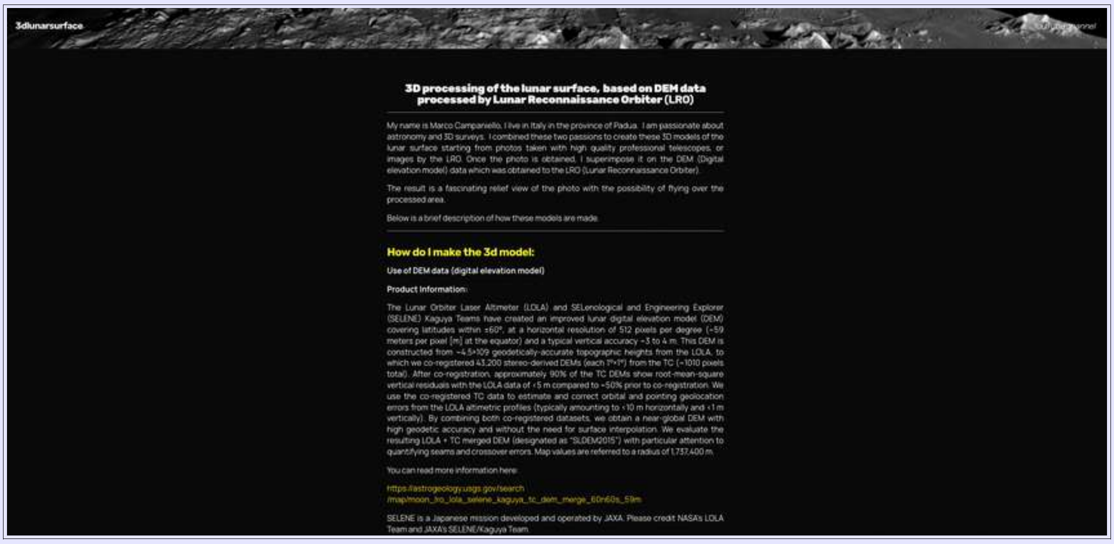
……..§………

Letters/e-mails:

Marco Campaniello's 3D Lunar surface models.

Marco has a rather interesting website with a number of fascinating 3D models of the lunar surface. You probably got a taste of some of these from the June LSC where Marco and Raf Lena wrote on 3D reconstructions using LRO data. His website is:

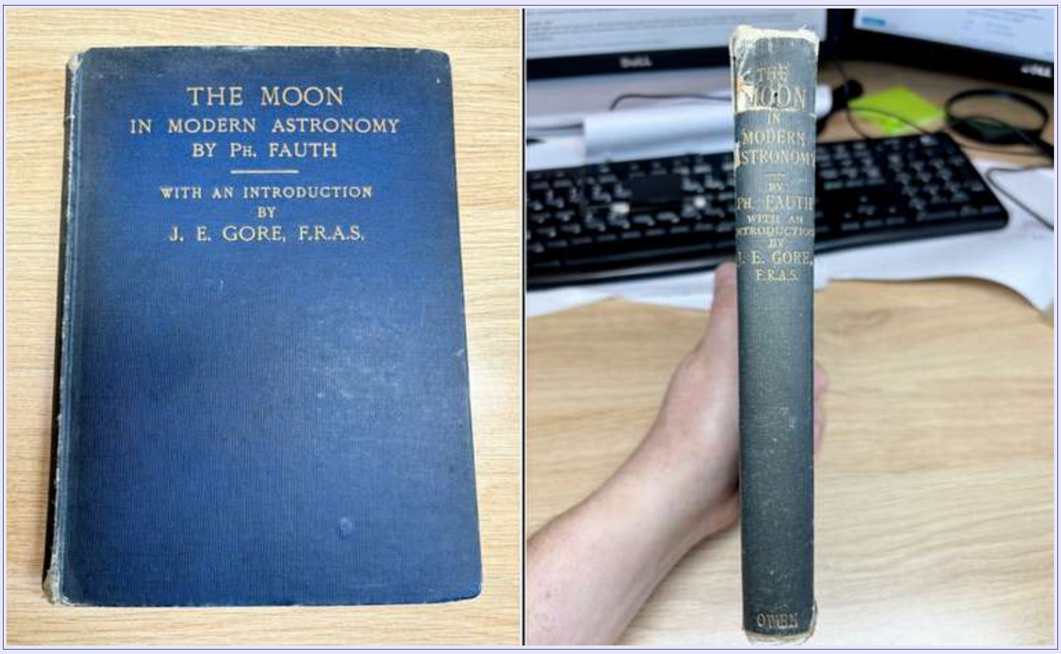
https://3dlunarsurface.wordpress.com/



…......and includes some rather stunning Fly-By videos that are well worth watching!

Rare Book for Sale - The Moon by Fauth.

The Moon by Fauth, presumed 1909 edition, spine has some minor damage at the top but otherwise the book is very good for its age. Price is £40 that would include postage – but only within the UK please.



Please contact james@dawson.me.uk.

James has some other rare books available including Nasmyth and Carpenter and a copy of Wilkins ring-bound Moon Maps and you can find further details on the BAA Forum at - https://britastro.org/forums/search/Dawson

Images.

Xenophanes

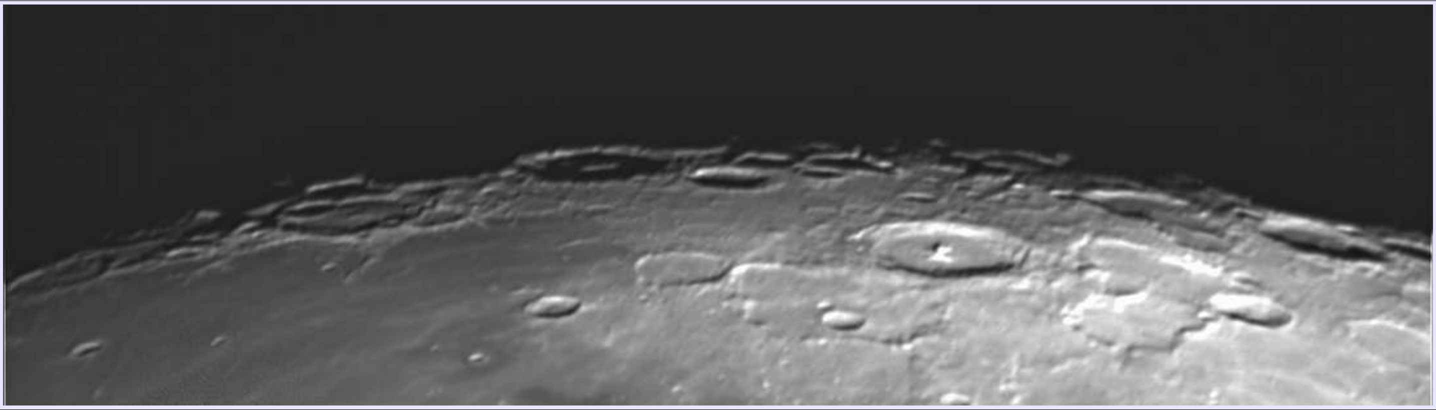
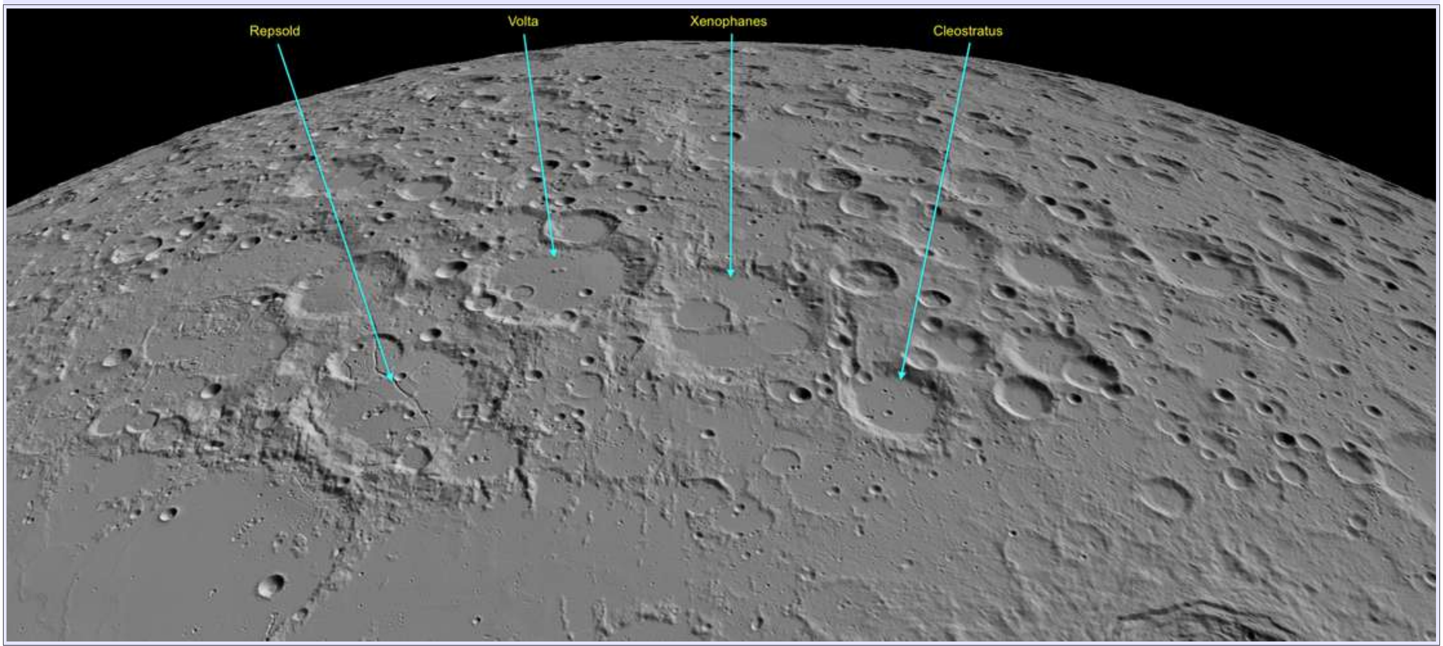


Image by James Dawson – Taken on the 18th August 2024 at 21:31 (UT) and consisting of 60 seconds of data with an ASI ZWO 174MM camera on the C14 (no Barlow). Stacked it in Autostekkart and tightened wavelets in Registax.

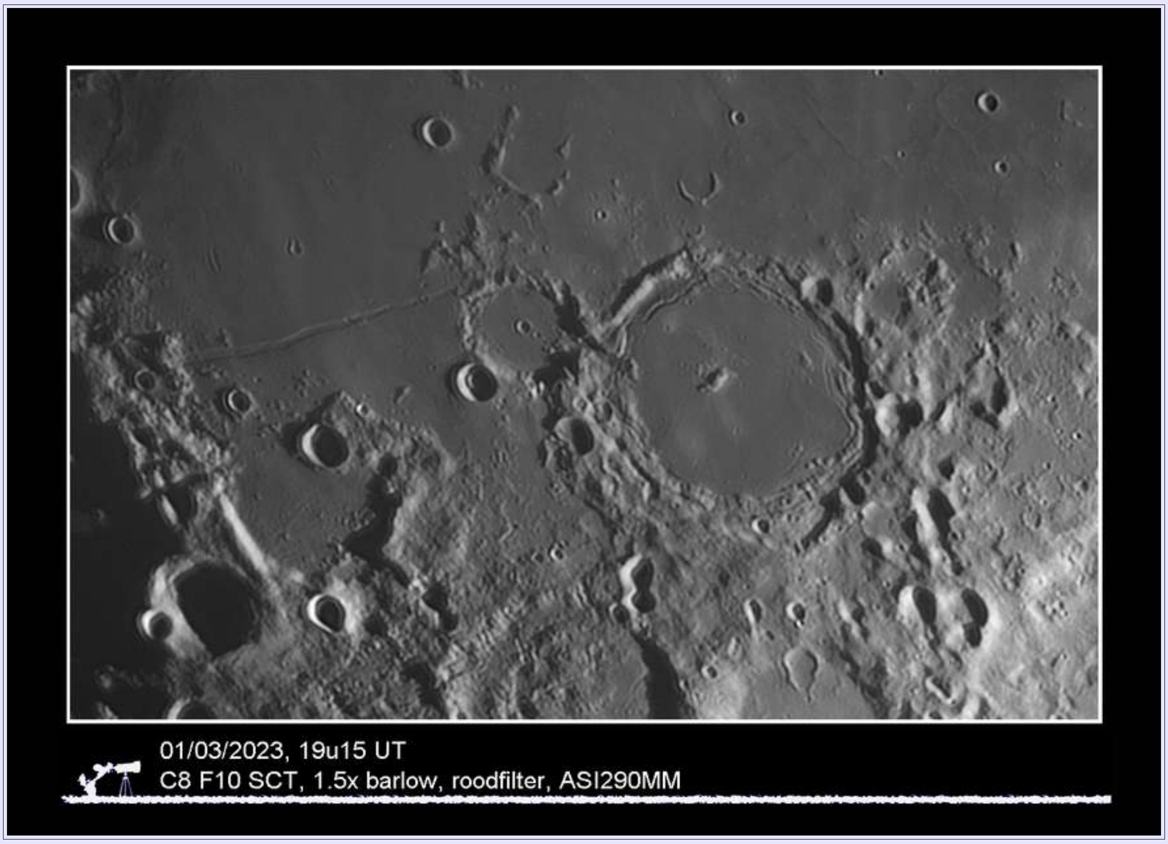
James Commented: *Whilst tinkering with the telescope last night I had a nose around the Moon and saw what I now know to be the central ridge of Xenophanes appearing as a linear bright feature coming in and out of focus surrounded by black and clearly encircled in a crater.*



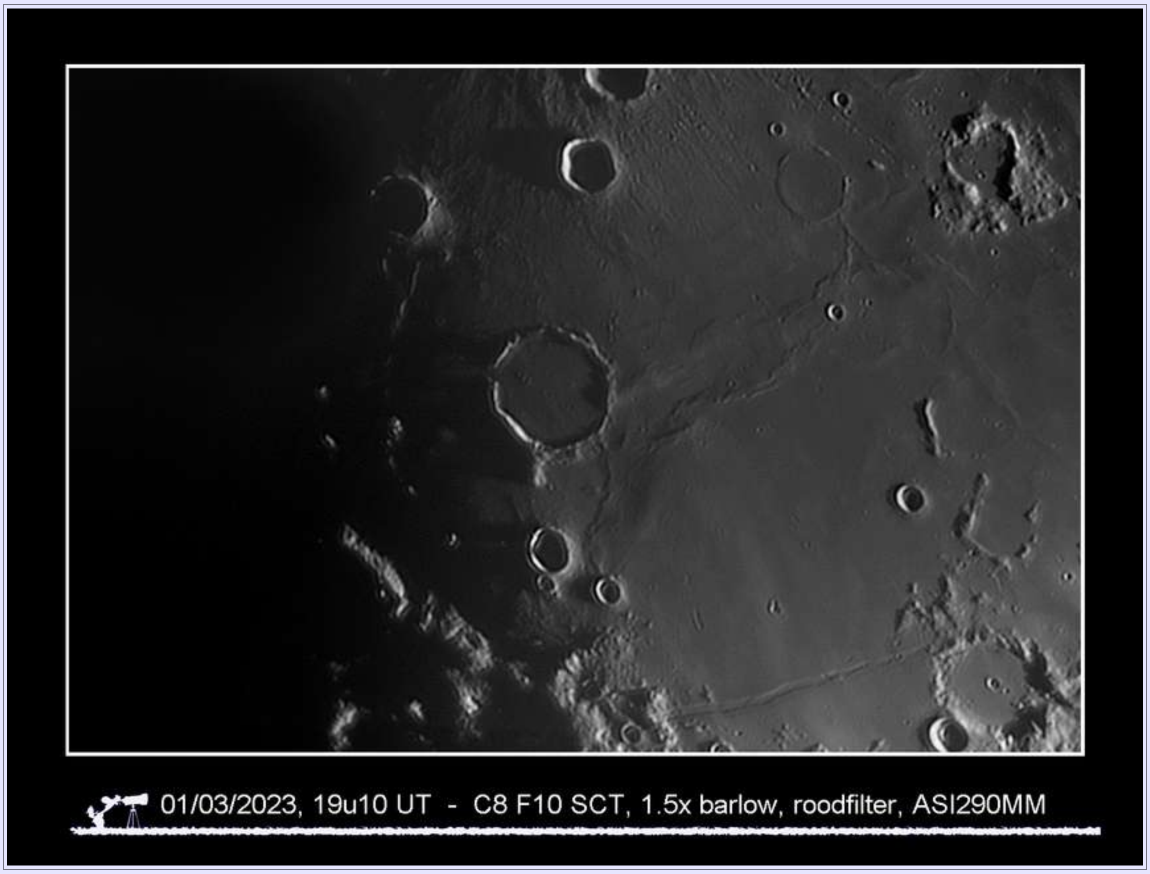
Ed. Comments: The ridge like central peak of Xenophanes stands out well in the image, this is an unusual configuration, but ridge like central peaks are not unknown on the Moon. Then again Xenophanes is Pre-Nectarian in age and its floor may have been modified by later impacts that may have had an effect on the original central peak shape. The crater itself is heavily scored by Imbrium Sculpture, swarms of parallel groves and crater chains that originated during the Imbrium impact event, these can be seen in the TerrainHillshade rendition below the main image.

None of this sculpture can be seen over the floor of Xenophanes, showing that the light plains that now occupy the crater floor obviously post-date the Imbrium impact.

Pitatus.



Kies.



Both above images by Alexander Vandenbohede with details of time/date and equipment as shown.

Hyginus Rille.

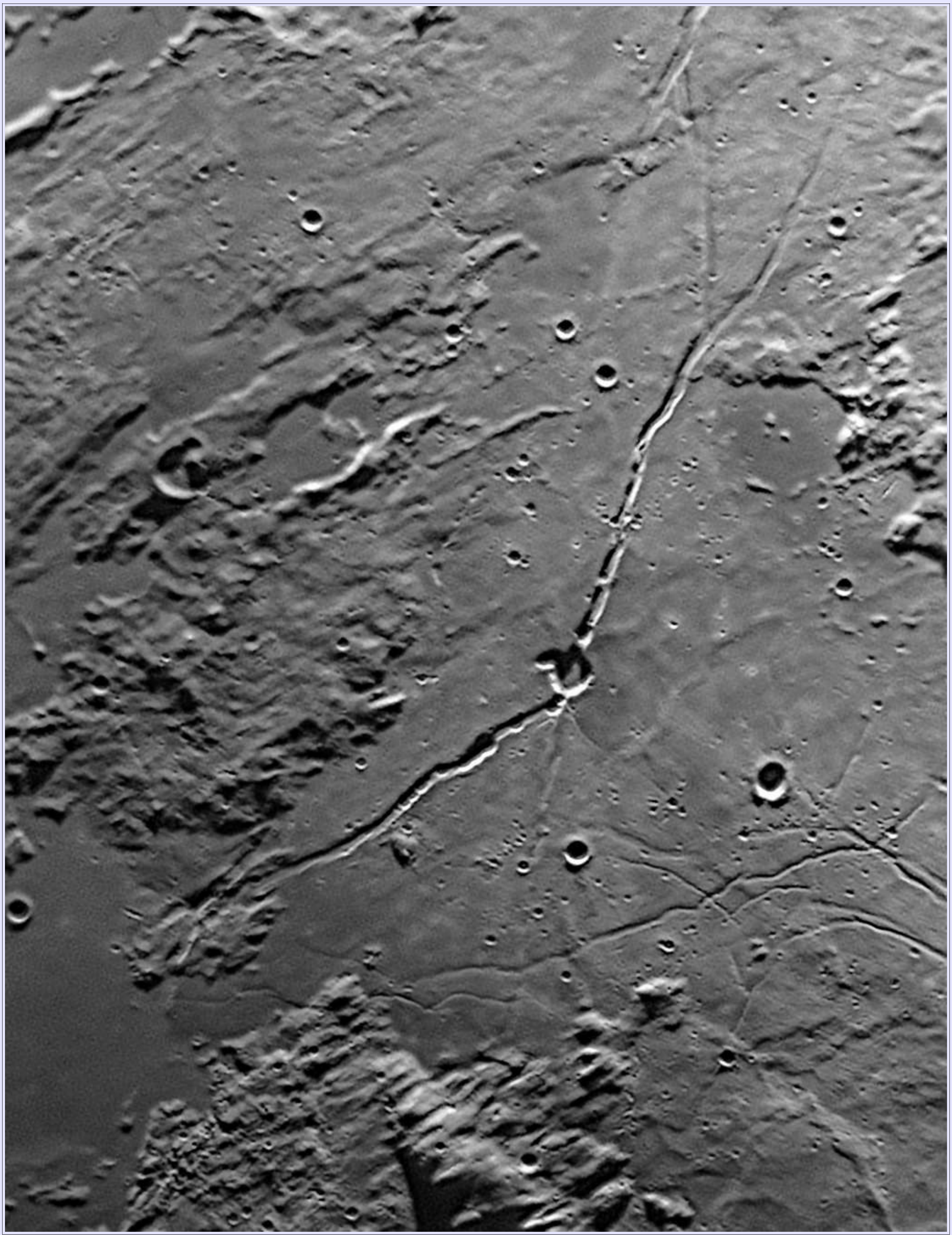


Image by Leo Aerts and taken on 18th January 2024 at17h19 using a Celestron C14 SCT.

Triesnecker Agrippa and Godin.

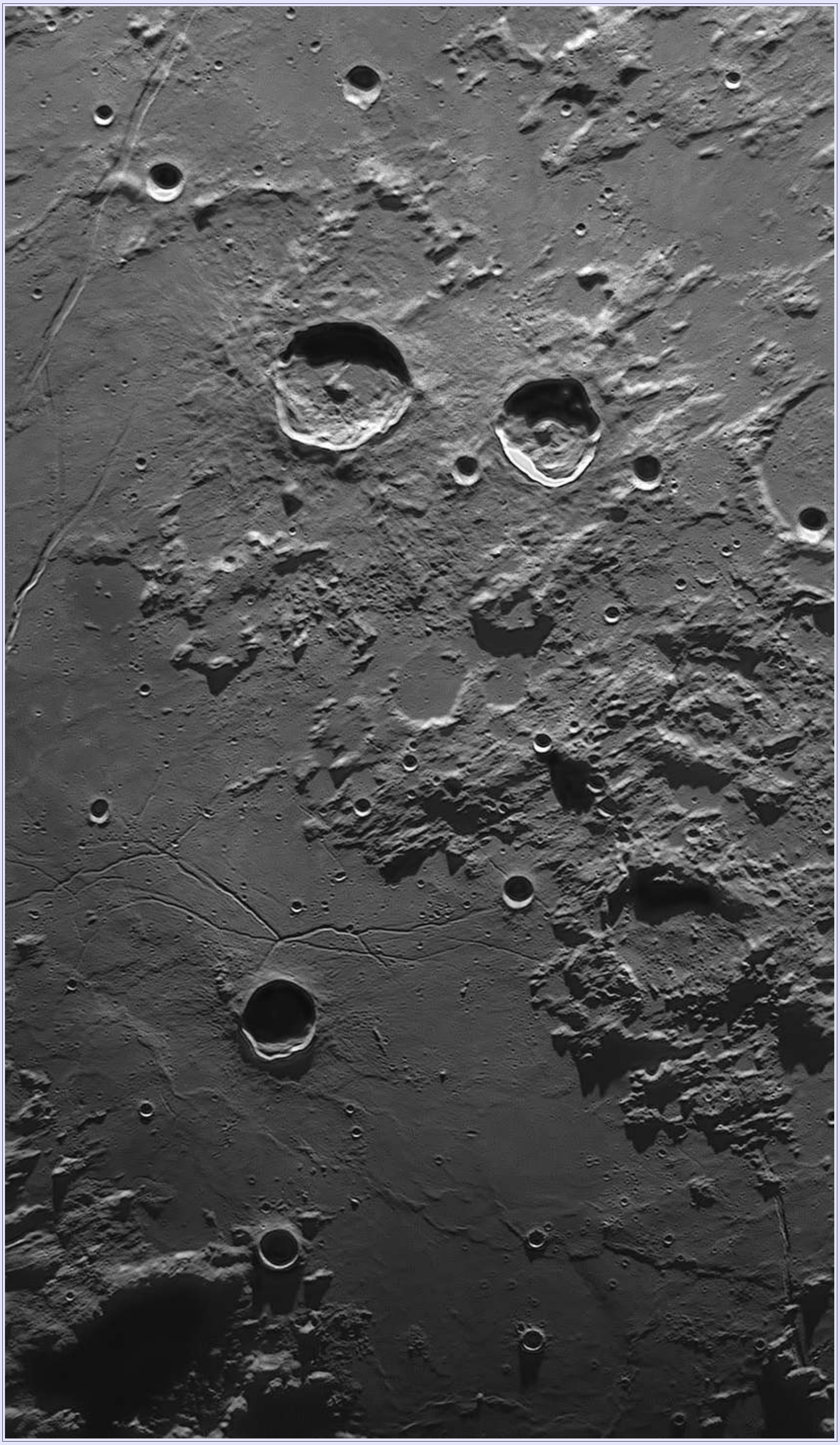
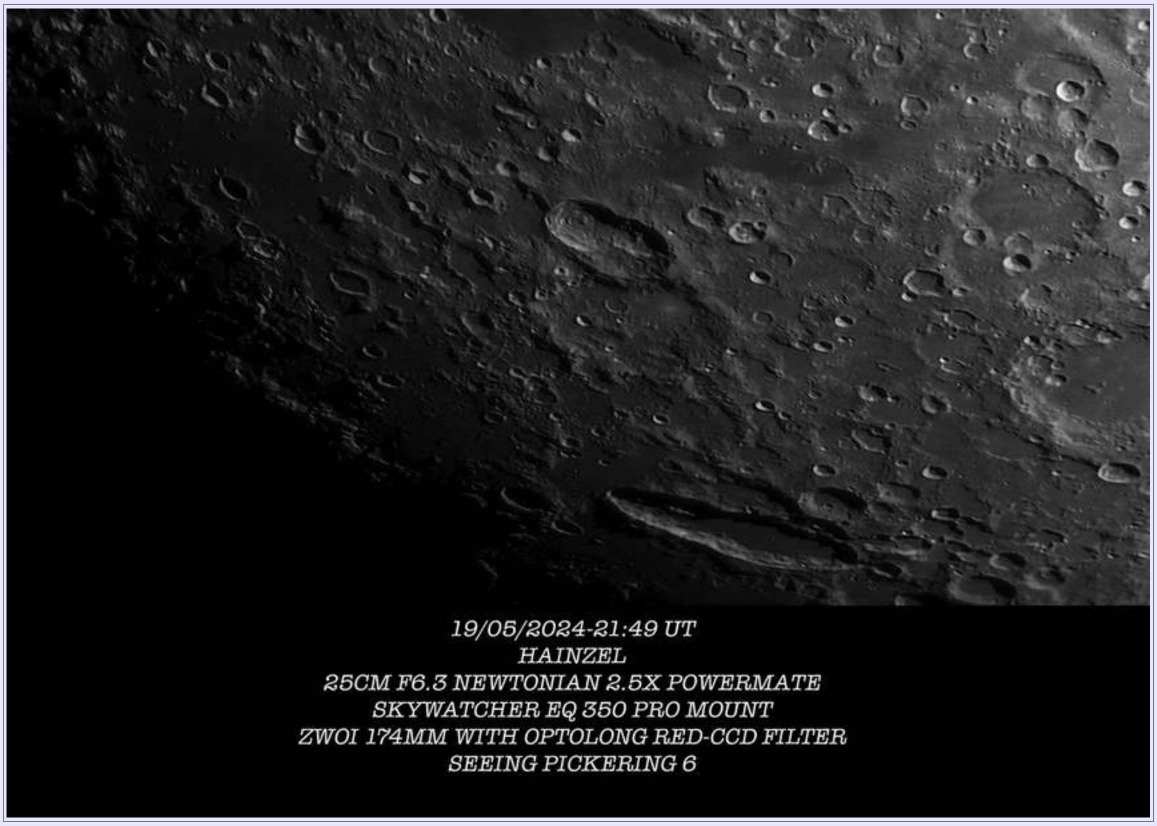


Image by Leo Aerts and taken on 18th January 2024 at17h18 using a Celestron C14 SCT.

Schiller and Hainzel.



Both images by Bob Stuart with details of time/date and equipment in captions.

Gassendi

Image by Maurice Collins taken on 0655UT ON 18th July 2024 using an FLT110, 3xBarlow and QHY5III462C

Aristarchus

Image by Maurice Collins taken on 0654UT ON 18th July 2024 using an FLT110, 3xBarlow and QHY5III462C

Apennines in detail.

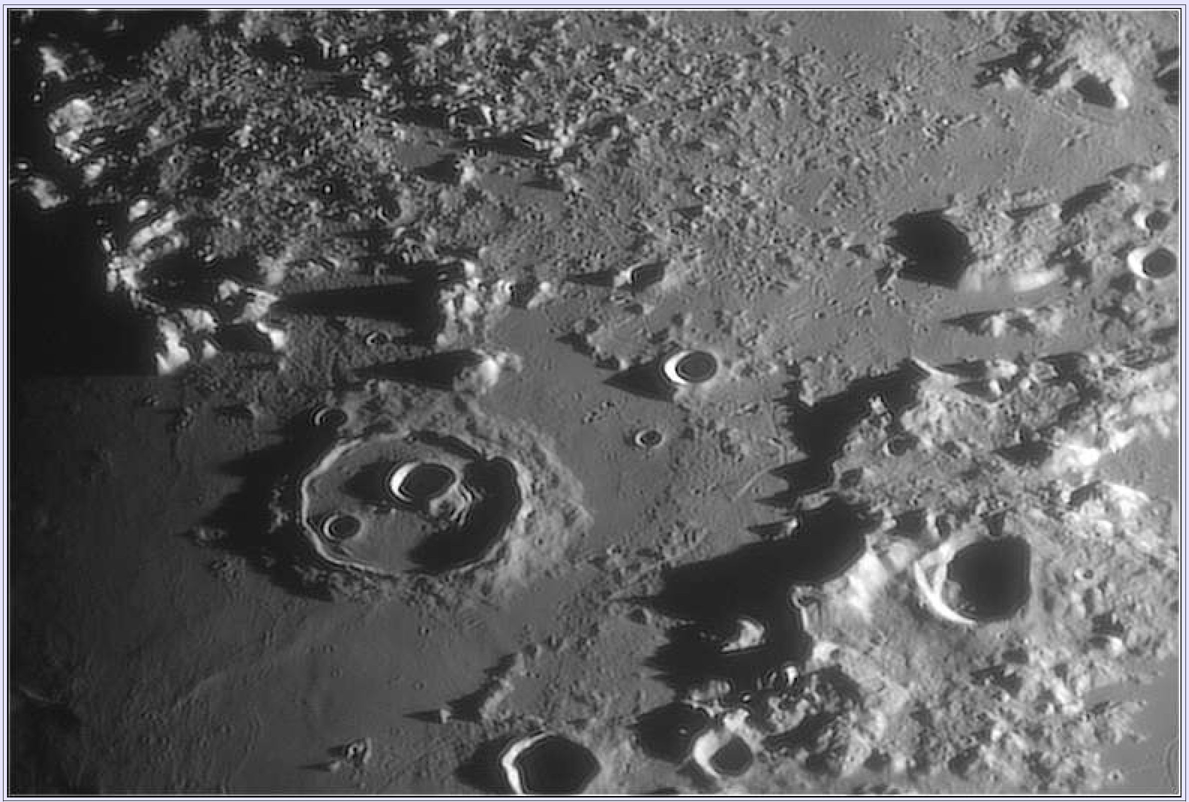
Rima Bradley, Mons Bradley, Rimae Archimedes, Conon 2024.03.18 20:24 UT, S Col. 13.2º, seeing 6/10, transparency poor. Libration: latitude -06º24', longitude +06º20'
305mm Meade LX200 ACF, f 25, ZWO ASI 120MMS camera, Baader IR pass filter: 685nm.
800 frames processed in Registax 6 and Paintshop Pro 8.
Dave Finnigan, Halesowen

Rima Hadley, Mons Hadley, Mons Hadley Delta, Aratus 2024.03.18 20:23 UT, S Col. 13.2º, seeing 6/10, transparency poor. Libration: latitude -06º24', longitude +06º21'
305mm Meade LX200 ACF, f 25, ZWO ASI 120MMS camera, Baader IR pass filter: 685nm.
800 frames processed in Registax 6 and Paintshop Pro 8.
Dave Finnigan, Halesowen

Both above images by Dave Finnigan with details of time/date and equipment as shown.

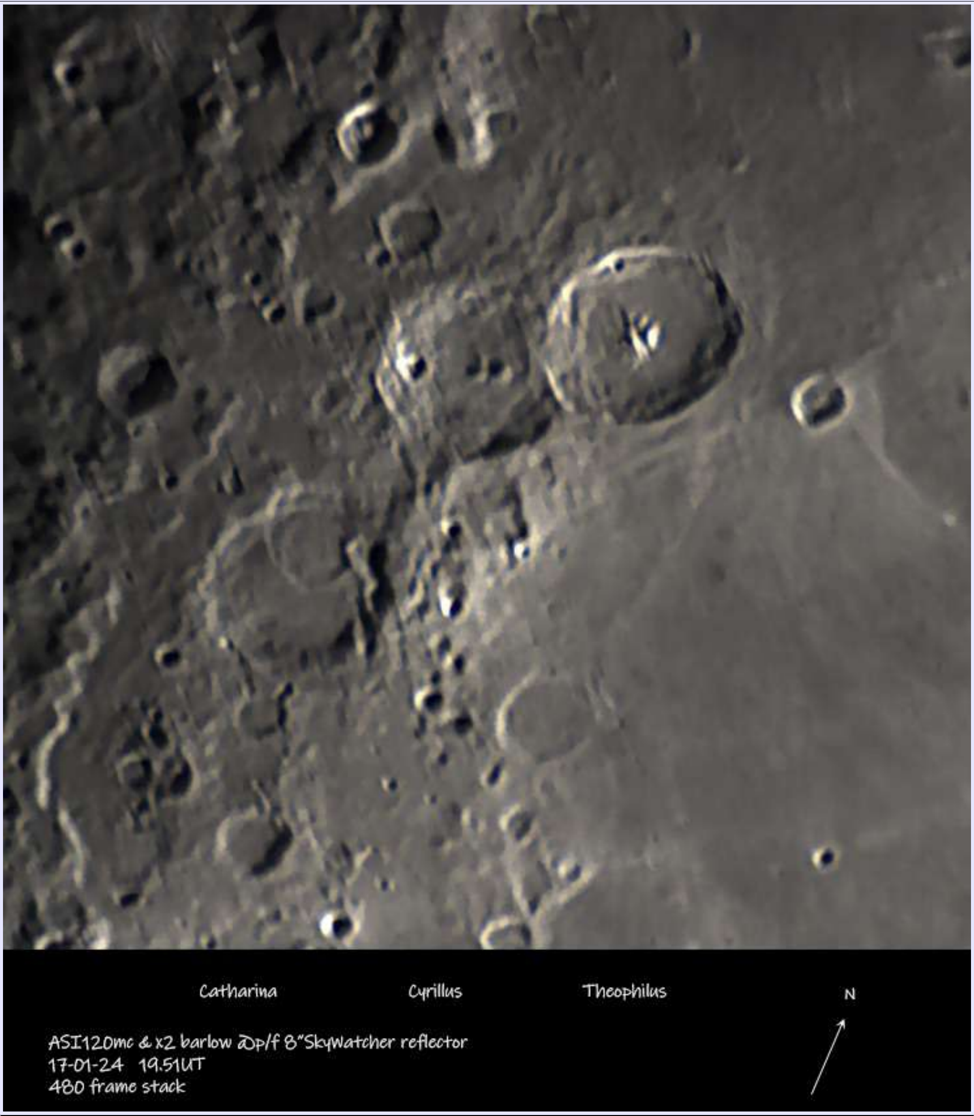
Lacus Doloris, Lacus Odii and Lacus Felicitatis.

Cassini-Caucasus Mts.



Both above images by Bill Leatherbarrow and taken on the 17th March 2024 at 18:46hrs (top) and 18:51hrs (bottom) with a 300mm Mak-Cass.

Cyrillus and Gemma Frisius.



Both above images by Les Fry with details of time/date and equipment as shown.

Moon 15th January 2024.

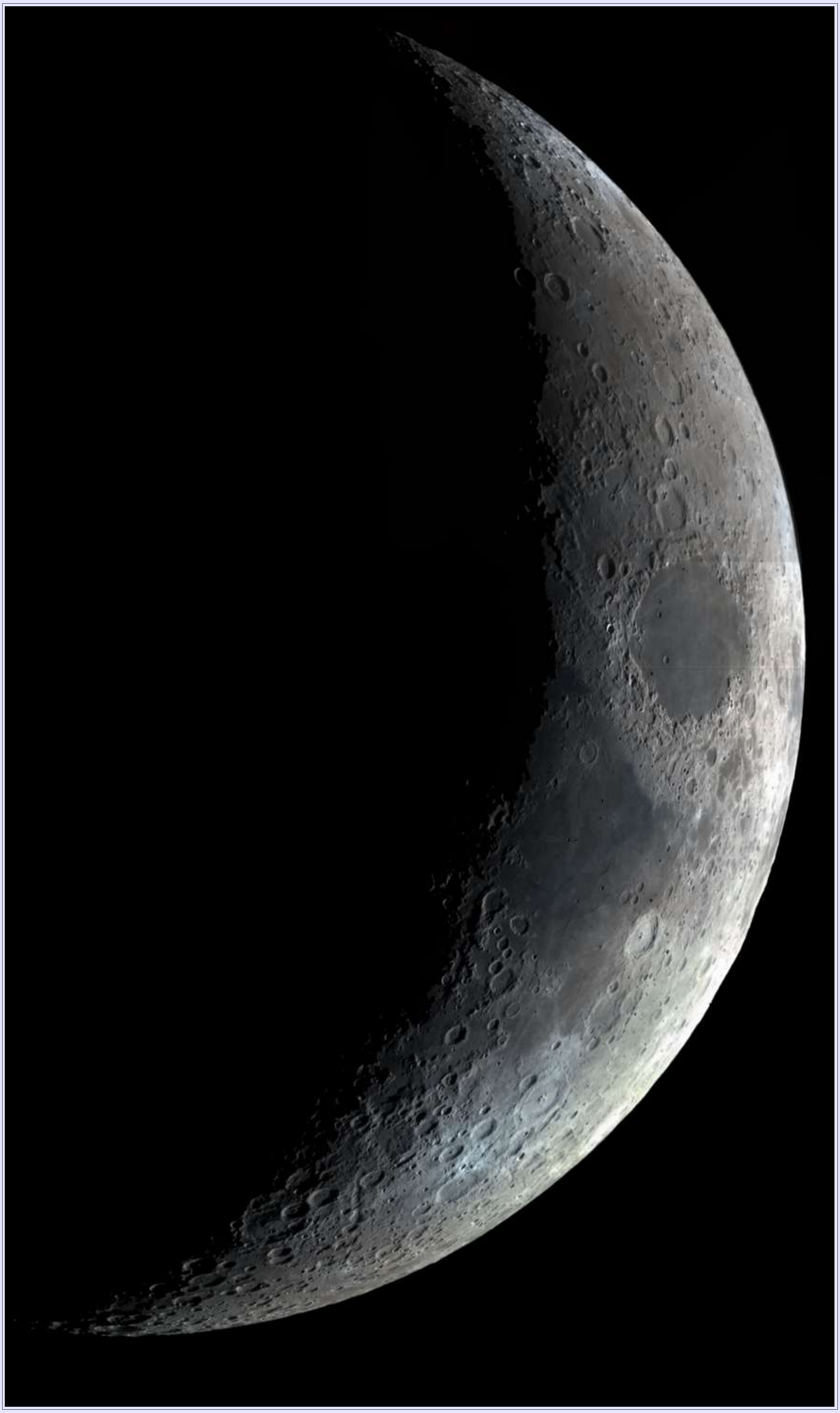
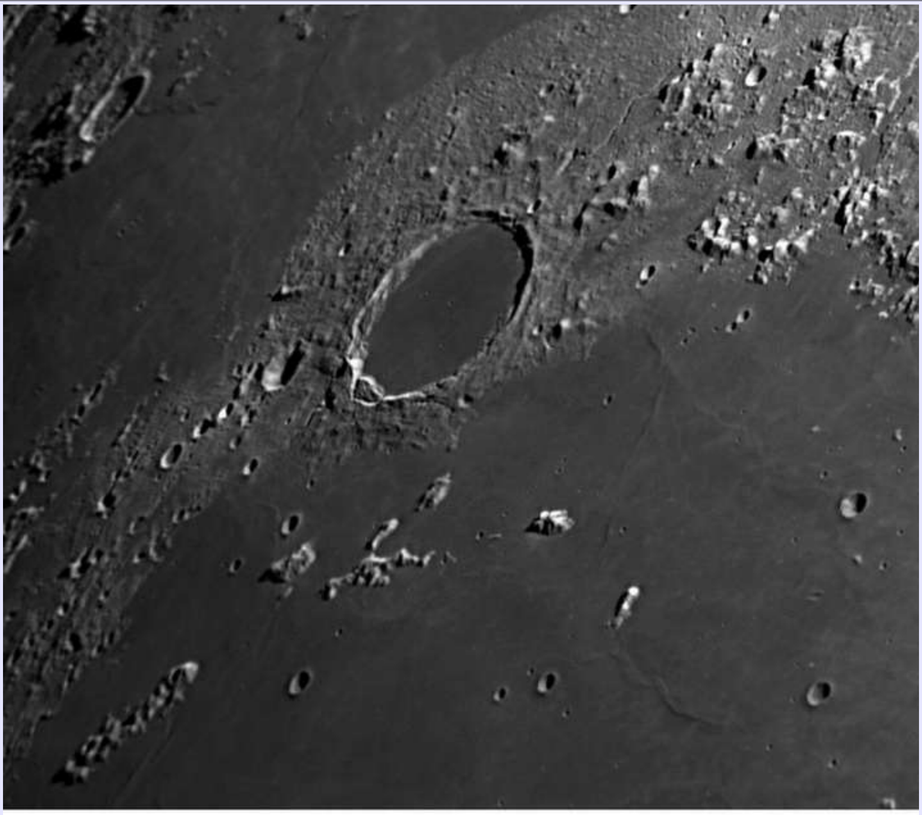
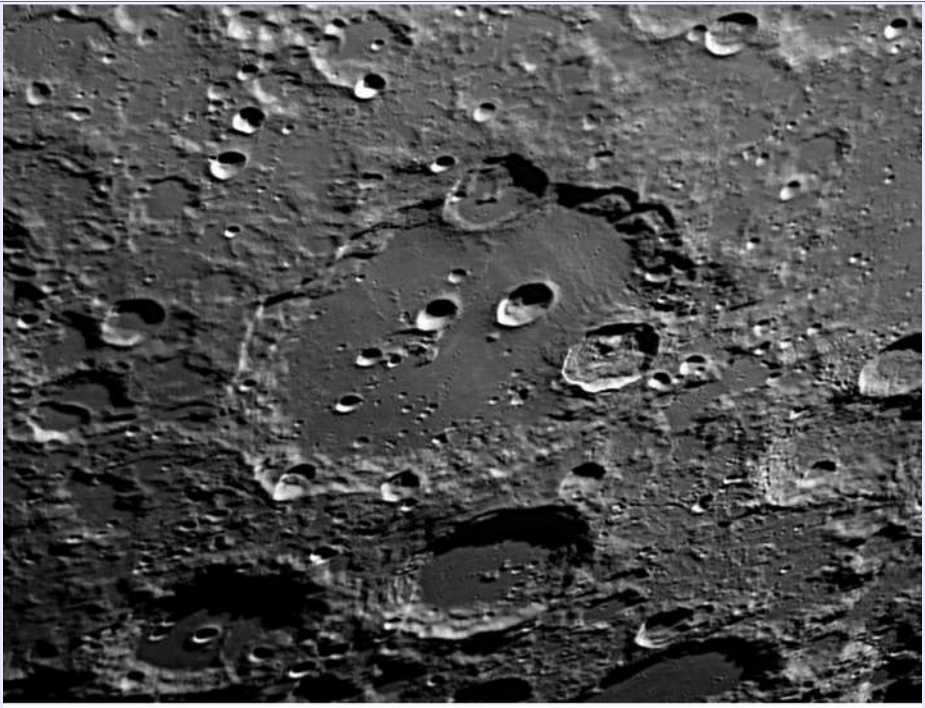


Image by Chris Longthorn.

Plato and Schickard.



Plato 2023.03.02 - 18.39 UT
300mm Meade LX90, ASI 224MC Camera with Pro Planet 742nm I-R Pass Filter.
900/3,000 Frames. Seeing: 8/10, steady. Rod Lyon



Clavius 2023.03.02 - 18.48 UT
300mm Meade LX90, ASI 224MC Camera with Pro Planet 742nm I-R Pass Filter.
900/3,000 Frames. Seeing: 8/10, steady. Rod Lyon

Both above images by Rod Lyon with details of time/date and equipment as shown.

Rupes Recta

Image by Mark Radice. Celestron C11 x2 Televue Powermate to give f20 ASI224MC with IR-filter and ADC Mounted on AZEQ6 in a off roof shed. Best 1,000 frames from 5,000 stacked and sharpened.

Mark Comments:

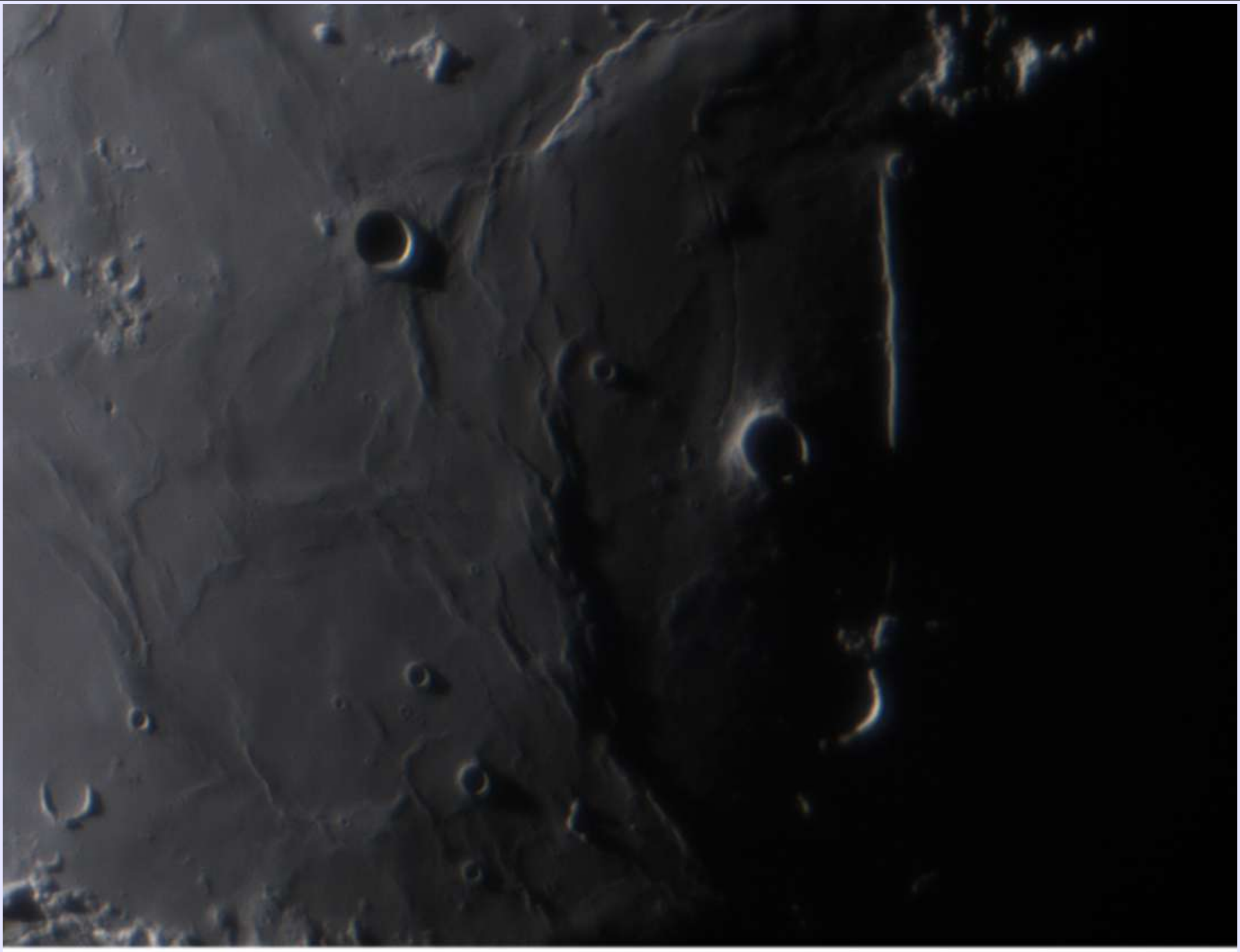
The images below taken only ~ 24 hours apart on 28 and 29 July 2024 show Rupes Recta (Latin for Straight Wall),as seen through my Celestron C11 at silly o'clock in the morning. Quite a captivating sight!

The Wall itself spans approximately 110 kilometres in length and rises to only 240-300 meters in height but technically speaking it is not a Wall and it is not straight! In fact, Rupes Recta is a lunar fault, where a section of the Moon's crust has been displaced. It was likely formed as Mare Nubium sank under the weight of the lava flows leading to a huge shear that formed the steep cliff we can see today.

Some liken Rupes Recta to a sword with a small, half-flooded crater forming the handle and the blade as Rupes Recta itself. It is located in a ghostly crater known informally as Ancient Thebit that is buried under tons of lava leaving only a shadowy outline of the crater rim.

The best time to observe this feature is around the first and last quarter phase of the Moon. At last quarter *(these images) it is illuminated by the sun and at first quarter it casts a shadow.*

Nearby is another intriguing feature, Rima Birt a channel cut by flowing lava in the lunar surface.



Rupes Recta

29 July 2024 0313 UT

C11 f20 AZEQ6 ASI224MC IR-filter

Mark Radice RefreshingViews.com

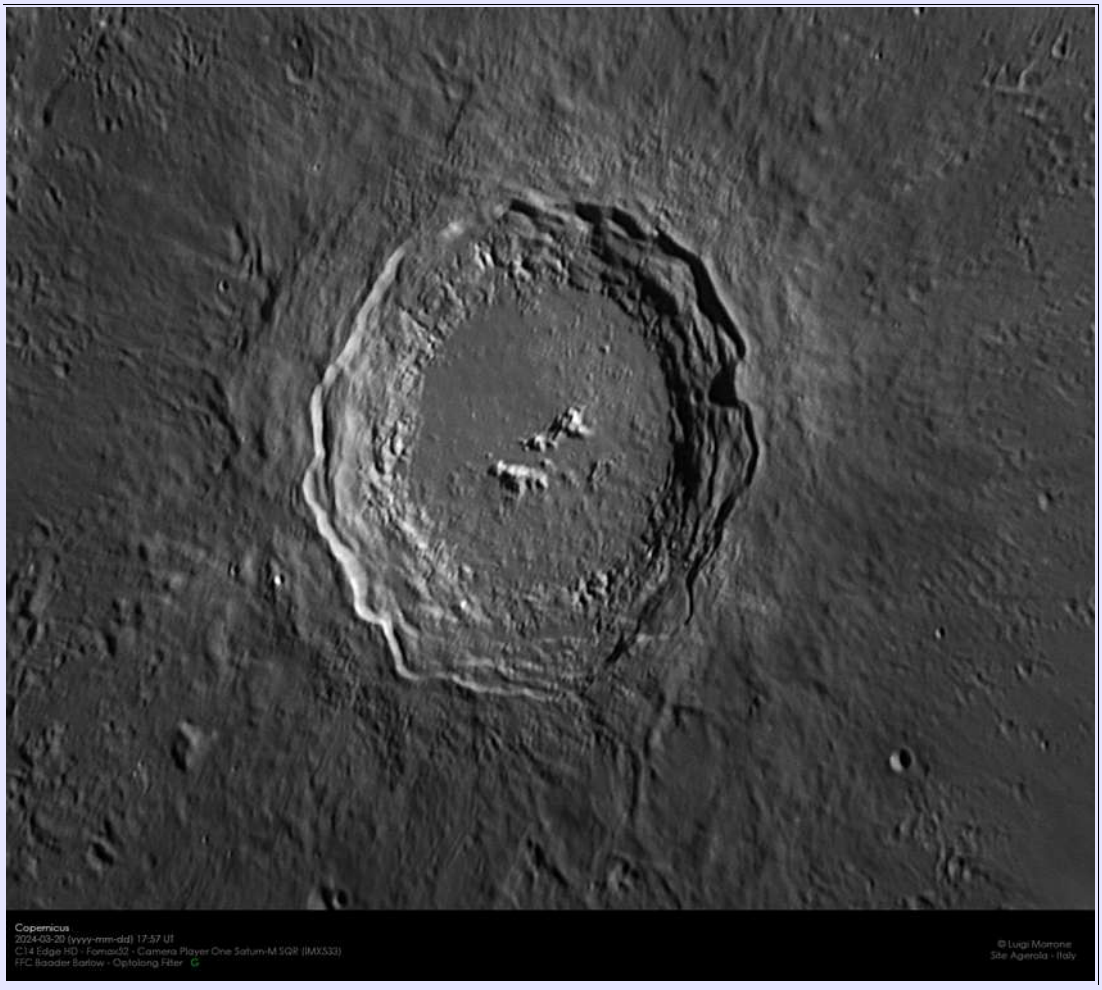
Moretus near the pole.

Image and text by Rik Hill: This image has the distraction of Clavius (231km dia.), the large crater in the upper left corner with distinctive line of smaller craters on its floor, decreasing in size as they curve to the left. The largest one, and least round, on the Clavius crater wall at bottom is Rutherfurd (56km) with its ejecta splash spread out on the floor of Clavius to the north. Going counterclockwise on the broad rim of Clavius we come to another similar sized crater Porter (54km). These latter two are very different ages with Porter being Pre-Imbrian (3.85-4.5 billion years old) and Rutherfurd being Copernican (1.1 b.y. to present) while Clavius itself is Nectarian (3.92-3.85 b.y.) in age. This seems to be a bit contradictory as it indicates that Porter is older than the crater on whose walls it was formed! Below and adjacent to Clavius is Blancanus (109km) half filled with shadow. Moving to the right we come to a nicely circular crater with terraced walls and a central peak. This is Moretus (117km), the most identifiable crater nearest the South Pole from our vantage point. Beer & Madler considered the central peak of this “walled plain” to be “the loftiest central mountain on the entire moon.” Quite a claim and I’m not sure it is borne out with recent spacecraft measurements. Though close, Moretus, with a lunar latitude of just over 71°, is still far from the pole. However, this image was captured at an unfavourable libration for the south.

Just below Moretus is the strongly foreshortened crater Short (51km), no pun intended. Between Moretus and Clavius is the poorly defined crater Gruemberger (97km) overlain as it is with ejecta from Moretus and several of the other nearby younger craters. Cysatus (51km) is the smaller crater just to the right and on top of Gruemberger. Then going further to the right of Moretus is another fairly large crater Curtius (99km) with a very well defined crater Zach (68km) above it.

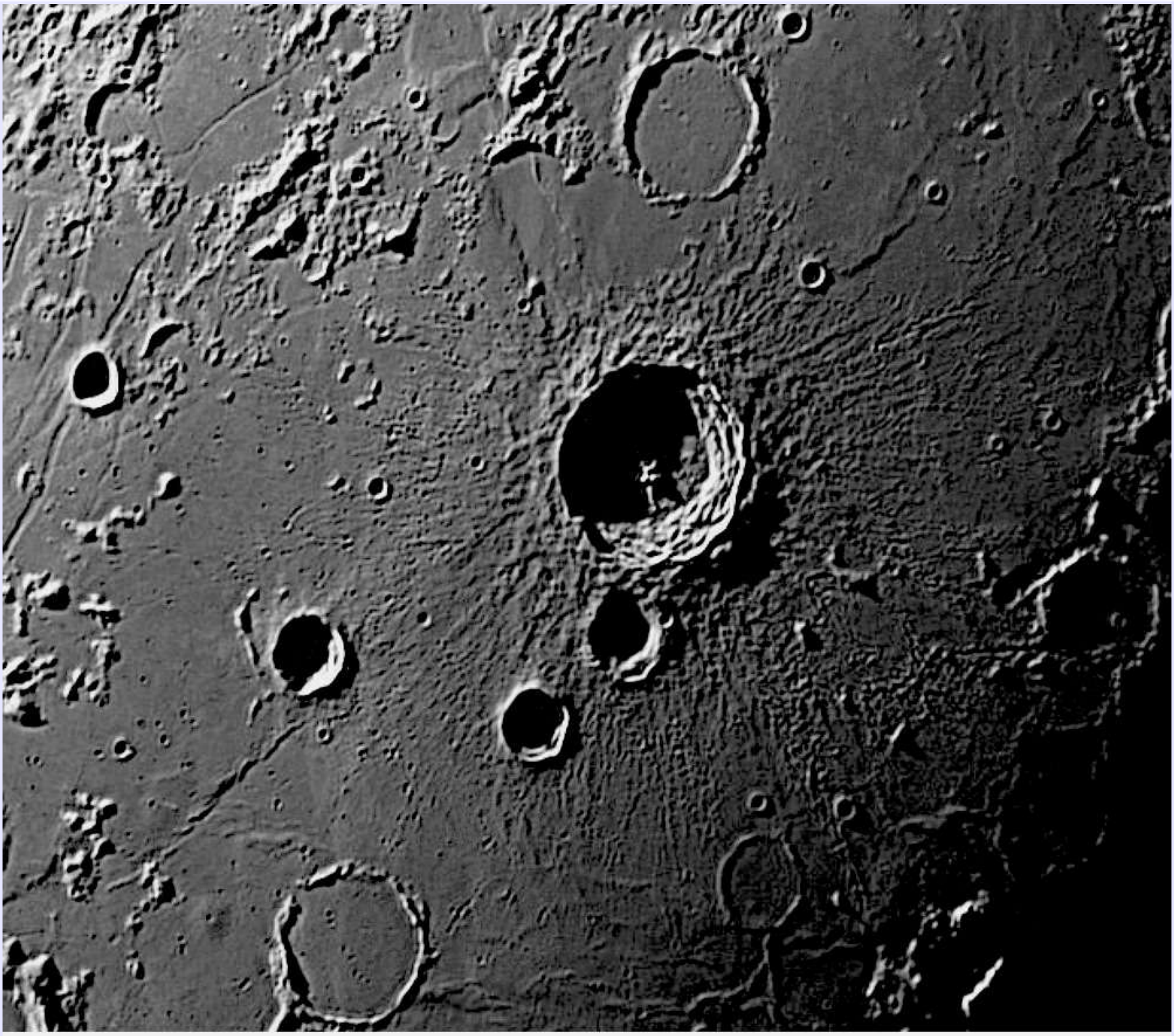
Below and left of Moretus is a large pool of dark overlapping ovals. The upper lobe of this pool is the crater Newton D that overlaps Newton (62km) to the south, which in turn overlaps another crater a little closer to the pole, Newton G. At the bottom of this pool of black, on the limb, is a bright rampart. This is the mutual wall of two craters Newton G and Newton A over our horizon and even further to the south. It is a very high plateau well shown on the USGS 1:1 million-Scale Maps of the Moon. This is as close to the pole as we can get here, still only -80°.

Copernicus and Clavius.



Both images by Luigi Morrone taken on 20th March 2024 at 1757hrs (top) and 1820hrs (bottom).

Bullialdus.

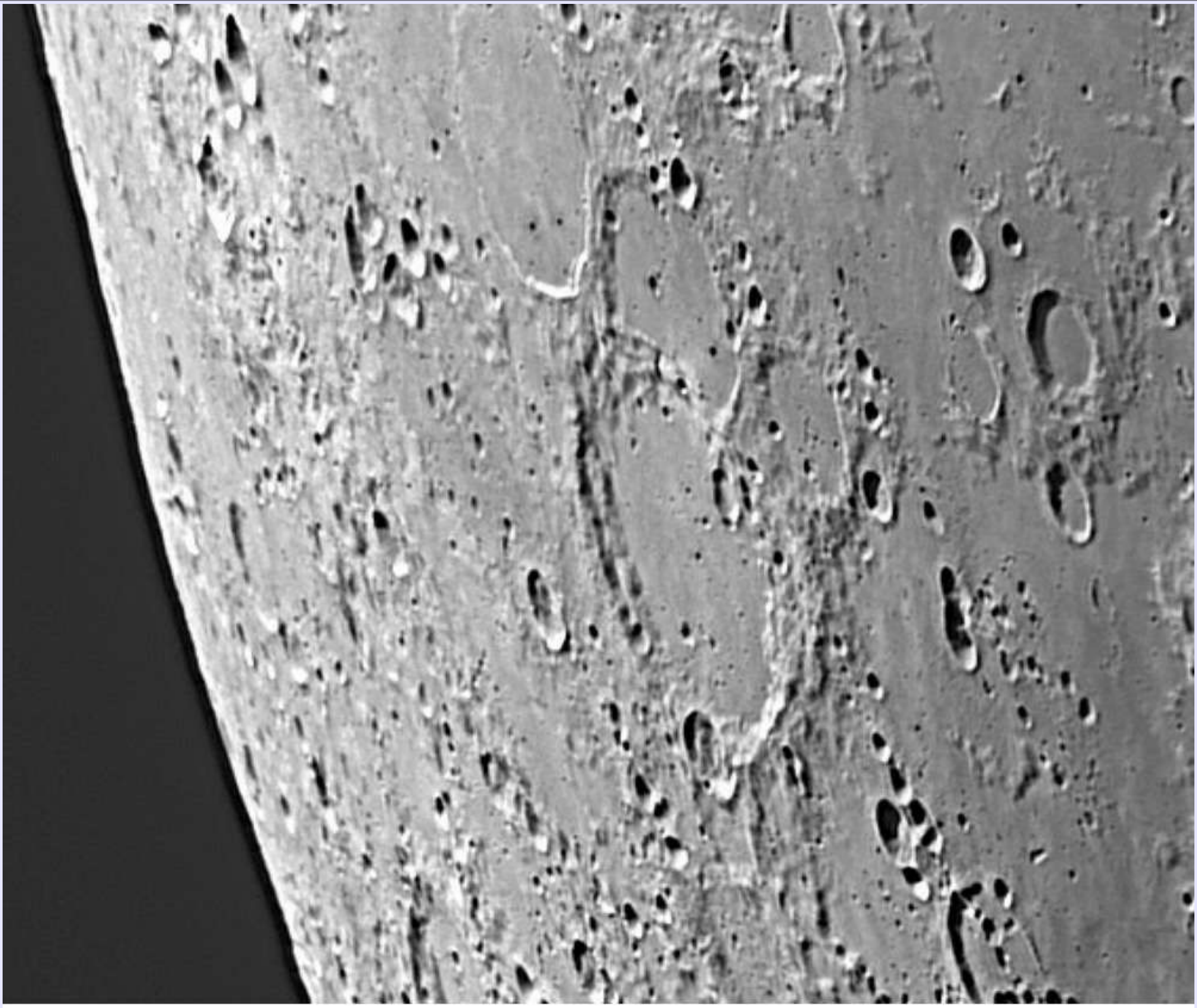


Bullialdus 2023.10.08 - 09.30 UT

300mm Meade LX90, ASI 224MC Camera with Pro Planet 742nm I-R Pass Filter
750/3,000 Frames. Seeing: 7/10. Rod Lyon

Image by Rod Lyon with details of time/date and equipment as shown.

Phocylides and Nasmyth.



Phocylides & Nasmyth 2023.10.08 - 09.19
300mm Meade LX90, ASI 224MC Camera with Pro Planet 742nm I-R Pass Filter
750/3,000 Frames. Seeing: 7/10. Rod Lyon

Image by Rod Lyon with details of time/date and equipment as shown.

Sinus Iridum Ray.

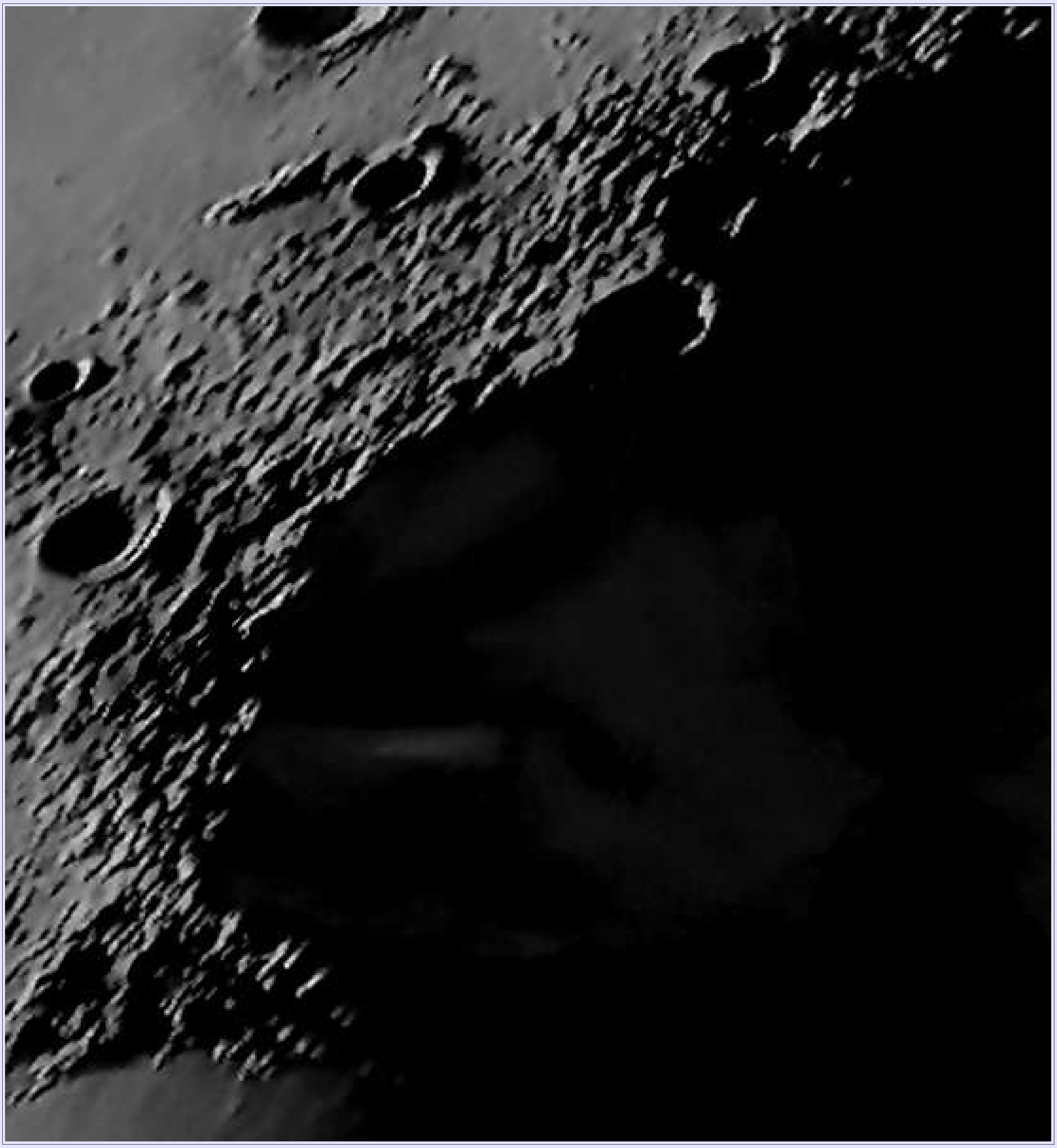


Image by K.C. Pau which shows the last streak of evening sunlight on the floor of Sinus Iridum. Taken on 10th April 2018 at 21h01m UT with 250mm f/6 Newtonian reflector + 2.5X barlow + QHYCCD 290M camera.

Lunar occultation of Saturn.

Images by Alexander Vandenbohede from a cloudy Bruges using a Sony alfa58 DSLR on a Celestron C8 SCT.

Saturn occultation August 21 2024. Generating a semi-synthetic high-dynamic range image of Saturn near the lunar limb by Raffaello Lena.

Introduction:

This article describes the method used for a full reconstruction of the occultation during the ingress phase. Lunar images of the Saturn occultation were taken on August 21, 2024, between 02:30 and 04:00 UT from Rome, Italy. The seeing was estimated as II Antoniadi and transparency as 3 (scale between 1 poor to 5 excellent). AVI films were made using a Mak Cassegrain 18 cm and a QHY 5 SIII 290 color camera at a gamma of 1.0, with variable gain and exposure times. The images shown in this note are the composition, given the notable difference in brightness between the planet and moon, of a correctly exposed image of the planet and one of the lunar limb.

Material and Methods:

Planet Saturn.

The image of Saturn was obtained from an AVI film made using a variable extension tube. After alignment and stacking with the Autostakkert III software package, the raw image (1500 frames stacked with the option normalize stack 75% and Sharpened blend Raw in 30%) was saved in TIFF format. The image obtained with a slight deconvolution was then processed using the Iris 5.34 software package with the following prompt commands: >mult 0.9 >mmse 500 2 >crisp 0.30 >af3 10. Hence, it was a combination of a slight low pass filter and a high pass filter. The final image was imported into Photoshop CS6 and further processed using another unsharp mask filter with a final adjustment of the levels, color balance and saturation. The final image, saved as BMP format, is the Master Frame A (see Fig. 1).

Figure 1: Saturn image (Master Frame A).

Lunar Limb.

A second AVI film was made on the lunar limb correctly exposed, at 40 fps because of degrading seeing, particularly evident close to the lunar limb. This procedure was necessary to cover the extremely high dynamic range of the scene, since the surface brightness of Saturn is much lower than that of the Moon. After alignment and stacking with the Autostakkert III software package (150 multi-alignment points of 90x90), the raw image (1600 frames stacked stacked with the option normalize stack 70% and Sharpened blend Raw in 40%) was saved in TIFF format and then processed with Iris 5.34, using a crisp filter. The final image was imported into Photoshop CS6 and further processed using another unsharp mask filter with a final adjustment of the levels, contrast, color balance and saturation.

The final image, saved as BMP format, is the Master Frame B (see Fig. 2).

Figure 2: Lunar surface (Master Frame B) where the Saturn occultation occurred. The processing is described in the text. Image cropped and reduced in dimension.

Occultation ingress.

A third AVI film was made during the occultation and it shows the ingress phase of the planet. The AVI film (ingress.avi) was imported into the program Virtual Dub and was then cut into an AVI segment at several times (including the first and last contact). The AVI segments were imported into the program K3 CCD Tool, obtaining several selected frames (ingress_series.bmp).

***Generating a semi-synthetic high dynamic range image of Saturn near the lunar limb: r*reconstruction of the ingress.**

For this work I selected 6 separate frames of the ingress_series.bmp. The selected frames of the ingress_series.bmp and the Master frame A were imported into Photoshop CS6 in order to obtain composite images. This process creates two separates layers assigned to each of the ingress_series frames (ingress_frame 1 to ingress_frame 6) and Saturn (Master frame A), respectively.

The image of Master frame A was selected and an area corresponding to the globe of the planet was copied by pressing "Ctrl-C" and pasted onto the ingress_frame 1 by pressing "Ctrl-V". Accordingly, Photoshop creates a new layer. It is important to align each layer obtaining the best superimposition of the globe in Master frame A onto the correct position of the globe in the ingress_frame 1. It was obtained using the "move tool", reducing the opacity (30%) and fill (86%). Two different layers were blinked in order to verify the correct fit. In the same way the lunar limb correctly exposed (Master frame B) was copied by pressing "Ctrl-C" and pasted onto the composite file. I have added the best Saturn image (Master frame A) with the option "if lighten at 100%", in a way those results are simply the Saturn images, cut from the bright lunar limb. Finally the layers, reported at initial opacity and fill of 100%, were flattened into a single image. This method was used for all others frames of the ingress_series repeating the same procedure.

The relative position of the Moon (lunar limb correctly exposed) and Saturn is metrically correct. It was determined based on structures visible at the lunar limb in the original video images (Figs. 3-5).

Figure 3: Composite image of the ingress series. See text for explanation.

Figure 4: Another composite image of the ingress series. See text for explanation.

Based on this procedure a mosaic was obtained showing the planet disappearing during the ingress phase (mosaic in Fig. 5).

Animation.
The single images may be easily co-registered also using Registax 5.0, with an alignment and optimizing process. At the end of the process, and after the optimization, Registax allows the creation of an AVI film. An animation may be obtained with the software Virtual Dub. An animation is a sequence of frames which is displayed over time. Each frame varies slightly from the preceding frame, creating the illusion of movement when the frames are viewed in quick succession. The previously chosen images are our frames that we want to view in quick succession. Finally a delay was assigned to each frame and a looping was specified so that the animation runs continuously (Fig. 6.Click on the image and start the animation).

Figure 5: Mosaic obtained regarding the reconstruction of the ingress and based on six images. Mosaic reduced in dimension.

Figure 6: Animation: click on link at https://britastro.org/observations/userimg/20240821_170941_3eb2b0929a08.gif*)*

Creation of a video clip.
As described in the previous section, an AVI film is created and it can be edited using Virtual Dub and the filters available. A reduced fps can be used to see the occultation run slowly. Hence a video clip can be published using YouTube channel (Fig. 7) and sharing the results in the web.

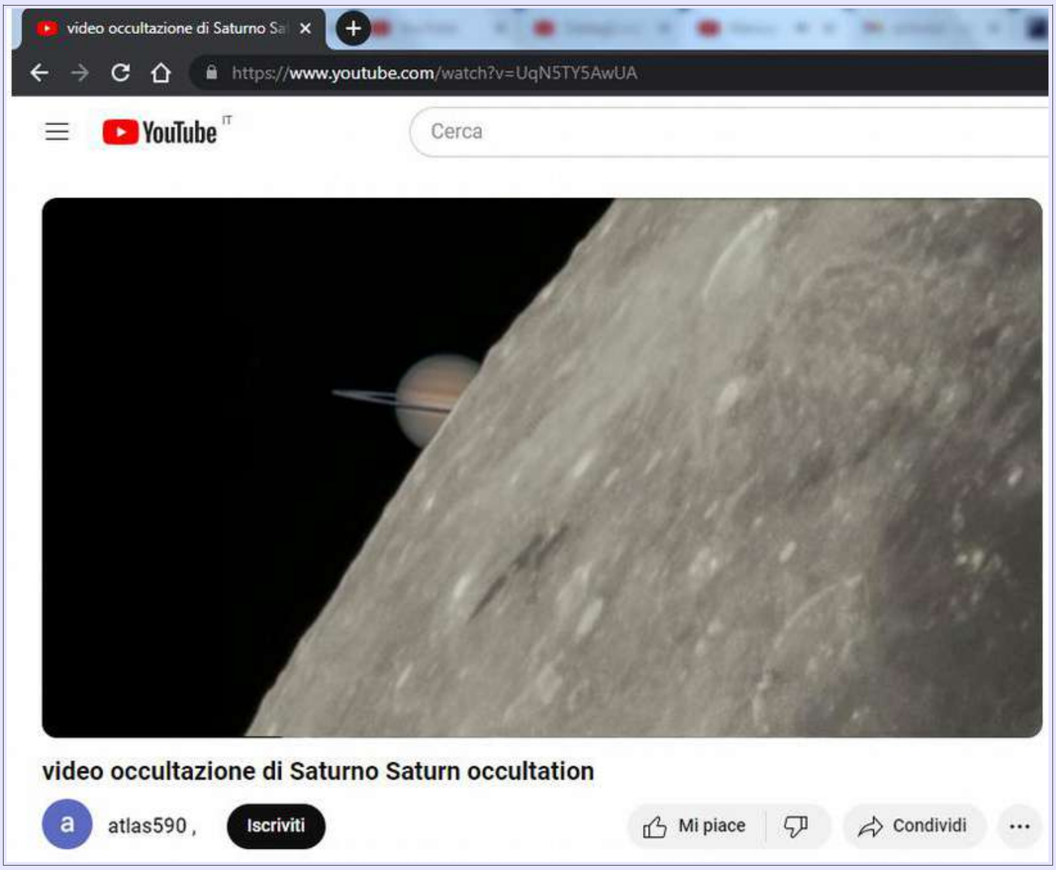


Figure 7: YouTube video of the author - click on the link at https://www.youtube.com/watch?v=UqN5TY5AwUA

Conclusion.

This article has described the methods utilized for the reconstruction of the examined occultation of Saturn by the Moon. Several high-resolution images are presented which show the ingress phase. The frames were processed with the method of composite images, using Photoshop CS6 to generate different layers. A second approach was used to generate a semi-synthetic high-dynamic range image of the planet during the ingress. This complex procedure is necessary in order to compensate for the strong difference in luminosity between the lunar limb and the planet during the occultation. The processed images are also used to create short animations and a final video clip of the occultation. The proposed method may deserve further experimentation and implementation.

……..§………

Lunar Cold Spots.
By Barry Fitz-Gerald.

What is a Lunar Cold Spot (LCS) and why are they cold? Well, the short answer is that they are areas of the lunar surface that show anomalously low nighttime temperatures, that are invariably associated with, and surround very young impact craters. There are some 2000 + known on the lunar surface, with the 'source' craters varying in size from a few 10's of meters up to somewhere around 2.5kms. In comparison to the 'normal' ejecta surrounding these craters, the cold spot itself can extend from ~ 10 – 100 crater radii out, showing that whatever is causing the coldness is not material thrown out of the crater. From the perspective of the average lunar observer, these features are effectively invisible, and the only way to study them is to use data from the Diviner Lunar Radiometer Experiment on LRO, with a number of overlays using this data being available in Quickmap, and available under the LRO Diviner tab.

The surface temperature mapping by Diviner reveals in detail variations in the lunar surface temperature, and of particular use is the Nighttime Soil Temperatures, as these are dependent on the thermal and physical characteristics of the surface, with a strong correlation between the two. This can be understood by considering a patch of the surface consisting of boulders and one dominated by a fine grained regolith. During the lunar day both areas heat up, but during the lunar night they cool down, with the rate of cooling dependent on surface area/volume ratio, with smaller rocks and regolith particles cooling more rapidly than larger ones. Density can also affect the cooling rate with less dense deposits cooling more slowly than denser deposits – and this could be influenced by the degree to which the regolith is compacted or otherwise. The overall effect is that areas with a rocky nature and where the regolith is dense retain their heat in the chill of the lunar night, whilst areas dominated by fine grained material or of a lower density loose their heat and cool down rapidly. The temperature differential between a cold spot and the adjacent surface need not be dramatic - and the temperature differences which can as little as 2° K.

The exact mechanism responsible for the cold spot production is still subject of some debate, but it appears to related to some form of regolith modification that has been compared to 'fluffing up' of the upper layers of the regolith, effectively reducing its density and forming an insulating layer that lowers the heat loss from below. The 'fluffing up' may be the result of a bombardment by small grains of material produced by horizontal flows of granular ejecta or possibly by the effect of the passage of a gas phase over the surface with the pressure differentials generated by it effectively 'sucking' the fine surface regolith up into a less dense configuration. Whatever the process involved, that actual surface itself shows no indication of this disruption in the available imagery, and the surface within the cold spot is indistinguishable from that beyond its boundary.

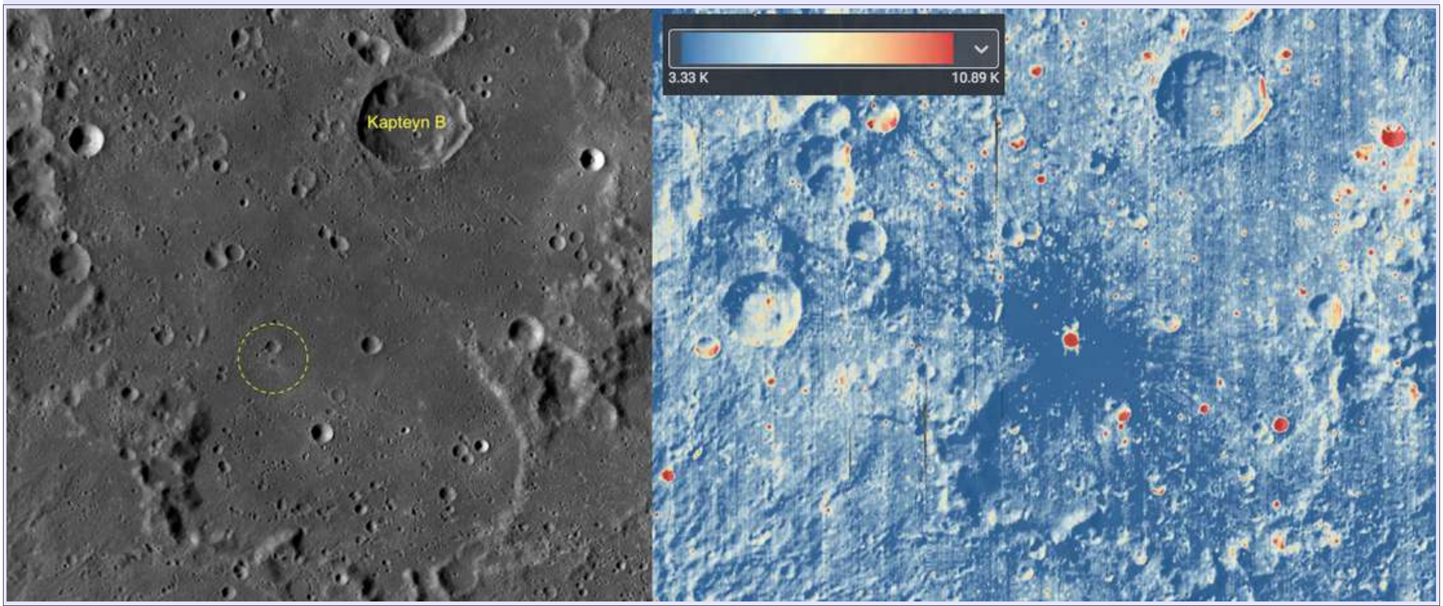


Fig.1 A Lunar Cold Spot associated with 900m diameter crater within Balmer shown in a wide angle view (left) and using a LRO DIVINER Nighttime Soil Temperature overlay (right). Note the extensive cold spot showing up as blue in this rendition.

Fig.1 is a typical LCS, this one located where the northern rim of Balmer should be – and this one *is* visible telescopically as discussed in an article in the October 2023 LSC. The crater itself is ~ 900m in diameter and whilst the densest part of the LCS is some 85kms across, thin tendrils can be seen to extend outwards some 110kms either side of the crater. This is because the ejecta is arranged in a 'butterfly pattern' with a Zone of Avoidance to the SW showing that the impact was of a low angle impactor travelling SW-NE.

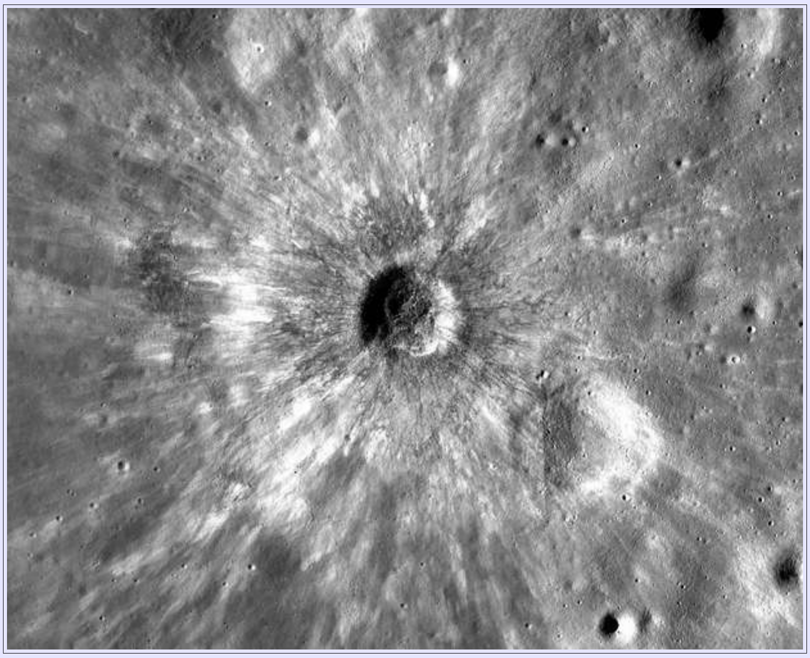


Fig.2 LRO NAC image of the crater identified in Fig.1 – note the very rocky deposits in and around the crater, and the feathery deposits beyond about 1 crater radius out.

Fig.2 is an LRO NAC image of the crater, and as can be seen the crater itself and the proximal; ejecta is dominated by bouldery deposits which result in the red colour coding in Fig.1. Beyond the rocky deposits high albedo feathery ejecta can be seen, and this is thought to be the result of a horizontal granular type flow of process, and which in close up views can be seen to be composed of multiple overlapping layers. Fig.3 shows a close up of this type of ejecta from the crater in Fig.2, and as can be seen there is ample evidence of local material being excavated by secondary impacts from the main crater, with the surface of the ejecta being scored in a myriad of radial elements. But as noted above, even this ejecta does not extend out as far as the cold spot margins, and when this ejecta peters out at distance, the surface looks completely undisturbed, despite still being within the cold spot boundary.

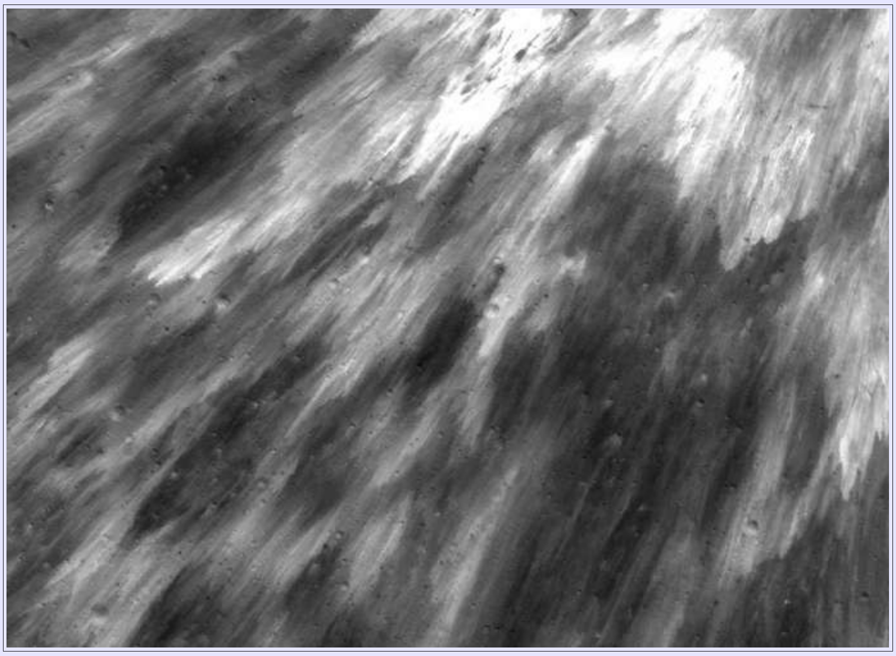


Fig.3 Detail of the feathery ejecta in the crater shown in Fig.2

Cold spots are transient features, and age rapidly in lunar terms, with a lifetime numbered in the hundreds of thousands of years and not the millions or billions we are normally used to when considering the Moon. One age estimate based on crater counts within the ejecta blankets suggest that a cold spot produced by an 0.8km crater would have an age range between 200 ka to1.1 Ma, whilst smaller ones could be obliterated in a little as 150ka – this is probably in keeping with the rate at which the upper few centimetres of the regolith is modified by micrometeorite bombardment and space weathering, so the cold spots that are visible are some of the youngest features we will ever see on the lunar surface.

Can cold spots be of any use to us in our own investigation of the Moon surface however? Well, it has crossed my mind that it might be possible to match some of these cold spots to some of the many reports of bright flashes having been observed on the Moon and which may represent recent impacts. Now, this could be an interesting exercise, but we are obviously dealing with a number of unknowns, with the veracity of the original observation, uncertainty in the location of the reported flash and the age of any cold spot crater present being three of the most salient ones. Having said that many recent impact flashes have been correlated with new craters detected in 'before' and 'after' images by LRO, so a delve into the historic records to hunt down likely candidates might (or might not) at least reveal some potential candidate craters that could match the observations.

The fact that LCSs age rapidly might be of some use here, but having said that a number of cold spots can exist within close proximity, making any potential identification impossible. There is also the added complication that not all recent impacts result in cold spots as demonstrated by the Apollo S-IVB boosters that were deliberately crashed onto the surface and did not result in any identifiable cold spots being produced. These had a mass of 13500kgs (13.2tons) and produced craters in the 40m size range. Some impact craters of this size *are* associated with cold spots so clearly some other factors must come in to play and a newly formed crater might not necessarily be associated with a thermal anomaly. Topography also has an impact of cold spot visibility due to the presence of slopes and depressions which influence the way heat is gained during the day and lost during the night.

I have made a start by going back through the Lunar Section archives to search for impact flash reports and hope to write up some findings in due course – perhaps you might care to join in the hunt?

For further reading see:

Williams, J.-P., Bandfield, J. L., Paige, D. A., Powell, T. M., Greenhagen, B. T., Taylor, S., et al. (2018). Lunar cold spots and crater production on the moon. Journal of Geophysical Research: Planets,123, 2380–2392. https://doi.org/10.1029/2018JE00565

Bandfield, Joshua & Song, es & Hayne, Paul & Brand, Brittany & Ghent, Rebecca & Vasavada, Ashwin & Paige, David. (2014). Lunar cold spots: Granular flow features and extensive insulating materials surrounding young craters. Icarus. 231. 221–231. 10.1016/j.icarus.2013.12.017.

Lunar Impact Flash Locations From NASA’s Lunar Impact Monitoring Program. NASA/TM—2015–218213 https://ntrs.nasa.gov/api/citations/20150021386/downloads/20150021386.pdf

…......§.........

Basin & Buried Crater Project by Skylar Rees and Tony Cook

Sinus Asperitatis (Bay of Roughness)

This month, we look at another basin, or perhaps buried crater, or both? "Asperitatis" appears in the basin catalog at 27°E, 8°S with a proposed diameter of 730 km. The mare material from Sinus Asperitatis lies in the corridor between Mare Tranquillitatis and Mare Nectaris, south and southeast of it respectively. It's centre is found at around 27°E, 4°S on the lunar nearside, and the eponymous mare is about 206km long. There are many nearby large craters such as Theophilus and Cyrillus. Then you have a buried crater by the same name of "Sinus Asperitatis" that lies at 28.2°E, 5.4°S and is 87 km in diameter and has a more recent crater, Torricelli above its centre.

As before, we infer from morphometric, gravitational and even geological filters on the NASA QuickMap web site. Remember if it is a basin it is of the order of 300km or so in diameter, where as if it is a buried crater then it is under this size. Up to an approximate diameter of 100km complex craters have central peaks, but for larger sized craters the central peaks can become ring peaks. Of course with buried craters the peaks, ring peaks or indeed the rim may be partly obscured and buried.

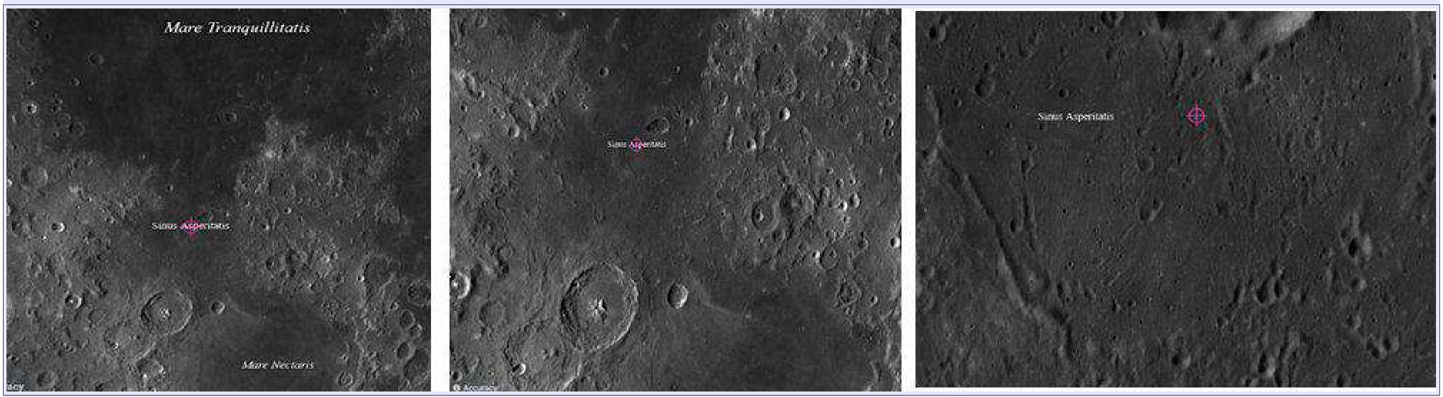


Figure 1. Views of *Asperitatis* using NASA's QuickMap mosaic tool. **(left)** *Asperitatis* is nestled between *Tranquillitatis* and *Nectaris*. **(centre)** Closer view of *Asperitatis* itself. **(right)** close-up of the suggested buried crater region.

Fig.1 (right) shows a vaguely diamond-like trace with a raised south-to-west edge. Many small craters seem to dot around this area as if constrained by its rim. The surviving rim seems to have a smooth and higher-albedo 'pile' next to it, which could indicate the ejecta from a now-buried impact. Moving anticlockwise from the *Sinus Asperitatis* label there is another vaguely concentric distribution of small impact craters.

TerrainSlope (Fig.2 centre) shows the partial rim of the buried crater though in general we see a flat surface surrounded by grooved, negatively sloping walls. The TerrainAzimuth (Fig.2 bottom) overlay shows the buried crater less well, but there appears to be some concentric arcs beyond the rim, further to the east. In both plots the buried crater is elongated in the N-S direction slightly. Just north of the centre of the buried crater is Torricelli – it is interesting to see that this sits upon a circular domed structure.

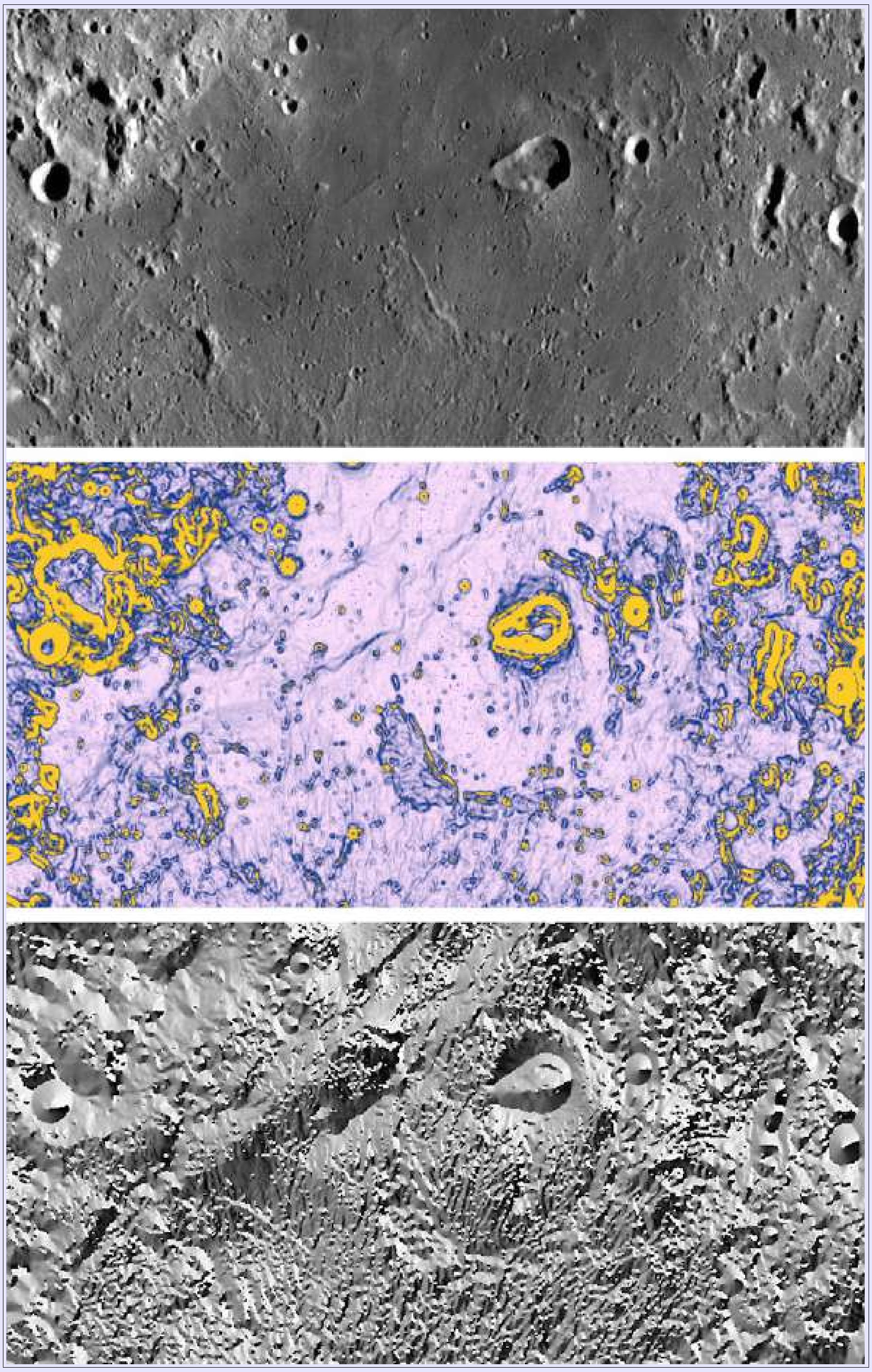


Figure 2. (Top) NASA LROC WAC image mosaic with shadows. **(Centre)** *TerrainSlope* filtered view, showing height variation. **(Bottom)** *TerrainAzimuth* view, highlighting impacts as 'aberrations' to the direction of azimuthal light. Scale for all three images is 350 km wide horizontally.

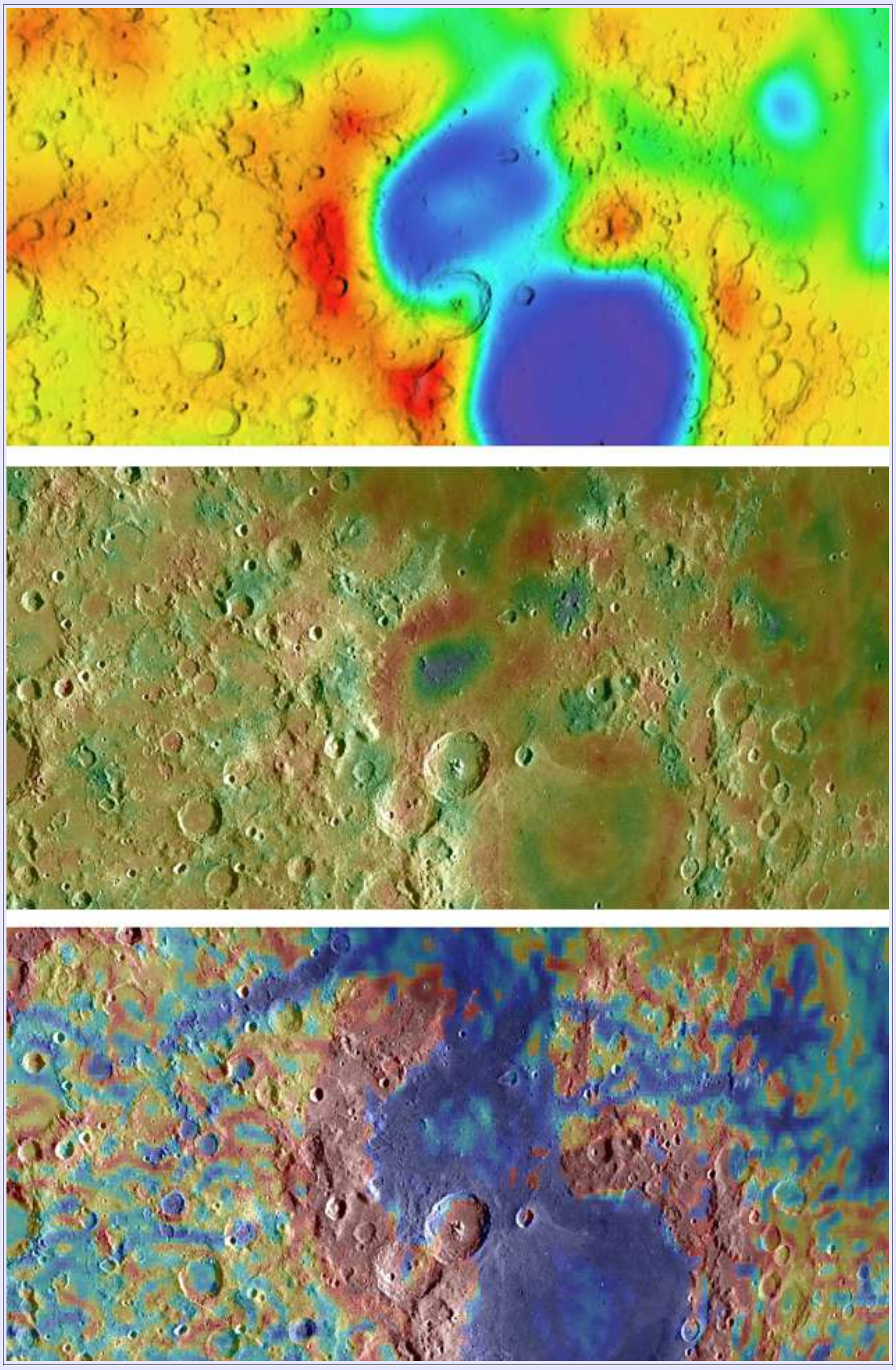


Figure 3. (Top) GRAIL Crustal Thickness map. **(Centre)** Bouguer Gravity (degree 6 to 660) with shading. **(Bottom)** Bouguer gravity gradients.

The crustal thickness map (Fig 3 Top) shows a thin crust, where the Asperitatis basin centre is supposed to be, and three reddish thick crust areas where a possible rim may be. The Bouguer gravity map (Fig 3 Centre) shows a non-mascon basin, but not all basins have mascon's at their centres. Finally the gravity gradient map (Fig 3 – Right) has a nice broad gradient arc on the western side of the basin

Is *Asperitatis* a buried crater or basin or both? The buried crater in Fig 1 may be related to the basin, perhaps an inner ring, or alternatively it may just be, by coincidence, another buried crater? Further telescopic evidence of the remains of the basin or buried crater would be appreciated.

Ed Comments: For more on this area, and particularly the southern rim of Sinus Asperitatis please have a look at 'In and around Torricelli' by Barry Fitz-Gerald in the January 2023 LSC.

Lunar domes (part LXXXIII): Lunar dome near Sömmering crater.
By Raffaello Lena and Barry Fitz-Gerald.

During a recent survey a possible dome was identified near the crater Sömmering. Some telescopic images of this feature, examined in the current study, are shown in Figs. 1-2.

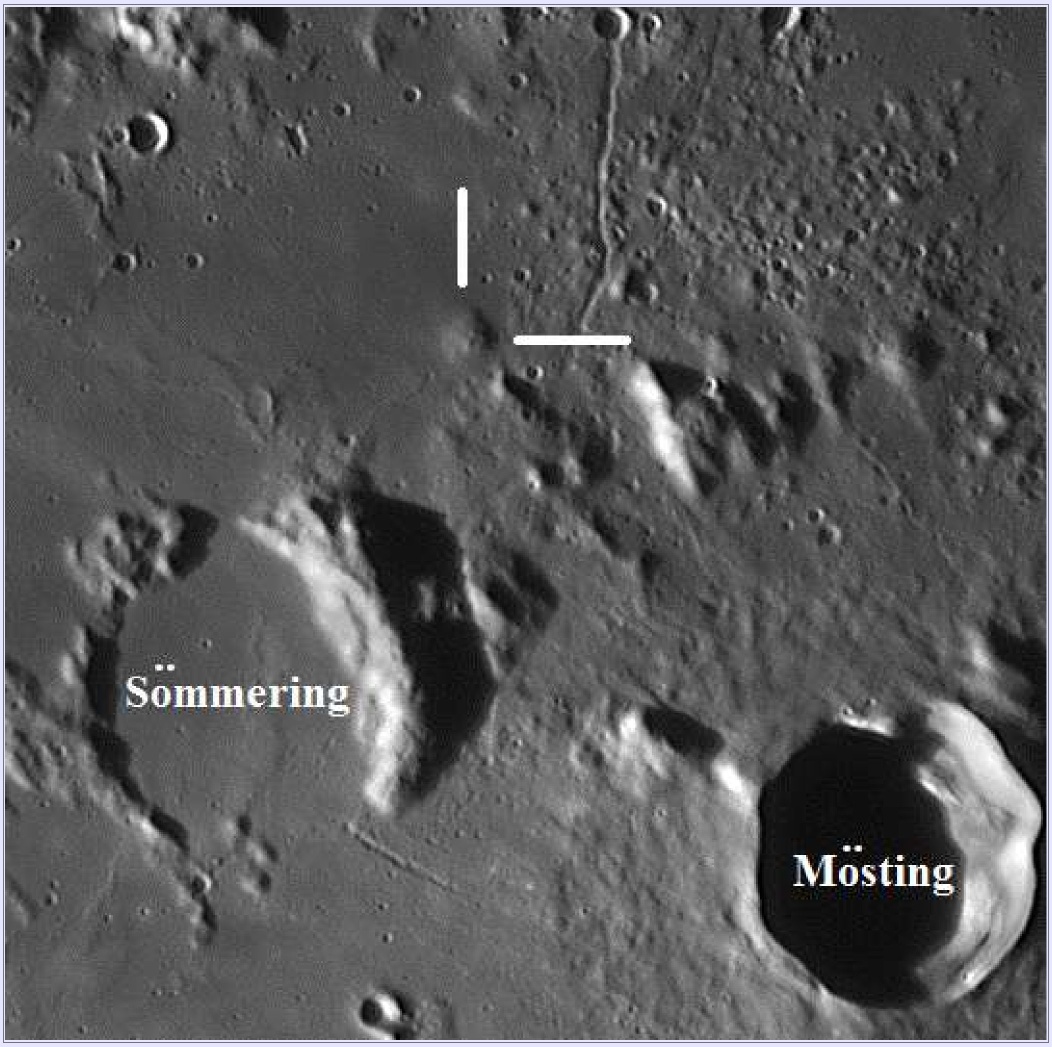


Figure 1: Lunar region imaged by Viladrich on October 28, 2021 at 5:19 UT. The examined feature to the NE of Sömmering is m*arked with white lines.*

Christian Viladrich has imaged the examined region on October 28, 2021 at 5:19 UT (Fig. 1), using a 500 mm Ritchey-Chrétien telescope.

On the same night, but at 4:09 UT, Teodorescu has imaged the same region using a 355 mm Newtonian telescope (Fig. 2).

A WAC imagery is shown in Fig. 3 and the examined feature, located at 1.0 ° N and 6.7° W, is marked with white line. A fissure (about 1 km) is present on the summit and 50 m depth.

Morphometric properties based on LRO LOLA DEM. ACT-REACT Quick Map tool was used to access to the LOLA DEM dataset, obtaining the cross-sectional profile of the dome (Fig. 4). An elevation map of the examined volcanic dome is reported in Fig. 5. The dome diameter amounts to 5.5km. The height is determined to be 210m, resulting in an average slope of 4.2°. A 3D reconstruction is shown in Fig. 6.

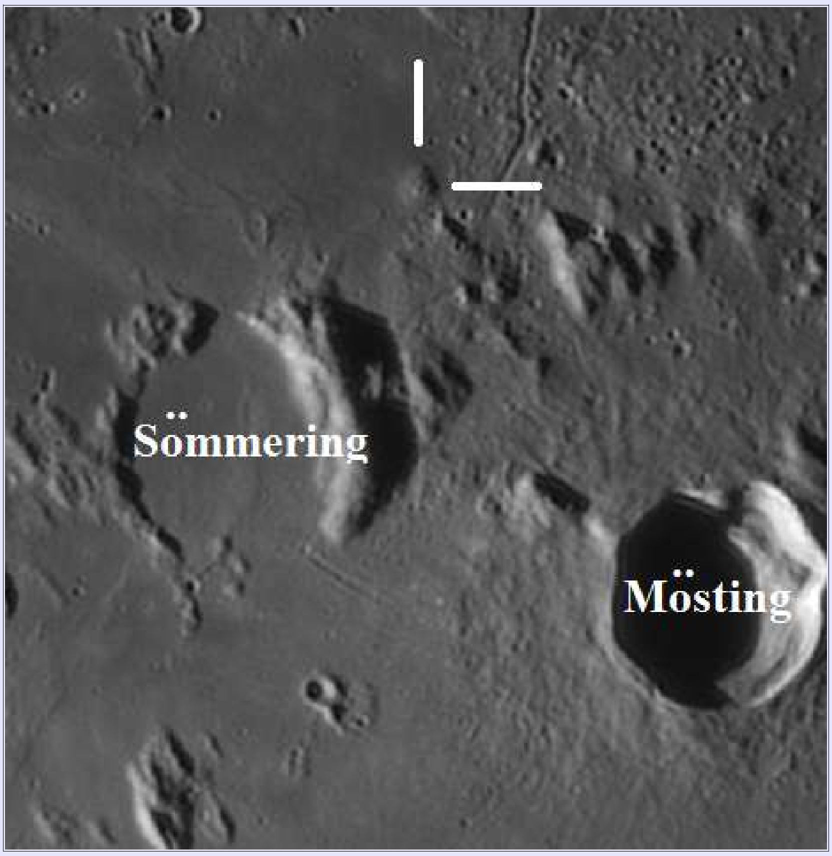


Figure 2: Lunar region imaged by Teodorescu on October 28, 2021 at 4:09 UT. The examined feature to the NE of Sömmering is marked with white lines.

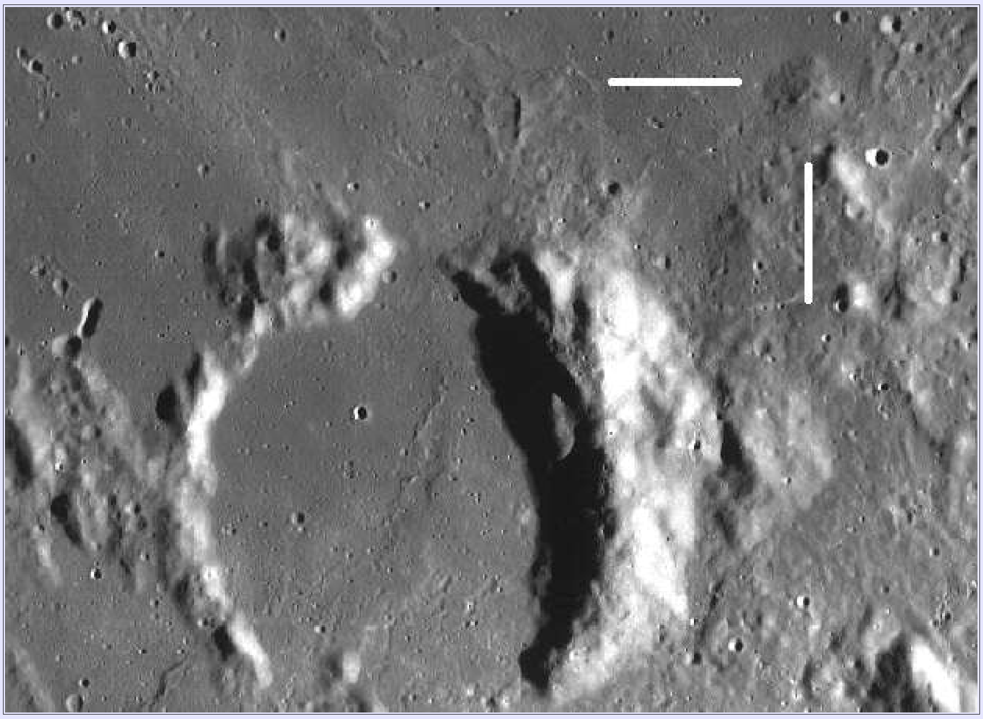


Figure 3: WAC Imagery including the examined dome.

Spectral properties: Diviner Lunar Radiometer Experiment (spatial resolution of 950 m/pixel) produces thermal emissivity data, and provide compositional information from three wavelengths centered around 8 µm that are used to characterize the Christiansen Feature (CF), which is directly sensitive to silicate mineralogy and the bulk SiO_2 content.These spectral bandpass filters are centered at 7.00, 8.25, and 8.55 µm. The major minerals of lunar soils- plagioclase, pyroxene, and olivine- have different ranges of CF values [1].

The feldspar and high silicic material, including quartz, silica-rich glass, and alkali and ternary feldspars are characterized by CF values of 7.8-7.3 µm. In case of olivine abundances the CF values is >8.7 µm[1]. Analyses of the Diviner CF map for the examined dome reveals that it does not display the short wavelength CF position characterizes silica-rich lithologies like the Gruithuisen domes. The average CF position is 8.35 ± 0.05 µm; this value is not different from the average CF position of the typical basaltic *maria*, which is 8.30-8.40 µm. Hence, the examined dome is not enriched in silica relative to the surrounding mare units and displays a classic basaltic composition.

The spectral data derived by Chandrayaan-1 Moon Mineralogy Mapper (M^3) display a narrow trough around 1,000nm with a minimum wavelength at 1009nm and an absorption band at 2,100nm (Figs. 7-8) corresponding to a typical high-Ca pyroxene signature[2], indicating a basaltic composition.

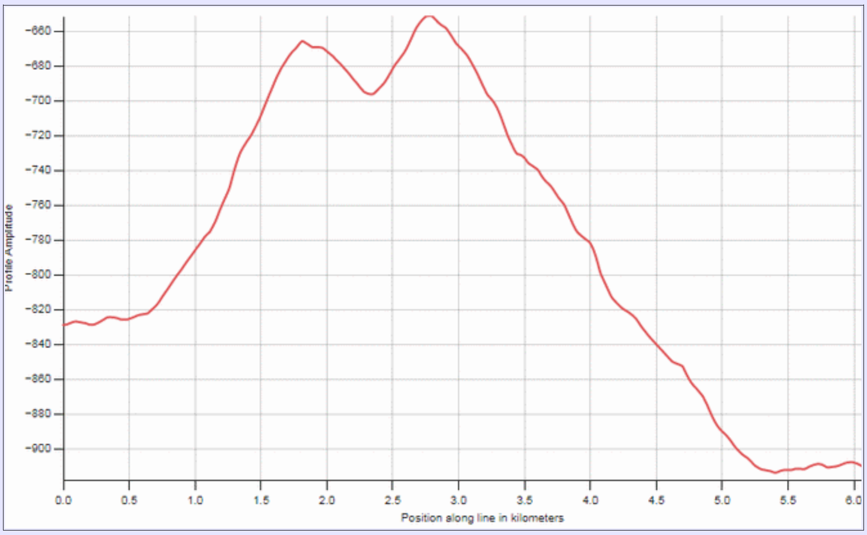


Figure 4: LRO WAC-derived surface elevation plot in East-West direction based on LOLA DEM.

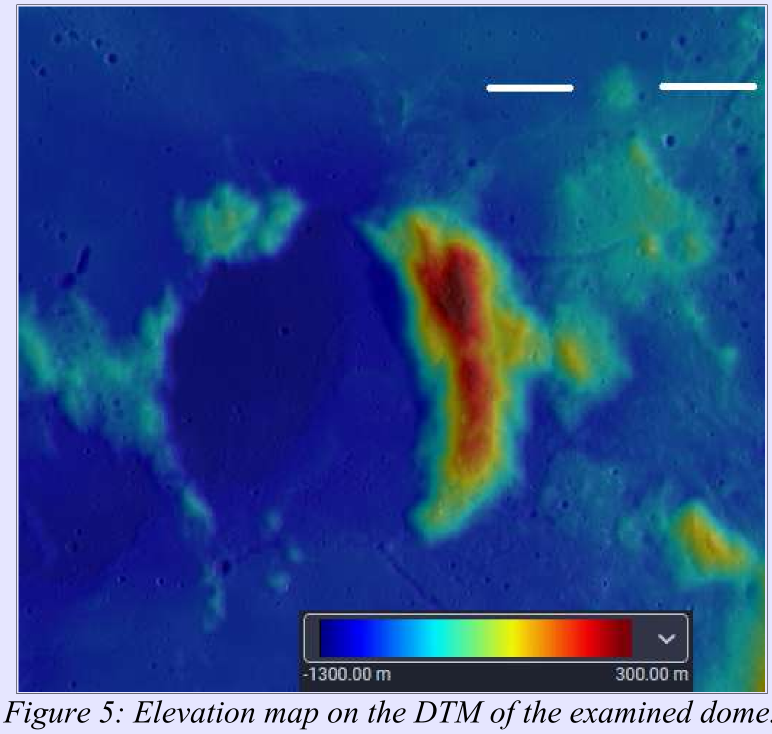


Figure 5: Elevation map on the DTM of the examined dome.

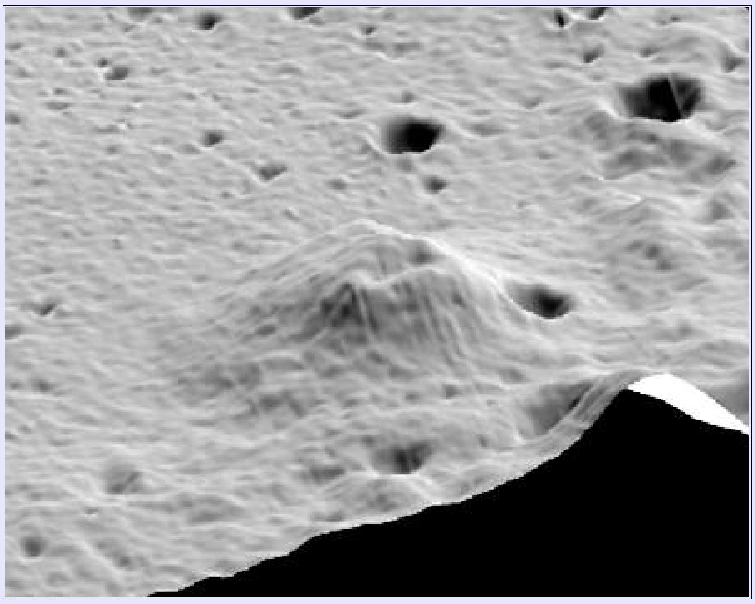


Figure 6: 3D reconstruction of the examined dome.

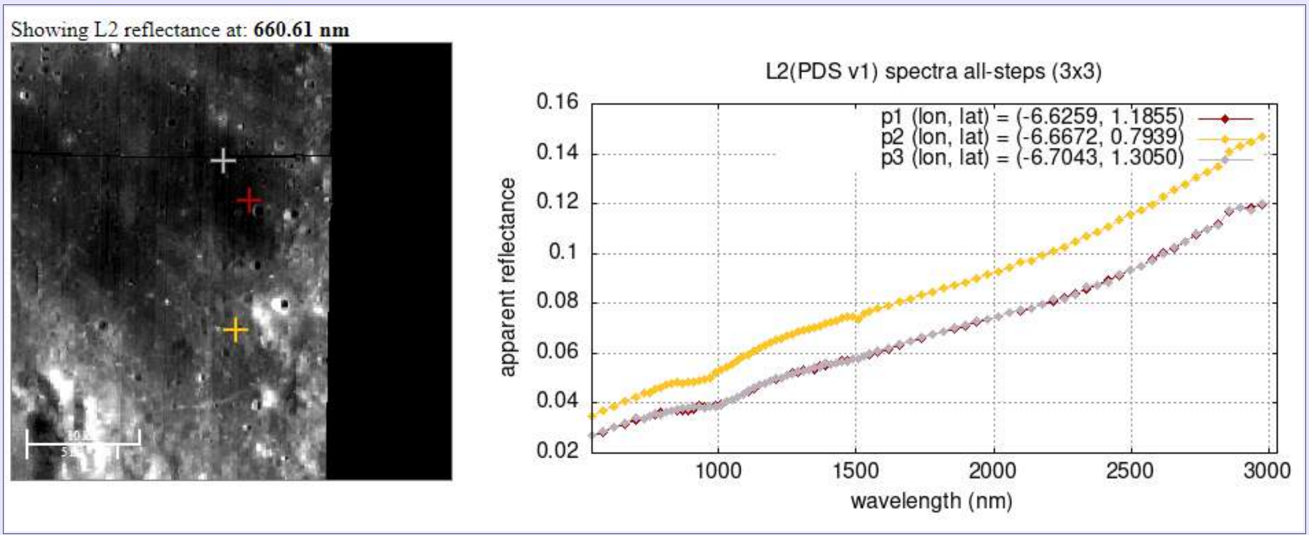


Figure 7: M^3 spectrum.Note the similar spectra from the dome (red) and the mare unit (white) different from the sampled highland (yellow).

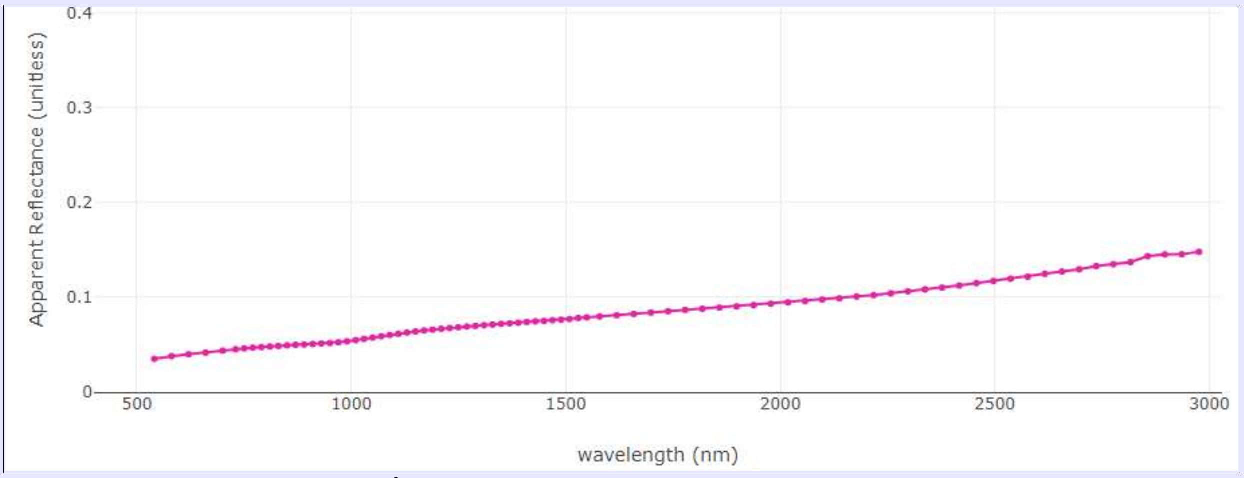


Figure 8: M^3 spectrum of the examined dome in Sömmering.

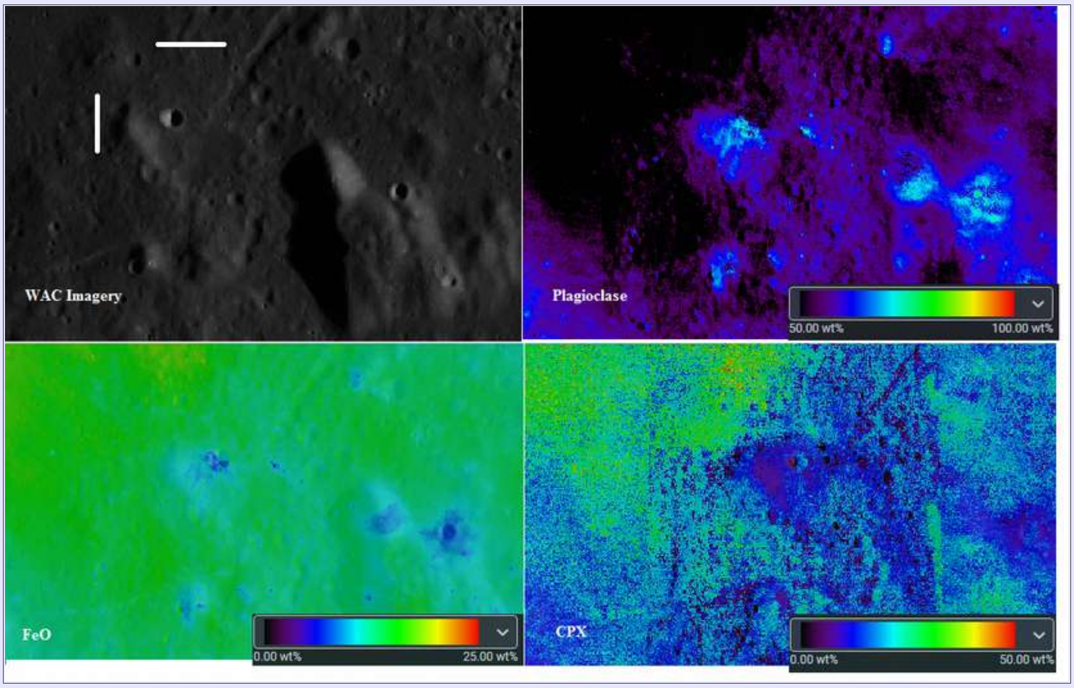


Figure 9: Multiband Imager (MI) data for mineralogical composition (Plagioclase, FeO and CPX).

Mode of formation and classification

The dome termed Sömmering 1 is located at 1.0° N and 6.7° W, with a diameter of 5.5km. The height amounts to 210m, yielding an average flank slope of 4.2°. Thus it is a steep dome, like the Hortensius domes [3-4]. The dome edifice volume is determined to 2.7km³ assuming a parabolic shape.

The rheologic model [3-4] yields an effusion rate of 25m3 /s and a lava viscosity of 1.8 x 107 Pa s. It formed over a period of time of 3.0 years. According to the classification scheme for lunar domes it belongs to class B1

Three rheologic groups of effusive lunar mare domes differ from each other by their rheologic properties and associated dike dimensions, where the basic discriminative parameter is the lava viscosity [3]. The first group R_1, is characterised by lava viscosities of 10^4 -10^6 Pa s, magma rise speeds of 10^{-5}-10^{-3} m s^{-1}, dike widths around 10-30 m, and dike lengths between about 30 and 200 km. Rheologic group R_2 is characterised by low lava viscosities between 10^2 and 10^4 Pa s, fast magma ascent ($U > 10^{-3}$ m s^{-1}), narrow ($W = 1$-4 m) and short ($L = 7$-20 km) feeder dikes. The third group, R_3, is made up of domes which formed from highly viscous lavas of 10^6-10^8 Pa s, ascending at very low speeds of 10^{-6} - 10^{-5} m s^{-1} through broad dikes of several tens to 200 m width and 100-200 km length.

Sömmering 1 was formed by lava ascending at speed of 1.1 x 10^{-7} m s^{-1} through a dike 140m width and 160km length. Thus it belongs to rheologic group R_3. Hence, if it is assumed that the vertical extension of a lunar dike is comparable to its length L [5], the dike length indicates that the magma that formed Sömmering 1, originated well below the crust or in the mantle.

Age. ACT-REACT Quick Map tool was used to access to the mare age units. In the corresponding map each polygon includes the unit name and crater size-frequency distributions model age. For the dome the model ages derived by ACT-REACT Quick Map tool indicates an age of 2.90 billion years ago which denotes Eratosthenian mare material (*Eratosthenian* period runs from 3.2 billion years ago to 1.1 billion years ago).

Sömmering 1 – an LRO view.

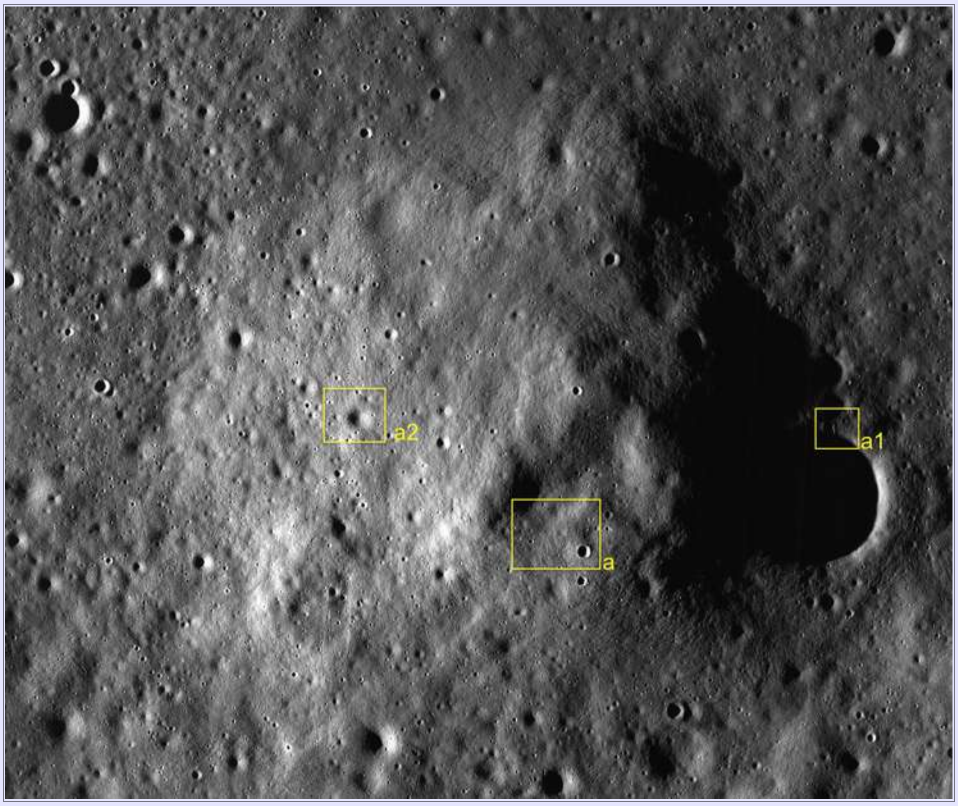


Figure10: NAC image of Sömmering 1 (with solar incidence angle between 80 and 89 degrees) showing the somewhat square outline, elongate summit vent and uneven flanks. Note the faint lineations orientated SW-NE running parallel to the vent long axis. Yellow boxes identify areas of interest discussed below.

Fig.10 is a NAC image of Sömmering 1, which shows some features that add support to the volcanic interpretation for this structure. The most obvious feature is an elongate summit depression which appears to be a vent, with the long axis orientated SW-NE. It measures some 1.3kms along this axis and reaches a depth of about 30m. This orientation may be related to a series of faint lineations that can be seen trending in the same direction, particularly on the northern and southern flanks and which give the northern 'edge' of the dome something of a straight edge, giving the dome an overall squarish look. There is a hint of a breach to the rim in this vent to the north, possibly a result of lavas overtopping the vent and flowing northwards down the flanks. What is also apparent is the hummocky surface, as opposed to the smoother surfaces we see in many other lunar domes, possibly indicating that the eruption style was somewhat explosive in nature.

The yellow boxes in Fig.10 identify the locations of features that support the volcanic interpretation suggested here. During the course of our investigations of domes and other volcanic areas, we have become aware of a class of feature that appears not to have been mentioned in the academic literature. These have been provisionally named 'immature Irregular Mare Patches' or iIMPs, as it is suspected that they represent small patches where the surface regolith has been removed by volcanic gasses venting from beneath the surface, a process implicated in the formation of some of the larger Irregular Mare Patches such as Ina. Physically they take the form of small (a few to several 10's of meters in scale) irregularly shaped light patches, which give the surface something of an 'etched' appearance. This is a consequence of them having a slightly depressed floor, which is not as deep as in the more well known classical IMPs, but possibly represents an early and limited stage of the same process. It is proposed that the light colouration of the patches themselves represents less optically mature/space weathered material that has been exposed as the more mature surface deposits were removed.

These iIMP's have been located on the flanks of domes, associated with summit vents as well as around the rims of small impact craters within volcanic areas. The yellow box 'a' in Fig.10 is shown in detail in Fig.11, and as can be seen a number of irregularly shaped pale iIMP's are visible on the inner wall of the summit vent.

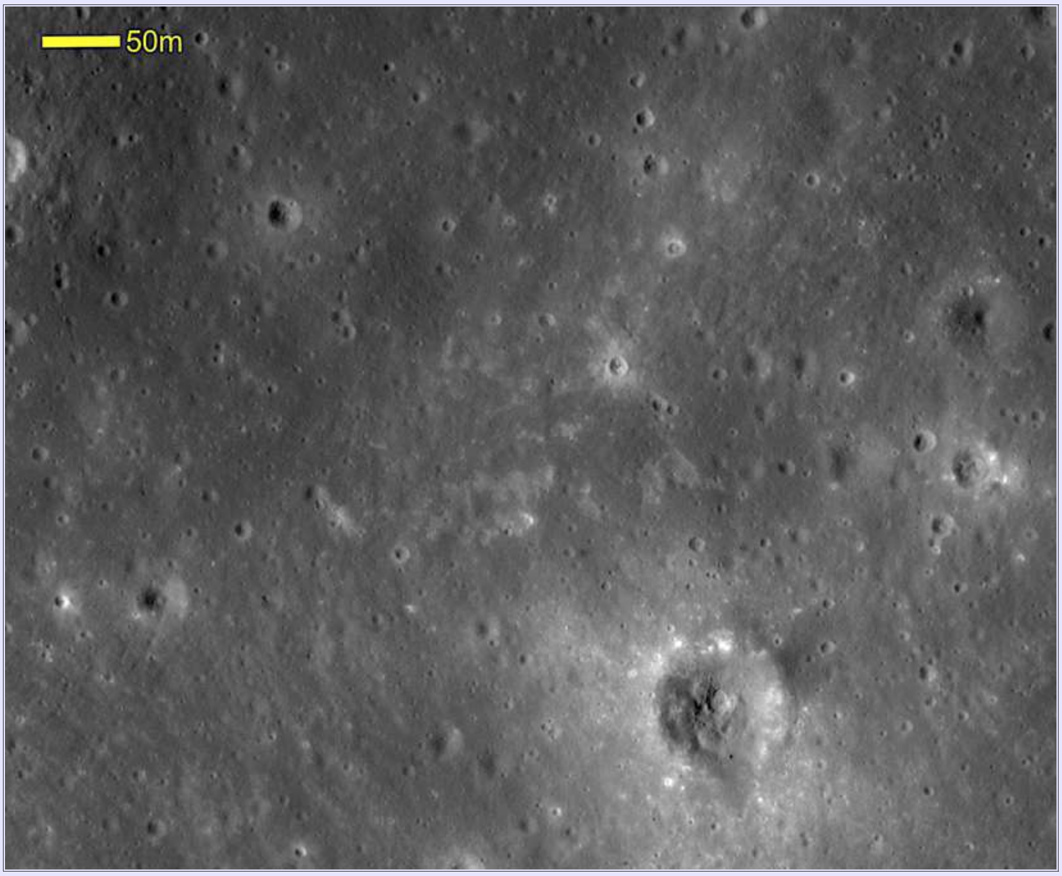


Fig.11 Detail of Box a from Fig.10 showing suspected iIMPs, which show up as irregular light patches on the inner southern rim of the summit vent. Note the slightly 'etched' appearance of the surface a typical result of presence of these features.

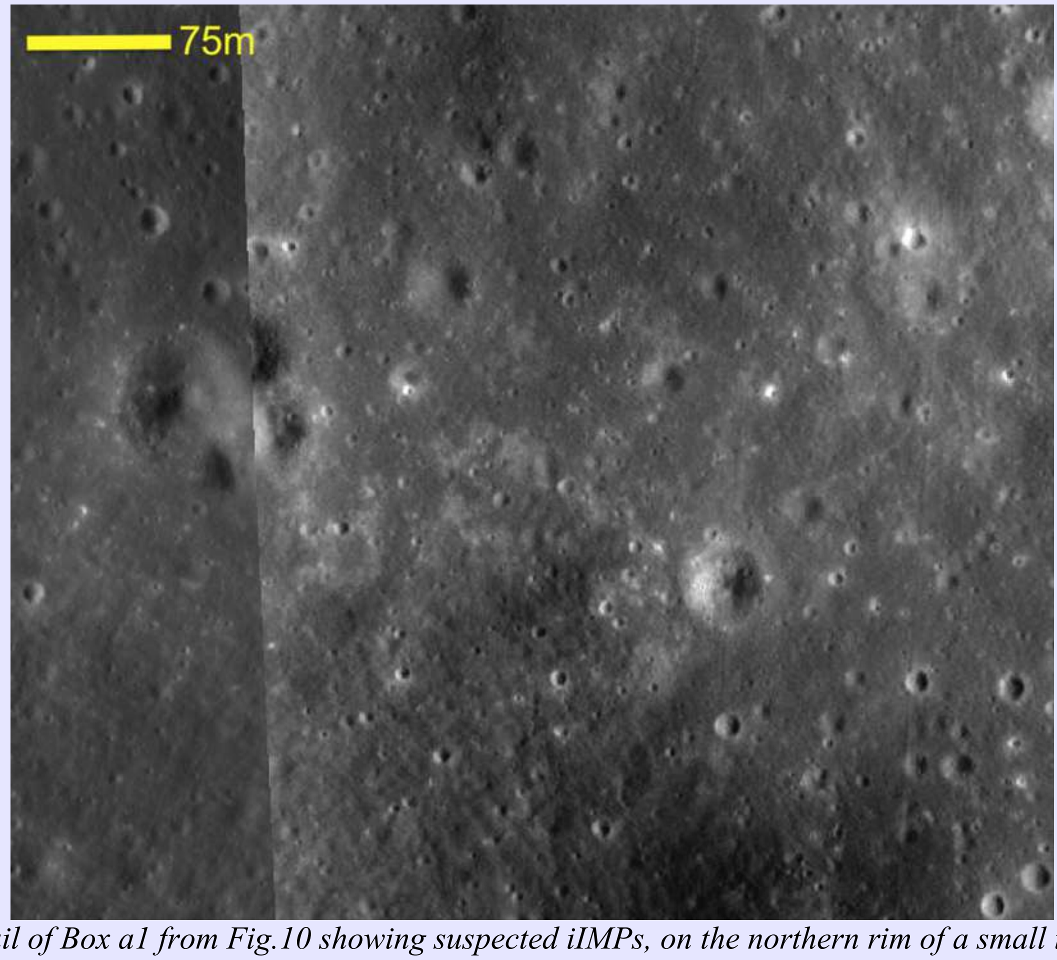


Fig.12 Detail of Box a1 from Fig.10 showing suspected iIMPs, on the northern rim of a small impact crater just below Sömmering 1's eastern flank.

Another patch of is iIMP's located in box 'a1' which covers part of the northern rim of a small impact crater (~ 1km diam.) just below the eastern flank of Sömmering 1. Here again the typical 'etched' morphology of the iIMP is visible, and it is worth noting that at this location a slightly more prominent part of the SW-NE lineations noted above crosses the crater rim. This may be significant as these lineations are interpreted to be the surface manifestation of a swarm of parallel fractures or faults that underlie this area.

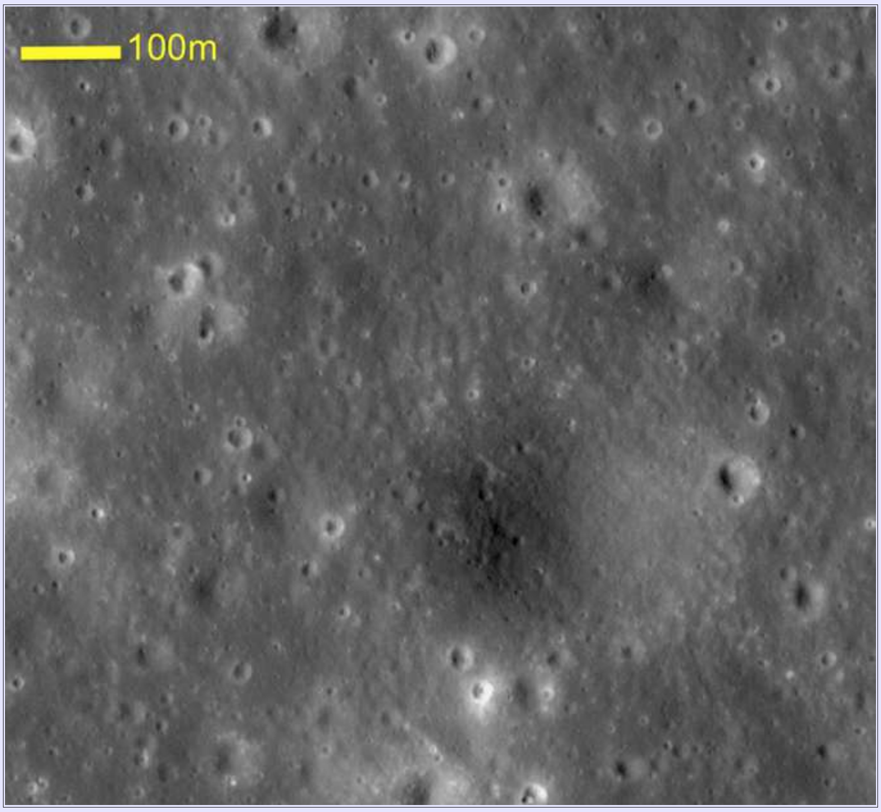


Fig.13 Detail of Box a2 from Fig.10 showing very subtle indications of iIMPs including some peculiar ripple structures that may be related.

These two examples are fairly conspicuous, but the western flank has a number of areas where quite subtle indications of iIMP's can be found, albeit they hard to spot. Fig.13 which is an enlargement of box a2 in Fig.10 shows one such area, where the typical 'etched' areas are accompanied by some peculiar 'ripple' like structures in the dark regolith. It is not known whether the two features are related at present, and a little more research is required to establish if any such link exists. The remainder of the surface of Sömmering 1 has subtle indications of iIMPs, and this is good supporting evidence for the volcanic origin suggested above. In practical terms, these structures may be related to terrestrial volcanic fumaroles, which are areas on active volcanoes where gas, mostly composed of water vapor, vents in the form of dense high temperature clouds. The water vapour is often heavily charged with compounds such as sulfur dioxide, carbon dioxide, hydrogen chloride, and hydrogen sulfide, and deposits around fumaroles are frequently exploited as commercial sources of sulphur. What the composition of the gas phase implicated in the formation of IMPs and possibly iIMP's is unknown, but the implied presence of such gas release may have a bearing on the interpretation that Sömmering 1 represents a form of eruption more explosive in nature than that sedate activity involved in forming the smooth sided lunar domes such as those in the Hortensius and Milichius areas.

Moving slightly further afield, Fig.14 shows the location of some features that may represent small volcanic vents. These are aligned and are orientated SW-NE, consistent with the lineations noted above and the long axis of the Sömmering 1 summit vent. These can be seen in greater detail in Fig.15. What this may be telling us is that this area is underlain by a system of fractures all trending along a SW-NE orientation and that these may have been exploited by rising lavas to produce, at one point, the Sömmering 1 dome. Evidence for the exploitation of these fractures by volcanic activity can be seen in the form of more iIMP'S associated with this fracture system and identified in Fig.14 in boxes 'b' and 'b1', one of which can be seen to be associated with the suspected vents in Fig.15.

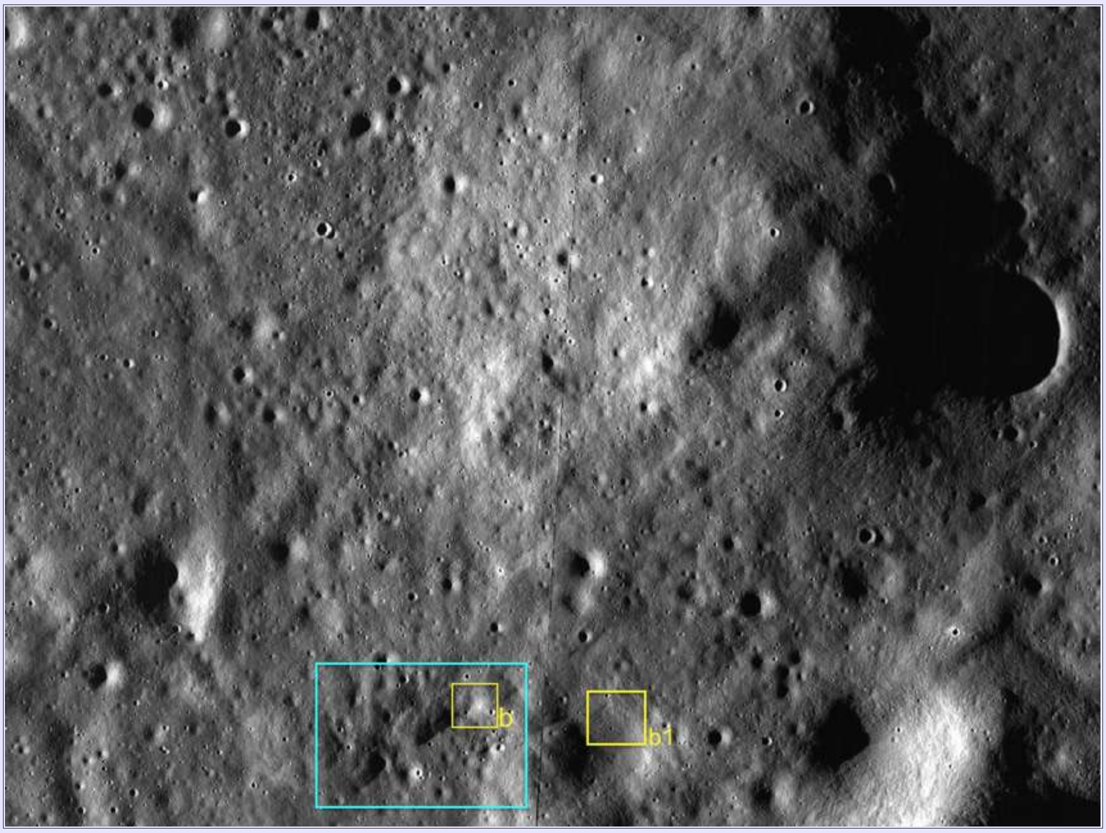


Fig.14 A wider view of the Sömmering 1 area showing suspected vents (within blue box) to the south of the dome.Boxes 'b' and 'b1' contain iIMP's discussed in the text.

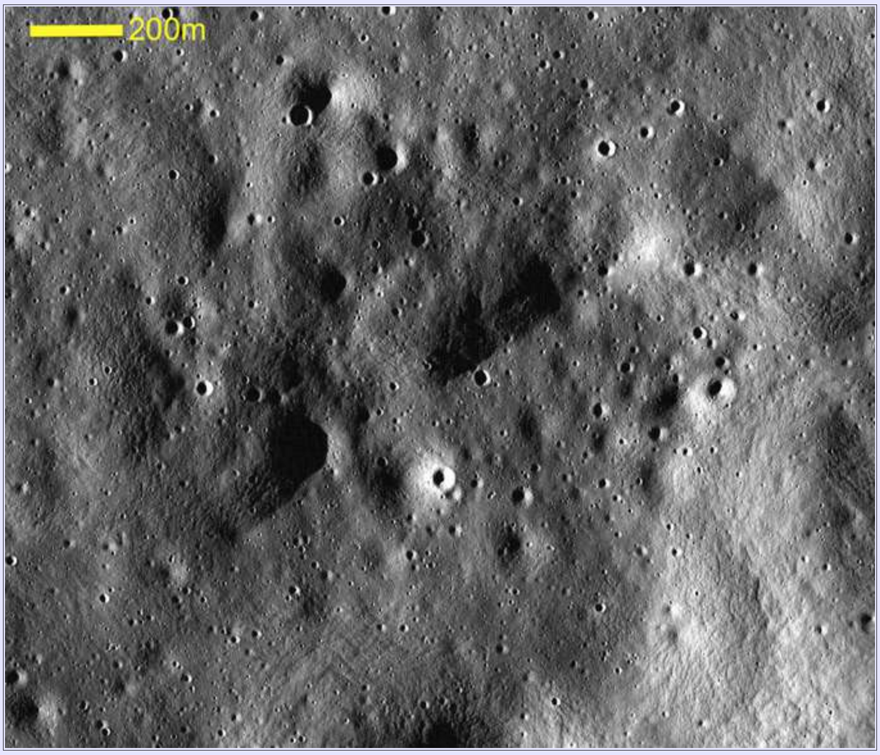


Fig.15 Two possible aligned vents highlighted in the blue box in Fig.14.

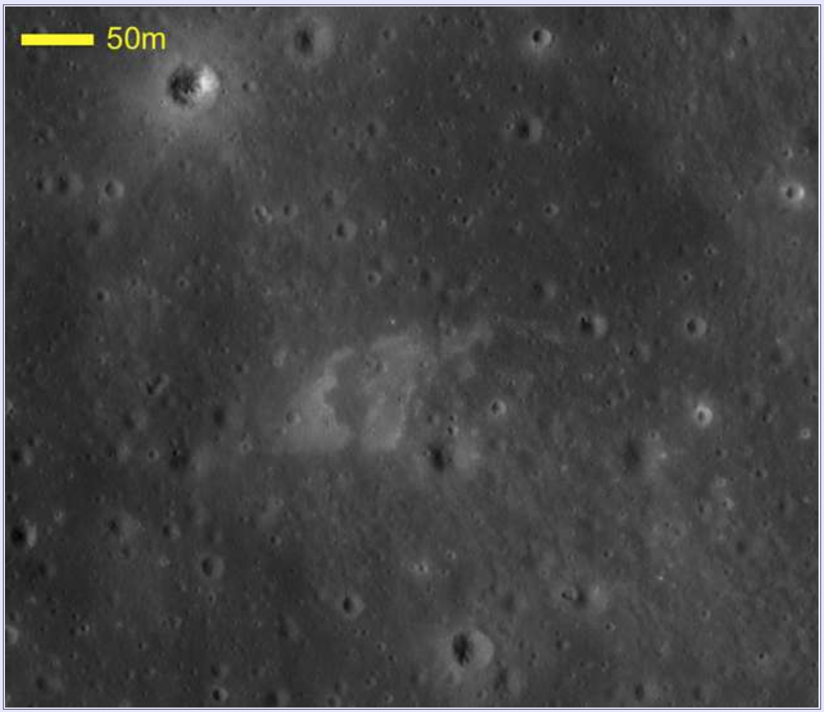


Fig.16 Detail of Box b from Fig.14 showing suspected iIMPs associated with the linear vents to the south of Sömmering 1. Note the small impact craters preserved within the boundaries of these iIMPs.

Fig.16 shows a well developed iIMP patch located at the northern section of the suspected vents shown in Fig.15. Evidence for the gentle removal of the surface regolith in the manner proposed above can be seen in the form of still preserved impact craters within the borders of the pale iIMP's, suggesting that these small craters existed before the gas venting occurred and the regolith forming their surface was removed without destroying the deeper structure of the crater itself. These craters have a rather subdued appearance, possibly as a result of this erosion of their surface mantling of regolith.

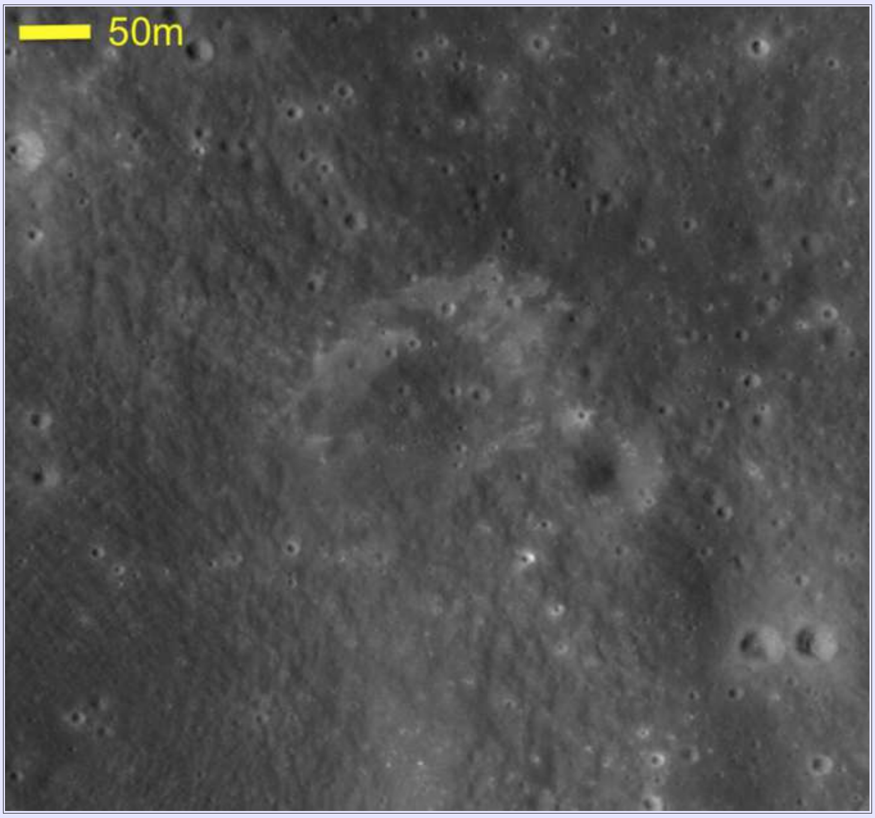


Fig.17 Detail of Box b1 from Fig.14 showing suspected iIMPs adjacent to those shown in Fig.14.

A further example of this can be seen in an adjacent area, also associated with this fracture system, and located in box b1 Fig.14, and enlarged in Fig.17. Again, the irregular 'etched' appearance is conspicuous, and the subdued, possibly eroded nature of the small impact craters within the iIMP boundaries is apparent.

Conclusion.

The mineralogical and topographic data outlined above, combined with an analysis of the local geological setting as shown in the LRO imagery support the contention that Sömmering 1 represents a volcanic dome of basaltic composition belonging to the rheologic group R3 which involves lavas of a highly viscous nature. The irregularity of the dome surface and the presence of iIMP's might suggest a combination of early vigorous explosive volcanic activity followed by a more sedate waning phase during which a reduced gas effusion rate produced these latter features by eroding the surface regolith. The alignment of the dome structure itself, the summit vent, nearby suspected volcanic vents and apparent lineations suggest the area is underlain by a SW-NE trending fault/fracture system that probably provided the conduit for the ascending magmas and gasses responsible for the features we see.

References

[1] Greenhagen, B.T., Lucey, P. G., Wyatt, M.B., Glotch, T. D., Allen,C.C., Arnold, J. A., Bandfield, J. L., Bowles, N. E., Donaldson Hanna, K. L., Hayne, P. O., Song, E., Thomas, I. R., Paige, D. A., (2010). Global Silicate Mineralogy of the Moon from the Diviner Lunar Radiometer. Science, Vol. 329, Issue 5998, 1507-1509. Abstract available at: https://ui.adsabs.harvard.edu/abs/2010Sci...329.1507G/abstract

[2] Besse, S., J. M. Sunshine, and L. R. Gaddis (2014), Volcanic glass signatures in spectroscopic survey of newly proposed lunar pyroclastic deposits, J. Geophys. Res. Planets, 119, doi:10.1002/2013JE004537. https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1002/2013JE004537

[3] Lena, R., Wöhler, C., Phillips, J., Chiocchetta, M.T., 2013. Lunar domes: Properties and Formation Processes, Springer Praxis Books.

[4] Wöhler, C., Lena, R., Lazzarotti, P., Phillips, J., Wirths, M., & Pujic, Z., 2006. A combined spectrophotometric and morphometric study of the lunar mare dome fields near Cauchy, Arago, Hortensius, and Milichius. Icarus, 183, 237–264.

[5] Jackson, P. A., Wilson, L., Head, J. W., 1997. The use of magnetic signatures in identifying shallow intrusions on the moon. Lunar Planet. Sci. XXVIII, abstract #1429.

….......§.........

LUNAR GEOLOGICAL CHANGE DETECTION PROGRAMME.

TLP Reports Received

No new TLP, or impact flash, reports have been sent in.

News: Nigel Longshaw has contacted me about discussion in last month's newsletter concerning the 1886 Nov 14th report by Lihou, as listed in the Cameron catalog:

Plato 1886 Nov 14 UT 21:45 Observed by Lihou (France?) "Brilliant band N-S, area marked G in NE was only slightly visible, poorly defined. Drawing (there were rays on the floor)." NASA catalog weight=3. NASA catalog ID #253. ALPO/BAA weight=ALPO/BAA weight=3.

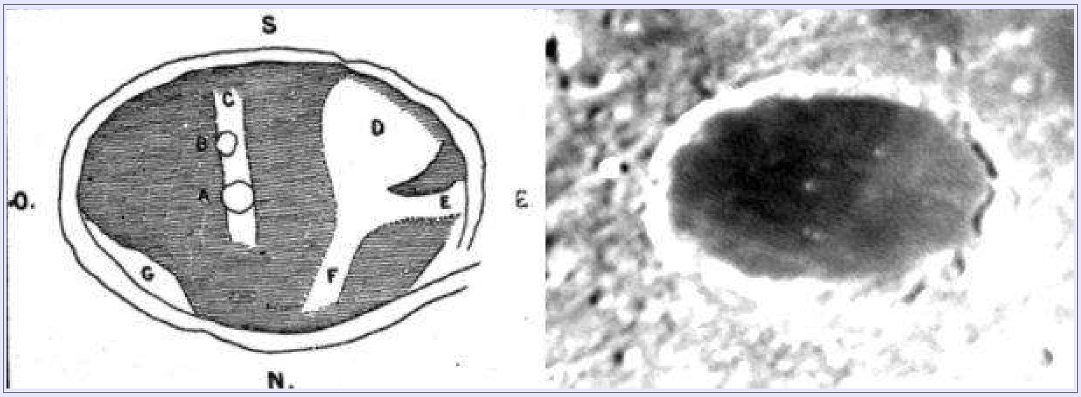


Figure 1. Plato orientated with south towards the top. **(Left)** a sketch by Benjamin Lihou (Société scientifique Flammarion de Marseille) published in L'Astronomie in 1887). **(Right)** a highly contrast stretched view of the floor of Plato from an image by Brendan Shaw (BAA) taken on 2004 Sep 02 UT 23:21 – taken under similar illumination.

Nigel managed to track down the relevant copy of L'Astronomie on the NASA ADS web site https://ui.adsabs.harvard.edu . Fig 1 (Left) shows Lihou's sketch and you can compare it to a modern day image under identical illumination by Brendan Shaw (Fig 1 Right). Nigel comments about Lihou: *"He seems to show the area (D,E,F) which was named 'the sector' by observers in the 19th century. I suspect the feature he shows as light streak may be part of 'the trident', again named by selenographers of the time. This usually forms a three pronged arrangement of light steaks (hence the name) which usually appear together, I can't find any drawings where a single steak is shown in the middle of the floor as Lihou depicts. But observers have in the past shown N/S streaks across the floor of Plato – Beer and Madler and Elger I think. So Lihou might have experienced a particular prominence of one of these streaks at the time of his observation. Worth keeping on the database I think.".* All I can say with regard to Nigel's comments is that the N-S streak (labelled C) does not show up in Brendan's image and the craterlets B and A seem slightly too far to the south. F,D,E are sort of visible if you blur or squint your eyes and so to G maybe? Anyway the fact that there is no white streak normally here for that selenographic colongitude is a good reason to retain this as a TLP of weight 3.

Routine reports received for July included: Bob Bowen (Newtown, UK – NAS) imaged: several features. Tony Cook (Newtown, UK – ALPO/BAA) videoed the Moon in the Short-Wave IR (1.5-1.7 microns). Maurice Collins (New Zealand - ALPO/BAA/RASNZ) imaged: Aristarchus, earthshine, Gassendi, Schickard, and several features. Walter Elias (Argentina – AEA) imaged: Alphonsus. David Finnigan (Halesowen, UK – BAA) imaged: Archimedes, Pitatus, Plato and Ptolemaeus. Valerio Fontani (Italy – UAI) imaged: Geminus and Maurolycus. Chris Longthorn (UK – BAA) imaged: several features. Franco Taccogna (Italy – UAI) imaged: earthshine, Eudoxus, Maurolycus, Plato, Promontorium Agarum, and several features. Luigi Zanatta (Italy – UAI) imaged: Plato.

Note that we I have included some BAA pooled observations in with this report.

Analysis of Routine Reports Received (July)

Maurolycus: On 2024 Jul 12 UAI observers Franco Taccogna and Valerio Fontani respectively obtained repeat illumination images of the following two events:

On 1971 May 01 at UT21:00-21:50 Staedke, Jorgensen (Berlin, Germany, x40 with filters) observed on Maurolycus a coloured, luminous projection from the crater into and through the small crater on the north rim. Colour of a dark candlelight then red. Length at diameter of small crater. a drawing was supplied. Cameron 1978 catalog ID 1293 and weight=2.

On 2012 Feb 28 R. Braga (Italy, Seeing III, Transparency very good, AOG 100mm) UT 19:45-20:00 noted that only the tip of the central peak was visible. Most of the crater was in darkness. When viewed through a red filter, the central peak was visible, but when viewed through a blue filter it was invisible. ALPO/BAA weight=2.

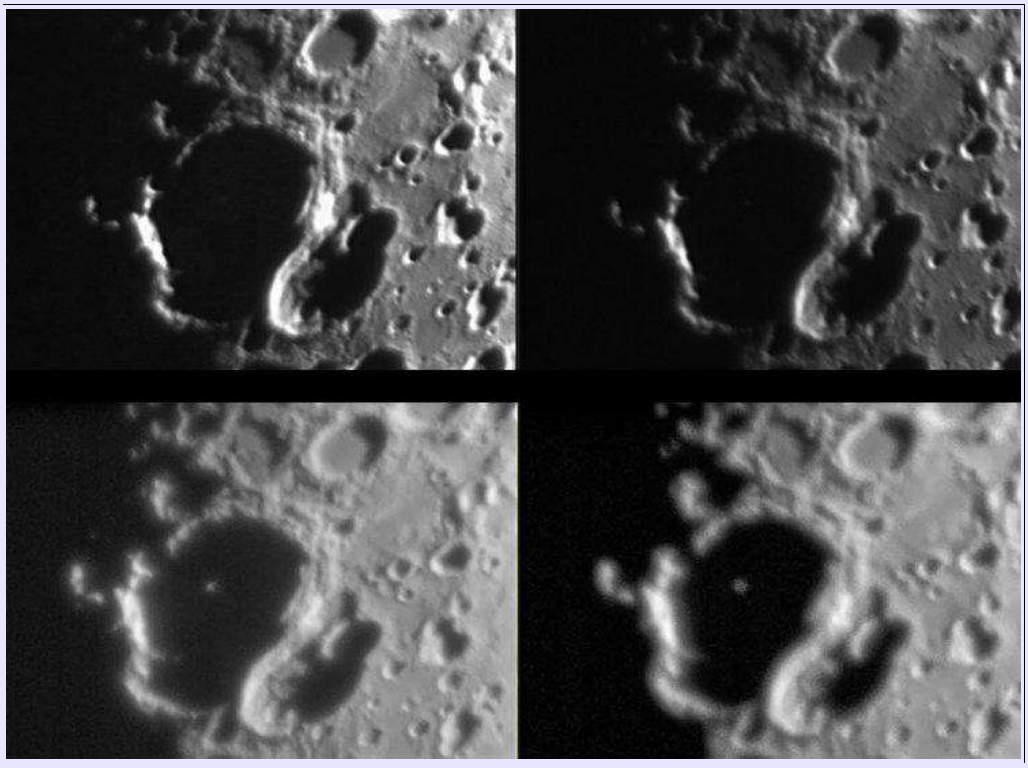


Figure 2. Maurolycus orientated with north towards the top, taken by UAI observers on 2024 Jul 12. **(Left Side)** Red filter images. **(Right Side)** Blue filter images. **(Top)** Images by Franco Taccogna taken at **(Left)** 1957 UT and **(Right)** 1959 UT. **(Bottom)** Images taken by Valerio Fontani at (Left) 20:32UT and **(Right)** 20:33 UT.

Franco's images (Fig 2 top left and top right) do indeed show a projection from the crater into and through the small crater on the north rim, though it appears just to be the illuminated rim of a neighbouring crater and you have a choice of three, one on the W, NW and N if one is not too fussy about compass directions. There appears to be not much in the way of enhancement in red light though, so I think we shall leave the ALPO/BAA weight at 2 for now.

Valerio's images (Fig 2 bottom left and bottom right) confirm Raffaello Braga's description of the interior being shadow filled apart from a protruding central peak. The central peak does appear to be sharper and more noticeable in Valerio's image through a red filter – the blue one being slightly more blurred and less visible. Maybe this can explain the 2012 observation, namely red and blue light come to different focal points, and maybe that is the reason why the peak was not visible in blue light, especially if the peak was just emerging and fussy. I will lower the ALPO/BAA weight from 2 to 1.

Aristarchus and Herodotus: On 2024 Jul 18 UT 06:54 Maurice Collins (ALPO/BAA/RASNZ) imaged this area under similar illumination to the following two TLP reports:

Aristarchus 1975 Mar 24 at UT19:08-19:45 P.W. Foley (Kent, UK) observed blueness in the North East (Classical?) corner of Aristarchus. Moon blink seen - pale in red. Most other observers clouded out. The ALPO/BAA weight=3.

Herodotus 2002 Sep 18 UT 22:00 Observed by Raffaello Lena (GLR, Italy). Event described was of two pseudo-peak/hill-like features, one on the southern floor of the crater, and another just slightly to the NW of the centre. on the southern floor of the crater. Lena suspects a combination of seeing effects and albedo markings on the floor. However this effect of two spots on the floor has not been repeated again. For further information, theory, and a sketch please see Fig 5 in this web link: http://utenti.lycos.it/gibbidomine/analisi123.htm ALPO/BAA weight=2.

Figure 3. Aristarchus and Herodotus, orientated with north towards the top. **(Left)** Image by Maurice Collins taken on 2024 Jul 18 UT 06:54 with colour saturation increased. **(Centre)** Same image but contrast stretched to bring out detail on the floor of Herodotus. **(Right)** A sketch by Raffaello Lena (BAA/GLR) captured from the GLR web site.

Maurice's image (Fig 3 – Left) has a dark slate grey appearance to the floor of Aristarchus, but no sign of any blueness on the NE (classical) or indeed NW of the crater rim. We shall therefore leave the weight at 2 for now.

Raffaello's sketch (Fig 3 right) from 2002 is remarkably detailed and accurate compared to Maurice's image (Fig 3 Left and Centre). Generally speaking, the spots that Raffaello draws, have areas in Maurice's image, that resemble them, all except for the two light spots on the floor of Herodotus, which we cannot see in the contrast stretched similar illumination image in Fig 3 (centre). I will therefore increase the ALPO/BAA weight from 2 to 3 as the effect differs from what we would expect and the observer is a skilled sketcher.

Alphonsus: On 2024 Jul 27 UT 03:13 Bob Bowen (NAS) imaged the whole Moon under similar illumination to the following report:

On 1958 Dec 02 at UT 06:00 an unknown observer detected a TLP on the Moon. The reference for this is from Palm, 1967 Icarus. The Cameron 1978 catalog ID=709 and weight=0. The ALPO/BAA weight=1.

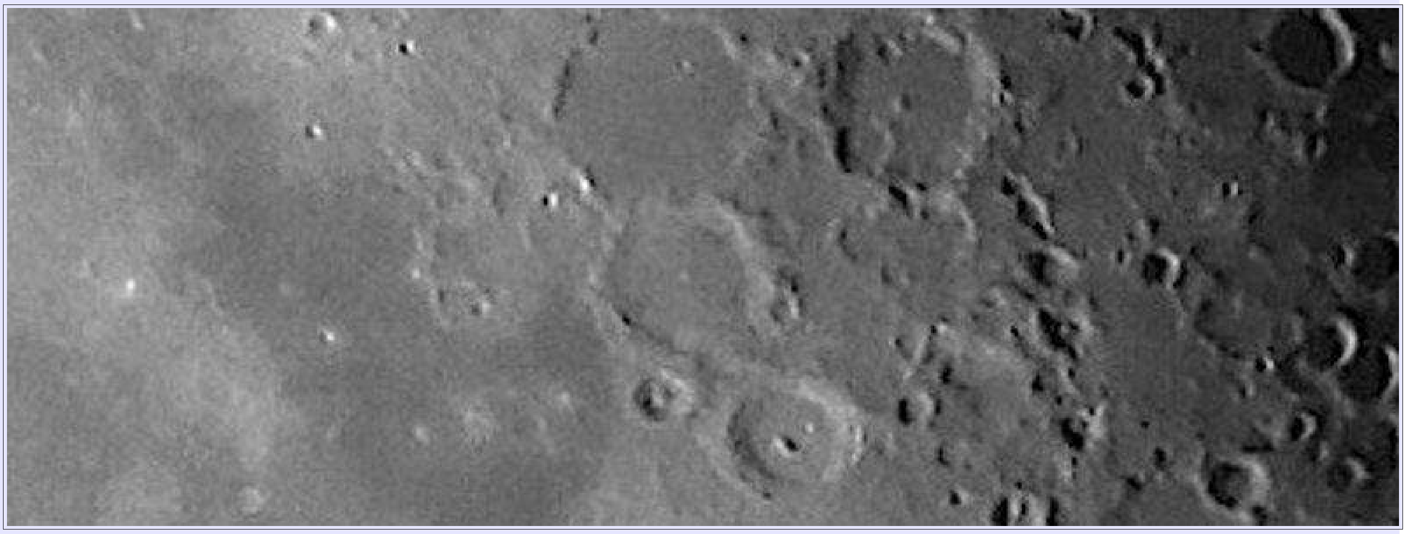


Figure 4. Alphonsus as imaged by Bob Bowen (NAS) on 2024 Jul 27 UT 03:13 and orientated with north towards the top.

Everything looks normal in Fig 4. We have covered a similar repeat illumination for the TLP before in the 2019 Nov newsletter. An examination of the Cameron cards for this event mentions that it was covered at an AGU meeting on Apr 20th, 1967. Alas I don't have access to this, nor an article by A. Palm "Enhanced Luminance of the Moon" published in Icarus, Vol 7, issue 1-3, p188-192. We shall leave the weight at 1 for now.

Alphonsus: On 2024 Jul 27 UT 10:58 Walter Elias (AEA) imaged this crater under similar illumination and similar topocentric libration (viewing angle) to within ±1˚ of the following report:

Alphonsus 1964 Oct 27 UT 05:18-06:10 Observed by Hall, Johnson, Weresulk (Pt. Tobacco, MD, USA, 16" reflector x400, S=5-7). "Red spot. Pink glow detected with Trident MB & seen visually too." NASA catalog weight=5. NASA catalog ID #863. ALPO/BAA weight=5.

Figure 5. Alphonsus as imaged by Walter Elias (AEA) on 2024 Jul 27 UT 10:58 and orientated with north towards the top. Image has been contrast normalized, slightly sharpened, and had its colour saturation increased.

There is no sign of a red spot in Alphonsus, in Fig 5, though there is some natural surface orange colour near Lassell K to the SW of Alphonsus. This begs the question why Hall did not detect that? Maybe the red spot was a lot more vivid than the orange colouration at Lassell K. You probably would not notice the orange colour visually looking through a telescope. We shall leave the weight at 5 for now as the TLP was detected back in 1964 with an electronic Moon Blink device.

Plato: On 2024 Jul 29 both Luigi Zanatta and Franco Taccogna had goes at trying to record the ashen light effect on the floor of the crater, sometimes seen around this colongitude at lunar sunset, for example a sketch made by Phil Morgan (BAA) from 2009:

BAA Request: It is around this Co-Longitude that some observers have reported seeing an Ashen Light effect on the shadowed floor of Plato, caused by scattered light off of an illuminated peak on the rim. Please have a go either visually, or with long exposure time lapse imagery to see if you can pick up the development of this weak illumination effect on the floor. Please send any sketches or images to: a t c @ a b e r . a c. u k .

Figure 6. Plato orientated with north towards the top. **(Left)** An image by Franco Taccogna taken on 2024 Jul 29 UT 01:06 ($\lambda_!$ =262.91˚, $\varphi_!$ =+1.35˚, Col=187.09˚). **(Centre)** An image by Luigi Zanatta (UAI) taken on 2024 Jul 29 UT 02:37 ($\lambda_!$ =261.13˚, $\varphi_!$ =+1.35˚, Col=187.87˚). **(Right)** A sketch by Phil Morgan (BAA) made on 2009 Jun 16 UT 03:20-03:40 ($\lambda_!$ =260.25˚-260.42˚, $\varphi_!$ =+0.93˚, Col=189.58˚-189.75˚).

In the original sketch (Fig 6 – right) by Phil Morgan, he quotes a selenographical colongitude of 189.0˚-189.2˚. This was used to define a search parameter in the Lunar schedule program which ran from 188.0˚-190.0˚ in terms of selenographic colongitude. Allowing for the precision of the lunar schedule program, this throw up some observing times for our UAI observers in Italy. Franco Taccogna took the earliest image (Fig 6 – Left) in this observing window, and Luigi Zanatta a later image (Fig 6 – centre). Although both show approximately the correct amount of shadow on the western floor as shown in Phil Morgan's Ashen light sketch (Fig 6 – Right), the central shadow spire in Phil's image does not show and the terminator below Plato is further west.

This suggests that something maybe in #correct with the 2009 observation. I checked the sub-solar colongitude from the NASA JPL Horizons web site (https://ssd.jpl.nasa.gov/horizons/app.html#/) and from that derived the selenographic colongitude for the 2009 Jun 16 report and it came out to be : Col=189.58-189.75˚ , off by 0.6˚ from Phil's calculations. In fact, it makes the crater completely shadow filled apart from this ashen light effect. I will adjust the selenographic colongitude range in the lunar schedule database to compensate for this. Although Franco and Luigi did not capture the completely shadow filled floor, and hence any ashen light effect, their observations have located an error in the calculations by Phil Morgan.

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 TLP, firstly read the TLP 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 TLP 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

Many thanks to all contributors. Items for the October circular should reach the Director or Editor by the 20th September 2024 at the addresses show below.

BAA Lunar Section contacts:
Director: Dr. Tony Cook (atc @ aber.ac.uk)
Lunar Section Circular Editor: Barry Fitz-Gerald (barryfitzgerald@hotmail.com)
Hardcopy Archivist : Bill Leatherbarrow (w.leatherbarrow1@ btinternet.com)
Committee members:
Tony Cook (Coordinator, Lunar Change project) (atc @ aber.ac.uk)
Tim Haymes (Coordinator, Lunar Occultations) (occultations @ stargazer.me.uk)
Robert Garfinkle (Historical) (ragarf @ earthlink.net)
Raffaello Lena (Coordinator, Lunar Domes project) (raffaello.lena59 @ gmail.com)
Nigel Longshaw
Barry Fitz-Gerald (barryfitzgerald@hotmail.com)