From the Director:

Although we have some good success in recovering past historical archive material, as our previous director Prof. Bill Leatherbarrow has demonstrated, notably in recovering notebooks by Thomas Elger, Alan Lenham, H.P. Wilkins and Harold Hill; digital observations are perhaps oddly less well preserved. Whilst it is possible to place backups of images onto clouds and other storage devices, when a member unfortunately passes away, it is not always a top priority to preserve the extensive work that they have undertaken with digital imaging. Some of their best images will have been sent into the Lunar Section and preserved in the archives and/or published in the Lunar Section Circular, but there are usually many more that have not – perhaps because their quality was regarded as not up to their usual standard, or maybe they simply did not get around to sending them in.

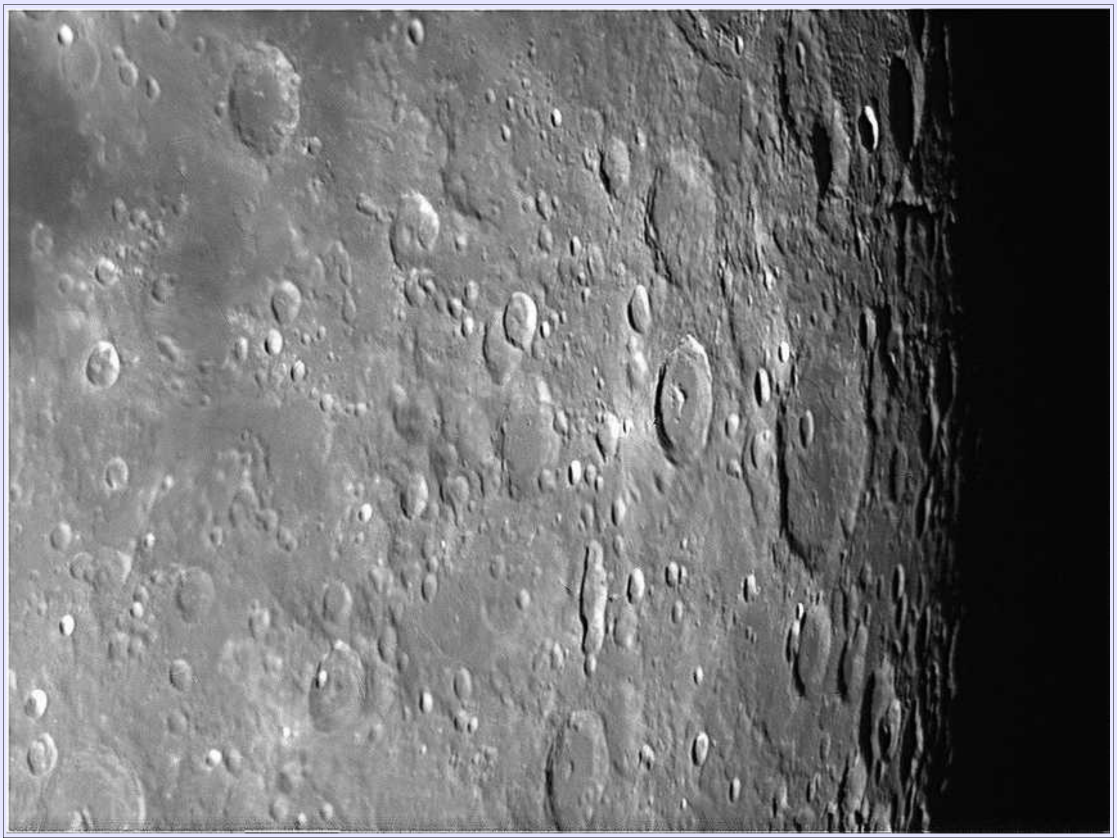


Image of the Furnerius area of the Moon taken under favourable libration, by Brendan Shaw on 2015 Jan 06 UT 23:34

I am therefore very grateful to Mary Tait, Brendan Shaw's (1956-2022) partner, who has kindly sent in the computer hard drives that Brendan, one of our former high quality lunar astrophotographers, used to archive his images. The images span from 2002 until 2016 and show the development of his imaging technique and cameras used over these fourteen years. Apart from the sharpness of many of the images (see above), another really important aspect of studying surface features is to have available observations from a diverse set of selenographic colongitudes. Having as many possible images, taken in different years, but at similar illumination and viewing angles can also be important for looking for changes on the Moon. Brendan's images will be added to the BAA Lunar Section digital archive, and undoubtedly appear in some of our analysis of lunar features in the years to come. If you any of our readers would like their own lunar images (not already sent to us) be preserved in the Lunar Section archives, please let me know and I'll set up an upload account for you.

For any reader who likes the challenge of photographing earthshine and the crescent Moon with a DSLR camera + telephoto lens, then you may be interested in a new ESA project where they are asking observers to image earthshine at the same time as an astronaut on-board the International Space Station. See the News section of the Lunar Geological Change article for further details.

Finally, if you had a break in the weather on October the 28th, don't forget to send in any images of the lunar partial eclipse in. Only a trickle has been received so far – I was certainly challenged by the variable weather here in Mid Wales, UK, which really degraded my observational capability. Let's hope that others had better luck!

Tony Cook.

…........................

Lunar Occultations November 2023 by Tim Haymes

Time capsule: 50 year ago: in Vol 8 No.11

[With thanks to *Stuart Morris* for the LSC archives.]

* Mr K Gayner (Occultation Coordinator) resigns. Reports to be sent to P Moore (Director)
* Mr H Ford FRAS (Dundee) joins the Committee.
* David Jewitt: comment on Crater Extinction Device (CED) for surface photometry.

Occultations during the Partial Lunar Eclipse of October 28th

I apologies for the date error in the last circular, and thank you those who brought the typo to my attention. It's unlikely I will be able to report on the eclipse before the November dead-line.
Please see the October issue for the contact times.

European Symposium on Occultation Projects (ESOP 42) Armagh, 2023

ESOP 42 was held at Armagh Observatory on September 16 to 17th. The presentations were attended by 26 on-site participants and 54 on-line. The slide sets (pdf) can be viewed on the web site here:

https://www.armagh.space/meetings-conferences/esop42#deeplink-3

HIP-27989 (Betelgeuse) [=SAO 113271, HD 39801)

The first session on Sunday morning was devoted to the rare upcoming asteroid occultation of alpha-Orionis by (319) Leona on night December 11/12. The shadow is across Southern Europe (Portugal, Spain, Italy, Greece) (see HBAA p55). The path is now highly constrained. The main uncertainty is the size of Betelgeuse itself, and to a lesser extent its position. We know that the event is most likely to be annular (or partial). The light profile will be dependent on wavelength, and V and R filters (or Ha) have been suggested. Those with a wider interest in occultation phenomena may read the *Journal for Occultation Astronomy* (JOA). The current (and past) issue can be found here: https://iota-es.de/ The JOA is free to view thanks to the efforts of the IOTA-ES membership.

There were no presentations on Lunar Occultations, however observers still provide the timing data, and still do study double stars. Graze events present challenges in our current UK climate but continue to be of high priority for studying minute changes in the lunar ephemeris. To improve the chances of seeing a graze, observers should use Occult4 software to predict events near "home". The Lunar Section (Occultations) can help with this. Contact the Director.

Is Alpha Orionis Occulted by the Moon ?

The Moon cover's +/- 6.5 degrees above and below the Ecliptic (Source: *Observational Astronomy for Amateurs, J.B.Sidgewick*). Thus Aldebaran is occulted, but Betelgeuse at 15 degrees South of the ecliptic and is not. The first recorded occultation of Aldebaran in modern times was on 1681 Dec 22 at the Royal Observatory, Greenwich, and at Leipzig University Observatory, Germany on the same night. (Source:Occult4 database).

References to Occultations in old books.

The writer has a library containing some nineteenth century books. Reference to lunar occultations are infrequent. In *The Moon by Proctor*, occultations are included in a discussion of the "lunar atmosphere". (Second edition 1878).

J B Sidgewick: *Observational Astronomy for Amateurs (1954)* in section 2.7 covers timing, personal equation, prediction and reduction, which is of interest from a historical perspective.

A more recent and detailed coverage can be found in *Practical Amateur Astronomy by P Moore (1975)*, in a section written by Gordon E. Taylor. In *Solar System Photometry Handbook Edited by Russell M, Genet*, (1983) there is a section in good detail including double star analysis and Fresnel diffraction. The forward is written by David W. Dunham. (IOTA) The most up-to-date info on occultation observing can be found on the web site of International Occultation Timing Association (IOTA) https://occultations.org/

Some Observations made in 1851-54: In a copy of Royal Astronomical Society's Notices, some occultation observations are indexed:

1851-2 Vol X11, p19:

By Mr. Snow of Ashurst, nr. Dorking (Long. Lat. Sidereal Time of 4 events).

By Capt. Shadwell R.N. FRAS, dockyard flag staff, Trincomalee.(*) (2 events). [Local Mean Time].

1854-5 Vol X1V, p185:

By Warren De La Rue of Mars on 1854-Mar-12 at 1433hr [Sidereal Time].

Tim Haymes

https://en.wikipedia.org/wiki/Trincomalee_Harbour

Daylight Occultation of Venus on November 9th at 9.7hrs UT

The circumstances for locations in Europe are:

Place	DB	CA	RD	CA
London		0947.3 -29S		1047.7 60S
Oxford	0946.0 -27S		1044.3 58S	
Leeds	0941.2 -30S		1041.7 60S	
Exeter	0950.0 -19S		1040.2 51S	
Edinburgh	0936.1 -31S		1036.3 60S	
Dublin	0942.9 -19S		1031.4 50S	

Graze phenomena:

The planet grazes the Moon in Northern, central and Eastern Spain. Alicante is well placed.

Occultation predictions for 2023 November (Times at other locations will +/- a few minutes)
Oxford: E. Longitude -001 18 47, Latitude 51 55 40
To magnitude ca 8 , Moon altitude >=15 degrees.

```
  day            Time      Ph    Star  Sp   Mag   Mag    % Elon Sun  Moon    CA   Notes
yy mmm  d  h  m    s        No  D*     v     r   ill      Alt Alt Az    o
23 Nov  1 21  8 40.9 R   77804 A0   7.3  7.1   81- 129     19  70  83N
23 Nov  1 21 56 26.6 R     909SB9  6.0  5.9   81- 128     26  78  83S
23 Nov  1 23 12 10.7 R   77909wA0  7.6  7.6   81- 128     37  92  57S
```

23	Nov	2	23	0	51.6	R		1067cK2	7.1	6.4	72-	116		27	80	43S	
23	Nov	3	5	40	36.9	R	X	99111S	7.2	7.0	70-	114		62	215	87N	
23	Nov	3	5	40	36.9	R		1093SF8	6.6		70-	114		62	215	87N	
23	Nov	4	1	46	34.7	R		1206 G8	5.9	5.3	62-	104		43	103	68S	omega Cnc
23	Nov	4	4	24	51.7	R		79936 K5	8.1	7.2	61-	103		62	153	26N	
23	Nov	5	2	54	51.1	R		1330pG5	7.8	7.5	52-	92		43	111	63S	
23	Nov	6	5	17	35.7	R		98751 G5	8.3	7.7	42-	80		51	142	78S	
23	Nov	7	2	11	3.2	R		99123 K0	7.3	6.5	33-	70		17	90	68S	
23	Nov	7	3	14	18.5	R		99149 A2	7.1	7.0	33-	70		26	102	30S	
23	Nov	7	5	52	30.4	R		1545 F2	8.0	7.8	32-	69		46	143	62S	
23	Nov	8	4	9	12.4	R		118729 K0	8.0	7.5	24-	59		24	109	52S	
23	Nov	8	4	23	3.5	R		1625SK3	5.8	5.2	24-	59		26	112	89N	
23	Nov	9	4	28	50.6	R		119126 K2	8.5	7.8	16-	48		17	108	86S	
23	Nov	9	6	10	6.4	R		1732cK0	6.8	6.1	16-	47	-10	29	131	41S	
23	Nov	9	9	45	59.6	D		Venus	-4.4	-4.4	15-	46	16	38	195	-27S	
23	Nov	9	10	44	24.0	R		Venus	-4.4	-4.4	15-	45	20	34	213	58S	
23	Nov	19	17	33	2.3	D		190337 K0	7.2	6.6	42+	80		17	179	78N	
23	Nov	19	18	15	6	D		3141 K3	5.8	5.0	42+	81		17	189	21S	35 Cap
23	Nov	19	18	27	9	R		3141 K3	5.8	5.0	42+	81		16	191	2S	35 Cap
23	Nov	20	20	13	55.0	D		165066pK0	8.0	7.5	54+	95		20	206	89S	
23	Nov	21	18	37	21.7	D		3419SK0	4.2	3.7	65+	107		29	168	85N	psi Aqr
23	Nov	21	19	47	55.8	R		3419SK0	4.2	3.7	65+	108		29	188	-71S	psi Aqr
23	Nov	22	19	28	35	Gr		12 B8	6.4	6.5	76+	121		32	**	GRAZE:	4 Psc
23	Nov	22	19	46	36	Gr		13cK2	6.2	5.5	76+	121		34	**	GRAZE:	5 Psc
23	Nov	22	19	50	16.4	D		15cG5	7.1	6.6	76+	121		36	174	62S	
23	Nov	22	22	39	45.0	D		22 K0	7.2	6.7	77+	122		29	223	74N	
23	Nov	23	19	16	15.5	D		133kA5	8.0	7.9	85+	134		38	148	47S	
23	Nov	23	20	56	17.4	D		109599PF5	7.7	7.5	85+	135		43	180	62S	
23	Nov	23	23	0	43.2	D		109641kA5	7.7	7.6	86+	136		37	219	24S	
23	Nov	23	23	8	39	Gr		109641kA5	7.7	7.6	86+	136		36	**	GRAZE:	nearby
23	Nov	23	23	37	15.8	D		153 K5	6.0	5.2	86+	136		34	229	83S	73 Psc
23	Nov	24	18	18	39.6	D		264 B9	7.1	7.1	92+	147		32	116	35N	
23	Nov	24	20	3	0.5	D		272SF2	5.9	5.8	92+	147		45	144	65S	54 Ceti
23	Nov	25	1	29	17.1	D		290 A6	6.1	6.0	93+	150		31	249	45S	
23	Nov	25	1	51	53	Gr		290 A6	6.1	6.0	93+	150		28	**	GRAZE:	nearby
23	Nov	25	3	0	45.5	D		92761 K0	6.9	6.3	93+	150		18	268	58S	
23	Nov	25	21	9	56.8	D		407 K0	7.2	6.5	97+	161		52	146	49S	
23	Nov	28	19	36	44.8	R		833 B5	7.1	7.1	97-	161		25	77	79S	
23	Nov	28	20	17	6.2	R		77258 K0	7.8	7.1	97-	161		31	84	78N	
23	Nov	28	20	30	16.7	R		77272cF7	7.6	7.3	97-	161		33	87	44S	
23	Nov	29	1	35	11.0	R		868SA0	7.5	7.5	97-	159		66	188	46N	
23	Nov	29	3	37	29	R		77588cB8	7.7	7.7	96-	158		55	239	24S	
23	Nov	29	4	31	12.8	R		77604 K0	7.0	6.2	96-	158		48	253	89S	
23	Nov	29	5	0	27.1	R		77619 F2	7.1	6.9	96-	158		43	260	81S	
23	Nov	29	5	4	15.4	R		77621 M3	7.5	6.6	96-	158		43	261	58N	
23	Nov	29	5	12	5.7	D		890cA0	4.6	4.6	96-	158		42	262	-84S	136 Tau
23	Nov	29	6	16	8.8	R		890cA0	4.6	4.6	96-	157		32	275	65N	136 Tau
23	Nov	29	23	13	2.3	R		78580SA2	7.3	7.2	92-	148		49	108	53N	
23	Nov	30	3	4	34.5	R		1035cK3	6.7	6.0	92-	147		64	205	77N	

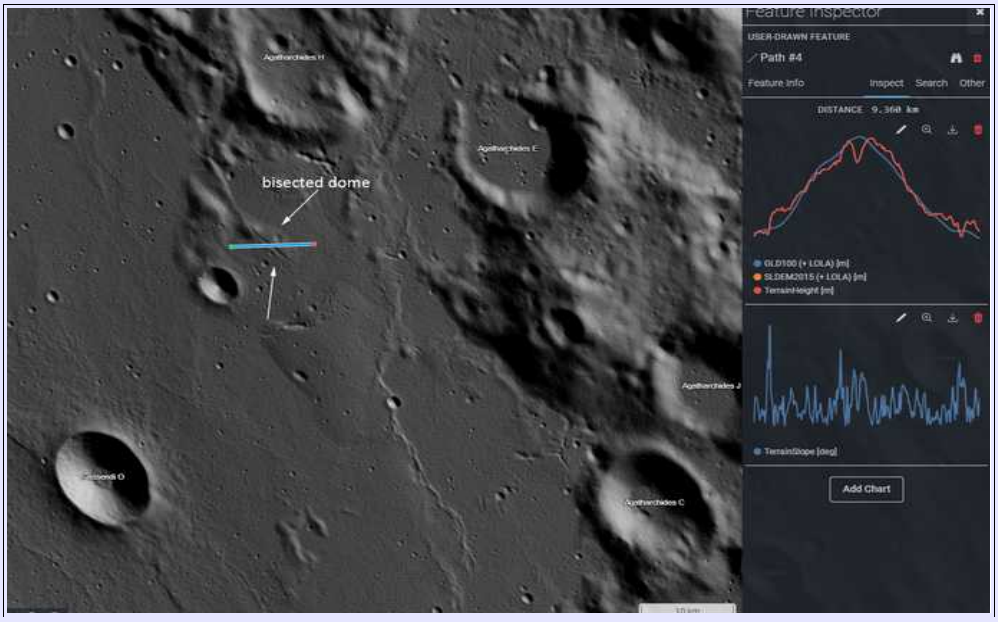
Double Stars

Note: D* The D column (above) which previously was removed, indicates a Double Star.
The characters w,S,c etc indicate the type of double and is explained in Occult4 Help.
To save a bit of editing, I have left them in-place. Please use them to signify whether the star is double in the Washington Double Star Catalogue. (WDSC)

New doubles are being discovered in occultation recordings, particular close doubles not detectable by other measurement techniques. For example, 245 doubles have been discovered while observing asteroidal occultations. The separations are usually small and in the range 10-100 mas. Please send double star occultation reports to the LS.

Notes from Members.

Follow up to K.C.Pau's image 'Gassendi and a possible Dome' in the October LSC by K.C.Pau.



K.C Comments: *Many thank for your finding a suspected dome in my Gassendi image. I have also checked it in Quickmap. By re-adjusting the reading in TerrainHillshade, I find another suspected bisected dome N of it. Enclosed is an image for your information*

James Nasmyth versus the Digital Present by Leo Aerts.

Having read parts of Epic Moon* by Sheehan and Dobbins, I was intrigued by way that James Nasmyth** created his lunar sculptures, especially one covering part of Mare Imbrium which comes very close to reality of what we can easily photograph (Fig.1). I searched in my lunar files to pick up a picture with the same shadow conditions as the Nasmyth renderings. I compared the digital results with the Nasmyth art work. Herewith are some results (Fig.2). The left rows of the close ups are the work of Nasmyth; the right row is a digital result with my C14 of July 2017. Be amazed by the Nasmyth results!

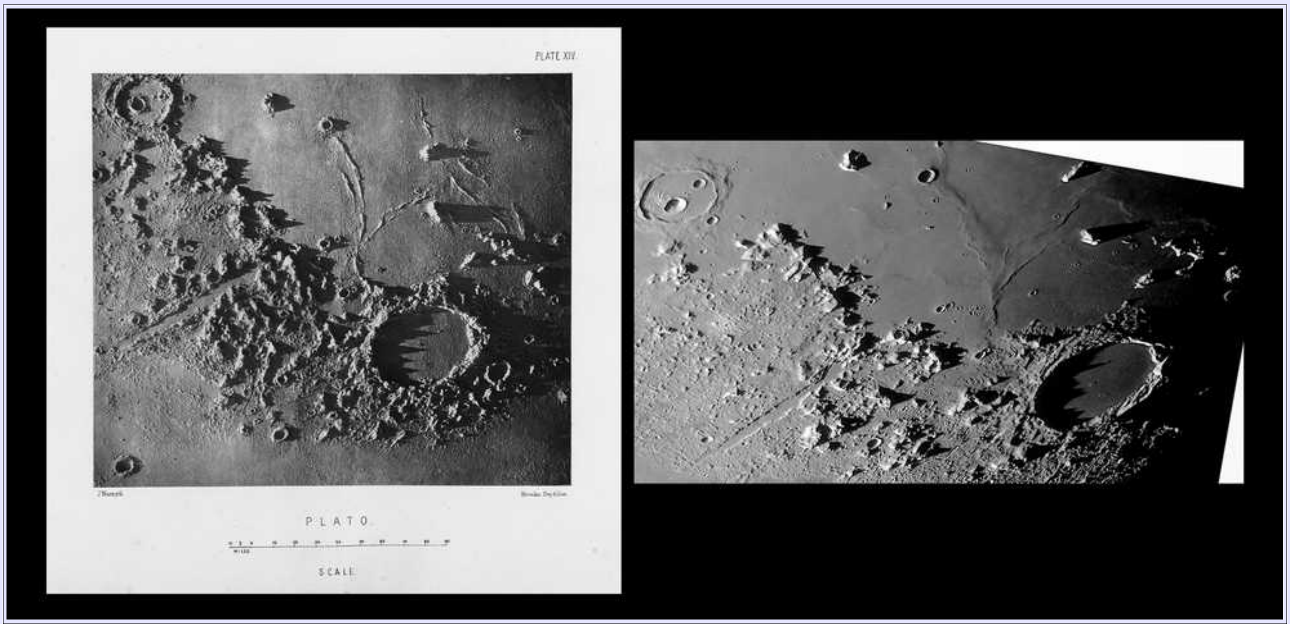


Fig.1

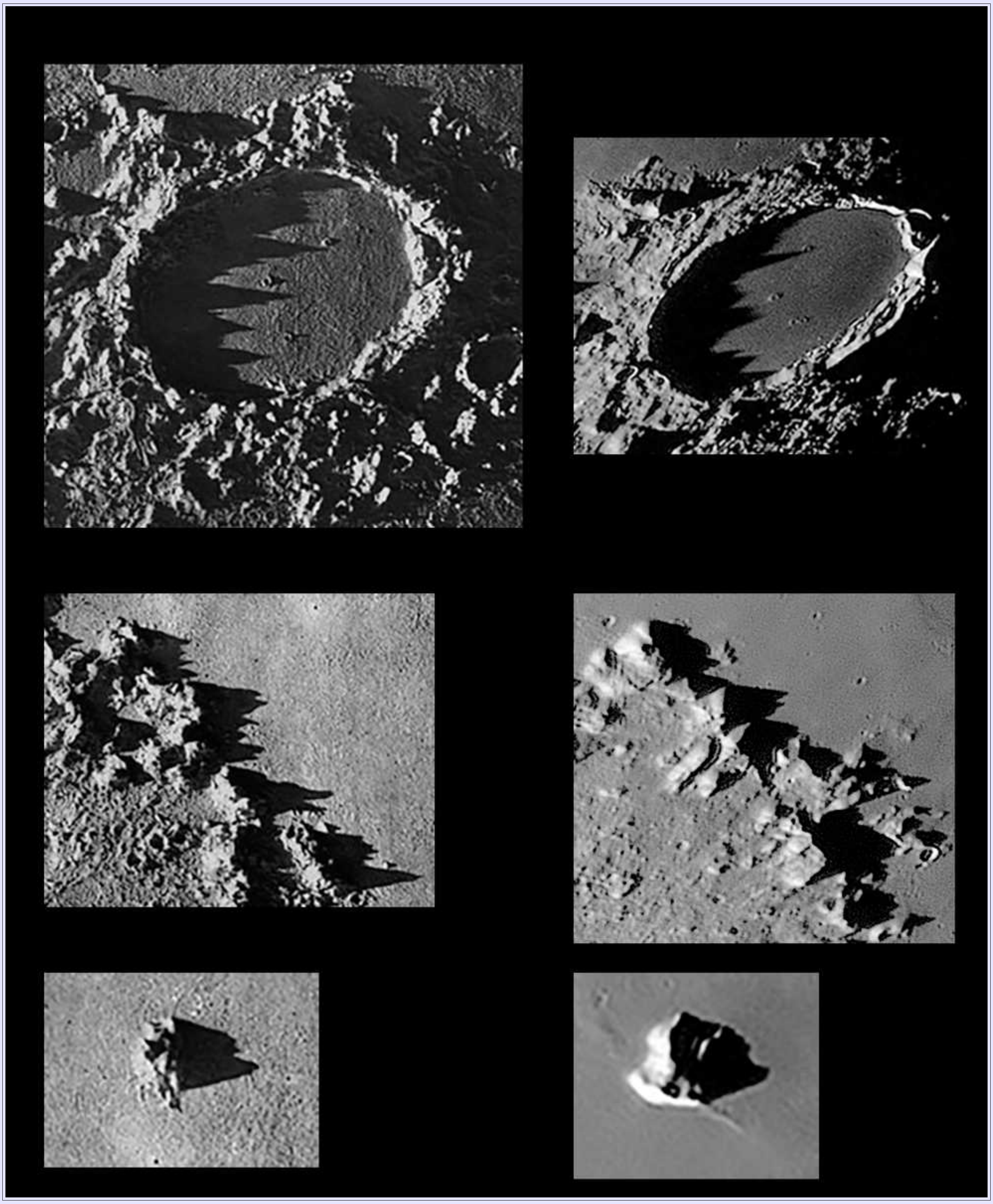


Fig.2

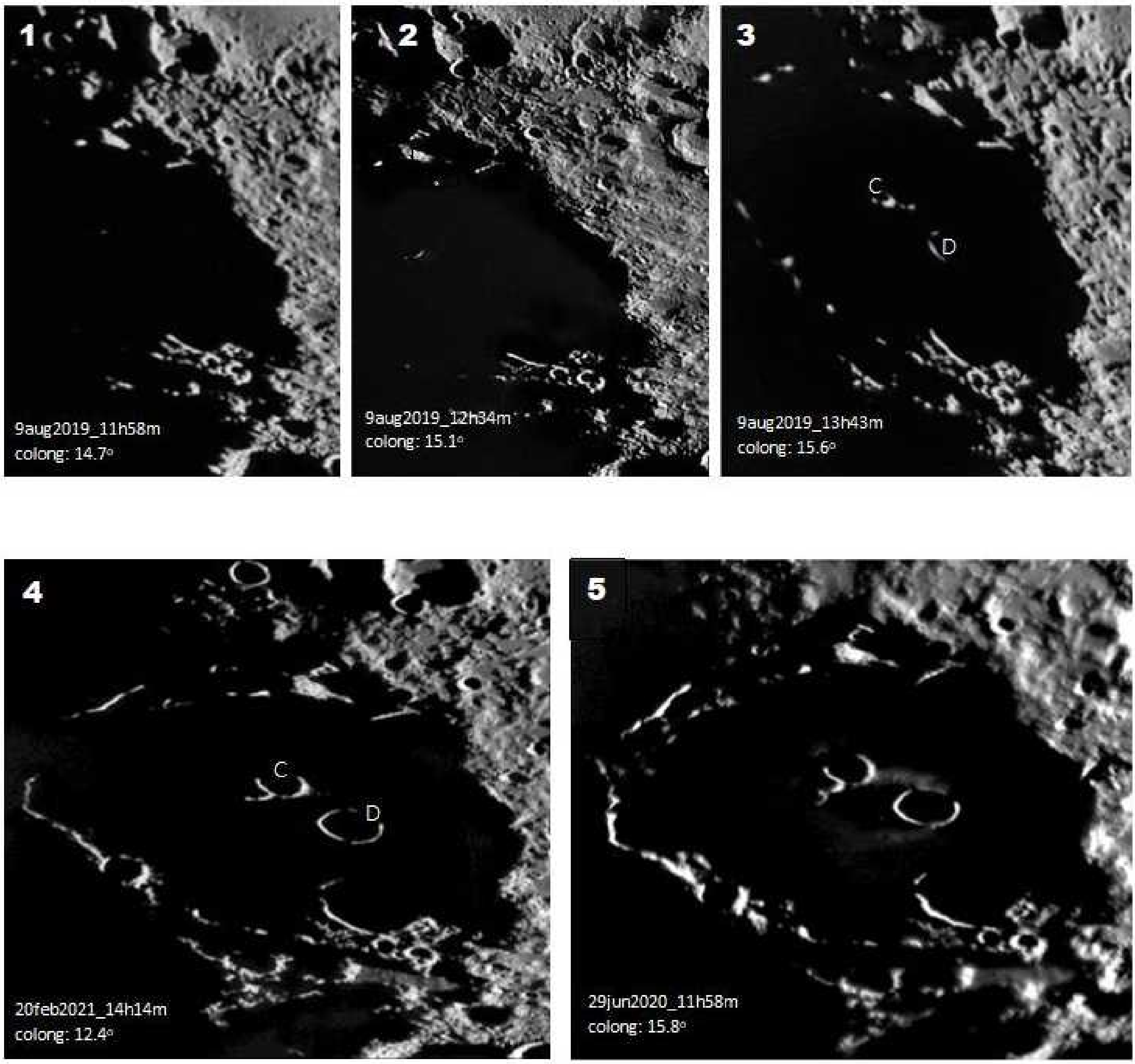
Ed. Comments:

*** Epic Moon: A History of Lunar Exploration in the Age of the Telescope by William Sheehan and Thomas Dobbins. Willmann-Bell (1 Jun. 2001) One of the very best histories of lunar observation – secondhand prices are reasonable at the moment.**

**** The Moon, considered as a planet, a world, and a satellite by Nasmyth, and Carpenter, J. Murray, London 1903. Available as a high quality pdf at:**
:https://ia800204.us.archive.org/32/items/moonconsideredas00nasmrich/moonconsideredas00nasmrich.pdf

Eyes of Clavius by K.C Pau.

Around the 8-day moon, Clavius will have a fascinating scene of clair-obscur effect for observers to enjoy. The effect is well-known as “Eyes of Clavius”. The following images self-explain the sequence of events on the scene. The best time to observe the Eye of Clavius is between 12° ~ 18° colongitude. Libration and solar inclination will affect the position of the terminator on the moon.



Members Images and Drawings.

Partial Lunar Eclipse October the 28th.

Image by by Alan Tough with details in text below.

Alan Comments: *On Saturday, here in Elgin, it rained all day. However, from about 8:30 p.m. (BST) I could see the Moon through some thinner patches of cloud. I quickly gathered some equipment and managed to capture a sequence of photos, around the time of greatest eclipse, through a big gap in the rain clouds.*

The resulting image (attached) is actually a stack of 10 x 1/320th second images. Further details below:

Date: 2023 October 28th Time: 20:13 UT
Equipment: Canon EOS 5D Mark III DSLR, Sigma EX DG 150-500mm lens, Manfrotto tripod.
Exposures: 10 x 1/320th second @ f/6.3 and ISO-320.

Looking at the photos straight out of the camera, I thought I could detect a slight redness above the Earth's umbral shadow. Therefore, in Photoshop, I increased the saturation slightly in each of the ten sub-frames to try to ascertain if the colour was due to the eclipse or caused by the atmosphere (or my imagination!). I think it is a genuine effect of the eclipse. Some of the 'mineral Moon' images on SpaceWeather.com seem to confirm this.

To the naked eye the shadow was very dark, so my Danjon scale estimate would be a 0.

3 Day old Moon.

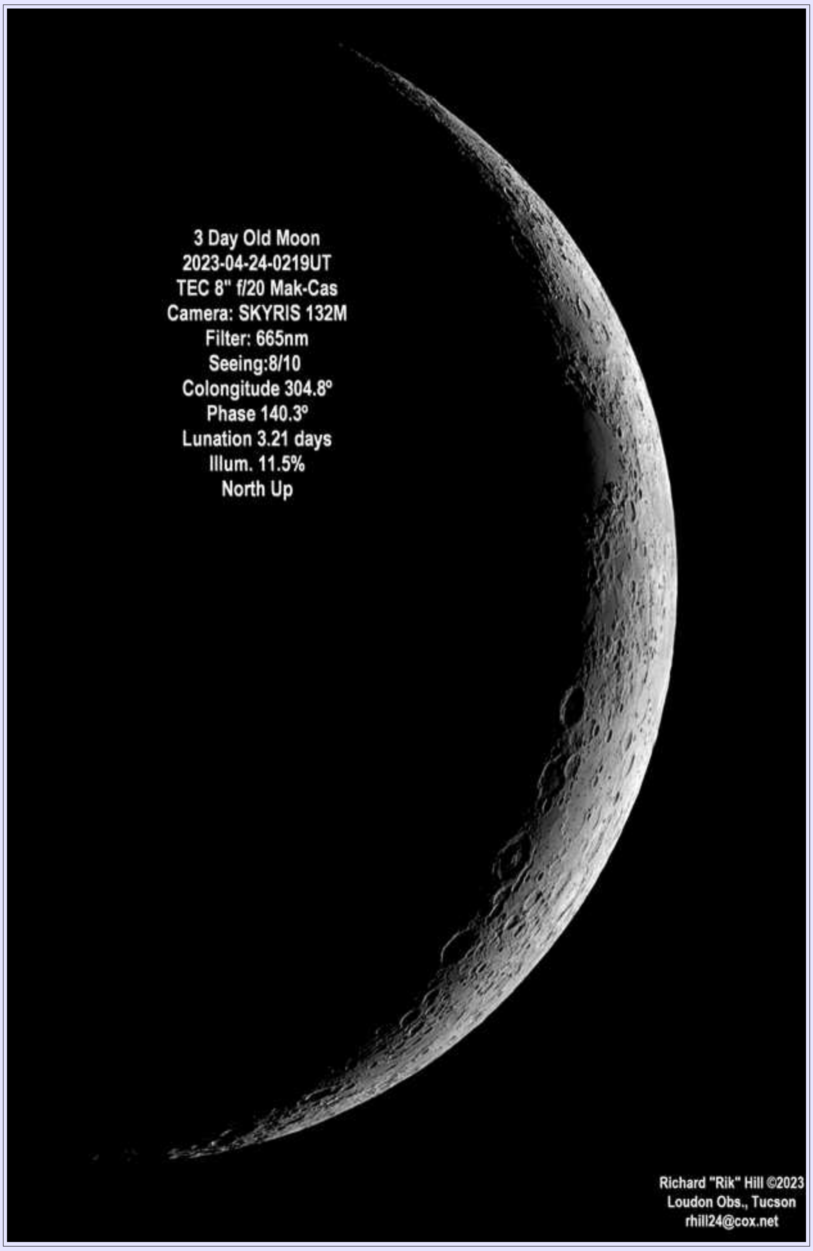


Image by Richard Hill with the time/date and equipment as shown.

Rik Comments: *Usually I will not do a whole-Moon lunar image but I could not resist with this beautiful crescent hanging like a charm in the twilight glow. My artist father, when I was just a nascent amateur astronomer, would point out the crescent and call it a fingernail clipping in the sky. That allegory always stuck with me over the years. Notice in this image how one cusp is so much sharper than the other. Something to watch for in crescent moons.*

In this image we see a row of large craters on the southern terminator starting on the northern end with Langrenus (136km dia.) with the overlapping craters just below it of Vendelinus (151km) with Lame (87km) on its northeastern wall. Below these is Petavius (182km) with its obvious bright central peak and the last one in the chain below this monster is Furnerius (129km). Between these last two you can see two more craters, Hase (82km) and Hase D (57km). It's interesting that while people have reported seeing (or detecting) Copernicus *and Ptolemaeus when on the terminator there are no such reports for Petavius or Langrenus. This, like sighting the earliest moon each month, might be a fun challenge for the naked eye observers.*

This image was made from 6, 1800 frame AVIs stacked with AVIStack2 (IDL) and knitted together with MicroSoft ICE and finally processed with GIMP and IrfanView.

Longomontanus.

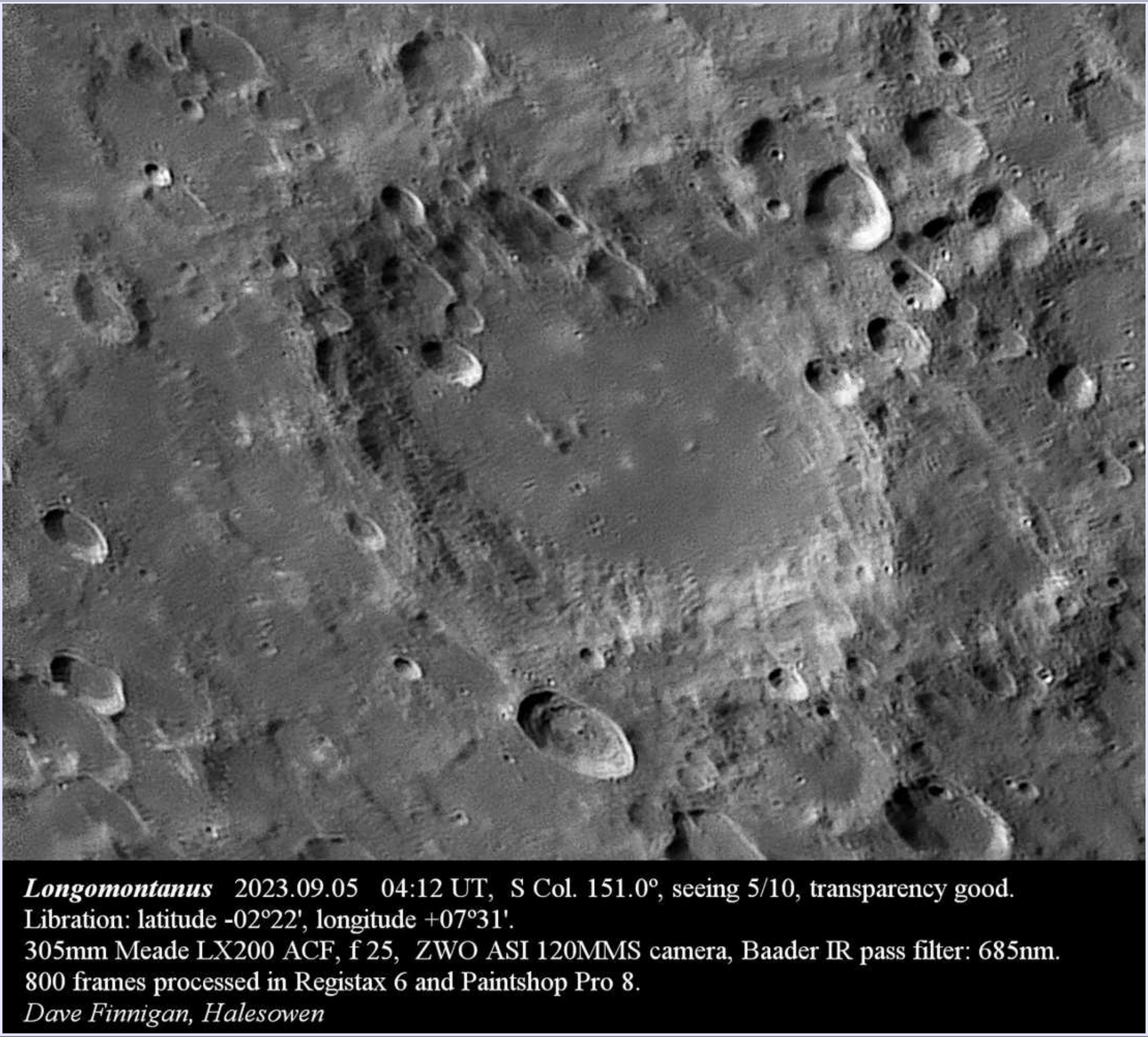


Image by Dave Finnigan with the time/date and equipment as shown.

Mare Imbrium.

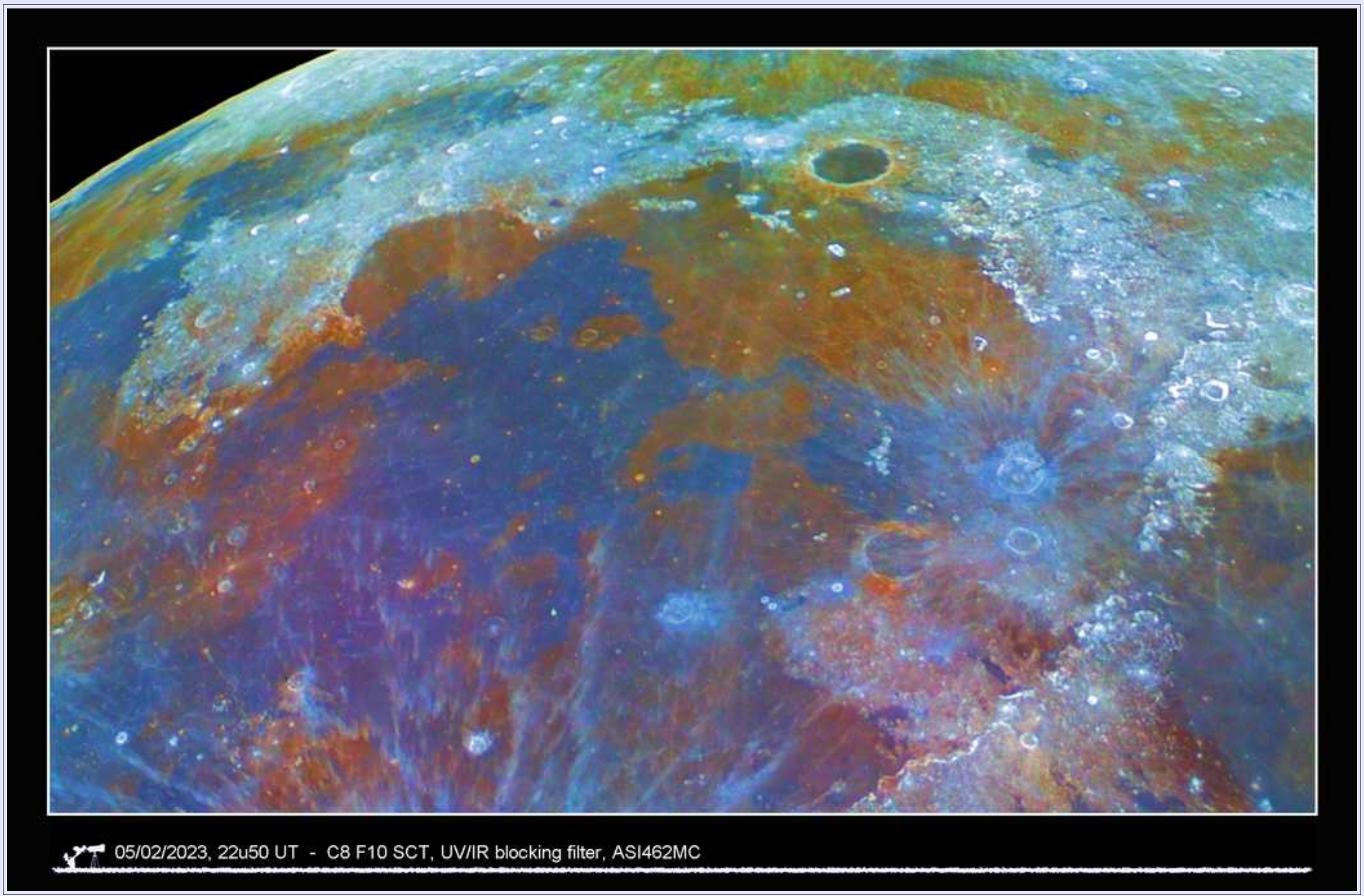


Image by Alexander Vandenbohede with the time/date and equipment as shown.

Towards the Lunar South Polar Region.

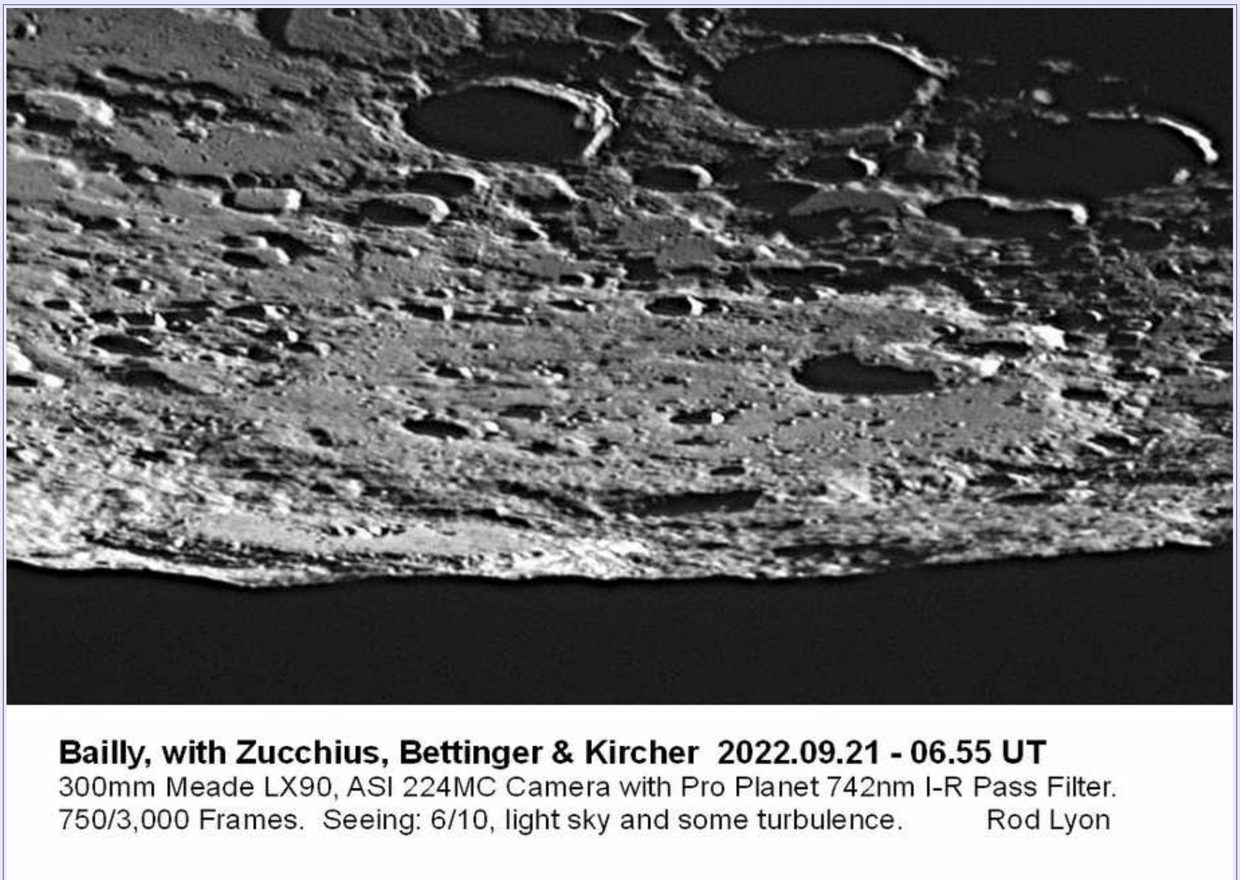


Image by Rod Lyon with the time/date and equipment as shown.

Indian Chandrayaan-3 landing site.

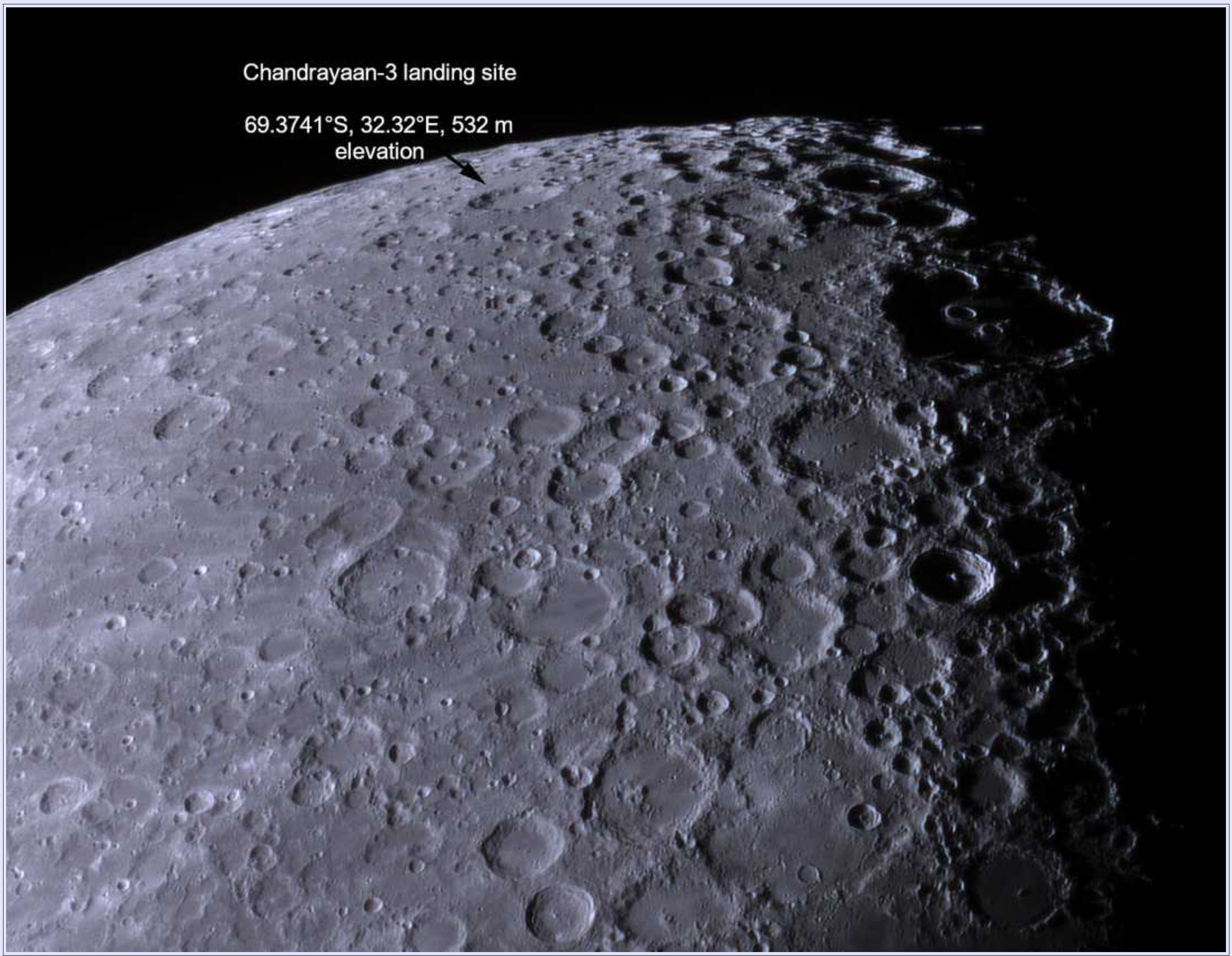


Image by Maurice Collins taken on August 25 2023 at 0755UT

Maurice Comments: *My father asked me where the Indian Chandrayaan-3 landing site was on the Moon. Now that LRO has found it and given the coordinates, I decided to use LTVT to find the spot and then put an arrow on one of my images to show where it landed. I had no idea myself until I did this, so now we know!*

Lunar South Pole Region.

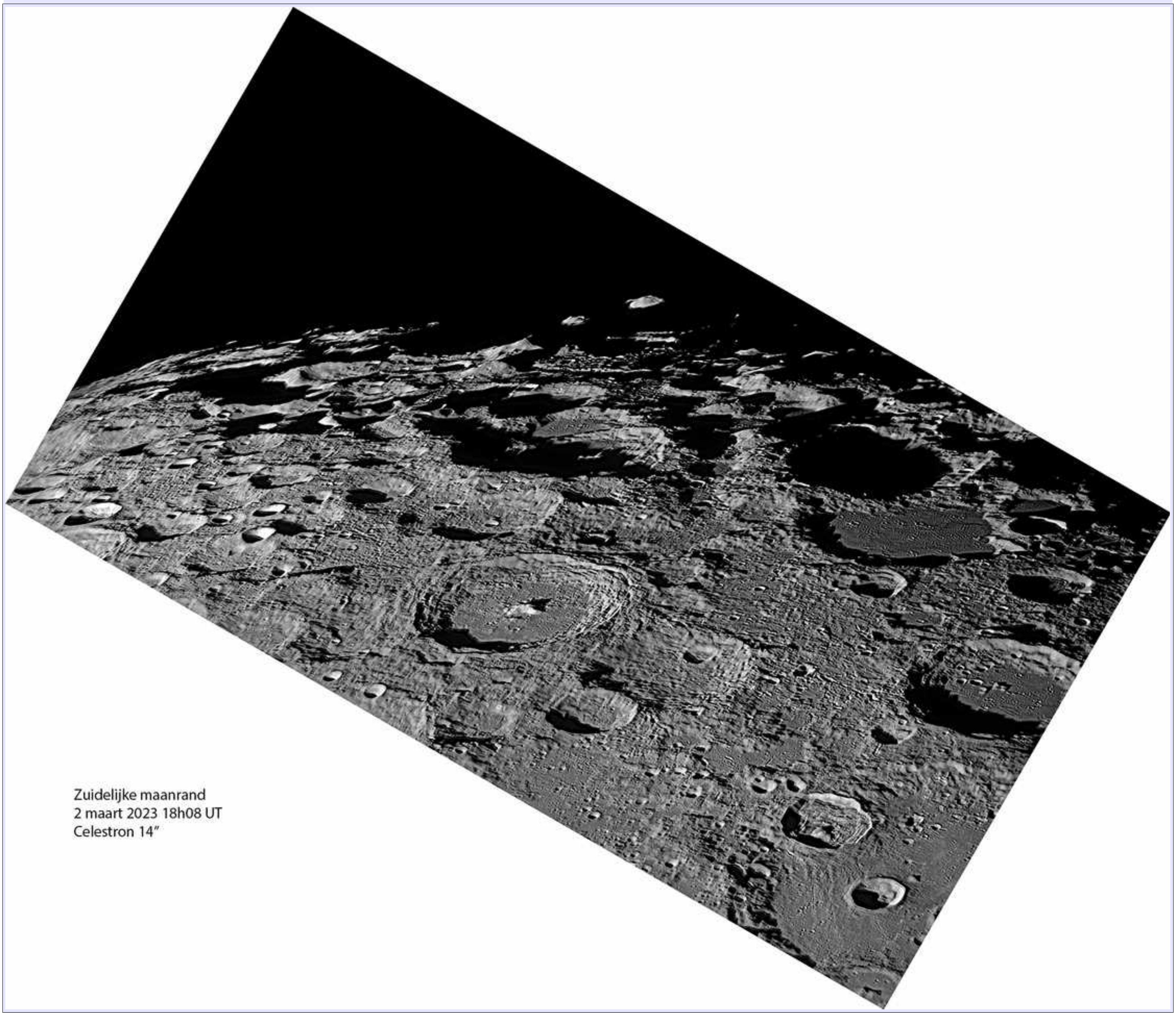


Image by Leo Aerts taken on 2nd March 2023 with a Celestron C14.

Cleomedes.

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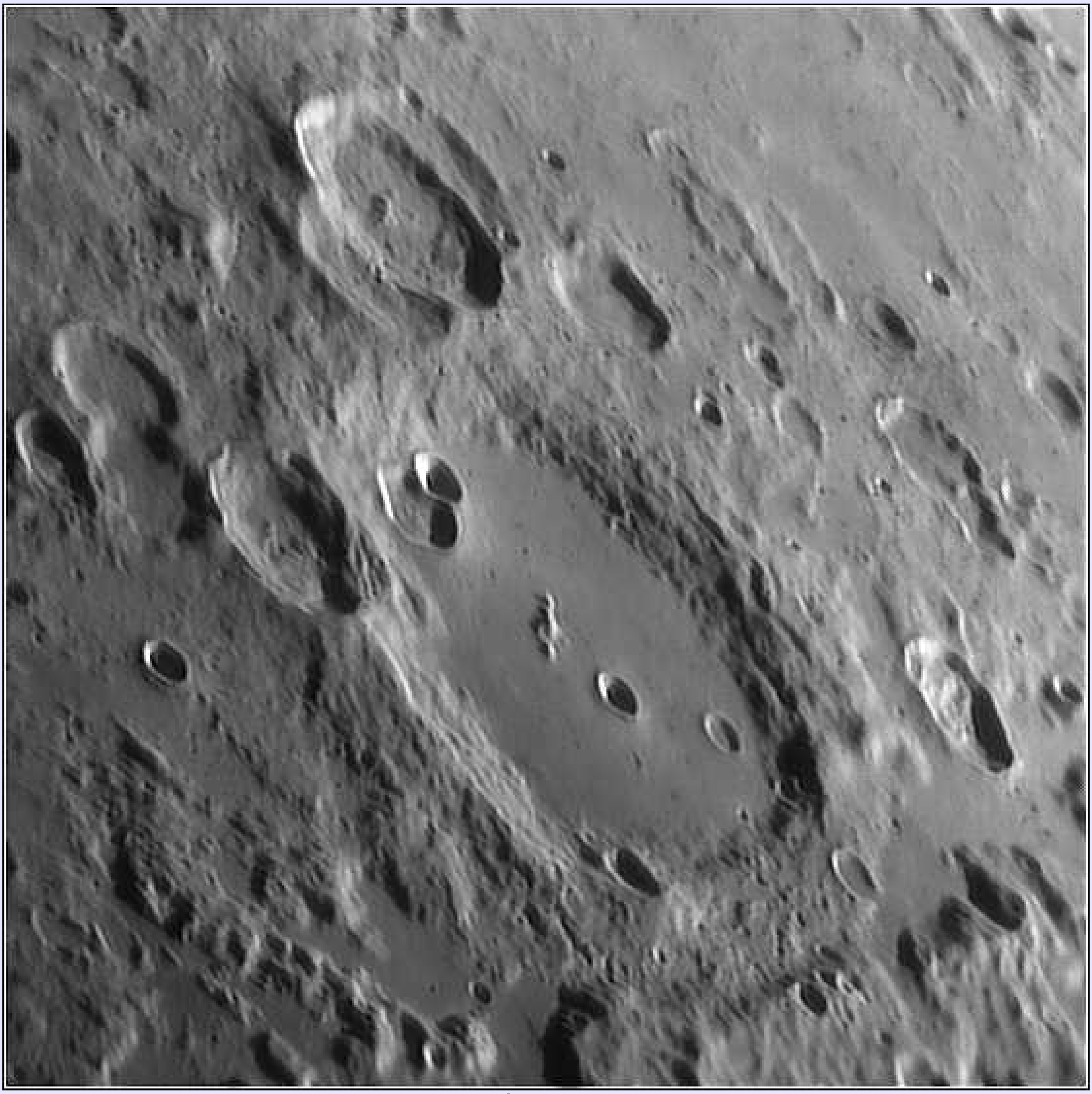
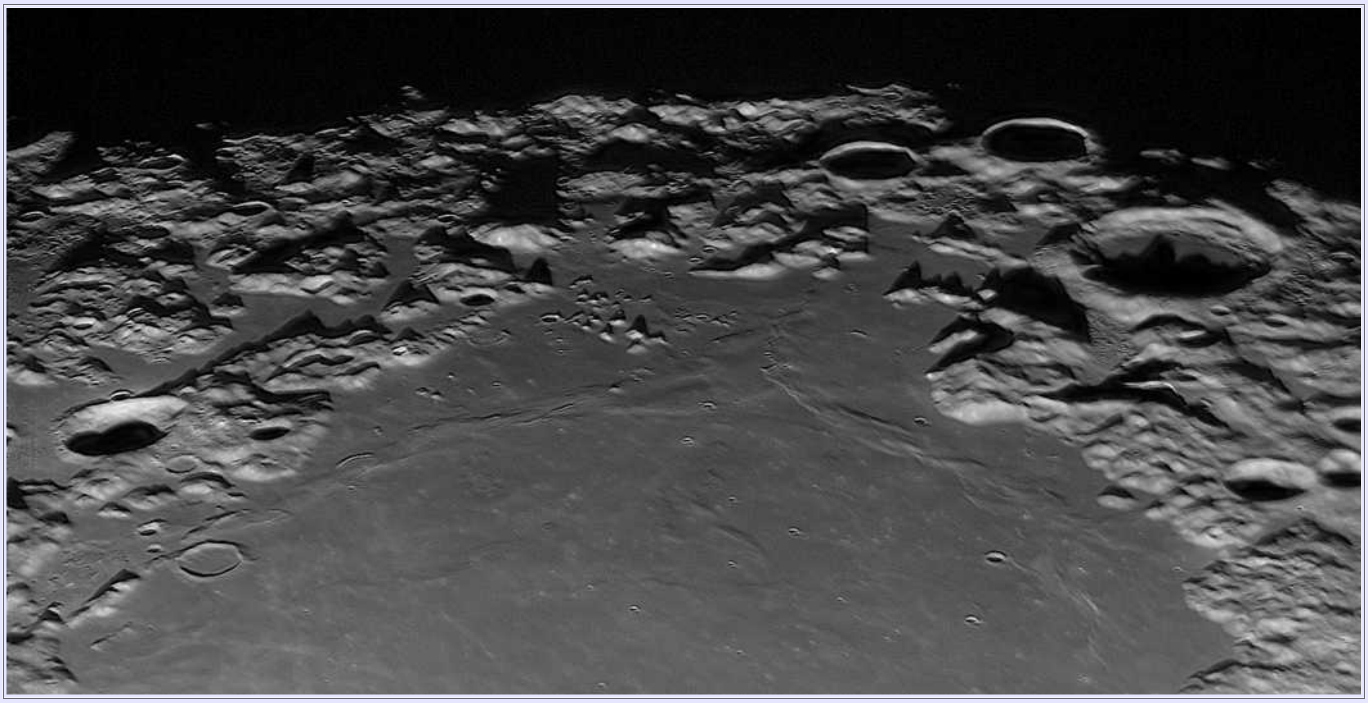
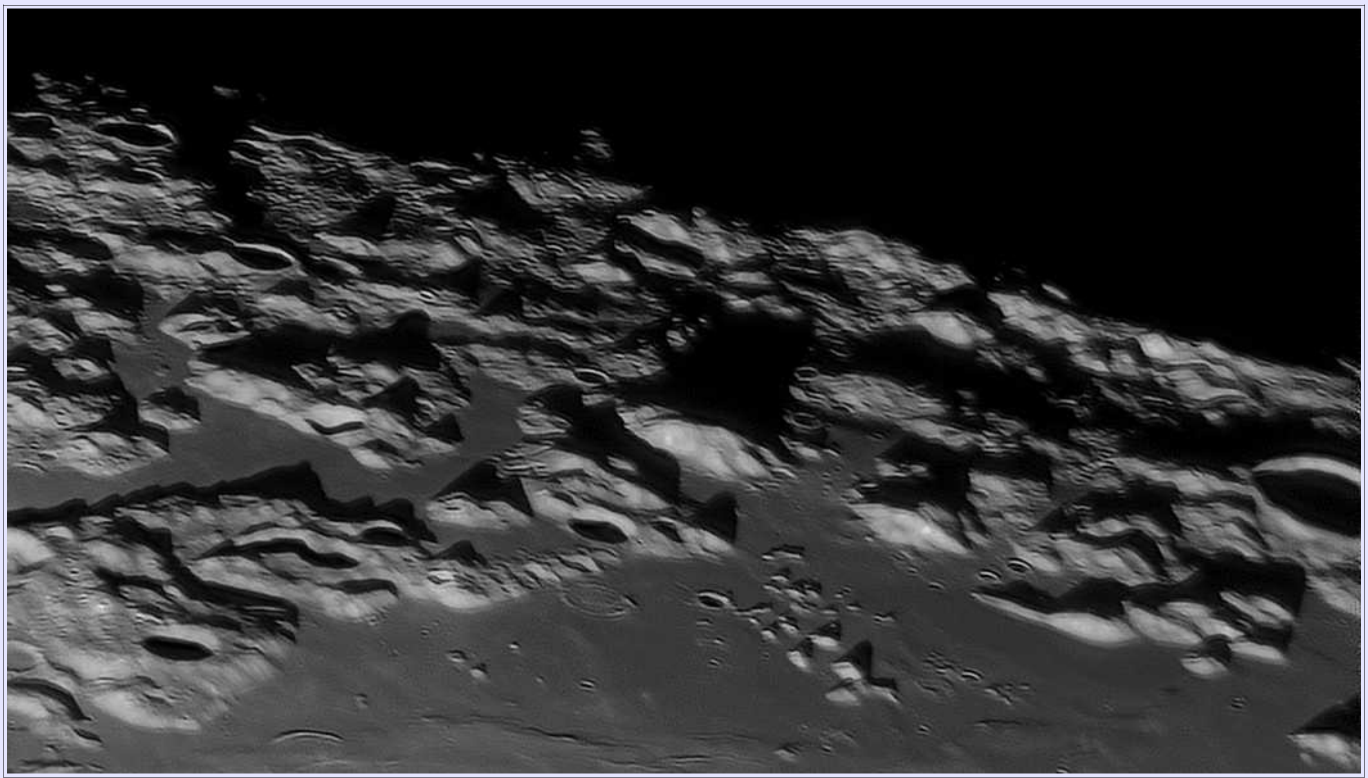


Image by William Leatherbarrow taken on 24th April 2023 at 2050UT with an Orion Optics OMC300

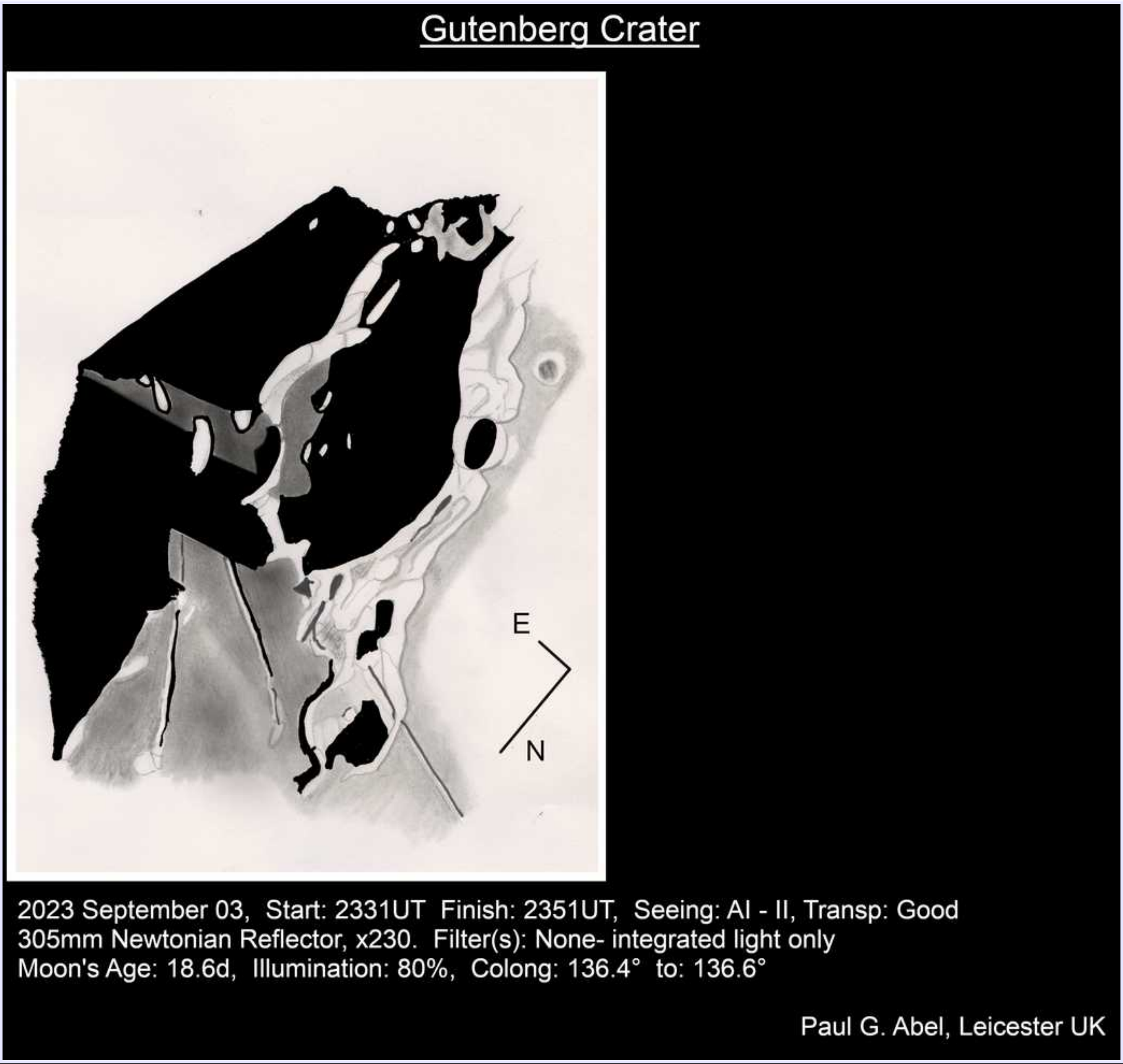
Eastern shore Mare Crisium and Alhazen α





Images by Leo Aerts taken on October 1st 2023 Celestron 14, red filter and ASI 290MM

Gutenberg.



Drawing by Paul Abel with details of observation as shown.

Paul Comments: *The above is an observation I made of Gutenberg crater on 3rd September, and I had some nice views of the crater and surrounding regions. The observing notes are below.*

Gutenberg Crater in good seeing conditions, x230. Gutenberg is an impact crater located near the to the western edge of the Mare Fecunditatis. It is quite a large crater, some 74 km in diameter and a depth of 2.3km. The evening terminator was close to the feature and there were a number of points of interest.

First, the satellite crater Gutenberg E on the eastern wall (in fact it overlaps Gutenberg's wall). There was a thin wedge shaped section of the floor of Gutenberg E visible which looked very distinctive. To the north, to long rille shaped features could be seen and these two features must be part of the Rimae Goclenius. The Rimae Gutenberg could also be made out to the NW.

Alfraganus.

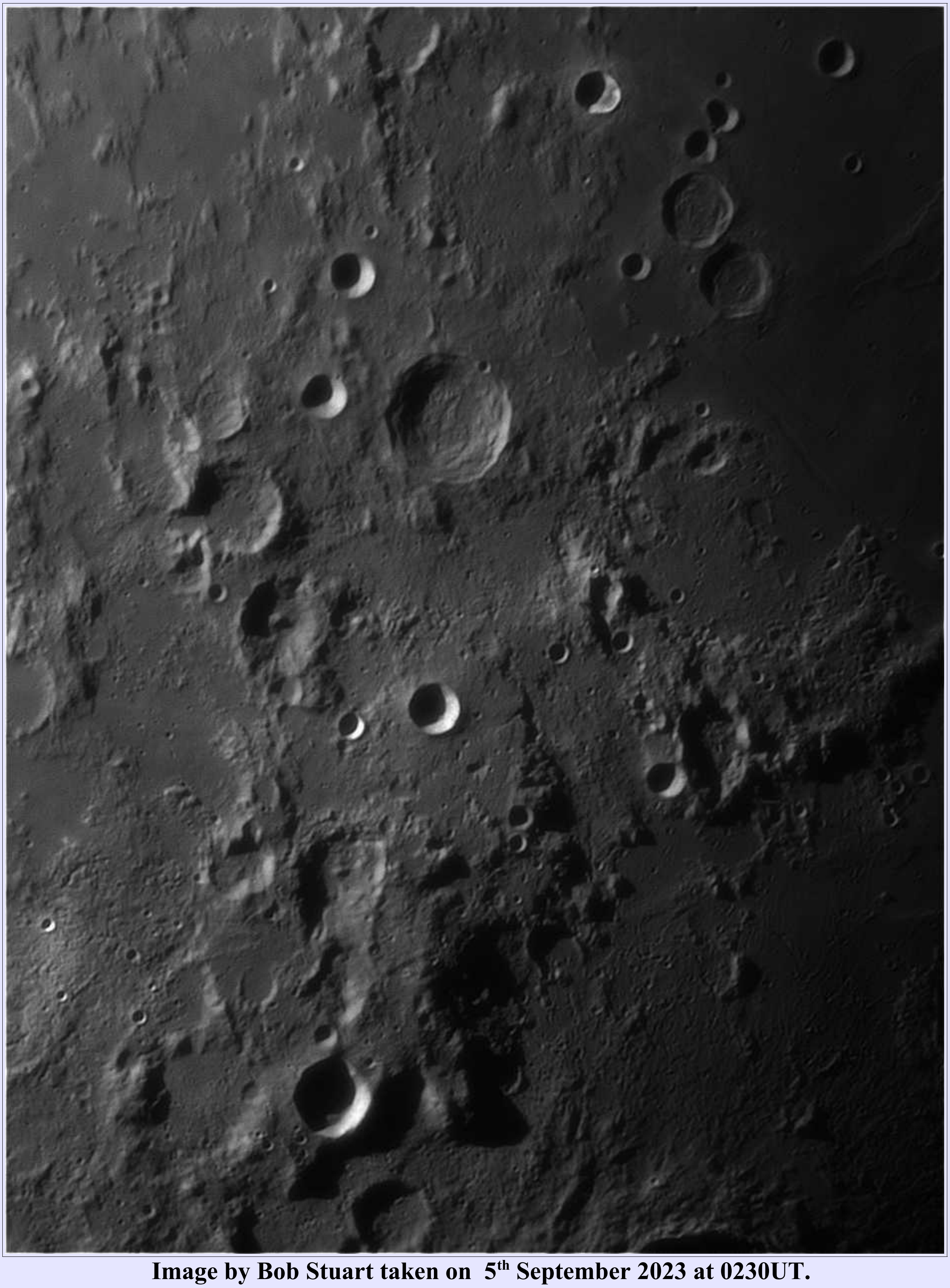
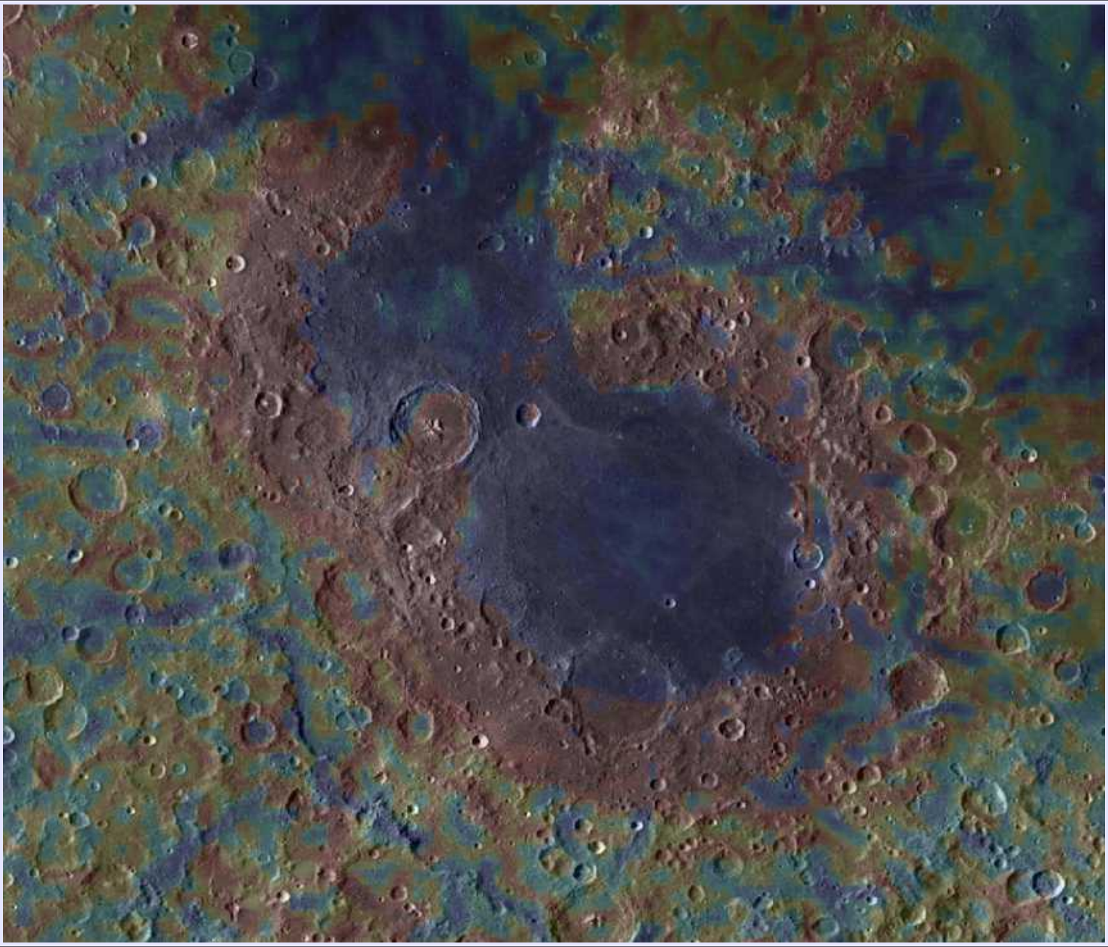


Image by Bob Stuart taken on 5th September 2023 at 0230UT.

Geological Notes: Alfraganus is the 20km diameter simple crater in the middle of the image, with the larger, older 51km diameter Delambre some 80kms to the north. The bottom right of the image is occupied by the south-western part of Sinus Asperitatis and this image gives the very strong impression that we are seeing the rim of a larger basin type structure. What we are seeing here is north western quadrant of Rupes Altai, which is not usually conspicuous, but is picked out here by the low angle of illumination.

This is not too much of a surprise as Mare Nectaris is just to the south-east, but what is not so obvious is that Mare Nectaris lies on top of an older Asperitatis multi ringed basin of only slightly smaller dimensions, which is only visible in the GRAIL gravity data such as that shown below which is a Bouguer gravity gradient overlay.



As you can see the blue and red 'bullseye' define the inner part of the basins with the blue being the central part occupied by later mare basalts forming the features known as MASCON's or *Mass Concentrations* since Apollo days, whilst the red indicates zones of increased crustal thickness. Note that in the case of Mare Nectaris these structures are well within Rupes Altai, so are features of the inner basin – so the same probably applies to the Asperitatis Basin, who's diameter is thought be in the region of 730kms.

Just to the east of Alfraganus in Bob's image you can see a trough like structure orientated roughly NNW-SSE, with a rather jagged western edge. This is, as you can see from the GRAIL image, right on top of the inner red ring of the Asperitatis Basin, but this also corresponds to the position of the arc of the Rupes Altai shown in the image, so the rupes appears to directly overlie the inner ring of the Asperitatis Basin. The trough itself looks to be radial to Nectaris, and so could be related to this basin – possibly caused by ejecta blasted in a down-range direction as the basin formed or by radial faulting. The low angle of the Sun in Bob's image also picks out some subtle lineations that share the same orientation as this trough – could these be further features produced by Nectaris ejecta, analogous to the Imbrium Sculpture?

The Descartes lunar swirl, the strongest known magnetic anomaly on the lunar near side, can be seen as the high albedo patch towards the bottom left of the frame. The origin of these magnetic anomalies continues to generate new hypotheses as noted in comments on another of Bob's images in last month's LSC. It is interesting to note that the terrain around this particular anomaly is quite 'knobbly' in appearance and broken up into numerous small hills which are quite apparent within the crater Descartes itself. Whilst this unusual topography might be explicable using the old 'antipodal impact' model for magnetic anomalies it might not be so under the new 'magnetised iron rich basin ejecta' model mentioned last month.

Pytheas.

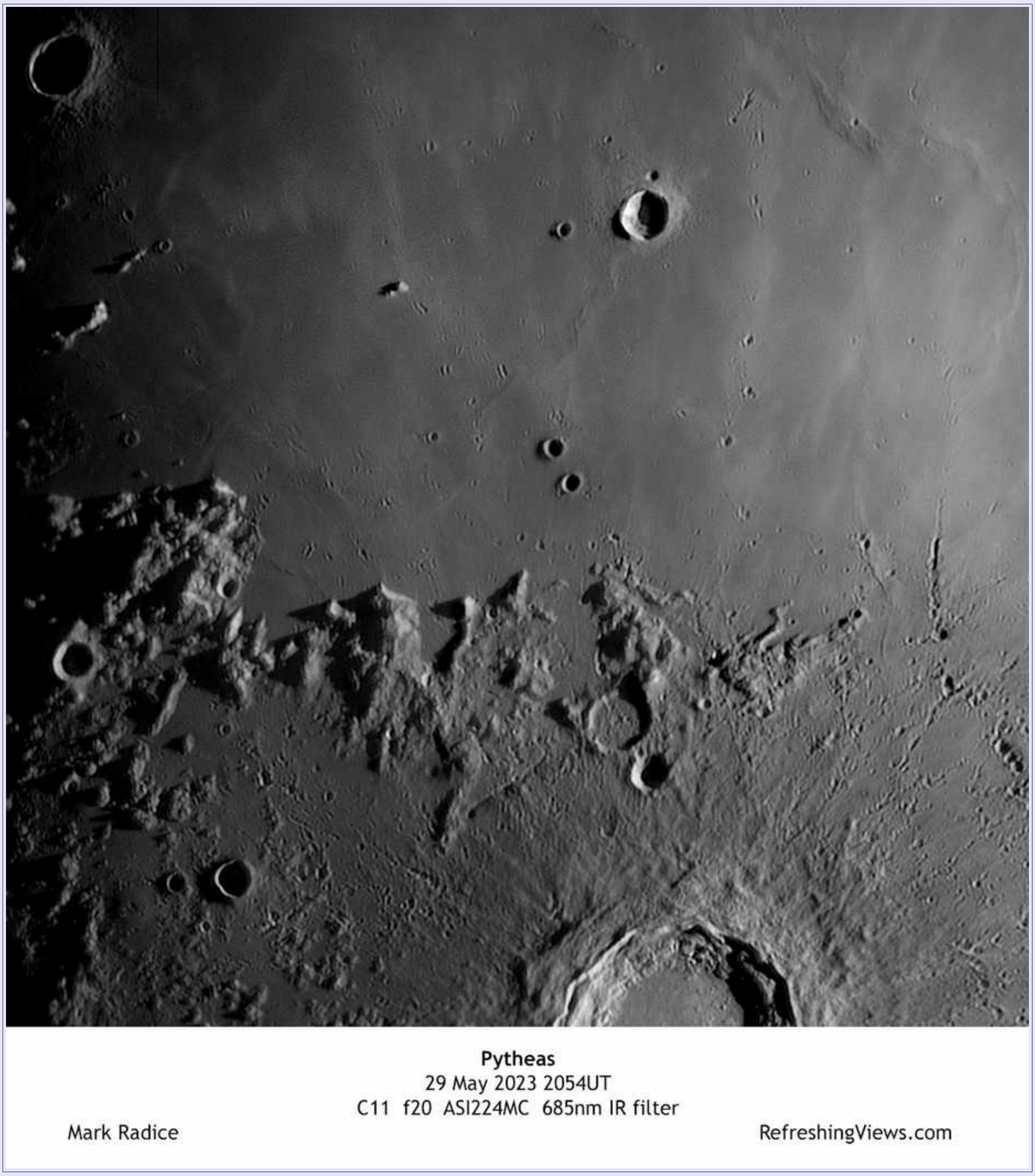


Image by Mark Radice with details of time/date and equipment as shown.

Geological Comments: Mark's image picks out the ejecta and crater chains to the north of Copernicus and over southern Mare Imbrium where it brackets the small crater Pytheas. There is a reasonable amount of evidence to suggest that Copernicus and Pytheas formed simultaneously during the impact of a binary asteroid travelling from south to north. So, if you zoom in on Pytheas using the LRO Quickmap you can see places where the ejecta from Pytheas overlies that from Copernicus, but in other places you can see that ejecta from Copernicus overlies that from Pytheas*. The only way this rather bizarre juxtaposition of ejecta can have come about would be if the ejecta from both craters was being deposited at the same time, but with various components of that ejecta arriving in a sequence as the excavation process proceeded in each crater. If this hypothesis holds water, it is also another example of binary asteroids becoming '*trajectory aligned'* as they entered the Earth-Moon gravitational environment – and ending up travelling in trail formation as they approached the Moon's surface.

***Pytheas and Copernicus, Vol. 54 No. 8-9 August - September 2017**

Waxing Gibbous Moon.

Image by Ivan Walton taken on 26th October 2023 at 1929UT.

Basin and Buried Crater Project by Tony Cook.

No images or sketches have been sent in specifically for the BBC project, taken during October, nor any armchair work done at the computer, so I thought that I would pick another candidate buried crater from the catalog, and look at evidence for there being a crater there, or not? So this month's buried crater is: PFC 32, which is located at 42.5˚W 10.6˚S with a diameter of 111 km.

Just to remind the reader, PFC stands for "Partly Filled Crater". The PFC's listed come from the paper by: A.J. Evans, J. M. Soderblom, J. C. Andrews-Hanna, S. C. Solomon, and M. T. Zuber (2016), Identification of buried lunar impact craters from GRAIL data and implications for the nearside maria, Geophys. Res. Lett., 43, 2445–2455, doi:10.1002/2015GL067394.

So let's look at the NASA Quick Map web site and see what is there at this location. The WAC nearside mosaic (with shadows) shows quite clearly 60% of a crater rim, and adding nomenclature we can see that this crater is called "Letronne" and so it is not correct to suggest that this was completely unknown, and the Evan's et al. paper should have at least mentioned its name. According to NASA Quickmap the diameter of this crater is 117.6 km, i.e. 7.6 km bigger than the catalog entry, and located at 42.5˚W 10.5˚S. The age of the oldest part of the mare fill is 3.4Ga, according to the Hiesinger Mare Age Units map on Quickmap, so therefore the crater must be older than this.

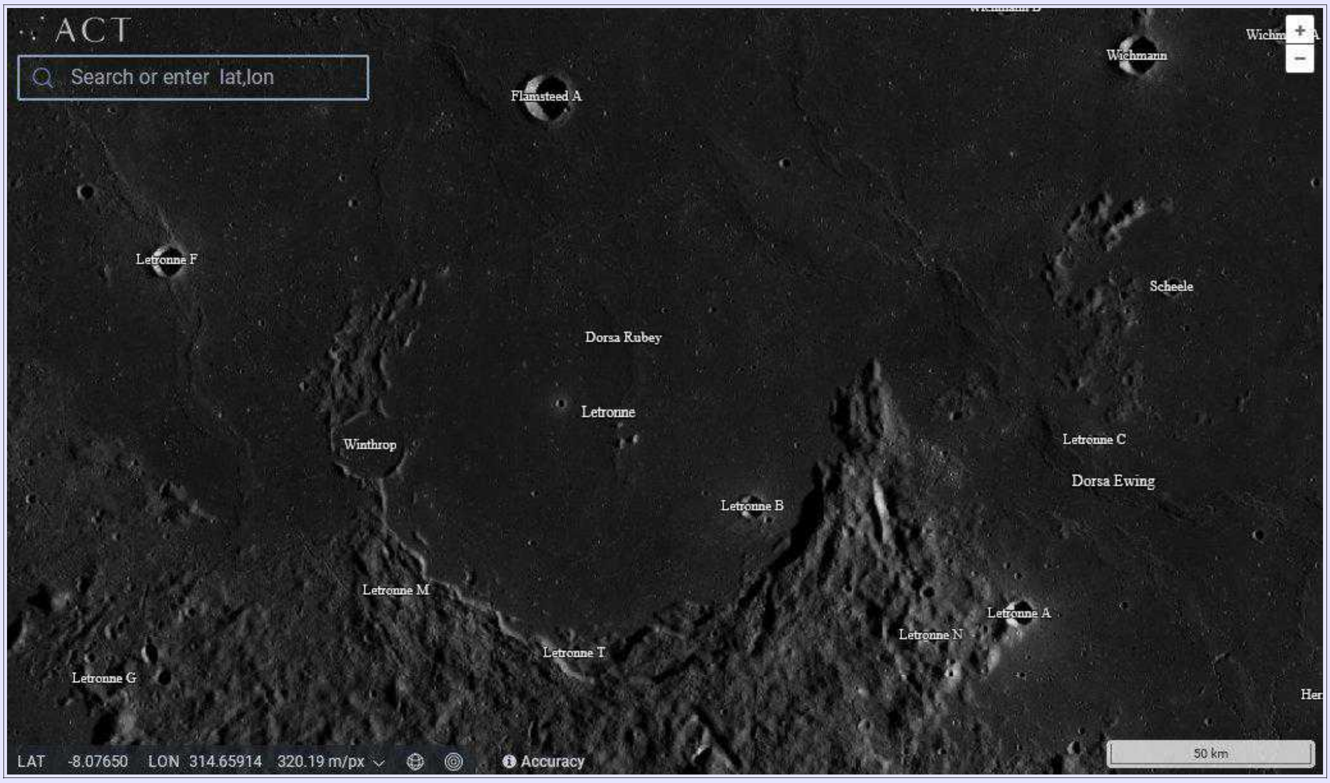


Figure 1 LROC Quickmap WAC nearside mosaic with shadows centred on the approximate location of PFC 32. Note that the scale bar on the bottom right corner is 50 km long.

As always, azimuth direction plots of the slope on the surface can be quite revealing. Fig 2 reveals that PFC 32's northern rim shows through the mare in Oceanus Procellarum and using this I was able to measure the diameter on 5 transects and come up with my own estimate of the diameter at 115.3 ± 2.2 km, which is a couple of kilometres smaller than the NASA LROC estimate.

As we have identified this buried crater as Letronne, and it's an IAU named crater, we can remove it from the Buried Crater list, as it is a well known crater and perhaps should not have appeared in the Evans et al. paper.

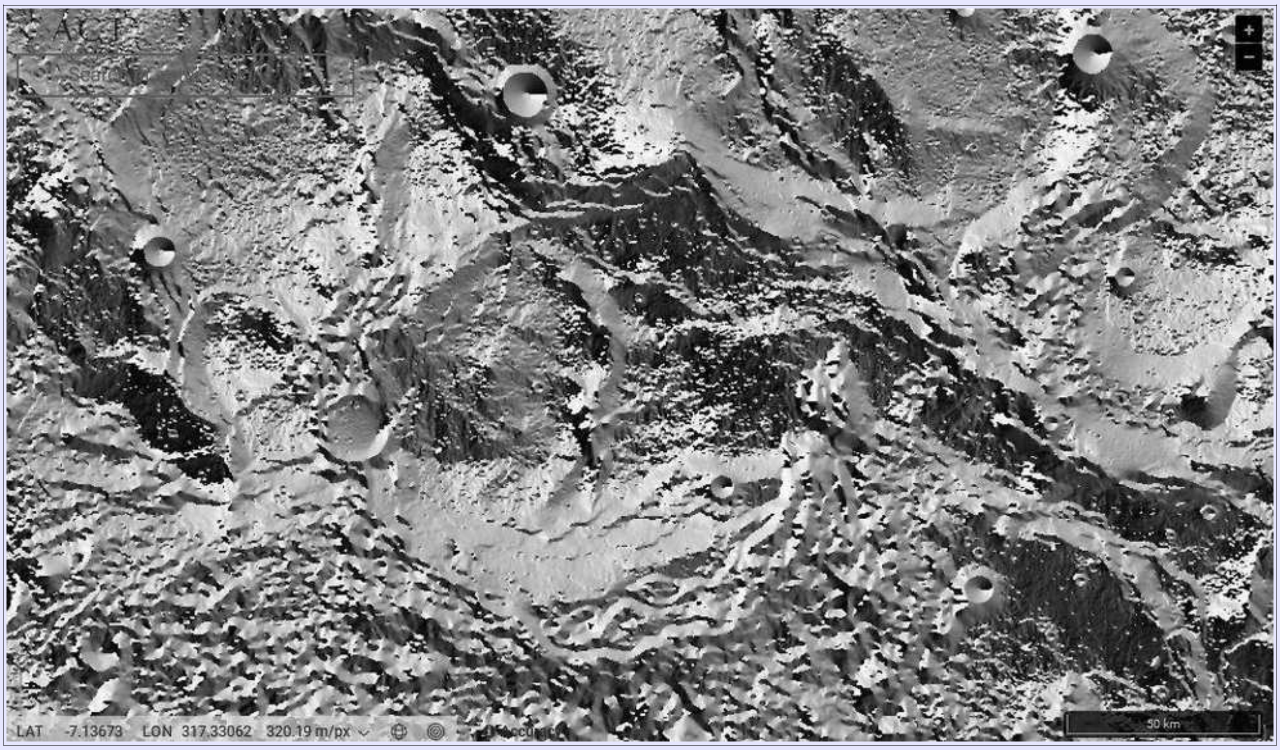


Figure 2 LROC Quickmap ACT Layers (Experimental): Terrain Azimuth. The scale bar on the bottom right is 50 km long.

If you think that you have discovered a new impact basin, or unknown buried crater, please check whether it has been found previously on the following web site, and if not email me its location and diameter so that I can update the list.

https://users.aber.ac.uk/atc/basin_and_buried_crater_project.htm.

Alternatively, if you want an observational challenge, try to see if you can image one of more of the basins or buried craters at sunrise/set and establish what colongitude range they are best depicted at. Or you can even do this "virtually" with LTVT software. As you can see from the tables on the web sites there are lot of blank cells to fill in on the sunrise and sunset colongitude columns – so a good opportunity for you to get busy!

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Lunar domes (part LXX): A lunar cone near Lassell H and J.
By Raffaello Lena.

In 1981, Dick Pike and Gary Clow published a paper, *Revised Classification of Terrestrial Volcanoes and Catalog of Topographic Dimensions, with New Results on Edifice Volume* (US Geological Survey Open-File Report 81-1038 https://pubs.usgs.gov/of/1981/1038/report.pdf), including data regarding some lunar cones. In this note a lunar cone located near the craters Lassell H and J will be examined. The examined lunar cone lies at 14.98° S and 10.88° W. Apollo 16 imagery shows the examined feature with a large central depression on the summit (Fig.1).

Figure 1: AS16-120-19237 (H) imagery. A lunar cone is marked with white lines.

A terrestrial telescopic image of this lunar region is shown in Fig. 2. The image was taken by Carmelo Zannelli on the evening of January 1, 2023 at 17:58 UT in good seeing conditions using a telescope Astrofaktorja DK20" F/27.

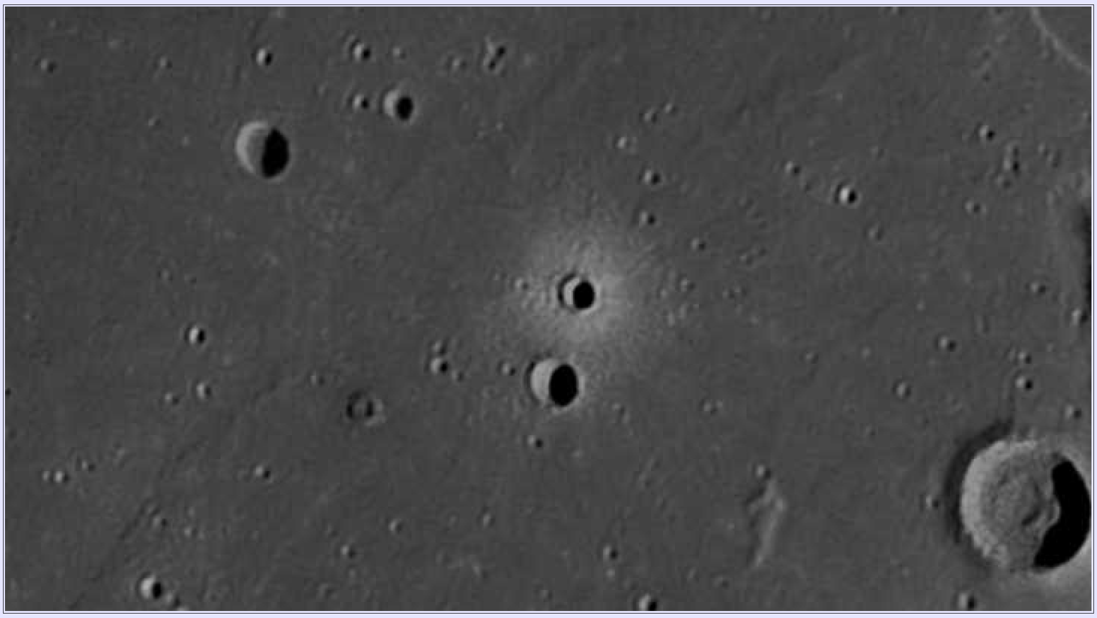

Figure 2: Image taken by Zannelli on January 1, 2023 at 17:58 UT. The lunar cone is apparent to the west of the craters Lassell H and J. Crop of the original image.

Morphometric properties

Figure 3: Derived surface elevation plot in East-West direction based on LOLA DEM.

The new global topographic map of the Moon obtained by the Lunar Reconnaissance Orbiter is the principal source of topographic information used in this study. Associated topographic profiles were extracted from the LOLA DEM and the GLD100 dataset using the Quickmap LRO global basemap. The cross sectional profile is shown in Fig. 3. The cone, here termed as Lassell HJ, has a base diameter of 2.65±0.1km, height of 130±10m and average slope angle of 6.1°±0.6°. The volume is determined to be 0.37km³ assuming a parabolic shape.

3D reconstructions based on NAC imagery

A realistic view based on NAC digital elevation-*QuickMap Terrain Shadows*- displays the shape of Lassell HJ (3D reconstruction shown in Fig. 4). A DTM elevation map derived using ACT REACT Quick Map tool is shown in Fig. 5.

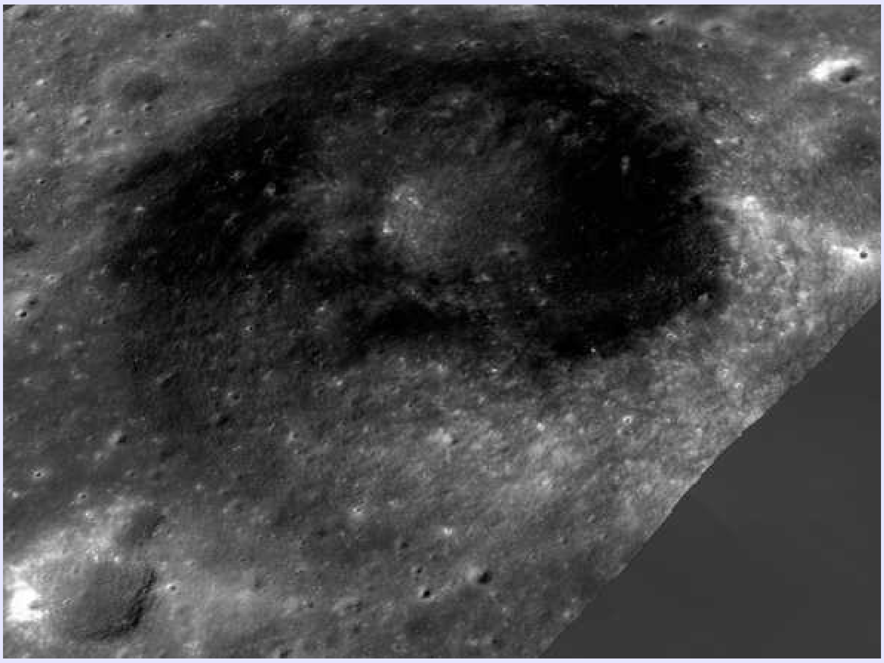

Figure 4: ACT REACT Quick Map tool- 3D reconstruction based on NAC imagery.

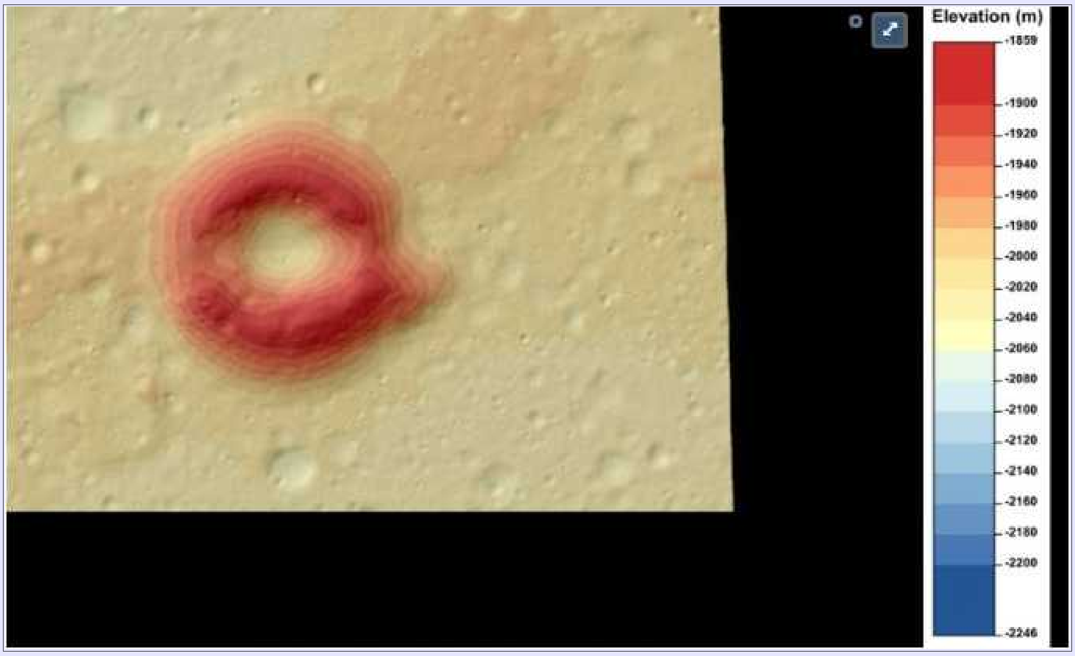

Figure 5: ACT REACT Quick Map tool. Elevation map.

3D Reconstruction based on telescopic image

Generating an elevation map of a part of the lunar surface requires its three-dimensional (3D) reconstruction. A well-known image-based method for 3D surface reconstruction is shape from shading (SfS). This method makes use of the fact that surface parts inclined towards the light source appear brighter than surface parts inclined away from it. The SfS approach aims to derive the orientation of the surface at each image location by using a model of the reflectance properties of the surface along with knowledge of the illumination conditions, to derive an elevation value for each image pixel (Lena et al., 2013). The SfS method requires accurate knowledge of the light-scattering properties of the surface in terms of the bidirectional reflectance distribution function (BRDF). The height h of a dome is obtained by measuring the altitude difference in the reconstructed 3D profile between the dome summit and the surrounding surface, considering the curvature of the lunar surface. The average flank slope is determined according to: slope = arctan 2h/D. The uncertainty results in a relative standard error of the dome height h of ±10 percent, which is independent of the height value itself. The dome diameter D can be measured at an accuracy of ± 5 percent. The 3D reconstruction is shown in Fig. 6.

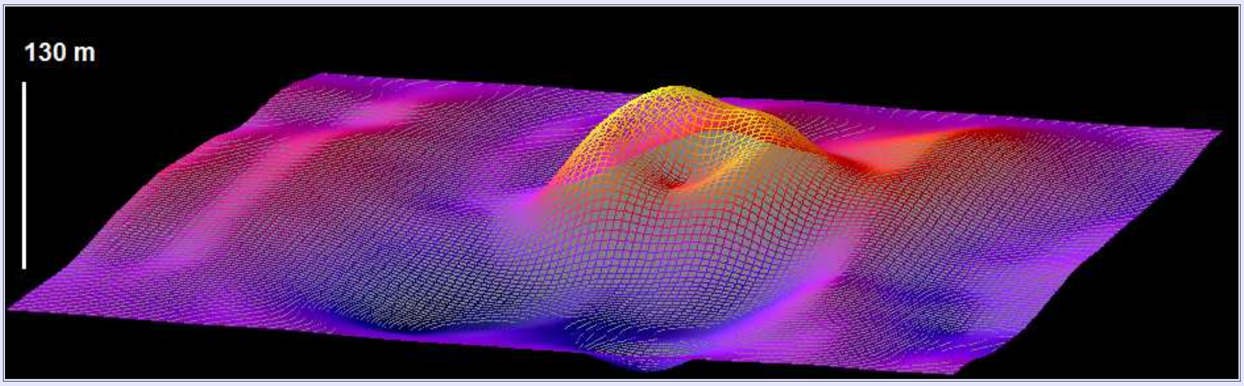

Figure 6: 3D reconstruction based on the image of figure 2, taken by Zannelli on January 1, 2023 at 17:58 UT.

Based on morphometric and spectral data Lassel HJ is identified as a lunar cone. Cones form a separate spectral and morphometric group in the lunar domes classification scheme (Lena et al., 2013), which is shown on a Principal Component Analysis (PCA shown in Fig. 7).

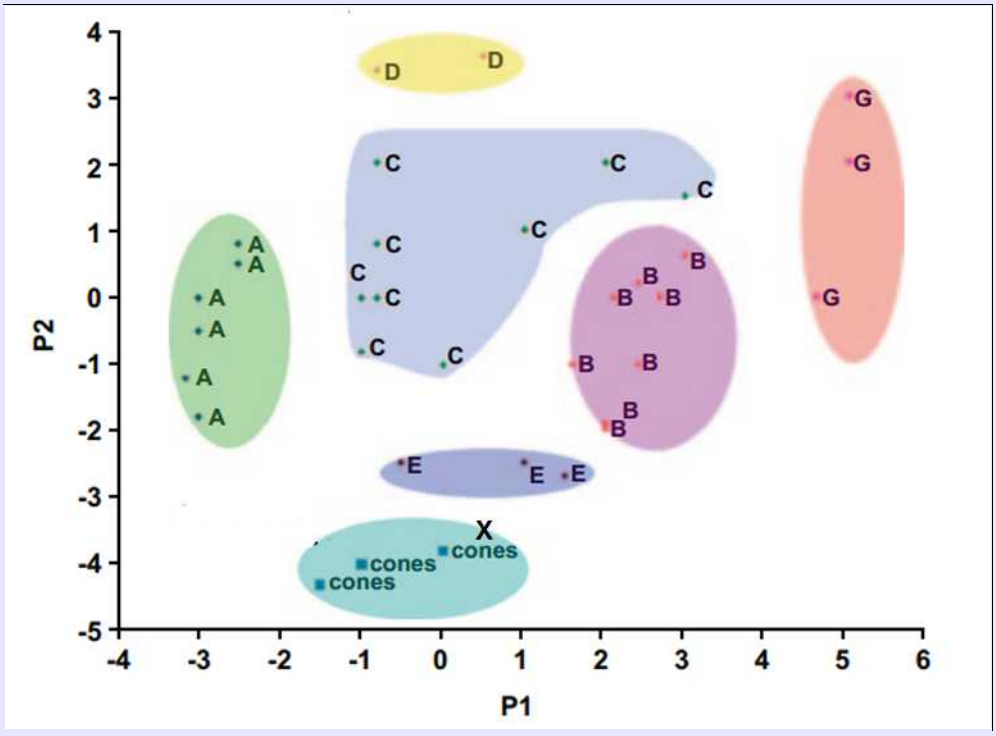

Figure 7: Classification scheme of effusive lunar mare domes and lunar cones based on a Principal Component Analysis (PCA). Scores P1 and P2 of the features vectors describing the domes on the first two principal components of the data distributions. The dome classes A–E and G (highland domes including Gruithuisen domes) and the lunar cones are indicated. Note that the examined feature belongs to lunar cones. It is marked with the symbol X.

For this study I have derived abundance maps in wt% of FeO, plagioclase, olivine, clinopyroxene, orthopyroxene and TiO_2 content created from topographically-corrected Mineral Mapper reflectance data acquired by the JAXA SELENE/Kaguya (Fig. 8).

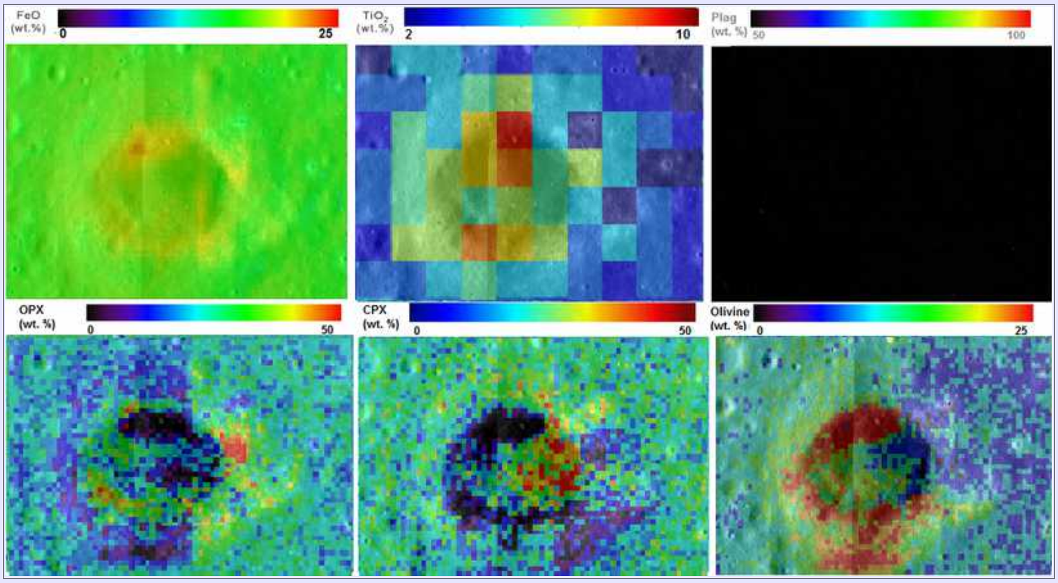

Figure 8: Top (left) FeO, (middle) TiO_2, (right) plagioclase. Bottom (left) orthopyroxene (OPX), (middle) clinopyroxene (CPX), (right) olivine content. Derived abundance maps in wt%.

The lunar cone displays a TiO_2 content of 4.0-8.0 wt% and low plagioclase content (<50.0 wt %). The FeO content varies from 17.0 wt % to 20.0 wt % and is higher than the nearby mare unit. This lunar cone has an enhanced abundance of orthopyroxene (from 17.0 wt % to 50.0 wt %) and a clinopyroxene (19.0-46.0 wt %) if compared with nearby mare units.

Furthermore the lower clinopyroxene content of the lunar cone is detected where the olivine abundance is higher, suggesting the presence, in the examined region, of different volcanic products of differing composition

(Fig. 8). The olivine abundance amounts to 18.0-25.0 wt % in the rim of the central depression.

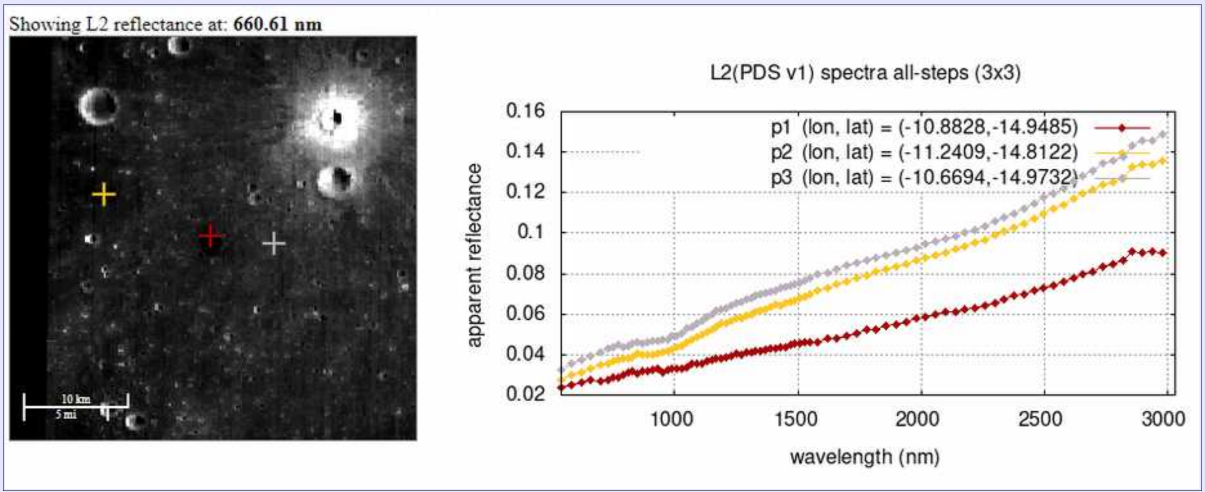

Figure 9: Spectral analysis. The spectrum of the cone indicates olivine and high-calcium pyroxene dominated composition.

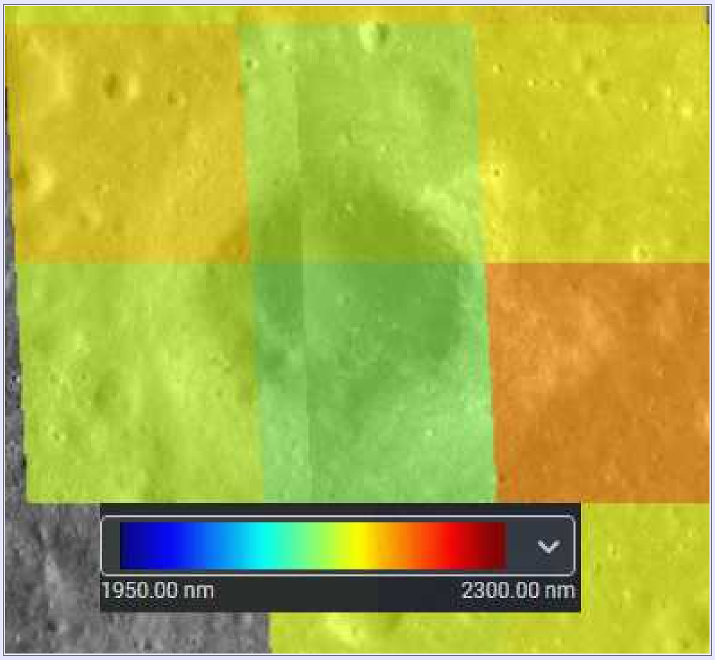

Figure 10: Center of the 2000 nm spectral absorption band, sensitive to pyroxene composition. To minimize the effects of noise, only pixels with band depths greater than 0.05 are shown.

Pyroxenes have two absorption bands, one centred near 1000 nm and another near 2000 nm; these band centres move to longer wavelengths as Ca and Fe substitute for Mg. Olivine has a complex absorption band centred beyond 1050 nm that moves as Fe substitutes for Mg (Besse et al., 2014). Significant amounts of olivine in lunar volcanic deposits will broaden the pyroxene absorption at 1000 nm and shift it to longer wavelengths, while the 2000 nm band remains fixed (Besse et al., 2011; Horgan et al., 2014).

The presence of Fe-rich volcanic glasses in lunar soils causes broad and shallow absorption bands because of the amorphous structure of the glasses as described by Besse et al. (2014). The 1000 nm band centre of lunar glass is generally shifted to longer wavelengths when compared to pyroxene, and the 2000 nm band centre to shorter wavelengths. Thus, the 1000 and 2000 nm band centre positions of lunar glasses will typically appear close together than those of pyroxenes.

The derived spectrum displays a mixture of pyroxenes and olivine (Fig. 9) confirming the data of the Mineral Mapper reflectance data acquired by the JAXA SELENE/Kaguya. Band centre at 2000 nm of lunar glass is generally shifted to shorter wavelengths. Figure 10 displays the derived values for the examined cone, which range from 2150 nm to 2180 nm.

The spectral analysis displays broad, composite absorption over 1,000 nm having the greatest affinity to typical olivine spectra admixed with pyroxenes.

References:

Besse, S., Sunshine, J. M, and Gaddis, L. R. (2014), Volcanic Glass Signatures in Spectroscopic Survey of Newly Proposed Lunar Pyroclastic Deposits, Journal of Geophysical Research - Planets, Vol. 119, doi:10.1002/2013JE004537.

Besse, S., Sunshine, J. M., Staid, M. I., Petro, N. E., Boardman, J. W., Green, R. O., Head, J. W., Isaacson, P. J., Mustard, J. F. and Pieters, C. M. (2011). Compositional variability of the Marius Hills volcanic complex from the Moon Mineralogy Mapper (M^3), J. Geophys. Res., 116, E00G13, doi:10.1029/2010JE003725.

Horgan, Briony H.N., Cloutis, Edward A., Mann, Paul and Bell, James F. Near-infrared spectra of ferrous mineral mixtures and methods for their identification in planetary surface spectra. Icarus, Volume 234, 2014, 132-154, ISSN 0019-1035, https://doi.org/10.1016/j.icarus.2014.02.031

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

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Sinus Fidei and Rima Conon.
By Barry Fitz-Gerald.

One of the photos included in the August LSC was taken by Leo Aerts and covered Archimedes, Palus Putredinis and the Apennine Bench Formation. It also included Sinus Fidei which sits to the east of the Apennine range and to the north of Mare Vaporum and within which is located the short stubby Rima Conon. Though this is obviously an interesting area, I had not previously paid too much attention to it, assuming that Rima Conon was a simple sinuous rille that originated at the head of Sinus Fidei before flowing south and emptying into Mare Vaporum. But Leo's image inspired me to have another look at the sinus and it seems that this area seems to be far more interesting than that first impression would suggest.

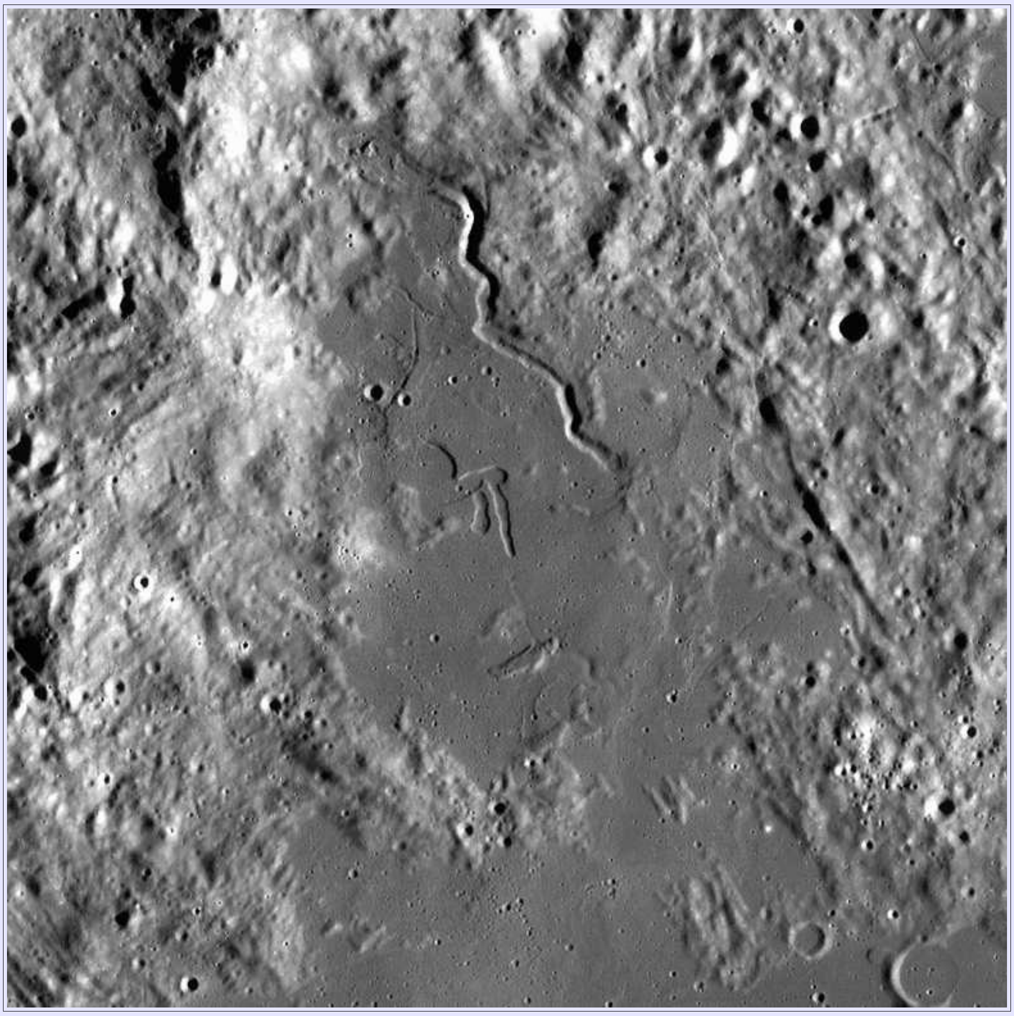

Fig.1 LROC WAC image of Sinus Fidei with Rima Conon apparently emerging in the northern end before flowing south towards Mare Vaporum.

Fig.1 shows the sinus, with Rima Conon running down from the north towards Mare Vaporum, and a rather conspicuous and oddly shaped depression with finger like projections to the south-west. The central part of the sinus itself is ever so slightly inflated by about 400m, whilst there is a general but gradual slope down towards the south and the surface of Mare Vaporum which is roughly 500m lower in elevation. The resulting slopes would be virtually imperceptible, and it would be a stretch of the imagination to suggest there is anything 'dome' like about the sinus. GRAIL data does however indicate the presence beneath the sinus of a tongue of dense probably volcanic rock that extends upwards from Mare Vaporum which could be implicated in either the inflation of the surface and/or volcanic activity. A number of graben cross the sinus, probably a result of uplift, but a number fainter ones are orientated ESE-WNW and may be part of a broader regional tectonic suite of fractures related to the Imbrium Basin.

There are also some rather subtle lobate scarps along the eastern margin of the sinus indicating an amount of surface compression acting in the east-west direction.

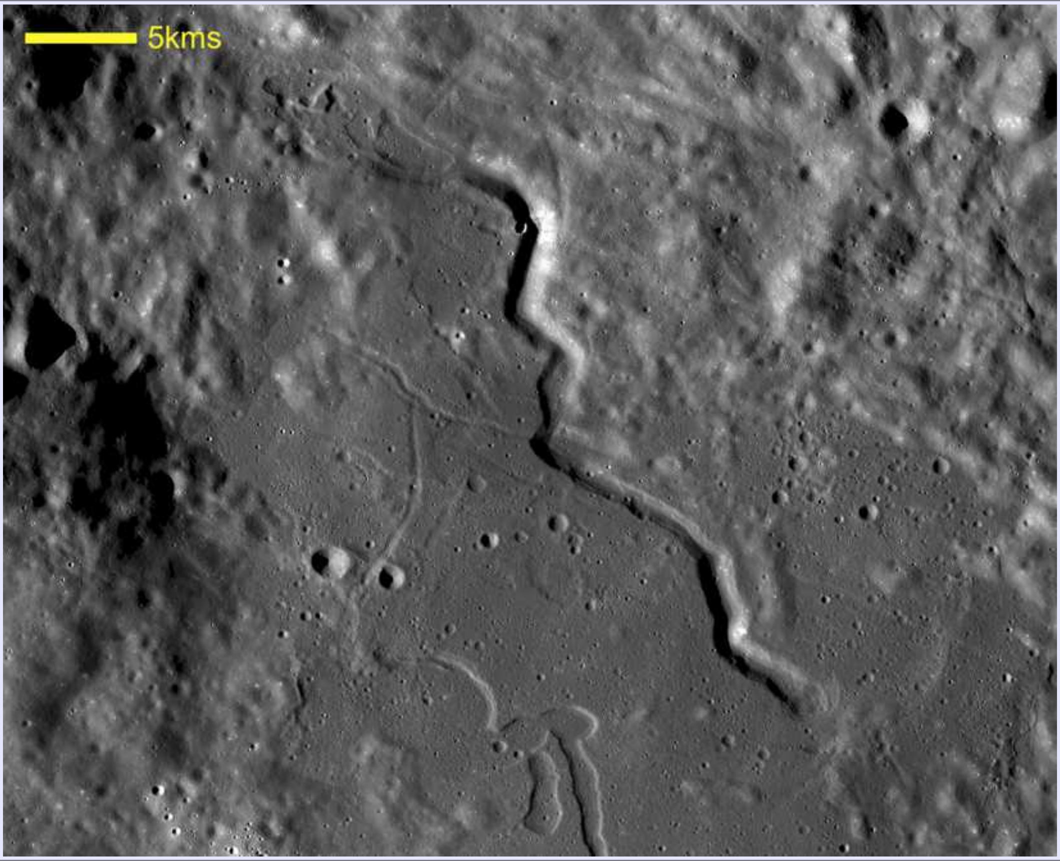

Fig.2 SELENE image of Rima Conon showing the complicated depression at the northern end of the sinus. Note the graben within the central part fo the sinus that may be related to a localised uplift as noted in the text, and also a fainter suite of graben trending ESE-WSW that may be related to the Imbrium basin.

Rima Conon is however the most conspicuous feature within the sinus, and as mentioned above, it *appears* on first glance to be a sinuous rille that originates in the northern tip of the sinus before heading south. This might not be the correct interpretation however, as the bed of the rille appears to slope northwards *away* from Mare Vaporum. Additionally the depression at the northern end is quite peculiar in morphology and not typical of other sinuous rille source pits such as the Cobra's Head. Fig.3 shows a detailed SELENE image of this depression which is some 12 to 13kms long and about 5kms wide. Depending on where you measure it, the depth approaches some 300m, but what is quite apparent is that the floor has terraces around its edge. An inner deeper bed (B in Fig.3) can be identified and about 100m above this a fairly broad terrace can be seen (T1 in Fig.3). There may be higher terraces which are less conspicuous (T2-3 in Fig.3) suggesting at least 3 different depth levels to this structure.

It is difficult to work out what is going on here but one idea that springs to mind is that this is a drained lava lake, where molten lavas ponded and produced the terraces as their level changed and/or the lavas thermally eroded downwards into the underlying rock. If this is the case then in is possible that lava flowed into the lake from the *south* as opposed lava flowing out of it and away *towards* the south. So, this could explain the presence of a lava lake here. There is also evidence to suggest that the lava in the lake flooded a much wider area of the northern part of the sinus, with well developed levees (blue arrows in Fig.3) along the western rim of the rima (which suggest the lava flow overtopped the channel – a feature seen in terrestrial lava flows) as well as the presence of a number of low scarps which may mark the shore of a much larger, but possibly shallower '*overspill'* lake (yellow arrows in Fig.3).

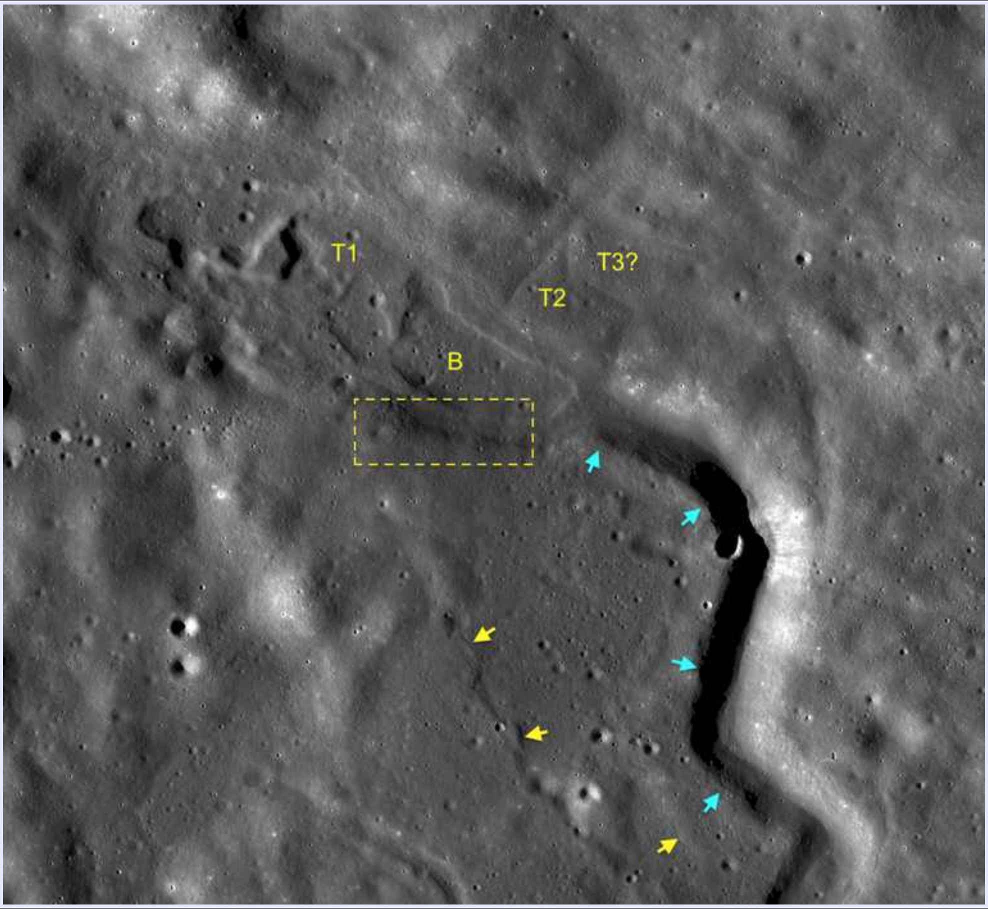

Fig.3 SELENE detail of the northern depression of Rima Conon showing the bed (B) and possibly 3 terraces (T1, 2 and 3). Yellow arrows show possible edge of a lava lake, and blue arrows the levees along the western rim of Rima Conon. The yellow box shows an area of suspected volcanic activity.

Moving south along Rima Conon we come to a sharp kink to the east where the rille clears the low hills that form the eastern edge of the sinus (Fig.4). Where the rille takes this kink it is wider (by about 500m) and deeper (by some 80m) forming something of a lenticular pit, and as can be seen in Fig.4 one of the ESE-WNW graben emerges from its western rim where it turns eastwards. Other fainter graben like structures can also be seen in the area suggesting a complex subsurface geology. To the south of this eastwards kink, the rille acquires a rather unusual terraced appearance, with in places one and possibly two terraces being visible above the bed of the rille (Fig.5).

These terraces do not appear to be slump structures (where the rille edges have collapsed) but probably represent different episodes of downwards erosion of the rille bed by the lavas flowing through it. This suggests a variable eruption or flow rate for this lava. Immediately to the west of this terraced section of rille is a C shaped escarpment, only some 25m high, open towards the east and with the ends of the C against the rim of the rille. This can be made out in Fig.2, and it encloses a low area which probably represents another '*overspill*' lava lake where lavas overtopped the rille and spread out onto the adjacent surface. Support for this interpretation comes in the form of small levees along the western rim of the rille, indicative of lava overflowing the channel.

To the south of this stretch of terraced stretch, the rille turns southwards, widens slightly and deepens (by over 100m!) before terminating in a rounded pit that butt's up against some higher ground to the south. It also shows a degree of terracing around its periphery suggesting a variable depth of lava was present at various times. I do not think that this is a source pit, despite a superficial appearance of one, as the mineral data shows it has no associated volcanic material surrounding it.

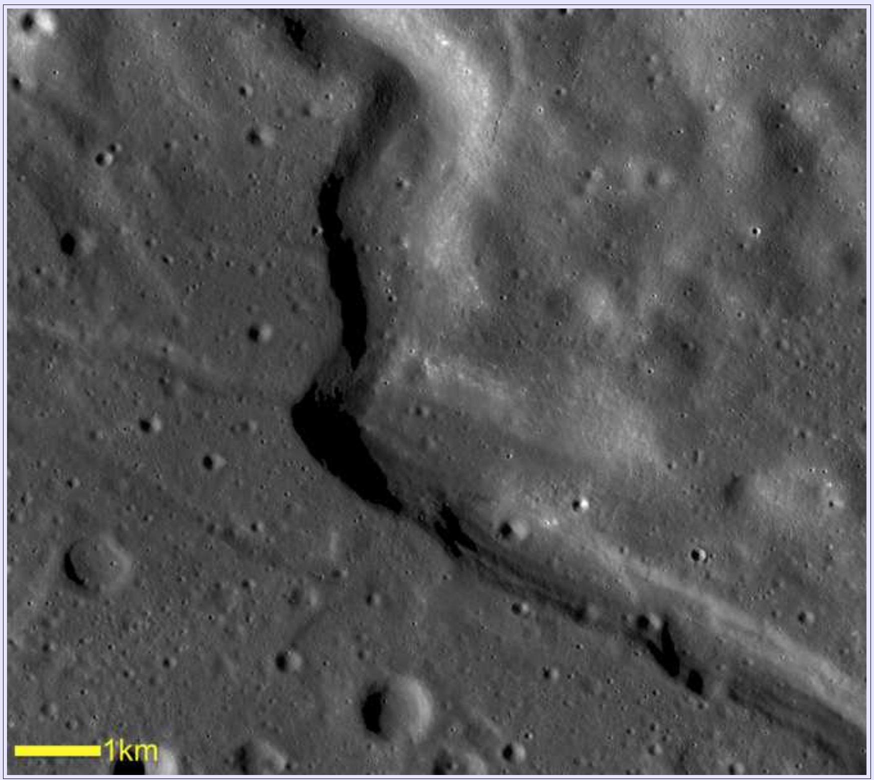

Fig.4 SELENE image of Rima Conon where it kinks to the east as described in the text. Note the graben emerging from the apex of the bend and the terraces along the sided of the rille towards the south.

Fig.5 LRO-WAC detail of the terraces (T1 and 2) within Rima Conon

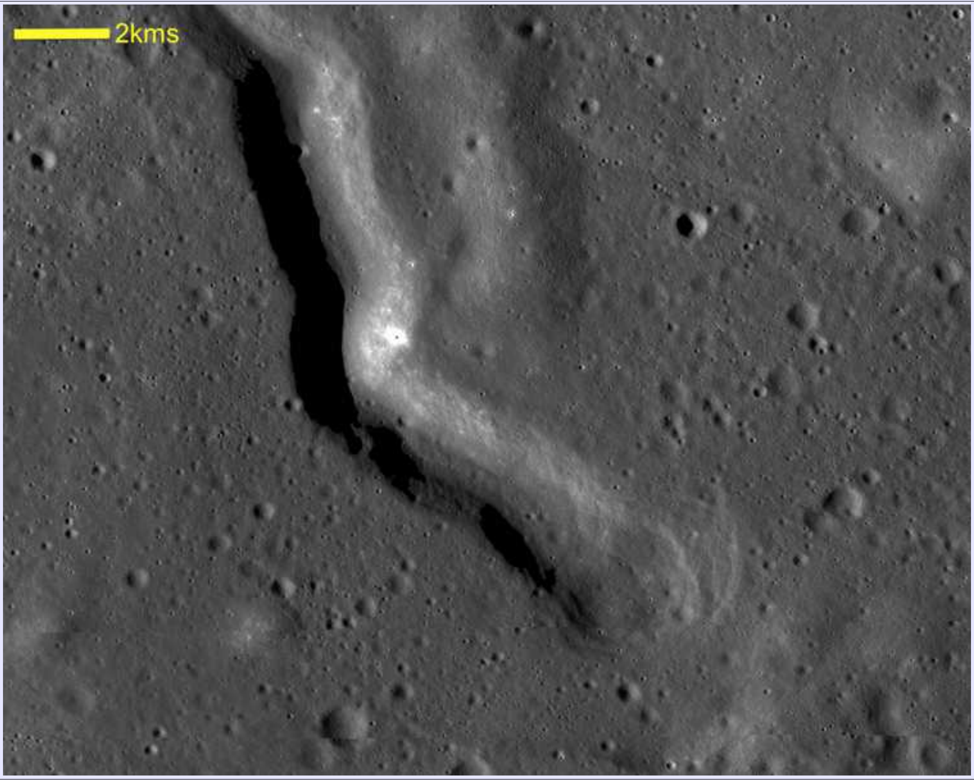

Fig.6 Southern end of Rima Conon showing the unusual termination with hints of terracing within.

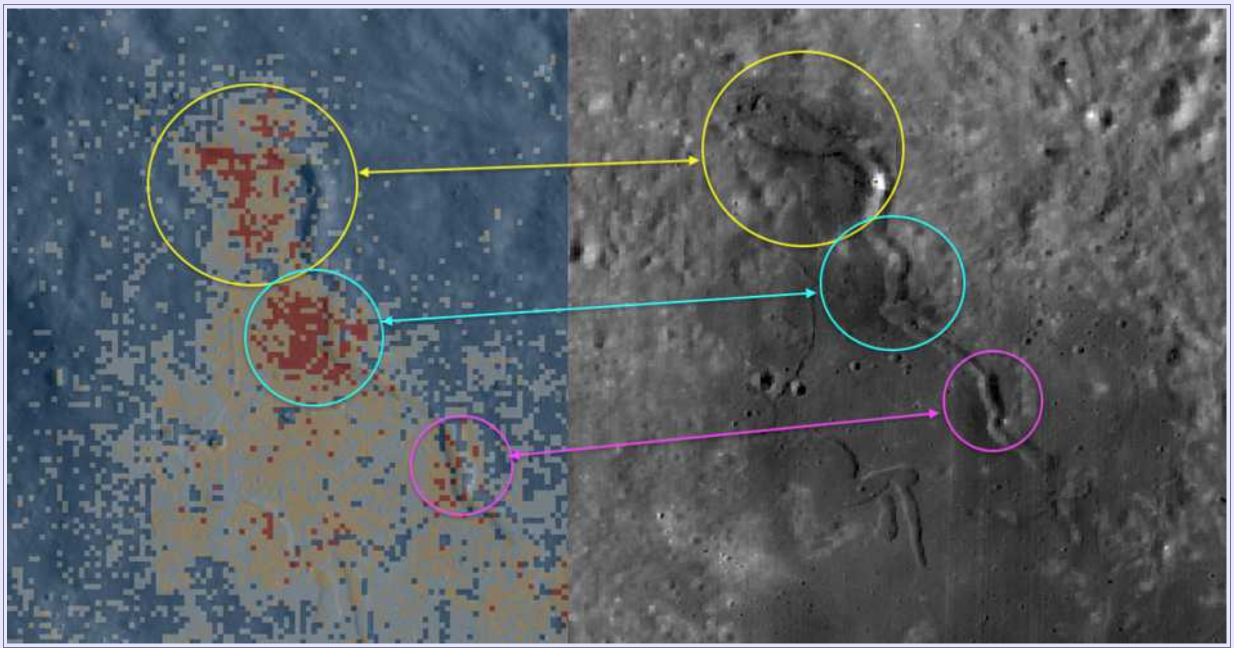

Fig.7 A TiO_2 abundance in wt% ovarlay (left) with yellow to red showing increased abundance and Chandrayaan-1 M3 Apparent Reflectance Mosaic @1489nm (right) with darker areas indicative of pyroclastic deposits. Note the correspondence between the increased TiO_2 abundance and the presence of pyroclastics as indicated by the coloured circles.

Figure 7 shows that three areas along the length of Rima Conon exhibit locally elevated levels of TiO_2 and their correspondence to locations where possible pyroclastic deposits which show up in the form of lower albedo patches both visually and in the Chandrayaan-1 M3 data. An elevated titanium content appears to be common to many volcanic areas in northern Mare Vaporum including the dome Yangel 1, the Marco Polo complex[1 and 2] as well as the enigmatic Ina structure, some 90kms to the east of Sinus Fideii. These elevated levels of Titanium may represent distinct and possibly early regional volcanic phase, during which lavas and pyroclastic of this particular composition were erupted. The highest concentrations of titanium as shown in Fig.7 correspond Rim

Conon's eastwards kink, the deep section south of the terraced stretch and the area surrounding the northern depression. This might suggest the possibility that these are multiple vents connected by short channels, and that the rima is not a simple sinuous rille with a single source vent. Of note is that these locations are also where the rima is at its deepest. There is not a huge amount of supporting evidence for the multiple vent idea apart from the increased depth and geochemical anomalies just mentioned, but these alone are quite suggestive. Additionally, as can be seen from Fig. 4, a graben emerges from the 'elbow' of the kink in the rille, could this have been exploited by ascending lavas locally to produce surface eruptions?

Along the southern edge of the northern depression is an approximately 5km stretch that exhibits features highly suggestive of eruptive activity. One feature is shown in Fig.8, which appears to be a low cone perched on the edge of the depression, with a rather peculiar local topography suggestive of a blanketing of loose unconsolidated material that has partially slumped down towards the highest terrace (T1). The surface texture is one of smooth lobate masses, and a 15-20m deep summit crater may signify the presence of a vent.

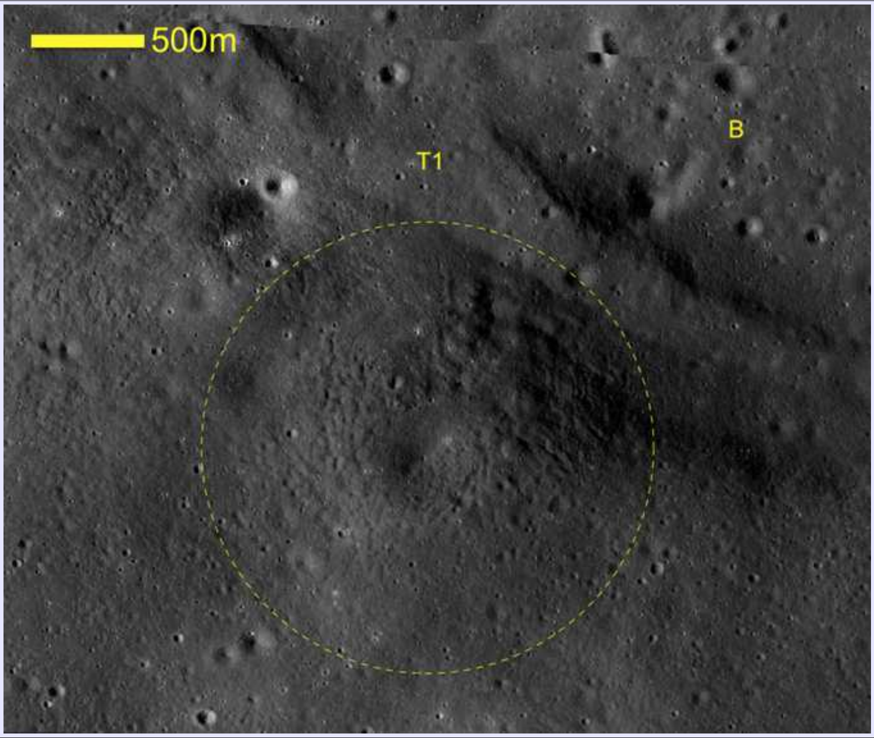

Fig.8 A possible small eruptive cone located on the southern rim of the northern depression of Rima Conon. Note the peculiar texture where lobate bounds of possibly unconsolidated material have slumped down slope.

Another anomalous patch is shown in Fig.9 which is a 3D view taken from the perspective of someone stood on the bed of the depression looking south towards the rim. The thing to notice here is the uneven albedo with several much lighter patches arranged in quite an irregular manner. Though the resolution is not good enough to be definitive, these are very reminiscent of patches I have noted on the flanks of the dome Yangel 1, and which I suspect to be areas where gasses have vented to the surface and disturbed the overlying regolith. This might be an early stage of the process that leads to the formation of Irregular Mare Patches or IMP's, and I have coined the term *immature Irregular Mare Patches* to distinguish them from the more fully fledged examples[3]. If this is the case it might suggest a more recent phase of volcanic activity, but a more in-depth analysis is really necessary. The presence of these two areas of suspected volcanic activity is however quite suggestive of some form of effusive volcanism located along the southern rim of this depression.

One of the most conspicuous features in Sinus Fidei appears to be another former lava lake with a deep (>100m) rounded depression or pond and 3 finger like projections which sprout off to the east producing a rather peculiar overall outline (Fig.10). The larger rounded 'pond' also has terraces visible around the margins, particularly the northern one, again indicating that the lake occupied different levels at various times, resulting in a 'tide mark' effect, a feature frequently seen in evacuated lava ponds. The molten lava may have eventually drained away via some low point in the rim, with a possible channel being located at the western margin of the southern rim of the rounded depression.

Fig.9 A perspective view looking south from the bed of the northern depression towards the southern rim. Note the irregular lighter albedo patches that *may* indicate where the regolith has been disturbed by the escape of gasses from beneath the surface

Some 9kms to the south of this former lava lake is an elongated hill (Fig.11) the eastern end of which which may be a small volcanic complex of some form. An LRO NAC image shows what appear to be at least 3 small volcanic breached cones which show an elevated TiO_2 abundance compared to their surroundings. It is likely that these ware also a source of lavas at some stage. A shallow trough like channel runs from the southern tip of the longest 'finger' like projection of the drained lake down to this small complex (Fig.11, blue arrows). It has the appearance of a sinuous rille, but is only some 15m deep, so may be more of a drainage channel formed as lava drained southwards over the rim at the tip of the 'finger'. Faint traces of a continuation of this channel to the south of the narrow volcanic hill can be seen (Fig.11 yellow arrows). The inconspicuous nature of these channel like features might well indicate that they have been obscured by later lavas partially filling them.

The features described above are but a fraction of those present within the sinus that indicate volcanic activity and a rather complicated geological past. The presence of the suspected vents along Rima Conon, the drained lava lakes and the small volcanic hill all point towards this little embayment of Mare Vaporum being the focus of volcanism, both intrusive to give rise to the slight upwards bulge detectable over the sinus, as well as extrusive in the form of lavas and possibly pyroclastic eruptions and cones. The lava lakes with their terraces suggest that the erupted lava ponded within topographic lows, and at times over-topping the lake banks and spread over wider areas. At other times the lava level dropped to produce the terraces along the lake edges. As the main part of the sinus is elevated above the level of Mare Vaporum it seems likely that eventually these ponded lavas flowed southwards into Mare Vaporum via channels that were carved out by the molten liquids – the channel marked with the yellow arrows in Fig.11 being one possible candidate.

So, far from being a simple embayment to Mare Vaporum, Sinus Fidei is a feature rich volcanic area like so many others surrounding this small patch of mare. This is not too much of a surprise considering the sheer number of nearby volcanic areas and features, and the probable abundant faults and fissures penetrating deep into the crust so close to the Imbrium Basin.

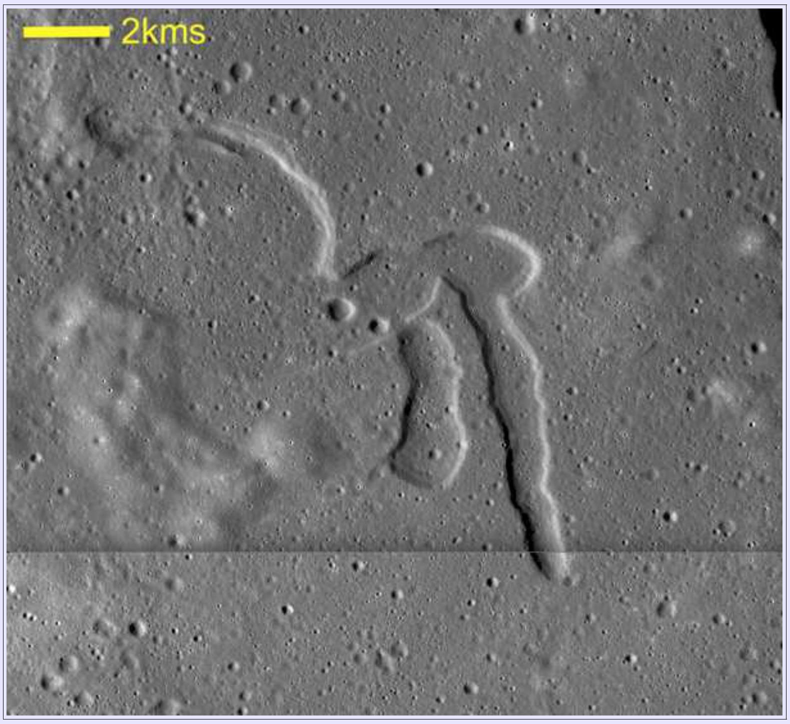

Fig.10. SELENE image of a drained lava lake showing finger like projections and a large circular depression with at least one terrace suggesting a drained lava level. A faint sinuous rille like channel extends away to the south from the southern tip of the longest finger. This shows up more clearly in Fig.11 below.

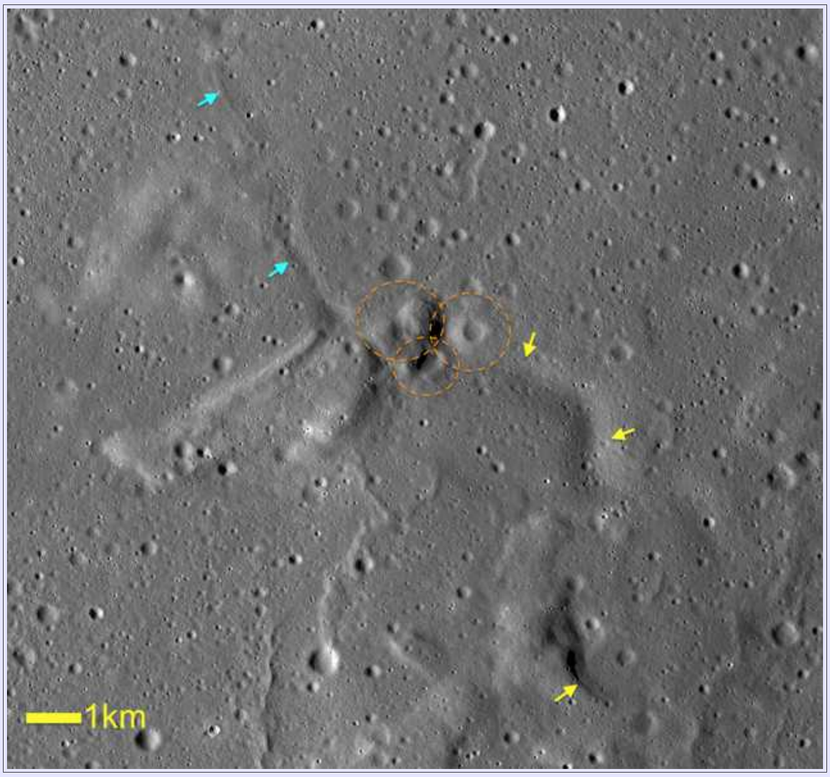

Fig.11 Small elongate volcanic landform to the south of the area shown in Fig.10. Blue arrows show a possible drainage channel/rille leading from the feature shown in Fig.11, whilst a possible continuation to the south is shown with yellow arrows. The orange circles indicate small volcanic cones shown in detail in Fig.12.

The lavas appear to range in TiO_2 content, with signals of a higher abundance associated with Rima Conon and the three cones shown in Fig.12 as well as a number of other areas located around Mara Vaporum such as the dome Yangel 1 and the IMP feature Ina. This might indicate they all erupted at more or less the same time – possibly being the source of the high TiO_2 lavas that dominate Mare Vaporum, and which appear to lie on top of older lavas of a lower TiO_2 content.

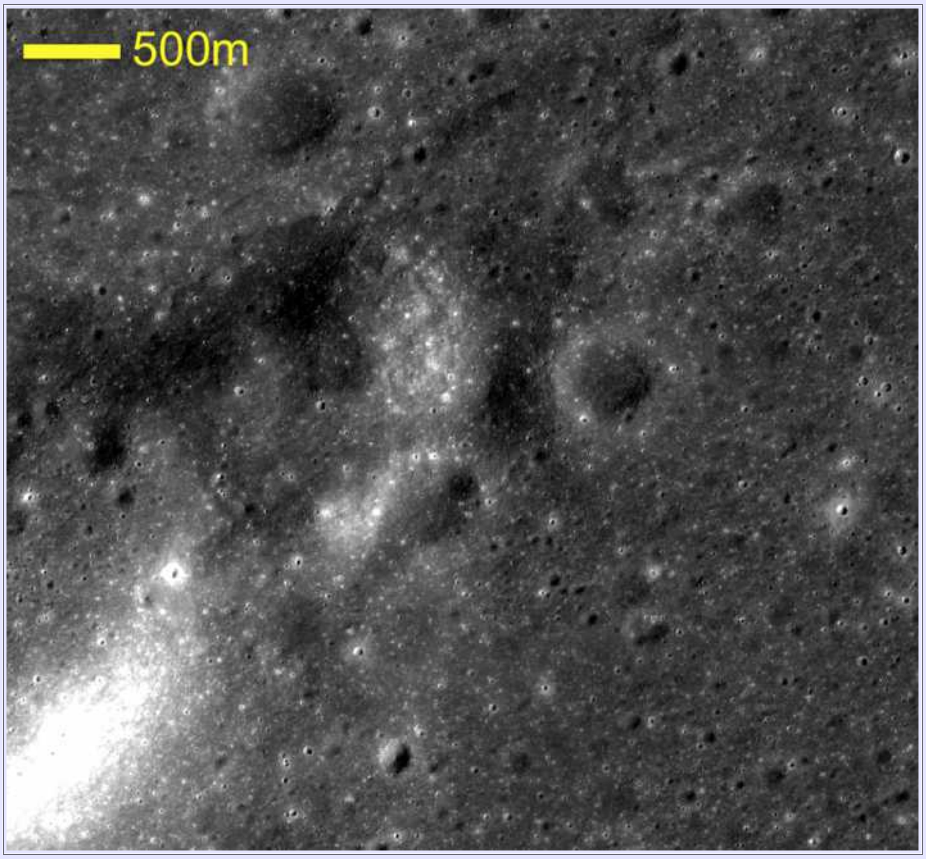

Fig.12 Cluster of 3 possible breached cones as highlighted in Fig.11 (orange circles). They appear to show an elevated TiO_2 abundance compared to their surroundings and may have been the source of localised lava flows.

So, far from being a simple northwards embayment of the mare, this area might well be one of the source areas for the lavas that inundated Mare Vaporum sometime around 3.5 to 3.2Ga in the Imbrian Epoch.

References:

1. Raffaello Lena, Barry Fitzgerald, (2014) On a volcanic construct and a lunar pyroclastic deposit (LPD) in northern Mare Vaporum, Planetary and Space Science, Volume 92, Pages 1-15.

2. Raffaello Lena and Barry Fitz-Gerald (2016) The Marco Polo complex. Morphometric analysis and mode of formation of the megadome: another possible lunar volcanic shield. THE MOON Occasional Papers of the Lunar Section of the British Astronomical Association. Volume 3 September 2016.

3. Raffaello Lena and Barry Fitz-Gerald (2021) LUNAR DOMES (part XLIX): Dome north of Rhaeticus L LUNAR SECTION CIRCULAR Vol. 58 No. 7.

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Lunar Geological Change Detection Programme by Tony Cook.

News: I've been contacted by Dr Peter Thejll, a climate scientist of the Danish Meteorological institute, in Copenhagen, Denmark. He has been running a research project for at least a decade now to study reflected light from the Earth's entire surface, utilizing observations of the brightness of earthshine. Much of this includes regular images captured from a telescope in Mauna Loa, Hawaii. However, with earthshine being only visible when the Moon is not too far above the horizon, time coverage is limited. Since August he is being supplied by images of earthshine taken on board the International Space Station, and this has an approximately 90 minute orbit, so the Moon is not always in the right position to photograph continuously. Peter is now asking for help from amateur astronomers, via a European Space Agency (ESA) project:

https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Illuminating_Earth_s_shine

I have copied (word for word) the text contents of the above web site into this article and would like to ask for any of our members with DSLR cameras or wide field imaging telescopes to participate:

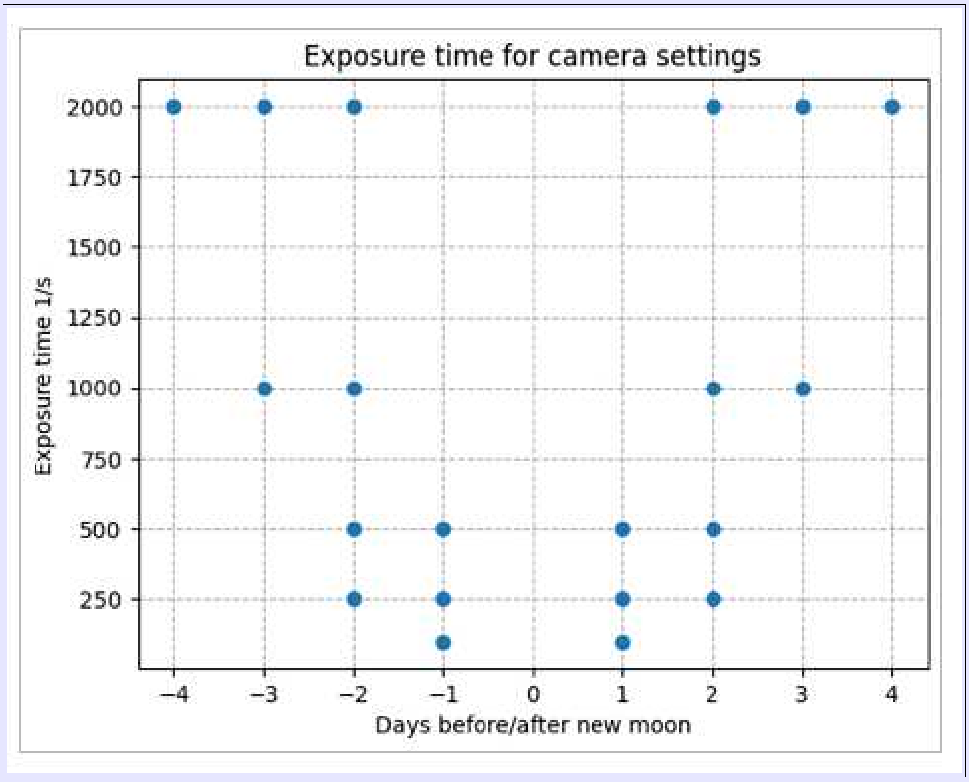

Figure 1. ***A graph showing which exposure settings to use for taking pictures of the new moon phase with ISO set to 4000.***

*"As part of the experiment, ESA and DMI invite the public to take their own pictures of the new Moon and share them using the hashtags **#NewMoonSnap** and **#Huginn** in their social media posts. The scientists are hoping that despite some atmospheric disturbances, a substantial amount of people capturing pictures could provide valuable contributions.*

"We want to engage people in our climate science and with Andreas on the Space Station, people can help us from the ground" says Thejll. Each month, a photo posted with the two hashtags will be selected and receive a Huginn mission patch

The new Moon is best photographed using a good quality digital camera. If you are in a pinch, your mobile phone can work. It is recommended to use the 'Professional' or 'Pro' mode in your camera app as it provides more options for the settings.

To take good photos and help the scientists, here are the settings that should set your camera up for success:

- *On your camera, set the file format to RAW or NEF, if possible.*
- *Set ISO to 4000 and the f-stop to f/2.8*
- *Exposure should be between 1/2000 to 1/250 s, see the graph in the article for what exposure to use on which day.*
- *Keep the Moon centred in the frame.*
- *If possible, use a telephoto lens.*

It is best to take photos after sunset, or in the morning before sunrise. Here are the days throughout the Huginn mission that would be best for taking photos of the new moon:

- *14 to 18 August 2023*
- *13 to 17 September 2023*
- *12 to 16 October 2023*
- *11 to 15 November 2023*
- *11 to 15 December 2023*
- *9 to 13 January 2024*
- *8 to 12 February 2024"*

N.B. Apart from adding social media Hashtags for the project to find, please email in your images of earthshine so that we may keep a backup copy in the ALPO/BAA archives. These could be useful, for example, to monitor the brightness of the suspected TLP site, Aristarchus over time.

Note that suggested observing times, on the web site, are limited to just a few cities. Peter recommends imaging earthshine if you can see it on the dates concerned.

TLP Reports: No TLP or impact flash reports were received for September.

Routine reports received for September included: Maurice Collins (New Zealand - ALPO/BAA/RASNZ) imaged: Aristarchus, and several features. Anthony Cook (Newtown, UK – ALPO/BAA/NAS) imaged/videoed: several features & earthshine in the Short-Wave IR. Walter Elias (Argentina – AEA) imaged: Aristarchus. Massimo Giuntoli (Italy – BAA) observed Cavendish E. Michael Hather (Sheffield, UK – BAA) observed Aristarchus, Gassendi, Plato, Posidonius and several features. Bob Stuart (Rhayader, UK – BAA) imaged: Alfraganus, Delambre, Dionysius, Mons Penck and Theophilus.

Analysis of Reports Received (September): It seems that most people have been affected badly by weather this month in both hemispheres of our planet!

Cavendish E: On 2023 Sep 01 UT 21:00 Massimo Giuntoli (BAA) found that the crater had a normal appearance. A 12.7 cm f/7 Newtonian used at x180 and seeing was Antoniadi IV.

Aristarchus: On 2023 Sep 04 UT 02:30-02:50 Michael Hather (BAA) observed visually this crater, some 5 minutes before the following repeat illumination observing window opened:

Near Aristarchus 1970 Mar 26 UT 17:00 Observed by Sekiguchi, Maisumoto (Tokyo, Japan, 36" reflector) "Pts. N & S of crater were brighter by 0.3 & 0.2 mag. respectively than normal -- far beyond limits of error. Colour index (CI) also showed less depend. on phase by 0.1-0.2 mag. Did not show reddening dur. enhancement. Polariz. was less by 1-2%. Photog. photom. showed brightening over whole moon. Resolution = 2,3 km" NASA catalog weight=5 and catalog ID #1236. ALPO/BAA weight=3.

Michael was using a Takahashi FC-100DF, 100mm; Takahashi TOE3.3mm, x224 under Antoniadi I seeing and average transparency. He reported that the crater looked normal and nothing unusual was seen. The Maisumoto report was published in the paper: Sekiguchi, N. (1971) An Anomalous Brightening of the Lunar Surface Observed on March 26, 1970, The Moon, 2, p 423-434. We shall leave this at a weight of 3 for now.

Unknown: On 2023 Sep 05 UT 02:36 Bob Stuart (NAS/BAA) imaged a number of localized areas on the Moon under similar illumination to the following report:

On 1888 Nov 23 at 16:15-17:00 UT Von Speissen & others of Berlin, Germany, using a 3.5" refractor (x180), saw a "Triangular patch of light (time in Middlehurst catalog wrong? Moonrise was at > 18:30h. If year =1887, age=8.8 days & time OK. must be same observation as
ID=256 in Cameron 1978 catalog - note similarity of names and also the reference date). Cameron 1978 catalog ID=258 and weight=1.

Figure 2. Theophilus and Cyrillus and imaged by Bob Stuart on 2023 Sep 25 UT 02:36 and orientated with north towards the top.

This is an ambiguous TLP report as firstly it is not clear where the triangular patch was seen and secondly according to Cameron the year could have been 1887 or 1888. Bob was imaging under similar illumination to the candidate 1888 Nov 23 hypothesis. Out of all Bob's images of: Alfraganus, Delambre, Dionysius, Mons Penck and Theophilus, only the Theophilus one (Fig 2) exhibits some triangular patch of light in the form of three peaks in the central peak area of Theophilus. However, reading Cameron's account carefully, she is of the opinion that it was probably 1887 Nov 23 and 20:00UT and may refer to a triangular patch on the floor of Plato? I agree with her in that if you plug in the 1888 Nov 23 UT 16:15-17:00 then the Moon is clearly below the horizon in Berlin, and does not rise till 18:58UT. If you plug in 1887 Nov 23 then the Moon is already well above the horizon at sunset. I think we will delete the 1888 Nov 23 TLP, which was reported as such in the previous Middlehurst catalog from 1967.

Figure 3: Plato from 2014 Mar 09 – North is towards the top. (Left) Image by Brendan Shaw from 19:41UT. (Centre) Sketch made by Nigel Longshaw at 19:50-20:05UT. (Right) Image by Brendan Shaw from 20:15UT.

If you are interested in what Plato would have looked like in 1887 Nov 23, Fig 2 shows a copy of some repeat illumination observations published in the 2024 May TLP newsletter. It is possible that the Berlin observations may have been a bit earlier than Cameron estimates i.e., 20:00 UT, in which case you would have had a transition between an oval light area on the floor and the Fig 3 images.

Mare Crisium: On 2023 Sep 21 UT 07:09-07:12 Maurice Collins imaged the whole Moon as a mosaic under similar (±1˚) illumination, and topocentric libration to the following report:

Mare Crisium 1826 Apr 13 UT 20:00 Observed by Emmett (England?) "Black moving haze or cloud" NASA catalog weight=2. NASA catalog ID =109. ALPO/BAA weight=1.

I have always been a bit skeptical about TLP reports that involve movement, simply because the fact that the escape velocity on the lunar surface is only 2.4 km/s, and doing a simple calculation, 1 degree at the surface of the Moon spans approximately 30 km, so anything traversing 30 km (or 1 deg) in less than 30/2.4=12.5sec (at the lunar equator or along a lunar latitude line) will likely escape from the Moon unless it is on a shallow trajectory. Now we do not know how fast the cloud was moving. Mare Crisium spans 550km E-W and 400km N-S, so if something was moving at escape velocity it would cover the mare interior in 3.8 and 2.8 min respectively.

Now the Emmett report does not specify what rate the cloud moved or expanded it. It is possible that it might have been ejecta from an impact event, but that would have had a bright flash followed by an increasingly enlarging ejecta cloud which would fade out radially. If the impact were near parallel to the surface, then the expanding cloud would be more directional, but again would fade out. Such clouds from impacts tend to be fairly translucent, and unlikely to appear "black" or cast a strong shadow. Another possibility, again without knowing much detail about the original report, is that it could simply be a cloud in our atmosphere going across the Moon in the line of sight. Of course, an experienced observer would not be fooled by this so easily. So, for now we shall leave the weight at 1. At least we know what Emmett would have seen at Mare Crisium on that night in 1826 if everything had been normal, namely what we see in Fig 4.

Figure 4: Mare Crisium, extracted from a larger mosaic, made by Maurice Collins and taken on 2023 Sep 21 UT 07:09-07:12. North is towards the top.

Aristarchus Area: On 2023 Sep 27 UT 23:42 Walter Elias (AEA) imaged this crater under similar illumination to the following two reports:

Aristarchus observed by P. Moore on 1995-11-5 Colour seen between Aristarchus and Herodotus by P. Moore and G. North. ALPO/BAA weight=3.

Vallis Schroteri - On 1994 Apr 24 at UT 03:50 R. Manske (Waunakee, WI, USA) found that the Cobra Head appeared to have an obscuration on the top eastern half. The ALPO/BAA weight=2.

Walter's image (Fig 5) shows no obvious sign of colour between Aristarchus and Herodotus, and nor any obscuration on the top eastern half of the Cobra's Head. Therefore we shall leave the weights of these TLP reports as they were. It is interesting though that the Cobra Head crater has a slight pinkish cast to it, but so do some other small craterlets, and so it is most likely atmospheric spectral dispersion?

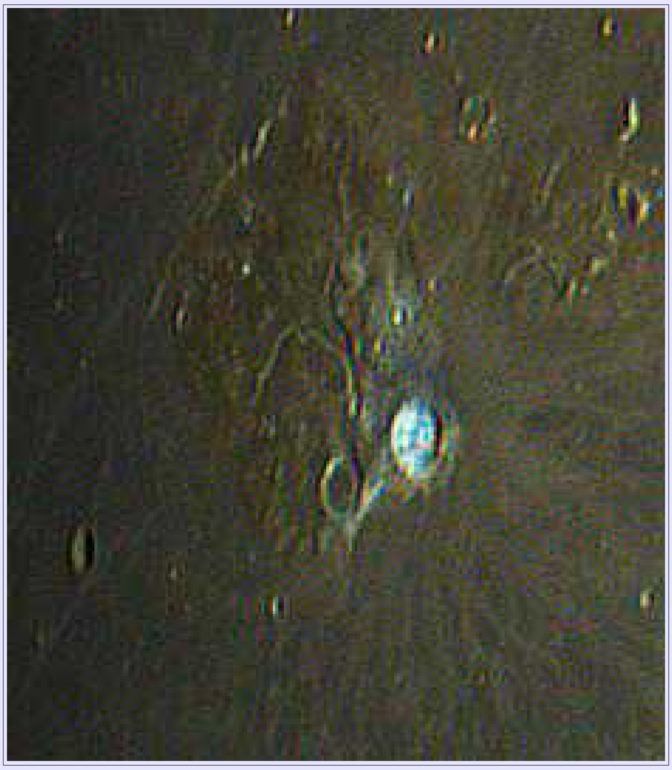

Figure 5: An image of Aristarchus taken by Walter Elias on 2023 2023 Sep 27 UT 23:42 and orientated with north towards the top. Note that the colour saturation has been enhanced to make colours more pronounced than you would see normally visually.

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 .

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Items for the December circular should reach the Director or Editor by the 25th November 2023 at the addresses show below – Thanks!

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