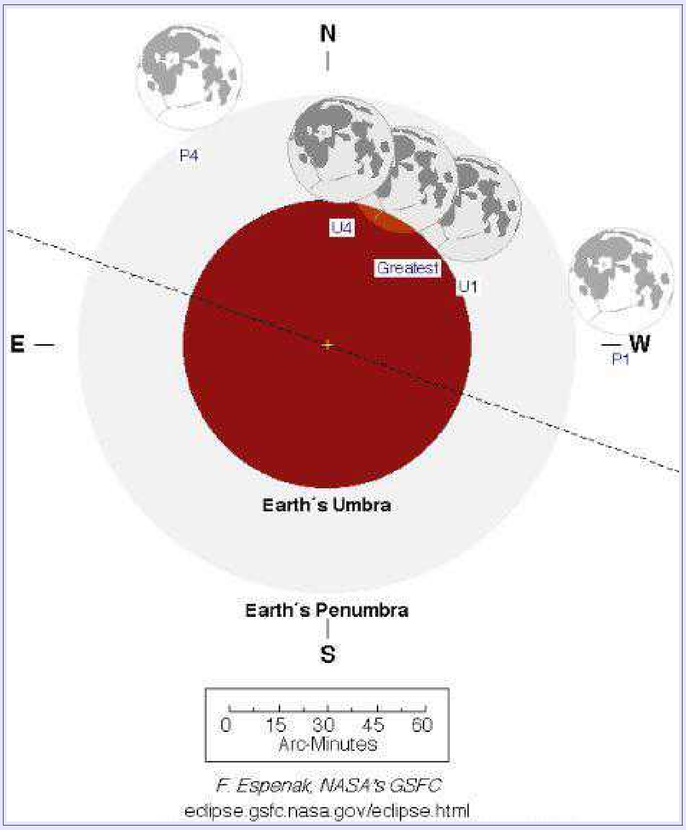
From the Director:



For observers in the UK, we seem to have waited many years for a proper umbral lunar eclipse, whilst colleagues in the rest of the world have enjoyed clear views on many other occasions. Well on October 28th we have a chance to see a partial lunar eclipse from the UK, and indeed Europe, Africa and Asia, and it is at a convenient social time of the evening. But please do not get too excited though as the dark shadow extent will occupy just be about 12% of the lunar surface, close to the lunar south pole area, and of course we have the weather to contend with!

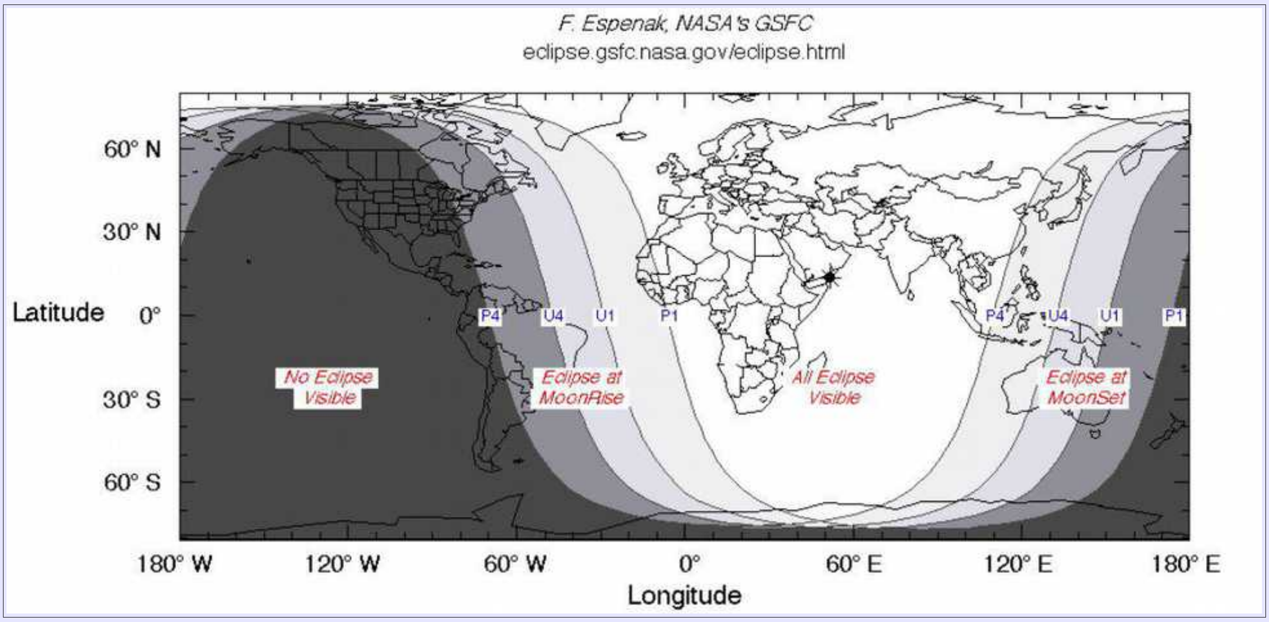
Usually during eclipses, even many partial ones, it's possible to do a bit of science such as estimate how visually dark the eclipse shadow is (Dajon Scale) , observe some occultations and even go hunting for impact flashes in the shadow. However, as it is only a small area of the Moon, in dark umbral shadow, the last two options are doubtful, though you should certainly make an attempt at estimating the darkness (Dajon Scale) of what little of the umbral shadow you can see and its size.

Just a reminder of the Dajon scale, which is available for naked eye or binocular observers:

0 = very dark shadow - so virtually impossible to see anything inside the shadow.
1 = dark eclipse – features in shadow only just visible – colour of shadow often dark grey or brown.
2 = a “rust” or deep red colour to the umbral shadow and the centre of the umbra is really dark but the edge maybe brighter.
3 = ”Brick Red” colouration with a tendency for a yellow outer edge.
4 = a bright copper colour shadow, sometimes even orange, and the edge of the umbra can be bluish, and certainly quite bright.

The main umbral eclipse starts at 19:35 UT and ends at 20:53 UT with the eclipse maximum at 20:14 UT. The fainter penumbral shadow starts at 18:02 UT and leaves the Moon at 22:26UT.

Visual estimates with a telescope or binoculars, of which craters, the edge of the umbra is passing over, have been used in the past to determine the extent of the Earth’s shadow, which is affected by the vertical state of the Earth’s upper atmosphere. Factors such as is the umbral darkness and size of the shadow have a possible link with the solar cycle. The shadow darkness can also be affected by the presence of any volcanic dust, or forest fire smoke, in our atmosphere. So you can see why historical records of eclipse darkness and/or shadow size can be important for studying the climate.



Tips for photographing lunar eclipses, are to use a tripod, and set your camera to the maximum telephoto setting. A delayed shutter release, or automated image sequence picture taking, can help reduce vibrations and consequent blurring of images. In windy weather I often hang weights off the bottom of the tripod to help dampen down wind vibrations – or you can move the camera and shield it from the wind behind a wall or shed. Vary the exposures so you can see detail inside the dark umbral shadow at times, but at other times you might want to under expose to see if you can detect the fainter penumbra. For those of you who are into image processing, take images of the Moon before and after the penumbral phases, and subtract the eclipsed images from these. That subtraction will leave you with just an image of the Earth’s shadow. Of course you will have to align and possibly rotate the images before the subtraction, but it is an interesting experiment to try.

Please send in any images, or sketches, or visual reports, so that we can then show these in the November and/or December circular.

Tony Cook.

Lunar Occultations October 2023 by Tim Haymes

Time capsule: 50 year ago: in Vol 8 No.10

* P. Moore: Catalogue II of Lunar TLP events (1967-71) in JBAA Vol 81, No.5
* Ken Gaynor - occultation report 12.
* R.A Mackenzie: A Theory for the Causation of Fading at lunar Occultation.
* Miss C.M Botley: Comment on the cause of Lunar Fade Occultations
* G Taylor: Jupiter sat. Io occulted a star – prediction by Taylor. Observed in the West Indies and Florida (Reported in the RAS Journal Match. A diameter of 3660 +/- 4km was derived)

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

European Symposium on Occultation Projects (ESOP) Armagh.

ESOP 42 was held at Armagh Observatory on Sept 16 to 17th. The presentations were attended by 26 on-site participants and 54 on-line. Zoom recordings will be available and I will include the link in the next circular. The facilities and exhibition area at Armagh Planetarium are first class, the best I have seen anywhere. There are some historic and newer instruments in the observatories, and we were given a tour after the formal end of the symposium.

Armagh has the longest history or astronomical research of any observatory (it was said), in that older establishments no longer do research on site. Armagh has the facilities to do this. One of the instruments is a robotic 15” in a Sirius Observatories dome.

Occultations during the Partial Lunar Eclipse of October 18, 20hr UT

On the 18th there is a small partial umbral eclipse, but from the occultation perspective, no stars are occulted within the umbral phase of about 12% across the southern limb, at least, none that are observable with typical equipment. However, I would be pleased to receive reports of any stars seen near or close to umbral eclipsed limb.
TYC 636-461-1 (11.4 magnitude) will brush the S limb at 1940UT from Oxfordshire.

The month ahead,

There is a day-light occultation of Antares. It will be at low elevation from the UK, and so I don’t expect many will see this on the 18th The Disappearance is at about 1253 UT.

Occultation predictions for 2023 October (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 yy	mmm	d	Time h	m	s	Ph	Star No	Sp D*	Mag v	Mag r	% ill	Elon	Sun Alt	Moon Alt	Moon Az	CA o	Notes
23	Oct	1	1	56	6.3	R	272	SF2	5.9	5.8	96-	158		49	194	11S	54 Ari
23	Oct	1	23	45	44.0	R	93039	A2	8.0	7.8	91-	145		46	129	68N	
23	Oct	2	1	2	46.0	R	400	A2	8.0	7.9	91-	145		53	154	86N	
23	Oct	3	1	43	10.5	R	76050	pA0	7.3	7.2	83-	131		57	146	71S	
23	Oct	3	23	48	48.6	R	683	A2	7.4	7.4	75-	120		38	97	67N	
23	Oct	4	2	13	16.8	R	698	K2	7.5	6.8	74-	119		58	134	23N	
23	Oct	4	4	20	3.0	R	76704	B8	8.3	7.8	73-	118		64	192	19N	
23	Oct	5	1	39	52.6	R	77258	K0	7.8	7.1	64-	107		47	107	42S	
23	Oct	5	2	6	20.4	R	77266	F0	8.1	7.9	64-	107		51	113	76S	
23	Oct	5	2	46	10.8	R	840	cK0	6.3	5.5	64-	106		57	125	37N	
23	Oct	6	0	40	45.8	R	78410	K1	7.7	7.1	55-	96		31	83	66S	
23	Oct	6	1	12	26.1	R	78434	K0	8.6	7.8	55-	95		36	89	56S	
23	Oct	6	2	59	15.6	R	78480	cK5	7.5	6.7	54-	95		51	112	86S	
23	Oct	6	3	14	28.6	R	78496	K0	7.5	6.9	54-	95		54	116	59N	
23	Oct	6	4	2	36.3	R	1008	A0	5.3	5.3	54-	94		60	132	52N	49 Aur
23	Oct	7	3	23	48.8	R	79431	K2	8.2	7.3	44-	83		47	106	48N	

23	Oct	9	3	47	59.5	R		80693 G0	8.4	8.1	26-	61		31	96	12S	
23	Oct	18	12	52	46.1	DD		2366dM1	1.1	0.1v	15+	45	27	8	154	89N	Antares
23	Oct	18	14	6	52.7	RB		2366dM1	1.1	0.1v	15+	46	22	11	170	-76N	Antares
23	Oct	23	17	58	55.0	D		190556 K1	7.0	6.4	68+	111	-10	15	155	85N	
23	Oct	23	18	50	38.3	D		3178cA0	6.2	6.1	68+	111		18	167	83N	
23	Oct	24	18	41	47.5	D		3323MA5	7.5	7.3	79+	125		20	151	45S	
23	Oct	26	0	14	23.2	D		3486 K2	7.7	6.9	89+	141		23	225	40N	
23	Oct	26	20	17	48.5	D		55cG8	6.4		95+	153		33	145	50S	10 Ceti
23	Oct	29	23	10	59.8	D		465 K2	4.4	3.8	98-	165		53	141	-76N	delta Ari
23	Oct	30	0	21	58.0	R		465 K2	4.4	3.8	98-	165		58	169	89N	delta Ari
23	Oct	30	20	22	30.6	R		594pB9	6.9	6.9	95-	154		26	84	81N	
23	Oct	30	20	22	40.2	R		76389pB9	7.8	7.7	95-	154		26	84	82N	
23	Oct	31	0	19	13.2	R		611kK2	7.0	6.4	94-	152		58	143	76S	
23	Oct	31	0	53	45.9	R		76480kA3	7.4	7.3	94-	152		61	158	79N	
23	Oct	31	1	6	13.1	R		76483 G5	7.2	6.6	94-	152		62	163	72S	
23	Oct	31	20	27	20.4	R		745wK0	7.3	6.9	89-	141		20	73	45S	
23	Oct	31	22	45	57.6	R		76945 A2	7.5	7.4	88-	140		41	98	22N	
23	Oct	31	23	26	36.3	R		762cB5	6.6	6.5	88-	140		47	108	62S	
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	5	48	16.2	R		952 K2	8.0	7.2	79-	125	-12	56	238	85S	
23	Nov	2	23	0	51.6	R		1067cK2	7.1	6.4	72-	116		27	80	43S	
23	Nov	2	23	21	1.5	R		78976wA0	8.2	8.1	72-	116		30	83	85N	
23	Nov	3	5	40	38.4	R	X	99111S	7.2	7.0	70-	114		62	215	87N	
23	Nov	3	5	40	38.4	R		1093SF8	6.6		70-	114		62	215	87N	
23	Nov	4	1	46	36.0	R		1206 G8	5.9	5.3	62-	104		43	103	68S	o Cnc
23	Nov	4	4	24	53.2	R		79936 K5	8.1	7.2	61-	103		62	153	26N	
23	Nov	5	2	54	52.5	R		1330pG5	7.8	7.5	52-	92		43	111	63S	

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 are explained in Occult4 Help.
To save a bit of editing, I have left them in-place. Please use them to signify 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 oocultations. The separations are usually small and in the range 10-100 mas. The most recent was this year 2023.

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Communications from Members.

A month of Visual Lunar Occultation Observations.
by Peter Anderson.

I have been visually observing lunar occultations for some 50 years with well over 10,000 reported observations to my credit. Unlike some other observations that can be made at will as the opportunity provides, the occultation observer must be available at the appropriate predicted time since a missed event, whether from cloud or other reason, counts for nothing. Therefore the number of observations reported, being limited by the number of events predicted and other constraints can be considerably fewer than in some other fields.

Starting in the mid 1970's with a 9.5" (24cm) reflector, from 1980 I used a 16" (41cm) reflector in my backyard observatory. Since 2015, as a septuagenarian, and tiring of clambering up ladders, this instrument was replaced by a Celestron 14 (35.5cm). I have found a medium magnification is most useful. With the 16" I used x198 and with the C14 I use a 25mm eyepiece which provides good eye relief and produces x156. Having lived in the same house since 1974, these observations constitute a continuing record from the same site using the same overall methods. I time the occultation events rather than re-appearances because they are easily visible adjacent to the advancing dark lunar limb before full Moon rather than time the re-appearances that 'pop out' from the dark limb of the waning Moon after full Moon. I have found the results for the latter to be insufficiently accurate because the reaction time to a sudden re-appearance can be considerably longer, particularly if on occasion, you are not anticipating the precise area of re-appearance. It is more satisfying to watch the Moon creep up to the star and occult it.

Visual timing is a very personal experience and I have found myself one of the last of a dying breed. Timings via video methods are much more accurate and provide a lasting record. However there is much to be said for waiting, pre-set stopwatch in hand, and listening in my case to the WWVH radio or a GPS beeper box time signal anticipating an event, not knowing exactly when and what might happen. It might be a little late or early and occasionally there might be a fade or a stepped disappearance. Occultation observers experience something comparable to Forrest Gump's mother's description of a box of chocolates because… "You never know what you're gonna get!" Once the event occurs, after reading the result and subtracting the reaction time, the stopwatch is again checked and a small adjustment made if the time it displays has drifted a little from when it was originally set a few minutes before. Of course you have additional supporting estimate from having simultaneously listened to the audible time signal as described.

For this article I selected a reasonably productive month, August 2023, during which I timed 38 such events. Of these there were several short fading events, mainly restricted to one night when the breeze changed to south-easterly bringing higher humidity and destabilising the stellar images which then wobbled and twinkled. These conditions resulted in some swift fades but each were no longer than an estimated fifth of a second. They were therefore clearly atmospheric in nature and were not reported. However such rapid twinkling can present a real problem for events occurring in the polar regions of the Moon when the observer cannot be sure that they are not 'real' as the star passes behind ragged protruding features on the lunar limb, or whether they are simply the degradation of the image by our own atmosphere.

Of the other fades, and there were four of them, three occurred on the same night under much better conditions. Fortunately between two of them there was a standard instantaneous disappearance that enabled me to mentally 'reset' and verify that I was not seeing things! These fades ranged from a fifth to half a second and clearly showed some anomaly, most likely a previously unknown double star - for the two shorter fades at least. Because a star has a finite, but small apparent diameter at the lunar distance, shallow angle occultations in the polar regions of the Moon sometimes display fades as the image slides behind the limb at a very similar angle. At the extreme, such circumstances produce grazes where the star literally grazes the lunar limb and winks on and off as it passes behind rough features on the limb – plus of course a few fades and slow re-appearances thrown in for good measure. Obviously the track of such grazes is fairly narrow and the observer needs to be in the right spot!

Image by the author taken in the early 1970's at the prime focus of a 6" F5 Newtonian

Two of my other observations involved stepped disappearances. In such cases the star disappears leaving behind a faint companion, otherwise unseen in the glare of the primary star. Often this faint star is visible for a fraction of a second but sometimes longer before itself being occulted. Such was my experience with one star on the 27th August. Conversely there was a predicted event on the 26th where an equal brightness component only 0.1 arc seconds distant was due to be occulted over a quarter second later. No dip in brightness was seen, just a single event.

In the past the predictions were not as accurate and the events could be early or late by a matter of seconds. Now using predictions self generated from the 'Occult' programme (available free on the internet), the accuracy is quite consistently around a second, though there are the occasional early or late surprises.
When my results for this month of August 2023 were analysed, they were as usual quite consistent with the average Observed minus Calculated (O-C) variation from predicted being -82 milli arc seconds or -0.23 seconds of time. The range of variation was +/- 47 milli arc seconds or +/- 0.12 seconds of time. My expected accuracy of stopwatch observations is usually no more than +/- 0.15 seconds of time so the results produced are consistent. However they are skewed a little to the negative and this has been the case since early 2021.
There are a number of external factors that may be at play to produce this and the analysis of lunar occultation observations over a period of time not only allows analysis of the finer motions of the Moon but has other spin offs, including detecting variations in the rotational speed of the Earth. Add to that the number of new double stars discovered using this method, details of double star separations and angles updated or corrected, interesting objects discovered, and catalogue errors identified and it can be seen that observing lunar occultations can produce some quite valuable results.

The half degree wide occulting disc of the Moon travelling monthly around the sky has also proved itself very useful a number of times in the past as the following example demonstrates: Because of the longer wavelengths employed by standard Radio telescopes, they are not accurate in determining precise celestial positions. The first Quasar to have an accurate position measured was 3C273. To help understand this new class of object it was very important to determine if there was an optical component as well so a precise position was necessary to facilitate its identification.

To quote 'Wikipedia': *After accurate positions were obtained using lunar occultation by Cyril Hazard at the Parkes Radio Telescope, the radio source was quickly associated with an optical counterpart, an unresolved stellar object.[Actually mv. 12.9, centrally located in a faint host galaxy.] In 1963, Maarten Schmidt and Bev Oke published a pair of papers in Nature reporting that 3C 273 has a substantial redshift of 0.158, placing it several billion light-years away.*

Tim Haymes would like to add the following to Peter's article: *Peter points out that twinkling can produce unexpected fading of a star, and I can agree with this. In my reading of the LSC in the 1970s/80s, I have not seen this discussed at all. But we do know that Fresnel diffraction during a Lunar graze can produce similar appearances. Indeed this occurs during asteroid occultations as well and video recordings show this. Peter is to be congratulated on his many visual timings, and I would encourage any "new" observer to use the classical method to start with. And by this I mean the eye-stopwatch-time signal method. In this digital age, we can still find digital stop watches, and I think the land-line can still give the pips. Some phone apps are also good for this.*

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Elger's Scythe by Alexander Vandenbohede

I'd like to react on a note of Nigel Longshaw in the latest LSC concerning his reaction on the image of the Pitatus region. My image is indeed part of a somewhat larger mosaic, containing the Weiss-Cichus area. And yes, it shows Elger's Scythe. I noticed it when processing the image but was not aware of Elger's observation. So, nice to have it pointed out! The topographic data in the Quickmap tool shows that the floor of Palus Epidemiarum west of Cichus has a convex shape that is catching the first sun rays. But a high hill northwest of Cichus J still casts a long shadow so that two areas are seen, just like Nigel's drawings.

…......

Elger's Scythe by Nigel Longshaw

I am indebted to Alexander Vandenbohede for his prompt response to my enquiry in the September Circular regarding a recent image secured by himself of the wider area around Pitatus under sunrise conditions. Alexander kindly provided an additional image which, as I suspected, extend to the west of the original image and captured the lighting effect noted by T.G.Elger (1836-1897) as an 'illuminated thread' of light which Elger suggested was the prolongation of the apparent cleft cutting the through the plateau south of Cichus. Elger's original hypothesis was that due to the ephemeral nature of the feature it represented '*... some kind of exhalation, overlying the cleft, illuminated by the rays of the rising Sun*'.

Fig.1

Figure 1 is the original image forwarded by Alexander. Figure 2 represents the same image which I have crudely enhanced to bring out the faintly illuminated portion of the Palus Epidemiarum. It seems probable from the enhanced image that the narrow thread of light seen visually under slightly earlier illumination may represent the southern edge of what develops into a larger patch of light on the Palus Epidemiarum as sunrise progresses. The extent of the 'curvature' of the first ray of light probably depends to some extent on the position of the Sun over the lunar surface at the time of observation, and the curvature of the edge of the light patch seems quite pronounced on Alexander's image, as it did on Elger's original drawing (perhaps exaggerated in the case of the drawing).

Fig.2.

What is equally intriguing is the quite pronounced raised feature (hill or small crater – possibly Cichus H?) nestled at the 'fork' in the eastern end of the illuminated region, close to the plateau. This appears quite distinct in Alexanders image yet does not appear so visually, being recorded neither by Elger or myself. Again, the detection of this feature may be dependent upon the Sun's position over the lunar surface at the time of observation.

Whilst it seems clear now that Elger's thread of light is nothing more than the first stages of illumination across the Palus Epidemiarum as the Sun rises over the plateau north of Cichus and shadows retreat, there is still a great deal to interest the visual observer, lunar imager or those who have an interest in the history of selenography in this region.

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Images sent in by Members.

18 Day old Moon.

Image by Maurice Collins with details of time/date and equipment as shown.

Kies .

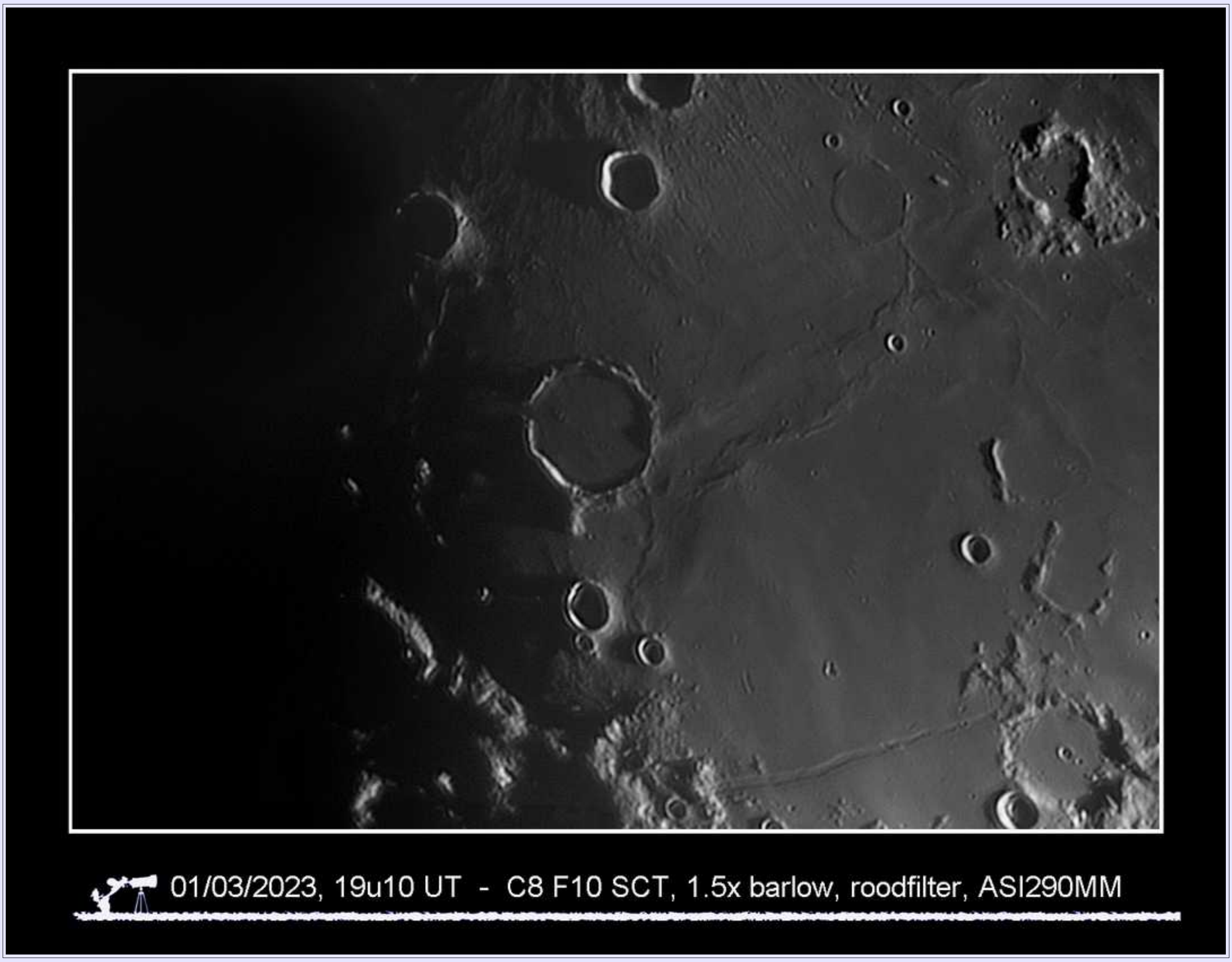


Image by Alexander Vandenbohede with details of time/date and equipment as shown.

Geological Notes: Alexander pointed out that his image captures the first rays of sunlight illuminating the eastern flank of the dome Kies Pi, just to the west of Kies itself. This dome is 240m high, 16kms in diameter, and has a summit crater about 220m deep, so almost reaching the same level as the surrounding mare surface. Raf Lena and others* have proposed the existence of a 'megadome' called Kies 2 formed by the injection of magma into the crust to the south of Kies Pi, and the illuminated eastern flank this raised area can be seen framed by the two straight shadows extending westwards from the promontory dangling off the southern rim of Kies and from the northern rim of Kies A. You can also just about make out a shaft of sunlight extending westwards from the western rim of Kies A, this is because the western rim is lower than the rest of the rim, and sunlight spills through this gap before it has cleared the top of the rest of the rim. This is a result of Kies A being a low angle impact crater with the approach direction from the west, which resulted in that rim (the up-range one) being lower than the rest.

The odd heart shaped structure Wolf can be seen in the top right corner, this might be a volcanic structure of some sort as opposed to an impact crater. It exhibits an elevated silicic composition, rather like the various 'Red Spots' such as the Gruithuisen domes and the Lassell massif to the north-east, and could represent some form of pre-mare volcanism that produced granitic as opposed to basaltic lavas.

*Lena, Raffaello & Wöhler, Christian & Lazzarotti, Paolo & Phillips, Jim. (2011). Identification of a megadome near the lunar crater Kies: Morphometric analysis and proposed intrusive origin. The Journal of the Royal Astronomical Society of Canada. Royal Astronomical Society of Canada. Available via https://rasc.ca/sites/default/files/publications/JRASC-2011-02-hr.pdf

Lindsay.

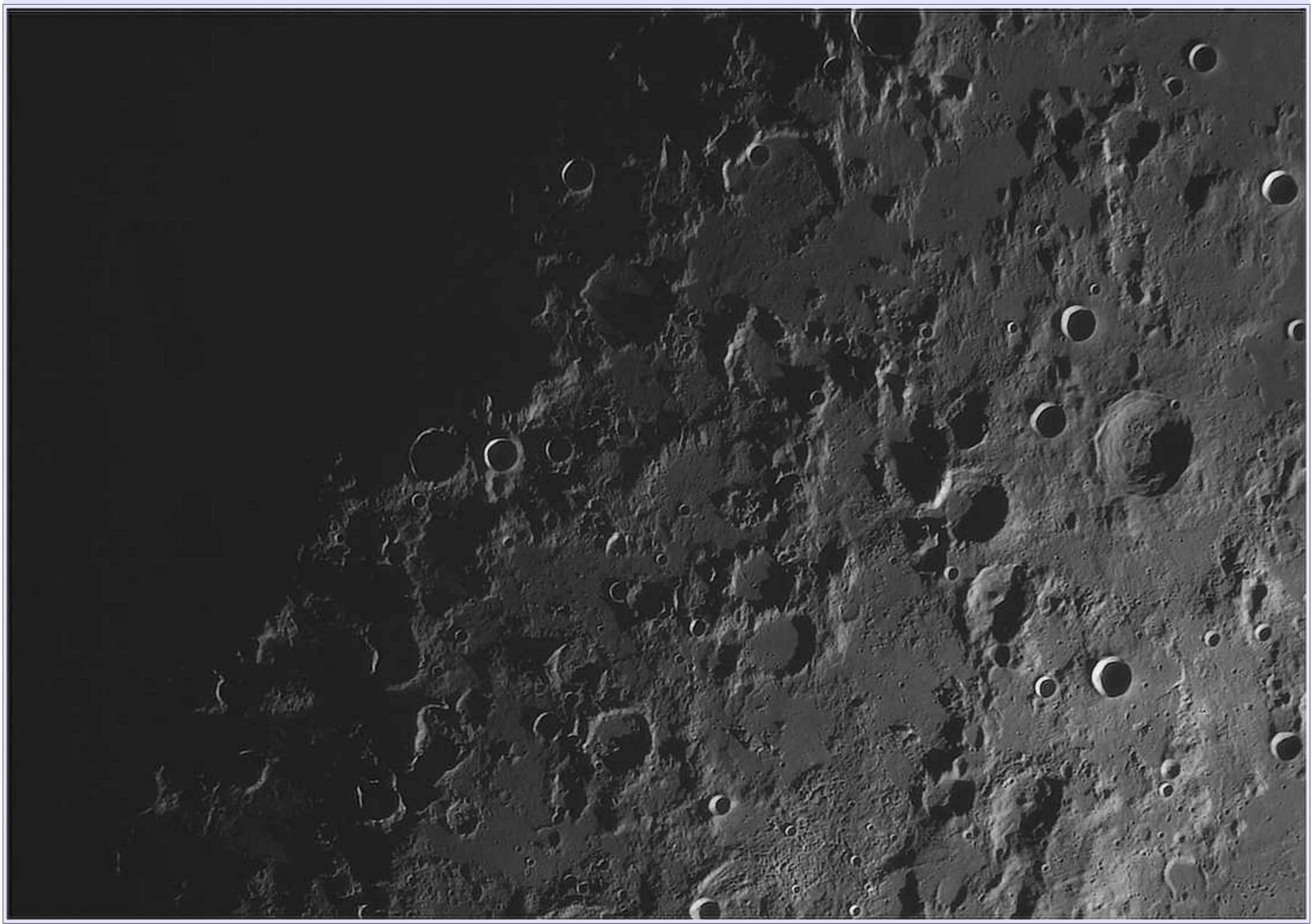


Image by Bob Stuart and taken at 1939UT on 26th May 2023.

Geological Notes: Just to get you orientated, the middle size crater with the wavy rim towards the middle right of the frame is the 51km diameter Delambre, whilst the pale looking rather cracked terrain mid way along the bottom of the frame is the Descartes lunar swirl, and just above that is the Apollo 16 landing site. Lunar swirls are thought to form when a strong magnetic anomaly shields part of the surface from incoming charged particles, thus reducing the intensity of space weathering. The cause of these anomalies has been debated, but the leading contender suggests that this magnetisation has something to do with large impacts at locations *antipodal* to the swirl location. A relatively new study* however has plotted the location of these anomalies and proposes instead that many of them are orientated along lines radial to the Imbrium and Orientale impact basins. Reiner Gamma, Hartwig, Descartes, Abel, Airy and another swirl are, it is proposed, lined up radial to the Imbrium Basin, but the mechanism generating the swirls is still uncertain. One possibility is that basin radial fractures become the focus of upwelling magma, that *may*, under some circumstances be sufficiently magnetised to do the job. Another is that fragments of the impactor – presumably a large iron body - get entrained in the basin ejecta which travels radially outwards and locally enhances the magnetic strength when the ejecta is deposited. The Reiner Gamma, Hartwig, and Rima Sirsalis swirls are also, according to this hypothesis, the products of the Imbrium Basin impact. The light plains or 'Caley Formation' deposits (that Apollo 16 explored in the belief that they were of volcanic origin) which can be seen to the north of the Descartes swirl are thought to be composed of "fluidized" ejecta from basins such as Imbrium, and it is suggested that it is within these deposits that the impactor iron might be mixed. An interesting hypothesis, and well worth reading the paper which is available open source: (https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2020JE006667).

*Lon Hood, Cecilyn Torres, Joana Oliveira, Mark Wieczorek, Sarah Stewart. (2021) A New Large-Scale Map of the Lunar Crustal Magnetic Field and Its Interpretation. Journal of Geophysical Research. Planets.

Messala and Berzelius.

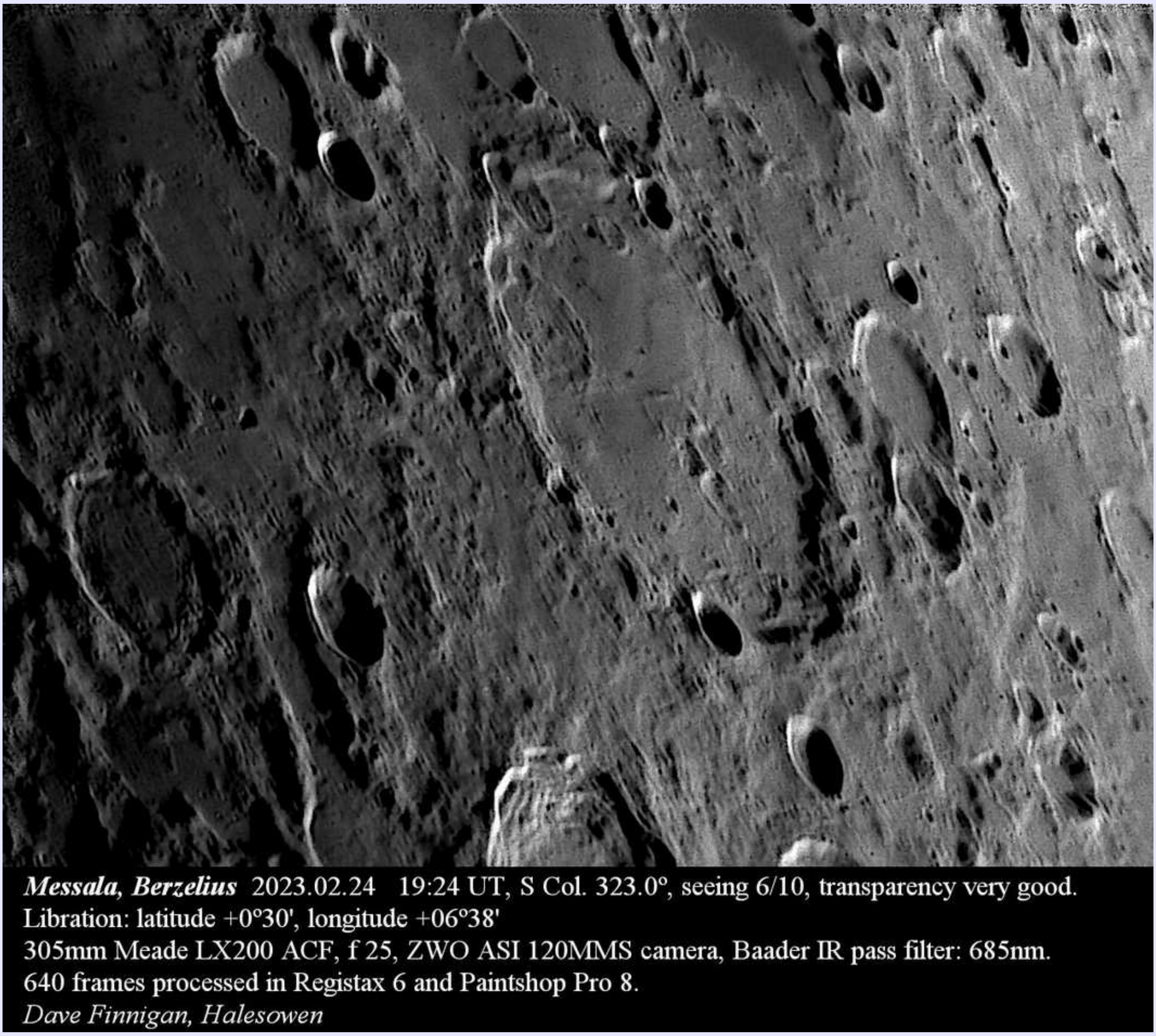


Image by David Finnigan with details of time/date and equipment as shown.

Geological Notes: Messala is the prominent crater occupying the middle of the frame whilst Berzelius is just on the left edge of the frame. At 122kms in diameter Messala is large crater, but it is only 2000m deep, so clearly filled in with a lot of *other* material. The LRO images show a network of largely obscured linear graben on the floor, so it is likely that Messala was at some stage a Floor Fracture Crater (FFC) and that its floor has been uplifted by the injection of a magma body beneath it. Some of these fractures have become the focus of pyroclastic volcanic eruptions, similar to those present on the floor of Alphonsus. Two of these vents can just about be made out to outside the southern rim of Messala K which is the sallow crater straddling the northern rim in about the 11:00 o'clock position in this image. Messala is also one of those craters with an offset central peak – or in this case probably a peak ring, which appears to be displaced some 20kms towards the SE rim. This is not unusual and can be seen in other large FFC's such as Posidonius. The 45km diameter Berzelius may be another FFC but again the fractures are extremely inconspicuous. There are some unusual pits on the floor of the crater that *could* be volcanic, but there is not much in the way of mineralogical data in the Quickmap overlays to support this idea. Younger impact derived deposits may however blanket many of these older craters and obscure any volcanic deposits that pre-date them, making their identification difficult.

Firmicus.

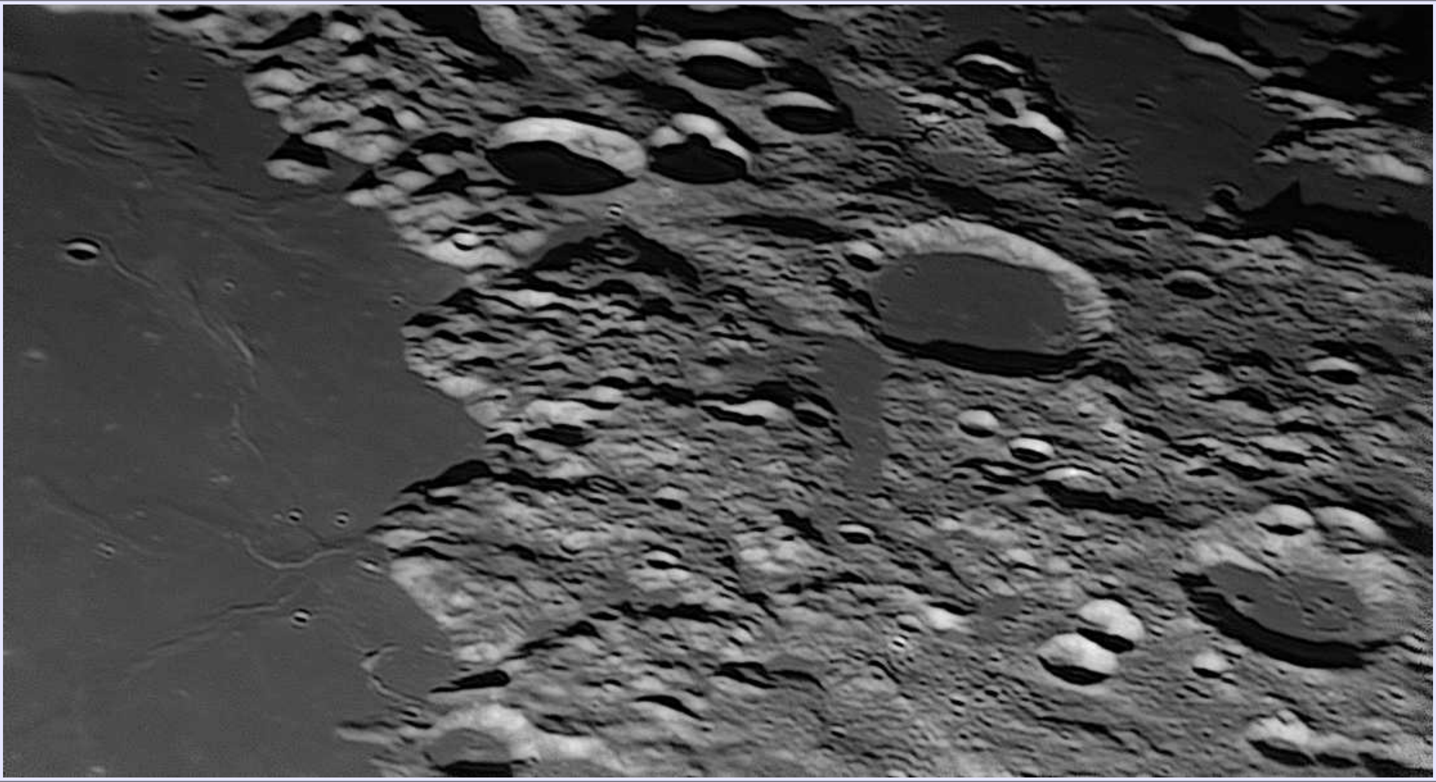


Image by Leo Aerts and taken on 12th October 2022with a 25 cm f/15 Opticon Schmidt Cassegrain and ASI 290MM webcam.

Geological Notes. Firmicus is the mare filled crater just off to the right of the centre of the frame, and is located just outside the south-eastern rim of Mare Crisium which is to the left of frame. The crater has a diameter of 58.8kms, and its remarkably flat floor lies 2300m below the eastern rim. We are looking towards that eastern rim in this image, and you will be able to see that the inner crater wall has a somewhat curved dark line running across it, approximately half way up. This line marks the top of a large slump, or more accurately a cluster of slumps where material has collapsed down towards the crater floor. Other slumps have occurred off the southern crater wall (to the right in this image) which have resulted in a rather 'striated' appearance. The crater floor is covered in high titanium basalts, possibly erupting at the same time as the basalts of similar composition in Mare Crisium, Mare Undarum (which can be seen beyond Firmicus) and the finger like Lacus Perseverantiae in front of it.

Two small concentric craters (CC's) Apollonius N and Firmicus C are shown in this image, though the inner torus is not apparent. The prevailing hypothesis is that these are caused by magmatic intrusion into the base of these small craters, causing the crater floor to bulge upwards and form the torus. The evidence for volcanic products within CC's is however virtually non existent, with Firmicus C being the one exception. But even here, the volcanism is restricted to a small spot of pyroclastic material on the torus and some basaltic material on the northern rim. There are very many small craters as well as irregular hollows filled with mare lavas in this area, which indicates that these basalts have had little trouble reaching the surface, which begs the question that if CC's are produce by magma being intruded into their bases – why did it not erupt within these craters? So, I suspect that volcanism in this sense is not responsible for the formation of CC's – but it may be indirectly as regional volcanism may cause uplift and this may de-stabilise crater rims and cause them to collapse inwards and produce a torus, without the need for magma to be injected into the base of the crater itself.

Gassendi and a possible Dome.

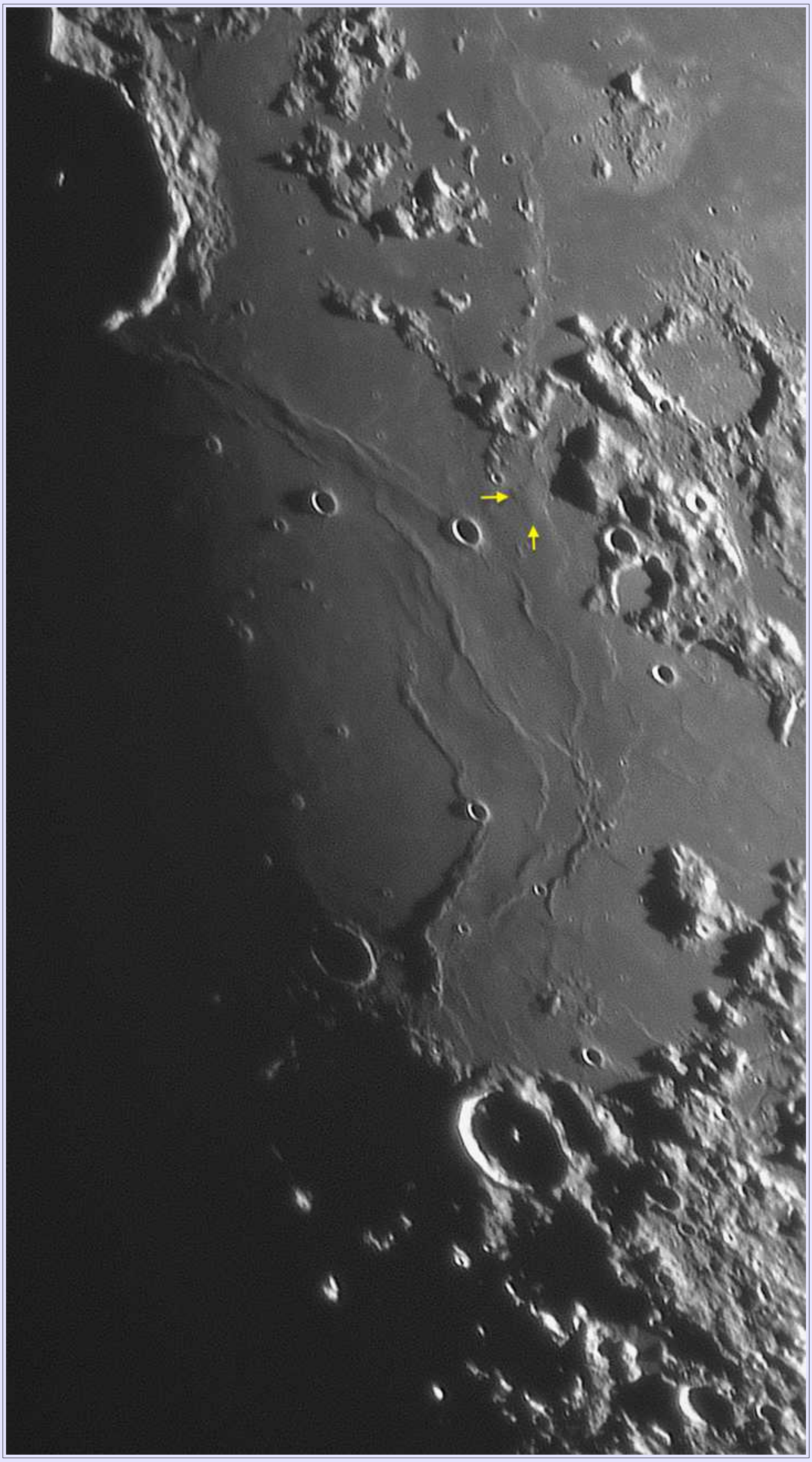


Image by K.C Pau taken on 25 Sep 2023, 12h52m UT with a 250mm f/6 Newtonian reflector + 2.5X barlow + QHYCCD 290M

Geological Notes: I hope K.C will forgive me for defacing his image with two yellow arrows, but it looks like he has captured what appears to be a dome like structure on the eastern shore of Mare Humorum and just to the NE of Gassendi O. Using the LRO Quickmap, this feature appears to be somewhere around 22kms long N-S and 12kms wide E-W, though with many of these low swells, judging where it begins is a bit like the game of Pinning the tail on the Donkey – somewhat uncertain (Fig.1). It reaches a maximum height of about 200m, and has a fracture running E-W for about 6kms along its northern edge, which may in fact be a fault where the terrain to the north has subsided and been inundated with later mare lavas.

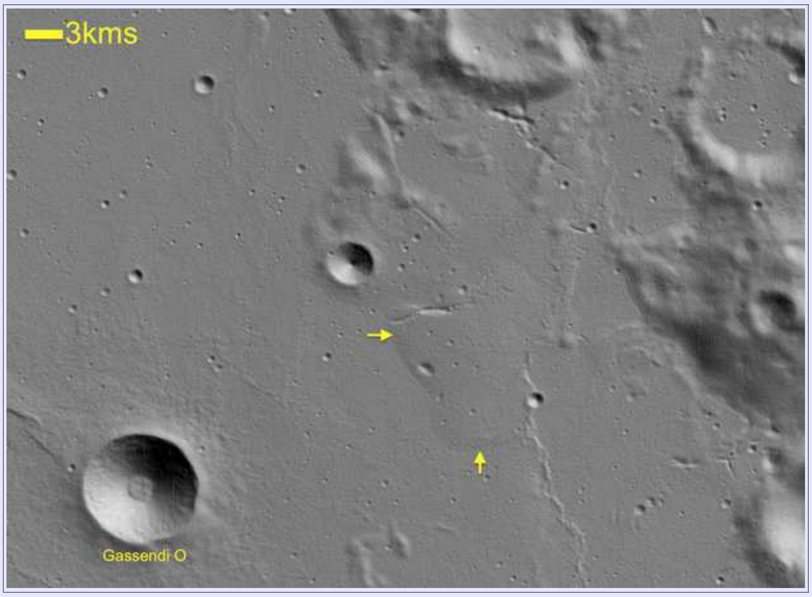


Fig.1.

There is plenty of evidence for volcanism in this corner of Mare Humorum – and locally a nice little cluster of volcanic vents can be seen just to the south of Agatharchides H, whilst Clementine Colour Ratio images show the 'dome' to be part of a larger area of possible volcanic deposits (Fig.2) which show up as orange. It appears to be embayed by later mare lavas, so might represent an early phase of volcanism in the basin.

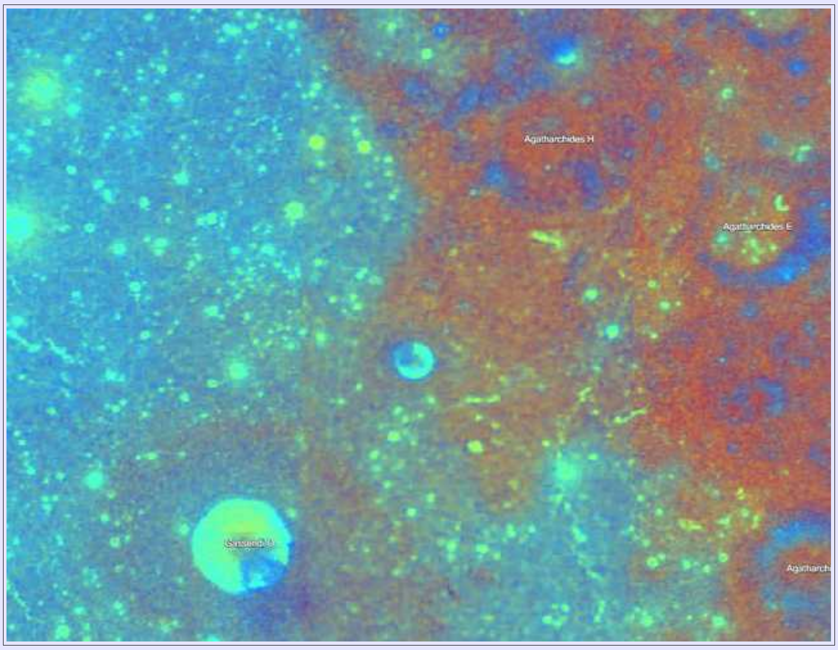


Fig.2

Is this feature new (if so, well done K.C) or is it a known dome or suspected dome? If unknown it might be a good candidate for some follow up research. If you have observations or knowledge of this feature please let us know.

Mare Smythii.

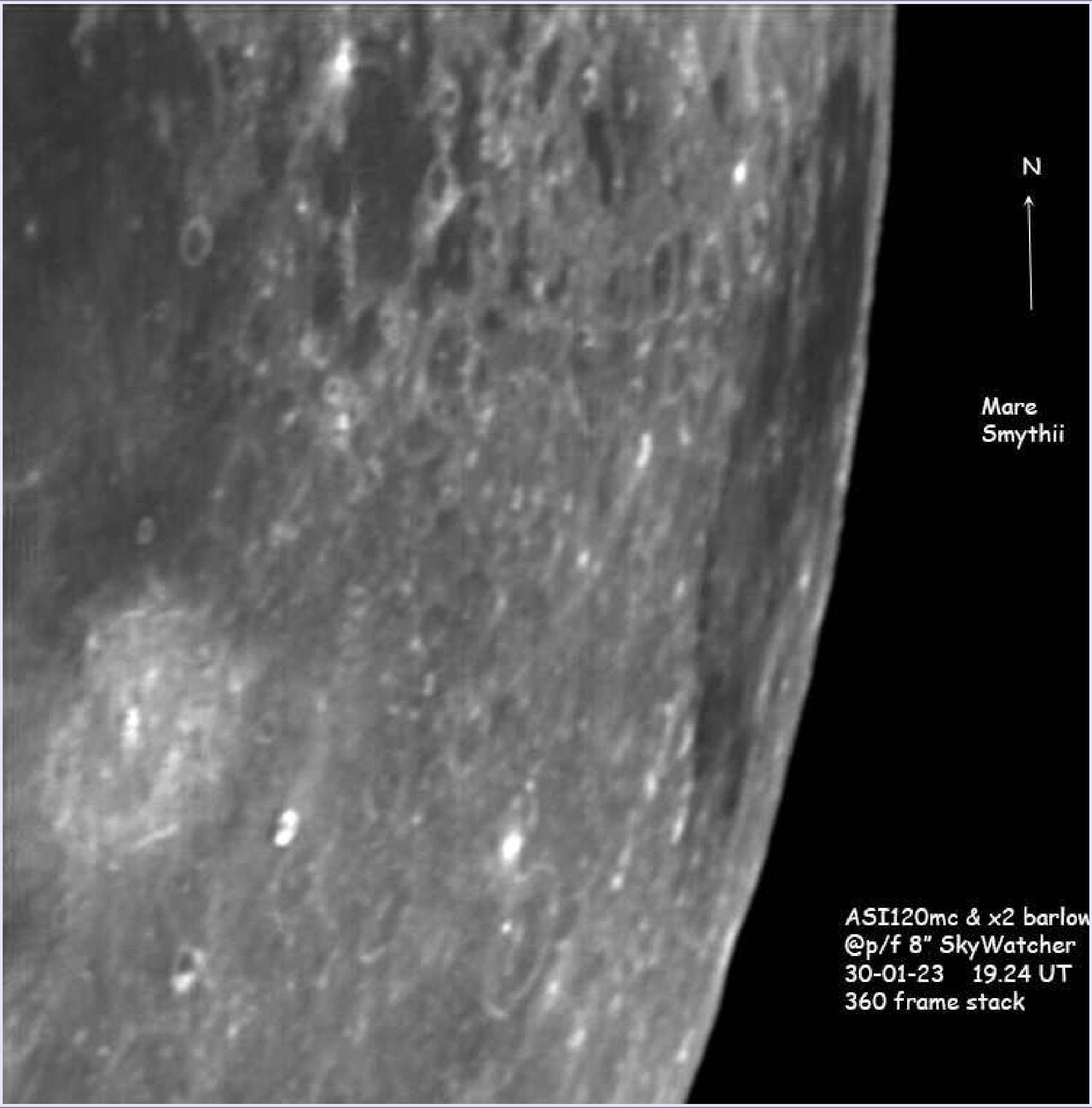


Image by Les Fry with details of time/date and equipment as shown.

Geological Notes: Mare Smythii is just the mare filled central part of the much larger Smythii Basin, and whilst the mare filled area is about 360kms in diameter the basin itself is thought to span some 820kms, though estimates also stretch up to 910kms. The basin has been subject to some recent study, and the two papers listed below, which are open access give you a flavour of what has been discussed. It is comparable in size to the Orientale Basin, and a comparison of the two gives you a good idea of how these basins age and become obscure with the passage of time. The Smythii Basin is aged at 4.26Ga whereas Orientale is dated to between 3.68Ga and 3.8Ga – so an age difference of, let's call is 500 million years to give it a nice round number. This is the length of time that complex multicellular life has existed on our planet – and when you consider the peripatetic wanderings of the continents and the changes that have affected the Earth's surface in that time, it makes you realize that the rate of change on the Moon is *extremely* slow to say the least, as Smythii is still recognisable as a basin.

R. S. Albach et al (2020) The Geology of the Smythii Basin on the Moon51st Lunar and Planetary Science Conference. (Available at: https://www.hou.usra.edu/meetings/lpsc2020/pdf/2826.pdf)

Runyon et al.(2022) Identifying Impact Melt from the Smythii Basin: Toward an Improved Chronology for Lunar Basin Formation. The Planetary Science Journal (available at: https://iopscience.iop.org/article/10.3847/PSJ/ac51e2/pdf)

Taurus-Littrow, site of the Apollo 17 landing.

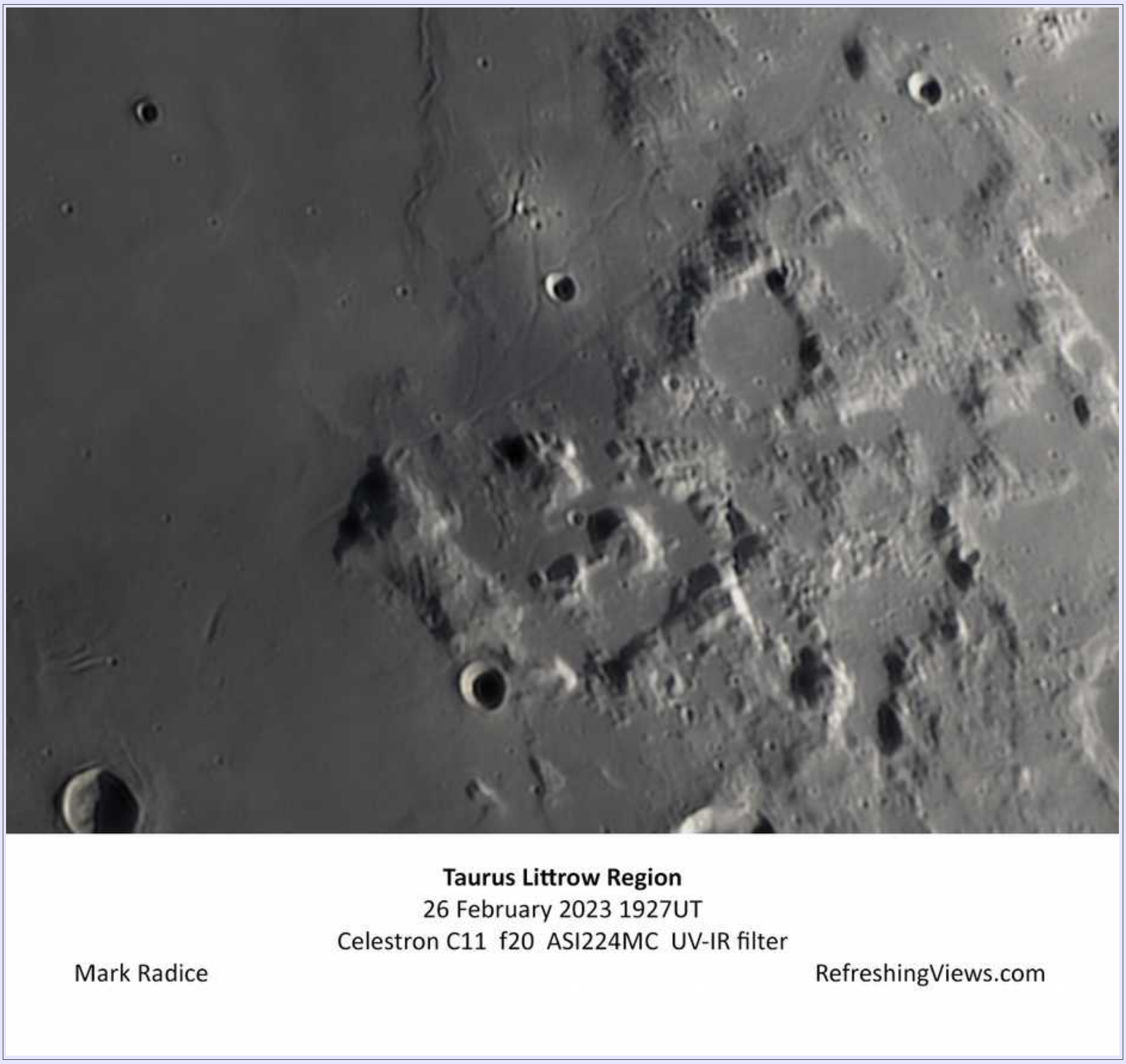


Image by Mark Radice with details of time/date and equipment as shown.

Geological Notes. The Apollo 17 landing site was in the Taurus-Littrow Valley which is just to the right of the prominent peak named the South Massif, which is surrounded by a broken ring of hills in the bottom half of the frame. If you look carefully at the north-eastern flank of the South Massif you will see a small patch of light material stretching away to the NE across the valley floor. This is a landslip that originated on the summit of South Massif and cascaded some 2000m down the flank onto the mare surface below. Once there however it did not stop but continued as a 5km run-out across the darker mare surface in what has been termed a 'hypermobile' Light Mantle landslide*. It is estimated to be about 16m deep at the base of the massif grading down to 3m further away. How it achieved this feat of mobility is still a subject of active research.

An overlooked feature shown in this image is Catena Littrow, visible as the small crater cluster surrounded by a bright halo in the middle top part of the frame. This is a spectacular 10km crater chain formed by when a fragmented asteroid, with the fragments travelling one behind the other (*à la* Shoemaker–Levy 9) struck the surface. The westernmost crater, formerly known as Littrow BA is the largest component with a diameter of 3.5kms diameter, the remaining 7 or so craters to the east are smaller and shallower. From the distribution of ejecta the impactor came from the west, so possibly the largest fragment was last in line with a string of smaller fragments in front of it.

*Magnarini, G. et al (2023). Friction Experiments on Lunar Analog Gouges and Implications for the Mechanism of the Apollo 17 Long Runout Landslide. The Journal of Geophysical Research Planets. 128.
(available at: https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2022JE007520)

Janssen to Rheita.

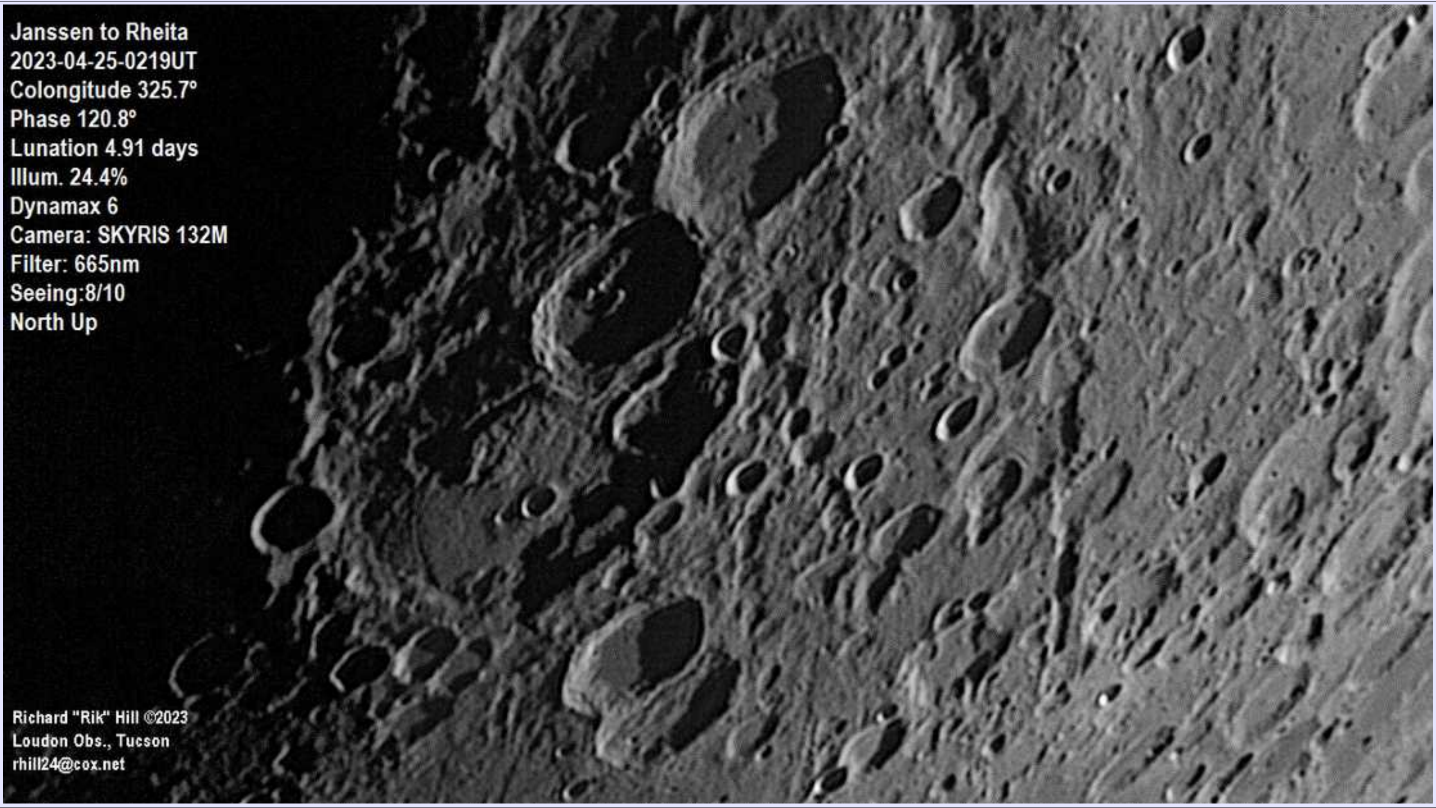


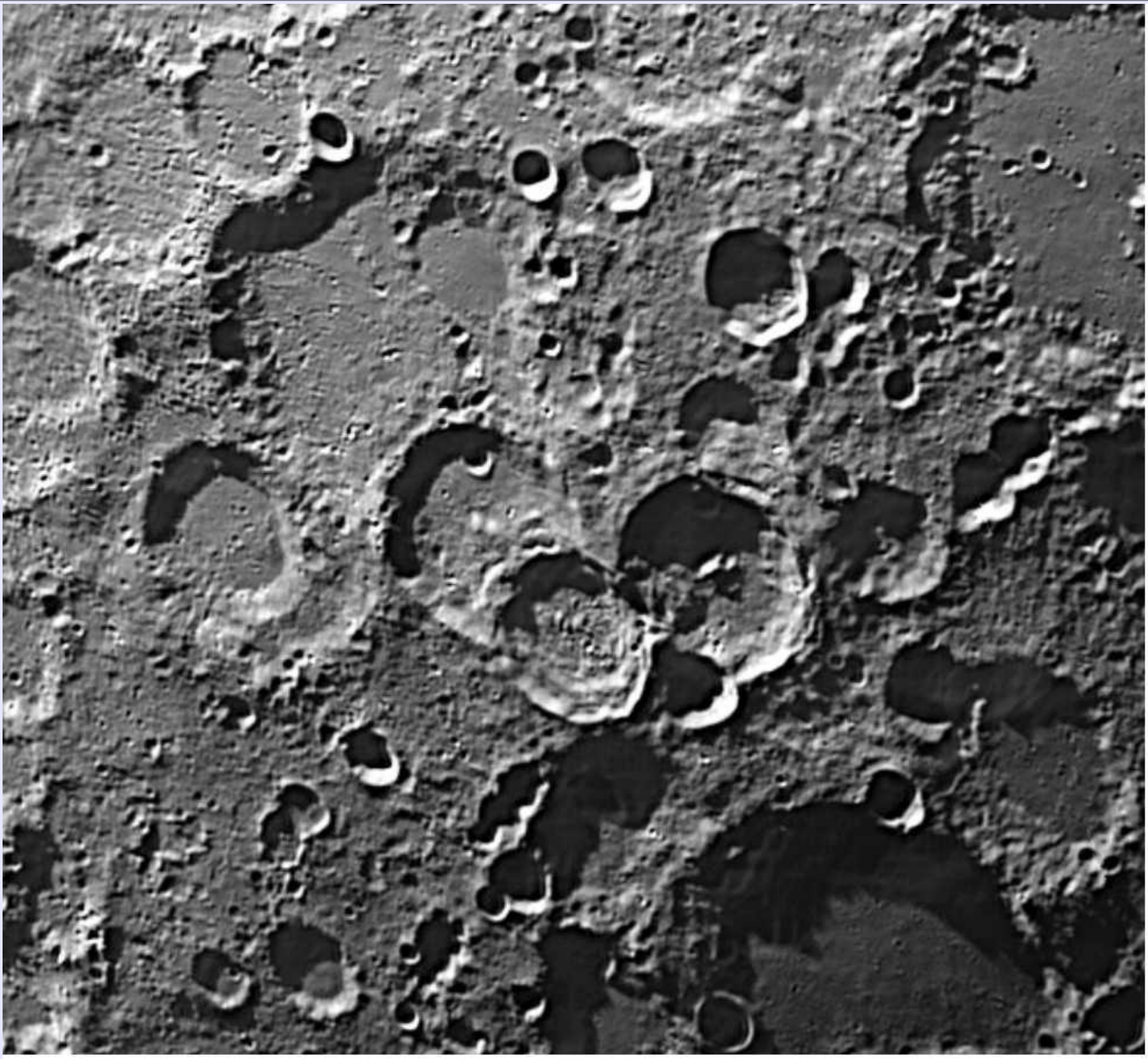
Image by Rik Hill with details of time/date and equipment as shown.

Rik Comments: A*n electronic failure with my larger telescope has forced be back to the Dynamax 6. This image comes from that. On the left side of the image we see the large ancient crater Janssen (196km dia.). On its floor is beautiful system of rimae, some of which are still in deep shadow here. On the north wall is the crater Fabricius (80km) and its near twin (in size) Metius (90km). The former has a very interesting mountain range on its floor but most of that too is in shadow. Running down the image from top to bottom just right of center is the huge trench of Vallis Rheita. Going south from Metis are two (three?) parallel smaller similar trenches. These are controversial with some believing they are just overlapped craters and others that they are scars from a large impact to the north with craters formed on top of that. The problem with that is that neither Vallis Rheita nor the other two smaller grooves point exactly back to a large impact. They miss Mare Nectaris by some distance.*

It is interesting to point out the dark elongate feature that runs from between Fabricius and Metius to the upper left into the terminator. This is created by the chance alignment of crater walls and mountain shadows and not a real feature like the Vallis itself. This is the kind of thing that lighting can do to trick you on the Moon!

This image is made from two 1500 frame AVIs stacked with AVIStack2 (IDL) knitted together with MS Ice and further processed with GIMP and IrfanView

Orontius and adjoining craters.



Orontius and adjoining craters 2022.09.17 - 06.35 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

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

Geological Notes: Orontius, which is the one on the left of the frame is a large 121km diameter ancient and partially demolished crater, but it is difficult to make out an actual circular outline. Located only 1700kms or so from Tycho, it is plastered in ejecta, and scoured by secondary craters and crater chains. One small, much younger 350m deep crater that has penetrated this ejecta on the floor of Orontius has excavated material with a high iron and olivine signature. This shows that beneath this ejecta there is a mare like surface, probably a bit like that visible in Stöfler (which is at the bottom right of the frame) and also that the Tycho ejecta is at least 350m thick at this point.

Schomberger, Manzinus and Mutus

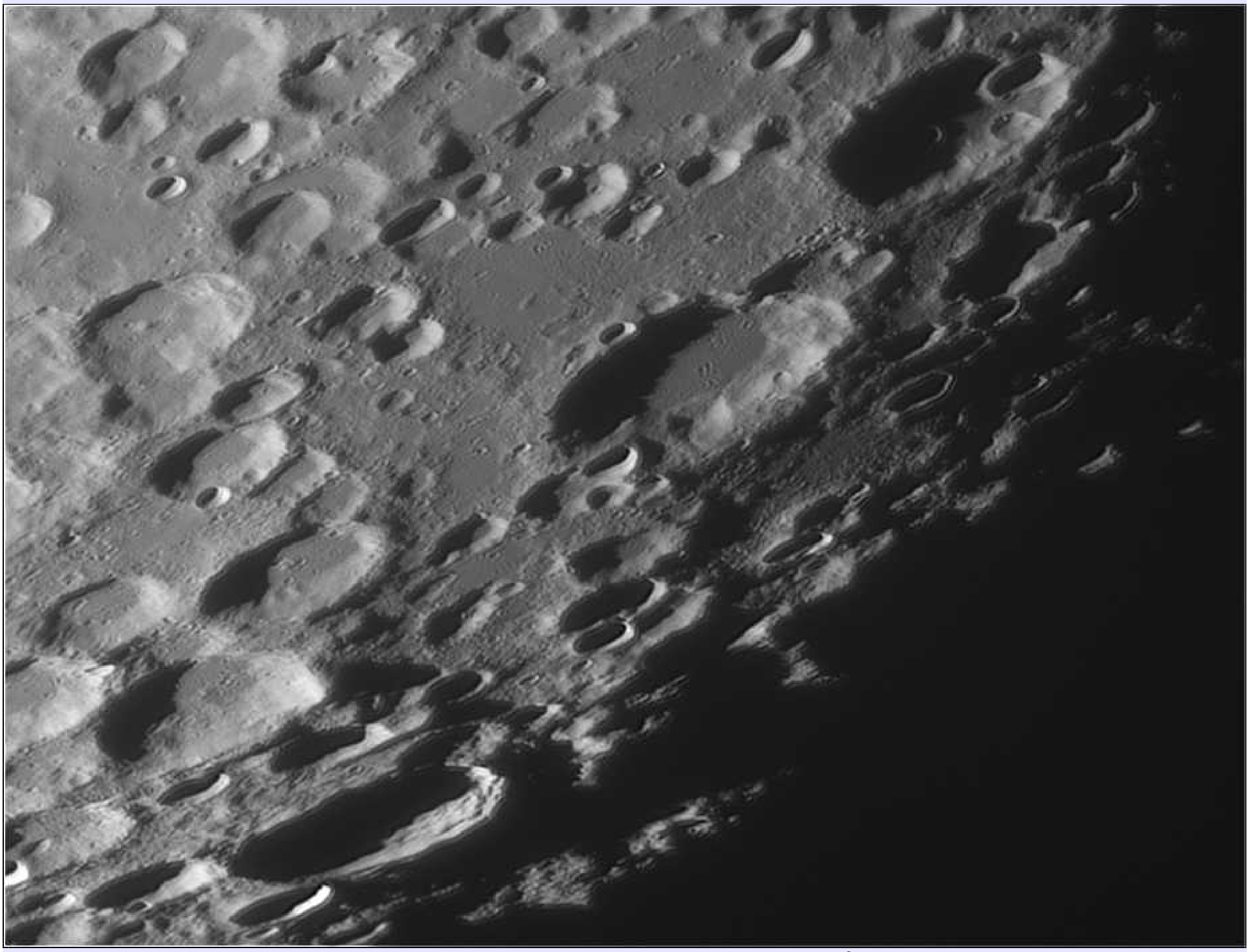


Image by William Leatherbarrow taken at 0115UT 13th November 2022

Geological Notes: Ignoring the trio named in the title, the crater Pentland (56kms diam.) located towards the left edge of the frame has what appears to be a bright straight edged smear down its south-eastern inner wall, extending from the rim down to the crater floor. This looks to be a relatively fresh landslide, but the only problem is that the LRO Quickmap shows little evidence for one, with no boulders, boulder trails or fresh exposures of rock along the rim. There is similarly nothing in the limited mineral data covering the area to show a difference between the lighter area and the surrounding terrain as would be the case if this was indeed a landslide exposing fresh, unweathered rocks. Playing with the various tools and overlays however it can be shown that the straight edge to this bright patch corresponds to a deep ravine that runs from the rim to the crater floor, and that this ravine marks the western side of large flat slab of crater wall. It is possible therefore that what we see is an effect of illumination with the flat expanse reflecting the evening light. If you look at the Quickmap image of Pentland you can see this feature clearly, as the default view is also an evening one.

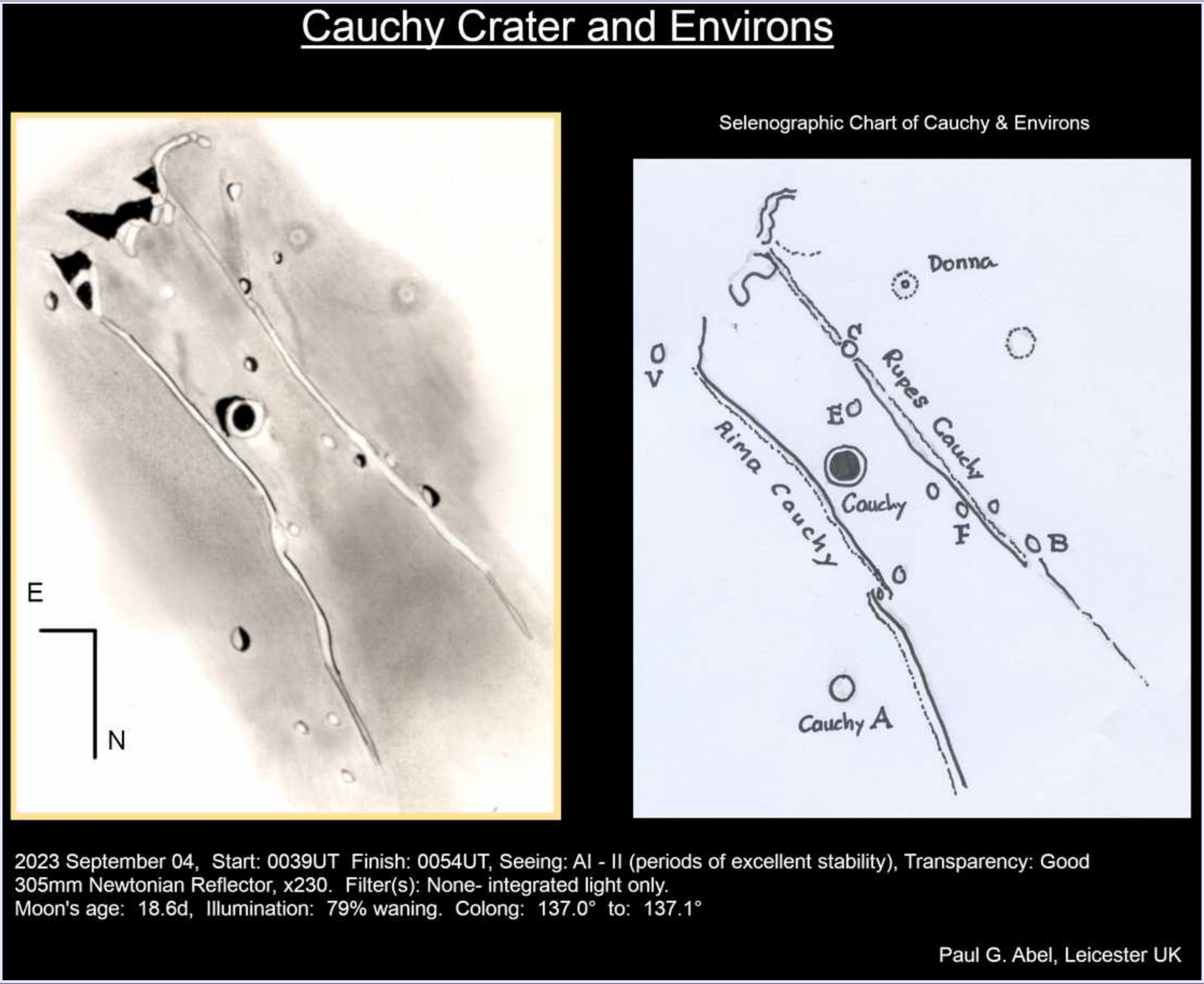
Another thing that catches the eye is the flat featureless almost circular patch between Pentland and Manzinus and just above the middle of the frame. There are a number of these odd little patches in the southern highlands and it is curious that they exist in a terrain that should be saturated with craters. Does this one represent a crater that has been filled in by some form of deposit? A topographic profile reveals its surface to be remarkably flat and horizontal, and there is no trace of structures that might represent a rim if it is an ancient crater. Curious to say the least!

DSLR and Phone Camera images.

Image by Alex Vincent taken on 6th September 2023 at 00:06UT using a 600mm lens at f5.6 with a 1/250th second exposure on ISO 800.

Image by Tony Deyes taken on Monday September 4th 2023 at 00.25BST using a Samsung Galaxy J5 smartphone attached to a Celestron 6 using the Celestron NexYZ Smartphone adapter.

Cauchy Crater and Environs.



Drawing by Paul Abel.

Paul Comments: *We had some exceptional seeing conditions here on the morning of the 4th September- I call it 'Mountain Top Seeing' since that's exactly what it was like!!! I observed Cauchy and Gutenberg crater, attached is my drawing of Cauchy along with my observing notes.*

Observing Notes:
Cauchy crater itself is small impact crater some 11.8km in diameter. I did notice some white lunar material to the NW of the crater. Also clearly visible was the Rima Cauchy and Rupes Cauchy. To the north of Cauchy crater I noticed that the Rima Cauchy splits- on hi-res images there is a small crater here, I was unable to see that but the whole area was a very brilliant white colour not to unlike Linne in appearance. There were many satellite craters also clearly visible- I have included a chart of the area which shows the labelled features- some craters seem to have no name, presumably because they are small.

The final point of interest was the two volcanic domes to the SW of Cauchy- one of these contains the crater Donna. This crater is small (only 2km in diameter) but it could be seen as a darker grey dot on the top of the dome.

Lunar domes (Part LXIX) Domes in Manilius.
By Raffaello Lena.

The region to the south and southwest of Mare Imbrium is characterised by mare patches and highland remnants that have been scoured by Imbrium impact ejecta [1]. The Imbrium impact occurred 3.85 billion years ago, creating fractures in the rock layers and spreading ejecta throughout this region. The magma ascended along the fractures produced by the Imbrium shockwave in dikes which generated effusive flows (a large part of Mare Vaporum), pyroclastic events (southeast section of Mare Vaporum) and graben (Hyginus Rille) due to pressurised magma at shallow depth generating a stress field at the surface [2].

In previous studies [3-6] I have described some lunar domes located in the examined region shown in Fig. 1 and Table 1.

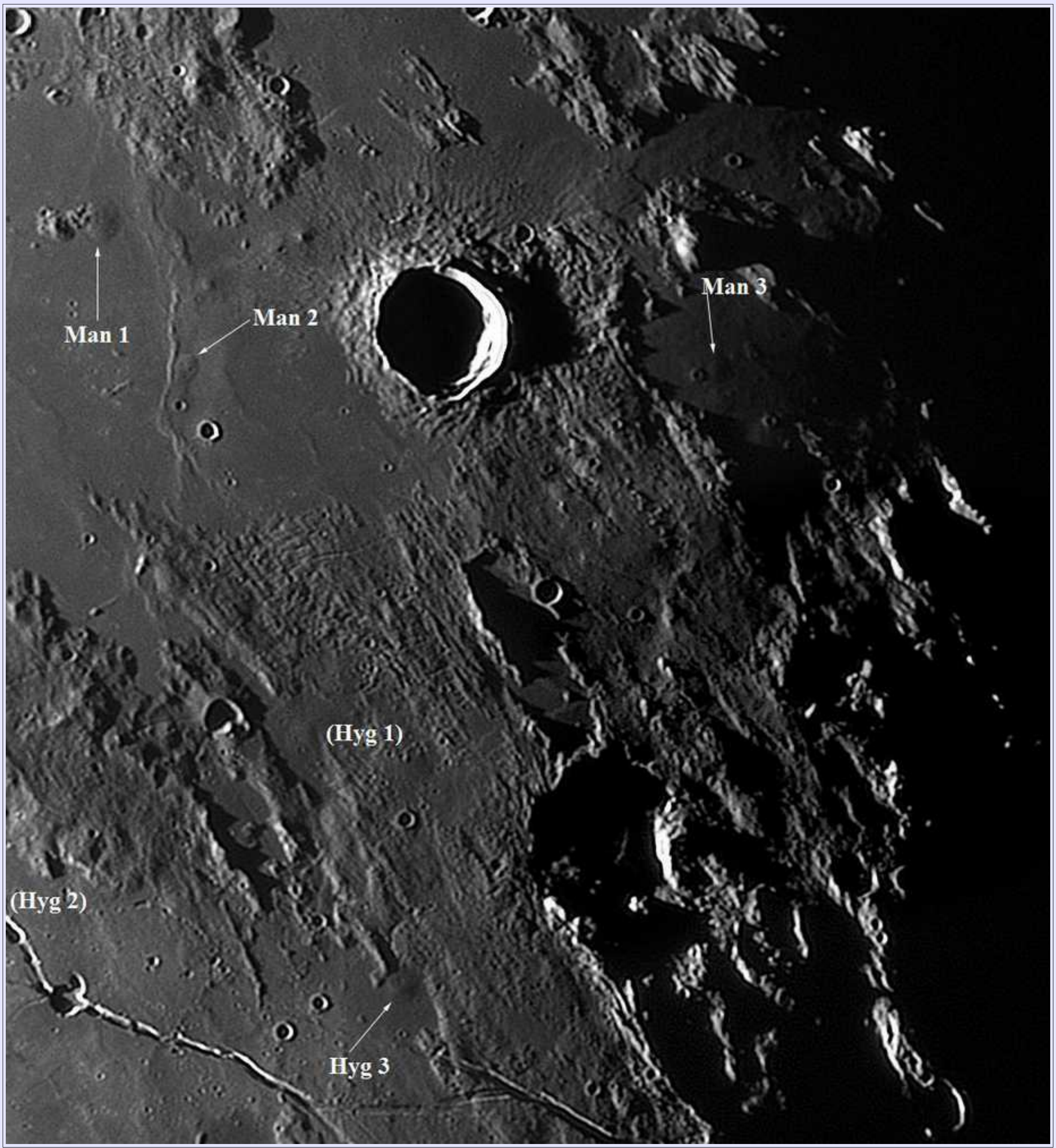


Figure 1: Telescopic image of the examined region. The image was taken by Pau on November 2, 2017 at 13:29 UT, using a 250 mm f/6 Newtonian reflector and a QHY CCD camera.

dome	Lat. [°]	Long [°]	Heigth [m]	Slope [°]	D [km]	V [km³]	η [Pa s]	E [m³ sec⁻¹]	T [years]
Man 1	14.14	5.77	185	1.90	10.6	8.1	2.0×10^6	155	1.60
Man 2	13.80	6.70	80	1.14	8.0	2.5	7.4×10^4	200	0.30
Man 3	14.36	11.70	57	0.93	7.0	1.1	1.7×10^4	220	0.15
Hyg 3	8.27	9.36	120	1.37	10.0	4.7	3.1×10^4	210	0.70

Table 1: Morphometric and rheologic properties of the examined domes

The image shown in Fig. 2 was taken by Dionisi on August 8, 2023 at 00:04 UT, using a 250 mm f/6 Newtonian reflector and the Uranus C camera. In this image some further domes are detectable, which I have named Manilius 4 and 5 (Man 4 and 5).

Hence, in this note two further lunar domes have been characterized in their morphometric and mineralogical composition.

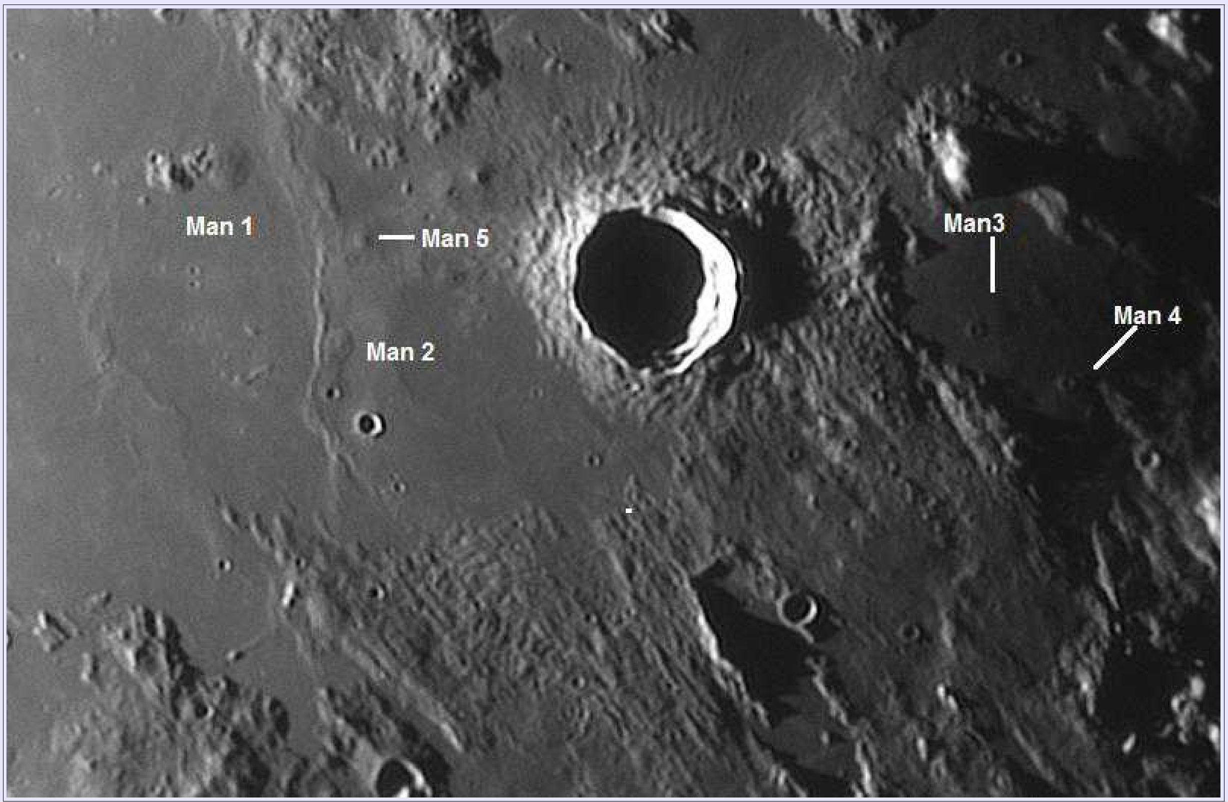


Figure 2: Telescopic image of the examined region. The image was taken by Dionisi on August 8, 2023 at 00:04 UT, using a 250 mm f/6 Newtonian reflector and the Uranus C camera. In the current study the domes Manilius 4 and 5 will be described.

Dome Manilius 4. This dome is located in Lacus Lenitatis, at coordinates 12.33º E and 13.66° N, with a diameter of 21.5 ± 0.3 km. Morphometric data are obtained using LOLA DEM. The height of Manilius 4 is 100 ± 10 m, yielding an average flank slope of 0.6° ± 0.1° (Figs. 3-4). The dome edifice volume, assuming a parabolic shape, is determined to be 18.4 km³.The low slope and large edifice volume of the dome Man 4 yields a high effusion rate of 800 $m^3 s^{-1}$, a low lava viscosity of 2.0 x 104 Pa s, and a short duration of the effusion process of only 0.72 years. The Clementine UVVIS data reveal that the dome appears spectrally bluish. It has a rather low 750 nm reflectance of R750 = 0.0992, and a R415/R750 = 0.6217, indicating a moderate to high TiO_2 content. It belongs to Class C1 with a tendency towards class C2 in the classification scheme [4]. The 3D reconstruction based on LOLA DEM is shown in Fig. 5.

Figure 6 shows the derived elevation of the previous described dome Manilius 3 and the examined Manilius 4.

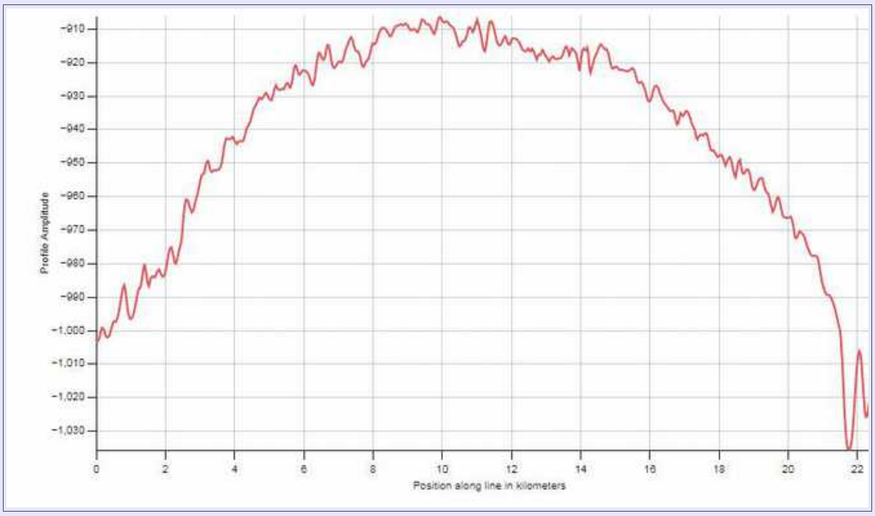


Figure 3: LRO WAC-derived surface elevation plot of a north to south cross-section of the examined dome named Man 4.

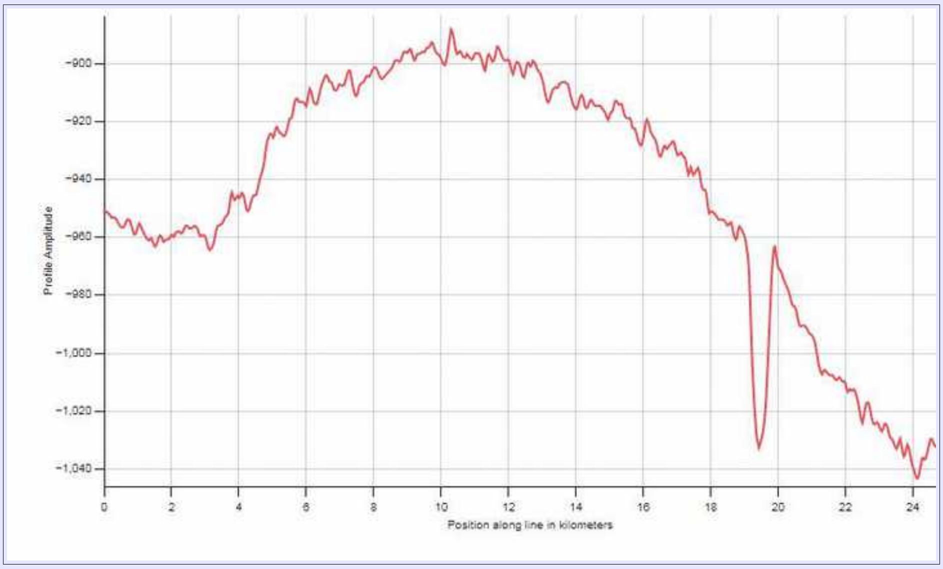


Figure 4: LRO WAC-derived surface elevation plot of an east to west cross-section of the examined dome named Man 4.

For this study I have derived abundance maps in wt% of FeO, plagioclase, olivine, clinopyroxene, orthopyroxene and TiO2 content created from topographically-corrected Mineral Mapper reflectance data acquired by the JAXA SELENE/Kaguya.

Manilius 4 displays a TiO2 content of 4.5 wt% to 8.0 wt% indicating a moderate to high TiO2 content (Fig. 7) and low plagioclase content (<50.0 wt %). The FeO content varies from 16.0 wt % to 19.0 wt % like the nearby mare units. Moreover, it has an enhanced abundance of clinopyroxene (20.0-43.0 wt %) and lower abundance of orthopyroxene (from 21.0 wt % to 33.0 wt %) like the nearby mare units. The olivine abundance ranges from 4.0 wt % to 12.0 wt % in some restricted regions on its summit.

Generating an elevation map of a part of the lunar surface based on telescopic images 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 [4] assuming that the surface material has the same albedo and light scattering properties.

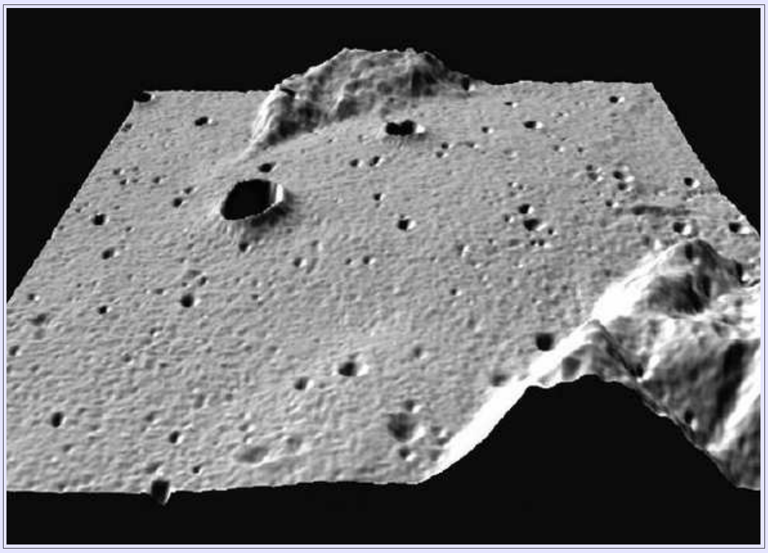


Figure 5: Digital elevation map of the dome Man 4 based on LOLA DEM. The vertical axis is 7 times exaggerated.

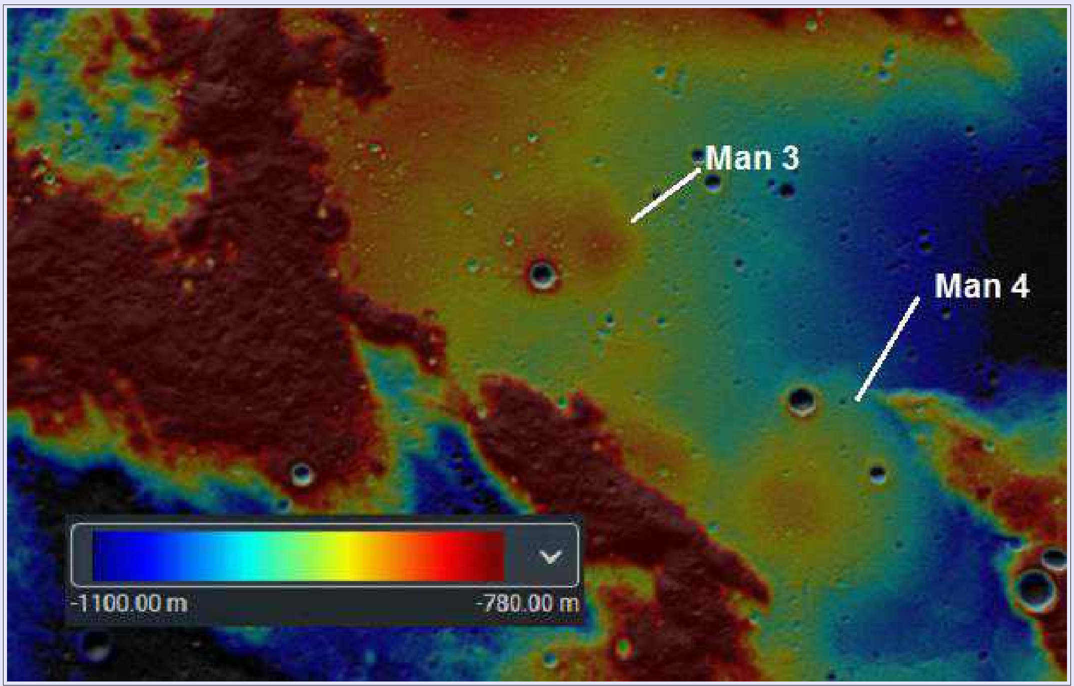


Figure 6: Elevation of the domes Manilius 3 and Manilius 4 on the digital terrain model (DTM).

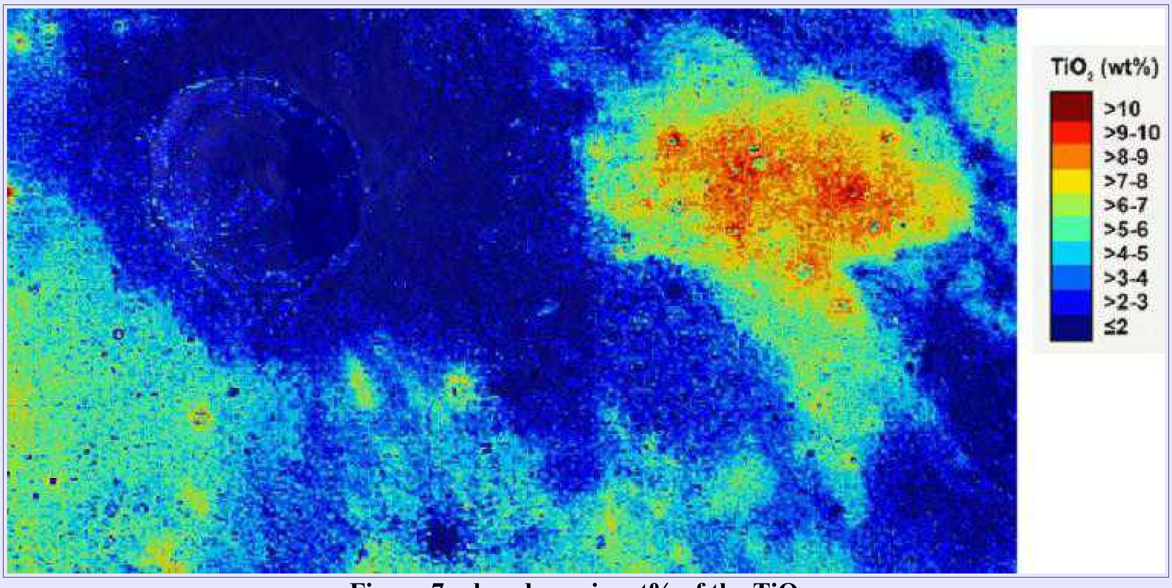


Figure 7: abundance in wt% of the TiO_2.

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. 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 obtained from the image of Fig. 2 is shown in Fig. 8.

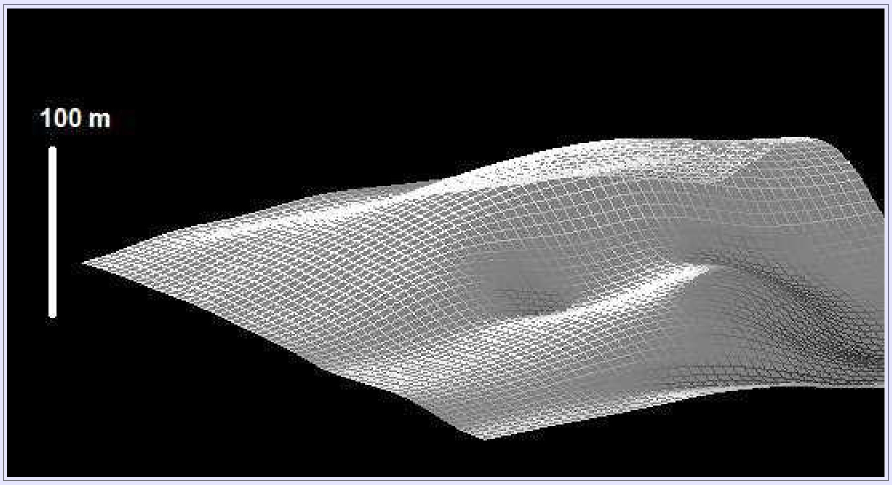


Figure 8: Digital elevation map of the dome Manilius 4 derived from telescopic image of Fig. 2 as seen from northwest direction. The vertical axis is 30 times exaggerated.

Dome Manilius 5. This dome is located to the north of Manilius 2 (Fig. 2), lies at coordinates 6.83 º E and 14.63° N, with a base diameter of 4.3 km ± 0.3 km. The height amounts to 95 m ± 10 m yielding an average flank slope of 2.53° ± 0.2° (Fig. 9). The edifice volume is determined to 0.72 km^3. Figure 10 displays the derived elevation of the previous described dome Manilius 1-2 and the examined Manilius 5. The rheologic model yields an effusion rate of 200 $m3s^{-1}$and lava viscosity of 7.5x 105Pas. It formed over a period of time of 0.65 years. The Clementine UVVIS spectral data of the dome reveal a 750 nm reflectance of R750 = 0.1019, a moderate value for the UVVIS colour ratio of R415/R750 = 0.6093, indicating a low to moderate TiO2 content. According to the classification scheme for lunar domes [4] Man 5 belongs to class E1 due to its small diameter and lower edifice volume. The 3D reconstruction based on LOLA DEM is shown in Fig. 11.

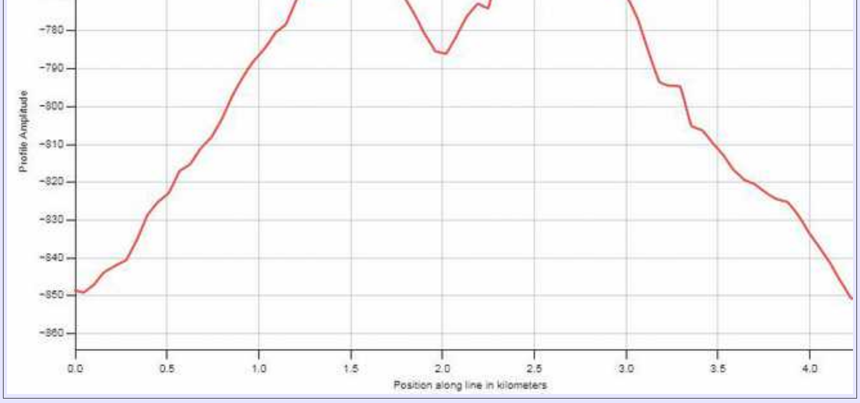


Figure 9: LRO WAC-derived surface elevation plot of an east to west cross-section of the examined dome named Man 5.

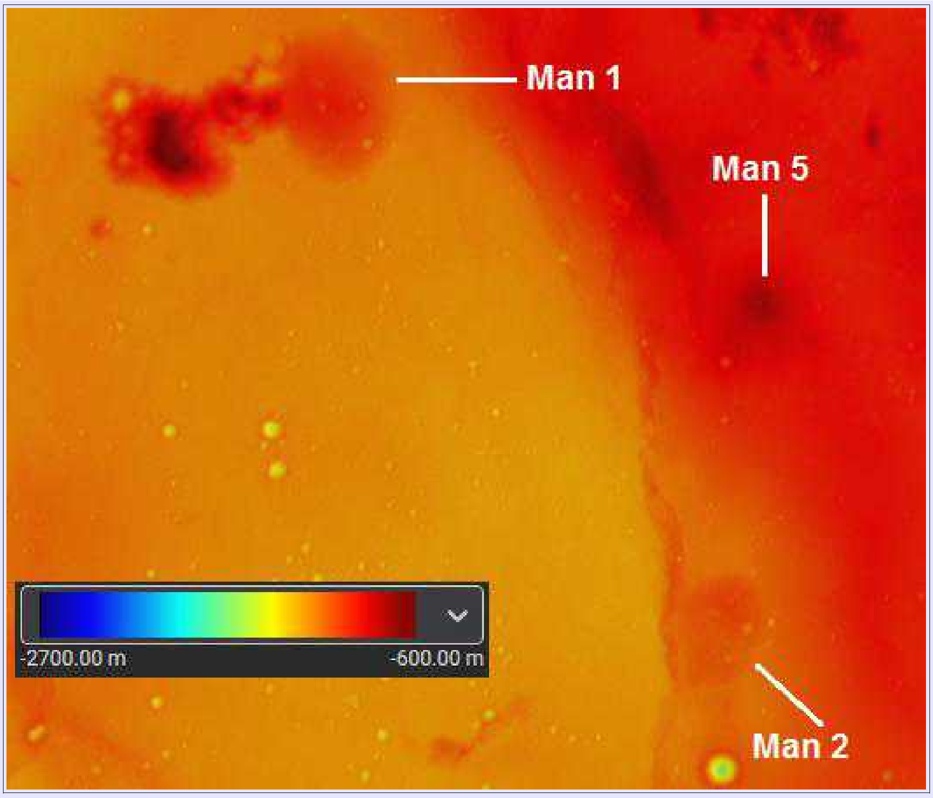


Figure 10: Elevation of the domes Manilius 1-2 and Manilius 5 on the digital terrain model (DTM).

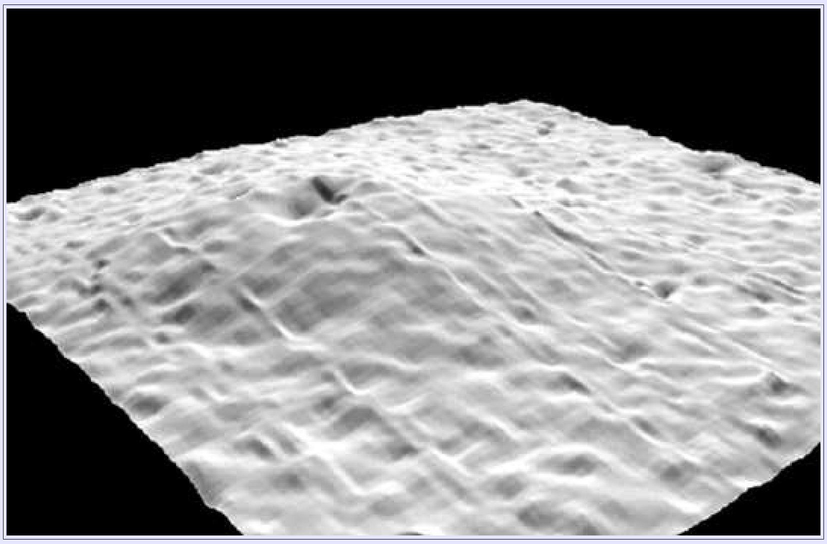


Figure 11: Digital elevation map of the dome Man 5 based on LOLA DEM. The vertical axis is 7 times exaggerated.

The dome Manilius 5 displays a TiO2 content of 3.5 wt% to 7.0 wt % indicating a moderate to high TiO2 content (Fig. 12) and low plagioclase content (<50.0 wt %). The FeO content varies from 15.0 wt % to 17.5 wt % like the nearby mare units. It has an enhanced abundance of clinopyroxene (20.0-49.0 wt %) and lower abundance of orthopyroxene (from 16.0 wt % to 38.0 wt %) like the nearby mare units. The olivine abundance ranges from 5.0 wt % to 18.0 wt % in some restricted regions on its summit. The 3D reconstruction of Man 5 obtained from the image of Fig. 2 is shown in Fig. 13.

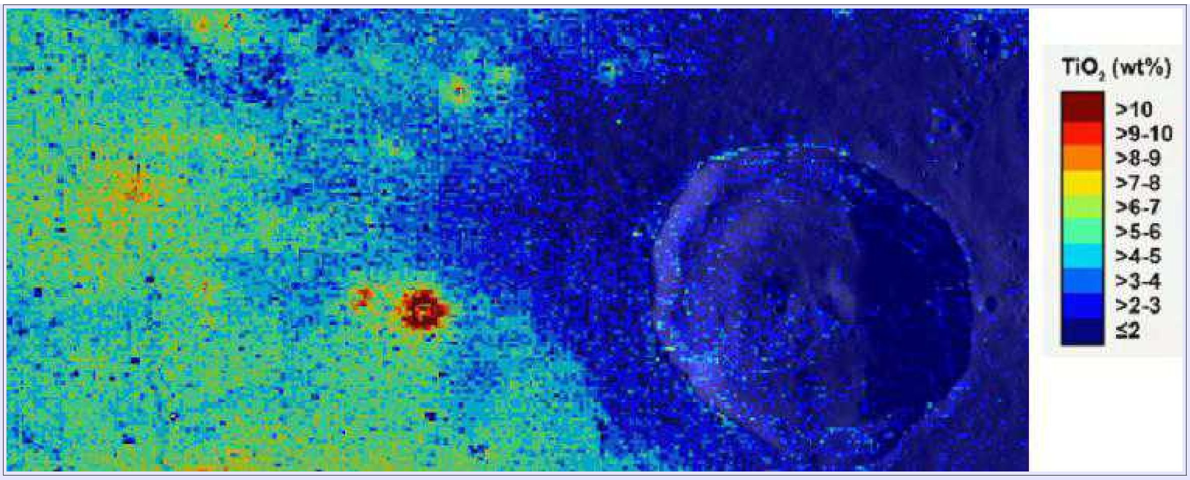


Figure 12: abundance in wt% of the TiO_2.

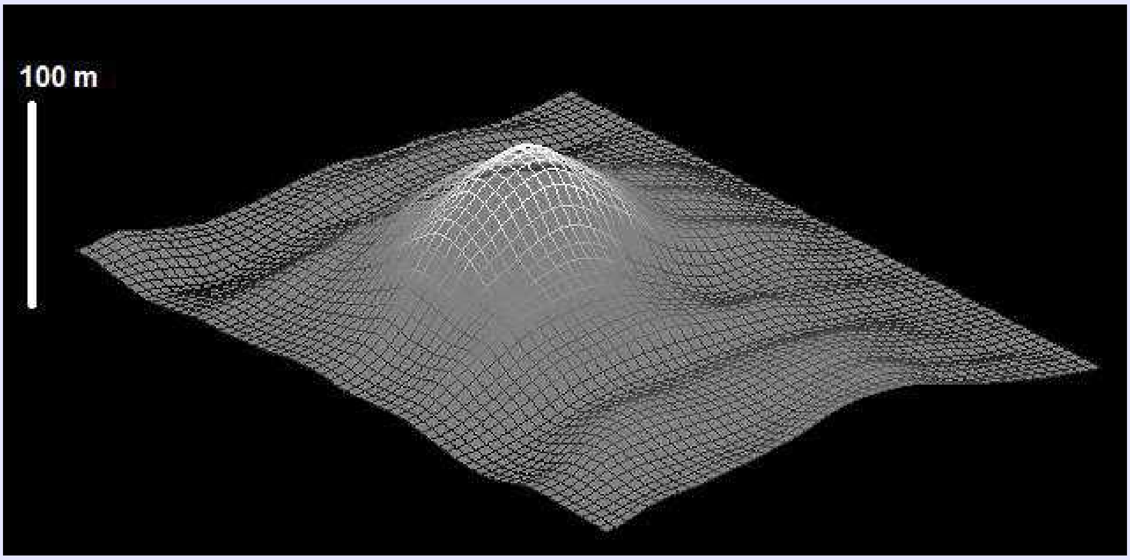


Figure 13: Digital elevation map of the dome Manilius 4 derived from telescopic image of Fig. 2. The vertical axis is 20 times exaggerated.

Conclusion

In our catalogue we have included two further domes in Manilius region. Based on the derived data Manilius 4 is a dome belonging to class C_1 with a tendency towards class C_2. Manilius 5 is small dome with a base diameter of 4.3 km, belonging to class E_1.

References

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Basin and Buried Crater Project by Tony Cook.

No images or sketches have been sent in specifically for the BBC project, taken during September, so I thought that I would pick another candidate buried crater from the catalog, and look at evidence for there being a crater there. So this month's buried crater is: PFC 31, which is located at 1.5˚W 15.5˚N with a diameter of 52 km. 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.

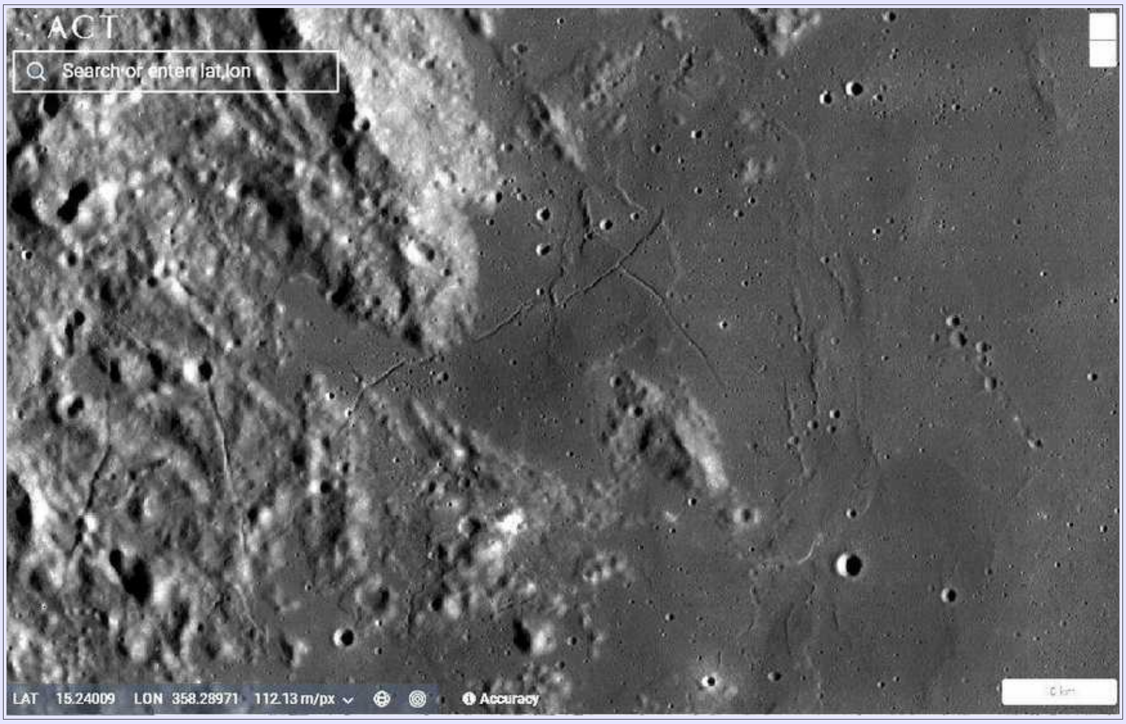

Figure 1 LROC Quickmap WAC nearside mosaic with shadows centred on the approximate location of PFC 31. Note that the scale bar on the bottom right corner is 10 km long. The scale bar on the bottom right is 10 km long.

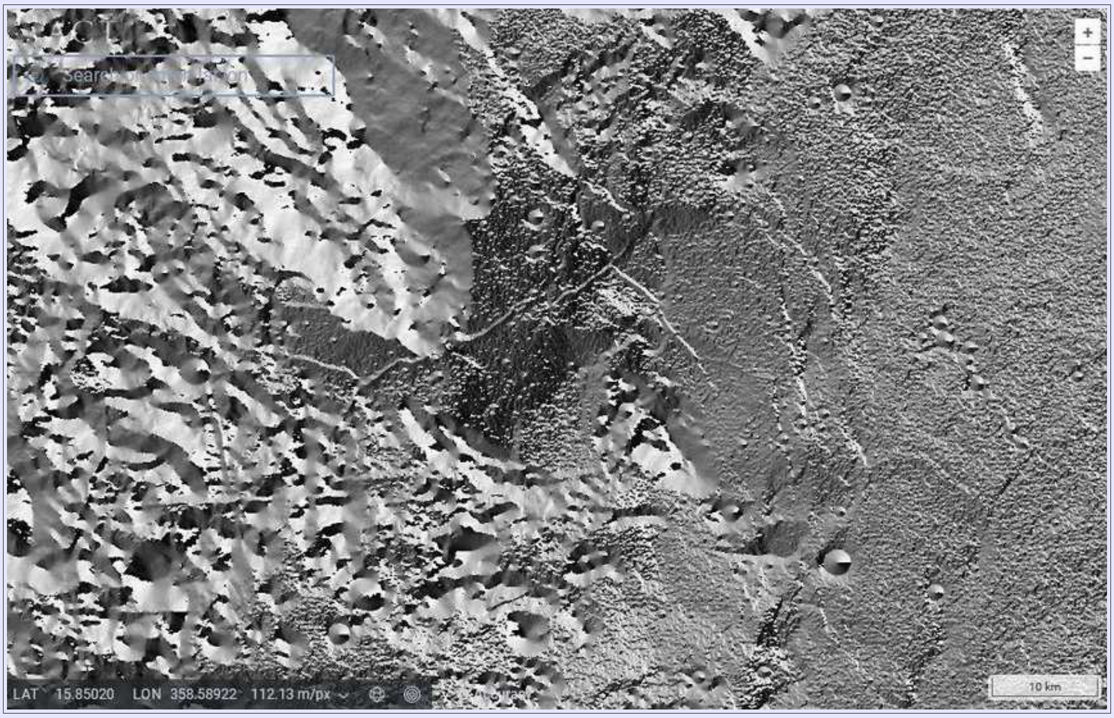

Figure 2 LROC Quickmap ACT Layers (Experimental): Terrain Azimuth. The scale bar on the bottom right is 10 km long.

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) does not look too promising at the centre of Fig 1, though there seems to be some dark material roughly in the right location, but this could be volcanic dome related in origin other than just routine mare material. As always, azimuth direction plots of the slope on the surface can be quite revealing. Fig 2 shows that the proposed PFC 31 has a nice arc of the south rim visible, but other parts of the rim are either destroyed or buried under the mare.

The PFC 31 impact crater appears to be centred on 0.2W, 15.2N and is approximately 30 km in diameter, not the previously published 52 km.

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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South end of the Sirsalis Cleft as drawn by Dr. S.R.B.Cook.

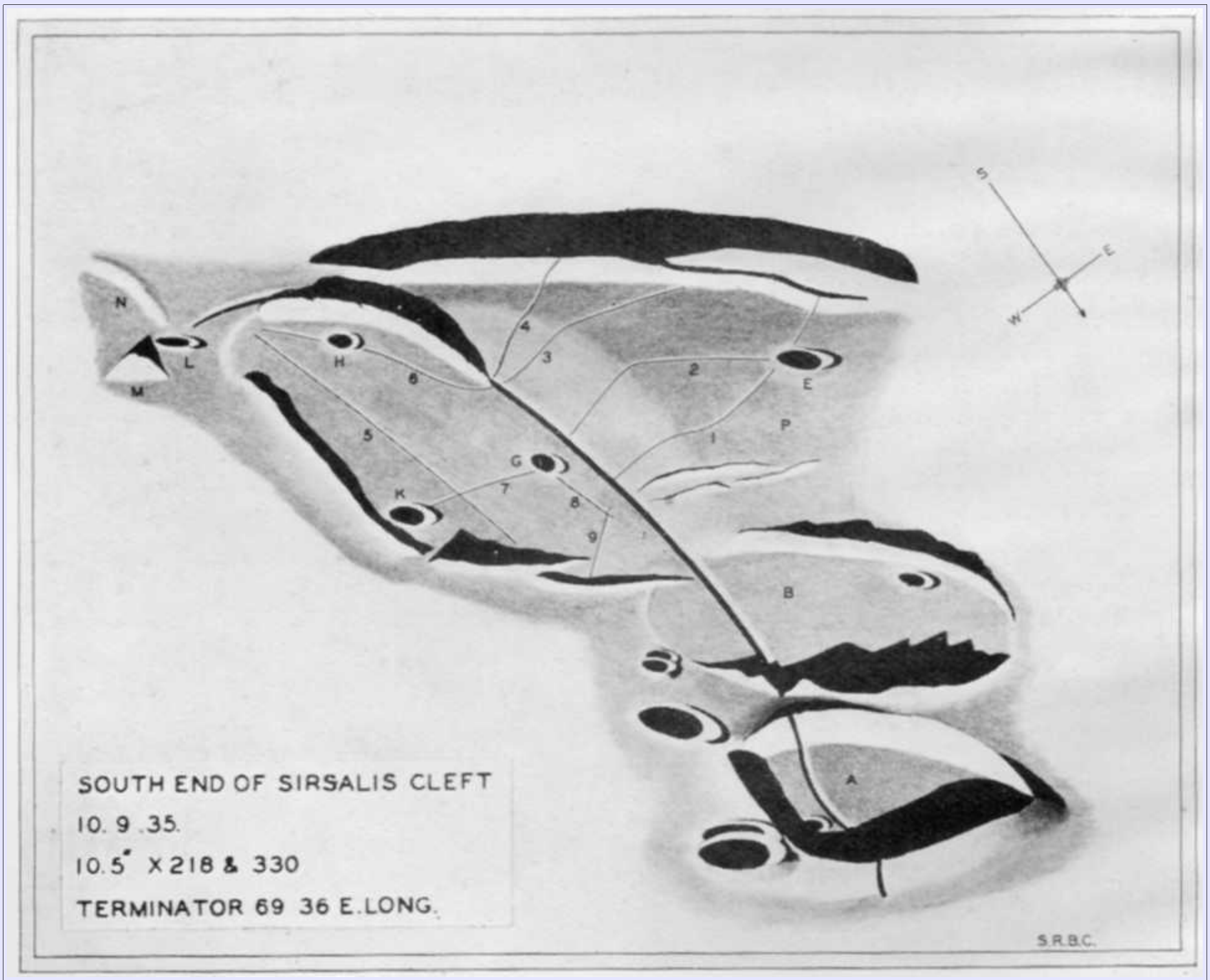

Image reproduced from Memoir of the British Astronomical Association, Vol.32, Part A October 1936.

The Lunar Region South-West of Vendelinus.
By Barry Fitz-Gerald.

I came across a rather nice drawing, shown in Fig.1, made by S.R.B.Cook whilst browsing some vintage BAA Journals[1], and not being familiar with the area decided to have a look at the LRO images for comparison. Cook's article was a follow up of an earlier article by E.F Emley[2] and both record a number of small features within this rather flat terrain, which is located on the eastern limb, and therefore not a particularly favourable location for telescopic observers. Harold Hill also produced an accurate rendition of the area which is reproduced on page 223 of his 'Portfolio'.[3]

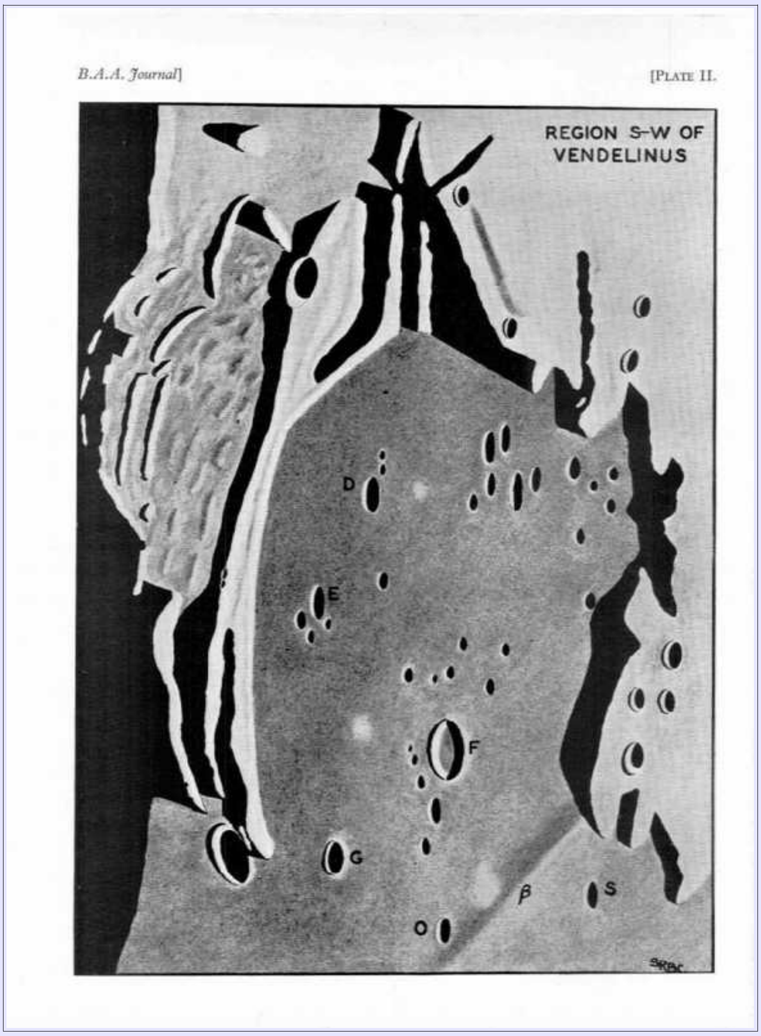

Fig.1 A drawing made by S.R.B.Cook of the area to the South-West of Vendelinus made in 1926 and reproduced in his report in the JBAA for October 1946 entitled The Lunar Region South-West of Vendelinus.

The area is not named in either article but is now known as the crater Balmer, a name only adopted by the IAU in 1964. It lies within the boundary of the Balmer-Kapteyn Basin, an ancient structure which shows up in the GRAIL data as being centred not surprisingly between Balmer in the south and Kaptyen in the north (Fig.2). The dimensions of any of these buried basins is open to debate but a recent paper suggests a diameter of some 250kms and an age dating to some time in the Pre-Nectarian (~ 4.1 Ga to 4.2 Ga) [4]. The region is believed to host one of the largest cryptomare deposit on the nearside[5] based on the number of Dark Halo Craters (DHC's) present, these being small impact craters that have excavated ancient basalts from beneath lighter surface material – and as a consequence have low albedo ejecta surrounding them.

One of these DHC's can be seen depicted as a bright patch to the left of the 'β' in Cook's drawing. LRO images reveal it to be 1.2 kms in diameter and 200m deep (Figs.3 and 4). This gives an impression of the depth of burial of these ancient basalt lavas beneath the lighter surface layers, in this particular spot at least. A regolith temperature anomaly image of this small DHC shows a cold extended ejecta blanket, with a Zone of Avoidance to the SW which would be the approach direction of the impactor. The coldness of the ejecta reflects the presence of an abundant fine fraction within the ejecta deposits which makes these 'cold spots' stand out in the LRO Diviner temperature data.

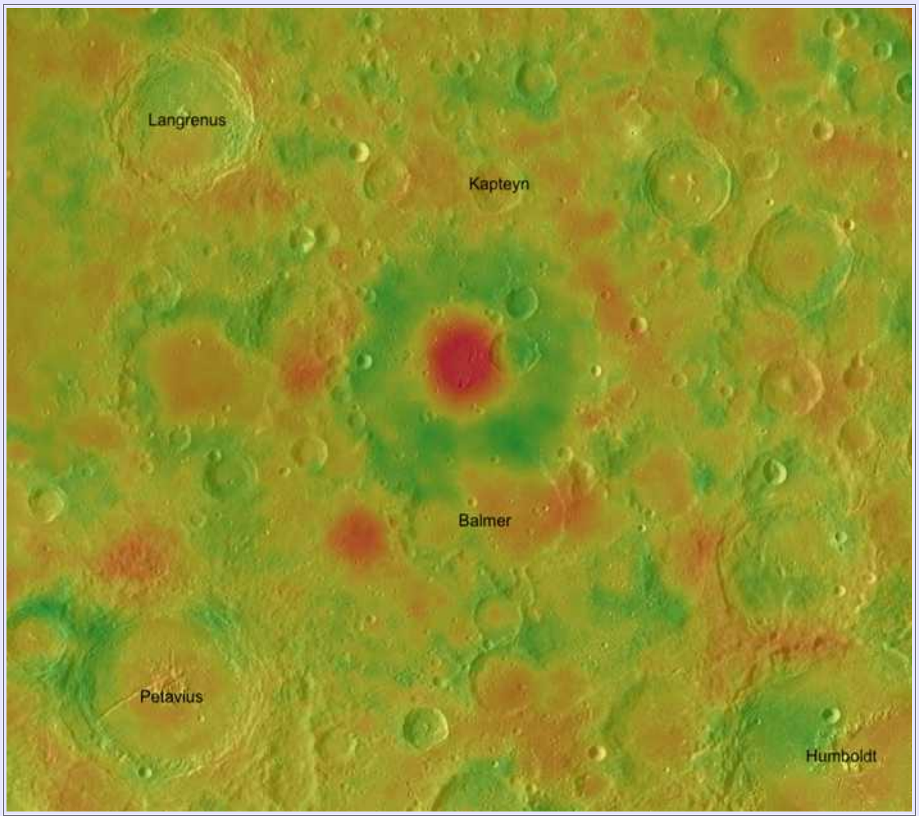

Fig.2 LRO GRAIL overlay (Bouguer gravity filtered from degree 60 to 660) showing the central red blob of a mantle uplift beneath the central part of the Balmer-Kapteyn Basin.

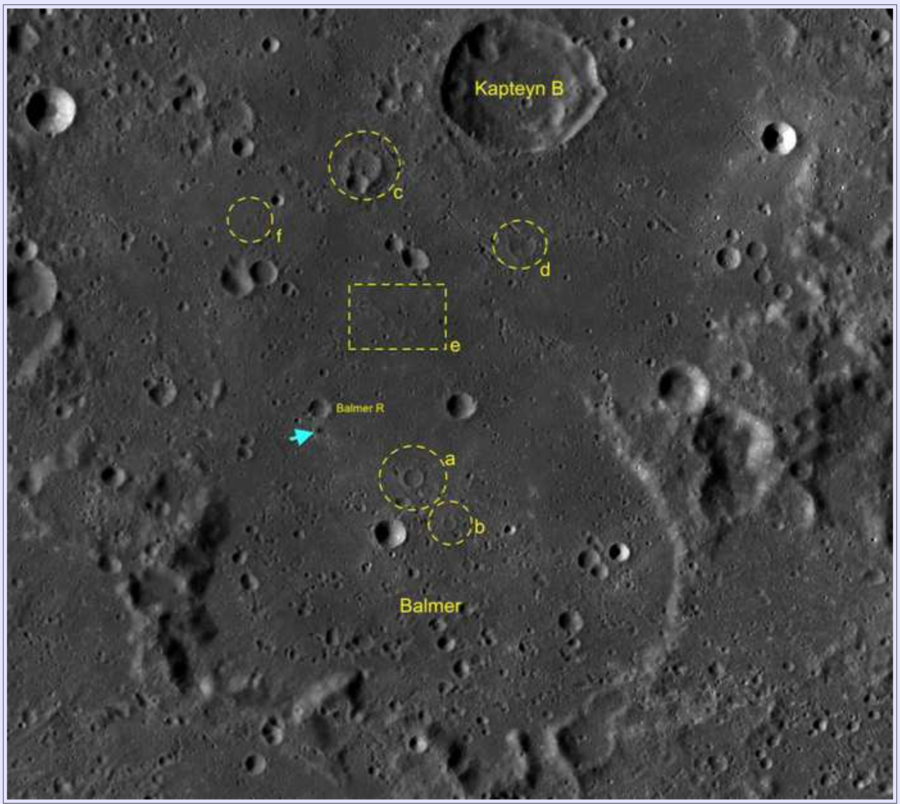

Fig.3 LRO WAC image of Balmer and the central part of the Balmer-Kapteyn Basin. The blue arrow indicates the position of a small DHC shown in Fig.4, whilst the boxed and circled features are discussed below. Note the lower albedo areas in northern Balmer and around Kaptyen B.

A glance at Fig.3 shows areas of darker, low albedo surfaces to the north of Balmer and up to and around Kaptyen B, and it has been proposed that these represent a mare *like* deposit, possibly derived from an unknown volcanic source and mixed with highland derived ejecta which is believed to dominate the surface in these ancient basins. These proposed deposits have been termed *Mare-Like Cryptomare Deposits* (MCD)[6] and have elevated FeO and TiO2 abundances compared to the surrounding area. The area occupied by these MCD's are also noticeably less heavily cratered than adjacent terrain,suggesting a younger re-surfacing and a possible hidden '*Construct-like Volcanic Feature*' has been identified which *may* have been the source of these mare like deposits[ibid]. In this context the word *hidden* implies a buried structure with no surface expression, and identified solely on the basis of remote sensing data.

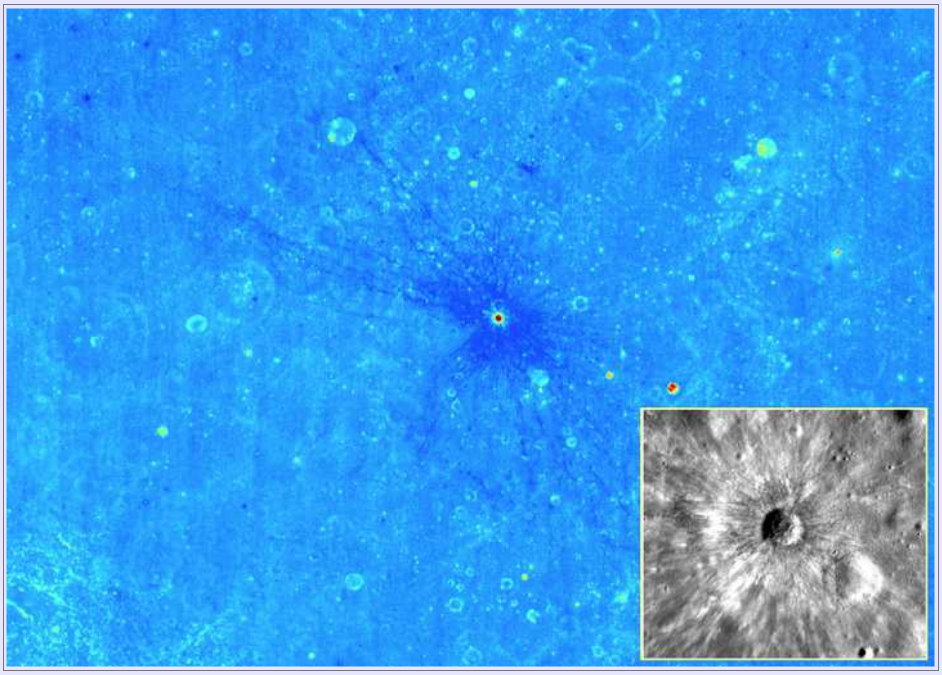

Fig.4 Regolith temperature anomaly overlay for Balmer showing the extensive cold ejecta blanket associated with the small DHC marked with the blue arrow in Fig.3.

Scanning the Balmer area using the various Quickmap overlays as well as SELENE images however reveals plenty of possible volcanic features that are far from being hidden. These take the form of shallow crater like constructs, one exhibiting dome like features within, a possible crater chain and a rather low amorphous vent like structure. Structures comparable to these can be found elsewhere on the nearside so they are not unique to this area.

In Fig.3 a number of these features are identified, and I will deal with each one in turn starting with the feature labelled 'a' and shown in LRO WAC detail in Fig.5. This is a 5km diameter crater like ring, approximately 1400m high, enclosing a floor of similar depth at its deepest point. Now, you could say that this is just another partially filled impact crater – but if you compare the topographic profile of this feature with that of a comparably sized impact crater you can immediately see that there is quite a difference between them.

Fig.6 shows two 10.5km long topographic profiles, one across a 5km crater which is identified by the letter E in Cook's drawing (Fig.1) and the other across feature 'a'. Although the vertical scale is different, you can see that the impact crater depth is much greater (~1000m) than the rim height (~250m) whilst feature 'a' has a similar rim heigh and depth, and so rather than puncturing the surface, feature 'a' sits on the surface. Feature 'a' might therefore more easily be explained as being the rim of a volcanic cone of some form as opposed to an impact crater – even an infilled one. At 5kms it is on the large side for a volcanic crater – domes are often in this size range but any associated crater is usually much smaller. There is also an absence of any obvious mineralogical signals associated with this feature, though it is located on the southern edge of the lower albedo MCD patch noted above.

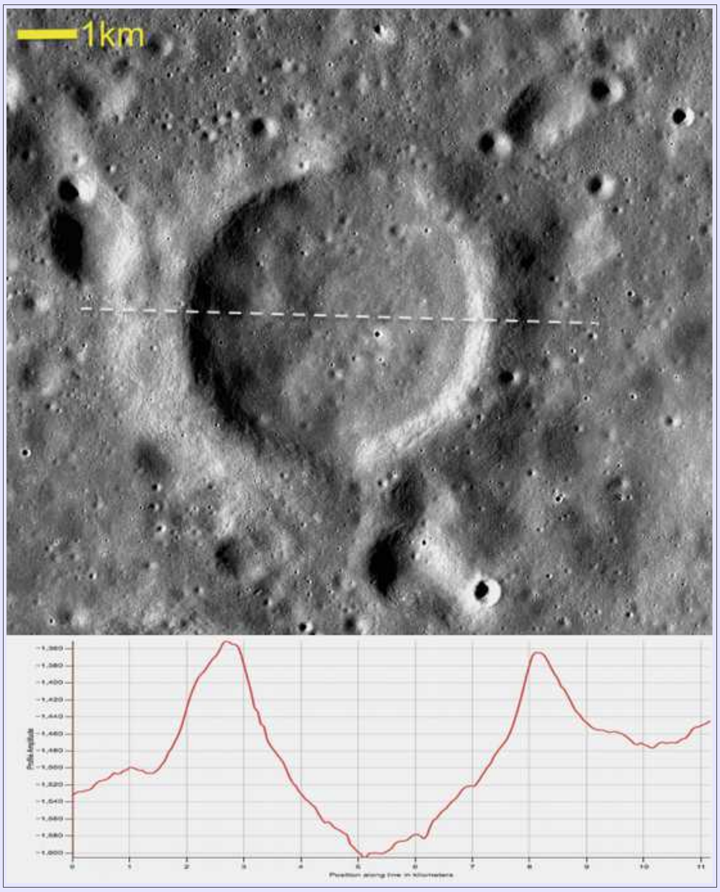

Fig.5 LRO-WAC image of feature 'a' in Fig.3. The lower panel shows a topographic profile on approximately the same linear scale taken along the white dashed line.

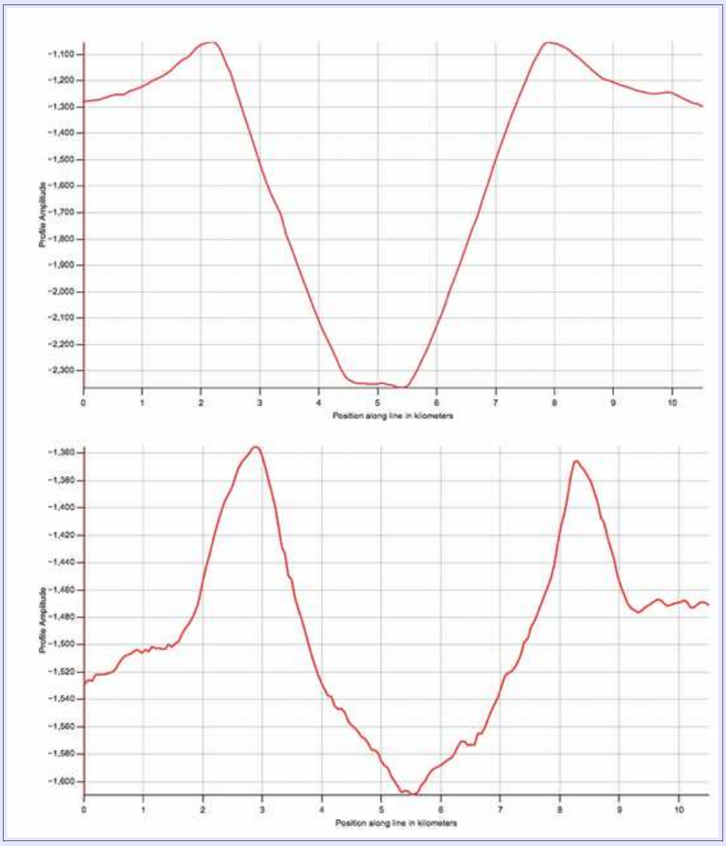

Fig.6 Two 10.5km profiles, one across a small 5km diam crater (E in Cook's drawing in Fig.1) shown in the top panel and another across feature 'a' in the lower panel. Note the conspicuously different profiles.

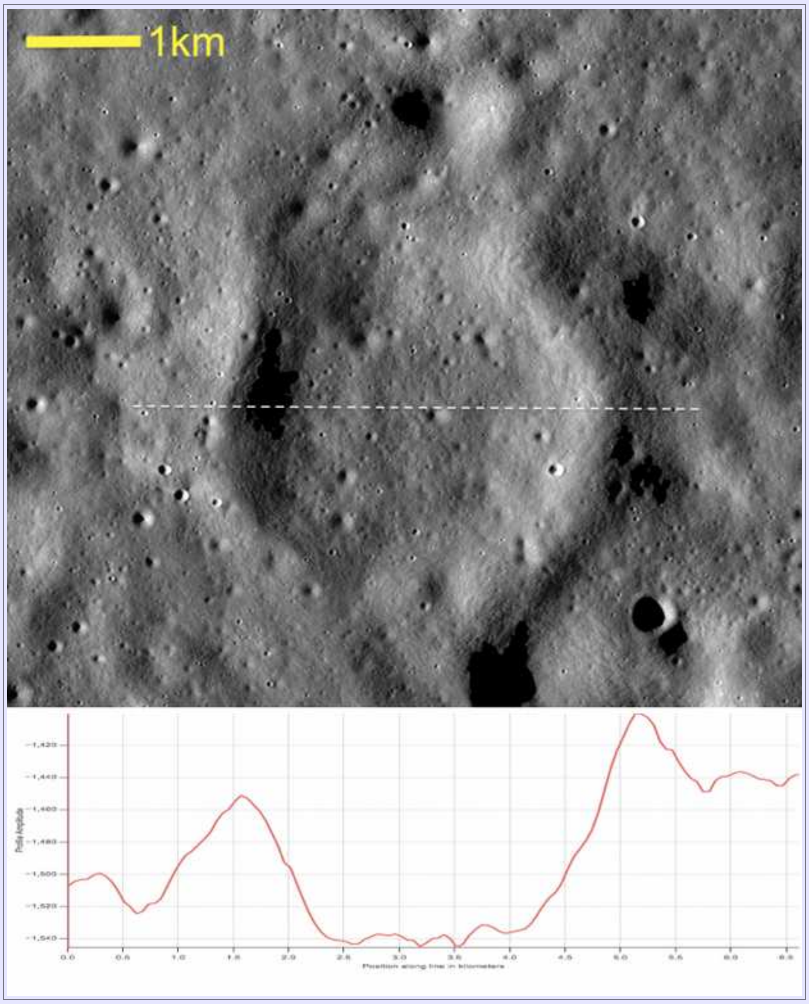

Fig.7 Feature 'b' from Fig.3 above with topographic profile along dotted white line below.

Feature 'b' (Fig.7) is located about 12kms to the SE of 'a', and appears to be a smaller version of it, with a similar topographic profile but with hardly any depth – so again sitting on rather than embedded into the surface. As with 'a' there is no conspicuous difference between the mineralogical signature of the feature and the surrounding terrain. The 'rim' is apparently breached to the north which is *suggestive* of some form of outflow, possibly lavas, but no flow fronts or other diagnostic features are visible to support this.

Feature 'c' (Fig.8) is located about 20kms to the SW of Kaptyen B, is about 9.5kms in diameter but its floor appears to be raised relative to the surrounding terrain. The height of the rim varies around the 300-400m mark and in outline is more irregular that features 'a' and 'b' and with a somewhat crenulated edge. The southern part of the structure has been removed by what appears to be a 6km diameter secondary impact crater, whilst there is a small fresh impact crater on the raised floor of 'c' that has a bright ejecta blanket with relatively elevated abundances of clinopyroxene and plagioclase and reduced iron and olivine abundance, possibly consistent with an anorthositic gabbro type of rock. This may hint at the type of rock forming the underlying geology.

Feature 'd' (Fig.9) is about 7kms in diameter and shares the same morphology as 'a', 'b' and 'c', but in addition has a small group of 3 dome like structures on its floor. The most prominent is about 60m high and 1500m in diameter, and again shows a slightly elevated abundance of clinopyroxene and plagioclase similar to the ejecta surrounding the fresh crater in 'c'. These may be small dome like structures composed of late stage viscous lavas erupted into the cone during the final phases of volcanic activity. In some ways it is similar to the dome Me3 described by Raf Lena and I in a previous JBAA article[7].

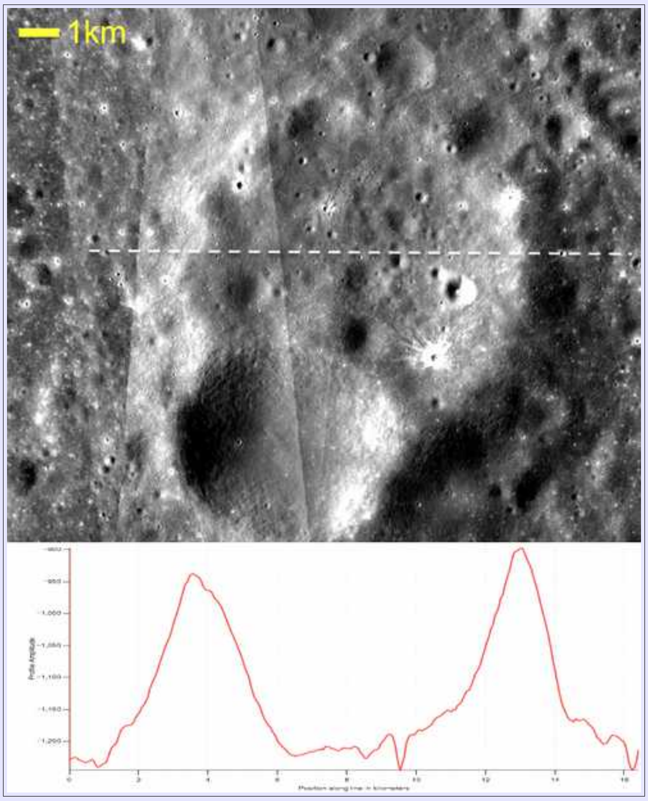

Fig.8 Feature 'c' from Fig.3 above with topographic profile along dotted white line below.

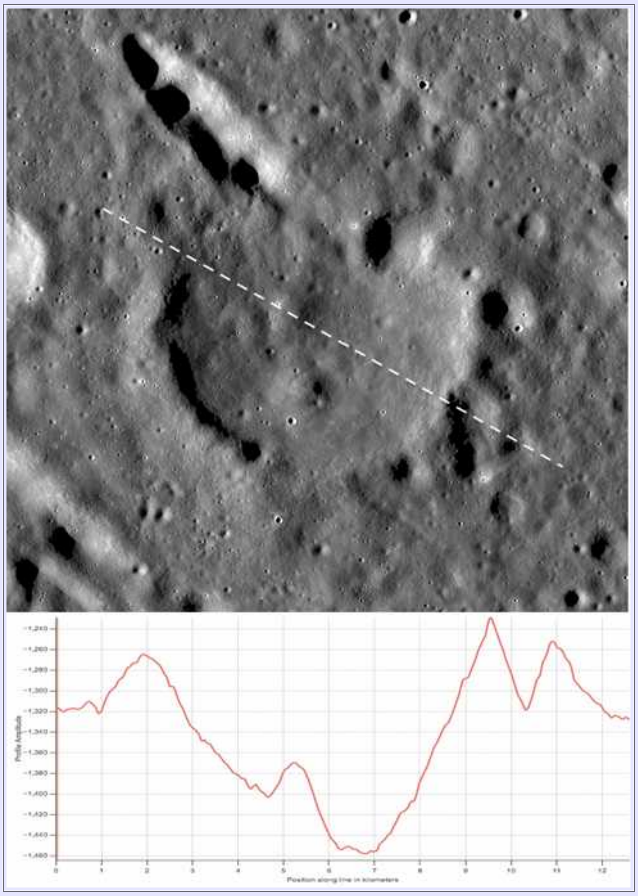

Fig.9 Feature 'd' from Fig.3 above with topographic profile along dotted white line below. Note the small dome like structures on the floor.

Feature 'e' (Fig.10) is made up of two components, the first one being a crater chain approximately 20kms long, orientated in a NW-SE direction, and consisting of 5 or 6 confluent roughly square craters. As can be seen from Fig.10, which includes a topographic profile across the northernmost crater, their morphology is similar to the structures we have examined before, with a prominent rim some 40-50m high surrounding a floor which is at or only slightly below the level of the surrounding terrain, so not an impact crater chain as even secondary craters would produce a deep depression. The southernmost crater in this chain has a distinct heart shaped outline with a couple of dome like hills and small irregular craters within it, which may indicate some form of endogenous volcanic activity during its formation.

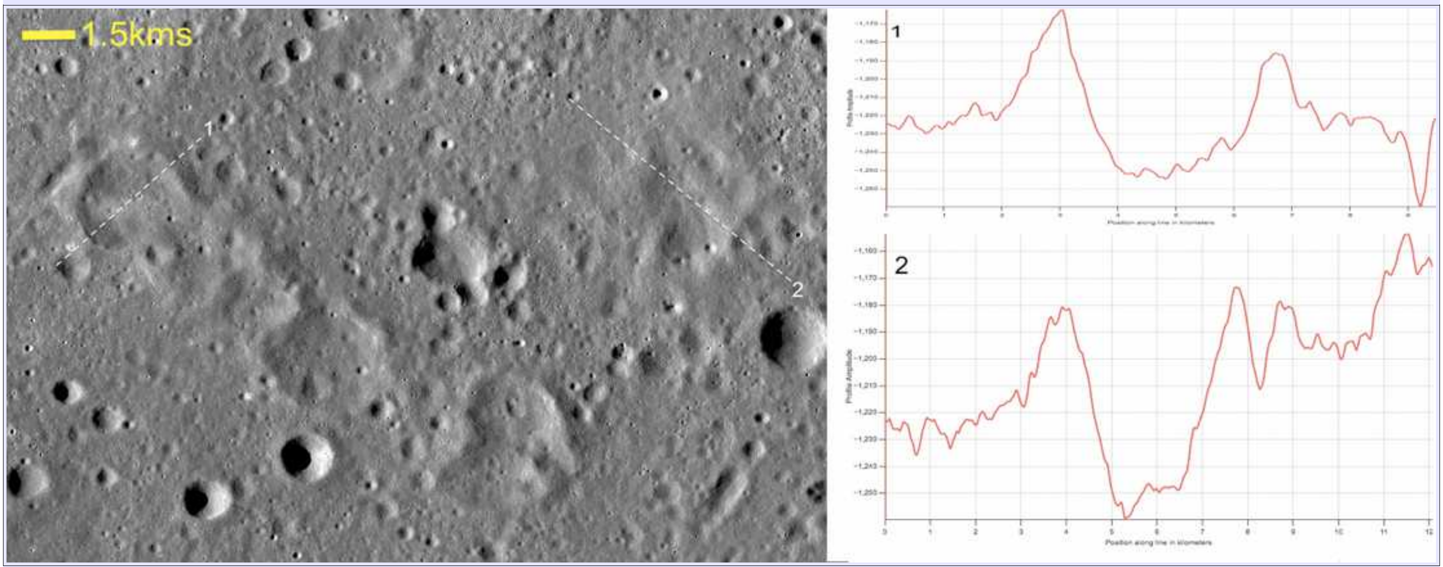

Fig.10 Feature 'e' from Fig.3 which consists of a 20km long crater chain on the left orientated in a NW-SE direction and a small amorphous mound like dome on the right. The topographic profiles on the right show a path across the crater chain (above) and the dome (below) roughly along the dotted white lines.

The second feature is an amorphous, irregular dome like structure, approximately 7kms in diameter, and again a floor level with or only slightly below the surrounding terrain. What is noticeable in the NAC imagery is that the surface of this structure exhibits far fewer superimposed impact craters than the surrounding surface which is supported by a low reading in the LOLA roughness map data. This would indicate a younger surface superimposed on an older one – so possibly another volcanic edifice (Fig.11).

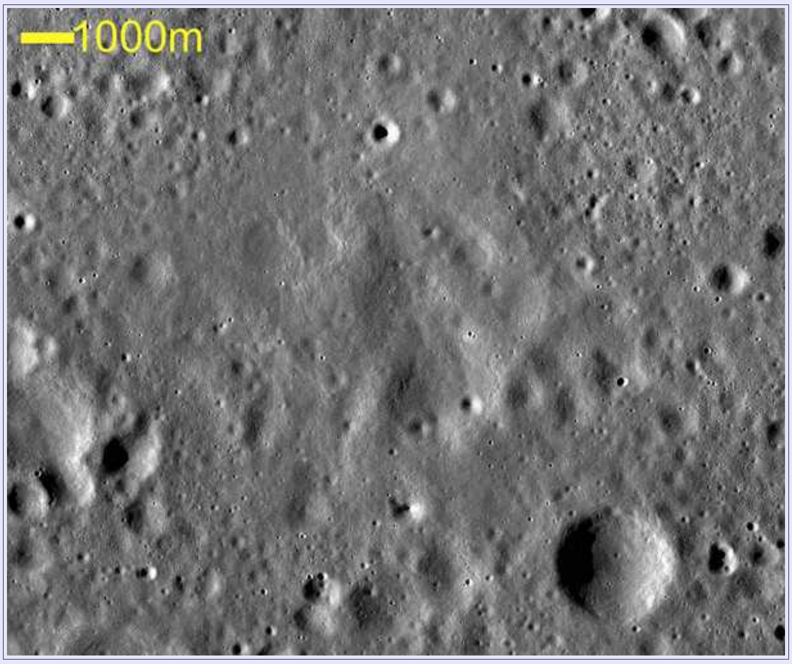

Fig.11 NAC detail of the dome like component of feature 'e' seen on the left of Fig.10. Note the absence of superimposed impact craters compared to the surrounding terrain.

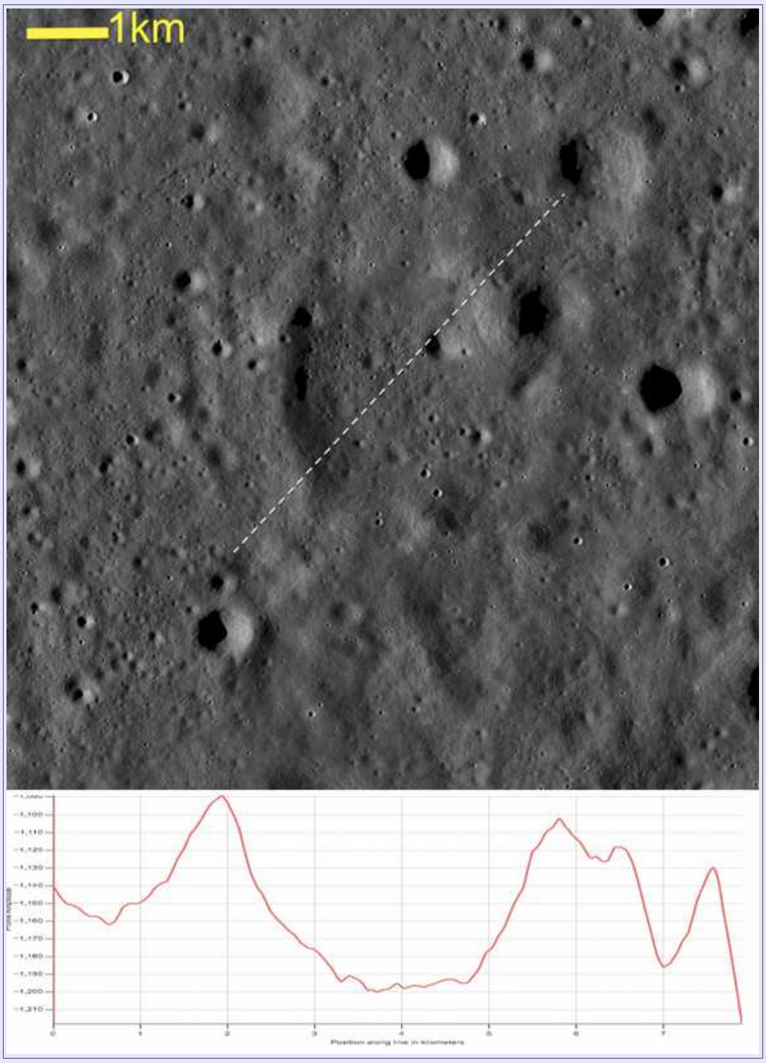

Fig.12 Feature 'f' from Fig.3 above with topographic profile along dotted white line below. Note possible rim breaches to the east and north.

Feature 'f' (Fig.12) is a smaller example of the type seen in features 'a' to 'd' and sharing the same morphology. There are possible breaches in the rim to the east and north, though part of this structure may have been obliterated by ejecta from an impact crater to the south. This feature is about 50kms to the NW of the crater chain of feature 'e' and aligned with its long axis. Could this indicate an alignment of these structures along a subsurface fracture – something for future investigation.

There are many other structures that I *suspect* to be volcanic features in the area of the Balmer-Kapteyn Basin, but I think the examples given so far are enough to give a flavour of what is likely to be a fairly substantial population of previously unrecognised edifices. I cannot resist including the example shown in Fig.13 however which is another example of the types described above, this one being located between Lamé E and Lamé L and on what is identified as part of the extensive cryptomare deposit. This example is a rather fine breached cone, with a breach in the rim to the SW which may have been the result of explosive activity *or* the eruption of lavas. Unlike the previous examples however this feature is at the centre of an area with a conspicuous FeO abundance, whilst a nearby 250m deep DHC has excavated deposits with an elevated olivine signature, indicating the presence of buried material of a possible basaltic composition.

So what does all this tell us about what is going on in Balmer and the terrain between it and Kaptyen B? The lower albedo and lesser concentration of impact craters do suggest a *younger* surface possibly consisting of some mare like deposit – and as noted above these have been recently termed '*Mare-Like Cryptomare Deposits'* (MCD) to distinguish them from ordinary mare deposits [6]. The reason the term MCD was coined was because previous research had concluded that up to 1800m of largely highland impact derived ejecta covered the area[8] and so any true mare deposits would likely be deeply buried. Remote sensing of the surface however suggested a composition that appeared to be a mixture of highland material with mare like deposits – so a somewhat hybrid composition.

The source of the mare like contribution to this sub-surface has not been identified, and the only candidate source suggested, the 'Construct-like Volcanic Feature' mentioned above appears to be sub surface. A mineralogy consistent with 'gabbro and monzogabbro enriched in high-Ca pyroxene' is exposed in the ejecta of the small DCH already mentioned and illustrated in Fig.4[4,7] and this is suggested as possibly representing the composition of the *hidden* volcanic feature and a source of the MCD's. This may be similar to the mineral observations made here regarding features 'c' and 'd'

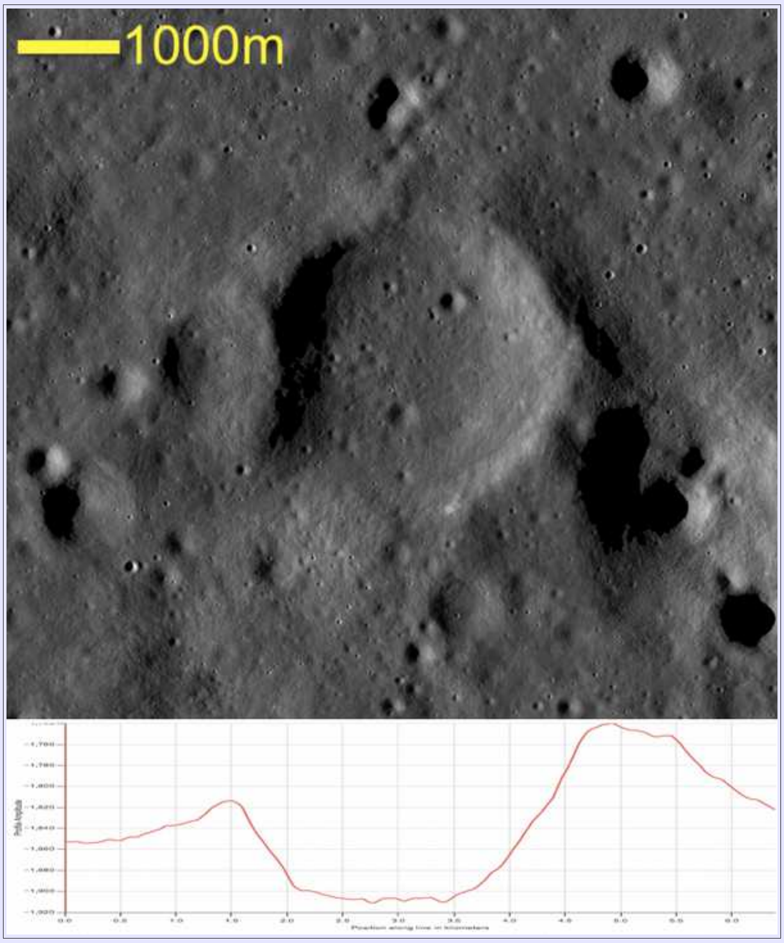

Fig.13 A nice example of a breached cone located between Lamé E and Lamé L on the Balmer-Kapteyn cryptomare deposits.

What has been identified here however appears to represent that missing element, the potential source structures of the mare like material that contributes to the unusual MCD composition. All of these features appear to represent volcanic cones or crater chains, some with breached rims suggesting outflows of lava, and many with substantial rims which indicate an eruptive phase where fragmentary material built up to form a 'cinder cone' type of structure. Some (features 'd' and 'e') have small dome like structures within them which may represent the late stage eruption of viscous lavas, whilst the dome like component of feature 'e' appears to be much younger than the surrounding terrain, indicating activity over a protracted period of time.

The visibility of these structures also shows that whilst there is a mantling of highland derived material over the area, this is insufficiently deep to have buried them completely, though it may well have obscured them to the degree that it masks any volcanic mineralogical signature. This might suggest a relative age for these structures and a time frame when they were active – but this will require a little further study, and is beyond the scope of this article which was supposed to be a short note on an old drawing.

Additional Note:

I ran these observations past Raf Lena to see if he could shed any light on the area using his expertise in examining domes and other volcanic features. He determined that the small dome like structures in feature 'd' were *possibly* volcanic cones or possibly parasitic cones, but confirmation of a volcanic origin was not possible. A compositions consistent with a mare/highland composition was found but there was an absence of any clear indication of volcanism or pyroclastic activity.

Indeed there was no trace in the spectral data to suggest any volcanism or pyroclastic activity in the area, but a mare composition was detected in the small crater near Balmer R, which is consistent with previous work, and with the hypothesis that this crater has excavated mare like material from beneath the surface. So, rather disappointing overall – but not unexpected.

Raf's examination seems to confirm the view that there is little evidence on the surface within the Blamer area for volcanic activity. This seems at odd's with the presence of the structures described above and identified as volcanic, and obviously some form of explanation is required. The identification of a type of mare/highland composition within the area, which was confirmed by Raf's analysis indicates the presence of a mare type component and this must have come from somewhere. If the features described above are volcanic and a possible source for this mare material, then their mare composition seems to be well masked, possibly by a blanketing of basin derived ejecta which is believed to dominate these light plains surface deposits. An alternative is that these features have been mis-identified as volcanic and are in fact ordinary impact craters and crater chains, but I think there is enough evidence presented above to support the volcanic structure identification. Clearly some more more work is required!

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7 Lena.R and Fitz-Gerald. B. (2020) Lunar domes & volcanic constructs in Mare Fecunditatis. Journal of the British Astronomical Association, vol.130, no.4, p.219-227

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Lunar Geological Change Detection Programme

TLP Reports: No TLP or impact flash reports were received for Aug other than what was mentioned last month for three candidate impact flashes.

Routine reports received for August included: Alberto Anunziato (Argentina – SLA) observed: Plato, Ross D and Theophilus. Francisco Alsina Cardinalli (Argentina – SLA) imaged: Aristarchus and Mare Serenitatis. Maurice Collins (New Zealand - ALPO/BAA/RASNZ) imaged: Aristarchus, Clavius, Copernicus, Mare Imbrium, Mons Rumker, Plato, Rupes recta, Vallis Alpes, and several features. Walter Elias (Argentina – AEA) imaged: Aristarchus. Bill Leatherbarrow (Sheffield, UK – BAA) imaged Clavius and Ptolemaeus. Eugenio Polito (Italy - UAI) imaged Aristarchus. Anthony Cook (Newtown & Mundesley, UK – ALPO/BAA) imaged/videoed: several features & earthshine in the Short-Wave IR and in visible light. Ivan Walton (Cranbrook, UK - BAA) imaged: several features.

Analysis of Reports Received (August):

Aristarchus/Copernicus/Kepler: On 2023 Aug 02 Walter Elias (AEA) imaged this crater under similar illumination and topocentric libration to the following report:

On 1963 Nov 01 at UT 00:20-00:35 Kopal and Rackham (Pic du Midi, France, 24" reflector) observed in Kepler an enhancement in red light at 672.5nm and 545.0nm. Luminescence ~86% +/-3% of background. According to the Cameron catalog, Moore (12" reflector, UK) noted something unusual between 22:30 and 03:00 but this might apply to Kepler, Copernicus, and/or Aristarchus and that was seen 23:30-03:00? - the catalog is not very clear. The Cameron 1978 catalog ID=779 and weight=5. The ALPO/BAA weight=5.

This 1963 TLP is especially interesting as it is a weight 5 report (highly reliable), which is either confirmed by 2 independent observers, or there are some unequivocal scientific measurements that confirm the reality of the report. In this case we have two professional astronomers, using a 24-inch aperture scope at one of the world's best observatories for planetary observation, showing a significant 86% difference between images taken in yellow-green, and red light, around Kepler and to its north. See Fig 1 (Bottom Left) and compare it to (Bottom Right). Even allowing for the fact that the exposures and contrast were different, the left-hand side of the red filter image is a lot brighter in the vicinity of Kepler, and the effect is over a large area. The effect was first noted in red/green pairs taken at 22:35 and 22:42 UT, and then the effect faded, and then it returned at 00:20 to 00:35UT. Comparison images, in the same two filters, made in between these times, and on another night, failed to show this significant change in colour. In their Sky and Telescope paper of March 1964, Kopal and Rackham, speculated that radiation particles, from two small flares that occurred on the Sun, some 8.5 hours earlier perhaps instigated some large-scale luminescence on the lunar surface, covering an estimated 60 thousand square km. However, we now know, with hindsight, that luminescence from protons does not have this kind of effect on the Moon, as lunar soils returned by Apollo have been bombarded by radiation in the laboratory and do not luminesce by such amounts.

The effect is certainly not due to natural surface colour on the Moon. For a start Fig 1 (top right) does not show any significant red around Kepler and to the north, and secondly the TLP report from 1963 had variability, which natural surface colour does not exhibit in this kind of short time scale.

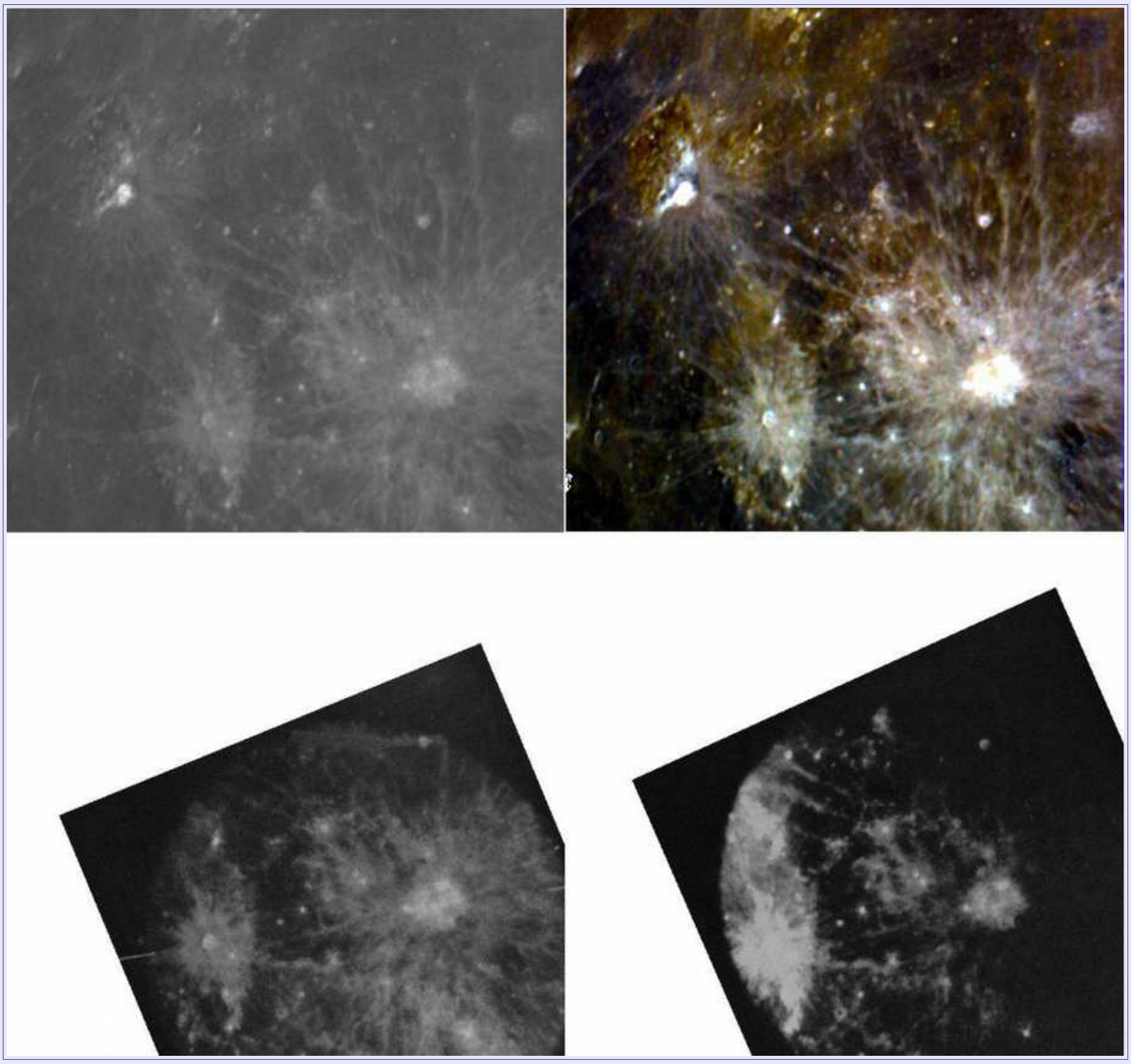

Figure 1. Aristarchus, Kepler, Copernicus area, orientated with north towards the top. **(Top Left)** A non-enhanced image by Walter Elias (AEA) taken on 2023 Aug 02 UT 01:23. **(Top Right)** A processed version of the image, in the top left, which has been colour normalized and then had its colour saturation increased. **(Bottom Left)** A yellow-green band (545nm, FWHM=9.5nm) photographic image (0.5 sec exposure) taken on 1963 Nov 02 UT 00:35 from Pic du Midi observatory by Manchester University observers: Zdenek Kopal and Thomas Rackham. **(Bottom Left)** A red band (672.5nm, FWHM=4.5) photographic image (5 sec exposure) taken on 1963 Nov 02 UT 00:20 from Pic du Midi observatory by Manchester University observers: Zdenek Kopal and Thomas Rackham.

So let us compare Walter's image with each filter image from 1963, and see if we can learn something. Firstly, the green 1963 image (Fig 2 – left) does not appear much different to Walter's image (Fig 2 – Right). So, this tells us that in green light, back in 1963, everything looked perfectly normal, as you can hardly tell any difference between the two images.

However, when we switch to red light (Fig 3 - Left), and compare to Walter's image (Fig 3 – Right), everything changes. It was quite difficult to decide what part of the Moon to match the contrast on, so I picked Kepler crater. What is odd is how much darker Copernicus is – or rather Copernicus is normal and Kepler is brighter. All the surface texture, and detail around Kepler is largely the same in both red light and visible light. However, look to the north of Kepler, and you will find a bright elongated rays around Bessarion crater, just to the NW of this, is a bright area (going up to the circular edge of the Pic du Midi scope field of view) that is not visible on Walter's visible light image.

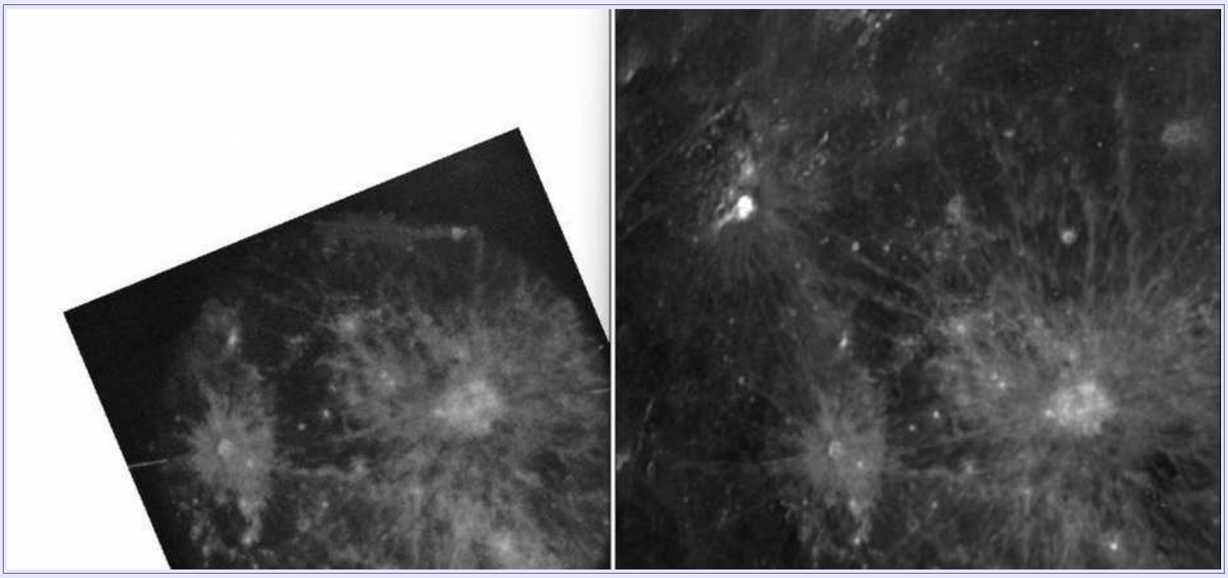

Figure 2. Aristarchus, Kepler and Copernicus region with north towards the top. **(Left)** A green band image from 1963 Nov 02. **(Right)** Walter's image, contrast stretched to approximate to the contrast in the Pic du Midi image.

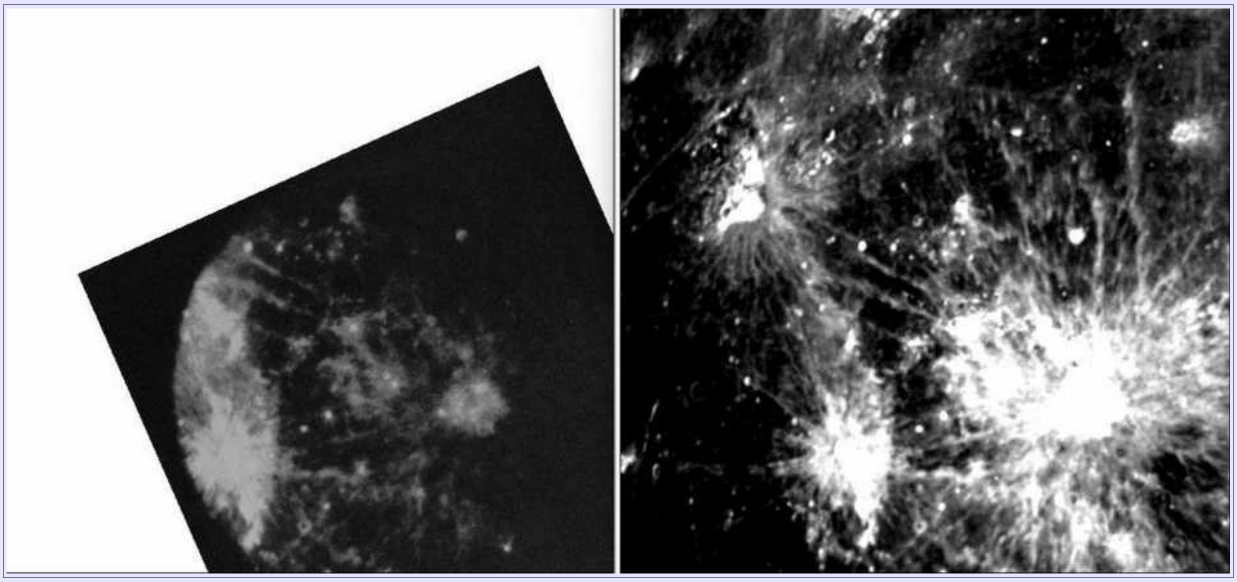

Figure 3. Aristarchus, Kepler and Copernicus region with north towards the top. **(Left)** A red band image from 1963 Nov 02. **(Right)** Walter's image, contrast stretched to approximate to the contrast in the Pic du Midi image, in the vicinity of Kepler crater.

So, what might be causing these very large areal brightness anomalies? The luminescence idea proposed by the Manchester University astronomers is not tenable for lunar soil. One more mundane possibility could be that by the time the red filter images were taken, something like condensation or frost may have formed on the filter optical surface, darkening the area around Copernicus, temporarily, or maybe some undetected (by the observers) cloud was passing across the Moon. Either way the effect would have to vanish during the calibration images (when nothing was seen) and come back again for the later images – this may not be very likely.

One other point, Patrick Moore said that he had confirmed a TLP in the area, however the Cameron report is a bit sketchy as to which crater, he was referring to, and alas I don't have access to the Patrick Moore log book for that night – maybe it's in the Science Museum archives in London?

I will lower the weight of this report from 5 to 4, as the red filter image is not what I would expect from even a large area TLP.

One other thing to note is how bright Aristarchus appears in Walter's image (Fig 1 – Top Left) in comparison to Kepler and Copernicus. However, what is missing was how bright it was compared to other bright craters such as Tycho, Hell, Proclus, Censorinus etc., as these are out of the field of view. This has been a common problem with accounts of when observers say that Aristarchus is "very bright", without ever comparing it to other bright areas on the Moon.

Aristarchus: On 2023 Aug 03 UT 21:40-22:20 Eugenio Polito (UAI) imaged this crater under similar illumination that spanned some of the following three reports:

Aristarchus 1964 Oct 23 UT 02:35-02:45 Observed by Bartlett (Baltimore, MD, USA, 3" refractor, 133 & 200x, S=3-5, T=4) "South floor region granulated, 6 deg bright with very faint trace of pale yellow color; rest of crater 8 deg bright." NASA catalog weight=4, NASA catalog ID #859. ALPO/BAA weight=2.

Aristarchus 1983 Oct 23 UT 19:00-01:30 Observer: Foley (Kent, UK, 12" reflector, seeing=II) noticed at 19:00UT an extended bright spot on E wall and extending beyond. This was brighter than other areas of the crater. There was also occasional star-like glistening. Foley comments that the inside of Aristarchus was slightly obscured. The TLP started fading from UT20:30 and finished by 01:30UT. six out of nine independent observers confirmed the effects seen. In total 14 observers observed, 9 reported back and 6 found abnormalities in Aristarchus though all encountered variable seeing conditions - some had spurious colour. Cameron comments that this was one of the best recorded/confirmed TLP events. All CED brightness measurements obtained were very high. Moore, Nicolson and Clarke (5" refractor and 15" reflector, 230-350xseeing III) found the crater to be very bright at 19:11UT through a 5" refractor and there was a blob on the east rim (Bartlet's EWBS?) at 19:14UT. Nicolson also saw a very bright star-like area on the eastern wall but this was not defined as it usually is. The crater was also very bright at 22:43UT using the 15" reflector available to these observers. At 01:07UT they used a Moon blink and discovered that the bright region was bright in blue light and less bright in red - although this was not a detectable blink when switching rapidly between filters. They found that the crater had returned to normal by 01:15UT. M.C. Cook (Frimley, UK, seeing III-IV) observed a large diffuse spot on the east of the crater that was brighter in blue than in red light and the CED device gave a high reading. J.D. Cook (Frimley, UK, seeing III-IV) made a sketch that showed the bright spot extended on the east wall - again the CED reading was high and a lot of detail was visible on the floor. A.C. Cook(Frimley, UK, seeing III-IV) also noted remarkable detail and the bright (as confirmed by CED) blob on the eastern rim. G. North (Sussex, UK, seeing III-II) also confirmed the bright blob on the eastern wall. Wooller found the north west wall was a dirty yellow colour - though no colour was seen elsewhere in or outside the crater. Mosely found the crater to be bright and his sketch revealed the extension of the bright blob on the eastern rim and again a great deal of interior detail. Amery (Reading, UK, seeing III) found Aristarchus to be "a brilliant *splash against dulled background in violet filter, especially polarizing filter. CED + polarizer readings high, but not as high as previous night". Mobberley (Suffolk, UK, seeing III-IV) remarked that "spurious colour a total mess around Aristarchus & nothing abnormal seen". A photograph was taken at 20:50UT reveals the bright blob and entire detail. Peters (Kent, UK, seeing III-II) observed Aristarchus with a UV screen from 20:15-21:23UT and commented that although being very bright, there was no variation between white and UV. It was checked with a Moon Blink device and the radial bands were clearly seen in white light, < in blue. The Cameron 2008 catalog ID=233 and the weight=5. The ALPO/BAA weight=4.*

On 2002 Sep 23 at UT22:45-23:56 C. Brook (Plymouth, UK) noticed that the bands inside Aristarchus varied (UT22:45-22:56) in definition whilst the rim of Herodotus and the rays of Kepler and Copernicus remained sharp. These bouts of variation were 1-2min in duration. At 23:56UT when he checked again the periodic blurring's of the bands were still present. The observer suspected atmospheric effects. M.Cook (Frimley, UK) observed 22:00-22:30 and could see only 2 bands on the west wall - but this may have been because of poor transparency. The ALPO/BAA weight=1.

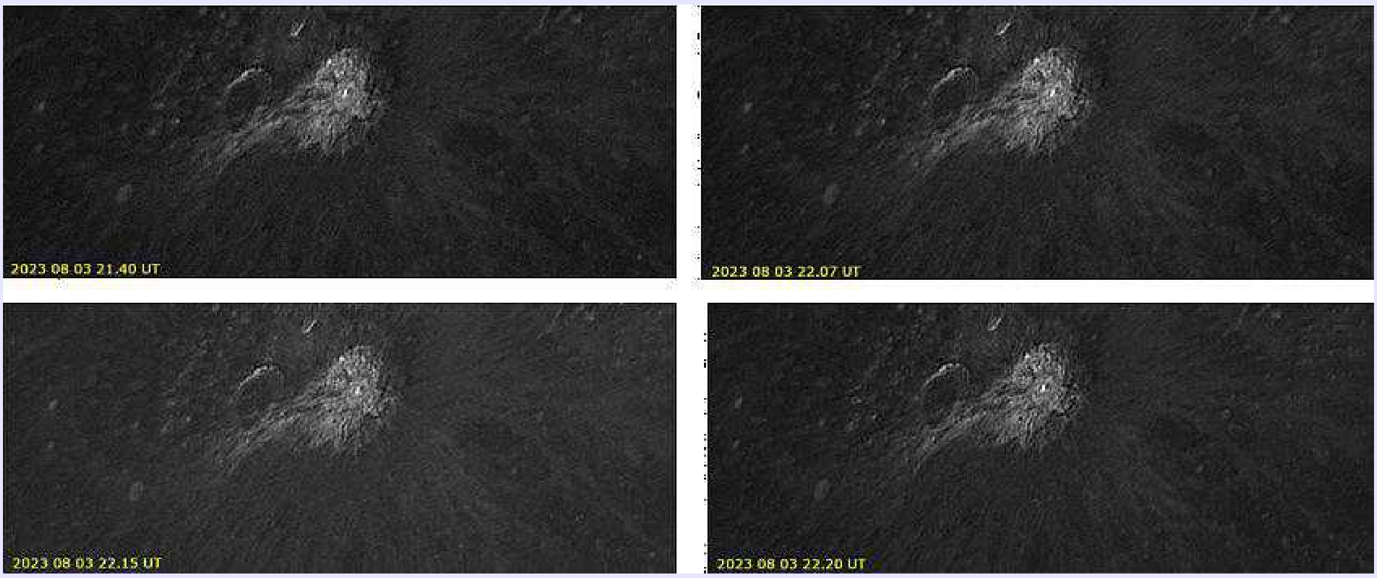

Figure 4. Aristarchus as imaged in monochrome by Eugenio Polito (UAI) on 2023 Aug 03 and orientated with north towards the top. UTs are given in the images. Note that for some of the past TLP reports above, different sets of images may fall within the repeat illumination criteria of ±0.5˚ for those reports.

For the 1964 TLP report, the south floor does not look especially granulated (See Fig 4) compared to other parts of the floor - just a lot of detail. It is doubtful if Bartlett could have seen such detail through his 3" refractor. We shall leave the weight at 2 for now as colour was also involved. We have covered this report before in the 2019 Jan newsletter.

For the 1983 report there is an extension coming off the east wall over the rim into the mare (See Fig 4), but it is simply not the brightest spot on the crater. The honour of the brightest spot goes to the central peak, or maybe a bright spot just inside the NW rim. Certainly, there is no sign of the star-like point on the eastern rim as reported by Nicolson. I did find a sketch made by myself and this can be seen in Fig 5., which looks more like the images that Eugenio took, than what was earlier described by Foley, however according to Foley the TLP had started fading by that stage. I think we shall leave the weight at 4 for now, but we have one of the most detailed images yet of what the crater should have looked like if it had been normal during that event in 1983. We have covered this report before in the 2019 Jan newsletter.

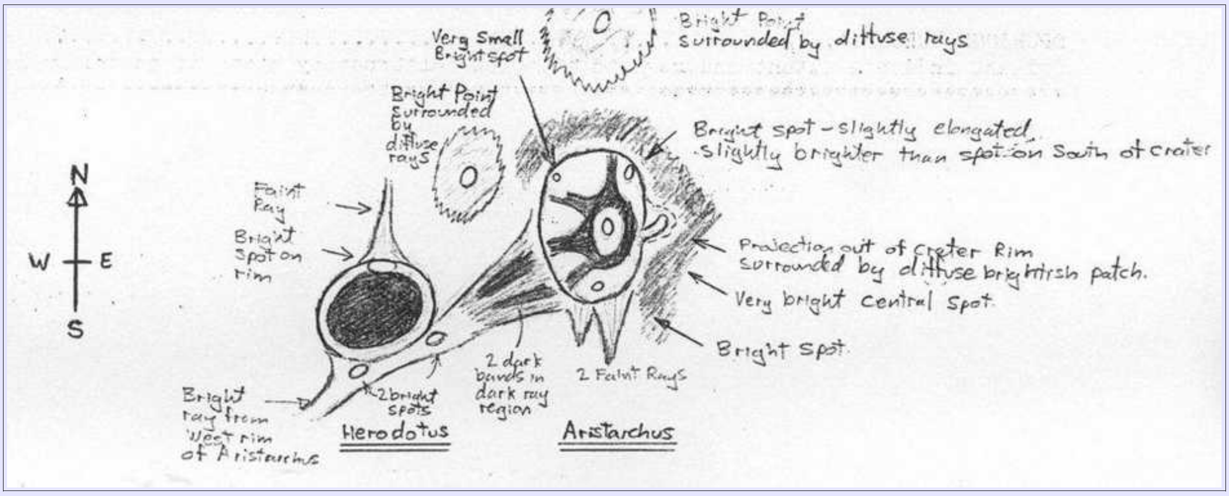

Figure 5. A sketch of Aristarchus made by Tony Cook (BAA) on 1983 Oct 23 UT 20:35-20:50 and 21:34-21:55. A 6” Newtonian was used at x144.

For the 2002 TLP, looking at the images in Fig 4, there appears to be no variation in the bands, which might infer the seeing conditions, at the time of the TLP, were to blame. We shall leave the weight at 1 for now. We have covered this report before in the 2019 Jan newsletter.

Plato: On 2023 Aug 05 UT 04:50-05:02 Alberto Anunziato (SLA) observed this crater under similar illumination to the following report:

Plato 1886 Nov 14 UT 1:45 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=3.

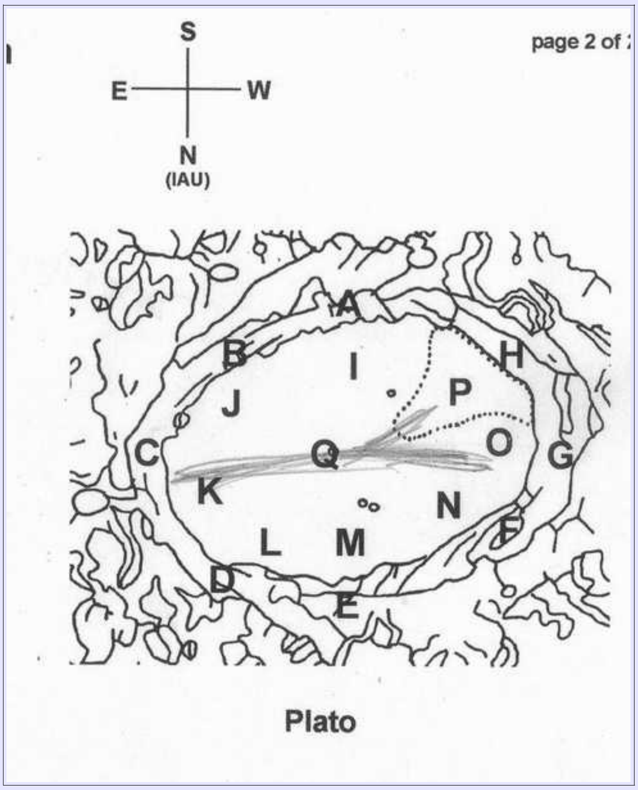

Figure 6. A prepared sketch of Pato showing the location of a W-E trending suspected ray, made by 2023 Aug 05 UT 04:50-05:02 by Alberto Anunziato (SLA). Orientation of sketch as depicted by arrows.

Alberto commented that Plato looked normal, but no bright N-S band seen, only a glimpse of a ray W-E (See Fig 6). We shall leave the weight of the original report at 3.

Briggs: On 2023 Aug 29 UT 07:46 Maurice Collins (ALPO/BAA/RASNZ) imaged this area as part of a larger region just 6 min after the similar illumination window to the following report:

On 2010 Apr 27 at UT 00:10-00:30 and 01:45-02:00 P. Grego (St Dennis, UK, 20 and 30cm reflectors) noticed a craterlet just to the east of Briggs and an E-W trending lineament or wrinkle ridge that did not show on NASA LAC charts. Further checks did not reveal it on Lunar Orbiter mosaics, or on very recent LROC images of the area. Possibly these are very low relief features that show only under very shallow illumination conditions. The ALPO/BAA weight=1 until we get confirmation at repeat illumination.

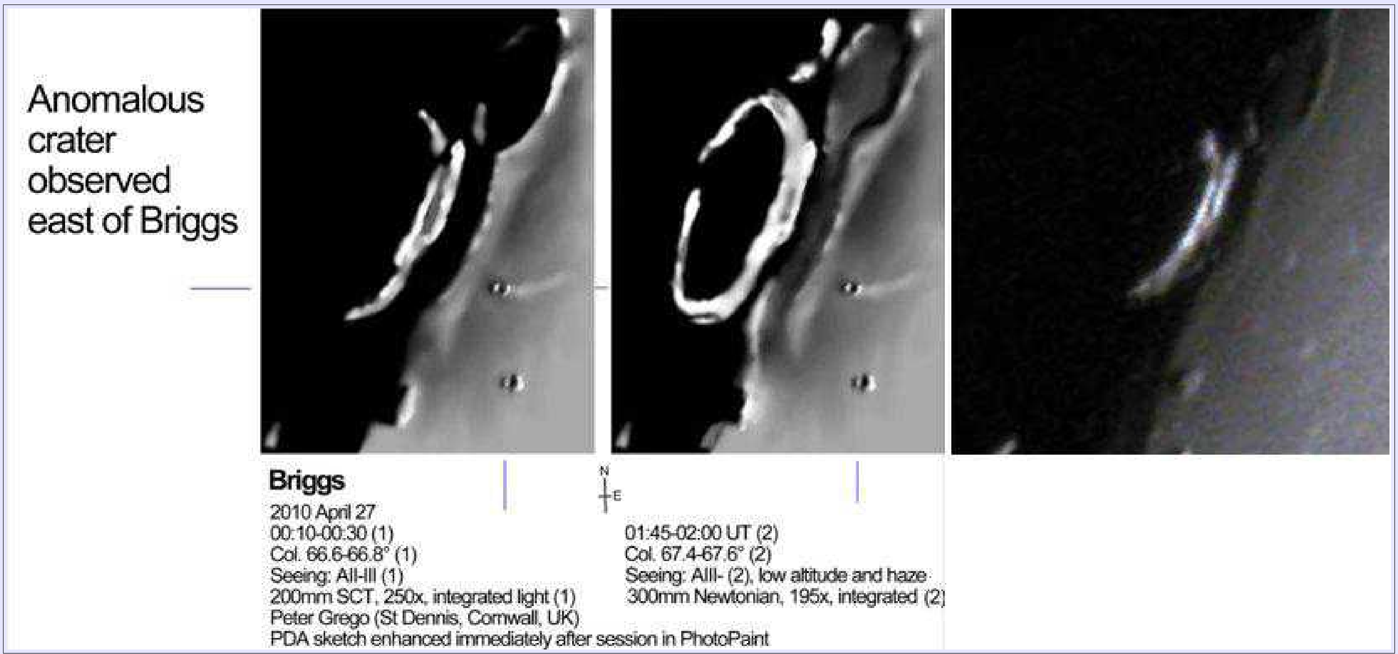

Figure 7. Briggs, orientated with north towards the top. **(Left & Centre)** Sketches by Peter Grego (BAA/SPA) with information about the observations adjacent to the sketches. **(Right)** An image by Maurice Collins, taken on 2023 Aug 29 UT 07:46.

Fig 7 (Right) shows how accurate Peter Grego's sketches (Fig 7 Left & Centre) were, and in Maurice's image, you can see a couple of mounds to the E and SE of Briggs that correspond to the craterlets that Peter drew. The repeat illumination prediction description needs updating as I have checked the LROC Quickmap web site, and in the shaded relief tool I can certainly see craterlets here. What I cannot see though so is the curved W-E ray or ridge coming off the northern most of those two craterlets. For this reason we shall leave the weight at 1, but I will update the description accordingly. We have covered repeat illumination observations of this crater before in the 2013 Mar and 2016 Feb newsletters.

Aristarchus: On 2023 Aug 30 UT 00:39 Francisco Alsina Cardinalli (SLA) imaged this crater under similar illumination conditions to the following four past TLP reports:

Aristarchus-Herodotus 1964 Sep 20 UT 04:15-04:50 - Observers: Crowe & Cross (Whittier, CA, USA, 19" reflector x390) "Several red spots in area between the 2 craters. No change in phenom. so stopped observing" NASA catalog weight=5 (very good). NASA catalog ID #849.

On 1965 Sep 09 at UT 13:20 Presson observed an orange-red strip on the floor of Aristarchus. Cameron says that this was confirmed later by Bartlett? The Cameron 1978 catalog ID=892 and weight=2. The ALPO/BAA weight=2.

On 1979 Oct 04 at UT21:05-23:40 P.W. Foley (Kent, UK, 12" reflector, x360, seeing=II) detected colour in Aristarchus (and also in Bullialdus - there was a TLP alert at this time for Bullialdus) but nowhere else on the Moon. Aristarchus had a CED brightness value of 3.8 at 21:05 (though at this time no colour) and 3.4 at 23:40 and the floor was now slate blue/gray in colour. Other features remained constant in brightness. The Cameron 2006 catalog ID=72 and the weight=0. The ALPO/BAA weight=1.

Aristarchus 1959 Jan 23 UT 06:20 - Observer: Alter (Mt Wilson, CA, 60" reflector x700) "Brilliant blue in interior later turning white. Photos obtained. (MBMW has this entry twice for diff. dates because source gave UT date as 23rd.)" NASA catalog weight=5. NASA catalog ID = #712. ALPO/BAA weight=4.

Figure 8. Aristarchus as imaged by Alsina Cardinalli (Argentina – SLA) on 2023 Aug 30 UT 00:39 in monochrome and orientated with north towards the top.

Although Alsina's image (Fig 8) is in monochrome, it does provide a useful context image of what the crater would have appeared like to the observers concerned, if its appearance was normal. We have covered the 1959 report in the 2015 Feb, 2018 Jan & Feb, and 2019 Jan newsletters. The 1964 report was covered before in the 2019 Jan newsletter, the 1965 and 1979 reports in the 2015 Feb newsletter.

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 September circular should reach the Director or Editor by the 25th October 2023 at the addresses show below – Thanks!

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