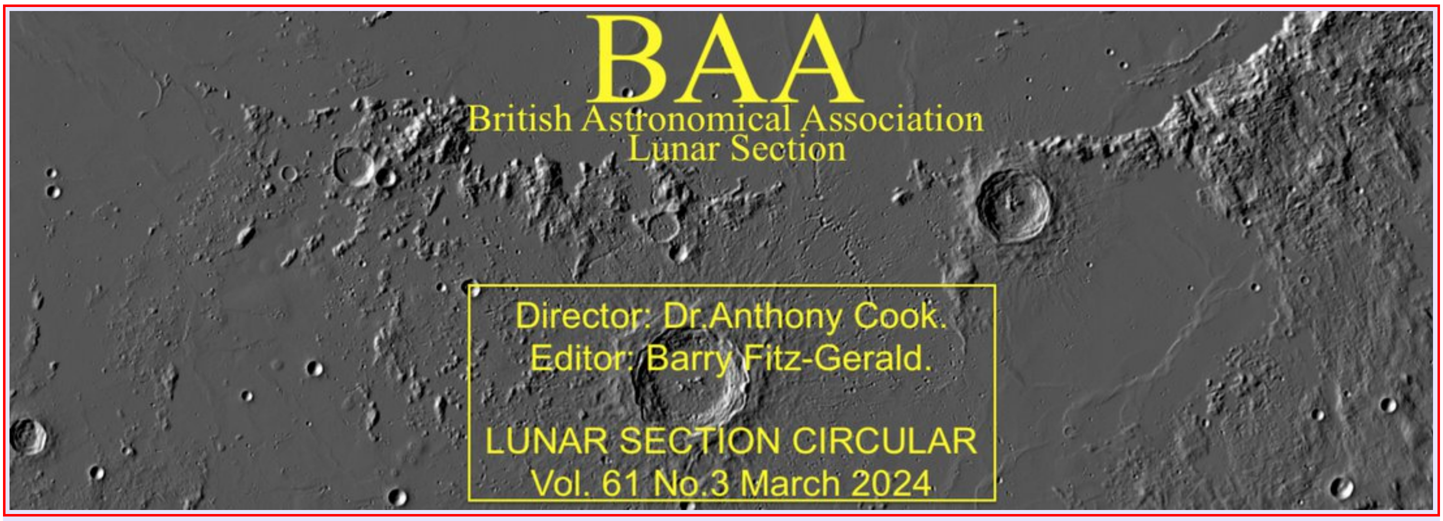


FROM THE DIRECTOR.

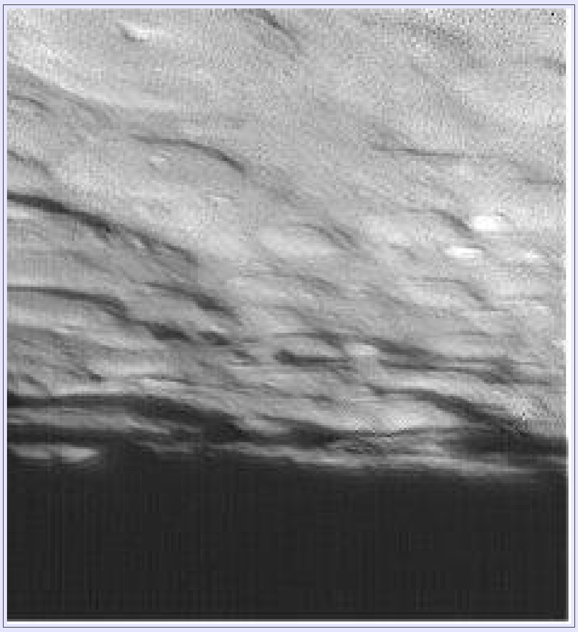


Figure 1. The landing site of the first private company spacecraft, IM-1, near to Malapert A, captured to the nearest minute of the published landing time of 22 Feb 2024 UT 23:23 UT in the short wave IR. Seeing conditions were very poor.

I have often wondered what it would have been like to have been observing the Moon at the time of the Apollo landings. Obviously one would not be able to see anything of the lunar module at a quarter of a million miles away, but having a view of what the Moon's surface would have looked like at those precise points in time would be an ever-lasting memory.

Roll onto 2024 and we now have a renewed interest in the Moon, leading up to manned returned of the Artemis missions. As a test I decided I would try to image the south pole area of the Moon at the precise moment that the IM-1 probe was landing on 2024 Feb 22. All was not well, it was partly cloudy, the seeing was terrible, and winds were hammering the sides of the 16 inch Dobsonian. I was using a short-wave infrared camera with a filter waveband covering 1.5-1.7 microns. The idea behind using this waveband was that the rocket engine, or heated ground, might glow hot in this waveband and stand out against the nearly Full Moon which was several times less bright at these wavelengths than in visible light. Alas nothing was seen to suggest this was possible, from the video, but it was worth a go. At the bare minimum, I at least obtained a rather rough looking view of the Moon's south pole area around Malapert A.

This circular is a bit shorter than normal because I have to suddenly be away and have not had time to send Barry some of the images that many of you sent me – sorry about this but we shall catch up next month.

Tony Cook.

<u>Lunar Occultations March 2024 by Tim Haymes</u>

Time capsule: 50 year ago: in Vol 9 No.1
[With thanks to *Stuart Morris* for the LSC archives.]

* Geoff Amery (Reading) is appointed Occultation Co-ordinator
* Saturn Occultation on March 2nd Observations requested.
* D Jewitt: The frequency of TLP. Observational bias and more.

Reports:

<u>Pleiades Challenge on Feb 16/17</u>

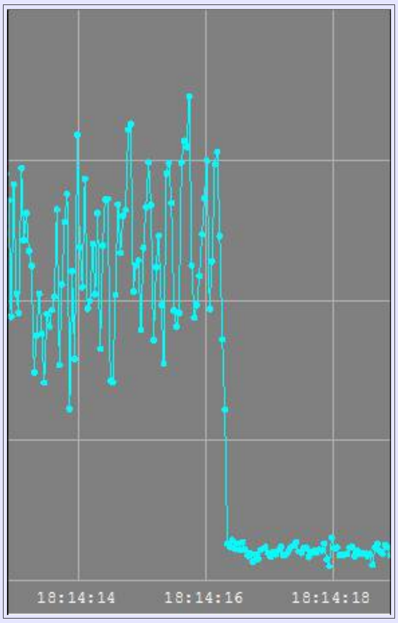
Last month I challenged observers to count which stars could be observed by eye or camera though their telescopes, or to sketch the Moon during its encounter with parts of Pleiades cluster. Many observers including the writer were effected by cloud. There are two successful reports:

Mazin Younis obtained an image of the Moon passing through the Pleiades on Feb 17 at 0243UT. Here is his very nice image with 20cm F/4: https://britastro.org/observations/observation.php?id=20240217_024332_dfe2d8b1d0ade687

Ivan Walton reports timing two occultations during the Pleiades passage, despite heavy cloud and wind, using the 22.5" at Cranbrook and District Science and Astronomical Society (CADSAS). He used a ZWO ASI174mm camera was with NTP timing. Good residuals (O-C) were obtained for SAO 76156 and SAO 76168.

<u>Chi Aqr on the 11th</u>

Tim Haymes observed chi Aquarii being occulted (DD) at the crescent phase on Feb 11th. He used a 300mm F5.6 lens and WAT-910HX video camera. On-frames time was supplied by GPSBOXSPRITE text overlay, and the video digitised for recording with laptop. Exposure was 1/25th sec.
"*The altitude was too low for the telescope, so I mounted the lens on a tripod and allowed the moon to drift through. Chi disappeared over a 2 frames duration. A nice event*."



This Month.

On the 18/19th the Moon passes through some dense star fields in Gemini. Look for fainter stars that may be followed in larger instruments.

Lambda Cancri is occulted on the evening of the 19th at about 2355 UT with the Moon in the South. This is the best event of the month.

Sigma Leo is occulted on the 23rd. The cusp angle of 24S is a little misleading, as the “cusp” at the near-full illumination is notional. It will look like a close graze on the bright side. It will be interesting to watch as the star is swallowed by the glare of the Moon. Will the disappearance be observable?

Occultation predictions for 2024 March (Times at other locations will +/- a few minutes)
Oxford: E. Longitude -001 18 47, Latitude 51 55 40
To magnitude ca v8

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day       Time      Ph    Star   Sp  Mag  Mag    % Elon Sun  Moon    CA
yy mmm  d  h  m   s        No  D*    v    r   ill      Alt Alt Az   o   Notes

24 Mar  8 10 53 30.2 r    3164SB3  4.5  4.6v   6-  28  31 19 184  38N
   R3164 = epsilon Capricorni
24 Mar 12 19 21 59.9 D     232 K0  8.1  7.4    8+  33     17 266  87N
24 Mar 12 20 24 51   m   92538 A0  8.4  8.3    9+  34      7 278   2S
24 Mar 14 16 18 35.1 D     486CB5  5.3     e  24+  59  16 59 190  51S  in
daylight
   R486 = Tau Arietis
24 Mar 14 19 28  3.4 D   75929 K7  8.0  7.1   25+  60     41 253  61N
24 Mar 14 20 18 44.6 D   75944 K0  8.6  8.0   25+  61     33 264  62N
24 Mar 15 19 55 29.0 D     655PF5  7.9  7.6   36+  73     47 250  31N
24 Mar 16  0 51 42.6 D     698 K2  7.5  6.8   38+  76      6 306  74S
24 Mar 16 21  2  7.2 D     812SF8  8.0        47+  86     48 254  82S
24 Mar 16 23 12 53.7 D   77224cF8  7.4  7.1   47+  87     28 280  52N
24 Mar 17  0 59 46.8 D     840cK0  6.3  5.5   48+  88     13 298  67N
24 Mar 17 19 38 42.2 D   78291 K0  7.7  7.0   56+  97     64 208  57S
24 Mar 17 20 46 51.3 D     979 A0  8.1  8.1   57+  98     58 235  80S
24 Mar 18  0 42  9.3 D   78480cK5  7.5  6.7   58+  99     23 286  79N
24 Mar 18  1 19 16   D   78496 K0  7.5  6.9   58+ 100     18 292  12N
24 Mar 18 19 23 10.6 D   79279 F0  8.3  8.2   66+ 109 -11 65 172  64S
24 Mar 19 20 11 23.9 D    1244cM8  8.6  7.9v  75+ 121     63 171  69N
   R1244 = RX Cancri
24 Mar 19 23  6 36.4 D   80089 G5  7.2  6.7   76+ 122     50 241  78S
24 Mar 19 23 56 34.8 D    1251 B9  5.9  5.9   76+ 122     43 254  76S
   R1251 = lambda Cancri
24 Mar 22  2 17 52.3 D   98897 K0  7.6  7.0   91+ 145     29 258  49N
24 Mar 23  1 57 21.0 D   99272 K2  7.5  6.8   96+ 156     33 241  39S
24 Mar 23 21  8 46.4 D    1644 B9  4.1  4.1   98+ 165     37 138  24S
   R1644 = sigma Leo
24 Mar 27  1 42 35.5 R  158011dF2  7.1  6.9   97- 160     26 186  49N
24 Mar 30  4  9 52.1 R    2298kK3  5.0  4.3   79- 125     12 187  51S
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D* : The D column indicates a Double Star in the Washington Double Star Catalogue. The characters w,S,c etc indicate the type of double and is explained in Occult4 Help.

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

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

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Images and Drawings from Members.

Waning Moon.

Image by Bob Bowen taken on 16th April 2023 at 2342hrs using a SkyWatcher ST80 f5, fitted with a 2x TelePlus Teleconverter and Canon 7D Mk2 DSLR.

Santbech.

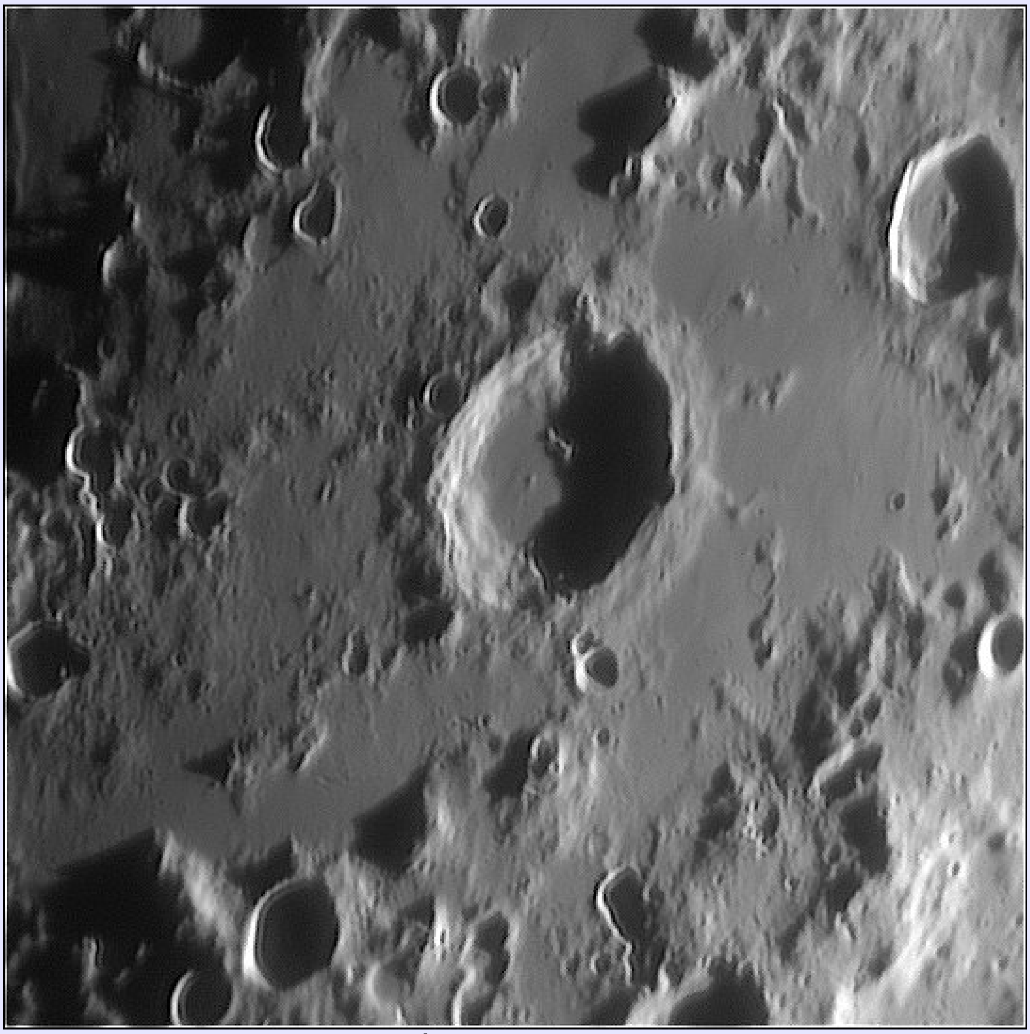
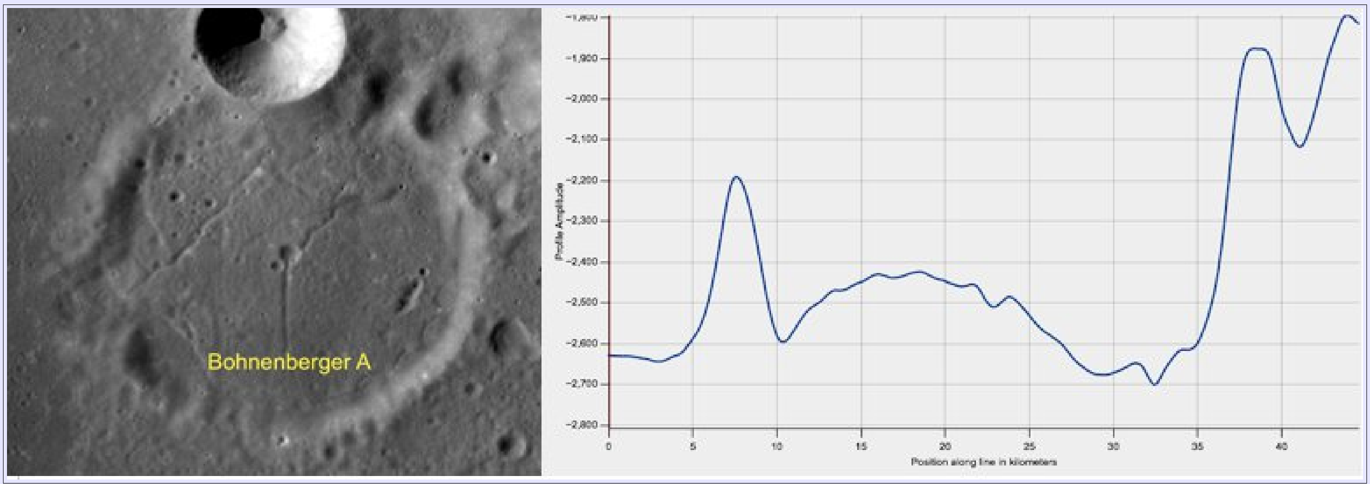


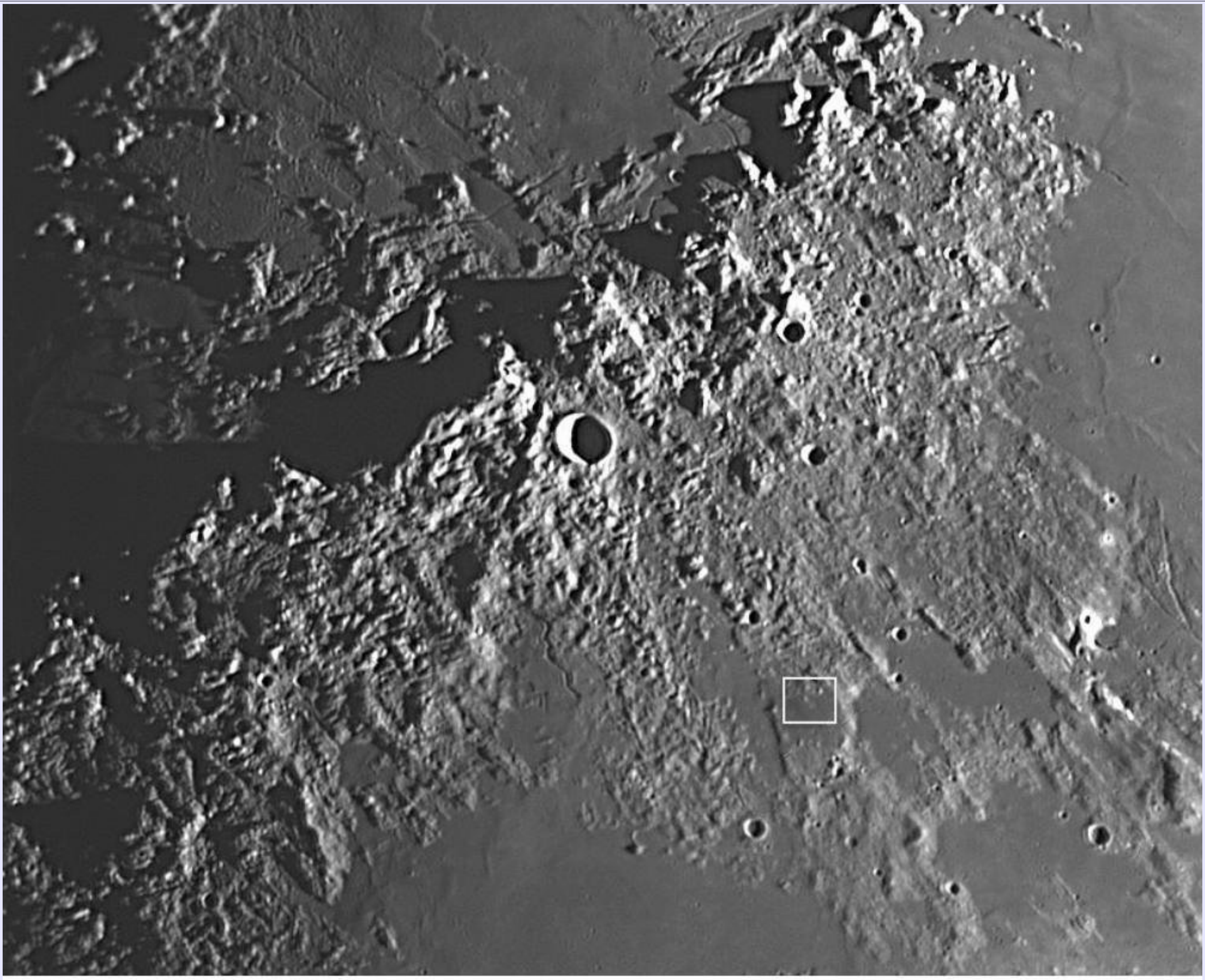
Image by Bill Leatherbarrow taken on 24th April 2023 at 2056hrs using an Orion Optics OMC300 Maksutov Cassegrain.

Bohnenberger A is the 30km crater just truncated by the top left of the frame. It is a Floor Fractured Crater – but the uplift is quite prominent and it looks like there is a volcanic dome hiding away in the crater (see below).



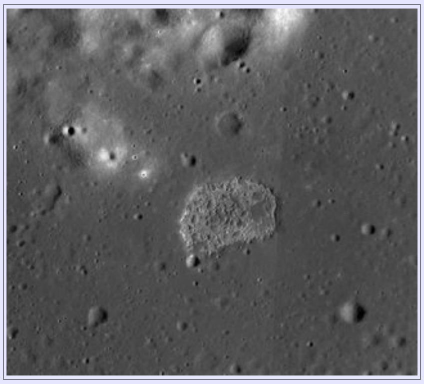
As for Santbech, it looks like it has an offset central peak, but I wonder if this is just a part of a 'ring' of peaks similar to that seen in Colombo to the north.

Montes Apenninus.



Montes Apennines with crater Conon 2023.05.27 - 19.47 UT
300mm Meade LX90, ASI 224MC Camera with Pro Planet 742nm I-R Pass Filter.
600/3,000 Frames. Seeing: 7/10. Rod Lyon

Image by Rod Lyon with details of time/date and equipment as shown. Box marks the position of 'Ina'.



You will note that Rod was using a 90mm telescope but the image still manages to capture the Irregular Mare Patch 'Ina' (LRO image above) which is a shade under 3kms long.

Mare Australe.

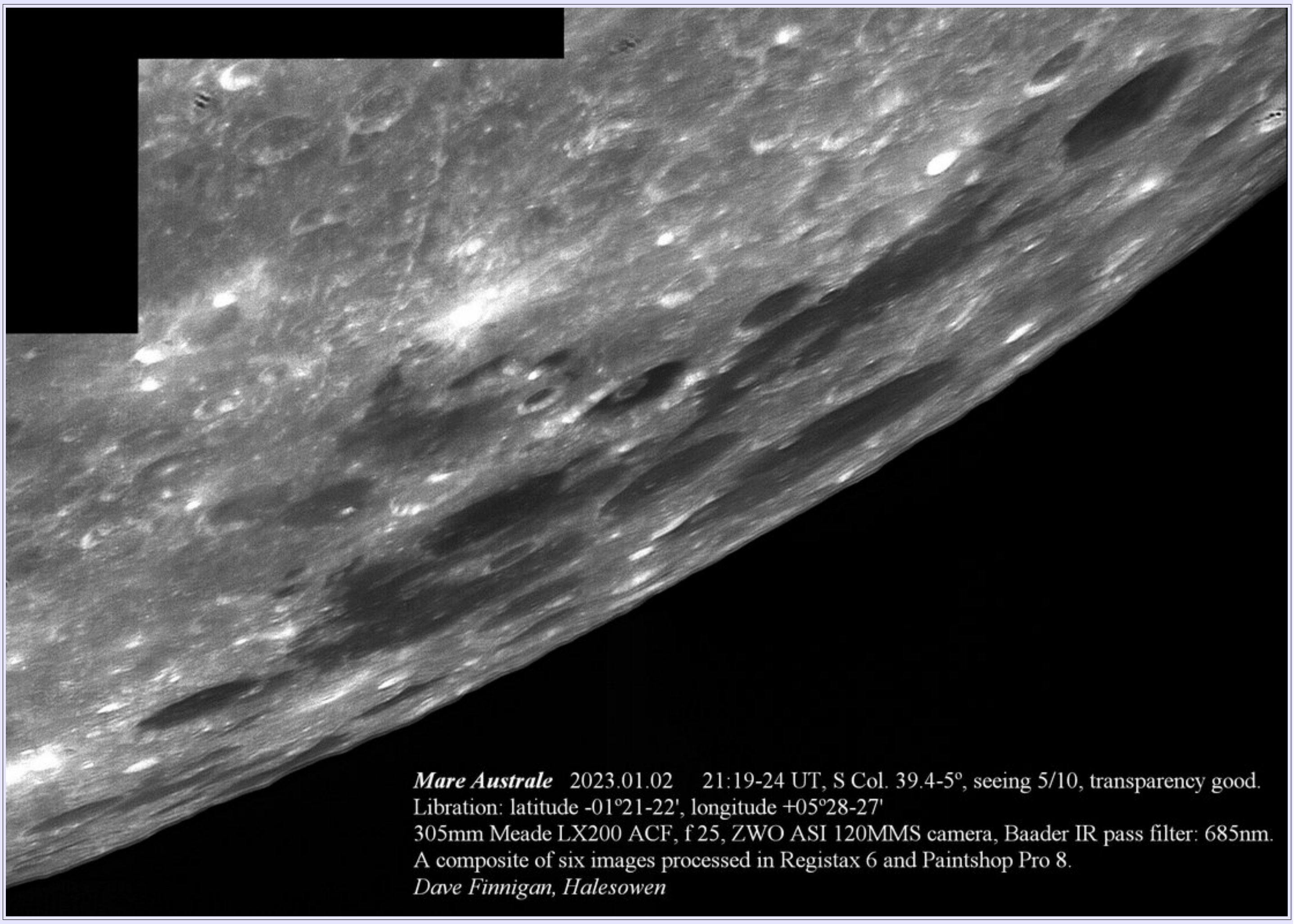
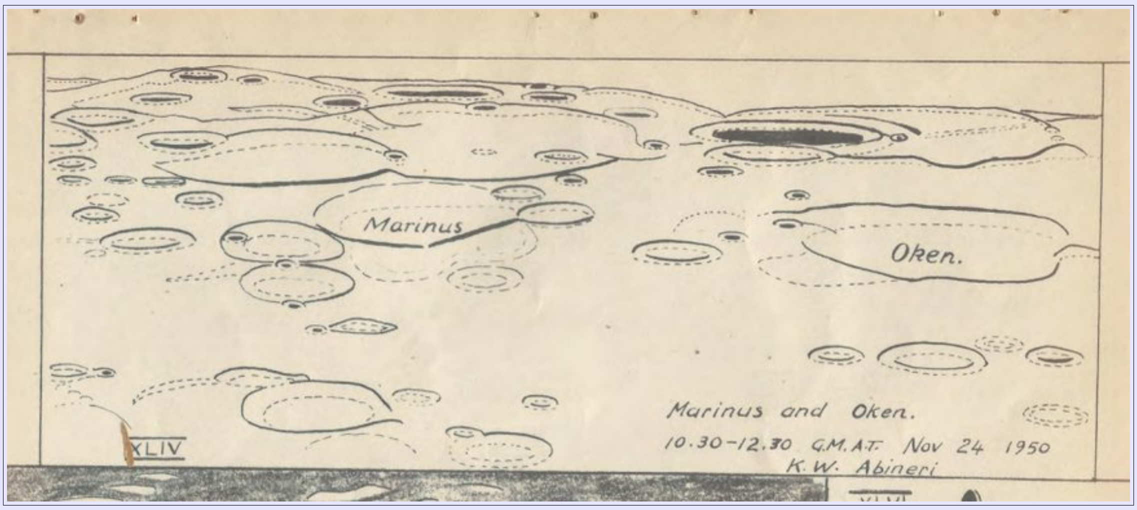


Image by Dave Finnegan with details of time/date and equipment as shown.

*Images of Oken: The mare filed Oken can be seen towards the top right of the frame – not ideally suited for high res-imaging, but both myself and Raffaello Lena would be interested in any images or drawings you may have of this crater. Below is an drawing by the late Keith Abineri taken from The Moon, Vol.1 No.3, May 1952 made using an 8” f8 Newtonian.



Tycho.

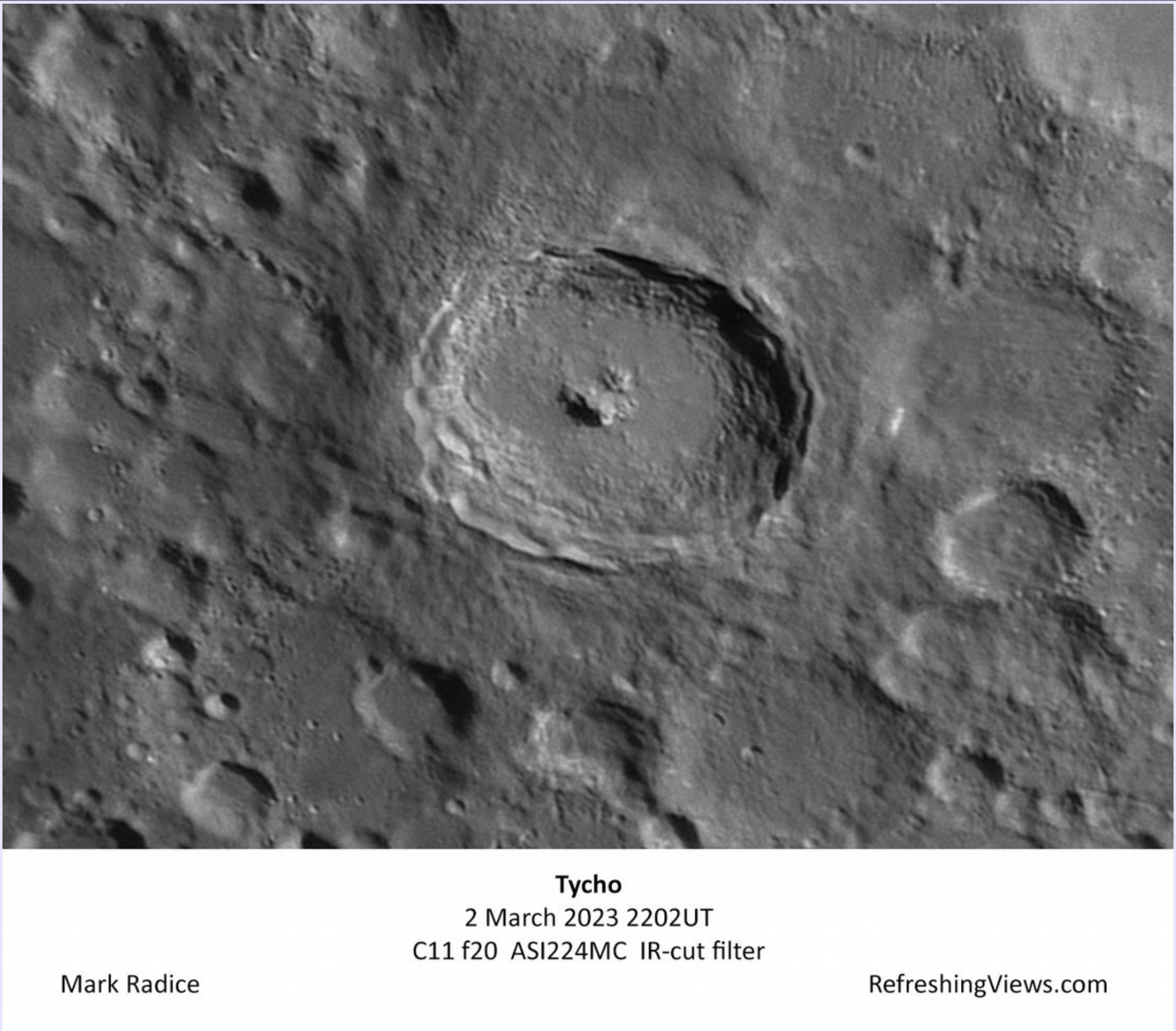


Image by Mark Radice with details of time/date and equipment as shown.

Mons Mouton.

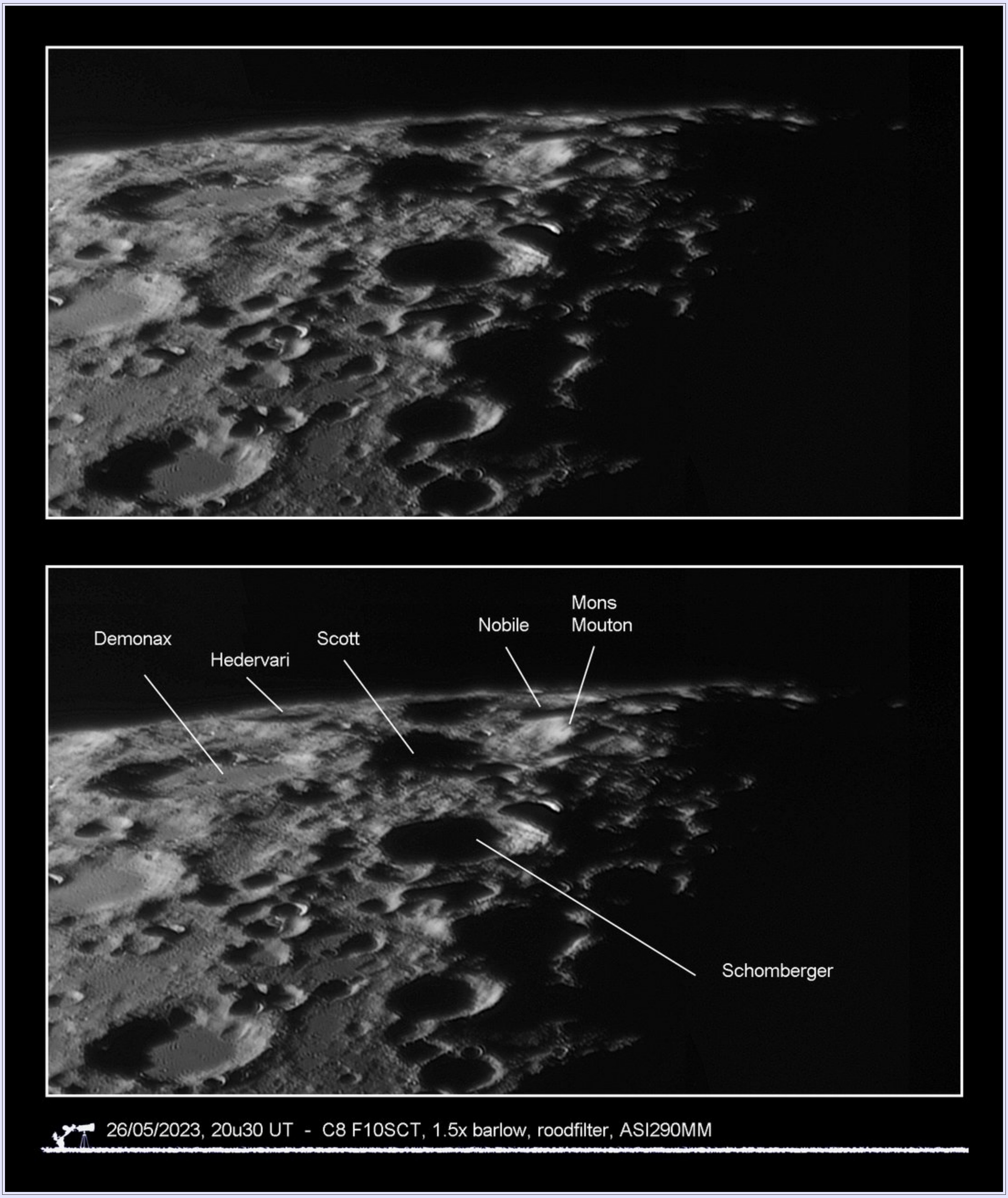


Image by Alexander Vandenbohede with details of time/date and equipment as shown.

Alexander comments that Leibnitz Beta was re-named Mons Mouton in 2023 and is the landing area for the VIPER mission.

Vallis Schroteri.

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

Kepler to Marius

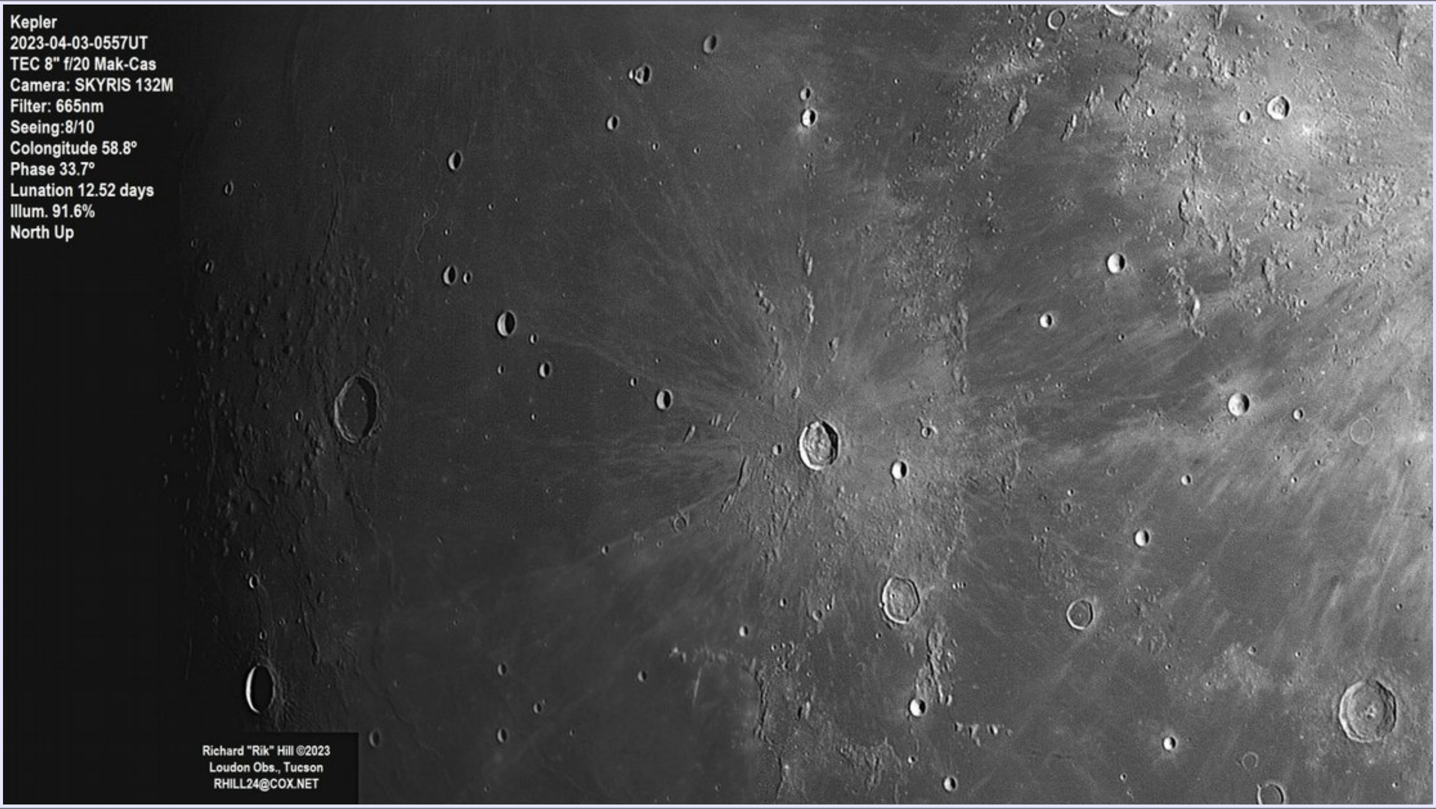


Image and text by Rik Hill.

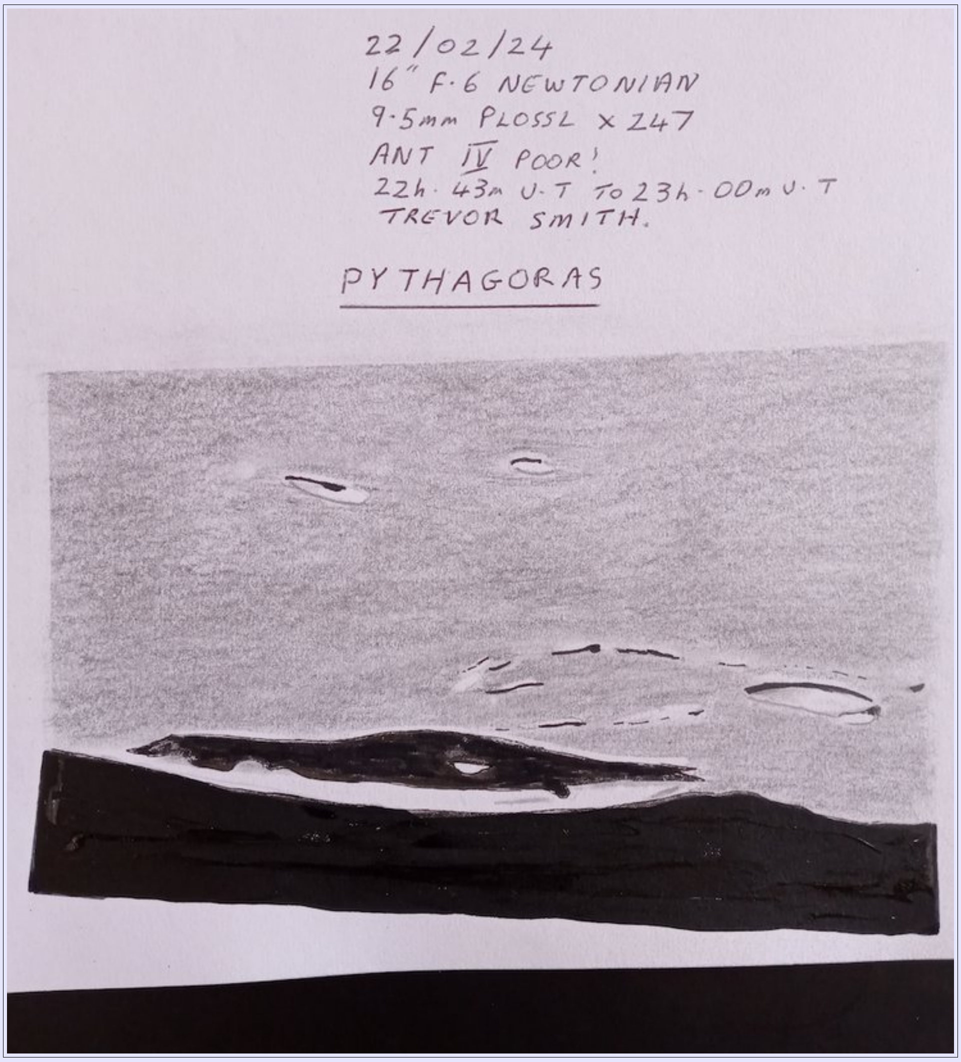
Situated on the east side of the sprawling Oceanus Procellarum is the great crater Kepler (32km diam) almost lost in splendour to its bigger brother further to the east, Copernicus, three times bigger with a much larger ray system surrounding it. Between these two is Mare Insularum a very isolated sea. There is much to be gleaned from the wonderful ray system of Kepler and surrounding features. First, notice the lack of symmetry to the Keplerian ray system, strongly attenuated on the right in line with the mountains that run roughly north-south there. I have never read anything on why this is so. Meanwhile, on the left side of Kepler notice the strong 'V' shape to the rays with fainter rays in the centre of the 'V' that point towards the flat floored crater Marius (40km). Interestingly, these central rays are quite feathered. In these central rays is the spot where Luna 7 lies. It was launched October 4, 1965 and due to improper rocket firing and then shutdown it suffered what Virtual Moon Atlas calls an involuntary impact (i.e. crash).

Below Kepler is the almost same diameter and older crater Encke (31km). It's a somewhat polygonal crater infilled with ejecta from the Kepler impact making it a lighter colour than the surrounding mare. In the lower right corner is Lansberg (41km). To the right of Kepler is a large right triangle of 8-14km diameter craters with Milichius (12km) at the vertex of the right angle and Hortensius (14km) on the lower vertex and Milichius A (8km) being the one closest to Kepler. The first two craters are hosts to other dome features, Dome Milichius and Hortensus Omega, which are not well shown here due to high sun at their longitudes but should be sought out when near the terminator.

Mentioned above, the flat floored crater Marius (40km) is on the left (west) side of this image. It is surrounded by a pox field called Domes Marius or colloquially, the Marius Hills. These are small upwellings and volcanic domes with central pits on many that can by spied by sharp eyed observers with sufficient aperture and magnification. The altitudes of these hills are only about 200-500m with sinuous rimae winding between some of them and in one case southeast of Marius itself, several rimae cut right through the hills. The low altitudes mean that like the Hortensius and Milichius domes above, they have to be on the terminator to be seen clearly and vanish entirely in high sun. This is a rich and rewarding area for the lunar observer, worthy of good scrutiny by the northern hemisphere observers on the bright moon nights of fall and winter when this gibbous phase is high in the sky.

This image is a composite made from two 1800 frame AVIs stacked with AVIStack 2 (IDL) then united with MS-ICE and finish processed with GIMP and IrfanView.

Pythagoras.
With drawing and observing notes by Trevor Smith.



1

PYTHAGORAS

22/02/24 WAS NICE AND CLEAR BUT THE SEEING WAS RATHER UNSTEADY AT AROUND ANT IV HERE IN CODNOR, DERBYSHIRE.

THE 142 km DIA CRATER OF PYTHAGORAS WAS EASILY VISIBLE NEAR THE NORTH/WEST LIMB.

THE MOON WAS 97% ILLUMINATED WHICH MEANT THE NORTH/WEST LIMB WAS NOT QUITE FULLY SUNLIT. THIS, ALONG WITH THE SOMEWHAT UNFAVOURABLE LIBRATIONS GAVE THE FALSE IMPRESSION OF THE CRATER BEING CLOSER TO THE LUNAR LIMB THAN IT REALLY WAS

THE CENTRAL PEAK IS MADE UP OF A PAIR OF USUALLY QUITE CONSPICUOUS MOUNTS. HOWEVER, A QUICK LOOK AT x 247 SHOWED THE NORTH/WEST MOUNT OF THE TWO WAS HIDDEN FROM VIEW BY ITS SOUTH/EASTERLY TWIN!

THE NORTH/WEST INNER WALL OF PYTHAGORAS WAS VERY BRIGHT WHEREAS THE SOUTH/EAST WALL WAS BLACK WITH SHADOW. THE CENTRAL FLOOR WAS BLACK WITH THE CENTRAL PEAK STANDING OUT IN SHARP CONTRAST.

2

THE VERY OBVIOUS FORESHORTENING OF THE CRATER ALLOWED, IN MOMENTS OF BETTER SEEING, THE INNER NORTH/WEST WALL TO BE SEEN TO BE SOMEWHAT TERRACED. THIS TERRACING OF COURSE IS HORIZONTAL TO THE LENGTH OF THE WALL BUT AT TIMES AND RIGHT ON THE LIMIT OF VISUAL PERCEPTION THERE APPEARED TO BE A FEW VERY FAINT GREY RADIAL LINES/BELTS RUNNING VERTICALLY UP THE WALL. THESE LOOKED LIKE A VERY FAINT VERSION OF THE ARISTARCHUS BELTS.

I COULD NOT IN ALL HONESTY SAY I SAW THESE RADIAL LINES WITH 100% CERTAINTY DUE TO THE POOR SEEING.

PERHAPS OTHER OBSERVERS/IMAGERS HAVE STUDIED THIS AREA AND CAN SHED MORE LIGHT ON THIS.

I CHECKED MY OBSERVING LOG AND FOUND I HAD SKETCHED PYTAGORAS UNDER MORE FAVOURABLE CONDITIONS ON 25/04/21. I NOTICED BOTH CENTRAL PEAKS TO BE EASY BUT I DID NOT RECORD ANY SIGN OF ANY RADIAL BELTS.

HAVE OTHERS SEEN THESE BELTS OR AM I MISTAKEN?

IT WAS A PITY THE SEEING TONIGHT WAS NOT MORE STEADY BUT THESE DIFFICULTIES ARE WHAT MAKES AMATEUR OBSERVING SO INTERESTING.

NOTE: A SMALL CRATERLET (WHICH COULD NOT BE SEEN TONIGHT) LIES MIDWAY FROM THE FLOOR TO THE TOP OF THE NORTH/WEST INNER WALL. THIS COULD PERHAPS BE THE SOURCE OF ONE OF THE (SPURIOUS) BELTS, BUT THIS DOES NOT ACCOUNT FOR THE OTHER BELTS.

I WONDER WHAT OTHERS THINK?

Lamont.

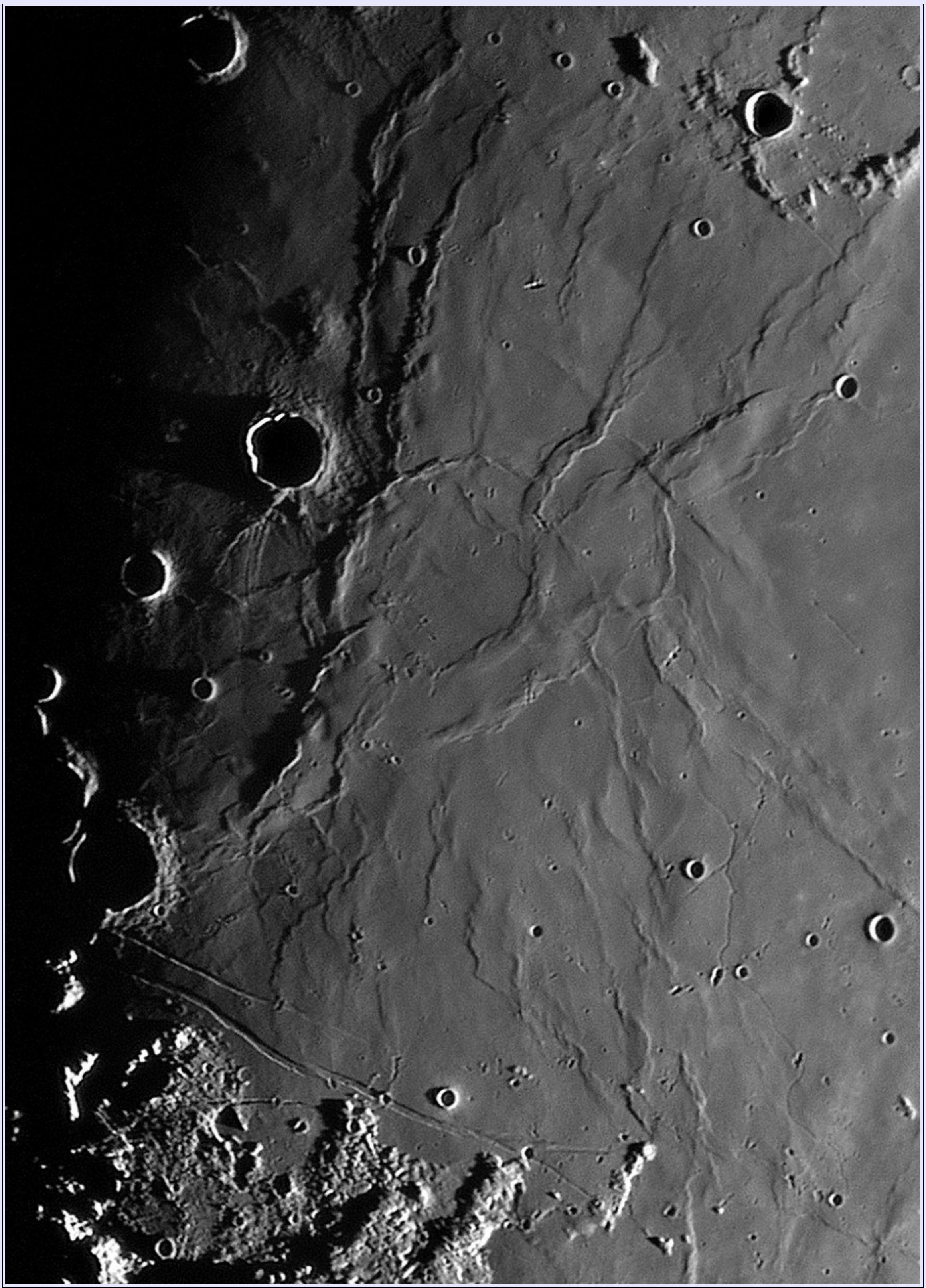


Image by K.C.Pau taken on 15the February 2024 at 1202UT with a 250mm Newtonian reflector + 2.5X barlow + QHYCCD 290M camera

K.C commented that: *Usually, the weather in spring in Hong Kong is miserable. Out of expectation, I had some clear nights in February to get some moon photos. Though the Moon was high in the sky, the amount of dust particles increased unexpectedly, therefore, the photo may be a bit noisy.*

Sunrise over Aristarchus plateau.

Image by Chris Longthorn taken on 24th November 2023

Eratosthenes.

Image by Maurice Collins from New Zealand and taken on 23rd October 2023 at 0736UT using an ETX-90 and QHY5III462 Camera.

Ptolemaeus.

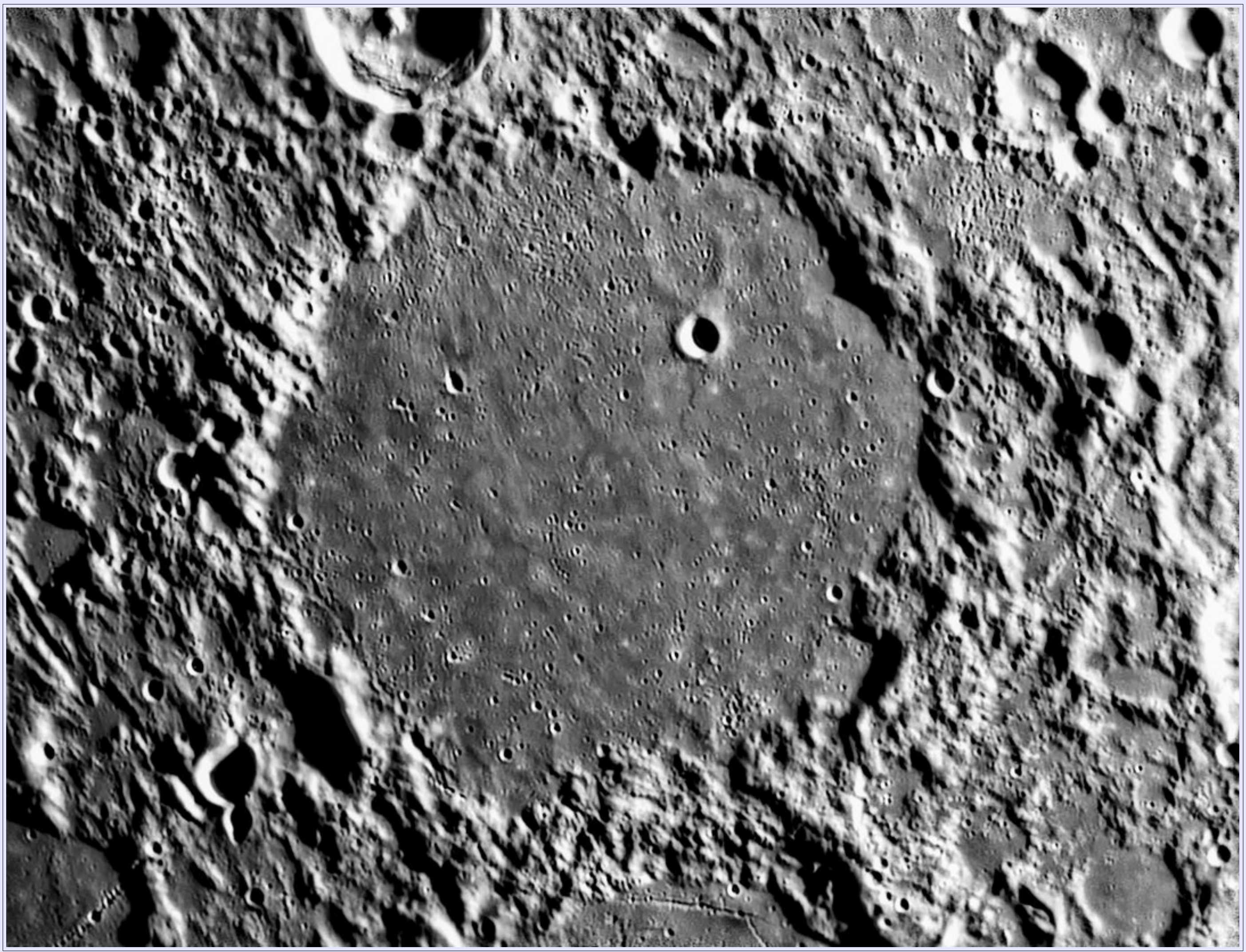
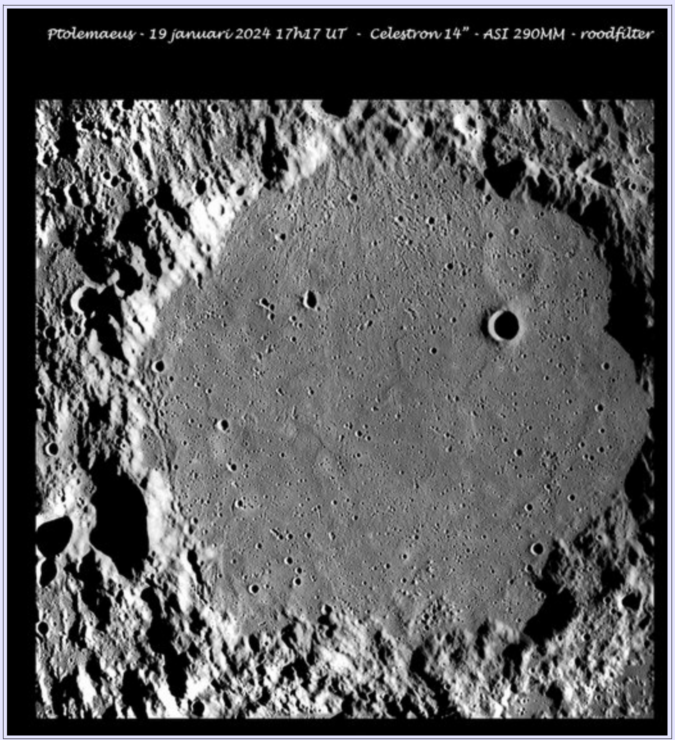


Image by Leo Aerts taken on January 19th 17h17 UT, using a Celestron C14, red filter and ASI 290MM.



Leo also submitted the above image which is an Apollo 16 image of the same crater under the same lightning conditions.

Hercules and Atlas.

Image by Bob and Sophie Stuart with details of time/date and equipment as shown.

Lunar domes (part LXXIII): A lunar dome near Encke crater
by Raffaello Lena.

In this contribution I will examine a dome, termed Encke 1 (En1). The dome lies to the south of the crater Encke, at coordinates 3.55° N and 36.73° W and has a base diameter of 33 x 30 km. The new global topographic map of the Moon obtained by the Lunar Reconnaissance Orbiter (LRO) is the principal source of topographic information used in this study. Associated topographic profile of the examined dome was extracted from the GLD100 database using the Quickmap LRO global basemap (http://target.lroc.asu.edu/da/qmap.html) . The dome was imaged by Mike Wirths under oblique solar illumination angle on February 26, 2018 at 00:40 UT using an 18" Starstructure dob-driven (quartz Zambuto primary) F 4.5, ASI174mm camera, red filter and a 4X Powermate barlow (Fig.1).

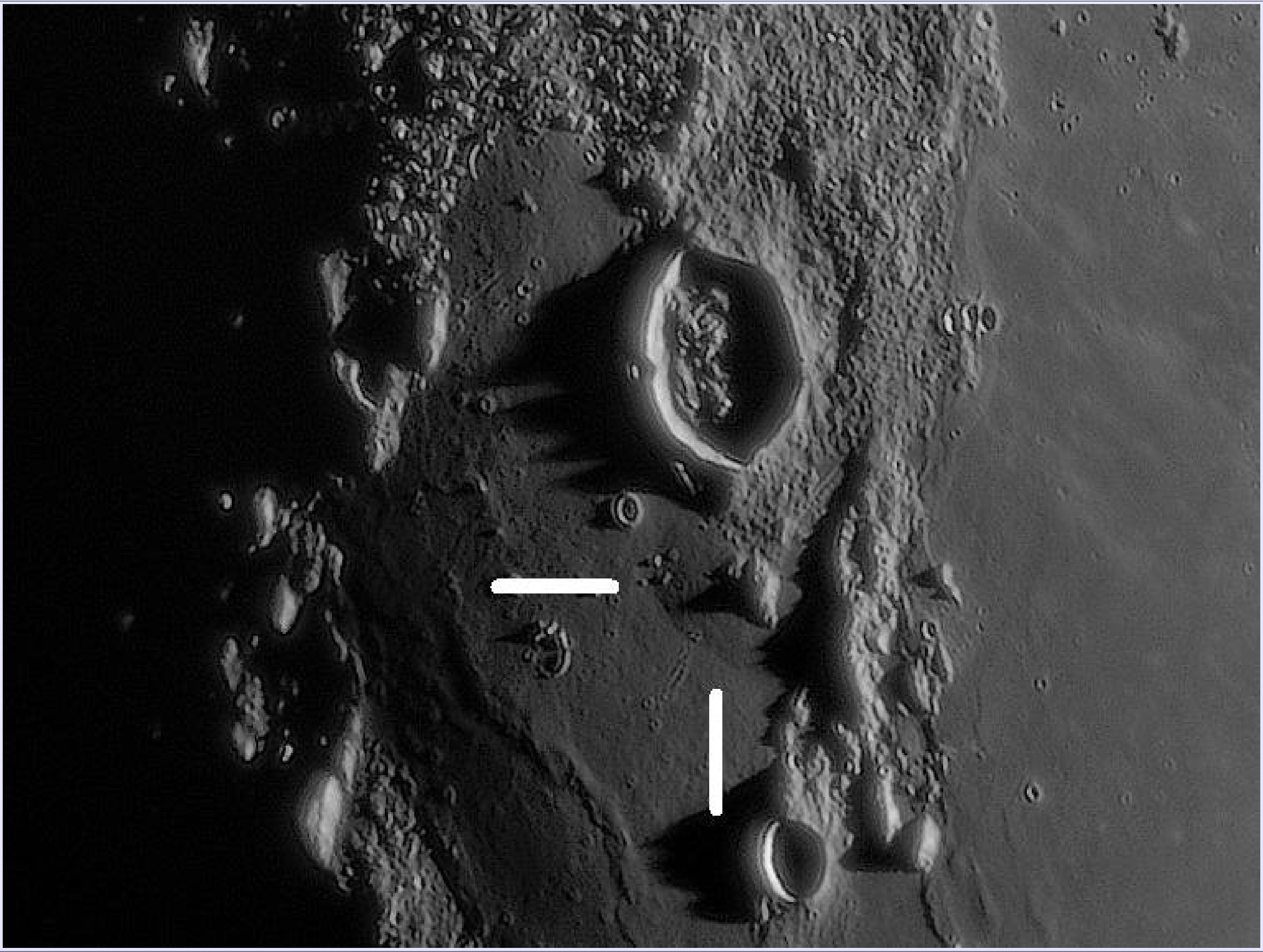


Figure 1: Image by Mike Wirths showing the dome, marked by white lines.

The 3D reconstruction using WAC mosaic draped on top of the global WAC-derived elevation model (GLD100) is shown in Fig. 2. Two non volcanic hills are located on the top. The dome height, determined using the cross-sectional profile in E-W direction (Fig. 3), amounts to 180m, while the average slope angle ξ corresponds to 0.62°. Its edifice volume was estimated of 74 km^3, assuming a parabolic shape.

Furthermore, the flat appearance of En1 suggests that the rising magmas did not build up a dome through a series of flows, but that it was more likely formed by rising magma collecting in a reservoir, forming a subsurface intrusion.The dome En1 is associated with two graben traversing its northeastern summit and the central summit, respectively (Fig. 4).

We suggest that during the formation of the large dome, and as is the case of the well known *Valentine dome*, fracturing and faulting of the crust occurred, reducing the strength of the crust and facilitating the uplift of large volumes of crustal material visible as a large intrusive dome; hence the uplift resulted from the rise of magma that did not erupt onto the surface, producing a vertical rupture of the surface.

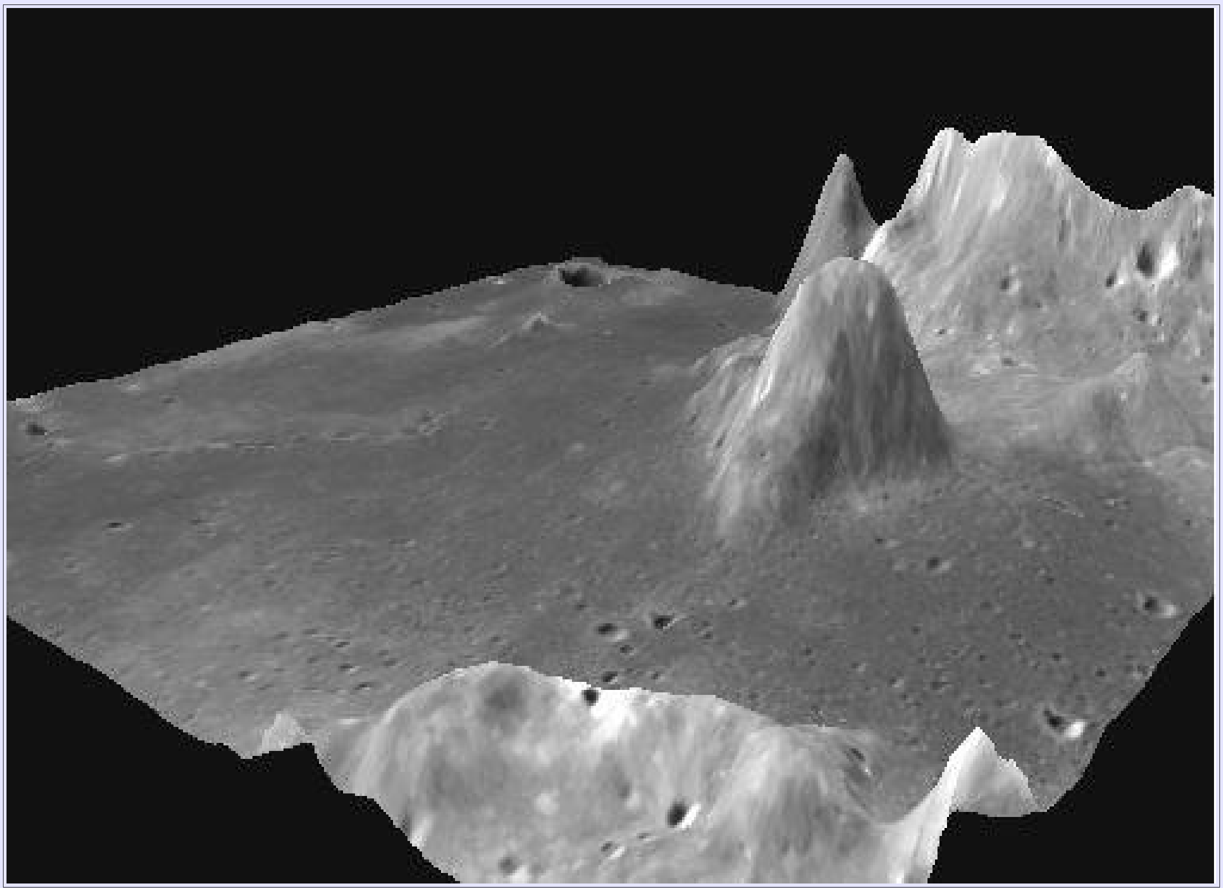


Figure 2: 3D reconstruction. The elevation of the dome corresponds to 180 m. The hill rises to an elevation of 350 m.

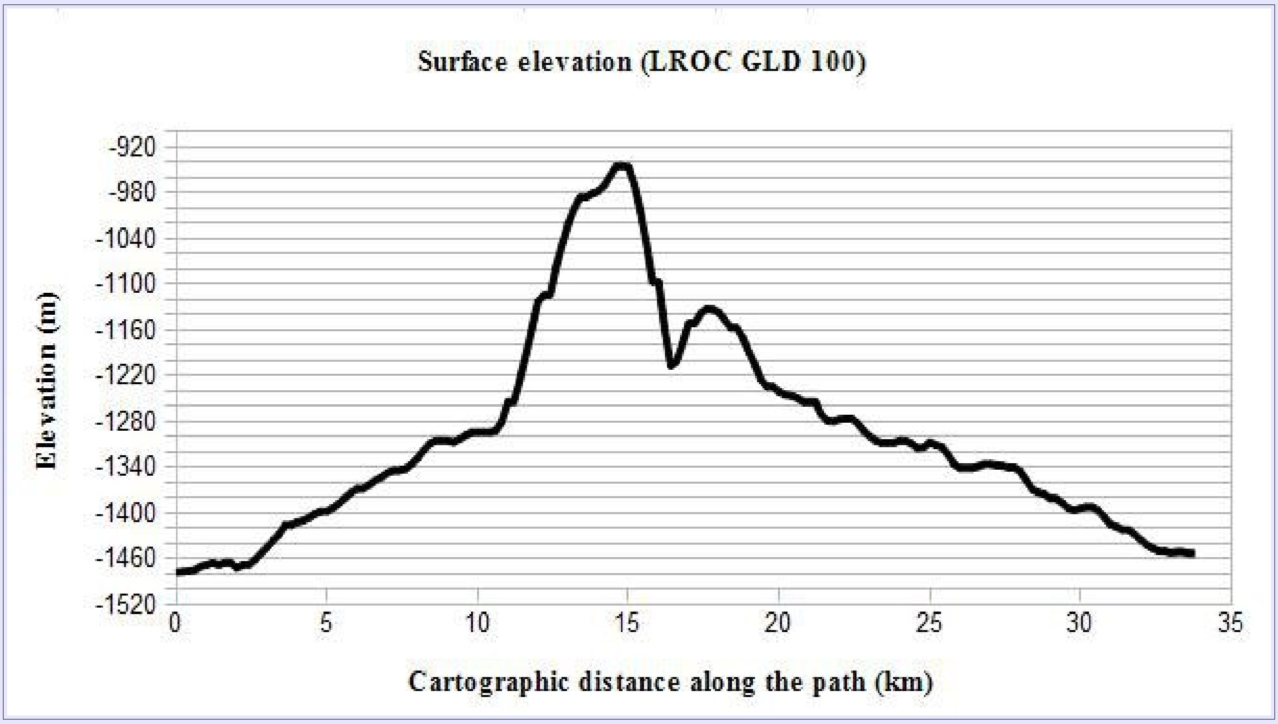


Figure 3: Cross-sectional profile in E-W direction of the dome En1.

The tensional stress resulted in the formation of the graben, and the dome was likely formed in a way similar to a terrestrial laccolith. Hence the magma accumulating beneath the surface produced not only an uplift of the surface rock layers but also induced failure in the overlying rock strata (fracturing).

A classification scheme and interpretation of origin for large domes with very low slopes has been proposed, interpreting these domical objects or “swells” as the possible result of intrusive doming. The first class, In1, comprises large domes of elongated size with diameters above 25 km, flank slopes of 0.2°–0.7° and characterized by the presence of linear rilles crossing the surface, class In2 is made up by smaller and slightly steeper domes with diameters of 10–15 km and flank slopes between 0.4° and 0.9°, and domes of class In3 have diameters of 13–20 km and flank slopes below 0.3°

Due to its large diameter and edifice volume, the dome En1 matches the properties derived for putative intrusive dome belonging to group In1. The laccolith formation is characterised by three distinct stages. During the first stage, a thin sill-like unit undergoes lateral growth. The second stage consists of vertical growth caused by flexure of the overlying strata due to the pressurized magma. If the flexure-induced vertical uplift exceeds a few hundred meters, piston-like uplift of a fault-bounded block may occur during the third stage of laccolith formation.

Figure 4: WAC imagery of the dome. The graben traversing the summit are detectable.

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More Irregular Mare Patches.
By Barry Fitz-Gerald.

Irregular Mare Patches or IMPs have puzzled lunar geologists since they were first spotted in Apollo 15 imagery[1] with features like 'Ina' being the most familiar. A few of the larger IMPs have received a lot of attention over the years, such as those near the craters Sosogines, Maskelyne and Cauchy. Their association with volcanic areas has led to them to be interpreted as the product of volcanic activity, but the exact form of that volcanism remains something of an open question[2]. There is also a large population of smaller IMPs that have been subsequently discovered using high resolution lunar imagery, some isolated on the mare surface, some associated with small (often ghost) craters and others on or in domes or graben[3]. Many of the larger examples such as Ina consist of a depression with a high albedo rocky floor upon which are steep sided featureless mounds, whilst most of the smaller IMPs lack the mounds but exhibit the a high albedo rocky floor. IMP ages are problematic[4] with some age estimates being as young as ~33My which appears inexplicable when thermal models of the Moon predict that volcanic activity on the moon ceased between ~ 1.0 and 1.2 Ga[5].

So, these features are still subject of a fair amount of controversy and a recent paper reviewed all the various proposed formation mechanisms, many of them highly imaginative, and concluded that they were not the result of effusive volcanism (due to a lack of volcanic glass) and that either outgassing or drainage into sub surface voids was, based on all the available evidence, more likely[6]. Some of the diagnostic features that were noted include a mineralogy dominated by clinopyroxene, optical immaturity compared to their surroundings and a higher thermal inertia suggesting a rocky nature at least within the upper ~ 15cm of the surface [7].

The lunar regolith is obviously a diverse environment subject to space weathering, gardening, emplacement of impact ejecta and mass wastage, but the general rule is that it starts off extremely fine grained at the surface and becomes coarser and rockier as you go deeper[8]. If you consider gasses escaping *upwards* through such a sequence of material, you could imagine the finer surface material being blown away by the gas venting to the vacuum of space, leaving the coarser material behind. This is the sort of process that could produce the physical and optical features characteristic of IMPs and the amount and vigour of the outgassing would have a big impact on how much material was removed, and how deep and extensive the resulting 'excavation' was. I imagine that something along the lines of Ina would be at the upper end of the scale, but it is interesting to speculate what could be at the other end, where the gas release was more of a wheezy cough as opposed to a protracted blast.

There are a number or areas where I suspect the wheezy cough level of outgassing has affected the surface, producing not full blooded IMP's but what I have termed 'immature IMPs' or 'iIMPs'. These often share the same optical and thermophysical properties as the larger examples but are smaller in extent and seem to have involved the removal of only a superficial layer of regolith, so not always exposing a particularly rocky under layer. They are often associated with their larger brethren, hinting at a common origin via outgassing. Fig.1 is an example of one of these iIMPs which is located on a crater wall on the side of the volcanic dome Manilius 1[9] in Mare Vaporum. There is a more conventional IMP nearby, clearly demonstrating that there is such activity in the area, but in the example shown in Fig.1 the level of regolith removal appears to be superficial, producing a higher albedo irregular patch, which in this case has a rockier surface than the adjacent darker surfaces. Another possible interpretation is that these are simply mass wastage scars where the surface regolith has sloughed away and cascaded downslope, but these features exhibit a more ragged and irregular outline when compared to lunar avalanches, and in many cases they are found in or on flat terrain which rather rules this mechanism out.

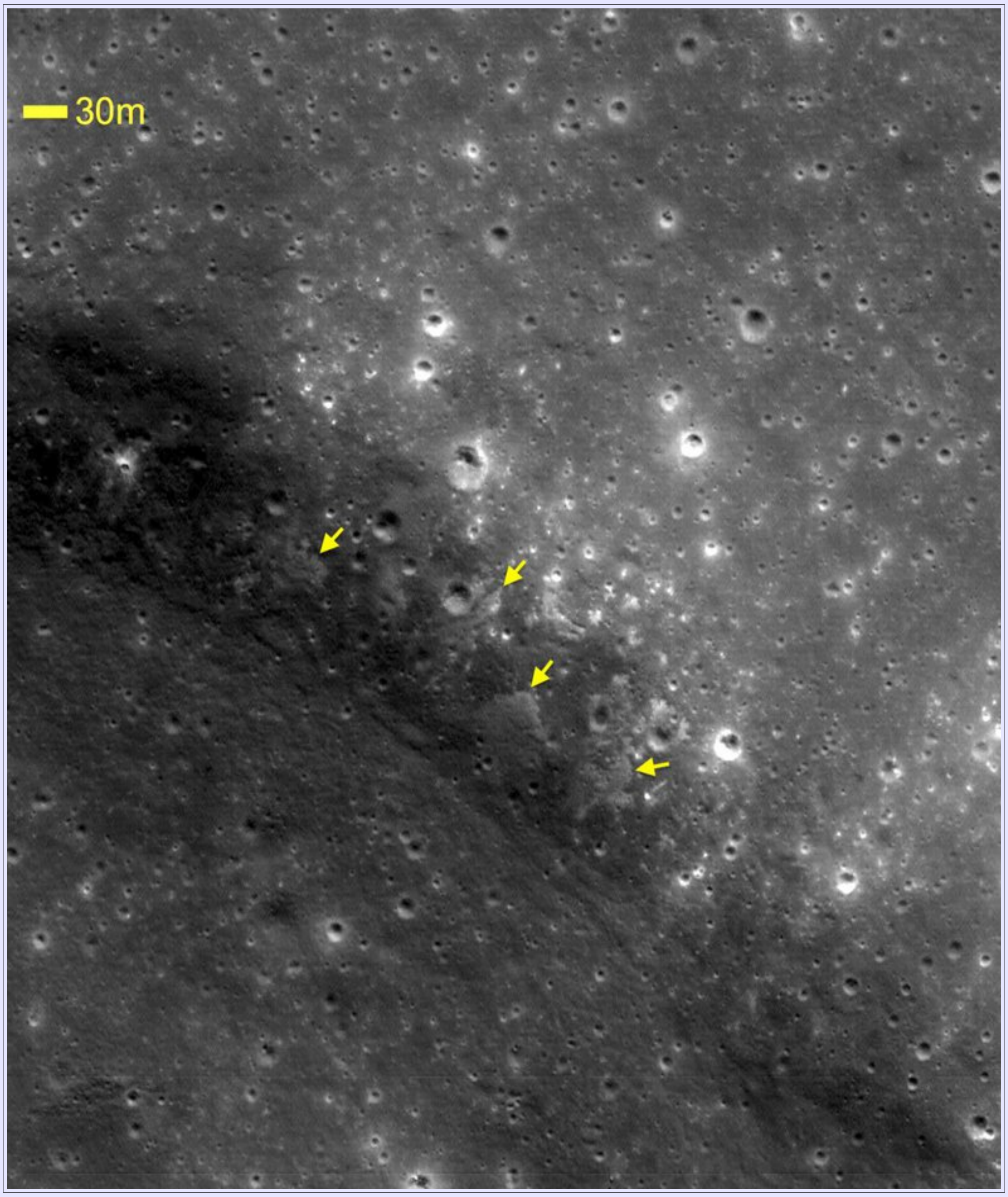

Fig.1 NAC detail of suspected iIMP's (yellow arrows) located on the inner wall of an eroded crater near the volcanic dome Manilius 1 in Mare Vaporum. The iIMPs show up as irregular light patches on the inner crater wall,

An interesting place to hunt these suspected iIMP's turns out to be the lunar backwater of Sinus Honoris, which is not too far from the crater Sosigenes and Rimae Sosigenes, both hot spots of IMP activity. The examples I discuss below are however even less like conventional IMP's than the ones shown in Fig.1 and the interpretation given is quite speculative, so please feel free to wade in with any flaws in the arguments that you spot.

Fig.2 shows Sinus Honoris, with some potential locations of iIMP's marked 'a' to 'e'. Two are crater like structures ('a' and 'e') which may (or may not) be volcanic in nature. The larger and more prominent 'a' is almost circular, with a raised rim and a diameter of about 2.7kms, therefore possibly a bit on the big side to be a volcanic vent (Fig.3 upper panel). There is also no associated volcanic material or structures associated with it, so an interpretation of small impact crater would seem logical. It is however perched on a 'step' in the mare surface, suggestive of an escarpment with the higher ground to the NW and lower ground (by some 80m) to the ES. This could indicate the presence of a fault running approximately NW-SE beneath feature 'a' (Fig.3 lower panel) – and coincidentally parallel to Rimae Maclear and Rimae Sosigenes. Additionally the rim to the east is symmetrical in cross section, quite unlike a impact crater rim, and more like a volcanic cinder cone rim – so maybe a volcanic origin is not too outrageous a suggestion.

Fig.3 shows a more detailed view of feature 'a' and as can be seen the inner walls, particularly the northern and western one are streaked with numerous light coloured patches, which to all intents and purposes look like ordinary mass wastage scars. A more detailed look as shown in Fig.4 however reveals a bit of a difference in the morphology of these patches.

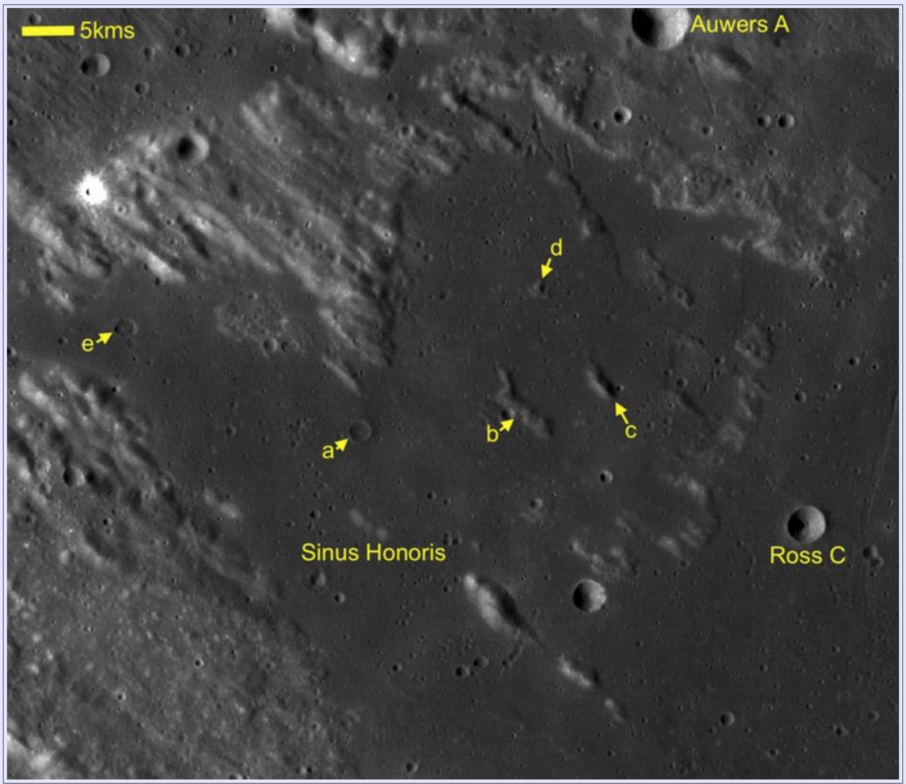

Fig.2 WAC image of Sinus Honoris showing the location of the features described in the text below.

The light patches on the western wall are obviously quite rocky, with what appears to be a few “avalanche' type structures, with well defined lower snouts or terminations, but with their upper edges being less well defined. The northern wall by contrast has a number of irregular light patches, not obviously as rocky, and not showing the well defined lower margins of the 'avalanche' type structures. Their upper margins are also somewhat more well defined. Clearly some process here has removed the darker surface regolith to reveal less space weathered, brighter material, and as this is on a slope (~14°) mass wastage is the obvious interpretation.

There are one or two indications that this might not be the whole story though, the first being that these odd light patches are also spread over the eastern inner wall, but in the form of small isolated areas, frequently only measuring a few meters across, and quite irregular in shape and not at all like small avalanche structures (Fig.5) but quite similar to other suspected iIMPs. Secondly, the northern and eastern wall, where we see most of these light patches have a strong clinopyroxene signal in the SELENE/Kaguya Mineral Mapper reflectance data (Fig.6) whereas the more rocky western wall does not. So is this evidence that these patches are not mass wastage scars but are in fact iIMP's? Well no, not exactly, but it is at least suggestive of the sort of thing we see elsewhere in less ambiguous settings. This could however equally be a result of other factors influencing the abundances determined by the instruments – so should be treated with caution.

Moving on to features 'b' 'c' and 'd' we enter murky territory, as these features are not volcanic at all, but appear to be ridge like hills of highland material, orientated radial to the Imbrium Basin and probably representing partially submerged highland terrain of the Imbrium Sculpture. As such they should in theory not be host to anything volcanic, but there are hints of something odd going on. For this discussion I will just refer to feature 'c' but the same observations apply to 'b' and 'd'.

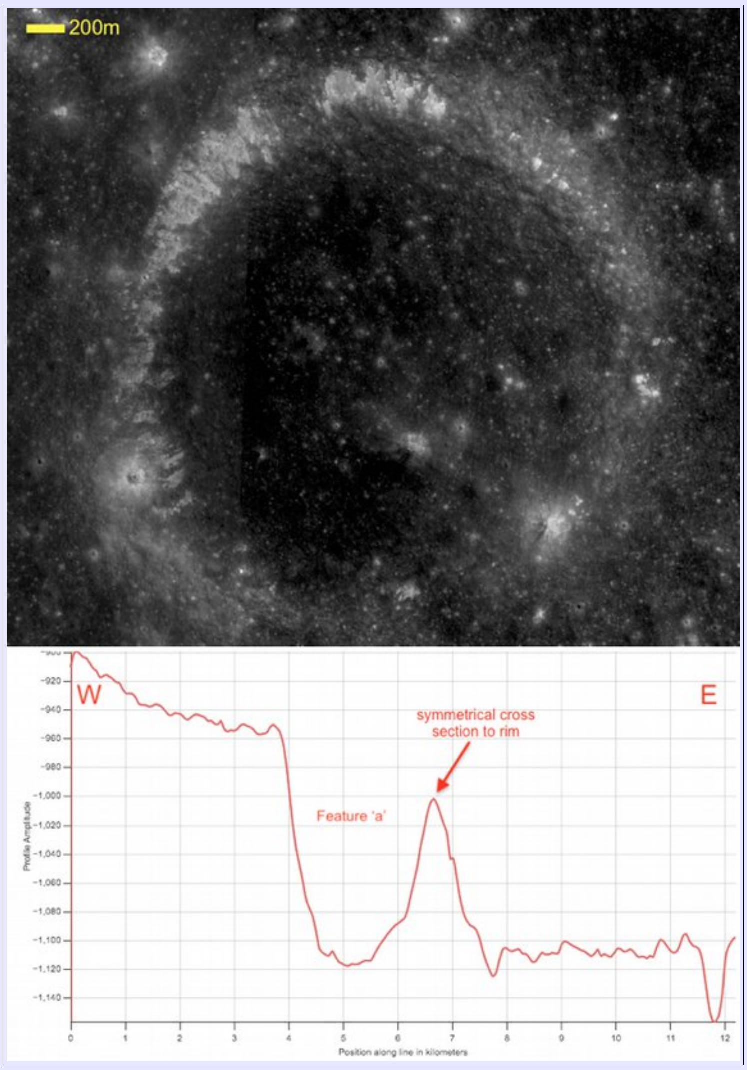

Fig.3 Upper panel shows a NAC image of feature 'a' showing the light coloured patches, some of them suspected iIMP's on the inner wall. The lower panel is a cross section W-E across 'a' showing its location on the edge of an east facing scarp that may indicate the presence of a fault running N-S across this part of Sinus Honoris.

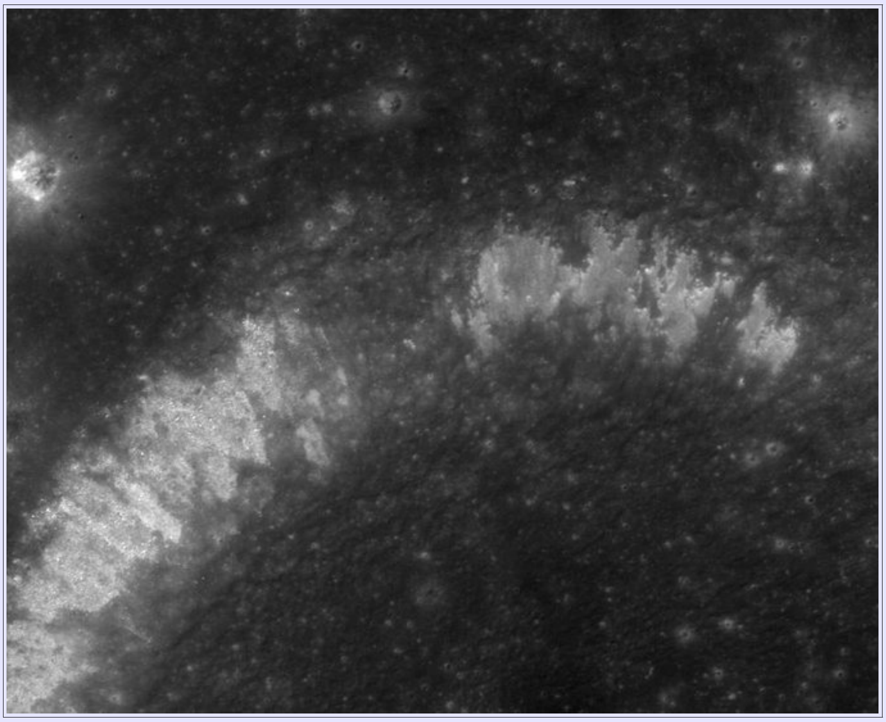

Fig.4 Detail from Fig.3 showing light patches on the inner wall of 'a' and showing a rockier nature along the western inner wall, and less rocky and finer grained to the north.

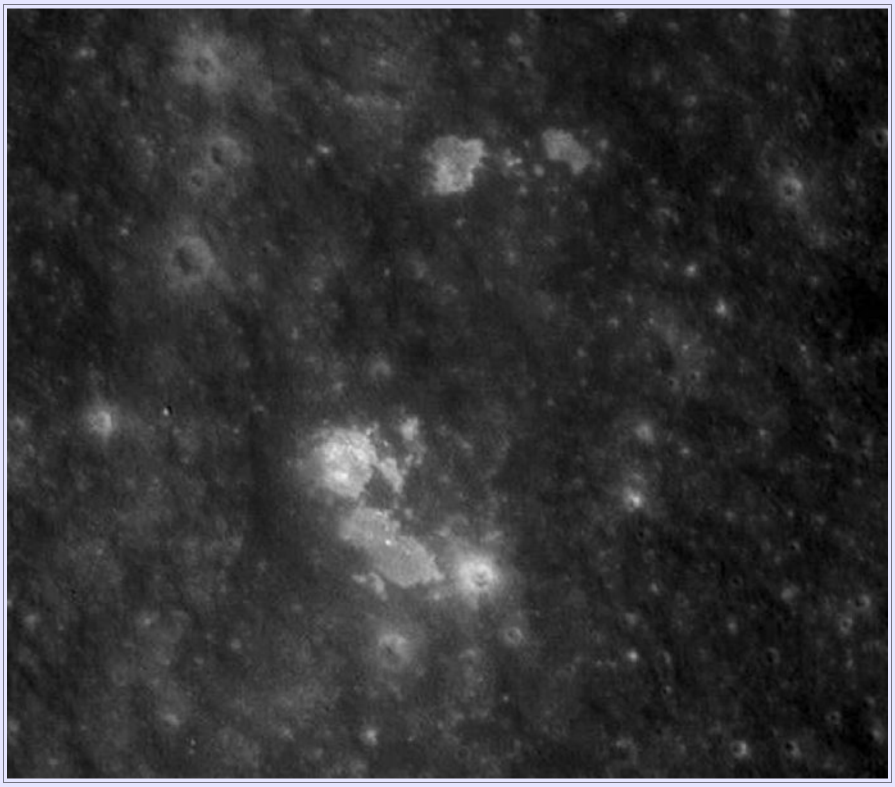

Fig.5 Small isolated suspected iIMP's on the eastern inner wall of feature 'a'. Note their fairly well defined edges, unlike that of debris avalanches.

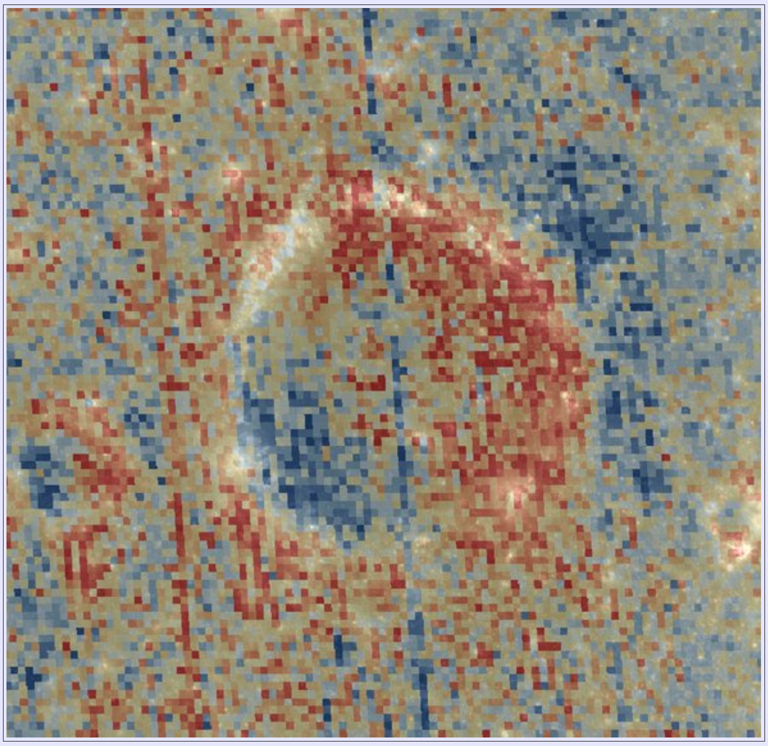

Fig.6 Abundance of clinopyroxene over feature 'a' colour coded from red (high abundance) to blue (low abundance). The area of higher abundance corresponds to the parts of the inner wall where iIMP's are seen. This may relate to IMP activity but it could equally be due to other unrelated factors.

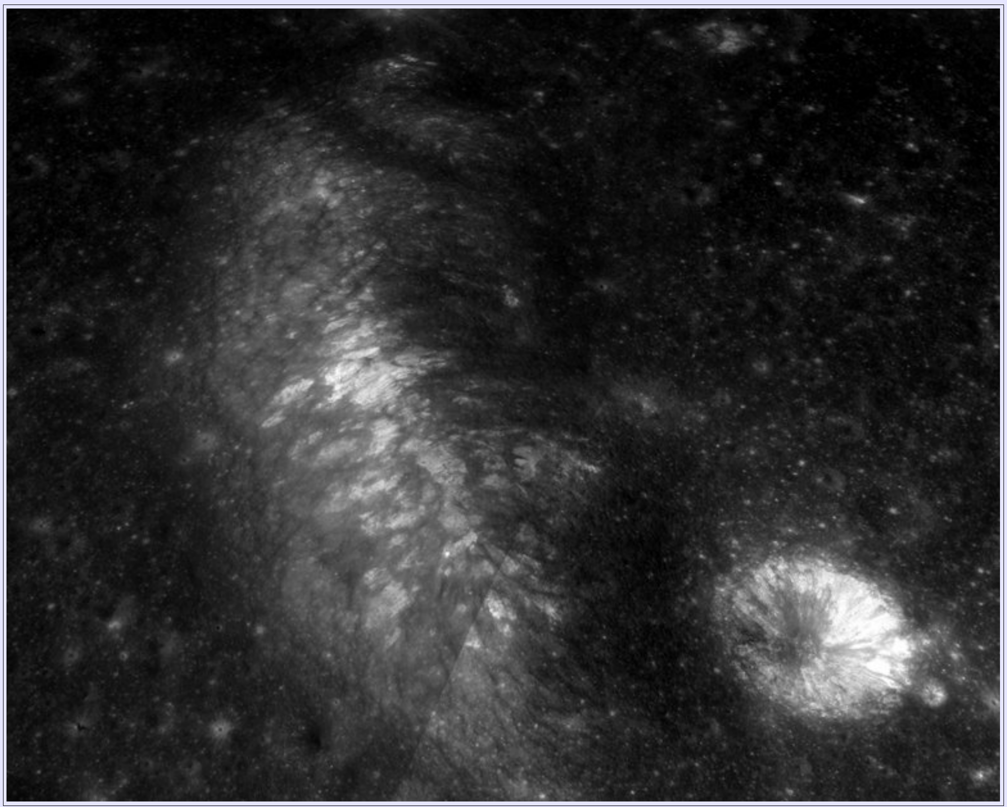

Fig.7 3D rendition of the elongate ridge like hill feature 'c'. Note the presence of the light patches which are particularly abundant along the summit of the hill as well as on the steeper flanks. These patches are concentrated on the southern part of the hill.

Fig.7 is a NAC image of 'c' which is a 'whaleback' hill measuring 6kms long by 2.5kms wide, a height of some 400m and flank slopes of about 18°. There are very many high albedo patches visible particularly on the southern half of 'c', but what you will note is that these are mostly concentrated along the summit of the hill, where slopes are negligible, as well as on the steeper slopes to the east and west. Of course mass wastage off such a hill would not be unexpected, and you can compare these patches on the hill to the inner walls of the nearby crater which are draped in avalanche material which looks at this scale to be identical.

If we zoom in a bit however we start to see something of a different structure within the light patches on the hill, especially along the summit ridge. Fig.8 shows the concentration of light patches along this ridge with some even appearing to have their origin on the summit itself, which is odd due to the absence of any steep slopes. Also along one section, between the two yellow arrows in Fig.8 there is what appears to be a linear feature running parallel to, and along the ridge summit, to either side of which light patches, with a peculiar streaky pattern, stretch away down-slope. What is the relationship between this linear feature and these light patches, and why do the light patches apparently spread down-slope and away from it? If I felt bold I might suggest that this is a fracture along which venting gas has displaced regolith to either side – that would imply iIMP type behaviour, but that would be, as I suggested a bit of a bold interpretation.

A more detailed view is shown in Fig.9, and the dark and light streaks are quite conspicuous. This is not dark and light material alternating however, the dark streaks are in fact gullies running down slope which score the surface and cut through the lighter material. The light patches are also quite rocky with abundant boulders visible on their surfaces and making up the bright streaks that extend downslope. The presence of gullies is interesting as the erosion of gullies might suggest a protracted flow of material as opposed to a single slump of loose debris. An iIMP episode might account for this, as the fall-back of material ejected from the summit over a period of time could potentially be responsible for the erosion of gullies, but again this is no more than speculation.

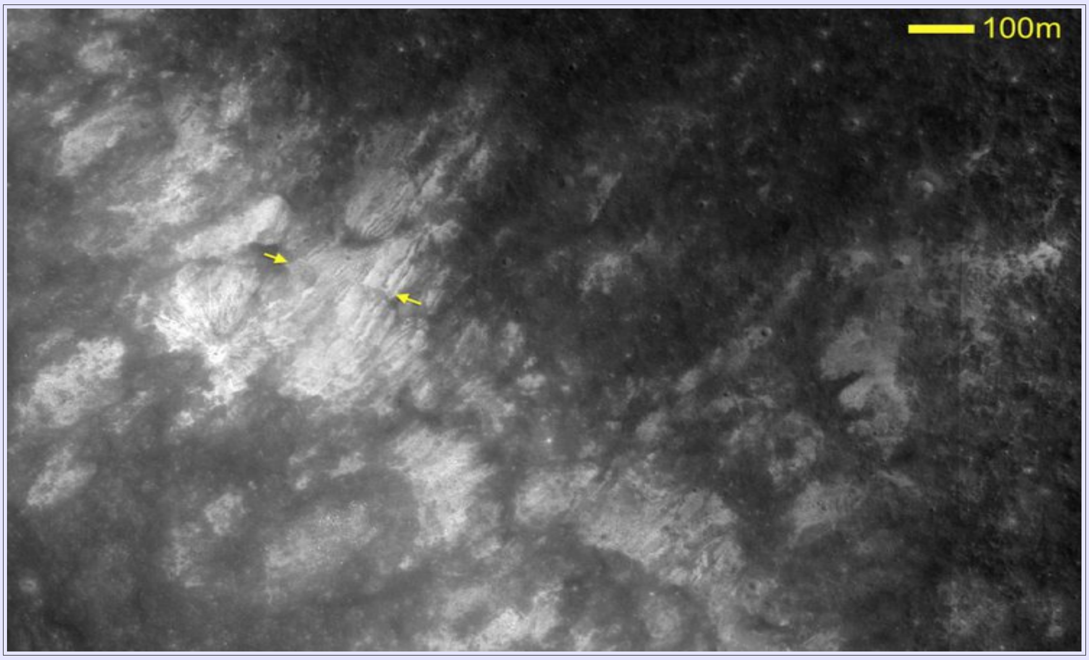

Fig.8 LRO NAC image of the summit of feature 'c' showing the light patches that may have resulted from iIMP type outgassing activity. Note that the patches are distributed over the summit of the hill where slopes are negligible as well as the steeper flanks. The two yellow arrows identify a linear feature running along the summit of the hill.

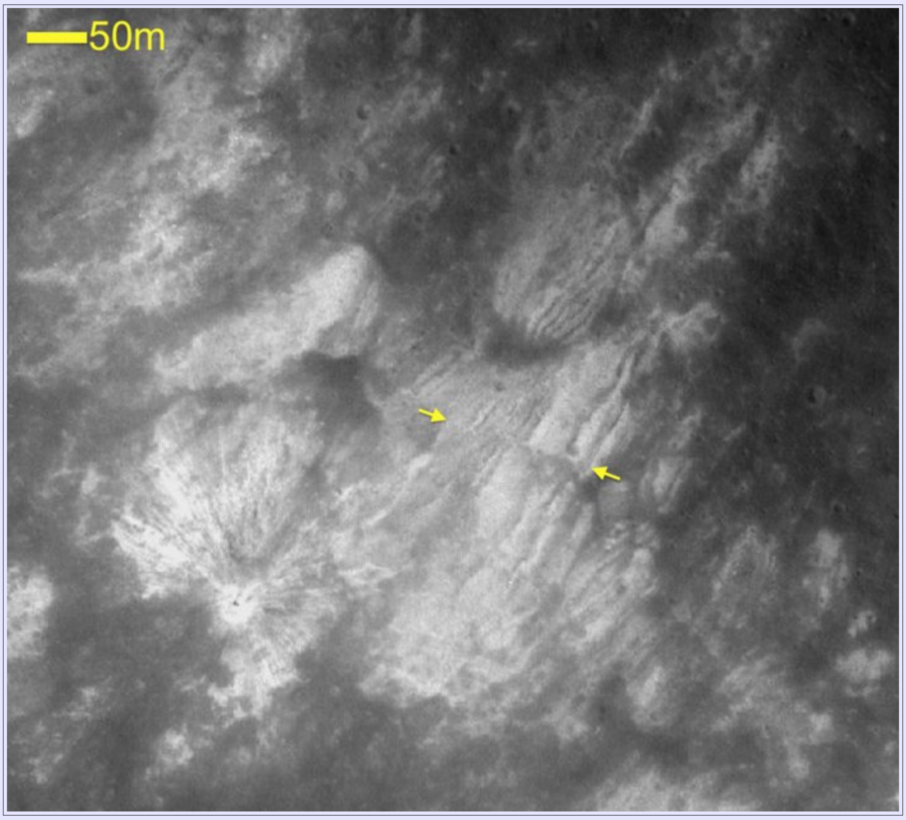

Fig.9 detail from Fig.8 showing the linear feature between the two yellow arrows that runs along the summit of 'c' and the light material that is distributed downslope and to either side. The dark lanes within the lighter material are gullies incised into the lighter deposits.

A mineralogical curiosity is that area covered in the light patches also displays a high abundance of the mineral olivine, whilst the flanks have a higher abundance of plagioclase. The presence of plagioclase is no surprise as this hill is as noted above is probably the summit of submerged highland terrain gouged by Imbrium Sculpture, but the distribution of olivine, a mineral common in mare basalts and volcanic settings is more of a conundrum.

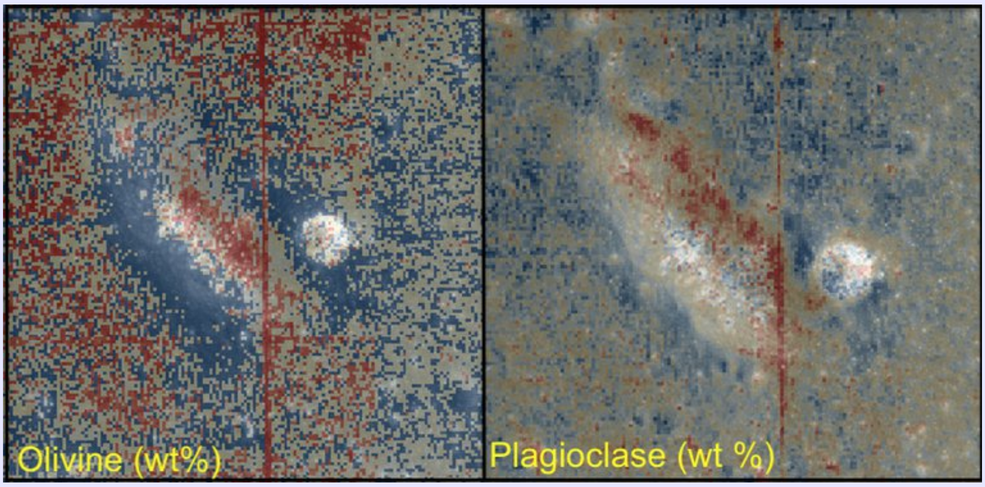

Fig.10 SELENE/Kaguya Mineral Mapper plots of Olivine and Plagioclase abundance over feature 'c' with colour coding from high shown in red to low shown in blue. Note the increased abundance of olivine corresponding the the location of the light patches running along the summit.

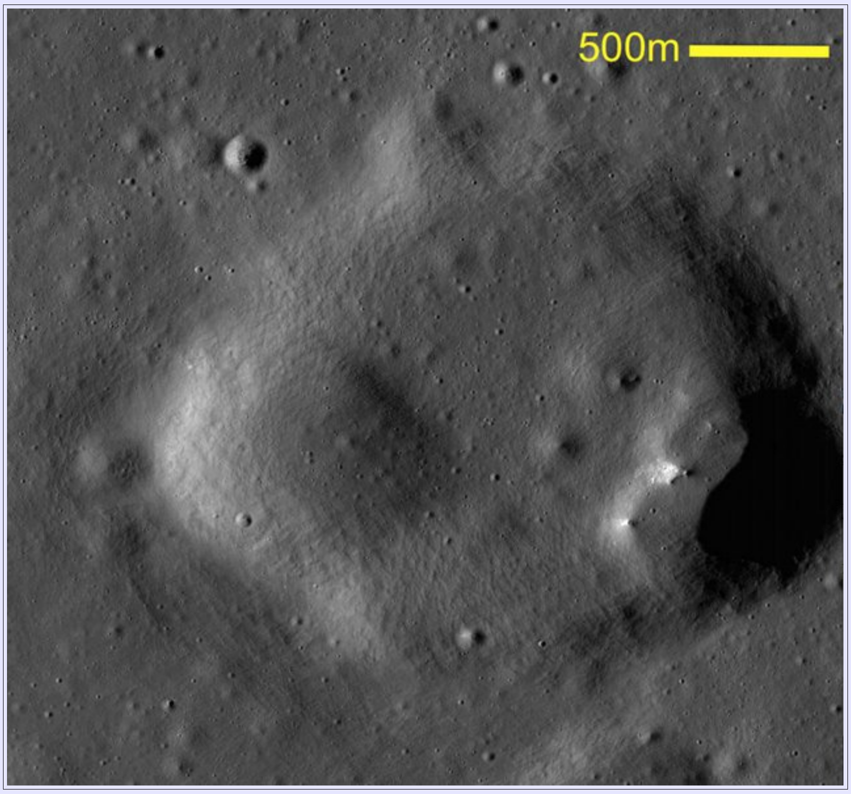

Fig.11 NAC image of feature 'e' showing the depressions at either end of the possible collapse feature, and the pit or skylight at the base of the eastern one.

The most peculiar feature in this area is however feature 'e' which is a rimless crater like structure measuring 3kms by 2.5kms and with a depth of some 150m. It has deep depressions at the eastern and western ends, separated by a central raised mound (Fig.11). This is probably a volcanic structure formed by collapse, but there are no obvious volcanic features or deposits visible in or around it to support this conclusion. The central mound is made up of relatively featureless material with apparently a fine grained texture as compared to the inner walls of the feature which are in places quite rocky. At the bottom of the eastern depression is what appears to be a small 10-15m diameter pit or 'skylight' which appears to penetrate the surface and lead to a 'subterranean' cavity (Fig's.12 and 13).

Immediately to the west of this pit is a 'fan' shaped scatter of rocks and boulders set within a slight depression in the surface. It could be that these rocks are here as a result of them rolling down the slope to the west and towards the lowest point, which happens to be occupied by the pit or skylight. An alternative, and this ties in with the gas release hypothesis for iIMP's, is that gasses have vented *from* the pit, with the jet orientated towards the west and that this has removed the finer material over the area of the 'fan' revealing the less space weathered, rocky subsurface layers beneath. The rim of the pit can also be seen to be bright (Fig.13) indicating freshly exposed (relatively speaking) material.

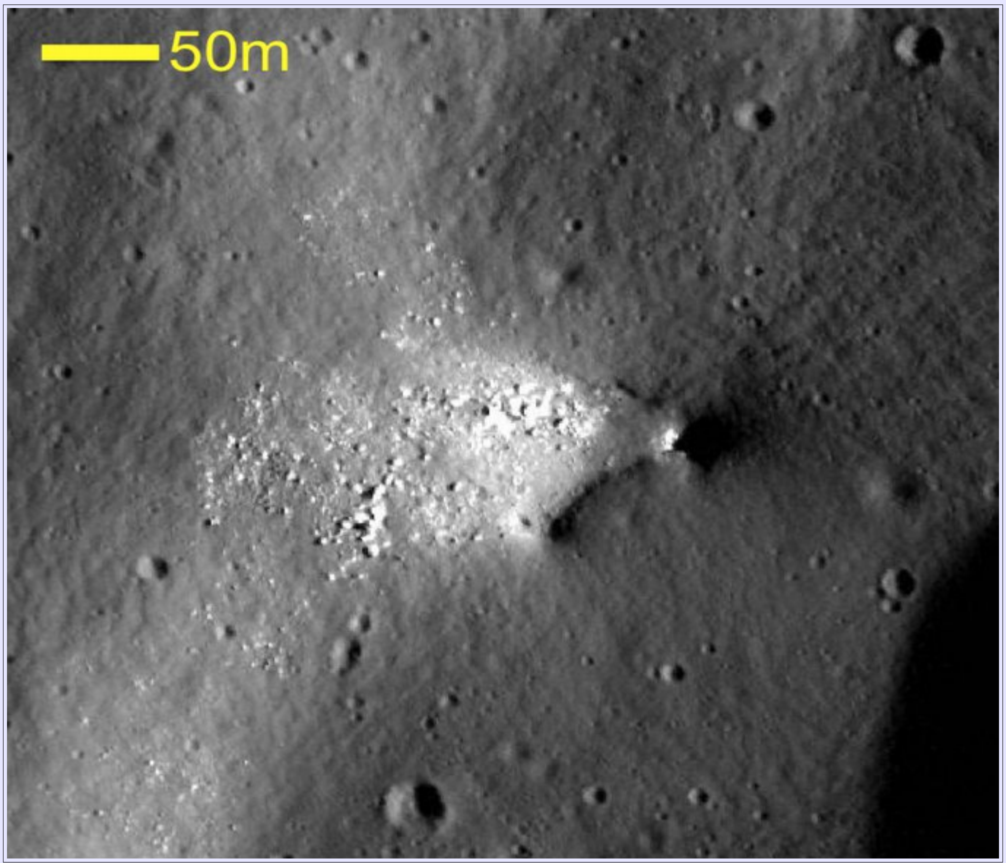

Fig.12 NAC detail of the pit or skylight at the base of the eastern depression in feature 'e'. Note the bright fan of boulders which are more exposed closer to the pit than further away.

This process might have piled up the finer material over the central mound producing its rather fine grained surface texture. The fact that the most bouldery part of the 'fan' is closest to the pit is supportive of the outgassing scenario, as this is where the effect would be most pronounced, whilst the local morphology is quite reminiscent of that seen in conventional IMP's. If this is a correct interpretation this would be a rare example of an outgassing vent, something that I do not think has been recorded elsewhere on the lunar surface.

So, a number of features within Sinus Honoris could be examples of what I have termed iIMP's, and which may be the result of a limited amount of outgassing from beneath the surface, resulting in the removal of the finer surface regolith and exposure of rockier, fresher material beneath. The key word here is *may* as these ideas are base on a limited amount of data and an extrapolation of one interpretation of how IMPs in general form. It is always possible that these are not related in any way to outgassing but are simply the result of mass wastage as surface material slumps down slope under gravity, without any help from escaping gas.

In the case of feature 'a' the light patches on the northern inner wall shown in Fig.4 may simply be mass wastage scars, where only the surface material has slumped away and the rockier subsurface has not been exposed to erosion. This would be difficult to disprove, but the presence of quite discrete features nearby such as those shown in Fig.5 which are morphologically similar to other suspected iIMPs (such as those in Fig.1) suggest a possible link. Additionally the correspondence of the distribution of these light patches to the increased abundance of clinopyroxene within 'a' would be consistent with what is observed in other IMP's.

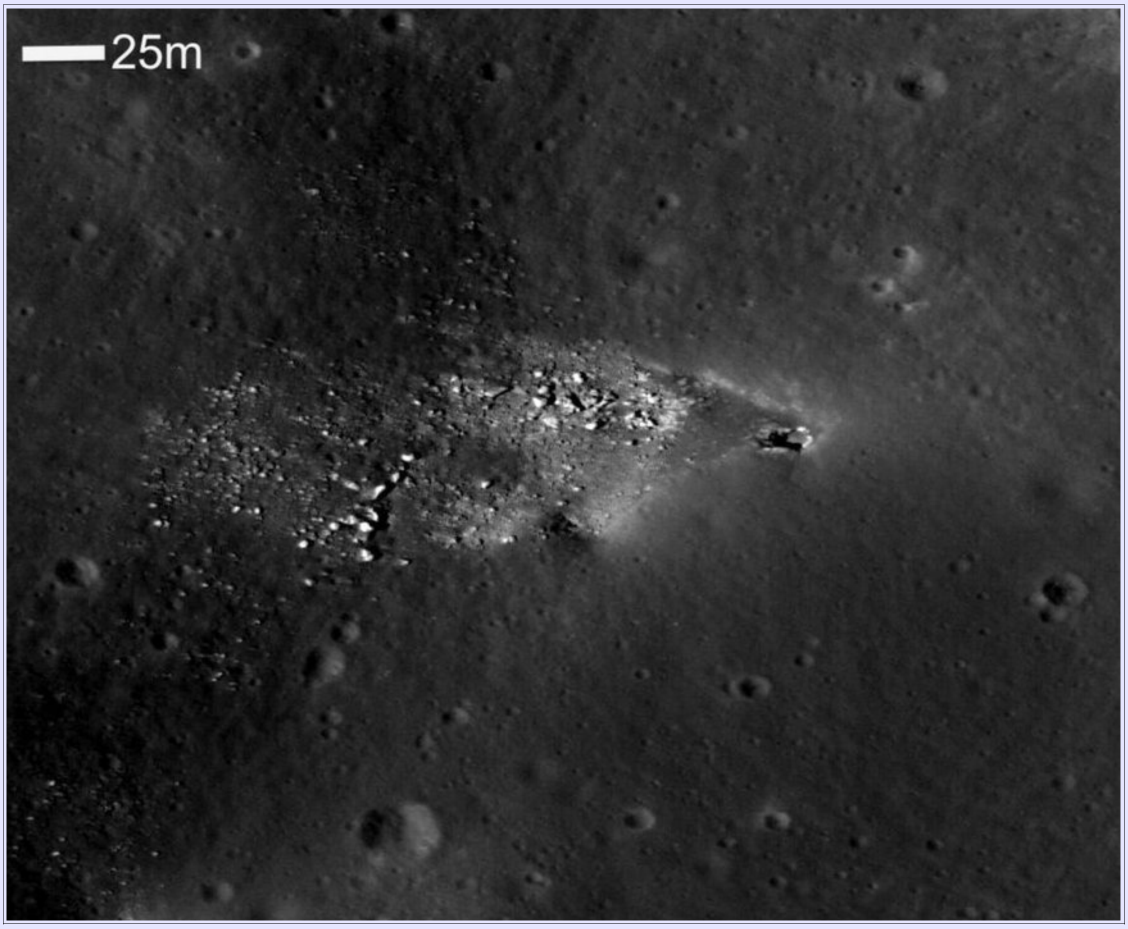

Fig.13 NAC image of the the pit or skylight at the base of the eastern depression with its bright rim, possibly indicating freshly exposed material. Note the interior of the cavity is illuminated. Also note the boulders closer to the pit are more exposed than those further away.

In the case of feature 'c' which is most probably a ridge of highland material poking up from beneath the lavas covering Sinus Honoris, mass wastage would again be the most obvious interpretation of the light patches. Here however the patches are distributed along the summit where slopes are negligible or gentle at best, and they are restricted to the southern part of the hill, whereas mass wastage could be expected on any slopes with sufficient gradient. Fig.9 is a good illustration of this where what *appears* to be a linear feature runs along the summit and light patches are arranged to either side and down slope, as if the material forming them originated here. This would appear quite unlike the behaviour we would expect from mass wastage. The increased abundance of olivine associated with these patches as shown in Fig.10 again suggests something other than mass wastage.

Feature 'e' is unlikely to be the product of mass wastage as here we have a distinct pit or skylight with evidence of erosion of the surficial regolith nearby – it *is* possible that the boulders in the fan shown in Fig's 12 and 13 are rolling downhill into the pit from the slopes on the left, but erosion by outgassing *from* the pit is more consistent with what we see.

These examples in Sinus Honoris are also rather unique, and nothing with a similar morphology (such as the light patches on the elevated features 'b' to 'd') is present on adjacent terrain, it is restricted to these specific locations. Sinus Honoris is also near to the Sosigenes and Rimae Sosigenes complex with their extensive IMPs, so activity of this sort is not wholly out of place here. Are they iIMPs though? I would say that I am leaning heavily towards that interpretation, whilst recognising that some other process such as mass wastage could be responsible – what do you think?

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Lunar Geological Change Detection Programme.
By Tony Cook.

TLP Reports: No TLP reports were received for January.

Routine reports received for December included: Alberto Anunziato (Argentina – SLA) observed: Aristillus, Copernicus, Eratosthenes, Plato, Vallis Schroteri. Massimo Alessandro Bianchi (Italy – UAI) imaged: several features. Maurice Collins (New Zealand - ALPO/BAA/RASNZ) imaged: Archimedes, Clavius, and several features. Walter Elias (Argentina – AEA) imaged: Kepler and Plato. Valerio Fontani (Italy – UAI) imaged: Cyrillus. Jean-Marc Lechopier (Teneriffe, Spain – UAI) imaged: Cyrillus. Bill Leatherbarrow (Sheffield, UK – BAA) imaged: Bullialdus, Burg-Lacus Mortis area, Catherina, Clavius, Copernicus, Fracastorius, Montes Recti, Piccolomini, Pitiscus-Hommel area, Pythagoras, and Theophilus. Euginio Polito (Italy – UAI) imaged: Aristarchus, Copernicus, Cyrillus, Ramsden and several features. Franco Taccogna (Italy – UAI) imaged: Aristarchus, Copernicus, Cyrillus, Plato, Ramsden, and several features. Aldo Tonon (Italy – UAI) imaged: Aristarchus, Mons Vinogradov, and several features. Alexander Vandenbohede (Belgium – BAA) imaged: Petavius. Fabio Verza (Italy – UAI) imaged: Plato and Ramsden. Ivan Walton (UK - BAA) imaged: Eudoxus.

Luigi Zanatta (Italy – UAI) imaged: Plato and Ramsden.

Note that due to extenuating circumstances beyond my control, I have to finish this report early, so a few observations are missing, and will try to include them next month with the rest of the January observations received – then hopefully we shall have caught up.

Analysis of Routine Reports Received (December):

Copernicus: On 2023 Dec 06 UT 06:09 Bill Leatherbarrow imaged this crater just 9 min outside the ±0.5˚ similar illumination criterion for the following TLP report:

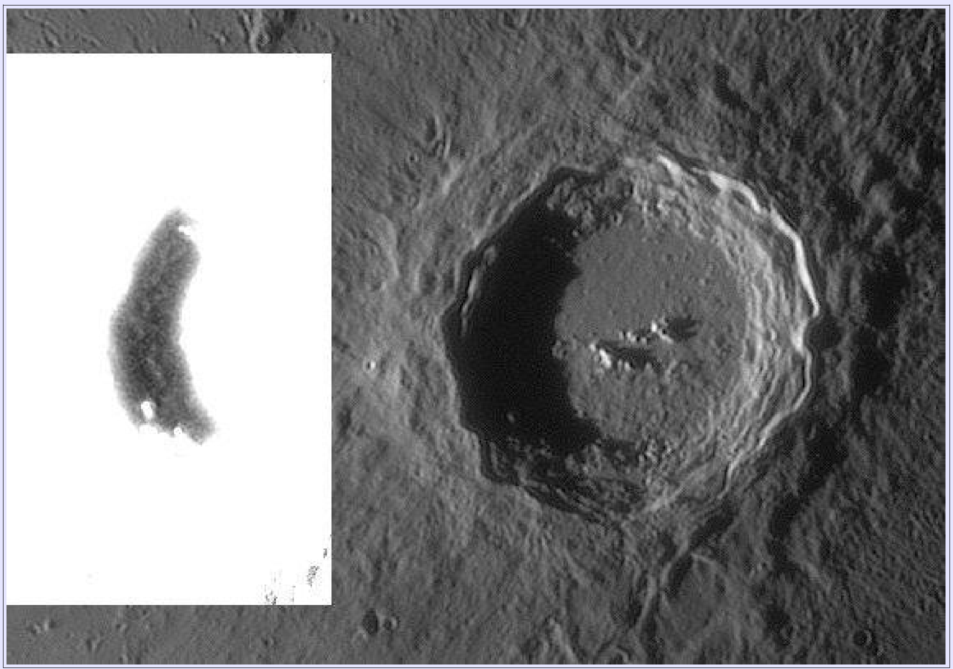

Figure 1. Copernicus as imaged by Bill Leatherbarrow on 2023 Dec 06 UT 06:09 and orientated with north towards the top. The left insert is a contrast stretched view of the west shadow interior.

In 1899 Aug 29 at UT 15:30-16:15 Fauth (Landstuhl, Germany) noted that the inner parts of Copernicus glowed in weak phosphorescent light though not directly illuminated by the Sun. He thought it probably due to multiple reflections from lighted walls. The craters Bullialdus and Reinhold did not show this effect though. The Cameron 1978 catalog ID=305 and the weight=0. The ALPO/BAA weight=1.

After doing a contrast stretch (Fig 1 – Left), on the inner shadow of Copernicus in Bill's image, it's possible to see some faint terracing inside the interior west shadow – undoubtedly illuminated by light from the rest of the crater. I think it is reasonable therefore to lower the weight from 1 to 0 and remove it from the TLP database. This matches the original Cameron weight of 0. Fauth must have good eyesight to spot this effect though because as you can see its quite faint, even with modern equipment.

Cyrillus: On 2023 Dec 18 UAI members: Valerio Fontani, Jean-Marc Lechopier, Eugenio Polito, and Franco Taccogna, imaged this crater according to the following lunar schedule request:

BAA Request: Cyrillus. There is a small white craterlet just north of the three central peaks. We are interested to receive high resolution images of this in order to find out at what selenographic colongitude, in the lunar evening, that it loses its white spot appearance. Please use scopes larger than 5 inches in diameter. Please email these to: a t c @ a b e r . a c . u k

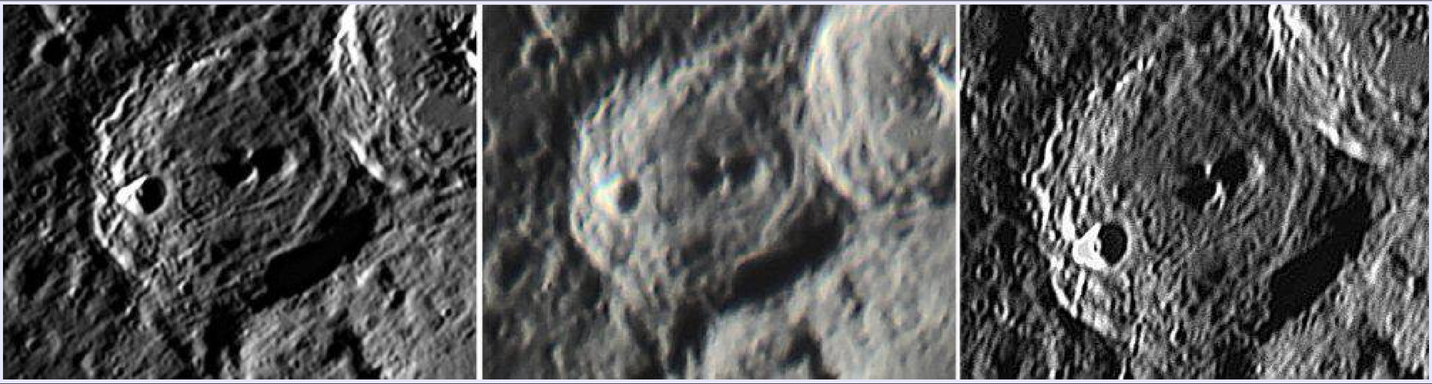

Figure 2. Cyrillus as imaged by UAI observers on 2023 Dec 18 and orientated with north at the top. (Left) imaged by Eugino Polito at 16:46 UT (Centre) Imaged by Valerio Fontani at 18:00 UT. (Right) Imaged by Jean-Marc Lechopier at 18:24UT.

None of the images in Fig 2 reveal the small but bright spot just north of the three central peaks. Therefore for the evening apparition of this spot, we know that selenography colongitudes: 344.4-345.2˚are too late into the evening, therefore the lunar schedule program will try earlier colongitudes in the evening to see if the light spot shows up.

Mons Piton: On 2023 Dec 20 UT 01:00 Ivan Walton (BAA) used a remotely operated telescope in Chile to capture a whole Moon image, but it included Mons Piton and Proclus which are mentioned in the TLP report below:

On 1992 Oct 04 at UT 02:15-03:18 D. Louderback (South Bend, WA, USA, 3" refractor, x80) found that Mons Piton was very bright and was equal to Proclus (brightness of 9) in white light and 7.5 in violet, and 9.3 in red (Proclus was 9.2 in red). Ïn blue both features = (9?). "points on Piton affected were B, D, and C (S, W & N resp.) D in violet was fuzzy - ill defined". The Cameron 2006 catalog ID=454 and the weight=4. The ALPO/BAA weight=2.

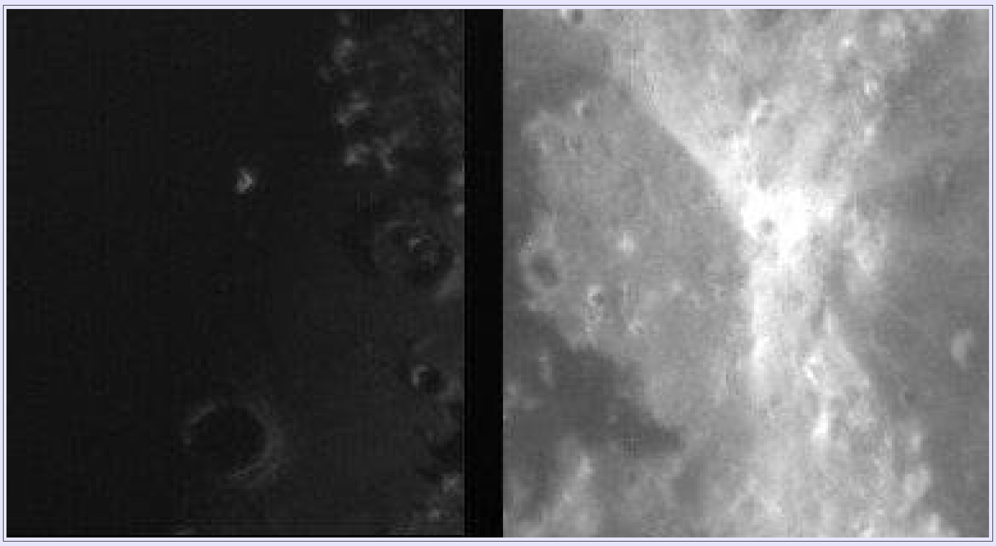

Figure 3. Subsections of an image by Ivan Walton (BAA) taken on 2023 Dec 20 UT 01:00. (Left) Mons Piton and Archimedes. (Right) Proclus.

Ivan's image (Fig 3) shows that at this illumination, Mons Piton was less bright than Proclus. We shall therefore increase the ALPO/BAA weight from 2 to 3.

Censorinus and Proclus: On 2023 Dec 21 UT 08:43-08:47 Maurice Collins (ALPO.BAA/RASNZ) made a Moon mosaic (Fig 4 – top) that covered similar illumination to the following report:

On 1981 May 12 UT 22:45-2325 M.C. Cook (Frimley, UK and using a 12" reflector), noticed that Censorinus was very bright, fuzzy and occasionally brighter than Proclus. However both Foley (Kent, UK) and Amery

(Reading, UK) using a C.E.D. found that Proclus was brighter than Censorinus as it had been during April and May 1981. However Chapman obtained the reverse of this. Cameron 2006 extension catalog ID=138 and weight=3. ALPO/BAA weight=1.

Although we don't have a functional Crater Extinction Device (CED) now for observers to look at a feature and keep on adding neutral density filters until it's no longer visible – hence estimating its brightness, we can do a similar thing with image processing. This can be achieved by either placing a cursor over the brightest part of a feature and taking an average over a small area or alternatively by contrast stretching to darken the rest of the Moon until we only see the brightest features remain – akin to brightness thresholding i.e. anything below a given brightness value is black and anything above is white. Anyway doing this to Maurice's image (Fig 4 – bottom) shows that Proclus has a greater proportion of bright pixels on its northern rim than Censorinus. I have also checked maximum pixel values, with a cursor, and Proclus also wins out here. Therefore Proclus is brighter than Kepler. This concurs with the Foley and Amery reports but contradicts the Chapman observation. To be honest using a CED is tricky. From my own experience of using the device, a few decades ago, I found that when you have the most dense filter in place, the sensitivity of the eye depends upon how long you look through them as the eye/brain get dark adapted. Originally invented by the professional astronomer David Jewitt, the CED was designed originally as a way of comparing bright features in a quantitative way and was a definite improvement of amateurs just saying "Aristarchus is looking bright tonight". Another deficiency of CEDs I suspect is that detectability is affected by contrast of the brightness of a feature to its background, and for small bright features, these can be blurred by poor seeing conditions making them drop their peak brightness considerably as the photon flux is spread into neighbouring pixels on the camera or in one's eyes. Libration of sun-facing slopes affects viewing angle and may also make features appear brighter at the same colongitude on one observing session but less bright on another occasion.

Figure 4. Wide angle area of the Moon covering the bright ray craters: Censorinus and Proclus, Taken by Maurice Collins (ALPO/BAA/RASNZ) on 2023 Dec 21 UT 08:43-08:47 and orientated with north towards the top. (Top) Original image. (Bottom) image highly contrast stretched to bring out the brightest features.

Eratosthenes: On 2023 Dec 22 UT 02:41-02:47 Alberto Anunziato (SLA) observed visually this crater under similar illumination to the following report:

On 1936 Oct 25 at 01:35 UT W. Haas (Alliance, OH, USA, 12" reflector) saw small bright spots on the floor of Eratosthenes, (Pickering's atlas 9A, col. 30deg, shows no spots - according to Cameron). Cameron 1978 catalog TLP=417 and weight=4. ALPO/BAA weight=1.

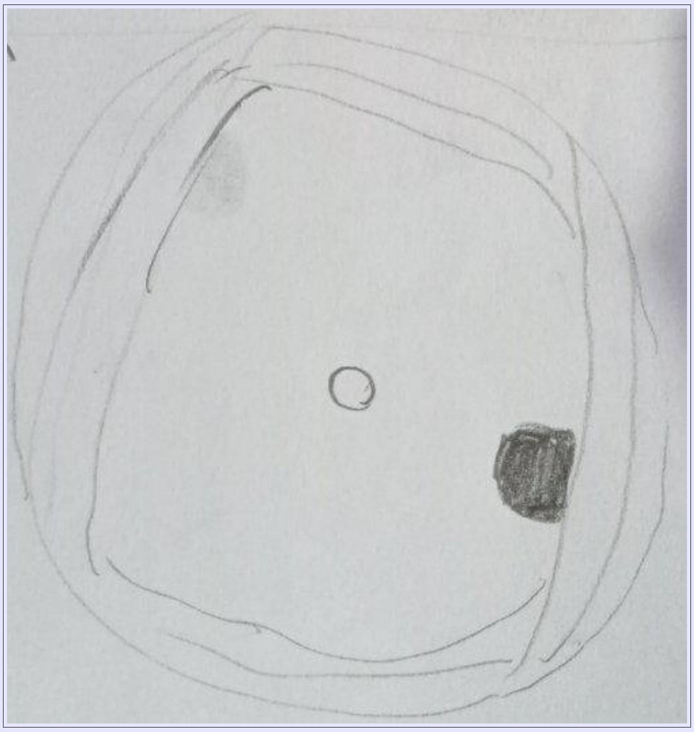

Figure 5. Eratatosthenes as sketched by Alberto Anunziato on 2023 Dec 22 UT 02:41-02:47 using a Meade EX 105 at x196. Sketch re-orientated so that north is towards the top.

Alberto, commented that there was a bright spot, in a zone as indicated in Fig 5, that he thought could be into the floor, southwest or maybe even in the outer wall? We shall leave this at a weight of 1 for now.

Plato: On 2023 Dec 26 UT 18:00 Franco Taccogna (UAI) imaged during the repeat illumination window, and Massimo Alessandro Bianchi imaged at UT18:40, just 10 minutes after the similar illumination window for the following TLP report:

On 1992 Oct 10 at 18:57-19:04 UT I.S.Brukhanov (of Minsk, Belarus, using a 6" refractor x40 and x98) saw a star like point inside Plato crater of similar brightness to the central peak of Alphonsus. The event lasted 90 seconds before weakening and vanishing completely at 19:04UT. Cameron 2006 catalog extension ID=455 and weight=3. ALPO/BAA weight=3.

No sign can be found of anything on the floor of Plato (Fig 6 Top) representing something of similar brightness to the central peak of Alphonsus (Fig 6 – bottom) and the duration of the 1992 event might infer that it was outgassing or the after effects of an impact event. However no other observers saw this so we shall leave the weight at 3 for now.

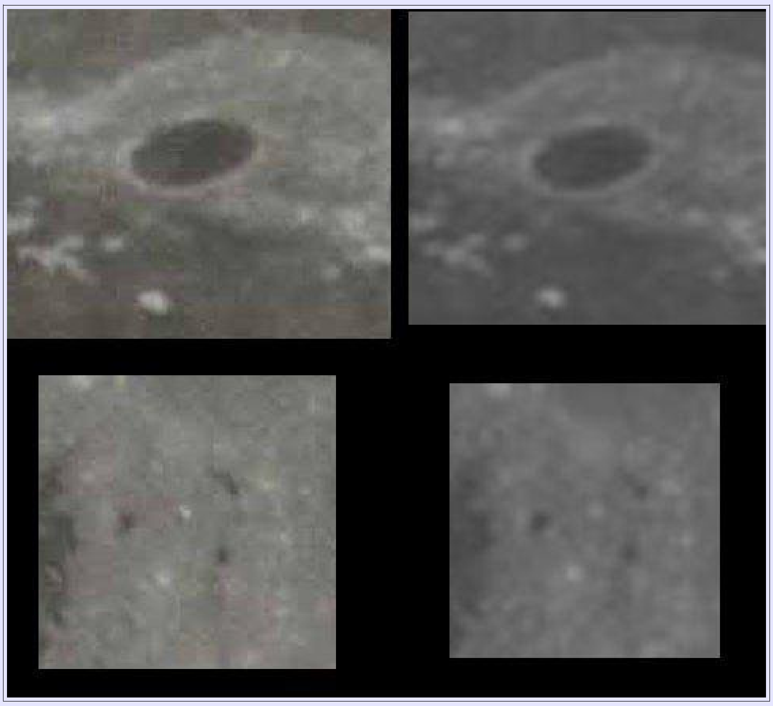

Figure 6. Plato (Top) and Alphonsus (Bottom) on 2023 Dec 26, cut out from larger image mosaics and orientated with north towards the top. (Left) Taken by Franco Taccogna at 18:30 UT. (Right) Taken by Massimo Alessandro Bianchi imaged at UT18:40.

Kepler: On 2023 Dec 31 UT 04:06 Walter Elias (AEA) imaged this crater under similar illumination to the following report:

Near Kepler 1966 Dec 31 UT 03:00? Observed by Petrova, Pospergelis (Pulkova Observatory, Russia) "Special glow in this area. Confirmed by photoelectric method (Petrova) & polarimetric (Pospergelis?) almost simultaneously recorded by both" NASA catalog weight=5. NASA catalog ID #1007. ALPO/BAA weight=4.

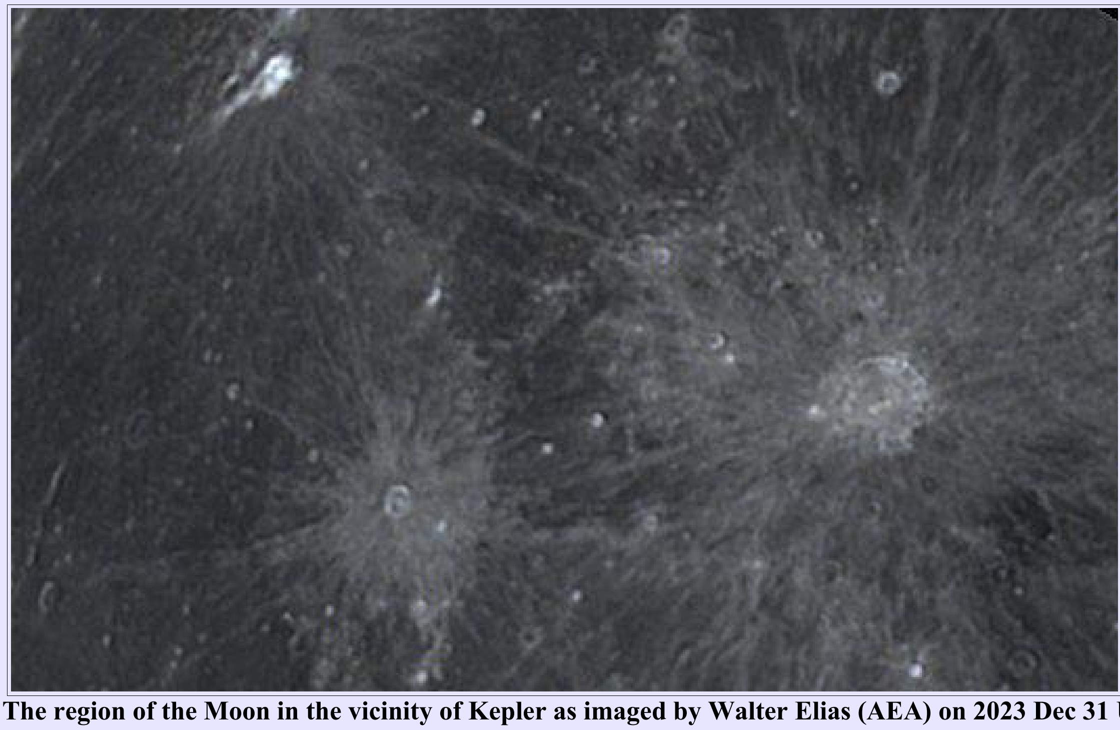

Figure 7. The region of the Moon in the vicinity of Kepler as imaged by Walter Elias (AEA) on 2023 Dec 31 UT 04:06.

Figure 7 shows no obvious “special glow” near Kepler – so you can see why Cameron assigned a weight of 5. The ALPO/BAA weight is less at 4 as it is unclear whether an independent confirming report was made. Also the UT given in the Cameron catalog of 03:00 is an estimate, and it is unclear whether the terms "photoelectric" and "polarimetric" imply single point measurements (it can be tricky to guarantee that a photometer aperture is centred exactly over a crater) or had some imaging capability e.g. micro-densitometer scans of photographic plates. But anyway Walter's image shows that everything should normally appear like Fig 7 in this area with Aristarchus appearing considerably brighter than the ray craters of Kepler and Copernicus. We shall leave the weight at 4 for now until we find out more information about the original report.

Analysis of Routine Reports Received (January):

Alphonsus: On 2024 Jan 18 UT 21:31 Liz Daly (NAS) imaged the Moon for the first time, using a mobile phone against a 20mm eyepiece on a 102 Maksutov Skywatcher (1300 mm focal length). By chance this was under similar illumination to the following 1970's report:

Alphonsus 1972 Sep 15 UT 18:48-18:56 Observed by Hopp (13.25E, 52.5N, 75mm refractor) "Diffuse white to blue area within the crater - not sure" T=4, S=4. Ref: Hilbrecht & Kuveler Moon & Planets (1984) Vol 30, pp53-61. Cameron Catalog weight=1. ALPO/BAA weight=1.

Figure 8: A wide angle view of the area of Alphonsus, taken by Liz Daly (NAS) on 2024 Jan 18 UT 21:31, orientated with north towards the top. Made using a Skywatcher 102 Mak with 1300mm focal length with a mobile phone attached to a 20mm eyepiece. The image has been sharpened, rotated, and had colour saturation increased to bring out colours. The curve on the right is the edge of the eyepiece.

Please bear in mind that Fig 8 was Liz's first ever imaging effort at the Moon through a telescope and is only a small part of the original image. Nevertheless it has sufficient detail to show that what Hopp saw back in 1972, visually through an inferior instrument was most likely the central peak of the crater emerging from the shadow. Liz's image also shows a faint blue colour which could be due to chromatic aberration from the glass in the lens – something which could easily have affected Hopp with a small refractor too. As Cameron had many doubts about the reports in the Moon and Planets paper, principally because they were made with small scopes, I will lower the ALPO/BAA weight from 1 to 0 and remove it from the TLP data base.

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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