Lunar Section
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British Astronomical Association
Director: Bill Leatherbarrow

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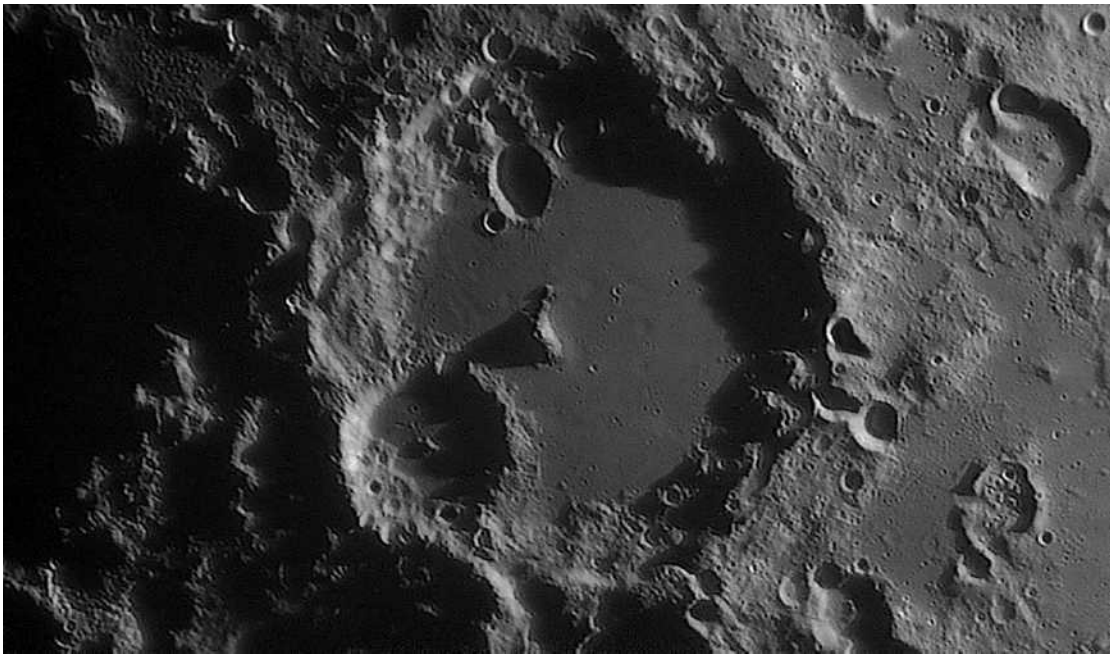
FROM THE DIRECTOR



Central peak summit crater in Albategnius, 29 May 2020, C14 (Leo Aerts)

We are now deep into that time of year when, for observers in the northern hemisphere, telescopic observation becomes difficult because of short hours of darkness and the low altitude of the Moon and planets. The lunar observer at least has the option of turning to the various spacecraft datasets and websites such as QuickMap in order to continue study of our satellite.

The two articles by Raf Lena and Barry Fitz-Gerald in this issue show what can be achieved using such resources. Barry's article on Gassendi raises among other things an issue that has long interested me: the nature and frequency of summit craters on central peaks. Patrick Moore and H.P. Wilkins made a special search for these back in the 1950s, and they reported a great number using some of Europe's largest telescopes. They saw this as evidence for the volcanic theory of lunar crater formation, since you would expect to find summit craters on volcanic peaks, but would expect them to be rare 'lucky strikes' if they were of impact origin, since – as Patrick was fond of saying – 'the bomb does not fall into the bucket every time'!

In fact many of the summit 'craters' discovered subsequently turned out to be illusory, since the complex irregularity of such peaks when imaged in close up by spacecraft could often create under lower resolution a false impression. It might be an interesting project to compare telescope and spacecraft images of central peaks with this in mind. Barry's article, however, raises the intriguing instance of the central peak in the far-side proto-basin Compton, where the peak appears to interrupt the course of a feature that should be much younger, according to our current thinking about how central peaks are formed. Again, it would be worthwhile using spacecraft imagery to see if there are other examples of this anomaly.

If you find any, do let us know!

Bill Leatherbarrow

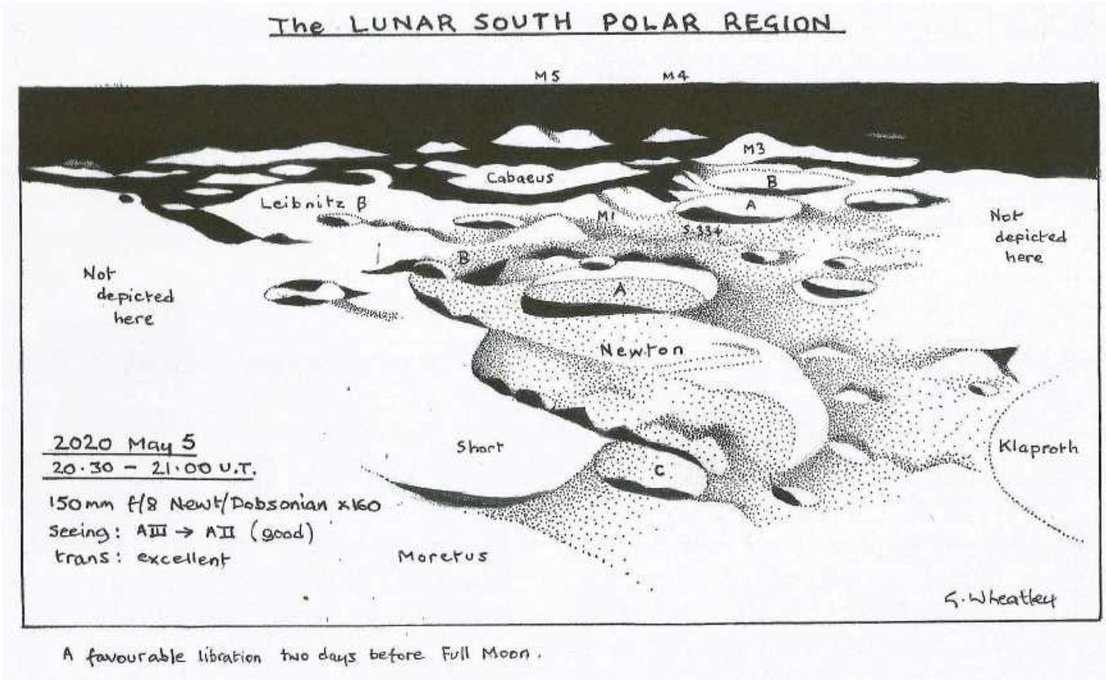
OBSERVATIONS RECEIVED

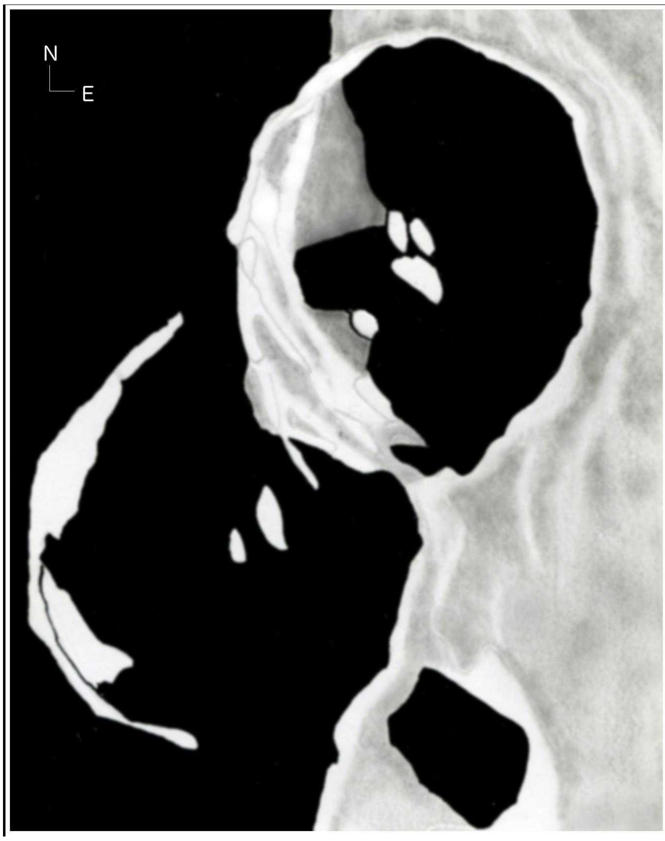
Images, drawings and/or reports have been received from the following observers: Paul Abel, Leo Aerts (Belgium), Maurice Collins (New Zealand), Rob Davies, Darryl Dobbs, Dave Finnigan, Murray Foster, Mike Foulkes, Rik Hill (USA), Rod Lyon, Simon Pinnick, Mark Radice, Phil Shepherdson, Bob Stuart, Alexander Vandenbohede (Belgium), Derrick Ward, Grahame Wheatley (via Colin Ebdon), George Whiston, and the Director.

A selection of the work received appears below, with apologies as ever to those whose contributions do not appear this month because of limitations of space. A reminder again that BAA members are welcome to post their images and drawings on the Members' Pages of the BAA website, where they will receive a wide audience. Remember though also to send your work to me for the Section archive and possible inclusion in the Circular.

LUNAR DRAWINGS

It is good to see that the art of lunar sketching is still alive, since it provides a valuable link with the past observational records of the Lunar Section. We feature here a fine sketch of the complex South Polar Regions by Grahame Wheatley and a rendering of Theophilus by Paul Abel.





Theophilus Crater

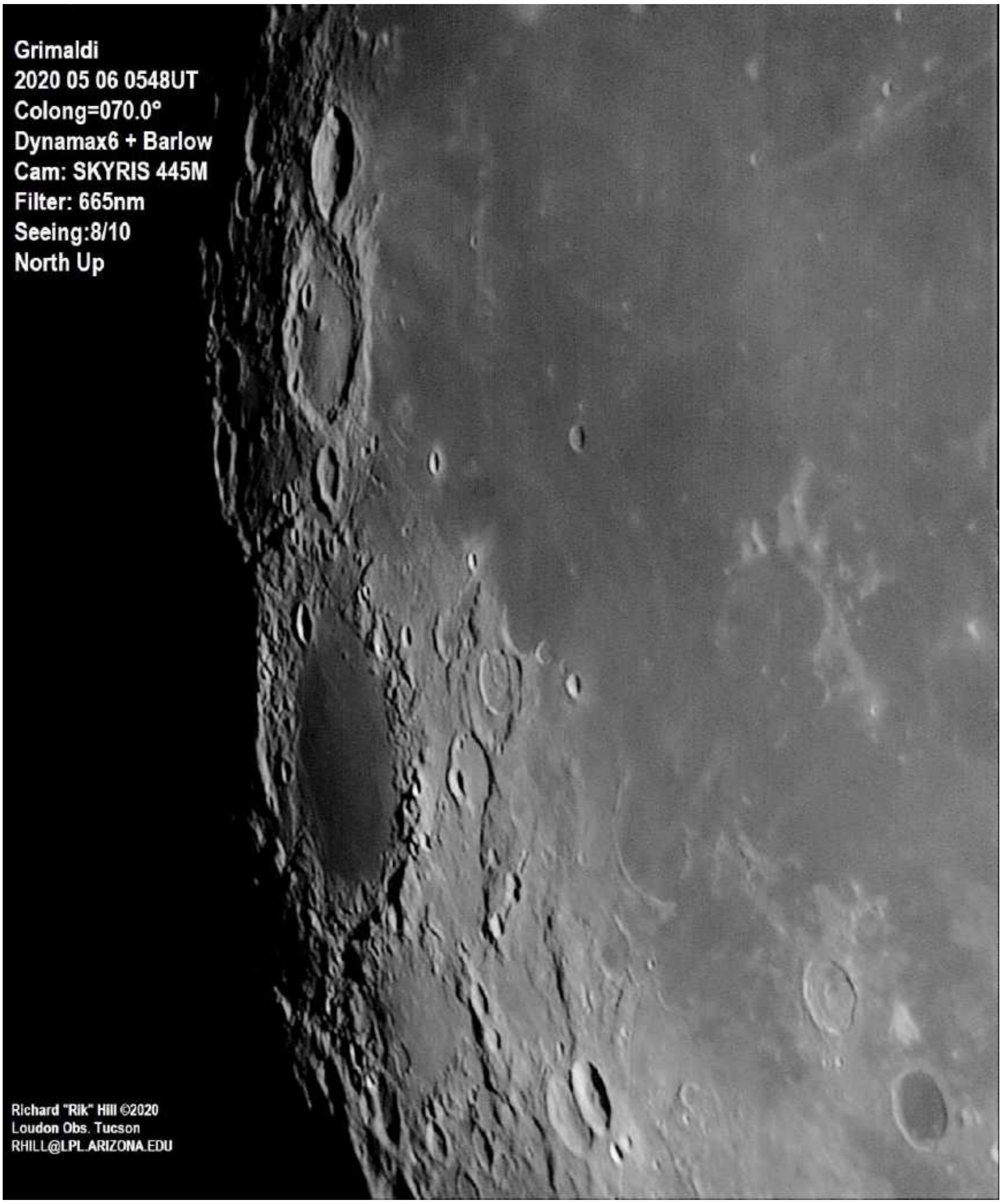
2020 May 27, Start: 2051UT Finish: 2110UT
305mm Newtonian Reflector, x167, S: AIII
Moon's age: 5.1d, Illumination: 26%

Colong: 336.7° to: 337°

Paul G. Abel, Leicester UK

IMAGES GALLERY

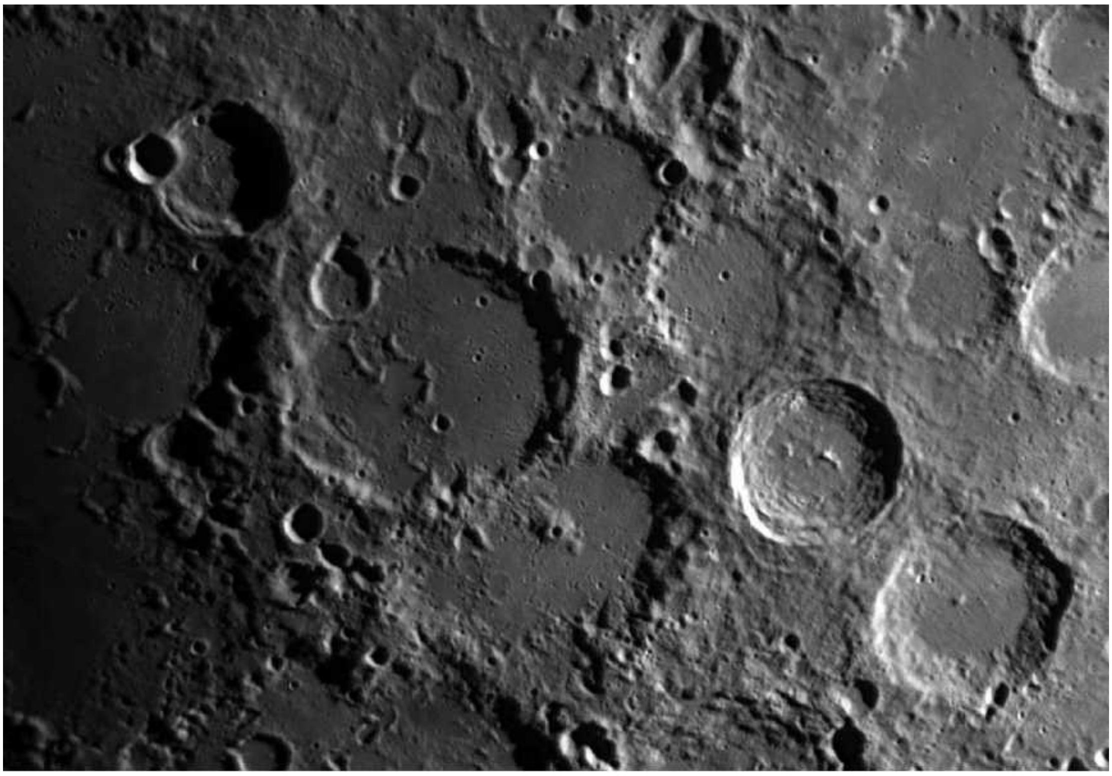
Rik Hill has submitted the following image and report on the region around Grimaldi.



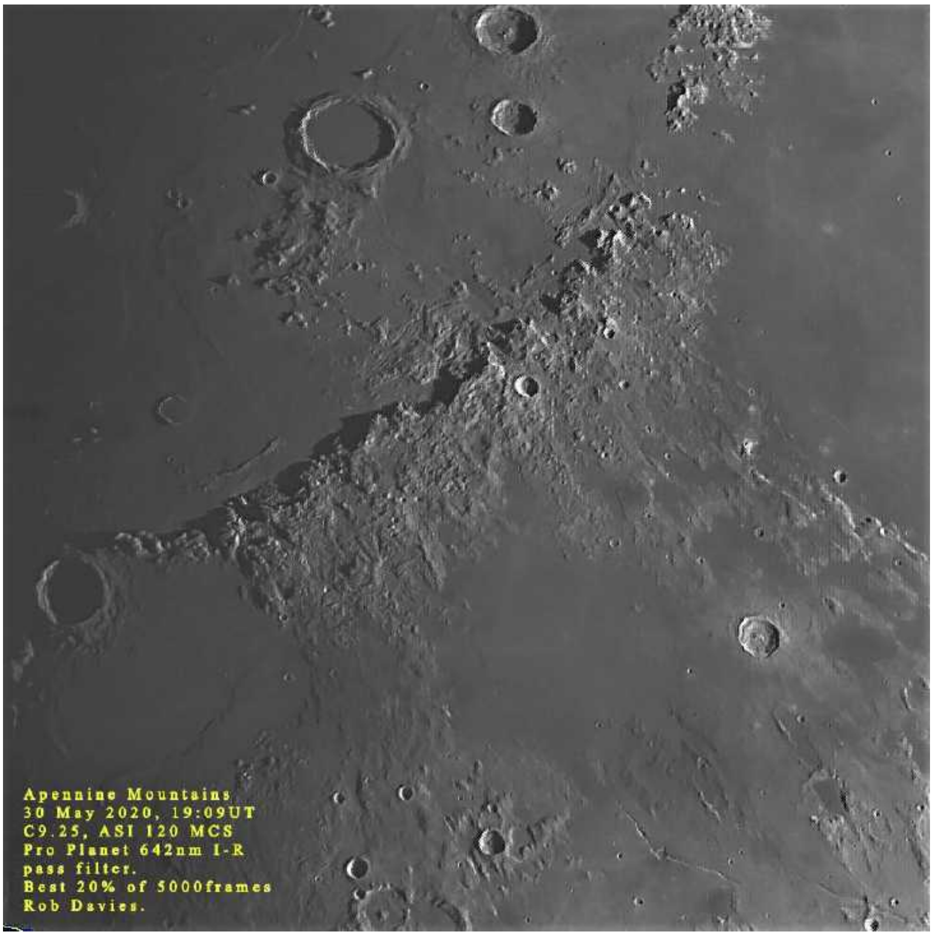
‘About a day before full moon you can see this amazing landscape in the center of the terminator. The large dark crater just left of center is Grimaldi (228km diameter) one of the stepping stones to Mare Orientale when the libration is right. There's a cluster of craters east (right) of Grimaldi. The easternmost one is Damoiseau (37km). South of this is a well defined crater near the bottom of the image, Sirsalis (43km). In the lower right corner is the dark crater Billy (48km) distinctive for its dark floor, darker than the surrounding Oceanus Procellarum making it stick out visually.

Above Grimaldi is another large crater Hevelius (109km) with the small crater Lohrmann (32km) just below. Above Hevelius is a deeper crater, Cavalerius (60km). Notice the apparent gash between Hevelius and Grimaldi. There is a shallow valley here, seen on the LROC Quick Map, and a couple of small craters that add to the effect, but it looks more dramatic than the true topography at this lighting. On both sides of Lohrmann note the unnamed system of rimae. I'm quite surprised they are not named. Another curious gash is below to the right of Grimaldi. It appears to pass through two craters but in fact is a linear alignment of around 10 eroded craters. Then south of Grimaldi are more rimae. These are named Rimae Grimaldi. They lead out into a flat area further to the south that is Rocca W (102km). As big as Hevelius but, alas, only a satellite crater to Rocca. This is definitely a region worthy of careful examination...just when you thought the Moon was almost full and there was nothing left to see!'

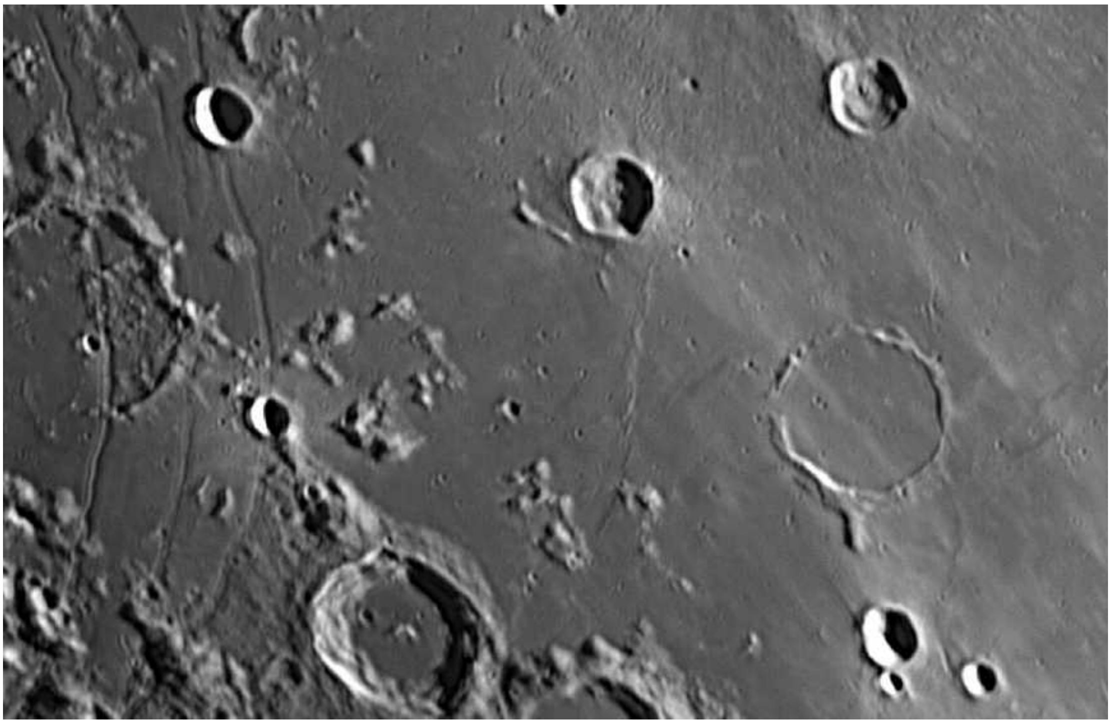
Note from the Director – The shallow gash or valley between Hevelius and Grimaldi is known informally as the Miyamori Valley and it was the object of much attention from Lunar Section observers in the 1950s and 1960s. Interested readers are referred to past issues of *The Moon*, available to BAA members via the Lunar Section website at: https://britastro.org/downloads/11775



Thebit, Purbach, Werner & Aliacensis 2020.05.30 - 18.46 UT
300mm Meade LX90, ASI224MC Camera with Pro Planet 742nm I-R Pass Filter.
400/4,000 Frames. Seeing: 7/10, with occasional wind in dome slit. Rod Lyon



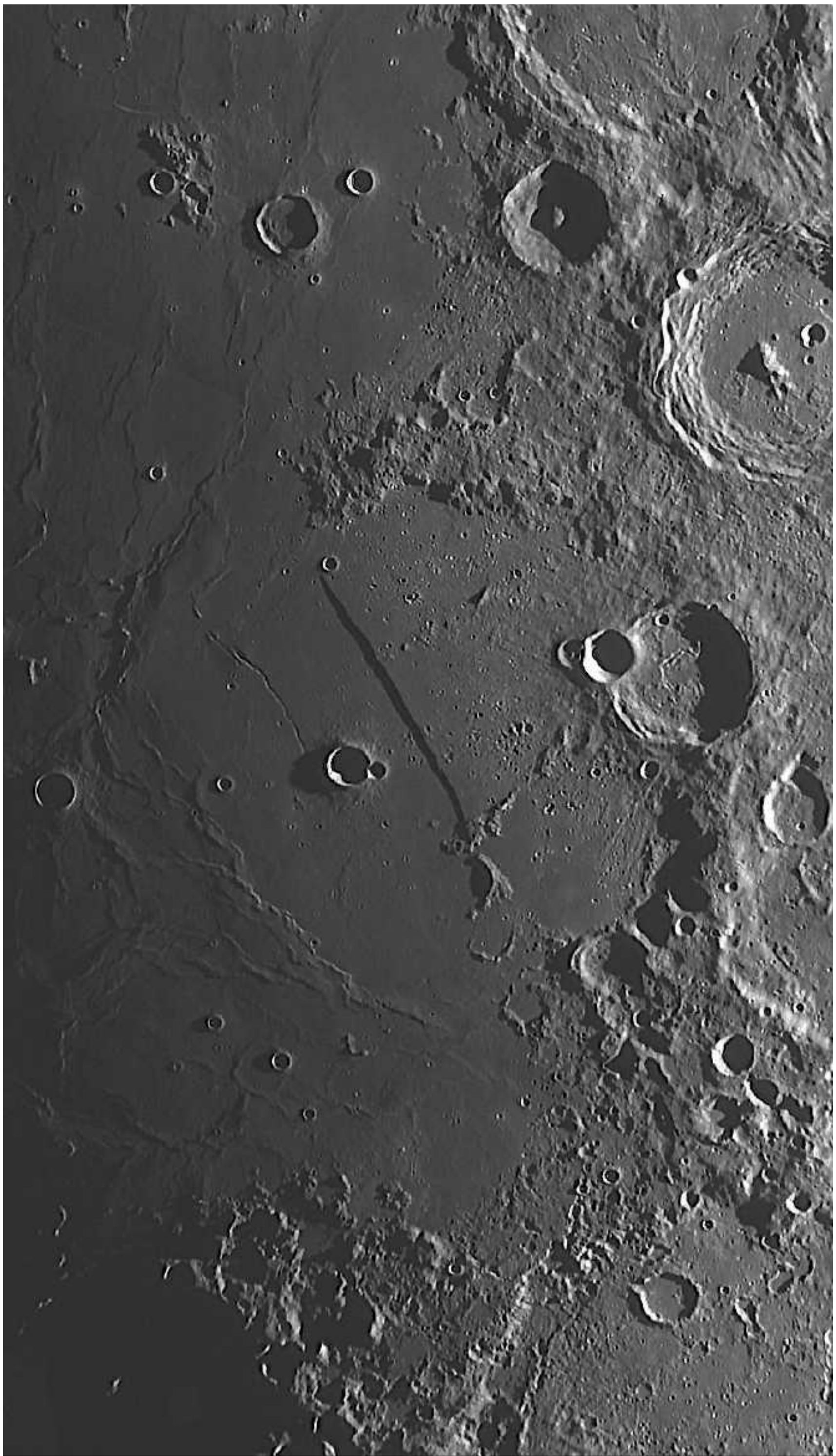
Theophilus, 28 May 2020, 22.12UT, C11 (Simon Pinnick)



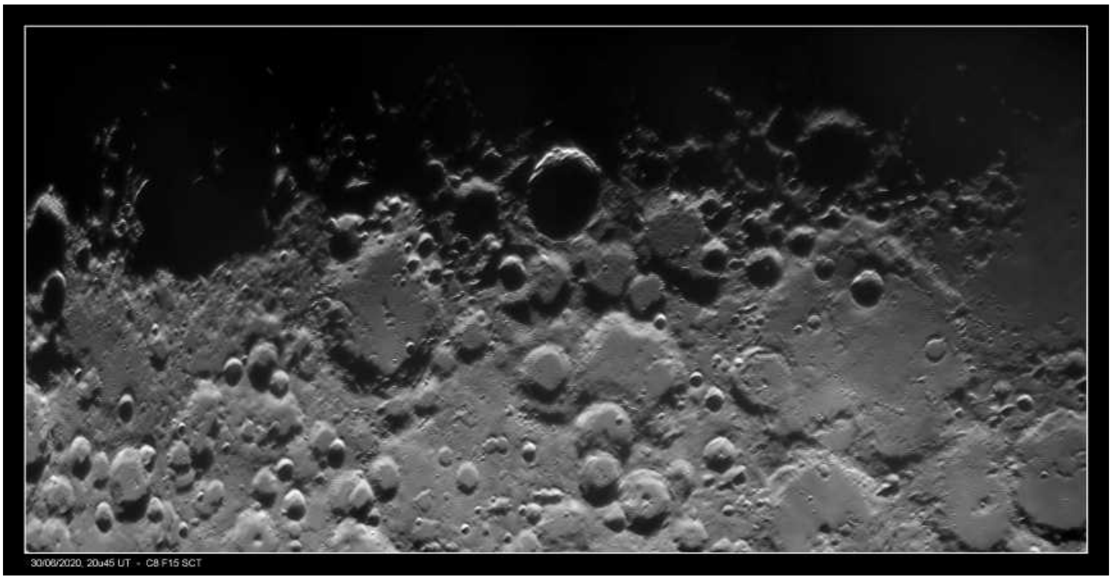
Kies and dome Kies π, 1 June 2020, C11 (Mike Foulkes)

Rupes Altai
28May 2020 2032Z
C11 f20 ASI224MC 784nm IR filter

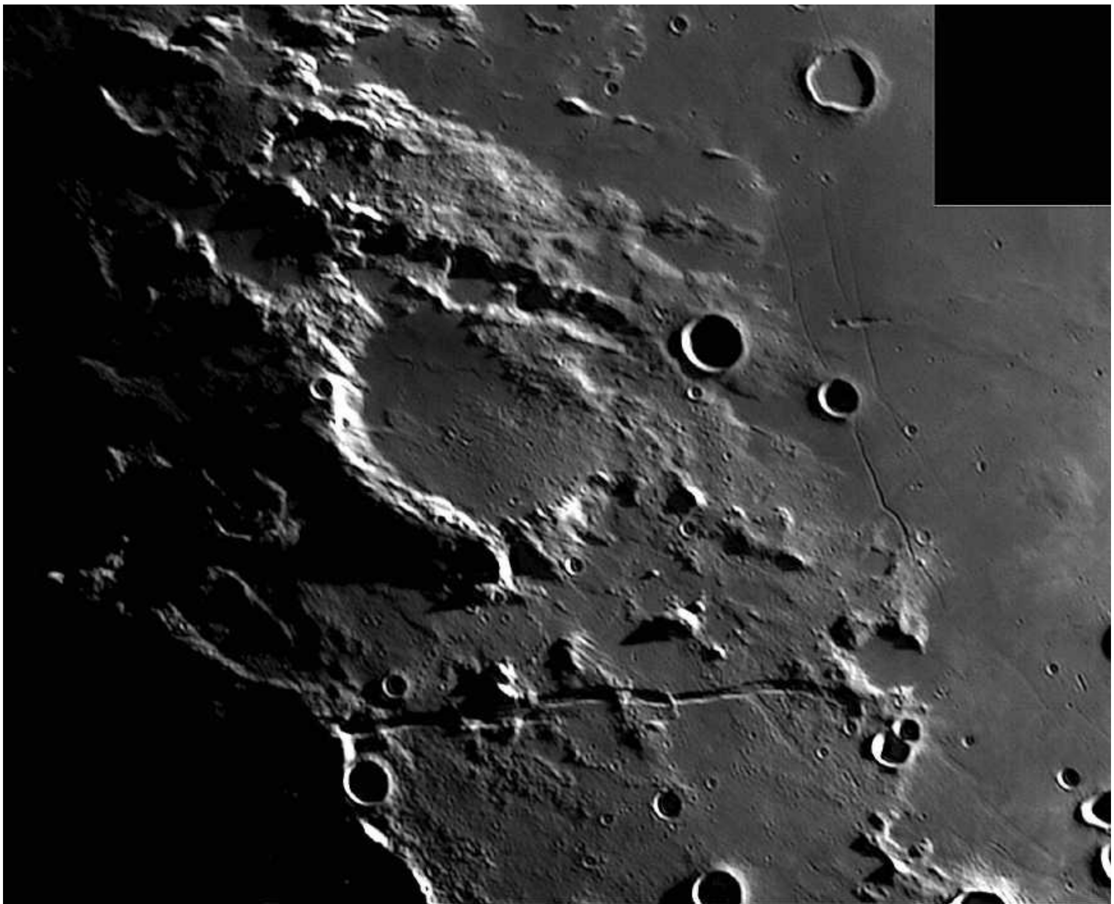
Mark Radice RefreshingvViews.com



Bob Stuart
30/05/2020 20:25UT
Birt,Straight Wall (Rupes Rectus) Rima Birt
25cm f6.3 Newtonian
ZWOI 174MM
3x PowerMate
Baader 500nm green filter



Southern Highlands, 30 May 2020, C8 (Alexander Vandenbohede)



Julius Caesar, Rima Ariadaeus, Sosigenes, Rimae Sosigenes 2020.05.28 20:57 UT, S Col. 349.5°, seeing 5/10, transparency good. Libration: latitude -4°35', longitude -05°59'
305mm Meade LX200 ACF, f 25, ZWO ASI 120MMS camera, Baader IR pass filter: 685nm.
A composite of two images, 1280 frames processed in Registax 6 and Paintshop Pro 8.
Dave Finnigan, Halesowen

LUNAR DOMES (part XXXIX): Domes in the Gambart region and spectral properties Raffaello Lena

In the June issue of the LS circular [1] I described two effusive domes near Gambart C crater, termed Gambart 1-2. The height of Gam1 was determined to 190 ± 20m, resulting in flank slopes of 1.11° ± 0.1°. It belongs to the class C_1. The height of the second examined dome, Gam2, was determined to 50 ± 5m, resulting in flank slope of 0.63° ± 0.06°. Due its morphometric properties, Gam2 is situated between classes C_1 and C_2.

To estimate the abundances of six key elements in the region of Gambart, I rely on the regression-based approach which involves the analysis of the mafic absorption trough around 1000nm present in nearly all lunar spectra. These spectral features allow us to estimate the abundances of the elements Ca, Al, Fe, Mg, Ti, and O based on a second-order polynomial regression approach, using the directly measured LP GRS abundance data as 'ground truth' [3-4]. The uncertainty of the derived elemental abundance maps is ± 1 wt%. Based on this approach, the abundances of the elements Ca, Al, Fe, Mg, Ti, and O are estimated (Fig. 1). The wt % range is as follows: aluminium (0-20 wt %), calcium (2-18 wt %), iron (0-25 wt %), magnesium (0-16 wt %), oxygen (40-47 wt %), and titanium (0-6 wt %).

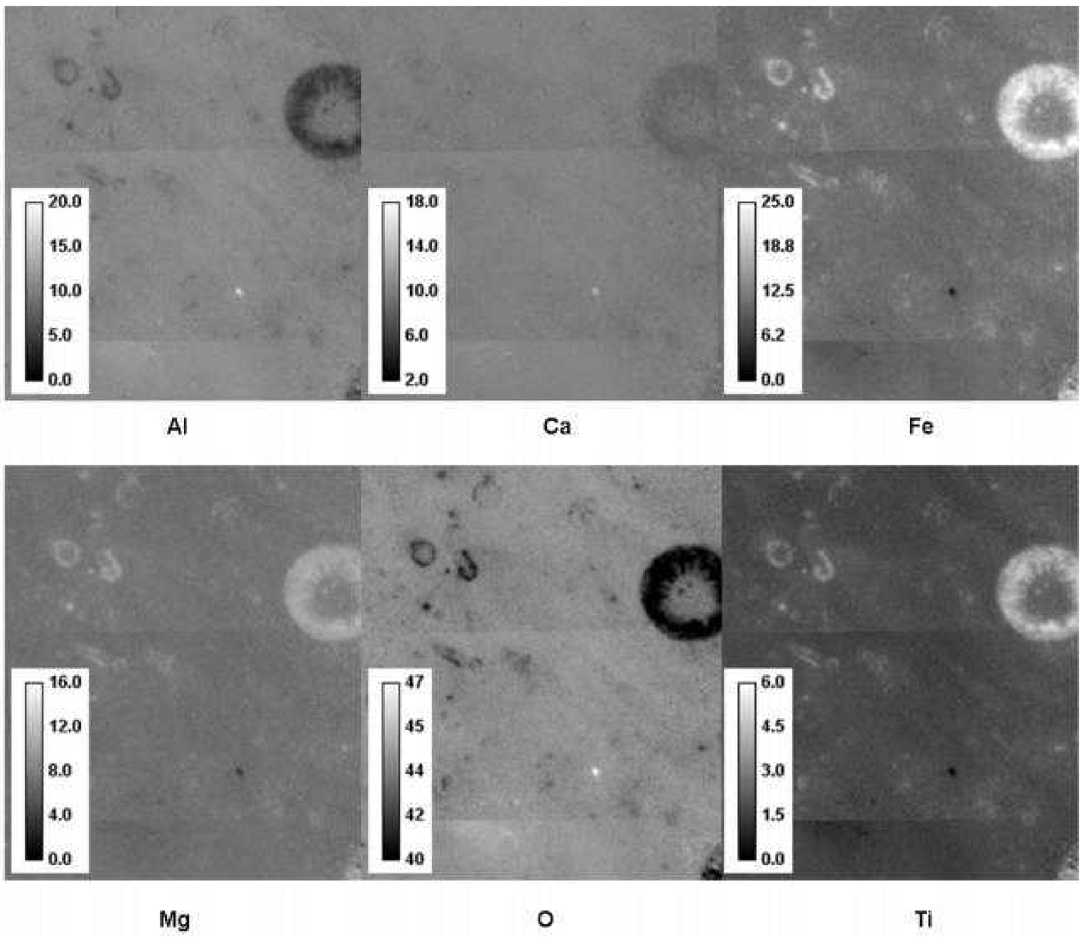


Figure 1. Elemental abundances wt %. The crater is Gambart C

Another dome, termed Gambart 3 (Gam 3), is located to the south of the crater Gambart B, at coordinates 0.42° N and 11.15° W, and near Sommering A, as shown in Fig. 2.

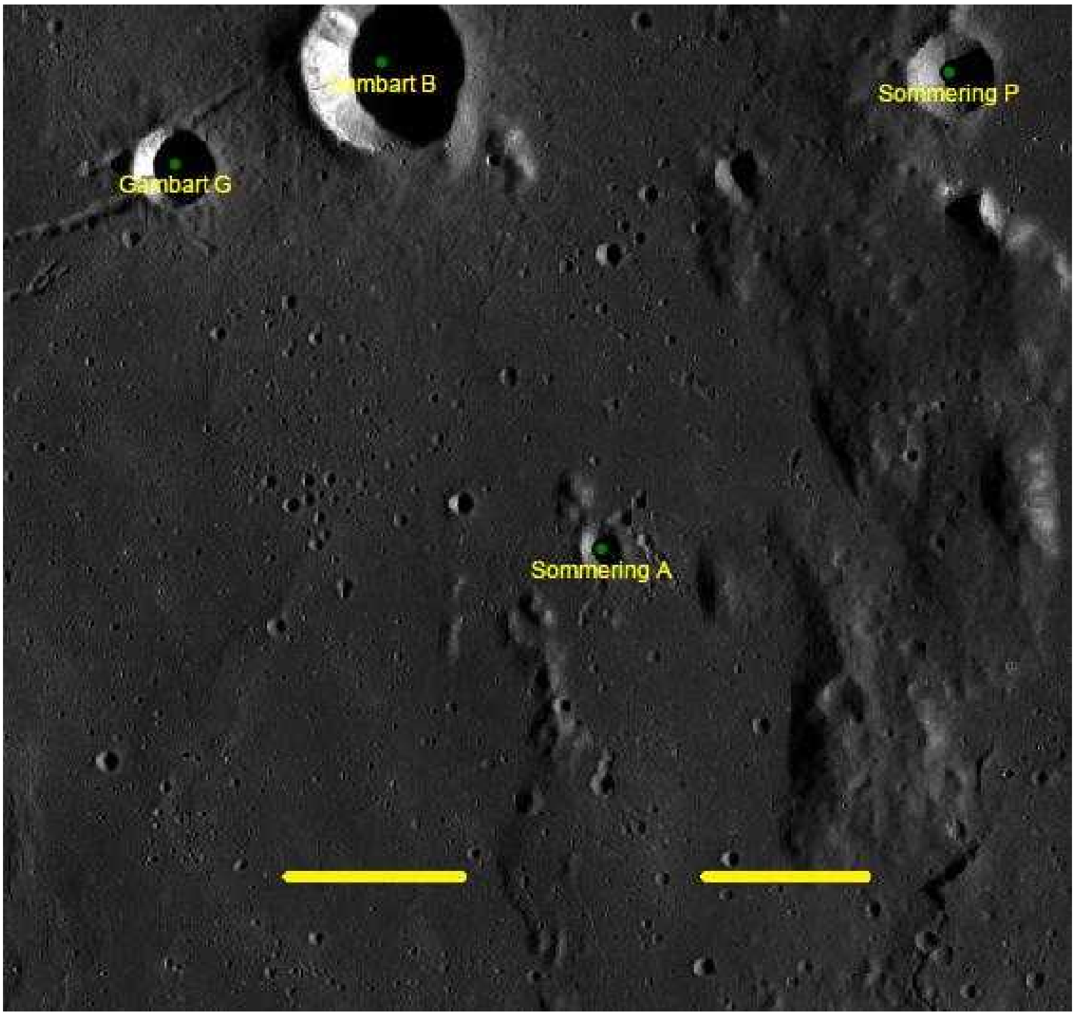


Figure 2. (Top) WAC image of the examined region. The dome Gam 3 is marked with yellow lines

Figure 3 displays the examined dome and the dome Gambart 1 in an image recently taken by the author on April 15, 2016 at 20:52 UT with a Mak-Cassegrain 18 cm.

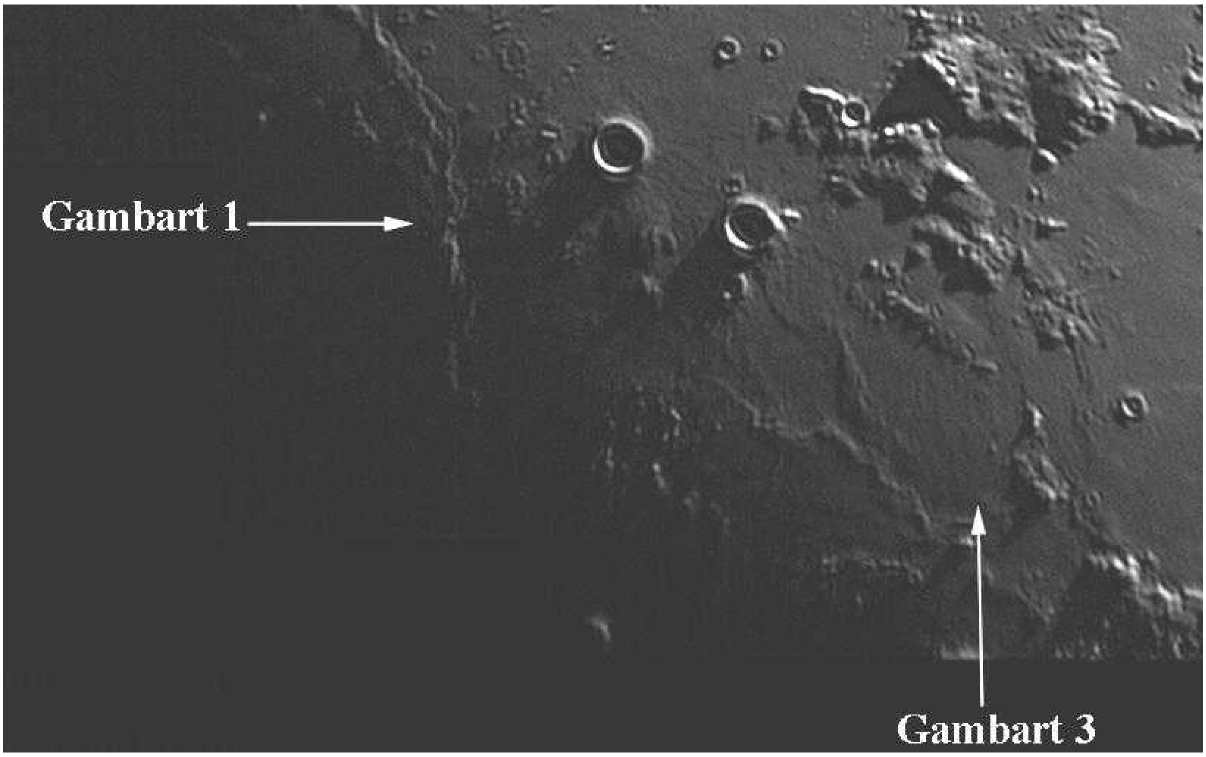


Figure 3. The domes Gambart 1 and 3. Image taken by the author (see text for detail)

Gambart 3 has a diameter of 13.0 ± 0.4km, a height of 170 ± 20m (Fig. 4), yielding a flank slope of 1.5° ± 0.1°. Assuming a typical form factor of f = 1/2, the estimated volume amounts to 11.5 km³. Fig. 4 and 5 show the 3D reconstruction results obtained with the GLD100 dataset [5].

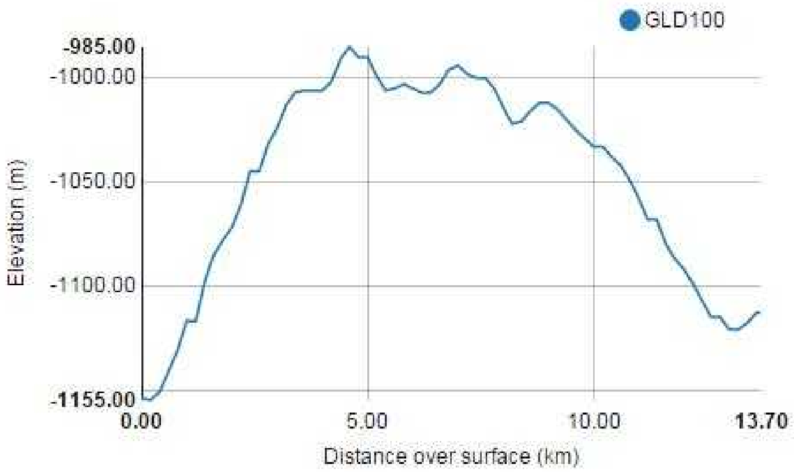


Figure 4. GLD100 dataset. E-W sectional profiles of Gambart 3

Figure 6 shows the 3D reconstruction of Gam 3, based on a combined photoclinometry and shape from shading technique applied to the telescopic CCD image.

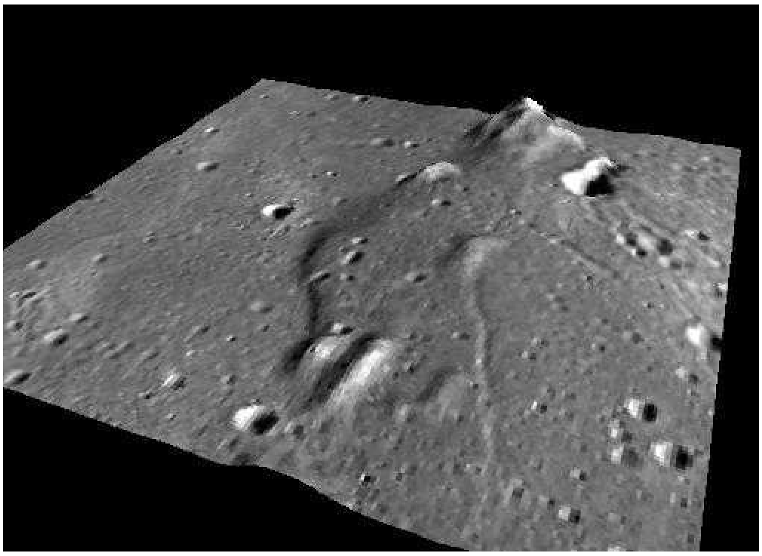


Figure 5. 3D reconstruction obtained with GLD 100 dataset. A sinuous rille lies on the dome summit

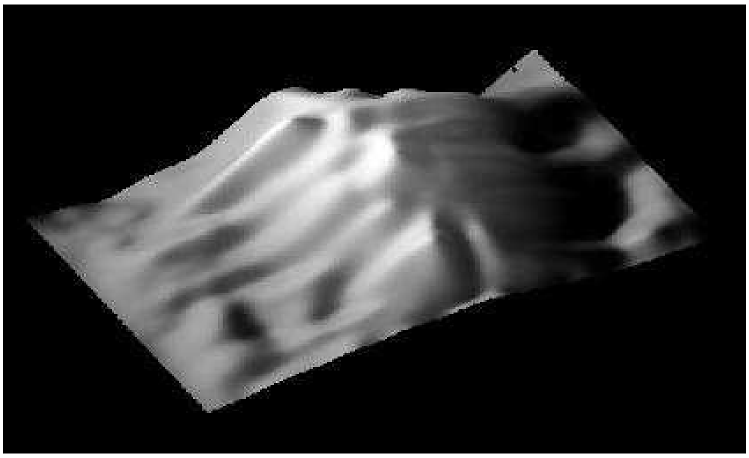


Figure 6. 3D reconstruction based on CCD telescopic image of Fig. 3

Gambart 3 belongs to class C_2 in the classification scheme for lunar mare domes [2] and formed over a period of time of about 2 years, with an effusion rate of 170 $m^3\,s^{-1}$ and lava viscosity of 8.7 $x10^5$ Pa s. The large dome Gambart 1, described in [1], was originated by lava viscosity of 2.6 $x10^5$ Pa s, a higher lava effusion rate of E = 356 $m^3\,s^{-1}$, and a duration of the effusion process of T = 2.7 years. The inferred values for Gam2 yield a lower lava viscosity of 2.6 $x10^3$ Pa s, a lava effusion rate of E = 413 $m^3\,s^{-1}$, and a duration of the effusion process of T = 0.12 years.

Figure 7 displays a WAC image where I have analyzed the spectral properties, based on global data acquired with the Moon Mineralogy Mapper (M^3), of the dome, of the *dark halo impact crater* (DHIC) south of Sommering A and of the *dark halo* south of Gambart L crater.

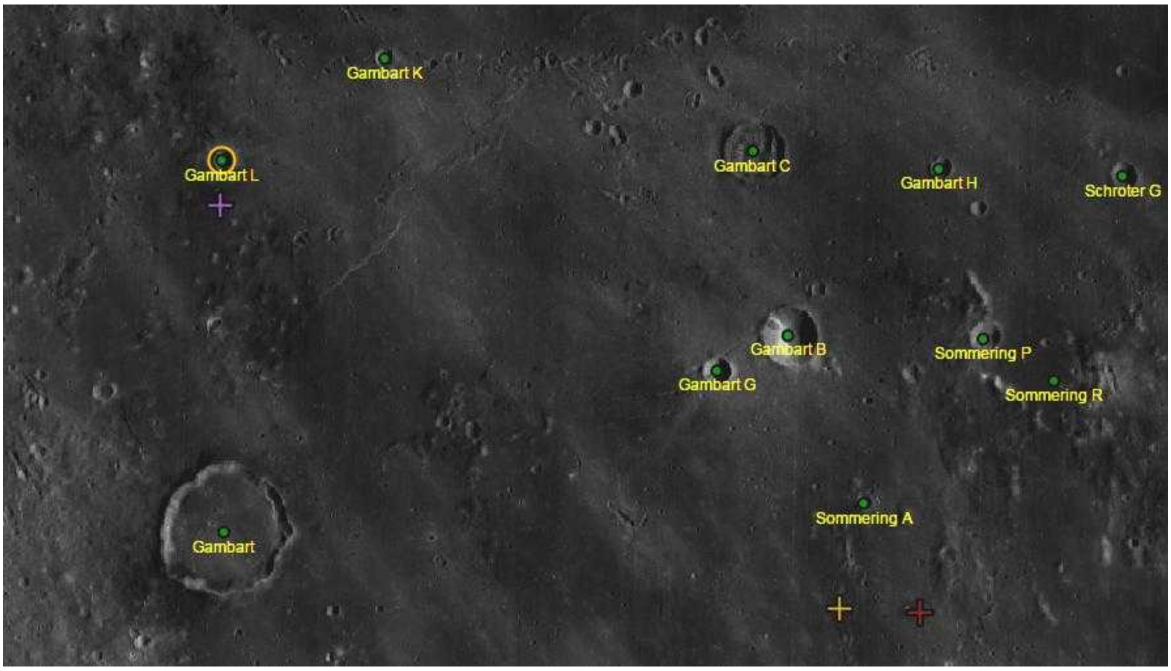


Figure 7. The Gambart region. WAC imagery

The spinel deposits are defined spectrally in the near infrared by their strong 2000nm absorptions and extremely weak or absent 1000nm absorptions, as is characteristic of spinel group minerals. According to previous works [6-8], I have identified the presence of spinel-rich deposits in *the dark halo* south of Gambart *L* as demonstrated by the spectral signature, characterized by a strong 2000nm spectral absorption (Fig. 8). On the other hand the spectra of the examined dome and the nearby DHIC based on M^3 data, from OP2C1 orbital period, display a classical pyroxene signature (Fig. 8). The spectrum of the dome summit displays two absorption bands centered at 990 nm and a wide band at ~ 2200 nm, corresponding to a clinopyroxene spectrum [4].

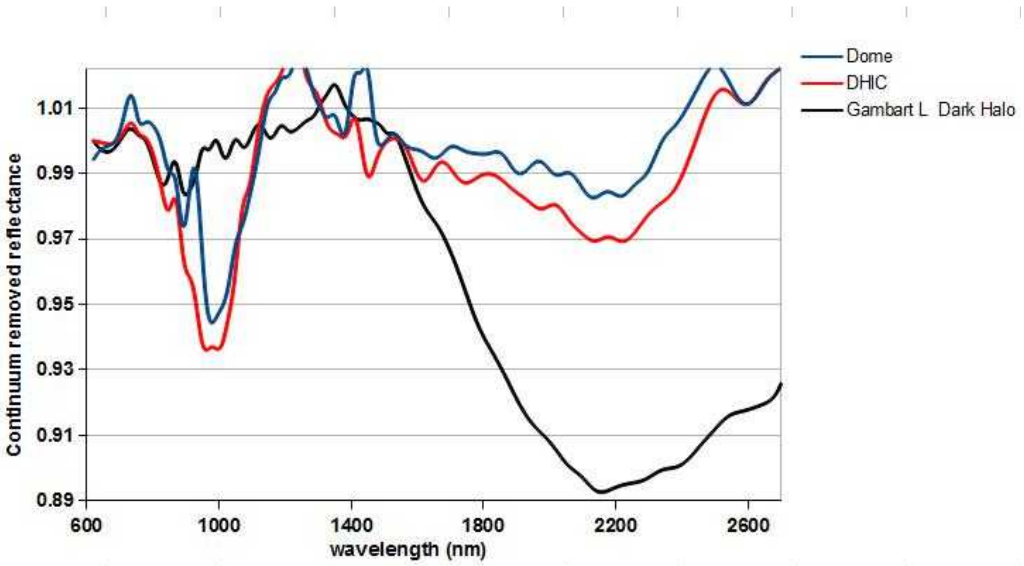


Figure 8. M^3 spectral analysis. Spectra of three sampled regions showing the presence of Cr- spinel rich deposit in Gambart L dark halo.

References

[1] Lena, R., 2020. 'Domes in Gambart C'. BAA LS circular, June 2020, pp. 13-18.

[2] Lena, R., Wöhler, C., Phillips, J., Chiocchetta, M.T., 2013. *Lunar domes: Properties and Formation Processes*, Springer Praxis Books. Wilhems, D. The geologic history of the Moon, USGS Prof. Paper 1348, 1987

[3] Evans, R., Wöhler, C., Lena, R., 2009. 'Analysis of Absorption Trough Features Using Clementine UVVIS+NIR Imagery'. Lunar Planetary Science Conference, XXXX, abstract #1093.

[4] Wöhler, C., Berezhnoy, A., Evans, R., 2011. 'Estimation of Elemental Abundances of the Lunar Regolith Using Clementine UVVIS+NIR Data'. *Planetary and Space Science*, vol. 59, 1, pp. 92-110.

[5] Scholten, F., Oberst, J.,Matz, K.-D., Roatsch, T.,Wählisch, M., Speyerer, E.J., Robinson, M.S., 2012. 'GLD100: the near-global lunar 100m raster DTM from LROC WAC stereo image data'. *J. Geophys. Res*. 117 (E00H17), http://dx.doi.org/10.1029/2011JE003926.

[6] Sunshine, J. M., Besse, S.N., Petro, E., Pieters, C. M., Head, J. W., Taylor, L. A., Klima, R. L., Isaacson, P. J., Boardman, J. W., Clark, R. C. and the M3 Team. 2010. 'Hidden in Plain Sight: Spinel-Rich Deposits on the Nearside of the Moon as Revealed by Moon Mineralogy Mapper (M3)'. 41th Lunar and Planetary Science Conference, abstract #1508.

[7] Sunshine, J. M.,. Petro, N. E., Besse, S., Gaddis, L. R., 2014. 'Widespread Exposures of Small-Scale Spinel-Rich Pyroclastic Deposits in Sinus Aestuum'. 45th Lunar and Planetary Science Conference, abstract# 2297.

[8] Bhattacharya, S., Chauhan, P., Ajai, A., 2012. 'Mg-spinel-rich lithology at crater Endymion in the lunar nearside', 39th COSPAR, E1.5-7-12, 173.

GOINGS-ON IN GASSENDI

Barry Fitz-Gerald

Gassendi is a favourite target for visual observers and imagers due to the abundant detail visible within this 111km diameter Floor-Fractured Crater. The numerous graben that criss-cross the floor formed when a magma body was intruded beneath, forcing it upwards and resulting in extensional forces that gave rise to swarms of faults. These faults produced graben or linear rilles which are usually quite angular in trend and profile, quite distinct from the sinuous rilles produced by erosive lava streams which are common in the maria. These are the 'fractures' in Floor-Fractured Craters (FFCs). On occasion, however, a graben is encountered that looks something of a hybrid, having both a tectonic look but with a hint of the volcanic about them, and one or two of the rilles in Gassendi show this unusual combination. It is sometimes assumed that lavas from Mare Humorum flowed through a low point in the southern rim of Gassendi, to produce the smooth mare unit visible as an arc on the southern crater floor. This may not be the correct interpretation and volcanic features within the crater may turn out to be more likely source for these lavas [1].

Amongst the volcanic features present within the crater are extensive depressions which have been interpreted as drained lava lakes, identified on the basis of 'high-tide' terraces where the molten lavas congealed as a rim to be exposed as the lake level fel1 [2], [3]. In places more than one terrace can be seen, showing that the level of the lake oscillated, either draining and then almost re-filling or draining episodically with a new levels being established long enough for more terraces to form around the lake margin [4].

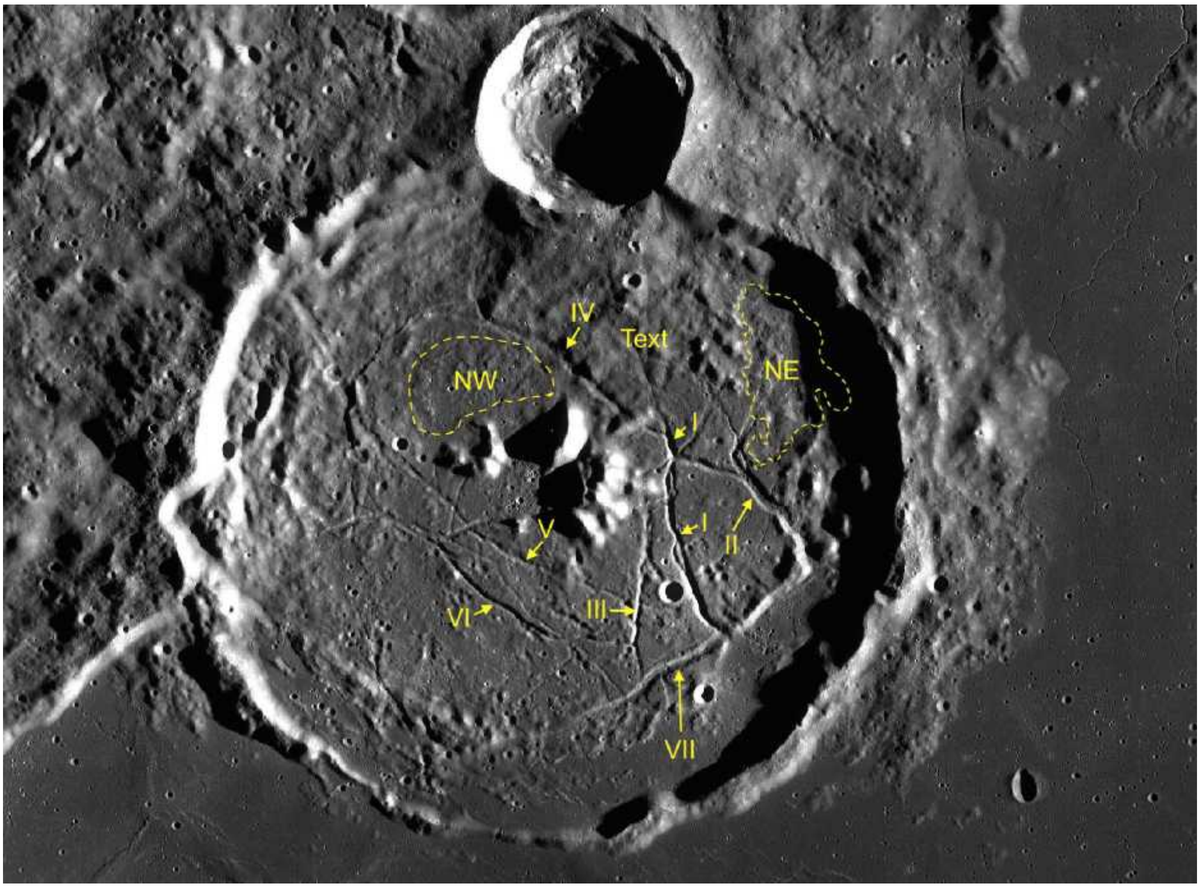


Fig. 1 LROC WAC image of Gassendi showing the network of graben which forms Rimae Gassendi. Individual Rima are numbered I to VII. The location of north-eastern (NE) and north-western (NW) lava lakes are shown with dotted yellow lines. Note the mare unit inside the southern rim.

Two such drained lakes are shown in Fig. 1 one located in the north-eastern part of the craters floor (NE) and another to the north-west of the central peak (NW). The NE lake has a maximum depth of some 200m and measures very approximately 20kms by 10kms. The interior has a spectral signature indicative of high-Ca pyroxene mare basalts, which is the same composition as the mare basalts nestled inside the southern rim [2]. This might suggest that the lavas from the NE lava lake found their way southwards and ended up ponded against the southern rim. The possibility explored below is that they did this by exploiting the floor-fracture graben as channels, and in the process modified their course and profile. This may account for the observation mentioned above that some of these graben have a hint of the volcanic about them, though they clearly originated as tectonic features.

Several individual graben make up Rimae Gassendi, with those in the south-eastern quadrant including Rima I, II and VII being the most conspicuous. Rima II for instance is in places 200m deep and 2kms wide and Rima I 1.7kms wide and 300m deep at its southern end (for the sake of brevity I will use R to denote Rima for the rest of the text). A clue as to why these graben are more pronounced can be seen if we take a much closer look at the RII where it takes a slight kink to the west adjacent to the southern end of the NE lava lake (Fig. 2).

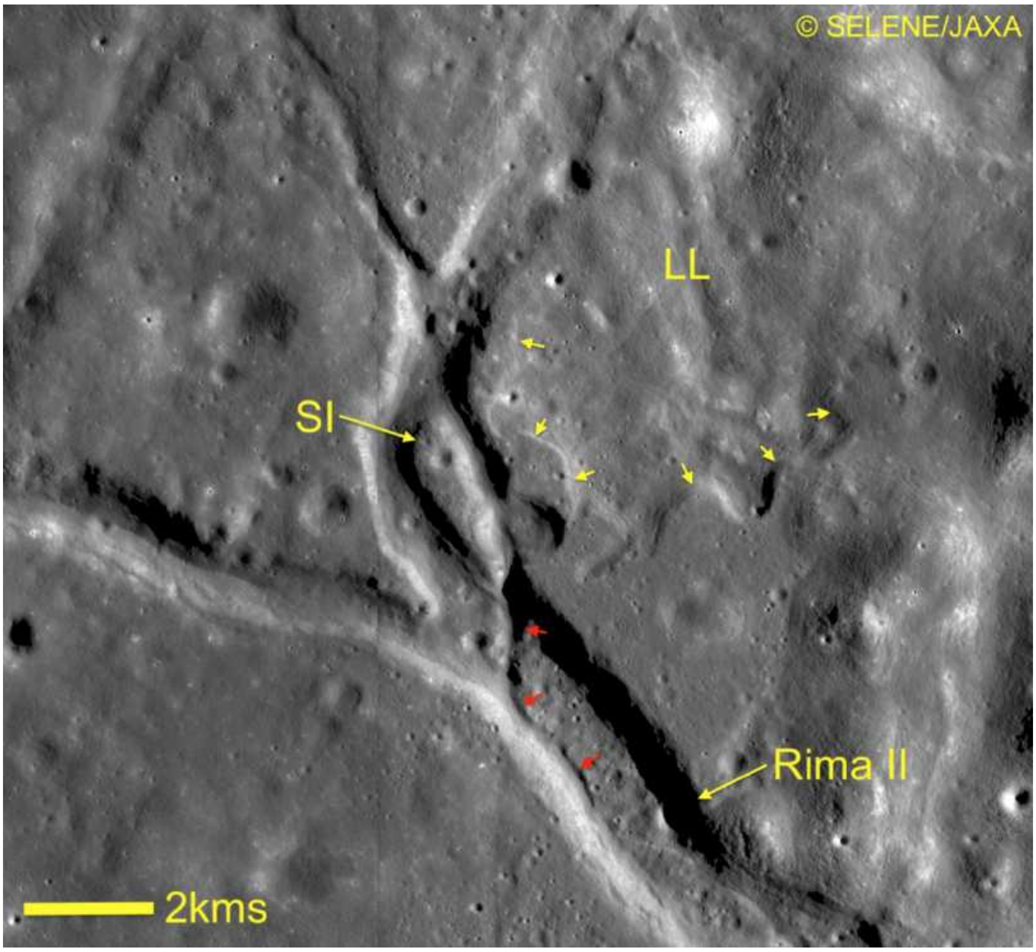


Fig. 2 LROC NAC image of RII showing its broad 2km wide floor adjacent the southern shore of the NE lava lake (LL). The shore is indicated with yellow arrows and show at least 3 former levels preserved as rocky terraces. Note the streamlined island (SI) formed by lava flowing into RII from the lava lake and narrow channel (red arrows) which was formed by the final dregs of lavas draining from the lake.

At this point the graben forks, one branch heading west-north-west and another towards the north. The northern branch is short and becomes less distinct as it merges into the low terrain of the NE lava lake, and it is more than likely that this is the main channel through which lavas from the lava lake drained away. Situated at the entrance of this northern branch is a small teardrop-shaped island about 2kms long and 800m wide. This unusual landform appears to be a 'streamlined island' (SI) formed by erosion as molten lava drained in a powerful flow southwards from the lava lake and into RII. As can be seen this island is blunt at the 'upstream' end and tapers to a point towards the south which is consistent with a torrent of lava flowing from north to south. This island would not look out of place amongst the SIs formed by catastrophic outflows of water in the Jovis Tholus region of Mars [5], indicating that the flowing lavas were probably of low viscosity and high temperature and consequently very efficient at eroding the terrain over which they flowed.

A smaller narrow channel can be seen hugging the eastern edge of this island, before it crosses RII and continues southwards along the western side of the graben. A scenario that would account for this is that initially the lava lake breached its southern shore and lavas flowed south along a pre-existing graben which led into RII. The turbulent flow was sufficient to widen and deepen this graben and erode the channel and isolate a streamlined island. The draining of the lava lake was probably episodic as is suggested by the many lava terraces noted above, but ended as a much reduced volume of lava drained away forming the small channel seen at the bottom of R II.

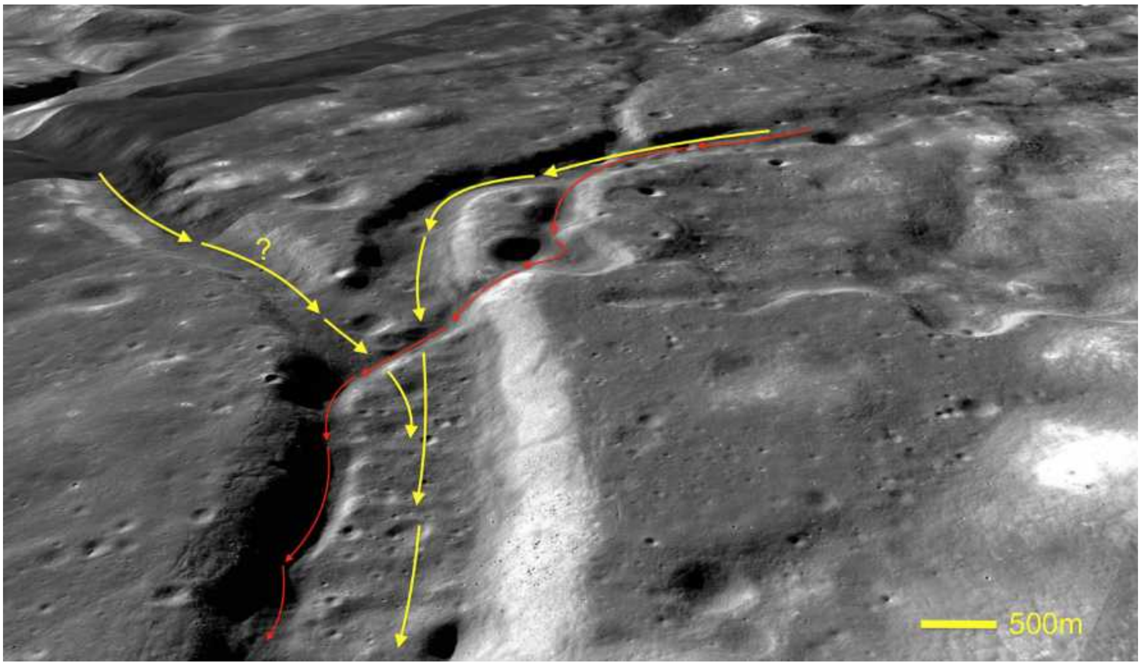


Fig. 3 Quickmap 3D representation of a perspective view northwards of the area shown in Fig. 2. Yellow arrows show the direction taken by lava draining from the lava lake into RII and then southwards towards Mare Humorum. A possible source of lavas from a now buried northern lava lake along a northern arm of RII is shown with a ? Red arrows show the course of a much reduced flow that carved the channel on the bed of RII as the final dregs of lava drained from the lava lake.

Fig. 3 is a 3D representation of LROC images showing a view northwards up RII, with the yellow arrows showing the proposed direction taken by the lavas draining from the NE lava lake, with a possible contribution of lavas from the branch to the west-north-west. The red arrows show the direction of the later smaller volume flow which produced the channel on the floor of the main graben. Smaller lava channels inside much wider deeper lava channels will ring a bell to anyone familiar with the Schröter's Valley sinuous rille which debouches off the Aristarchus plateau.

Two similar streamlined islands can be seen on the bed of RI (Fig. 4) each about 2kms long, which divide the graben bed into two branches that re-combine on the downstream side – which is to the south. As can be seen the morphology of this graben has a distinctly 'sinuous' appearance, as opposed to the more rectilinear form typical of exclusively tectonic graben. The source of the lavas that flowed southwards through RI is slightly more problematic though. If a lava lake existed on the northern crater floor this may have drained away to the south via the northern extension of RI (north of the junction of RI and II). This northern extension forms part of a complex 'starfish' shaped confluence of five graben including RII and RI as well as two smaller and less distinct graben (Fig. 4) which join from the east and west. This scenario is difficult to confirm as ejecta from Gassendi A blankets the northern floor of the main crater and has filled in much of RII's northern section, so any suitable lava lakes or modifications to RI are effectively buried. Another possible source could be the NW lava lake but any connection between it and RII is unclear.

An alternative is that lavas drained into RII from the NE lava lake via the small channel that ends in a 'hanging valley' just at the point where RI and RII meet. Of course it is always possible that lavas could have flowed both north and south on entering RII before turning left and heading south down RI, but this would depend on the slopes of the graben floor as existed at the time and the volume of lava draining out.

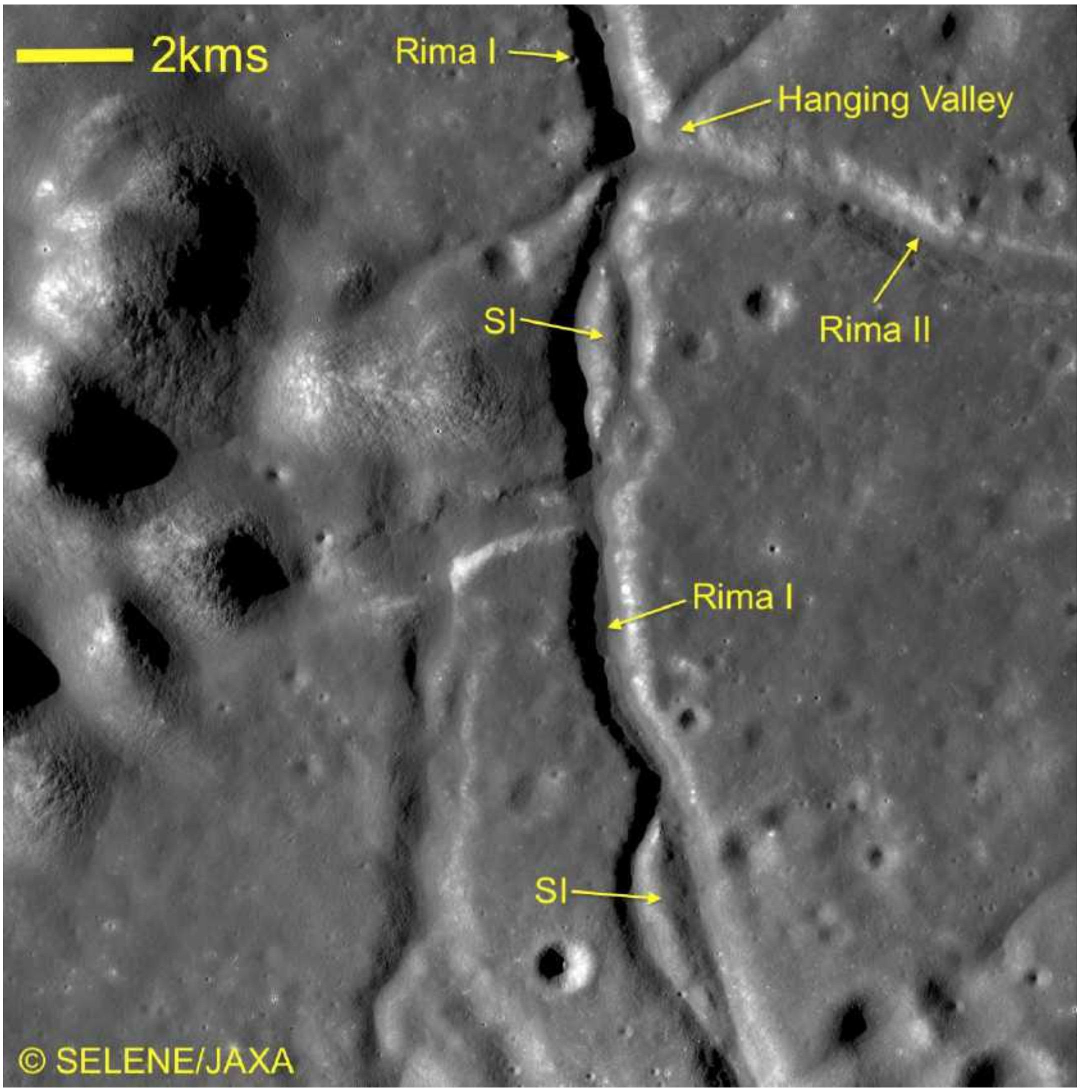


Fig. 4. JAXA/SELENE image of the streamlined islands (SI) which formed in RI as a result of lava flow erosion. Note the five-armed 'starfish' junction formed where RII and the northern and southern parts of RI intersect. Note the small channel that enters from the north-east and forms a 'hanging valley'.

Reconstructing any potential past flow directions along these graben is not straightforward as the floor of Gassendi has undergone tectonic movements which have raised parts and lowered others, so what may have been a 'downhill' slope at the time the lava lake drained is now 'uphill'. Also if you travelled southwards down RII now you would be going uphill, because the southern part of the graben has been partially filled in by mass wastage off some hilly terrain (that represents slumping off the south-east rim) through which it passes. What looks fairly certain however is that the flow direction along RI and II was ultimately southwards, probably following the regional slope produced by the infilling of Mare Humorum, and the subsidence of Gassendi towards the south. Evidence for this can be seen in the southern terminations of RI and II where the lavas they carried emptied onto the southern crater floor to accumulate as a further lava lake, now preserved as the mare unit inside the southern rim. Both flows emptied directly into this lake but the lavas from RI also took a right turn and entered RVII which forms part of the northern edge of the mare unit (Fig. 5). This westwards flow along R1 then entered the lake via various breaches in the southern wall of RVII, and as it did it carved deep channels which isolated several further islands which are now visible as flat top hills. These are the same type of landforms as the streamlined islands described above, essentially nubbins of crater floor which were surrounded and isolated by turbulent flowing lavas and eroded in rounded teardrop shapes by the flow.

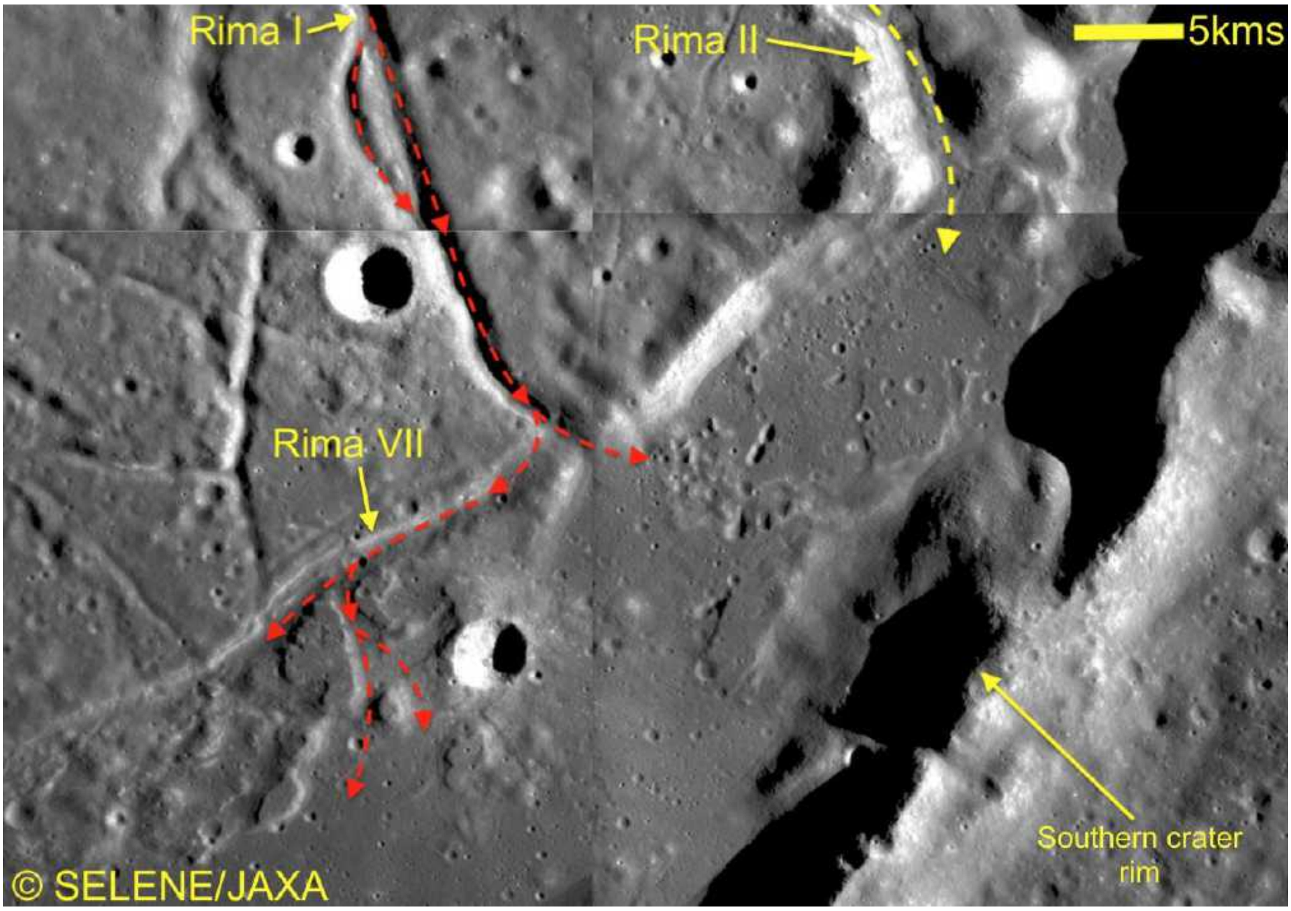


Fig. 5 JAXA/SELENE image of the southern ends of R's I and II and RI's confluence with RVII. Yellow arrows show the proposed flow of lavas out of RII southwards into the new lava lake. Red arrows show the flow out of RI into the lake and westwards into RVII. Note the flat topped lava eroded islands that now form the northern edge of this mare unit.

The flow of lava out of the NE lava lake may well have overwhelmed the capacity of RII to drain southwards as there are indications that lavas overflowed the graben rim and flooded the adjacent terrain. At the widest part of RII, just to the south of the lava lake, the graben walls (which have a slope of 19° - so not exactly vertical) are covered in bright boulder fields, with some boulders upwards of 50m across. Such boulder fields are not unknown along steeper lunar slopes: the Apollo 15 astronauts photographed such scenes as they looked across at the western rim of Hadley Rille. What was present at Hadley which is absent here however is any obvious layers of bedrock from which the boulders could originated. In addition the rim of RII has numerous cracks and fractures running parallel to its edge. The combination of the boulders and fractures suggests that lavas overtopped the rim and flowed over the nearby low-lying terrain during a particularly voluminous

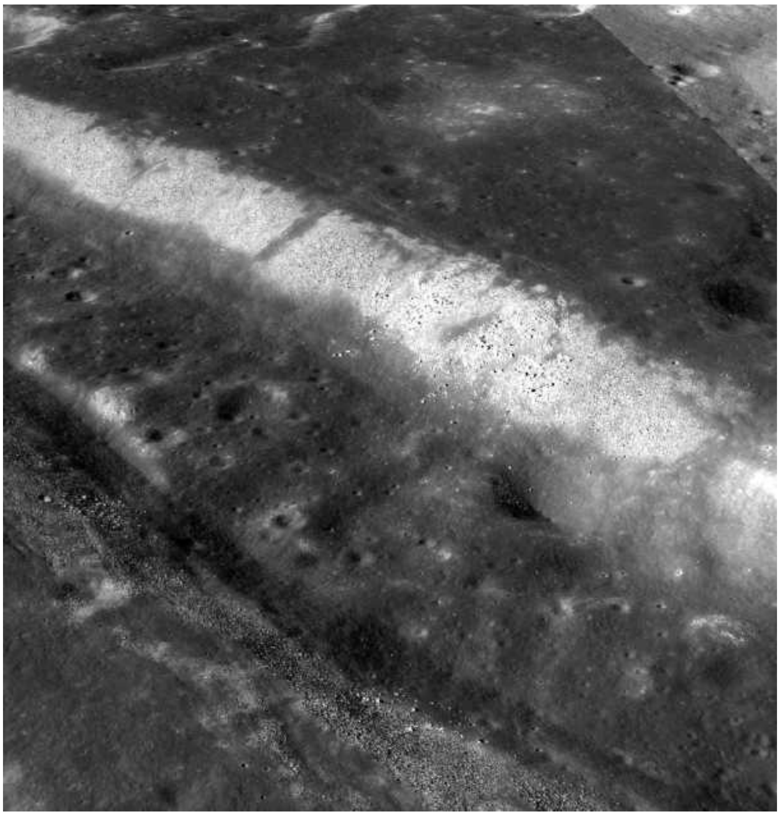


Fig. 6 Quickmap 3D View across RII looking north-east from a point in the bottom left of the scene shown in Fig. 3. The graben here is a shade over 2kms wide here and over 200m deep. The dark streak visible on the far (eastern) wall just left of centre is 100m wide. Note the extremely rocky walls and multiple shallow fractures in the surface parallel to the edge.

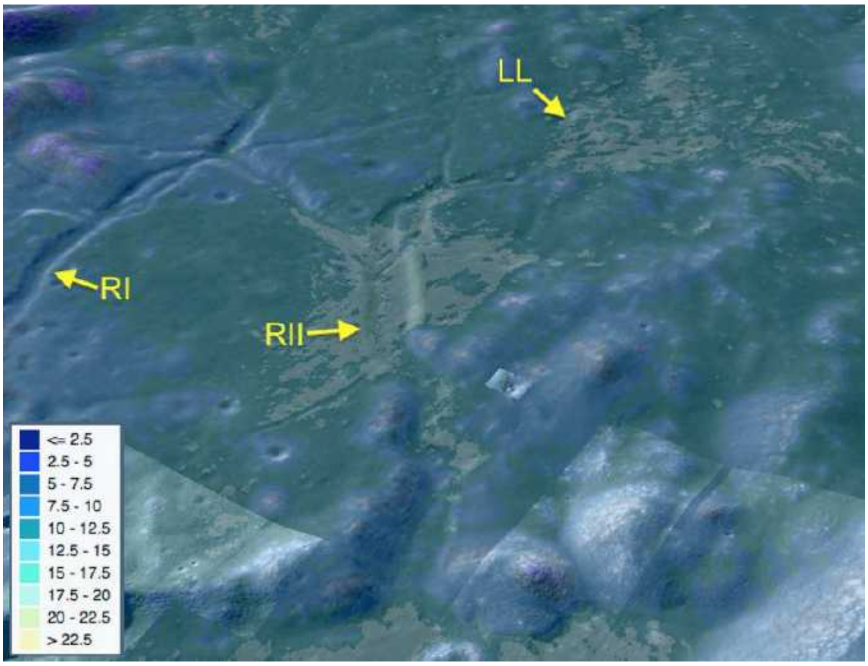


Fig. 7 Quickmap overlay of abundance of FeO (wt %) derived from SELENE/Kaguya data with paler shades of blue and yellows indicating a higher abundance. Note the high abundance signal within the lava lake (LL). Also note the high abundance signal over the upper reaches of RII showing where basaltic lavas overtopped the graben rim and spread over the adjacent terrain.

or rapid surge of lava that could not drain away to the south fast enough. This would have draped the area in a rigid basalt layer once cooled, and subsequent erosion would have cracked and fragmented it to produce the boulder fields we see now.

This interpretation is supported by multispectral data showing the abundance of iron oxide (FeO wt %) which is found in mare basaltic lavas (Fig. 7). This indicates the presence of basaltic rocks within the NE lava lake and forming the mare unit inside the southern rim, which comes as no surprise. There is however also an area of elevated abundance in and around the widest part of RII which would be consistent with basaltic lavas overtopping the graben and inundating low-lying terrain. This signature can also be seen extending part way up the northern extension of RII, and to the south where the graben passes through the hilly terrain of the rim collapse.

The exploitation of graben within FFCs by flowing lavas is not stretching the imagination too far, as these craters are formed by the intrusion of magma beneath their floors and effusive volcanism is evident in very many examples in this class. As a result it is likely that there will be other examples of this type of modification within other FFCs. One good example can be seen on the floor of Petavius (Fig. 8).

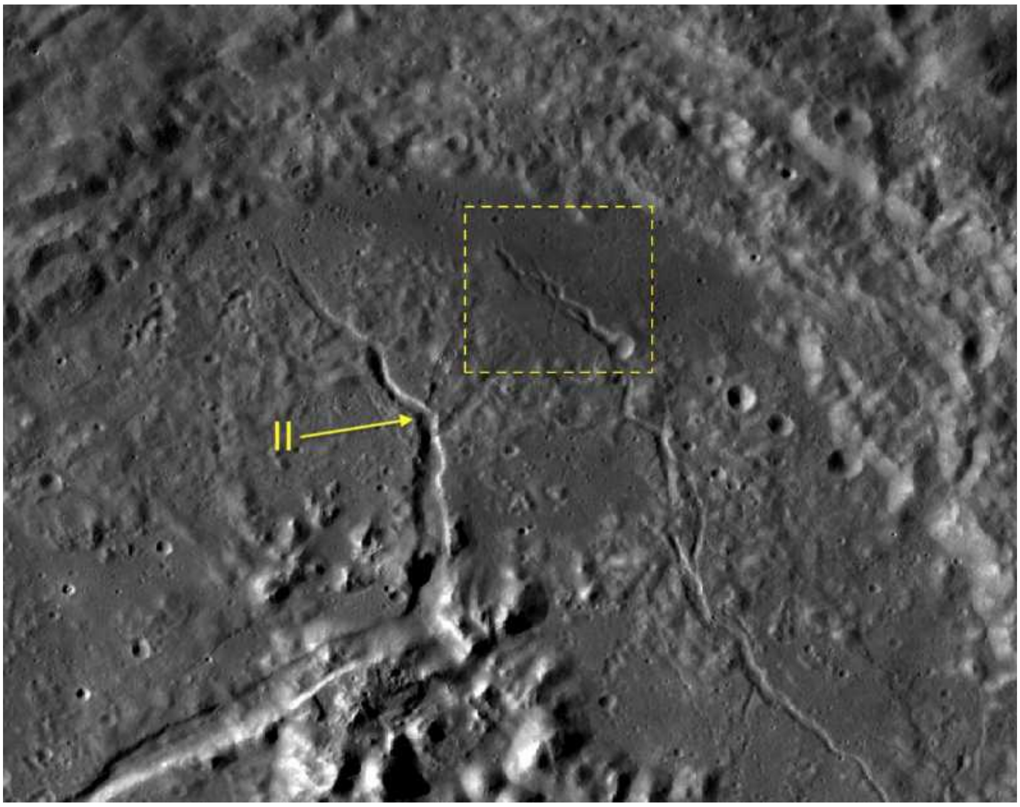


Fig. 8 Northern floor of Petavius showing graben cutting the eastern floor and ending in a small mare unit inside the northern rim. The section in the yellow box has been modified by flowing lavas and is shown in detail in Fig. 9.

Here a graben crossing the eastern floor and roughly parallel with Rima Petavius II, has been modified by flowing lavas including erosion giving rise to streamlined islands within the graben itself. This is most apparent at its northern end where the lavas have debouched and accumulated as a basaltic mare unit which represents a fossil lava lake. The flow was from the south towards the north, with the lavas having the same iron-rich spectral signature as that seen in Gassendi. Despite the modification by flowing lavas, elements of the angularity typical of tectonic graben are still visible even in the short section that contains the islands (Fig. 9).

Another example of a FFC with possible modified graben is the 164km diameter Compton, not strictly a crater but a proto-basin [6] which has a number of large shallow graben cutting the floor, some of which show signs of having hosted flowing lavas. The interior of Compton is notable because of the presence of extensive terraces associated with extensive lava lakes, suggesting that huge volumes of lava were sloshing about the interior during an intense volcanic phase.

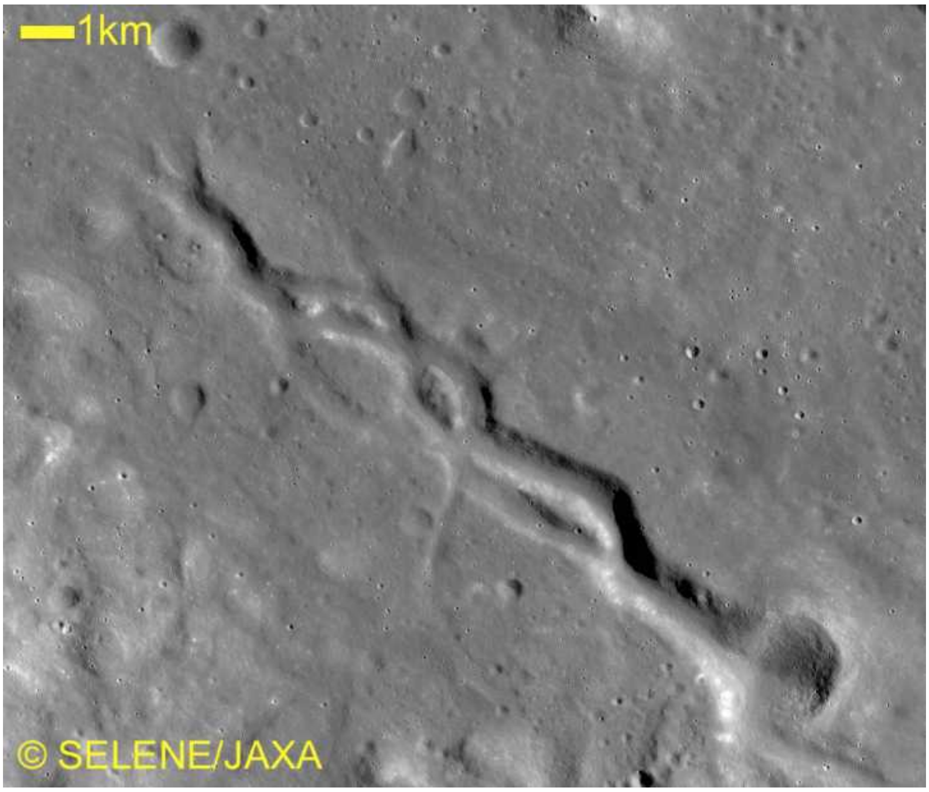


Fig. 9 Detail from SELENE showing the lava modified graben on the northern floor of Petavius. Note the streamlined islands caused by flowing lavas and the angular course of the northern wall of the graben which reflects a tectonic origin.

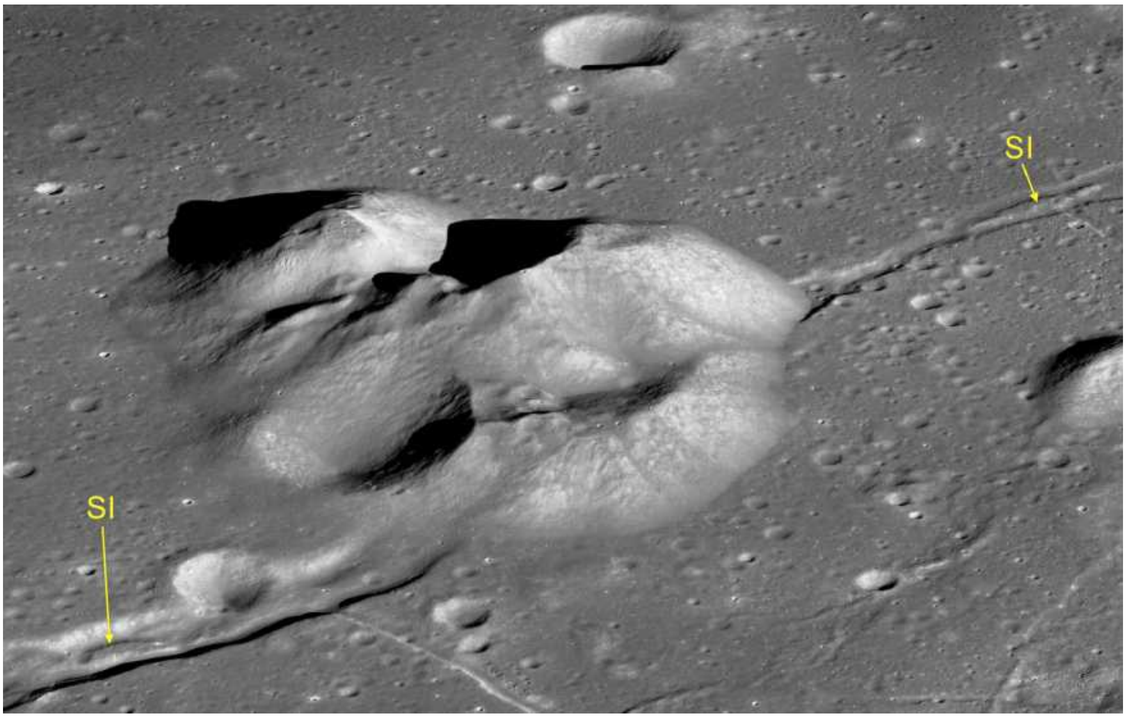


Fig. 10 LROC image of the central peak of Compton which sits on top of the main graben running across the proto-basin floor. Note the suspected streamlined islands (SI).

A glance at Compton will however show that the main graben which contains some suspected streamlined islands passes beneath the central peak (Fig. 10), and obviously this peak would block any potential flow along the graben – a strong argument against the flow hypothesis. This could be explained by suggesting that the graben originally passed to one side of the central peak, and that the peak has spread out laterally as it eroded with rocky debris mantling the lower slopes and surrounding area. This is the case in many central peaks where partially buried craters can be seen peeking out from beneath their edges. There is, of course, another interpretation – that the central peak is a later construct and not an uplift generated during the impact event – but this involves straying from the hypothetical to the heretical, and an argument best left for a later date.

Acknowledgements:

LROC images reproduced by courtesy of the LROC Website at
http://lroc.sese.asu.edu/index.html,
School of Earth and Space Exploration, University of Arizona.

Selene images courtesy of Japan Aerospace Exploration Agency (JAXA) at:
http://l2db.selene.darts.isas.jaxa.jp

References:

[1] Schultz, Peter H. 1976. *Moon morphology: interpretations based on Lunar Orbiter photography***.** Austin: University of Texas Press.

[2] Giguere, T., Gillis-Davis, J., & Lemelin, M. (2019). 'Cryptomare Mineralogy and Lava Lake Processes within the Gassendi Crater'. 50th Lunar and Planetary Science Conference.

3. Hawke, B.R., Giguere, T.A., Gillis-Davis, J.J, Lucey, P.G, Peterson, C.A, Lawrence, S.J., Stopar, J.D. and Robinson, M.S. (2013) 'An Investigation of Cryptomare and Pyroclastic Deposits in the Gassendi Region of the Moon'. 44th Lunar and Planetary Science Conference.

4. Hawke, B.R., Giguere,T.A., Peterson,C.A., Lawrence, S.J., Stopar, J.D., Gaddis, L.R. (2015). Cryptomare, Lava Lakes, and Pyroclastic Deposits in the Gassendi Region of the Moon: Final Results'. 46th Lunar and Planetary Science Conference.

5. Vijayan, S and Sinha, R.K. (2017). 'Amazonian fluvial outflow channels in Jovis Tholus region, Mars'. *Journal of Geophysical Research: Planets,* Vol. 122, Issue 5.

6. Baker, D.H., Head, H.J., Fasset, C.I., Kadish, S.J., Smith, D.E., Zuber, M.T and Neumann. G.A. (2011). 'The transition from complex crater to peak-ring basin on the Moon: New observations from the Lunar Orbiter Laser Altimeter (LOLA) instrument', *Icarus*, 214, 377-393, doi: 10.1016/j.icarus.2011.05.030.

LUNAR OCCULTATIONS **July 2020** Tim Haymes

Time capsule: 50 years ago (LSC Vol. 5, No. 7)

Director: Dr. Ron Maddison, Secretary: Phil Ringsdore.

The Danish Astronomical Association has secured 1,500 occultation observations with small instruments. Predictions were by the RGO and USNO. Their observers have built ingenious chronographs combined with wireless signals.

Through the Atmosphere: David Allen describes atmospheric phenomena and refers to a 'delightful little book': *The Nature of Light and Colour in the Open Air* by Prof. Minnaert.

W.J. Deane presents the last in a series of 10 articles on Famous Lunar Astronomers: Dr. H.P. Wilkins (1896-1960).

R. Turner discusses TLP in Linne.

See: https://britastro.org/system/files/Lunar%20Section%20Circular%201970%20-%2007.pdf

Occultation of Venus, 2020 June 19th

David Arditti created a BAA Challenge and some really fine images are on the BAA community pages from Peter Carson in Spain and Peter Goodhew with a remote telescope also in Spain, in good conditions. The writer and many others in UK were clouded out. These are splendid examples of remote telescope use. Many thanks to the contributors.

One example from Peter Carson is here: https://britastro.org/node/22732

Observation in May/June

The Coordinator continues to plan observations, but many have been thwarted by local horizon considerations or the weather. I have been using a C11 with F6.3 reducer working at F5.6 by extending the projection distance to 120mm. This is now my current routine setup for all occultations (Lunar, asteroids) and Deep Sky imaging, until my 30cm F/4 is operational again. For lunar imaging I use native F10.

No further progress has been made on high speed imaging (>= 100fps)

Grazes

There is favourable prediction for 33 Psc on July 11, 03h UT, but twilight may interfere. Nevertheless a good one to try if you are located in Wales. Flamsteed 33 Piscum is magnitude 4.6.

Graze predictions for 2020 are available to download from the Lunar Section link here: https://britastro.org/downloads/17673

Geodetic Applications of Graze Occultations (D.W.Dunham)

I discovered an early paper by David Dunham (IOTA North America) while browsing Springer Books and clicking on a Google Scholar link. Dr Dunham was a pioneer in the early days of lunar graze predictions, and collaborated with the late Gordon E. Taylor, both gentlemen working on similar projects at the time. I'm just about to read it via a free pdf link. David is a leading observer and outreach enthusiast, and a past president of the International Occultation Timing Association (IOTA).

https://www.cambridge.org/core/services/aop-cambridge-core/content/view/CD05435A5D87964A47049E247E15402B/S1539299600000654a.pdf/geodetic_applications_of_grazing_occultations.pdf

The reader might also like to locate the *Occultation Newsletter* (ON, past issues) or current issues of the *Journal for Occultation Astronomy* (JOA), both written for enthusiasts by enthusiasts!

ON Heritage Project https://www.iota-es.de/onheritage/ON_Vol01_No01.pdf
JOA : https://www.iota-es.de/joafree.html

2020 July predictions for Manchester (Occult4 by D.Herald).
W. Long. 002d 15’, N Lat. +53 25’, Alt. 50m

		day	Time			P	Star	Sp	Mag	Mag	%	Elon	Sun	Moon		CA	
y	m	d	h	m	s		No		v	r	ill		Alt	Alt	Az	o	Notes
20	Jul	8	0	34	11.6	R	3164	B3	4.5*	4.6	91-	145		13	150	85N	epsilon Cap
20	Jul	8	4	9	15.0	R	3175	G8	4.7*	4.3	90-	144	1	17	201	64N	kappa Cap
20	Jul	11	3	49	8.4	D	5	K1	4.6	4.1	67-	110	-2	30	161	-5N	33 Psc
20	Jul	11	4	1	35	Gr	5	K1	4.6	4.1	67-	110	1	29	**	GRAZE:	Nearby
20	Jul	11	4	10	45.2	R	5	K1	4.6	4.1	67-	110	1	31	167	26N	33 Psc
20	Jul	13	3	47	41.3	R	109952	K0	7.4*	6.6	48-	88	-2	33	135	89N	
20	Jul	15	6	22	16.5	R	454	K3	5.6*	5.1	29-	65	18	48	151	67S	
20	Jul	16	1	23	19.3	R	93585	A0	7.8	7.7	22-	56		5	70	80N	
20	Jul	16	1	44	33.1	R	93589	F0	8.1	7.9	22-	56		8	74	70N	
20	Jul	16	2	56	57.7	R	93615	F5	7.2	7.0	21-	55	-8	19	87	75S	
20	Jul	24	15	41	28.6	D	1702	M0	4.0*	3.3	19+	52	38	44	180	80N	nu Vir
20	Jul	24	16	47	25.3	R	1702	M0	4.0*	3.3	20+	53	28	42	202	-58N	nu Vir
20	Jul	27	22	55	1.1	D	2088	F5	6.2	6.0	55+	95		3	246	89S	
20	Jul	28	21	3	31.0	D	2209	K4	5.6	4.8	65+	108	-8	17	209	72N	32 Lib Dbl*
20	Jul	31	20	25	45.9	D	2659	M3	6.2	5.2	91+	146	-4	11	161	68S	
20	Aug	3	23	10	7.4	R	3106	K0	5.2	4.6	100-	174		15	160	70S	phi Cap
20	Aug	8	0	33	37.8	R	128784	K5	7.0	6.3	82-	130		23	131	28S	
20	Aug	9	3	26	35.7	R	109783	G5	7.3	6.7	73-	118	-10	39	165	21S	
20	Aug	10	0	2	27.8	R	286	B9	7.6	7.6	66-	108		17	101	48N	
20	Aug	10	2	22	35.3	R	110253	F3	8.4	8.2	65-	107		35	133	71S	
20	Aug	10	3	23	53.0	R	110268	K5	7.4	6.5	65-	107	-11	41	150	81S	

Prediction up to August 10th

Notes on the Double Star selection.
Doubles are selected from Occult 4, where the fainter companion is brighter than mag 10, and the time difference(dT) is between 0.1 and 10 seconds. **Please report double star phenomena.**

Key:
P = Phase (R or D), **R** = reappearance **D** = disappearance
M = Miss at this station, Gr = graze nearby (possible miss)
CA = Cusp angle measured from the North or South Cusp.
Dbl* = A double star worth monitoring. Details are given for selected stars.
Mag(v)* = asterisk indicates a light curve is available in Occult-4
Star No:
1/2/3/4 digits = Zodiacal catalogue (ZC) referred to as the Robertson catalogue (R)
5/6 digits = Smithsonian Astrophysical Observatory catalogue (SAO)
X denotes a star in the eXtended ZC/XC catalogue.
The ZC/XC/SAO nomenclature is used for Lunar work. The positions and proper motions of the stars in these catalogues are updated by Gaia.

Detailed predictions at your location for 1 year are available upon request.
Occultation Subsection Coordinator: Tim Haymes

LUNAR GEOLOGICAL CHANGE DETECTION PROGRAMME

Tony Cook

Reports have been received from the following observers for May: AEA observers (Argentina – observations submitted via Walter Elias) imaged: Alphonsus. Copernicus, Hyginus & N, Messier, Plato, Ross D, Torricelli B, and Tycho. Jay Albert (Lake Worth, FL, USA - ALPO) observed: Agrippa, Aristarchus, Atlas, Censorinus, Copernicus, Daniell, Herodotus, Kepler, Plato, Ross D, and Tycho. Alberto Anunziato (Argentina - SLA) observed: Alphonsus, Bullialdus, Daniell, Gassendi, Hyginus N, Messier, Plato, Proclus, Ross D and Tycho. Luis Francisco Alsina Cardinali (SLA) imaged: Messier, Plato, Plato, Ross D, Tycho and several features. Maurice Collins (New Zealand – ALPO/BAA/RASNZ) imaged: Aristarchus, Bailly, Copernicus, earthshine, Grimaldi, Hevelius, Kepler, Mare Humorum, Plato, Schickard, Tycho and several features. Tony Cook (ALPO/BAA) videoed the Moon in the thermal IR and imaged several features in near-IR wavebands. Rob Davies (Mid-West Wales, UK - BAA/NAS) imaged the Montes Apenninus and several features. Daryl Dobbs (Risca, UK – BAA) observed: Mare Frigoris, Maurolycus, and Ptolemaeus. Valerio Fontani (Italy – UAI) made a time lapse video of: Vallis Schröteri. Les Fry (Mid-West Wales, UK – NAS) imaged: Albategnius, Bailly, Bullialdus, Byrgius, Cassini, de Vico, Delambre, Hipparchus, Hommel, Mare Crisium, Mare Nubium, Messier, Plato, Reinhold, Riccius, Theophilus, Tycho, and Walther. Rik Hill (Tucson, AZ, USA - ALPO/BAA) imaged Copernicus, Fracastorius, Gassendi, Grimaldi and Gutenburg. Bill Leatherbarrow (Sheffield, UK – BAA) imaged: Fontenelle, Maurolycus, and Sinus Iridum. Nigel Longshaw (Oldham, UK - BAA) observed: Daniell, earthshine, Mons Piton and Proclus. Phil Shepherdson (York, UK – BAA) observed/imaged Ptolemaeus. Trevor Smith (Codnor, UK – BAA) observed: Aristarchus, Bailly, Plato and Proclus. Bob Stuart (Rhayader, UK – BAA/NAS) imaged: Agrippa, Albategnius, Alphonsus, Arzachel, Birt, Bullialdus, Cassini, Cepheus, Clavius, Copernicus, Cuvier, Cyrillus, Demonax, Deslandres, Eratosthenes, Fernelius, Geminus, Gutenberg, Heraclitus, Hercules, Hyginus, Jansen, Janssen, Kaiser, Lacus Somniorum, Langrenus, Montes Apenninus, Nearch, Petavius, Piccolomini, Plato, Posidonius, Ptolemaeus, Rheita, Sinus Amoris, Theophilus, Torricelli, Triesnecker, Tycho, Vallis Alpes, Vlacq, Werner and several features. Franco Taccogna (Italy – UAI) imaged: Herodotus, and Vallis Schröteri. David Teske (Louisville, MS, USA – ALPO) imaged Herodotus. Gary Varney (Pembroke Pines, FL, USA – ALPO) imaged: Bullialdus, Clavius, Plato, Sinus Iridum Tycho and several features. Fabio Verza (Italy – UAI) imaged: Herodotus, Mare Frigoris, and Vallis Schröteri. Derrick Ward (Swindon, UK – BAA) imaged: Alphonsus, Autolycus, Daniell, Mons Piton, Plato, Proclus, and Ross D. Luigi Zanatta (Italy – UAI) imaged: Herodotus.

TLP reports: No TLP were reported in May. However a likely candidate impact flash was recorded from France on 2020 May 27 UT 20:49. If you were recording earthshine then, perhaps for an occultation, then please let me know if you spot a flash in any video that you captured.

News: As you can see from the list of observers above, this is now occupying half of a page. This emphasizes a healthy observing program. Now I really do enjoy writing and doing a quick analysis on observations from you all. However I am now getting into a bit of a space and time problem. Space-wise last month we occupied 11 pages of the BAA Lunar Section Circular and the ALPO TLO (The Lunar Observer). Time-wise it took me 2.5 days to sort through the observations, write, format and perform a quick analysis. I am not complaining and strongly encourage observers to send in their observations. However, I think we need to do things differently to get the monthly LGC newsletters down to a more manageable production time. I propose keeping the list of observations received at the top of the newsletter, to let you know who has observed what, but will have to be more selective in which observations to show. I haven't decided upon the right way to do this yet, as everyone likes to see their own observation mentioned. Indeed, in this month's BAA newsletter I have had to leave out analysis of reports/images received from Nigel Longshaw, Trevor Smith, and Bob Stuart as the deadline is almost up at the time of writing. I will however add them to the ALPO version of this newsletter.

Routine Reports: Below are a selection of reports received for May that can help us to re-assess unusual past lunar observations – if not eliminate some, then at least establish the normal appearance of the surface features in question.

Plato: On 2020 May 01 UT 22:15 and 23:40 AEA observers submitted two images via Walter Elias that corresponded respectively in terms of similar illumination (±0.5°) to the following two TLP reports:

On 1995 Sep 03 at UT19:40-20:15 P. Moore (Selsey, UK, 15" reflector at x400) observed that the floor of Plato was much darker than he would normally expect and furthermore no interior craterlets were seen. There was however a white patch that was barely visible at the location of the central craterlet should have been. G. North (UK) attempted to observe but the Moon was too low and seeing terrible. F. Doherty reported Plato normal. Cameron 2006 catalog ID=475 and weight=3. ALPO/BAA weight=1.

Plato 1949 Mar 09 UT 02:00-03:00 E.J.Reese (6" reflector x240) and one hour later T.R.Hake (5" refractor x300) both unable to see any detail on the floor of Plato, despite both being able to see a "difficult to see" cleft near to the crater Conon. Reese was able to see detail under similar illumination back in 1948 and 1947 and saw the floor craterlets in Plato clearly then. ALPO/BAA weight=1.

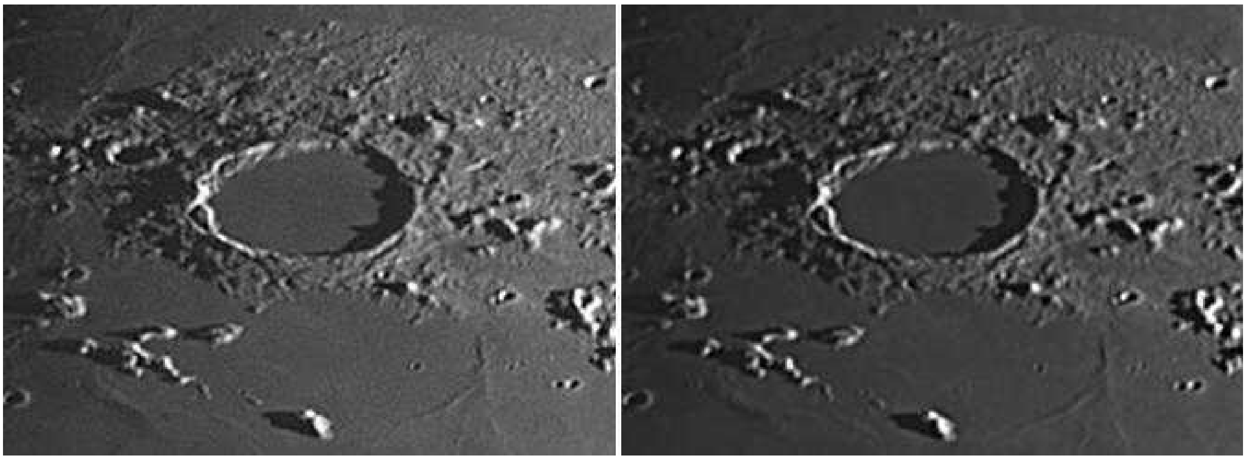


***Figure 1**. Plato taken on 2020 May 01 by AEA observers (Images supplied by Walter Elias) and orientated with north towards the top. **(Left)** 22:15UT. **(Right)** 23:40UT.*

As you can see from Fig. 1, both images show no detail on the floor. Furthermore, the contrast in Fig. 1(Right) does make the floor of Plato look darkish. I will therefore lower the weights of both these reports to 0 to make them non-TLPs.

Tycho: On 2020 May 01 UT 23:16-23:17 Luis Francisco Alsina Cardinali (SLA) imaged the crater under similar illumination (±0.5°) to the following report:

Tycho 1940 Jul 14 UT 02:00? Observed by Haas (NM? USA, 12"? reflector) "Luminous marks in shadow, ragged edged & irreg. shape. E. wall had a milky luminosity" NASA catalog weight=4. NASA catalog ID #468. ALPO/BAA weight=2.

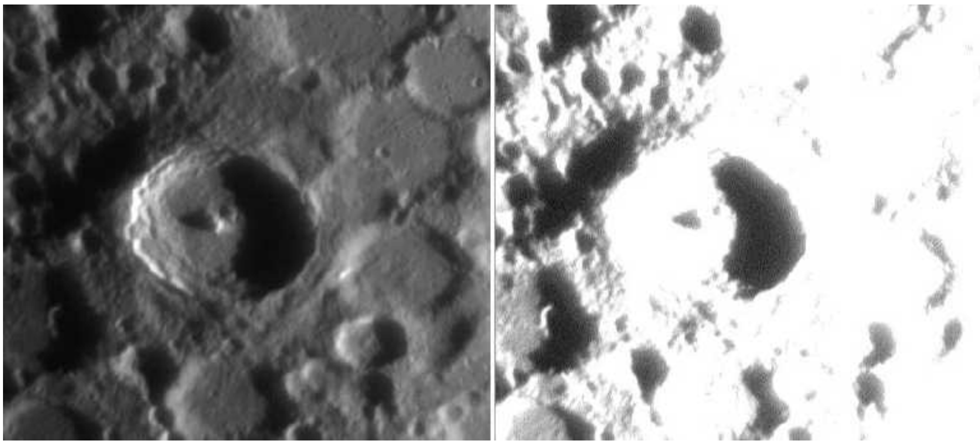


Figure 2. *Tycho orientated with north towards the top. Image taken by Luis Francisco Alsina Cardinali (SLA) on 2020 May 01 UT 23:16-23:17.* ***(Left)*** *Image as captured with some slight sharpening.* ***(Right)*** *Contrast stretched version to show up detail in the shadows – if present.*

Fig. 2 shows none of the luminous marks in the shadow that Walter Haas reported in 1940. Therefore, we shall leave the weight of that TLP at 2 for now.

Daniell: On 2020 May 02 UT 21:52-21:54 Derrick Ward (BAA) imaged the crater and Alberto Anunziato (SLA) sketched 22:20-22:25 this crater under similar illumination (±0.5°) to the following report:

Daniell 1979 Jul 04 UT 20:40-21:19 Observed by Saxton (UK?, 216mm refractor?, seeing III, transparency: Good) "noticed that the east end of Daniell was bright and fuzzy and had somewhat poorly defined edge to the bright part. A sketch was made, and possibly shows the same as in past reports" BAA Lunar Section Report. Cameron 2006 extension catalog ID=59 and weight=3. Observer located in Leeds, England and used a 9" reflector x250. Seeing=III and transparency=good. ALPO/BAA weight=2.

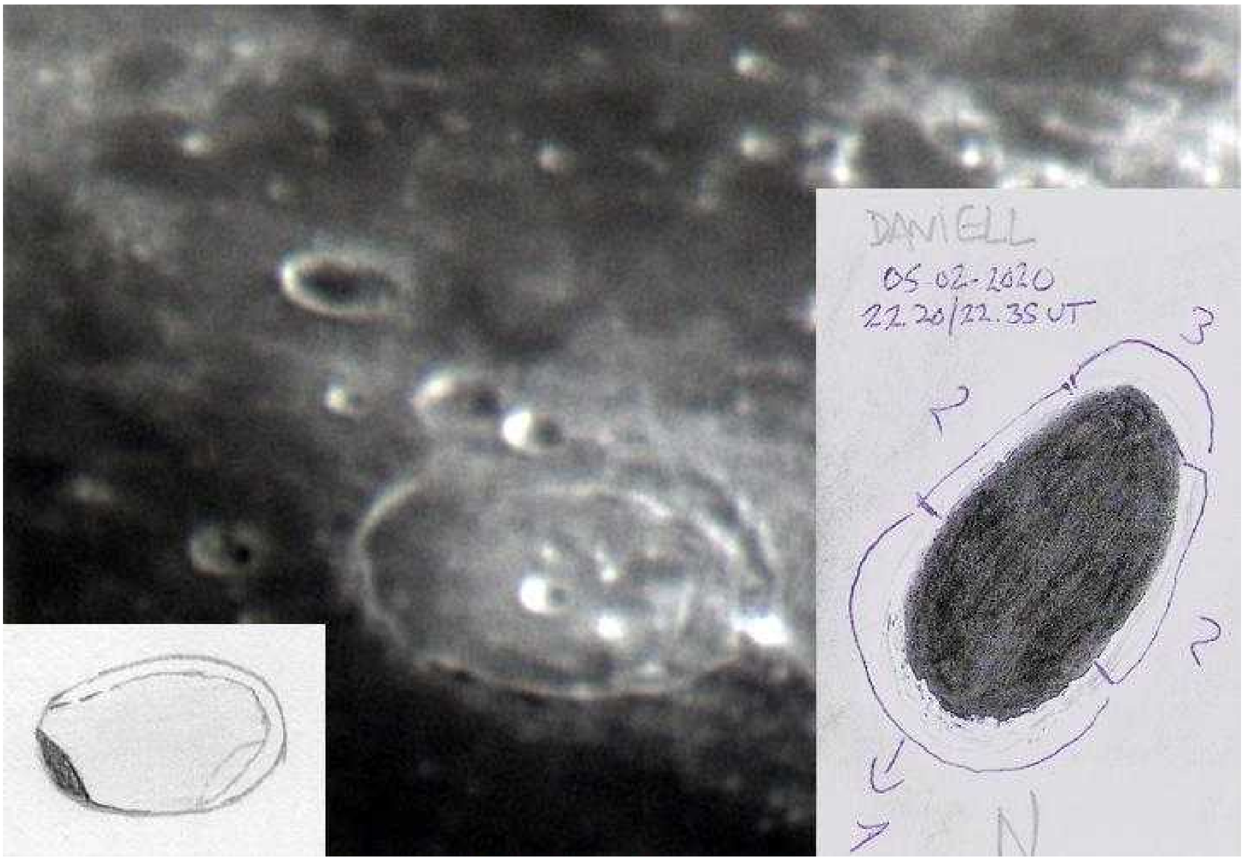


Figure 3. *Daniell.* ***(Background)*** *An image by Derrick Ward (BAA) taken on 2020 May 02 UT 21:52-21:54 and orientated with north towards the top.* ***(Bottom Left)*** *A sketch by John Saxton (BAA) made on 1979 Jul 04 UT 20:40-21:19 orientation presumably with north towards the bottom?* ***(Right)*** *A sketch by Alberto Anunziatio made on 2020 May 02 UT 22:20-22:35 with an "N" indicating where north is – the numbers indicate relative brightness.*

It is nice and clear from Derrick's image (Fig. 3 - Background) that the floor of Daniell is dark, the west wall is nice and bright and the east wall diffuse. Alberto's sketch (Fig. 3 – Right) confirms the dark appearance of the floor but also shows the relative brightness values of the rim. Now the sketch provided by Saxton (Fig. 3 – Bottom Left) has no North indicator, but by convention (also looking at his sketches of other craters) probably has north towards the bottom. So, in this case why does Saxton say that the east of Daniell was bright and fuzzy whereas in Derrick's image it is the west wall? Back in the late 1970s the BAA Lunar Section transitioned from the 'Classical' way of defining East and West on the Moon to the IAU system. Saxton does not make clear which system they were using, though in sketches submitted later that year it is clear that they use IAU as they start putting IAU in brackets every time they mention a direction. I therefore suggest that '*noticed that the east end of Daniell was bright and fuzzy and had somewhat poorly defined edge to the bright part'* should read: *'noticed that the west end of Daniell was bright and fuzzy and had somewhat poorly defined edge to the bright part'*. However, this still does not agree with Derrick's image which shows a bright west end and a fuzzy east end. We shall therefore leave the weight of this 1979 report at 2 for now.

Copernicus: On 2020 May 02 UT 04:43 Rik Hill (ALPO/BAA) imaged the crater in monochrome under similar illumination to the following two reports:

On 1995 Jul 07 at UT 04:22 R. Spellman (Los Angeles, CA, USA) noted that the floor of Copernicus was slightly darker in blue light. The ALPO/BAA weight=1. This report came from R. Spellman's web site.

Copernicus 1969 Nov 18 UT 21:10-21:11 Observed by Hedervari(Budapest, Hungary, 3.5" refractor) "Yellowish-red stripe on inner W. wall (chrom. aberr.? Apollo 12 watch)." NASA catalog weight=2. NASA catalog ID No. 1217. ALPO/BAA weight=1.

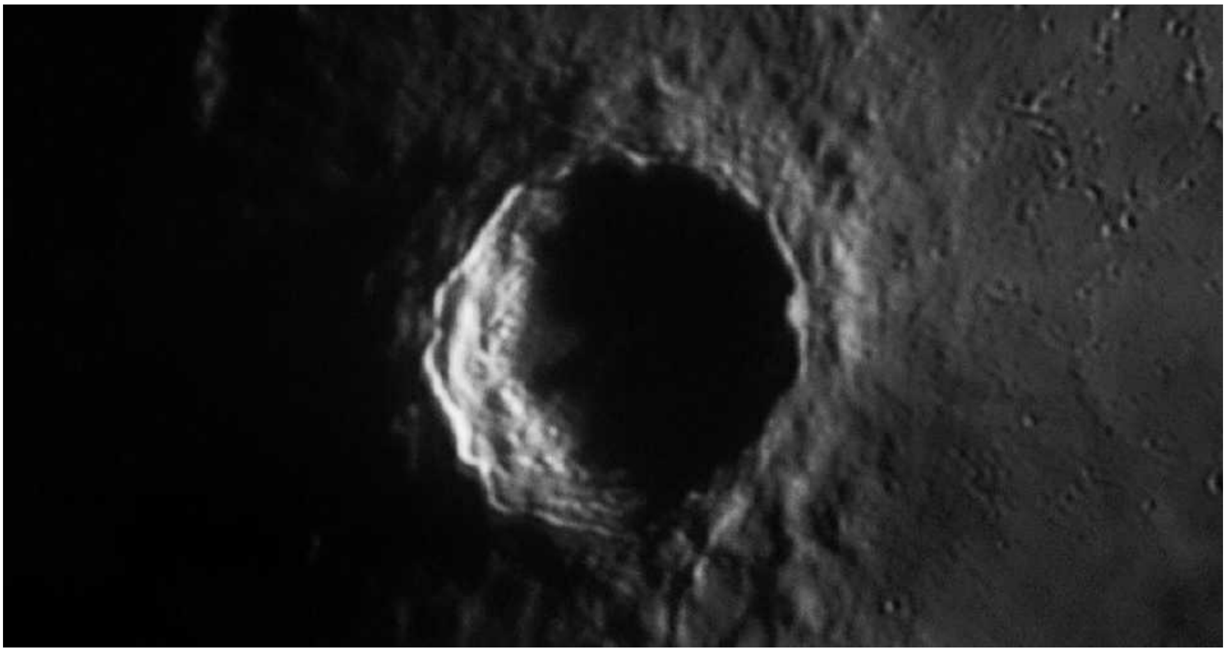


Figure 4. *Copernicus at 665nm as imaged by Rik Hill (ALPO/BAA) on 2020 May 02 UT 04:43 and orientated with north towards the top.*

Although Rik's image is monochrome, it does at least provide a very useful context image for what the overall appearance of Copernicus should have looked like to the respective observers back in 1995 and 1969. It can also prove useful for modelling atmospheric spectral dispersion, or chromatic aberration, to see if this could have generated the colours at the locations specified. We shall leave the weights as they are.

Plato: On May 04 ALPO observers: Jay Albert observed (01:25-01:40UT) and Gary Varney imaged (02:44UT) the crater under both similar illumination and topocentric libration (±1°) to the following report:

On 1980 Jul 22 at UT20:08-21:50 G.North (Sussex, UK, 8" reflector, x144 and x207, seeing III-V and transparency fair) suspected an obscuration on the north and north west wall. The effect came and went. May have been due to seeing and image contrast? Cameron 2006 catalog ID=101 and weight=1. ALPO/BAA weight=1.

…and for Gary Varney's image, just similar illumination (±0.5°) to the following report:

Plato 1970 Dec 08 UT 18:00-23:59 UT Observed by Fitton (Oldham, England, 8.5" reflector, S=VG) "All surrounding detail perfect, but barely a trace of floor detail. A suggestion of 2 or 3 white spots including central A seen only on one examination out of five. "sector" beginning to show. ALPO/BAA weight=1.

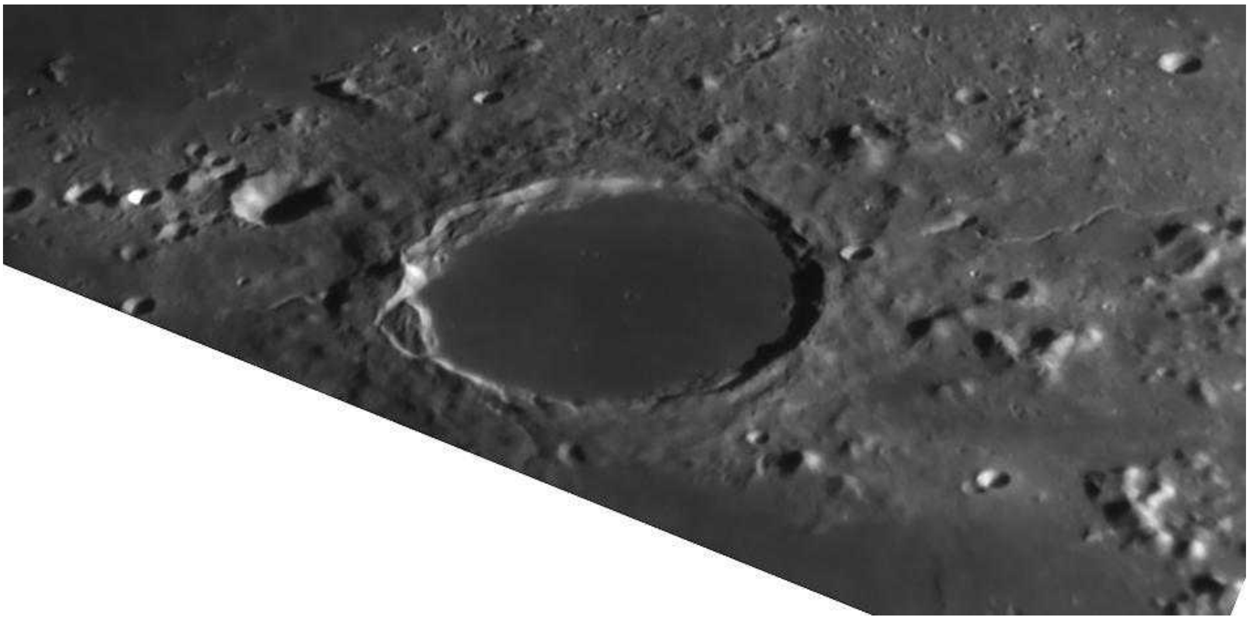


Figure 5. *Plato on 2020 May 03 at 02:44 UT as imaged by Gary Varney (ALPO). The image has been rotated so that north was towards the top – hence the triangular section missing on the bottom left.*

Jay comments that for the 1980 report that the central, N pair and S craterlets were seen, though the N pair and S craterlets were sometimes difficult and even momentarily missing. There was no hint of any obscuration or fuzziness on the N and NW walls. He did note however that part of the NE wall, which was also well detailed, appeared to have a lot of damage or deterioration. Gary's image (Fig. 5) confirms Jay's description. We can quite see why seeing variability could cause the obscuration effect seen by Gerald North. So, therefore, we shall lower the weight of that TLP to 0 and remove it from the TLP database.

Likewise, for the 1970 Fitton report, Fig. 5 tells us that the craterlets could probably only be seen during the really best moments of atmospheric seeing. We shall therefore lower the weight of that report to 0 and remove it from the ALP/BAA database.

Herodotus: On 2020 May 04 UAI observers attempted a repeat illumination request to try to detect the pseudo peak that occasionally has been reported on the floor of Herodotus:

BAA Request: Some astronomers have occasionally reported seeing a pseudo peak on the floor of this crater. However, there is no central peak! Please therefore image or sketch the floor, looking for anything near the centre of the crater resembling a light spot, or some highland emerging from the shadow. All reports should be emailed to: a t c @ a b e r . a c . u k

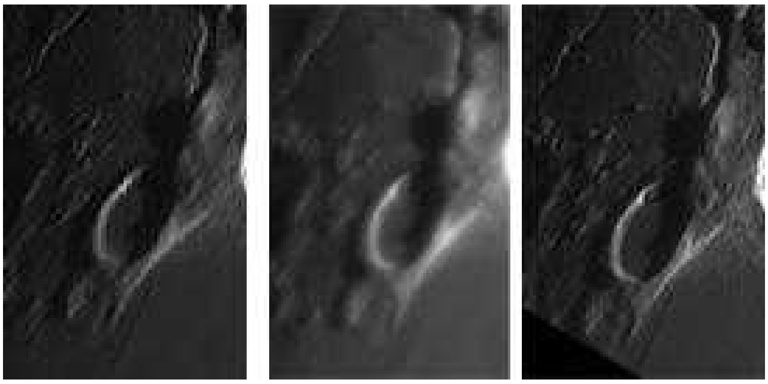


Figure 6. *Herodotus as imaged on 2020 May 04 by UAI members and orientated with north towards the top.* ***(Left)*** *Luigi Zanatta's image from 19:02UT.* ***(Centre)*** *Franco Taccogna's image from 10:39UT.* ***(Right)*** *Fabio Verza's image from 19:50 UT.*

We have an extremely nice set of time sequence images from our UAI observers (See Fig. 6), but alas no sign of the pseudo peak. It is possible that it was some kind of atmospheric effect e.g. image ghosting from different layers in our atmosphere travelling in different directions? We are definitely looking in the right colongitude range where it has been seen occasionally in the past – so whatever the cause of past sighting – lunar or atmospheric, it should hopefully recur given long enough.

Vallis Schröteri: On 2020 May 04 UAI observers: imaged the following area under a repeat illumination request that corresponded to the following TLP report:

Aristarchus Area 2004 Nov 22 UT 04:58-05:49 Observed by Gray (Winnemucca, NV, USA, 152mm f/9 refractor, seeing 4-5, transparency 4-5, x114, x228) "Blinked Herodotus with Wratten filters Blue 38A and Red 25. The illuminated west crater wall stood out brilliantly in blue light, much more so than in white light. This was true also of Aristarchus. Red light did not increase contrasts in Herodotus any more than they were in white light. Shadows in Herodotus appeared as black as the night west of the terminator and remained that way throughout the observing period. No TLP seen in Herodotus tonight. A possible TLP was seen to the west of Herodotus near the terminus of Schroter's Valley. It was noted at the beginning of the observing period that there were four very bright spots of light, one near the end of Schroter's Valley, the other three grouped together a little further north. Although not far from the terminator they were definitely east of it. It was noted that all of them nearly vanished in the Blue 38A filter while Aristarchus and the rim of Herodotus gleamed brilliantly. At 5:19UT it was noted that the most brilliant of the four lights, the one near the terminus of Schroter's Valley, had faded almost to invisibility in white light. When first seen it had been brighter than Aristarchus. It remained very dim after this through the remainder of the observing period, and was unchanged at 7:35-7:49UT when I again examined the area. The other three bright spots remained brilliant and unchanged."

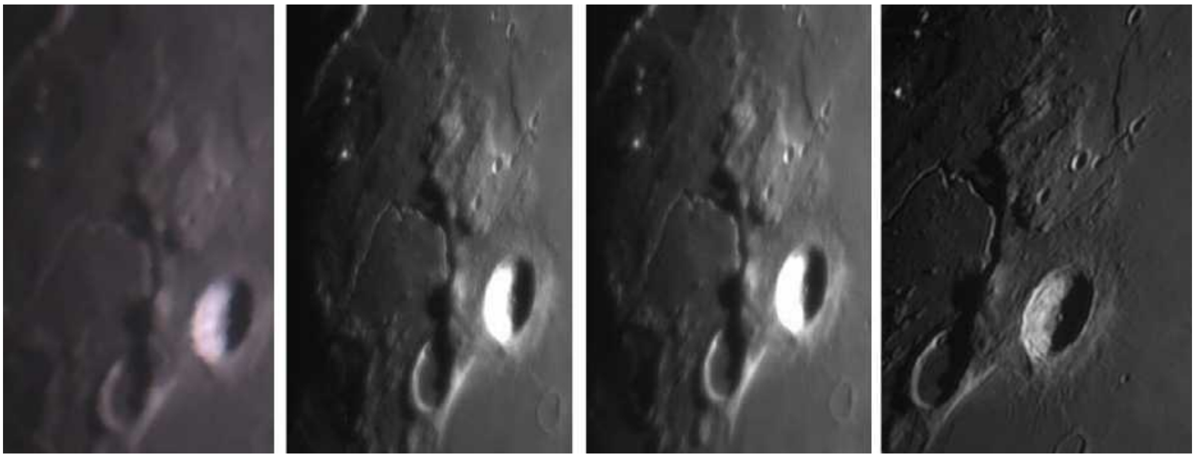


Figure 7. *Vallis Schröteri as imaged on 2020 May 04 by UAI observers and orientated with north towards the top.* ***(Far Left)*** *Valerio Fontani's colour image from 1944 UT.* ***(Left)*** *Franco Taccogna's image in red light from 19:47 UT.* ***(Right)*** *Franco Taccogna's image in blue light from 19:47 UT.* ***(Far Right)*** *Fabio Verza's monochrome image from 19:54UT.*

It is a shame that I cannot show you in thus PDF file but Valerio Fontani's image (Fig. 7 -Left) is part of an animated GIF file or a time lapse video that is very impressive to watch. Franco's images (Fig. 7 - Left and Right) are colour images but do not show up the effects that Robin Gray mentions. Fabio's image (Fig. 7 – far right) gives us the sharpest view. I am not quite sure what bright spots Robin Gray was referring to in his TLP report as he did not include a sketch. There are however some sunlit mountains way to the NW of Herodotus on the northern side of Vallis Schröteri. I think we shall leave the weight of the TLP report as it is now, but at least we have some very useful context images from which to judge this report in the future.

Herodotus: On 2020 May 05 UT 02:20 David Teske (ALPO) imaged the crater some 28 min after the end of the repeat illumination window (±0.5°) for the following report:

On 1993 Sep 28 at UT 04:30-06:10 S.Beaumont (Cambridge, UK)observed that the north east edge of Herodotus appeared as a "highland area spilling over into" the Cobra's Head border or "overlook". The shadow on the elevation was contiguous with a similar shadow over the Cobra's Head "like a darkening of the terrain. Shadow appears softer diffused without sharp bounds of most Lunar shadows. sketch. S. edge of crater started to appear at 0615". The Cameron 1978 catalog ID=468 and the weight=2. The ALPO/BAA weight=1 as the date or UT are wrong.

Figure 8. *Aristarchus and Herodotus on 2020 May 05 UT 02:20 as imaged by David Teske (ALPO) and orientated with north towards the top.*

Jay Albert, who was also observing at the time, comments that contrary to the TLP description, Herodotus was completely sunlit and visible with the terminator roughly 5 Herodotus diameters further W. The crater's E wall was in shadow but the floor was sunlit. The Cobra Head stood out in high relief with some shadow on its W slope. This is confirmed in David's image (Fig. 8). I will take a look again at the report and try some alternative dates and times in the lunar schedule web site.

Plato: On 2020 May 06 UT 07:49 Maurice Collins (ALPO/BAA/RASNZ) imaged the crater under similar illumination to the following report:

Plato 1874 Jan 01 UT 20:00? Observed by Pratt (England?) "Unusual appearance" NASA catalog weight=1. NASA catalog ID #183. ALPO/BAA weight=1.

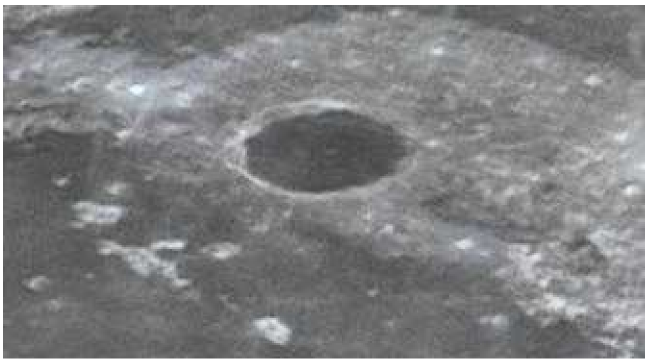


Figure 9. *Plato as imaged by Maurice Collins (ALPO/BAA/RASNZ) on 2020 May 06 UT and orientated with north towards the top.*

Note that the time of the 1874 report was estimated. Nevertheless, Maurice's image (Fig. 9) is the best guess as to what the normal appearance should have looked like –

nothing unusual. We shall keep the weight of the 1874 report at 1 until we can find out more about it.

Ptolemaeus: On 2020 May 29 UT 21:10-21:35 Daryl Dobbs observed, 22:47 Les Fry (NAS) imaged at 22:47 and Phil Shepherdson observed (22:45-23:13UT) this crater under a BAA lunar schedule request for the following report:

BAA Request: Examine the floor visually, sketch, or image to show the progression of the shadow spires across floor and the emergence of the centre of the floor into sunlight. If observing visually, how would you describe the appearance of the central lit area on the floor? If imaging, do a time lapse e.g. 1 image per minute to show the progression of the shadow spires. We are asking for these observations following an observation by P. Shepherdson (BAA) on 2020 Feb 01 UT 19:40-19:50 who commented on an unusual appearance to the floor. However, an image supplied suggests it is just shadow spires. Nevertheless, we would like to check at a repeat illumination. As another challenge, because the light illuminating the floor may come from narrow horizontal gaps on the eastern rim, and maybe slightly polarized see if you can use a polarized filter in the field of view at the eyepiece, or in front of the camera, and rotate through different angles. Do you see any change in the appearance of the illuminated area of the floor? Any sketches, visual descriptions, or images taken, should be emailed to: a t c @ a b e r . a c. u k

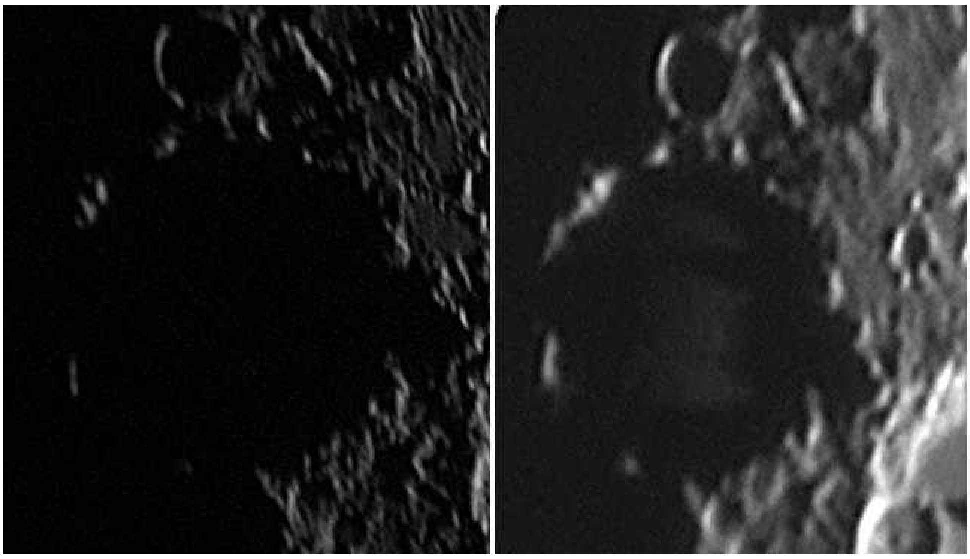


Figure 10. *Ptolemaeus on 2020 May 29.* ***(Left)*** *an image taken by Les Fry (NAS) at 22:47 UT.* ***(Right)*** *an image by Phil Shepherdson (BAA) taken at 23:13 UT.*

Daryl reports *: 'The object of this observing run was to see if the emerging floor and shadow spires had any unusual features. Observation terminated due to obscuring hill and houses. Throughout this observing run I used a Baader polarizing filter swapping it out every 3-4 minutes, each time I used the filter I rotated it in the focuser 360 degrees, however I could not detect any discernible difference in using the filter. When I started the observing run the floor was in deep shadow, by 21.15 a light elongated area became visible under the southern wall. As the shadow spires appeared the next area to come into illumination was in the centre of the crater followed progressively towards the original area and slightly north of centre, until at the end of the observing run an area approximately 1/3 of the crater width and 2/3rds* *its length was illuminated pierced with shadow spires. The area being illuminated had an even tone as the area increased in size. The first area to be illuminated between 22.18 and 22.30 had an uneven edge facing the Southern wall of Ptolemaeus, this was in contrast to the sharp edges on the rest of the shadow spires. After 22.30 until the observing run ended this turned into a sharp edge. The seeing conditions however deteriorated from Antoniadi ii to iii, due most likely to rising heat from houses nearby. From 22.15 a dark line appeared running SW to NE the area either side of this was a uniform shade, the dark line. I could not detect anything unusual compared to previous observations apart from the uneven edge on the illuminated area under the southern wall'.* A sketch was provided but is not shown here.

Phil Shepherdson comments that *'Luckily last night (29 - early 30 May) I managed to observe once more the shadows within Ptolemaeus but this time, there was no bright "ashen" light that I had observed on Feb 1st. Please forgive my sticking to my guns, but I will stand by my observation however weird it appears to be. I have taken a picture of 30 May just after midnight of the crater, but it is not very good'* (Fig. 10 -Right). Les Fry also took an image that night, but it was too early for the shadow spires to occur (Fig. 10 – Left) as the floor is completely shadow filled at that point.

Mons Piton: On 2020 May 29 UT 22:48 Rob Davies (BAA/NAS) imaged the area under similar illumination (±0.5°) to the following report:

On 1983 May 20 at UT00:00-03:00 K. Marshall (Medellin, Columbia) noted that Mons Piton was too bright near the terminator and was surrounded by shadow. A sketch was made. The mountain appeared segmented with one thin shadow line. The mountain looked like a Mexican Sombrero hat. This appearance is normal. What was abnormal was that Piton was brighter than Proclus, and only slightly fainter than Censorinus. The CED brightness measurements were normal Piton=3.6, Proclus=3.5 and Censorinus=3.7. Please check to see whether this is still the case. The Cameron 2006 catalog ID=221 and the weight=3. The ALPO/BAA weight=1.

***Fig. 11.** Mons Piton as imaged by Rob Davies (BAA/NAS) on 2020 May 29 UT 22:48 and orientated with north towards the top.*

As you can see from Rob Davies' image (Fig. 11), Mons Piton is bright, but perhaps not 'very bright'. We shall therefore leave the weight at 1 for now.

Mare Frigoris: On 2020 May 31 Daryl Dobbs sketched (21:00-21:42UT) and Bill Leatherbarrow imaged (20:30UT) this area for a repeat illumination request by the UAI:

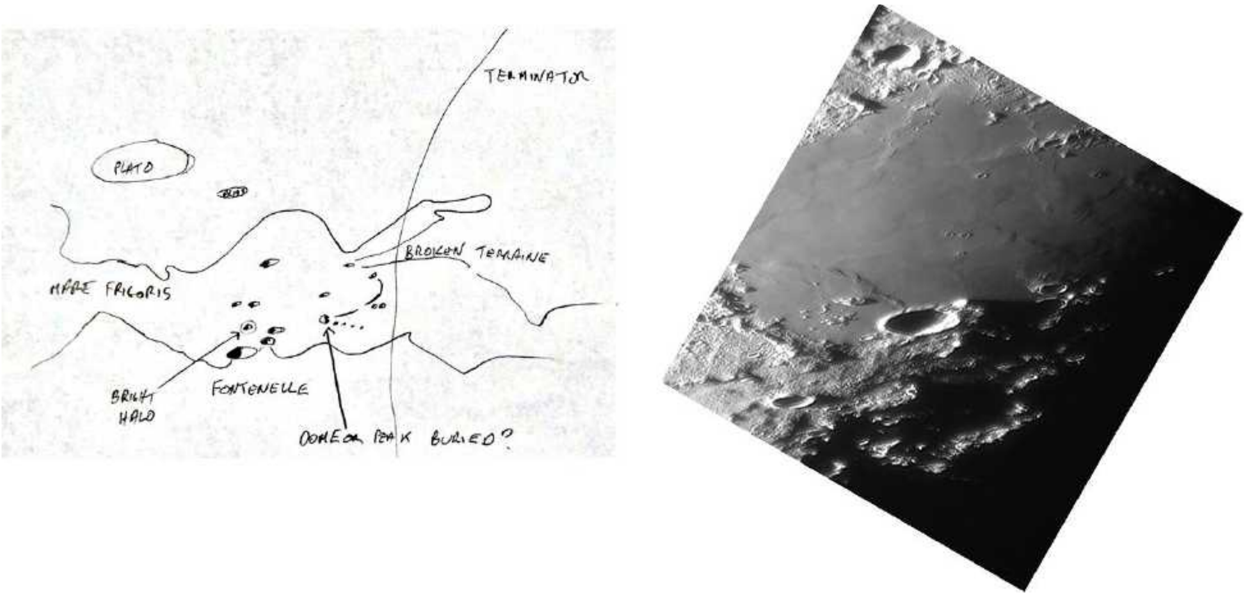


Figure 12. *Mare Frigoris on 2020 May 29 orientated with north towards the bottom.* ***(Left)*** *a sketch by Daryl Dobbs made at 21:00-21:42UT.* ***(Right)*** *An image by Bill Leatherbarrow (BAA) made at 20:30 UT.*

As the observational request was from the UAI, these reports will be sent off to them. However, I just wanted to show you how useful the Lunar Schedule website can be for purposes other than eliminating past TLP reports e.g. it is also useful for dome observing.

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 . Only by re-observing and submitting your observations can we fully resolve past observational puzzles. To keep yourself busy on cloudy nights, why not try 'Spot the Difference' between spacecraft imagery taken on different dates? This can be found on: http://users.aber.ac.uk/atc/tlp/spot_the_difference.htm . 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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