
5-Day
MOON

OVERVIEW: THE MOON, AGE 5-6 DAYS.

It's late afternoon in the start of December (2019-12-02, 17:00), and I'm out in the astronomical dusk to catch the 5.9 days waxing crescent moon (35% illuminated) hanging low in the south, at almost 16° altitude in *Capricorn*. The temperature is at the freezing point (0°C) with a medium humidity (80%), and the dew point is down at -2°C. The LP is a good suburban/rural transition NELM 6.5 (SQM 20.9), but the transparency is varying fast 2-4/7 due to low incoming *stratus fractus* clouds. The seeing is just above medium (6-7/10), but somewhat hampered by a steady wind that gives rise to a rather shimmering moon image. I've set up my telescope for a full disc view at 86x magnification in a 1.2° FOV, but I have to make my observation quick and short tonight, as our oldest son will be dropping off our youngest grandchild within an hour, -- where after the Moon will have to take care of itself...

The terminator area of the **6-day Moon** is dominated **by several large, lava filled basins**.

On the **N hemisphere** I can detect two remnants of the outermost part of the oldest pre-Nectarian basin *Procellarum (*aka *Gargantuum):* the *Vitruvius Ring* segment of mountain massifs arching up towards the N, as well as its presumed continuation encircling the mare-filled trough known as the eastern part of *Mare Frigoris*; Below Frigoris, *Serenitatis* was created by a pair of Nectarian impacts that formed a large southern basin (now holding *Mare Serenitatis*) plus a smaller northern basin (with *Lacus Somnorium*).

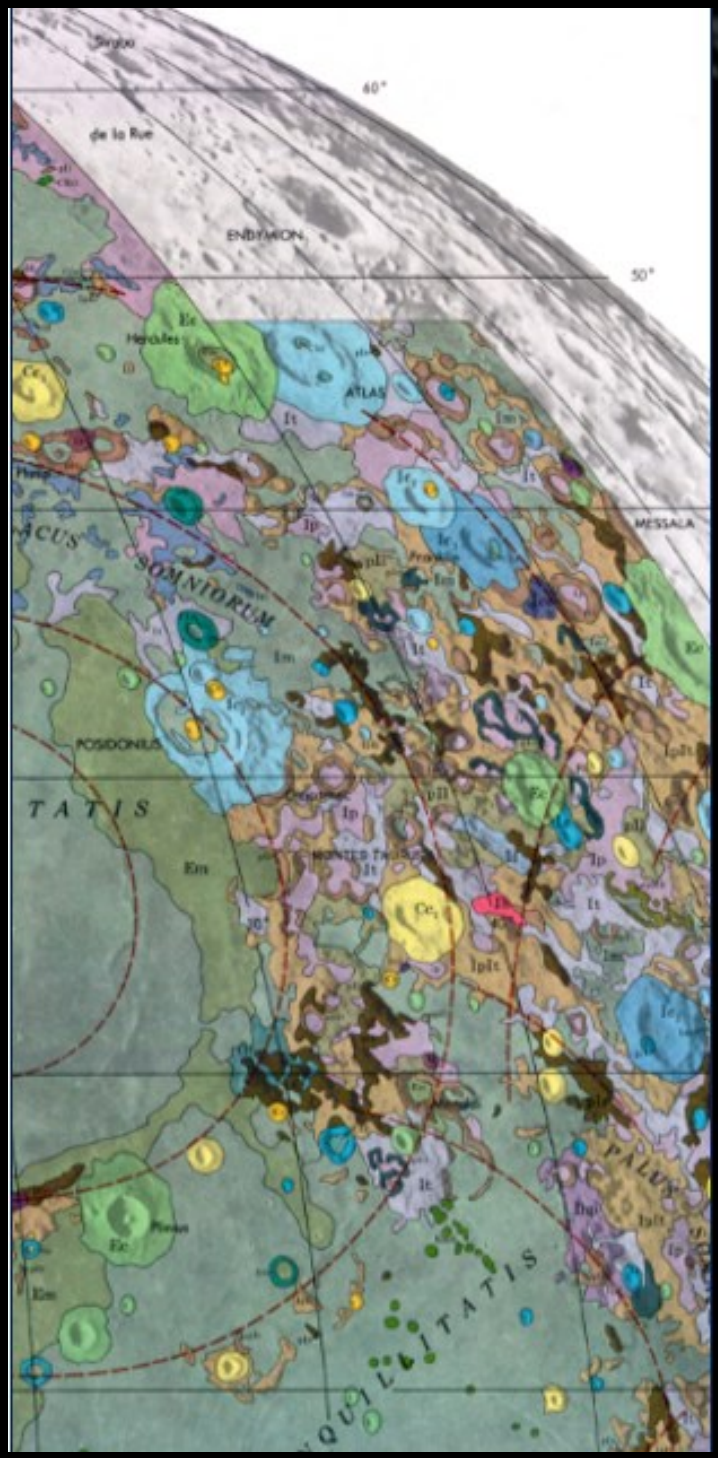
On the **S hemisphere**, the oldest and evidently subdued basins are the pre-Nectarian *Tranquillitatis* and *Fecunditatis*, now partly overlaid by the younger and splendid, multi-ring Nectarian-period (sic...) basin *Nectaris.*

Starting from the N, *Mare Frigoris* reaches, in an arcuate line, from west *above* Plato on the outer Imbrium basin ring (now E of the terminator), to the far east bordering on the crater pair *Hercules* and *Atlas*. Frigoris is part of a depressed lava-filled zone *around* the Imbrium basin, but *inside* the excavation boundary of the *Procellarum* basin, which is marked by the *arcuate Vetruvius Front* to the E of the Serenitatis basin.

The *South Serenitatis* basin is bounded by the outer *Taurus-Littrow* ring (#2), but it also features an inner *Wrinkle ridge* ring (#1) in the mare lava, which to the E is marked by the long *Serpentine Ridge*. Serenitatis is of a relatively young Nectarian age, as can be seen by secondary craters from its basin ejecta being superposed on the Crisium structure (early Nectarian). The large crater *Posidonius* at the NE shore of M. Serenitatis shows an interesting lava-filled, uplifted and fractured floor with a rille system (*Rimae Posidonius*) and a prominent landslide ridge. Other **interesting** structures in this area are the partly lava-flooded crater *Le Monnier* and the *Taurus-Littrow* Mountain complex N of Vetruvius, where Apollo 17 landed; – these deserve higher magnification studies, but I must postpone that for a later observation.

Continuing down S, the *Nectaris* basin is prominently centered, like a bull's eye on the SE lunar limb, with the W and S sectors showing a well-defined **4-ring structure**, while the two outer rings (#3, #4) are more degraded by younger deposits towards the N and E; The *Altai Scarp* (ring #4) is obvious from Piccolomini in the S to Hypatia in the N, while the next inner ring (#3) is traceable from *Santbech*, down S of *Fracastorius* and up to the chain of large craters *Catharina-Cyrillus-Theophilus* towards the W. Ring #2 delineates the small circular Nectaris mare shore with the *Pyrenees Mountains* towards the E, and finally an inner *wrinkle-ridge* ring (#1) can be seen, most conspicuous towards the W and E. The reason that the multi-ring structure of Nectaris is weakest towards the NE is probably that the two old pre-Nectarian basins *Tranquillitatis* and *Fecunditatis* had already hammered this sector, thus thinning and weakening the crust, and so, during the lava flooding in upper Imbrium, the lowest and weakest ring structure of Nectaris in this area was mostly submerged, apart from a rectangular patch of highland between the two pre-Nectarian mares (named "*Colchis*" by Hevelius in 1647).

The Nectaris basin also shows a strong **radially lineate sculpture** from secondary impacts chains, notably the *Rheita* and *Snellius Valleys* towards the SE. (There are also some crater chains towards the N: Hypatia, and Capella, but these were formed later, by the Imbrium impact). The large and young Eratosthenian crater **Theophilus** is spectacular in the lunar sunrise with its steep rim crest, terraced inner wall and flat floor with a tight group of three central peaks, -- that are not quite resolved at 86x tonight; I can however see how the impact melts have "splashed" up over the NE lower crater rim to form a frayed ejecta carpet on the mare surface of Sinus Asperitatis. The **albedo of M. Nectaris** show many interesting details, such as the small (4.4km Ø) craterlet *Beaumont L* that has a halo of dug-up darker lava, and the crater *Rosse* (R, 12km Ø), which is crossed by a bright ejecta ray from the recent Copernican Tycho impact.



MOON 5.7dy (36%) Waxing crescent, Alt:15°

2019-12-02, 17:00 CEST UT+1, Astronomical dusk
Temp.: 0°C, Hum.: 88%, DewPt.: -2°C
LP: SQM 20.9 (NELM 6.5), Rural/Suburban trans.
Transparency: 2-4/7 drifting cumulus, Seeing: 7/10

86x Magnification, 1.2° TFOV

7" f/10 Mak, 21mm ETH EP
iPhone XS, NightCap v 9.7 App

HUMBOLDTIANUM

I: Gärtner

UI: MARE FRIGORIS
P: Procellarum

E: Hercules UI: Atlas

UI: LACUS
N: SOMNIORIUM

UI: Posidonius

N: Le Monnier

UI: MARE
N: SERENITATIS

Ring	Diameter km
#1: Wrinkle ridge	400
#2: Taurus-Littrow	740

UI: Vetruvius

E: Plinius

C: Proclus

UI: MARE
N: CRISIUM

MARGINIS

UI: MARE
P: TRANQUILITATIS

Zeiss AS63/840, 1.7x GPC
Zeiss 10 mm Ortho
iPhone-4, 143x

UI: MARE
P: TRANQUILLITATIS

Imbrian
Ejecta

UI: MARE
P: FECUNDITATIS

SMYTHII

4
3
2
1

I: Hypatia
I: Capella
E: Theophilus
N: Cyrillus
N: Catharina
N: Fracastorius
UI: Piccolomini

UI: MARE
N: NECTARIS
N: Santbech
Snellius
Rheita

Ring	Diameter km
#1: Wrinkle ridge	240
#2: Pyranees Mts.	400
#3: Santbech-Cyrillus	620
#4: Altai Scarp	860

AUSTRALE

86x Magnification, 1.2° TFOV
7" f/10 Mak, 21mm ETH EP
iPhone XS, NightCap v 9.7 App

MOON 5.7dy (36%) Waxing crescent, Alt:15°
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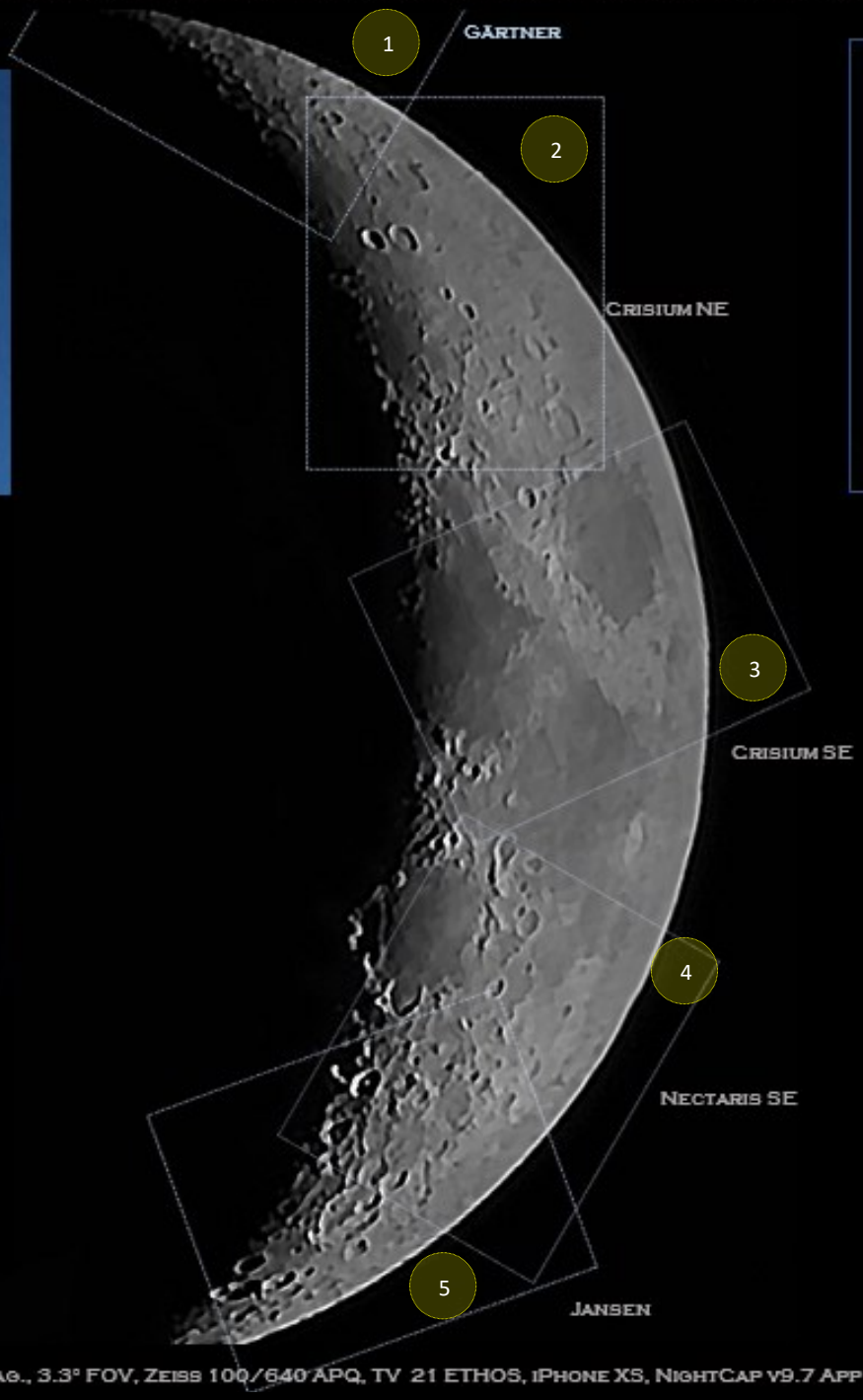
MOON 2020-02-28 18:30-19:30 Local CEST (UT+1). Phase 5 Day, Illum 22% Waxing Crescent. Trsp. 4-5/7, Seeing 5/10. Temp 5°C, Hum. 80%, DewPt, 0°C

1x Magnification, iPhone XS, NightCap v9.7 App

Old MOON in New moon's Arms, 12x Mag., 4.2° FOV
Zeiss 100/640 APQ, TV 55 PLO
iPhone XS, NightCap v9.7 App



16x Mag. @ 4.2° FOV
Zeiss 100/640 APQ, TV 41 PAN
iPhone XS, NightCap v9.7 App

5-Day Crescent Moon, 30x Mag., 3.3° FOV, Zeiss 100/640 APQ, TV 21 ETHOS, iPhone XS, NightCap v9.7 App

The 5-Day waxing crescent Moon.

It's the **end of February** (2020-02-28, 19:00 local CEST, UT+1), and also the end of winter here on the N hemisphere. It has been the wettest February month in recorded meteorological history in Denmark (since 1874), and also the warmest winter we have ever experienced; Our climate in N Europe is changing in a direction that is not favorable for amateur astronomy, resulting in higher humidity, more clouds and stronger winds (aka. lower transparency and reduced seeing).

This evening the forecast says overcast with rain and sleet, -- but right now there's a hole in the clouds through which I can catch the **5-Day (22% illuminated) Moon**, cruising at 30° altitude towards the SW, up in the tail of the diving Whale (*Cetus*). The temperature is a warm(!) 5°C, humidity 80% and dew point 0°C, and it's calm with a transparency of 4/7, seeing ~6/10 and darkness currently transiting from nautical to astronomical twilight in my suburban backyard (SQM 20.3, NELM 6.2).

The **libration** this evening is: +6 Lat and -5 Long, which means that the NW quadrant is most favorably inclined, whereas the E rim is tilted 5° *away* from me. When I last observed the E rim (6-Day Moon, 2019-12-02, 17:00 UT+1), the libration was more favorable (+5½° Lat, +2½° Long), so tonight I will *not* be able to study for instance *Mare Smythii* and *Australe*, -- but there are of course other features of interest on the E Moon 😊

I rush out my small 4" refractor in the hope of being able to make some close-up studies of the **larger E lunar craters** (*De la Rue, Cleomedes, Taruntius, Petavius, Jansen* etc.) and **valleys** (*Snellius, Rheita*). The Moon with close by Venus is a beautiful sight up there, trailing the setting sun in the evening sky, as night falls and I can see the old moon resting in the arms of the new moon at low magnification as my scope cools down. (I can relate to that, being married to a girl 5 year younger than me).

I now zoom in on the crescent moon, as I plan a **sweep from N to S** along the lunar rim, from *Gärtner*, past *Crisium* and *Nectaris,* down to *Janssen* towards the south.

1

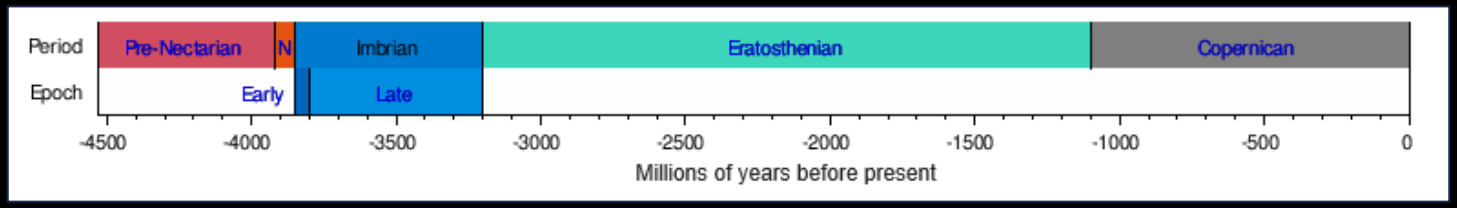
The 5-Day Moon – N
Gärtner

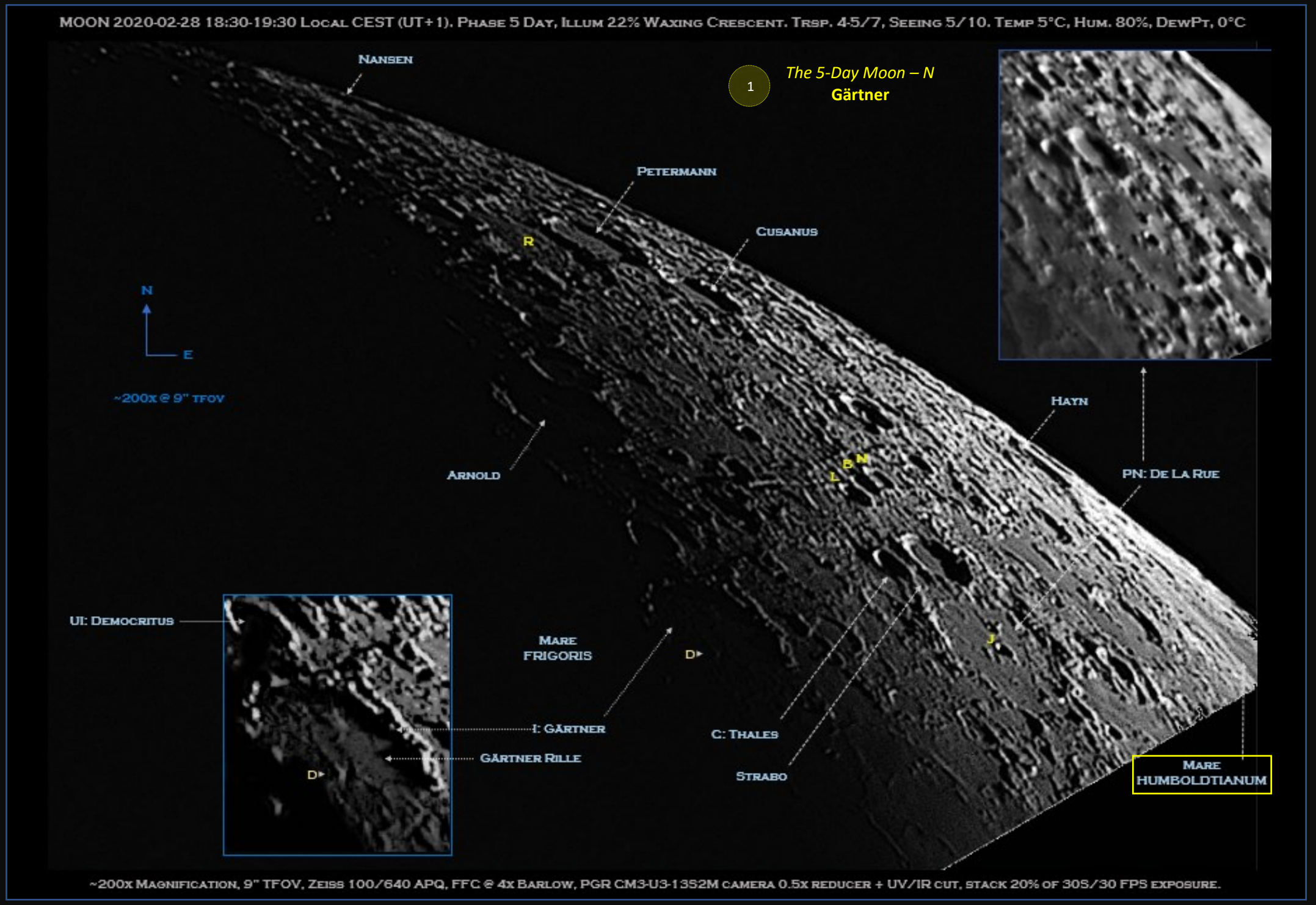
Starting at the far NE rim of the crescent moon, we are in **Nectarian country**, dominated by ejecta from the **Humboldtianum** basin impact. The upper Imbrian lava fill in the N part of *Mare Humboldtianum* can just be seen in the lower SE corner of my image, with light-albedo ejecta

A dominant impact in this area is the large but ancient and degraded walled plain: **De La Rue**, -- a pre-Nectarian crater with a small central crater (J: 14km Ø), an almost drowned crater towards the NW and a cluster impact of 3 craters at the SE wall. *De La Rue* is bordered at the NE wall by the two young craters: ***Thales*** (Copernican) and ***Strabo***, the later with a row of cluster satellites: *Strabo L, B* and *N* a little up NW.

Another conspicuous feature is the walled plain **Gärtner** on the N rim of the *Procellarum* basin; It is younger (Imbrian epoch) than *De La Rue*, thus does not show as degraded crater walls, but it has been half drowned during the Imbrian *Mare Frigoris* lava fill. Gärtner is right at the terminator of the 5-day moon, so not easy to observe, -- but with some effort I can glimpse small details on the crater floor, including the hilly hummocky landscape at the NW end formed by the ejecta carpet from the Upper Imbrian **Democritus** crater, and also the *Gärtner sinuous rille*, winding from the *D* satellite crater up north.

Right at the rim of the moon is seen the large but foreshortened crater pair: **Petermann and Cusanus**, both with a relatively featureless lava-filled floor. Finally, out in the zone of libration, is seen almost in profile the high crater walls of the **Hayn** crater (88km Ø, towards SE) and the **Nansen** walled plain (123km Ø, towards the NE). Both of these are favorably exposed in tonight's +6 Latitudinal libration!




MOON 2020-02-28 18:30-19:30 Local CEST (UT+1). Phase 5 Day, Illum 22% Waxing Crescent. Trsp. 4-5/7, Seeing 5/10. Temp 5°C, Hum. 80%, DewPt, 0°C
1
The 5-Day Moon – N
Gärtner
Nansen
Petermann
Cusanus
R
N
E
~200x @ 9" tFOV
Arnold
Hayn
L
B
N
PN: De La Rue
UI: Democritus
Mare
Frigoris
D
I: Gärtner
Gärtner Rille
D
C: Thales
J
Strabo
Mare
Humboldtianum
~200x Magnification, 9" TFOV, Zeiss 100/640 APQ, FFC @ 4x Barlow, PGR CM3-U3-13S2M camera 0.5x reducer + UV/IR cut, stack 20% of 30s/30 FPS exposure.

2 The 5-Day Moon NE Crisium NE

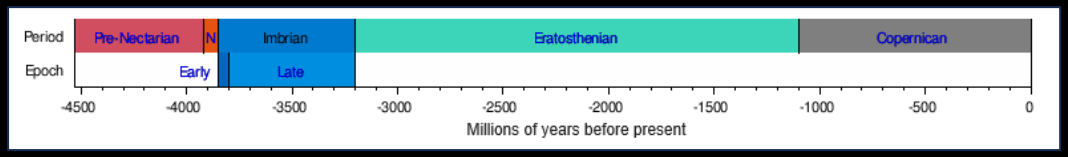
Continuing south to the NE part of the of the 5-Day waxing lunar sickle, the surface is still covered primarily by Nectarian deposits, now from both the Humboldtianum and the Crisium basin impacts. Towards the NE in my image is seen the inner Humboldtianum basin ring (excavation boundary), and in the SE corner of the image the most prominent feature is an arc of the outer Crisium basin ring (#3: the Cleomedes Ring).

Several spectacular old craters are seen in the broad borderland between the two major basin impacts, including a couple of ancient pre-Nectarian walled-plain excavations (*De La Rue, Messala*), but mostly many Nectarian craters *(Cleomedes, Gauss, Endymion*, etc.).

Later, in early Imbrium, the lower parts of this area were all flooded by volcanic mare basalts, today detectable as isolated "lakes" (*Temporis, Somnorium, Spei*) and lava fills forming the floors of some of the larger craters (*Endymion, Cleomedes*).

In the following upper Imbrian and Eratosthenian epochs the borderland region was finally battered and lightened by ejecta from young impacts like *Atlas, Hercules and Geminus*, all seen now with well-preserved terraced walls, edge slumps and central peaks.

Traces of the Imbrian volcanism are still detectable in crater-floor features such as lava rilles and pyroclastic DMDs (*Atlas, Cleomedes*), and also in grabens such *as Rimae G Bond* W of the Nectarian crater *Hall* (a "stretch mark" from mare basalt subsidence in *Lacus Somniorum*).



3 The 5-Day Moon Center Crisium SE

I've observed and described the overall landscape and geology of the Nectarian ***Crisium Basin*** formation before in this thread, so this evening I plan to concentrate on some interesting closer-up areas in this region.

At a 5-Day Moon, the uplifted frayed crust along the **excavation boundary** (Ring# 1) of the Crisium Basin is well illuminated, and the many upper-Imbrian **lava fills in the low troughs** W of the #2: Cleomedes Ring (*Mare Anguis*) and of the #3: Geminus Ring (*Lacus Risus Felis, Mare Undarum*) are also well exposed. A group of 3 large **Nectarian craters *(Condorcet, Firmicus, Apollonius)*** are prominent along the W edge of Mare Undarum, all showing dark and relatively smooth floors from the upper-Imbrian lava fill. Due to the unfavorable longitudinal libration, the Maria at the far eastern limb are not well seen tonight (*Marginis, Smythii*) but west and south of the Crisium Basin are some interesting young **Copernican Craters*: Proclus, Taruntius, Messier and Cauchy*:**

Proclus and Messier are both the result of oblique impacts, with the butterfly patterns revealing that the *Proclus* projectile came in from the W, while the *Messier*-projectile came in grazing low from the E, forming first the oblong *Messier* crater and then ricocheting downrange before impacting again as *Messier A*, throwing out a pair of long ejecta rays.

Taruntius, though a Copernican crater, shows a floor of uplifted and fractured, underlying older mare lava; The uplift has created an unusual concentric inner rim and some small patches of darker volcanic ash from vents SW of the low central peak.

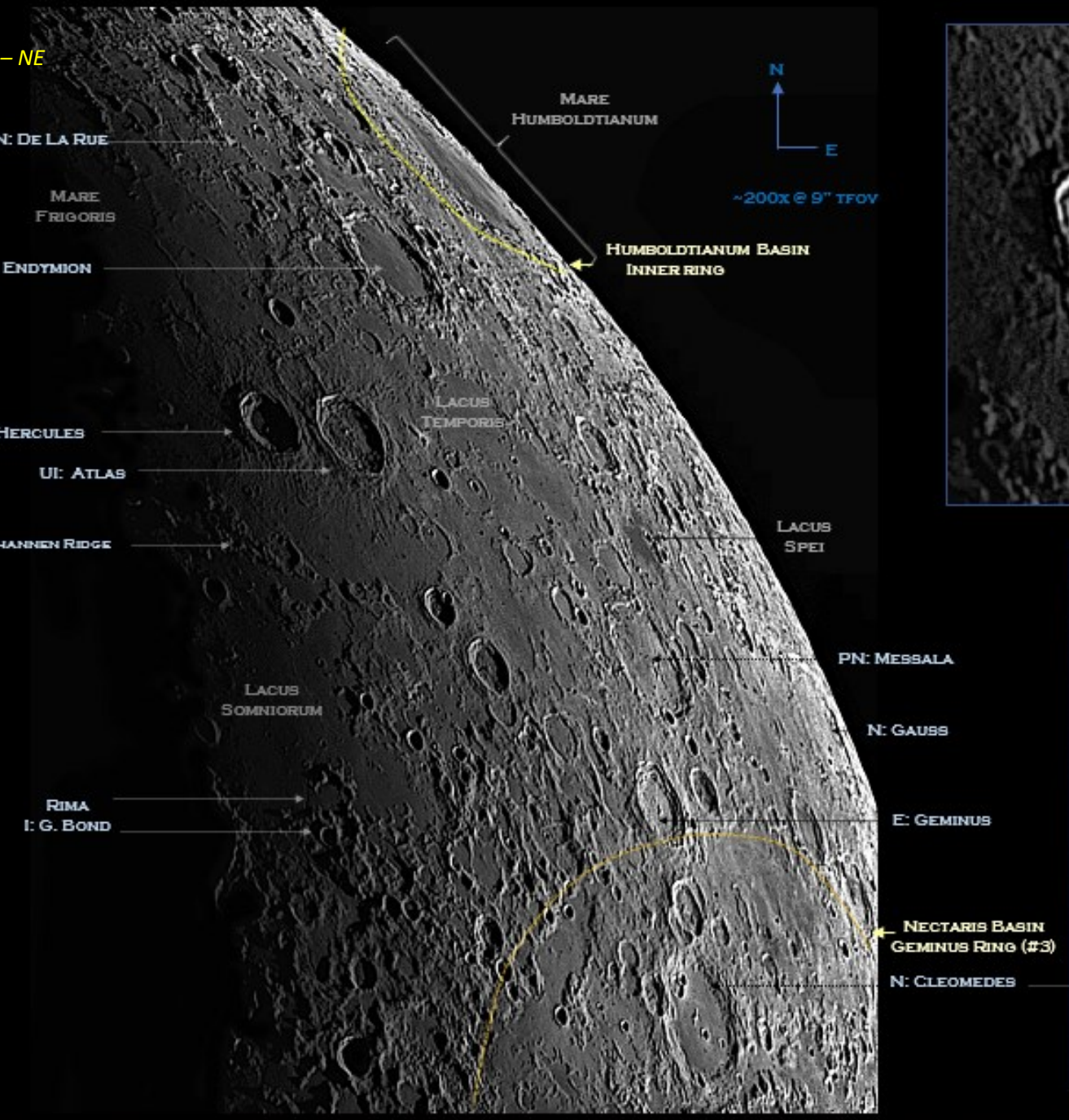
Finally, **Cauchy** is in itself an unremarkable small Copernican crater, but it is located on an interesting geological horst, i.e., a higher block formed by subsidence of the surrounding regions along a pair of fracture lines. In the telescope the two parallel lines look rather similar, but if you make a transect, it is evident that the E fracture is a graben while the W one is a fault. The *Cauchy Rille* (graben) was created as a stretch mark from the weight of the lava fill forming Mare Fecunditatis, and when the central mare finally subsided, it caused a fracture leaving the *Cauchy Fault*.

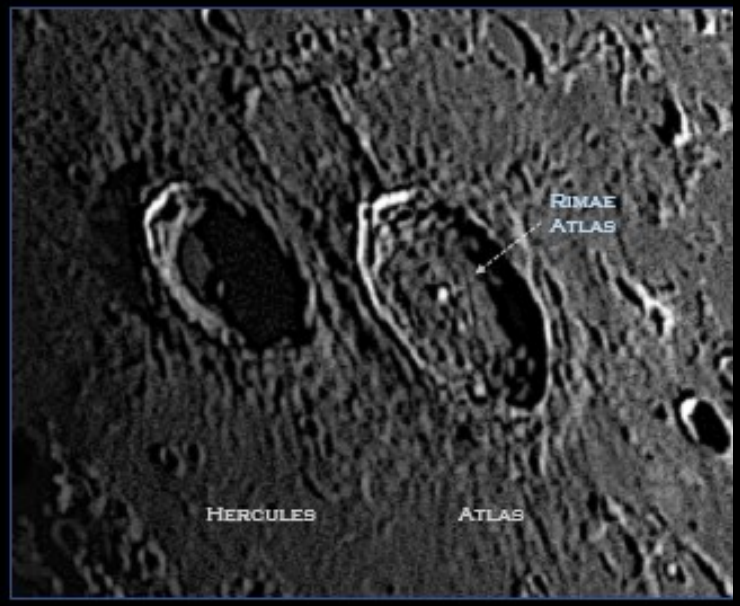
On my transect you can see that the current level of Mare Fecunditatis is -800m, while the surface of the horst is at -500m, so the fault is rising up 300m over a distance of 5km (i.e., a slope of 6%). To set that in perspective, I also did a transect from central Fecunditatis past Cauchy to central Crisium; On this you can see the Cauchy Block (horst), and also compare the level of Tranquilitatis (-800m) to the ~3km deeper Crisium (-3.700m).

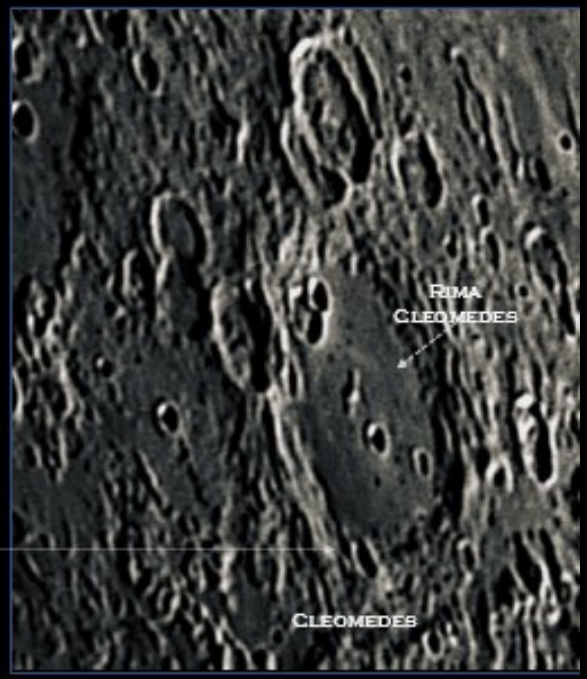
MOON 2020-02-28 18:30-19:30 LOCAL CEST (UT+1). PHASE 5 DAY, ILLUM 22% WAXING CRESCENT. TRSP. 4-5/7, SEEING 5/10. TEMP 5°C, HUM. 80%, DEWPT, 0°C

The 5-Day Moon – NE

Crisium NE

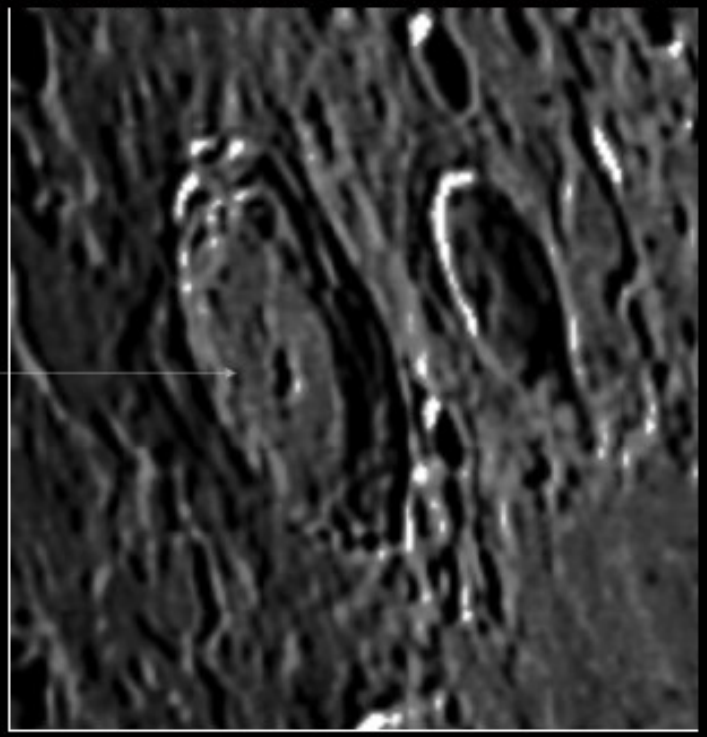






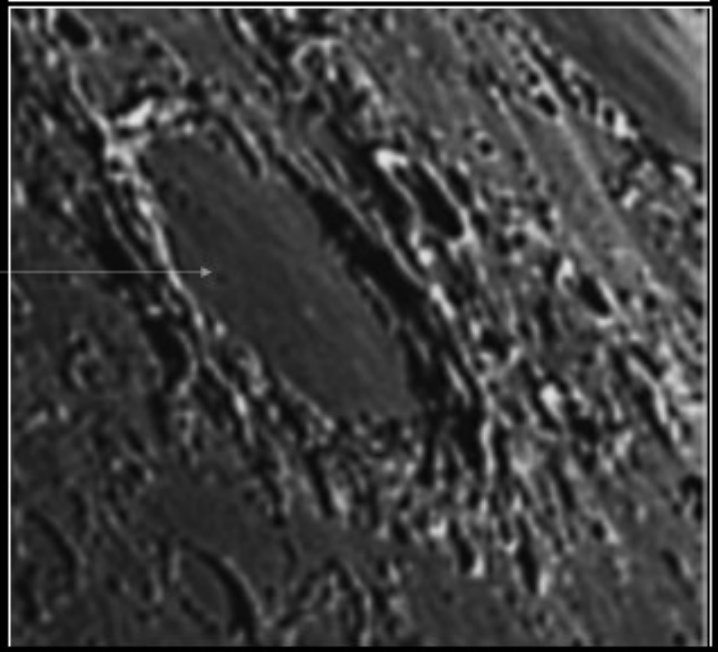
~200X MAGNIFICATION, 9" TFOV, ZEISS 100/640 APQ, FFC @ 4X BARLOW, PGR CM3-U3-1352M CAMERA 0.5X REDUCER + UV/IR CUT, STACK 20% OF 305/30 FPS EXPOSURE.

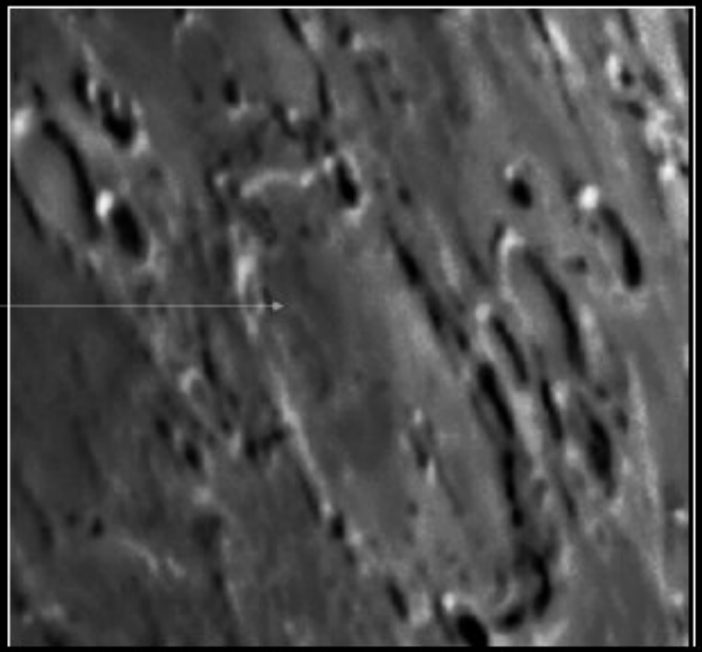
MOON 2020-02-28 18:30-19:30 Local CEST (UT+1). Phase 5 Day, Illum 22% Waxing Crescent. Trsp. 4-5/7, Seeing 5/10. Temp 5°C, Hum. 80%, DewPt, 0°C



N
E

~200x @ 9" TFOV





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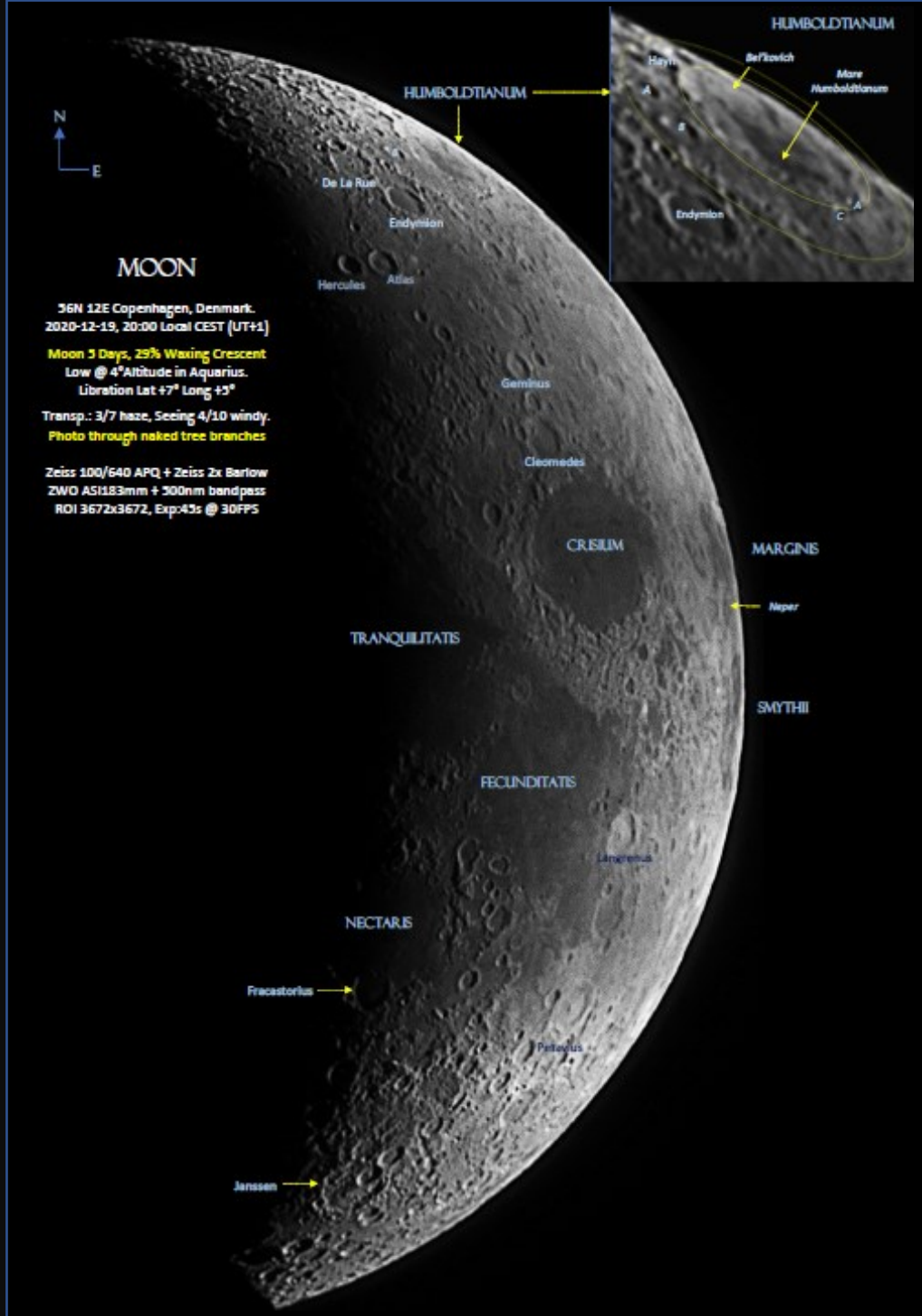
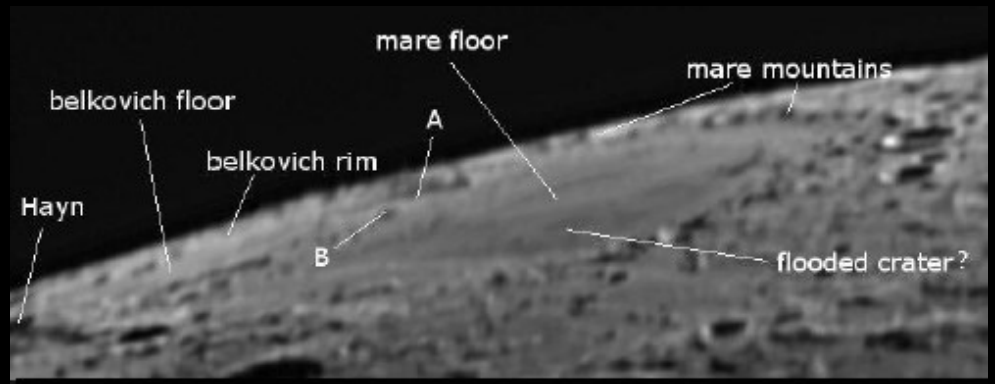
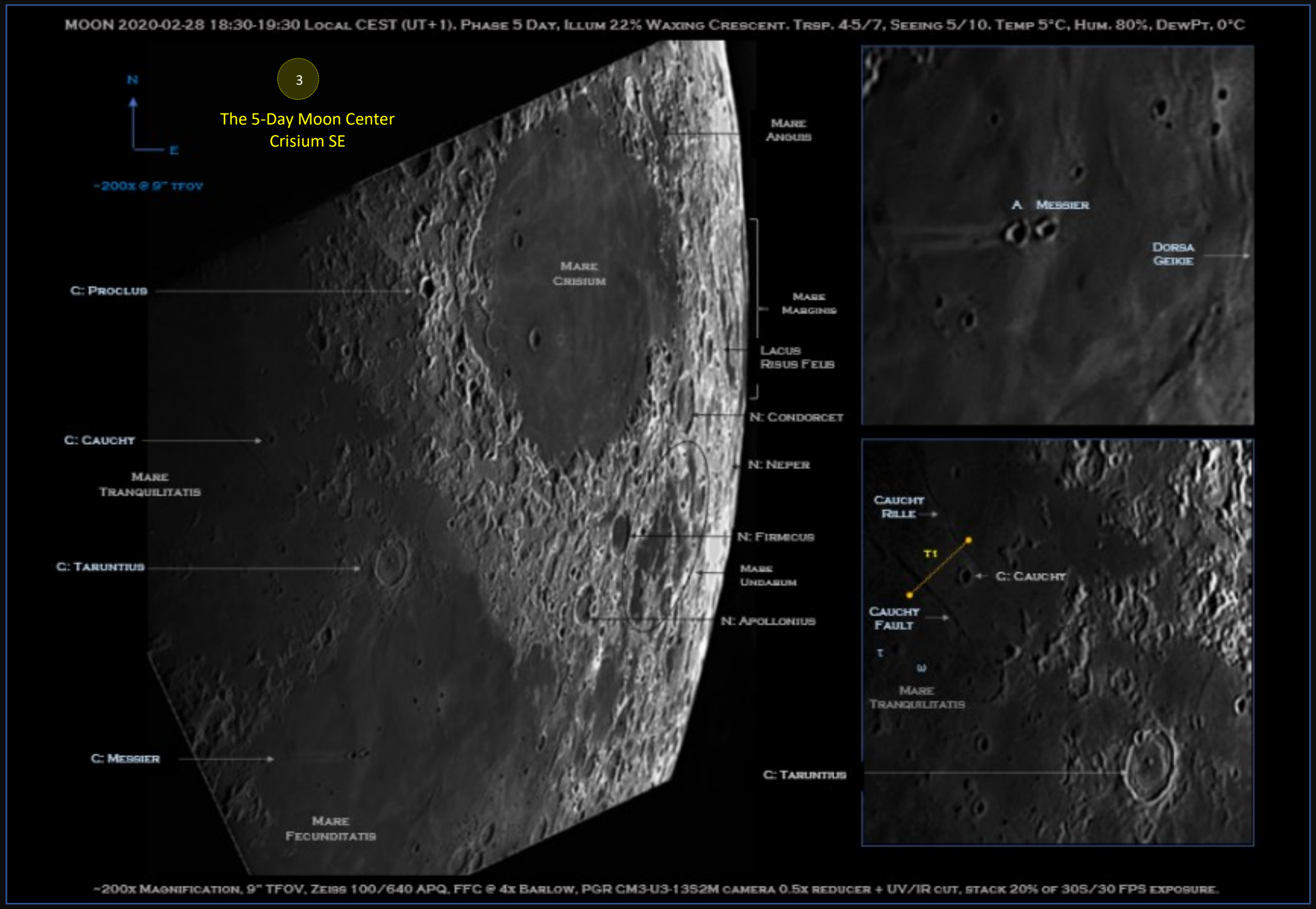
Humboldtianum

It's an early evening in mid-December (2020-12-19, 19:30 Local CEST, UT+1) and I have been out observing Mars for the last time this year, -- farewell to Terra Sirenum and Solis Planum, "the Eye of Mars". I close the observation evening with a view of the 5-day moon, which is now down at 4° and partly behind some trees in my neighbor's backyard.

The lunation is very favorable for the Maria at the eastern rim tonight, so though both transparency and seeing are well below medium, I continue my lunar observation with a focus on the **Humboldtianum Basin.** Both rings of this impact basin are visible in their full extension, as are the large ancient crater Bel'kovich and the upper Imbrian basalt patches forming Mare Humboldtianum. Also, the Copernican crater Hayn is well seen N of Bel'kovich.



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N
E
~200x @ 9" TFOV
3
The 5-Day Moon Center
Crisium SE
MARE ANGUIS
MARE CRISIUM
MARE MARGINIS
LACUS RISUS FELIS
C: PROCLUS
C: CAUCHY
MARE TRANQUILITATIS
N: CONDORCET
N: NEPER
N: FIRMICUS
MARE UNDARUM
C: TARUNTIUS
N: APOLLONIUS
C: MESSIER
MARE FECUNDITATIS
C: TARUNTIUS
A MESSIER
DORSA GEIKIE
CAUCHY RILLE
T1
C: CAUCHY
CAUCHY FAULT
MARE TRANQUILITATIS
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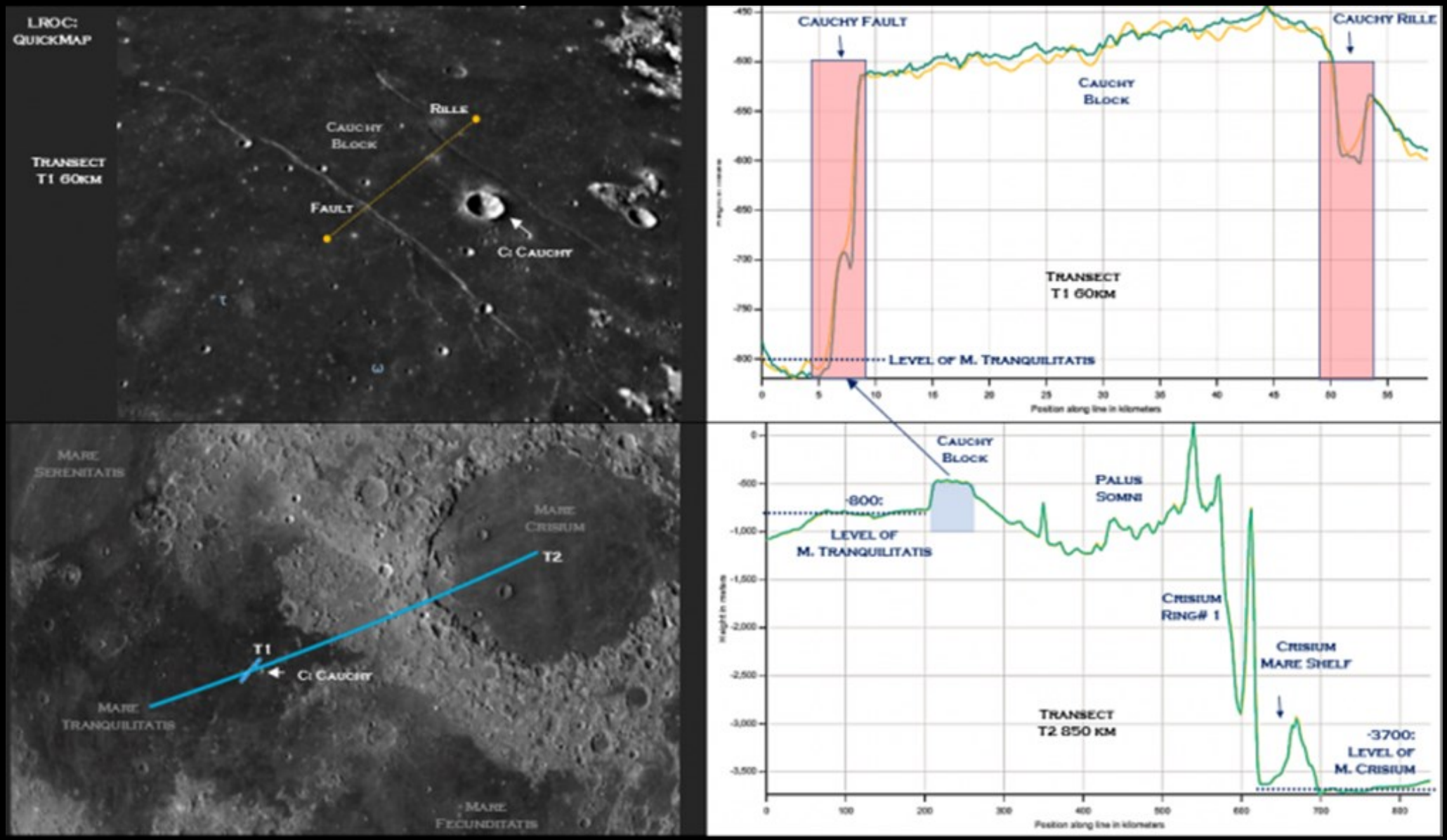

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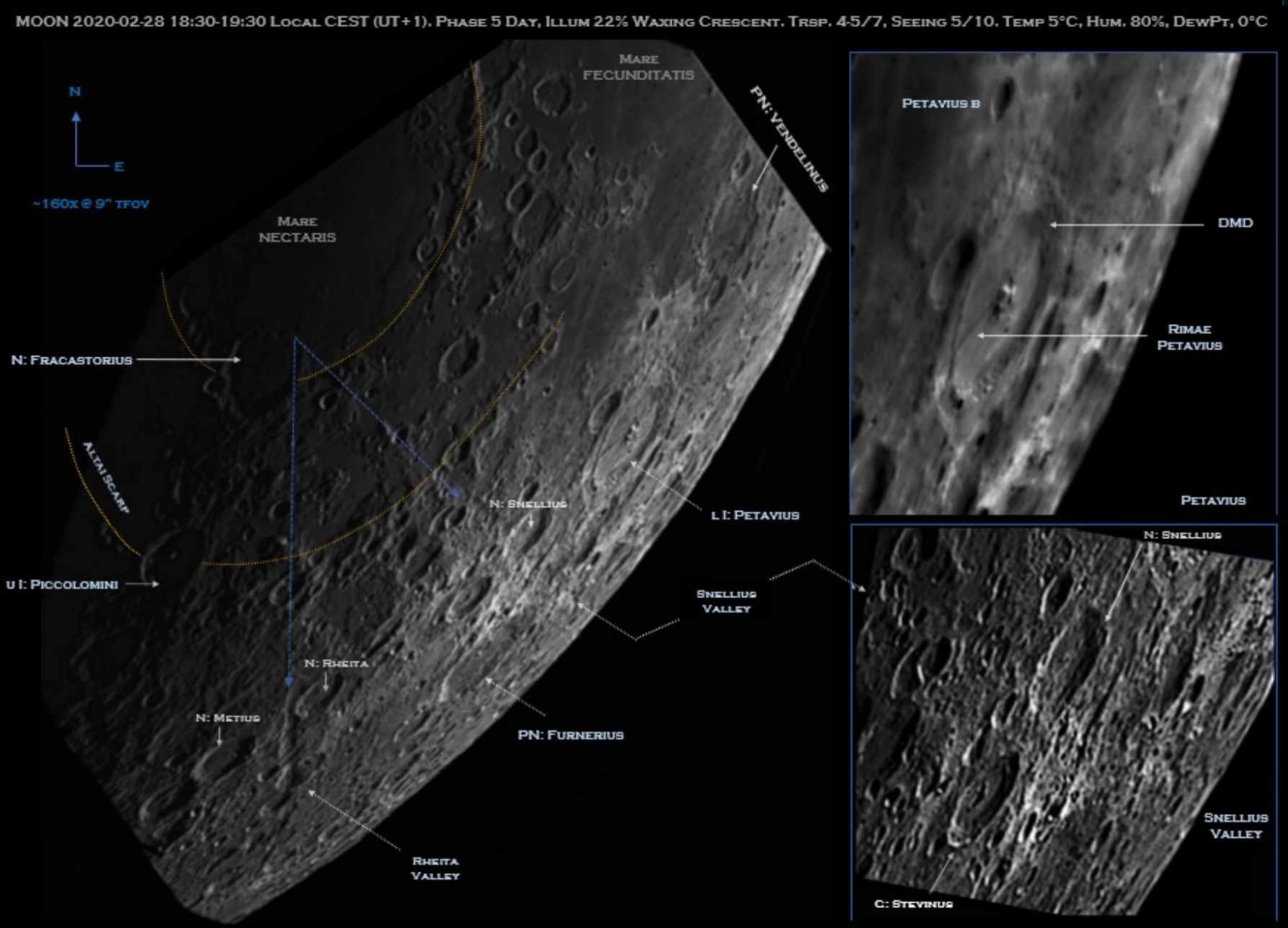
The 5-Day Moon: Nectaris SE

The region SE of Mare Nectaris is naturally dominated by ejecta from the Nectaris Impact basin (3.92 Byr ago); The most spectacular features in this area are the two long secondary crater chains ("valleys") radial to central Nectaris*: Snellius and Rheita*, but older (pre-Nectarian) craters *like Vendelinus, Furnerius and Janssen* were also battered and smoothed by the carpet of crust-debris thrown out by the Nectarian basin excavation.

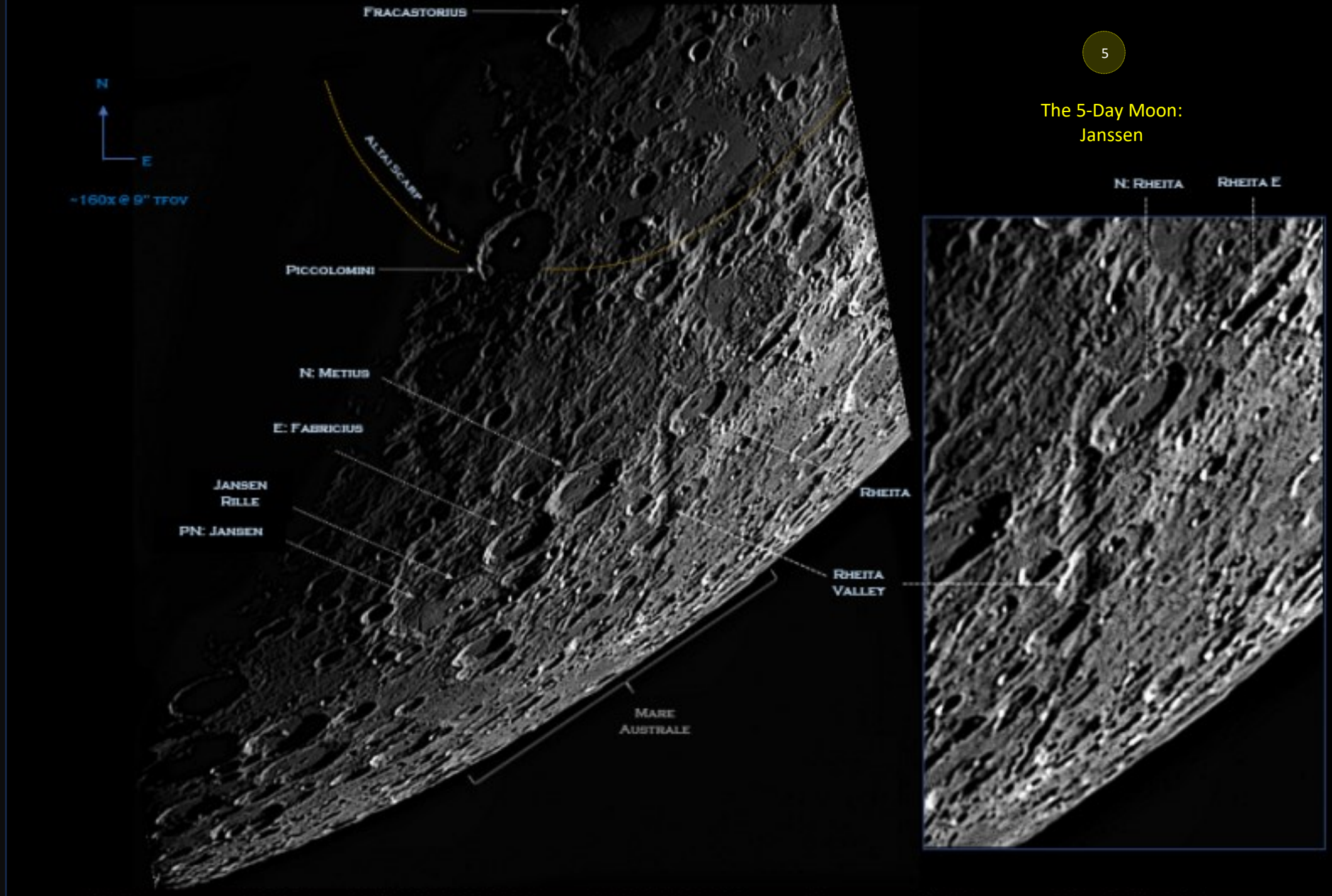
Later, the upper Imbrian lava flooding filled up the Nectaris Basin, and the rise of magma during this epoch also uplifted and fractured the floors of both ancient pre-Nectarian craters like Furnerius and also some lower-Imbrian craters in the area, for example Petavius. These so-called FFC formations (Floor Fractured Craters) are usually large and located on thin lunar crust near the shores of maria in their enclosing basins, and besides causing fractures in the floors, the uprising magma has in many cases also leaked into pools and/or vented as fire fountains, depositing patches of dark ash (DMD) in the craters. Good examples of such FFCs are of course Posidonius (in Serenitatis), Gassendi (in Humorum) and Taruntius (in Fecunditatis). In my observation tonight, Petavius shows an obvious tension crack from the central peak SW to the crater wall, and also a patch of dark ash deposits (DMD) at the N part of the crater floor.



MOON 2020-02-28 18:30-19:30 LOCAL CEST (UT+1). PHASE 5 DAY, ILLUM 22% WAXING CRESCENT. TRSP. 4-5/7, SEEING 5/10. TEMP 5°C, HUM. 80%, DEWPT, 0°C

5

The 5-Day Moon:
Janssen



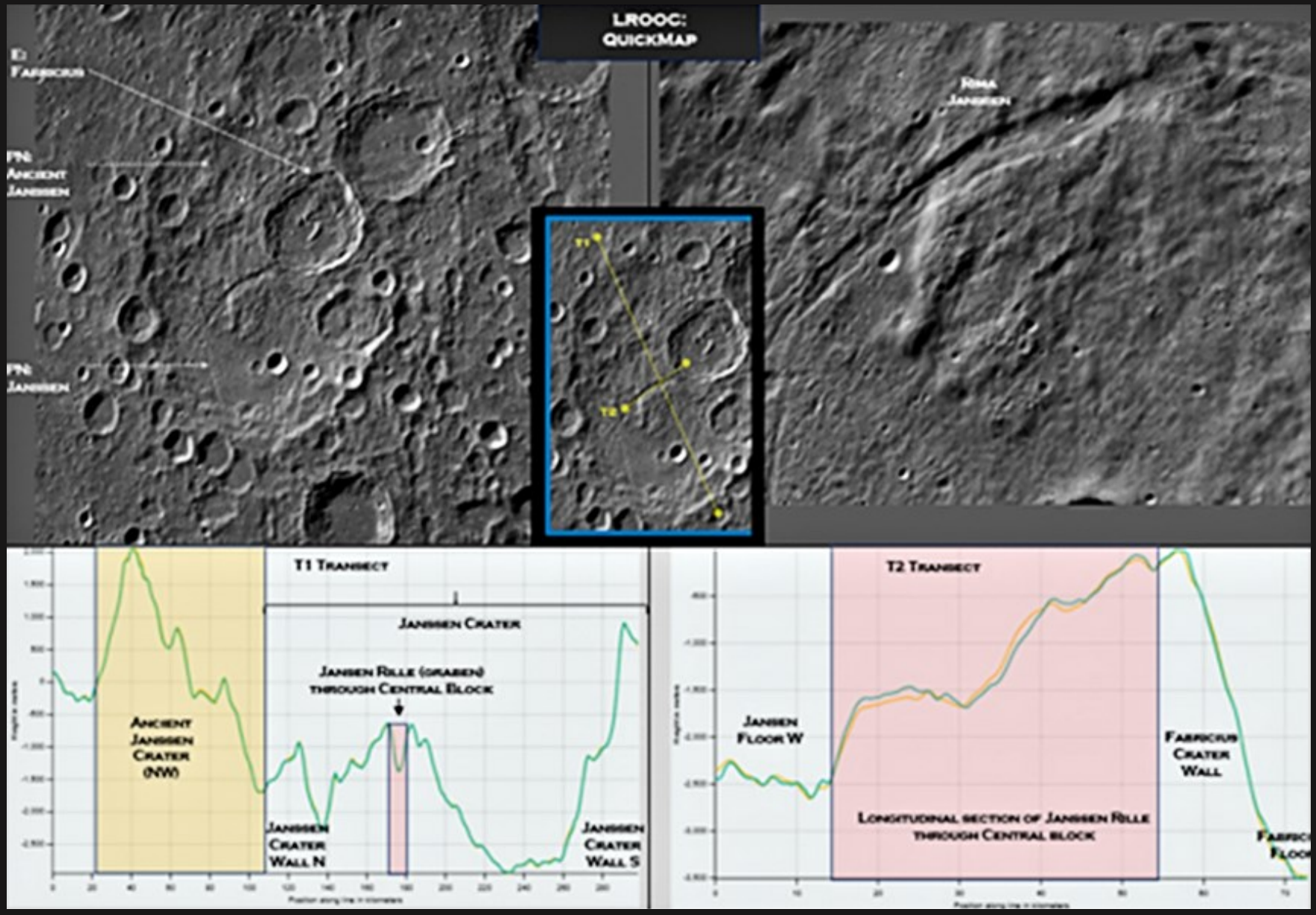
~200x MAGNIFICATION. 9" TFOV. ZEISS 100/640 APQ. FFC @ 4x BARLOW. PGR CM3-U3-13S2M CAMERA 0.5x REDUCER + UV/IR CUT. STACK 20% OF 30S/30 FPS EXPOSURE.

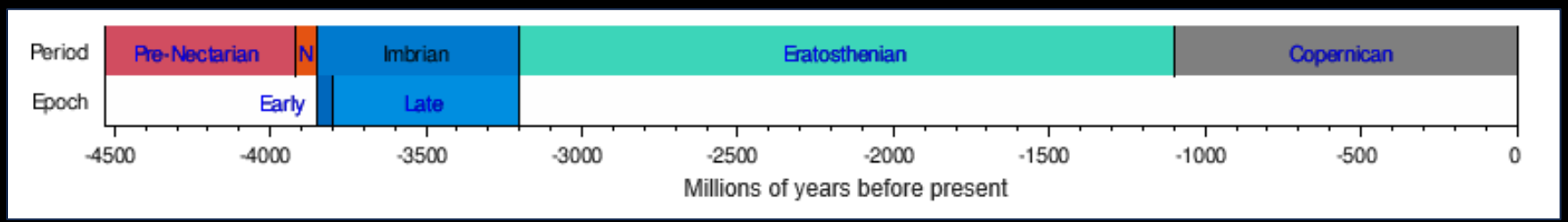
Moving on further S on the 5-day crescent waxing Moon, I start observing the interesting large and very old crater complex *Janssen*. This lunar formation is the result of sequential crater impacts, one on top of the other (see LROC images, right).

Starting with the early pre-Nectarian "Ancient Janssen" (NW in the complex), this was followed by the later pre-Nectarian Janssen smashing into the southern wall of Ancient Janssen, digging deeper and causing a landslide of "rubble" from ancient onto the floor of new Janssen.

Then, in the early Eratosthenian epoch, the Fabricius impact crashed into the NW wall of Janssen, adding further ejecta to the Janssen floor and coating it with impact melt sloshed over the crater wall.

Finally, later in Eratosthenian time, the central Janssen rebound covered by landslide blocks and coated by impact melt seem to have slumped down in both a <-NW and SE-> direction, causing the tension crack we now can observe as a central graben: the Janssen Rille. – That, at least, is the story I tell myself tonight, while studying and trying to understand this unique formation ☺





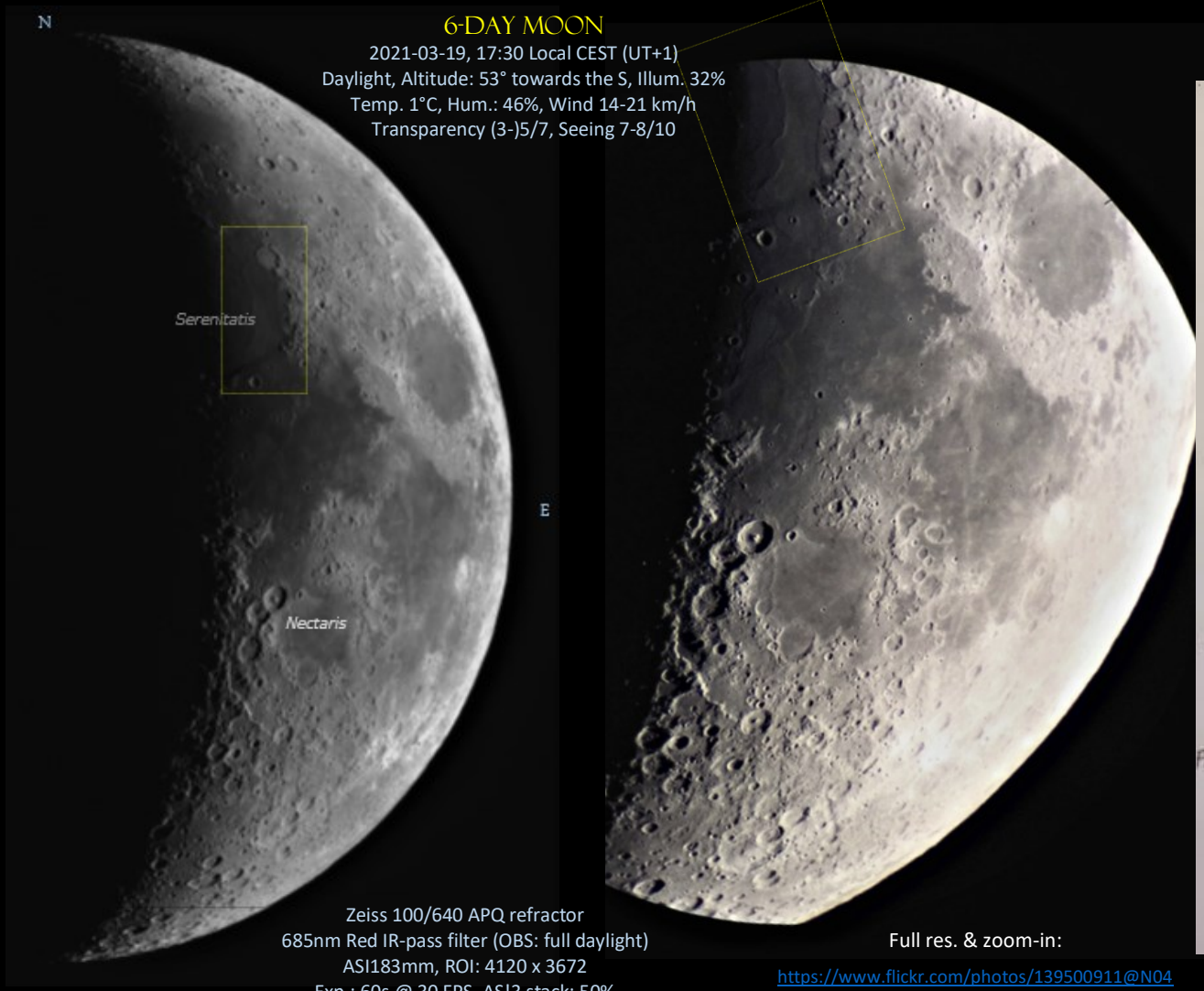
6-DAY MOON – NECTARIS

2021-03-19, 17:30 Local CEST (UT+1)
Daylight, Altitude: 53° towards the S, Illum. 32%
Temp. 1°C, Hum.: 46%, Wind 14-21 km/h
Transparency (3-)5/7, Seeing 7-8/10

Zeiss 100/640 APQ refractor
685nm Red IR-pass filter (OBS: full daylight)
ASI183mm, ROI: 4120 x 3672
Exp.: 60s @ 30 FPS, AS!3 stack: 50%
AI deconvolution & wavelet.

6-DAY MOON

2021-03-19, 17:30 Local CEST (UT+1)
Daylight, Altitude: 53° towards the S, Illum. 32%
Temp. 1°C, Hum.: 46%, Wind 14-21 km/h
Transparency (3-)5/7, Seeing 7-8/10

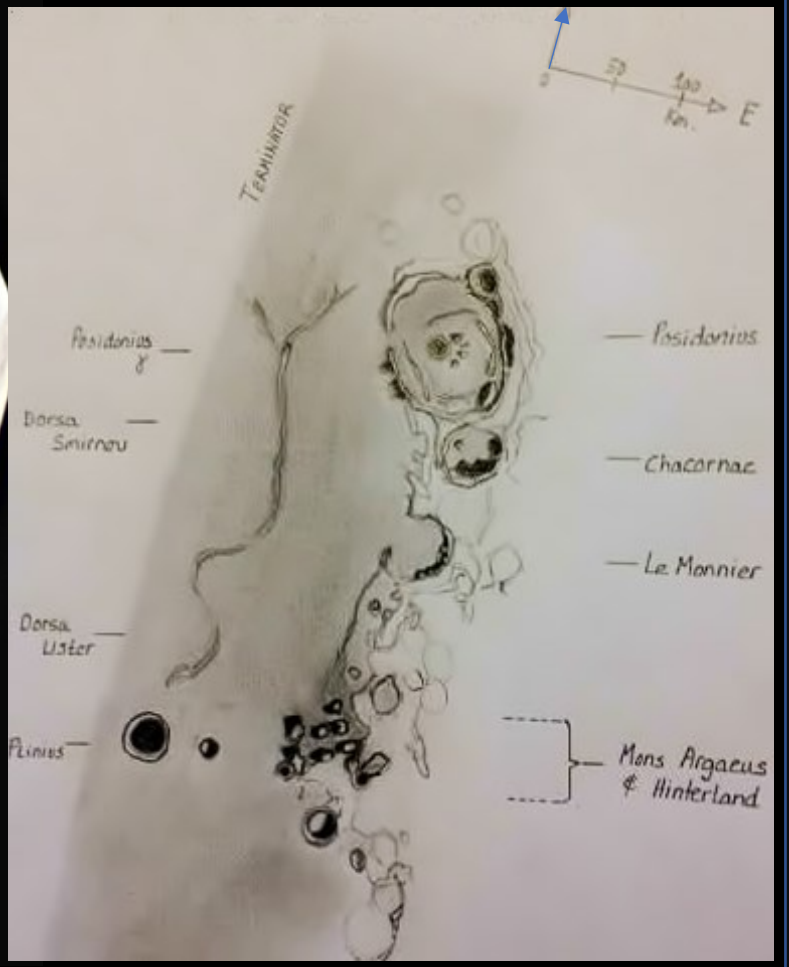


Zeiss 100/640 APQ refractor
685nm Red IR-pass filter (OBS: full daylight)
ASI183mm, ROI: 4120 x 3672
Exp.: 60s @ 30 FPS, AS!3 stack: 50%
AI deconvolution & wavelet.

Full res. & zoom-in:

https://www.flickr.com/photos/139500911@N04/51055616782/in/album-72157718716524361/

Mare Serenitatis, East, 6 DY



Weeks of dreary, damp and overcast weather in N. Europe... Then, on Jan. 25, the clouds scattered, and I had a clear view of the **6-day old moon** ! Sunrise on the **eastern shore of Mare Serenitatis**, one of the areas I had lined up for further study, so that was quite fortunate :-) On the negative side, as the evening turned into night, the temperature dropped, the humidity condensed to freezing fog -- and my R.A. motor went into some annoying backlash spasms. -- Anyway, I did manage an overall study of Posidonius plus the Mons Argaeus hinterlands, before the situation deteriorated from annoying to intolerable. The wealth of FFC details in ***Posidonius*** is always rewarding,-- the eastern landslide and central peaks were easily seen in the low sun.

I continue to find the **Mons Argaeus** area is fascinating, -- the geological history of the block faulted highlands is intriguing, and on top of that, there's the pyroclastic deposits (DMD) from volcanic eruptions. In my 80mm Vixen refractor at ~125x magnification, I could easily investigate the Taurus-Littrow valley and the area between the North and South Missives, where the Apollo 17 LEM touched down.

Alas, at this point the transparency dropped drastically, so further study must await the next CS with a favorable lunation

The 6-Day MOON

1

North east -- Posidonius and surroundings

I now continue my observation of the 6-Day moon, switching to my Zeiss binoviewer loaded with a pair of 8mm Ethos eyepieces. Using a 2x Zeiss barlow, I can just frame the moon at 160x in a 0.6° field of view -- *WOW!*

Sweeping from the North, I first focus on the NE part of the Nectarian epoch impact basin: ***Serenitatis***, specifically the area around the large floor-fractured crater (FFC) ***Posidonius***. The mountainous region E of Serenitatis (the *Taurus Mountains*) was created by outer deposits with secondary cratering from the ensuing Lower Imbrium basin impact. The mare lava flows covering the Serenitatis basin occurred in the later Upper Imbrian epoch, accompanied by local fire fountain volcanism, as seen in dark mantle deposits (DMD) in the *Taurus-Littrow Valley*. The magma flooding caused lava to be pushed up into low, concentric wrinkle ridges towards the rim of the Serenitatis basin (e.g., the *Lister, Serpentine, Aldrovandi* ridges), and flooded several borderline craters like *Le Monnier* and *Hall*.

A **wrinkle ridge** like *Dorsa Smirnow* has a width of ca 4km, and the "wrinkle" itself rises to ~150m above the surroundings, resulting in an inclination of around 4.3° (7.5%). These ridges however normally form between lava sheets of different ages and thickness, so there is often a larger height difference (for instance 200m) between the mare surface on each side of a ridge. For comparison the inclination of the up-tilted lava plate in *Posidonius* is only 2° (3.5%), but the fault towards the E drops down 600m over a 3km distance, corresponding to 12° (20%) inclination, -- which is double as tough as the most difficult mountain category in *Tour de France;* But on the other hand, the lunar gravity is only 1/6 of the Earth's, so bicycling up the *Posidonius Rupes* should be a piece of cheese...

Each individual lava flow has a thickness of ~50m, but the accumulated thickness of all the lava sheets in *Serenitatis* is at least 1.6Km, and the weight of this has caused the central mare to subside, creating **arcuate rilles (*graben*)** around the mare shores. Examples of this can be seen in the *Bond* and *Römer* rilles from *Lacus Somnorium*, down south past *Hall* and *G. Bond*, and further down to west of the *Römer* crater**. FFC craters** like the large *Posidonius* and *Atlas* are also thought to be linked to magma upwelling from the lunar mantle, while some smaller craters (like *Hercules*) got away with just a plain lava flooding of the crater floor. The *Bürg* formation NW of *Posidonius* is interesting in this context: Bürg itself is a young Copernican crater, but it is located on the lava-filled floor of the much larger walled plain *Lacus Mortis*; The W end of *Lacus Mortis* shows cracked lava in the shape of both rilles and a fault, though not in the typical configuration of an FFC crater.

2

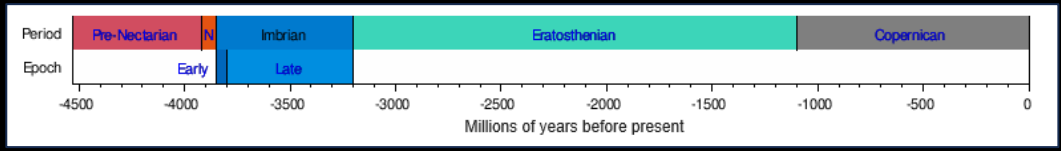
3

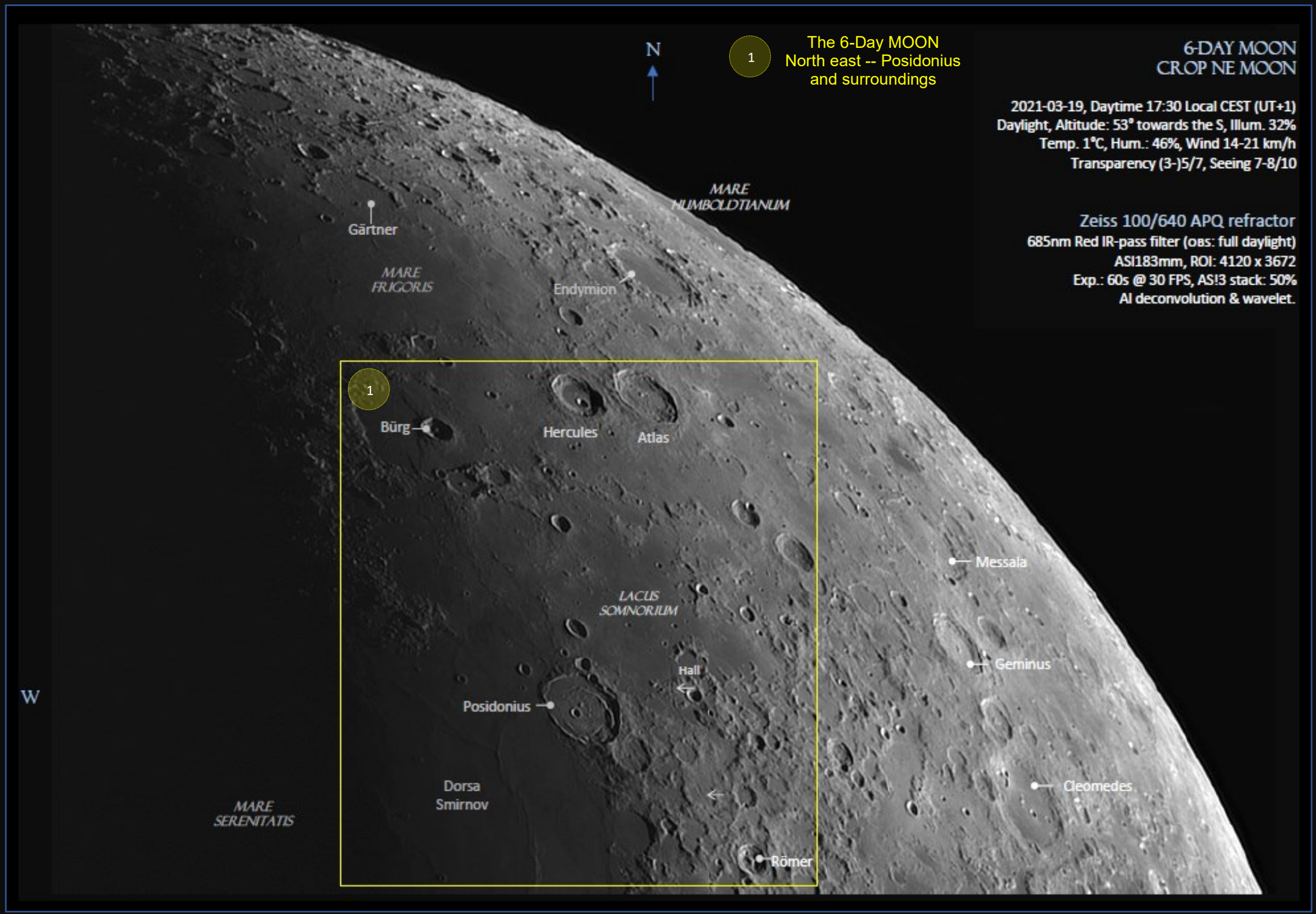
Tranquilitatis and Fecunditatis

Moving further S, I now pan across Mare Tranquilitatis and further down to Sinus Asperitatis. What catches my eye here is first the volcanic features in northern Tranquilitatis, and subsequently the large block of highland real estate wedged between Sinus Asperitatis and Mare Fecunditatis.

The region between the maria Serenitatis and Tranquilitatis shows several interesting features, such as:

- the dark old lava sheet surrounding Plinius (3.8 Byr Unit I), which was later partly covered by the younger, light-hued lava flows ponding in Serenitatis (3.4 Byr Unit III)
- as central Serenitatis sagged under the weight of the lava basalts, continuous lava flows pushed up wrinkle ridges in Unit III at the shores of Serenitatis (Dorsae: Lister, Smirnov etc.)
- and at the same time as the Serenitatis basin subsided, concentric cracks (arcuate graben) formed in the old, stiff lava shields surrounding Serenitatis (e.g., Rimae*: Plinius, Littrow, Römer, Chacornac, G. Bond*)
- the lava flows were accompanied by other volcanic activities, such as fire fountains covering the local surroundings in carpets of dark ash (DMD), as seen in the Taurus-Littrow region where the Apollo 17 LM touched down
- and rising lava pushing up the surface and erupting into domes, from the large 70km Ø caldera volcano known as the Gardner Megadome, to smaller magma chambers erupting as round shield volcanoes, such as the ~15km Ø and 300m high Arago domes (alpha, beta and gamma?) and the 10km Ø and 200m high Tau and Omega domes S of the Cauchy Rille.

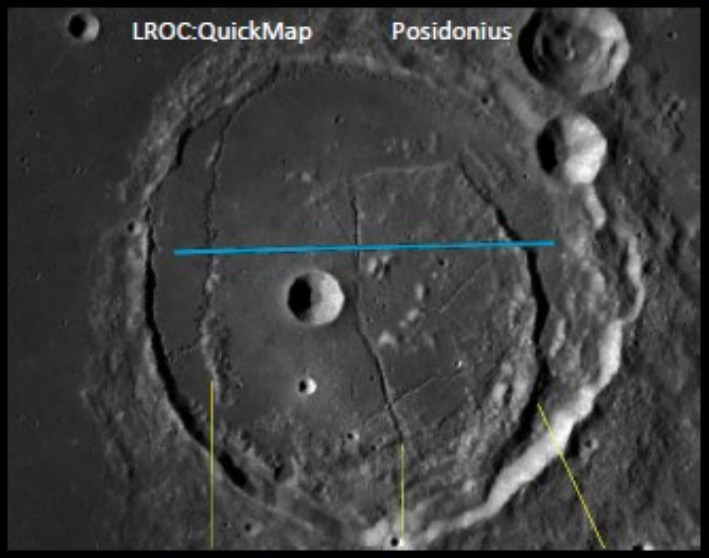


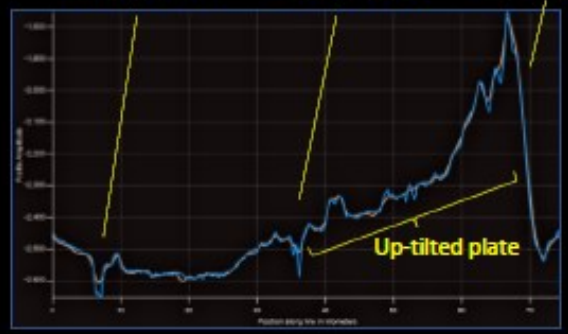

N
1
The 6-Day MOON
North east -- Posidonius
and surroundings
6-DAY MOON
CROP NE MOON
2021-03-19, Daytime 17:30 Local CEST (UT+1)
Daylight, Altitude: 53° towards the S, Illum. 32%
Temp. 1°C, Hum.: 46%, Wind 14-21 km/h
Transparency (3-)5/7, Seeing 7-8/10
Zeiss 100/640 APQ refractor
685nm Red IR-pass filter (OBS: full daylight)
ASI183mm, ROI: 4120 x 3672
Exp.: 60s @ 30 FPS, AS!3 stack: 50%
AI deconvolution & wavelet.
MARE HUMBOLDTIANUM
Gärtner
MARE FRIGORIS
Endymion
1
Bürg
Hercules
Atlas
Messala
LACUS SOMNORIUM
Geminus
Hall
Posidonius
W
Dorsa Smirnov
Cleomedes
MARE SERENITATIS
Römer

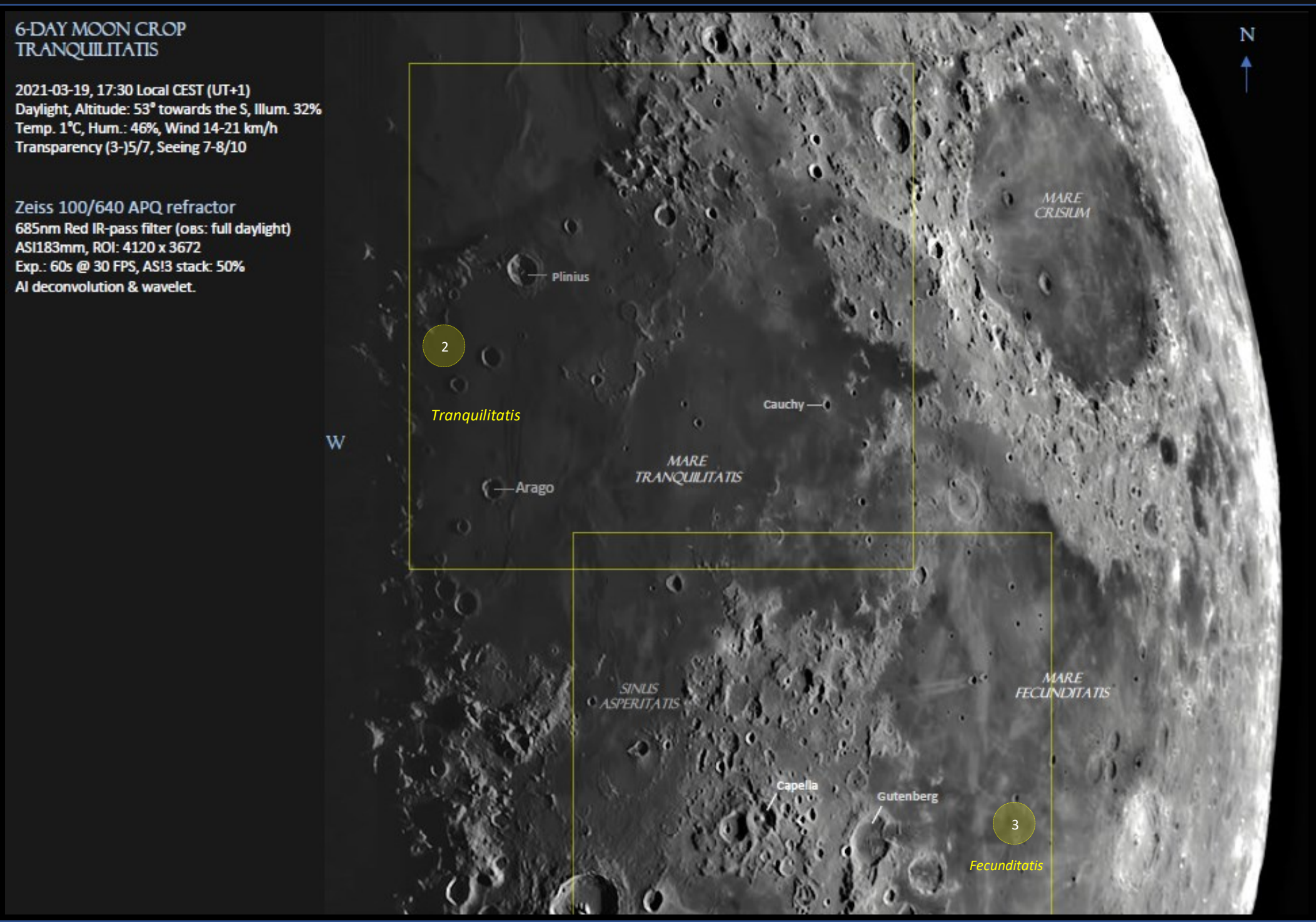
6-DAY MOON
CROP NE SERENITATIS

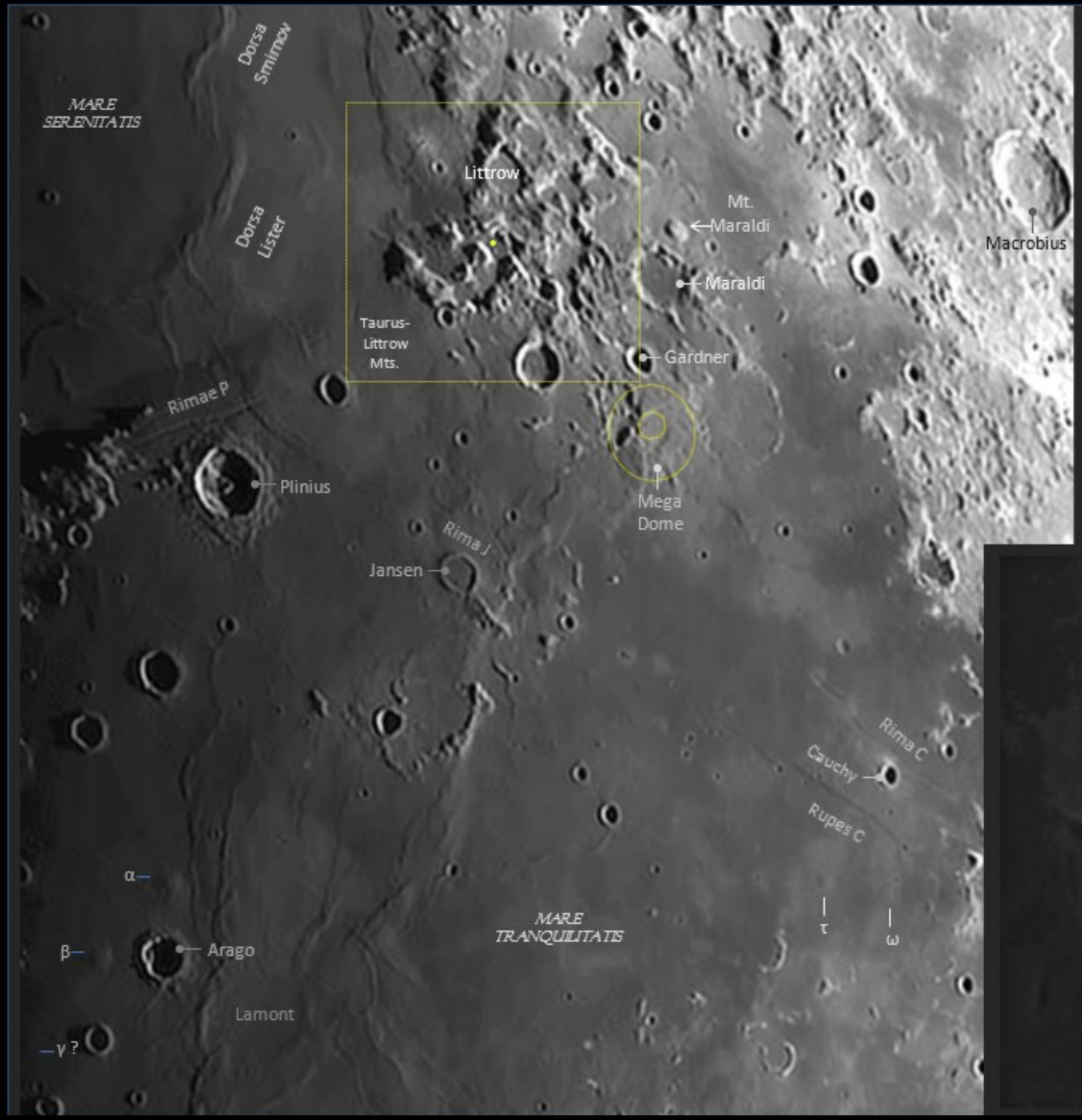
2021-03-19, Daytime 17:30 Local CEST (UT+1)
Daylight, Altitude: 53° towards the S, Illum. 32%
Temp. 1°C, Hum.: 46%, Wind 14-21 km/h
Transparency (3-)5/7, Seeing 7-8/10

Zeiss 100/640 APQ refractor
685nm Red IR-pass filter (OBS: full daylight)
ASI183mm, ROI: 4120 x 3672
Exp.: 60s @ 30 FPS, AS!3 stack: 50%
AI stronger deconvolution & wavelet.






6-DAY MOON CROP
TRANQUILITATIS
2021-03-19, 17:30 Local CEST (UT+1)
Daylight, Altitude: 53° towards the S, Illum. 32%
Temp. 1°C, Hum.: 46%, Wind 14-21 km/h
Transparency (3-)5/7, Seeing 7-8/10
Zeiss 100/640 APQ refractor
685nm Red IR-pass filter (obs: full daylight)
ASI183mm, ROI: 4120 x 3672
Exp.: 60s @ 30 FPS, AS!3 stack: 50%
AI deconvolution & wavelet.
N
W
MARE CRISIUM
Plinius
2
Tranquilitatis
Cauchy
MARE TRANQUILITATIS
Arago
SINUS ASPERITATIS
MARE FECUNDITATIS
Capella
Gutenberg
3
Fecunditatis



6-DAY MOON
CROP MARE TRANQUILITATIS NORTH

2021-03-19, 17:30 Local CEST (UT+1)
Daylight, Altitude: 53° towards the S, Illum. 32%
Temp. 1°C, Hum.: 46%, Wind 14-21 km/h
Transparency (3-)5/7, Seeing 7-8/10

Zeiss 100/640 APQ refractor
685nm Red IR-pass filter (OBS: full daylight)
ASI183mm, ROI: 4120 x 3672
Exp.: 60s @ 30 FPS, AS!3 stack: 50%
AI stronger deconvolution & wavelet.

2 *Tranquilitatis*

The 6-Day MOON

3 Crop Colchis Island

Wedged between *Sinus Asperitatis* and western *Mare Fecunditatis* is is a rectangular block of ancient pre-Nectarian highland, which Hevelius back in 1647 named "**Colchis**" *.

A system of 4 parallel rilles **(linear graben)** cuts through this highland block from NW to SE, from Sinus Asperitatis through Gutenberg (Rimae Gutenberg) and further down through Goclenius (Rimae Goclenius). The orientation of these rilles is radial to Imbrium (as is also the Cauchy rille and fault seen in my previous post); They are all probably tension cracks from the formation of this basin. Another feature created by the Imbrium impact is **Catena Capella,** a line of ejecta secondary craters that cuts like a valley through the Capella crater.

** [On the southern night sky, Hevelius named the large constellation Argo Navis (the Ship Argo), which according to mythology was sailed by Jason and the Argonauts to Colchis in search of the Golden Fleece. In pre-Hellenistic Greco-Roman geography, Colchis was located on the E coast of the Black Sea, while in Lunar Geography it is now on the E coast of Sinus Asperitatis. Maybe a Starship will sail there in the hopefully not too distant future; If so, I hope Space-X will name it "Argo"!]*

4 *Crop: Nectaris*

The **Nectaris Basin** was lava-covered in the Upper Imbrian flooding (Im: Imbrian Mare), and then - in the following Eratosthenian epoch - the *Theophilus* impact threw out a magnificent ejecta carpet radially up in Sinus Asperitatis and out over Mare Nectaris with small secondary craters creating the light-hued patches seen in the dark mare basalt surface. A couple of interesting smooth lava plains can be seen NE of Mädler, and these local floodings must have occurred in late Eratosthenian, as they have covered the ejecta carpet from Theophilus.

5 *Crop: Theophilus*

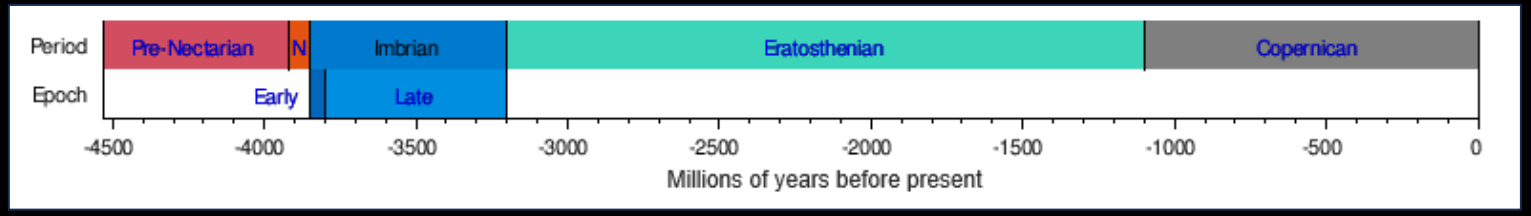
Just inside the main basin rim of the Nectaris impact (the Altai Scarp) is seen - on the W shore of Mare Nectaris - a row of **three large craters,** each ~100km Ø. From south we have:

- the oldest and most degraded crater **Catharina** (~4Byr Nectarian, with the 45km Ø crater P superimposed on the N rim),
- then the somewhat younger FFC crater **Cyrillus** (~3.7Byr Nectarian, with an uplifted and cracked floor)
- and finally, the young crater **Theophilus** (~2Byr Eratosthenian, with a "hard fist" of a central mountain). A transect of this crater shows that the S wall is highest (4.5Km), "piled up" so to speak onto the rim of Cyrillus. Also, on the transect, you can see the smooth plains of impact melt in the N part of the crater floor and "splashed out" into ponds over the lower N crater wall.

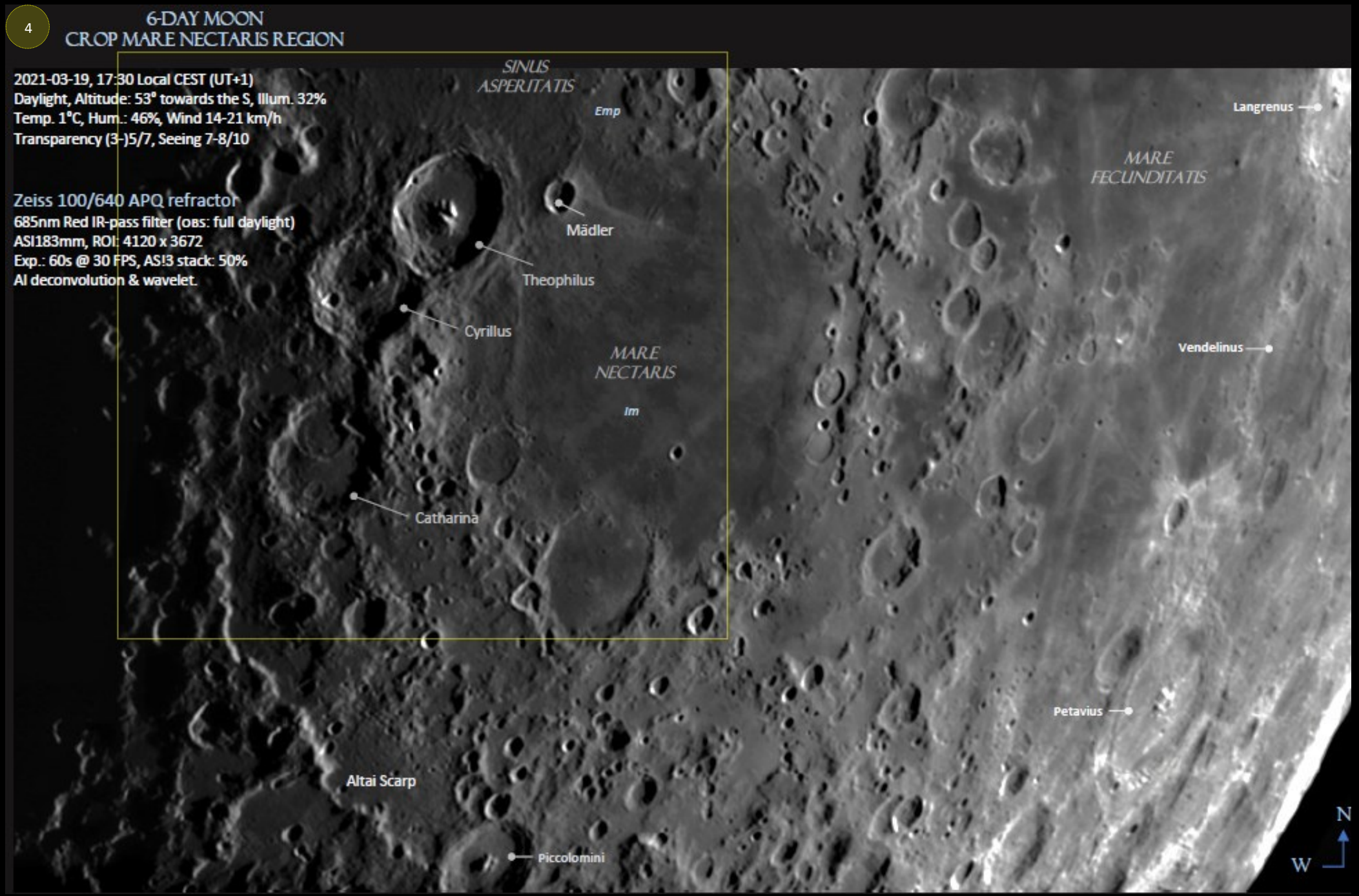
6 *Crop: Janssen Region*

The Janssen Region shows several interesting features, most notable the **radial structures** created by Nectaris basin secondary cratering and ejecta: the *Rheita Valley*, plus a couple of *ridges/scarps* (which I've indicated with yellow dashed lines on my photo). The *Neander Fault* is also roughly radial to the Nectaris Basin, and thus may be related to that same impact.

The unusual oblong crater **Rheita-E** may have been created by three overlapping impacts from an asteroid-breakup; Smooth floor highland craters like **Rheita, Metius and Steinheil** are formed by filling with fluidized basin ejecta, probably from the Imbrium impact (*"Imbrian plain", Ip*).




N
W
Maskelyne
SINUS ASPERITATIS
Torricelli
Messier
MARE FECUNDITATIS
Leakey
Rimae Gutenberg
Catena
Capella
Capella
Gutenberg
Goclenius
Daguerre
Theophilus
3
6-DAY MOON
CROP COLCHIS ISLAND BLOCK
2021-03-19, 17:30 Local CEST (UT+1)
Daylight, Altitude: 53° towards the S, Illum. 32%
Temp. 1°C, Hum.: 46%, Wind 14-21 km/h
Transparency (3-)5/7, Seeing 7-8/10
Zeiss 100/640 APQ refractor
685nm Red IR-pass filter (OBS: full daylight)
ASI183mm, ROI: 4120 x 3672
Exp.: 60s @ 30 FPS, AS!3 stack: 50%
AI stronger deconvolution & wavelet.
Catena
Capella ?
Rimae
Gutenberg
Gutenberg


4
6-DAY MOON
CROP MARE NECTARIS REGION
2021-03-19, 17:30 Local CEST (UT+1)
Daylight, Altitude: 53° towards the S, Illum. 32%
Temp. 1°C, Hum.: 46%, Wind 14-21 km/h
Transparency (3-)5/7, Seeing 7-8/10
Zeiss 100/640 APQ refractor
685nm Red IR-pass filter (obs: full daylight)
ASI183mm, ROI: 4120 x 3672
Exp.: 60s @ 30 FPS, AS!3 stack: 50%
AI deconvolution & wavelet.
SINUS ASPERITATIS
Emp
Mädler
Theophilus
Cyrillus
MARE NECTARIS
Im
Catharina
Altai Scarp
Piccolomini
Langrenus
MARE FECUNDITATIS
Vendelinus
Petavius
N
W

6-DAY MOON – CROP THEOPHILUS REGION

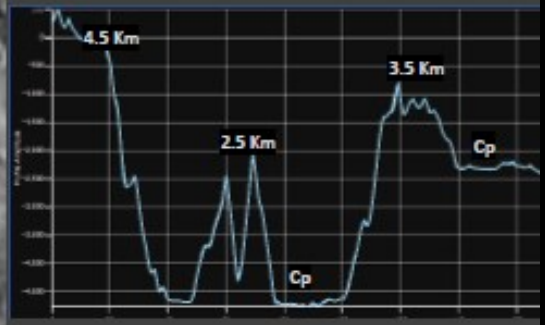
5

2021-03-19, 17:30 Local CEST (UT+1)
Daylight, S at 53° Alt., Illum. 32%
Temp. 1°C, Hum.: 46%, Wind 14-21 km/h
Transparency (3-)5/7, Seeing 7-8/10

Zeiss 100/640 APQ refractor
685nm Red IR-pass filter (full daylight)
ASI183mm, ROI: 4120 x 3672
Exp.: 60s @ 30 FPS, AS!3 stack: 50%
AI strong deconvolution & wavelet

SINUS ASPERITATIS
Isidorus
Emp
Cp
Cp
Emp
Mt. Penck
Mädler
Theophilus
Daguerre
Cyrillus
Im
Tacitus
P
MARE NECTARIS
Catena Abulfeda
Catharina
Beaumont
Fracastorius
Altai Scarp
N
W

S ← Theophilus Transect → N

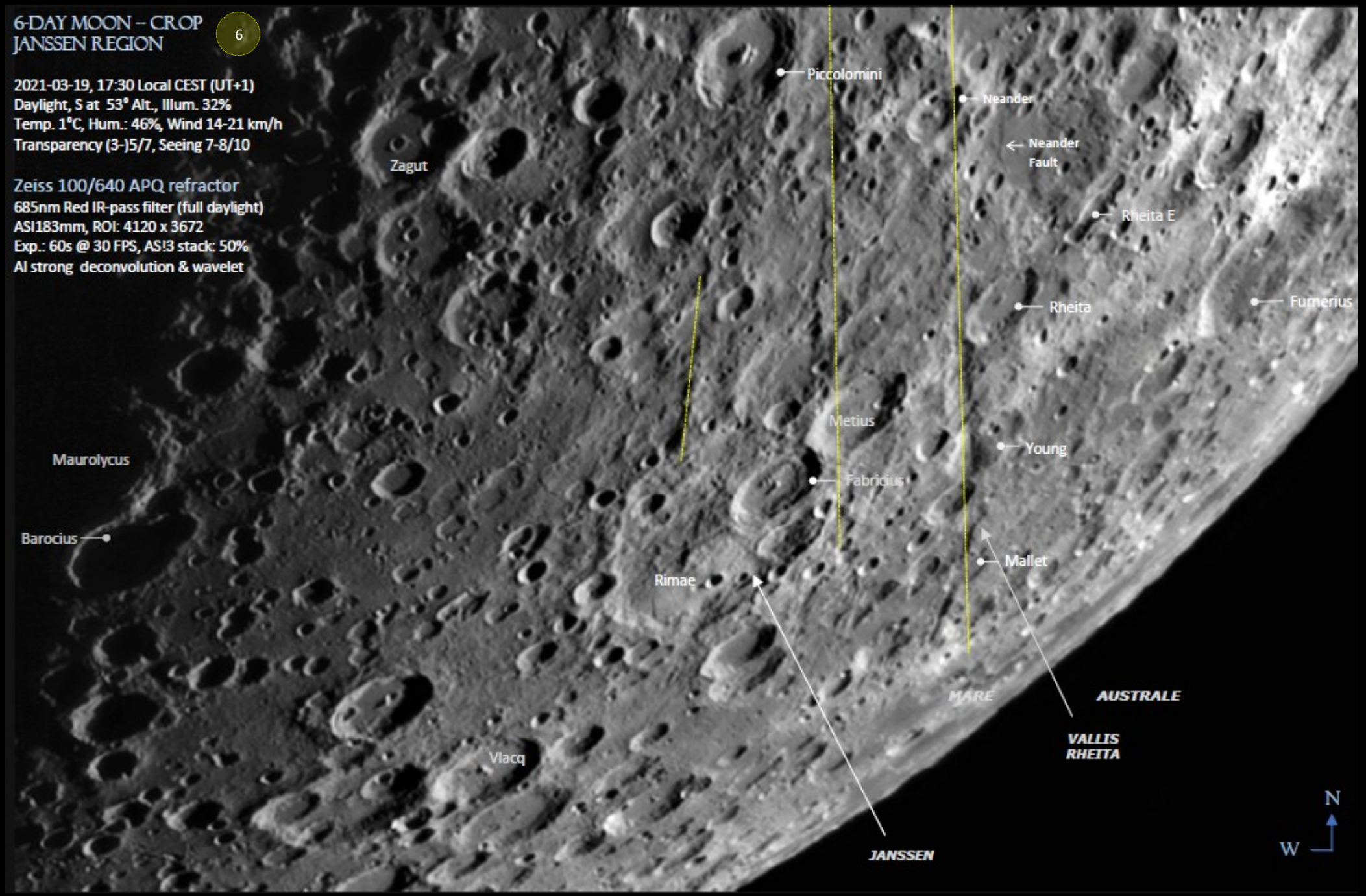


CYRILLUS
CATHARINA
FRACASTORIUS

Nectarian crater rims (pIc) of increasing age

THEOPHILUS

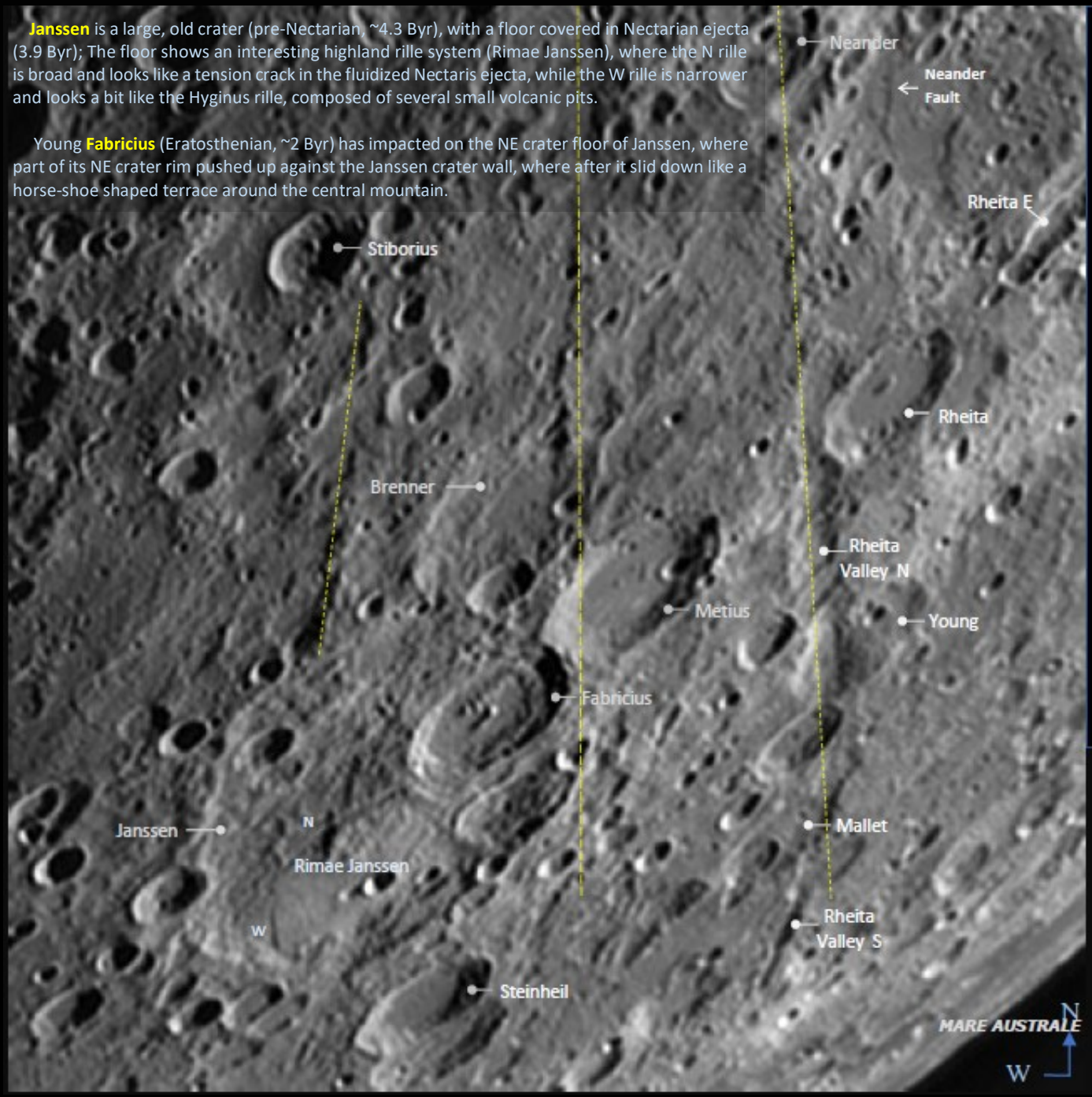
Eratosthenian crater w pools of impact melt (and a large ejecta car

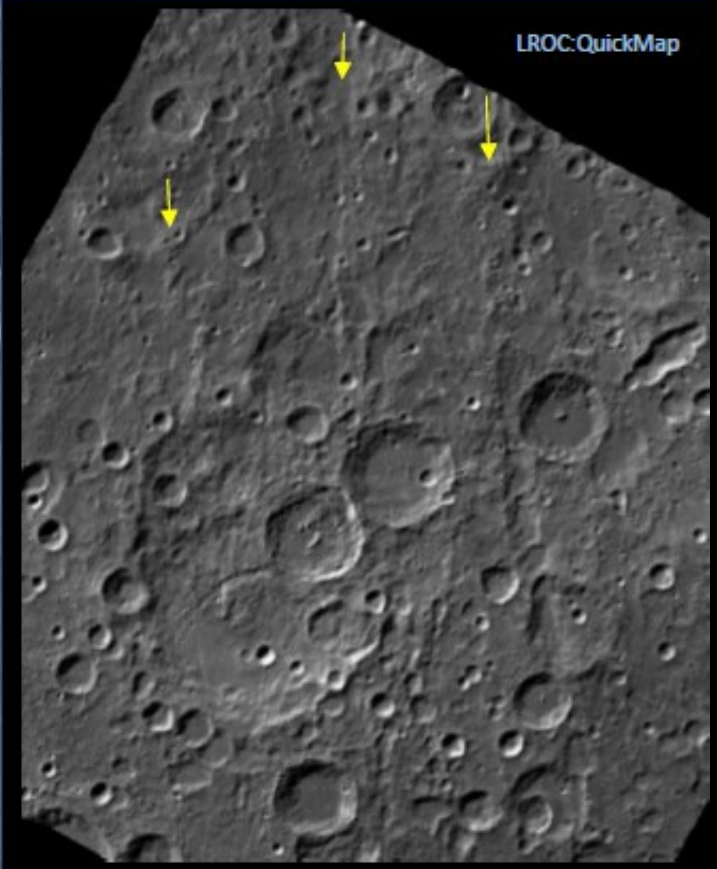

6-DAY MOON – CROP
JANSSEN REGION
6
2021-03-19, 17:30 Local CEST (UT+1)
Daylight, S at 53° Alt., Illum. 32%
Temp. 1°C, Hum.: 46%, Wind 14-21 km/h
Transparency (3-)5/7, Seeing 7-8/10
Zeiss 100/640 APQ refractor
685nm Red IR-pass filter (full daylight)
ASI183mm, ROI: 4120 x 3672
Exp.: 60s @ 30 FPS, AS!3 stack: 50%
AI strong deconvolution & wavelet
Zagut
Piccolomini
Neander
Neander Fault
Rheita E
Rheita
Furnerius
Metius
Young
Maurolycus
Fabricius
Barocius
Mallet
Rimae
Vlacq
MARE
AUSTRALE
VALLIS RHEITA
JANSSEN
N
W

6-Day Moon: Crop: Janssen

Janssen is a large, old crater (pre-Nectarian, ~4.3 Byr), with a floor covered in Nectarian ejecta (3.9 Byr); The floor shows an interesting highland rille system (Rimae Janssen), where the N rille is broad and looks like a tension crack in the fluidized Nectaris ejecta, while the W rille is narrower and looks a bit like the Hyginus rille, composed of several small volcanic pits.

Young **Fabricius** (Eratosthenian, ~2 Byr) has impacted on the NE crater floor of Janssen, where part of its NE crater rim pushed up against the Janssen crater wall, where after it slid down like a horse-shoe shaped terrace around the central mountain.





6-DAY MOON CROP JANSSEN

2021-03-19, 17:30 Local CEST (UT+1)
Daylight, S at 53° Alt., Illum. 32%
Temp. 1°C, Hum.: 46%, Wind 14-21 km/h
Transparency (3-)5/7, Seeing 7-8/10

Zeiss 100/640 APQ refractor
685nm Red IR-pass filter (full daylight)
ASI183mm, ROI: 4120 x 3672
Exp.: 60s @ 30 FPS, AS!3 stack: 50%
AI strong deconvolution & wavelet