SET 1

LUNAR MAPS

For Use with the Astronomical League Lunar I Observing Program

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Erect Image (North Up) Maps

With Selected Expanded Views

Revised 2012 September 20

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Published by Howard L. Cohen
Gainesville, Florida

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Maps Produced by Howard L. Cohen using a LROC (NASA) composite whole moon image with a supplementary full moon image by Howard Eskildsen, Ocala, Florida.

Preface

These maps were created to help star gazers learn more about the moon's surface characteristics by identifying one hundred features listed by the Astronomical League's Lunar Club. The A.L. tabulates these features on their web site and provides a convenient observing form (in pdf format) for recording the lunar observations. (A copy of this form is included at the end of these maps.) Listed features include some naked eye lunar objects plus many binocular and small telescope targets. (All objects can be discerned in a good 60 mm telescope.)

However, observers must use printed maps or use lunar software to identify and find most features. This effort takes time but can have immeasurable benefits for those who really want to study the Moon. Still, inexperienced observers may find this process daunting since most published maps show many hundreds if not thousands of lunar features. Instead, the included sets of maps primarily show and identify only the one hundred A.L. features. Therefore, even novice lunar observers can easily find and identify all features on the A.L. list. This process partially sacrifices the instructive value of having to learn features by looking them up on commercially available maps. Still, by using these maps, more people are likely to take up lunar observing.

In addition, the author has used a photographic image of the Moon based on images acquired by NASA's Lunar Reconnaissance Orbiter for the labeled maps. This composite image more realistically illustrates the Moon that observers will view although the base image shows only one sun angle and one libration. Finally, unlike some maps that use numerical labels for features that require reference to an index, the included maps show all labels on the maps themselves.

For convenience, map sets include some enlarged sections to aid identification of some small features. The included set **(called Set 1)** is produced with *erect* (north up) maps. In addition, maps sets **(Sets 2 & 3)** are also available for *inverted views* (common for reflector telescopes), and *mirror-reversed views* (north up, common for refractors). Using these maps, the author could find and identify all features given for a given phase on the A.L.'s list within fifteen minutes or less observing time. **Recommendation:** Print on "high-quality" printer settings so fine detail shows. **Suggestion:** Insert maps into plastic sheet protectors to reduce absorption from moisture.

See the A.L.'s web site for details on the Lunar Club and other A.L. observing clubs: www.astroleague.org.

Howard L. Cohen
Gainesville, Florida
February 2012

Contents

***Additional maps also available*: **Set 2** (Inverted or South Up); **Set 3** (Mirror-Reversed).

Introduction

The Astronomical League's Lunar Program Introduces Amateur Astronomers to the Moon

RULES AND REGULATIONS To qualify for the **AL's Lunar Program Certificate and pin,** one must be **a member of the Astronomical League** and **observe 100 features** on the Moon. These 100 features are in three groups: 18 naked eye, 46 binocular, and 36 telescopic features. (The A.L. also conducts a more advanced lunar program, Lunar II.) The image map index lists all 100 features.

Any pair of binoculars and any telescope may be used. If you have difficulty observing features at one level, *go to the next higher level.* So, if you have trouble with any of the naked eye objects, move up to binoculars. If you have trouble with any of the binocular objects, then you may move up to a telescope.

OBSERVING FORM The A.L.'s Lunar I observing form lists all 100 features to observe for their Lunar Program. The map appendix includes a copy of this form. For more information go to the AL's website: **astroleague.org/al/obsclubs/lunar/lunar1.html.**

IMAGE MAPS The following pages show full image lunar maps that may help you identify features. The maps show all 100 features but some features may appear on more than one map. A few supplementary features are listed as additional aids. *Small features that may not show well on the full image maps are also shown on supplementary, enlarged maps.* Different maps illustrate features listed by the A.L. for several different lunar phases. However, maps can help identify features visible at other phases. Finally, most full image maps for each phase have two parts to reduce the number of features listed on each map.

THREE SETS OF MAPS This document contains maps only for *erect views* of the Moon with north up **(Set 1)**. Additional maps are **available as separate documents** for *inverted views* with south up **(Set 2)**, and for *mirror-reversed views* with north up **(Set 3)**.

BASE IMAGES FOR MAPS The lunar maps used are a composite from the NASA **L**unar **R**econnaissance **O**rbiter **C**amera (**LROC**). Actual illumination and libration at the time of observation may differ from what the maps show since the map composite is made from images all shown under similar, moderate solar illumination angles. In addition, an image for an actual Full Moon taken by Howard Eskildsen (Ocala, FL) was also used as a supplementary image to help illustrate example lunar rays, which are most noticeable under high solar illumination. For more information about LROC see: **www.lroc.asu.edu.**

Extra Resources

Commercially Available Lunar Maps and Lunar Software*

MAPS FROM SKY PUBLISHING CORP.
(www.shopatsky.com/category/maps-and-globes/?m=leftnav_maps-and-globes)

- Moon Map Laminated Item, #59198, Price: ~$6.95
- Mirror Image Moon Map Laminated, Item #5921X, Price: ~$6.95
- Sky & Telescope Field Map Of The Moon, Item #59228, Price: ~$12.95
- Field Map of the Moon (Mirror Image) Item #59295, Price: ~$12.95
- Chuck Wood's Lunar 100 Card Plastic, Item #L100, Price: ~$6.95

SOFTWARE

- Lunar Map Pro 5.0 by RITI, Deluxe Edition: $79.95 (www.riti.com/prodserv_lunarmappro.htm
- Virtual Moon Atlas Pro, 5.1: Free Download (ap-i.net/avl/en/download)

*Prices at time of publication.

Naked Eye Objects

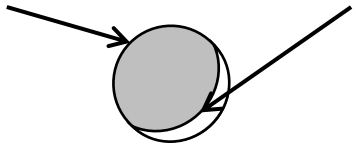
Crescent Moons

Imaginary Figures

MOON: NAKED EYE OBJECTS — CRESCENT MOONS

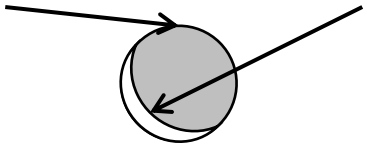
(Northern Hemisphere Views — Reverse Lunar Images for Southern Hemisphere)

Old Moon in New Moon's Arms



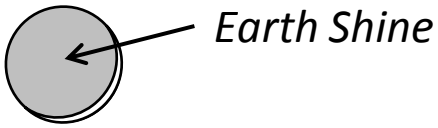
Western Horizon, Early Evening
(Within 72 Hrs of New)

New Moon in Old Moon's Arms



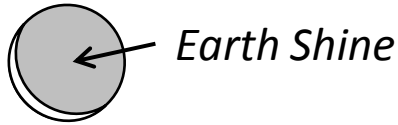
Eastern Horizon, Early Morning
(Within 72 Hrs of New)

Crescent Moon, Waxing



Western Horizon, Early Evening
(Within 40 Hrs of New)

Crescent Moon, Waning



Eastern Horizon, Early Morning
(Within 48 Hrs of New)

Cred. Diagram by HL Cohen (2012)

MOON: NAKED EYE OBJECTS — IMAGINARY LUNAR FIGURES

Man in the Moon

Woman in the Moon

Rabbit in the Moon

Cow Jumping Over Moon

Cred. Diagram by HL Cohen (2012) using A.L. Drawings

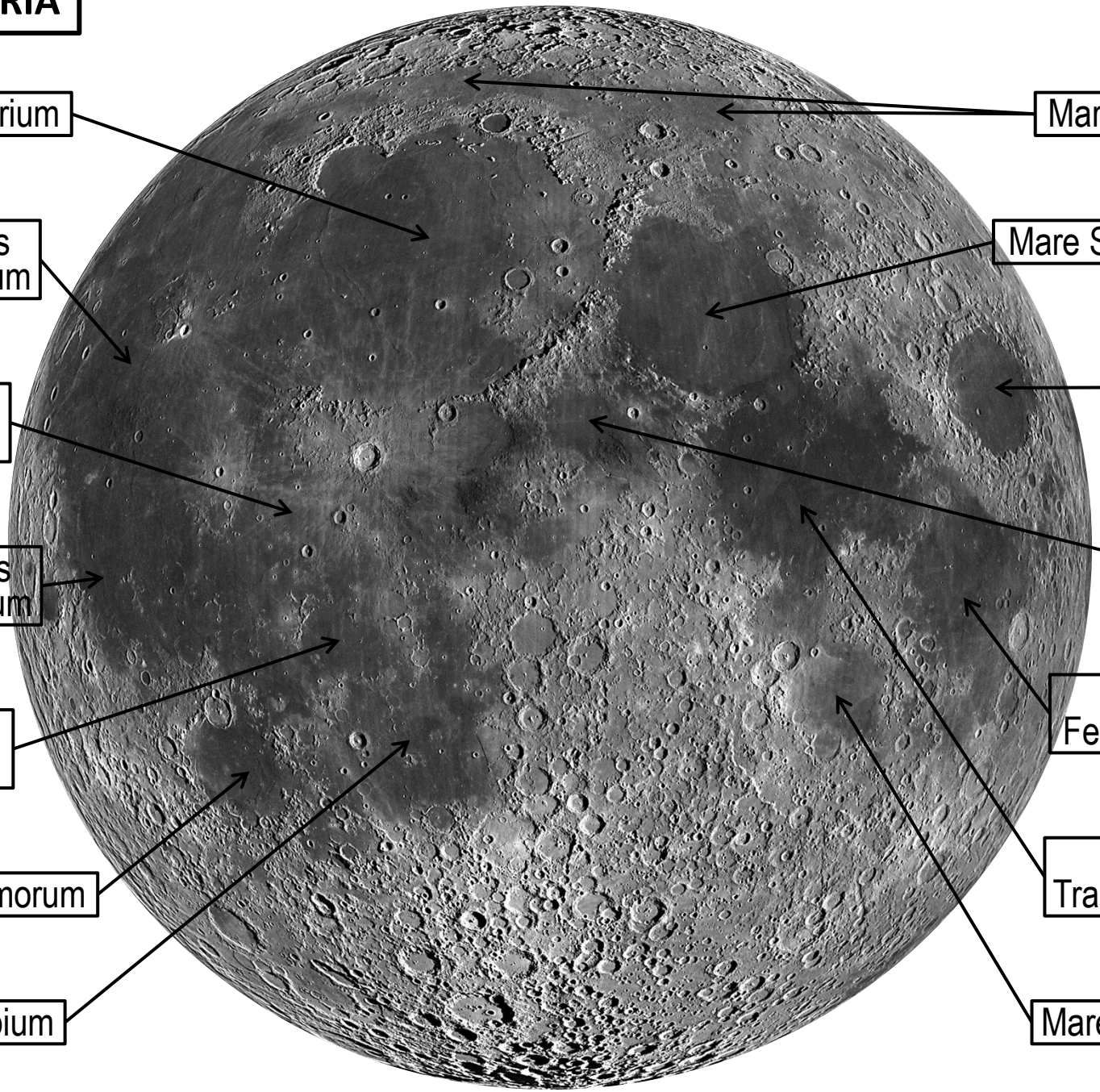
Set I: Full Image Maps

Direct Image Maps

(North Up)

MOON: MARIA

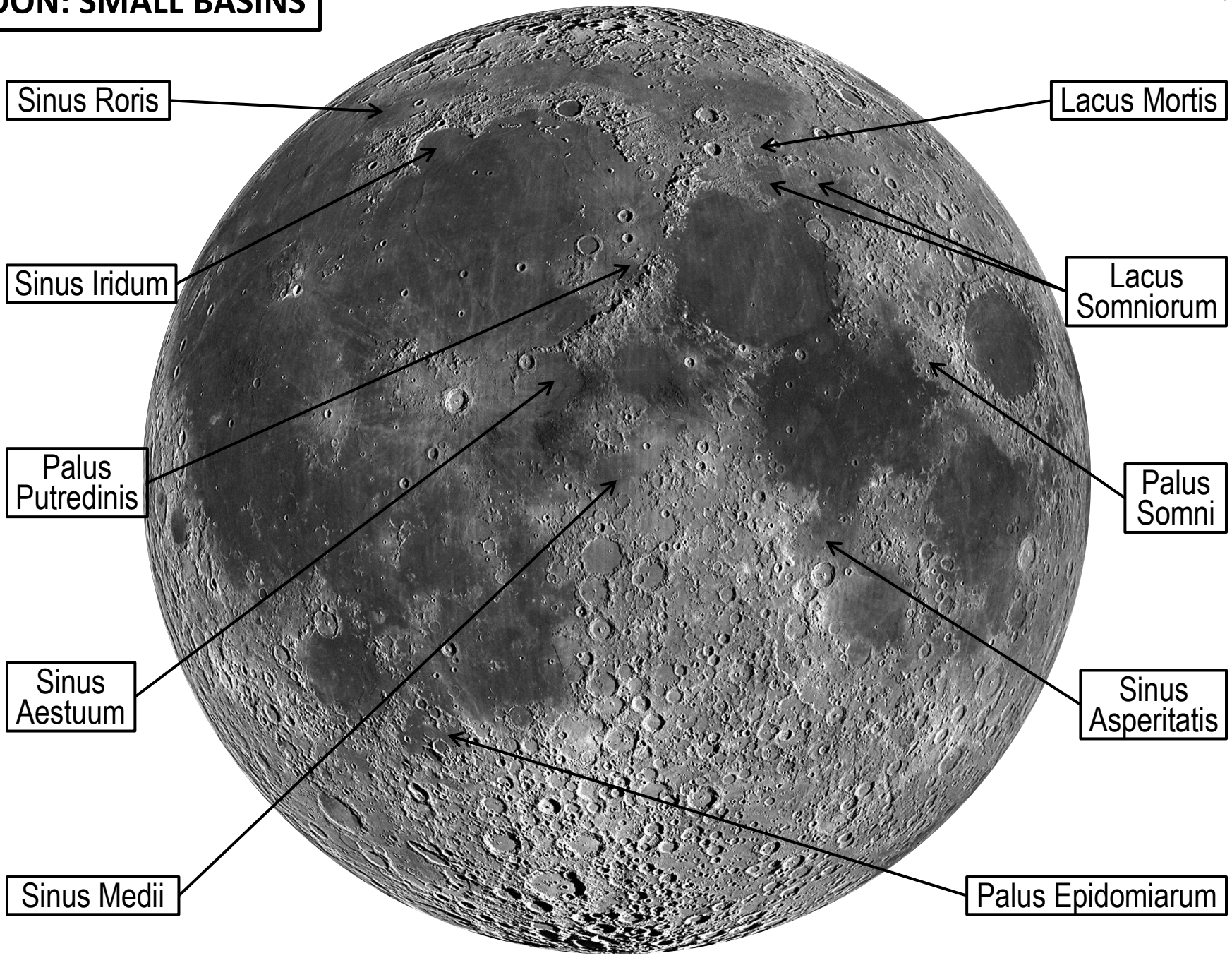
[NORTH UP]



Cred. Map by HL Cohen (2012) using LROC (NASA) image.

MOON: SMALL BASINS

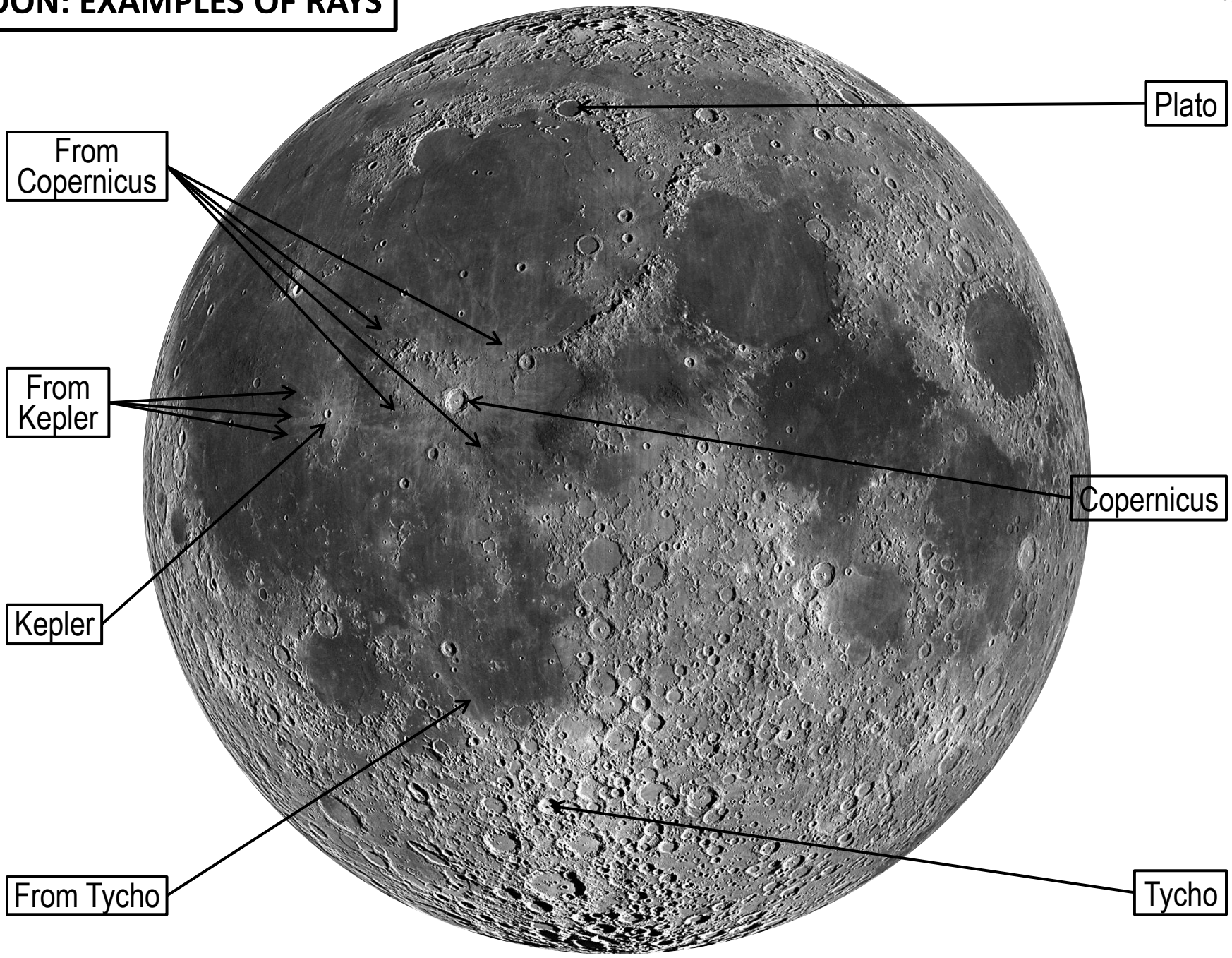
[NORTH UP]



Cred. Map by HL Cohen (2012) using LROC (NASA) image.

MOON: EXAMPLES OF RAYS

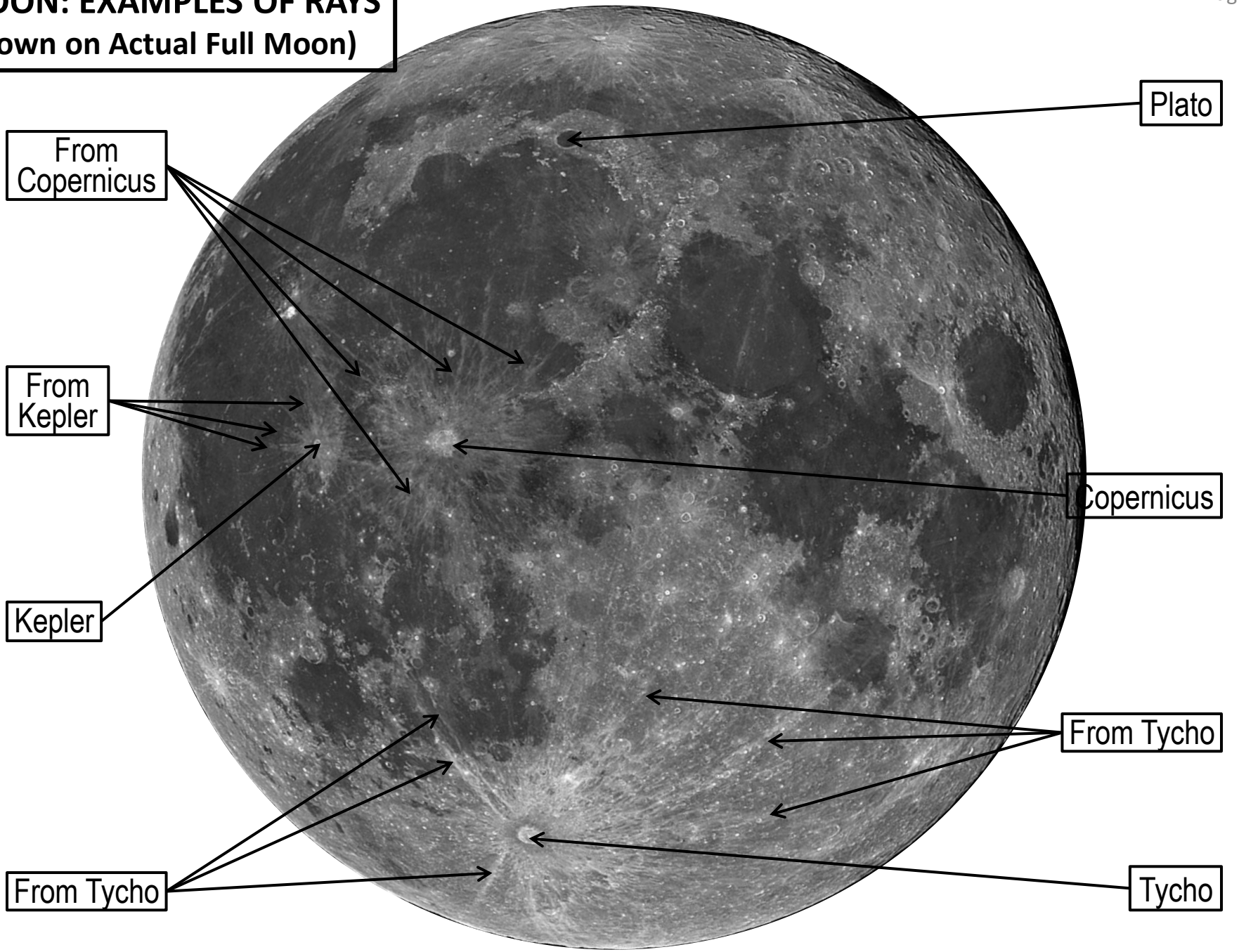
[NORTH UP]



Cred. Map by HL Cohen (2012) using LROC (NASA) image.

MOON: EXAMPLES OF RAYS
(Shown on Actual Full Moon)

[NORTH UP]

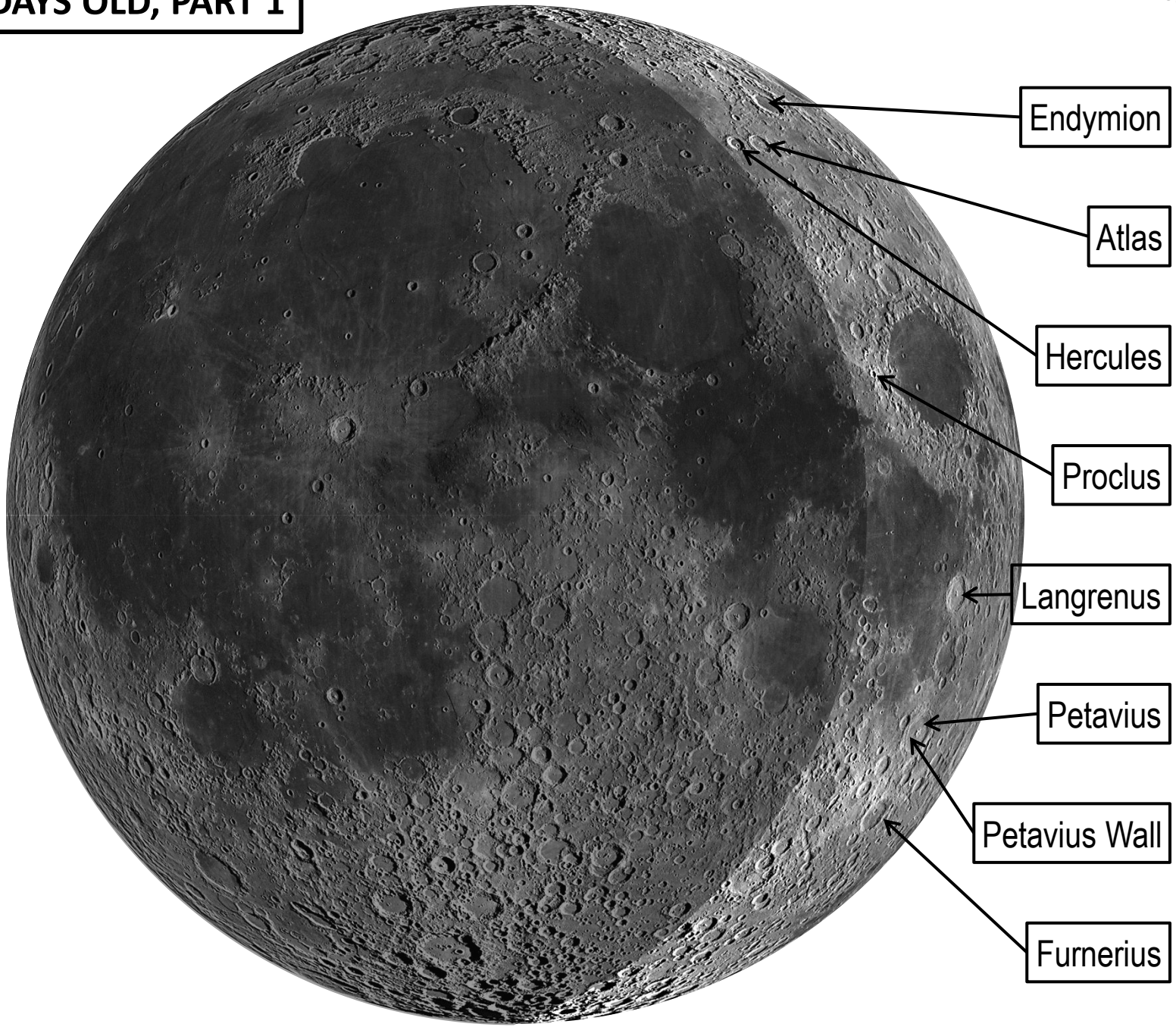


Illumination ~99.6%

Cred. Map by HL Cohen (2012) using image by Howard Eskildsen

MOON: ~4 DAYS OLD, PART 1

[NORTH UP]

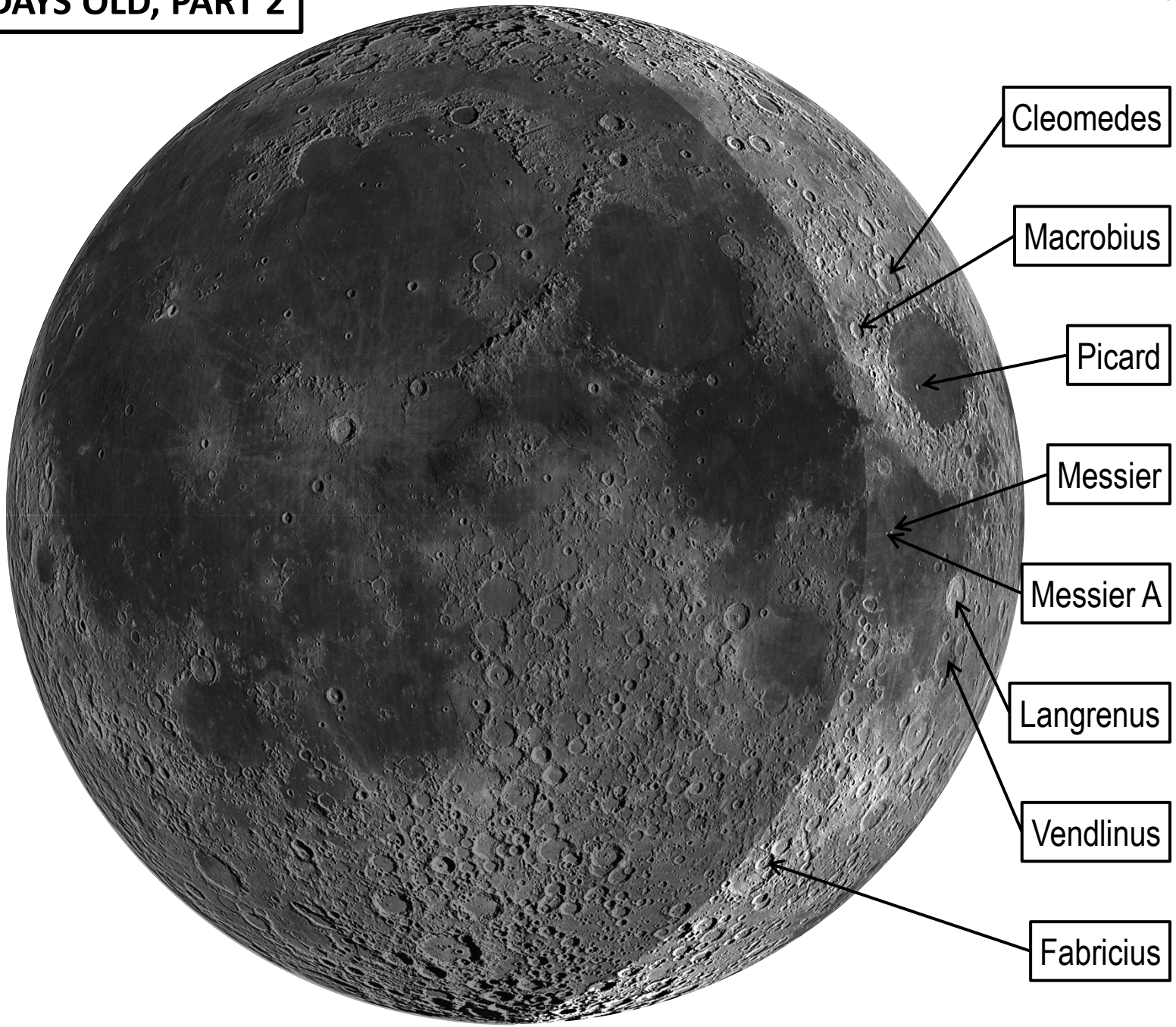


Illumination ~17%

Cred. Map by HL Cohen (2012) using LROC (NASA) image.

MOON: ~4 DAYS OLD, PART 2

[NORTH UP]

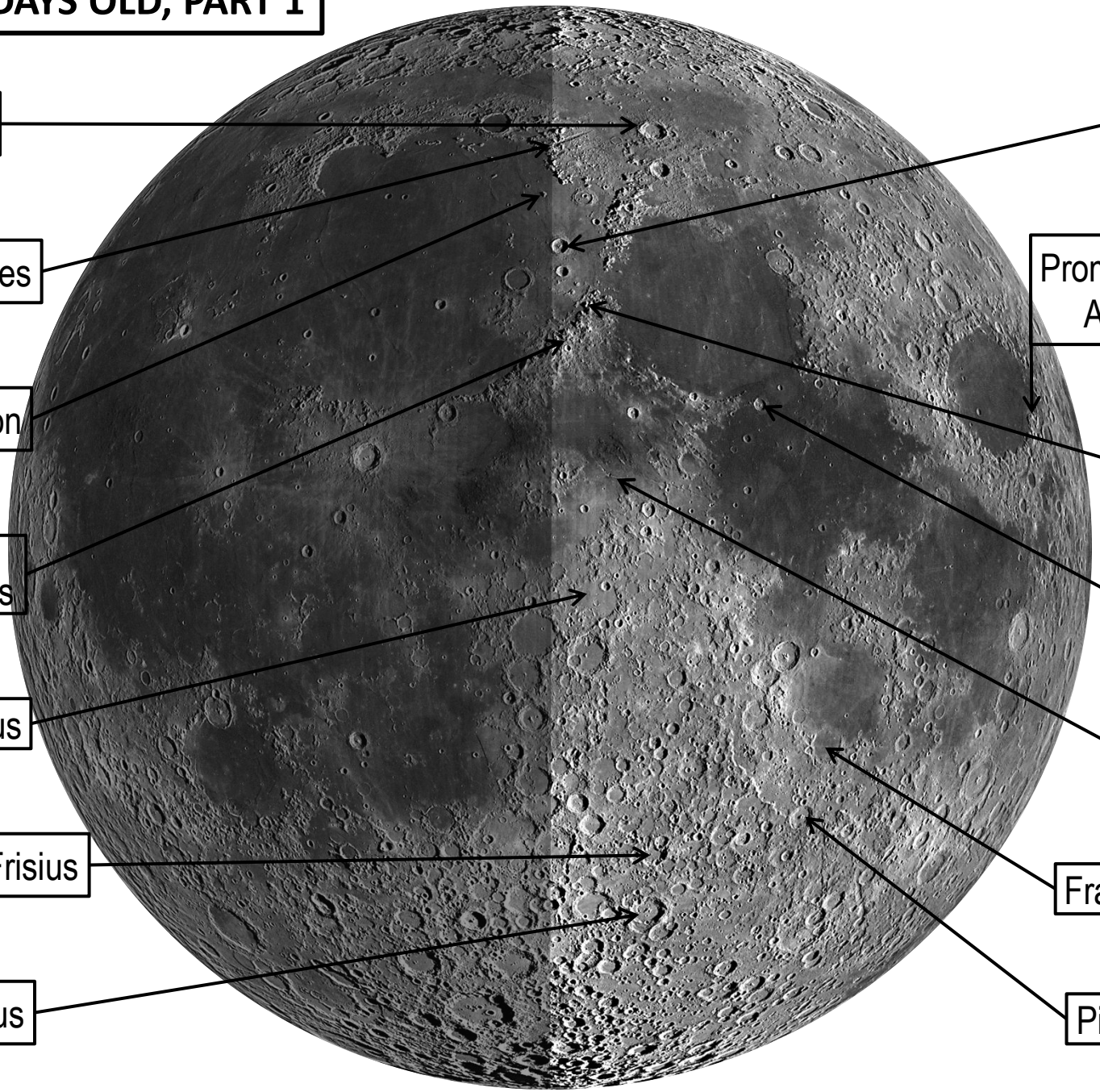


Illumination ~17%

Cred. Map by HL Cohen (2012) using LROC (NASA) image.

MOON: ~7 DAYS OLD, PART 1

[NORTH UP]

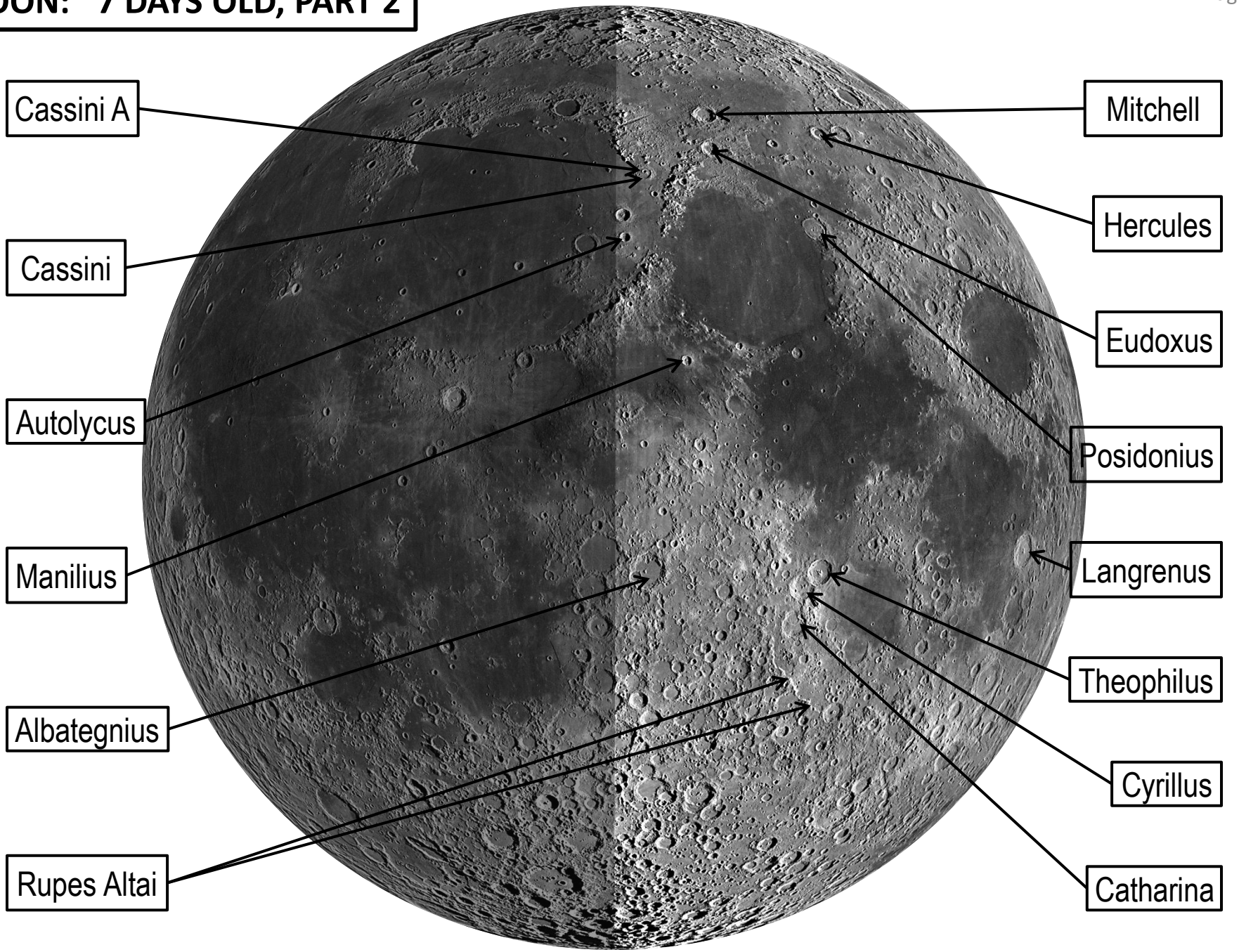


Illumination ~50%

Cred. Map by HL Cohen (2012) using LROC (NASA) image.

MOON: ~7 DAYS OLD, PART 2

[NORTH UP]

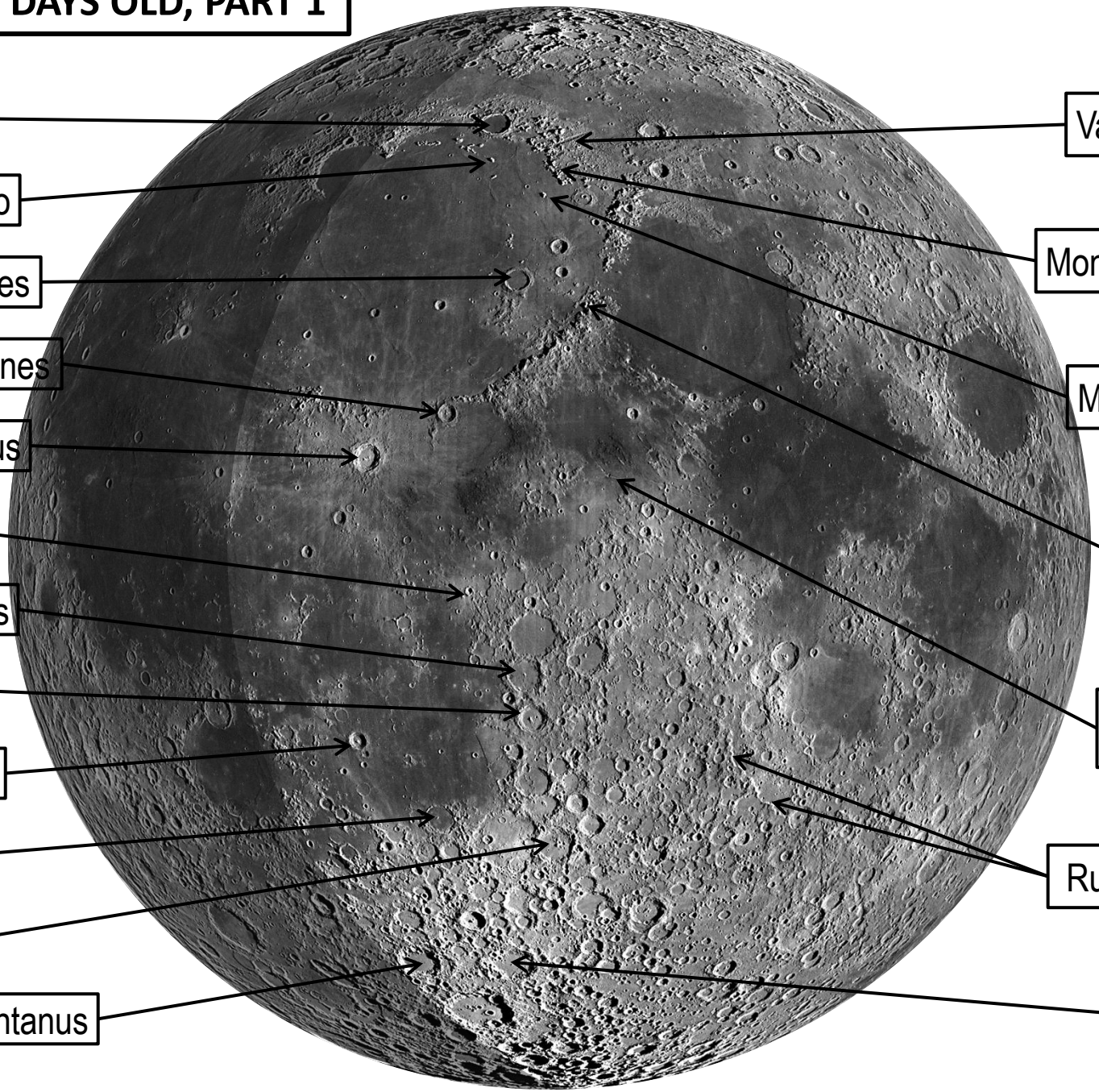


Illumination ~50%

Cred. Map by HL Cohen (2012) using LROC (NASA) image.

MOON: ~10 DAYS OLD, PART 1

[NORTH UP]

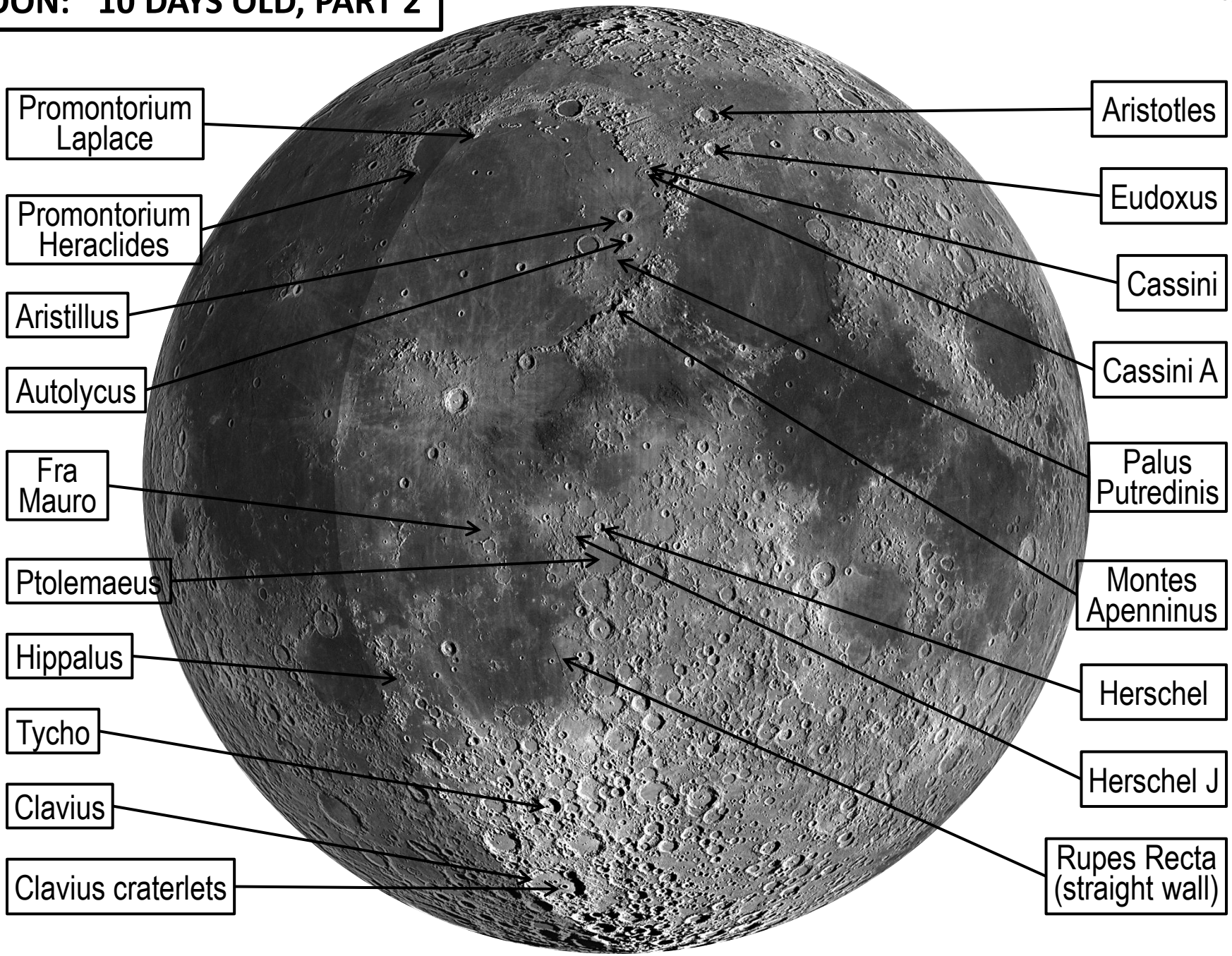


Illumination ~70%

Cred. Map by HL Cohen (2012) using LROC (NASA) image.

MOON: ~10 DAYS OLD, PART 2

[NORTH UP]

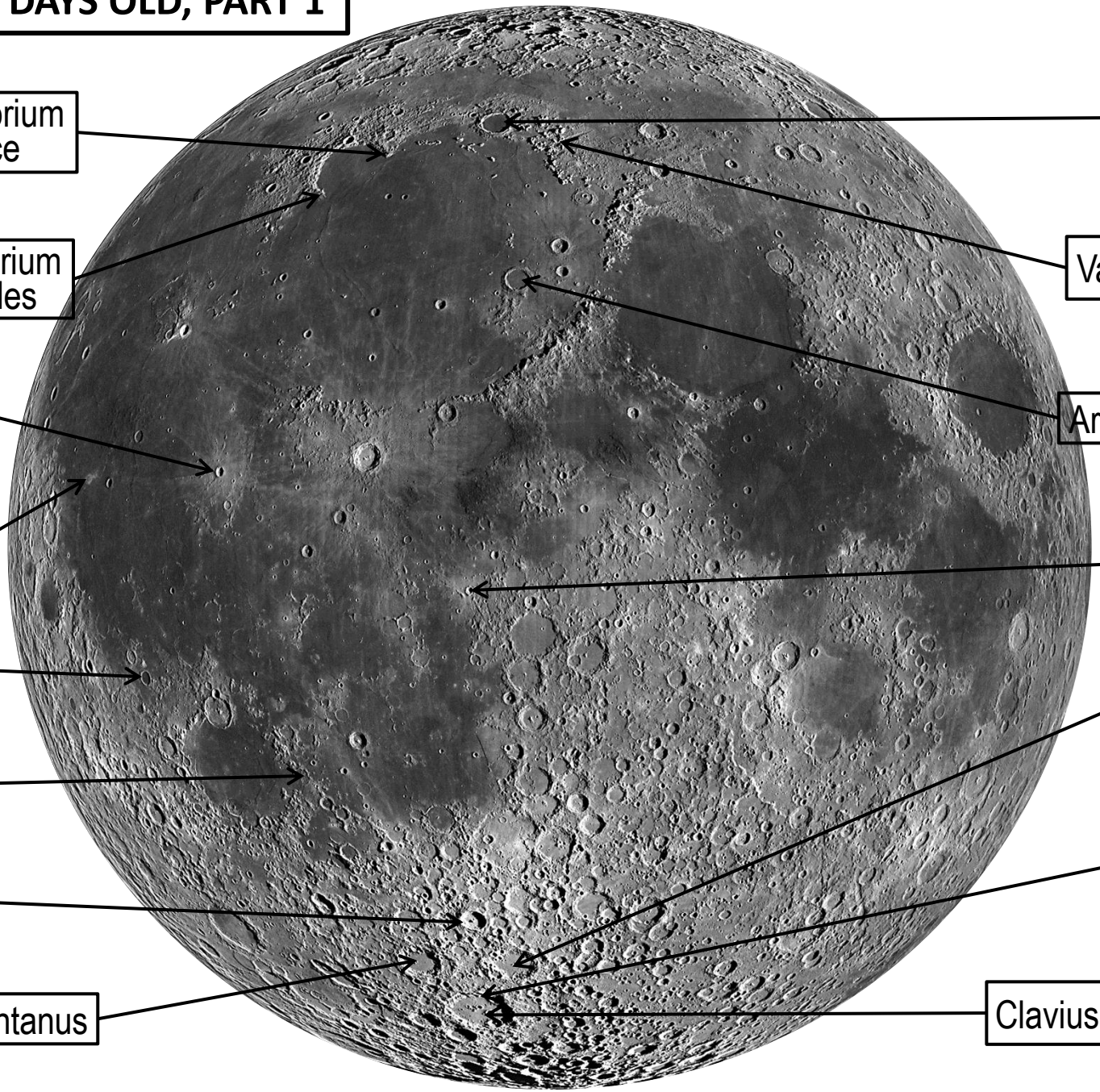


Illumination ~70%

Cred. Map by HL Cohen (2012) using LROC (NASA) image.

MOON: ~14 DAYS OLD, PART 1

[NORTH UP]

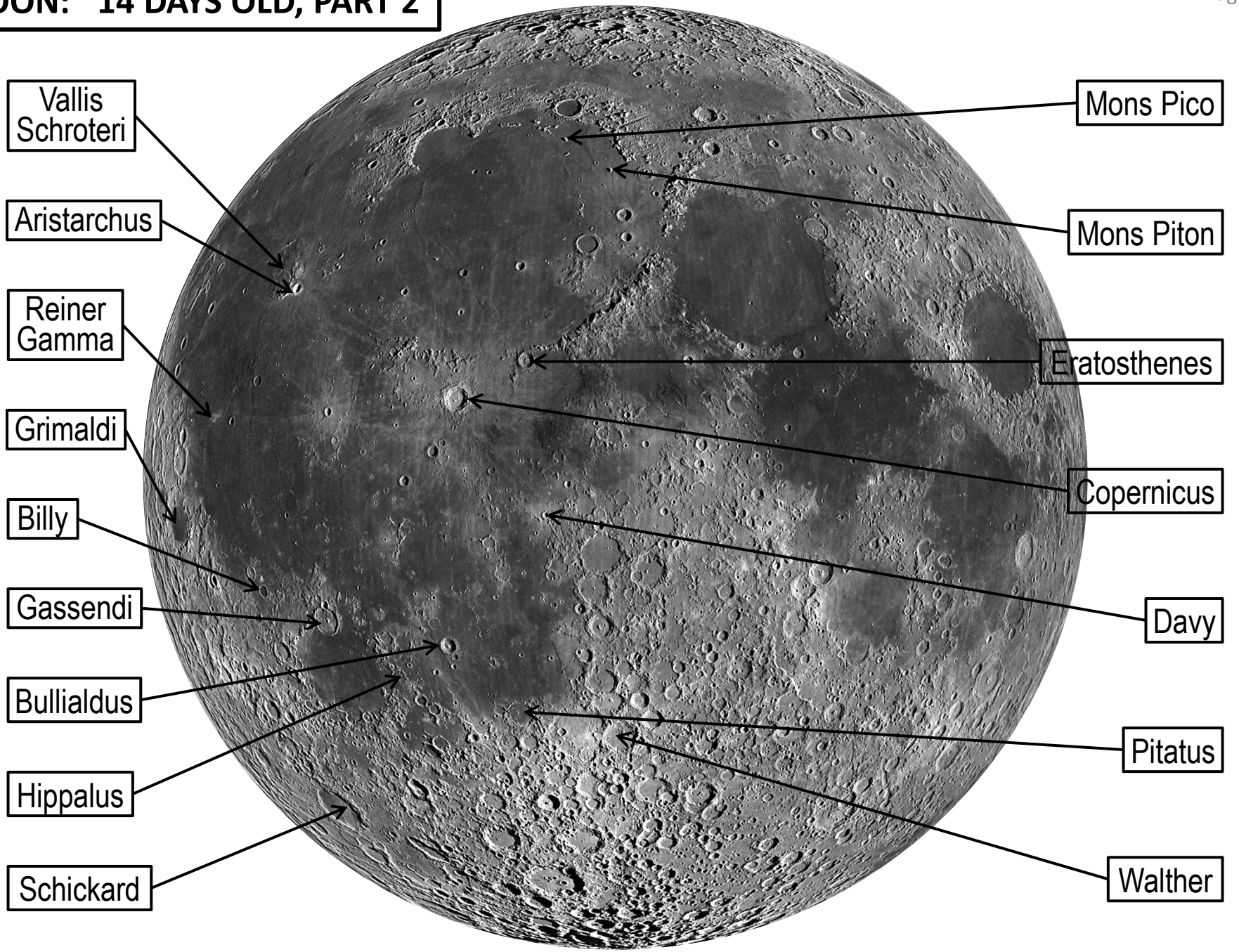


Illumination ~100%

Cred. Map by HL Cohen (2012) using LROC (NASA) image.

MOON: ~14 DAYS OLD, PART 2

[NORTH UP]



Illumination ~100%

Cred. Map by HL Cohen (2012) using LROC (NASA) image.

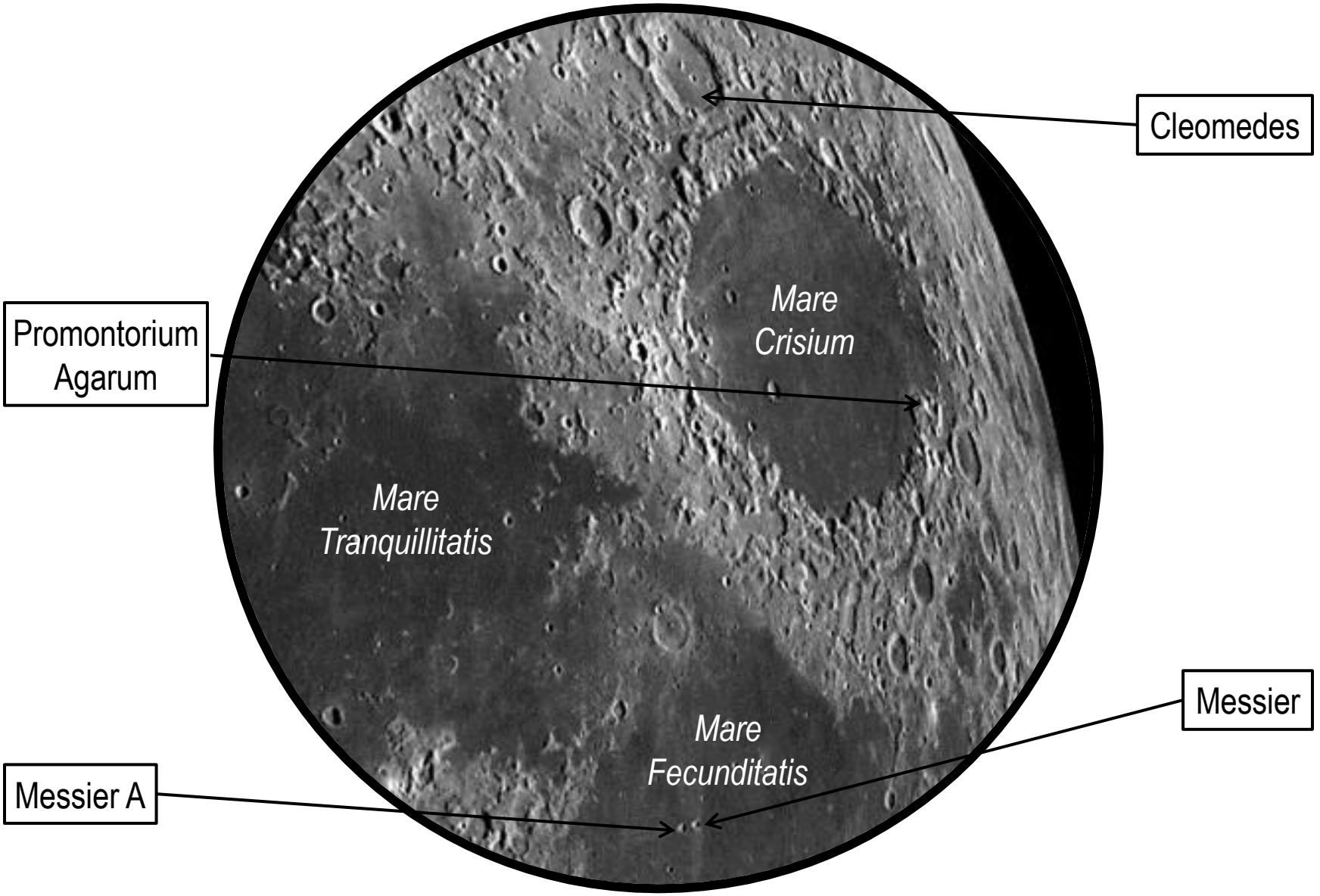
Set I: Enlarged Image Maps

Erect Image Maps

(North Up)

MOON: ~4 DAYS OLD, SECT. 1

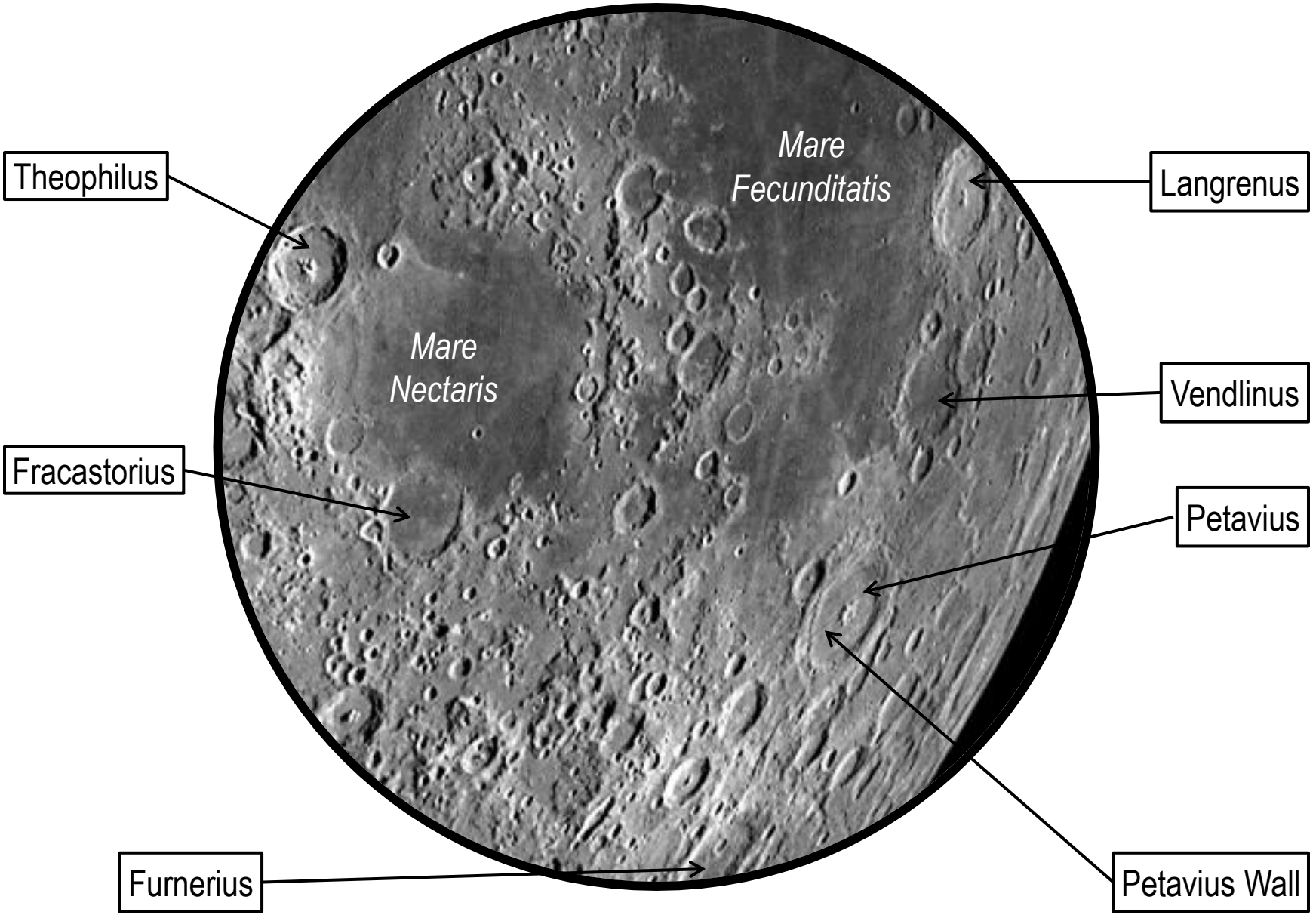
[NORTH UP]



Cred. Map by HL Cohen (2012) using LROC (NASA) image.

MOON: ~4 DAYS OLD, SECT. 2

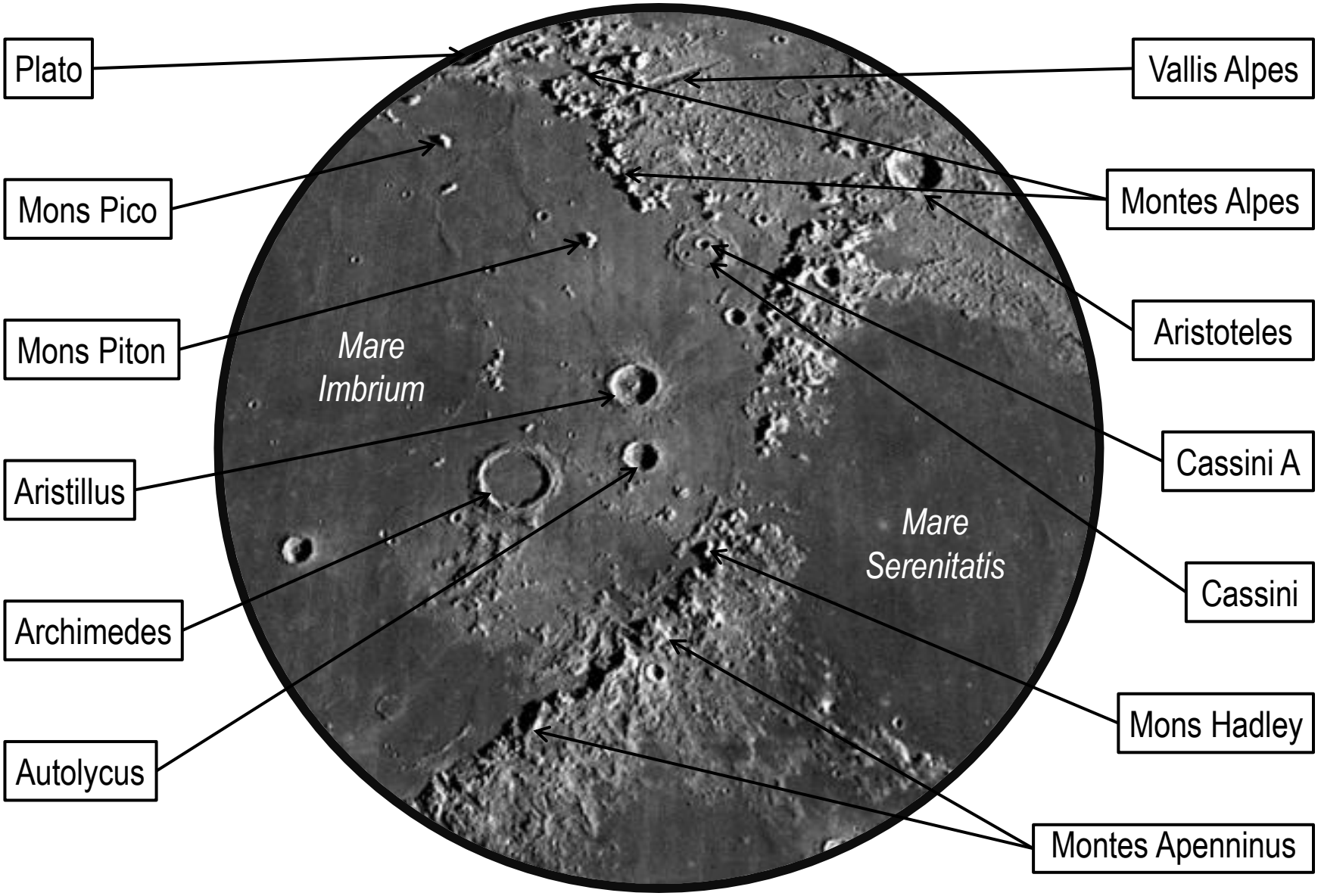
[NORTH UP]



Cred. Map by HL Cohen (2012) using LROC (NASA) image.

MOON: ~10 DAYS OLD —SECT. #1

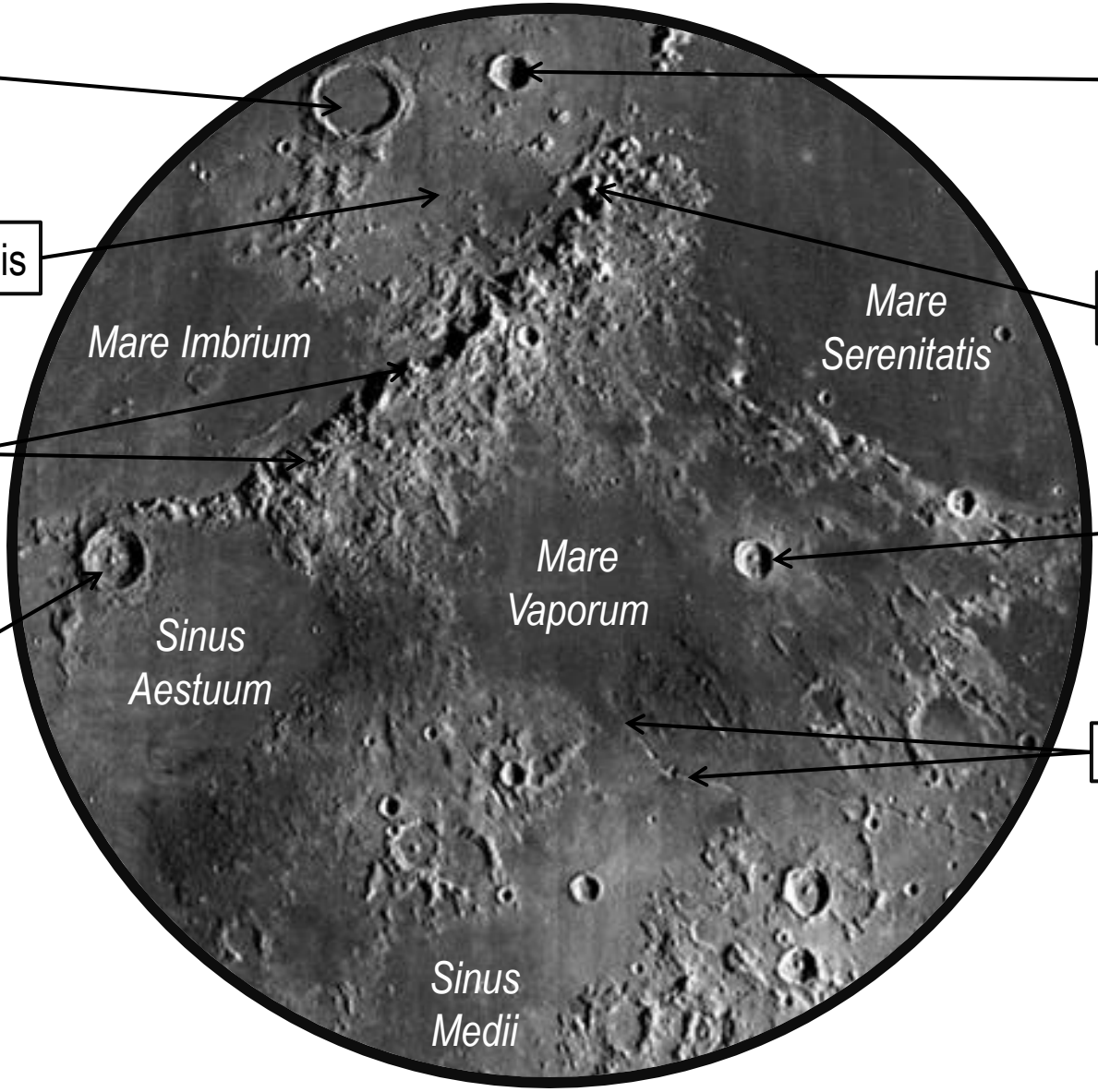
[NORTH UP]



Cred. Map by HL Cohen (2012) using LROC (NASA) image.

MOON: ~10 DAYS OLD—SECT. #2

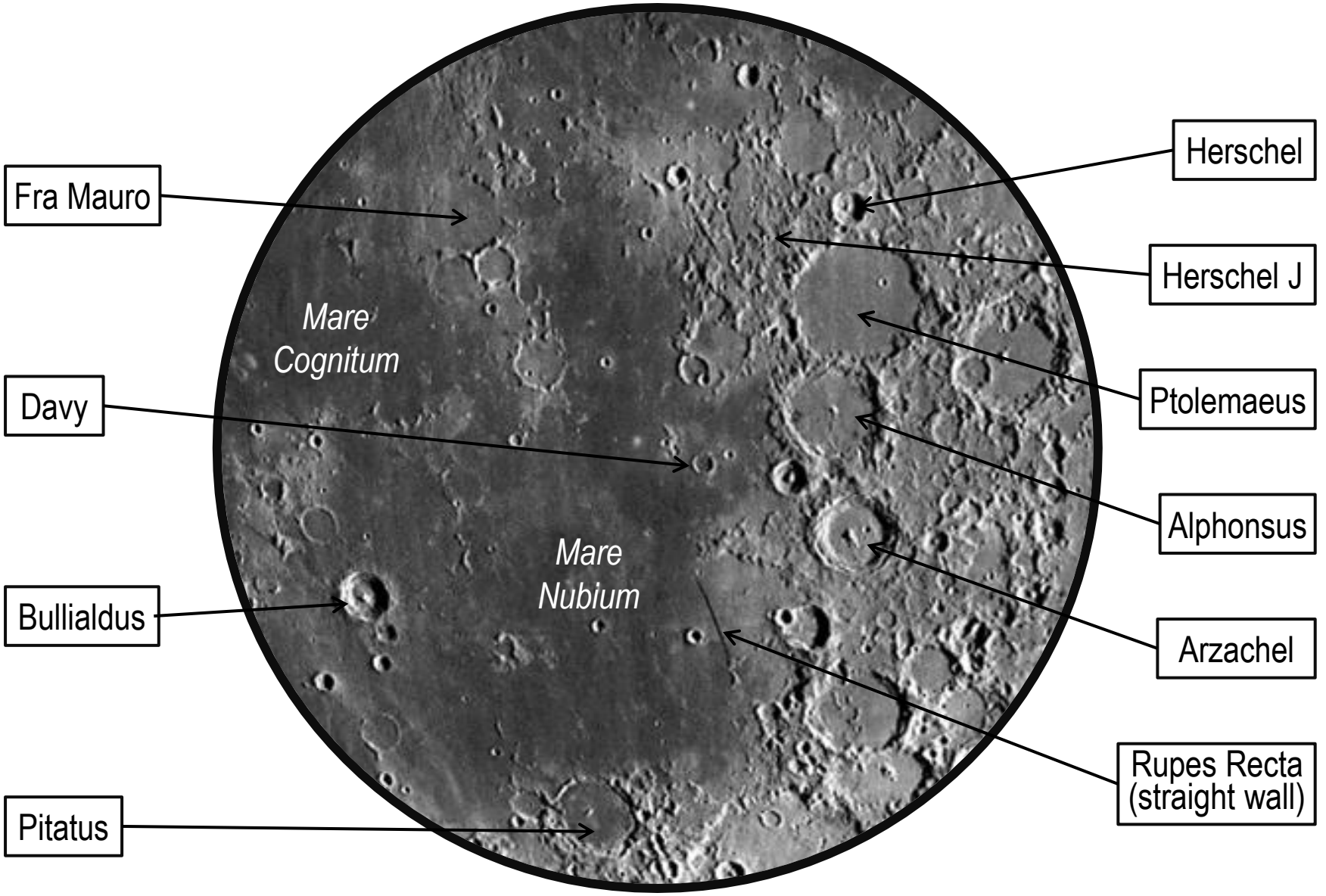
[NORTH UP]



Cred. Map by HL Cohen (2012) using LROC (NASA) image.

MOON: ~10 DAYS OLD—SECT. #3

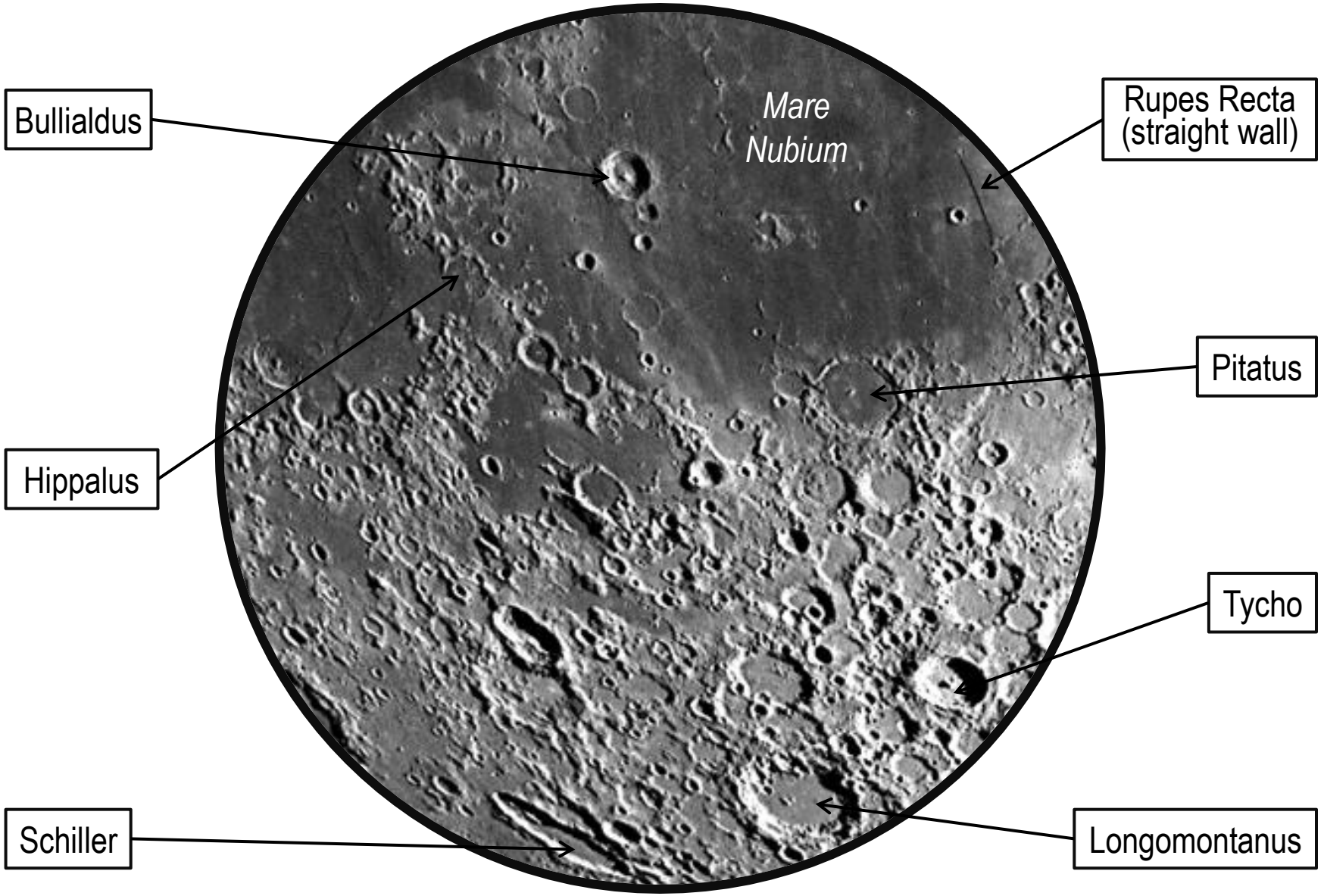
[NORTH UP]



Cred. Map by HL Cohen (2012) using LROC (NASA) image.

MOON: ~10 DAYS OLD—SECT. #4

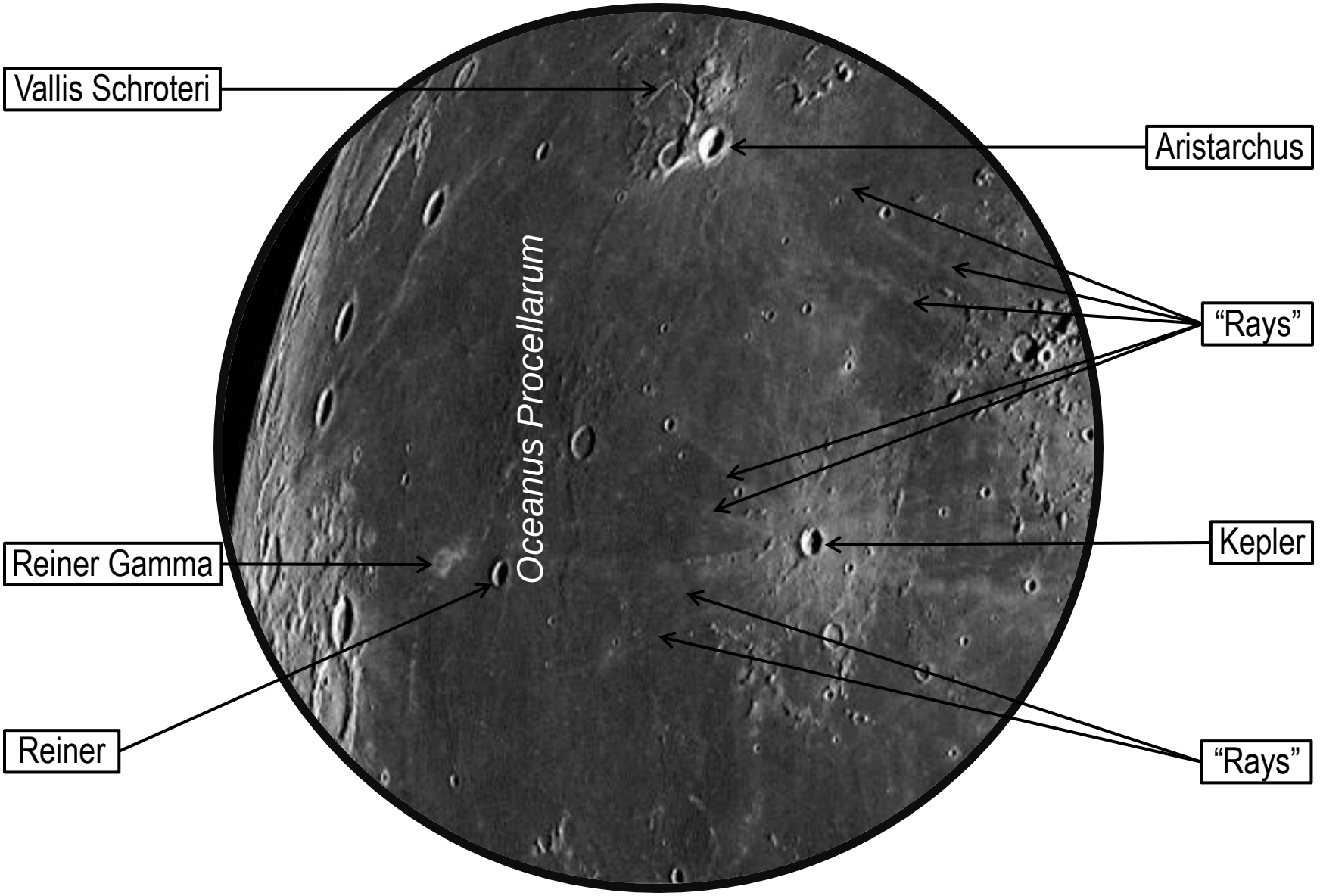
[NORTH UP]



Cred. Map by HL Cohen (2012) using LROC (NASA) image.

MOON: ~14 DAYS OLD—SECT. #1

[NORTH UP]



Cred. Map by HL Cohen (2012) using LROC (NASA) image.

Appendix

– Lunar Feature Glossary –

– Some Maria and Similar Features –

Lunar Feature Glossary

basin large, bowl-shaped depression probably of impact origin
caldera large crater formed by volcanic explosion or by collapse of a volcanic cone
catina (pl. *catinae*) crater chain
cliff high, steep, or overhanging face of rock
craterlets small craters
craters bowl-shaped depression or basin usually of impact origin
domes rounded hill probably of volcanic origin often capped with small crater
graben elongated depression or channel caused by vertical geologic faults
lacus (pl. *laci;* Latin *lake*) dark, isolated irregular patch
libration slow apparent lunar oscillation in latitude (abt. 7°) and longitude (abt. 8°); allows 59% of surface to be seen
mare (pl. *maria;* Latin *sea*) large dark basin
mons (Latin *mountain*) a mountain; sometimes the walls of large basins
montes mountain range or group of mountains
oceanus large dark region (cf. mare)
palus (pl. *pali;* Latin swamp or marsh) small plain (or "marsh")
peak pointed mountain summit
promontory high ridge
ray light-colored, linear features extending radial from (usually younger) lunar craters; conspicuous near Full Moon
rille (alt. *rima)* well-defined, long, narrow valley or cleft with sides approximately parallel
- **arcuate rille** curved rille, often concentric; confined within circular mare
- **sinuous rille** long, winding steep walled valley; often discontinuous; likely lava channels; V-shape
- **strait (linear) rille** strait rille that appears to be a linear *graben*; flat floors

rima (pl. *rimae*) a rille, crack or fissure (see *rille*)
rupes (pl. *rupes*) a lunar *scarp*
scarp (*escarpment*) steep slope or long cliff often from faulting or erosion
sinus (*bay*, pl. *sini*) indentation in edge of high ground; protrusion from dark area
valles (*valley*) elongated lowland between mountain ranges, hills, or uplands

Some Marian & Similar Features

(Most named for water bodies — not all on A.L. Lunar I Feature List)

- Lacus Mortis (Lake of Death)
- Lacus Somniorum (Lake of Dreams)
- Mare Anguis (Sea of Snake)
- Mare Australe (Southern Sea)
- Mare Crisium (Sea of Crisis)
- Mare Fecunditatis (Sea of Fertility)
- Mare Frigoris (Sea of Cold)
- Mare Humboldtianum (Sea of Humboldt)
- Mare Humorum (Sea of Moisture)
- Mare Imbrium (Sea of Rain)
- Mare Insularum (Sea of Islands)
- Mare Nectaris (Sea of Nectar)
- Mare Nubium (Sea of Clouds)
- Mare Sernitatis (Sea of Serenity)

- Mare Smythii (Smyth's Sea)
- Mare Spumans (Foaming Sea)
- Mare Tranquillitatis (Sea of Tranquility)
- Mare Vaporum (Sea of Vapors)
- Mare Undarum (Sea of Waves)
- Oceanus Procellarum (Ocean of Storms)
- Palus Epidemiarium (Marsh of Disease)
- Palus Nebularum (Marsh of Mists)
- Palus Putredinus (Marsh of Rot)
- Palus Somni (Marsh of Sleep)
- Sinus Aestuum (Seething Bay)
- Sinus Iridium (Bay of Rainbows)
- Sinus Medii (Central Bay)
- Sinus Roris (Bay of Dew)

INDEX OF THE 100 A.L. LUNAR I FEATURES

(Bold Page Numbers: Features on Full Image Maps; Non-Bold Page Numbers: Features on Enlarged Maps)

A.L. Lunar Program

Official A.L. Observing Record Sheets

Lunar Club Program

Naked Eye Objects

Instruments Used _____

	OBJECT	FEATURE	DATE	TIME
[ ]	(Within 72 Hrs of new)	Old Moon in New Moon's Arms	_____	_____
[ ]	(Within 72 Hrs of new)	New Moon in Old Moon's Arms	_____	_____
[ ]	(Within 40 Hrs of new)	Crescent Moon, Waxing	_____	_____
[ ]	(Within 48 Hrs of New)	Crescent Moon, Waning	_____	_____
[ ]		Man in the Moon	_____	_____
[ ]		Woman in the Moon	_____	_____
[ ]		Rabbit in the Moon	_____	_____
[ ]		Cow Jumping Over the Moon	_____	_____
	Maria			
[ ]		Crisium	_____	_____
[ ]		Fecunditatis	_____	_____
[ ]		Serenitatis	_____	_____
[ ]		Tranquillitatis	_____	_____
[ ]		Nectaris	_____	_____
[ ]		Imbrium	_____	_____
[ ]		Frigoris	_____	_____
[ ]		Nubium	_____	_____
[ ]		Humorum	_____	_____
[ ]		Oceanus Procellarum	_____	_____

Binocular Objects

Instruments Used _____

	OBJECT	FEATURE	DATE	TIME
[ ]		Lunar Rays	_____	_____
[ ]		Sinus Iridum	_____	_____
[ ]		Sinus Medii	_____	_____
[ ]		Sinus Roris	_____	_____
[ ]		Palus Somnii	_____	_____

[ ]		Palus Epidemiarum	_____	_____
[ ]		Mare Vaporum	_____	_____
	Craters			
[ ]	~4 Days old	Langrenus	_____	_____
[ ]		Vendelinus	_____	_____
[ ]		Petavius	_____	_____
[ ]		Cleomedes	_____	_____
[ ]		Atlas	_____	_____
[ ]		Hercules	_____	_____
[ ]		Endymion	_____	_____
[ ]		Macrobius	_____	_____
[ ]	~7 Days old	Piccolomini	_____	_____
[ ]		Theophilus	_____	_____
[ ]		Cyrillus	_____	_____
[ ]		Catharina	_____	_____
[ ]		Posidonius	_____	_____
[ ]		Fracastorius	_____	_____
[ ]		Aristoteles	_____	_____
[ ]		Eudoxus	_____	_____
[ ]		Cassini	_____	_____
[ ]		Hipparchus	_____	_____
[ ]		Albategnius	_____	_____
[ ]		Aristillus	_____	_____
[ ]		Autolycus	_____	_____
[ ]		Maurolycus	_____	_____
[ ]	~10 Days old	Plato	_____	_____
[ ]		Archimedes	_____	_____
[ ]		Ptolemaeus	_____	_____
[ ]		Alphonsus	_____	_____
[ ]		Arzachel	_____	_____
[ ]		Walter	_____	_____
[ ]		Maginus	_____	_____
[ ]		Tycho	_____	_____
[ ]		Clavius	_____	_____
[ ]		Eratosthenes	_____	_____

[ ]		Longomontanus	_____	_____
[ ]		Copernicus	_____	_____
[ ]		Bullialdus	_____	_____
[ ]		Aristarchus	_____	_____
[ ]		Gassendi	_____	_____
[ ]	~14 Days old	Kepler	_____	_____
[ ]		Grimaldi	_____	_____

Telescopic Objects

Instruments Used _____

	OBJECT	FEATURE	DATE	TIME
[ ]		Sinus Aestuum	_____	_____
[ ]		Lacus Mortis	_____	_____
[ ]		Palus Putredinis	_____	_____
[ ]		Promontorium Laplace	_____	_____
[ ]		Promontorium Heraclides	_____	_____
[ ]		Promontorium Agarum	_____	_____
[ ]		Montes Alpes	_____	_____
[ ]		Montes Apenninus	_____	_____
[ ]		Mons Hadley	_____	_____
[ ]		Mons Piton	_____	_____
[ ]		Mons Pico	_____	_____
[ ]		Rupes Altai	_____	_____
[ ]		Rima Hyginus	_____	_____
[ ]		Vallis Schroteri	_____	_____
[ ]		Vallis Alpes	_____	_____
[ ]		Rupes Recta (straight wall)	_____	_____
	Craters			
[ ]	~4 Days old	Picard	_____	_____
[ ]		Furnerius	_____	_____
[ ]		Petavius Wall	_____	_____
[ ]		Messier/Messier A	_____	_____
[ ]		Proclus	_____	_____
[ ]		Fabricius	_____	_____

[ ]	~7 Days old	Plinius	_____	_____
[ ]		Mitchell	_____	_____
[ ]		Cassini A	_____	_____
[ ]		Manilius	_____	_____
[ ]		Gemma Frisius	_____	_____
[ ]	~10 Days old	Davy	_____	_____
[ ]		Pitatus	_____	_____
[ ]		Billy	_____	_____
[ ]		Fra Mauro	_____	_____
[ ]		Clavius craterlets	_____	_____
[ ]		Hippalus	_____	_____
[ ]		Herschel, J.	_____	_____
[ ]	~14 Days old	Schickard	_____	_____
[ ]		Reiner Gamma	_____	_____