Geological Setting of the Luna Glob Candidate Landing Site Region in the Northern High Latitudes: Characterization from LOLA and Related Data

A.M. Abdrakhimov, A.T. Basilevsky, M.A. Ivanov,
Vernadsky Institute, RAS, Moscow 119991, Russia
J.W. Head, J.L. Dickson
Department of Geological Sciences, Brown University, Providence, RI 02912, USA
D. Smith, *Goddard Space Flight Center, Greenbelt, MD USA*
M. Zuber
Earth, Atmospheric and Planetary Sciences, MIT, Cambridge, MA 02139, USA
D.B.J. Bussey, C.D. Neish
The John Hopkins University Applied Physics Lab, Laurel, MD 20723

Landing Site Selection for LUNA-GLOB mission
International Workshop #2
Moscow, Institute for Space Research (IKI), May 31 – June 2, 2011

Criteria of the Luna Glob Candidate Landing Site selection:

1. NPOL Ballistic constraints: The boundaries of landing area:

   70-85º N, -30 – 60º E

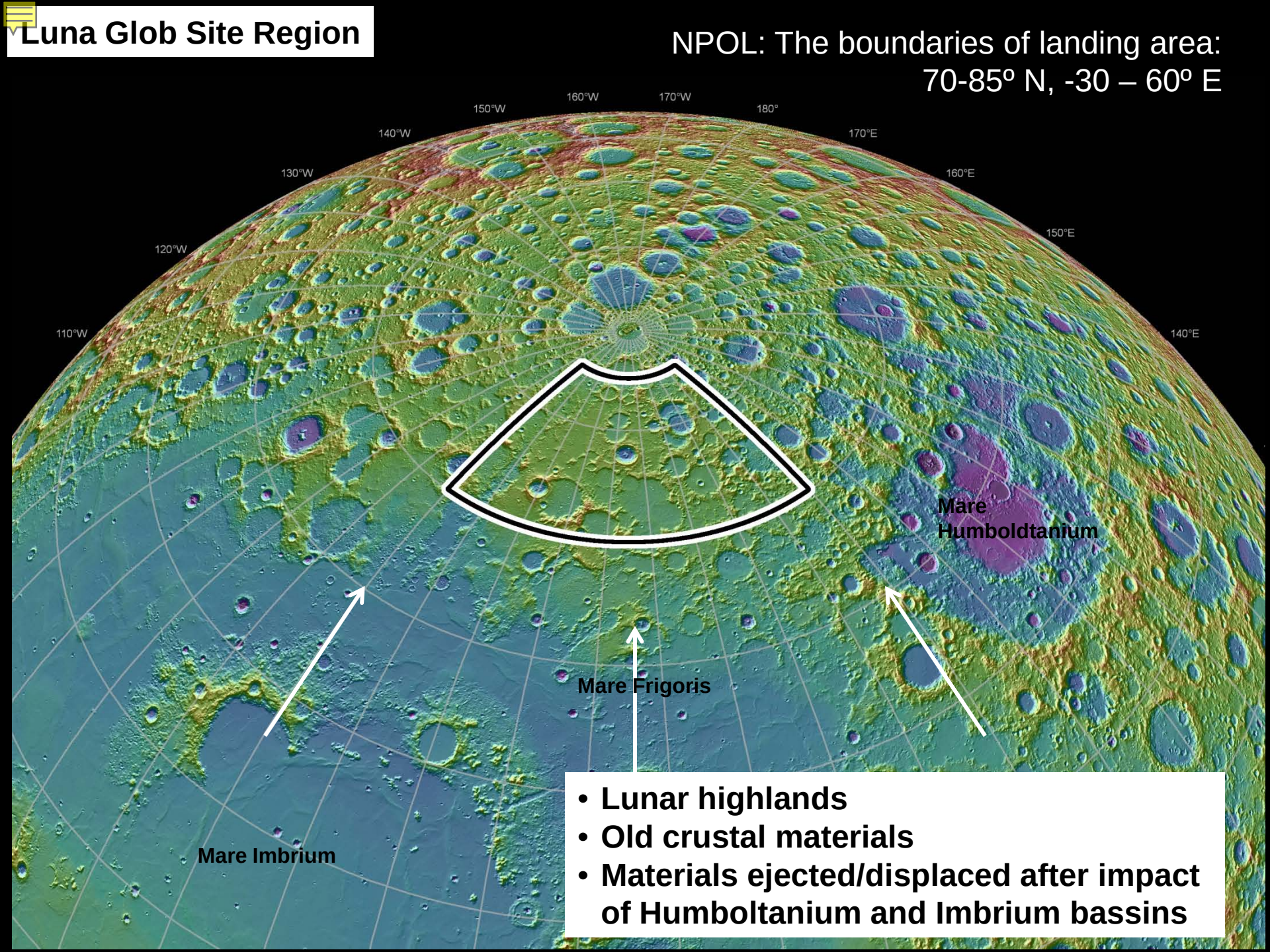
2. High Volatile Enrichment (by LEND data, Low neutron flux).

3. Safety of approaching trace (LOLA data).

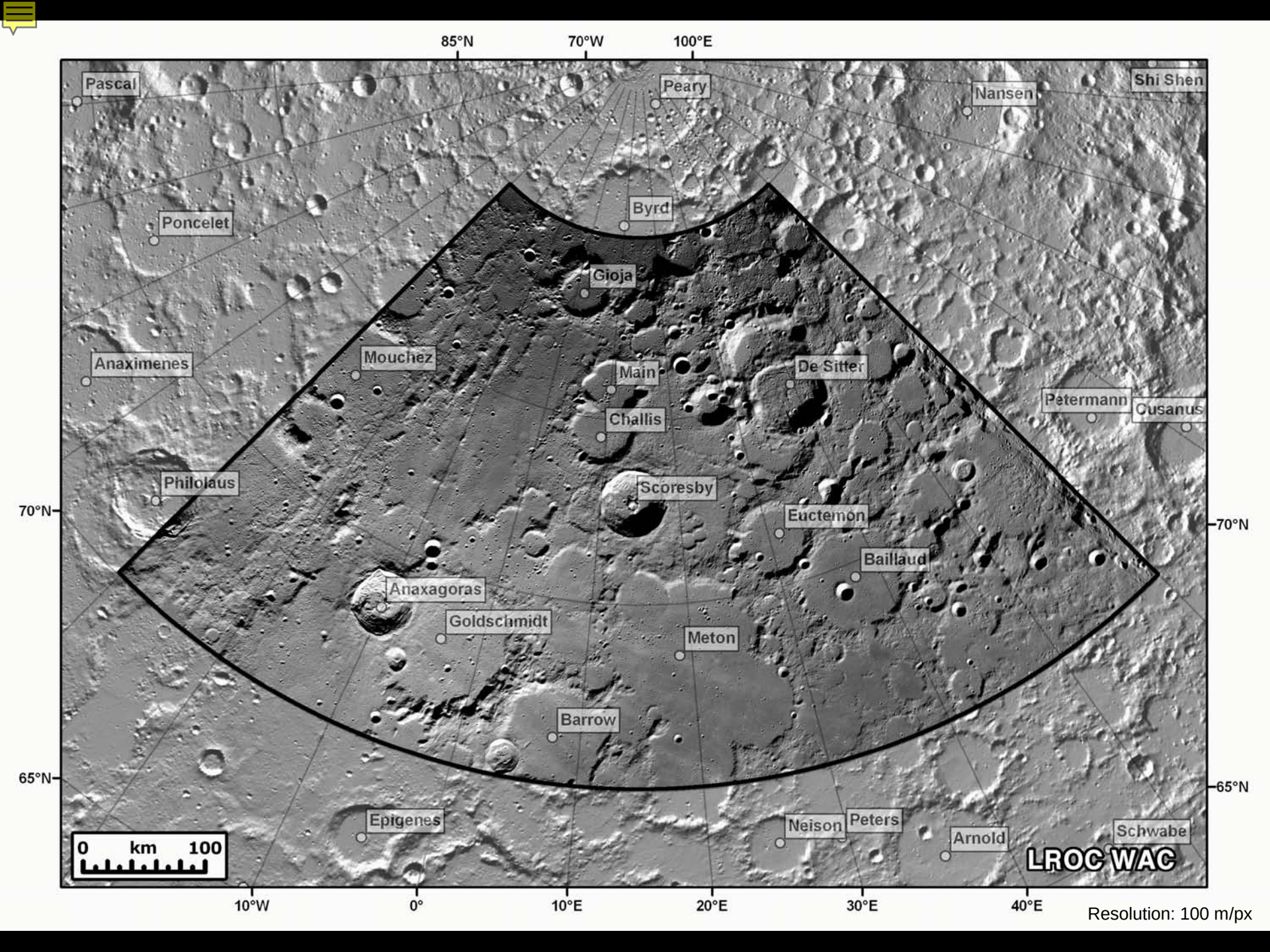
4. The landing area (15x30 km ellipse) should be safely smooth (LROC, LOLA, Micro-RF data).

Luna Glob Site Region

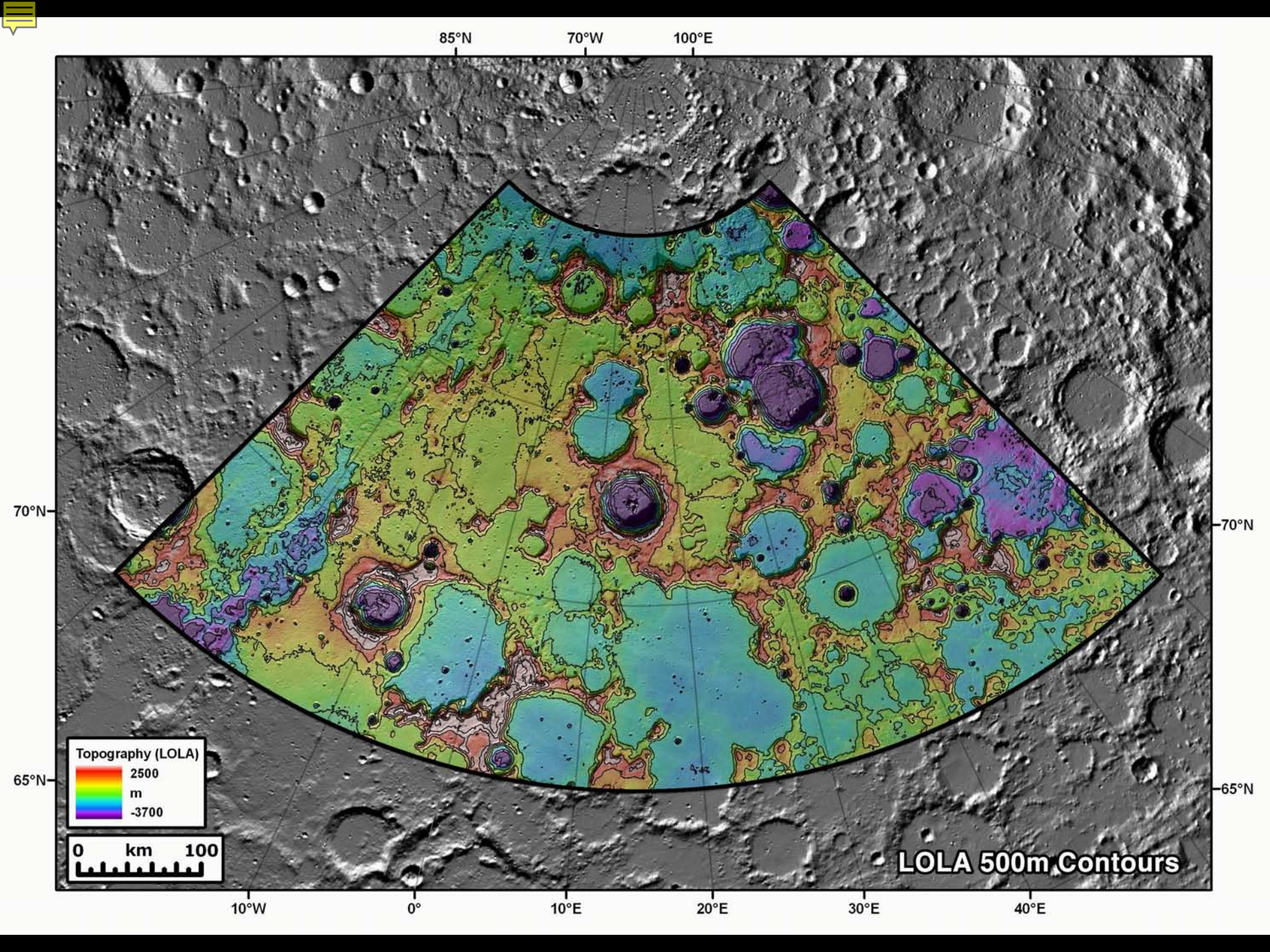
NPOL: The boundaries of landing area:
70-85º N, -30 – 60º E

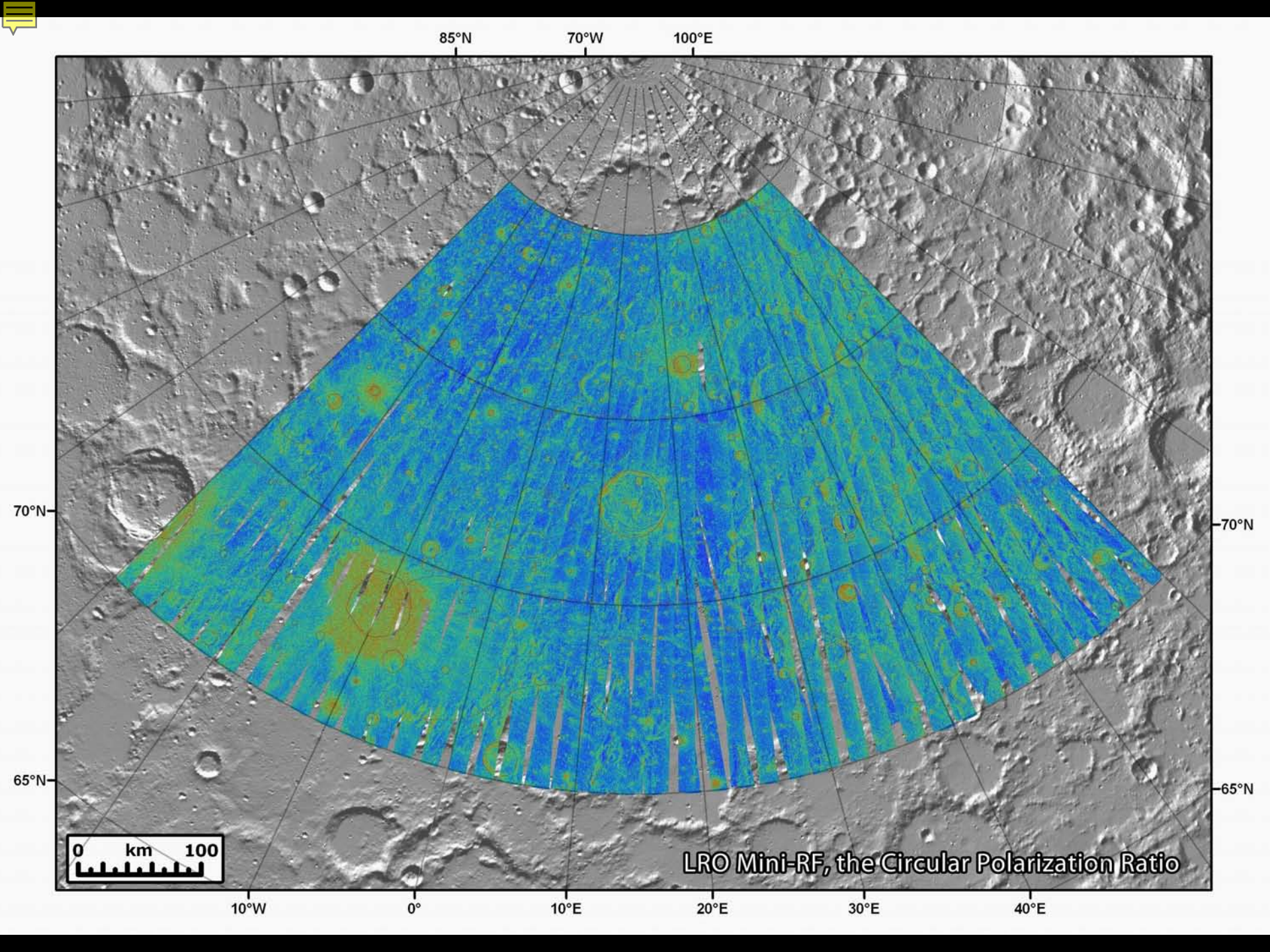


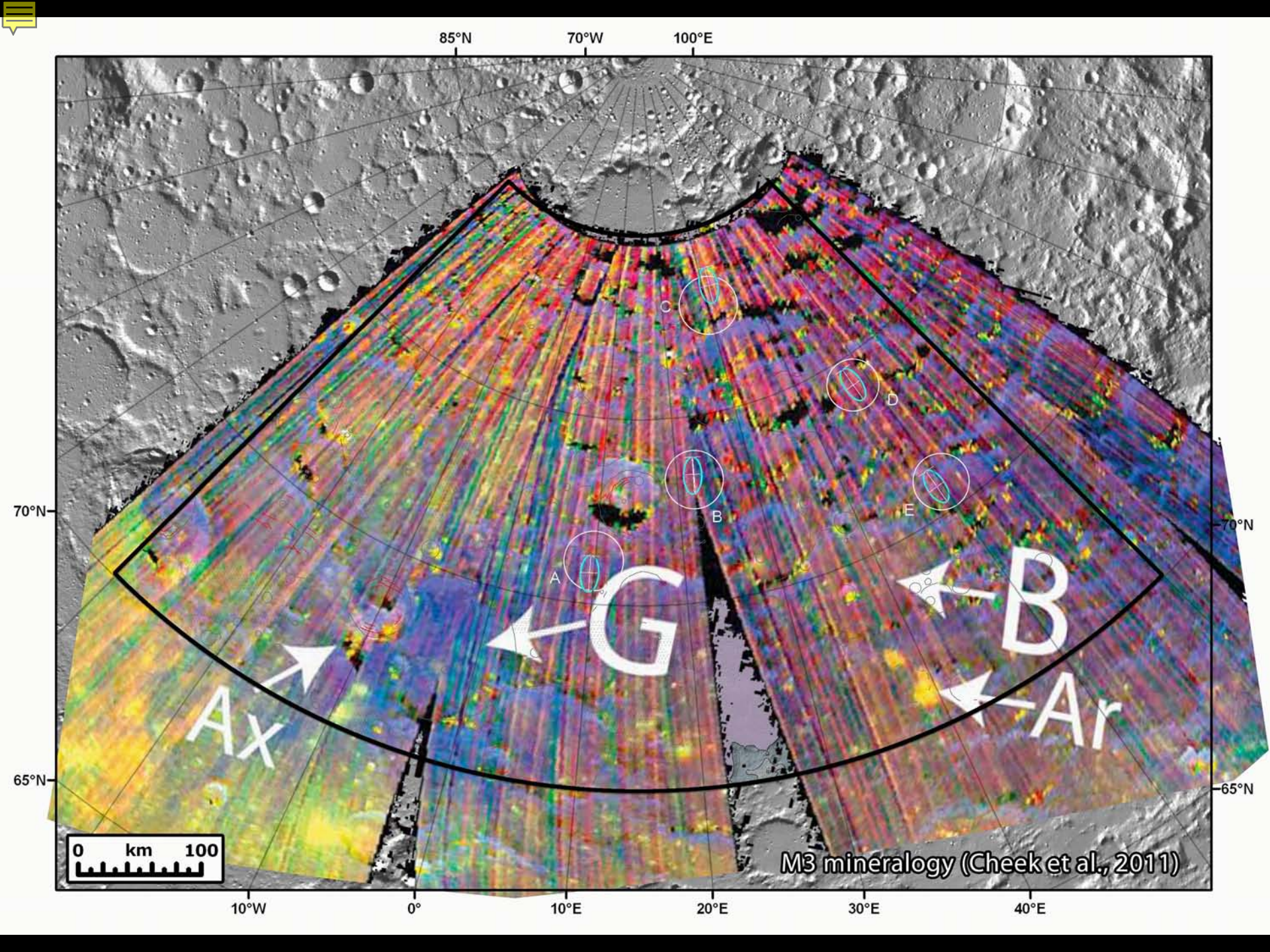
- **Lunar highlands**
- **Old crustal materials**
- **Materials ejected/displaced after impact of Humboltanium and Imbrium bassins**

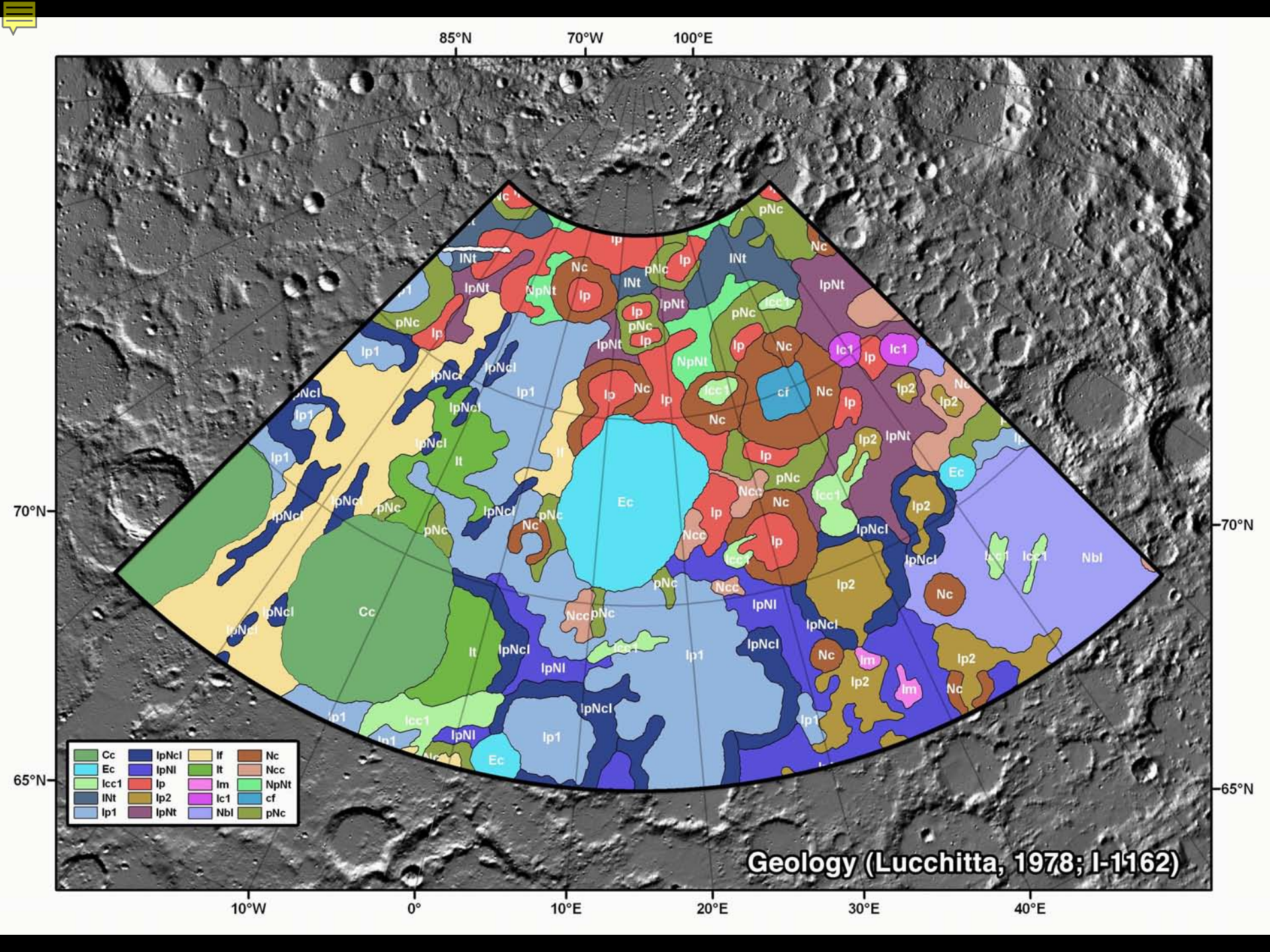


Resolution: 100 m/px

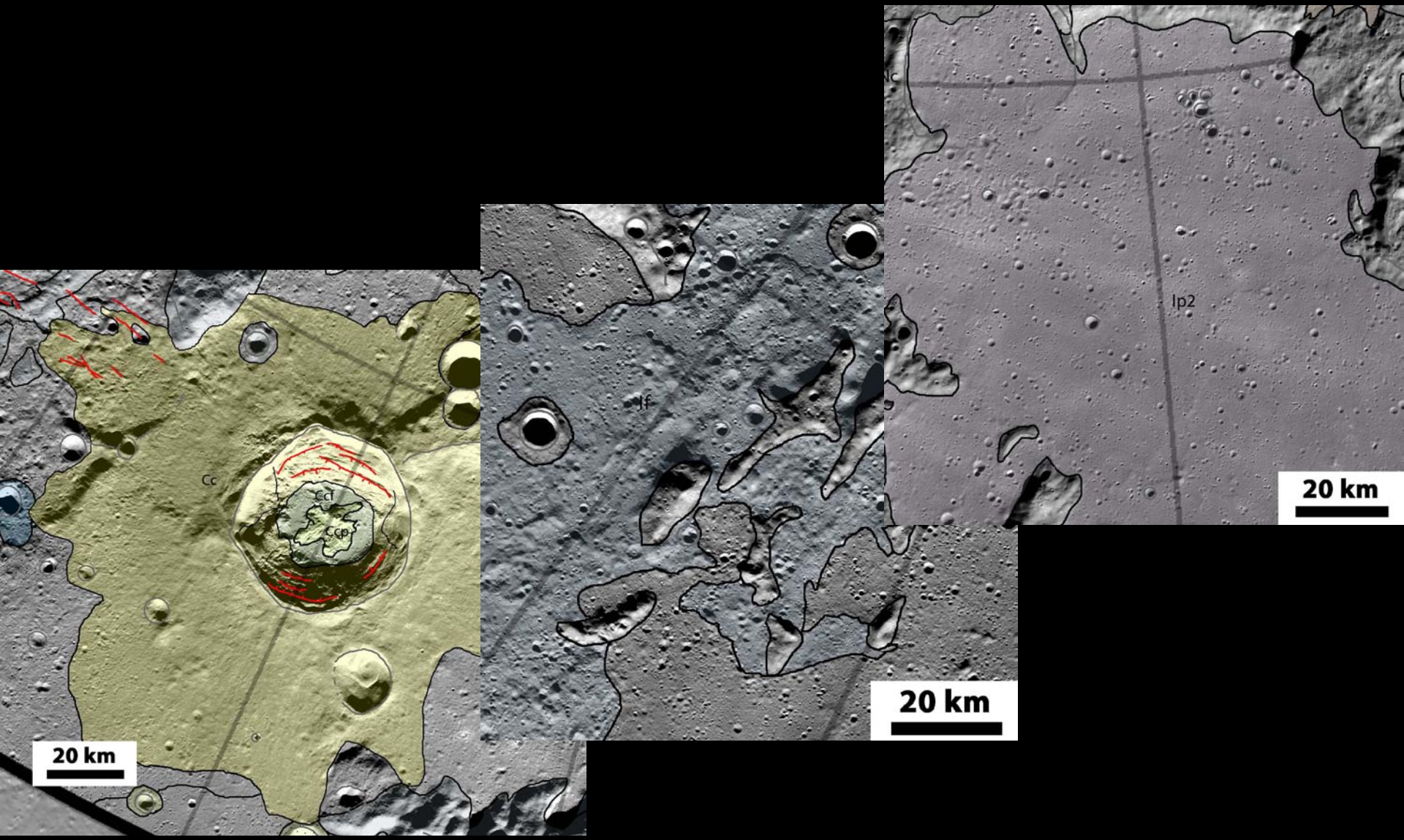

85°N
70°W
100°E
70°N
65°N
Topography (LOLA)
2500
m
-3700
0 km 100
LOLA 500m Contours
10°W
0°
10°E
20°E
30°E
40°E

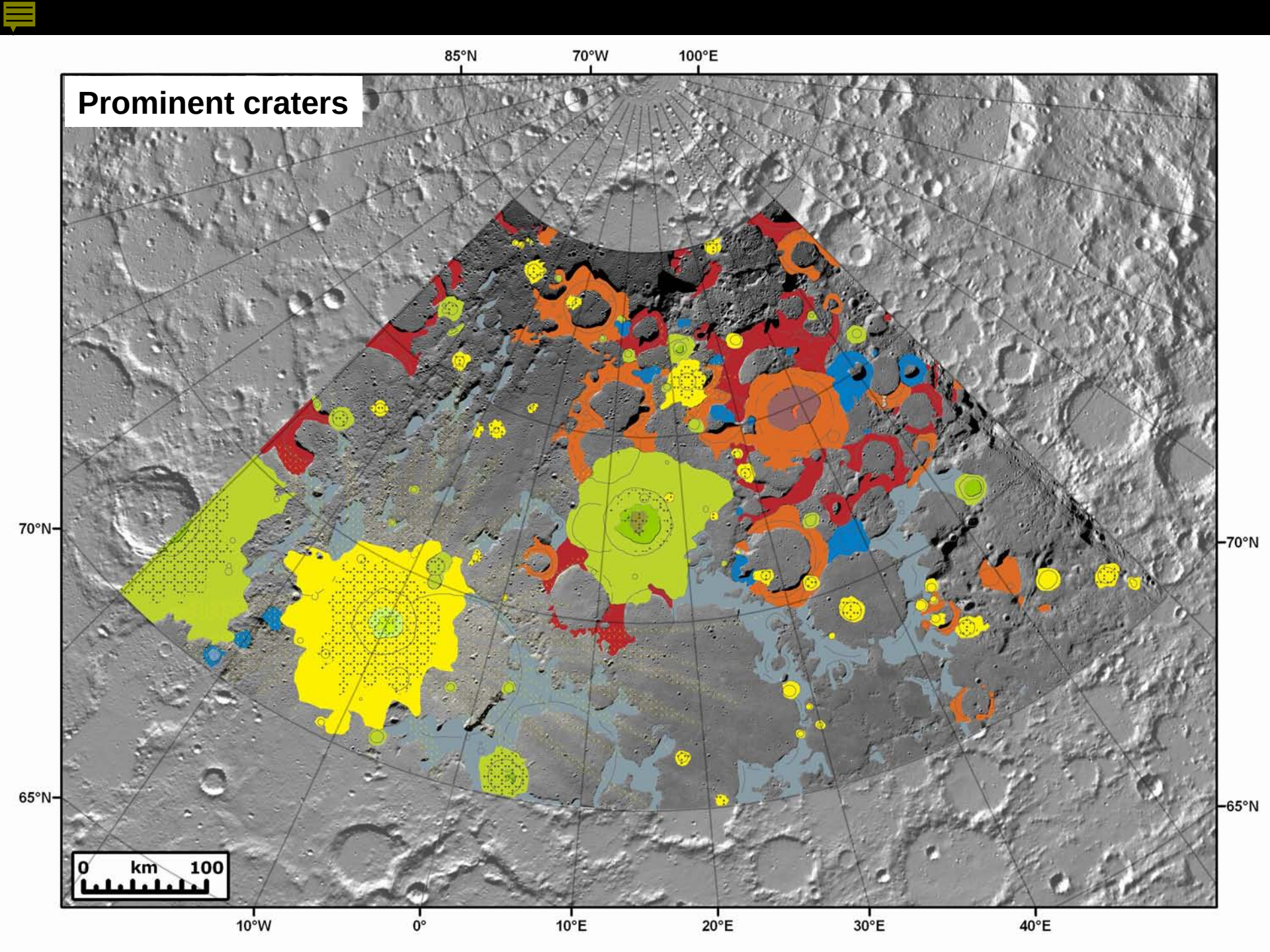

85°N
70°W
100°E
70°N
65°N
0
km
100
LRO Mini-RF, the Circular Polarization Ratio
10°W
0°
10°E
20°E
30°E
40°E

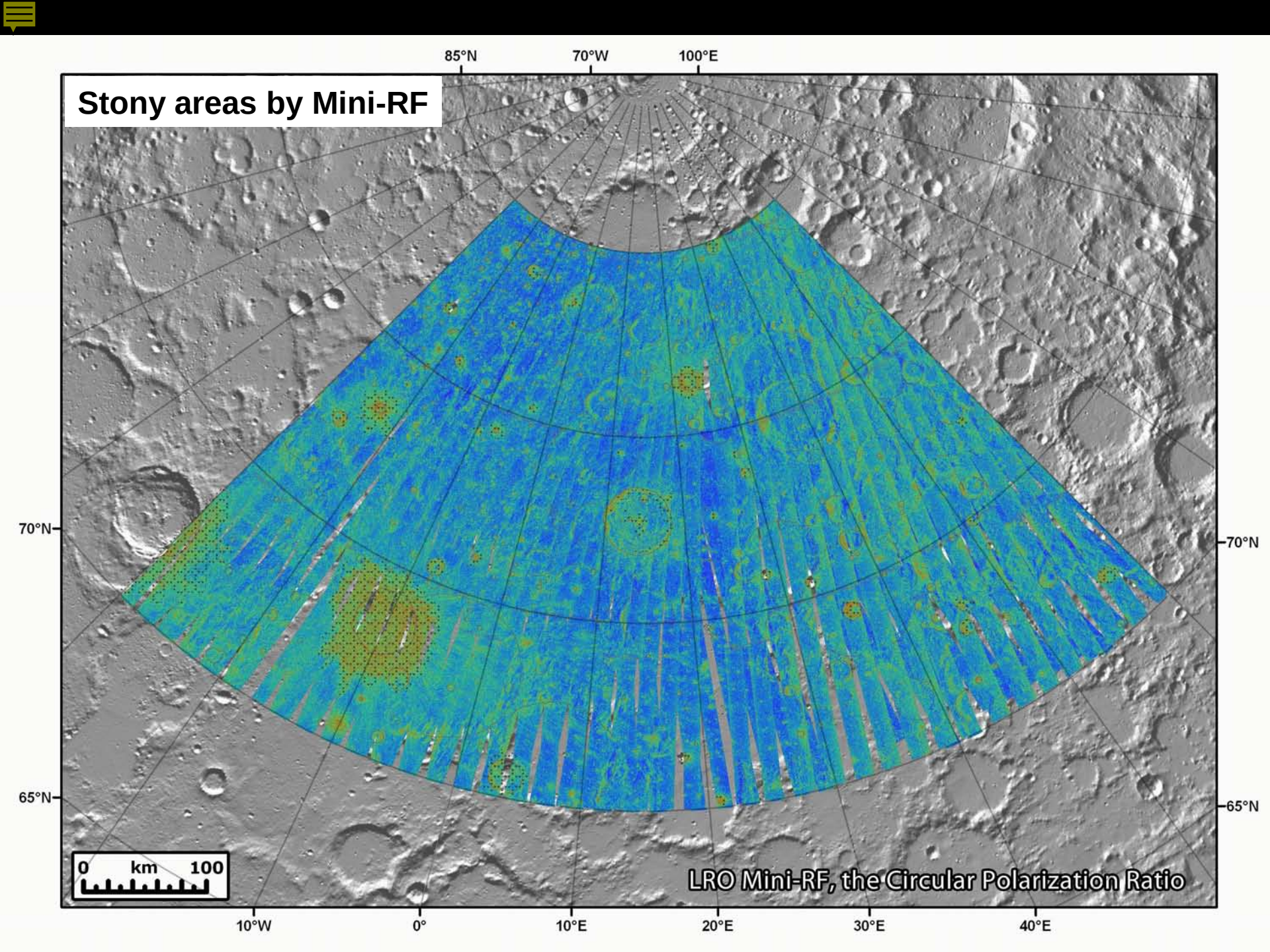

85°N
70°W
100°E
70°N
65°N
10°W
0°
10°E
20°E
30°E
40°E
A
B
C
D
E
Ax
G
B
Ar
0 km 100
M3 mineralogy (Cheek et al., 2011)

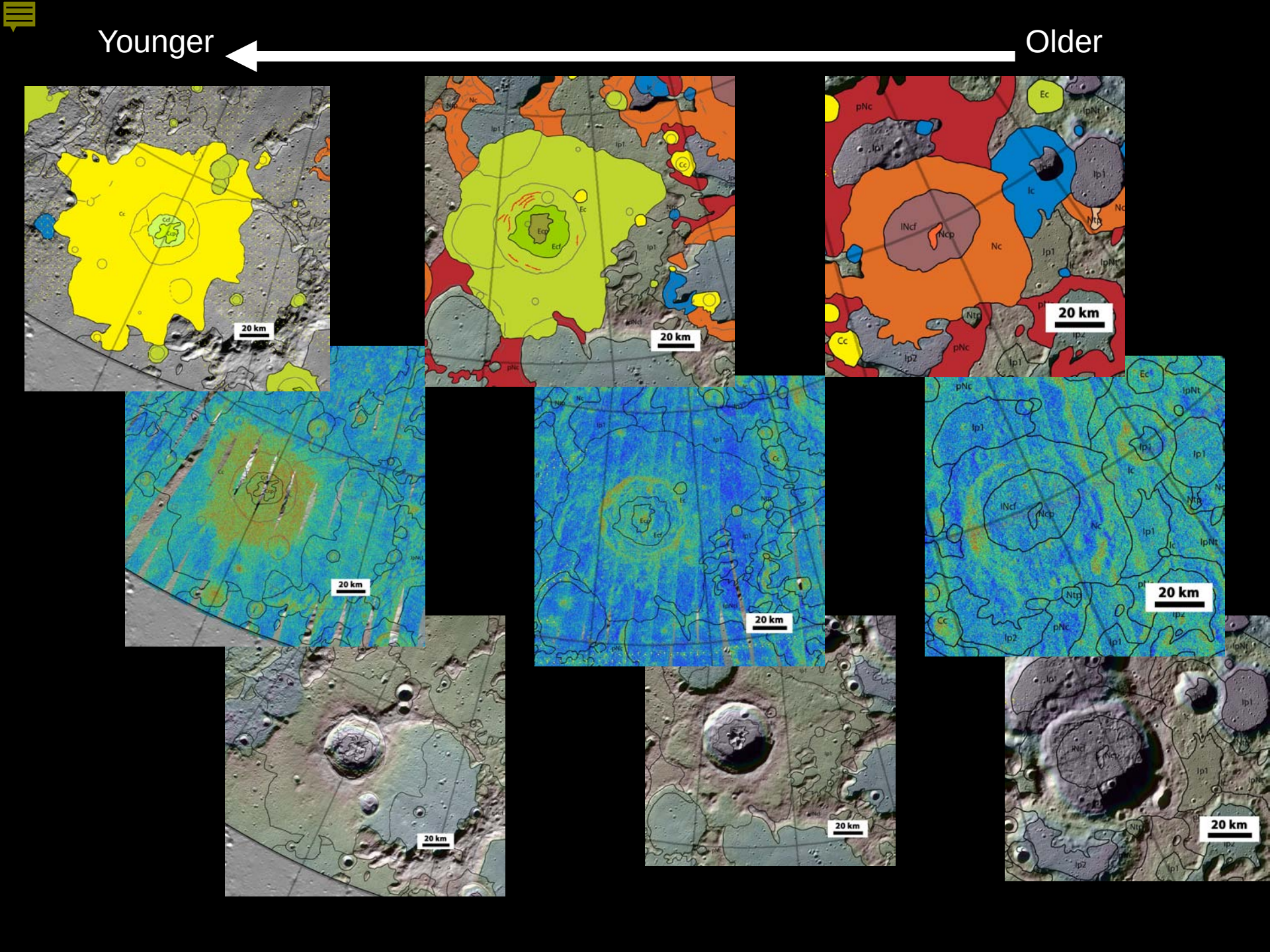

85°N
70°W
100°E
70°N
65°N
10°W
0°
10°E
20°E
30°E
40°E
Cc
Ec
Icc1
INt
Ip1
IpNcl
IpNl
Ip
Ip2
IpNt
If
It
Im
Ic1
Nbl
Nc
Ncc
NpNt
cf
pNc
Geology (Lucchitta, 1978; I-1162)

Main Terrain materials: prominent craters, bassin ejecta, plains

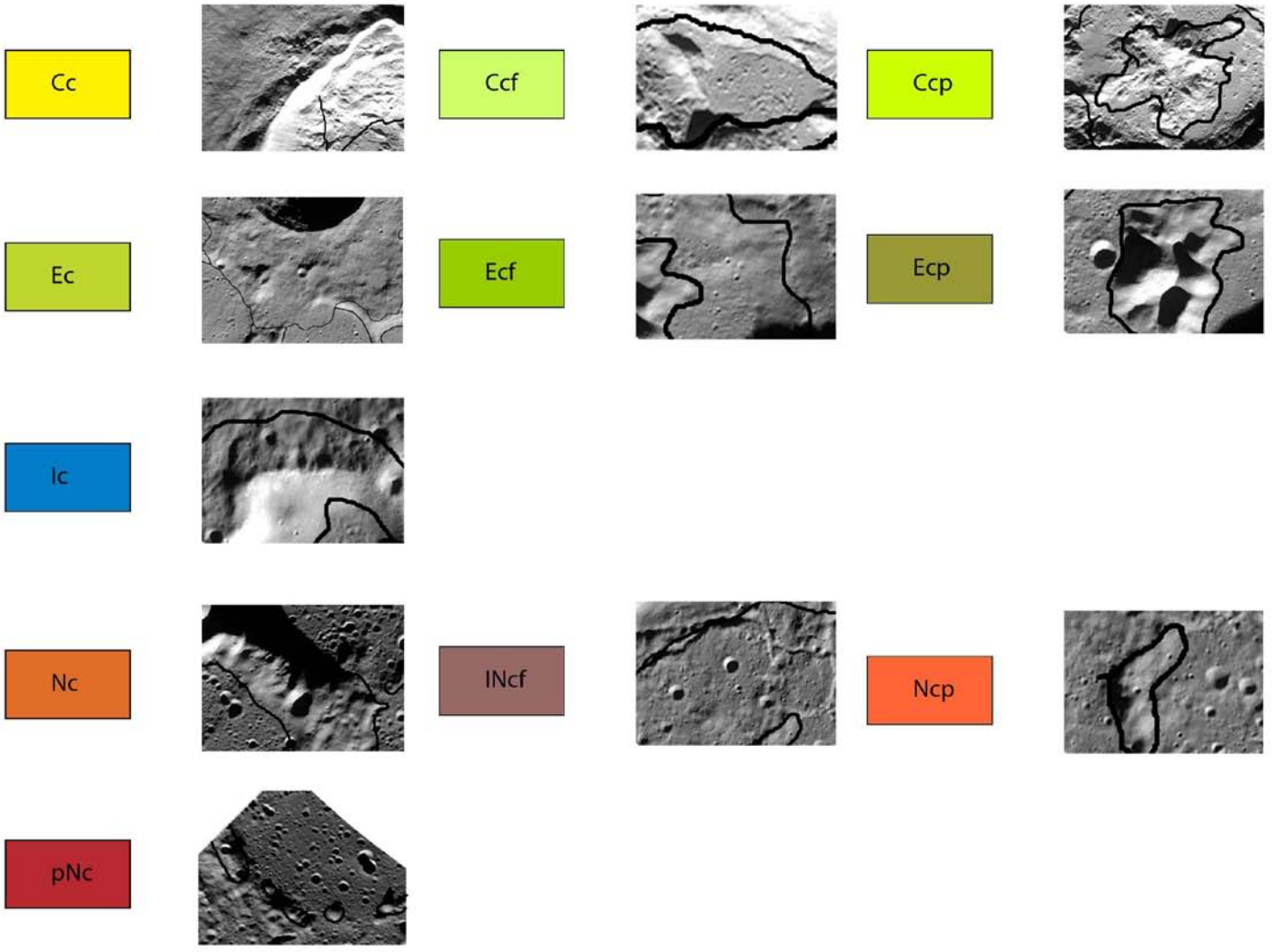


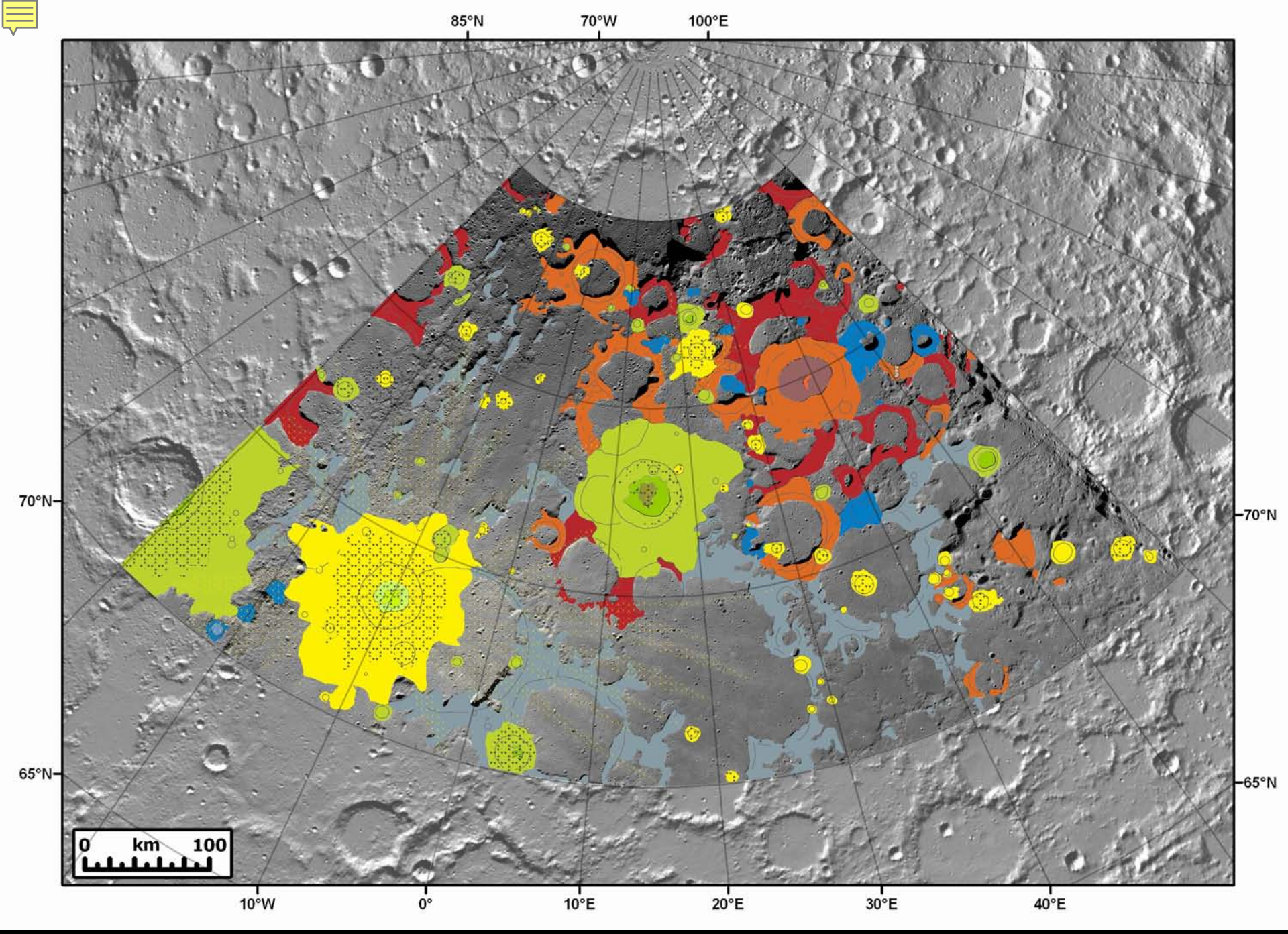

Prominent craters
85°N
70°W
100°E
70°N
65°N
0
km
100
10°W
0°
10°E
20°E
30°E
40°E


Stony areas by Mini-RF
85°N
70°W
100°E
70°N
65°N
0
km
100
LRO Mini-RF, the Circular Polarization Ratio
10°W
0°
10°E
20°E
30°E
40°E


Younger
Older
20 km

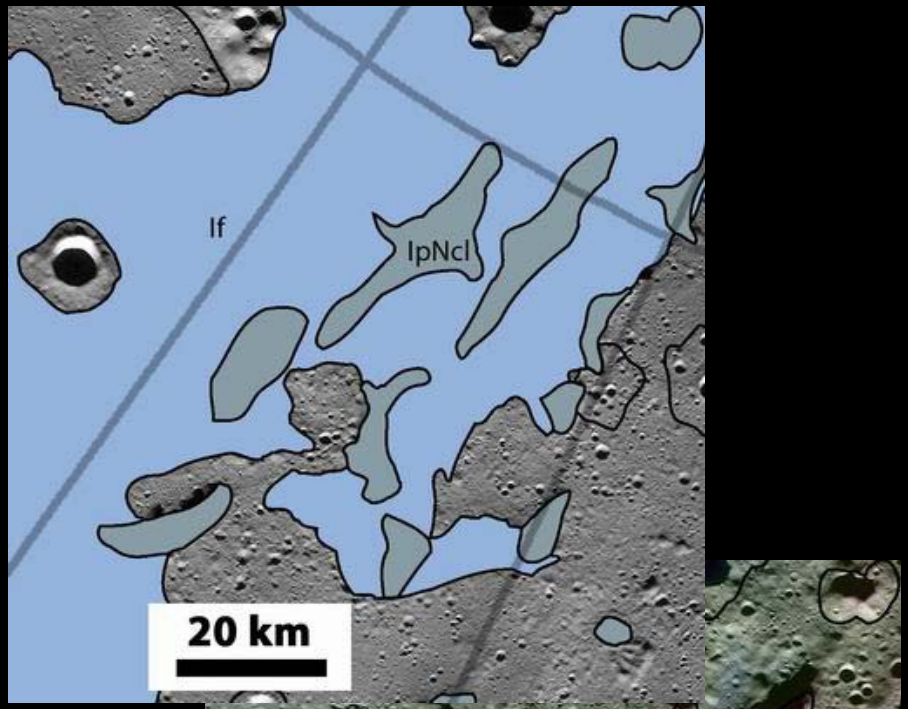
Crater complexes from old to younger

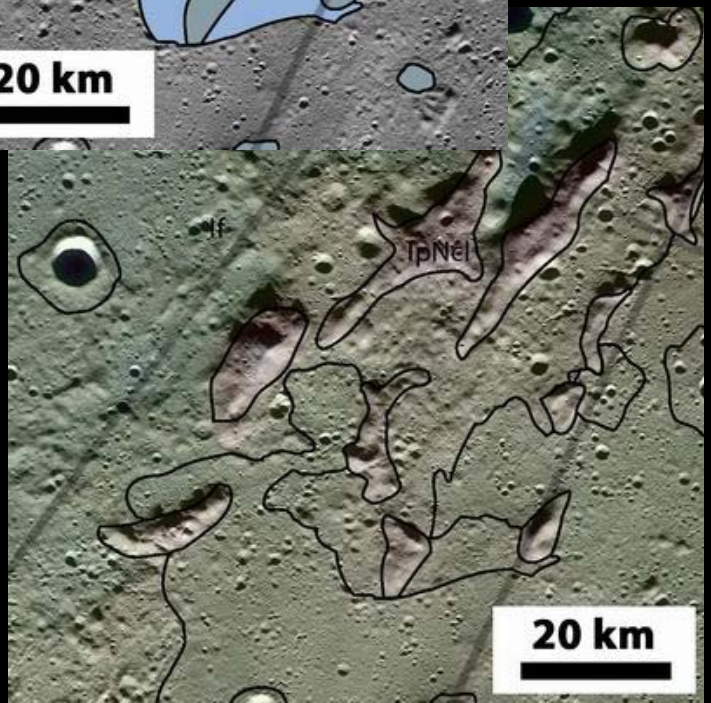



85°N
70°W
100°E
70°N
65°N
0 km 100
10°W
0°
10°E
20°E
30°E
40°E

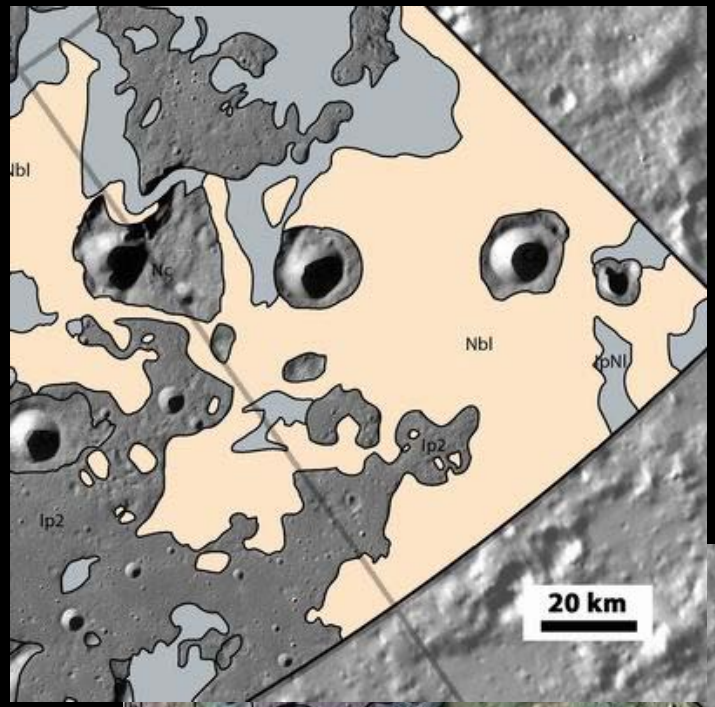
Basin materials

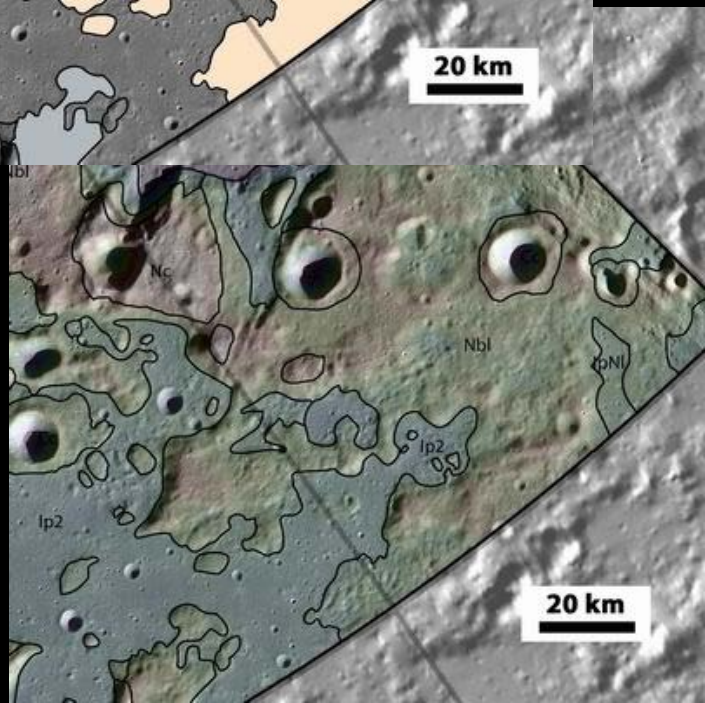
Formation Fra-Mauro If
(Imbrium basin material)

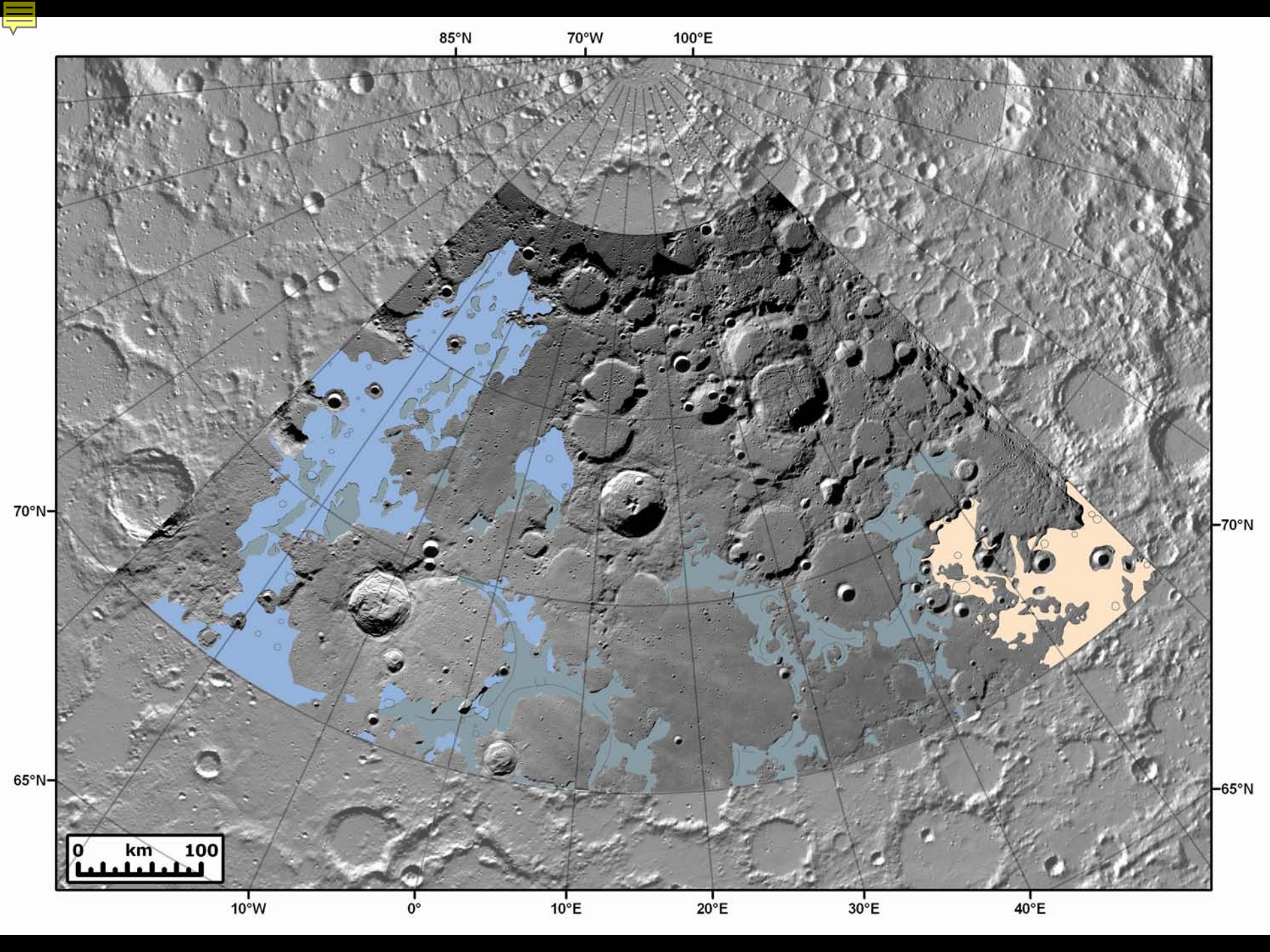




Complex Nbl (Nectarian
Humboldtanium basin material)



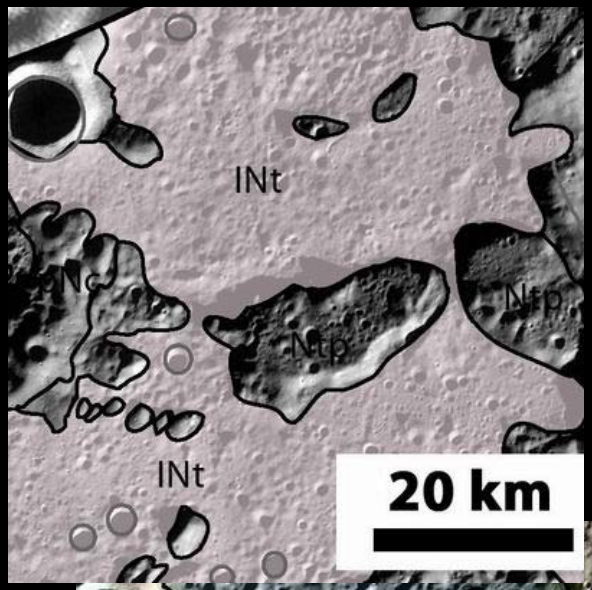


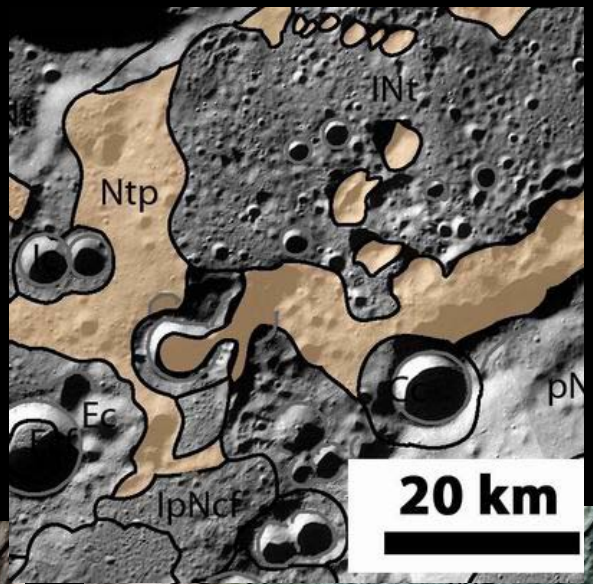

85°N
70°W
100°E
70°N
65°N
0 km 100
10°W
0°
10°E
20°E
30°E
40°E

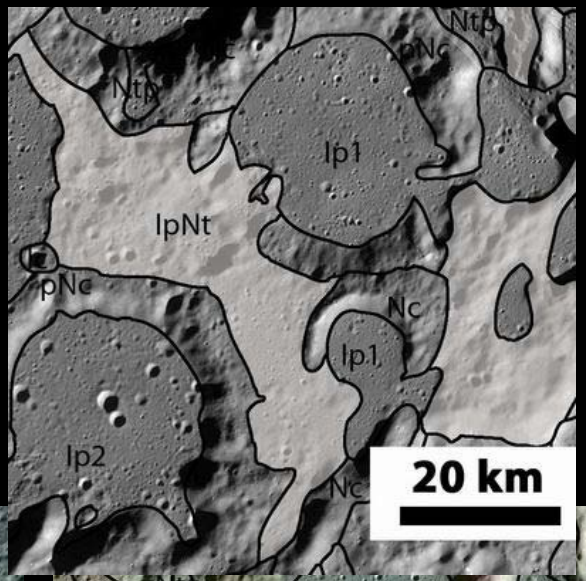
Old intracrater highland terrain and plain materials

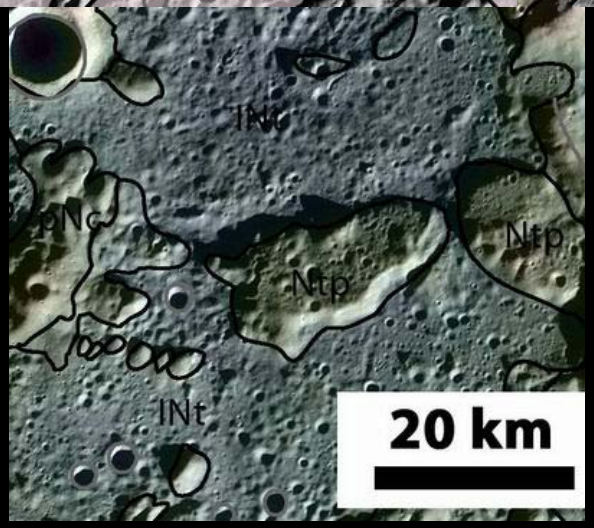
INt Ntp IpNt

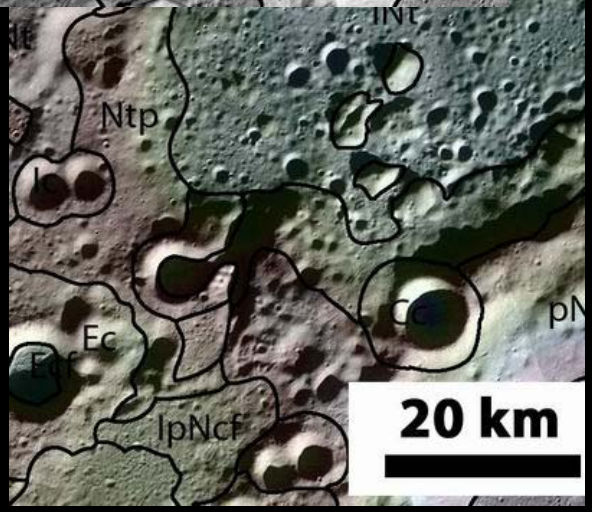
Younger ← Older

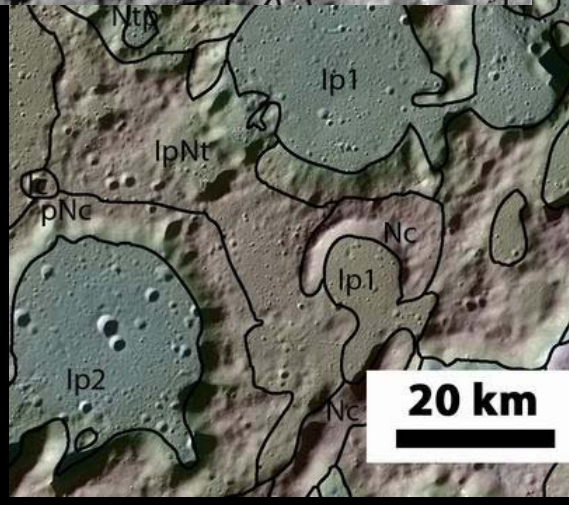


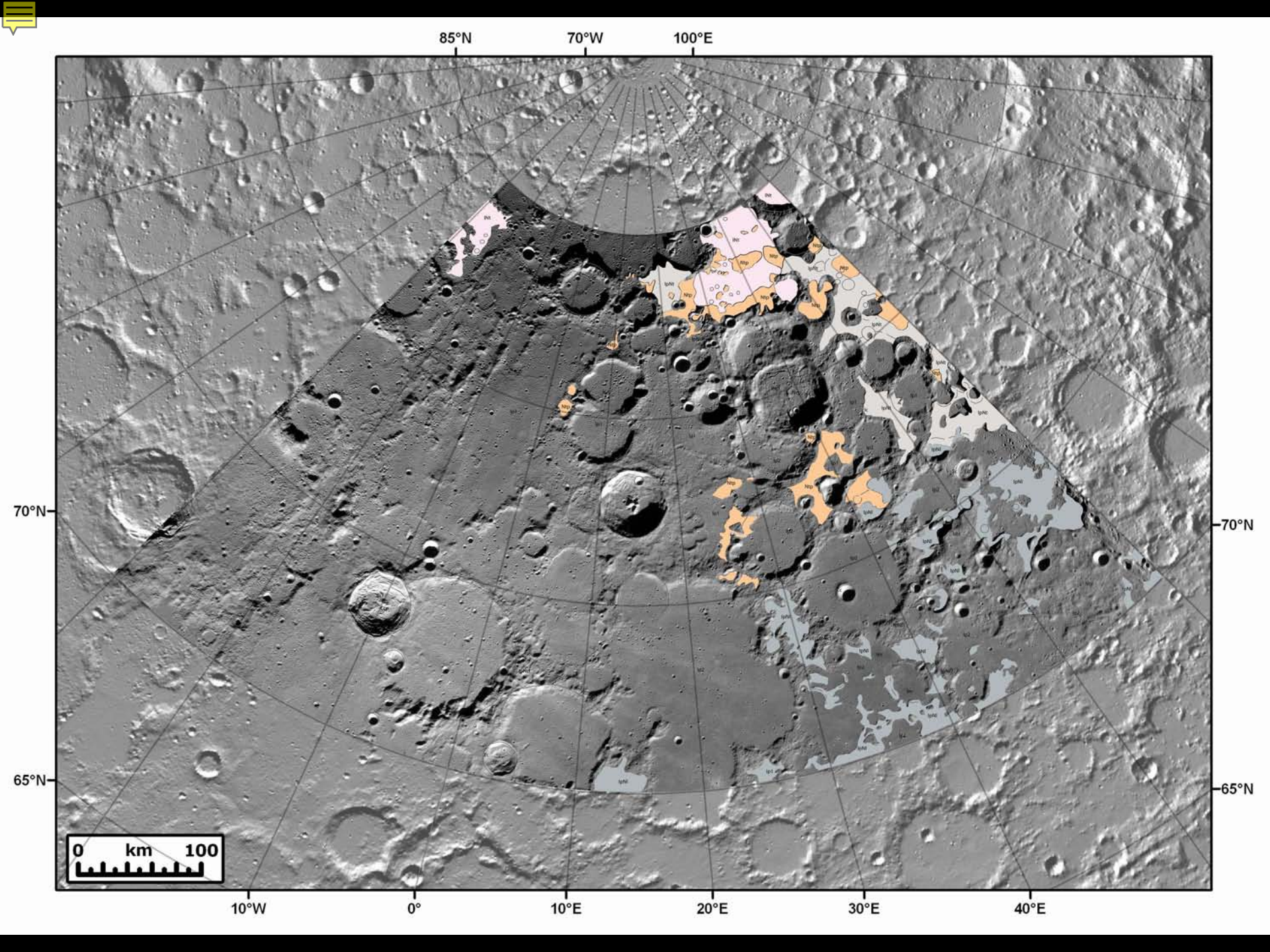











85°N
70°W
100°E
70°N
65°N
0 km 100
10°W
0°
10°E
20°E
30°E
40°E

Younger highland plain materials Ip and mare material Im

Mare material Im

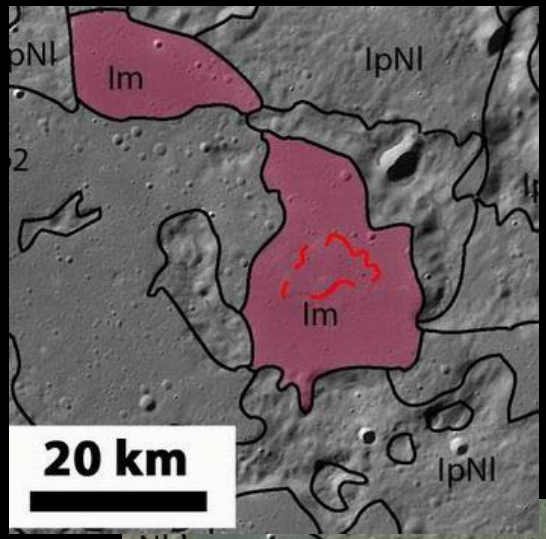
Younger highland plain material Ip

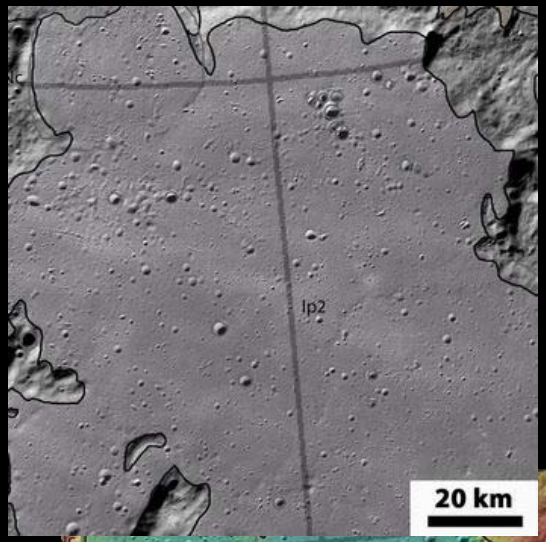
Ip2

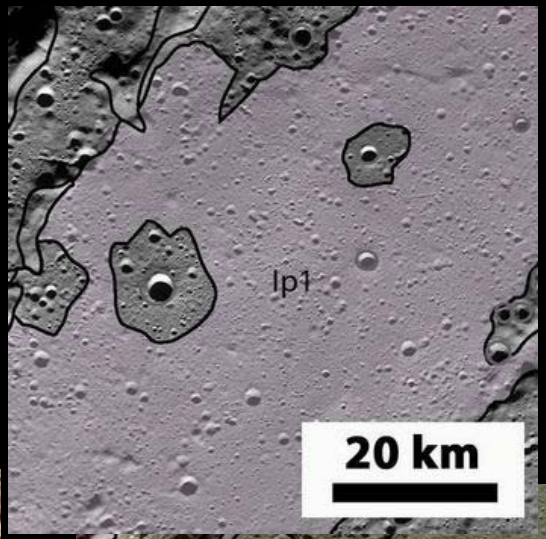
Ip1

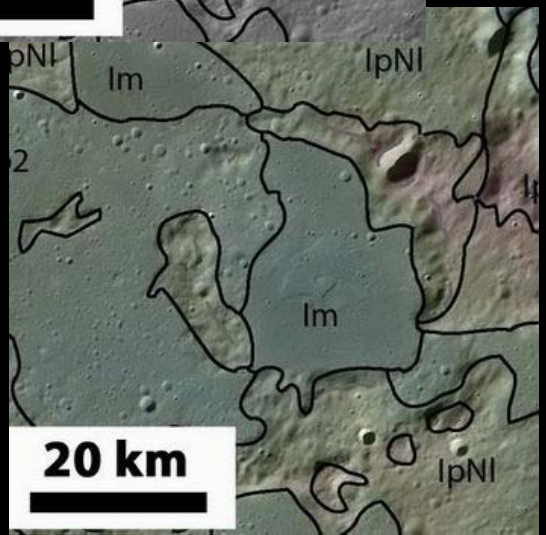
Younger

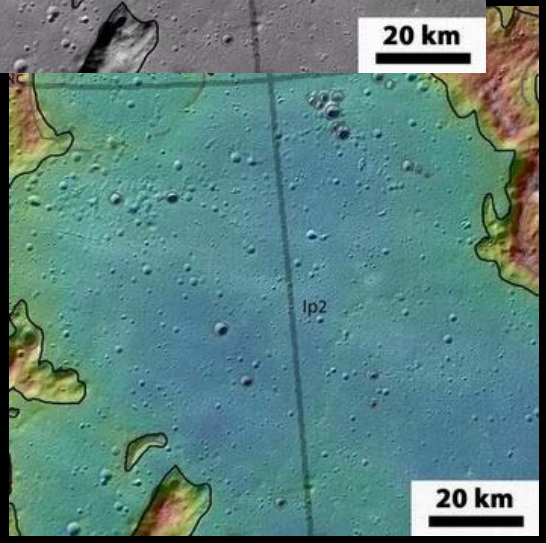
Older

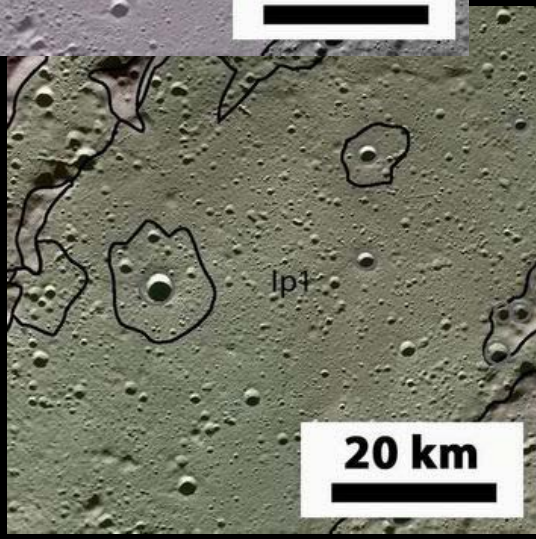


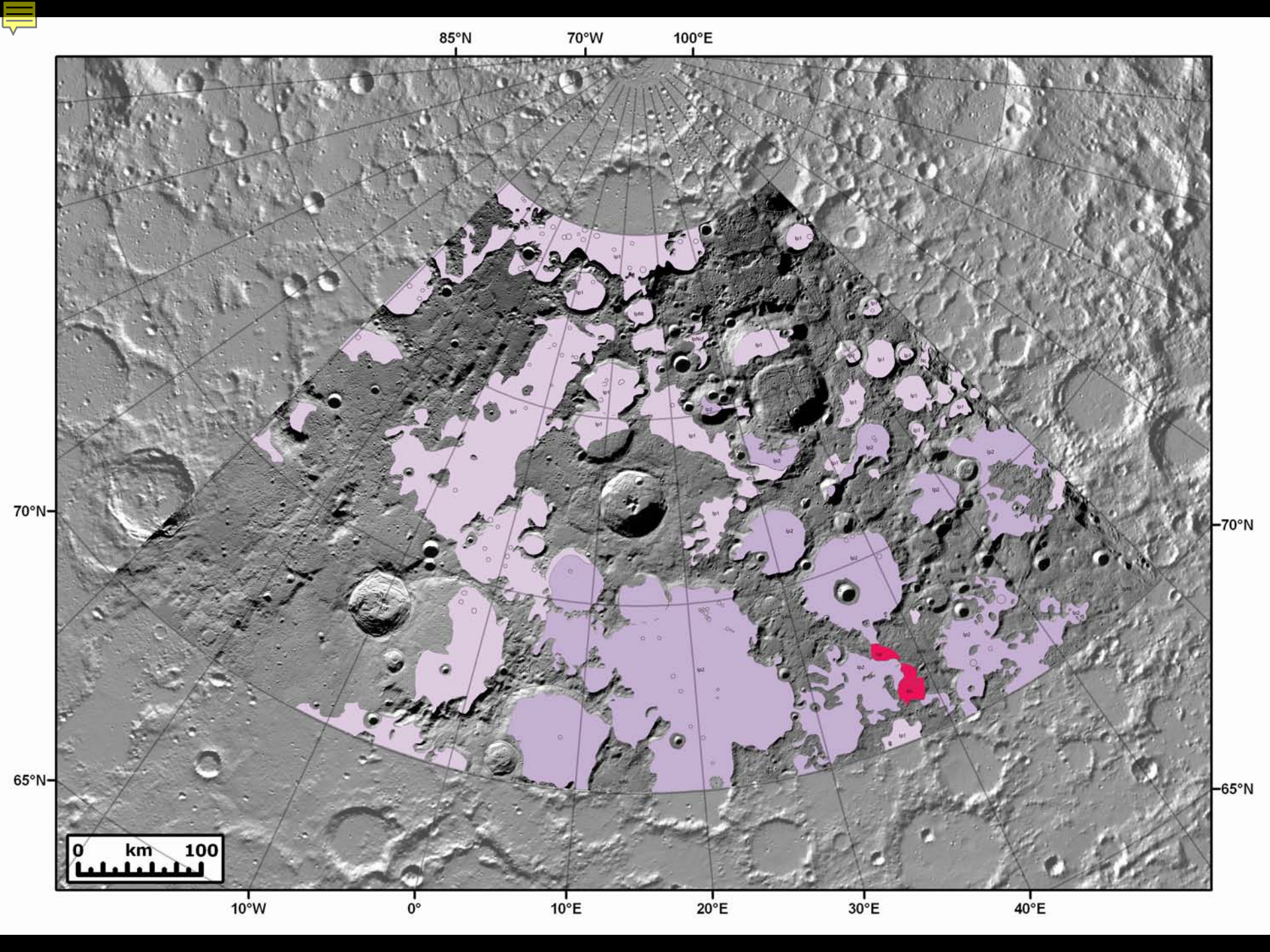


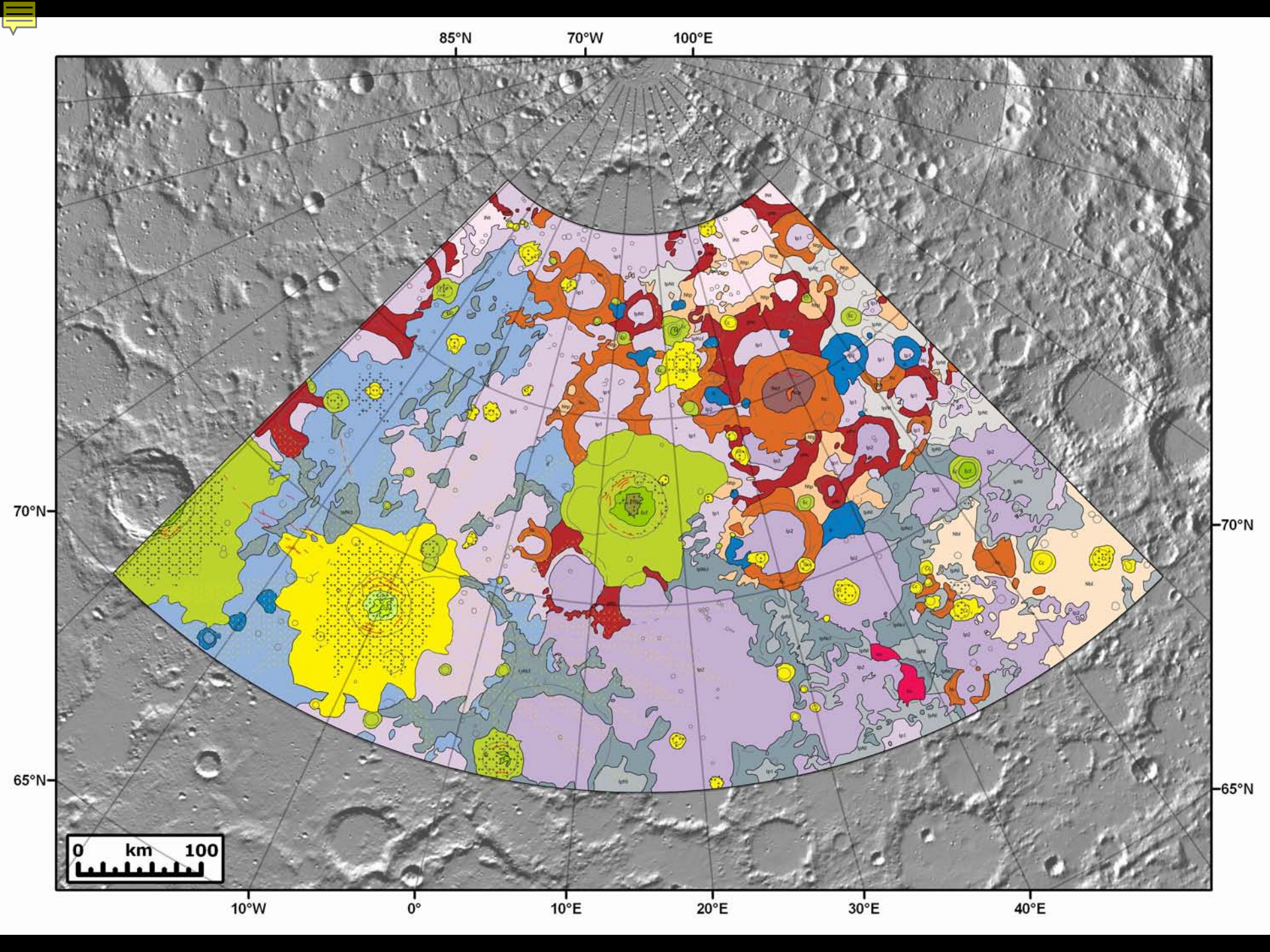




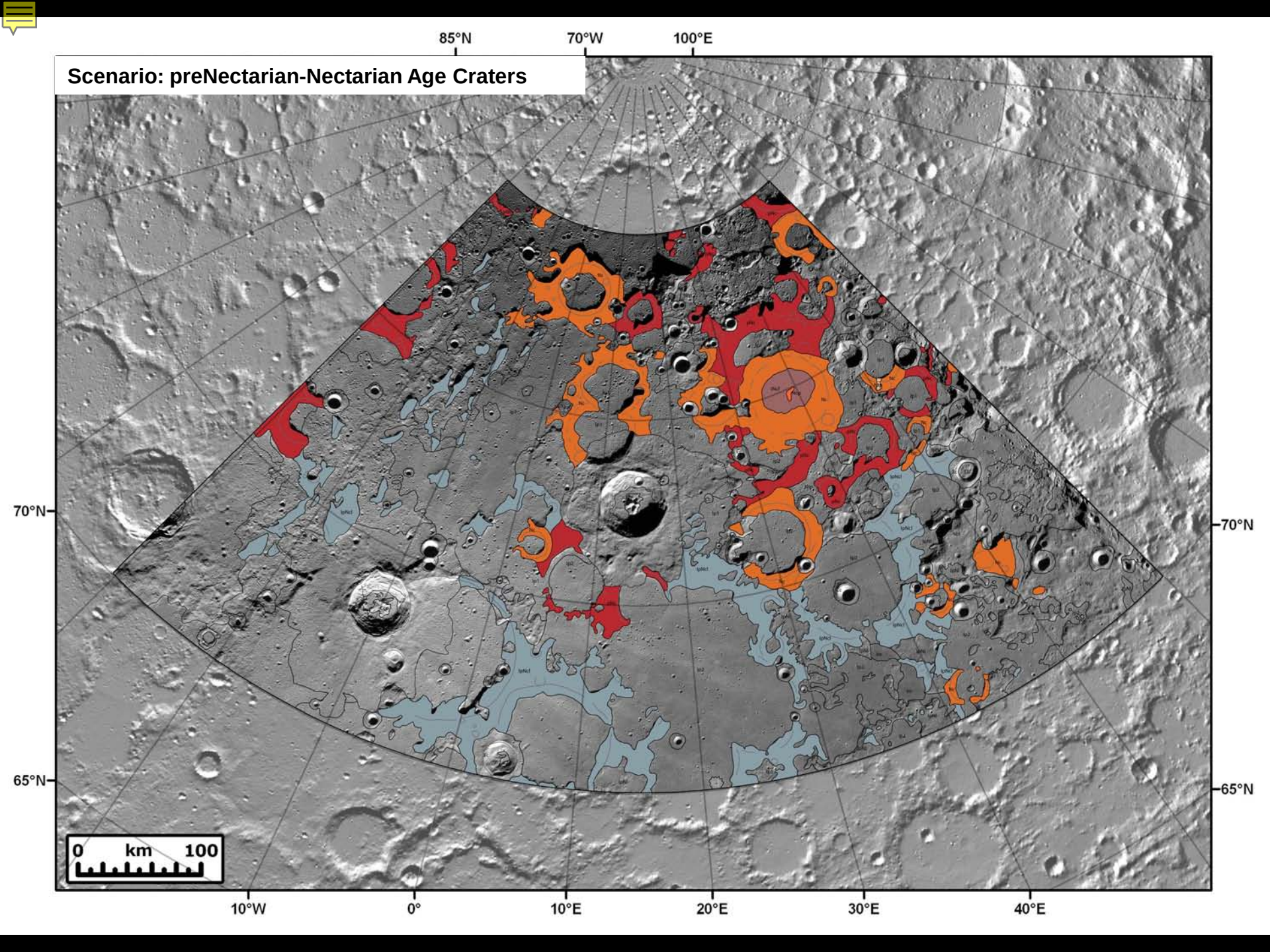


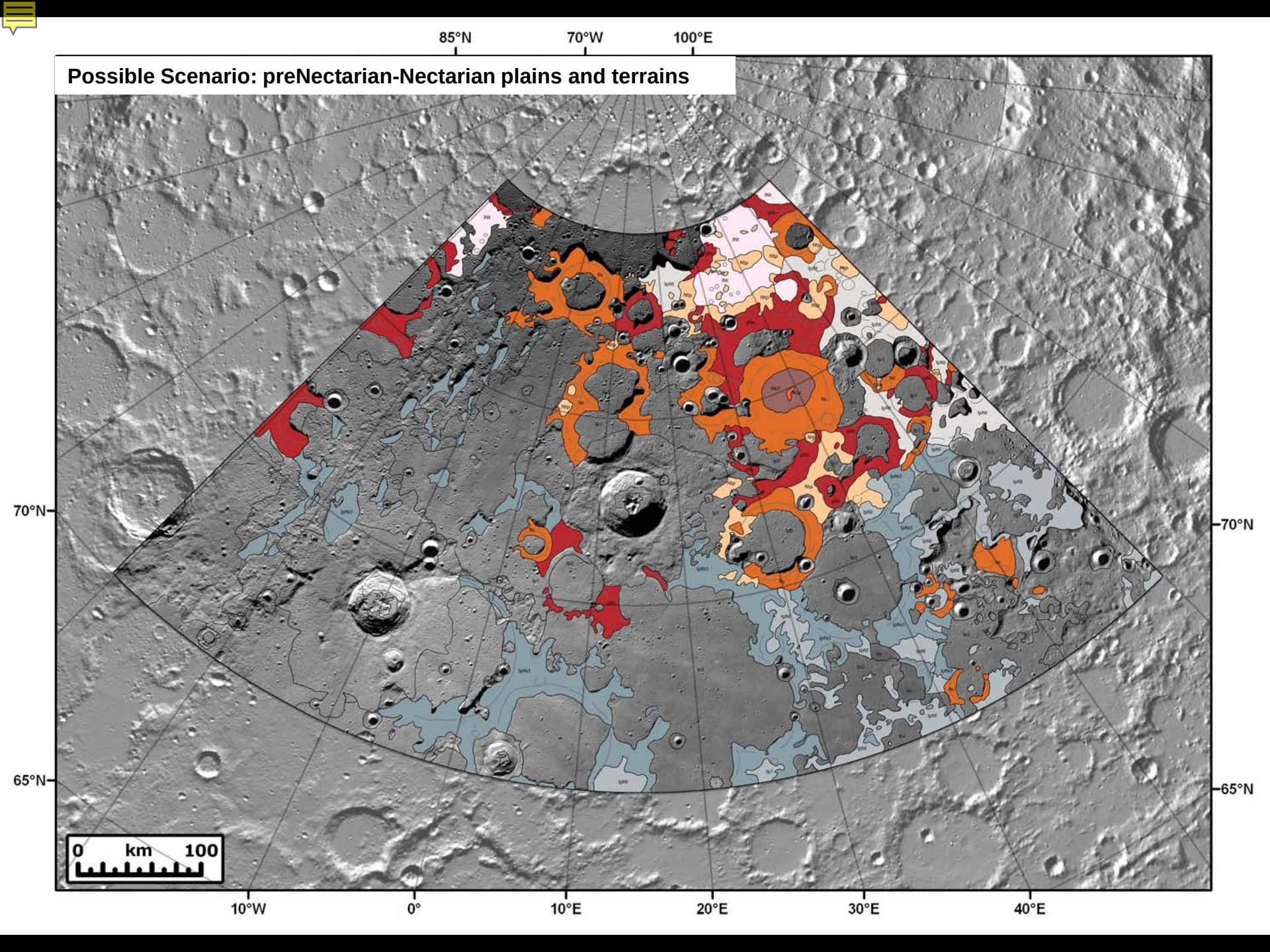


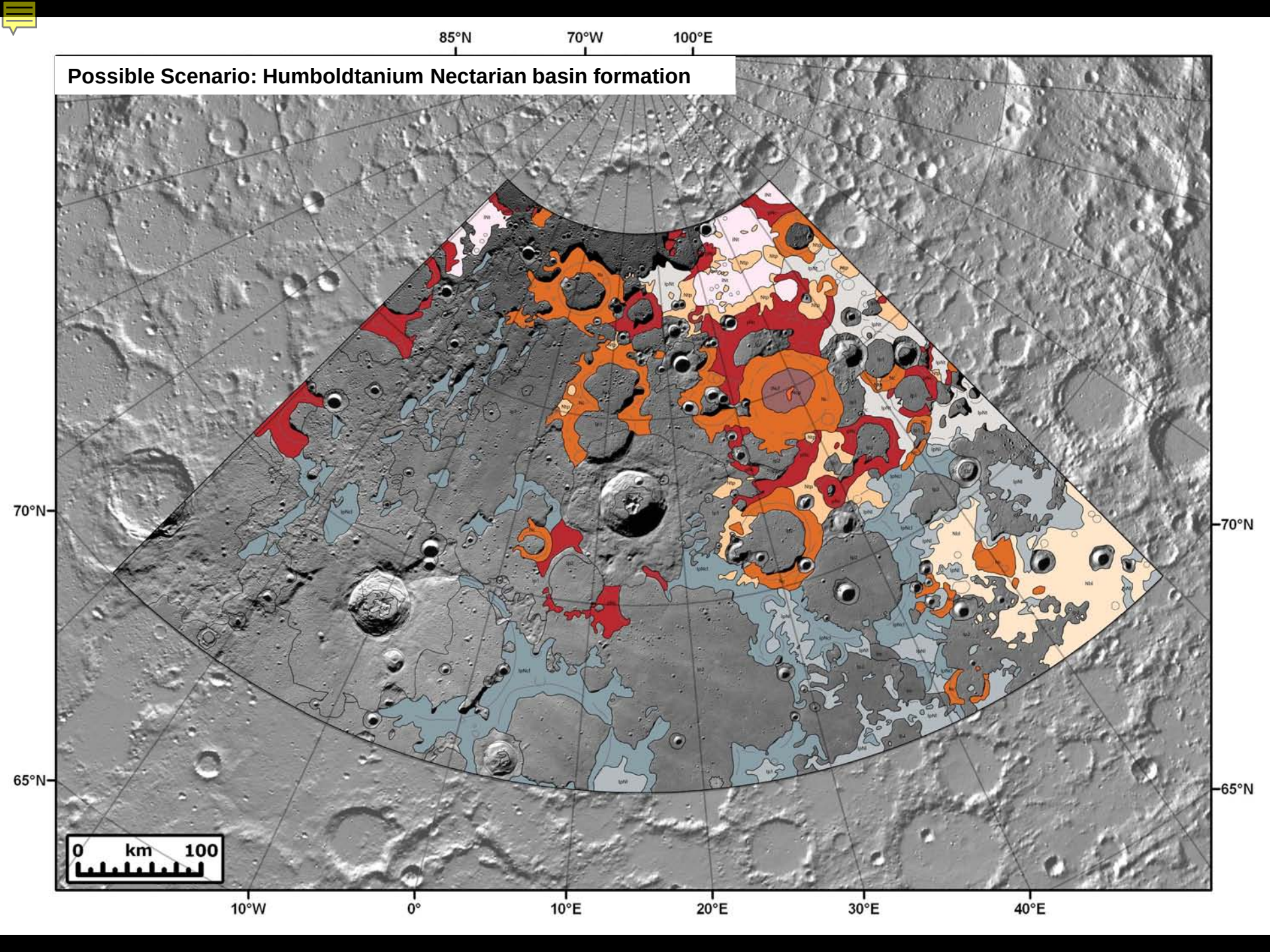

85°N
70°W
100°E
70°N
65°N
0 km 100
10°W
0°
10°E
20°E
30°E
40°E

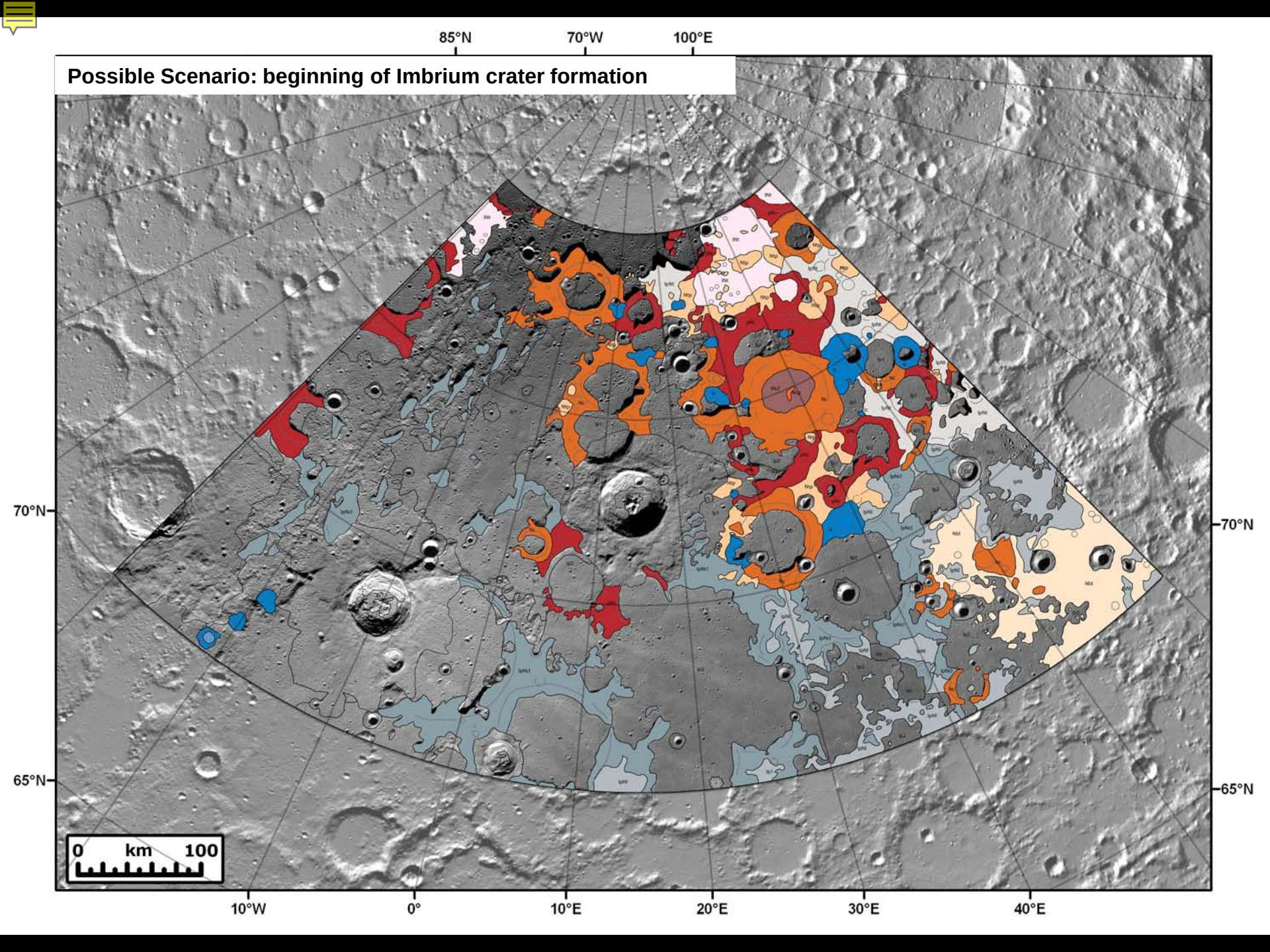

85°N
70°W
100°E
70°N
65°N
0 km 100
10°W
0°
10°E
20°E
30°E
40°E

Scenario of Geologic evolution of the studied area

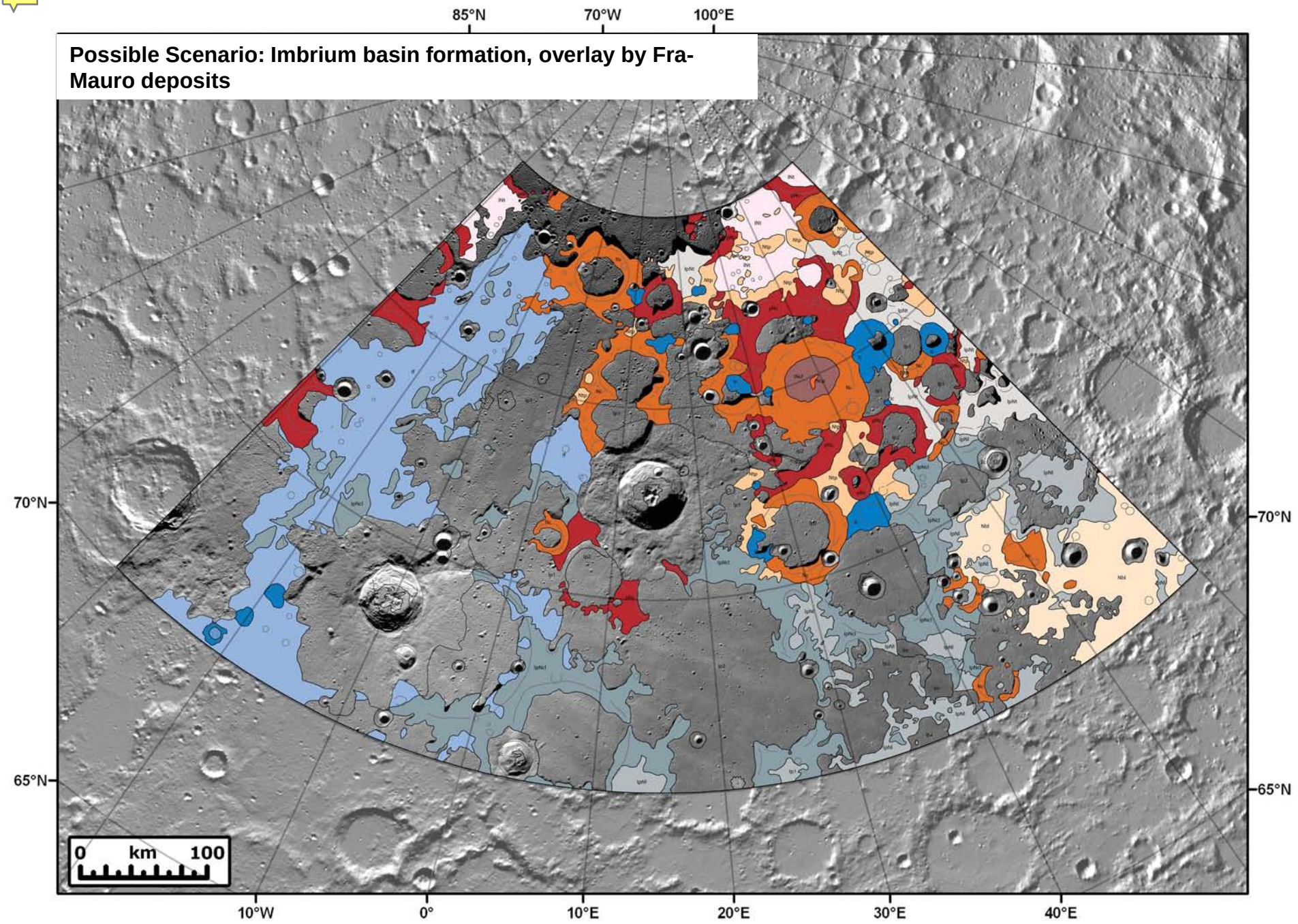

Scenario: preNectarian-Nectarian Age Craters
85°N
70°W
100°E
70°N
65°N
0
km
100
10°W
0°
10°E
20°E
30°E
40°E

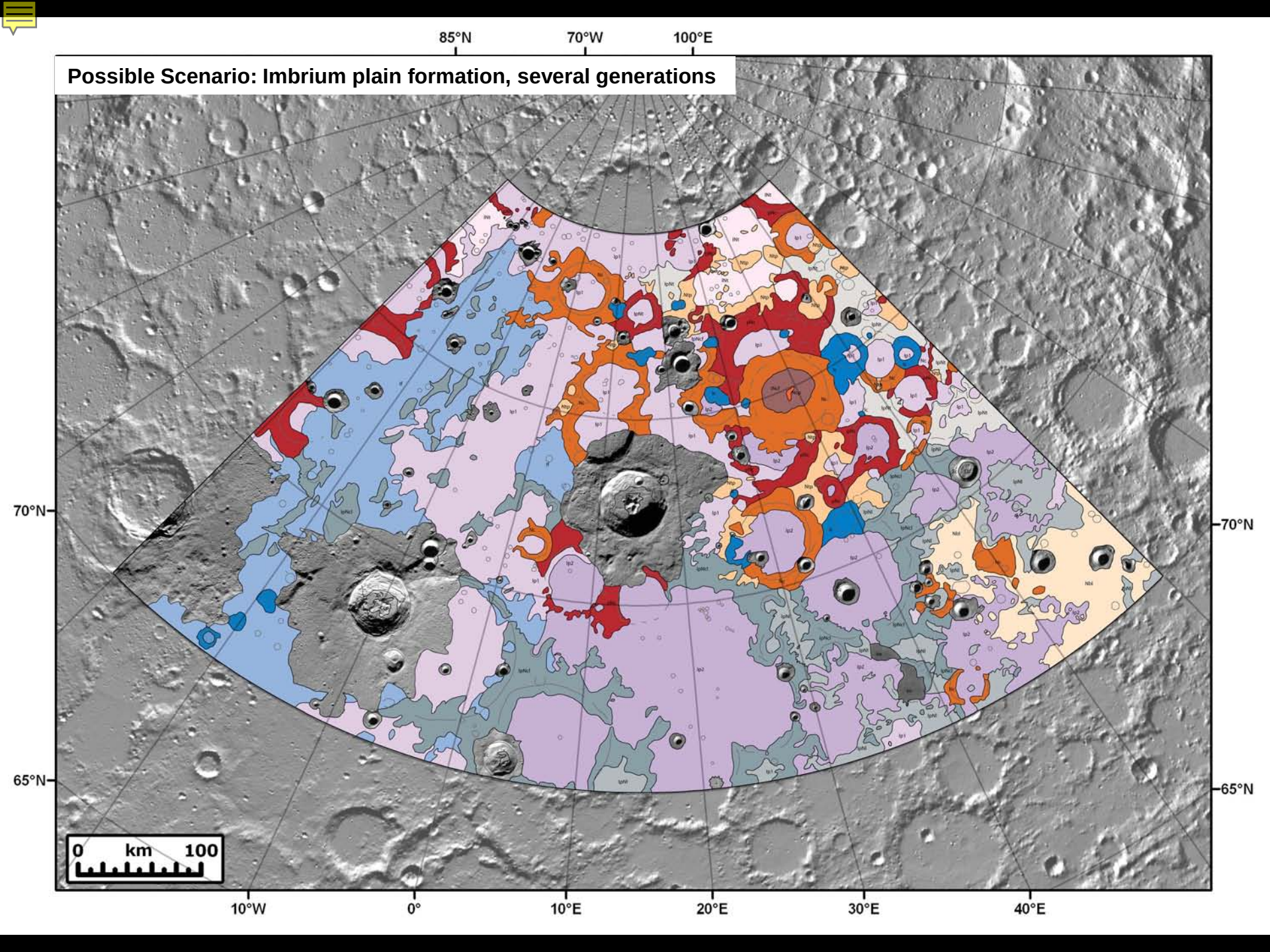

Possible Scenario: preNectarian-Nectarian plains and terrains
85°N
70°W
100°E
70°N
65°N
0 km 100
10°W
0°
10°E
20°E
30°E
40°E

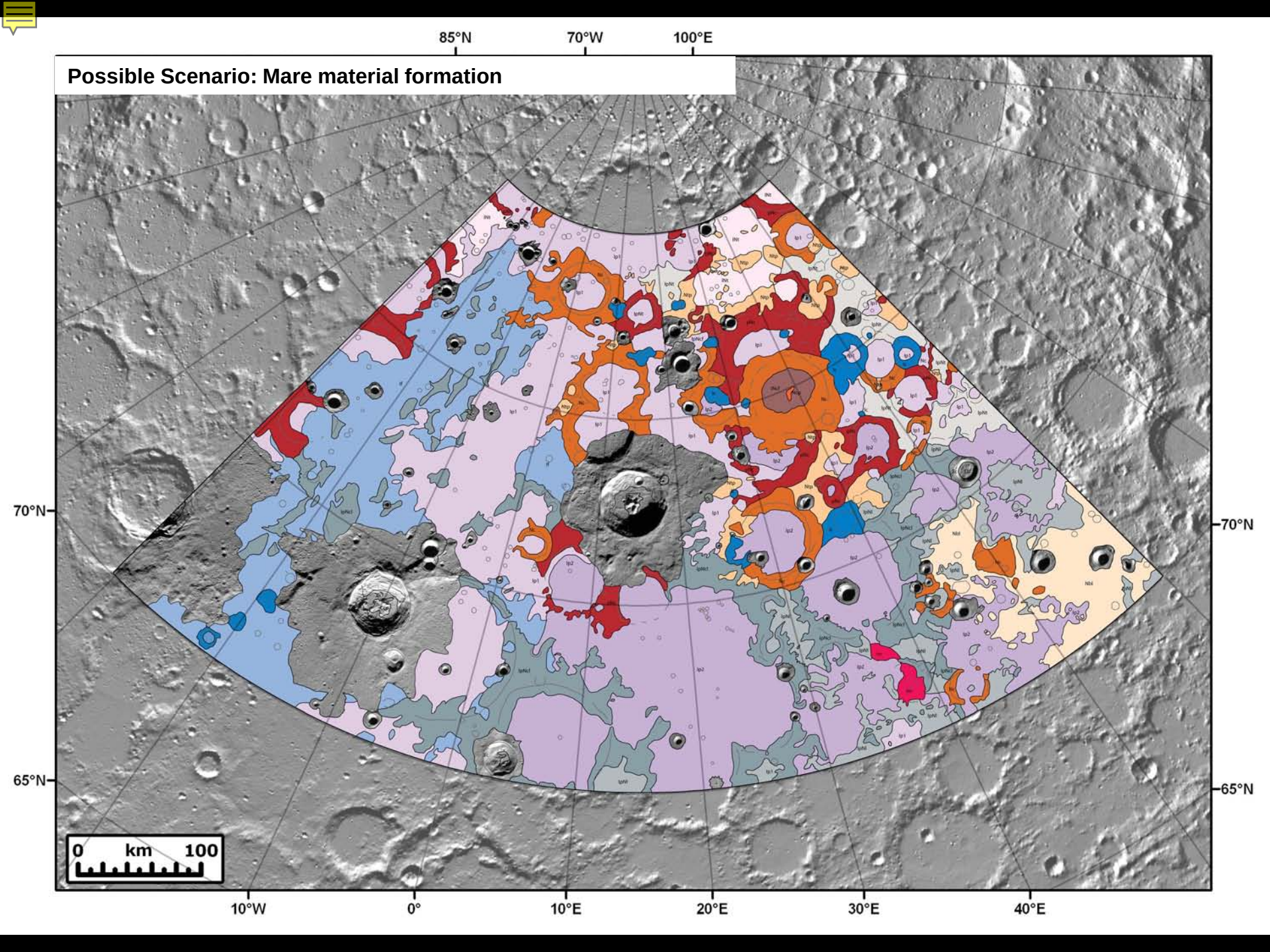

Possible Scenario: Humboldtanium Nectarian basin formation
85°N
70°W
100°E
70°N
65°N
0 km 100
10°W
0°
10°E
20°E
30°E
40°E

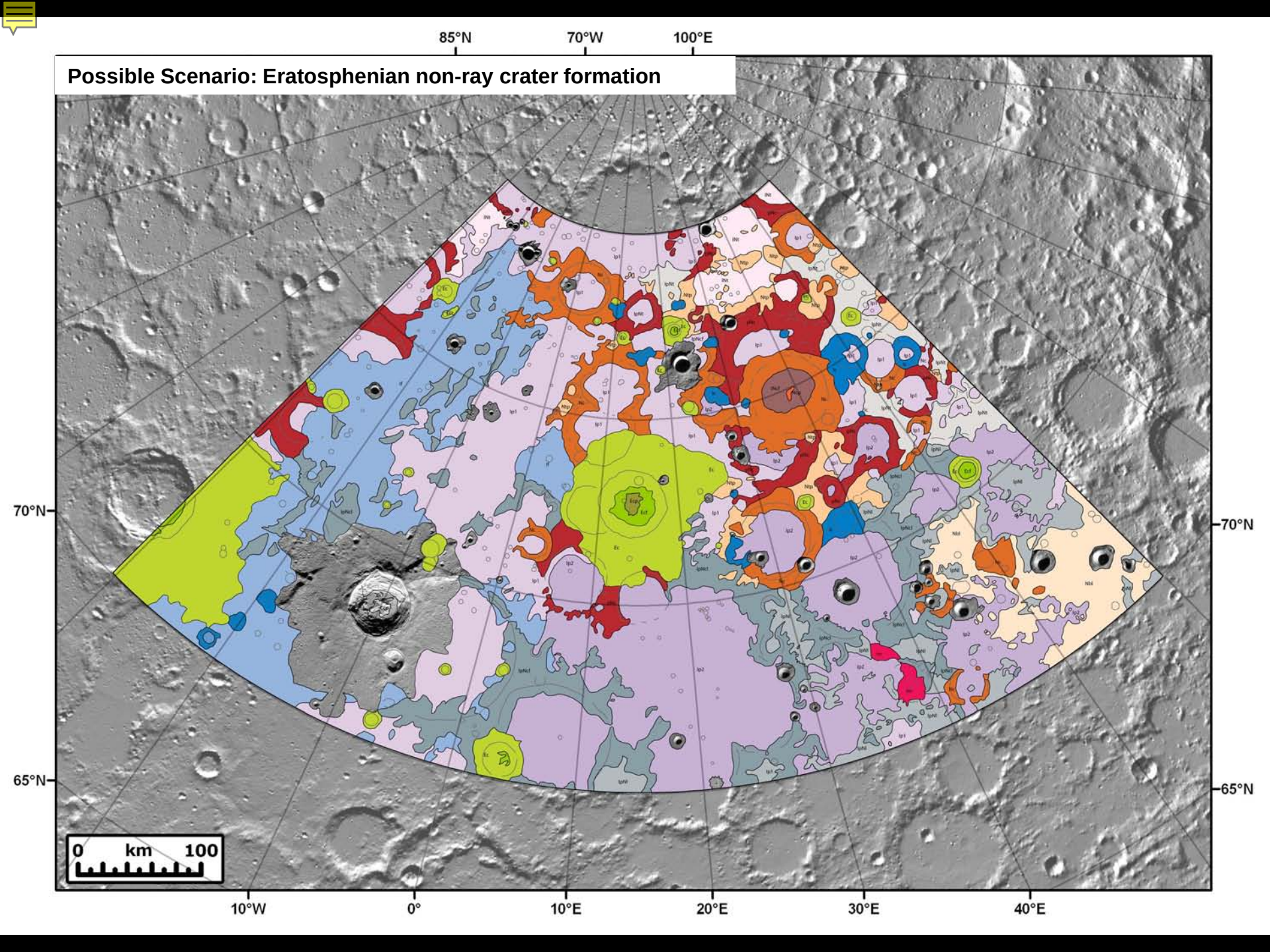

Possible Scenario: beginning of Imbrium crater formation
85°N
70°W
100°E
70°N
65°N
0 km 100
10°W
0°
10°E
20°E
30°E
40°E

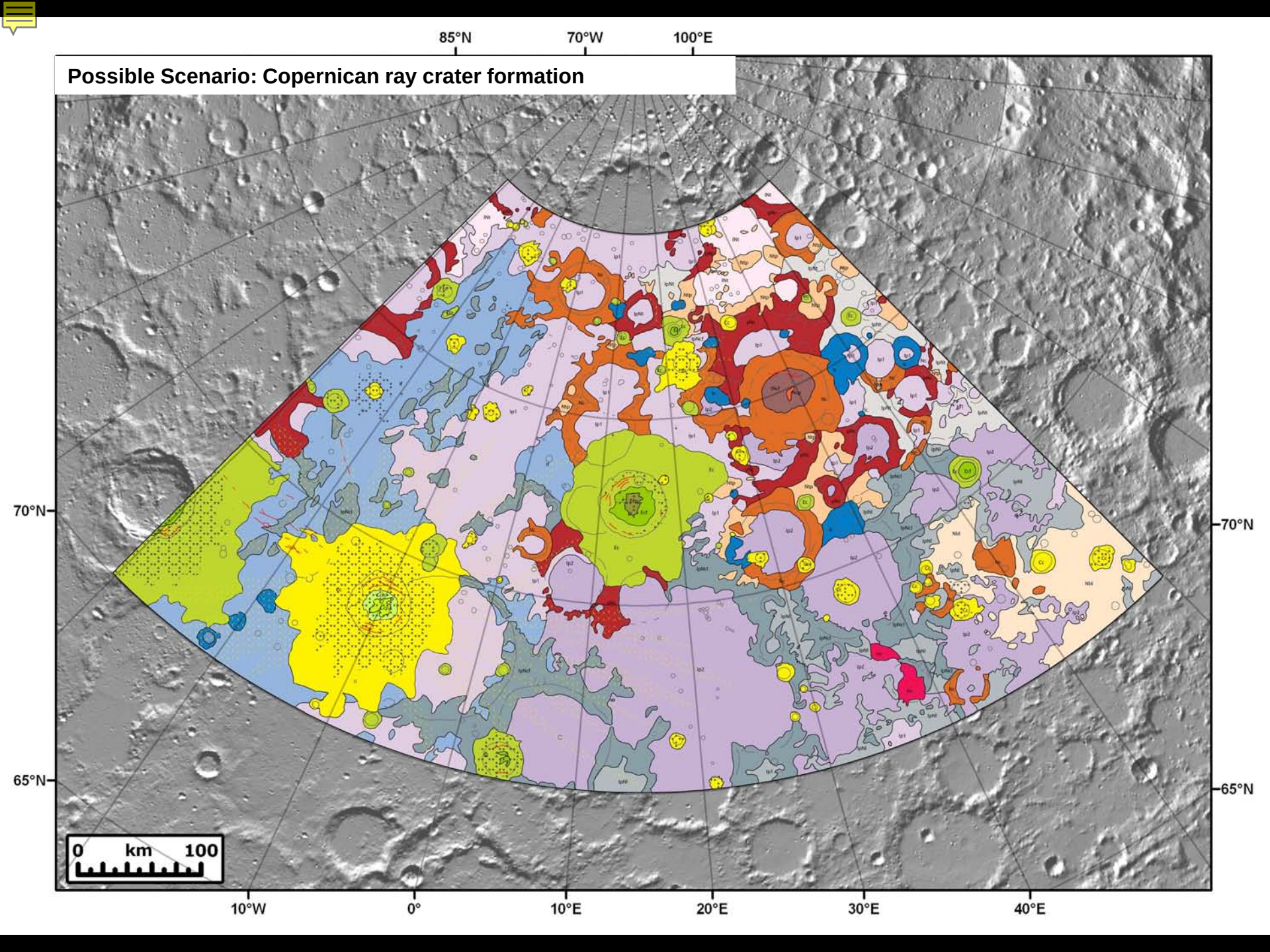
Possible Scenario: Imbrium basin formation, overlay by Fra-Mauro deposits




Possible Scenario: Imbrium plain formation, several generations
85°N
70°W
100°E
70°N
65°N
0 km 100
10°W
0°
10°E
20°E
30°E
40°E


Possible Scenario: Mare material formation
85°N
70°W
100°E
70°N
65°N
0 km 100
10°W
0°
10°E
20°E
30°E
40°E


Possible Scenario: Eratosphenian non-ray crater formation
85°N
70°W
100°E
70°N
65°N
0 km 100
10°W
0°
10°E
20°E
30°E
40°E


Possible Scenario: Copernican ray crater formation
85°N
70°W
100°E
70°N
65°N
0 km 100
10°W
0°
10°E
20°E
30°E
40°E

Criteria of the Luna Glob Candidate Landing Site selection:

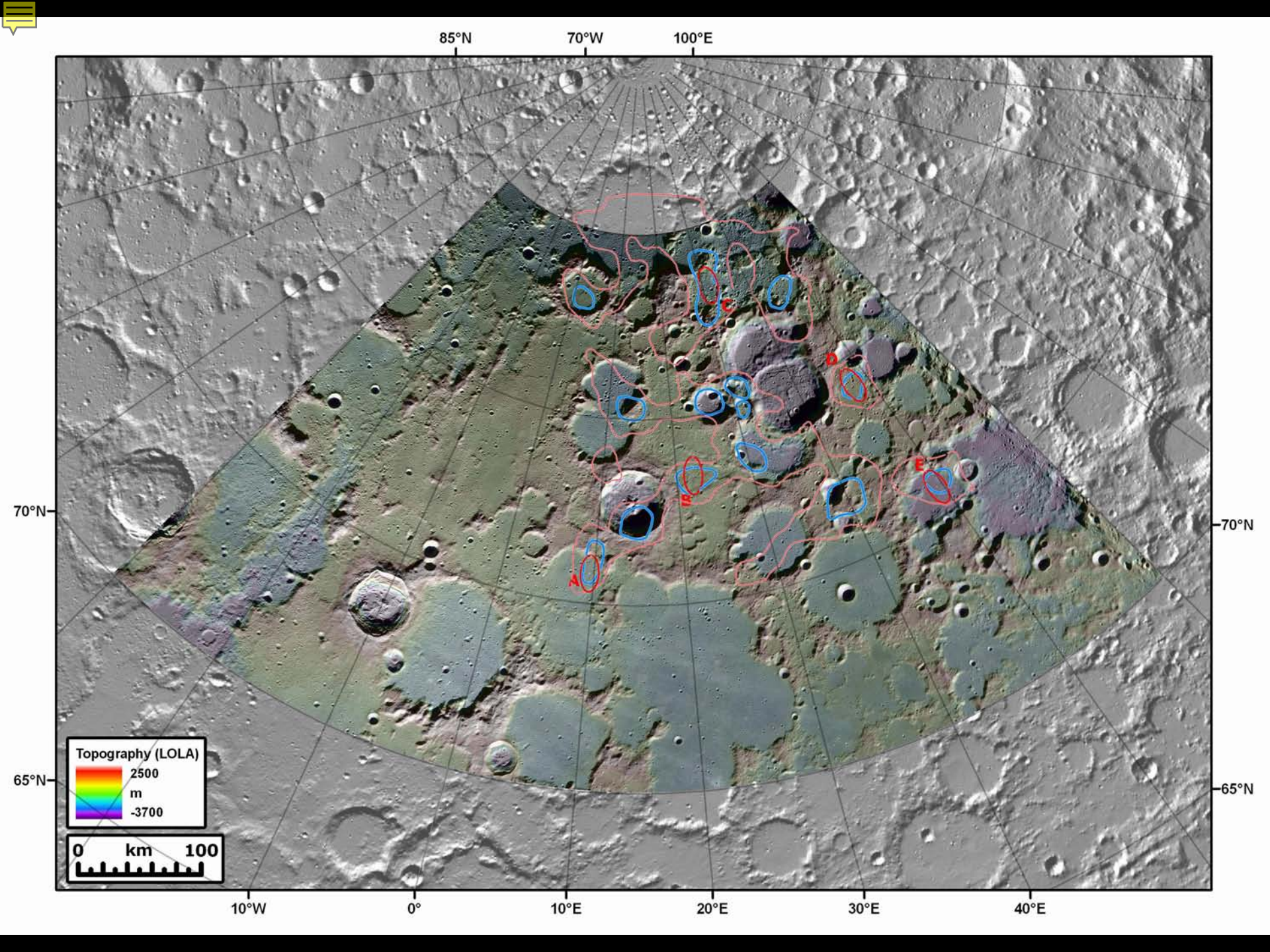
1. NPOL Ballistic constraints: The boundaries of landing area:

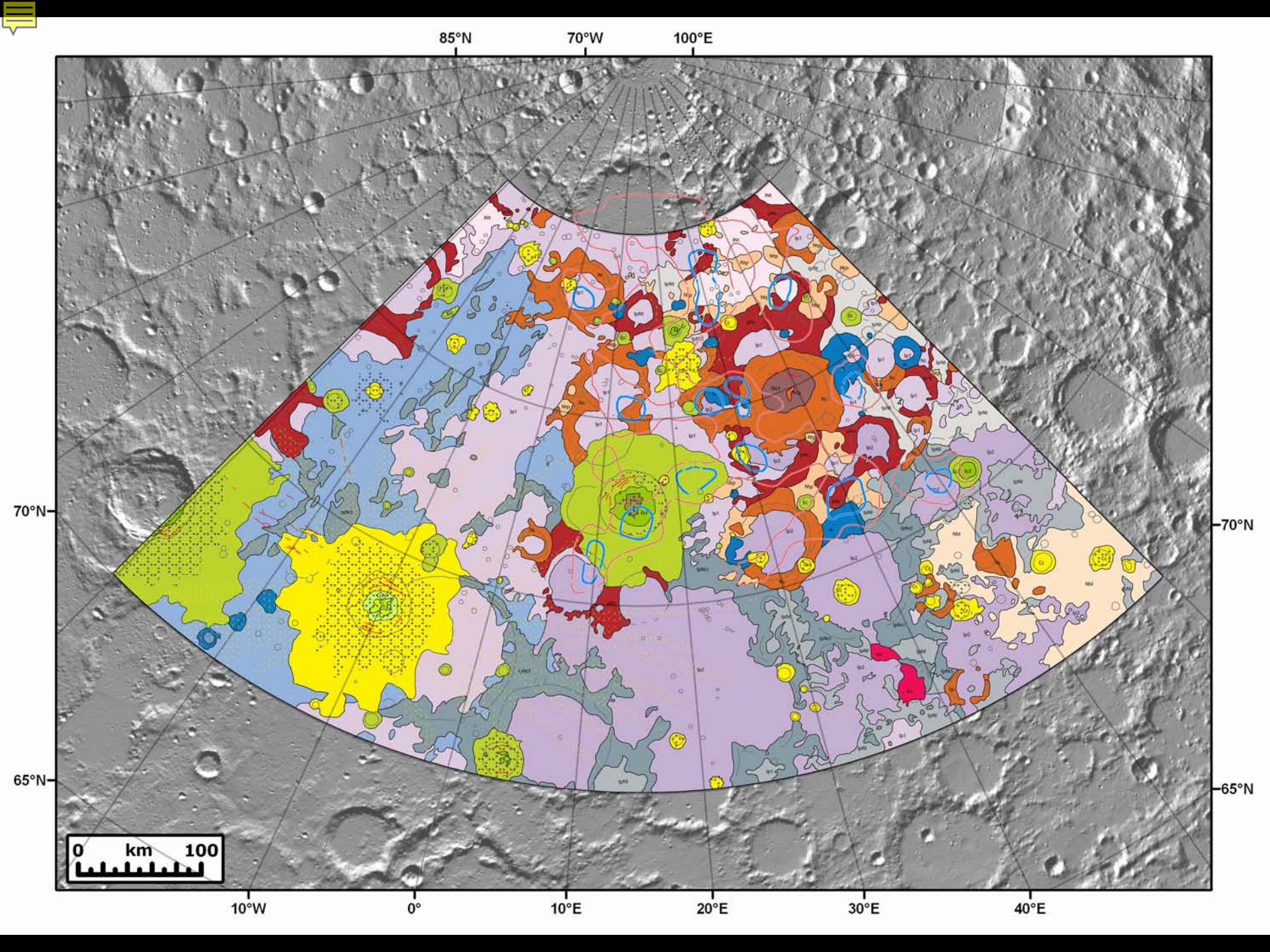
   70-85º N, -30 – 60º E

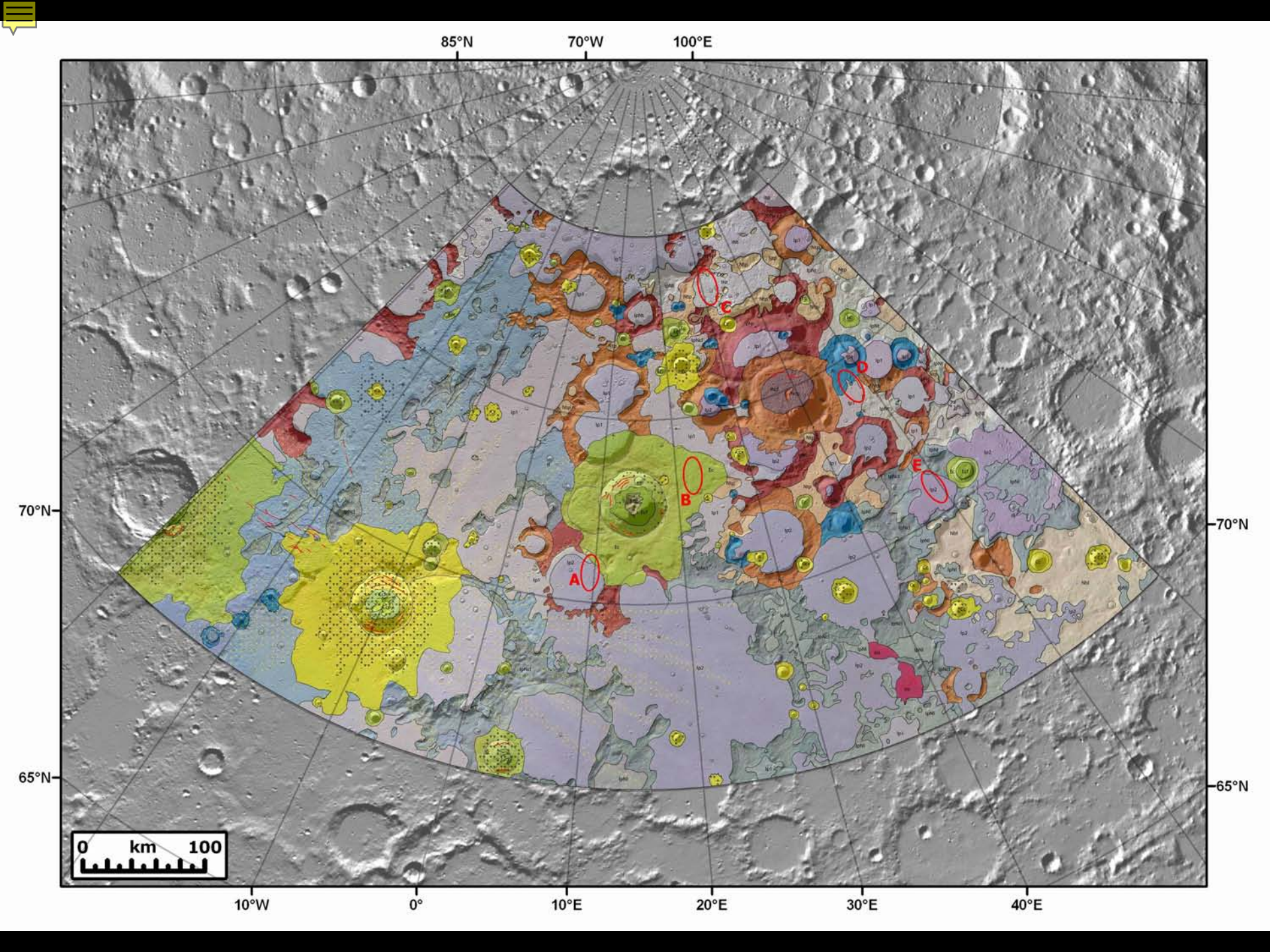
2. High Volatile Enrichment (by LEND data, Low neutron flux).

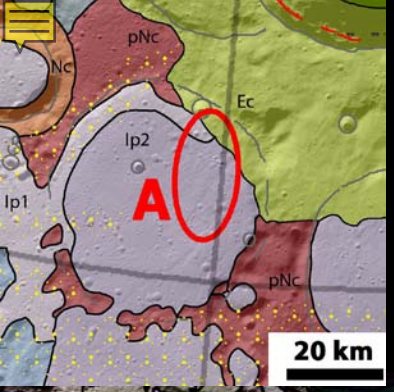
3. Safety of approaching trace (LOLA data).

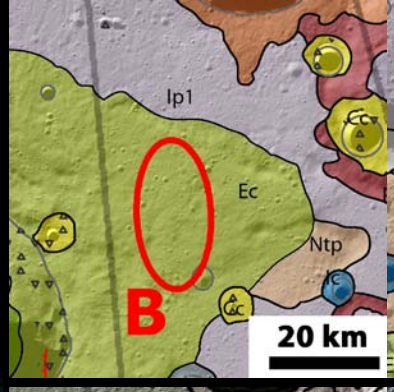
4. The landing area (15x30 km ellipse) should be safely smooth (LROC, LOLA, Micro-RF data).

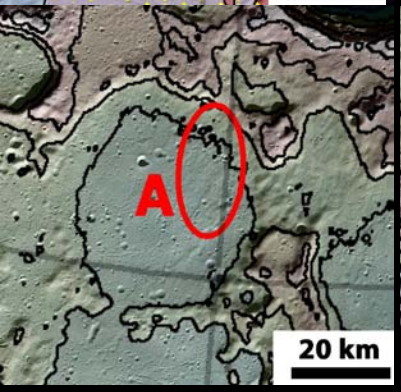

85°N
70°W
100°E
70°N
65°N
A
B
C
D
E
Topography (LOLA)
2500
m
-3700
0
km
100
10°W
0°
10°E
20°E
30°E
40°E

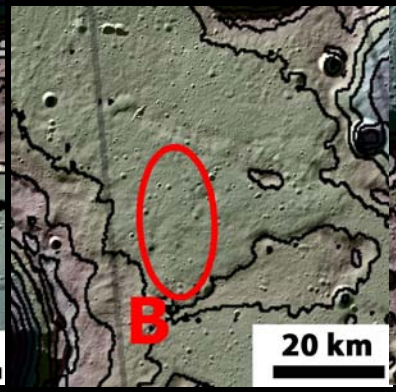

85°N
70°W
100°E
70°N
65°N
0 km 100
10°W
0°
10°E
20°E
30°E
40°E

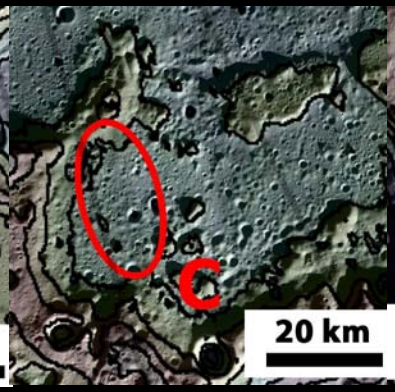

85°N
70°W
100°E
70°N
65°N
A
B
C
D
E
0 km 100
10°W
0°
10°E
20°E
30°E
40°E

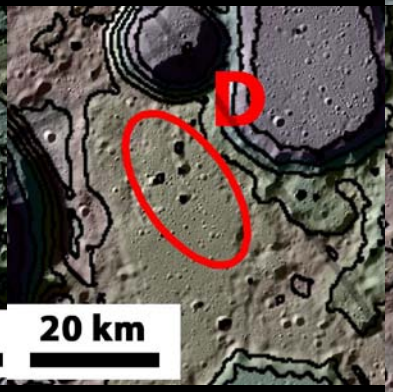


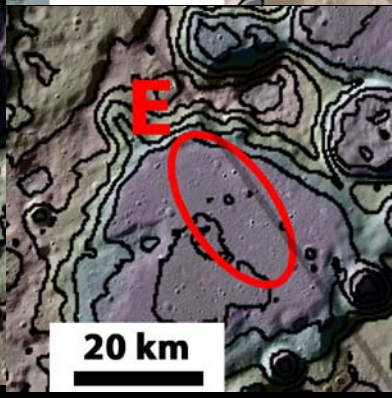












A north

75.8º N, 9.5º E

Plains Ip2, (Rays of Cc ?)

The Floor of big crater filled by plain material Ip2

Relatively good approach

Highland mineralogy

B north

78.4º N, 22.2º E

Crater material Ec (possible Ip1 ?)

Outflow of craters

Good approach

Highland mineralogy

C north

83.3º N, 31.6º E

Material of hum-mocky terrain INt

Oldest smoothed terrain

Danger Slopes Before landing

Highland mineralogy

D north

79.3º N, 47.7º E

Material of plains Ip1, craters Ic

Old Intracrater terrain area filled by plain material Ip1

Relatively good approach

Highland mineralogy

E north

75.7º N, 49.3º E

Material of plains Ip2

The Floor of big crater filled by plain material Ip2

Danger N Slopes Before

Highland mineralogy

Conclusions

- There is no correlation between Hydrogen anomalies and specific geologic complexes and position
- Preferable landing point material: A-North – material of imbrium highland plains Ip1, B-North – material of outflow of moderately young crater Ec

Acknowledgements:

We are doing selection of landing sites on different bodies of the Solar system since late 60’s, but it is the first time when we have so good data for that. These data are being provided by our coauthors who specially process them for us and we express our gratitude to these colleagues and institutions which support their and thus our activity. They are:

- Department of Geological Sciences, Brown University, Providence, RI, USA
- Goddard Space Flight Center, Greenbelt, MD, USA
- Earth, Atmospheric and Planetary Sciences, MIT, Cambridge, MA, USA
- The John Hopkins University Applied Physics Lab, Laurel, MD 20723
- NASA USA