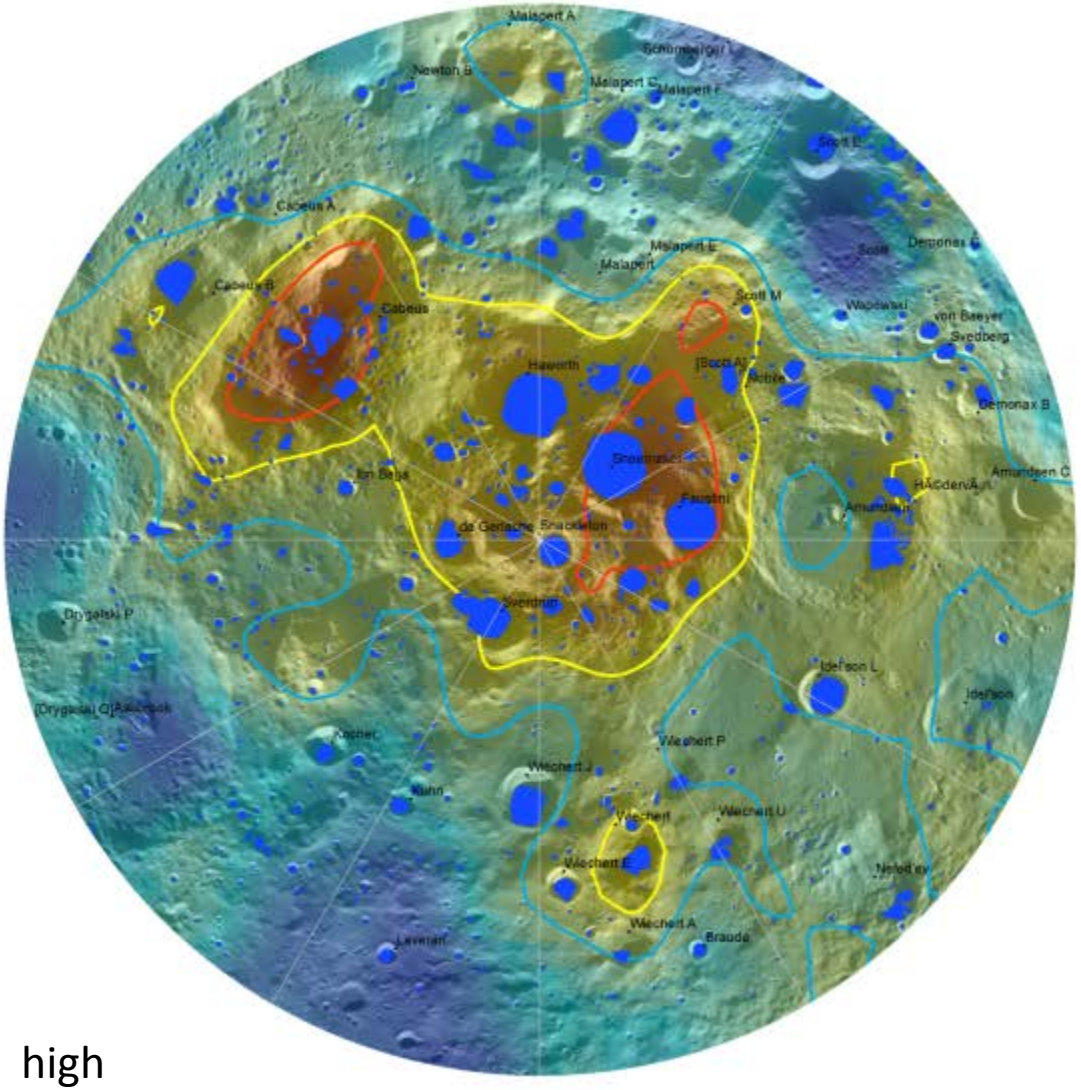
ROI for lunar volatile investigations

An appendix to the 'European response' to the recent Lunar Exploration and Analysis Group (LEAG) Volatiles Special Action Team (VSAT) report on lunar volatiles – A report of advisory team under the umbrella of the ESA's Topical Team on Exploitation of Local Planetary Materials (TT-ELPM)

South Pole

Hydrogen content (SP)

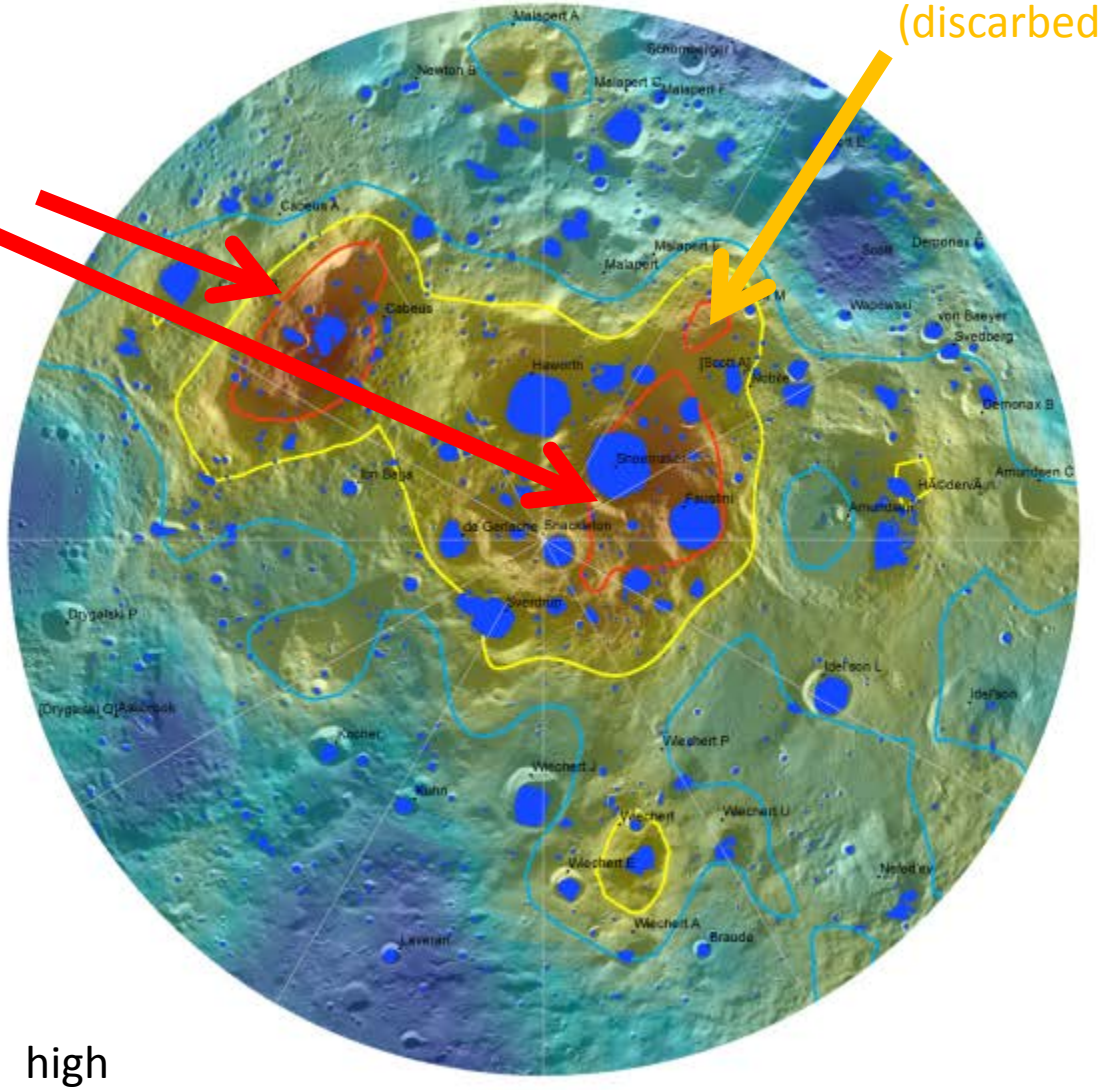


H contours:
150 ppm
125 ppm
100 ppm

PSR

low high

Hydrogen content (SP)



Temperature too high
(discarbed by LEAG)

ROI reported
by LEAG

H contours:
150 ppm
125 ppm
100 ppm

PSR

low high

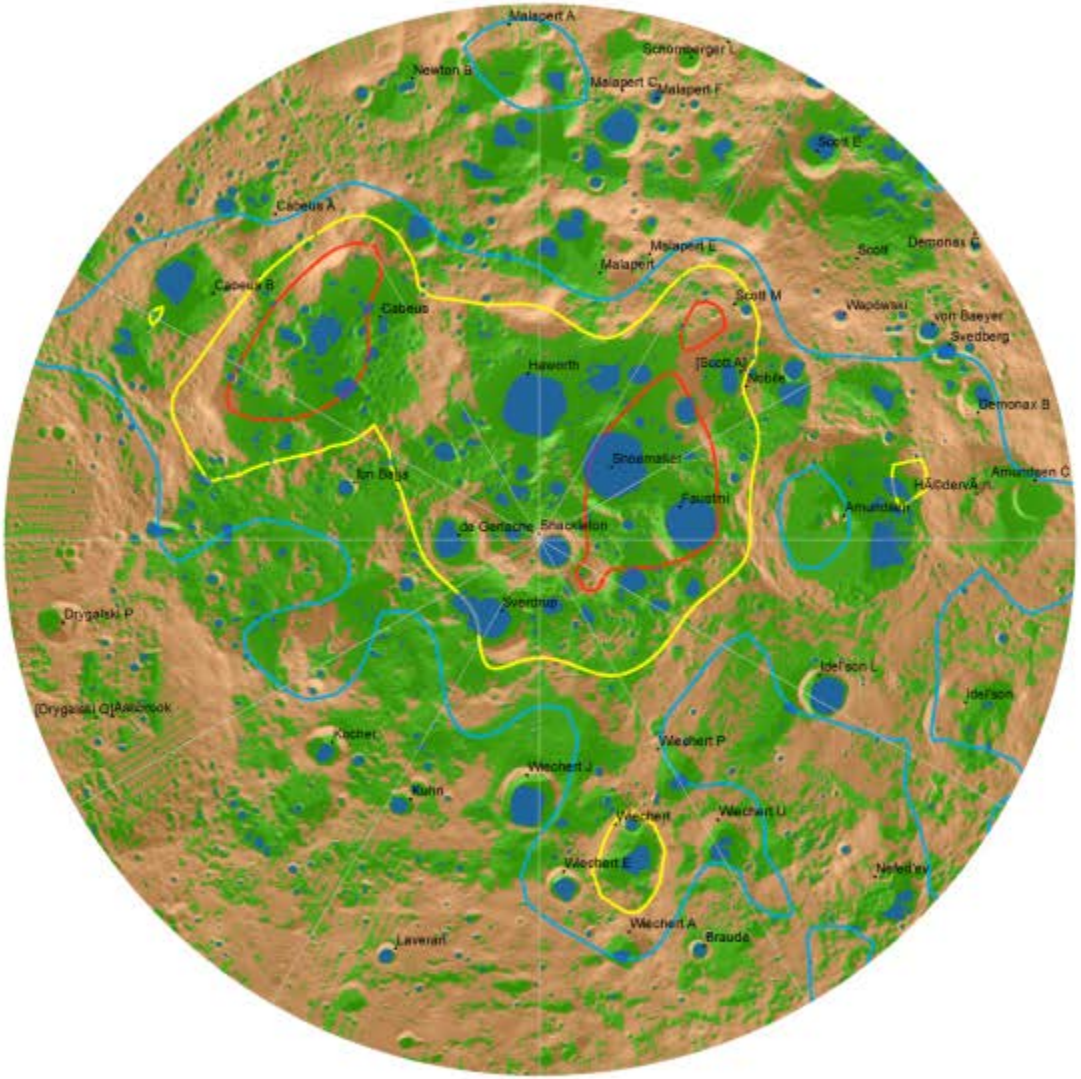
Diviner avg. Temperature (SP)

(min. and max. temperature are also available)

Diviner avg. T:

Below 110K

Above 110K



H contours:

150 ppm

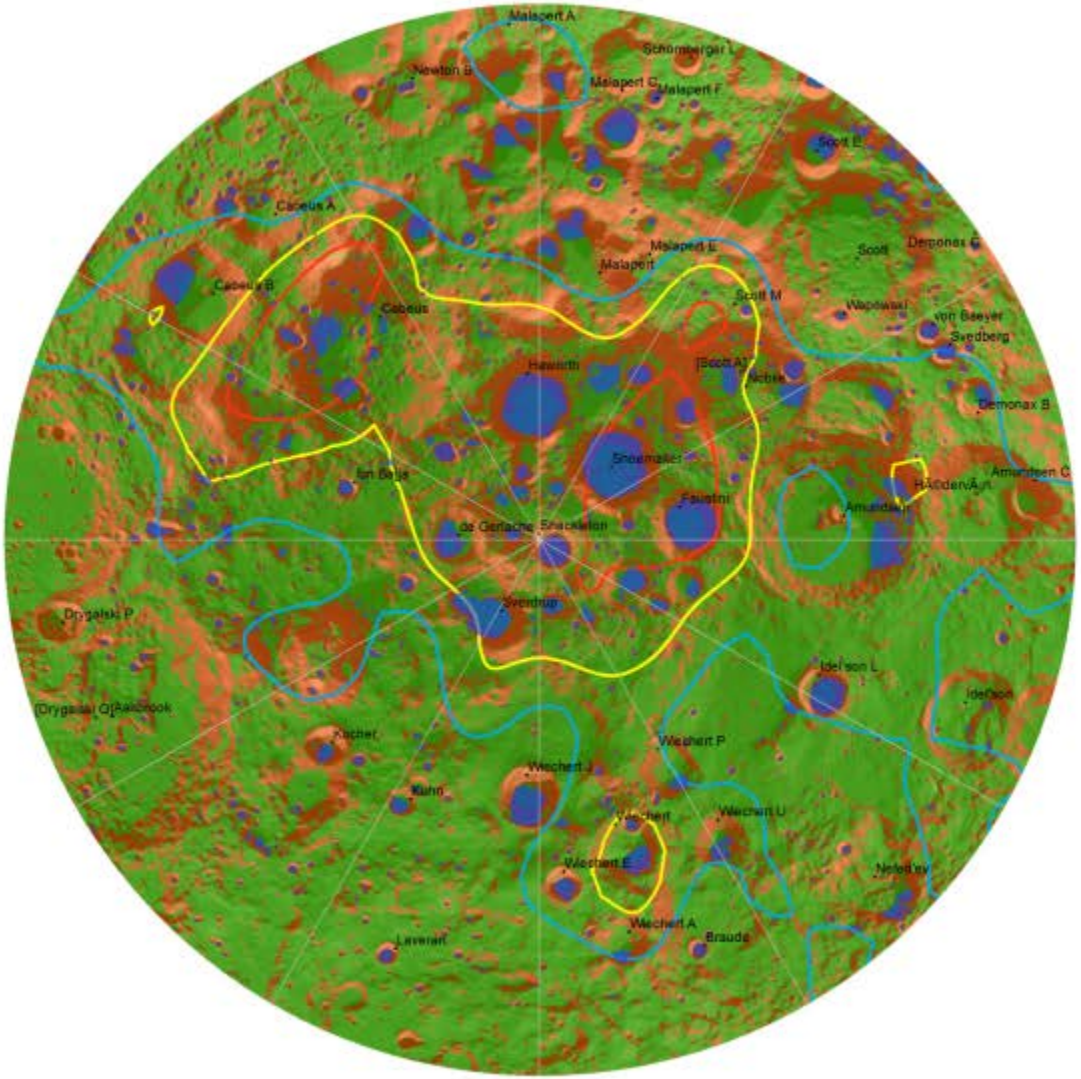
125 ppm

100 ppm

PSR

Slope (SP, 20 m scale)

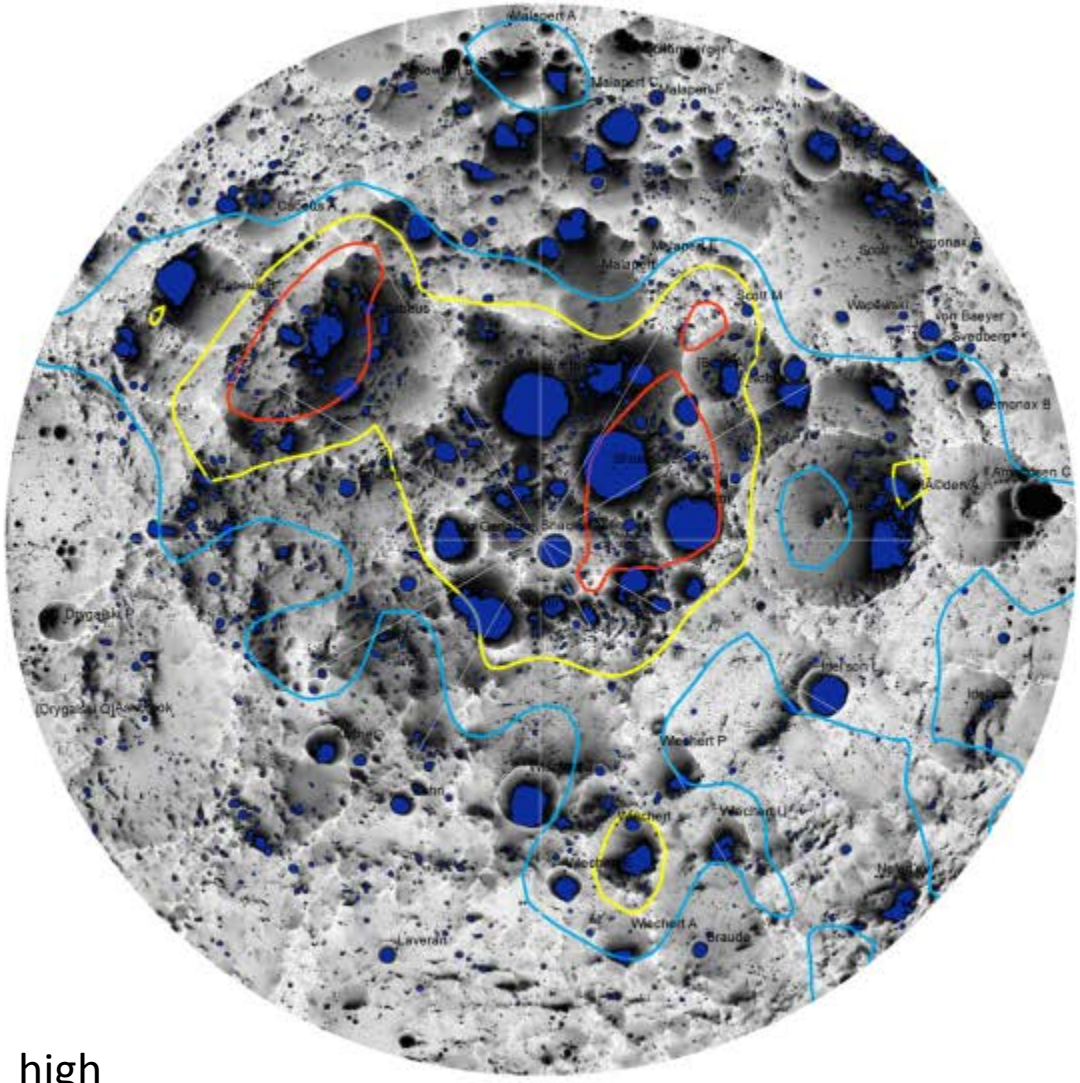
Slope:
Below 10 deg
Above 10 deg



H contours:
150 ppm
125 ppm
100 ppm

PSR

Illumination (SP)

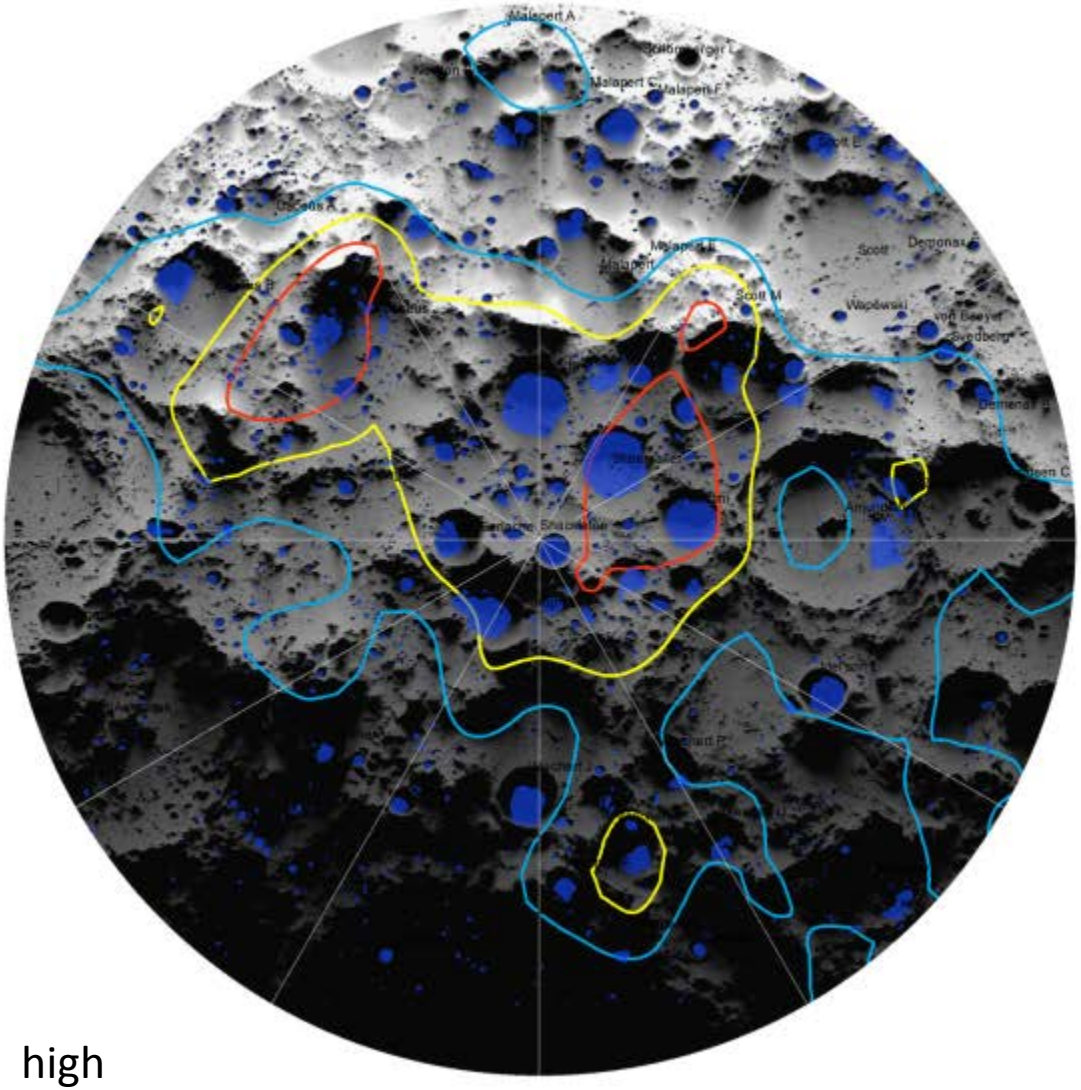


H contours:
150 ppm
125 ppm
100 ppm

PSR

low high

Earth visibility (SP)

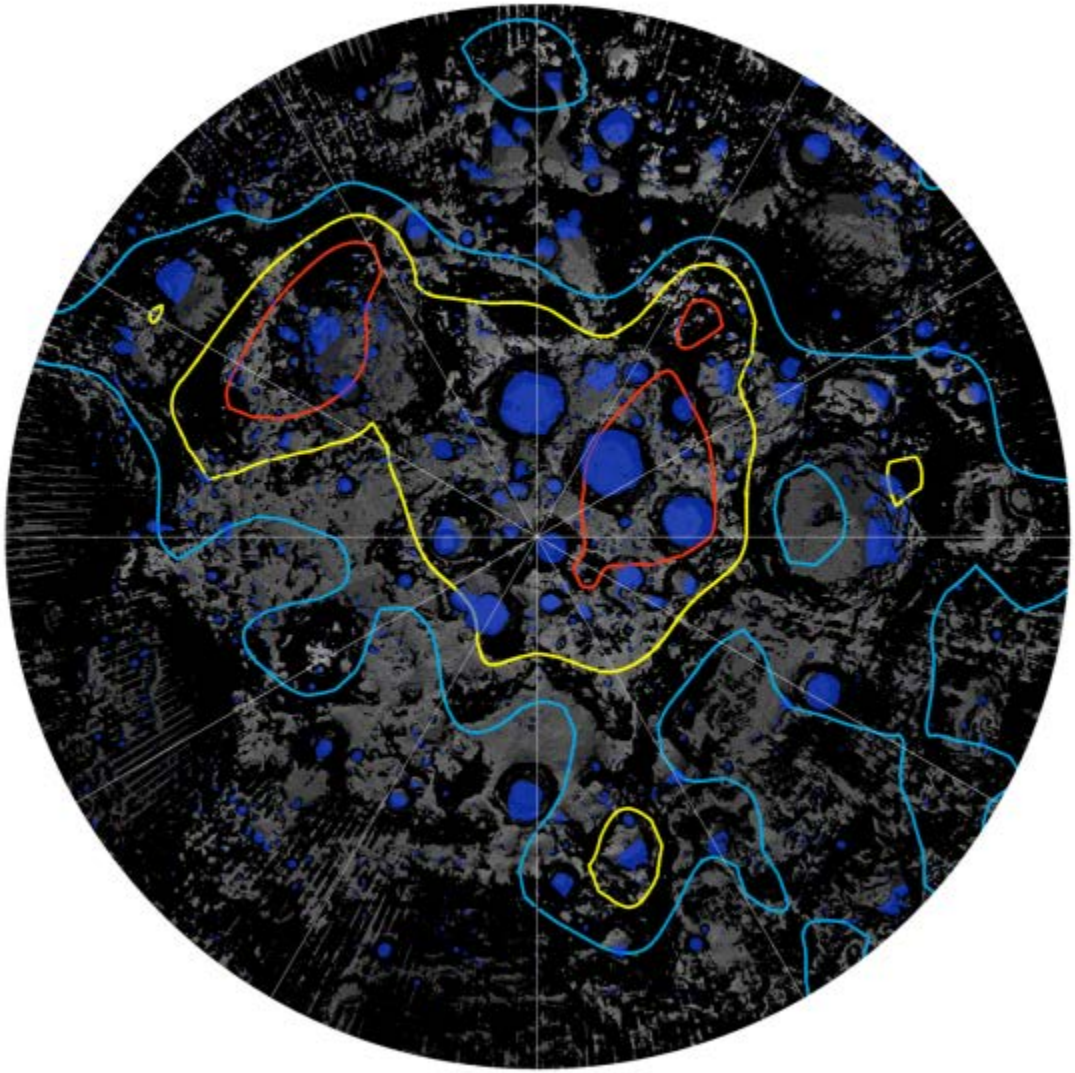


H contours:
150 ppm
125 ppm
100 ppm

PSR

low high

South Pole potential ROI



H contours:
150 ppm
125 ppm
100 ppm

PSR

Black areas= Temperature and/or slope too high

South Pole potential ROI

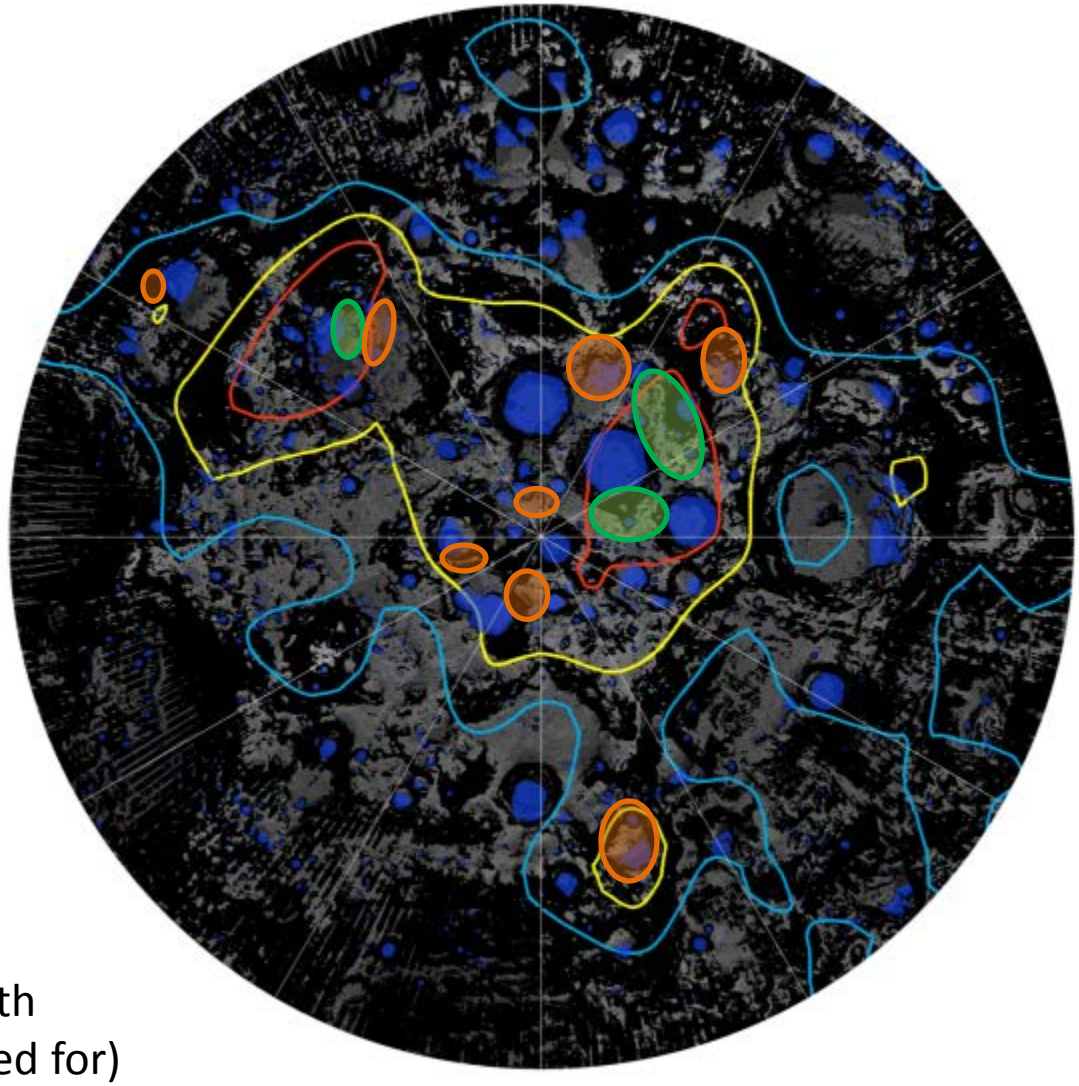
Between 80° and 90° latitude:

- 3 areas with H > 150 ppm **(same ROIs as in the LEAG report)**
- 1 of these areas has avg. T > 110 K.
- Removing direct Earth communication/illumination constraints doesn't increase number of potential ROI.
- Reducing H to > 125 ppm increases number of potential ROI

South Pole potential ROI

ROI with **H>150**, slope<10 and avg. T<110

ROI with **150>H>125,** slope<10 and avg. T<110



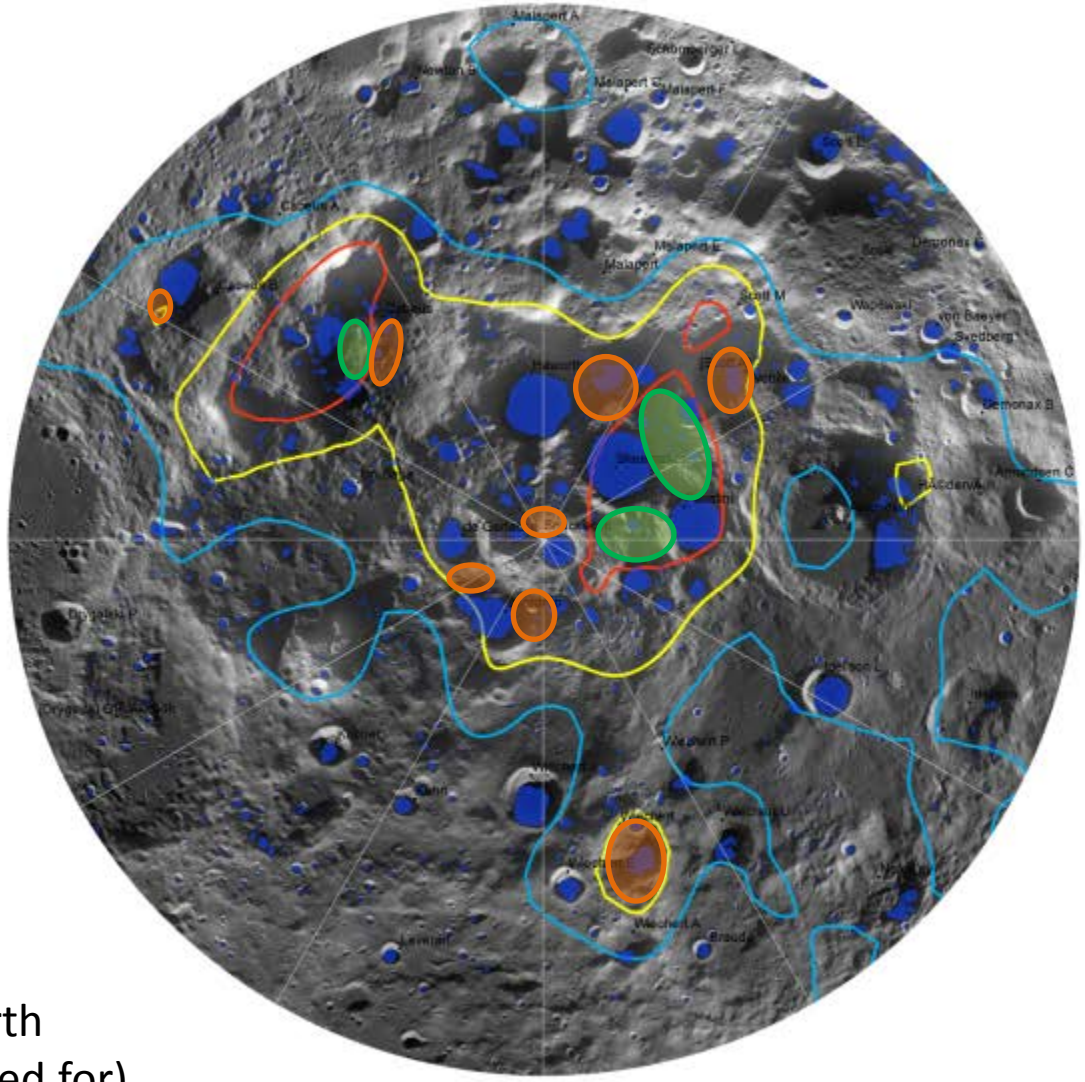
(illumination and Earth visibility not accounted for)

Black areas= Temperature and/or slope too high

South Pole potential ROI

ROI with **H>150**, slope<10 and avg. T<110

ROI with **150>H>125,** slope<10 and avg. T<110



(illumination and Earth visibility not accounted for)

WAC mosaic

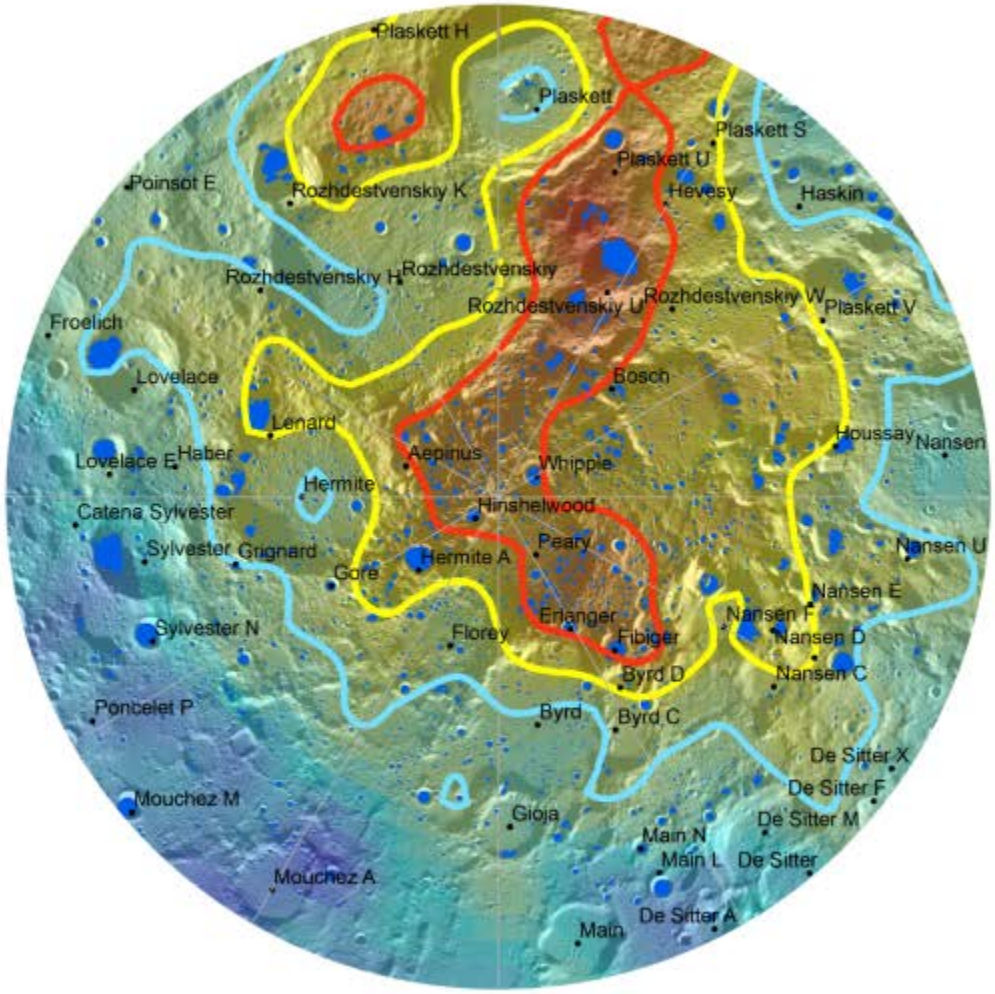
South Pole potential ROI

Potential Additional step:

Looking for potential sites that are close to (but not necessarily meeting) the LEAG threshold values but could be of higher scientific interest because of potential additional science.

North Pole

Hydrogen content (NP)



H contours:

150 ppm

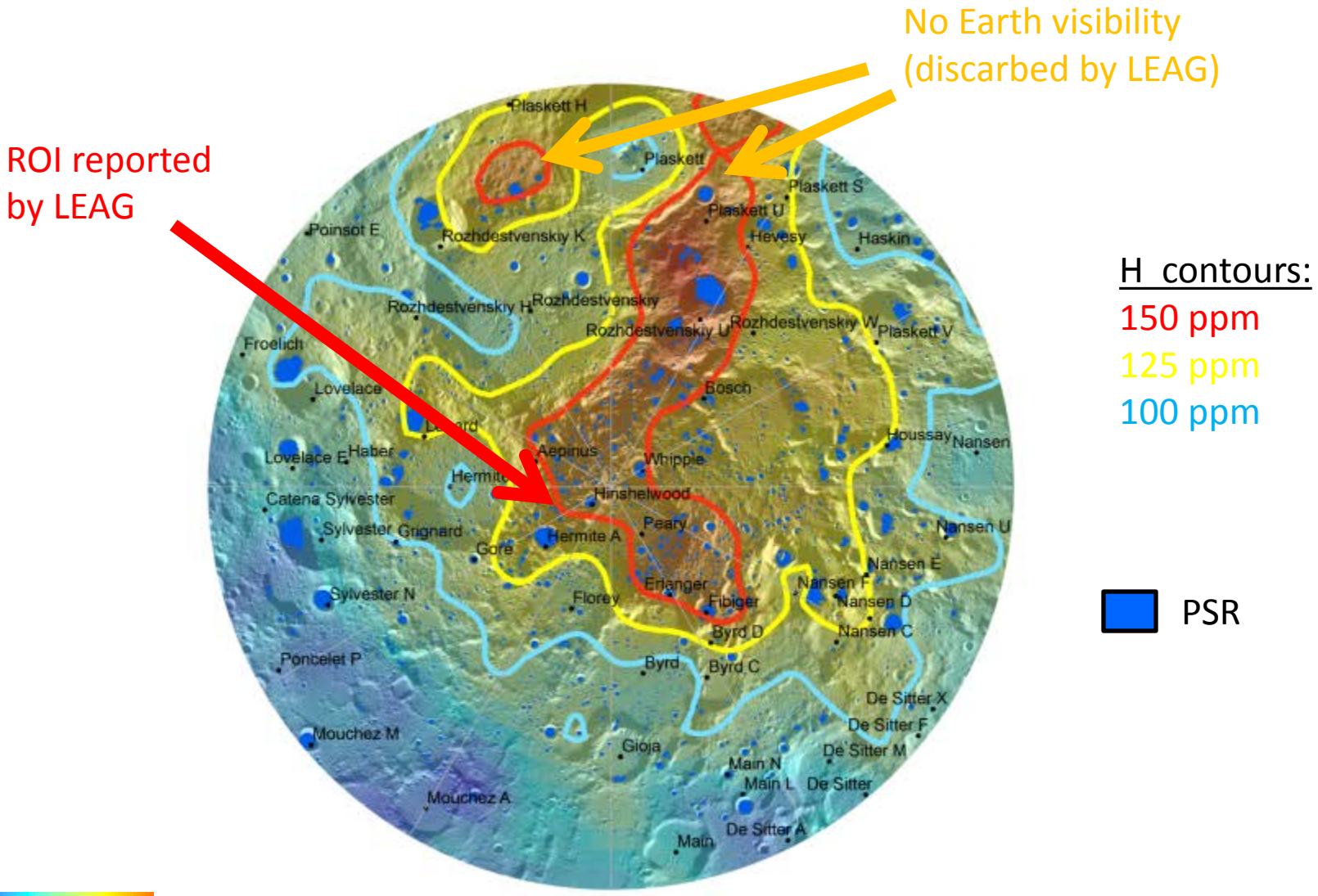
125 ppm

100 ppm

PSR

low high

Hydrogen content (NP)



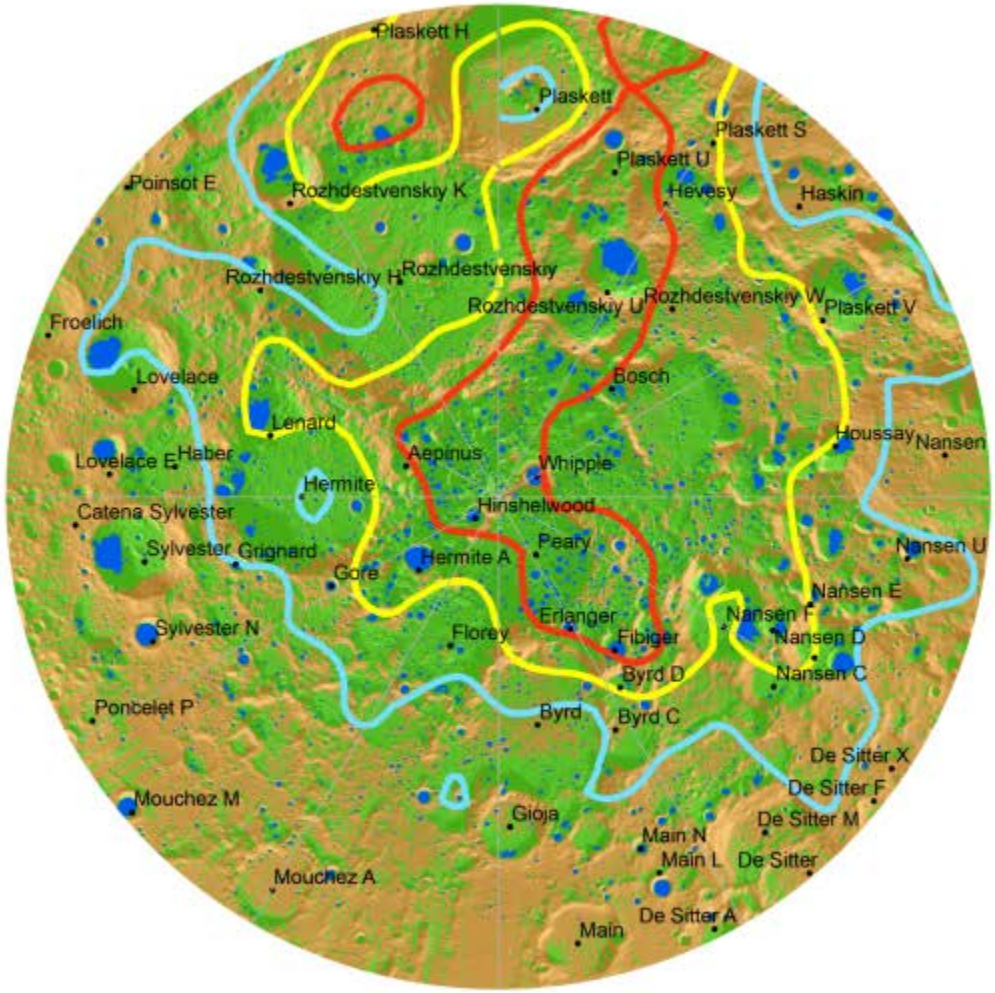
Diviner avg. Temperature (NP)

(min and max Temperature are also available)

Diviner avg. T:

Below 110K

Above 110K



H contours:

150 ppm

125 ppm

100 ppm

PSR

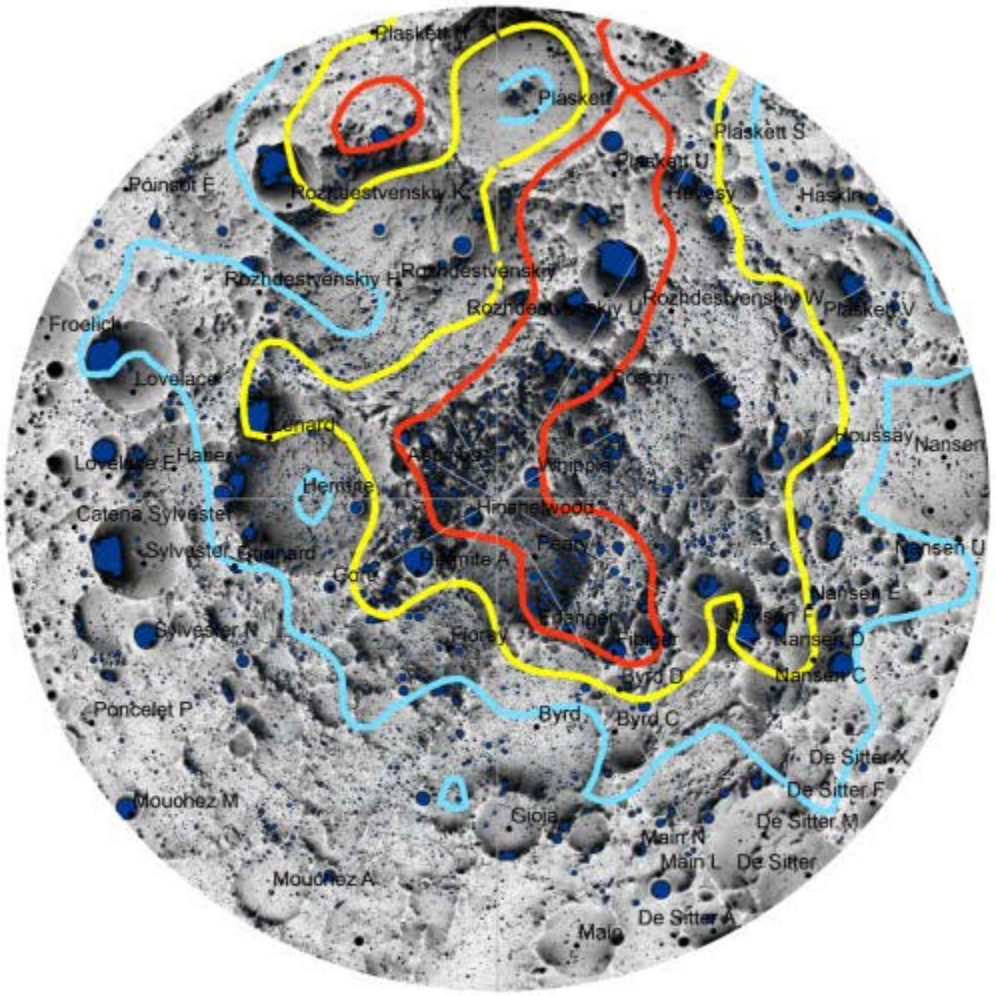
Slope (NP, LOLA DEM)

Slope:
Below 10 deg.
Above 10 deg.

H contours:
150 ppm
125 ppm
100 ppm

PSR

Illumination (NP)



H contours:

150 ppm

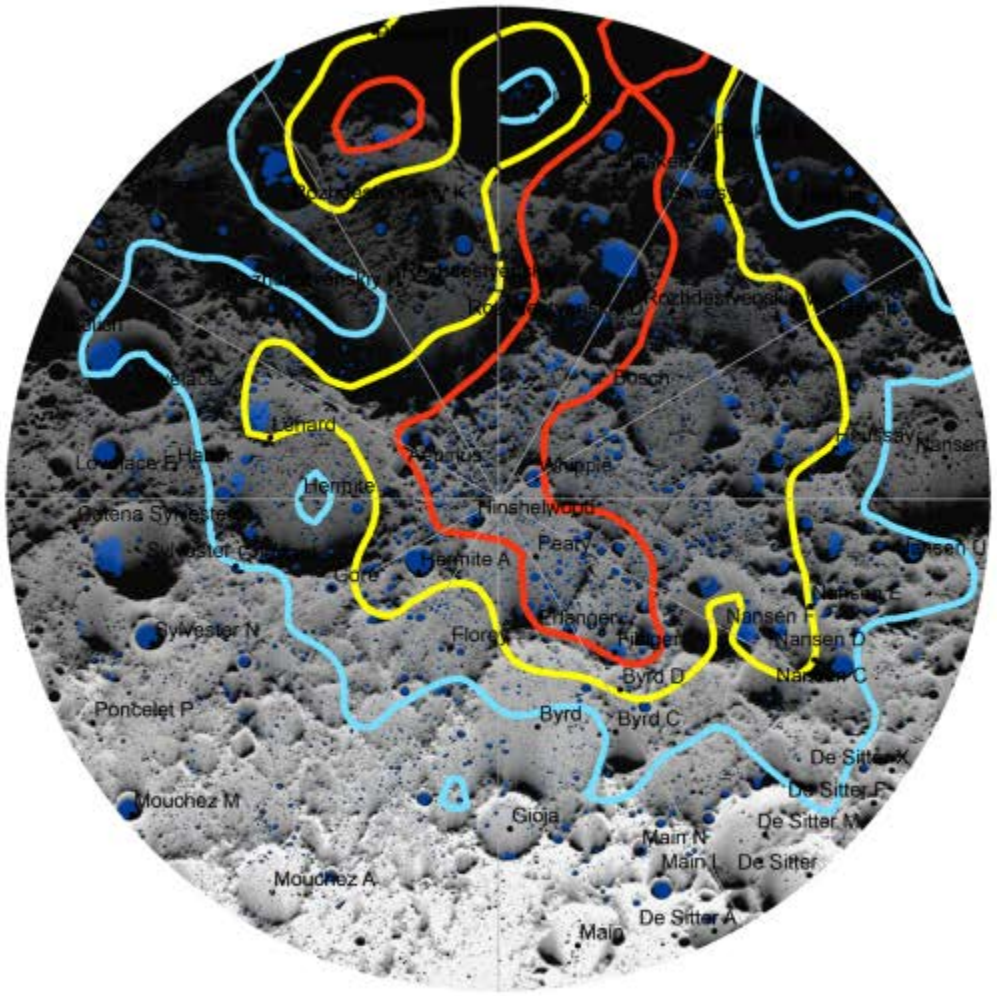
125 ppm

100 ppm

PSR

low high

Earth visibility (NP)



H contours:

150 ppm

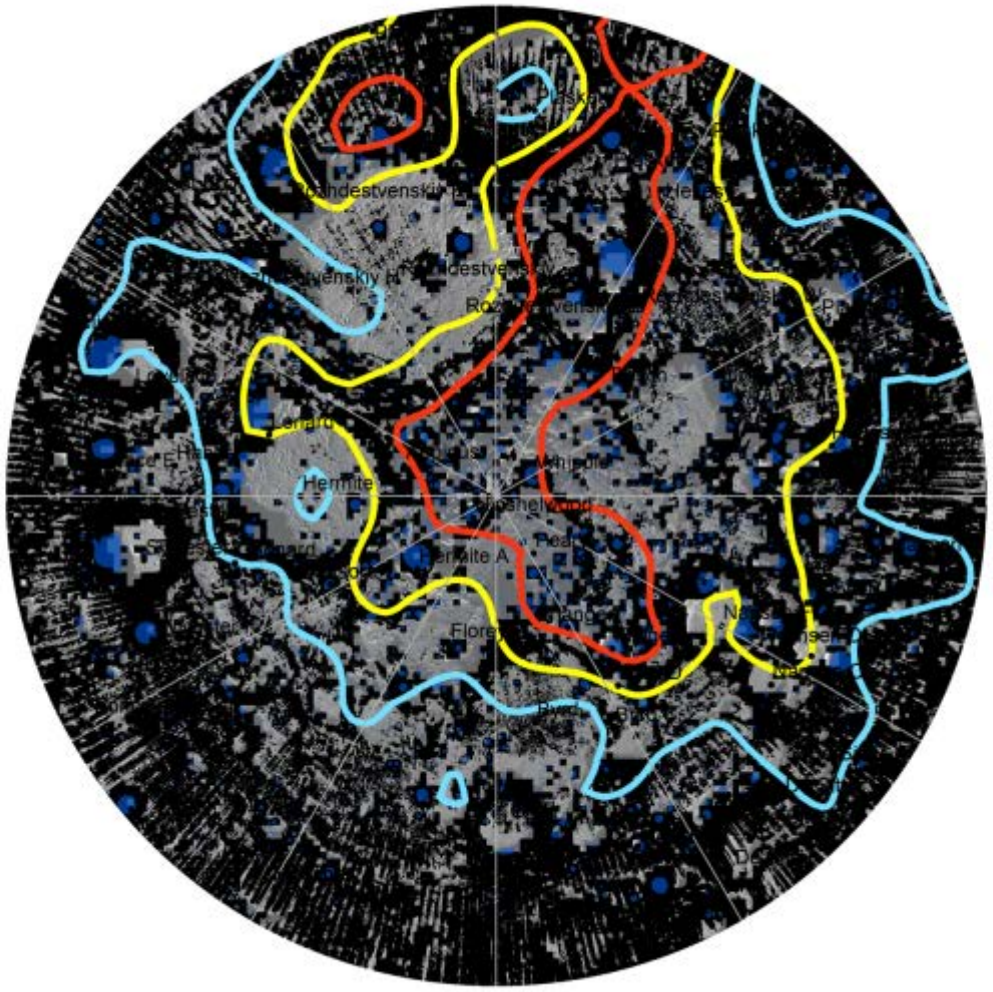
125 ppm

100 ppm

PSR

low high

North Pole potential ROI



H contours:
150 ppm
125 ppm
100 ppm

PSR

Black areas= Temperature and/or slope too high

North Pole potential ROI

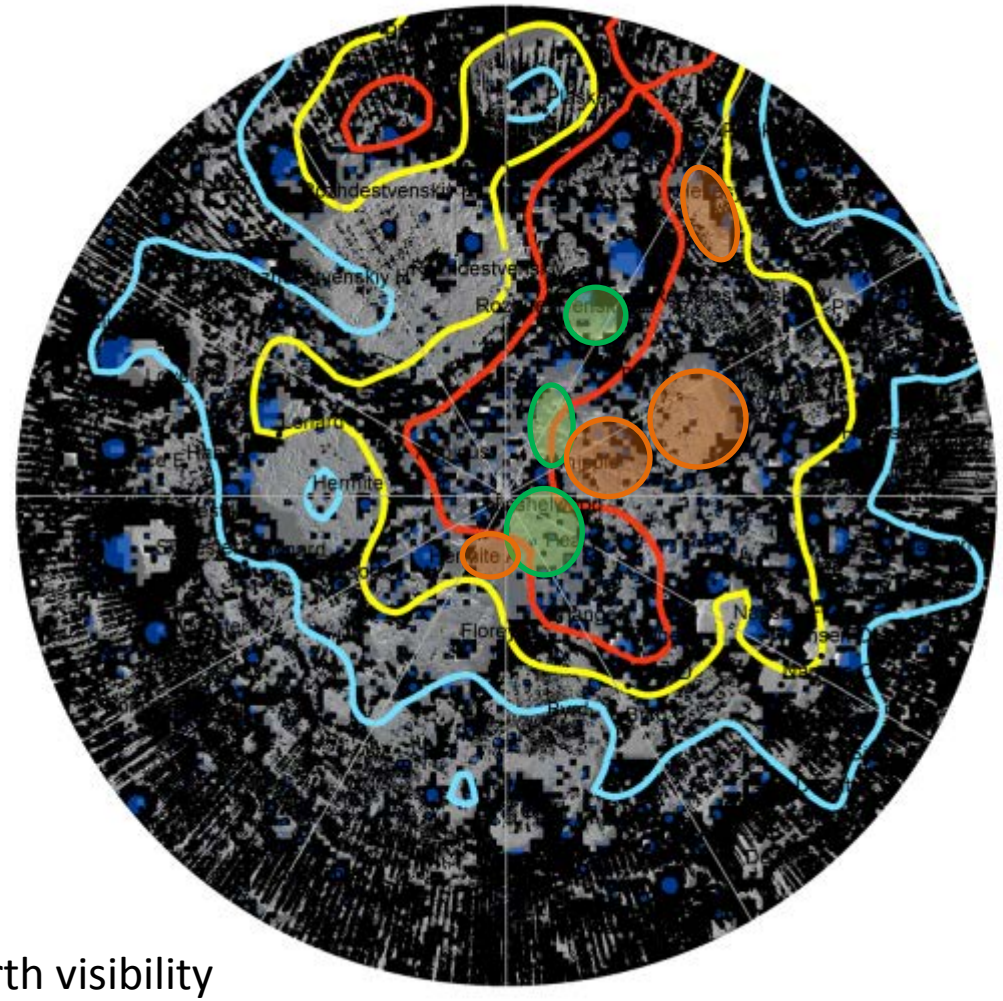
Between 80° and 90° latitude:

- 2 areas with H > 150 ppm
- In the LEAG report, 1 area was discarded and the other significantly reduced because of direct Earth communication/illumination constraints
- Lowering H to > 125 ppm or discarding the direct Earth communication criteria significantly increases the number of potential ROI
- High H abundance areas extents below 80° in latitude

North Pole potential ROI

ROI with
H>150,
slope<10 and
avg. T<110

ROI with
150>H>125,
slope<10 and
avg. T<110



H contours:
150 ppm
125ppm
100 ppm

PSR

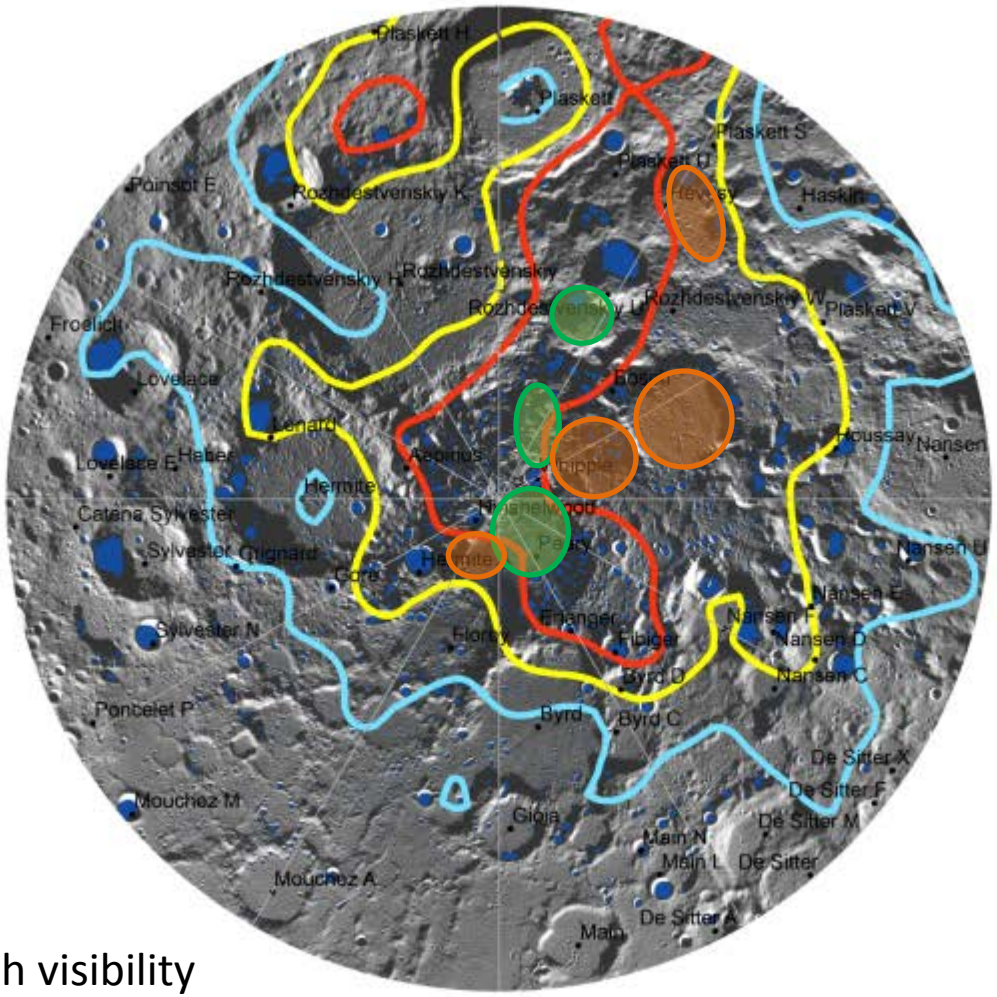
Black areas=
Temperature
and/or slope
too high

(illumination and Earth visibility
are not accounted for)

North Pole potential ROI

ROI with
H>150,
slope<10 and
avg. T<110

ROI with
150>H>125,
slope<10 and
avg. T<110



(illumination and Earth visibility
are not accounted for)

WAC mosaic

North Pole potential ROI

Additional step:

Looking for potential sites that are close to (but not necessarily meeting) the LEAG threshold values but could be of higher scientific interest because of potential additional science. For example:

- the H-rich pockets below 80 deg. latitude
- The H-rich, young (Erastosthenian, Upper Imbrian) features close to the pole (e.g., Rozhdestvenskiy K crater, Plaskett crater, whose N wall is associated with a SELENE pure anorthosite detection).

Credits – Data sources

- Hydrogen content (Lunar Prospector, PDS)
- Bolometric Temperature, avg., min., max. (personal communication with the Diviner team, courtesy of Pierre Williams)
- PSR (LOLA, MIT)
- Slope (LOLA + polar LROC DTM, PDS + ArcGIS)
- Illumination (LOLA, MIT). *Various alternative maps are available (LAMP, WAC… cf. Bussey et al., Nova et al., …)*
- Earth visibility (LOLA, MIT)

Source for LOLA/MIT data:
http://imbrium.mit.edu/EXTRAS/ILLUMINATION/

Source for 20m slope maps:
LPI interns Concept 4 team /CLSE Global Lunar Landing Site Study, http://www.lpi.usra.edu/exploration/CLSE-landing-site-study/

GIS assembled by Jessica Flahaut, contact: jessica.flahaut@ens-lyon.org