Phoenix Landing Site Characterization and Certification

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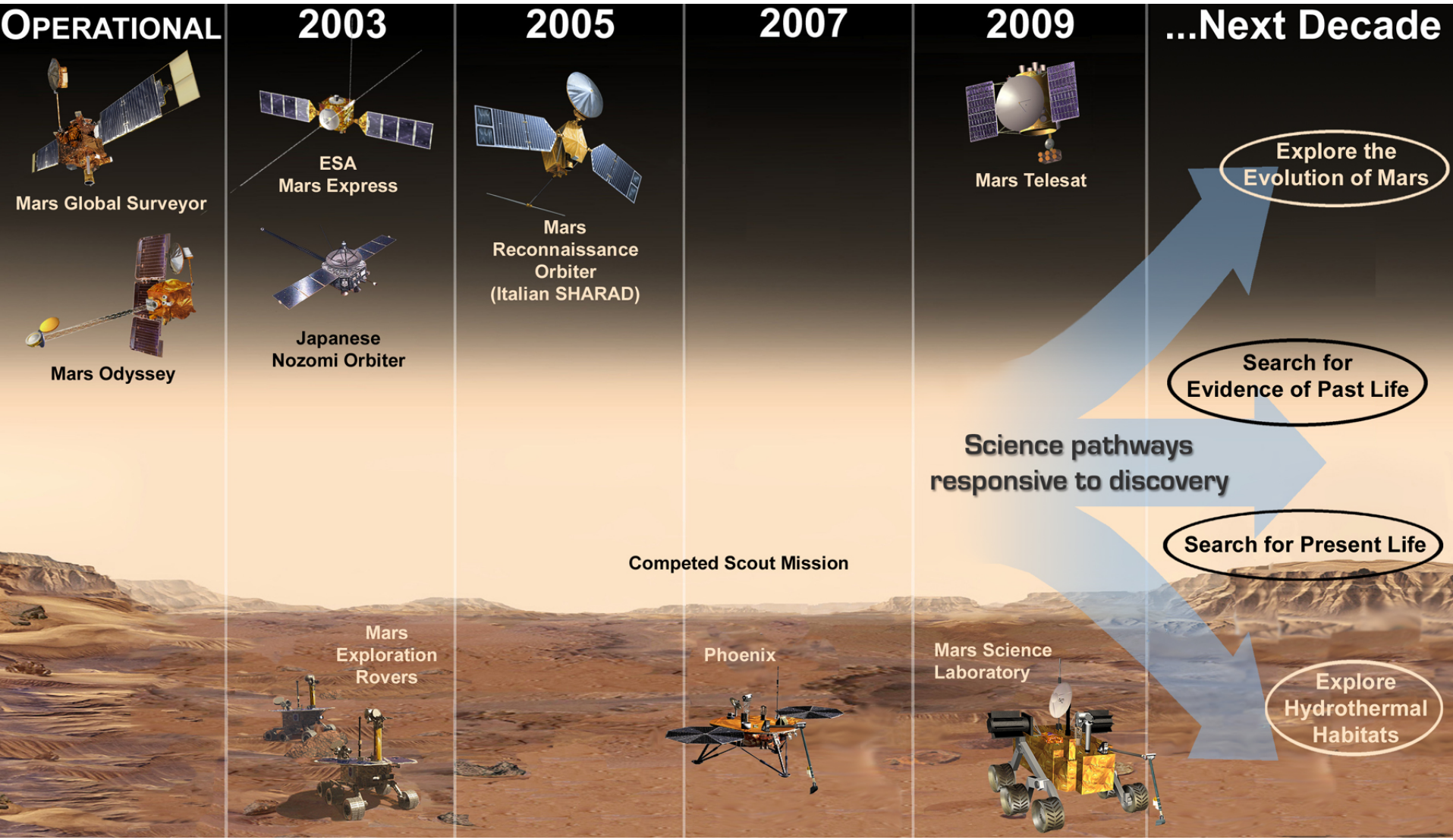
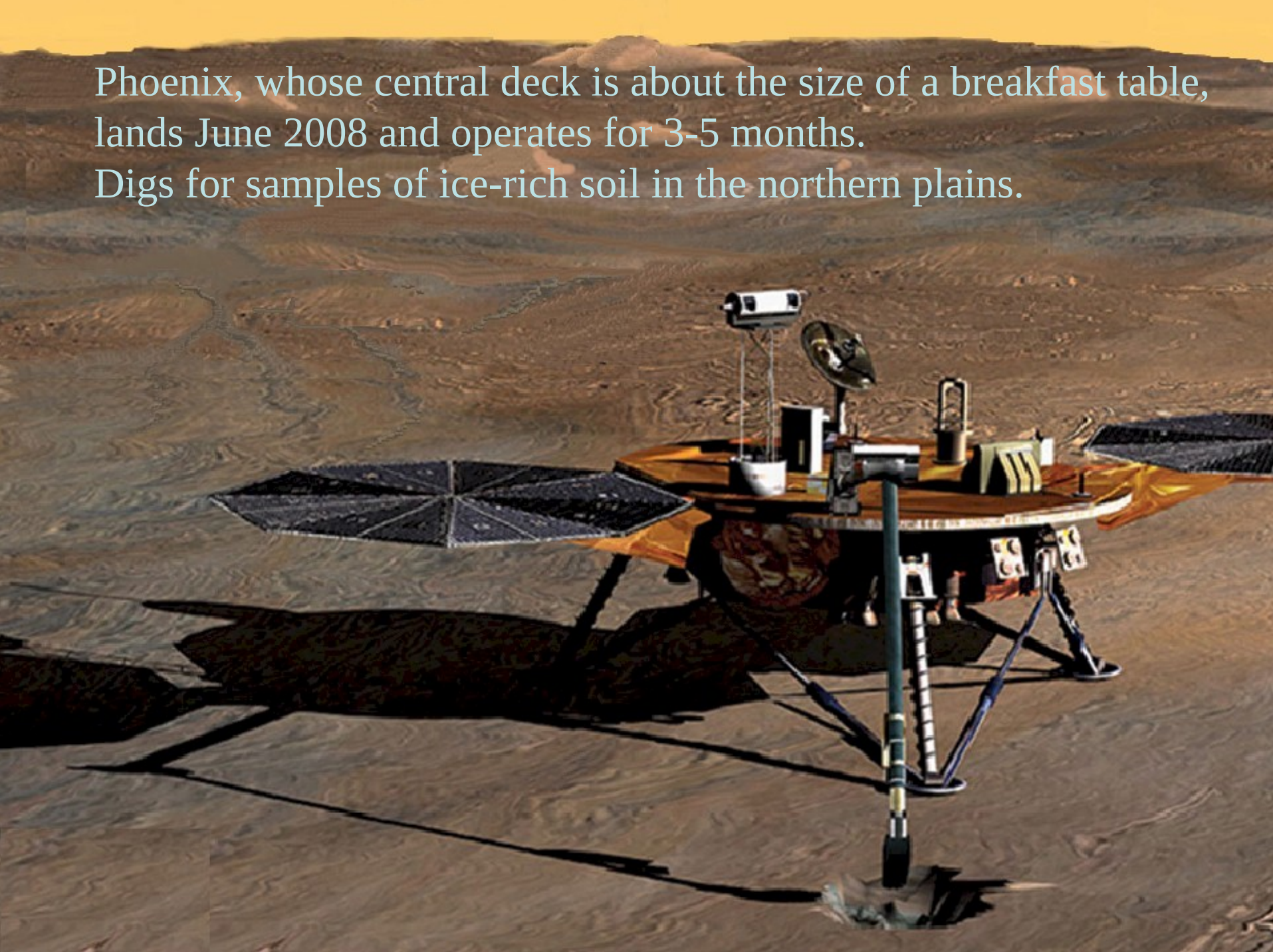
2. University of Arizona
3. Jet Propulsion Laboratory

02/24/05

Mars Exploration Program



Phoenix, whose central deck is about the size of a breakfast table, lands June 2008 and operates for 3-5 months.
Digs for samples of ice-rich soil in the northern plains.



History of Water Written into the Soil

- Verify that subsurface ice exists
- Altered and weathered minerals in the soil above the ice carry clues to the melting of the ice
- Distinct layers beneath the surface reveal historic events
- Grain morphology indicates weathering processes
- Salts concentrated by evaporation
- pH indicates chemical history of the soil
- Gather clues to the interaction of the subsurface ice and the atmospheric water vapor

Local geomorphology

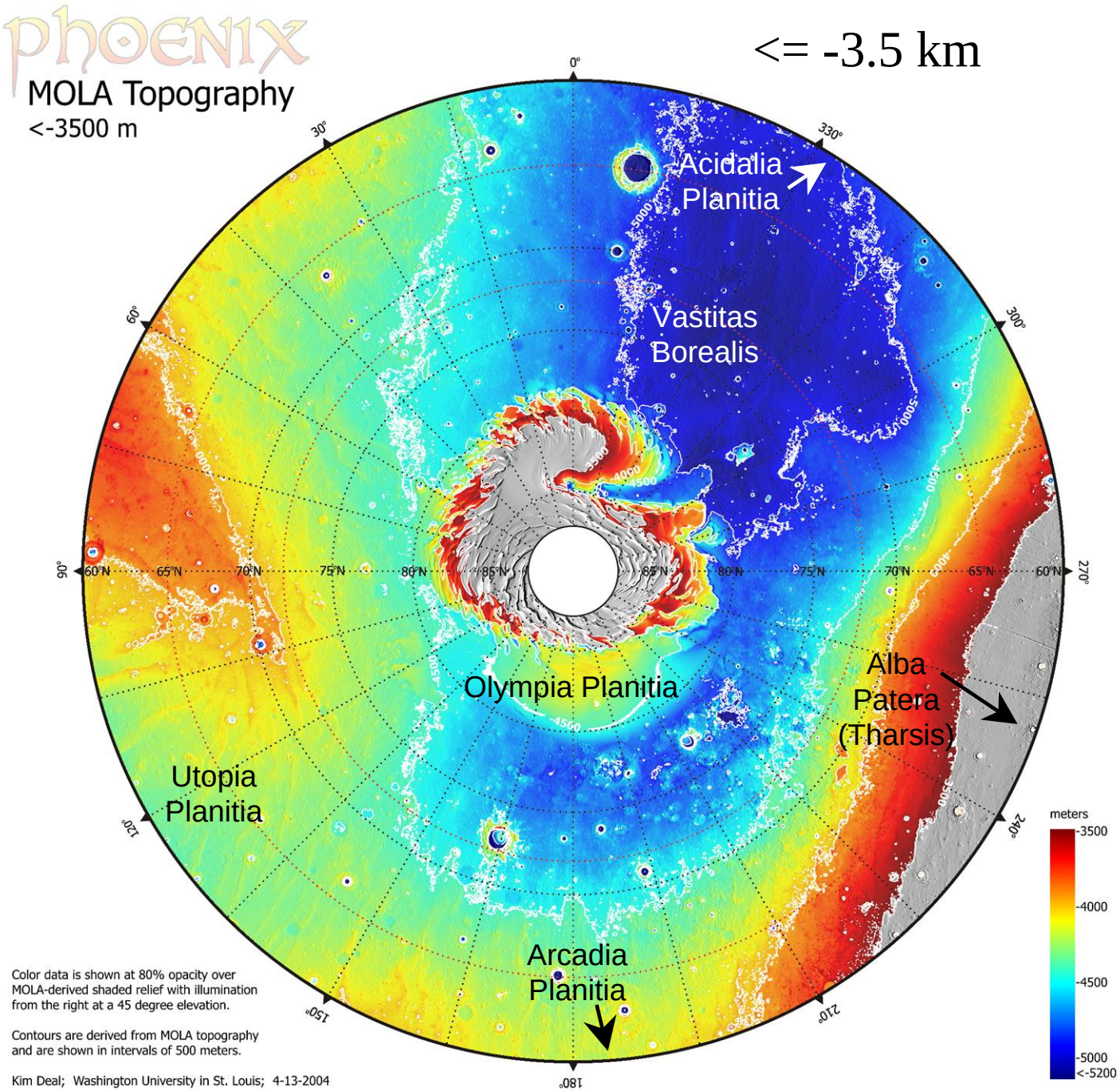
- Study of the landforms along with knowledge of the subsurface soil and ice may lead to understanding of the formation processes
- Orbital images, descent images, panoramas, and trench-wall mosaics provide a vast data set for this study

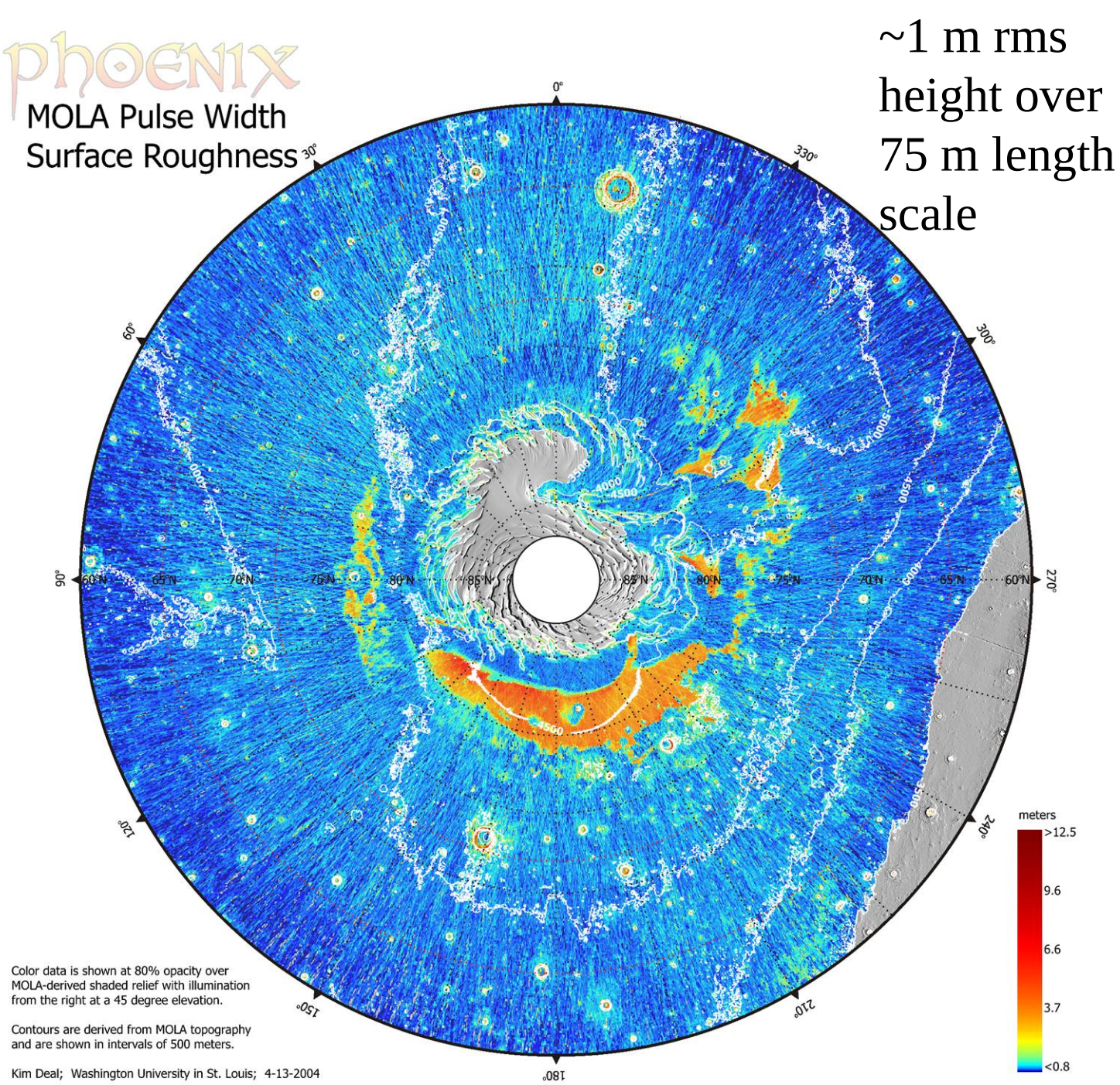
Biological Potential

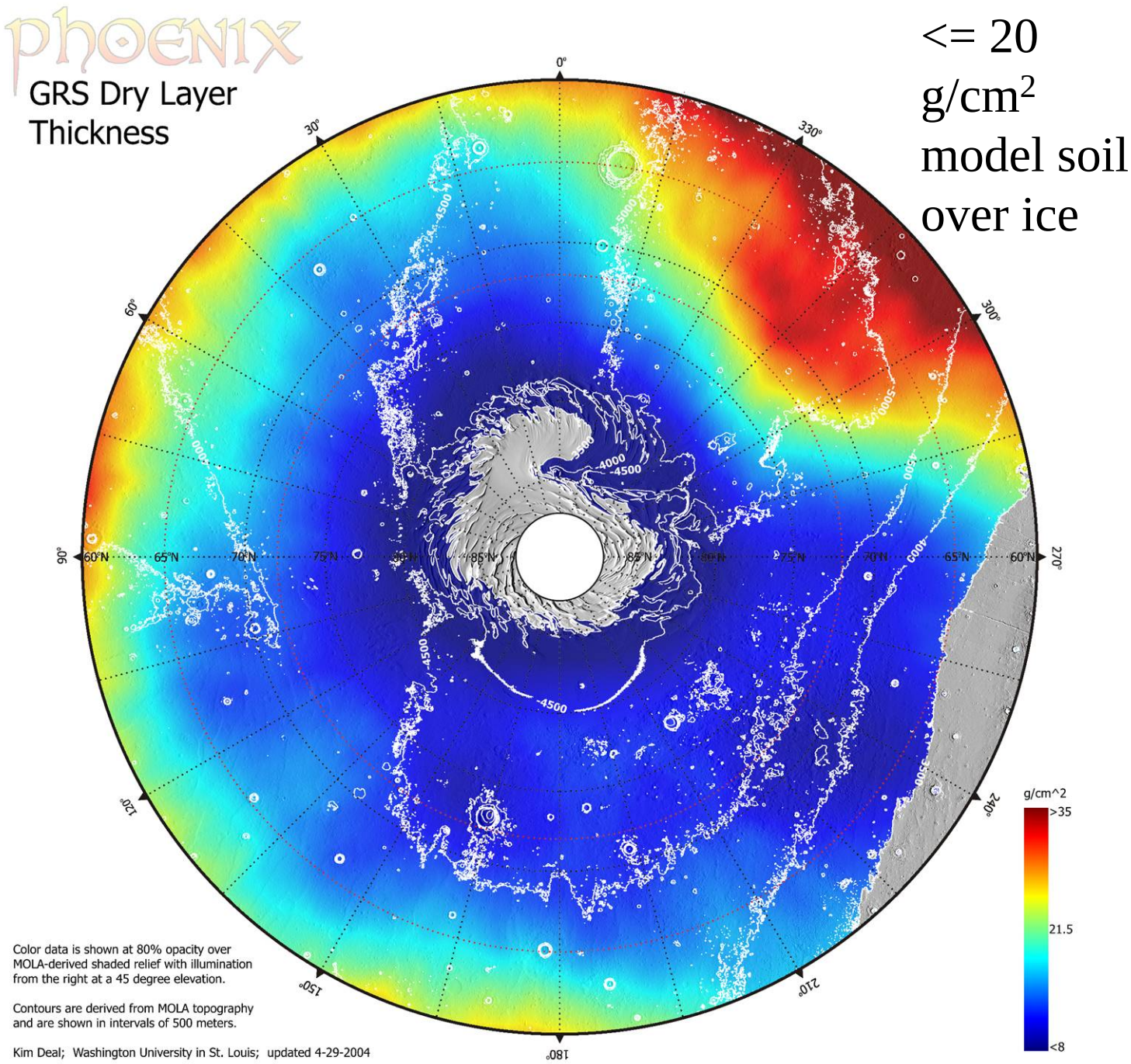
- The 3 factors that we search for are
  - Periodic presence of liquid water
  - Energy sources that can support microbes
  - Building blocks, that is the chemical elements of life in a usable form
- Finally, the presence of complex organic molecules associated with the subsurface ice
  - Note that Phoenix will have little chance of distinguishing biotic and abiotic organics

Desirable Landing Site Characteristics

- Presence of subsurface ice
  - Observed by Odyssey GSS
  - Geomorphology shows ice-rich soil
- Enough overburden of soil to allow meaningful chemical analysis
  - Gradients of chemical composition are important
  - 20 cm of soil is desired
- Presence of salts or other indicators that liquid water has been present


phoenix
MOLA Topography
<-3500 m
<= -3.5 km
Acidalia Planitia
Vastitas Borealis
Olympia Planitia
Alba Patera (Tharsis)
Utopia Planitia
Arcadia Planitia
meters
-3500
-4000
-4500
-5000
<-5200
Color data is shown at 80% opacity over MOLA-derived shaded relief with illumination from the right at a 45 degree elevation.
Contours are derived from MOLA topography and are shown in intervals of 500 meters.
Kim Deal; Washington University in St. Louis; 4-13-2004

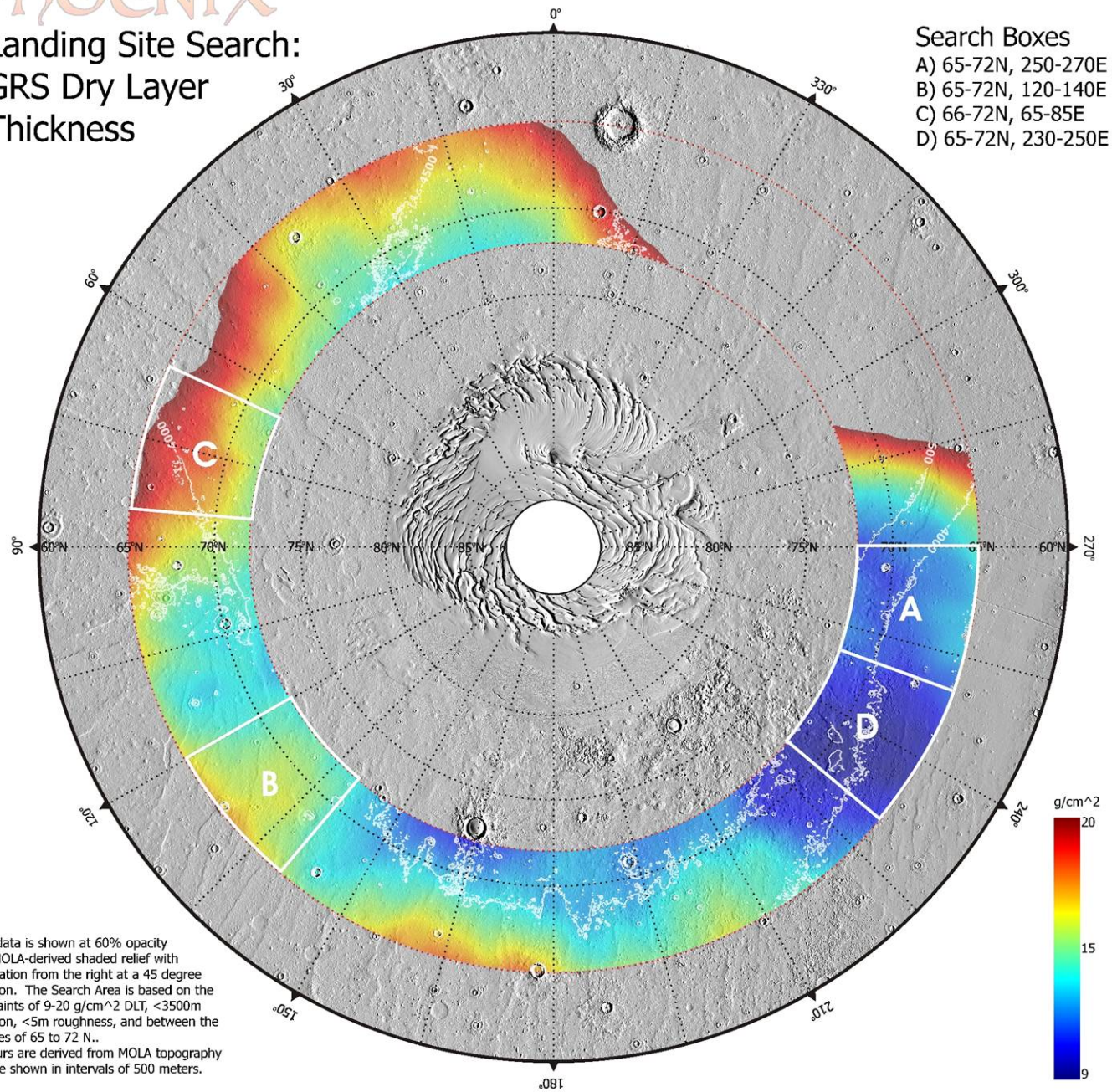

phoenix
MOLA Pulse Width
Surface Roughness
~1 m rms height over 75 m length scale
0°
30°
60°
90°
120°
150°
180°
210°
240°
270°
300°
330°
60°N
65°N
70°N
75°N
80°N
85°N
meters
>12.5
9.6
6.6
3.7
<0.8
Color data is shown at 80% opacity over MOLA-derived shaded relief with illumination from the right at a 45 degree elevation.
Contours are derived from MOLA topography and are shown in intervals of 500 meters.
Kim Deal; Washington University in St. Louis; 4-13-2004


phoenix
GRS Dry Layer Thickness
<= 20 g/cm2 model soil over ice
0°
30°
330°
60°
300°
90°
270°
120°
240°
150°
210°
180°
60°N
65°N
70°N
75°N
80°N
85°N
-4000
-4500
-5000
g/cm^2
>35
21.5
<8
Color data is shown at 80% opacity over MOLA-derived shaded relief with illumination from the right at a 45 degree elevation.
Contours are derived from MOLA topography and are shown in intervals of 500 meters.
Kim Deal; Washington University in St. Louis; updated 4-29-2004

PHOENIX

Landing Site Search: GRS Dry Layer Thickness

Search Boxes
A) 65-72N, 250-270E
B) 65-72N, 120-140E
C) 66-72N, 65-85E
D) 65-72N, 230-250E

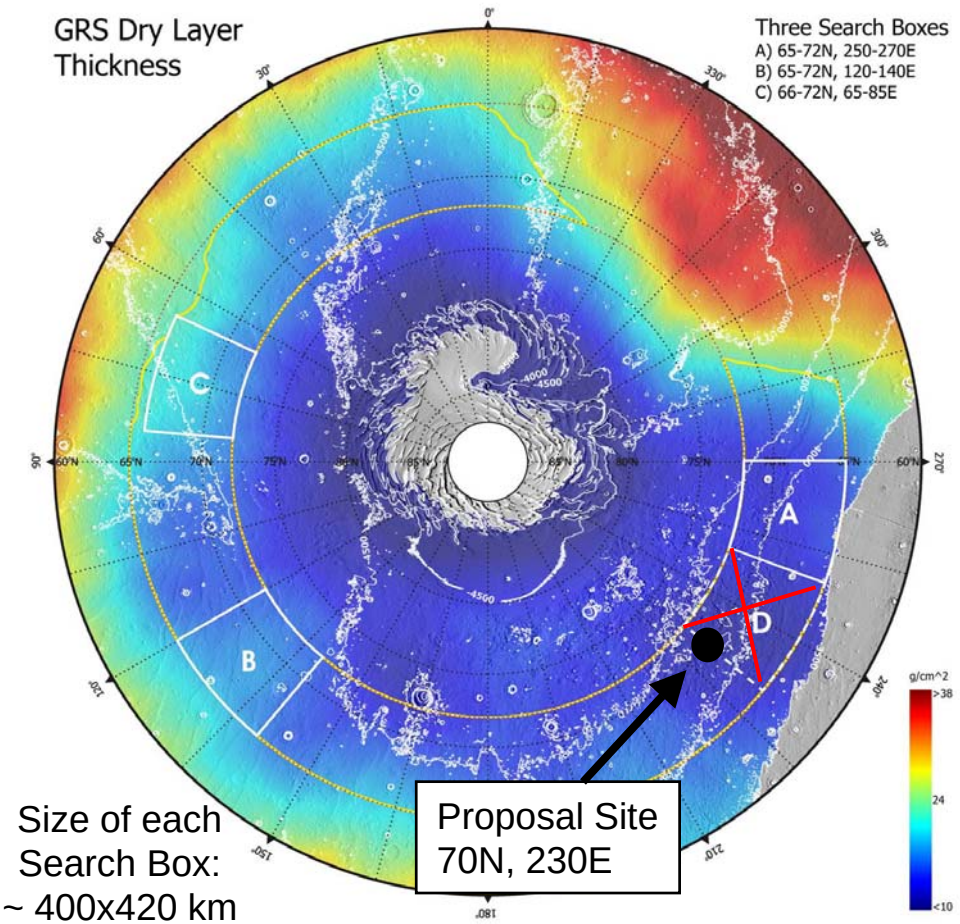


Color data is shown at 60% opacity over MOLA-derived shaded relief with illumination from the right at a 45 degree elevation. The Search Area is based on the constraints of 9-20 g/cm^2 DLT, <3500m elevation, <5m roughness, and between the latitudes of 65 to 72 N..
Contours are derived from MOLA topography and are shown in intervals of 500 meters.

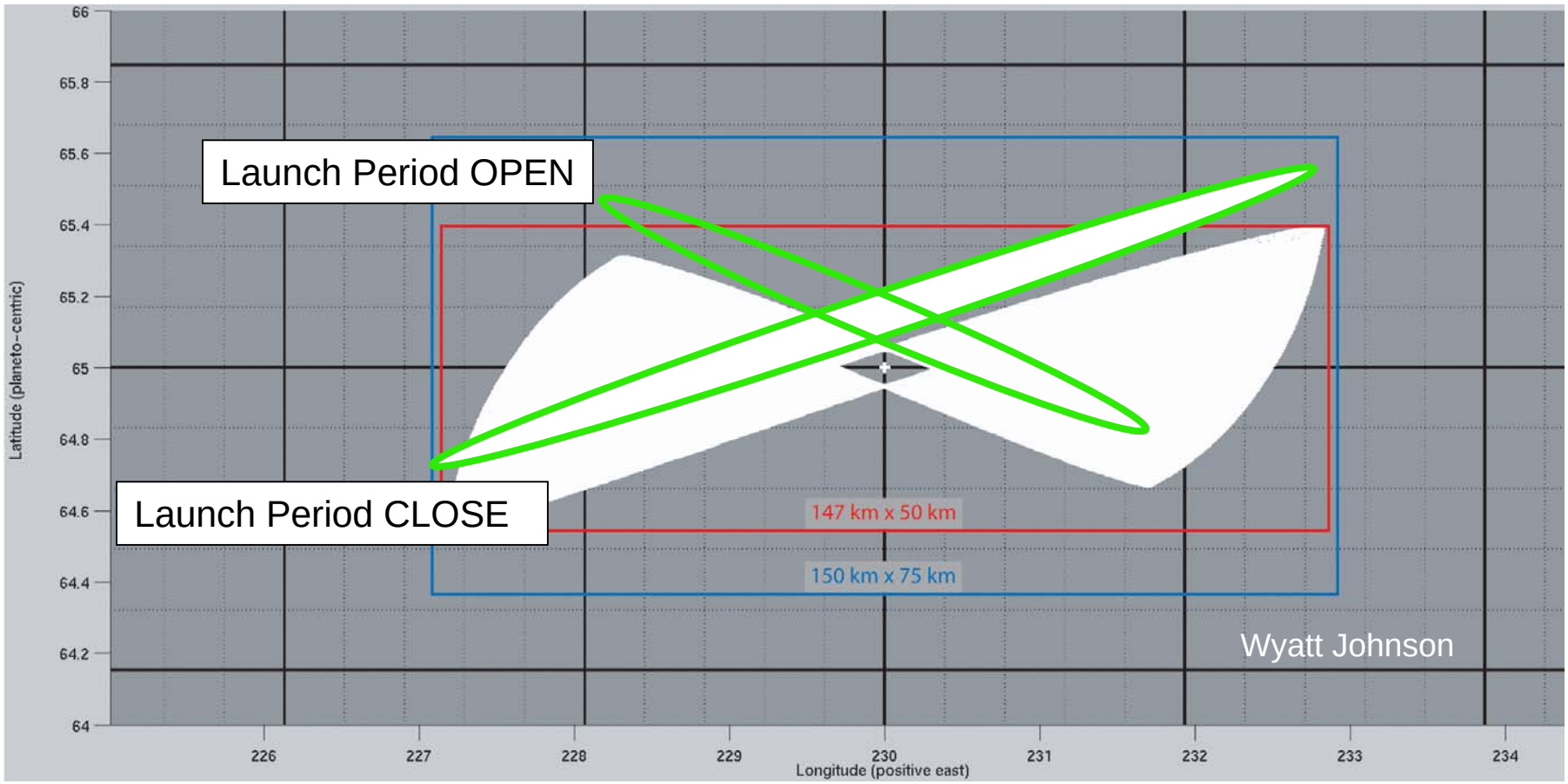
Kim Deal; Washington University in St. Louis; created 6-19-2004

Landing Site Selection Activities

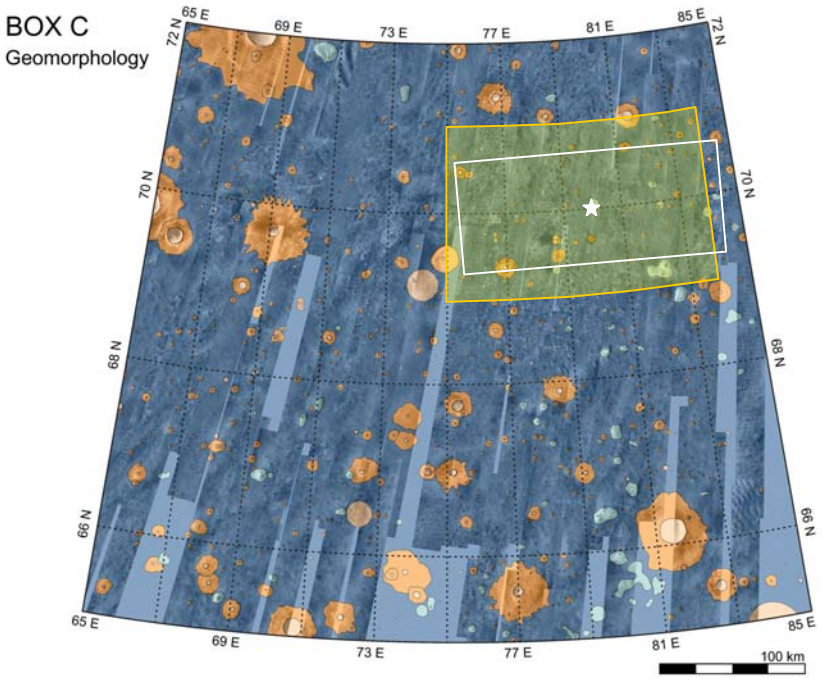
- **4 broad search regions defined based on science and engineering constraints:**
  - < -3500m elevation wrt MOLA (engr)
  - Between 65-72º North (engr)
  - Between 9-20 g/cm^2 GRS modeled Dry Layer Thickness (DLT) (science)
- **Selected 150x75km landing ellipse ("butterfly") regions within each search box**
- **December workshop focused on the characterization of**
  - Geomorphology
  - Ice Thicknesses and Hydration
  - Thermophysical Properties
  - Boulders and Slopes
  - Atmospheric Conditions
  - VL2 site as analog
  - <u>Eliminated Box D because of safety concerns and its similarity to Box A in DLT</u>

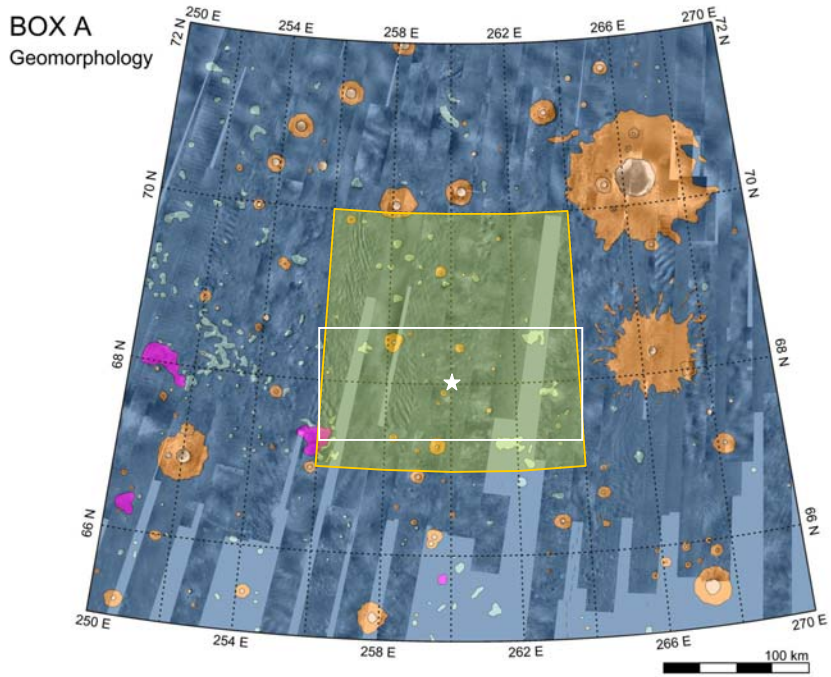


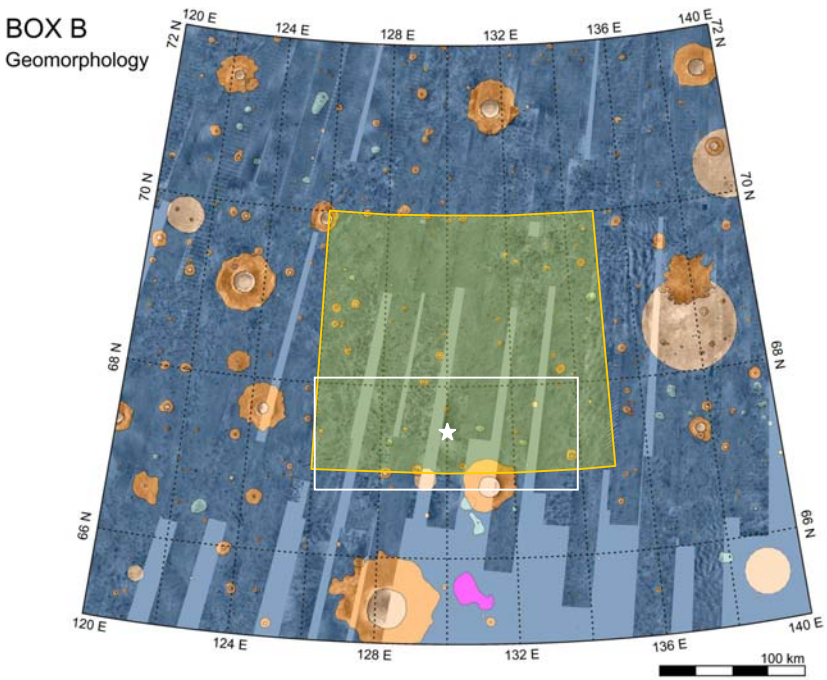
65N, Ballistic Landed Footprints (“Butterfly”) for entire launch/arrival space

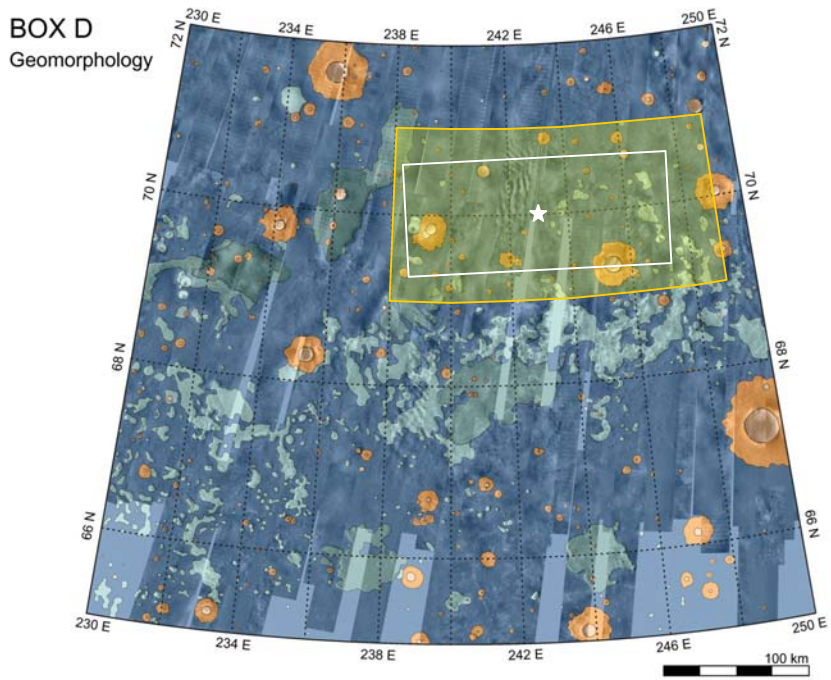


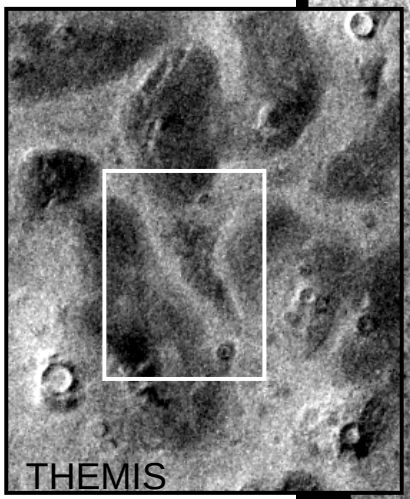
Landing Site Regions

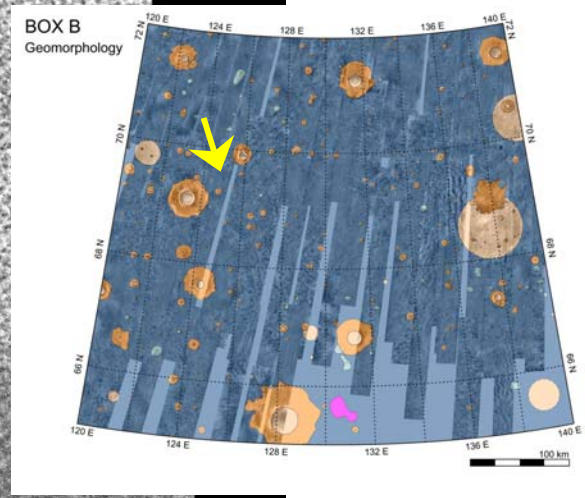


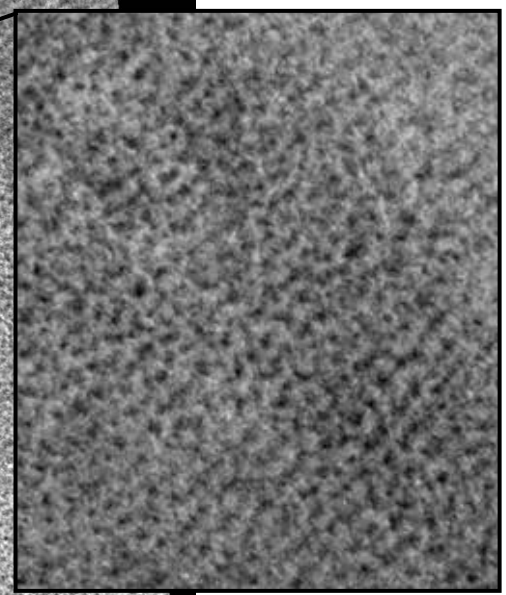












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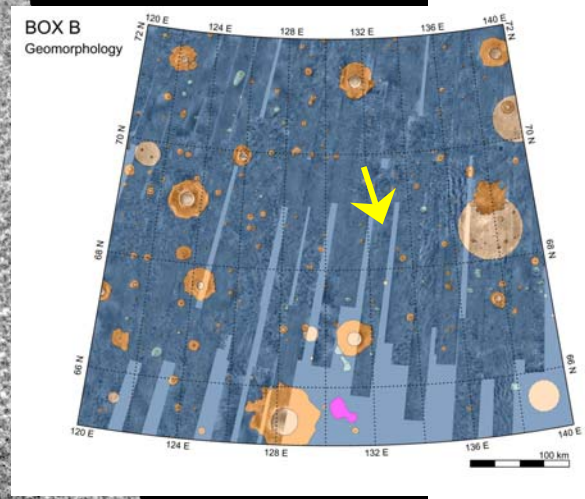
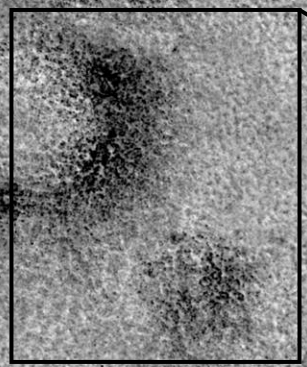
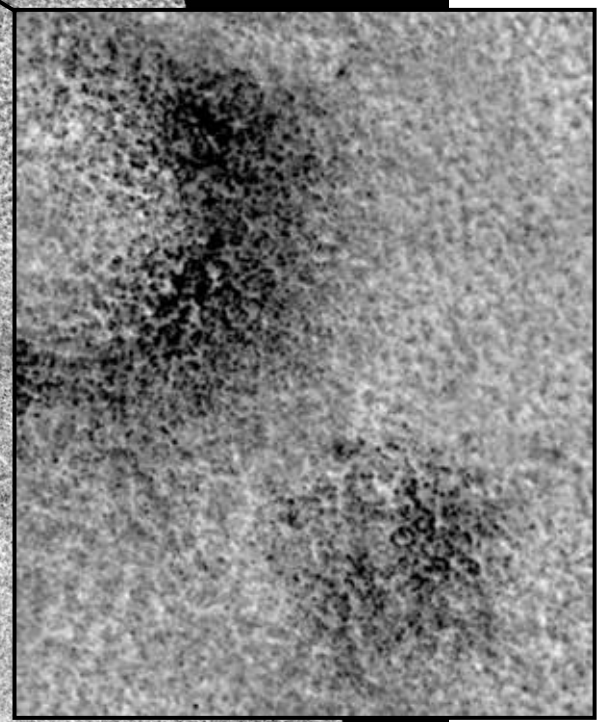
R20-00383







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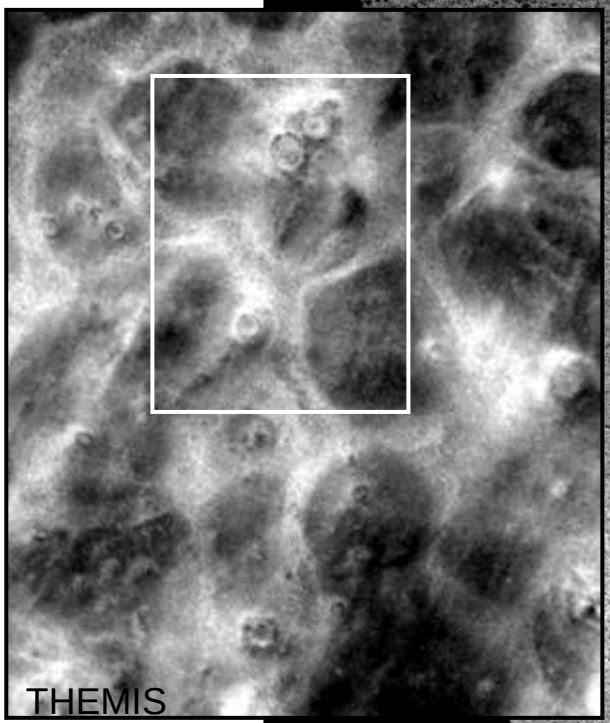

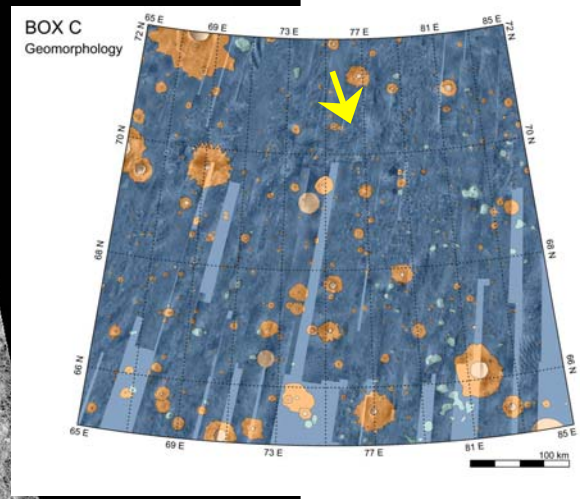

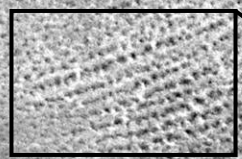

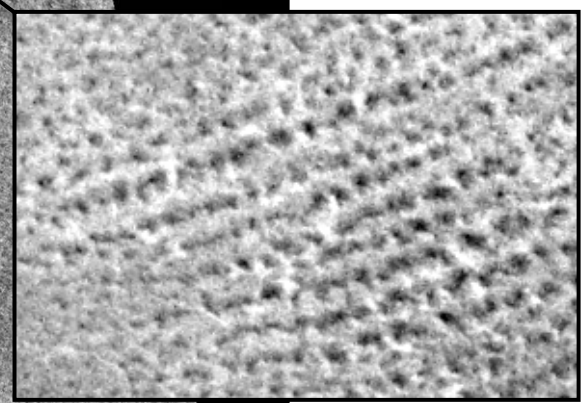

R22-00425, R22-01728

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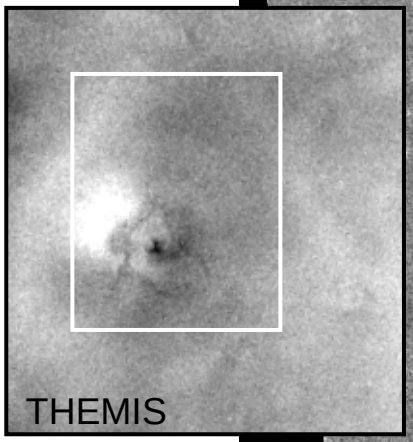

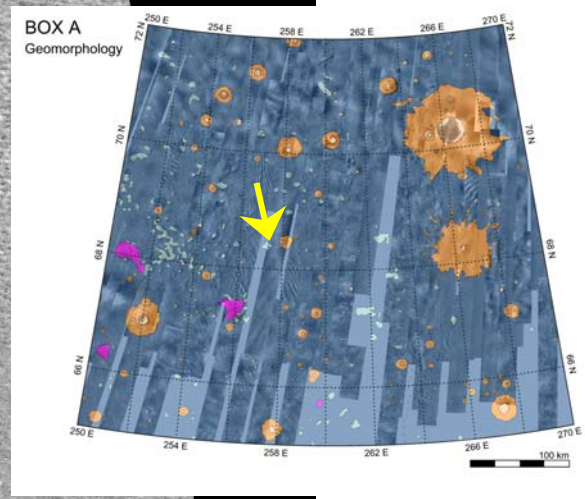

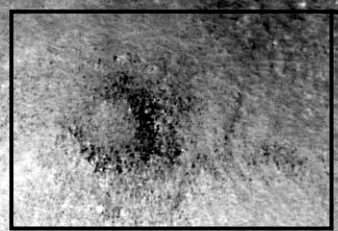

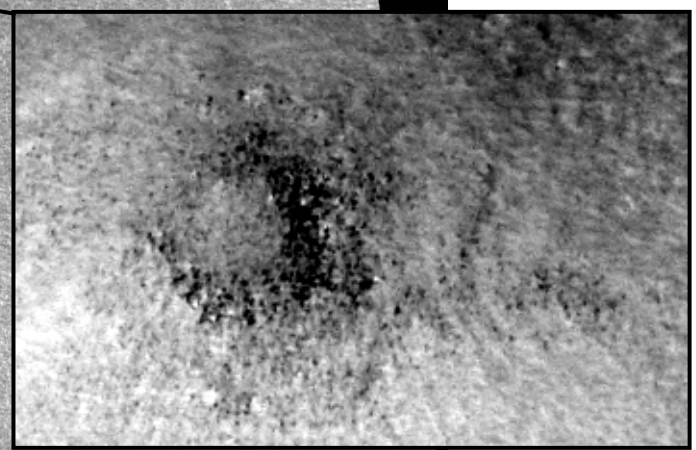

R20-00031

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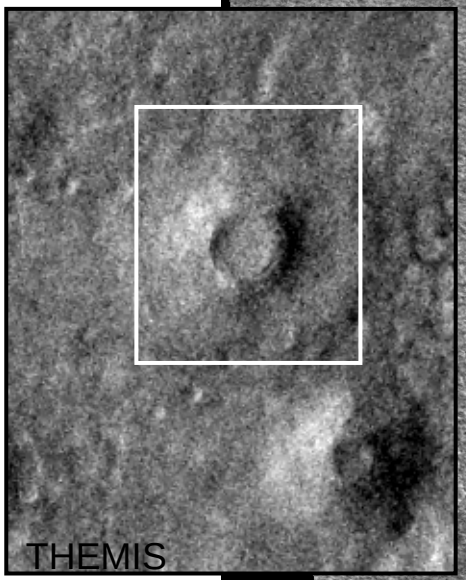

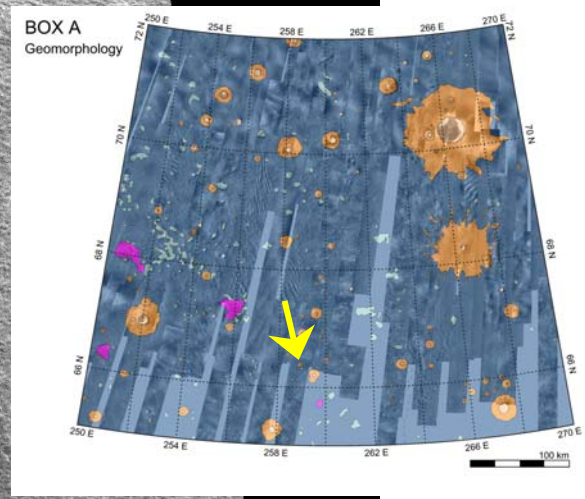

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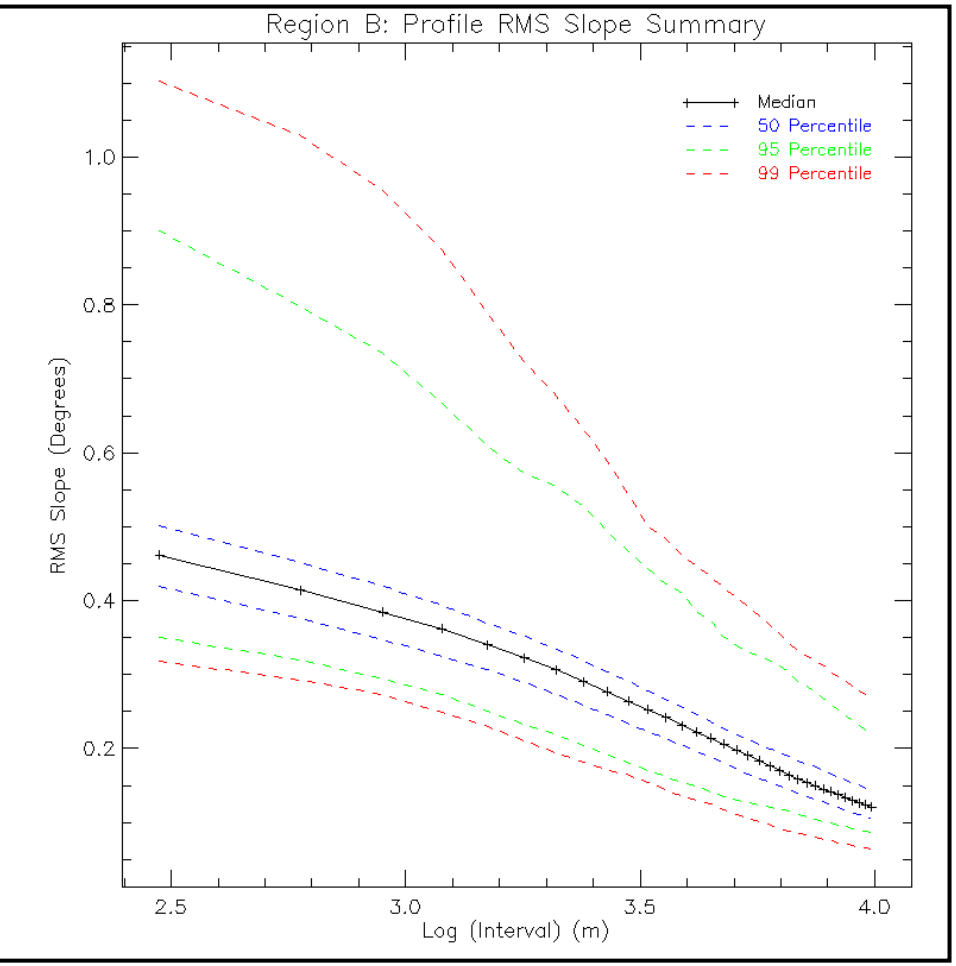
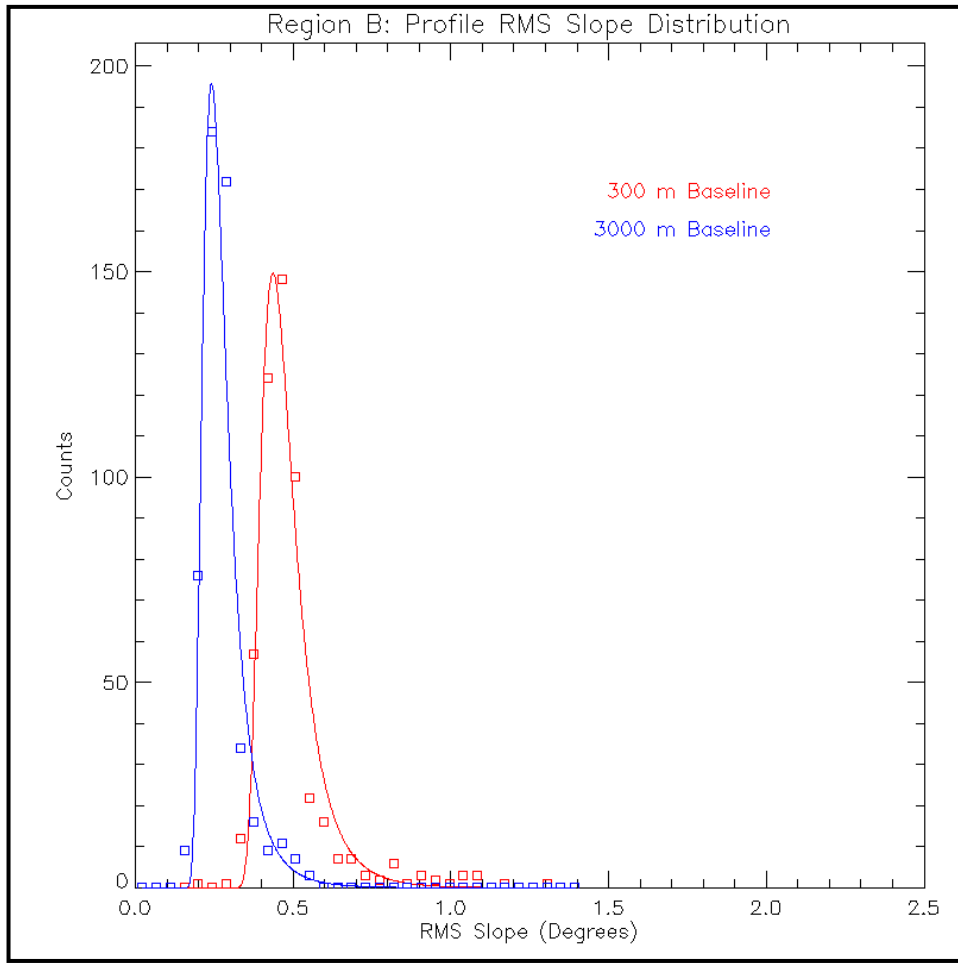
R22-00237

MOLA-Based Slopes





Near Term Future Work

- June 28-29 Landing Site Selection Workshop focusing on science, characterization, certification of candidate landing sites
  - GSS, MOC, THEMIS, OMEGA, HRSC, TES data analyses, including topography
  - Focus on depth to ice, together with slopes and rocks at lander scales
  - Consider atmospheric models for EDL

Phoenix Schedule