Hvor skal vi lande på Mars?

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The purpose of this workshop is to identify and discuss candidate locations where humans could land, live, and work on the martian surface.
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“We have set a clear goal vital to the next chapter of America's story in space: sending humans to Mars by the 2030s and returning them safely to Earth, with the ultimate ambition to one day remain there for an extended time.”

“Getting to Mars will require continued cooperation between government and private innovators….”
Exploration Zone (EZ) = candidate locations.
- Contains a collection of Regions of Interest (ROIs) within approximately 100 km.
- ROIs are relevant for scientific investigation and/or necessary resources.
- Contains a landing site and a habitation site to be used by multiple human crews.
Krav til forslag om landingssted:

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*It is anticipated that funding and support for future calls will be available for teams of scientists and engineers to conduct detailed characterizations of the EZs that emerge from this workshop.*
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- in the latitude range of plus or minus 50 degrees around Mars
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Deuteronilus Mensae
Krater tætheden fortæller om overfladens alder
Deuteronilus Mensae
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Smooth material may have once covered entire area.

Ridge suggests down slope movement and compression, maybe aided by ice.

Picture at left is in red box.

Wide context
MARS

Year 687 days
Day 24.6 hours
Gravity 0.38 · g

Orbital parameters:
½ major axis 1.52 AU
Eccentricity 0.09
Inclination 25.2°

The Surface:
Pressure 7 ± 1 mbar over a year
Temperature 140 - 300 K (average around 210 K)

The atmosphere:
CO₂ (95.3%)  N₂ (2.7%)  Ar (1.6%)
Hvorfor ser vi ikke flydende vand på Mars i dag?

Fasediagram for H₂O

Jorden

Mars
Mars • North Polar Cap
Hubble Space Telescope • WFPC2

October 1996

January 1997

March 1997

PRC97-15b • ST Sci OPO • May 20, 1997 • P. James (Univ. Toledo), T. Clancy (Space Science Institute), S. Lee (Univ. Colorado) and NASA
$H_2O$ on Mars
- where is it -

- Polar ice caps
- Glaciers
- Permafrost
- Vapour
The permanent polar caps on Mars

[Images of Mars's polar caps, labeled North and South]
Polar caps on Mars. 1 km resolution data from Mars Orbiter Laser Altimeter (MOLA)
Mars idag:
koldt, tørt og støvet

360 degree mosaic

RA workspace

One of our dig trenches

Phoenix missionen (2008) finder permafrost
Ice under the Phonix lander and in the trenches.
Ice cubes one day, gone a few sols later…

Phoenix detected 0.6 wt % perchlorate ClO$_4^-$ in the soil, most likely as Mg(ClO$_4$)
Friske spor efter flydende vand på Mars’s overflade:

Er det spor efter et smeltende snedække?
Recurring Slope Lineae in Equatorial Regions of Mars
A.S. McEwen et al., Nature Geoscience, 10 December 2013
Recurring Slope Lineae (RSL) in Equatorial Regions of Mars

Right: Animation of 4 MRO/HiRISE images of RSL in crater on floor of central Valles Marineris; scene 193 m wide
Map of fully confirmed RSL sites on global topography and albedo maps

- Acidalia Planitia
- Valles Marineris
- Hale Crater
- Horowitz Crater

[Map Image]
Why do equatorial RSL matter to future exploration of Mars?
Distribution of VFFs (Milliken et al. 2003)
Viscous Flow Features on Mars

"Tropiske" gletschere på Mars

Greenland

Mars
Figure 2.8: subset from CTX image P02_001768_2160_XI_36N303W, centred on 56.6°E 35.5°N, showing LVFs from five valleys which converge in a central basin. The image is oriented north-up.

Figure 2.9: subset from CTX image P20_008770_2240_XN_44N322W, centred on 37.59°E 45.07°N, showing a GLF with two tongues.
Lobate Debris Apron at 105°E, 45°S

CTX imagery / JMars
Data

MOLA elevation data are combined with measurements from SHARAD to get an interpolated bed topography.

(a) SHARAD data converted from two-way travelt ime to depth.
(b) Corresponding MOLA elevation and manually picked bed.
Because ice is a deforming material, there is a relationship between volume and area, theoretically: $V \propto A^{1.25}$

Total estimated volume of lobate debris aprons: $1.55 \cdot 10^5 \text{ km}^3 \pm 25\%$
Obliquity varies in time and causes *dramatic changes* in climate on Mars:

10 Myr obliquity history (Laskar et al. 2004)

**Climate models:**
- polar ice becomes unstable for obliquity > around 35°
  (e.g. Levrard et al. 2004)

**Geologic mapping:**
- Evidence of recent glacial activity at low latitudes
  (Head et al. 2005, Marchant)
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Krav om adgang til vand er højt prioriteret!

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