Emerging Reconnaissance Strategies to Enable Human Missions to Mars

SpaceNews Webinar

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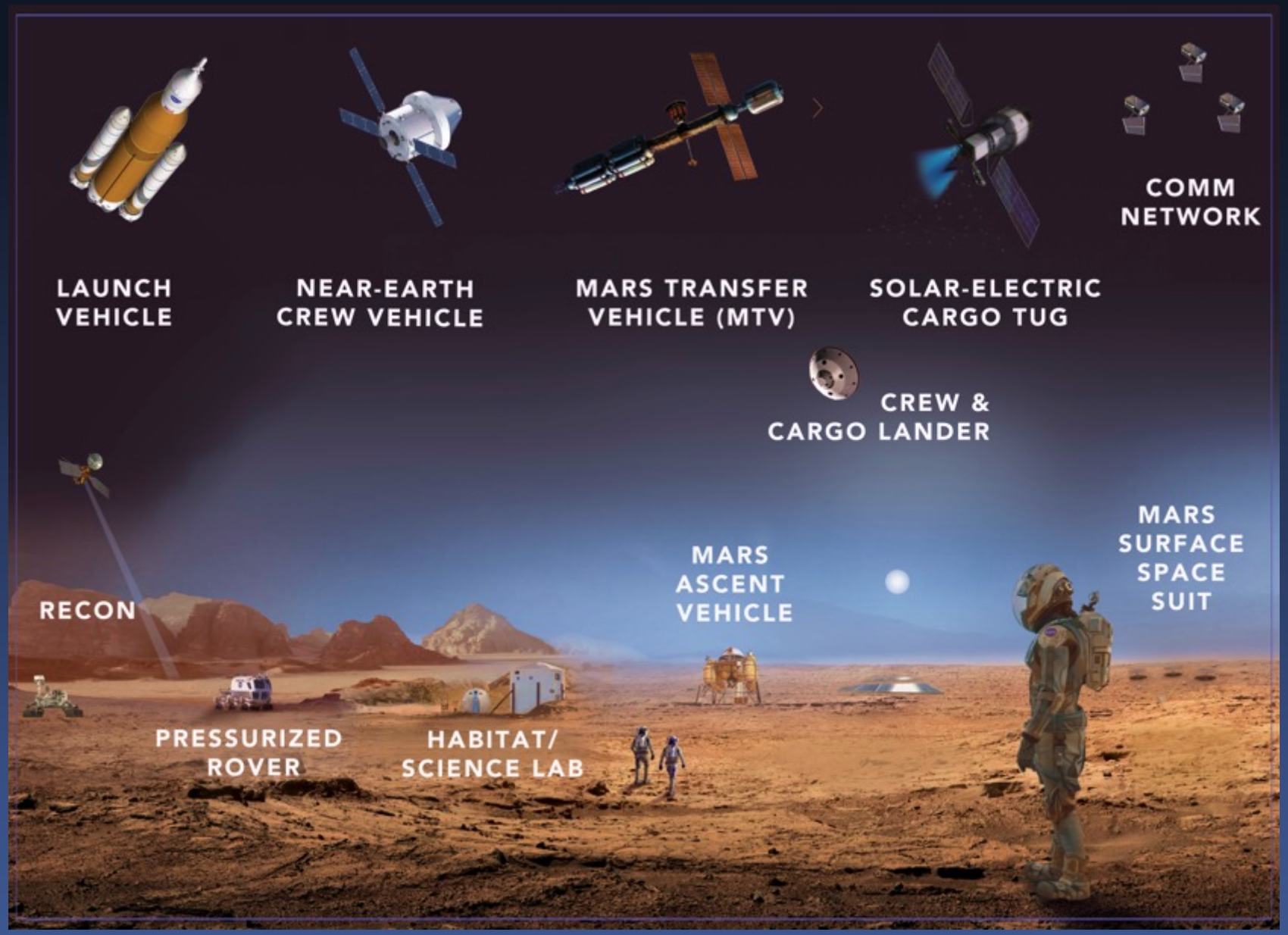
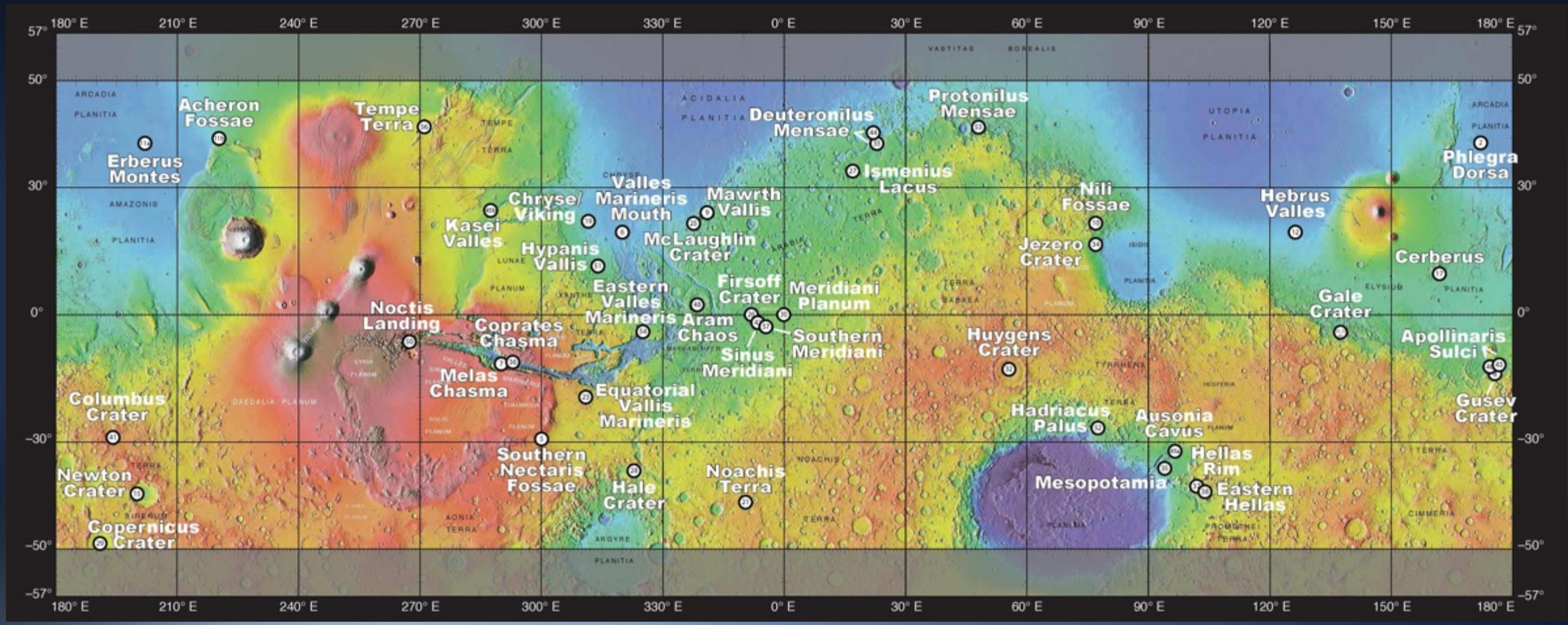
Components for the Round-trip Human Journey

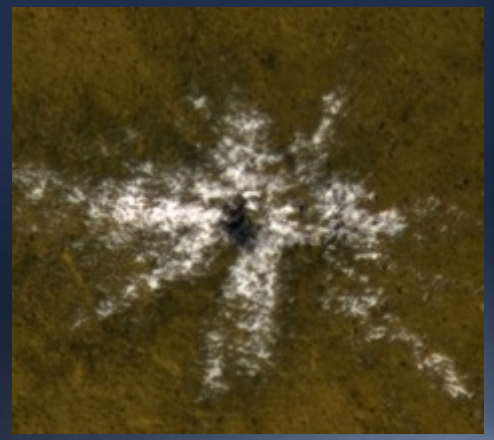


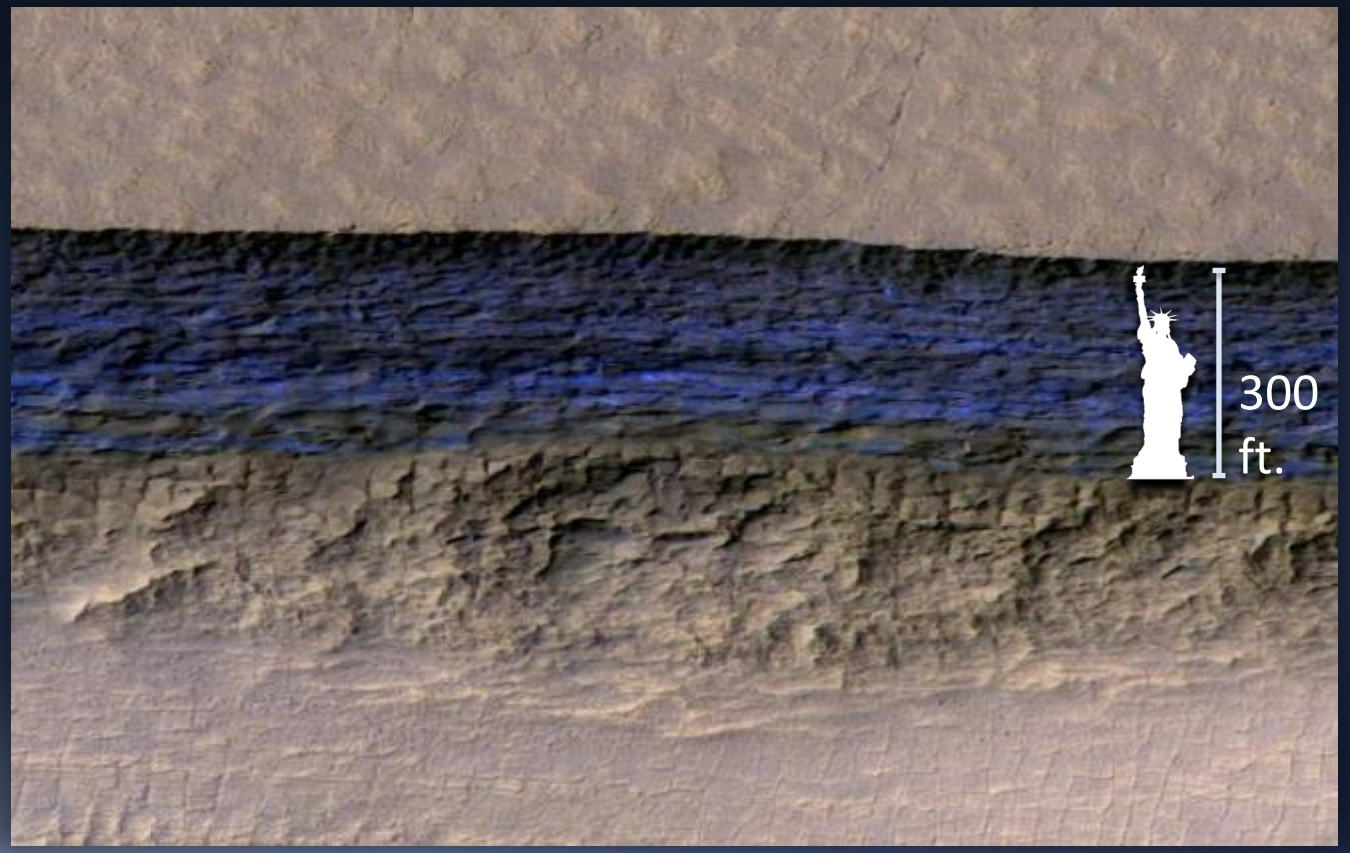
Recon Leads to Selecting A Great Landing Site

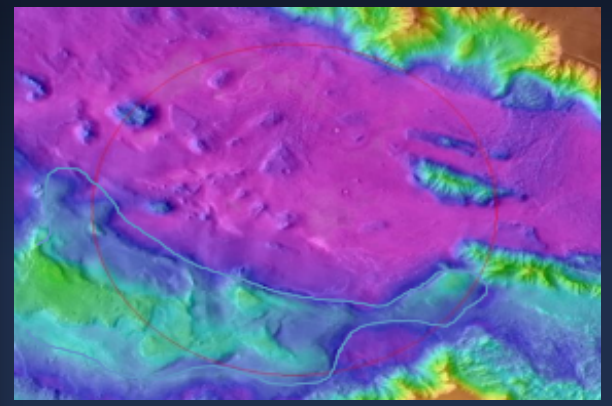


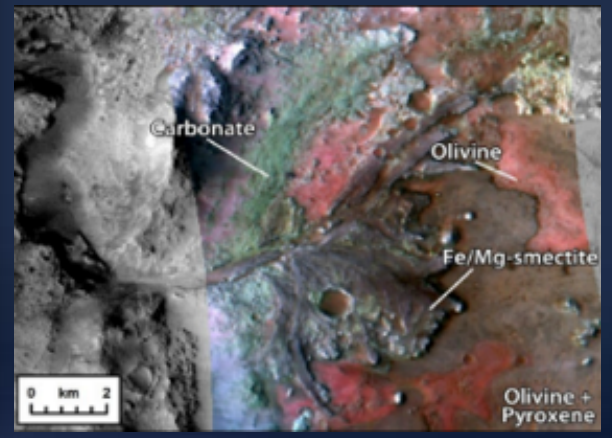
MARS

Recon Reveals Critical Water Resources





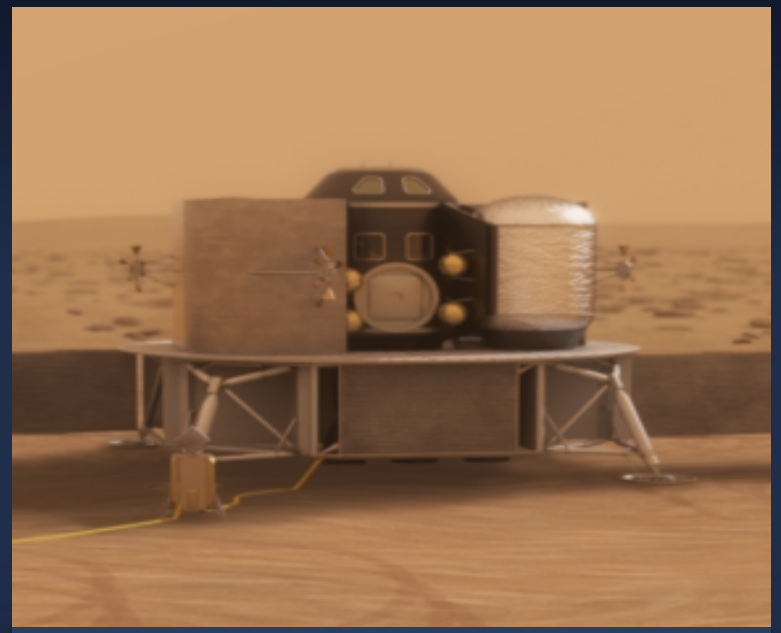




MARS

How would a Mars mission use abundant water?

Highest Water Mass Requirements



Propellant for Mars Ascent Vehicle (MAV)

~20 tons for a 4-person crew

Eventually: Agriculture/Hydroponics

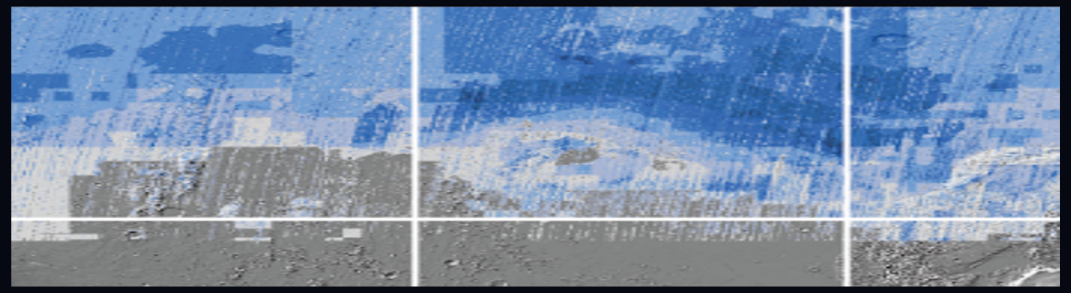
Other major uses:

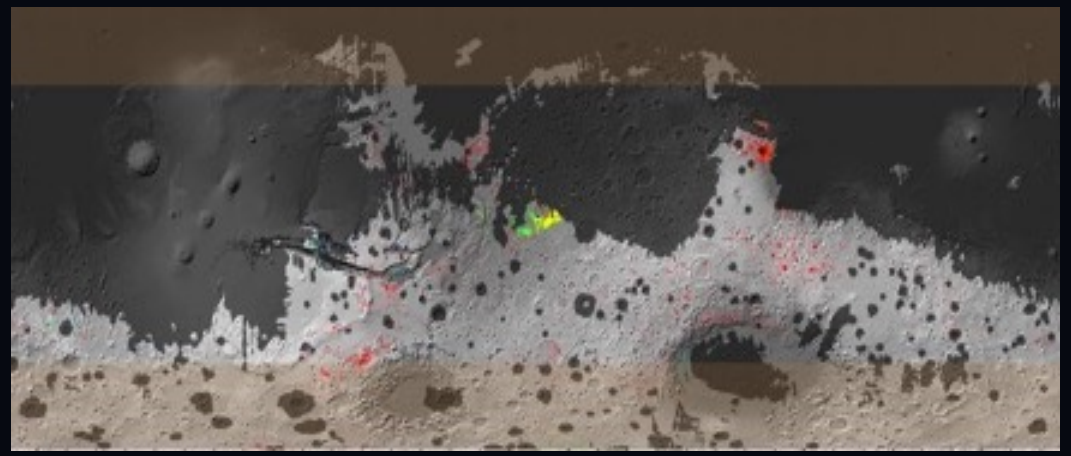
- Crew health, hydration, and hygiene
- Regulating oxygen, pressure, and humidity
- Material for construction and radiation shielding
- Cooling for space suits and equipment

MARS

Post-HLS2 Workshop Next Step Accomplishments

- Multiple multi-directorate “next step” activities resulted in significant changes to the knowledge state, with implications for identifying candidate landing sites at the next HLS^2 workshop (i.e., modified criteria/constraints to test the validity of the EZ concept)
- Several studies commissioned to reduce uncertainties related to water resources, providing some of the most sophisticated understandings of Martian water to date:





Global Water-Ice Map (complete 6/20)

- Integrates all existing relevant data and models
- Seeks to determine available water-ice resources in the mid-latitudes and as far equatorward as possible

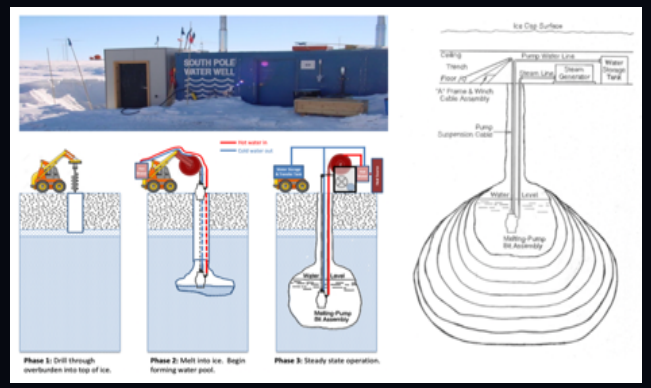
Global Hydrated Minerals Map (2/20 completed 2-year contract that built on a 10-year mapping effort)

- Illustrates that only 30% of Mars can be assessed for the presence of hydrated minerals given dust cover/other mantling, as well as landing-related latitude and elevation constraints
- Documents uncertainties about abundance given measurement challenges
  e.g., data for only first few microns of surface; mantling obscures signature detection in many places, unknown structure of minerals (i.e., hard material or one that crumbles, the latter of which is better for ISRU) etc.

Post-HLS2 Workshop Next Step Accomplishments

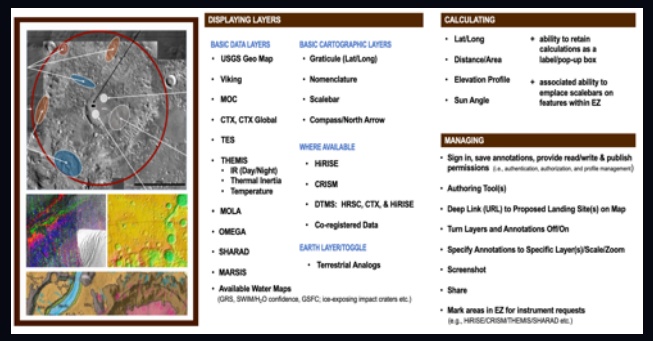
Mars Water ISRU Planning (M-WIP) Study (4/16)

- Highlighted knowledge gaps for systems to access and extract water
- Characterized the potential of water-ice and hydrated-mineral ISRU systems to meet estimated human mission water demands
- First attempt to evaluate potential ISRU systems: mass, power, and operational complexity



Trade Study on Water ISRU (7/16)

- Rodriguez Well (Rodwell) approach for water-ice resources determined potentially best approach
  - a hole in the ice slowly expanded by melting and pumping water out
  - most efficient re. power even if the water-ice feedstock is up to 50 km from the main ISRU plant/MAV
  - while significantly higher mass, given the power savings, still the best option
  - operational complexity being studied based on use in Antarctica, modified for the Martian environment



Mars Geographic Information Systems (GIS) Workshop (1/17) & Community Survey (12/19)

- Assessed the state of Mars GIS systems and solicited feedback from the Mars GIS and HLS^2 communities on tasks to meet landing-site-selection needs
- Created a steering committee to develop detailed task statements based on community input
- Completed extensive community survey that provided data on the community's capabilities, assessed needs, and collected ideas on data tools and displays for EZ characterization and evaluation

MARS

Potentially Needed Recon Thrusts

From the International Mars Exploration Working Group

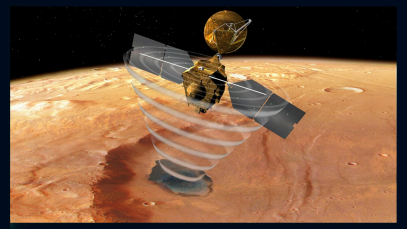
Make History: the 1st Roundtrip Demonstration

Confirm the mechanical properties of the regolith/dust
- abrasiveness, oxidizing potential, particle size etc. -

- how it will interact with surface systems
(suits, rovers, habitats)

- potential human health hazards
(toxicity, respiratory, potential extant life)

WATER RECONNAISSANCE



Identify Near-surface Ice

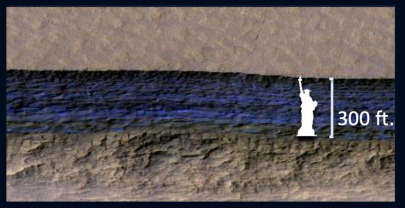
Assess Potential
of Hydrated Minerals

Groundtruthing

SPECIAL REGIONS DRILL

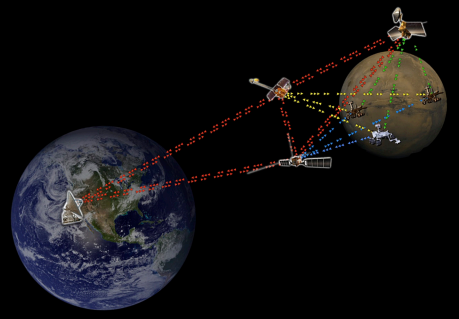
Search for Life

Characterize the Water
- for ISRU
- for human use



- Ease of Access -

Next-gen High-Res Imaging
(Visual, IR, Radar)
- Target 80% Planetary Coverage
- Compactness of Surface
- Support Change Detection
- Rock Count/Terrain Roughness
- Slope



Next-gen Communications
- Increased Data Rate
- Support Small Missions
- Support Change Detection
- Greater Access to Surface Assets (Data & Communications)

Next-gen Weather
(Orbital & Surface)
- Density Profiles (EDL)
- Winds Aloft
- Potential Microbial Transport

Mars is a
Human Effort

We Need Ideas

For more information contact us:

http://www.nasa.gov/journeytomars/mars-exploration-zones

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