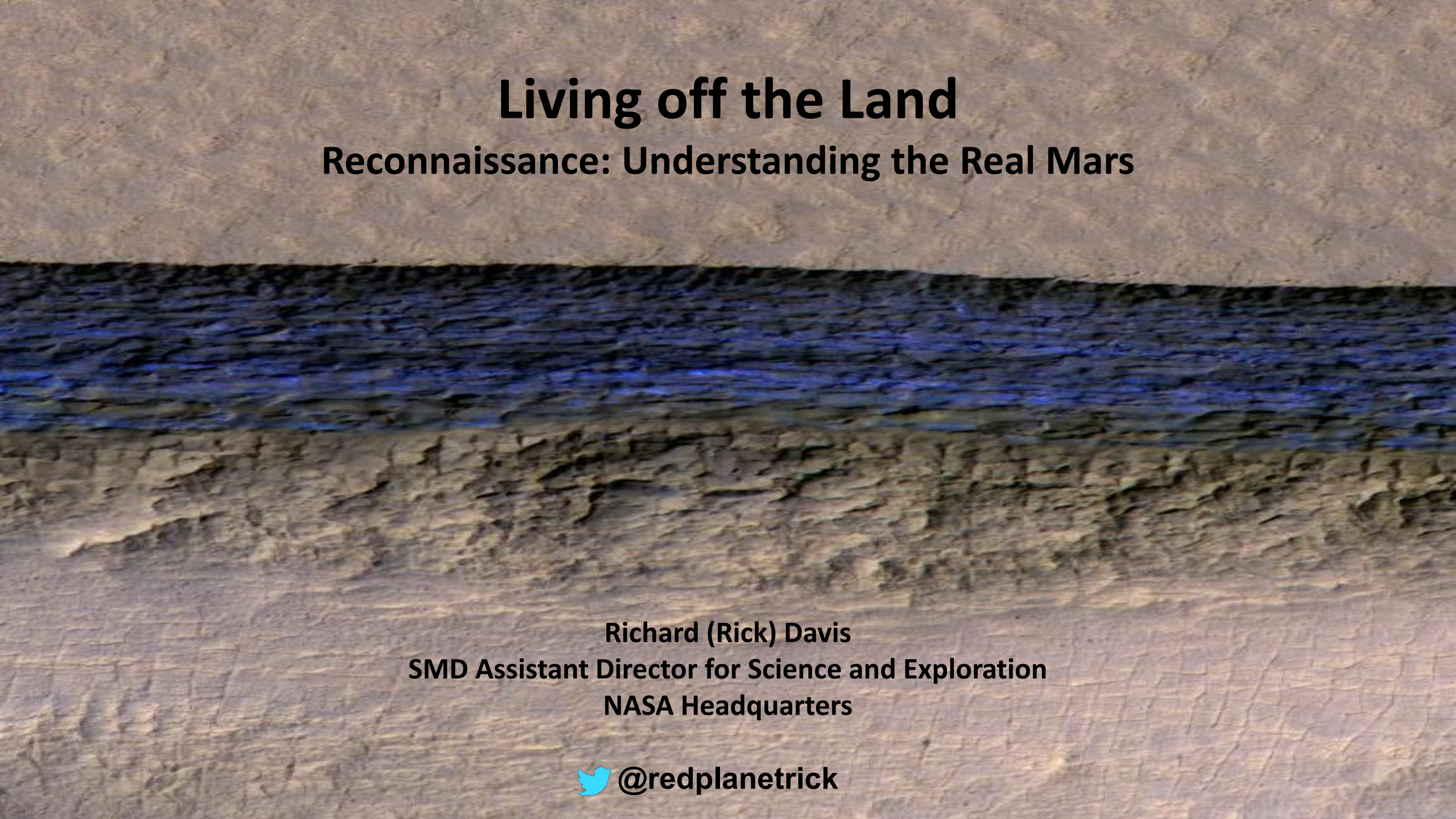


Living off the Land

Reconnaissance: Understanding the Real Mars

Richard (Rick) Davis
SMD Assistant Director for Science and Exploration
NASA Headquarters

@redplanetrick

The Real Mars

We must not be fooled into thinking it is easy –

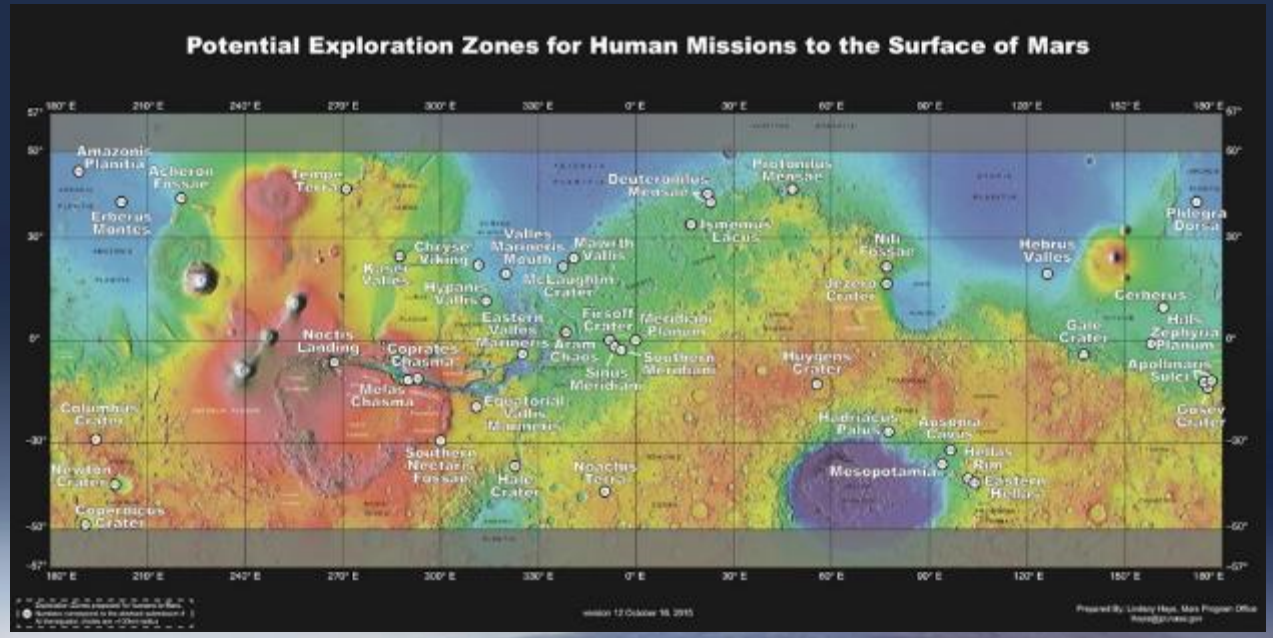
Mars is closer to the extreme heights of the Himalayas than it is to the peaceful (if hot) deserts on Earth.

MARS

Water and the Human Landing Sites Study (HLS2)

Goal of Study: Identify landing sites for human surface exploration of Mars.

- These landing sites provide access to Exploration Zones (EZs) which are regions on Mars that contain multiple sites of scientific interest as well as satisfying engineering and human constraints for human exploration.
- Leverage Mars Reconnaissance Orbiter (MRO) data collection capabilities to acquire data of potential prioritized human Mars landing sites within the exploration zones
- Establish a database of high interest sites—science and resources, which can easily be updated as we learn more about Mars and what is needed to support humans on the planet
- Inform future reconnaissance needs (particularly water) at Mars—orbital and landed missions



This effort is a joint Human Exploration and Operations Mission Directorate (HEOMD) / Science Mission Directorate (SMD) study

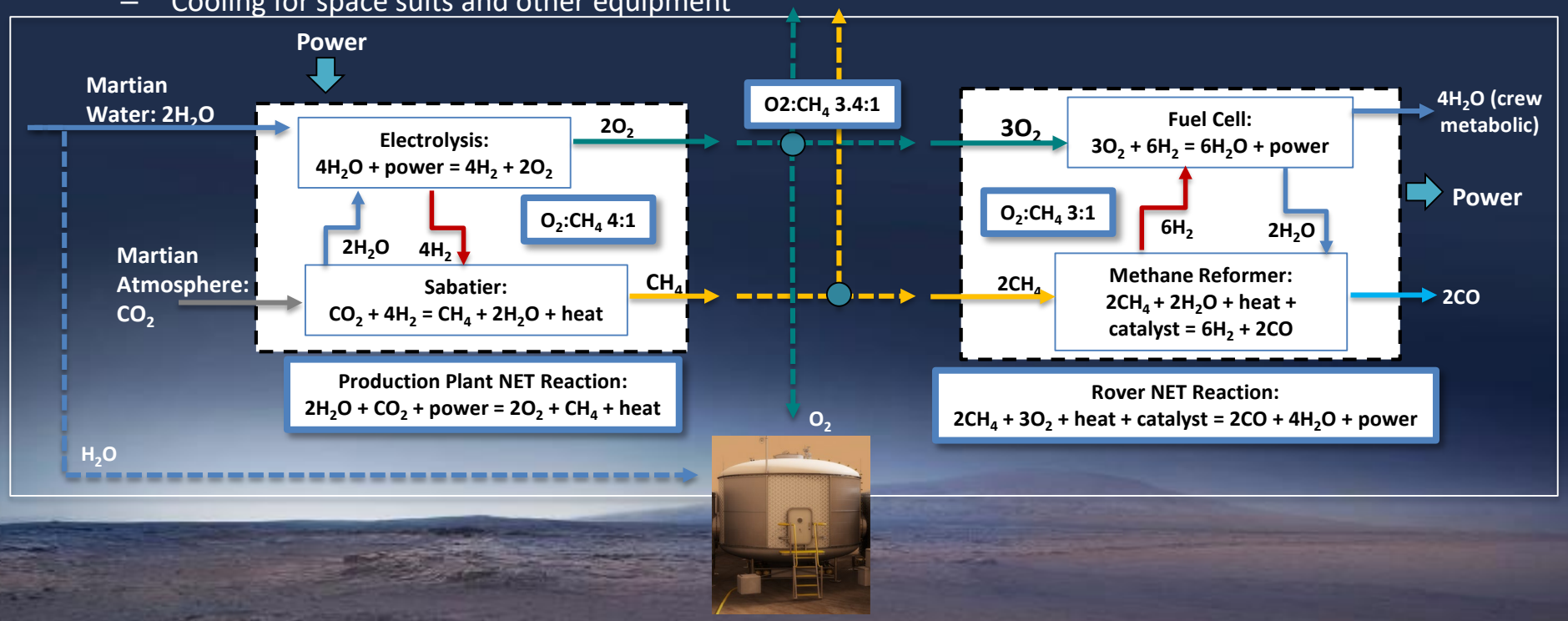
Workshop Significantly Increased Awareness of Importance of Water

- Workshop significantly increased the Agency's awareness of the availability of water on Mars and the potential of water resources there to enhance human surface operations.
  - Fuel the Mars Ascent Vehicle, consumption, agriculture, etc…
- HLS2 work has also increased the understanding that water reconnaissance and ISRU technology development are integrally tied. Since the workshop, two studies have been completed to better understand potential of water feedstocks and what it takes in the form of ISRU equipment to produce water from those feedstocks.
  - https://www.nasa.gov/sites/default/files/atoms/files/mars_ice_drilling_assessment_v6_for_public_release.pdf
  - https://mepag.jpl.nasa.gov/reports/Mars_Water_ISRU_Study.pdf
- Reassessing mission architectures assuming a water rich environment.

MARS

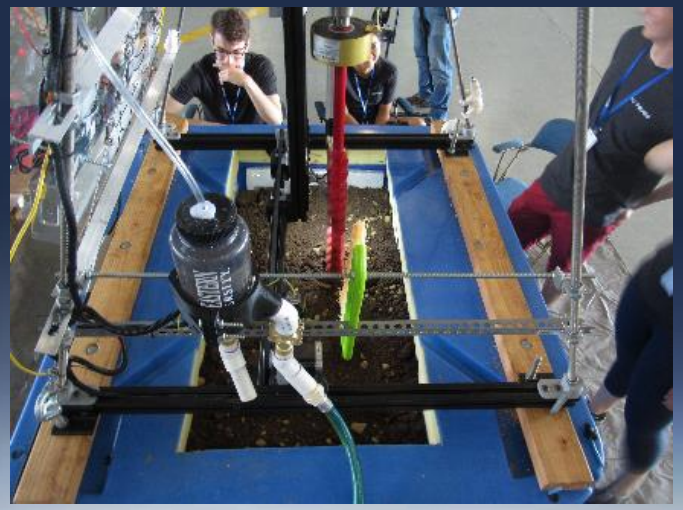
How Would a Mars Mission Use Abundant Water?

- Highest water mass requirements:
  - Propellant for MAV (~20 tons for a four-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 other equipment



Creatively Using the Tools Available to Us

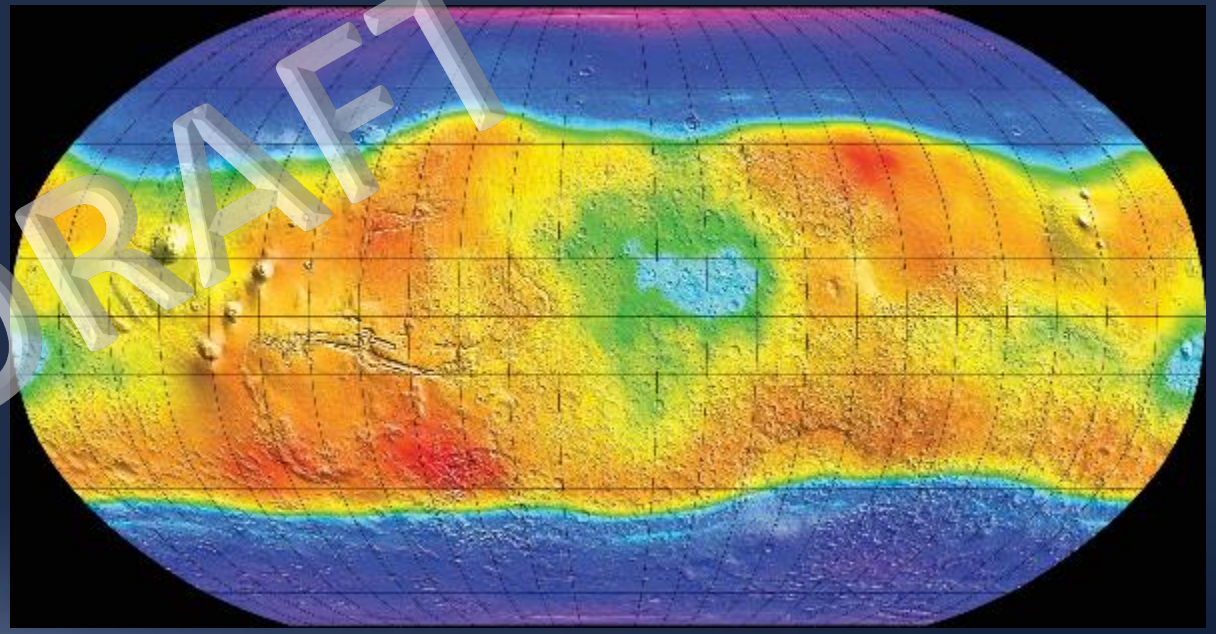
- Creative Partnerships (International and Commercial)
- Small Missions
- STEM Programs and Competitions
- Analog Missions
- Others?



Potentially Needed Future Missions

From International Mars Exploration Working Group

- Mars Sample Return
  - Accomplish Decadal Science Priorities
  - In addition, MSR is probably needed to confirm the mechanical properties of the regolith/dust (abrasiveness, oxidizing potential particle size, etc.), how it will interact with surface systems (e.g., suits, rovers, habitats, etc.), and potential human health hazards (toxicity, respiratory, potential extant life, etc.).
- Water Recon
  - Identify near surface ice
  - Assess Potential of Hydrated Minerals
  - Ground Truthing
  - Ease of access
- Special Regions Drill
  - Search for life
  - Characterize the water
    - For ISRU
    - For potential human use
- Next-Gen Weather Capabilities (Orbital and Surface)
  - Density Profiles
    - (EDL)
  - Winds Aloft
  - Potential Microbial Transport
- Improved Communications
  - Increased data rate



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

Twitter: @RedPlanetRick

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NASA-Mars-Exploration-Zones@mail.nasa.gov