



Mars System Reconnaissance Panel

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Data and Mission Needs for Human Landing Site Selection

Sydney Do, Ph.D. (NASA Jet Propulsion Laboratory, California Institute of Technology)

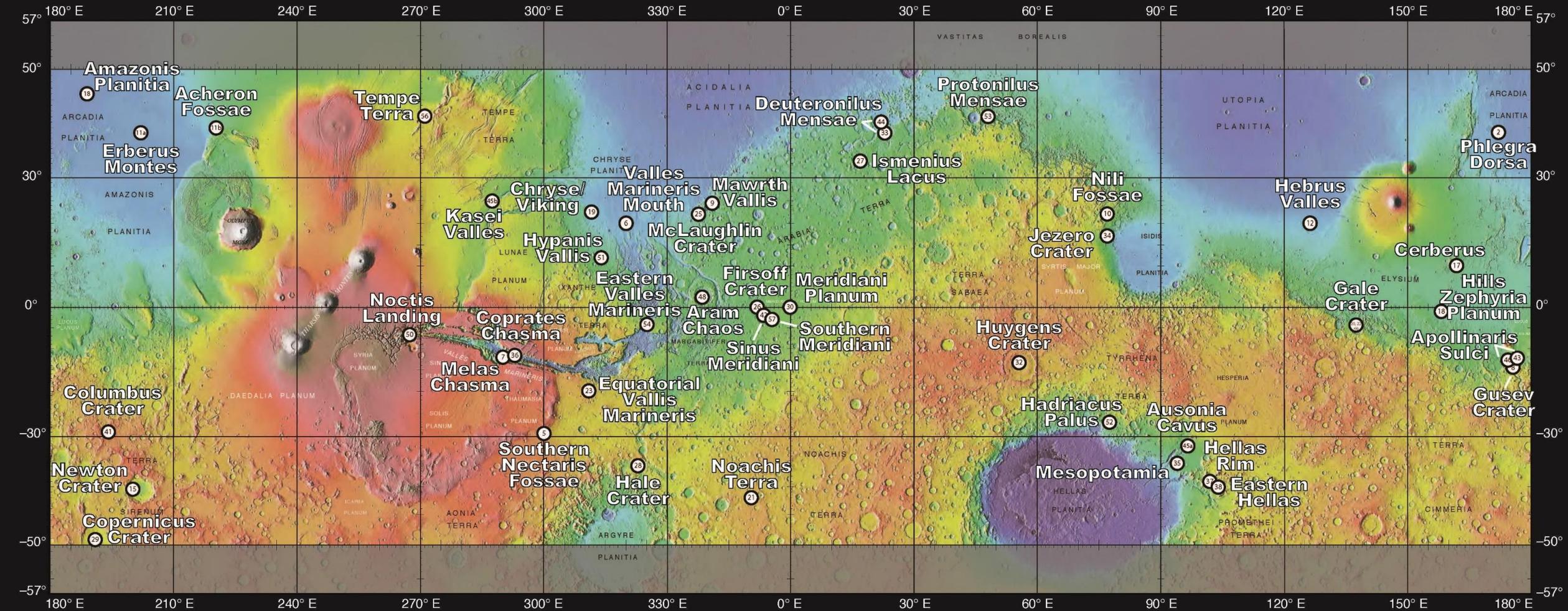
Humans to Mars Summit 2018, May 8-10, 2018, The George Washington University, Washington D.C.

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Pre-Decisional Information -- For Planning and Discussion Purposes Only



Where should we land humans on Mars?



- - - - - Exploration Zones proposed for humans to Mars. - - - - -
 (1-56) Numbers correspond to the abstract submission #
 At the equator, circles are ~100km radius.

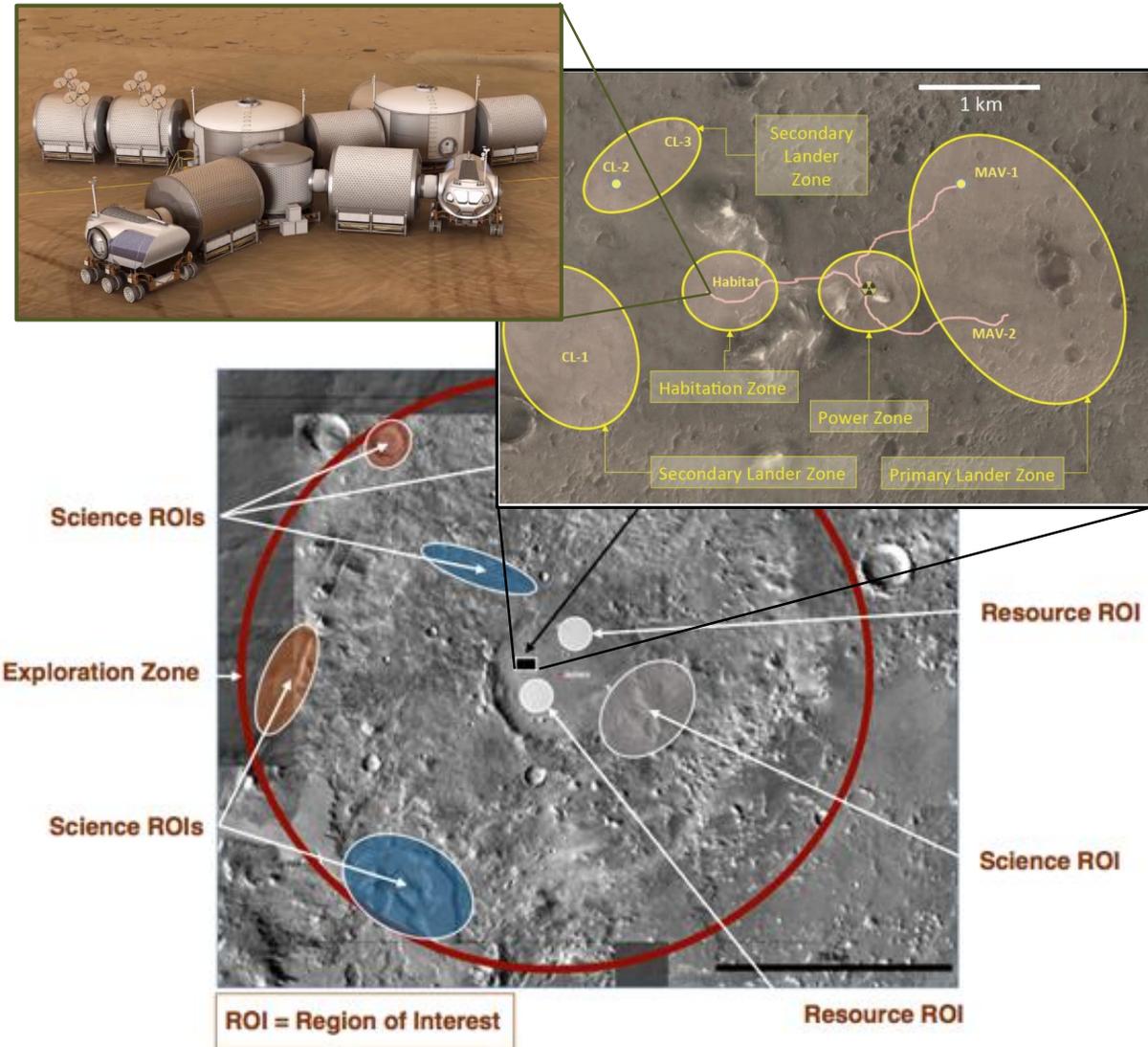
version 12 October 16, 2015

Prepared By: Lindsay Hays, Mars Program Office
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Exploration Zone (EZ) – Current Definition



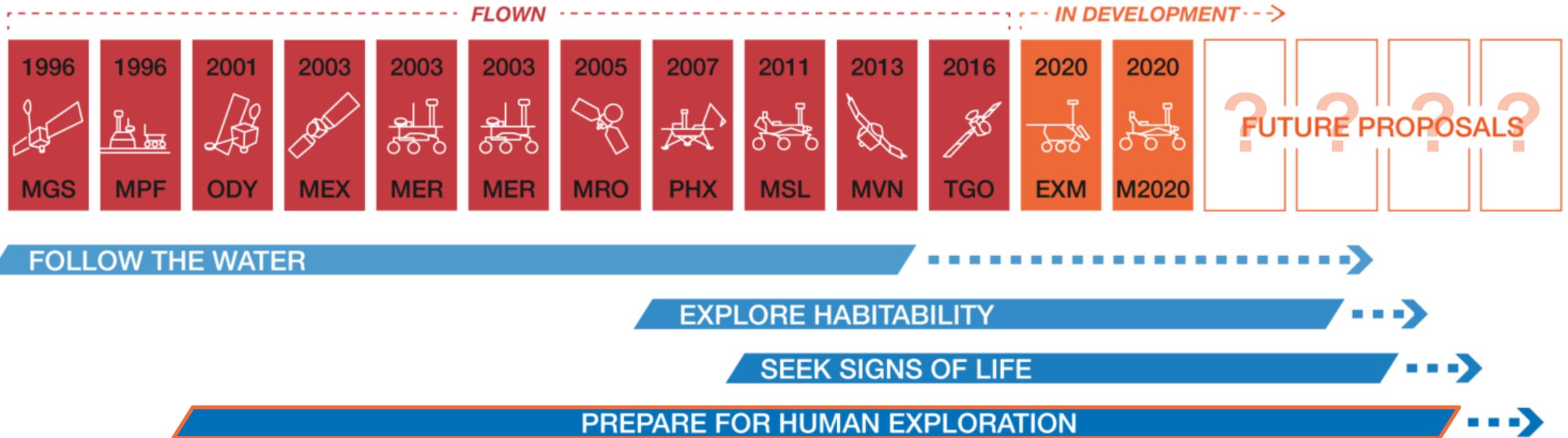
- 100km radius site at latitude band: $\pm 50^\circ$
- Contains:
 - **Habitation Site:** Flat, stable terrain for emplacement of infrastructure, located $\leq 5\text{km}$ from landing site location
 - **Landing Site(s):** Flat, stable terrain, low rockiness, clear over length scales greater than landing ellipse
 - **Resource Regions of Interest**
 - One or more potential near-surface ($\leq 3\text{m}$) **water resource feedstocks** in a form that is minable by highly automated systems, and located within $\sim 1\text{-}3\text{km}$ of ISRU processing and power infrastructure. Total extractable water should be $\sim 100\text{MT}$ (supports ~ 5 missions)
 - Show potential for minable metal/silicon resources, mainly Fe, Al, and Si, located within $\sim 1\text{-}2\text{m}$ of the surface
 - **Science Regions of Interest**
 - Related to Astrobiology, Atmospheric Science, and Geoscience



What data do we need to inform landing site selection?



EVOLVING SCIENCE STRATEGIES FOR MARS EXPLORATION



What future missions are needed to gather this “reconnaissance” data?

Key Mars System Reconnaissance Data Needs



Hazard Potential of Regolith and Dust on Humans and Systems



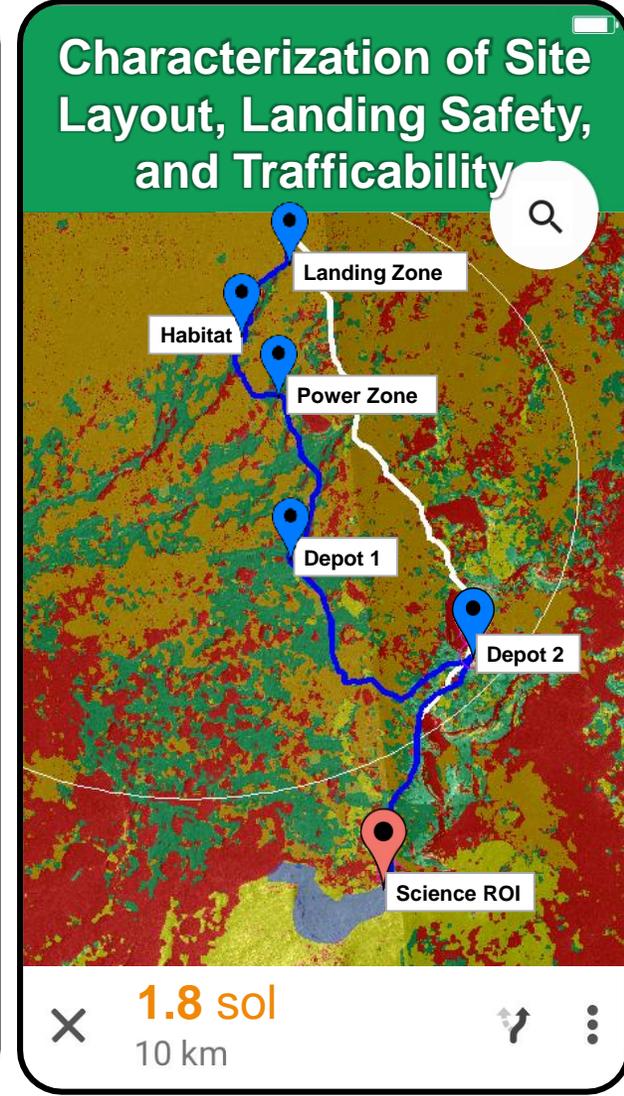
Characterization of Upper & Lower Atmosphere and Surface Pressure Conditions



Resource Mapping and Characterization



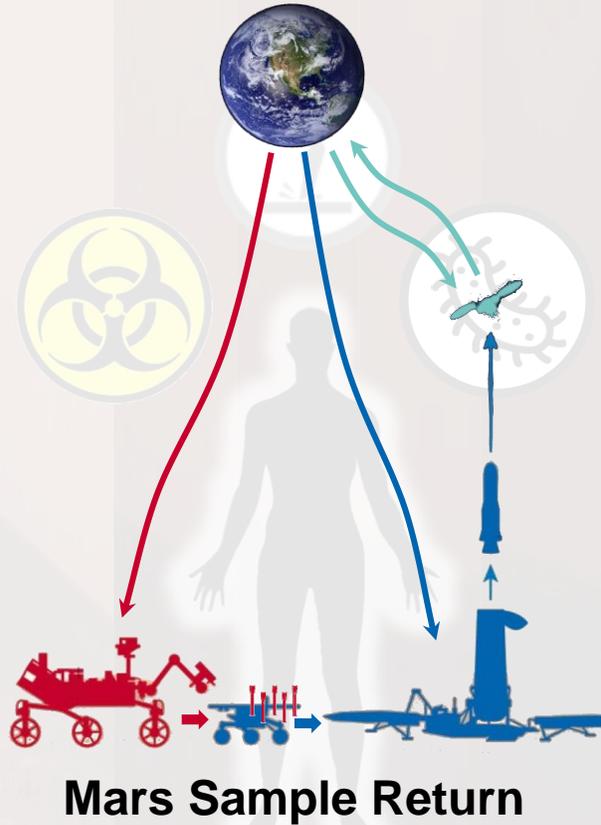
Characterization of Site Layout, Landing Safety, and Trafficability



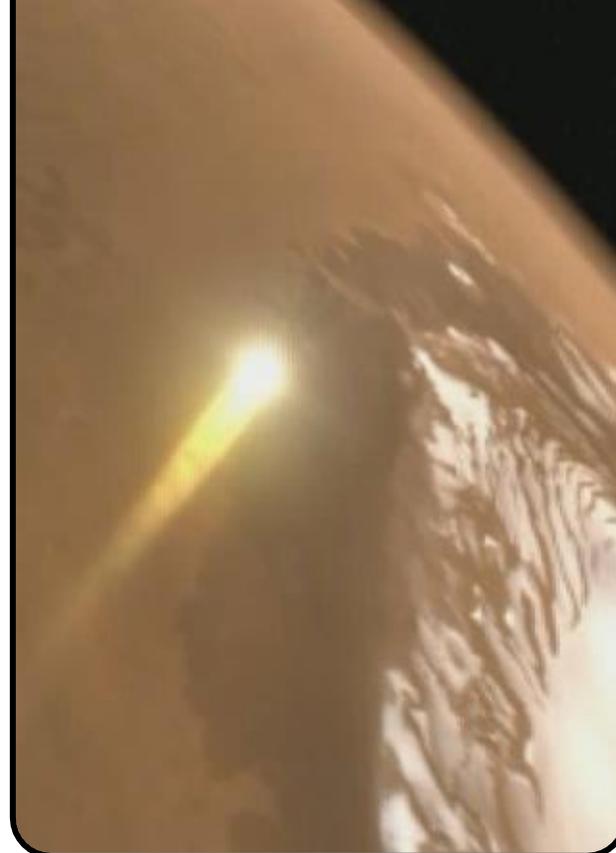
Mars System Reconnaissance – Enabling Missions



Hazard Potential of Regolith and Dust on Humans and Systems



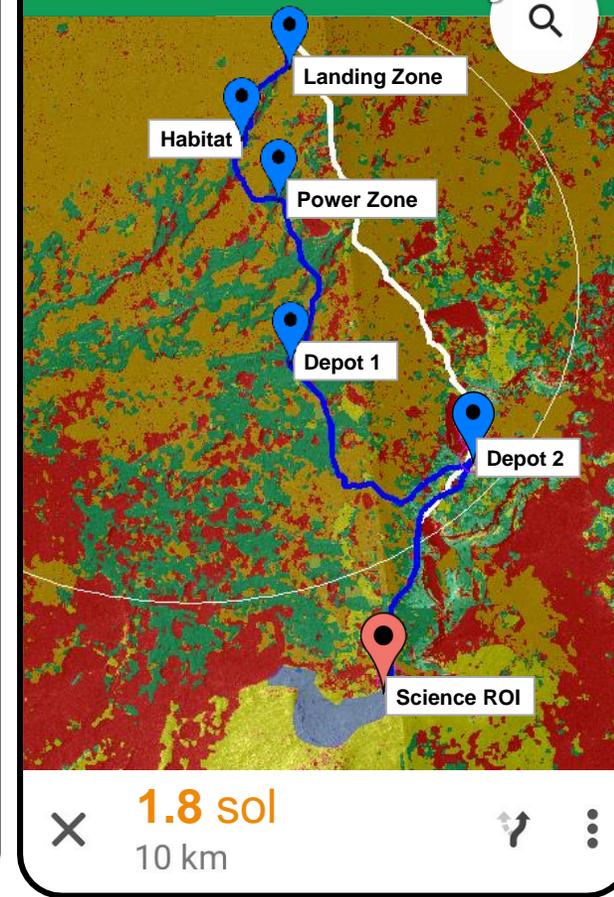
Characterization of Upper & Lower Atmosphere and Surface Pressure Conditions



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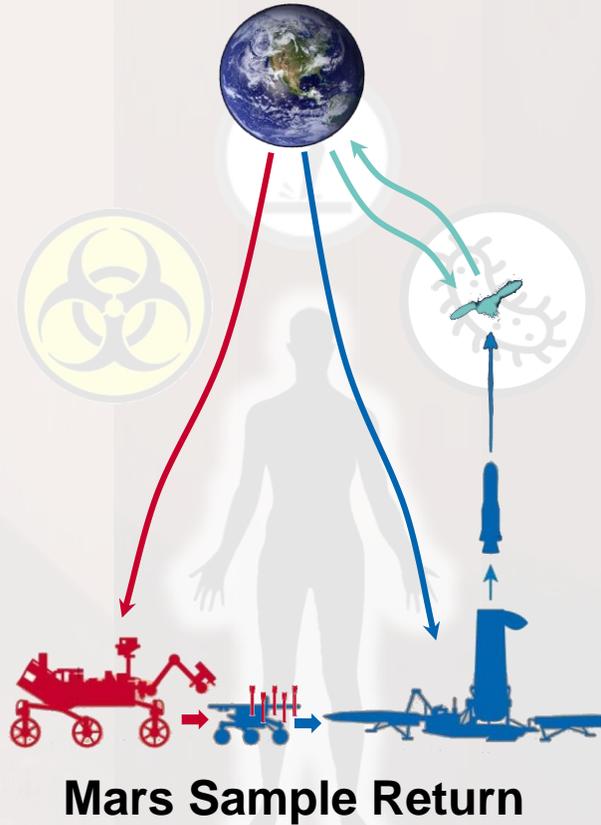
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Mars System Reconnaissance – Enabling Missions

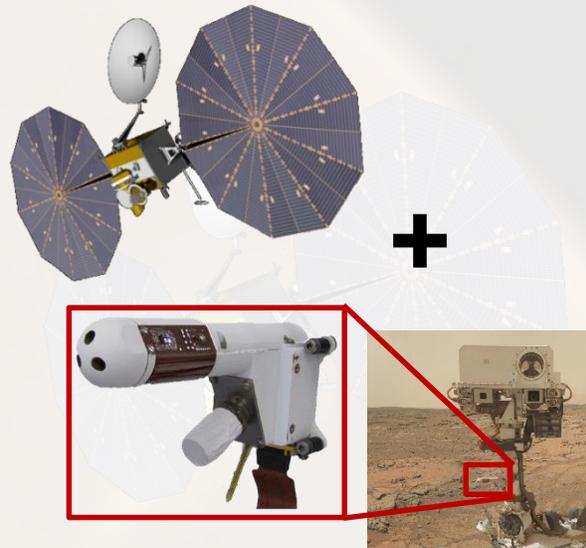


Hazard Potential of Regolith and Dust on Humans and Systems



Mars Sample Return

Characterization of Upper & Lower Atmosphere and Surface Pressure Conditions

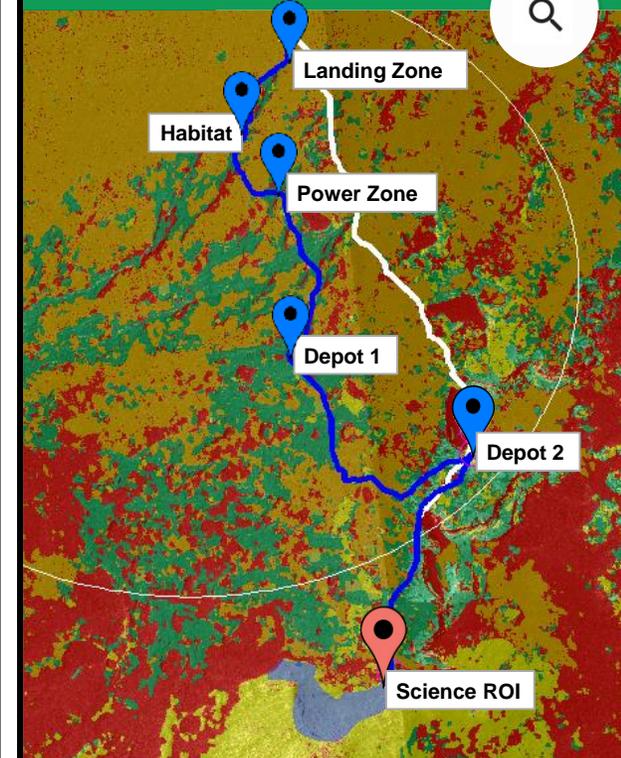


Orbiting Atmospheric Sounder Instrument + Surface Weather Packages

Resource Mapping and Characterization



Characterization of Site Layout, Landing Safety, and Trafficability

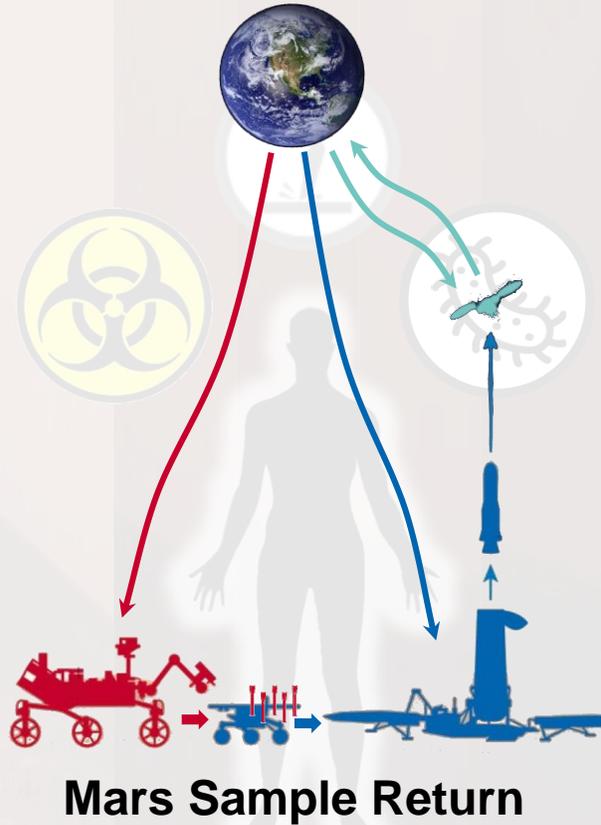


1.8 sol
10 km

Mars System Reconnaissance – Enabling Missions

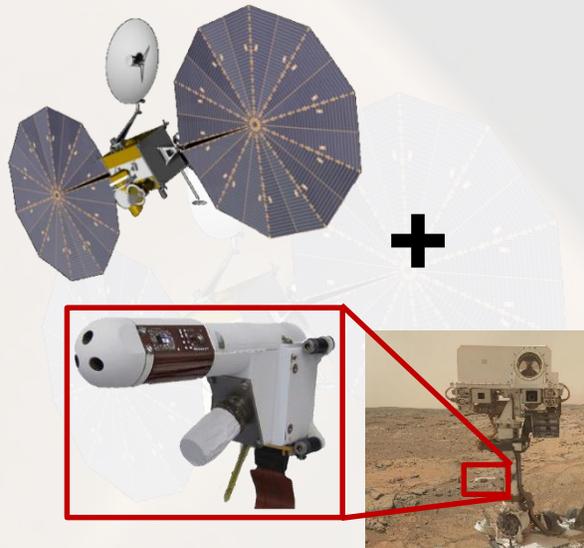


Hazard Potential of Regolith and Dust on Humans and Systems



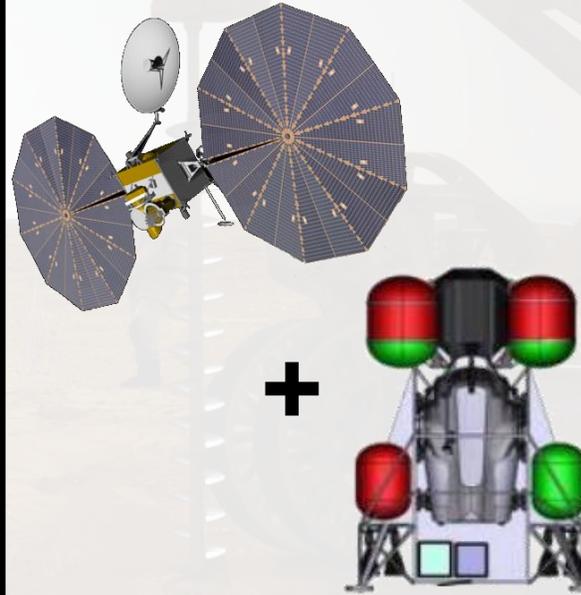
Mars Sample Return

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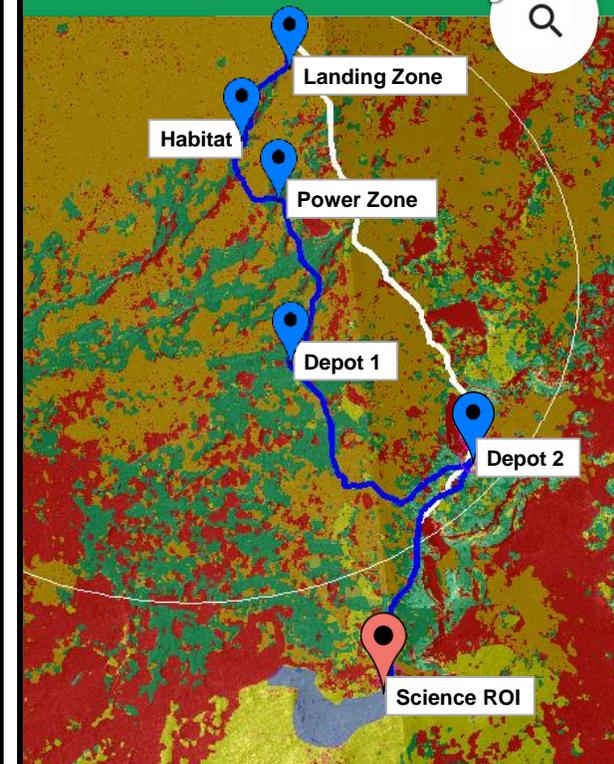
Orbiting Atmospheric Sounder Instrument + Surface Weather Packages

Resource Mapping and Characterization



Mapping Orbiter + Ground-Truthing Lander(s)

Characterization of Site Layout, Landing Safety, and Trafficability

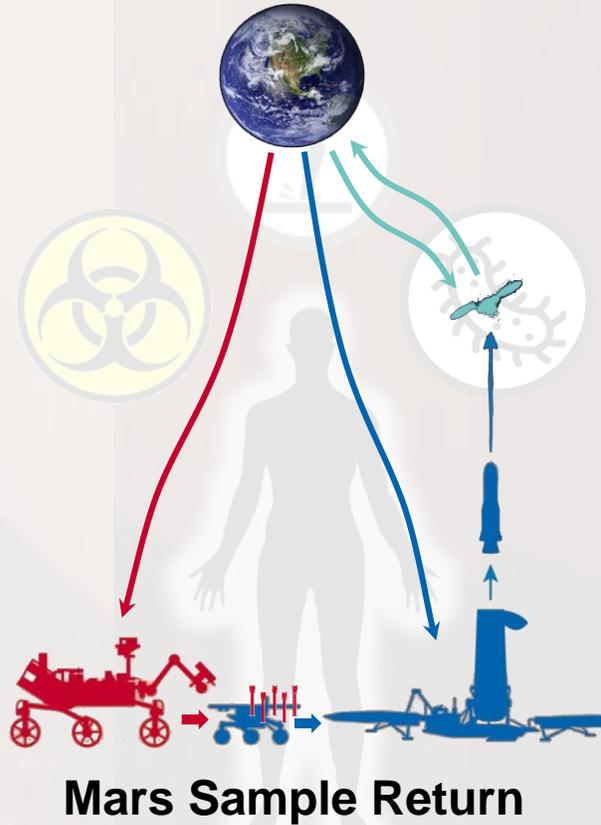


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Mars System Reconnaissance – Enabling Missions

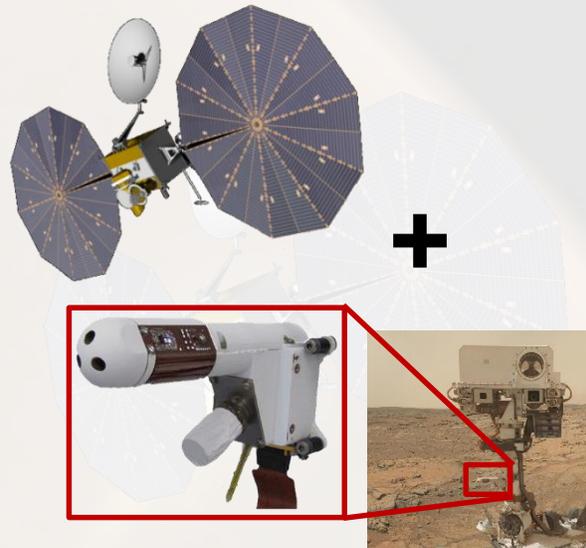


Hazard Potential of Regolith and Dust on Humans and Systems



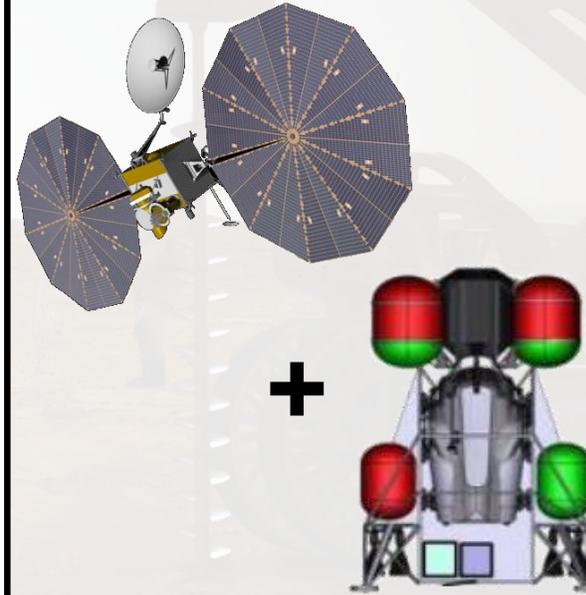
Mars Sample Return

Characterization of Upper & Lower Atmosphere and Surface Pressure Conditions



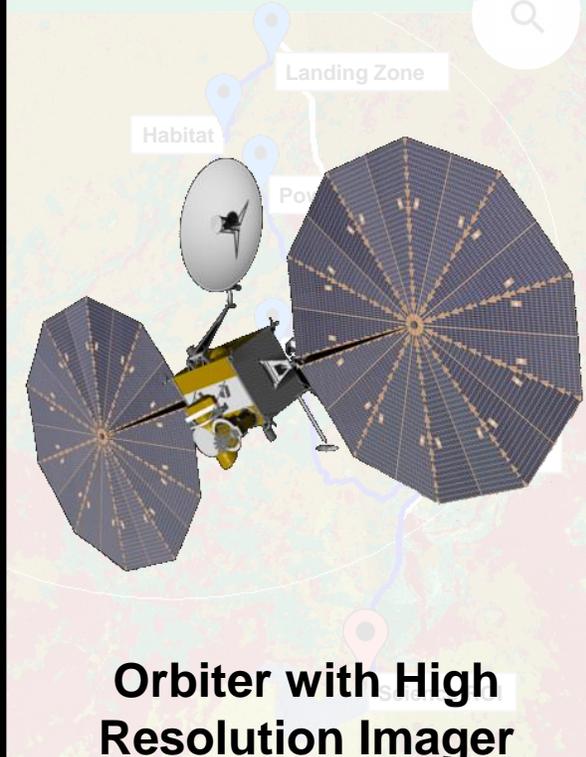
Orbiting Atmospheric Sounder Instrument + Surface Weather Packages

Resource Mapping and Characterization



Mapping Orbiter + Ground-Truthing Lander(s)

Characterization of Site Layout, Landing Safety, and Trafficability



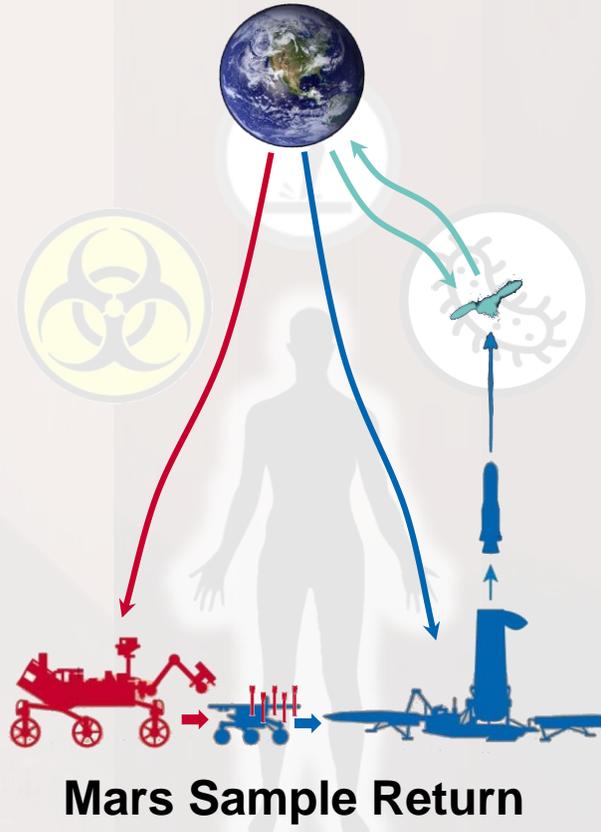
Orbiter with High Resolution Imager

1.8 sol
10 km

Mars System Reconnaissance – Enabling Missions

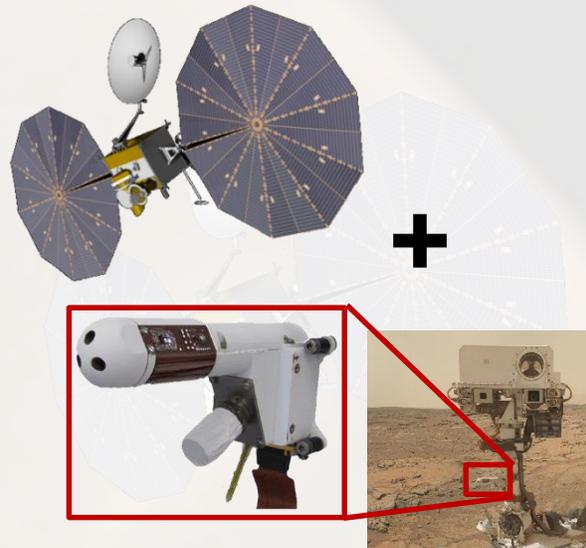


Hazard Potential of Regolith and Dust on Humans and Systems



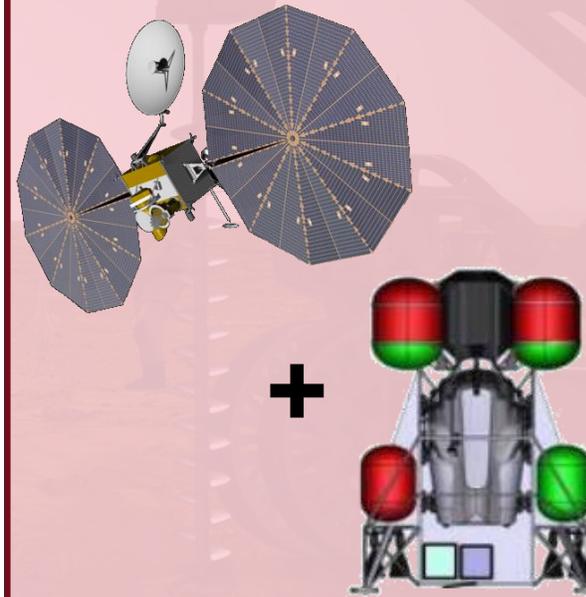
Mars Sample Return

Characterization of Upper & Lower Atmosphere and Surface Pressure Conditions



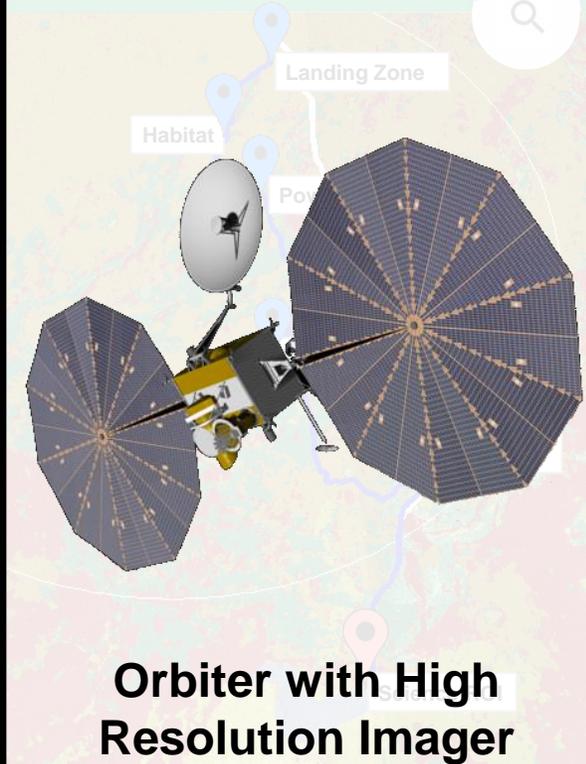
Orbiting Atmospheric Sounder Instrument + Surface Weather Packages

Water Resource Mapping and Characterization



Mapping Orbiter + Ground-Truthing Lander(s)

Characterization of Site Layout, Landing Safety, and Trafficability



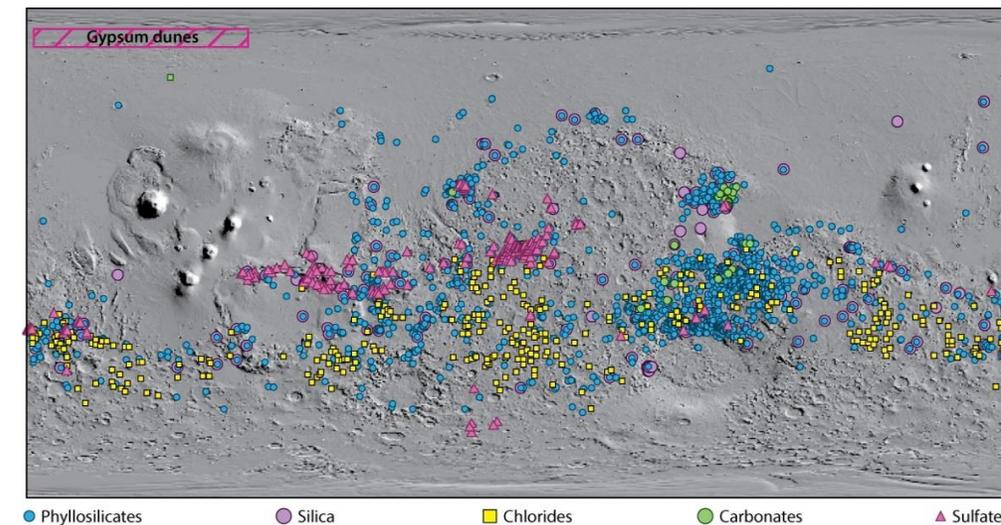
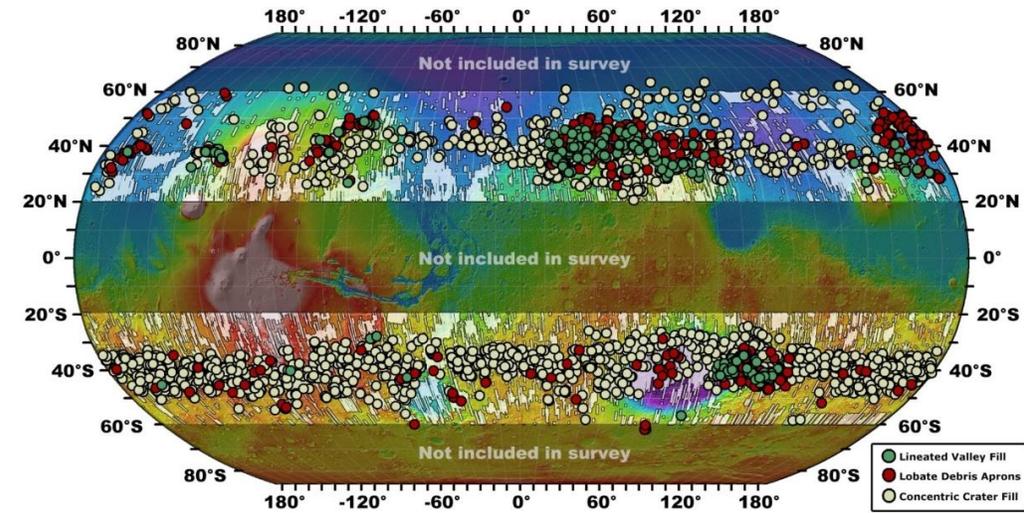
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10 km

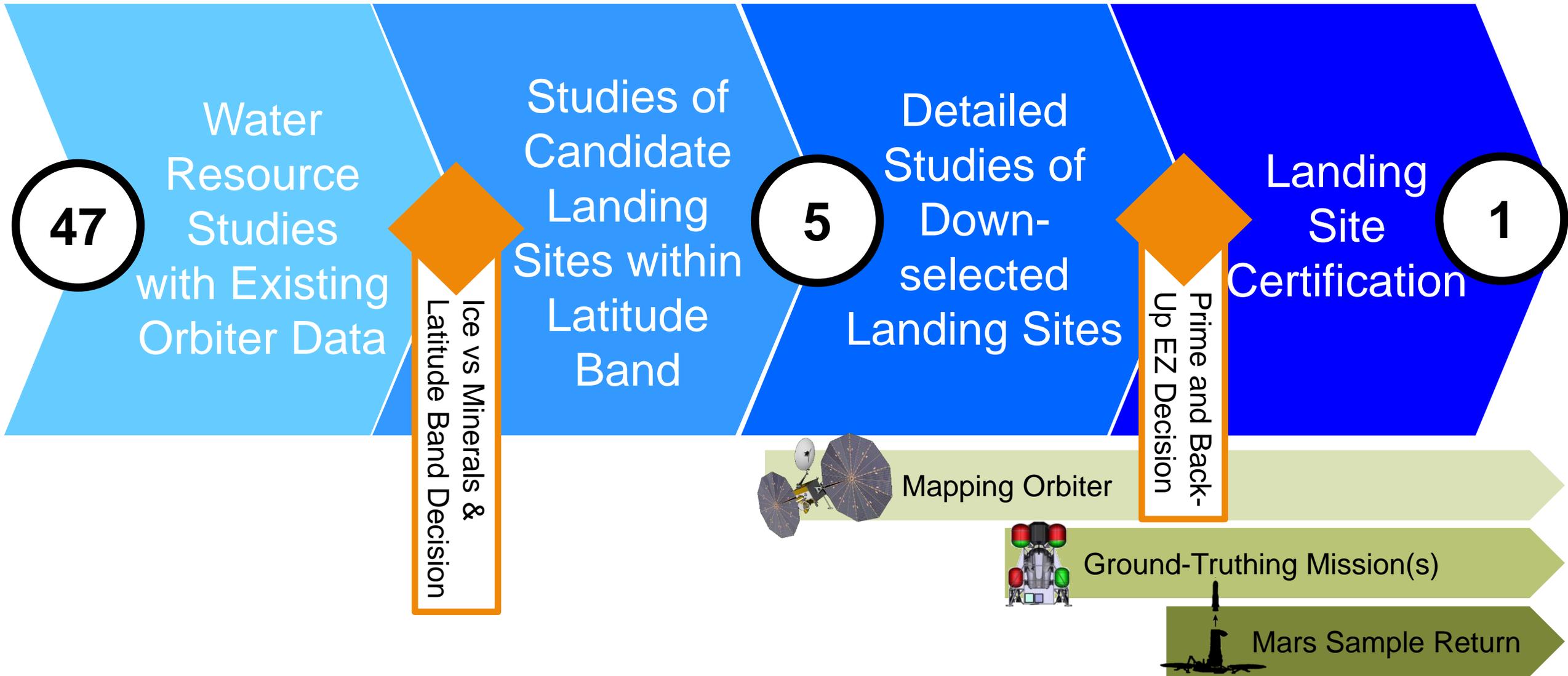
Near-Term Work: Mars Water Mapping Projects



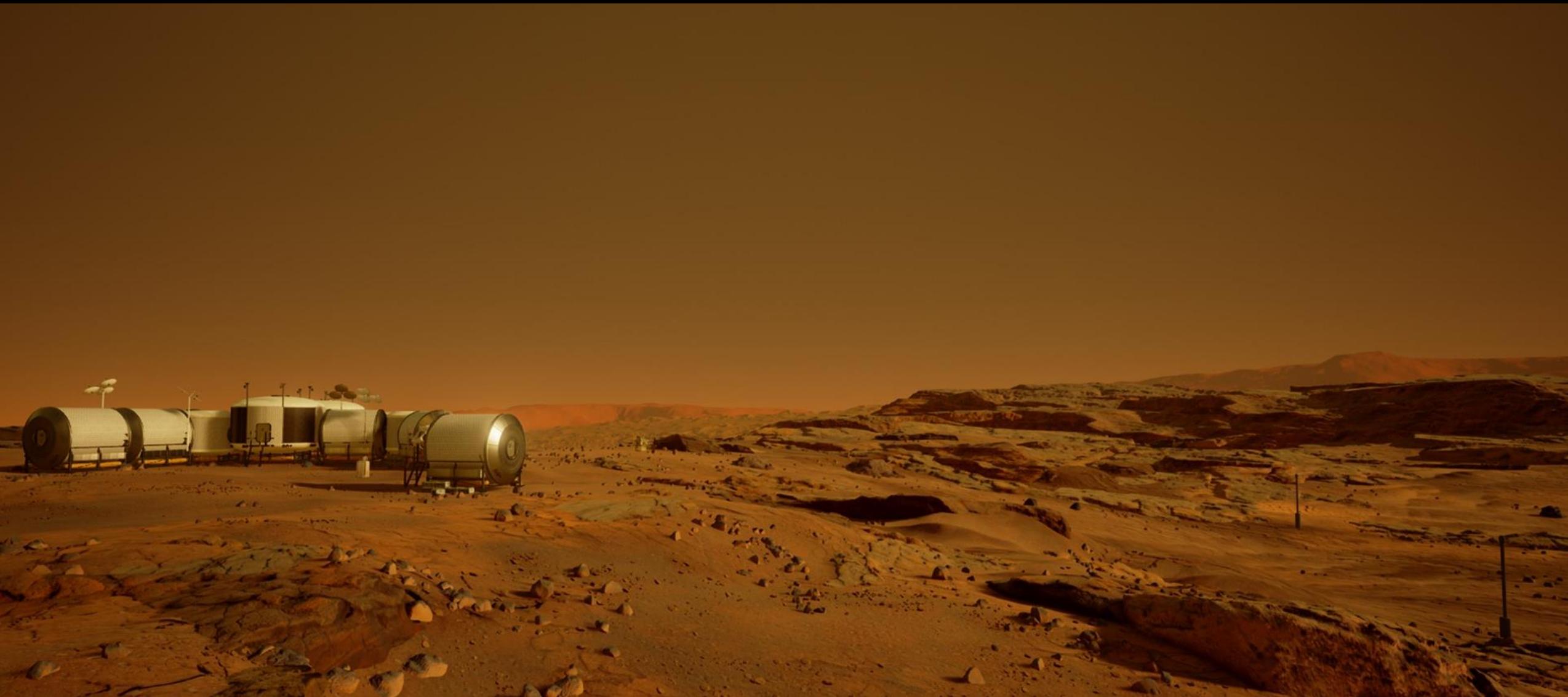
- Ongoing projects to create the best possible maps of water distribution by combining currently available orbiter data
- Two teams selected for each of two types of mapping projects:
 - **Task A – Subsurface Ice Mapping (Proof of Concept)**
 - *Within a single 5-10° wide longitudinal swath from 0°-60°N latitude, generate a map that identifies potential locations of subsurface water ice at low- to mid-latitudes and characterizes the nature of the gradational boundary from regions of continuous ice to discontinuous ice, through to regions of no ice.*
 - **Task B – Hydrated Minerals (Global Map)**
 - *Develop algorithms to partially automate the processing of spectra of hydrated mineral detections. Use developed algorithms to generate global map of all existing near-surface hydrated mineral detections*
- Maps expected April 2019



Notional Path Forward for Mars Human Landing Site Selection



Thank You!



May 9th 2018

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