

Columbia Base: The Dawn of a New Era

Abstract #1008

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Why Go To Mars?

1st EZ Workshop for Human Missions to Mars



“It is difficult to say what is impossible, for the dream of yesterday is the hope of today and the reality of tomorrow.”

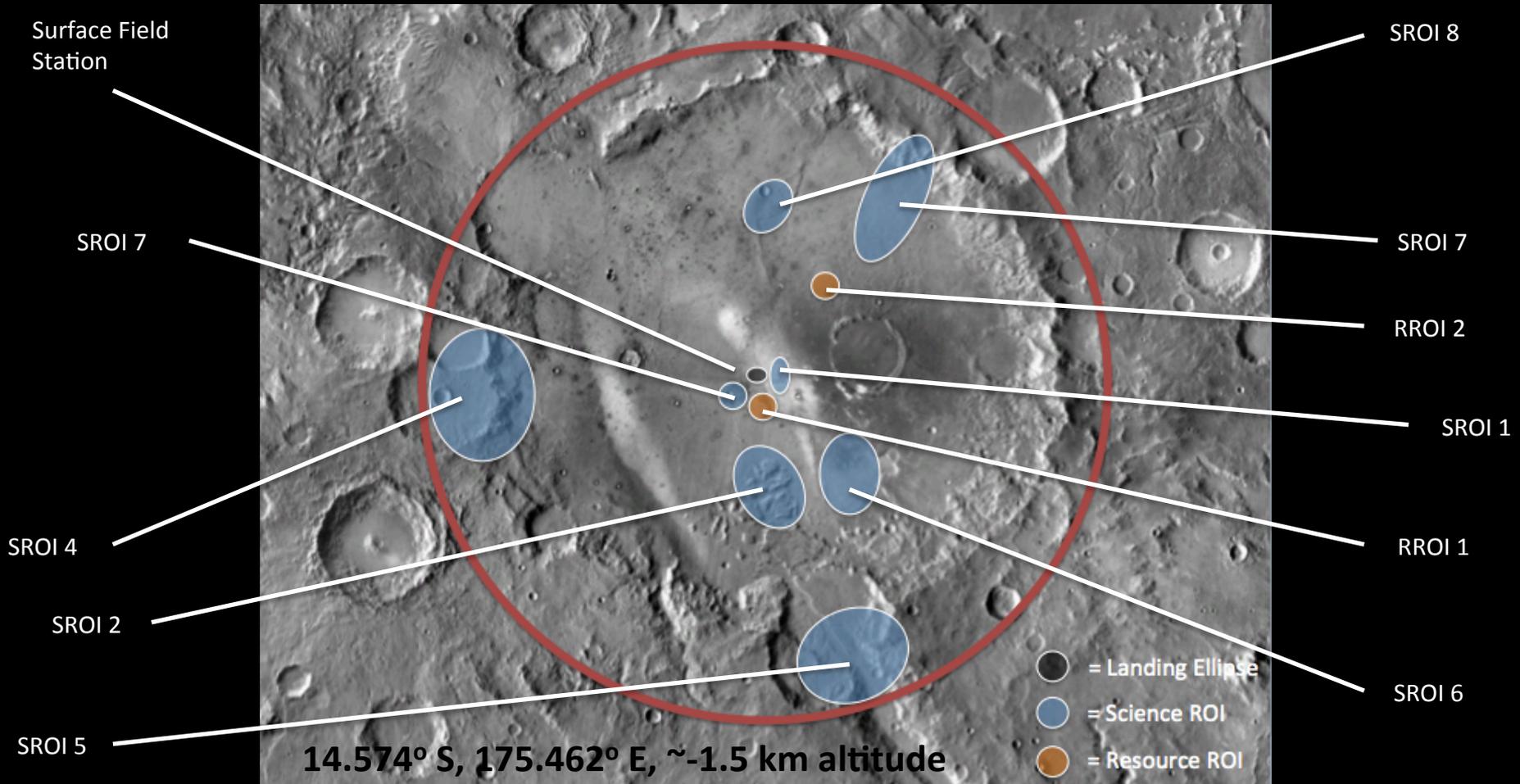
- Robert Goddard

“We choose to go to the Moon in this decade and do the other things, not because they are easy, but because they are hard.”

- John F. Kennedy

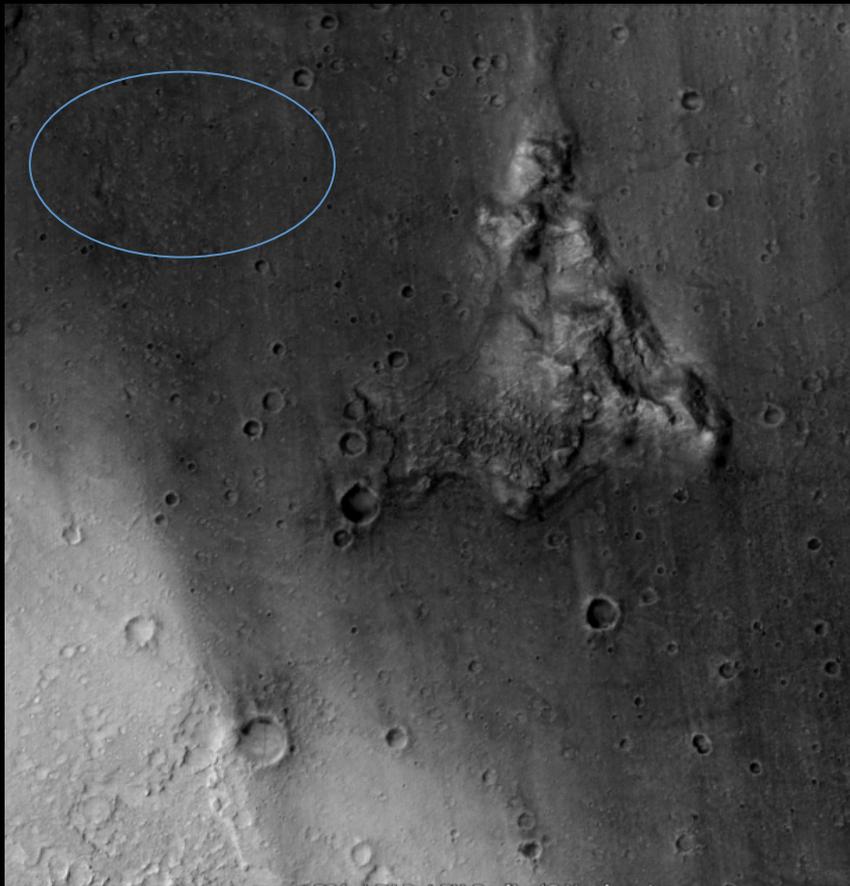
Exploration Zone Map

1st EZ Workshop for Human Missions to Mars



Engineering Safety

1st EZ Workshop for Human Missions to Mars



- Few landing site obstructions
- Easily navigable by a human pilot
- Adjacent to science, resources
- Traversable EZ

Science ROI(s) Rubric

1st F7 Workshop for Human Missions to Mars



Site Factors			SROI 1	SROI 2	SROI 3	SROI 4	SROI 5	SROI 6	SROI 7	SROI 8	RROI 1	RROI 2	EZ SUM		
Astrobio	Threshold	AND/OR	Potential for past habitability												
		Potential for present habitability/refugia													
	Qualifying	Potential for organic matter, w/ surface exposure													
Atmospheric Science	Threshold	Noachian/Hesperian rocks w/ trapped atmospheric gases													
	Qualifying	Meteorological diversity in space and time													
		High likelihood of surface-atmosphere exchange													
		Amazonian subsurface or high-latitude ice or sediment													
		High likelihood of active trace gas sources													
Geoscience	Threshold	Range of martian geologic time; datable surfaces													
		Evidence of aqueous processes													
		Potential for interpreting relative ages													
	Qualifying	Igneous Rocks tied to 1+ provinces or different times													
		Near-surface ice, glacial or permafrost													
		Noachian or pre-Noachian bedrock units													
		Outcrops with remnant magnetization													
		Primary, secondary, and basin-forming impact deposits													
		Structural features with regional or global context													
		Diversity of aeolian sediments and/or landforms													

- Yes
- Partial Support or Debated
- No
- ? Indeterminate

DISCLAIMER: This rubric was filled out by an amateur planetary scientist. It is intended to simply serve as a source to influence further discussion.

Resource ROI(s) Rubric

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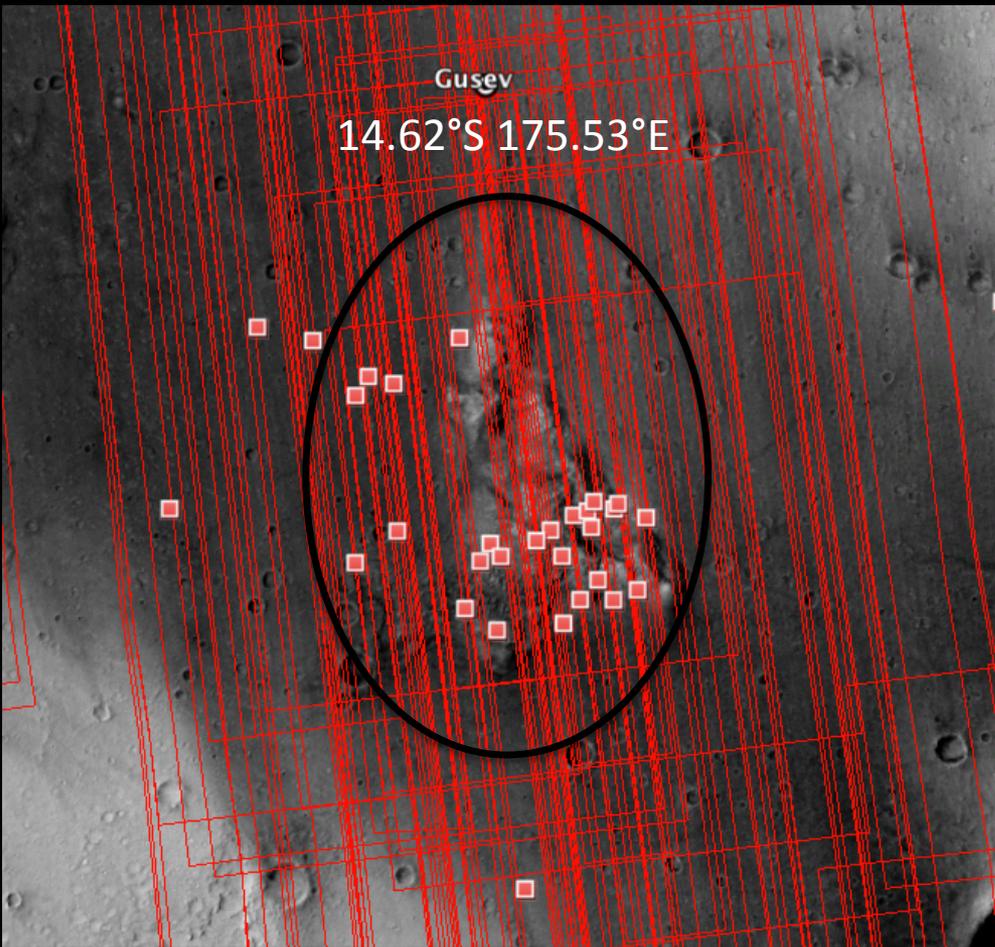


Site Factors			Landing site	SROI 1	SROI 2	SROI 3	SROI 4	SROI 5	SROI 6	SROI 7	SROI 8	RROI 1	RROI 2	REZ SUM	Key		
Water Resource	Threshold	Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)	●	●	●	●	●	●	●	●	●	●	●	11, 0	<ul style="list-style-type: none"> ● Yes ○ Partial Support or Debated □ No ? Indeterminate 		
		AND/OR	Potential for ice or ice/regolith mix	●	○	?	●	●	●	●	●	●	●	●		1, 3	
			Potential for hydrated minerals	●	○	●	●	●	●	●	●	●	●	●		4, 3	
		Quantity for substantial production	●	○	●	●	●	●	●	●	●	●	●	●		5, 1	
		Potential to be minable by highly automated systems	●	●	●	●	●	●	●	●	●	●	●	●		5, 0	
		Located less than 3 km from processing equipment site	●	●	●	●	●	●	●	●	●	●	●	●		2, 0	
		Located no more than 3 meters below the surface	●	●	●	●	●	●	●	●	●	●	●	●		6, 0	
	Accessible by automated systems	●	●	●	●	●	●	●	●	●	●	●	●	●		11, 0	
	Qualifying	Potential for multiple sources of ice, ice/regolith mix and hydrated minerals	●	●	○	●	●	●	●	●	●	●	●	●		3, 1	
		Distance to resource location can be >5 km	●	●	●	●	●	●	●	●	●	●	●	●		8, 0	
		Route to resource location must be (plausibly) traversable	●	●	●	●	●	●	●	●	●	●	●	●		11, 0	
	Civil Engineering	Threshold	~50 sq km region of flat and stable terrain with sparse rock distribution	●	●	●	●	●	●	●	○	●	○	●		4, 2	
			1-10 km length scale: <10°	●	●	●	●	●	●	●	●	●	●	●		●	4, 0
			Located within 5 km of landing site location	●	●	●	●	●	●	●	●	●	●	●		●	3, 0
Qualifying		Located in the northern hemisphere	●	●	●	●	●	●	●	●	●	●	●	0, 0			
Evidence of abundant cobble sized or smaller rocks and bulk, loose regolith	●	●	●	●	●	●	●	●	●	●	●	●	5, 0				
Utilitarian terrain features	●	●	●	●	●	●	●	●	●	●	●	●	●	8, 0			
Production	Qualifying	Low latitude	●	●	●	●	●	●	●	●	●	●	●	●	11, 0		
		No local terrain feature(s) that could shadow light collection facilities	●	●	●	●	●	●	●	●	●	●	●	●	5, 0		
		Access to water	●	●	?	●	●	●	●	●	●	●	●	●	1, 3		
		Access to dark, minimally altered basaltic sands	●	●	●	●	●	●	○	○	●	○	●	●	3, 3		
Metal/Silicon Resource	Threshold	Potential for metal/silicon	?	?	?	?	?	?	?	?	?	?	?	?			
		Potential to be minable by highly automated systems	?	?	?	?	?	?	?	?	?	?	?	?	?		
		Located less than 3 km from processing equipment site	?	?	?	?	?	?	?	?	?	?	?	?	?		
		Located no more than 3 meters below the surface	?	?	?	?	?	?	?	?	?	?	?	?	?		
	Accessible by automated systems	?	?	?	?	?	?	?	?	?	?	?	?	?			
	Qualifying	Potential for multiple sources of metals/silicon	?	?	?	?	?	?	?	?	?	?	?	?	11, 0		
		Distance to resource location can be >5 km	?	?	?	?	?	?	?	?	?	?	?	?	?		
		Route to resource location must be (plausibly) traversable	●	●	●	●	●	●	●	●	●	●	●	●	8, 0		
		●	●	●	●	●	●	●	●	●	●	●	●	●	11, 0		

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Science ROI 1: Columbia Hills

1st EZ Workshop for Human Missions to Mars



- An Ancient Hydrothermal System
- Carbonates and Ancient Lakes
- Periods of Volcanic and Aqueous Activity (volcanic tephra basin fill)
- Recent Fluvial Activity (~2-5 mya)
- Ground truth from Spirit
- Datable volcanic surface

Major Spirit Discoveries ROI 1

1st EZ Workshop for Human Missions to Mars



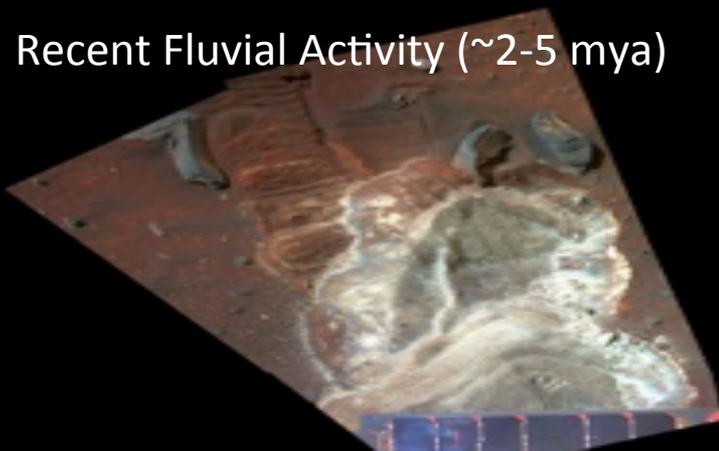
An Ancient Hydrothermal System



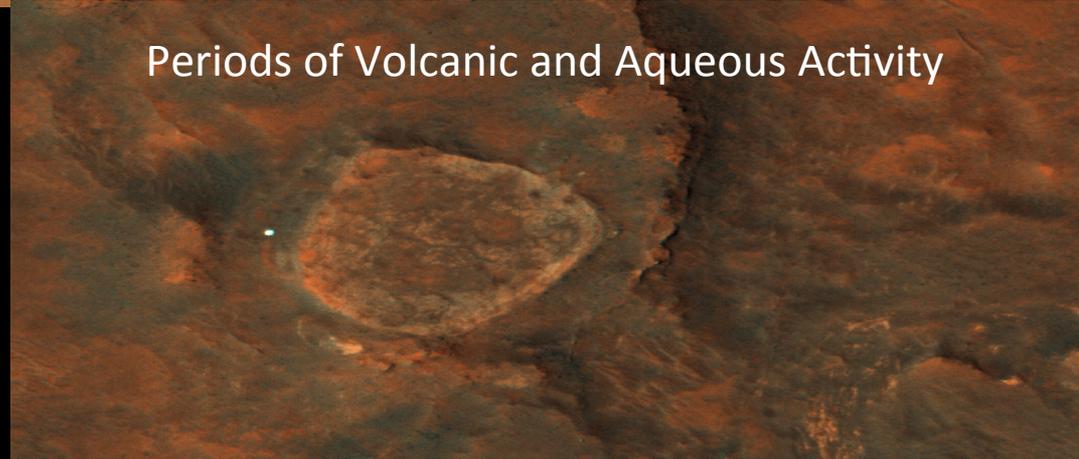
Carbonates and Ancient Lakes



Recent Fluvial Activity (~2-5 mya)



Periods of Volcanic and Aqueous Activity



A Habitable Environment ROI 1



1st EZ Workshop for Human Missions to Mars

El Tatio Hydrothermal
Field, Chile, Earth



Columbia Hills, Gusev
Crater, Mars



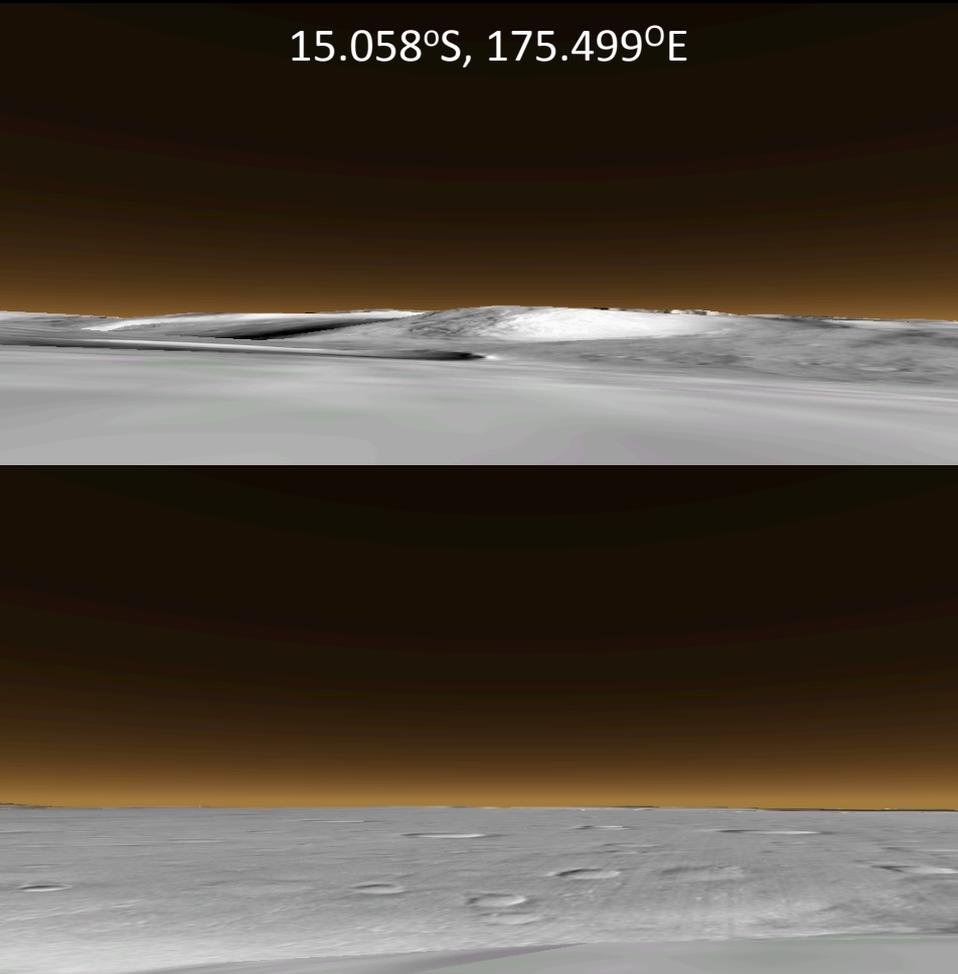
Credit: Steve Ruff

Science ROI 2: Mesas

1st EZ Workshop for Human Missions to Mars



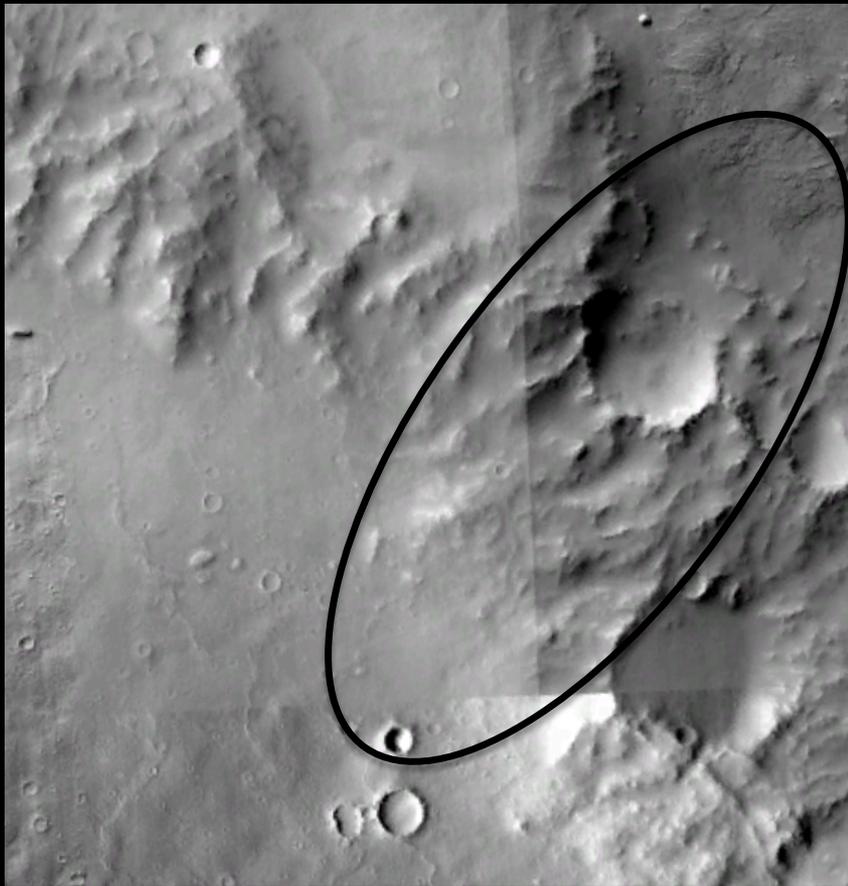
15.058°S, 175.499°E



- Mesas located at the mouth of Ma'adim Vallis
- Origins are unknown, but the mesas could be a flood deposit, deltaic remnant, or chaotic terrain
- 400-500 meters tall
- Only 1 HiRISE image, no CRISM
- Surrounded by volcanic plains

Science ROI 3: Eroded Crater Rim

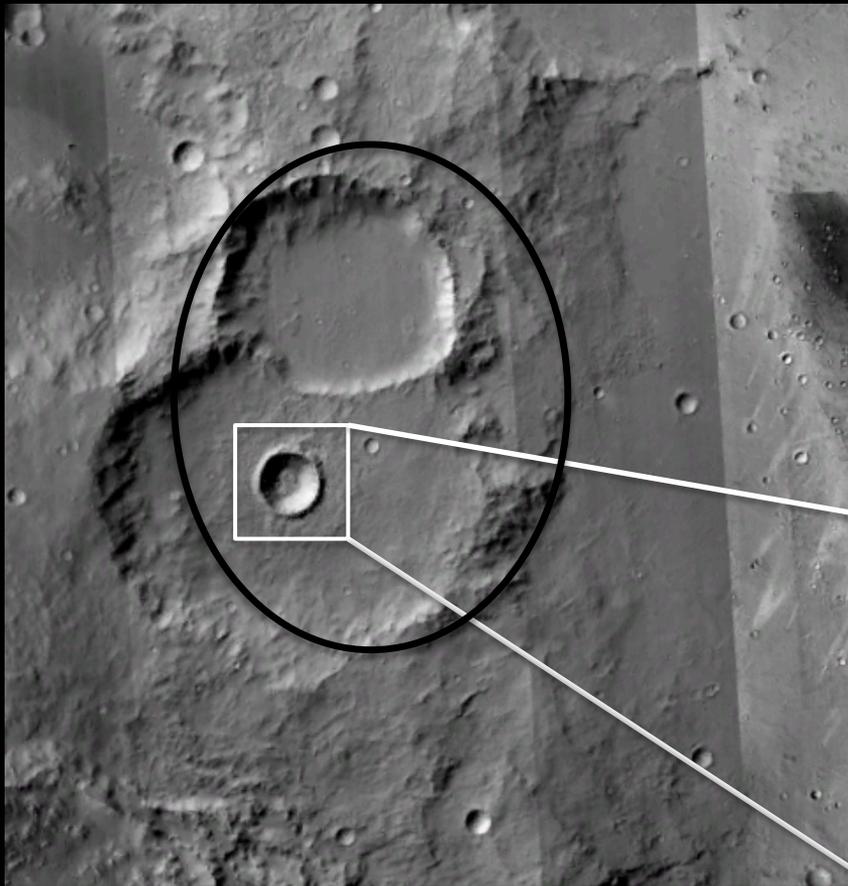
1st EZ Workshop for Human Missions to Mars



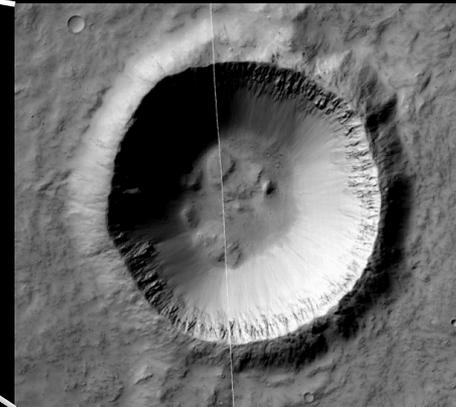
- 13.600°S, 176.499°E
- Record of climate change includes Noachian, Hesperian, Amazonian eras
- Extensive fluvial alteration
- No imagery coverage

Science ROI 4: Secondary Craters

1st EZ Workshop for Human Missions to Mars

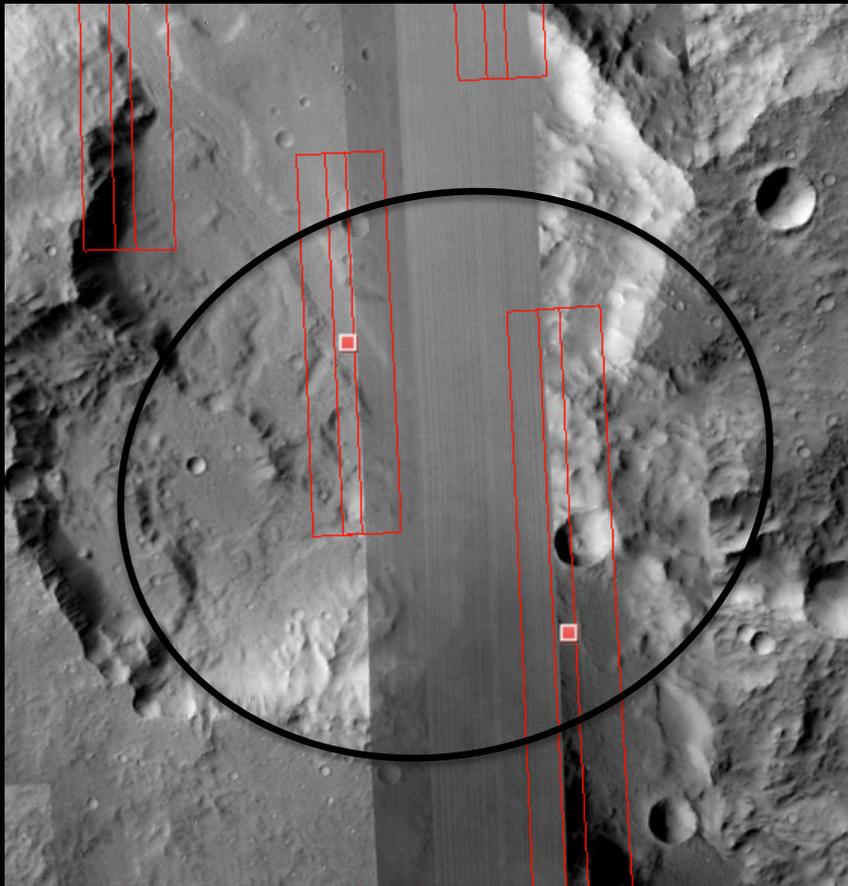


- 14.764°S, 173.962°E
- Younger impacts
- “Windows” into geologic past
- Concentric craters



Science ROI 5: Ma'adim Vallis

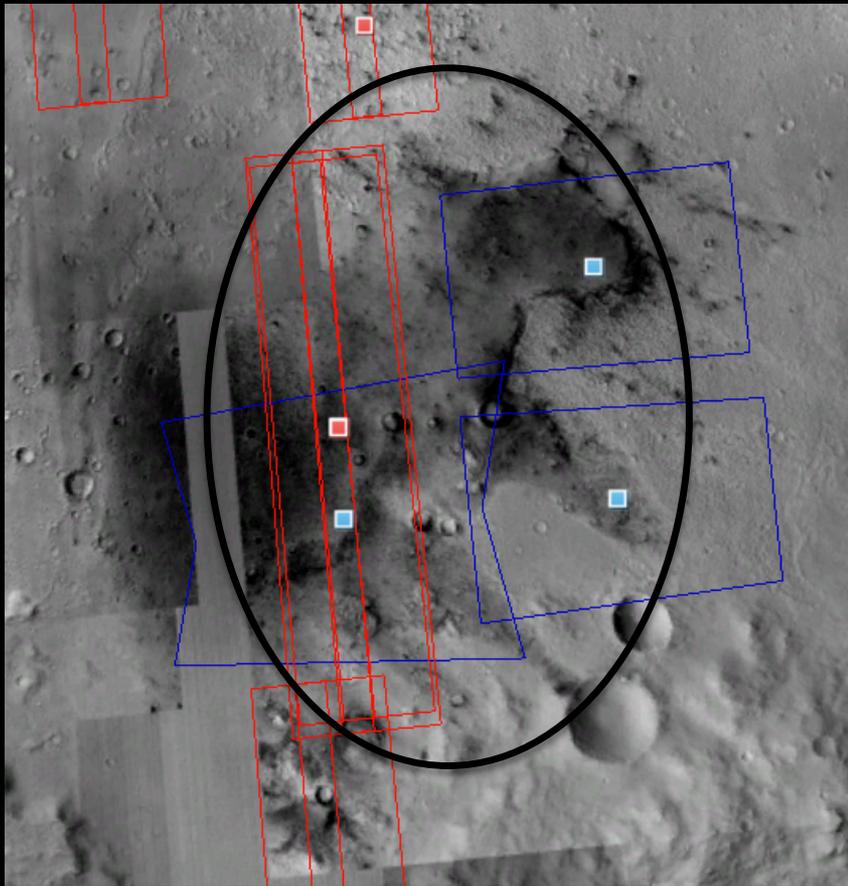
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- 15.841°S , 175.918°E
- Postulated source of Gusev Crater's water
- Layered rocks preserve ancient habitable environments

Science ROI 6: Clays

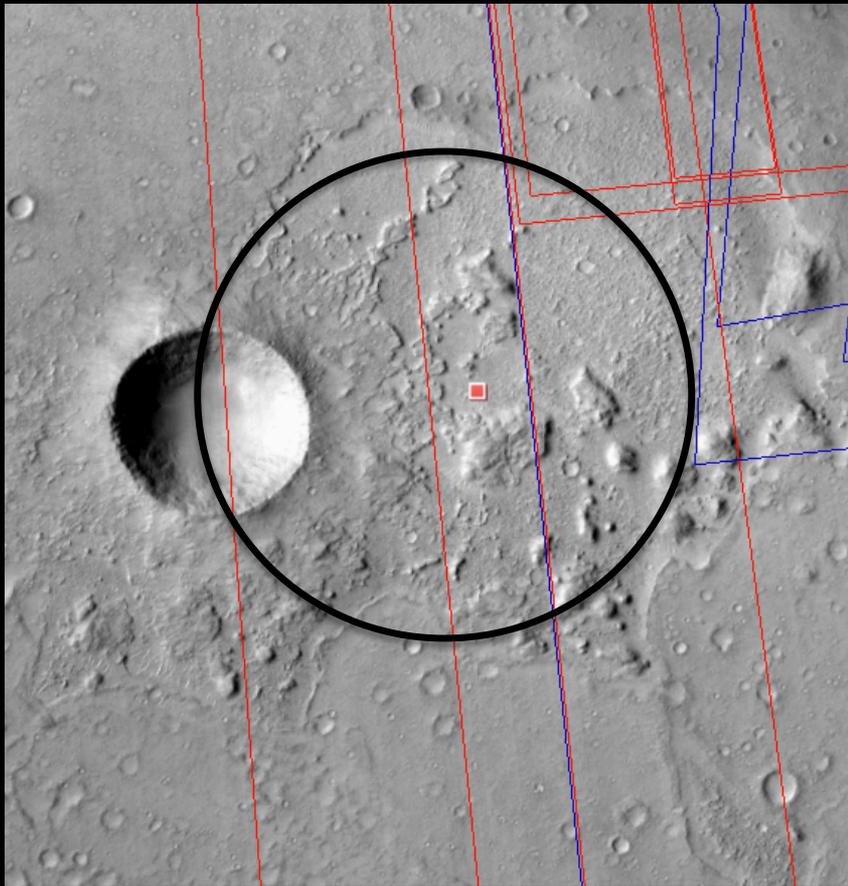
1st EZ Workshop for Human Missions to Mars



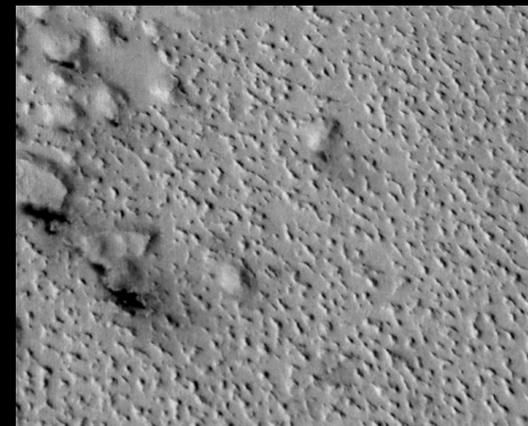
- 15.143°S, 176.014°E
- Widespread deposits
- Formed in a habitable, pH-neutral environment
- Fe-rich, Al-rich clays present (climate change in the presence of water)

Science ROI 7: Etched Terrain

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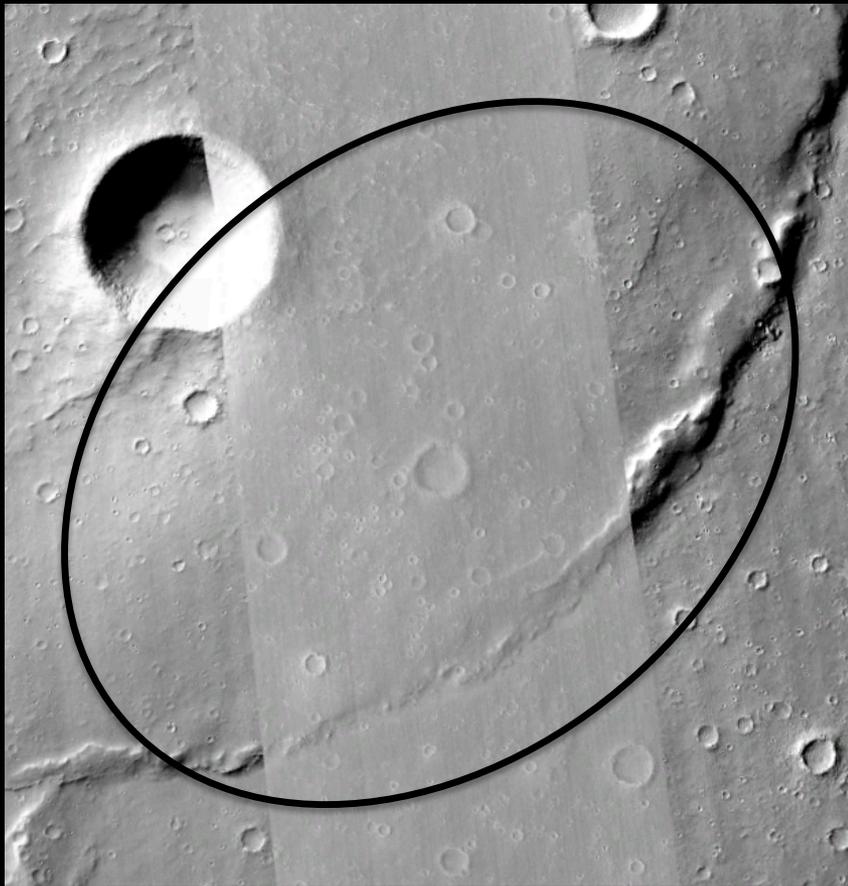


- 14.530°S , 175.333°E
- Glacial origin???
- Wind erosion???
- Similar thermal inertia to ancient layers
- Unique to Mars



Science ROI 8: Basaltic Plains

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- 13.587°S , 175.489°E
- Allows for interpretation of absolute age
- Formed during Hesperian era
- Tectonic/volcanic wrinkle ridge
- No imaging available

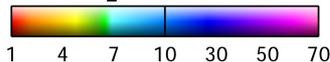
Resource ROI 1: Etched Terrain

1st EZ Workshop for Human Missions to Mars

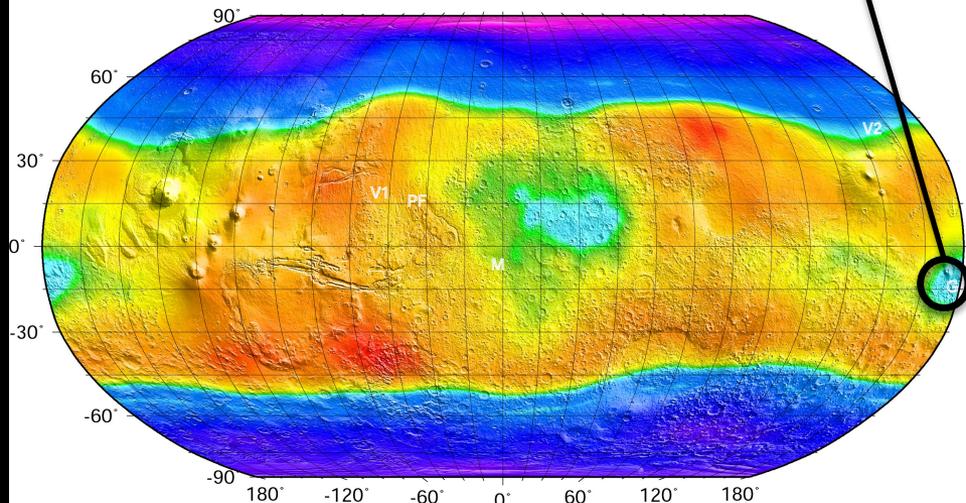


Data from 2001 Mars Odyssey
Gamma Ray Spectrometer

H₂O (Wt%)



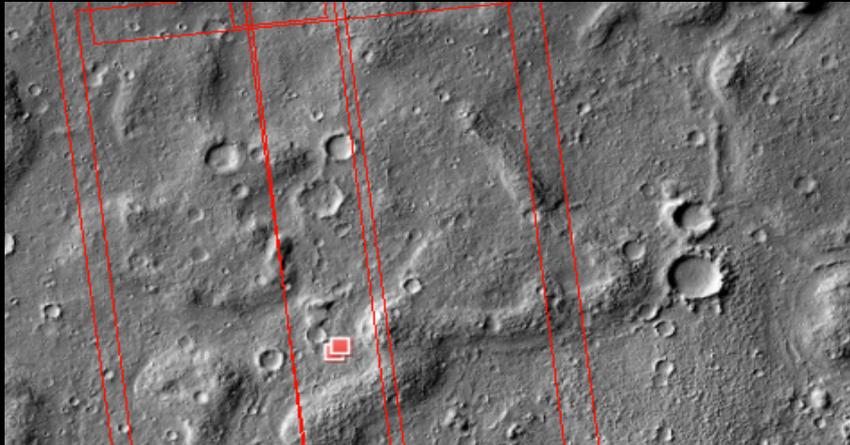
Gusev



- >2% water abundance throughout the soil
- Abnormal for an equatorial site
- All resource ROIs do not jeopardize planetary protection concerns

Resource ROI 2: Pingos

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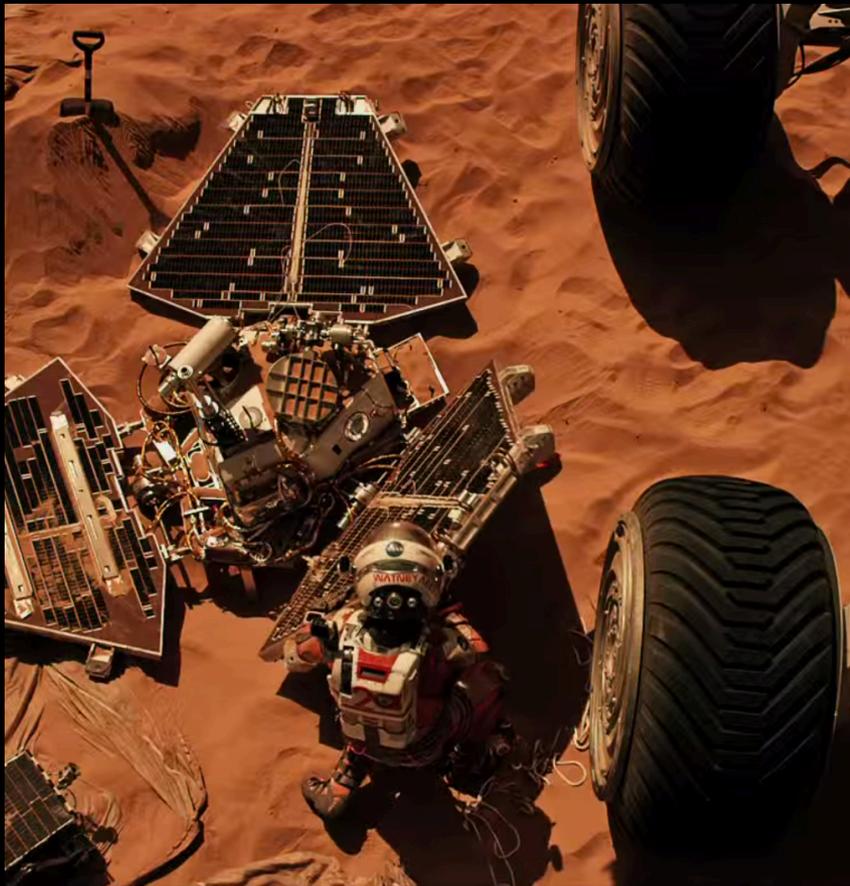


- 14.194°S, 175.839°E
- Permafrost is an extremely effective preserver of organic material, and even fossil microbes
- Pingos can also be used as a major source of water
- Accessible ~ 30 km from EZ center



Resource ROI 3: “The Great Spirit Rescue Mission”

1st EZ Workshop for Human Missions to Mars



- Enrichment resource! We can repair Spirit as a tool for future explorers
- “If it isn’t impossible, it isn’t worth doing.”
 - Marc Rayman
- Spirit can inform us on how mechanical components weather in the environment (Jim Rice)

Prioritization List of EZ Data Needs

1st EZ Workshop for Human Missions to Mars



1. Mars 2020 rover mission (long-term objective)

- Confirm/disprove potential biosignature
- Ground truth >1 science, >1 resource ROIs
- Acquire environmental data on Spirit hardware
- Assemble collection of ROI 1 returnable samples

2. Additional CRISM and HiRISE coverage of all ROIs, except Columbia Hills

CRISM of mesas (SROI 2) is highest priority
(understand the history of the environment)

3. MARSIS radar data on pingos (are they really permafrost?)

Honoring the past, innovating in the present, and hoping for the future,
we will pioneer the final frontier of space for the future of all mankind.

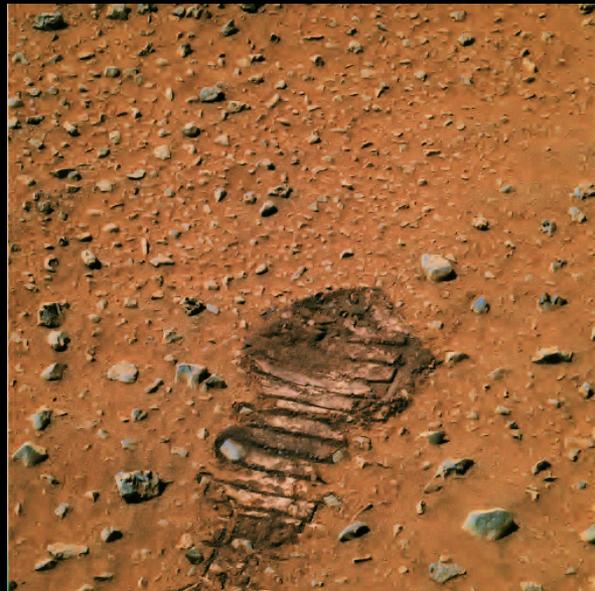


Thank You!

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“What I really want for our rovers, more than anything else, is boot prints in our wheel tracks.”

- Steve Squyres, MER Principal Investigator



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