

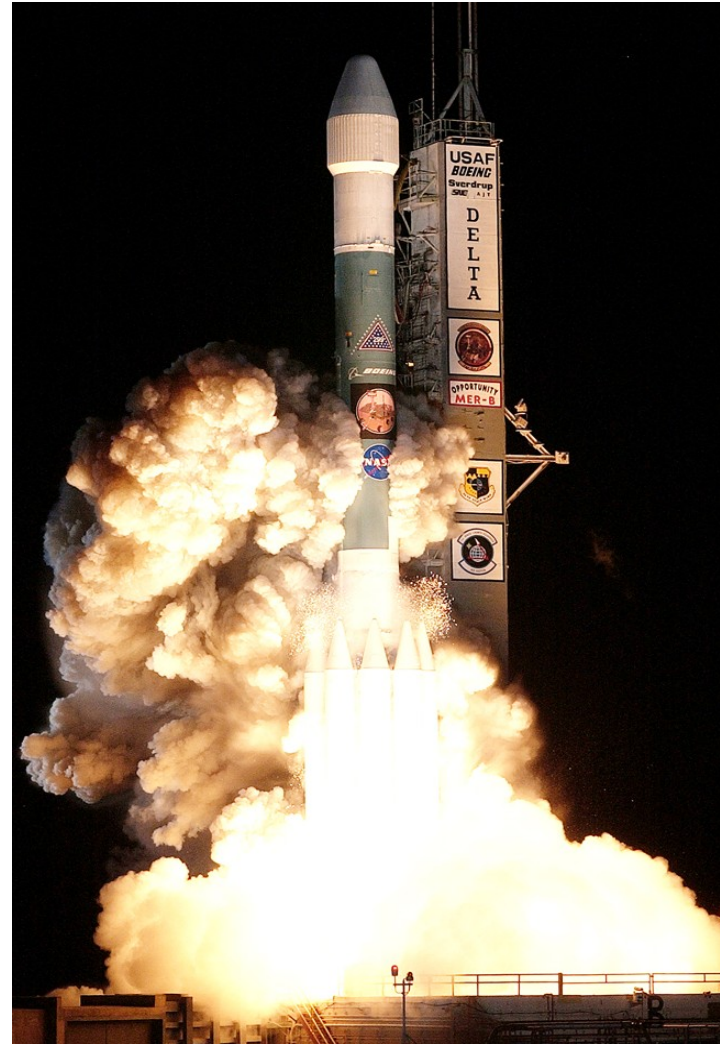
The Exploration of Mars through Science, technology, data and supporting infrastructure

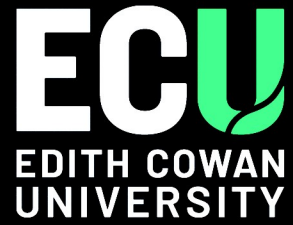
Prof. Paulo de Souza  
Executive Dean, School of Engineering

Creative  
thinkers  
made here.



# Would you go to Mars?

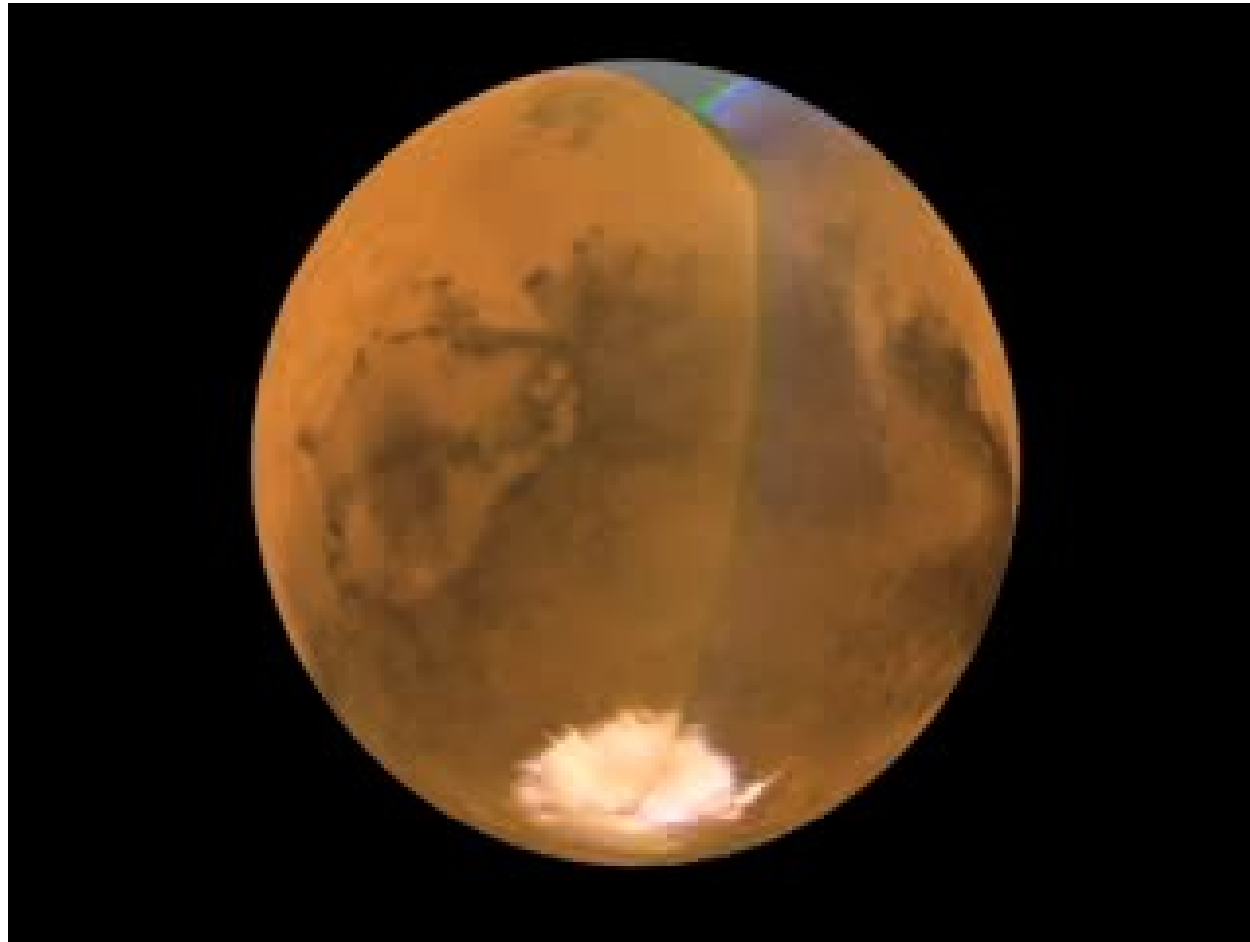




# Science and Technology

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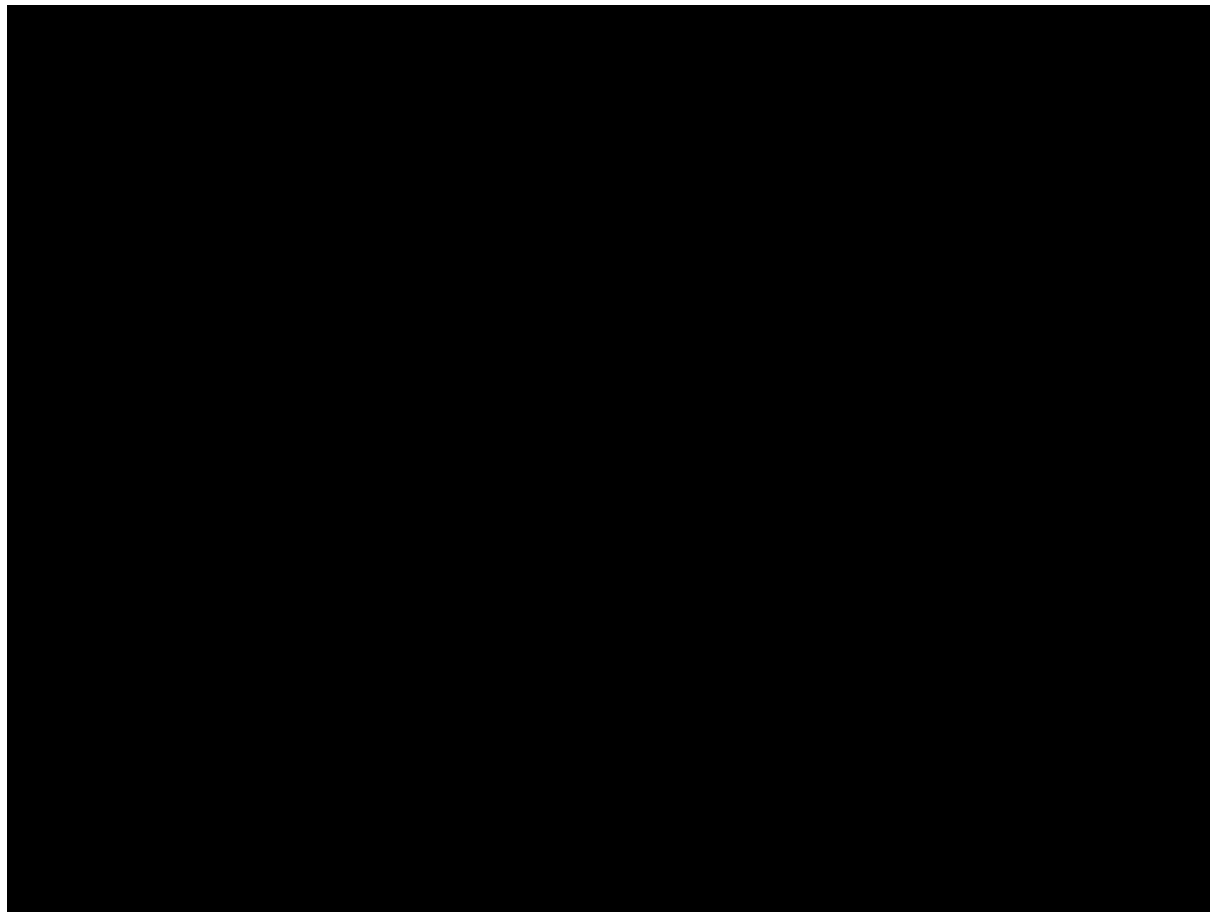
# Why Mars?



# Mission Objective

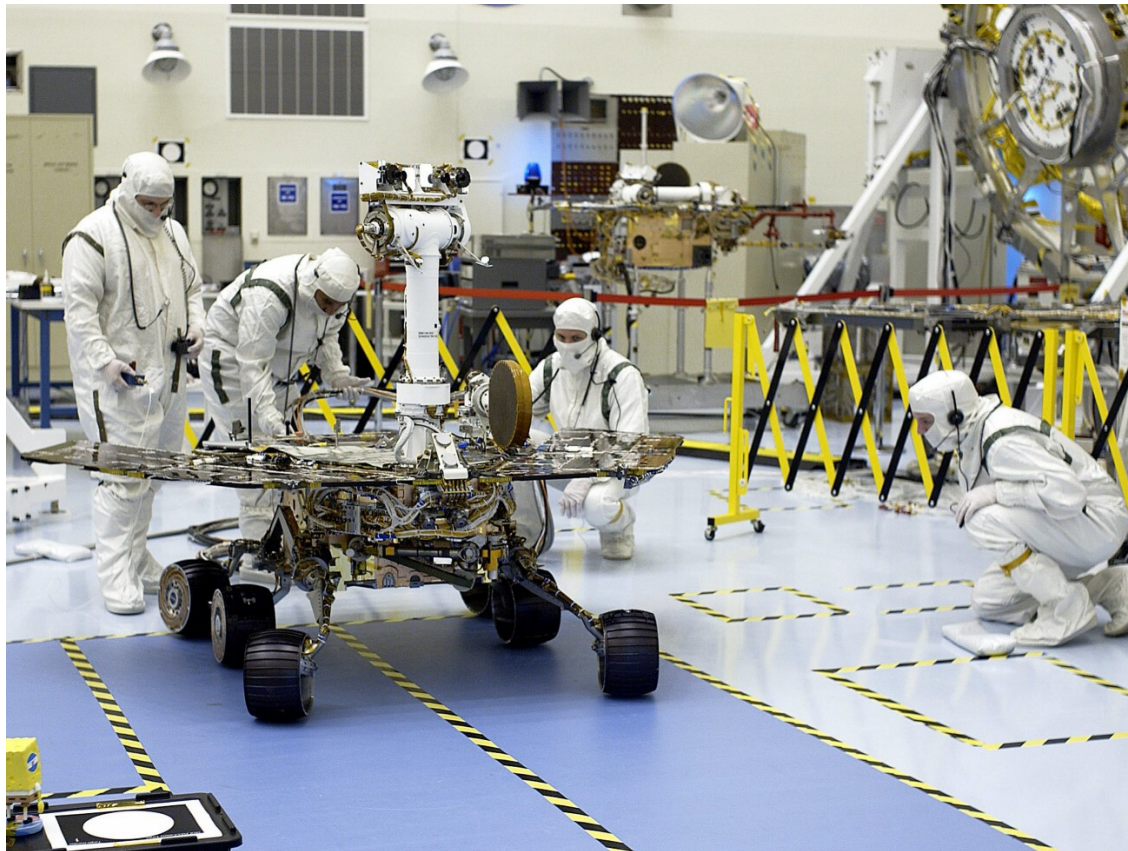
It is all about water on Mars!





# Mission Objective

To determine if Mars was once wet



# The Athena Science Payload

## Remote Sensing Package

*Pancam Mast Assembly (PMA)*

*Pancam*

*Mini-TES*

## In-Situ Package

*Instrument Deployment Device (IDD)*

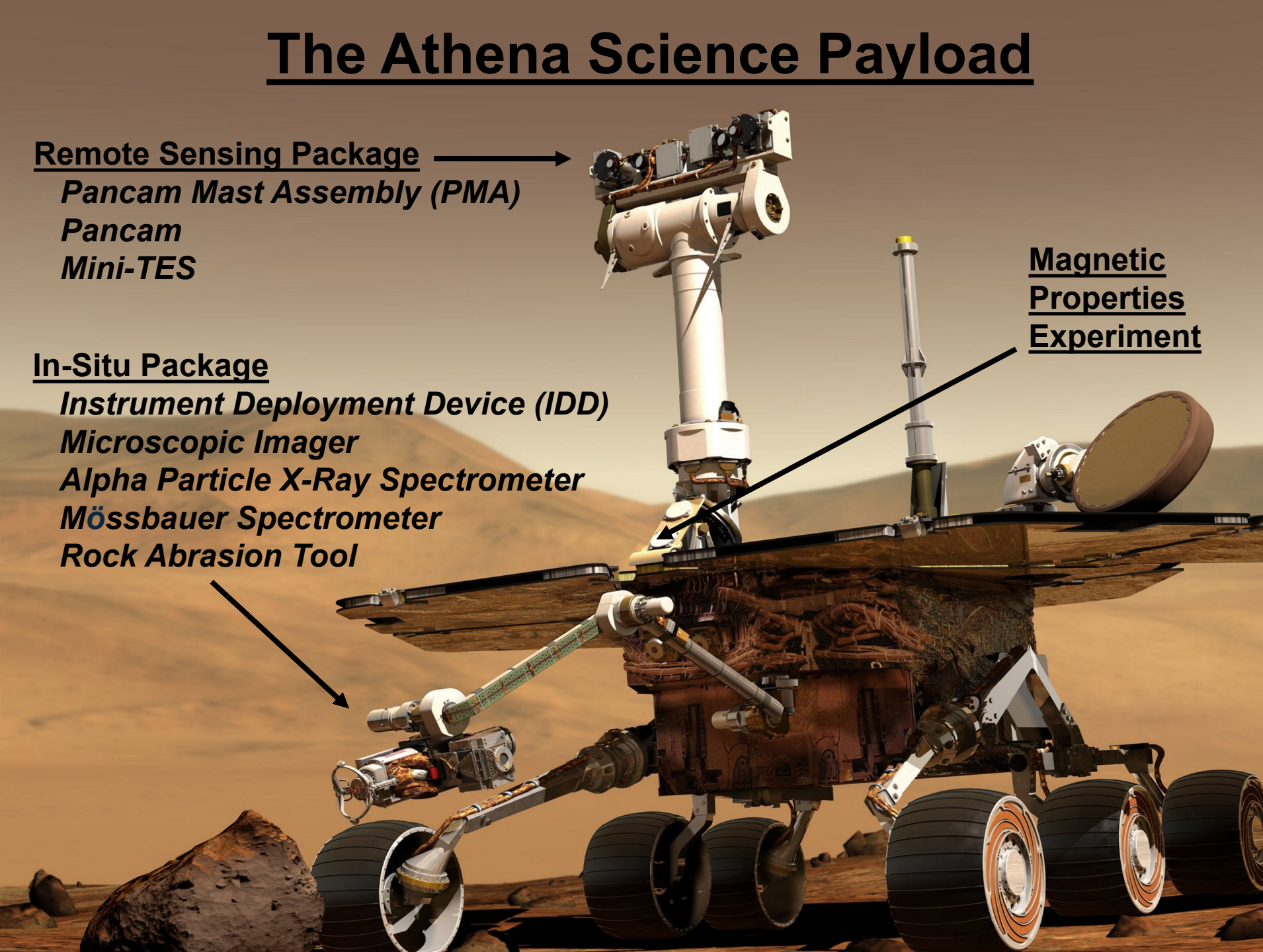
*Microscopic Imager*

*Alpha Particle X-Ray Spectrometer*

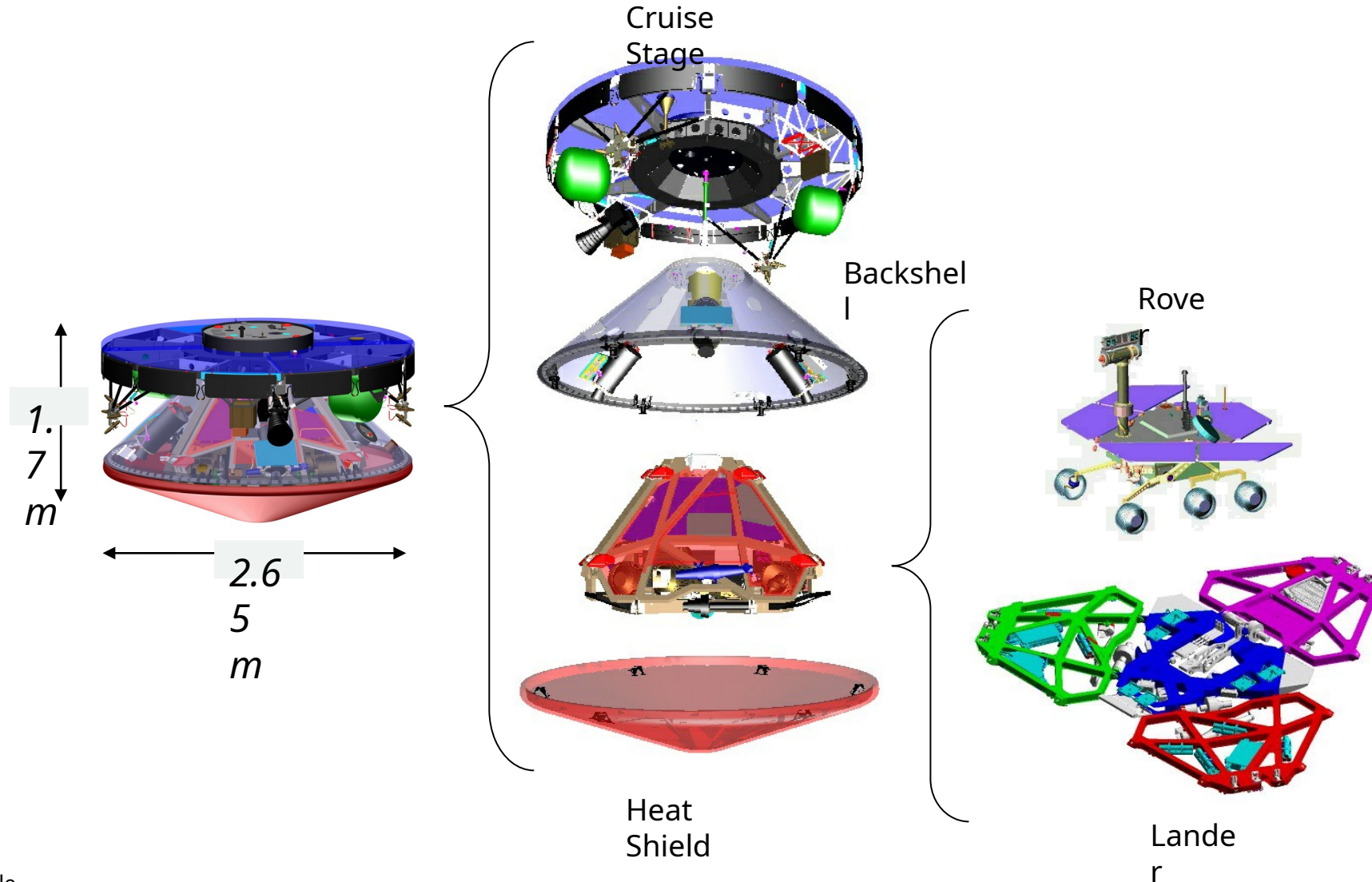
*Mössbauer Spectrometer*

*Rock Abrasion Tool*

Magnetic  
Properties  
Experiment



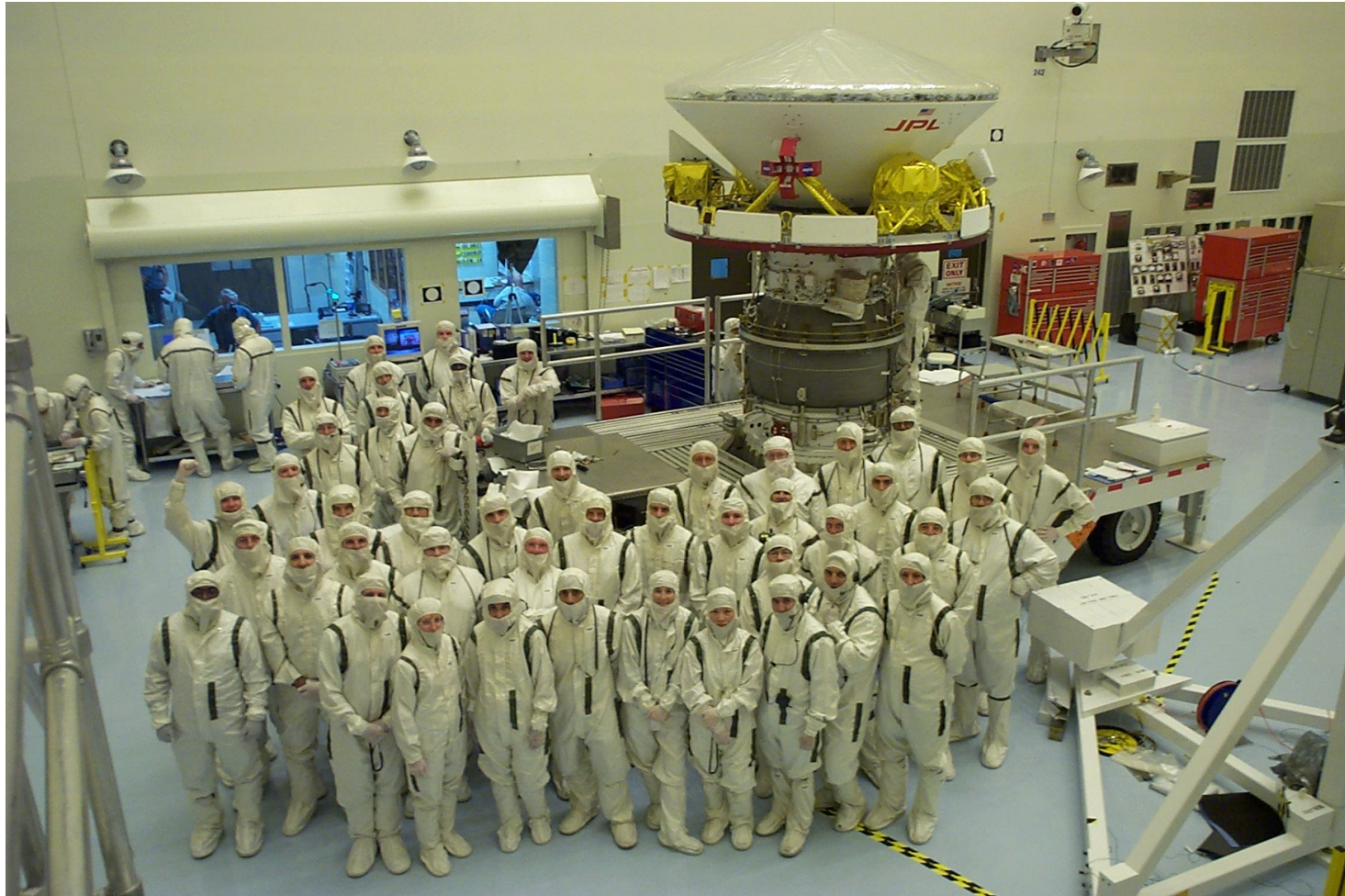
# Spacecraft configuration



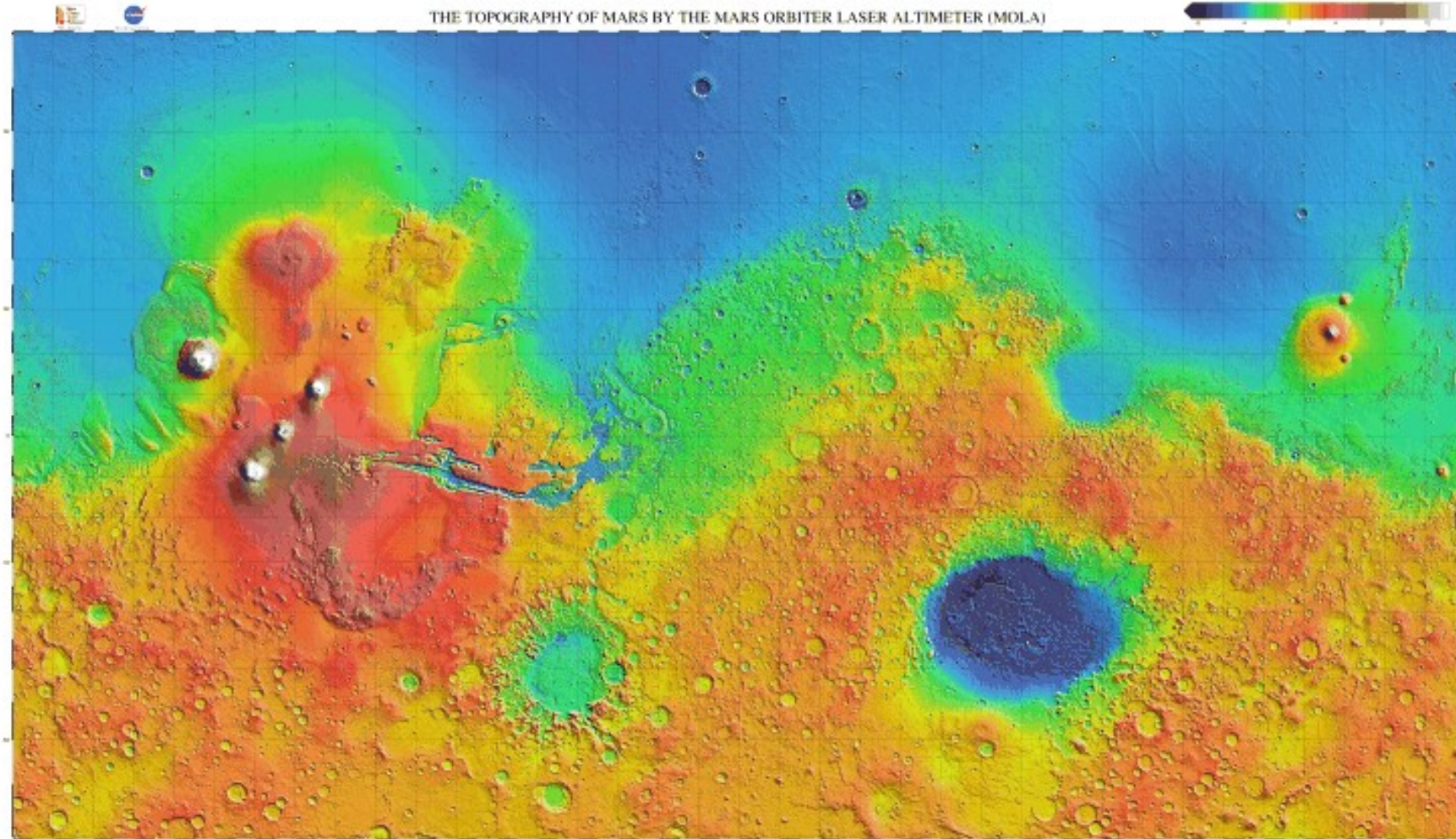
# Packaged and ready to go



# Third Stage



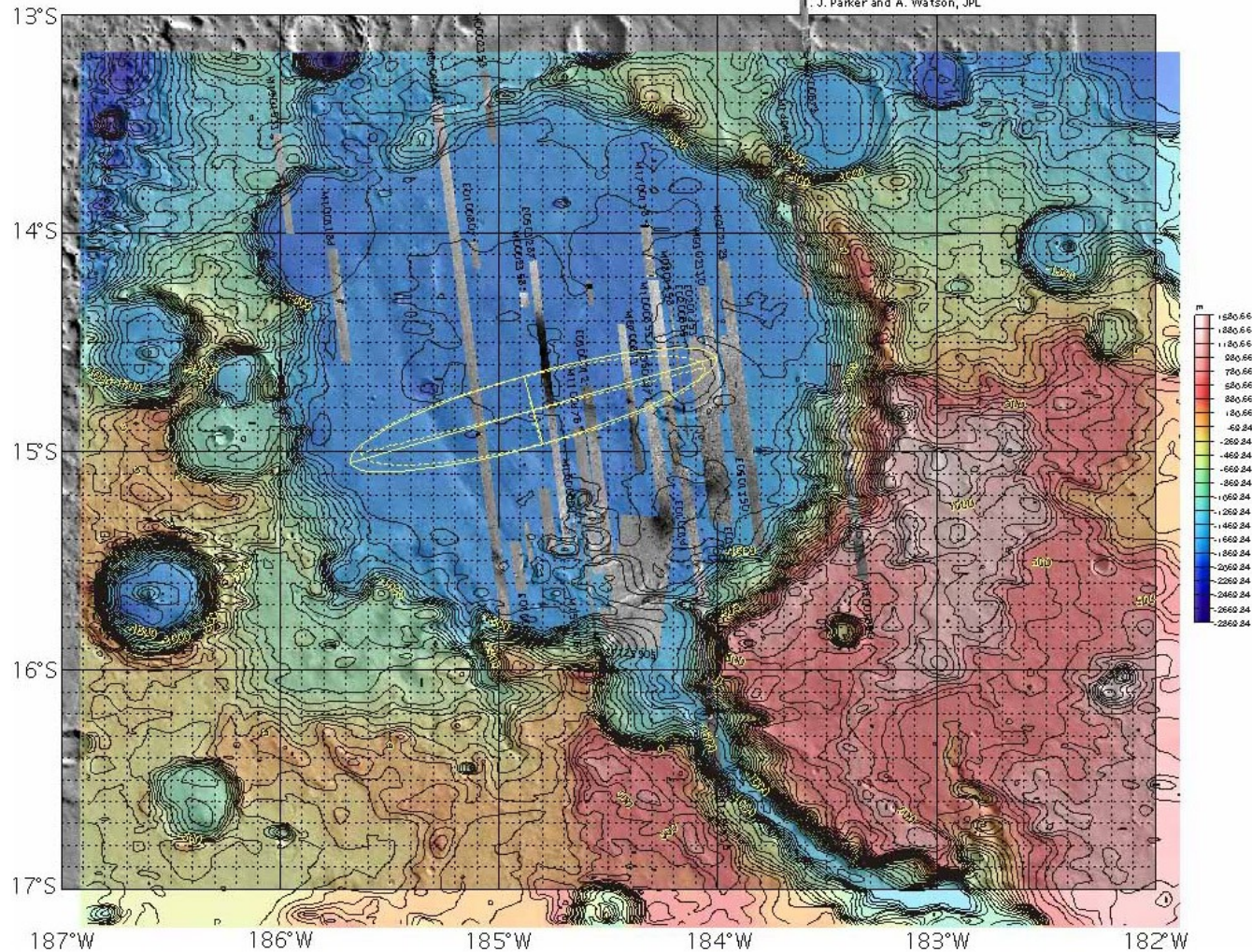
# Landing Sites



# Landing Site

Gusev Crater Site (TCM-5 DeltaDOR, -2Day:  
MER-A; Open of window=dashed, Close=solid)

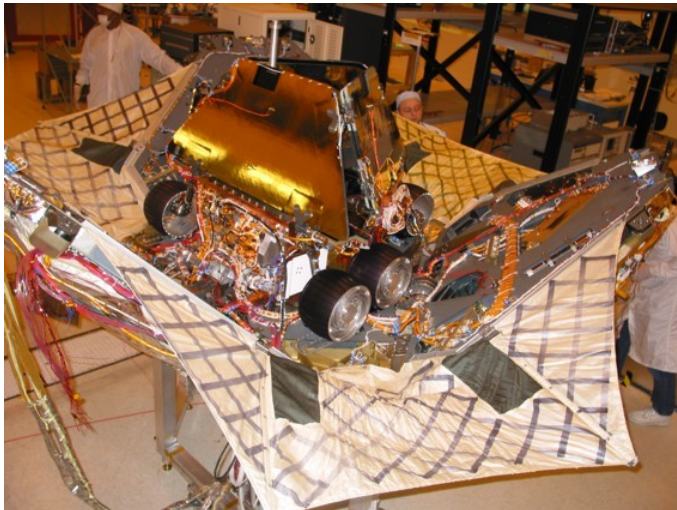
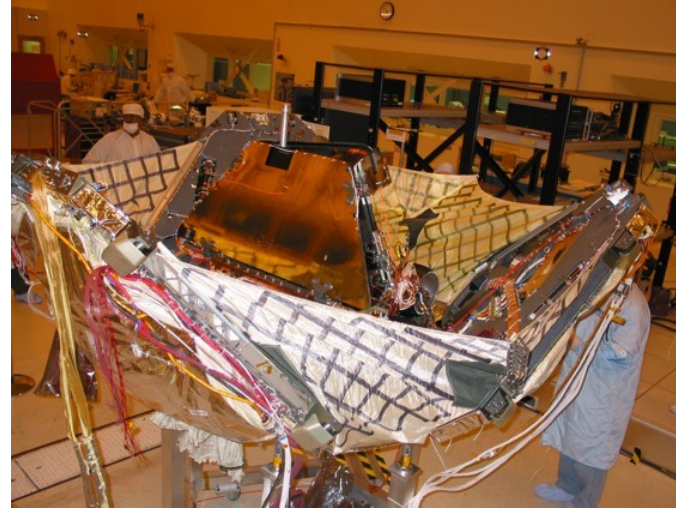
T. J. Parker and A. Watson, JPL



# Early Egress Testing



# Egress Ramp Testing

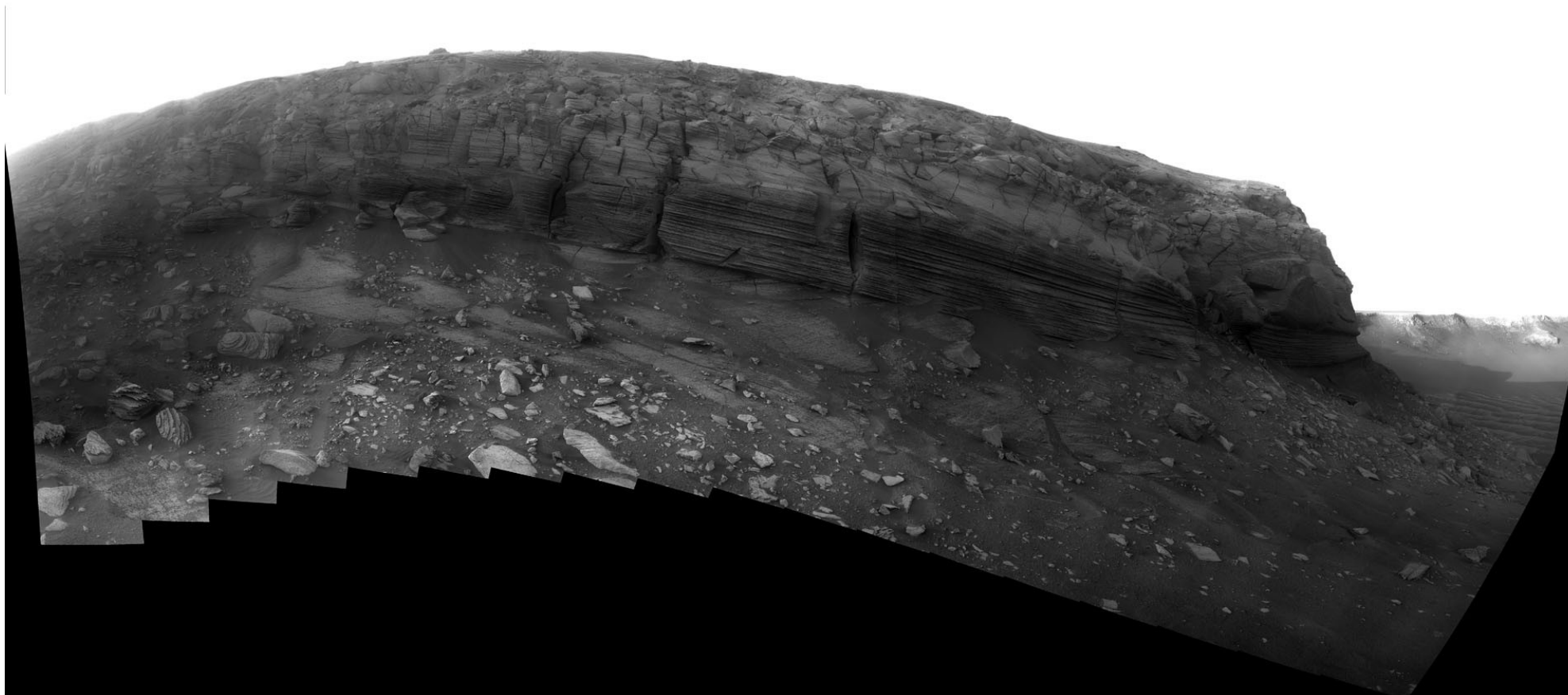


# It works!



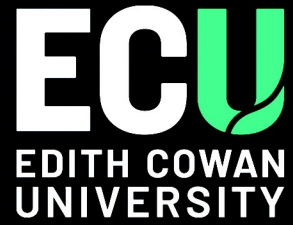










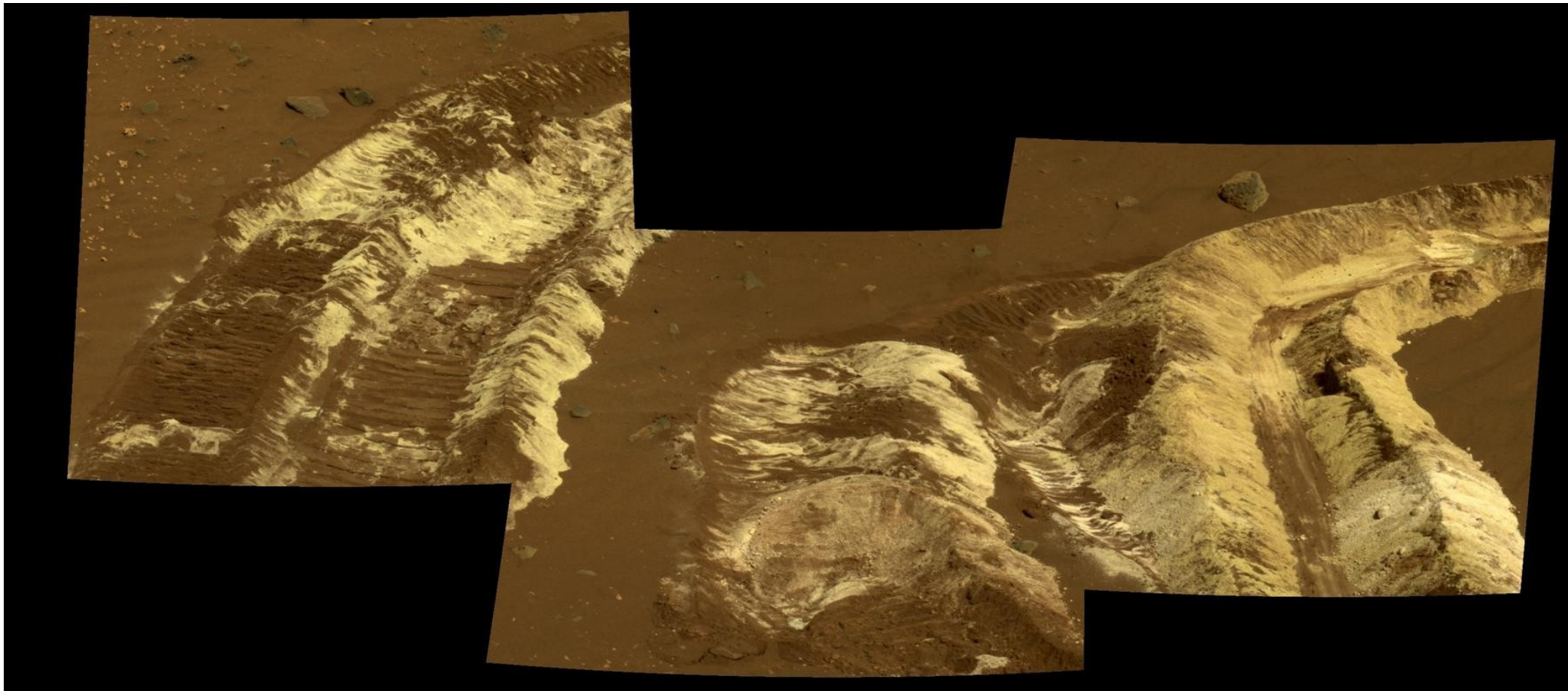


# Bright Soils (Disturbed)

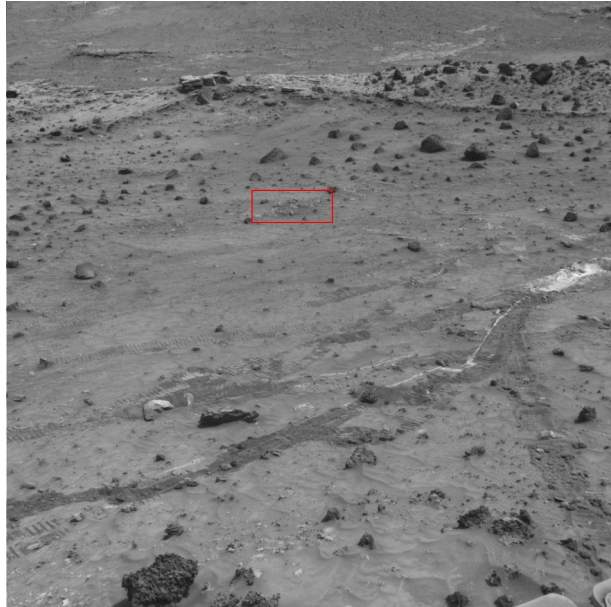
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made here.



# Disturbed Bright Soil at Gusev Crater



# Disturbed Bright Soil at Gusev Crater



## Detection of Silica-Rich Deposits on Mars

S. W. Squyres,<sup>1\*</sup> R. E. Arvidson,<sup>2</sup> S. Ruff,<sup>3</sup> R. Gellert,<sup>4</sup> R. V. Morris,<sup>5</sup> D. W. Ming,<sup>5</sup> L. Crumpler,<sup>6</sup> J. D. Farmer,<sup>3</sup> D. J. Des Marais,<sup>7</sup> A. Yen,<sup>8</sup> S. M. McLennan,<sup>9</sup> W. Calvin,<sup>10</sup> J. F. Bell III,<sup>1</sup> B. C. Clark,<sup>11</sup> A. Wang,<sup>2</sup> T. J. McCoy,<sup>12</sup> M. E. Schmidt,<sup>12</sup> P. A. de Souza Jr.<sup>13</sup>

Mineral deposits on the martian surface can elucidate ancient environmental conditions on the planet. Opaline silica deposits (as much as 91 weight percent SiO<sub>2</sub>) have been found in association with volcanic materials by the Mars rover Spirit. The deposits are present both as light-toned soils and as bedrock. We interpret these materials to have formed under hydrothermal conditions and therefore to be strong indicators of a former aqueous environment. This discovery is important for understanding the past habitability of Mars because hydrothermal environments on Earth support thriving microbial ecosystems.

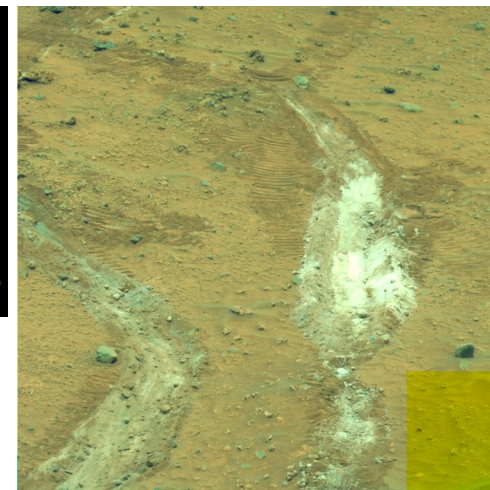
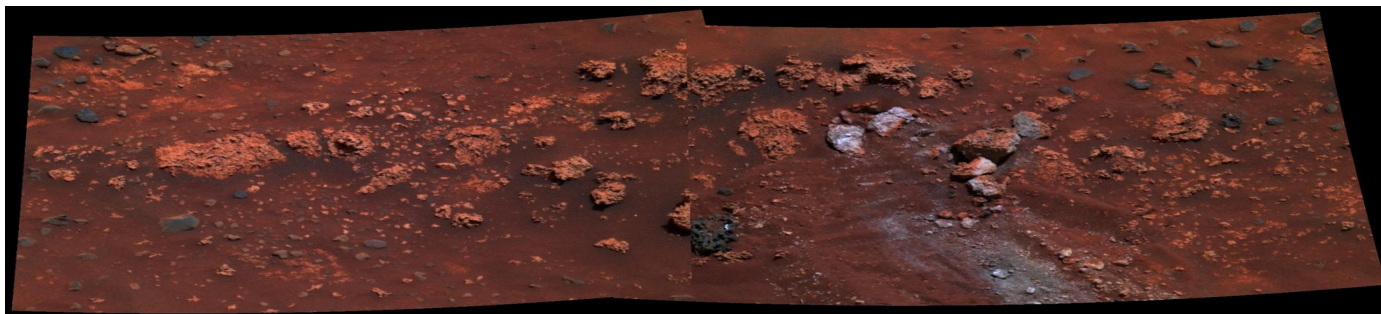
Opaline silica deposits are an indicator of past aqueous activity. Some regions of Mars exhibit a thermal infrared spectral signature that has been interpreted to result from coatings of amorphous silica on rocks (1, 2), although this interpretation is not unique (3). Results from the Mars rover Opportunity have suggested that opaline silica could be present in

sulfate-rich sedimentary rocks at Meridiani Planum (4). The rover Spirit recently investigated the Eastern Valley between Home Plate and the Mitcheltree/Low Ridge complex (Fig. 1) in Gusev crater. Here we describe the discovery of silica-rich deposits in the Eastern Valley and farther east near sulfate-rich soil deposits.

Home Plate consists of laminated-to-cross-bedded tephra that shows evidence for a volcanic explosive origin, including a bomb sag produced when an ejected ~4-cm clast fell into deformable ash deposits (5). Mitcheltree Ridge and Low Ridge, located east of Home Plate, are partially eroded synclinal structures that expose tephra deposits (including lapillistones) capped by a deposit of vesicular basalt boulders. Soils in the Inner Basin ~250 m to the north (Samra) and ~50 m to the east (Tyrone) (Figs. 1 and 2) of Home Plate contain hydrated ferric sulfate deposits (6, 7). The mobility of ferric iron under apparently oxidizing conditions, leading to ferric sulfates and oxides, is suggestive of low pH con-

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# Publi



Where  
Engineering  
can take  
you?

# Breakthrough of the Year

## THE WINNER

The Mars rovers, with the help of remote-sensing spacecraft, have sniffed out water and found the remains of one or more ancient environments where life could have survived. Indeed, early Mars is looking wetter and wetter

## On Mars, a Second Chance for Life

Inanimate, wheeled, one-armed boxes roaming another planet have done something no human has ever managed: They have discovered another place in the universe where life could once have existed. Aided by other robots in orbit and a modicum of luck, the two Mars rovers earlier this year homed in on locales once rich with water.

### BREAKTHROUGH ONLINE

For an expanded version of this section, with references and links, see [www.sciencemag.org/sciext/btoy2004](http://www.sciencemag.org/sciext/btoy2004)

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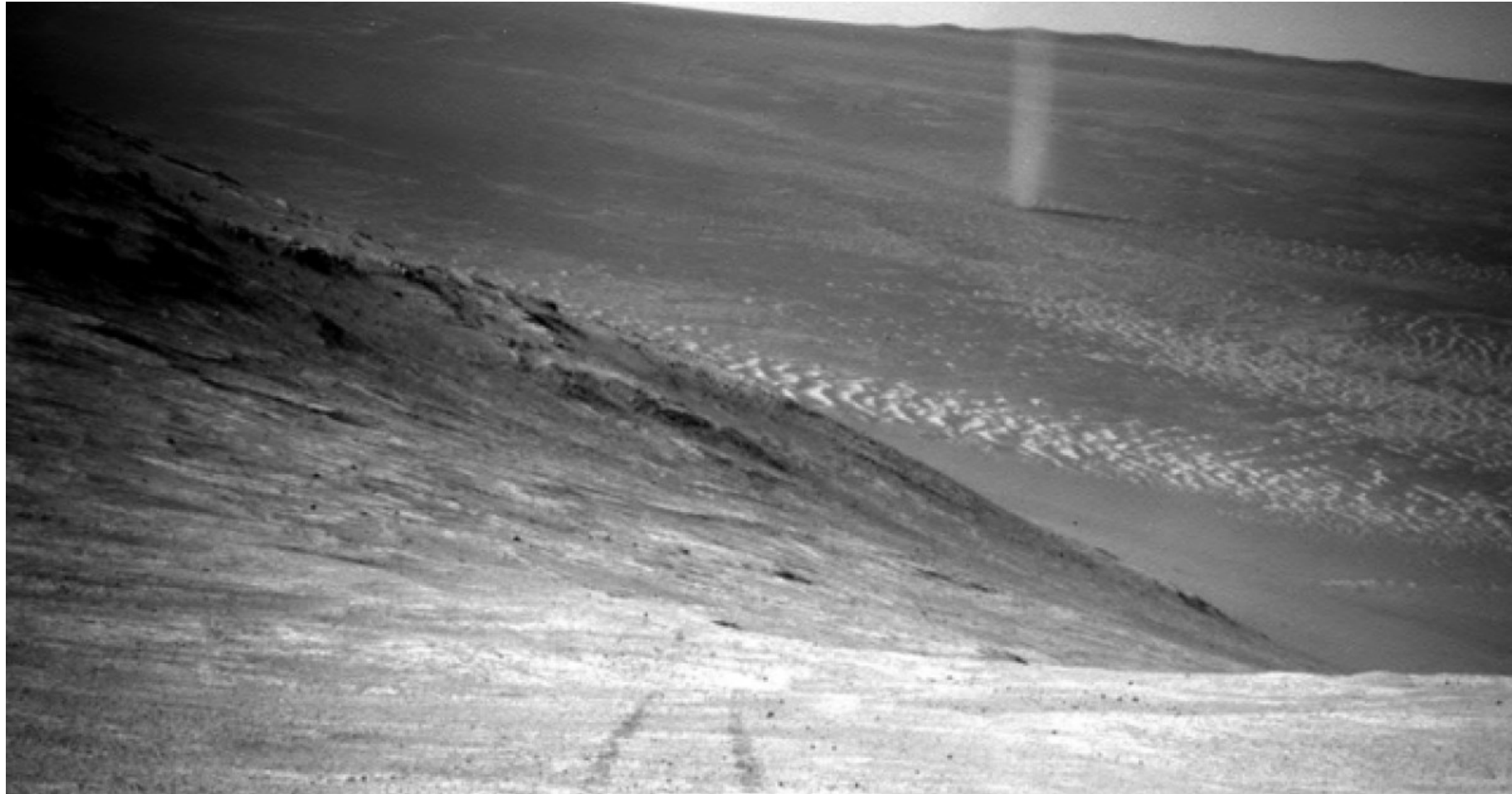
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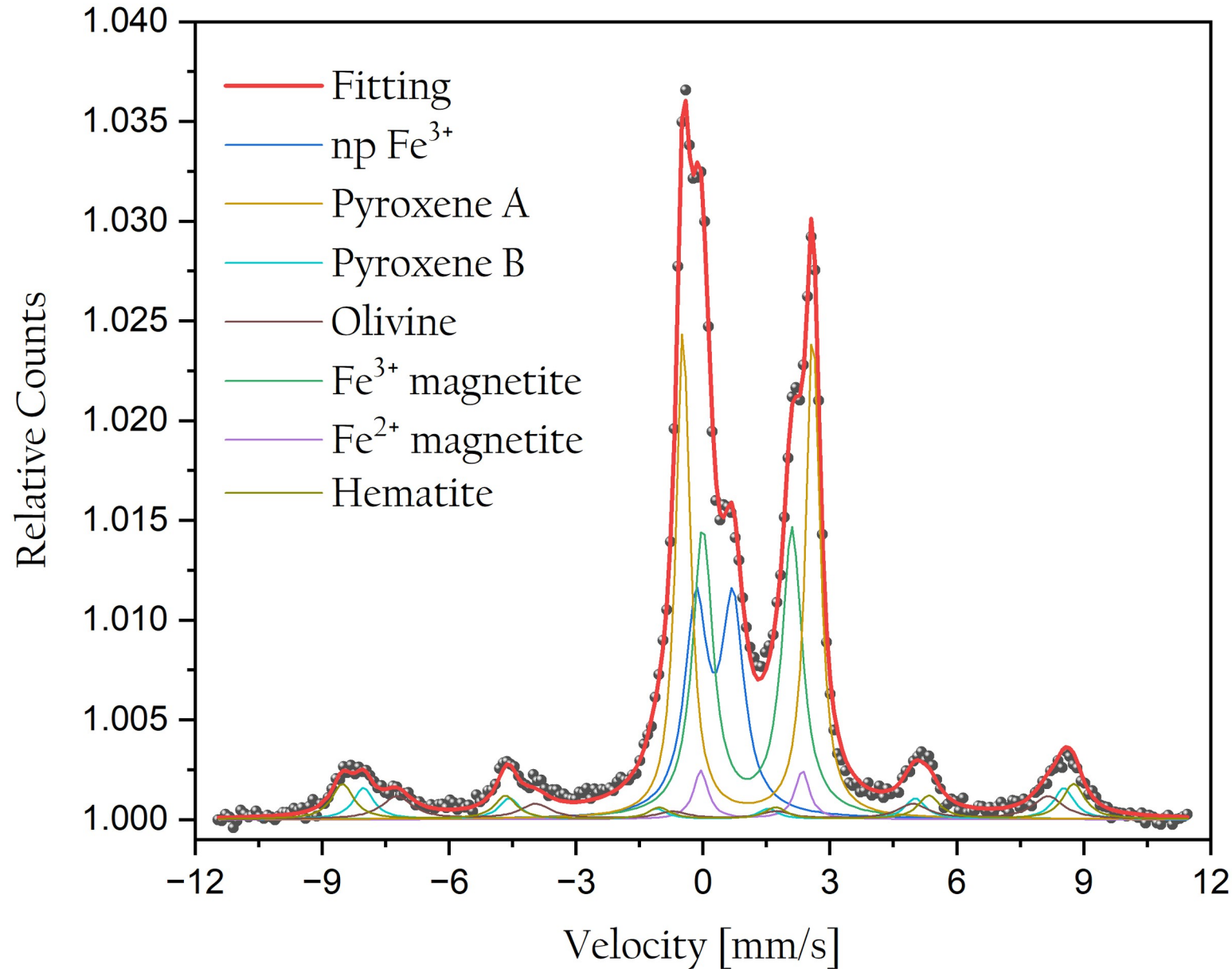
On arriving encased in protective balloons, Opportunity needed a couple of lucky breaks. First off, it stumbled—bounced and rolled, actually—into a geologist's perfect field site. As hoped, a small impact had exposed light-toned bedrock around the rim of its crater. This proved to be the long-sought evidence for prolonged surface waters. The

www.sciencemag.org on February 1, 2008

# “undisturbed” soils



# Undisturbed Soil from Gusev Crater





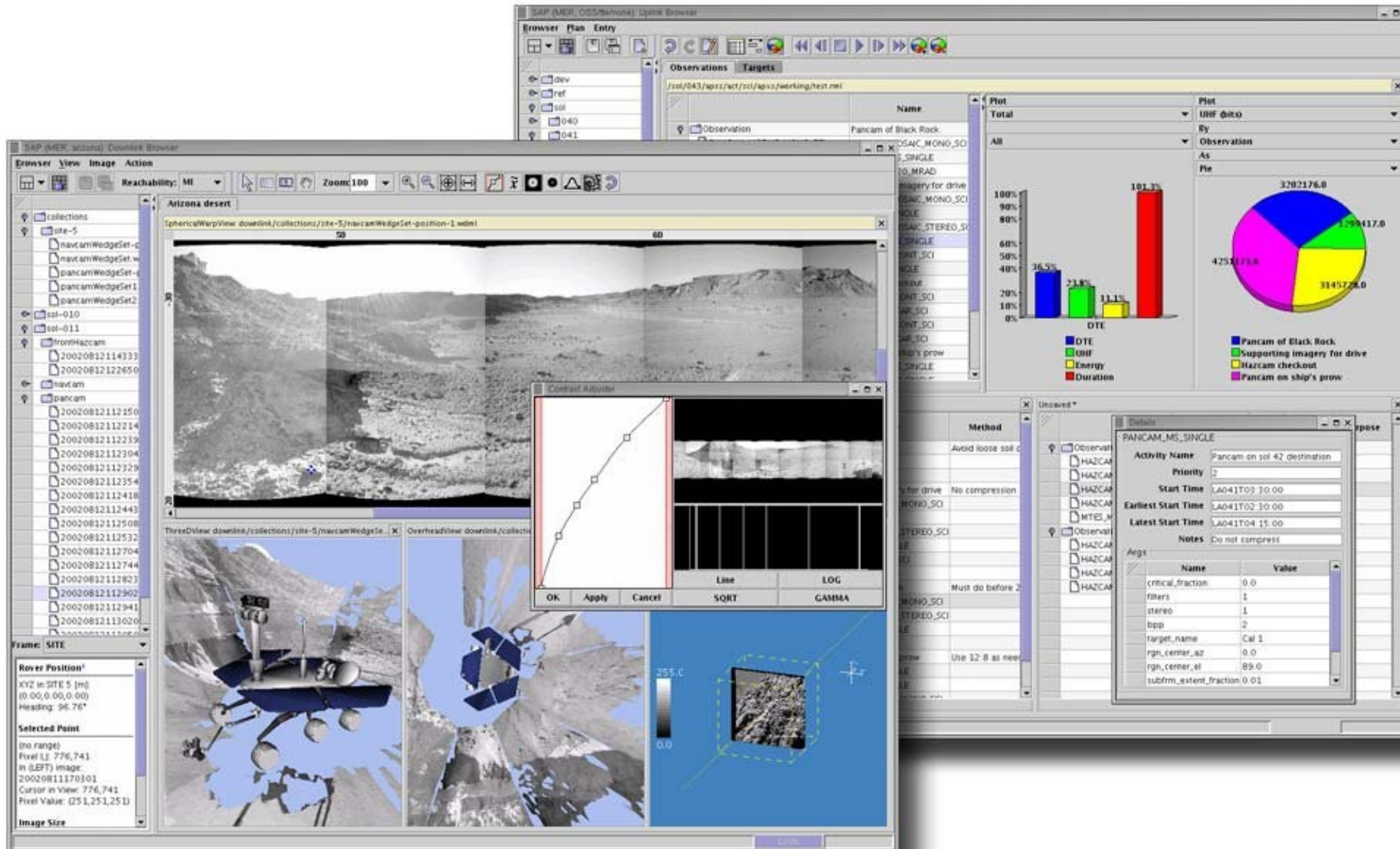
Data

Creative  
thinkers  
made here.

# Data I - Planning

- Observations are based on science rationale and rover capability using proprietary software
- PUL/PDL create commands
- SOWG verifies & uplink happens through DSN to orbiters

# Data II - Planning



The screenshot displays the SAP MER software interface, which is used for mission planning and data management for Mars rovers. The interface is divided into several key sections:

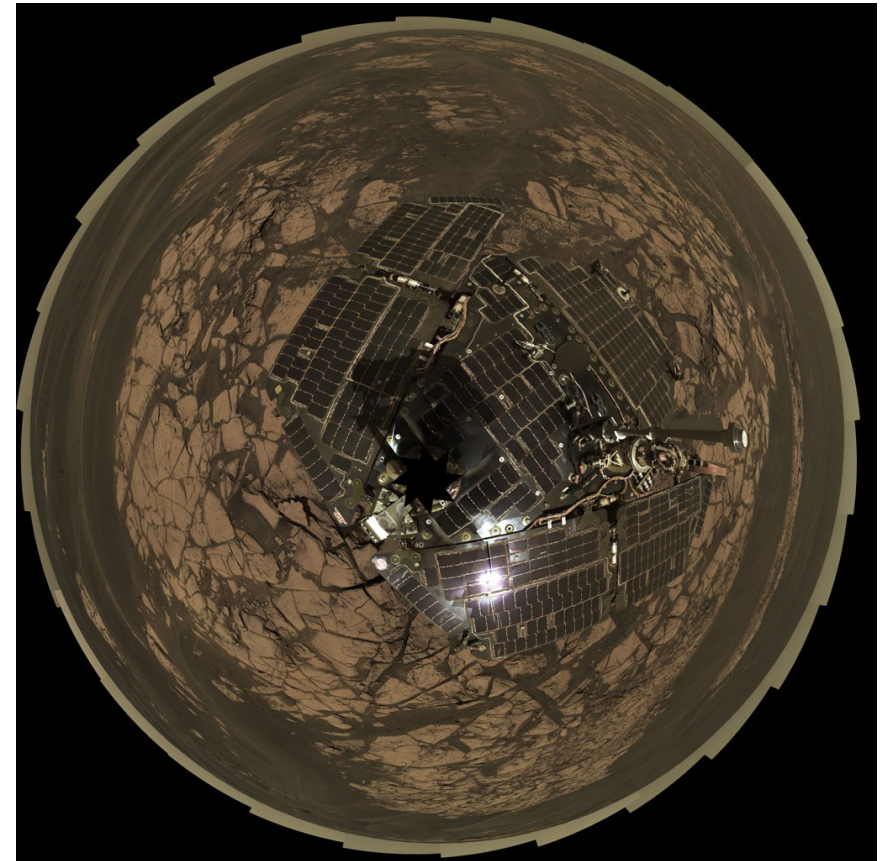
- Left Panel (File Browser):** Shows a hierarchical tree structure of mission data, including collections, sites, and specific observations like 'pancamWedgeSet1' and 'sol-010'.
- Main View (Arizona desert):** Displays a grayscale image of a desert landscape, likely a Mars terrain. A 'Contrast Adjuster' window is overlaid on this view, showing a graph of contrast levels and a preview of the adjusted image. The graph shows a curve starting at (0,0) and rising to a peak of approximately 100 at a contrast value of 1.0.
- Top Panel (Browser Plan Entry):** Contains a table of observations and targets. The 'Observations' tab is active, showing a table with columns for Name and various parameters.
 

Name	Value
Pancam of Black Rock	
DSAC_MONO_SO	
S_SINGLE	
10_MRAD	
Imagery for drive	
DSAC_MONO_SO	
NOLE	
DSAC_STEREO_SO	
S_SINGLE	
SPIT_SCI	
NOLE	
IMOUT	
SPIT_SCI	
AR_SCI	
SPIT_SCI	
AR_SO	
AR_SO	
Weg's prov	
S_SINGLE	
- Right Panel (Charts):** Contains two charts. A bar chart shows the distribution of mission parameters: DTE (36.5%), UHF (23.8%), Energy (11.1%), and Duration (181.3%). A pie chart shows the distribution of data types: Pancam of Black Rock (3282176.8), Supporting imagery for drive (1299417.0), Hazcam checkout (3145728.0), and Pancam on ship's prov (4251776.8).
- Bottom Panel (Details):** Shows a 'Details' window for a specific observation, 'PANCAM\_MS\_SINGLE'. It lists various parameters such as Activity Name, Priority, Start Time, and target\_name.
 

Name	Value
critical_fraction	0.0
filters	1
stereo	1
bpp	2
target_name	Cal 1
rgh_center_az	0.0
rgh_center_el	89.0
subfrm_extnt_fraction	0.01
- Bottom Left Panel (Rover Position):** Displays the rover's current position and status, including 'Rover Position', 'Selected Point', and 'Image Size'.

# Data III - Verification

- Data becomes available in Maestro
- PDL verifies and validates data
- Protocols for each instrument
  - Scientific Data
  - Engineering Data
- QA/QC
- Documentation
- Archiving



# Data IV – Daily Communication

SOL 4838 DOWNLINK REPORT FOR MER-B

Status: GREEN

MER-B is healthy and all subsystems are functioning as expected as of the ODY\_48381 pass.

Filed by:

Based on data from passes: ODY\_48381

!!! Amnesia Event detected prior to yestersol. Check EVRs and init counter for amnesia!!!

Missing 2 FSW init(s) (possible Amnesia Event) between SOL 4837 18:05:17 and SOL 4838 16:38:51

\*\*\* Amnesia event detection due to persistent RAM mode. Missing FSW inits due to sol 4837 wake for deep sleep at 18:31:25 and sol 4838 wake for HGA pass at 11:10:08.

EVR Analysis: All failures and warnings were explained.

\*\*\* EVR list seems to be missing. Will investigate on Monday once MDOT has had a chance to finalize their processes.

Upload Status:

No new sequences were found in the EVRs tosol.

Sol 4838 nominal beep delta +20 seconds

Sol 4836 nominal beep delta +15 seconds

Sol 4834 nominal beep delta +14 seconds

POWER:

Peak solar array curr: ~0.010 Amps SOL 4838 17:00:35 ODY\_48381

Avg tau value(Lemmon, L8): No tau found for 4838

Actual Max SOC for Sol 4838: ~NYA Ahr

Actual Min SOC for Sol 4838: ~NYA Ahr

**34** Array Energy: ~NYA Whr

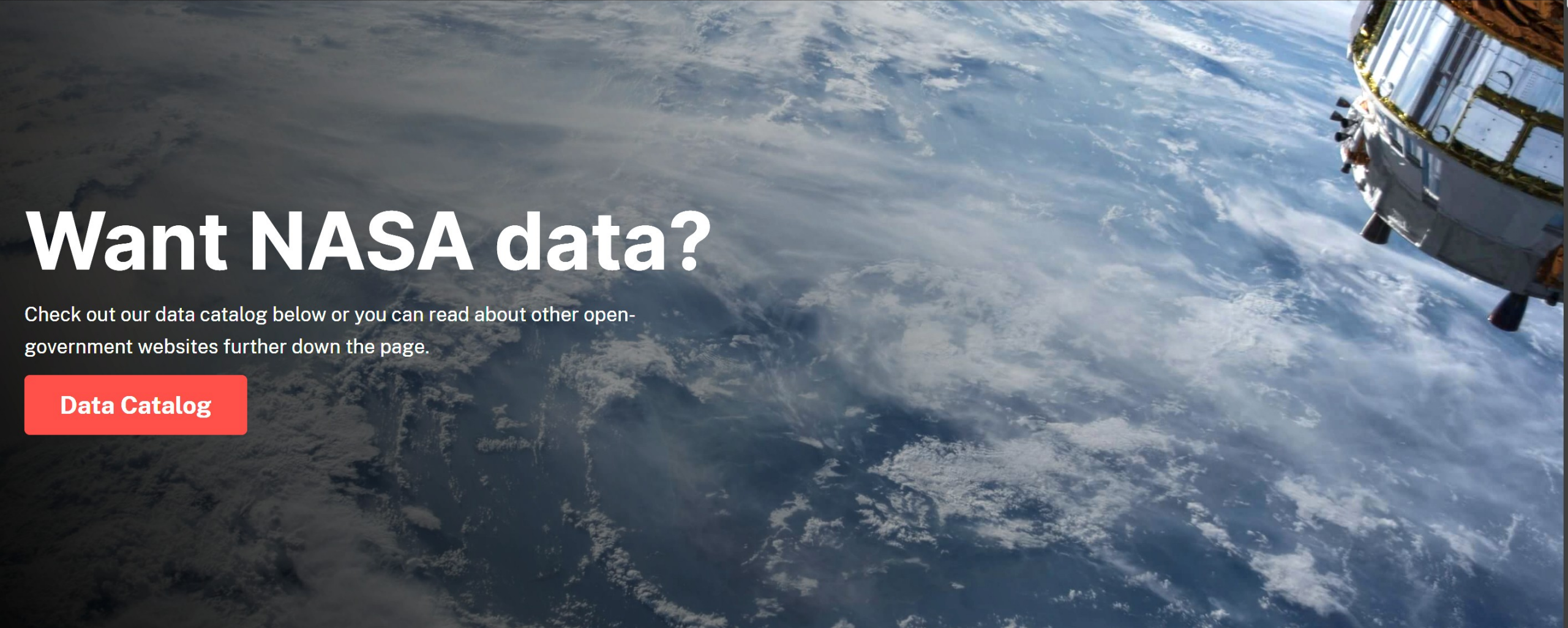
# Data IV – Who can Access the Data?



## Want NASA data?

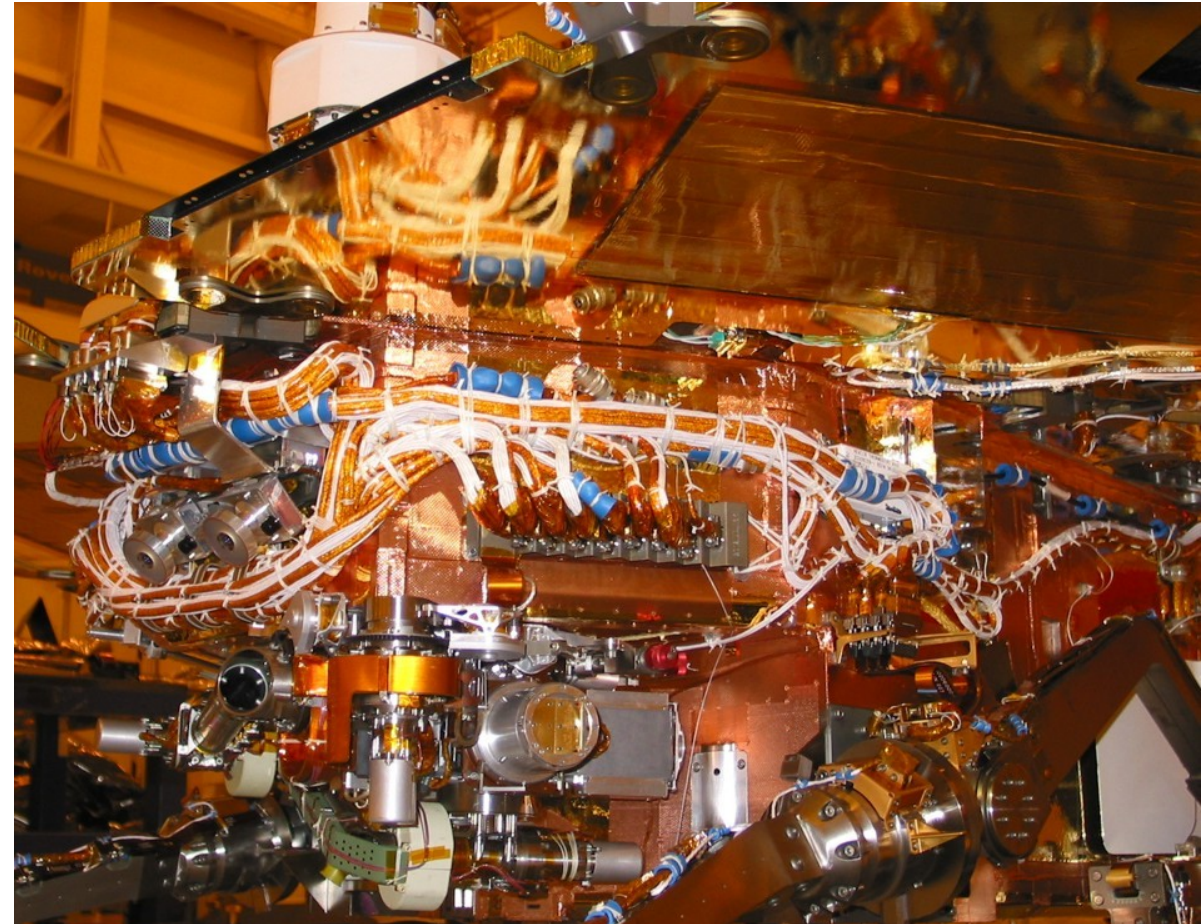
Check out our data catalog below or you can read about other open-government websites further down the page.

[Data Catalog](#)



# Who can access the data?

- During Proprietary Period
  - Mission Scientists and Engineers
  - Participating Scientists
- After Proprietary Period
  - You!



# How do we decide to publish?

“Rules of the Road”



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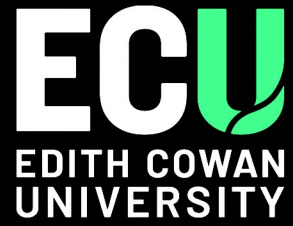
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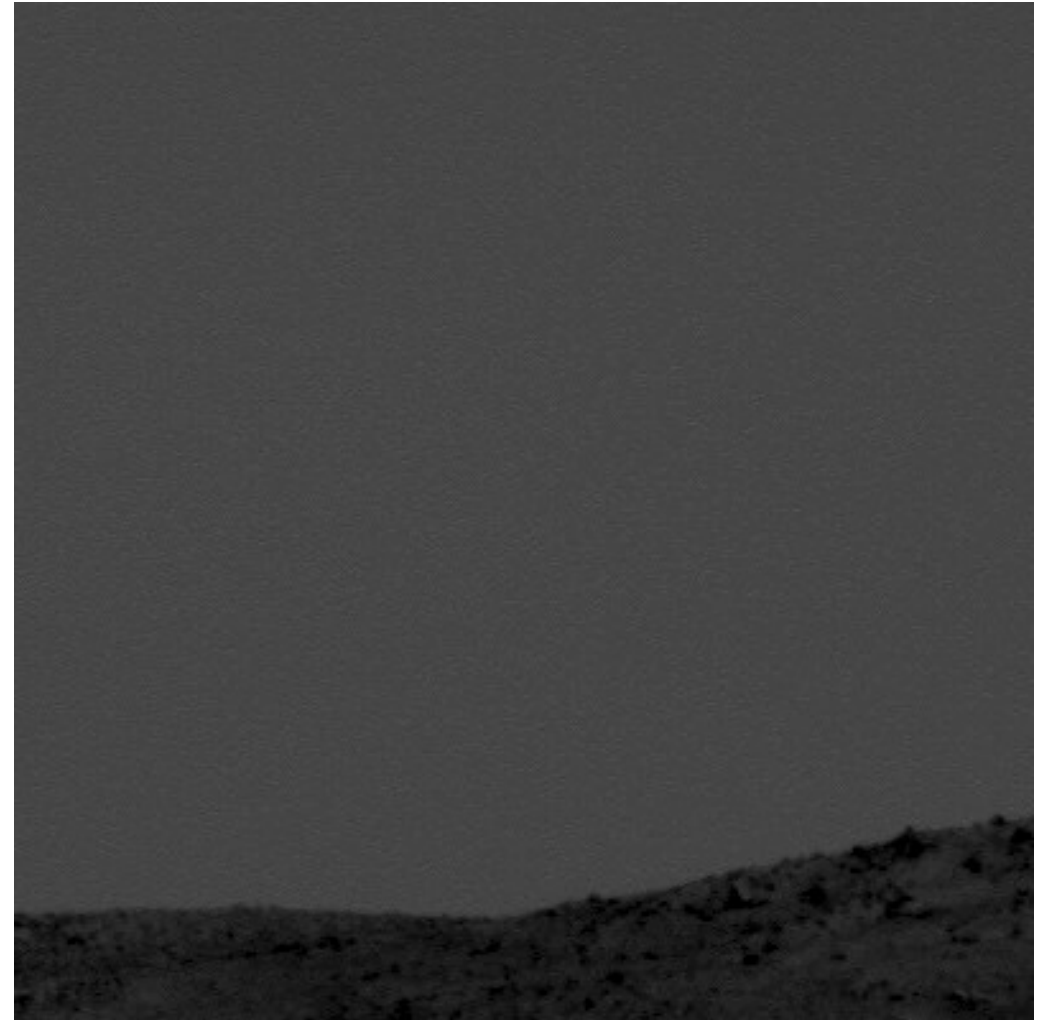
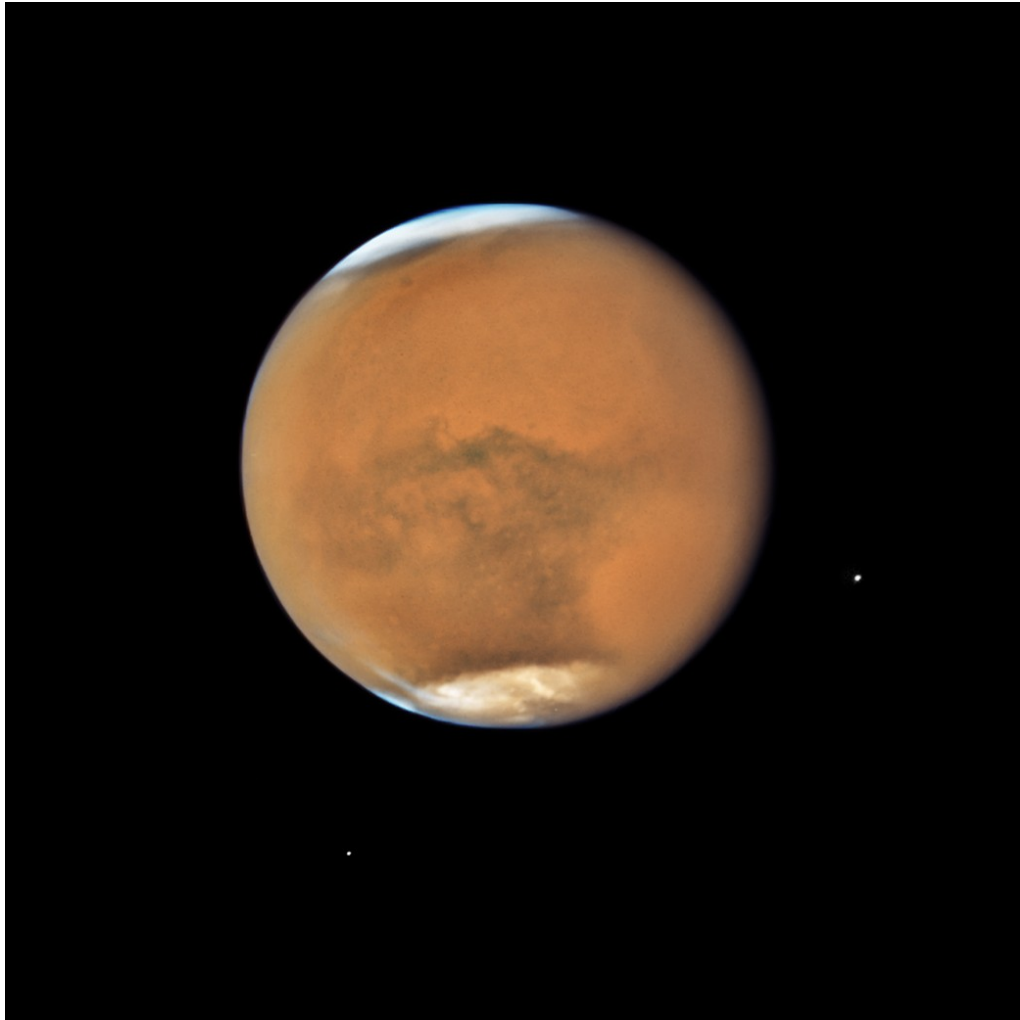
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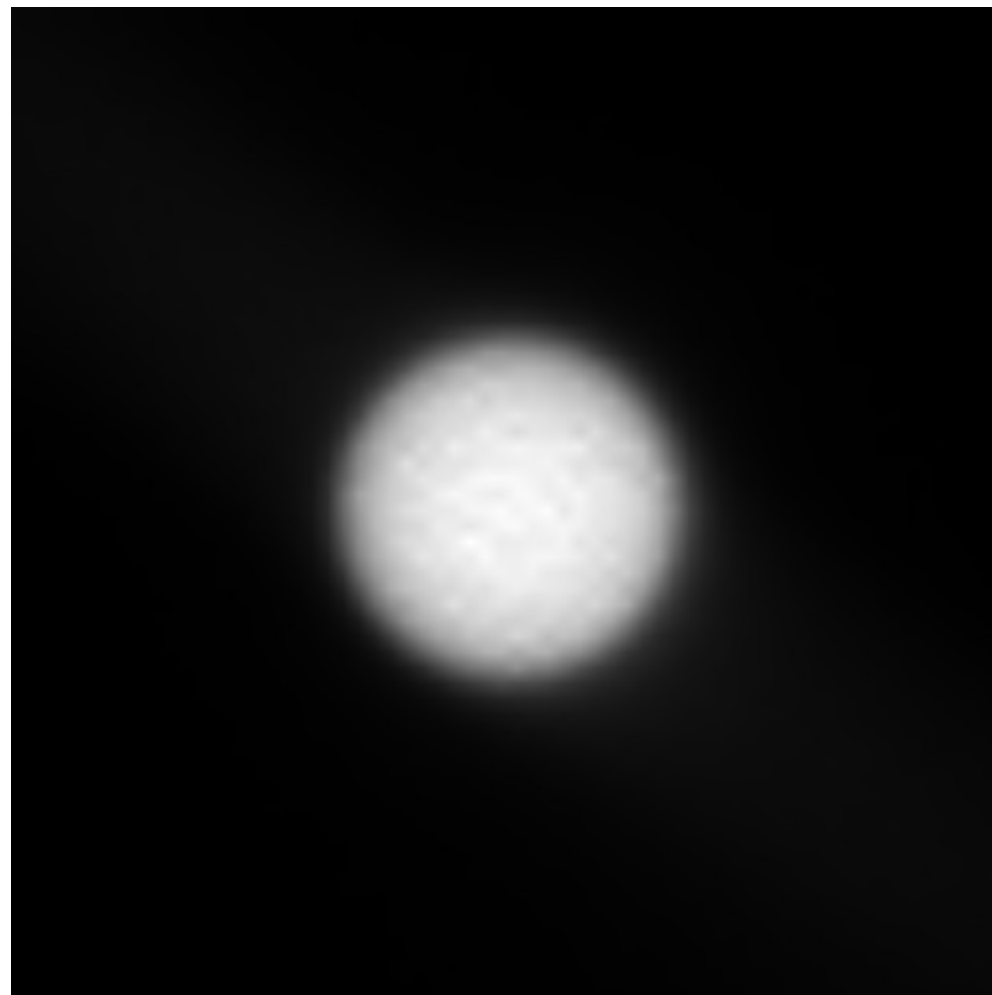
1 [www.sciencemag.org](http://www.sciencemag.org) on February 1, 2008



# Some Cool Stuff

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**earthrise**



# Thank You

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thinkers  
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Prof. Paulo de Souza  
[p.desouza@ecu.edu.a](mailto:p.desouza@ecu.edu.au)  
[u](#)