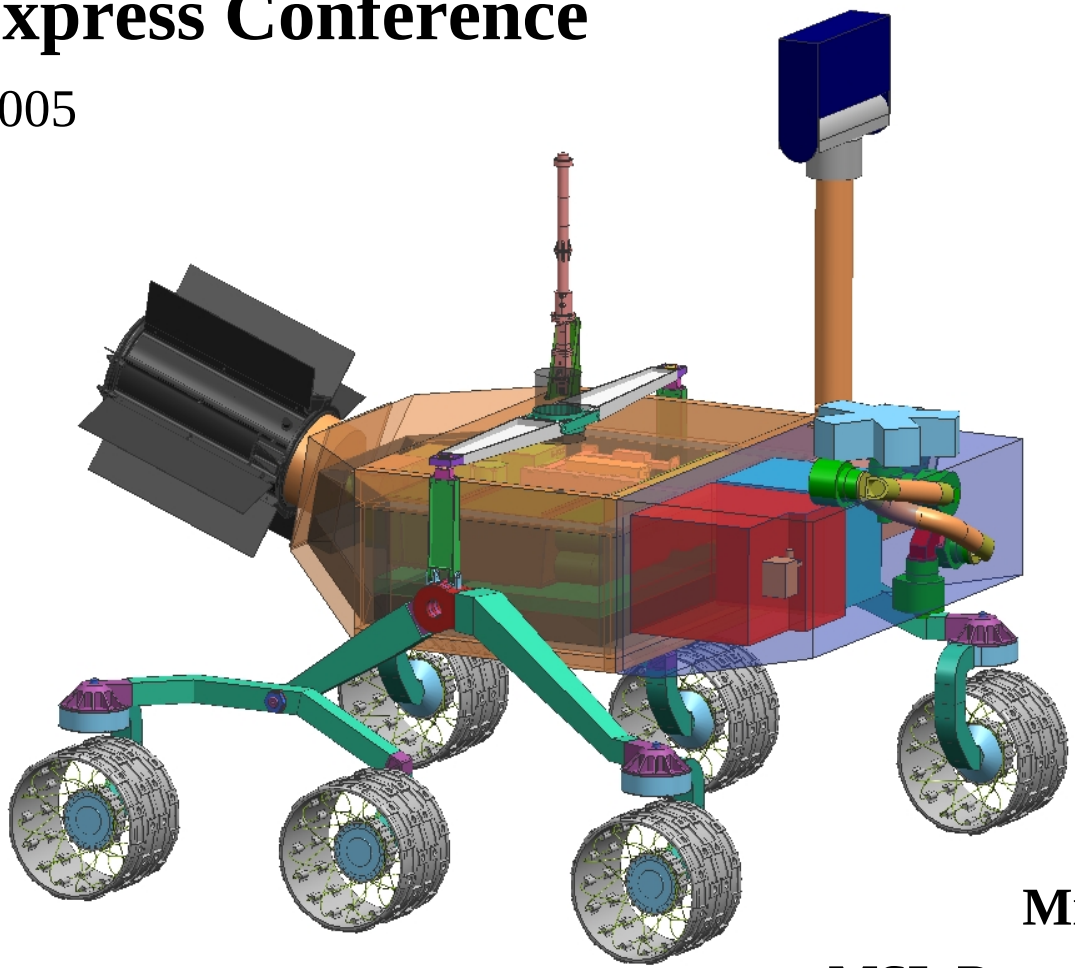
Mars Science Laboratory - Overview

Mars Express Conference

February 2005



Michael Meyer

MSL Program Scientist

Mars Science Laboratory—the AO

The overall MSL science objective is to explore and quantitatively ***assess a local region on the Mars surface as a potential habitat for life, past or present***. This mission will use a variety of instruments carried on a rover platform that will operate under its own power and telemetry and is expected to remain active for one Mars year.

For the purpose of this AO, a science investigation includes the construction of the proposed instrument(s), delivery to NASA, mission operation and data collection, calibration, validation, and analysis with delivery of data to the Planetary Data System (PDS).

AO Science Objectives – Floor

The overall MSL science objective is to explore and quantitatively assess a local region on the Mars surface as a potential habitat for life, past or present.

A. Assess the ***biological potential*** of at least one target environment identified prior to MSL or discovered by MSL.

B. Characterize the ***geology*** of the landing region at all appropriate spatial scales (i.e., ranging from micrometers to meters).

C. Investigate planetary processes of relevance to ***past habitability***, including the role of water

AO Science Objectives

D. Characterize the broad-spectrum of the ***surface radiation environment***, including galactic cosmic radiation, solar proton events, and secondary neutrons

E. Of Lower Priority was to…

- Investigate the presence of known toxic materials, such as Cr VI, as part of the basic geochemical surveys of Martian regolith or rocks

MSL Project Science Integration Group (PSIG) Report 2003

A. Assess the *biological potential* of at least one target environment (past or present).

I. Determine the nature and inventory of organic carbon compounds.

II. Inventory the chemical building blocks of life (C, H, N, O, P, S).

III. Identify features that may record the actions of biologically-relevant processes.

B. Characterize the *geology of the landing region* at all appropriate spatial scales.

I. Investigate the chemical, isotopic, and mineralogical composition of Martian surface and near-surface geological materials.

II. Interpret the processes that have formed and modified rocks and regolith.

C. Investigate planetary *processes that influence habitability*.

I. Assess long-timescale (i.e., 4-billion-year) atmospheric evolution processes.

II. Determine present state, distribution, and cycling of water and CO_2.

MSL Investigation Groups

- **Analytical laboratory investigations—**instruments to analyze Martian atmosphere (gas) samples and/or regolith, rock, ice samples provided by the Sample Acquisition, Processing, and Handling System

- **Remote sensing investigations—**instruments mounted on the rover's mast

- **Contact instrument investigations—**instruments mounted on the rover's robotic arm

- **Other investigations—**instruments mounted elsewhere on the rover, including a sensor to assess the radiation environment at the local Martian surface

Selected Payload

PI Name	Proposal	**Instrument**
Michael Malin	**Mast Camera**	Panoramic Imager
Roger Wiens	**ChemCam**	Laser-Induced Bkdn Spectrometer
Kenneth Edgett	**MAHLI**	Contact Microscope
Ralf Gellert	**APXS**	X-ray Spectrometer
David Blake	**CheMin**	XRD/XRF
Donald Hassler	**RAD**	Radiation Detector
Michael Malin	**MARDI**	Decent Imager
Paul Mahaffy	**SAM**	GC/MS
Igor Mitrofanov	**DAN**	Neutron Detector
Juan Mercader	**REMS**	Meterology

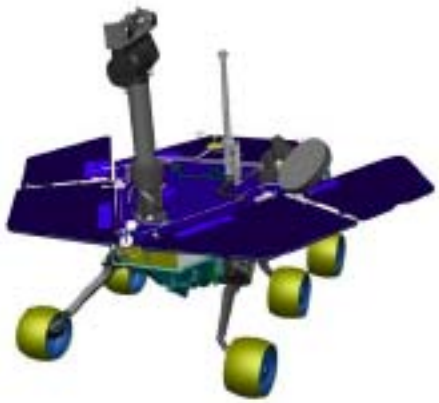
LEGEND

Mast Analytic (body)

Arm Ancillary

Evolution of MSL

Sojourner



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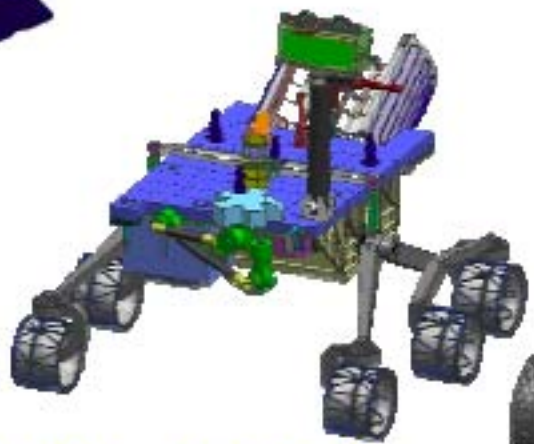
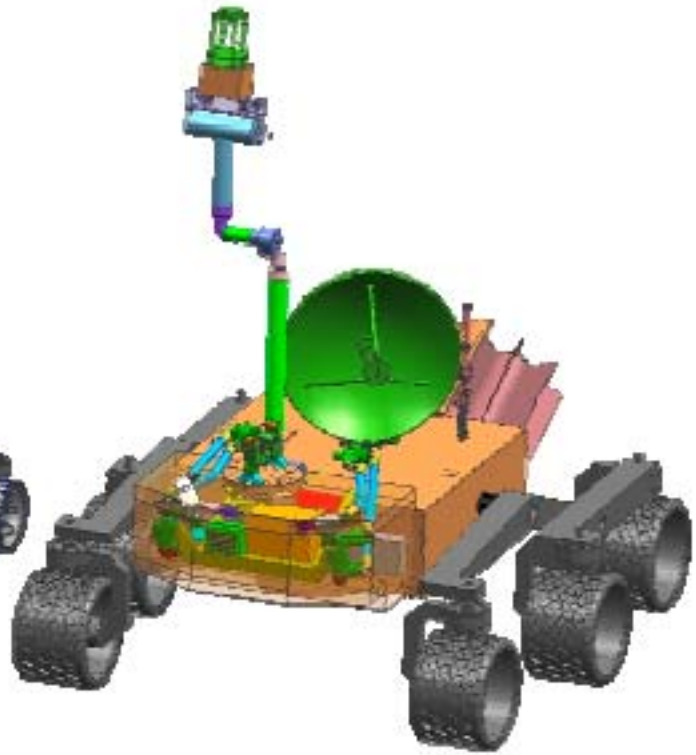
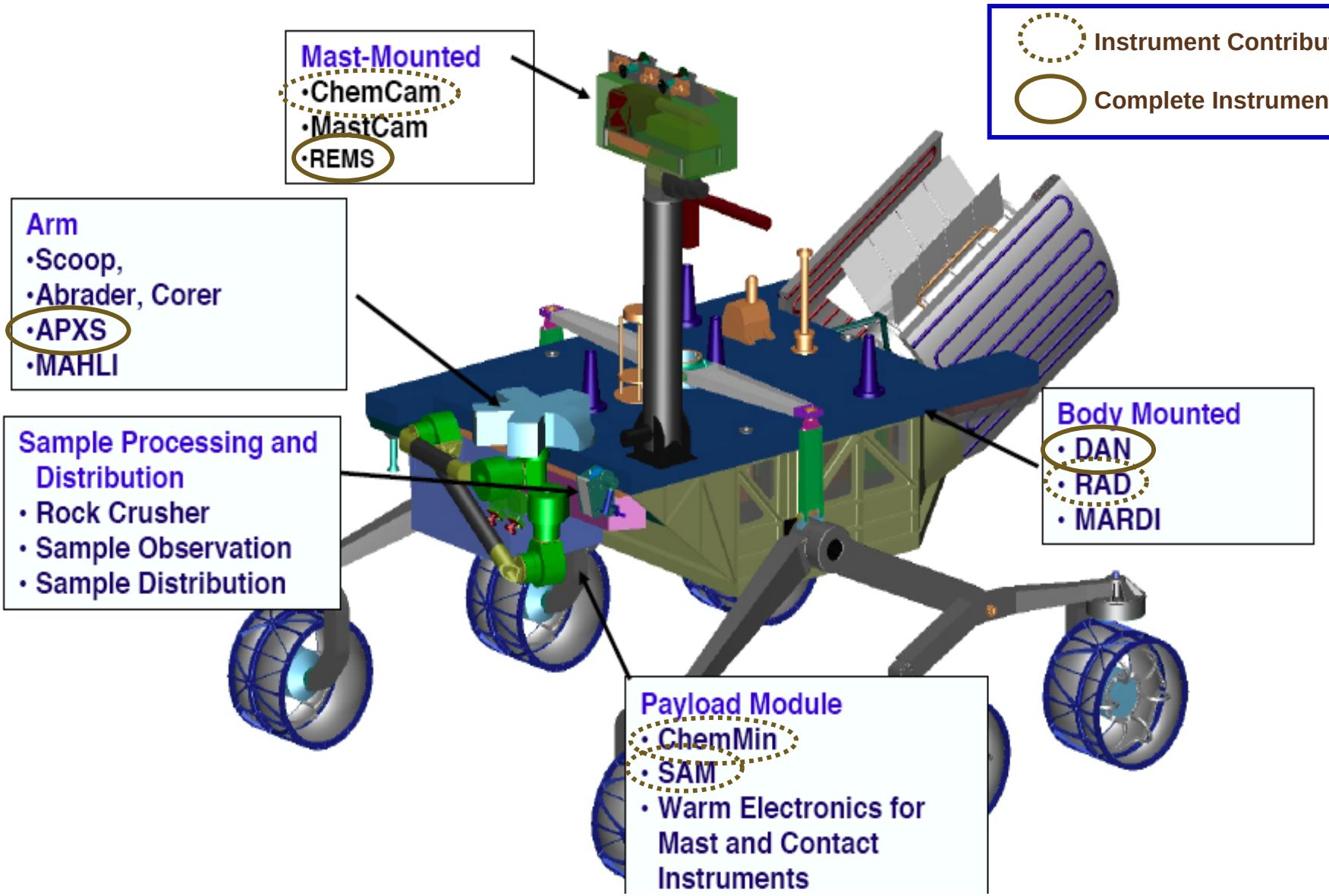


MSL – Dec 2004



MSL – Oct 2003

MSL International Participation



MSL Science Traceability to AO

A. Assess the biological potential…..

AO Science Objective	Science Return from Selected Instruments
1. Determine the nature and inventory of organic carbon compounds.	**SAM**: carbon abundance, identification of carbon compounds **CHEMIN**: carbon-containing minerals **CHEMCAM**: remote identification of carbon, C_2 & CN **MAHLI**: fluorescence from some organics
2. Inventory the chemical building blocks of life (C, H, N, O, P, S).	**SAM**: elemental composition of rocks/fines **CHEMIN**: mineralogy & elemental composition of rocks/fines **CHEMCAM**: elemental composition or rocks/fines **APXS**: elemental composition of rocks/fines
3. Identify features that may represent the effects of biological processes.	**SAM**: identification of carbon compounds, atmospheric methane **CHEMIN**: mineralogical biomarkers **MAHLI**: morphological biomarkers **APXS**: chemical context for biomarkers

MSL Science Traceability to AO

B. Characterize the geology and geochemistry……

AO Science Objective	Science Return from Selected Instruments
1. Investigate the chemical, isotopic and mineralogical composition of martian surface and near-surface geological materials.	**CHEMIN**: definitive mineralogy, chemical composition of rocks and fines **MAHLI**: color, texture, optical properties and fluorescence of rocks/fines **APXS**: derived chemical composition of rocks/fines **CHEMCAM**: derived chemical composition of rocks/fines **SAM**: isotopic composition of volatile C, S, O. H **DAN**: abundance of subsurface hydrogen bearing materials
2. Interpret the processes that have formed and modified rocks and regolith.	**CHEMIN**: aqueous and diagenetic mineralogy **APXS**: chemical composition of altered or weathered rocks/fines **CHEMCAM**: elemental composition of altered or weathered rocks/fines & properties via imager **MASTCAM**: geology/geomorphology, properties of rocks/fines, aeolian activity **MAHLI**: properties of rocks/fines at fine scale **MARDI**: synoptic geology/geomorphology of landing site at cm scales **RAD**: rate of radiation-induced chemical modification of regolith

MSL Science Traceability to AO

C. Investigate planetary processes of relevance to past habitability…..

AO Science Objective	Science Return from Selected Instruments
Investigate planetary processes of relevance to habitability including the role of water.	**CHEMIN**: water-precipitated/deposited minerals **CHEMCAM**: composition of sedimentary materials **MASTCAM**: geology/geomorphology in vicinity of rover **MARDI**: geology/geomorphology of landing site area **APXS**: composition of sedimentary materials
1. Assess the long-timescale (i.e., 4-billion-year) atmospheric evolution processes.	**SAM**: isotopic composition of atmosphere & any trapped gases
2. Determine the present state, distribution, and cycling of water and CO_2.	**DAN**: distribution and abundance of subsurface water **REMS**: diurnal/seasonal cycles of humidity, pressure, temperature. winds **MASTCAM/MAHLI**: frost on surfaces or rover **CHEMCAM**: frost on surfaces **RAD**: production rate of ^{14}C in atmospheric CO_2

MSL Science Traceability to AO

D. Characterize the broad spectrum of surface radiation…...

AO Science Objective	Science Return from Selected Instruments
1. Characterize the broad spectrum of surface radiation, including galactic cosmic radiation, solar proton events, and secondary neutrons.	**RAD**: energetic ions, protons, helium, neutrons, electrons, x-rays, and gamma rays **REMS**: UV radiation 200 - 400 um

Summary

The Mars Science Laboratory mission has selected a payload that:

- Fits within the stated mission constraints
- Meets all the PSIG recommendations & AO/PIP science objectives
- Includes significant international participation

MSL investigations are expected to:

- Significantly advance our understanding of the potential habitability of Mars, and
- Determine the thrust of science investigations for the next decade.