Report of the 2018 Joint Mars Rover Mission Joint Science Working Group (JSWG)

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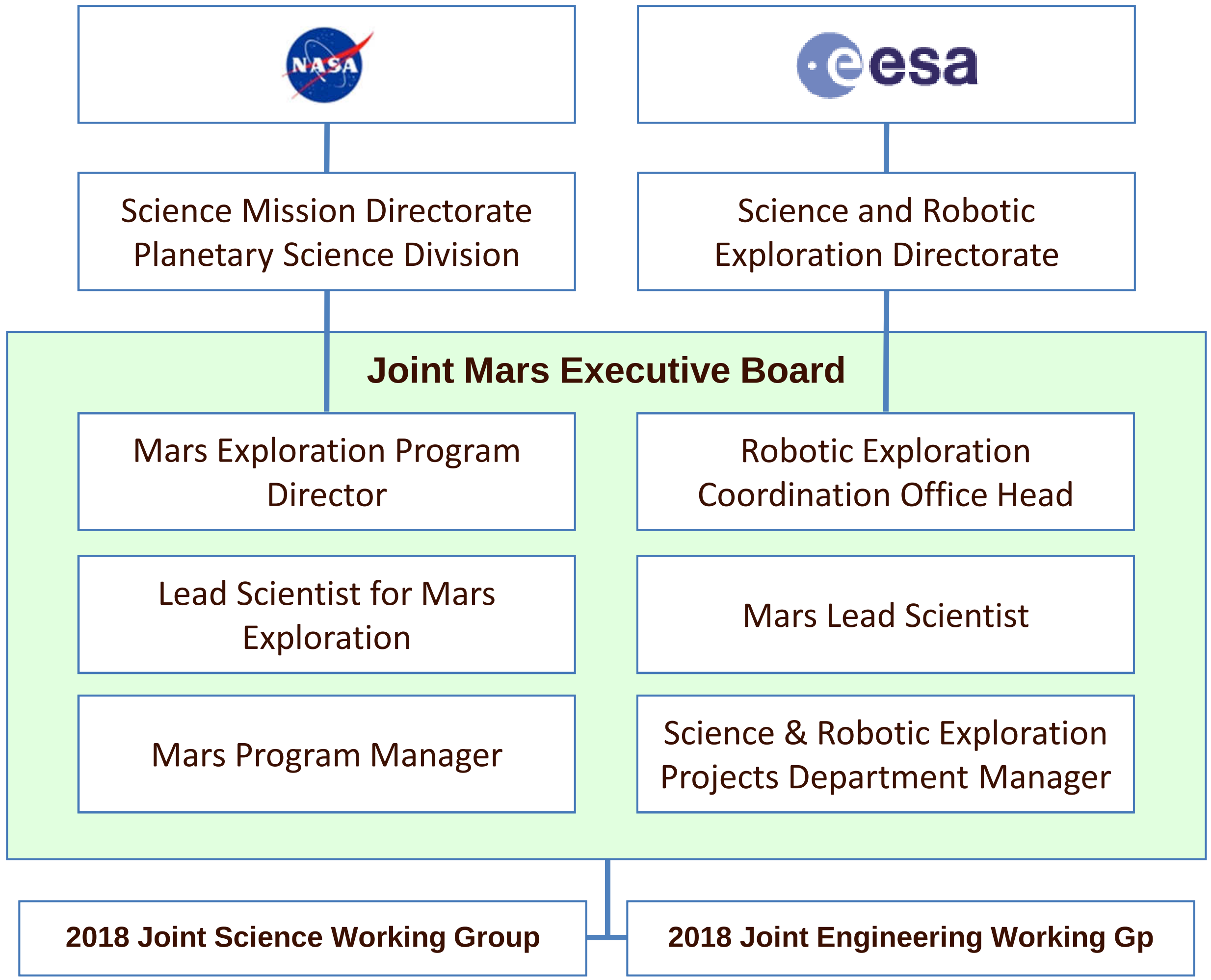
Dave Beaty, Gerhard Kminek, Allwood, A.C., Arvidson, R., Borg, L.E., Farmer, J. D., Goesmann, F., Grant, J. A., Hauber, E., Murchie, S.L., Ori, G.G., Ruff, S. W., Rull, F., Sephton, M. A., Sherwood Lollar, B., Smith, C. L., Westall, F., Pacros, A.E., Wilson, M.G., Meyer, M.A., Vago, J.L., Bass, D.S., Joudrier, L., Laubach, S., Feldman, S., Trautner, R., Milkovich, S.M.

JSWG Charter

- Joint Science Working Group (JSWG) was chartered by the Joint Mars Exploration Executive Board to serve as the science definition team for a 2018 mission concept
- Assumptions:
  - The joint rover is tightly cost-constrained
  - The joint rover needs to incorporate the scientific objectives and requirements from the ESA ExoMars rover
  - The joint rover needs to incorporate scientific objectives and priorities related to preparing for the eventual return of samples from Mars from the NRC's Decadal Survey and from the MEPAG End-to-End international Science Analysis Group



MEPAG
E2E-iSAG

Report of the MEPAG E2E-iSAG

Lisbon, Portugal; June 16, 2011

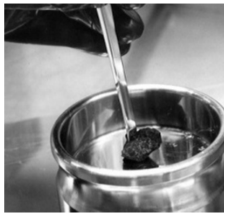
Scott McLennan and Mark Sephton, E2E-iSAG co-chairs,
and the E2E-iSAG team

Pre-decisional: for discussion purposes only

The E2E Team

Co-Chair	Mark Sephton	Imperial College, London, UK	Organics, ExoMars
	Scott McLennan	SUNY Stony Brook, NY	Sedimentology, geochemistry Co-I MER
Science Members	Carl Allen	JSC, Houston, TX	Petrology, sample curation, Mars surface
	Abby Allwood	JPL, Pasadena, CA	Field Astrobio., early life, liason MAX-C
	Roberto Barbieri	Univ. Bologna, IT	Astrobiology, paleontology, evaporites
	Penny Boston	NM Inst. Mining & Tech, NM	Cave geology/biology, member PSS
	Mike Carr	USGS (ret.), CA	Mars geology, water on Mars
	Monica Grady	Open Univ. UK	Mars meteorites, isotop., sample curation
	John Grant	Smithsonian, DC	Geophys., landing sites, MER, MRO
	Veronika Heber	UCLA	Gas geochemistry
	Chris Herd	Univ. Alberta, CAN	Petrology, sample curation
	Beda Hofmann	Nat. Hist. Museum, Bern, CH	Geomicrobiology, ExoMars (Deputy CLUPI)
	Penny King	Univ. New Mexico	Petrology, geochemistry, MSL
	Nicolas Mangold	Univ. Nantes, FR	Geology, spetroscopy MEX, MSL
	Gian Gabriele Ori	IRSPS, Pescara, IT	Mars geology, sedimentology, MEX, MRO
	Angelo Pio Rossi	Jacobs Univ. Bremen, DH	Planetary geology, HRSC, SHARAD
	François Raulin	Univ. Paris 12, FR	Astrobio., extraterrestrial material, Deputy MOMA
	Steve Ruff	Arizona State Univ.	MER operations, spectral geology, MGS, MER
	Barb Sherwood Lollar	Univ. Toronto, CAN	Astrobology, stable isotopes
	Steve Symes	Univ. Tennessee	REE, geocronology, member CAPTEM
Eng. Reps.	Peter Falkner	ESA	Advanced mission planning, MSR
	Mike Wilson	JPL	Advanced mission planning, MSR
Ex-officio	Dave Beaty	Mars Program Off., JPL	Liason to MEPAG, cat herder

Overview



Prioritized MSR science objectives

Derived implications

- Samples required/desired to meet objectives
- Measurements on Earth

Critical Science Planning Questions for 2018

- Variations of interest?
- # of samples?
- Types of landing sites that best support the objectives?
- Sample size?
- Measurements needed to interpret & document geology and select samples?
- On-Mars strategies ?

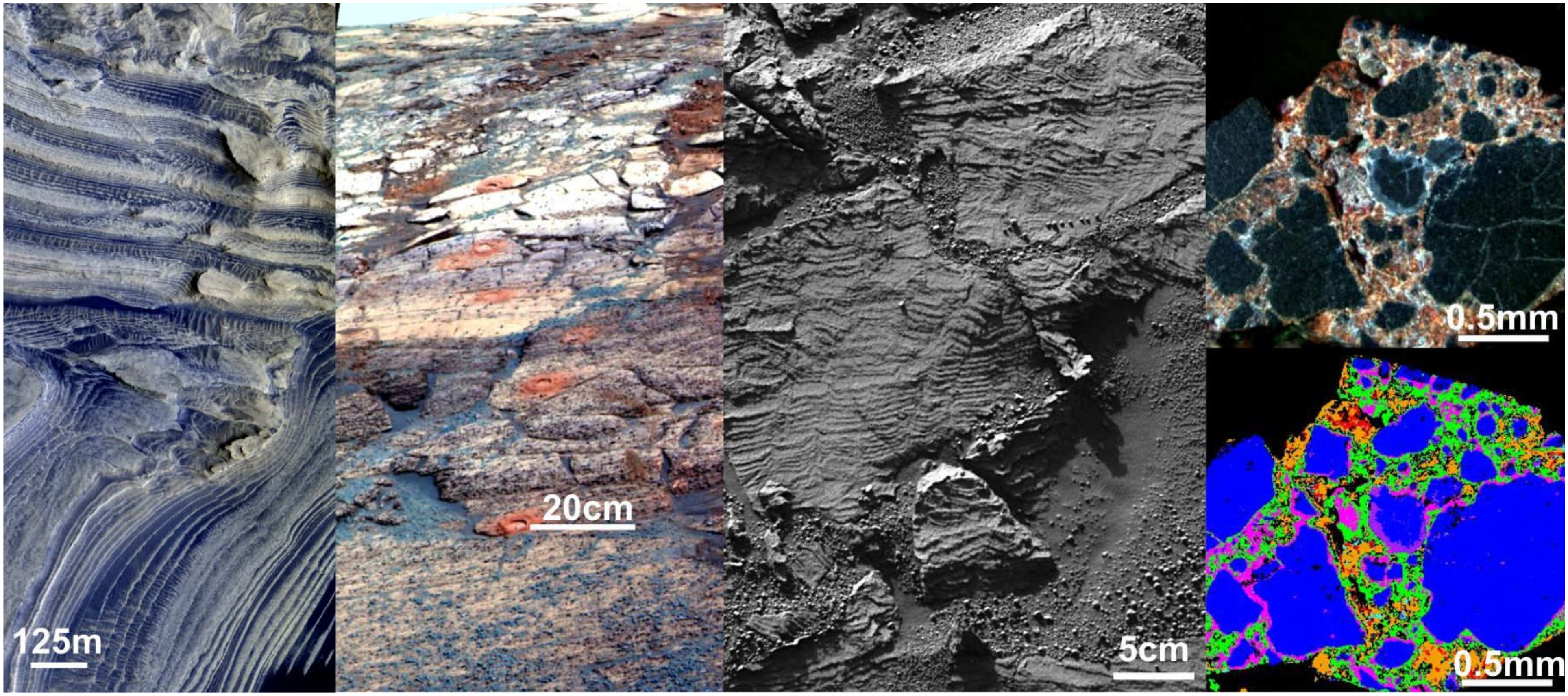
Engineering implications

- Sampling hardware
- Instruments on sampling rover
- EDL & mobility parameters, lifetime, ops scenario
- Sample preservation

How did this information flow forward to JSWG/JEWG?

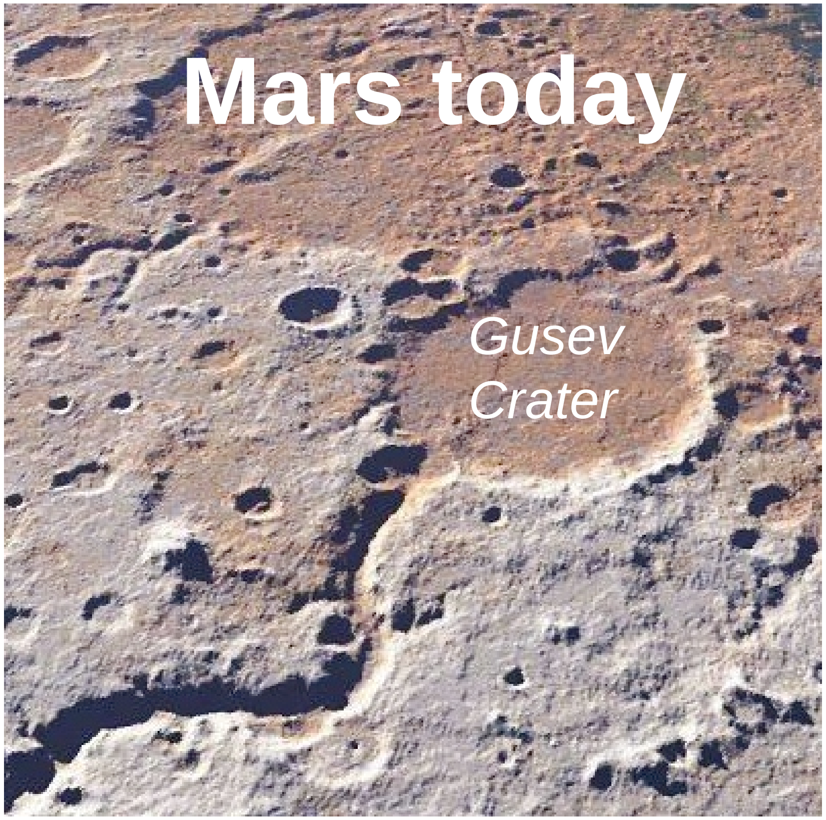
Proposed Objective 1:

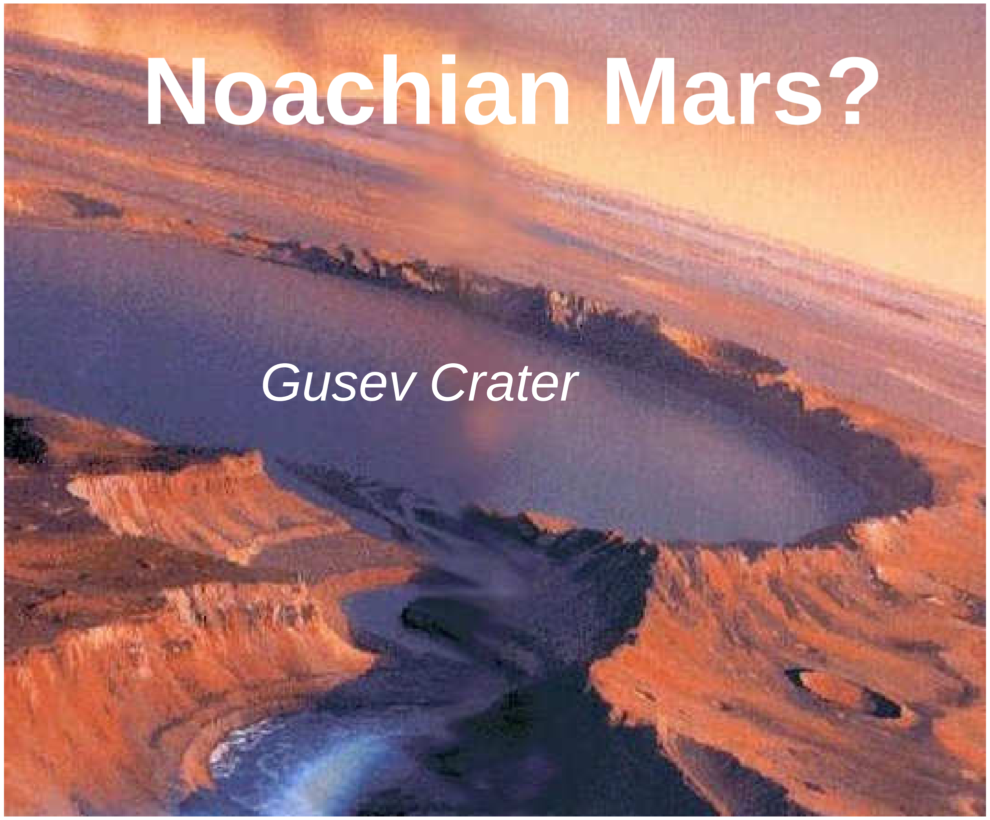
Analyze the local geology over kilometer to sub-millimeter scales and to a depth of ~2 meters, with emphasis on supporting the objectives 2–4



Proposed Objective 2:

Investigate geological settings indicative of past habitability & favorable for preserving physical or chemical signs of life and organic matter

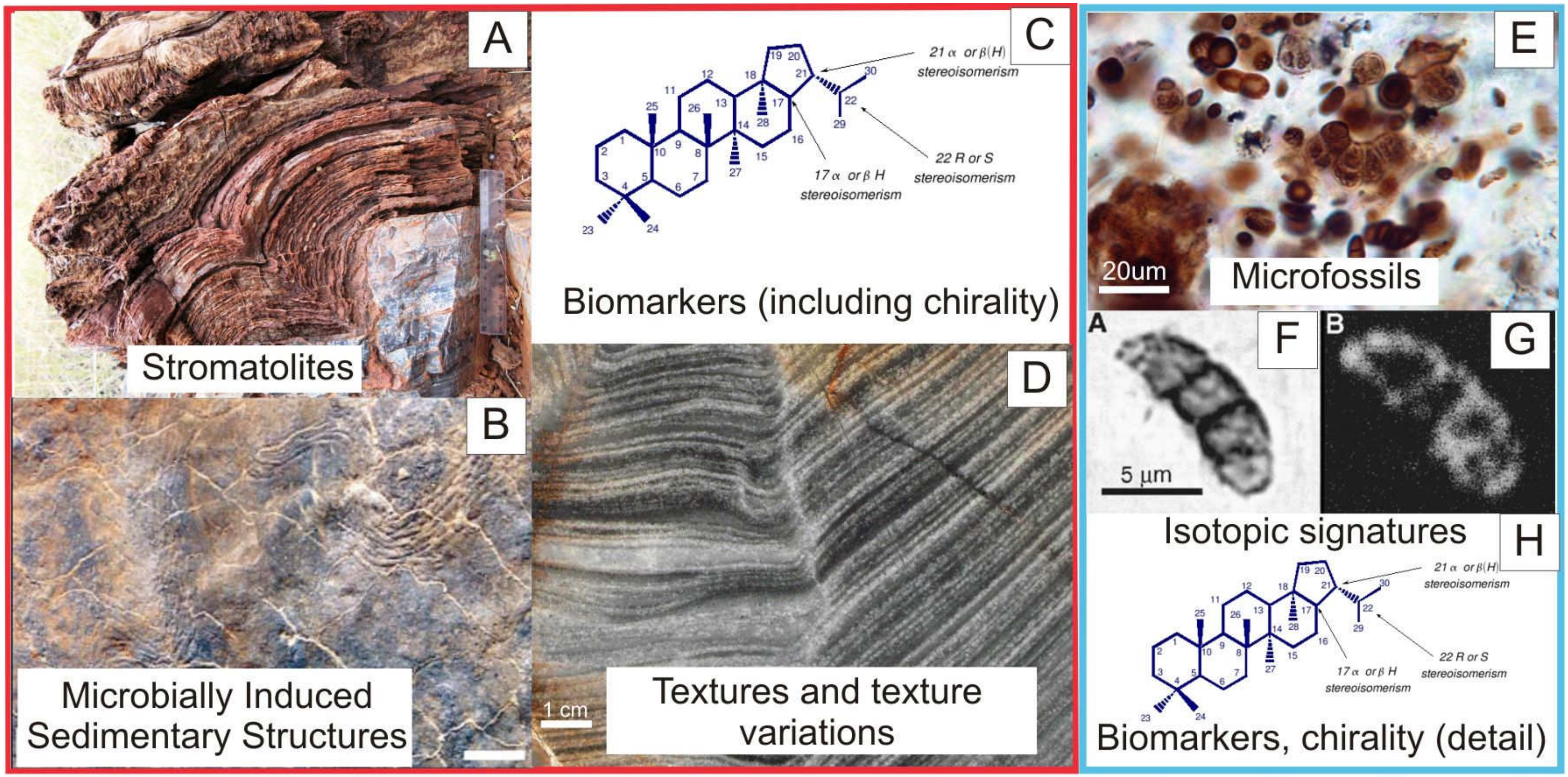




Key Strategy: Seek the signs of life in paleoenvironments with high habitability and preservation potential.

Proposed Objective 3:

Search for evidence of abiotic carbon chemistry, and for physical and chemical signs of life



Detectable with proposed *in situ* instruments

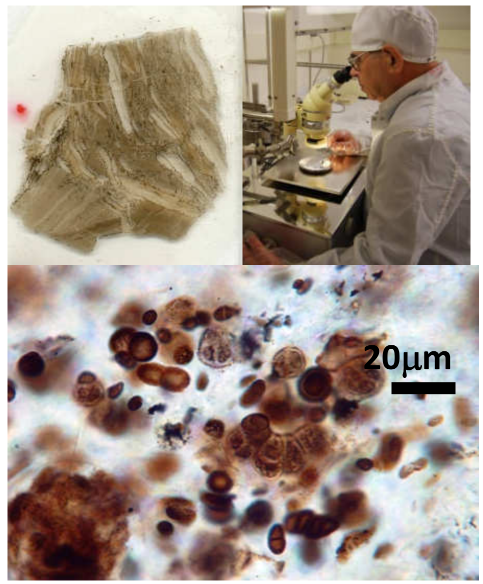
Requires returned samples

Proposed Objective 4:

Select, establish context for, collect, and cache samples that could be returned to Earth for definitive analysis

Reasons for returning samples for analysis on Earth…

Instrumentation not amenable for flight to Mars.



Use of techniques requiring complex sample preparation.

Application of a virtually unlimited array of different instruments, and investigation pathways that are discovery-responsive.

Five Primary Proposed Science Strategies

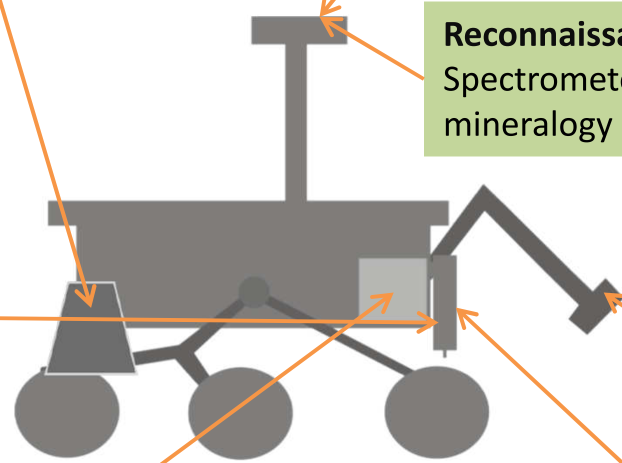
1. Land and operate a rover safely at a landing site of compelling scientific interest.
2. Equip the rover with a set of instruments capable of investigating the surface outcrops, rocks and soils at multiple scales
3. Have subsurface exploration capabilities, including a deep drill to support the characterization of the local geology and the search for martian organic chemistry and life.
4. Achieve a scientifically compelling cache of samples using several linked strategies, including careful establishment of geologic context, high selectivity from a wide range of possibilities, and sample encapsulation to preserve scientific value.
5. Pursue the search for martian life using three complementary investigation strategies: observation of field relationships, in-situ analysis on Mars, and analysis of returned samples.

Instrument Summary

Subsurface Investigations

WISDOM
Ground penetrating radar

Ma_MISS
Drill hole VIS and IR spectrometer; operates during drilling, app. 5mm above end of drill bit



Geologic mapping, target acquisition

PanCam
Panoramic stereo camera with geological filters, and high resolution camera

Reconnaissance mineralogy
Spectrometer for outcrop-scale mineralogy survey

Outcrop, rock/soil Investigations,

Close-up Rock/Soil Instrument suite
Elemental chemistry
Fine-scale mineralogy
Microscopic colour imager

CLUPI
Microscopic colour imager

In-situ sample analysis

Instruments in the Analytical Laboratory Drawer (ALD)

MicrOmega	Combined VIS imager and NIR spectrometer
Raman	Raman Laser Spectrometer
Mars-XRD	XRD and XRF
MOMA	GC-MS + LD-MS
LMC	Life Marker Chip: antibody-based detection system