MEPAG Status Report

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MEPAG Chair
June 7, 2007
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MEPAG Science Analysis Group (SAG) Activity
- 2013 MSO-SAG2
- HEM-SAG

7th International Mars Conference
Goals Document Revision
Mars Special Regions Colloquium
Planning
Mars Science Orbiter (MSO 2013)

MEPAG Science Analysis Group Activity

Science Analysis Group (SAG-1) Chaired by C. B. Farmer

Recommended Aeronomy and Trace Gas Measurements

- Emphasized characterization of loss of water to space through the upper Mars atmosphere.
- Complemented by measurements of key biogeochemical gases (e.g., methane, ethane, etc.) in the lower Mars atmosphere, possibly identifying local areas for future landed exploration.
- Cost of mission, with straw-man payload, included in 2006 POP guidelines (carried over to 2007).

Follow-up

- Two Mars Scout teams, both focusing on the upper atmosphere processes and escape to space, were selected for a head-to-head competition for the 2011 launch opportunity.
- A new Science Analysis Group was formed to re-evaluate options for the 2013 launch opportunity.

The New Study for MSO

Science Analysis Group (SAG-2) Chaired by W. M. Calvin

Charter:

- Review concepts for MSO 2013 including, but not limited to:
  - Trace Gas Investigation (including work from SAG-1)
  - Imaging (1-meter/pixel class or better to support future missions)
  - Orbital Geophysics
  - Combination with a landed (drop-off) package
- Goal: Identify MRO-Class Missions with outstanding science and with scientific feed-forward to future near-term missions

Final Report (posted this week on MEPAG website)

- Group held weekly telecons, augmented by subgroup telecon meetings.
- Subgroups organized along discipline lines to develop key science questions, traceable to MEP goals and objectives:
  - Atmospheres, Polar, Geology/Geophysics, Landed Geophysics
- Several science themes considered with agreement on 3 final mission scenarios, each of which addresses an overall theme of Dynamic Mars: Activity, Transport, and Change:
  - Plan A: Atmospheric Signatures and Near-Surface Change
  - Plan P: Polar and Climate Processes
  - Plan G: Geological and Geophysical Exploration

A Core-Mission-Concept providing a good balance of in-depth focus and cross-disciplinary reach was defined for each scenario.

Cost/mass option space was explored by considering options which either augmented or reduced the scope of the core concept.

One core concept and two augmented options included a landed drop-off package with the following science:

- Geophysics (seismology, tracking for geodynamics, heat flow), Meteorology
# Mars Science Orbiter (MSO) 2013

## Science Rationale

<table>
<thead>
<tr>
<th>Science Thrusts</th>
<th>MEPAG Science Themes</th>
<th>MSO Science Goals</th>
<th>Feed-Forward</th>
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</table>
| Atmosphere/Surface | Past and Present Habitability  
Modern Water Cycle  
Current Climate Activity | Atmospheric Signatures of  
Subsurface Activity  
Biotic or Geochemical?  
Surface Change  
Changes in Geomorphology | Science:  
Astrobiology  
Atmospheric Transport  
Surface Change Today |
| Geology/Geophysics | Tectonic Activity on Mars  
Geological History of Water on Mars  
Past and Present Climates | Seismic Activity  
Crustal activity and Dynamics  
Surface Change  
Change in Geomorphology  
Subsurface Structure  
What lies beneath the dust mantle? | Missions:  
Network, MSR  
Mid-Range Rovers |
| Polar/Climate | Polar Mass and Energy Budgets  
Polar Processes Today  
Geologically Recent Climate Change | Ice Cap Volume  
Volatile Inventory  
Dynamics of Volatile Exchange  
Polar Energy Balance  
Stratigraphy | Science:  
Modern Climate Change  
Volatile Inventory  
Polar Processes  

Missions:  
Polar AFL or Station  
Mid-Range Rovers, MSR |

**Credits:** NASA/JPL and MRO CTX & MARCI (MSSS), MRO HiRISE (UA), MGS MOC (MSSS), M. Allen (JPL)
SAG-2 did not prioritize among the 3 scenarios

- Each scenario will return significant new information relevant to our understanding of Mars, its history and potential for life
  - Each scenario provides new orbiter remote sensing capabilities at Mars--no one orbiter can address all scenarios adequately
  - A landed drop-package can return significant science return even from a single station

- All three scenarios have implications for missions now being studied to follow MSO, though the implications differ in nature and degree depending on the scenario and the future mission
  - Imaging with sub-meter resolution and high signal-to-noise capability is needed for certification of future landing sites
  - Different scenarios provide different kinds and levels of characterization of other environmental factors (e.g., winds for EDL)
  - All scenarios provide information (though of different types) needed for human exploration of Mars

SAG-2 Findings

- The Core Mission and Augmented scenarios may range $20-65M above the present cost guidelines: this requires some funding augmentation, a paring down of orbiter costs, or provision of a major component by international partners
  - All major payload elements, whether or not contributed, should be reviewed against the key measurement requirements
  - The maturity of the required instruments is likely to vary considerably and reserves should be scoped accordingly
  - The need for science team preparations for Phase E should not be overlooked for Phases B-D

- A core Mars mission should address key questions with innovative, synergistic capabilities
  - The Core Mission Concepts achieve this with the significant science gain enabled by the proposed augmentations to the cost guidelines
  - All resources should not be devoted principally to one element of the mission
  - This includes maintaining significant, innovative orbiter science should a drop-package be part of the mission

Immediate Programmatic Decisions Needed

- Is the drop-package to be a key component of the MSO mission?
  - The character of the MSO mission is very different with and without this high-profile package
  - The landed payload must accommodate (i.e., provide funding and mass) a meaningful geophysical package and should carry an integrated meteorological package as well to justify its cost

- Which scenario should the Science Definition Team focus on?
  - All return great science--programmatic issues thus become the discriminators
  - Different science scenarios are likely to require different choices of mission parameters (e.g., orbit inclination)

- What cost and mass resources will be baselined for MSO?
Analysis of scientific objectives for the initial human exploration of Mars started in February, 2007.

Part of a larger study jointly sponsored by SMD and ESMD.

Focus is to develop a reference program of 3 crewed missions that can be used to guide long-lead planning:

- Robotic missions to Mars
- Activity on the Moon
- Space station
- Work on Earth (computer modelling, lab work, test facilities, Mars analog sites)
HEM-SAG Initial “convergences” (Phase 1):

- Preliminary analysis of Human Science Reference Missions (HSRM) guided by “test case” landing sites
  - Considered test cases as a function of geological epoch and for astrobiology and climate (e.g., Centauri Montes, Isidis, Mangala, Tharsis, near-polar)
- Developed initial list of HSRM landing sites appropriate for MEPAG Goal I, II, III priorities projected ahead to circa 2030
  - Developed rationales for 50+ HEM mission landing zones (for science)
  - Concluded most current priorities will remain priorities even in 2030
- Evaluated trade-space between human mission length of surface stay vs site visitation plan (same site each trip vs multiple independent sites)
  - Concluded “long-stay/multiple sites” (LSMS) is scientifically optimal given MEPAG priorities
  - Next-best for science may be “short-stay/multiple-sites” (SSMS) given critical scientific diversity issues at Mars
- Analyzed (using test cases) surface mobility, sub-surface access, and sample mass to Earth requirements
  - Initial conclusions favor ~100km class surface mobility, but other variables require detailed analysis (sample mass to Earth may be 100kg ‘class’)  
    - Drilling may be required at ~ 100m levels, with rapid “pitting” at 1-2 m (as part of traverses)
    - Tradeoff between in situ analysis capability and sample mass to Earth underway
- Developed Action plan forward to ensure results by late July (as inputs to MAWG etc.)
  - HSRM studies of Meridiani (Opportunity site) as benchmark
  - Sample Mass to Earth analysis via scaling analysis from APOLLO (cf. CAPTEM)
  - Sub-surface mobility requirements guided by Life, Climate, Geology goals
  - Projected science priorities to mid 2020’s to further guide HEM mission capability requirements
  - Treatment of extant life science priorities given Forward-backward contamination realities
The Search for Life on Mars by Humans

Humans have the qualities of adaptability, recognition, decision-making and intelligence and possess a unique perspective for the search for life on Mars.

Understanding habitability and life in the context of Mars as a planetary system and its spatial and temporal interplay of climatic and tectonic cycles is the ultimate goal of human scientific exploration.

- Human Science Reference Missions (HSRM’s) have been developed by HEM-SAG that support this view, using examples that span martian geologic time (Noachian, Hesperian, Amazonian) and which treat several potential settings for understanding planetary habitability and the preservation of life.

- HEM-SAG has developed initial thresholds for capabilities that will allow humans in situ on Mars to use their unique qualities to quantitatively accelerate the pace of understanding about the prospect of life on Mars.
What has the last decade of data told us about Mars?

Caltech, July 9-13, 2007

Record number of abstracts: 404
Attendance expected to be 550-600
Will be the launching point for MEPAG’s reassessment of its Goals Document
Catalyst for several associated Mars-related meetings, including NRC Mars Colloquium
Revision of the MEPAG Goals Document

Last major revision of MEPAG Goals Document in 2004
Since 2004, we have learned a great deal about Mars from MER, MEX, ODY, MGS, MRO, and the R&A programs.

Proposed 2007 revision process:

- Goals Committee will review state of Mars Science at 7th Mars Conference and draft revision to Goals Document
- Draft revision will be available for community comment via web for 2 months starting late July, along with survey regarding Document priorities
- Goals Committee will revise Document based on web comments
- Executive Committee (EC) will provide comments on revised draft
- Goals Committee will incorporate EC comments and present penultimate draft at Feb. 2008 MEPAG for additional community input via breakout sessions chaired by Goal Representatives
- Update Goals Document for release at LPSC 2008
COSPAR Colloquium on Mars Special Regions

- COSPAR-sponsored workshop to forge international scientific consensus on operational definition of Mars special regions
- MEPAG part of the organizing committee
- Input to a proposed COSPAR Planetary Protection Panel Workshop, scheduled for February 2008
- Potential impact on landing and operations of MSL and on design and implementation for all future missions (including ExoMars, AFL, and MSR)
- Significant past contribution by MEPAG via SR-SAG and anticipated key role at international level through organization, participation, and post-colloquium publication
By the end of 2007, the following things will converge:

- Selection of the 2011 Scout mission
- Report of the 2013 SDT
- Revision of the MEPAG Goals Document
- Report of the HEM-SAG, with an updated analysis of the required pre-human robotic program.
- Findings from any planning teams sponsored by MEPAG during the summer (still under discussion)

Major MEPAG meeting anticipated in Jan-Feb. 2008 to discuss
Next MEPAG Meeting: 07-10-07

Scheduled as an evening session (Tuesday) at the 7th Mars Conference.

***DRAFT*** Agenda for MEPAG meeting of July 10, 2007

<table>
<thead>
<tr>
<th>Start Time</th>
<th>Agenda Item</th>
<th>Presenter</th>
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<tr>
<td><strong>Tuesday, July 10, 2007</strong></td>
<td></td>
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<tr>
<td>7:00 PM</td>
<td>Welcome; MEPAG Purpose, Scope, Expected Results</td>
<td>J. Mustard</td>
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<tr>
<td>7:05 PM</td>
<td>Mars Program Status and Current Challenges</td>
<td>D. McCuistion/M. Meyer</td>
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<td>Discussion</td>
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<td>7:45 PM</td>
<td>Report on 2013 MSO SAG-2</td>
<td>W. Calvin</td>
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<td>Future Planning for MEPAG Activities</td>
<td>J. Mustard</td>
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<td>Revision of the MEPAG Goals Document</td>
<td>J. Johnson</td>
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<tr>
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