

April 30, 2018

Dr. Anne Verbiscer
Chair, Planetary Science Advisory Council
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Dear Dr. Verbiscer,

This letter reports on the 36th Mars Exploration Program Analysis Group (MEPAG) meeting held April 3-5, 2018 in Crystal City, VA. Approximately 135 individuals attended on site during the three days, with nearly 100 unique online daily participants via the Adobe Connect webcast of the meeting. The meeting included:

- ❖ Updates from NASA Headquarters and the Mars Exploration Program;
- ❖ Specific discussion of Mars Sample Return (MSR);
- ❖ A special forum to discuss non-MSR compelling science objectives and the means by which they might be addressed, including small spacecraft operating at/on Mars;
- ❖ Status of ongoing and upcoming national and international spacecraft missions;
- ❖ Recommended updates to the MEPAG Goals Document by the polar science community;
- ❖ Preparations for the next Planetary Decadal Survey (DS); and
- ❖ Human exploration activities, in addition to reports from conferences and studies.

A summary of the meeting and associated presentations can be found on the MEPAG website here: <https://mepag.jpl.nasa.gov/meetings.cfm?expand=m36>.

The meeting began with a summary of overarching concerns in the MEPAG community. These concerns included:

- (1) The age and deterioration of the communication infrastructure necessary to support ongoing orbital science and rover data relay capabilities.
- (2) The heretofore lack of apparent progress on addressing the missions required to complete MSR, as well as the absence of flight opportunities to address outstanding Mars science questions as part of, or in parallel with, MSR.
- (3) The severe downturn in the President's Mars budget after the completion of the Mars 2020 rover. This highlighted the need to define the next Mars architecture elements (including MSR and additional high-priority science missions) in order to create new starts in upcoming notional budgets, as well as to maintain funding necessary to continue operations and science analyses from Mars extended missions.

However, several reasons for optimism were reviewed at the start of the meeting as a counterbalance, which included:

- (1) NASA's recent ability to discuss MSR as part of a "lean" campaign to accelerate the return of samples.
- (2) Progress on technologies required to achieve sample return from the martian surface (including \$50M funding in the President's budget to support additional studies).
- (3) Ongoing discussions with potential international and commercial partners to support MSR.

The meeting was unique in that the first day included a community forum with the goal of preparing for the next DS. Over 30 abstracts were submitted prior to the meeting and the second half of the first day was devoted to "lightning talks" followed by a poster session and discussion in which these questions were addressed:

(1) What are the high-priority science questions that could be answered via Mars investigations over the next two decades during the era of MSR?

(2) What type of mission(s) in all classes (small spacecraft missions, secondary payloads, competed missions, follow-on flagships) could be used to significantly address this science?

(3) Are there topics/questions that could be addressed by a MEPAG study or workshop, that would better enable a particular concept or class of concepts to be considered by the 2023-2032 DS Committee?

The session created enthusiastic and vigorous discussion among the attendees that day and during the next day's overview when answers to the above questions were summarized with community inputs.

On the final day of the meeting, ten Findings (included below) were discussed by the community. They cover aspects of MSR, opportunities to address high-priority science goals aside from MSR, extended mission funding, Research and Analysis (R&A), international collaborations, small spacecraft opportunities, and preparations for the next DS. Included in these findings are suggestions and requests from MEPAG that were considered important to communicate to the PAC as part of your future discussions. MEPAG would be happy to provide additional details and/or discussion on these issues to the PAC.

Sincerely,



Dr. Jeffrey R. Johnson
MEPAG Chair

Distribution:

Dr. James Green, *NASA Chief Scientist, former PSD Director*
 Dr. Lori Glaze, *NASA Acting Director, Planetary Sciences Division*
 Mr. James Watzin, *Director, NASA Mars Exploration Program*
 Dr. Michael Meyer, *Lead Scientist, NASA Mars Exploration Program*

MEPAG Meeting #36 Findings

April 3-5, 2018, Crystal City, VA

- 1) Finding.** MEPAG is greatly encouraged that NASA is openly and enthusiastically moving forward on Mars Sample Return, thereby addressing the Decadal Survey's top priority for NASA flagship missions.

MEPAG encourages the Mars Exploration Program to maintain the goal of completing lean science-driven Mars Sample Return in the next decade and looks forward to receiving regular reports on progress made in technology development and international partnering.

- 2) Finding.** MEPAG commends the steady progress on the Mars 2020 mission and welcomes the open discussion by NASA of the follow-on elements of Mars Sample Return (MSR). However, the totality of a lean science-driven MSR campaign across multiple missions, including post-landing sample analyses, requires constant and productive long term communication and coordination amongst NASA programs and international partners. It is important that there be designated points of contact and clear lines of communication during technological development of all key components of the complete MSR campaign.

MEPAG suggests that NASA give strong consideration to integrated management of the entire multi-mission sample return campaign within the Mars Exploration Program, including scientific oversight to ensure that the scientific value of the returned samples is maintained.

- 3) Finding.** Mars Sample Return (MSR) remains a high priority for planetary science and the Mars Exploration Program, and continuing progress on science-driven MSR is welcome. However, enabling opportunities for the pursuit of other high priority Mars science objectives that can be addressed by the community in the coming decade would augment the science return to be gained from MSR alone.

MEPAG encourages NASA to explore additional, open-call (competed) opportunities to address high priority planetary science goals in the Mars system during the era of MSR and afterward, in particular, those objectives that have long strategic lead times for the future exploration of Mars.

- 4) Finding.** The extended Mars spacecraft missions are providing very high science return for a very modest investment. Many extended missions are being counted on to provide critical coverage and relay for the follow-on missions of the "lean" sample return architecture. However, aging relay infrastructures and landed assets will need more, not less, support to meet their engineering requirements. Cuts to mission budgets result in restricted operations of functioning spacecraft and reduced data acquisition, negatively

affecting programmatic interdependency and scientific goals. Science opportunities are typically lost disproportionately as a result.

MEPAG encourages that NASA adhere to the recommendations in the National Academy of Sciences report on Extended Missions and continue to fund extended missions at roughly constant levels, including adjustments for inflation.

5) Finding. MEPAG recognizes the vital role international partners have played and will continue to play during the next decades of Mars exploration, particularly during the era of “lean Mars Sample Return.” However, ongoing and future Mars and planetary science collaborations are contingent on the ability to reconcile international cooperation with the interpretation of security restrictions without hindering needed scientific and technological collaborations on spacecraft missions.

MEPAG encourages that the Science Mission Directorate review interpretations of security recommendations that may overly restrict the ability of international partners to fully carry out their agreed-upon responsibilities in mission development, operations, and data analysis while maintaining appropriate security.

6) Finding. Over the past two decades of successful Mars exploration, the careful decisions to maintain a portfolio of investments in the scientific analysis of large data sets collected by spacecraft, at analog field sites, and in the laboratory have culminated in an advanced understanding of the planetary evolution of an Earth-like, habitable planet. The Mars Exploration Program and the Science Mission Directorate would benefit greatly by continuing to capitalize on the expertise developed within the planetary science community to enable further discoveries that feed directly back into exploration plans for sample return and remote reconnaissance. However, as decommissioned missions end or deal with reduced funding, researchers previously engaged in data analysis directly via mission resources will rely increasingly on traditional Research and Analysis (R&A) programs to preserve these efforts. MEPAG recognizes that there is debate about whether recent increases in R&A funding have been commensurate with the previous Decadal Survey recommendations. However, the fundamental issue is that the growing base of Mars data and the increasing pool of expertise will require increased R&A funding to best advance knowledge of Mars that is needed to plan for future missions beyond sample return.

MEPAG recommends that R&A resources be incrementally increased in advance of a next decade of fewer non-MSR missions in order to exploit the rich value of the vast volumes of data already returned, and to ensure a critical core of expertise remains available to carry out associated science investigations and plan future missions to Mars, whether robotic or human.

7) Finding. Recent advances in small spacecraft mission capabilities are certain to continue and will provide additional opportunities for focused science measurements that will address key science questions in the Mars Exploration Program. By clearly linking science objectives with plausible small spacecraft capabilities, MEPAG could create a framework for the definition and evaluation of the science capacity of such missions, as well as identify significant scientific opportunities. Two major challenges for the success of small spacecraft missions in deep space are: 1) how to get there, and 2) how to get the data back. There is much energy and creativity being devoted to what small spacecraft can do, much of it arising from academic and private sector investments.

MEPAG encourages NASA to continue to support small spacecraft concept studies to help investigate engineering capabilities/challenges, coupled with science objectives and requirements. MEPAG also encourages identification of specific, near-term opportunities for small spacecraft missions/secondary payloads, and to the development by NASA with the commercial sector of technologies and infrastructure necessary to minimize the burden on individual missions for interplanetary propulsion and back-to-Earth telecommunication.

8) Finding. Long-lived, new, and planned international Mars spacecraft missions such as Mars Express, the ESA-ROSCOSMOS ExoMars Trace Gas Orbiter (TGO) and 2020 rover/surface/platform (RSP), the United Arab Emirates HOPE orbiter, ISRO's Mars Orbiter Mission (MOM), and the JAXA Mars Moons Exploration (MMX) missions have provided--or hold great promise to provide--substantial contributions to Mars science.

MEPAG congratulates these teams and their sponsors on the progress to date and looks forward to the data acquisition and analysis enabled by these missions and to the discoveries sure to come.

9) Finding. The Committee on Astrobiology and Planetary Science (CAPS) recommended that a suite of studies be prepared in advance of the next Planetary Decadal Survey. Among these were (1) new cost and technical evaluations of the next elements of the sample-return campaign, and (2) analysis of medium-class missions to explore ancient and modern aqueous environments.

MEPAG agrees with these recommendations and stands ready to work with NASA to provide assistance to complete these studies in a timely and efficient manner.

10) Finding. MEPAG acknowledges the importance of accurate, scientifically compelling, and standardized cartographic and geologic map products in the exploration of solar system bodies.

MEPAG encourages interaction between the Mapping and Planetary Spatial Infrastructure Team (MAPSIT) and all Analysis/Assessment Groups (AGs) to help prioritize the products in

most need of oversight and fabrication to achieve their exploration and analysis goals. MEPAG will strive to do its part, but wishes to understand how priorities can be set consistently across the program.
