Summary of the Presentations and Discussion of MEPAG Virtual Meeting #4 (VM4)
February 25, 2019; virtual attendance only, 11:00AM-1:00 PM PDT

Key goals of this virtual meeting were to bring the community up to date on MEPAG activities and NASA HQ status, including: 1) the recent NRA on Planetary Mission Concept Studies, 2) to receive a preliminary report on ICE-SAG activities, and 3) to begin discussion about Decadal Survey white paper preparation and possible MEPAG assistance.

Posted agenda, presentation files and this summary can be found at https://mepag.jpl.nasa.gov/meetings.cfm.

General or meeting-specific MEPAG feedback or suggestions can be sent via the email mepagmeetingqs@jpl.nasa.gov.

Meeting attendance included approximately 124 distinct logins.

MEPAG Update – J. Johnson
MEPAG Chair Jeff Johnson presented the agenda for the current virtual meeting (VM4) and an overview of MEPAG activities since the September 13, 2018 MEPAG Virtual Meeting #3. Highlighted items included the revision of the Goals Document after addressing polar science questions, initiation of the Ice and Climate Evolution Science Analysis Group (ICE-SAG), the MEPAG poster at the Fall AGU meeting and initial work on creating a joint statement on diversity goals among all Analysis/Assessment Groups (AGs).

Ben Bussey is rotating off of the MEPAG Executive Committee and Steve Ruff and Paul Withers are rotating off of the Goals Committee. Jake Bleacher, Paul Niles, Justin Filiberto and Barbara Cohen were welcomed as new participants to the Executive Committee, and Briony Horgan was welcomed to the Goals Committee. The continuing Executive Committee, Goals Committee and Mars Program Office members were also identified. MEPAG Committee membership can also be found on the MEPAG web site at: https://mepag.jpl.nasa.gov/about.cfm

Upcoming Mars Activities were identified:

- LPSC MEPAG meet-and-greet on Monday, March 18 from noon to 1:00PM.
    - This is not a formal meeting. Intent is to provide an opportunity to interact with MEPAG Executive and Goals Committee members and to continue Decadal white paper discussions that began later in this meeting
- LPSC Mars Sample Return forum on Wednesday, March 20 from noon to 1:00PM
- 9th International Conference on Mars from July 22-25 in Pasadena, CA.
- Mars Extant Life: What's Next? Conference from November 5-8 in Carlsbad, NM
    - Rescheduled from January 29-February 1, 2019

The next MEPAG Virtual Meeting is expected to occur around the week of May 6. The next MEPAG Face-to-Face meeting is expected to occur on Friday, July 26, directly following the 9th Mars Conference, in Pasadena, CA.

Reminders about upcoming R&A Program Element deadlines and the 2019 Planetary Science Division (PSD) Mission Senior Review Schedule were provided, and the MEPAG timeline was discussed.

NASA HQ Updates – M. Meyer

Michael Meyer, the lead scientist for NASA's Mars Exploration Program at NASA Headquarters, reported that the Mars Exploration Program experienced significant disruption during the recent partial government shutdown. It took several weeks to recover upon the reopening of the government. Some funds were lost due to cancellations of facilities rented for review panels, and the reviews had to be rescheduled. The Returned Sample Science (RSS) Participating Scientist Program (PSP) review is an example of a shutdown-delayed review. The hope is that the PSP review will be completed before the start of the next fiscal year. A near-term budget for FY19 has been determined, and everything is fully functional now.

The Mars Missions are doing well. MSL is having a memory problem, but the engineers have a potential solution. Operations are expected to resume this week. MAVEN is aerobraking in order to enter a better orbit for communications.

In the recent budget, the Mars Program received funding for studies involving Mars Sample Return (MSR). David Beaty (MPO/JPL) and Meyer have been working to organize workshops, studies and logistics for MSR. The MSPG (MSR Science Planning Group) has been formed and is comprised of 12 people from the US, Canada and ESA. Other countries may be considered in the future, but the group is being kept small for now. The receiving facility will be open to the world, and the MSPG is working towards a plan to ensure sharing. The earliest that it appears sample return could occur is 2029, but 2031 is probably more realistic.

The MSPG, co-chaired by NASA's M. Meyer and ESA's E. Sephton-Nash, has been working on requirements for the sample receiving facility. One meeting of the MSPG has occurred, and a second is planned in Leicester, UK in May. MSPG progress was discussed in a Town Hall at AGU. Additional community meetings will occur at the Lunar and Planetary Science Conference (LPSC) and European Geophysical Union (EGU). Future work on MSR will be determined next fiscal year, when this topic may be presented in the President's budget.

In addition to MSR, the Mars Program is gearing up to develop a strategic plan of non-MSR missions for the next decades in response to the recommendations from the mid-term Decadal Survey review panel.

A Mars 2020 Participating Scientist call focused on researchers other than the remote sample scientists selected in the first PSP will be solicited. Release of the call won't occur until FY 2020, because NASA's Science Mission Directorate (SMD) is double booked with reviews until the end of FY 2019.

NASA Research Announcement: Planetary Mission Concept Studies – L. Glaze

Lori Glaze is the Acting Director of NASA's Science Mission Directorate's Planetary Science Division. She reported mission highlights, including that

- The InSight Landing successfully occurred in November. SEIS, the seismometer instrument, has been deployed and leveled. The wind and thermal shield has been placed on top, and the instrument is performing with the high level of sensitivity expected. The grapple was released, and the mole will begin drilling into the crust. Temperature measurements will be made as the drill burrows deeper.
- OSIRIS-Rex rendezvoused with the asteroid, Bennu, in December. This was the smallest body ever orbited by a spacecraft. The mission discovered that hydrated minerals exist on the surface of Bennu. This shows the possibility of organic mineral and water transfer to the Earth.
- New Horizons flew by Kuiper Belt object, Ultima Thule, on New Year's Eve. The data collected during the fly-by will take 2 years to return.
- Opportunity's mission has ended. The rover operations team performed an amazing job during their attempt to recover the rover. The "remote geologist" concept had been solidified by this mission.

Dr. Glaze discussed the Planetary Mission Concept Studies (C.30 ROSES Program Element) NASA Research Announcement (NRA), which uses a different approach for generating mission concepts studies within Decadal Survey preparations than in the past. Dr. Glaze reminded the audience that the intent of the call is NOT to propose a favorite New Frontiers mission in an attempt to get it into the Decadal Survey. The purpose is to prioritize science objectives (mapped to a traceability matrix) and then have selected engineering teams perform design analysis and cost estimates. These design analyses will be delivered by NASA HQ as a package to the Decadal Survey panel for consideration. The costing results will then be delivered to Aerospace for determination of mission classes. Note that this exercise is being done in addition to the white paper solicitation.

Dr. Glaze responded to a series of questions that were provided by the community prior to the meeting. These questions were also forwarded to the listed Point of Contact (D. Daou) for this NRA for inclusion in the official FAQ for the C.30 program element, and we direct readers to that page for both questions and formal answers:
https://nspires.nasaprs.com/external/solicitations/summary.do?solId=%7B5F9A00FC-0359-E588-D345-287621C7D607%7D&path=&method=init

ICE-SAG Report – S. Diniega and T. Putzig

The MEPAG-chartered Ice and Climate Evolution Science Analysis (ICE-SAG) formed in October 2018, and the final report is expected to be delivered in March or April 2019. In addition to the Final Report, more information will be available at LPSC (see Poster 679 by Putzig et al., Tuesday Night; Abstract 2035).

This group was tasked with identifying:

- Science objectives pertaining to Polar Science, Modern Mars and Recent Climate (beyond Mars Sample Return) for the 2023-2032 decade and mapping to MEPAG Science Goals
- Measurements required to address the science objectives
- Mission approaches to address the science objectives and required measurements
    - Includes orbiters, landers, rovers, drillers and networks
    - Includes small spacecraft, Discovery, New Frontiers and Flagship-classes.

Input to the ICE-SAG analysis included recent discoveries for volatiles and climate, the MEPAG Goals Document, the NEX-SAG report, recent conference reports (see list on page 6 of the ICE-SAG presentation) and expected contributions to volatile and climate science from current and upcoming missions.

The presentation included a summary of how ICE-SAG has identified high-priority questions pertaining to Mars ice and "recent" climate science, and a list of the High-priority question areas and their associated measurements were described. ("Recent" includes the modern day and back through obliquity shifts within the Amazonian climate. It encompasses climate records on time scale of years through millions of years.)
The five "Priority Areas" are:

1. Ice layer formation processes
2. Vertical Structure within perennial ice deposits
3. Global distribution of perennial subsurface ice
4. Evidence of/record left by liquid water on Mars within "recent" climate
5. Transport of volatiles and dust to/from the poles

The presentation lists specific questions under each of these Priority Areas (pages 9-10).

Mission concepts were then developed to address these high priority questions (pages 12-15). More focus was given to New Frontiers class mission concepts, as directed by the group's charter; however, mission concepts within all mission classes and types were discussed and will be described in the report. ICE-SAG will describe six New Frontiers class concepts (shown on page 13-14); these concepts could each also be expanded into Flagship concepts or contracted into small satellites. Rough-order-of magnitude costs were estimated based on analogy with existing instruments and missions, with a limited number of concepts also analyzed by JPL's Team X. It is important to note that the detail in which some mission concepts were analyzed does not reflect prioritization of the concept, nor does ICE-SAG's focus on larger mission mean that smaller missions could not address compelling ice and climate science questions.

Connections between the ICE-SAG high-priority science areas and the 2018 MEPAG Goals, as well as astrobiology and human exploration interests, will be discussed in the ICE-SAG report. There is strong traceability between ICE-SAG report and the MEPAG Goals document.

Presenters were asked about whether ICE-SAG considered aspects of implementation, such as a telecom infrastructure for small spacecraft or if a mission concept could be supported by more

than one NASA directorate – and ICE-SAG did not. This group focused on the science measurements that need to be made, and considered only if a specific mission concept presented a feasible (in the next decade: 2023-2032) way of achieving the prioritized measurements.

A question was raised about if the group considered landers sent to both poles. ICE-SAG did not develop that particular mission concept, and the need for that would depend on the science question(s) investigated. The two ice caps are different, and so the science investigated would be different. For the mission concepts ICE-SAG describes, landers were generally sent to the north pole as its layered deposits appear to have a younger age and more uniform layering.

A question was also raised about if SAR requires 2 orbiters flying in tandem. Such a configuration is not required - the mission concept described by ICE-SAG involves two antennae on the same spacecraft.

Decadal Survey White Paper Planning – J. Johnson

MEPAG Chair Jeff Johnson presented, "Initial Discussions on Mars White Papers for the 2023-2032 Decadal Survey".

David Smith's timeline for the next Decadal Survey (presented at the April 2018 MEPAG face-to-face meeting) was shown.

White papers are defined as "community input from individuals or groups focusing on important science priorities for the coming decade". Consensus reports representing many individuals are strongly encouraged by the Decadal Survey. High priority white papers were used as input to the last Decadal Survey report. More than 60 white papers were provided to the Mars subpanel, which used those inputs for discussion and for requested presentations at their meetings.

A review of MEPAG's efforts during the previous Decadal Survey (2013-2022) was provided, (during the tenure of Chair Jack Mustard). Dr. Mustard sent a letter to the MEPAG community in April, 2009 following the announcement of Dr. Steve Squyres' selection as Decadal Survey Chair). MEPAG led preparation of several white papers on behalf of the community (references provided on pages 6-7 of the presentation). More than 60 additional white papers related fully or in part to Mars also were submitted by individual scientists (slides 8-9).

The recently convened Astrophysics Decadal Survey (ADS) was described, given that the Planetary Science Decadal Survey may follow a similar structure. In their introductory messages, the co-chairs of the ADS noted that input from scientists at all career levels was sought. They also provided several thematic areas for white paper submissions. In a similar manner, the following potential themes from prior MEPAG meetings were noted for possible MEPAG-led white paper submissions:

- Completion of MSR, including both science benefits and technological developments
- Summaries of completed Science Analysis Groups (SAGs)
- Science rationale, goals and exploration strategies.

These white papers could include topics on the scientific importance of MSR completion in the coming decade, technical approaches to the required follow-on missions after Mars2020 (including surface retrieval and orbital collection), and approaches to analyses of returned samples. Since the last Decadal Survey, seven SAG reports have been completed that could be summarized as white papers, in addition to a summary of the Goals Document. MEPAG could also support an integrated Mars Exploration Program strategy report, should it be asked to provide assistance from NASA HQ, in response to the mid-term Decadal Survey review panel recommendation for a "comprehensive MEP architecture."

MEPAG does encourage submission of white papers by community members. For your consideration, the science themes raised during the April, 2018 MEPAG Meeting #36 Forum could be useful to expand via white papers (e.g., ice/polar studies, modern surface/climate, strategies for orbit/surface/subsurface exploration, and astrobiology).

Open questions regarding the charter and/or scope of the next Planetary Decadal Survey will include: 1) the role of future humans-to-Mars, 2) connections between Mars and Moon exploration, and 3) the manner in which non-MSR missions will be addressed.

The issue was then raised regarding how best MEPAG could facilitate community-led white papers. MEPAG will further assist by keeping the Goals Document contemporary, including another major update after the 9th Mars conference. MEPAG will further enable participation from individual scientists at all career levels, because papers that include numerous, expert signatories were considered advantageous by the last Decadal Survey's Mars panels. The exact methods of assistance to these individual scientists are still being discussed, but the maintenance of a spreadsheet of relevant authors for specific topics of interest has been suggested. Technology to assist in communication will be considered. Methods that do not have prohibitively complicated layers of security are preferred.

MEPAG will also continue to keep the community updated on Decadal Survey preparation via virtual and face-to-face meetings and by continuing to provide a forum for reports from NASA, other space agencies, SAGs, and conferences/workshops. MEPAG has also been invited to the Committee on Astrobiology and Planetary Science (CAPS) meeting on September 10-12 to "hear and participate" in their planning discussions for the next Decadal Survey.

Ideas for ways in which MEPAG could assist the community are encouraged. The MEPAG meet-and-greet at LPSC (Monday, March 18 from noon to 1:00PM) is an opportunity for additional discussion.

Question was raised regarding how connections between Mars and Moon exploration would be discussed within the context of the Decadal Survey; that will have to wait for the charter/scope of the Decadal Survey to be completed to know if the Decadal Survey will ask for such information. However, Barbara Cohen, a member of the MEPAG Executive Committee, is also a member of LEAG and can assist with this type of discussion. It is similarly unknown if humans-to-Mars concepts are to be explicitly discussed in the Decadal Survey.

Although Diversity, Personnel, Training, etc. were not discussed in the previous Planetary Science Decadal Survey (*Visions and Voyages* report), it has been addressed by the current Astrophysics Decadal Survey. MEPAG would like to be ready should the Planetary Decadal Survey contain similar language.

When asked whether other SAGs will be formed in the 2019/2020 timeframe, it was noted that the formation of new SAGs will depend in part on Mars Program Office staffing availability and specific requests received from NASA HQ. However, suggestions for SAG ideas are welcomed (and can be emailed to mepagmeetingqs@jpl.nasa.gov).