Mars Exploration Program Analysis Group (MEPAG)

MEPAG Report to Planetary Science Advisory Committee

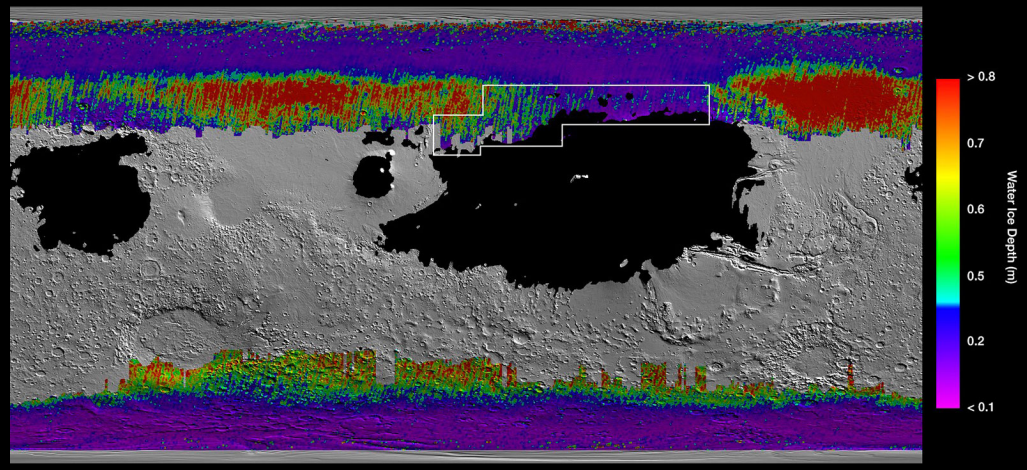
R Aileen Yingst, Chair

18 August 2020

United Launch Alliance Atlas V rocket launches with NASA's Mars 2020 Perseverance rover from Space Launch Complex 41, Thursday, July 30, 2020, at Cape Canaveral Air Force Station in Florida. Credits: NASA/Joel Kowsky

Outline

- MEPAG committees current memberships
- Recent and upcoming activities
  - DS White Papers
- Current issues and findings from MEPAG 38



Subsurface water ice on Mars as revealed by Odyssey. Cool colors are closer to the surface than warm colors; black zones indicate areas where a spacecraft would sink into fine dust; the outlined box represents the ideal region for landing and resource extraction. Image credit: NASA/JPL-Caltech/ASU

MEPAG Programmatics

- Committees:
  - Steering Committee (Chair: R. Aileen Yingst (PSI), appointed June 2019)
    - W. Calvin (Univ. Nevada Reno)
    - J. Eigenbrode (GSFC)
    - D. Banfield (Cornell)
    - J. Filiberto (LPI)
    - S. Hubbard (Stanford University)
    - Vacancy
    - J. Johnson (past Chair, JHU/APL)
    - M. Meyer (NASA HQ)
    - D. Beaty, R. Zurek (JPL)
    - J. Bleacher/P. Niles (HEOMD, NASA HQ) Ex Officio members

Self-portrait of InSight spacecraft.

  - Goals Committee (D. Banfield, Chair)
    - Goal I <*Life*> (S.S. Johnson, Georgetown University, J. Stern, GSFC; A. Davila, ARC)
    - Goal II <*Climate*> (R. Wordsworth, Harvard University, D. Brain (Univ. Colorado)
    - Goal III <*Geology*> (B. Horgan, Purdue, Becky Williams, PSI)
    - Goal IV <*Human Exploration*> (J. Bleacher, NASA HQ HEOMD; M. Rucker, P. Niles JSC)

Recent MEPAG Activities

- **Goals Document release (March, 2020)**
  - The Goals document has gone through regular revisions driven by new discoveries and new technologies. This last revision took six months and went through several opportunities for community input. Final document posted at https://mepag.jpl.nasa.gov/reports.cfm?expand=science
- **MEPAG #38 Face-to-Face (virtual) Meeting (15-17 April 2020):**
  - Decadal Survey preparations, Goals document update preparations, Mars mission reports, HEO/Commercial space, Mars program architecture discussion. Findings forwarded to the PAC, https://mepag.jpl.nasa.gov/meetings.cfm
- **MEPAG Virtual Meeting #9 (26 June 2020): Presentation of preliminary results from MASWG**
  - Mars Architecture Strategy Working Group (MASWG) invited comments from community; also had external reviews from community members
  - White paper: Mars, The Nearest Habitable World A Comprehensive Program For Future Mars Exploration ID37
  - Preparation of final text report in progress; expected to be finished by end of August

Recent MEPAG Activities: White Papers

- **Supported Decadal Survey white paper submissions**
  - Googledocs facilitated co-authors, co-signatories, and/or combining of similar efforts among multiple authors under a single entry; similar to effort in support of Planetary Mission Concept Studies; also pointed to LPI site.
  - MEPAG Steering Committee authored three white papers covering the MEPAG Goals update, addressing community consensus for Mars as a compelling target for exploration and science, and presenting findings of the community on whether there should be a list of candidate missions for New Frontiers.
    - Summary of the Mars Science Goals, Objectives, Investigations, and Priorities ID168
    - Mars System Science Why Mars Remains a Compelling Target for Solar System Science ID357
    - Mars as a Competitive Candidate for Inclusion in the New Frontiers Mission List: MEPAG Community Perspectives ID358
  - MEPAG Steering Committee also endorsed white papers on crucial topics to ensure their inclusion, and to provide reference for the community (Looking for Life Strategy for Mars; Mars Sample Return; Emerging Capabilities; SAG summaries).
  - Looking for Life (several): E.g., Groundwork for Life Detection ID231 ; Astrobiology on Mars: Organic Chemical Evolution on an Earth-like Planet ID43 ; We Should Search for Extant Life on Mars in this Decade ID135
    - Why Mars Sample Return is a Mission Campaign of Compelling Importance to Planetary Science and Exploration ID99
    - Mars Next Orbiter Science Analysis Group (NEX-SAG): White Paper Report ID49
    - White Paper Summary of the Final Report from the Ice and Climate Evolution Science Analysis group (ICE-SAG) ID20
    - Emerging Capabilities for Mars Exploration ID359
    - Mars Sample Return Campaign Concept Architecture ID355

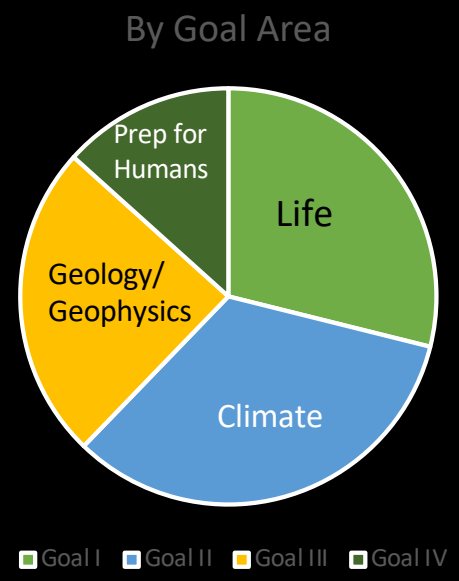
Mars White Paper Metrics

(as of 14 August 2020)

- Total: 76 white papers marking Mars as a category (not counting 8 redundant ones due to updates, fixes; 8 additional papers came in the last few days, not included in the metrics)
- White Paper categories marked in addition to Mars
  - Cross-Over
    - 3 Primitive Bodies, 2 Giant Planets, 3 Ocean Worlds, 1 ExoPlanet
  - Life / Habitability
    - 19 Life / Prebiotic
    - 19 Habitability / Water (*not the same 19 as above*)
  - Atmospheric Evolution / Climate
    - 13 Atmospheric / Exospheric Evolution
  - Surface / geological evolution
    - 13 in this category
    - 3 more on interior physics
  - Technology: 12 papers
  - 17 marked Other: SR, mission, dynamics, Human mission (health, ISRU)
  - Notable: 2 on PP, 2 on Ground-based elements, 2 on laboratory, 5 on field studies
- MEPAG Goals (some papers—e.g., sample return—addressed multiple goal areas):

  Life (including habitability) = 26 Climate (including cryosphere) = 30

  Geology/Geophysics = 22 Preparations for Humans = 12

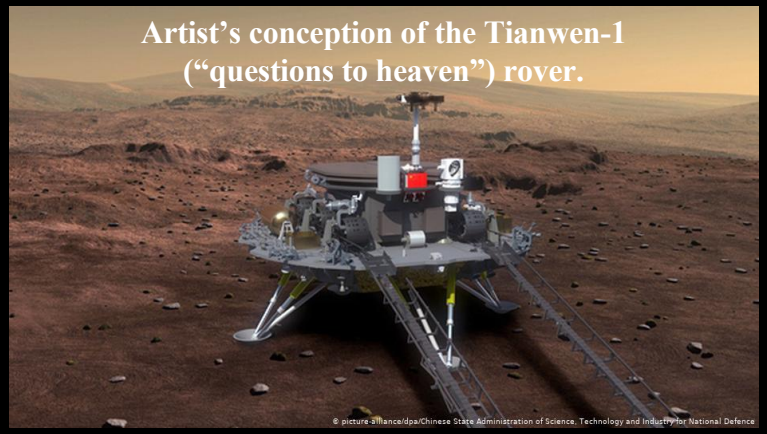


Summary - MEPAG-authored papers

- Mars as a compelling target
  - Mars retains, almost in its entirety, a record of planetary evolution not found in such pristine form elsewhere in the solar system (including Earth), and one that is unavailable for study outside the solar system — the record of a planet that once hosted habitable surface environments similar to Earth's, but, through a confluence of events, evolved environmental conditions of less certain habitability. Mars might be seen as the Earth that almost was, and understanding why this was so is crucial to understanding life's origins by deciphering what is required for life to evolve and thrive.
  - *All environments on early Earth also existed on early Mars, making Mars the most accessible extraterrestrial planet where habitability coexisted with the potential for life to arise.*
  - The MEP has proven that *the way to do science* is through a program, because it yields what science needs – a step-by-step way of building on previous results to more advanced understanding, and it allows scientists to plan ahead, not just to the next proposal or next election cycle, but through the next decade.
- Mars as a candidate for New Frontiers
  - **MEPAG supports the current process** -the Planetary Decadal Survey creates a New Frontiers Candidate List.
  - MEPAG encourages a formal, science-driven method for editing a Decadal Survey-provided NF mission candidate list, should mid-Decadal discoveries and technological advances warrant such a discussion. The inclusion of a well-defined process by which to request changes would be welcomed.
  - MEPAG believes there are several missions in the New Frontiers class needed to pursue science objectives that are compelling if we are to understand Mars as a system, and to address fundamental questions of habitability and climate change on terrestrial planets. The priority of the science investigations and goals is such is that these missions would be highly competitive with other areas of solar system exploration. Mars is still the "nearest habitable world" to Earth and the Martian climate still is most similar to our own.

Three launches to Mars!

- UAE Hope mission
- China Tianwen-1
- NASA Mars 2020 Perseverance



Artist's conception of the Tianwen-1 ("questions to heaven") rover.

The UAE finished construction on its Hope spacecraft, bound for Mars, earlier this year. Image: © Government of Dubai Media Office.

ExoMARS Rover/Surface Platform: Launch still planned —2023

FY21-25 Budget

- M2020 Phase E budget is short of the money needed to be fully prepared for the desired fast-paced operations on Mars
  - Bad news: M2020 overran its development budget
  - Good news: Heroic—and successful—effort to launch on time during a pandemic saved the millions that a launch delay would have cost
- Continuing Missions
  - Efforts continue to fund Odyssey for a full year of operations, including science as well as relay
  - MSL hoping for no further decreases as it moves into the "sulfate unit" on Mt. Sharp in FY21
  - MRO and MAVEN struggling to accommodate reduced science budgets despite high SR marks
- Congress
  - House mark-up included specific call-out to fund ODY and get on with MSR
  - Many expect federal government to be in continuing resolution until after November

MEPAG 38 Findings summary — 1: MSR and beyond

- Mars Sample Return (MSR) (Finding #1, Finding #2)
  - MEPAG commends the exemplary technical progress in the formulation of the next MSR campaign flight missions including solid NASA-ESA partnerships. These are long-awaited steps needed to make a major advance in our understanding of Mars and of solar system processes.
  - MEPAG commends the efforts by NASA to update the Planetary Protection procedures and documents (many now in review), and the involvement of a wide diversity of experts. The proposal to formalize this process as it relates to MSR through a board to address sterilization and molecular deactivation issues is a positive next step.

MEPAG Findings summary — 2: Mission findings

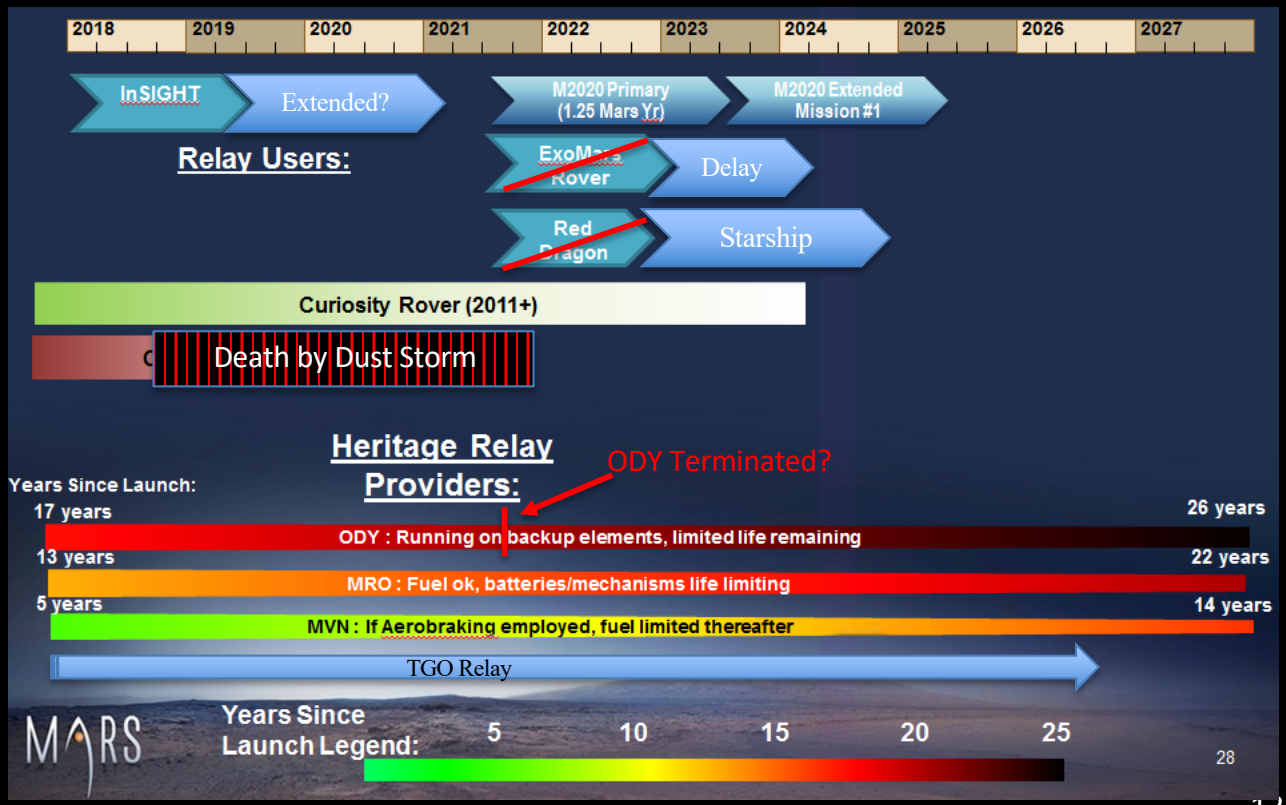
- Ice Mapper (Finding #3)
  - MEPAG is concerned that the process by which the Mars Ice Mapper mission appeared in the Mars mission portfolio, its scope, and the plans for its funding were unclear. MEPAG encourages greater transparency and community involvement in the formulation of this concept, in keeping with recommendations by MEPAG-sponsored science analysis groups and the *Visons and Voyages* document. Consequently, MEPAG recommends that PSD/MEP form a Mission Design Team (MDT), including scientists from the participating international partners and specialists from HEO, to review the M2M campaign requirements and to define appropriate instrumentation for the ice-as-a-resource mapper. To address the ice science objectives formulated by MEPAG through its science analysis groups (e.g., Ice and Climate Evolution Science Analysis Group [ICE-SAG], 2019) would require additional measurements (beyond the proposed SAR). The MDT could consider what additional instrumentation would be needed to realistically address the remaining ice science objectives. Should such objectives be included, MEPAG would recommend that the instruments to meet those objectives be competed.

MEPAG Findings summary — 2: Mission findings

- Senior Review mission funding (Finding #4)
  - MEPAG notes a disconnect between Senior Review funding recommendations for highly-rated extended missions, and the budget profile for FY 21 (e.g., decreases for three missions rated Excellent/Very Good, some of which were recommended for increased funding).
    - This finding was made before a reshuffling of budgets within the MEP. ODY, for example, has been given some budget relief.
- International missions to Mars (Finding #7)
  - MEPAG enthusiastically applauds the heroic support of current operations and launch activities in extremely difficult circumstances associated with COVID-19. Where possible and appropriate, MEPAG encourages NASA to leverage international missions and increase international collaboration by supporting Participating Scientist or Guest Scientist programs to these missions.

MEPAG Findings summary — 3: Infrastructure (Finding #5)

- The communication infrastructure is aging but continues to provide crucial science data. The relay burden will only increase given the arrival of missions to be launched in the next decade.
- *MEPAG encourages a systematic approach to supporting Mars relay requirements, including innovative solutions such as smallsats and commercial ventures.*



MEPAG Findings summary — 4: R&A (Finding #6)

- The Administration's FY21 budget contains an increase in support for Research and Analysis (R&A) and the House budget retains this increase. R&A is crucial in realizing the benefits of missions, and in transferring the benefits of robotic missions to human exploration efforts.

- *MEPAG is encouraged by the augmentation of the R&A budget for all planetary science (**not just Mars**), an action that enables flight missions to provide increased benefit to scientific knowledge, inform other NASA programs such as HEO, and increase the robustness of the next generation of scientists who will sustain NASA programs into the future.*

Summary

- Mars Exploration is moving forward: Missions from ***3 agencies*** launched this July
- MSR is moving forward:
  - Perseverance is on its way to Mars; next steps are being studied; MSR concept review in October
  - SMD has appointed a director for the next MSR flight campaign elements
- Planetary Protection issues are being revisited; MSR is compliant, focus is on the future.
- MEPAG continues to be concerned about M2020 Phase E and the Extended Mission (ODY, MRO, MSL, MAVEN) budgets, particularly as relay & reconnaissance needs grow
- MEPAG supports efforts by NASA to increase support for R&A across planetary science. We particularly applaud NASA's conscientious work to balance the needs of currently funded and proposing researchers at every level of their career during the particular challenges arising from the pandemic.
- *MEPAG is ready to respond to calls for assistance with planning and analysis.*