The MEPAG Goals Document

"Mars Science Goals, Objectives, Investigations and Priorities: 2020 Version"

Don Banfield, MEPAG Goals Committee Chair

Mars Exploration Program Analysis Group (MEPAG)

Goals Committee

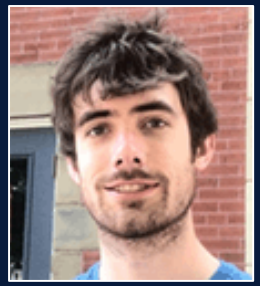
Jen Stern
NASA GSFC, Goal 1

Alfonso Davila
NASA Ames, Goal 1

Sarah Stewart Johnson
Georgetown, Goal 1

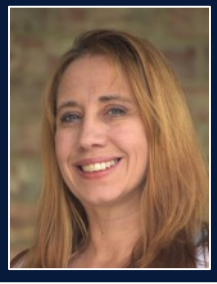
David Brain
UC Boulder, Goal 2

Robin Wordsworth
Harvard University, Goal 2



Don Banfield Cornell, Goal Committee Chair

Briony Horgan
Purdue, Goal 3



Becky Williams
PSI, Goal 3

Michelle Rucker
NASA JSC, Goal 4

Paul Niles
NASA JSC, Goal 4

Jacob Bleacher
NASA GSFC/HQ, Goal 4

Kevin D. Watts
NASA JSC, Goal 4

MEPAG Goals Document

- Prioritizes **“flight”** measurements to achieve high priority Mars system science questions
- Periodically updated, in response to new discoveries and research directions

What has been the timeline for this revision?

- Initiated at 9th Mars Conference (July 2019)
- Feedback on first draft (February 2020)
- Released on March 31, 2020

- **In time to serve as a reference for Decadal Survey White Papers!**

Mars Exploration Program Analysis Group (MEPAG)

I. Determine if Mars ever supported, or still supports, life	**A. Search for evidence of life in environments that have a high potential for habitability and preservation of biosignatures.** A1. Determine if signatures of life are present in environments affected by liquid water A2. Investigate the nature and duration of habitability near the surface and in the deep subsurface. A3. Assess the preservation potential of biosignatures near the surface and with depth	**B. Assess the extent of abiotic organic chemical evolution.** B1. Constrain atmospheric and crustal inventories of carbon (particularly organic molecules) and other biologically important elements over time B2. Constrain the surface, atmosphere, and subsurface processes through which organic molecules could have formed and evolved over martian history			
II. Understand the processes and history of climate on Mars	**A. Characterize the state and controlling processes of the present-day climate of Mars under the current orbital configuration.** A1. Lower atmosphere dust, water, CO_2 cycles A2. Volatiles/dust exchange with surface A3. Chemistry of atmosphere and surface A4. Upper atmosphere/magnetosphere state & controlling processes	**B. Characterize the history and controlling processes of Mars' climate in the recent past, under different orbital configurations.** B1. Determine recent climate record in polar region B2. Determine recent climate record in low- and mid-latitudes B3. Recent past atmospheric composition	**C. Characterize Mars' ancient climate and underlying processes.** C1. Determine changes in atmospheric composition and mass through time C2. find and interpret surface records of past climates		
III. Understand the origin and evolution of Mars as a geological system	**A. Document the geologic record preserved in the crust and investigate the processes that have created and modified that record.** A1. Characterize past and present water and other volatile reservoirs A2. Document the geologic record in sediments A3. Constrain ancient environmental transitions A4. Determine the construction and modification of the crust	**B. Determine the structure, composition, and dynamics of the interior and how it has evolved.** B1. Crust-mantle interactions B2. accretion, differentiation and thermal evolution	**C. Determine the origin and geologic history of Mars' moons and implications for the evolution of Mars.** C1. Origin of moons C2. Impactor flux		
IV. Prepare for human exploration Source: MEPAG 2020	**A. Human landing with acceptable cost, risk and performance.** A1. Atmospheric state affecting orbital capture and EDL for human missions A2. Orbital debris environment A3. Landing-site & environmental characteristics for safe landing	**B. Human surface exploration and EVA with acceptable cost, risk, and performance.** B1. Surface radiation and dust hazards B2. Impact of dust on hardware B3. Dust storm risks B4. Identify landing-site hazards	**C. ISRU of atmosphere and/or water with acceptable cost, risk, and performance.** C1. ISRU resilience to varying environmental conditions C2. Characterize water resources for ISRU for long-term human needs	**D. Biological contamination and planetary protection protocols with acceptable cost, risk, and performance.** D1. Definition of "special regions" in the exploration zone D2. Crew risk of martian biohazards D3. Earth risk of martian biohazards D4. Astrobiological baseline of landing site prior to human arrival D5. Survivability of terrestrial organisms at Mars	**E. Human missions to Phobos or Deimos with acceptable cost, risk, and performance.** E1. Geology to define science objectives, operations planning and resources E2. Surface and orbital conditions for proximity operations

Changes in Current version from 2018 version

Goal I (Life):

- Removed distinction between extinct and extant life
  - Objective IA. Search for evidence of life in environments that have a high potential for habitability and preservation of biosignatures.
    - i.e., Merging extinct and extant Objectives from prior versions
  - Objective IB. Assess the extent of abiotic organic chemical evolution
    - Balances IA., examining abiotic origins of organics

Goal II (Climate):

- Shortened & updated prose
- Re-prioritized sub-Objectives:
  - Reflecting MAVEN's advances and a renewed focus on polar science

Changes in Current version from 2018 version

Goal III (Geology):

- IIIA (Geologic Record) re-organized (concepts conserved)
  - Two new Investigations
    - History of sulfur & carbon
    - Link martian meteorites and returned samples to Mars' geologic evolution

Goal IV (Human Exploration):

- Significant re-structuring: Mission architecture agnostic
- Updates to:
  - planetary protection (Establish astrobiological baseline before human presence)
  - atmospheric knowledge requirements (supersonic retro-propulsion)

Latest version of the Goals Document always available at:

https://mepag.jpl.nasa.gov/reports.cfm