Evaluation by MEPAG Goals Committee

Don Banfield, MEPAG Goals Committee Chair

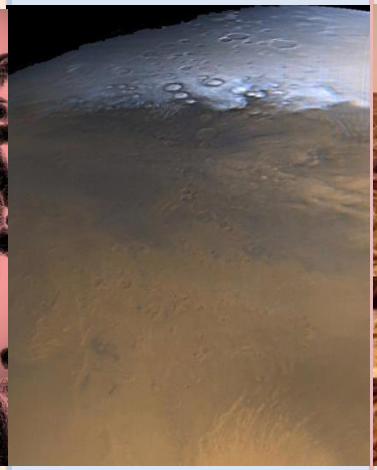
Outline:

1. Re-familiarize ourselves with the MEPAG Goals Document.
2. How, when, and by whom is the Goals Document revised?
3. What revisions are under consideration now?
4. How can I ensure it includes what my community thinks is important?

MEPAG Goals Document

- Outlines and prioritizes (within each Goal, *not between Goals*) "flight" measurements to achieve high priority Mars system science questions
- Periodically updated, in response to new discoveries and research directions (last was 2015) by Goals Representatives
- Model has served as basis of other AG Goals Documents

Mars Exploration Program Analysis Group (MEPAG)

Life	Climate	Geology	Human Exploration
			
I. Determine if Mars ever supported life	II. Understand the processes and history of climate on Mars	III. Understand the origin and evolution of Mars as a geological system	IV. Prepare for human exploration

Source: MEPAG 2015

Mars Exploration Program Analysis Group (MEPAG)

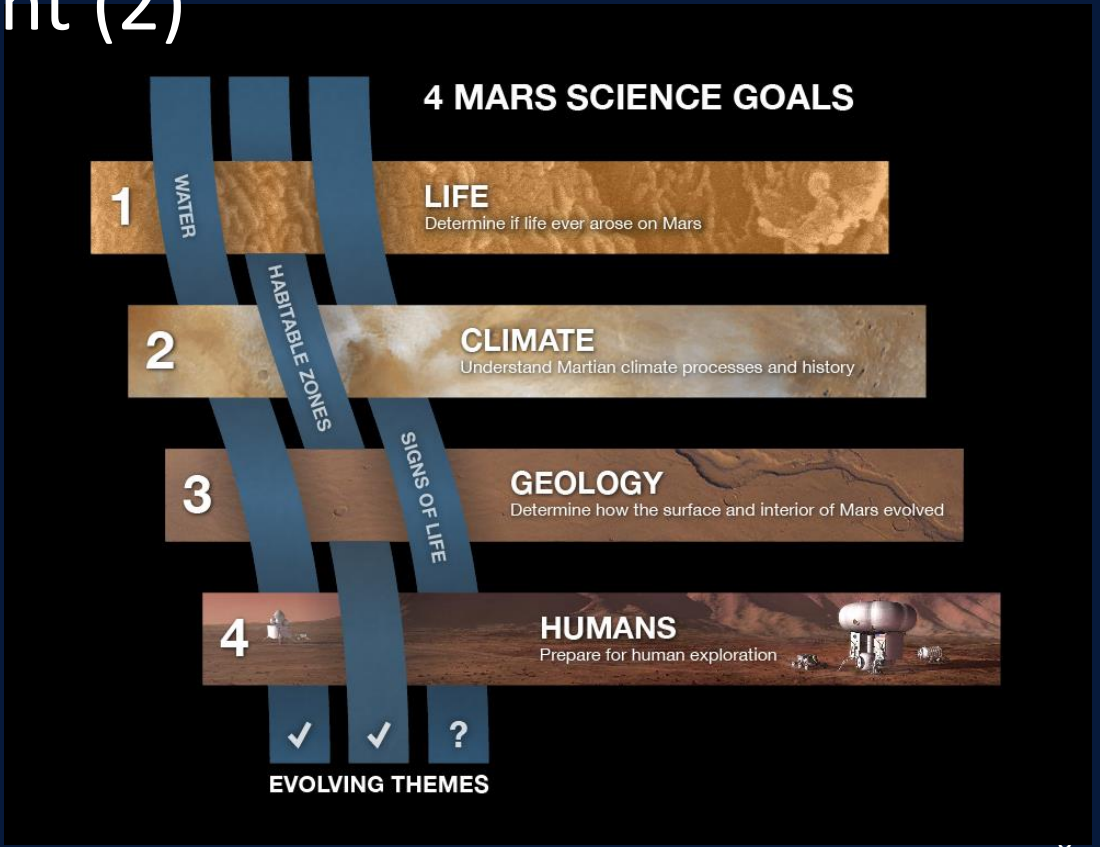
Life	**I. Determine if Mars ever supported life.**	A. Determine if environments having high potential for prior habitability and preservation of biosignatures contain evidence of past life. B. Determine if environments with high potential for current habitability and expression of biosignatures contain evidence of extant life.
Climate	II. Understand the processes and history of climate on Mars.	A. Characterize the state of the present climate of Mars' atmosphere and surrounding plasma environment, and the underlying processes, under the current orbital configuration. B. Characterize the history of Mars' climate in the recent past, and the underlying processes, under different orbital configurations. C. Characterize Mars' ancient climate and underlying processes.
Geology	III. Understand the origin and evolution of Mars as a geological system.	A. Document the geologic record preserved in the crust and interpret the processes that have created that record. B. Determine the structure, composition, and dynamics of the Martian interior and how it has evolved. C. Determine the manifestations of Mars' evolution as recorded by its moons.
Human Exploration Source: MEPAG 2015	IV. Prepare for Human Exploration.	A. Human mission to Mars orbit with acceptable cost, risk, and performance. B. Human mission to the Martian surface with acceptable cost, risk, and performance. C. Human mission to the surface of Phobos or Deimos with acceptable cost, risk, and performance. D. Sustained human presence with acceptable cost, risk, and performance.

Mars Exploration Program Analysis Group (MEPAG)

I. Determine if Mars ever supported life	**A. Determine if environments having high potential for prior habitability and preservation of biosignatures contain evidence of past life.** A1. Past habitable zones A2. Conditions that influenced preservation/ degradation, and identify regions of high preservation potential A3. Presence of biosignatures from prior ecosystems	**B. Determine if environments with high potential for current habitability and expression of biosignatures contain evidence of extant life.** B1. Environments that are presently habitable B2. Conditions that affect the expression/degradation of extant life B3. Presence of biosignatures of an extant ecosystem		
II. Understand the processes and history of climate on Mars	**A. Characterize the state of the present climate of Mars' atmosphere and surrounding plasma environment, and the underlying processes.** A1. Lower atmosphere aerosol profiles A2. Upper atmosphere dynamics/thermal structure A3. Present atmospheric composition A4. Volatiles/dust exchange with surface	**B. Characterize the history of Mars' climate in the recent past, and the underlying processes, under different orbital configurations.** B1. Recent past atmospheric composition B2. Preservation of recent climate change in polar region B3. Preservation of recent climate change in low- and mid-latitudes	**C. Characterize Mars' ancient climate and underlying processes.** C1. Ancient atmosphere composition C2. paleoclimate reconstruction C3. Volatile escape rates	
III. Understand the origin and evolution of Mars as a geological system	**A. Document the geologic record preserved in the crust and interpret the processes that have created that record.** A1. Water, ice, volcanic geomorphologies A2. Geologic unit age dating A3. Climate change in geological record	**B. Determine the structure, composition, and dynamics of the Martian interior and how it has evolved.** B1. Mantle-crust interactions B2. Interior structure	**C. Determine the manifestations of Mars' evolution as recorded by its moons.** C1. Phobos and Deimos geology C2. Impactor flux	
IV. Prepare for human exploration	**A. Human mission to Mars orbit with acceptable cost, risk, and performance.** A1. Aerocapture and aerobraking investigations A2. Orbital particulate environment	**B. Human mission to the Martian surface with acceptable cost, risk, and performance.** B1. Atmospheric dynamics - EDL B2. Biohazard assessment B3. Identify special regions B4. ISRU tech demo B5. Identify landing-site hazards B6. Surface radiation and dust hazards B7. Impact of dust on hardware	**C. Human mission to the surface of Phobos or Deimos with acceptable cost, risk, and performance.** C1. Phobos and Deimos science C2. Moon science	**D. Sustained human presence with acceptable cost, risk, and performance.** D1. Extractable water resources

MEPAG Goals Document (2)

- Attempts to also recognize cross-cutting within Goals (i.e., investigation contributes to more than one Objective/Goal) and between Goals (e.g., a science theme)
- High-priority science questions and strong mission concepts or research direction often are cross-cutting



How/when MEPAG Goals are revised

https://mepag.jpl.nasa.gov/reports.cfm?expand=science

- 2001, Chair R. Greeley
- 2004, Chair J. Taylor
- 2005, Chair J. Grant
- 2008, Chair J. Johnson
- 2010, Chair J. Johnson
- 2012 (published 2014), Chair V. Hamilton
- 2015, Chair V. Hamilton

Changes (and the reason) from the preceding Goals Doc are outlined in each.

How/when MEPAG Goals are revised (2)

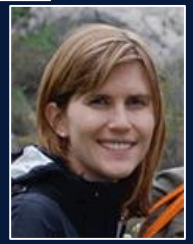
- Usually prompted by a workshop/conference report, where a *potential disconnect* is identified
  - Could be a potential gap in the content or priorities
  - A new mission/measurement could appear to address an investigation
  - A new discovery could obviate an old question or create a new question/elevate an existing one
  - Etc.
- The potential disconnect may be noted by a MEPAG/MPO person attending the meeting, or by a portion of the community.

How/when MEPAG Goals are revised (3)

- When a sufficiently large potential disconnect is identified -- Relevant Goals Representatives are asked to look into this and generate, as they think is necessary, edits to the Goals Document
- Full MEPAG Goals committee may be enlisted to review proposed edits
- When ready, proposed edits are put to the community for comment (~few months)
- After considering/incorporating input, Goals Representatives finalize their edits and the MEPAG Executive Committee reviews
- The Updated Goals Document is published.
- (and the cycle begins again)

Goals Committee

Jen Stern
NASA GSFC, Goal 1



Sarah Stewart Johnson
Georgetown, Goal 1

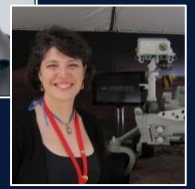
Paul Withers,
Boston University, Goal 2

David Brain
Univ. Colorado, Boulder
Goal 2

Robin Wordsworth
Harvard University, Goal 2

Don Banfield, Goals Committee Chair, Cornell

Steve Ruff, ASU, Goal 3



R. Aileen Yingst, PSI, Goal 3

Ryan Whitley,
NASA JSC, Goal 4

Jacob Bleacher,
NASA GSFC, Goal 4

Last (2015) MEPAG Goals Updates

- Prompted by 8th International Conference on Mars
  - July 2014 @ Caltech, Pasadena, CA
  - >650 attendees from 21 countries
  - https://www.hou.usra.edu/meetings/8thmars2014/
  - Based on program content and synthesis-focused discussion – re-evaluation of full Goals Document content and structure

Upcoming MEPAG Goals Update

- Currently in process: Polar Science and present-day activity
  - Prompted by 6th International Mars Polar Science and Exploration Conference
    - https://www.hou.usra.edu/meetings/marspolar2016/
    - Generated summary report, outlining Polar Science priorities
    - Continued discussion within that community (and with aeolian community – as have some overlapping "present-day activity" interests
  - MEPAG ExComm requested Goals Committee look into these areas
  - Initial report from Polar Science representatives was delivered late June 2017, with iterative discussion with Goal II and III Representatives since
  - Goals III representatives have just finished evaluating proposed changes, and Goal II representatives likely need about 1 more month. New draft expected to be released in June 2018.
  - Proposed edits will be available for community comment – will be announced via a MEPAG email with 1 month for public comment. WHICH WE WANT!

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Geology	III. Understand the origin and evolution of Mars as a geological system.	A. Document the geologic record preserved in the crust and ~~interpret~~ **INVESTIGATE** the processes that have created **AND MODIFIED t**hat record. B. Determine the structure, composition, and dynamics of the Martian interior and how it has evolved C. Determine the manifestations of Mars' evolution as recorded by its moons
Human Exploration	IV. Prepare for Human Exploration.	

Source: MEPAG 2015

Goal	Objective	Sub-Objective	Investigation
II. Understand the processes and history of climate on Mars	A. Characterize the state of the present climate of Mars' atmosphere and surrounding plasma environment, and the underlying processes, under the current orbital configuration	A1. Constrain the processes that control the present distributions of dust, water, and carbon dioxide in the lower atmosphere, at daily, seasonal and multi-annual timescales.	2. Characterize dust **AND OTHER AEROSOLS**, water vapor **AND CARBON DIOXIDE** and **THEIR** clouds in the lower atmosphere.
		A4. Constrain the processes by which volatiles and dust exchange between the surface and atmospheric reservoirs.	1. ~~Measure~~ **CHARACTERIZE** the ~~turbulent~~ fluxes **AND SOURCES** of dust and volatiles between surface and atmospheric reservoirs.
			2. Determine how the ~~exchange of~~ **PROCESSES EXCHANGING** volatiles and dust between surface and atmospheric reservoirs ~~has~~ HAVE affected the present **HORIZONTAL AND VERTICAL** distribution of surface and subsurface water and CO_2 ice.
			3~~. Determine how the exchange of volatiles and dust between surface and atmospheric reservoirs has affected the Polar Layered Deposits (PLD)~~.**DETERMINE THE ENERGY AND MASS BALANCE OF THE SURFACE VOLATILE RESERVOIR OVER RELEVANT TIMESCALES, AND CHARACTERIZE THEIR FLUXES.**

Goal	Objective	Sub-Objective	Investigation
II. Understand the processes and history of climate on Mars	B. Characterize the history of Mars' climate in the recent past, and the underlying processes, under different orbital configurations.	B1. Determine how the chemical composition and mass of the atmosphere has changed in the recent past.	2. **DETERMINE HOW AND WHEN THE BURIED CO2 ICE RESERVOIRS AT THE SOUTH POLE FORMED**.
		B2. Determine the **CLIMATE** record of the recent past that is expressed in geological, **GLACIOLOGICAL**, and mineralogical features of the polar regions.	1. ~~Map the ice and dust layers of the PLD and determine the absolute ages of the layers.~~ **DETERMINE THE VERTICAL AND HORIZONTAL VARIATIONS OF COMPOSITION AND PHYSICAL PROPERTIES OF THE MATERIALS FORMING THE POLAR LAYERED DEPOSITS.**
			2. DETERMINE THE ABSOLUTE AGES OF THE LAYERS OF THE POLAR LAYERED DEPOSITS
			~~2. Obtain compositional and isotopic measurement of gases trapped within the PLD.~~ **3. DETERMINE WHICH ATMOSPHERIC AND SURFACE PROCESSES ARE RECORDED DURING LAYER FORMATION.** (NOTE, WAS B2.2, NOW B2.3)
			4. CONSTRAIN MARS' POLAR AND GLOBAL CLIMATE HISTORY BY CHARACTERIZING AND INTERPRETING THE RELATIONSHIPS BETWEEN ORBITALLY-FORCED CLIMATE PARAMETERS AND THE LAYER PROPERTIES OF THE POLAR LAYERED DEPOSITS.

Mars Exploration Program Analysis Group (MEPAG)

Goal	Objective	Sub-Objective	Investigation
II. Understand the processes and history of climate on Mars.	B. Characterize the history of Mars' climate in the recent past, and the underlying processes, under different orbital configurations.	B3. Determine the record of the climate of the recent past that is expressed in geological and mineralogical features of low- and mid-latitudes.	~~1. Identify and map the location, age, and extent of glacial and peri-glacial features and quantify the depth to any remnant glacial ice.~~ **CHARACTERIZE THE LOCATIONS, COMPOSITION, AND STRUCTURE OF LOW AND MID-LATITUDE VOLATILE RESERVOIRS AT THE SURFACE AND NEAR-SURFACE.**
			2. DETERMINE THE CONDITIONS UNDER WHICH THE LOW AND MID-LATITUDE VOLATILE RESERVOIRS ACCUMULATED AND PERSISTED UNTIL THE PRESENT DAY, AND ASCERTAIN THEIR RELATIVE AND ABSOLUTE AGES.

Goal	Objective	Sub-Objective	Investigation
III. Understand the origin and evolution of Mars as a geological system.	A. Document the geologic record preserved in the crust and ~~interpret~~ **INVESTIGATE** the processes that have created **AND MODIFIED** that record.	A1. Identify and characterize past and present geologic environments and processes relevant to the crust.	4. Identify **FROST AND** ice-related processes and characterize when and how they have modified the Martian surface.
			6. DETERMINE THE PROCESSES THAT CREATE DUST AND DISTRIBUTE IT AROUND TH PLANET, IDENTIFY ITS SOURCES, AND FULLY CHARACTERIZE ITS COMPOSITION AND PROPERTIES. (NOTE: FORMER A1.6->A1.7)
		A3. IDENTIFY AND CHARACTERIZE PROCESSES THAT ARE ACTIVELY SHAPING THE PRESENT-DAY SURFACE OF MARS. (NOTE: FORMER A3->A4)	**1. IDENTIFY PRESENT-DAY CHANGES WITHIN THE ROCKY OR ICY SURFACES OF MARS, AND ESTIMATE PAST AND PRESENT RATES OF CHANGE.**
			2. DETERMINE RELEVANT SURFACE AND ATMOSPHERIC ENVIRONMENTAL CONDITIONS AND/OR PROCESSES THAT CAUSE OBSERVABLE SURFICIAL CHANGES OVER DIURNAL, SEASONAL, AND MULTI-ANNUAL TIMESCALES.
			3. EXTEND THE EVOLVING KNOWLEDGE OF ACTIVE SURFACE PROCESSES TO OTHER LOCATIONS ON THE PLANET AND BACKWARD IN TIME.

Next major MEPAG Goals Updates

- Will be informed by 9th International Conference on Mars
  - July 22-26, 2019 @ Caltech, Pasadena, CA
  - https://www.hou.usra.edu/meetings/ninthmars2019/
  - Likely to again involve synthesis-focused discussion
- Revisions will occur in following ~6 months (then allowing for a few months for community review)
- This is the MEPAG Goals Document that will be given to the next Planetary Science Decadal Survey committee (when they kick off in Spring 2020)

How to join the Goals Committee?

- Last year we asked for Committee volunteers – so please keep an eye out for future calls
- (And if you see one, please err towards self-nomination … even if not selected this round for the Goals Committee, such lists of interested individuals are also consulted for other MPO/MEPAG activities, such as SAGs)