CHARTER

Science Definition Team for a 2020 Mars science rover

Summary Statement of NASA Intent

The NASA Mars Exploration Program (MEP) has made dramatic progress in the scientific investigation of the Red Planet, most recently with the landing and initial surface operations of the Mars Science Laboratory (MSL) *Curiosity* rover (Aug. 2012 to present). In combination with discoveries from the ESA Mars Express orbiter, the state of knowledge of Mars points to a planet with a rich geologic history of past environments in which liquid water has played a significant role. On the basis of the results achieved by the surface reconnaissance activities of the Mars Exploration Rovers and the initial findings of the MSL *Curiosity* rover, it is increasingly evident that the "scientific action" is at the surface. Furthermore, thanks to the comprehensive inputs by the broader science community, there is an emerging consensus that the search for signs of past life within the accessible geologic record via missions that include the ESA ExoMars rover (2018) and future NASA surface missions is a fertile exploration pathway for the next decade.

Thus, NASA plans to continue the pursuit of its "*Seeking the Signs of Life*" Mars Exploration Program science theme beyond the near-term missions that include *Curiosity* and MAVEN. The 2020 launch of a Mars science rover mission will focus on *surface-based geological and geochemical reconnaissance in search of signs of life*, with clearly defined preparation for eventual return to Earth of carefully selected materials. Supporting *in situ* measurements will be undertaken to address key questions about the potential for life on Mars via possible preservation of biosignatures within accessible geologic materials. This mission will enable concrete progress toward sample return, thereby satisfying NRC Planetary Decadal Survey science recommendations, and will provide opportunities for accommodation of contributed Human Exploration & Operations Mission Directorate (HEOMD) payload element(s), technology infusion, and international participation.

To support definition of the pre-Phase A 2020 mission concept, the 2020 Mars rover Science Definition Team (SDT) is formed within the framework described below.

Primary Objectives

A. Explore an astrobiologically relevant ancient environment on Mars to decipher its geological processes and history, including the assessment of past habitability and potential preservation of possible biosignatures.

B. *In situ science*: Search for potential biosignatures within that geological environment and preserved record.

C. Demonstrate significant technical progress towards the future return of scientifically selected, well-documented samples to Earth.

D. Provide an opportunity for contributed HEOMD or Space Technology Program (STP) participation, compatible with the science payload and within the mission's payload capacity.

Primary Assumptions and Guidelines

- The mission will launch in 2020.

- The total cost of the instruments has a nominal cost limit of ~$100M (including margin/reserves). This includes the development and implementation costs of US instruments (~$80M) and the estimated costs of any contributed elements (~$20M), but not including surface operations costs. The cost of science support equipment, such as an arm, is budgeted separately and not included in this ~$100M/$80M limit for instruments.

- The mission will employ Mars Science Laboratory (MSL) SkyCrane-derived entry, descent, and landing flight systems, and *Curiosity*-class roving capabilities. Consideration of the scientific value and cost implications of improving access to high-value science landing sites should be provided by the SDT in consultation with the pre-project team.

- The mission lifetime requirement is surface operation for one Mars year (~690 Earth Days).

- Mission pre-project activities will provide additional constraints on payload mass, volume, data rate, and configuration solutions that will establish realistic boundary conditions for SDT consideration.

Statement of Task

The SDT is tasked to formulate a detailed mission concept that is traceable to highest priority, community-vetted scientific goals and objectives (i.e., *Vision and Voyages* NRC Planetary Decadal Survey and related MEPAG Goals/Objectives) that will be formally presented to the Mars Exploration Program and leaders of the Science Mission Directorate (SMD); any and all mission concepts must fit within available resources and associated levels of acceptable risk as provided by the pre-project team.

As such, the SDT shall:

1. Determine the payload options and priorities associated with achieving science objectives A, B, and C. Recommend a mission concept that will maximize overall science return and progress towards NASA's long-range goals within the resource and risk posture constraints provided by HQ.

2. Determine the degree to which HEOMD measurements or STP technology infusion/demonstration activities (Objective D) can be accommodated as part of the mission (in priority order), consistent with a separate (from SMD) budget constraint also to be provided by HQ.

3. Work with the pre-project team in developing a feasible mission concept.

4. For the favored mission concept, propose high-level supporting capability requirements derived from the scientific objectives, including both baseline and threshold values.

5. Develop a Level 0 Science Traceability Matrix (similar to those required for SMD mission Announcements of Opportunity) that flows from overarching science goals/objectives to functional measurements and required capabilities for the surface mission in 2020.

6. Define the payload elements (including both instruments and support equipment) required to achieve the scientific objectives, including high-level measurement performance specifications and resource allocations sufficient to support a competitive, AO-based procurement process:

- Provide a description of at least one "strawman" payload as an existence proof, including cost estimate
- For both baseline and any threshold payloads, *describe priorities for scaling the mission concept either up or down (in cost and capability) and payload priority trades between instrumentation and various levels of sample encapsulation.*

Methods and Schedule

The following delivery points are specified:

- Interim results (presentation format) shall be delivered no later than 2 April 2013.
- A near-final summary presentation to be delivered by 31 May 2013, in which the essential conclusions and recommendations are not expected to change during final report writing.
- A final text-formatted report to be delivered by 1 July 2013.

The Mars-2020 pre-project engineering team at JPL has been tasked to support the SDT as needed on issues related to mission engineering.

The SDT report will be essential in formulating the HQ-approved set of 2020 Mars rover mission science goals and measurement objectives suitable for open solicitation via a NASA SMD Payload AO that is to be released for open competition in Summer 2013.

Point of contact for this task:

Dr. Mitchell Schulte, NASA Program Scientist for the 2020 Mars science rover mission
Email: mitchell.d.schulte@nasa.gov

References (see http://mepag.nasa.gov/reports/index.html)

- Vision and Voyages for Planetary Science in the Decade 2013-2022
- Mars Program Planning Group *Report* 2012
- "Baseline" arm- and mast-mounted measurement functionalities for Objective A as described in Appendix 6 of JSWG (2012) [see also MPPG Final Report Appendix A].
- Candidate measurements and priorities for HEO and OCT from MEPAG P-SAG (2012).
- Assume (as a one point of departure) the scientific objectives and priorities for returned sample science from the recent work of E2E-iSAG, 2018 JSWG, and MPPG (2012)