EPSC Abstracts,
Vol. 2, EPSC2007-A-00308, 2007
European Planetary Science Congress 2007

Perspectives on science drivers for NASA's first human missions to Mars

J.E. Moersch (1), J. Garvin (2), J.S. Levine (3), D.W. Beatty (4), and the HEM-SAG Team

(1)University of Tennessee [jmoersch@utk.edu] (2) NASA GSFC, (3) NASA LARC, (4) JPL

In March, 2007, the Mars Exploration Program Analysis Group (MEPAG, a community of Mars scientists that provides NASA with scientific input for the Mars Exploration Program) was asked to assess priorities for the first three human missions to Mars that relate to our scientific understanding of that planet. A study team, which goes by the acronym of HEM-SAG, was formed. The purpose of this presentation will be to share some of the initial thinking of the HEM-SAG, and to solicit additional inputs into its on-going analysis. This work will not be 'final' until it has been vetted through MEPAG's formal processes, but until then the team is very open to additional ideas.

Part of the HEM-SAG's work thus far has been to identify capabilities that a human presence on the Martian surface offers for conducting Mars science as compared to the capabilities already provided, or projected to be provided in the next $\sim$25 years, by robotic missions. Human explorers possess the ability to adapt to new and unexpected situations in novel environments, are able to make real-time decisions, and have strong recognition abilities. Humans can perform detailed and precise measurements on the surface of Mars with sophisticated scientific equipment and instrumentation brought from Earth, comparable to the instrumentation and equipment available in scientific laboratories on Earth. The HEM-SAG envisions that the scientific exploration of Mars by humans will be performed as a synergistic partnership between humans and robotic probes, controlled by the human explorers on the surface of Mars. Robotic probes can explore terrains and features not suitable for human exploration and traverse great distances from the human habitat. Robotic probes also present fewer contamination challenges in exploring specific locations on Mars where extant life is possible.

Human explorers will be able to make compelling contributions in the general areas of Martian geology, geophysics, life, and climate. Although all of these are current foci within the ongoing robotic Mars exploration program at NASA, within each of these areas specific investigations can be identified for which the advantageous attributes of human explorers can be brought to bear. However, there are a number of critical questions that must be considered as part of the input into the design of required human surface systems:

- For the first three missions, what is the relative scientific value of landing at a different site each time vs. returning each time to the same site (outpost mode)?
- Can enough be accomplished on a 'short-stay' mission ($\sim$40 days) to make the mission scientifically worthwhile, or is a 'long-stay' ($\sim$500 days) required?
- How much surface mobility in association with a human exploration site is required to carry out a meaningful scientific program? What radial distance is required, and how much time is required on excursions away from the base?
- Is there a difference in the surface implementation if the mission has scientific objectives related to extant life vs. a mission whose life-related objectives relate only to the fossil record of past life?
- What are the scientific objectives and associated sub-surface access requirements related to subsurface access (i.e., drilling versus pitting)?
- How much capability is required for a human-tended on-Mars analytical laboratory? Is there a trade-off between mass invested in such in situ lab equipment versus the mass of samples to be returned to Earth (i.e. by adding more analysis capability on Mars, do we reduce the amount in mass of samples that need to be returned)?
- How much sample mass should be returned from Mars in support of the highest-priority scientific objectives?
- What is the degree of importance of a separated mission element (e.g., a robotic rover) that explores sites remote from the area of the human-occupied habitat?

Preliminary assessment results and open areas for discussion will be outlined in the presentation, as well as plans for completing the MEPAG chartered assignment.