INTRODUCTION TO THE WORKSHOP

Workshop Objectives

Current NASA planning envisions human missions to Mars as early as 2013, on a mission that would send six crew members for a 500-day stay on the surface of Mars. While our understanding of how we would get there and back is fairly mature, the planning for what the crew would do to explore while on the surface for 500 days is less detailed. Mission objectives are to understand the composition and geomorphology of the martian surface, and to continue to investigate and sample the geologic history of Mars. Special emphasis will focus on exploring for possible biogenic signatures, past or present, and on analyzing pre-biotic chemistry.

The purpose of this workshop was to explore the strategies, desired capabilities, skills, and operational realities required to lend success to the first human missions to Mars. Current mission planning dictates that there will be considerable mobility, sampling and analytical capability available to human crews, at a site warranting long-term geologic and possibly biological interest. However, the details of specific capabilities are not yet clearly defined.

Process

In order to develop a plan for what human crews would require in exploring the martian surface, the workshop process was divided into four sequential stages: First, we brought workshop participants up-to-speed on current NASA planning for Mars missions, so that everyone was using the same base-level of information for their discussions. This was done by first providing preliminary information and documents, including the Mars Reference Mission (Hoffman et al., 1997), to the participants prior to the meeting. At the meeting, NASA engineers, scientists, and astronauts gave presentations on various aspects of human missions. NASA mission planners presented the latest mission scenarios for Mars and clarified constraints and limitations. The workshop agenda is included in Appendix 3.

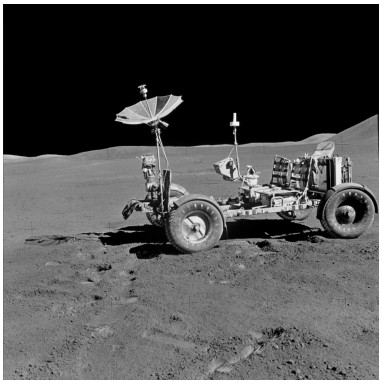
In the second step in the workshop all participants were engaged in a series of discussions focusing on four themes. Four discussion team leaders led the discussions, keeping them on target and within time constraints. Outlines of the discussions were developed before the workshop to guide and focus discussions, and to provide a template for the final product, a written report. These discussion outlines are included in Appendix 4. The third stage was to break into groups to accelerate discussions with smaller teams, and to generate recommendations. The final part of the process took place after the workshop, and entailed writing up the results of the four discussions.

The four discussion themes with associated questions were:

1. Approaches to Mars Field Geology
What should the exploration strategy be in the field? Are there significant differences between geological and paleontological field work? What tools are needed? What prior information must be gained/assumed?

2. Instrumentation: Analytical Capabilities on Mars
What observations and measurements do we need to make on Mars? What kinds and levels of analytical capabilities are needed in the field to make these measurements? In the laboratory? How should work in the field and work in the laboratory be coordinated? Which preliminary analyses are done on Mars?

3. Crew Skills and Training
What scientific skills are needed? What training environments are most important? What techniques for maintaining skills seem most important?



4. Communications Between Mars and Earth
What is the desired level of autonomy of crew members on Mars? What should be the principal objectives for communication between astronauts on Mars and scientists on Earth? What are the impacts of the forty-minute time lag? How do we handle pre-mission science planning vs. real-time changes in exploration strategy?

Fig. 1. Geologist and astronaut Jack Schmitt sampling impact breccia boulder at Taurus Littrow, Apollo 17.

Invited Participants

An additional major objective of the workshop was to bring together a unique mix of disciplines, skills, experience bases, and cultures within both the Earth science and aerospace communities with a common goal in mind: to consider what it would take to explore the surface of Mars with humans. Owing to the very focused goal of the workshop, individuals were invited to participate based on their specific qualifications. Members of the science community were invited on the basis of their past field experience on Earth or the moon, along with their expertise in laboratory analyses and instrumentation, and included field geologists, stratigraphers, paleontologists, microbiologists, geophysicists, geochemists, and astronaut trainers. The attendees included two Apollo astronauts who had done field geology on the lunar surface, and several of the geologists who trained them. Shuttle and future International Space Station astronauts attended, along with Mars mission planners, a JPL/Mars Pathfinder scientist, and space flight management from NASA Headquarters. One participant was a field geologist who is presently a test

subject for the latest Mars space suit, currently under consideration at the NASA Johnson Space Center EVA Office.

A list of workshop participants, their addresses, affiliations, and a brief biography for each individual is summarized in Appendix 2.

Baseline: Mars Reference Mission

The baseline for discussion during the workshop was the Mars Reference Mission (*Hoffman et al.*, 1997). It was necessary that participants have a common datum for developing their ideas on field campaigns, outfitting the Mars base laboratory and exploratory rovers with scientific instruments, and partitioning skill requirements among the crew members. To do this, we had to have a common understanding of what the mission capabilities and constraints were. This reference document can be located on the World Wide Web at the following addresses:

http://exploration.jsc.nasa.gov/EXPLORE/explore.htm

or

http://www-sn.jsc.nasa.gov/marsref/contents.html

In addition to the Mars Reference Mission, we used new information recently compiled in a document called The Mars Surface Reference Mission (*Hoffman*, 1998). This report deals specifically with the mission on the surface of Mars. It sheds light on the more detailed objectives of a 500-day surface mission, and the strategies and activities required to implement these goals. Pertinent excerpts from this document are included in Appendix 1.

Mars Science Objectives

Workshop participants were also presented with the science objectives for Mars exploration that have evolved over the past decade from workshops and conferences. Table 1 shows these science questions (after *Hoffman*, 1997).

TABLE 1. Science questions for Mars exploration.

Science Questions for Mars Exploration
• Did the climate change on Mars from warm and wet to a frozen desert, and if so, why?
• Has life ever existed on Mars, and if so, does any life exist there now?
• How did Mars evolve geologically?
• What is the resulting inventory of resources on Mars?