Science and the Human Exploration of Mars Workshop

Goddard Space Flight Center
Bldg. 26, Room 205

January 11-12, 2001

Agenda

(With preliminary concepts for discussion topical areas. These are not to be taken as instructions, but as a starting point for discussions. It is suggested that each discussion group first develop a scope for the discussion, then fill in details. A rapporteur has been assigned to each discussion group to aid in capturing the results of the discussions).

January 11, 2001

8:30 AM Welcoming remarks: Gary Martin, Jim Garvin, Scott Hubbard
8:50 Organization and Objectives of the Workshop: Ron Greeley, Doug Cooke (Co-chairs)

Opening session: Chair, Doug Cooke

9:10 Scientific Goals of the Mars Exploration Program – Jim Garvin
9:40 Roles of Robots and Humans in Mars Exploration– Matt Golombek
10:00 Problem Statements – Exploration Requirements – What information is required to address problems as understood now, and how will (should) that change in the next 10-12 years? Presentations and discussion.
- Astrobiology – Chris McKay
- Climatology – Dan McCleese
- Geology/Geophysics – Ron Greeley
11:30 Plenary Discussion: What scientific investigations are most likely to require humans? (Jim Garvin, chair, Clive Neal, rapporteur)

What are the characteristics of scientific investigations that make on-site (or at least near at hand) human participation essential? What are the characteristics of human explorers that meet these needs? Need trained observers? instant feedback from observations? complex manipulations? integrative powers? Etc? What will the important scientific questions be in a post-reconnaissance exploration program? Are they accomplishable without direct human participation? Are scientific investigations posed independently of the context of their implementation modes? How does the implementation mode mold the investigation? Will more complex investigations be posed for human missions than for robotic missions? How might these differ?

12:30 Lunch

Afternoon session Chair: Ron Greeley

1:30 PM Two Astronauts’ Perspectives on Mars Exploration – John Grunsfeld and Scott Horowitz
2:15 Cognitive Prostheses – Ken Ford
2:50 Environmental constraints to surface operations (radiation, toxicity, etc.) – John Charles
3:15  Physical limitations (EVA) – Richard Fullerton
3:40  Contamination by human explorers – Mark Lupisella
4:05  Telerobotic operation of systems (rovers, other equipment) by astronauts on Mars – David Akin
4:30  Analog studies in preparation for human exploration – Kelly Snook
4:55  Strategic issues for human exploration linking robotic and human exploration – Doug Cooke
5:15  Adjourn

January 12

Morning Session Chair: Doug Cooke

8:30 AM  Mars Field Geology, Biology and Paleontology Workshop Results – Pat Dickerson
9:00  Scientific Tasks for Humans
-  Field investigations - Bill Muehlberger
-  Drilling – Jim Blacic
-  Geological Sample analysis – Clive Neal
-  Astrobiology Sample Analysis – Marc Cohen
-  Plant growth experiments – Ken Corey
-  Exploration for Resources – Jeff Taylor
11:00 AM  Plenary Discussion: Can the expected contributions of astronauts to Martian exploration be quantified? (W. Mendell, chair, R. Vondrak, rapporteur)

What are the criteria that one would use to judge whether a task should be carried out by astronauts, astronaut-supervised robots, or autonomous robots? Can characteristics of task intensity (such as critical observations/hour, number of sites investigated/day, etc.) be utilized? Can characteristics of quality of observation (amount of information/observation, reproducibility of observation, etc.) be used? How can the ability to synthesize information on site be quantified? What is the value of on-site analysis done by astronauts? Can the benefits of ability for astronauts to communicate with scientists on Earth be quantified? How should public interest be incorporated into the criteria?

12:00  Lunch

1:00  Breakout Session Discussions

What understanding of Mars is most likely to influence scientific objectives of human missions? (Jim Garvin, chair, Clive Neal, rapporteur)

Categories for consideration include: (a) scientific knowledge. (b) knowledge of the environment. Among the current MEPAG objectives, which ones are likely to remain unanswered within a reasonable robotic program? Would they become objectives for human exploration? Which knowledge will most influence site selection?

What science and exploration tasks are best suited to humans? Why? (Jim Head, chair, Kelly Snook, rapporteur)
Some tasks for consideration: reconnaissance sample collection, in-situ field observations, teleoperated robotic investigations, sample analysis, data evaluation and interpretation, in-situ rock analysis, drilling.

What information/technology should be developed and managed to minimize human limitations and maximize science on human missions (continued)? (Chuck Weisbin, chair, Richard Fullerton, rapporteur)

What are the principal limitations of humans on a Mars exploration mission? The two principal types of limitations would seem to be the adequacy of time, resulting from the need for humans to conduct activities other than science, and reduction of capability that arises from having to work in the environment at great distances from Earth. Which of these are more important from the point of view of scientific accomplishment and what technology can be developed to optimize the return of science from human exploration missions?

3:00   PM Reports from breakout sessions – Chair: Ron Greeley
5:00   PM Adjourn