MARS SAMPLE RETURN MISSION: WHAT LEVEL OF COMPLEXITY?

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The complexity of the U.S. Sample Return Mission is ultimately dependent on current mission funding and the projected direction of the U.S. space program. Despite these uncertainties, it is important to examine mission scenarios to address desired scientific objectives that can be summarized in the following general list:

- Determine existence of climatic records in geologic records.
- Does Mars have a subpermafrost ground water system?
- Fundamental questions on the existence of Mars biology.
- What is the internal structure of Mars?
- Determine the systems for regolith formation.
- What is the contribution of meteorites to Martian geology and climate.

To address these objectives, the sample size, quantity and location must be established and whether this should be the only data searched for on the Martian surface. With this in mind, three mission scenarios are briefly discussed below, in order of increasing complexity.

SCENARIO A

This mission incorporates the use of a rover weighing 454 kg. with a travel range of 50-to-100 kilometers. Rover travel ranges need never exceed these distances to satisfy a significant number of objectives, given landing sites offering a variety of terrain in close proximity to safe landing areas. To simplify rover design many experiments (i.e. spectral, atmospheric) could be conducted from the lander [3].

SCENARIO B

This mission combines the rover in Scenario A with a combination helium-hot air balloon with instrumentation, traveling at an altitude of 4 kilometers during daylight hours [1]. The balloon craft is used augment and extend the rover mission. After performing low altitude photography of candidate landing sites prior to rover touchdown, the suspended instrument package would then move on to examine more distant features accessible via prevailing wind currents. Data from the Viking probes on atmospheric circulation is sufficient to plan such a balloon mission [4,6,7].

SCENARIO C

This mission combines the hardware of Scenario B with the use of a small, 226 kg. hydrazine powered aircraft [2] capable of staying aloft for as long as 30 hours. The balloon craft is used to place a small instrument package on the northern polar cap for sample boring, then continue on to low altitude photography of Martian features. This aircraft using an exaggerated wingspan flying at low altitudes in the denser atmosphere would examine specific features inaccessible by balloon due to wind patterns. Controlled flights along the length of the Valles Marineris or around the peaks of Tharsis Mons could be carried out.

Where the Mars initiative will fit into our space programs long range planning and budget is central to determining the scope of the sample return mission. If it appears that there will be a number of opportunities for robotic missions, then the less complex missions are in order. If, on the other hand, political and budgetary constraints reduce the Mars initiative to one robotic mission prior to a manned launch, we should bring back as much information as possible from that mission[5]. The scientists and space craft builders of NASA have successfully designed and built the most advanced robotic spacecraft ever conceived by man. No mission scenario is beyond the reach of the United States space program.

REFERENCES

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