

Planetary Protection for the Mars Sample Return Project

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Abstract

The NASA/CNES/ASI Mars Sample Return (MSR) Project will mark the first time a spacecraft brings material from another planet to Earth. While most experts agree that the probability that the returned material would involve any threat to the Earth's biosphere is exceedingly small, the probability is not zero; and thus this mission represents a significant new challenge in the field of planetary protection. The mission also involves the more familiar element of avoiding contamination of Mars. This paper summarizes the planetary protection requirements envisioned for the MSR Project and describes the status of design work in progress to implement these requirements.

The project involves Mars lander/rover/ascent vehicle combinations that will collect dozens of individual samples of Martian material and then place sample containers in Mars orbit. A joint CNES/NASA orbiter will rendezvous with the sample containers and place them into earth entry vehicles for the return trip. The paper gives a brief overview of the mission concept and describes the planetary protection requirements, design, and planned operations within that context.

Various science committees including COSPAR and the U.S. National Research Council have studied the issues associated with extraterrestrial material and made recommendations regarding precautions to be taken in handling material returned from Mars. The MSR Project has been collaborating with NASA Planetary Protection Officer to focus these recommendations into an achievable set of requirements for the project.

The key issue is assured containment, i.e. providing a high probability that no Martian material will be inadvertently released into the Earth's biosphere. This requires a very robust combination of sample containment and Earth entry and landing process. It also requires a design that "breaks the chain of contact" with Mars, i.e. it assures that all Martian material returned will be on the inside of the container.

Another important issue is avoiding contamination of the stored material by round-trip Earth organisms that could make it difficult to confirm the material as safe for release to science investigators. This leads to requirements for hyper-cleaning and sterilization of the sampling equipment, thorough cleaning of the other landed elements, and steps to avoid cross-contamination. The general spacecraft cleaning is also the main step in satisfying the requirement to minimize potential contamination of Mars.