9 Appendices and Supporting Files

9.1 Appendix 1: Charter

Mars 2020 Contamination Study Panel

Introduction

The proposed Mars 2020 rover is a strategic mission sponsored by NASA's Planetary Science Division, through the Mars Exploration Program (MEP), all of which are part of the Science Mission Directorate (SMD). This mission is designed to advance the scientific priorities detailed in the National Research Council's Planetary Science Decadal Survey, entitled "Vision and Voyages for Planetary Science in the Decade 2013-2022." The baseline design of the Mars 2020 rover is largely based upon the Mars Science Laboratory architecture that successfully carried the Curiosity rover to the martian surface. Additional mission information can be found at http://mars.jpl.nasa.gov/mars2020/ .

The Mars 2020 Science Definition Team report (http://mepag.nasa.gov/reports/MEP/Mars_2020_SDT_Report_Final.pdf) recommended that, among other *in-situ* science and technology objectives, the mission should acquire scientifically selected samples and place them into a cache that could potentially be returned to Earth by a future mission. These samples, should NASA choose to return them, would provide opportunities for performing a variety of Earth-based experiments including ones related to the search for signs of life.

In order to meet the requirement that the cache be returnable, the MEP and the Project must define hardware requirements and mission characteristics that would affect the quality of the samples and future measurement results. One such attribute is the ability to reduce terrestrial organic contamination to a point where its presence would not interfere with sensitive investigations of martian organic geochemistry—or with our ability to distinguish terrestrial from martian organic molecules. It is anticipated that these requirements will place constraints on spacecraft cleanliness (particularly organic cleanliness) and sampling/caching system capabilities, including potentially introducing a requirement for blanks, witness plates, and check material.

In order to further define these requirements, the MEP is convening a Contamination Study Panel. The summary statement of purpose of the Mars 2020 Contamination Study Panel is as follows:

> *Evaluate draft Mars 2020 mission sample contamination requirements. Assess implementation approaches with respect to returned sample science objectives to support the investigation of martian organic geochemistry in the returned samples and differentiation of indigenous molecules from terrestrial contamination.*

Assumptions

1. Assume that one central purpose for returning samples to Earth is to make scientifically defensible, measurement-based interpretations of Mars-sourced organic molecules in the samples. This requires either avoiding or recognizing and distinguishing potential Earth-sourced organic contaminants.
2. For the purpose of this study, assume that Earth-sourced organic molecules are the only source of organic contamination on returned Mars samples that would interfere with our objectives. Contamination by Mars-sourced organics, for example from a previously collected sample, is not in the scope of this study.
3. Assume that eventual life-detection/biohazard protocols will be defined by a later panel and are not in the scope of this study.

4. The type and quantity of organic contaminants that may affect the samples during their time in a Sample Receiving Facility prior to analysis are assumed to be small relative to the contaminants delivered to the samples by the Mars 2020 mission—and, thus, can be ignored for the purpose of this study.

Statement of Task

1. Decide which is the most relevant use of terms such as "organic," "reduced carbon," and "hydrocarbon" when considering organic contamination and consider how these terms may relate to fragments of or whole terrestrial microbes. Define and systematize their use. The panel's determination regarding usage may supersede the usage of the terms in this charter.
2. Mars 2020 will not be perfectly clean, and it will unavoidably deliver some Earth-sourced organic contaminants to the samples it collects and stores. Propose one or both of two kinds of limits for Earth-sourced organic contamination on the potential returned martian samples at the point in time when they are first analyzed for organic molecules: either a) total organic contamination or b) total unrecognized organic contamination (i.e., contamination above measured blank levels).
    a. Based on current knowledge and capabilities, construct a list of measurements anticipated to be made on the returned samples in support of scientific objectives related to martian organic geochemistry, including the presence of past or present life. Generate a list of representative instruments capable of these measurements and their performance characteristics, including detection limits.
    b. Determine the types and quantities of Earth-sourced organic contaminants of greatest concern, if they were on the samples, with regard to their possible adverse impact on the scientific objectives of potential future returned sample science. At minimum, specify a total organic carbon constraint.
    c. Assess possible implementation approaches for recognizing and distinguishing Mars-sourced organic molecules in the samples from Earth-sourced organic molecular contamination. Approaches should include, but not be limited to:
        i. Establishing a system of positive and/or negative control standards, in order to document the state of contamination at specific times/places. Consider separately control standards that would need to go to Mars on the Mars 2020 sampling rover vs. those that wouldn't.
        ii. Designing a set of blanks, witness plates, and other kinds of control samples that are taken before the rover is launched from Earth, then preserved for analysis when the Mars samples are potentially returned to Earth in the future.
        iii. Designing a set of control standards that could be used in association with the organic molecule measurements within the Sample Receiving Facility.
3. Evaluate draft Mars 2020 mission sample organic contamination requirements and draft verification methodologies (to be provided by the Mars 2020 project).
    a. Propose modifications to the draft Mars 2020 requirements and verification methodologies as needed.

Methods

The panel will have approximately 10 members, plus involvement of Program/Project/discipline support personnel. It is anticipated that the panel members would have expertise and knowledge spanning astrobiology, organic chemistry/geochemistry including theory and state-of-the-art lab practices, and contamination control and measurement.

The panel will meet by teleconference once or twice per week between March 1 and July 1, with 1-2 face-to-face meetings. The Mars Program Office at JPL will provide logistical support.

Deliverables

Draft findings/conclusions (PPT format) will be due May 8, and a final report (text format) July 1. The report should not contain any material that is proprietary or ITAR sensitive. Additional supporting documents may be prepared as needed.

The Study Group will produce a draft set of findings for review by the National Research Council Space Study Board (NRC SSB)-convened Meeting of Experts (MoE), also including participation from the European Science Foundation. The report will be made available to the NRC SSB by a date to be named later. The chair of the Study Group, or other community-appointed Study Group member, will present the findings of the report at an NRC SSB-convened MoE.

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