MARS SAMPLE RETURN SAMPLE RECEIVING FACILITY CONTAMINATION PANEL.

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Introduction: The Mars Sample Return Campaign is a multi-mission effort to bring scientifically selected geological samples to Earth for the purpose of scientific investigation. Significant parts of that research could be affected by Earth-sourced contamination that is either misinterpreted as being of martian origin, or masks a martian signal. Potential contamination is likely to be most significant during two primary phases of the Campaign:

1. *During sample acquisition and storage by the Mars 2020 (M2020) Perseverance Rover*. Several of the rover's components will come into contact with the samples—most notably the drill bits and the Returnable Sample Tube Assemblies (RSTAs). These can be a vector for the transfer of contaminants that originated at Earth, either inorganic or organic (biogenic or abiogenic), to the samples. Once the sample tubes are sealed, further contamination during the transportation stages of the MSR Campaign (including during ground transportation from the Earth landing site to the Sample Receiving Facility) is expected to be very limited (but not impossible).
2. *During each sample's residence inside the Sample Receiving Facility (SRF).* While the samples are in the custody of the Facility, they will need to be protected from unacceptable contamination. The Sample Receiving Project (SRP) will have additional aspects for which Contamination Control/Contamination Knowledge (CC/CK) needs to be planned (for example, in making use of external laboratories), but these requirements and processes can be planned for later. An immediate problem is understanding how the CC/CK constraints contribute to the design and operating requirements of the SRF.

Contamination control and contamination knowledge requirements for the two phases will have important impacts on the ability to successfully carry out sample science investigations that are sensitive to terrestrial contamination.

Potential contamination during sample acquisition was partly addressed by means of the Organic Contamination Panel (OCP)[1], which was chartered and completed its work in 2014. Their recommendations formed the basis of the CC and CK implementation plans for M2020. CC and CK requirements for the so-called ground segment (i.e., the Facility) have not yet been addressed. For this, we are requesting an MSR SRF Contamination Study (SCP).

Statement of Task: The SCP Phase 1 (SCP-1) shall propose terrestrial biological, organic and inorganic contamination limits for the samples from Mars during residence of the samples inside the SRF that are needed to protect the integrity of sample science analyses.

<u>For all forms of contaminants</u>

1. Starting Point. Beginning from the analysis of the total amount of terrestrial biological, organic and inorganic contamination that would potentially already be present in the MSR samples as a result of M2020's operations, based on the pre-launch requirement verification analyses conducted by M2020.
2. Define a proposed set of total terrestrial biological, organic and inorganic contamination limits for the samples' processing flow in the Facility, up to the point of allocation for analyses. This should be based on understanding of state-of-the-art instrumentation. Define separate contamination limits for subsamples that are targeted for:
   a) Organic or biological analyses
   b) Inorganic analyses
   c) Samples or subsamples that may eventually be used for any type of analysis (e.g., samples or subsamples during the Preliminary Examination whose eventual usage hasn't yet been defined)

<u>For organic contaminants</u>

3. Update the list of Tier 1 compounds classes, as well as representative compounds, prepared by OCP (2014) that should be used to verify and validate requirements compliance.
4. Assume that the list of measurements related to organic analyses are as described in the MSR Science Planning Group Phase 2 reports [2] and the Sample Safety Assessment Framework [3].

<u>For biological contaminants</u>

5. Define the terrestrial biological contamination limits defined in point 2 for:
   A. Live microbes
   B. Dead microbes
   C. Fragments of dead microbes

Committee Details & Process: The SCP-1 committee consists of 15 members of the international science community, co-chaired by Drs. Alex Sessions and Cara Magnabosco, as well as 5 ex-officio members representing NASA & ESA. This panel is expected to

present preliminary findings at this meeting, gather community feedback, and to produce a final report by April 15, 2023.

Next Steps: Once SCP-1 has completed it's work and delivered recommendations for total allowable sample contamination, the second phase of the SRF contamination study will commence. SCP-2 will be focused on deriving contamination control and knowledge requirements and implementation approaches for the Facility.

Disclaimer: The decision to implement Mars Sample Return will not be finalized until NASA's completion of the National Environmental Policy Act (NEPA) process. This document is being made available for informational purposes only.

References: [1] 2014 Organic Contamination Panel, R.E. Summons, A.L. Sessions, (co-chairs), A.C. Allwood, H.A. Barton, D.W. Beaty, B. Blakkolb, J. Canham, B.C. Clark, J.P. Dworkin, Y. Lin, R. Mathies, S.M. Milkovich, and A. Steele. Planning Considerations Related to the Organic Contamination of Martian Samples and Implications for the Mars 2020 Rover. Astrobiology. Dec 2014. 969-1027.http://doi.org/10.1089/ast.2014.1244 [2] MSPG2 committee, Kminek G. and Meyer M. (co-chairs) et al. (2022) Final Report of the Mars Sample Return Science Planning Group 2 (MSPG2) *Astrobiology*, 22, 5-26. [3] Kminek G. et al. (2022) COSPAR Sample Safety Assessment Framework (SSAF) *Astrobiology*, 22, 186-216.