

MARS SAMPLE RETURN (MSR) SAMPLE CACHING/RETRIEVAL STRATEGY. M. A. Meyer¹, G. Kminek², D. W. Beaty³, B. L. Carrier³, D. A. Spencer³, K. A. Farley⁴, ¹NASA Headquarters (Michael.a.meyer@nasa.gov), ²European Space Agency (gerhard.kminek@esa.int), ³Jet Propulsion Laboratory, California Institute of Technology, ⁴California Institute of Technology.

Introduction: In October 2020, NASA and ESA formalized a partnership to bring samples of Mars to Earth. One crucial piece of planning that will have a large impact on the potential number, nature, and diversity of returned samples, and thus on the science that can be performed on the samples, is the caching and retrieval strategy for the samples collected by the Perseverance rover. The delivery of samples to the Sample Retrieval Lander (SRL) is possible via transport by two pathways: 1) retrieval by the Sample Fetch Rover (SFR) of samples that have been placed in a depot, which would then transport them to the Sample Retrieval Lander; and/or 2) delivery of samples retained on Perseverance to the SRL.

There are multiple options for caching, and these would have an effect on the landing site location for the SRL, and to the performance design parameters for the SFR. The goal is the delivery of a scientifically-return worthy set of samples to SRL that can be loaded into the Mars Ascent System (MAS) for the journey to Earth. By adopting several simple strategies it is possible to create multiple options that will significantly reduce certain high-level mission risks involving single-point failures. An immediate consequence of the caching strategy will be whether and when Perseverance should take duplicate samples and which samples will constitute the first depot. Note that a cache in this context is defined as a discrete collection of samples, whether onboard the Perseverance rover or placed on the martian surface as a depot.

Which strategies are actually implemented will depend on the nature and perceived value of each sample, the diversity of the samples expected at a depot, landing site accessibility for SRL, the capabilities of Perseverance and Sample Fetch Rover, the projected risk of Perseverance and SFR survivability, and trafficability of the terrain encountered.

The Caching Strategy Steering Committee (CSSC) was chartered by NASA and ESA in November, 2020 to review a set of scenario-based decision guidelines to inform operational decisions for future MSR systems (SRL, SFR) and strategic mission planning for Perseverance. The CSSC included representatives of each of the MSR science stakeholder organizations: NASA, ESA, Perseverance, MSR, and the Mars science community.

MSR Sample Caching Strategy Workshop: As input into the formulation of the recommended sample

caching decision guidelines the CSSC conducted an initial review of the draft decision guidelines proposed in the Mars Exploration Program - Mars Sample Return Program Concept of Operations (ConOps) Guidelines Agreement, including discussions of what constitutes a scientifically-return worthy cache, approaches to duplicate sampling, and other related topics. The resulting materials and revised draft decision guidelines are serving as input to an open workshop with the science community which will have been held on January 21st, 2021. The purpose of this workshop will be to share and discuss potential scenarios, and collect community feedback on the draft decision guidelines and approach to sample caching. The inputs and discussion from the workshop will be incorporated into the CSSC deliberations and documented in a report that captures both the workshop results and recommended caching strategy guidelines. The report of the CSSC will be used to update the ConOps Guidelines Agreement between MEP/Mars 2020 and MSR.

This presentation will include a report out of both the MSR Sample Caching Strategy Workshop and the resulting CSSC report & recommendations.

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 information purposes only.