Mars Sample Return Overview

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What is the Mars Sample Return Program?

The Mars Sample Return Program (MSR) is an ambitious, international science mission to collect and return rock and sediment samples from the Martian surface.

It has been a priority of the past two National Academy Decadal Surveys.

It will be the first “round-trip” to another planet, paving the way for future human exploration.

MSR is a complex mission.

Requires a set of capabilities that were not demonstrated 20, or even 10, years ago.

It is only possible today as a result of the $10+B investment made through the formulation, technology and operational projects of the past decades, coupled with a strong international partnership with ESA.
GOAL —
First Sample Return From Another Planet

A priority since 1980 and of two National Academy Decadal Surveys
A first-step “round-trip” in advance of humans to Mars

The oldest known life on Earth existed ~3.5 billion years ago,
a time when Mars was habitable. Today,
<<1% of the Earth’s surface is 3 billion years or older
>50% of the Mars’ surface is 3 billion years or older

*The first billion years and life’s beginning in the Solar System:*
*The record is on Mars*
This presentation contains pre-decisional information for planning and discussion purposes only.

MSR Overview

MSR Program Architecture
This presentation contains pre-decisional information for planning and discussion purposes only.
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Perseverance completed its crater floor science campaign in mid March after collecting the 8\textsuperscript{th} rock core sample near the Octavia E. Butler Landing site. The rover is now conducting a rapid traverse campaign to drive counter-clockwise around the Séítah dune area towards the Delta front.

**Total 10 tubes sealed:**
- 1 Witness blank
- 1 Atmospheric sample
- 8 Rock Core samples

**Octavia E. Butler Landing Site**

**Sampling Sites**

*Courtesy of Fred Calef and M2020 team*
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MSR Overview

When is the MSR Mission?

February 2021: NASA’s Perseverance Rover landed on Mars in February 2021. It is collecting samples to be returned to Earth.

2027: ESA’s Earth Return Orbiter will launch to Mars. Its payload is the NASA Goddard Capture, Containment, and Return System (CCRS). It will receive the Martian samples and return them to Earth.
When is the MSR Mission (continued)?

**2028:** SRL-MAV (provided by NASA) and SRL-SFR (Provided by TBD) will launch to Mars.

**2030:** Samples will be retrieved and launched off the Martian surface, then captured by the Earth Return Orbiter with its Capture-Containment-Return Payload. The ERO begins its journey back to Earth.

**2033:** The samples touch down at the Utah Test and Training Range. Samples are collected for scientific handling.
MSR Overview

Testing MSR Technology

VECTOR = Vertically Ejected Controlled Tip-Off Release

• VECTOR is a pre-ignition separation mechanism for the MAS

• VECTOR provides a MAS separation state with a vertical velocity and pitch rate

• MAS ignition occurs a set time after separation within an established window that allows for successful flyaway
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EES Manufacturing Demonstration Unit #1 Drop Test
Utah Test and Training Range  March 1, 2022

NASA / USAF Team Photo
MDU1 Drop Test Video

Drop Altitude: ~1000 ft
Terminal Velocity at impact: ~33 m/s

Utah Test and Training Range – March 1, 2022
Notional MSR Dual-Lander Green Pathways

- **LEGEND**
  - M2020 Landing Point
  - M2020 Driven Path (through Sol 202)
  - M2020 Prime Mission Planned Strategic Traverse Path
  - Joint M2020-MSR Conops Reference Traverse Path Network
  - MSR Sample Fetch Rover Compatible Green Pathways
  - Dual Lander Compatible SRL Landing Site Options
  - Dual Lander Compatible Depot Options
MSR Overview

Campaign Timeline Overview

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M2020 ➔ ...

Launched 2020, arrived 2021, initial depot expected Feb 2024, and final depot Dec 2029

ER0 (with CCRS)

SRL-SFR

SRL-MAV

Earth to Mars

MOI

Final Depot ➔ EDL

MSR-M2020 Joint Ops

Surface

EDL

Surface

OS

Mars to Earth

M2020

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Summary

- This is the most significant planetary science undertaking in a generation

- Now is the time!
  - Perseverance on surface of Mars collecting samples
  - Orbital Relay assets in place around Mars

- MSR is made possible by strong and significant partnerships with European colleagues at ESA and their industrial consortiums