



National Aeronautics and
Space Administration

EXPLORE MARS SAMPLE RETURN

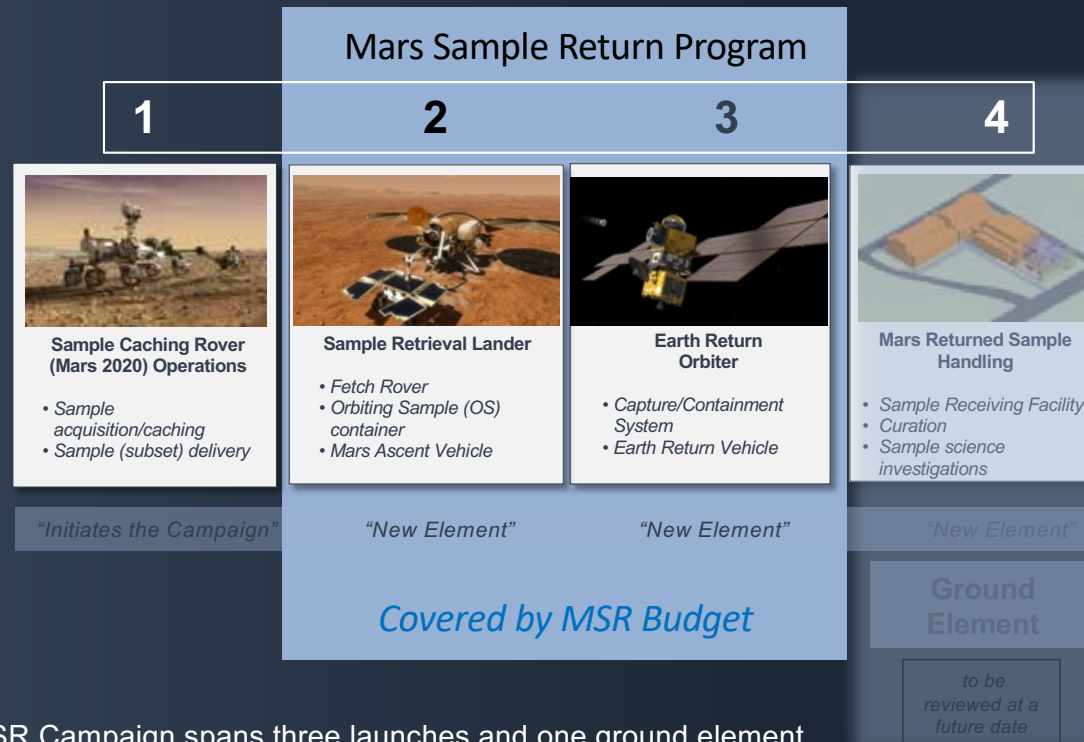
Jeff Gramling, MSR Program Director
NASA HQ

Briefing to PAC

November 15, 2021



MSR Campaign

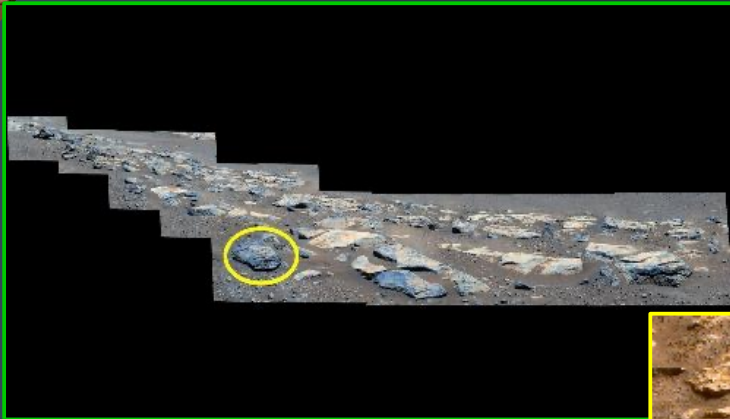


- The MSR Campaign spans three launches and one ground element
- The MSR Program manages development and operations of elements 2 and 3 above and interfaces to elements 1 and 4; program concludes with recovery/containment of samples for transfer to SRF
- The MEP Program manages M2020 Phase E operations & will be the home of the future SRF Project



First Scientifically Selected Samples Collected

Perseverance has successfully acquired paired rock samples



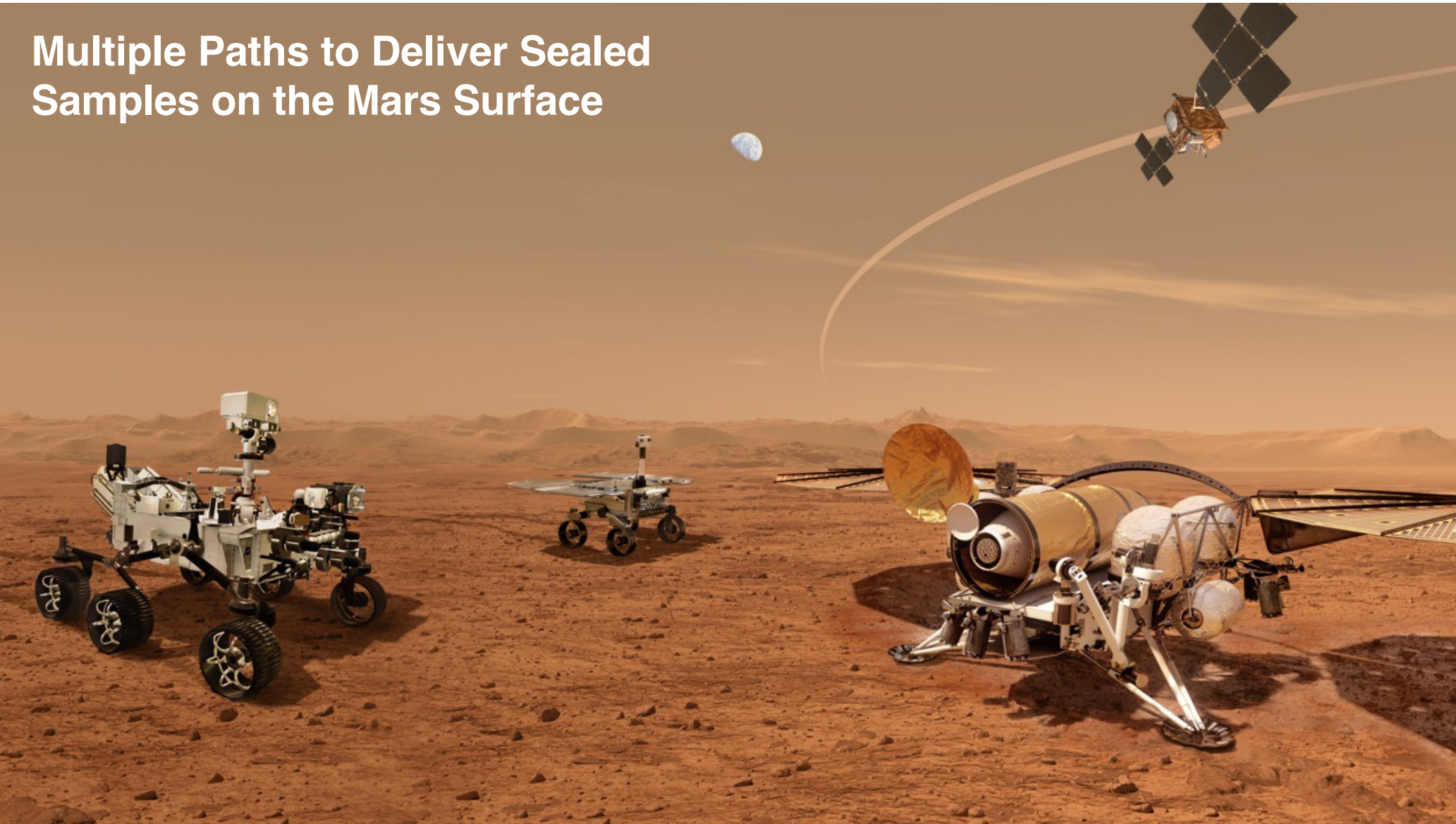
Rochette' After Perseverance Sampling: Sept. 7, 2021, PDT, shows two holes where the rover's drill obtained samples from rock nicknamed "Rochette." Credits: NASA/JPL-Caltech.

- 10% of the 43 sample tubes on Perseverance are now sealed and awaiting Earth return; in 2023, this will be over 33%



Pre-Decisional Information For Planning and Discussion Purposes Only

Multiple Paths to Deliver Sealed Samples on the Mars Surface

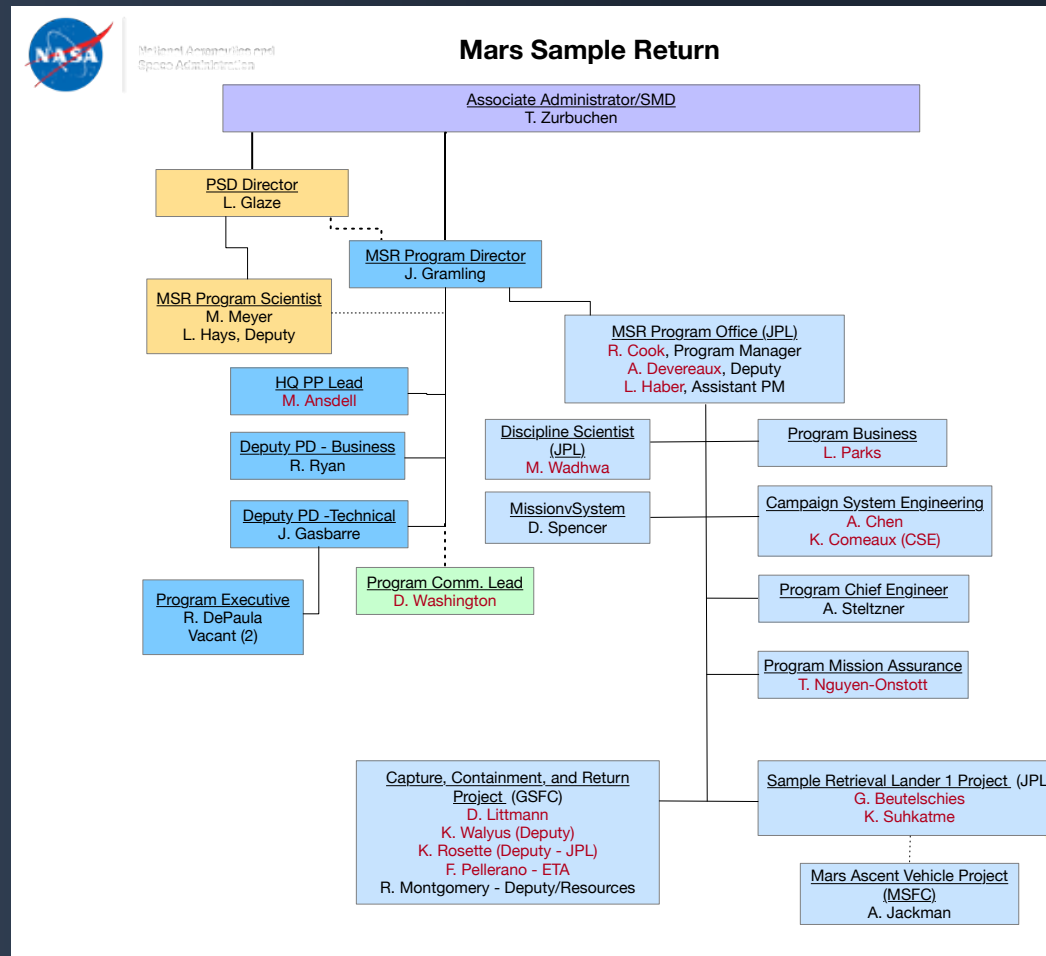




Progress

- Perseverance has collected first samples
- Program is emerging as a constructive collaboration with Europe
- Program making significant progress in establishing a viable, implementable architecture
- Resolved center roles & engaged industry in more significant ways
 - Significant progress on long-lead procurements
- Augmented team with numerous experienced implementation personnel
- Advanced key technologies & engineering developments and assessed a broad range of options in Phase A

MSR Organization Chart

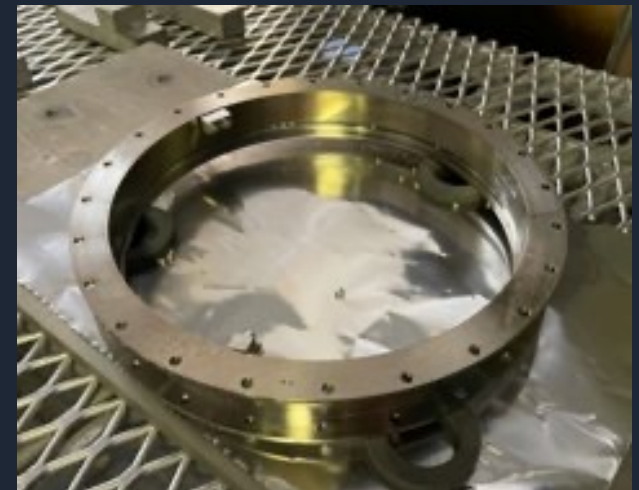


Pre-Decisional Information—For Planning and Discussion Purposes Only

Trade Study Highlight: Break-the-Chain Containment Assurance - Aseptic Transfer/Sealing

- The program is currently trading two aseptic transfer/sealing approaches to complete the primary containment vessel (PCV) assembly around the Orbiting Sample (OS) container
 - Baseline is use of brazing at joint
 - Alternate is a heat-shrink fit (HSF) approach
- Baseline autonomous brazing is TRL 4-5; efforts on track to demonstrate TRL 6 by CCRS PDR →
- Alternate approach, heated shrink fit, is in work to mitigate TRL development risk
 - Relies on well-understood joining method and maintains the capability to sterilize the PCV joint
 - Potential improvement in ground and on-orbit verification

Brazing Development: 1-Way Full Scale Ring



2nd FS ring from August 2021:
He tight and sealed to $< 4 \times 10^{-10}$ atm.cc/s.

Development Highlight: VECTOR

What is it?

- The Vertically Ejected Controlled Tip-Off Release (VECTOR) system “tosses” the MAV before ignition
- This minimizes dynamic coupling with launch dynamics and plume interactions while increasing ground testability/verification



VECTOR Prototype with MAV Simulator

Overall

- Design continues to mature
- Held an architecture review that confirmed the basic VECTOR approach
- Held development review to ensure solid maturity plan by PDR
- Prototype version 1 has been built



Gravity Offload and Catch System

Testing

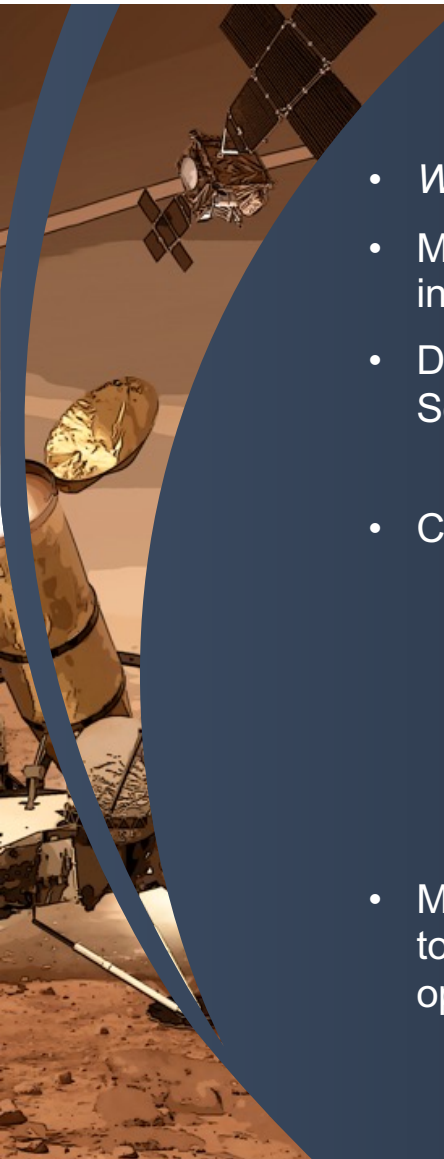
- Using JPL Building 280 with an MSL Z-Hangman structure utilizing a gravity offload and catch system
- Have started testing prototype with testbed (see next slide)



Testing Underway

VECTOR Prototype Testbed





MSR Science Question

- *What will Science Involvement with Mars Sample Return Campaign look like?*
- Mars Exploration Program has the responsibility for the science of Mars Exploration, including MSR
- Dr. Meyer/MEP is leading development of the Campaign Science Plan and Campaign Science Team in response to MSPG2 recommendations
 - Developing Science MOU with ESA
- Current Science Involvement
 - MSR Lead Scientist is also the MEP Lead Scientist (NASA HQ)
 - Deputy MSR Program Scientist (NASA HQ)
 - MSR Principal Scientist (JPL)
 - Deputy MSR Principal scientists (JPL) - interviews in progress
 - Lead Sample Integrity Scientist (JPL)
 - CCRS Sample Integrity Scientist (JPL)
 - Sample Return Project Scientist (TBD) (JPL)
- MEP and MSR Programs developed a MOA in March to define how the programs will work together to coordinate M2020 Phase E operations, the MSR program design and operations, and the Sample Receiving Facility
 - Definition of joint agreement in operational planning and operations concept development



Summary

- Perseverance has successfully acquired paired rock samples
- Staffed key leadership roles across program
- Completed Delta ASM, finalized center roles
- Working to complete technical & programmatic trades
- Long-lead procurements in progress
- Project and Program reviews scheduled in Winter 2021 and Spring 2022

The program has made significant progress in Phase A, maturing its technical, cost and schedule baseline



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