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NASA Planetary Science Advisory Committee (PAC) Meeting
November 2023

Mars Exploration Program Highlights

- Curiosity arrived at Gediz Valley Ridge!
- IMEWG In-person, Tokyo 7-10 Nov, 2023
- MAVEN 10 Year Launch Anniversary! Party @ GSFC Nov 20, 2023
- Mars Solar Conjunction ~Nov 11-25, 2023

- MDAP 2023 Step-1 submittals increased by ~30% from the recent declining trend; almost back to 2020 levels
  - Step-2 proposals due Nov 16, 2023
  - Review panel planned for Feb-Mar 2024
- Mars 2020 Participating Scientist Program (PSP)
  - Due to budget challenges, there will not be a new solicitation

MEP Future Plan Activities

Community Engagement

- Recent/Upcoming draft plan community presentations to solicit feedback
  - Astrobiology Townhall, SmallSat Conf, Industry Briefing, Mars Society, AAS DPS, ASCEND, IMEWG, AGU
- Industry Infrastructure/Technology Studies
  - Commercial services Guiding Principles and Design Reference Mission scenarios feedback solicited
  - Release of MEP Industry Studies RFP in late winter/early spring 2024

Search For Life Planning

- MEP is working with the Astrobiology program to charter a Search for Life (SFL) - Science Analysis Group (SAG)
  - Incorporate past activities across different communities into a coherent effort
  - Prioritize desired Martian broad-scale environments to search for extant life
  - Identify Technology development required to search for life in specified environments
- Planning to begin SFL-SAG member selection in early 2024
  - Terms of Reference (ToR) draft underway
  - Considering workshop(s) focused on the specific science and technology needs in spring/summer 2024, with a final report anticipated by the end of 2024

Rosalind Franklin Mission

Collaborating with ESA to ensure RFM has all essential elements for a 2028 Launch

- ESA Check Point Review late-November 2023 for mission procurement approval

Continuing MOMA-MS* preparations for launch

- PH power card replacement in process for risk reduction

*Mars Organic Molecule Analyser – Mass Spectrometer

Launch Service

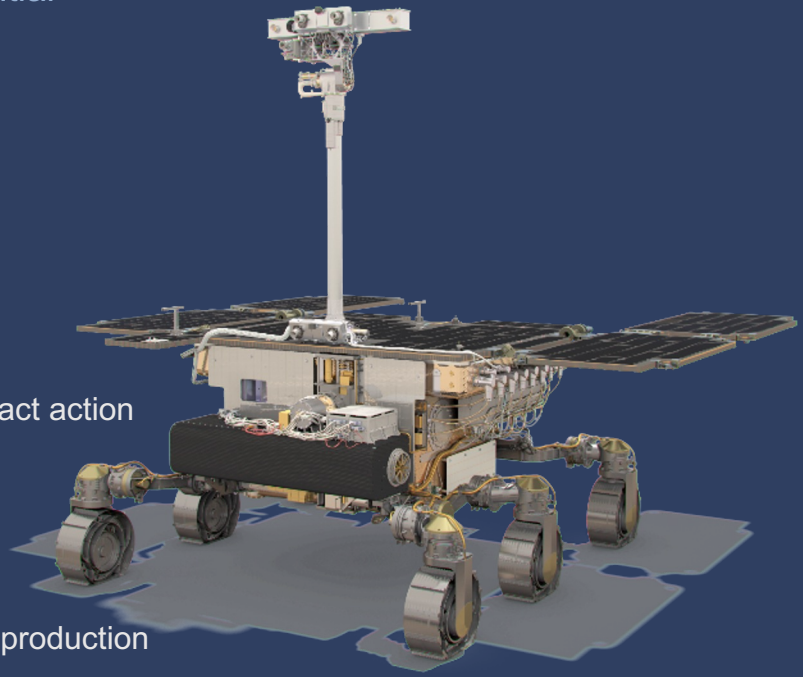
- Preparing for acquisition of launch vehicle via NLS-II contract action

Lander Descent Engines

- Procuring Long Lead Items from Aerojet & MOOG

Radioisotope Heater Units (RHUs)

- NASA is working with the Department of Energy to restart production of RHUs that will heat the rover



Credit: ESA

Sample Receiving Project

Measurement Definition Team (MDT)

- Developing strawman set of instruments needed within the high-containment facility to accomplish sample safety assessment, curation, and science
- 23 selected of 147 applicants, plus 6 ex-officio members
- Report expected in April 2024

Returned Sample Safety Assessment

- Developing protocol to determine if returned samples pose a hazard to Earth's biosphere and are safe to release from high-containment laboratories
- Kick-off meeting held Sept 2023
- Coordinating with MDT to ensure alignment with instrument and measurement recommendations
- Interim report in Dec 2023; Final report in Mar 2024

Investigating potential partnerships and collaboration opportunities for the Sample Receiving Facility

The SRP is the final element of the MSR Campaign that has a defined mission to recover, contain, transport, assess safety of, curate and scientifically investigate the samples returned to Earth by MSR

Primary Goal: Enable safe and rapid release of the returned samples to world-wide labs for science investigations

MEP Orbiters

Mars Relay Network (MRN)

- MEP successfully managing network activities with aging orbiters that are well into their extended missions
  - Spacecraft are operating nominally with instruments functioning properly
  - Projects are managing all consumables to extend science and relay operations

Odyssey

- Results of propellant investigation now estimates remaining propellant at 4 kg +/- 2 kg, usage 1 kg/year
- Project began its 9th extended mission in October 2022

MAVEN

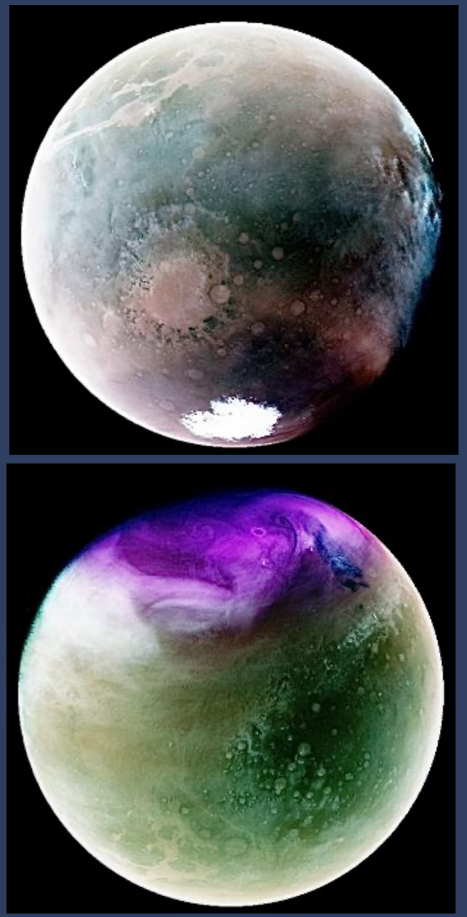
- No safe mode events since Feb 2023
- MAVEN operating in all-stellar attitude sensing mode to preserve lifetime of remaining IMU
- Project began its 5th extended mission in October 2022

MRO

- No safe mode events since Nov 2022
- Project began its 6th extended mission in October 2022

ExoMars/TGO

- Continuing to support relay operations for MEP; returning >50% relay data of landed assets



MAVEN's Imaging Ultraviolet spectrograph (IUVS) instrument obtained these infrared views of Mars when the planet was near opposite ends of its elliptical orbit. Credit: NASA/LASP/CU Boulder

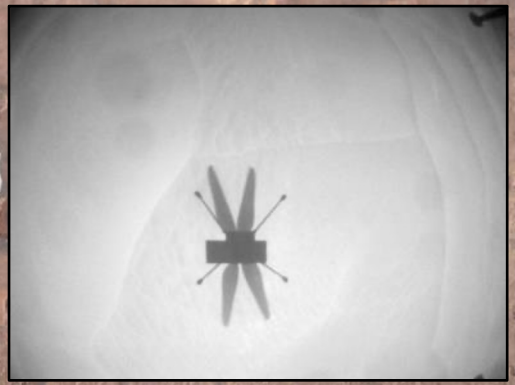
Mars 2020

Perseverance Odometer: 22.98 km*
Ingenuity Log: 66 flights, 14.9 km*
*** As of November 7, 2023**

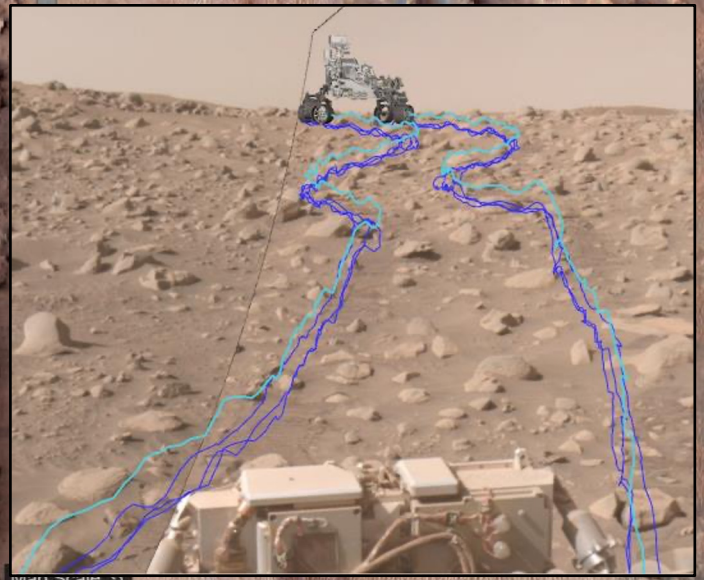
Margin Campaign

Delta Top Campaign

Three Forks



Ingenuity Flt 66, NavCam Image
Credit: NASA/JPL-Caltech



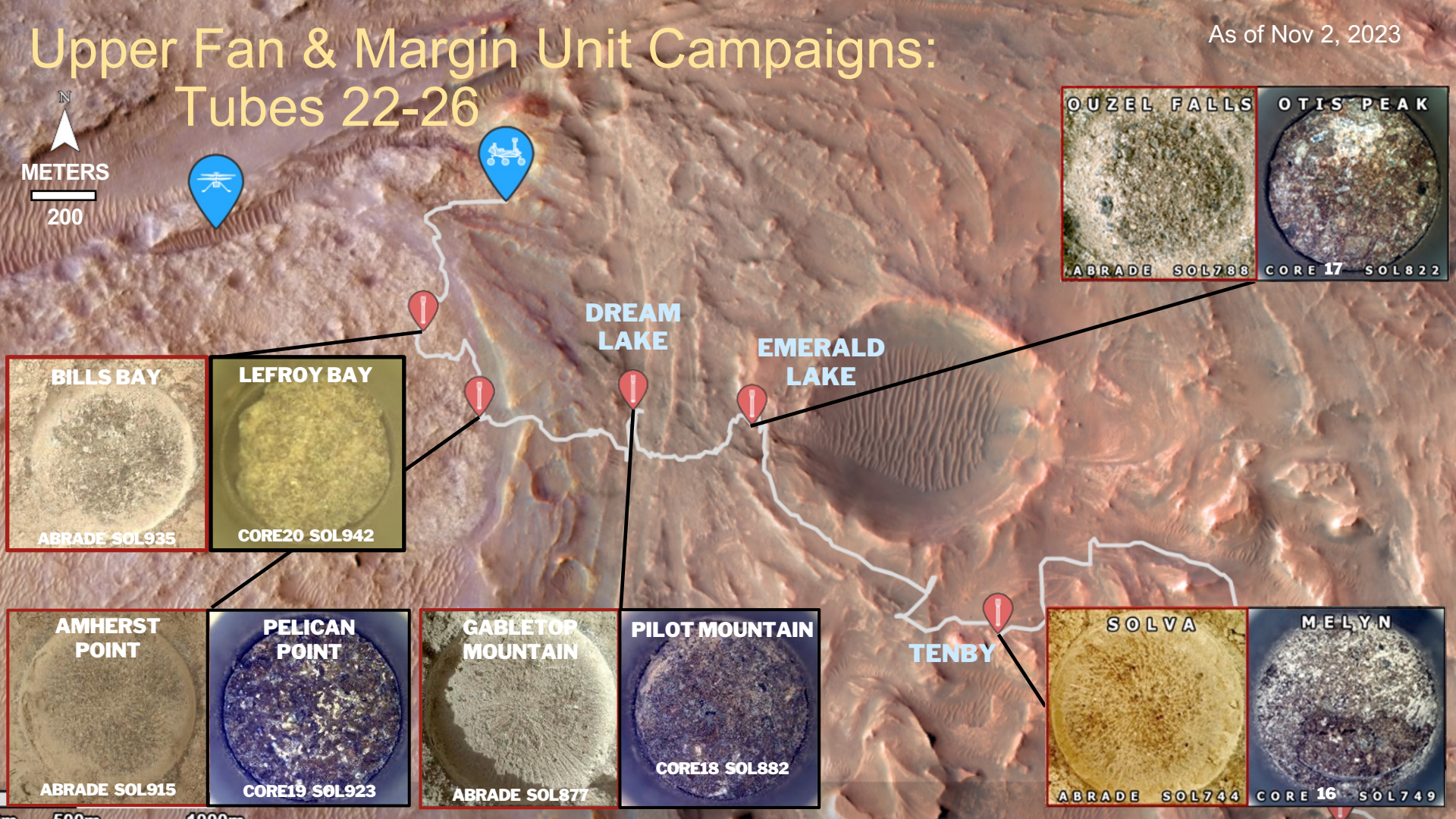
Annotated composite image shows the path Perseverance took through a dense section of boulders. The pale blue line indicates the course of the center of the rover's front wheel hubs, while the darker blue lines show the paths taken by the bottom of the rover's six wheels. Credit: NASA/JPL-Caltech

Map Scale
0 500m 1000m 2km

Longitude, Latitude 77.36692429°, 18.4470439

Upper Fan & Margin Unit Campaigns: Tubes 22-26

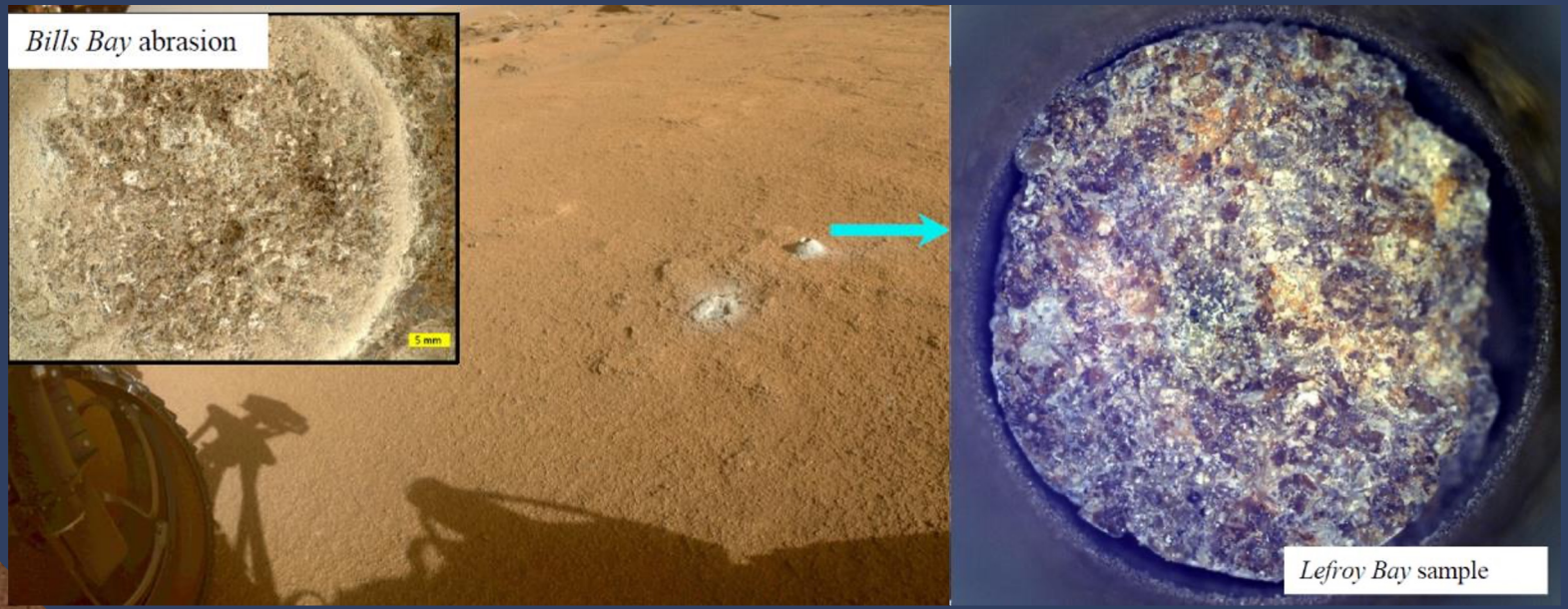
As of Nov 2, 2023



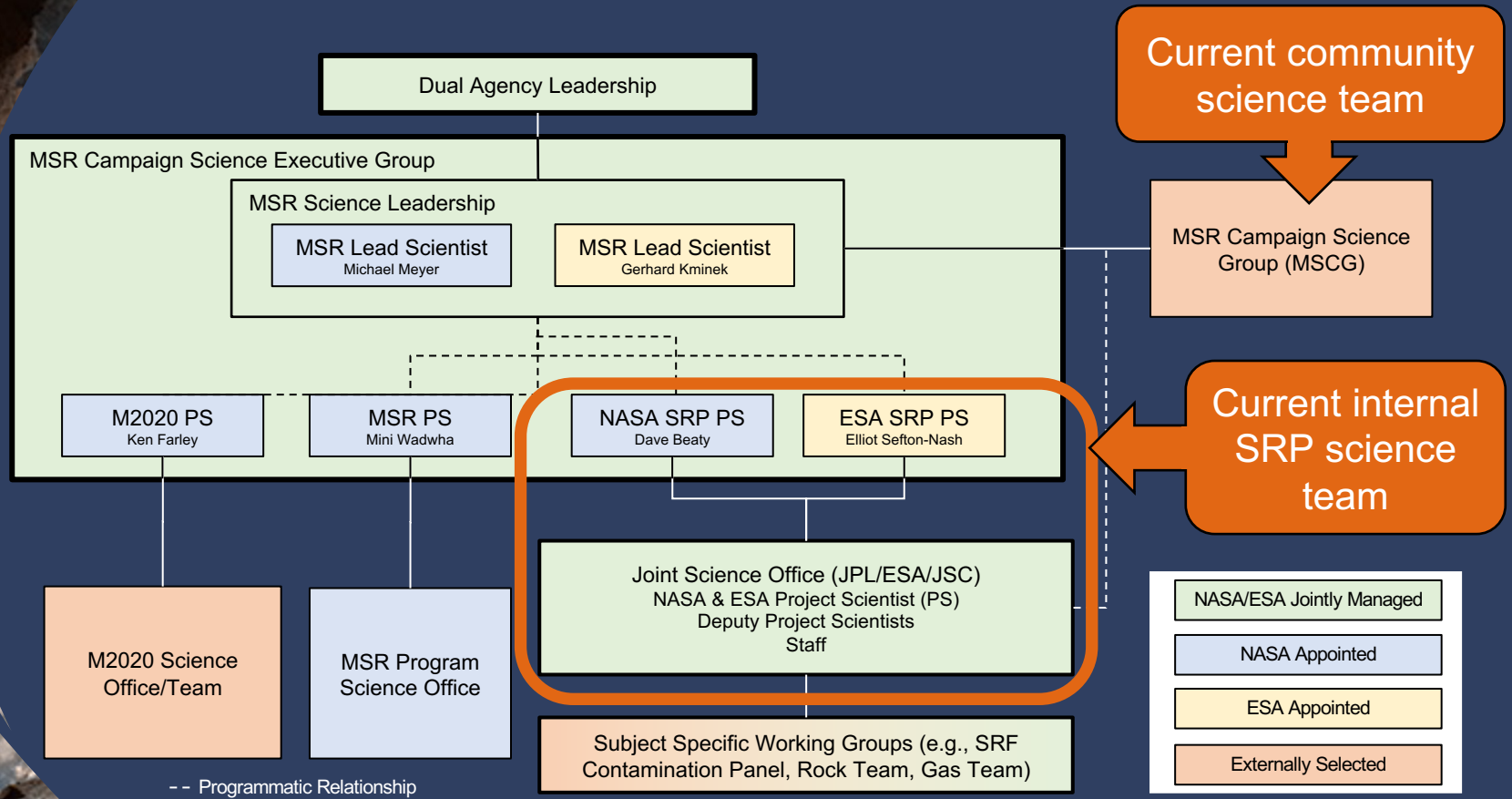
Latest Perseverance Sample: Lefroy Bay

Contains 1st confirmed presence of hydrated silica cement & hydrated carbonates

- Potential good preservation media for biosignatures
- Possible unique hydrated Mg sulfate and candidate phosphate or perchlorate detection
- Record of a distinct habitable environment different from the delta front and upper fan
- Opportunity to ground truth high-carbonate “hot spot” that led us to this outcrop by the CRISM data

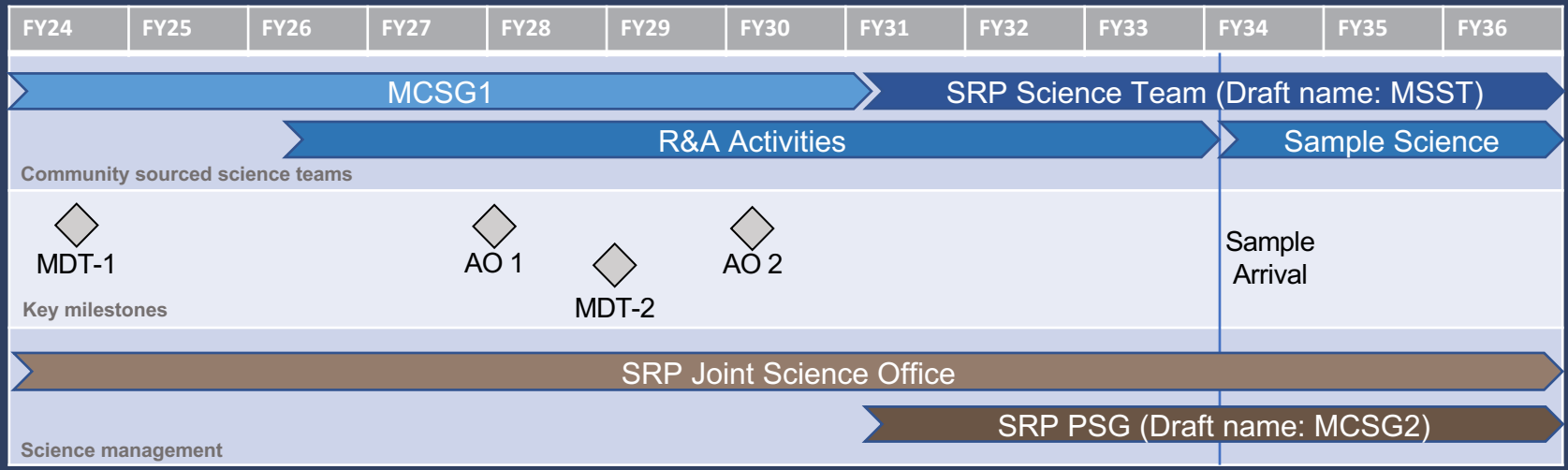


MSR Campaign Science Organization



Notional Plan for SRP Science Team

- Regardless of phase, a science group will always be in place to participate in relevant activities
- AO 1 will cover large instruments that need to be installed in the SRF during construction. AO 2 includes all other instruments both inside and outside the SRF.
- PSG is sourced from SRP science team alongside project scientists
- **Until AO-2, the community is represented by the MCSG**

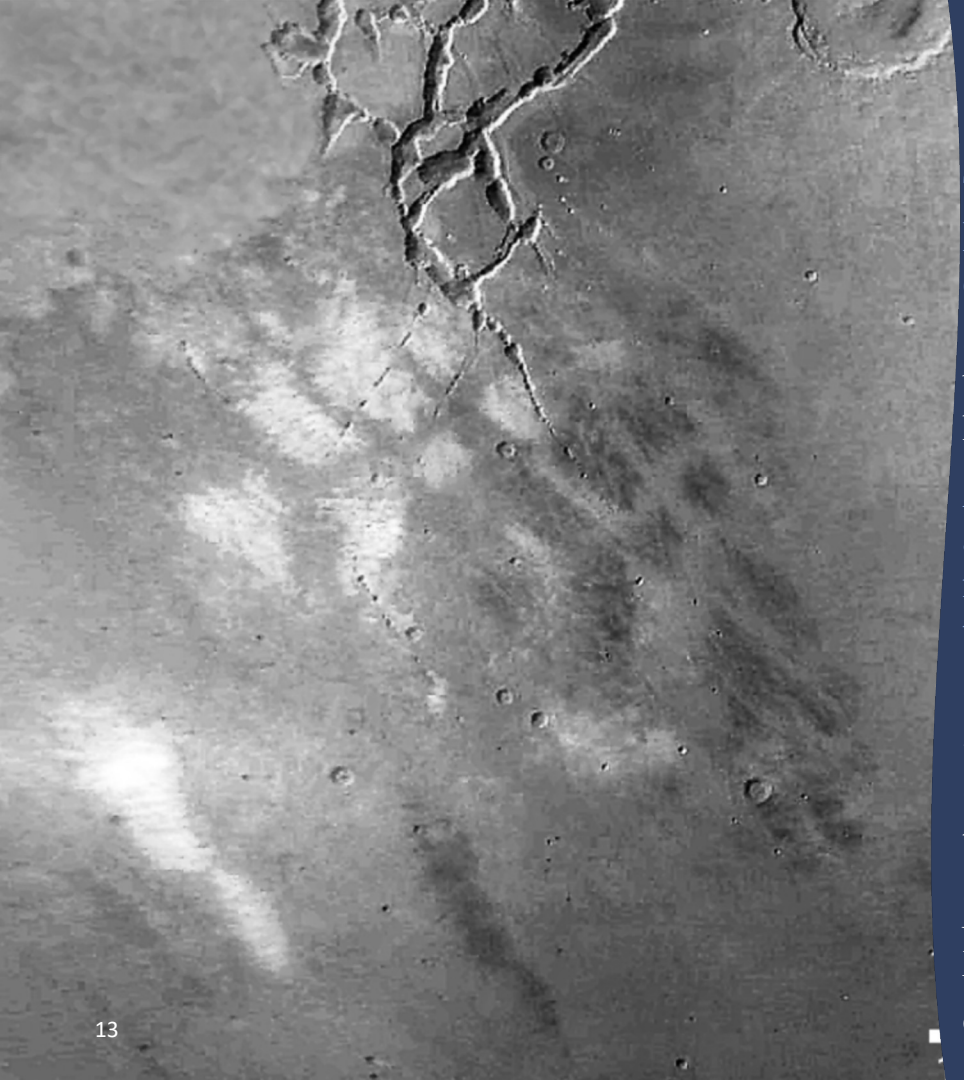


Mars Science Laboratory (MSL) Curiosity

Curiosity arrived at Gediz Vallis ridge August 14th!

- "After three years, we finally found a spot where Mars allowed Curiosity to safely access the steep ridge," Ashwin Vasavada (Project Scientist) commenting on reaching the ridge after previous attempts were thwarted by gator-back rocks and steep slopes
- Curiosity acquired a drilled sample from light-toned bedrock found in the dark-light interlayered bands of the magnesium sulfate-bearing unit. This is the 3rd drill sample since encountering the unit ~115 vertical meters below, and 39th drill sample overall.

NASA's Curiosity captured this panorama while parked below Gediz Vallis Ridge (seen at right), a formation that preserves a record of one of the last wet periods seen on this part of Mars. After previous attempts, the rover finally reached the ridge on its fourth try. **Credits: NASA/JPL-Caltech/MSSS**



MRO MARCI Clouds

The MRO MARs Color Imager (MARCI) observes Mars to build a global picture of the weather on Mars each day

- Condensate clouds play an important role in Mars' energy balance, both reflecting incident solar radiation and trapping heat emitted by the surface

Active local, deep vertical transport in the Mars atmosphere is shown in this image as afternoon mesospheric condensate clouds above Sinai Planum in the Southern Tropics

- This autumn cloud phenomena reached heights greater than 50 km as determined from shadow length measurements
- The checkerboard cloud pattern is indicative of organized thermal convection.
- The location of the clouds on the southern boundary of the Noctis Labyrinthus valley and canyon network suggests that upslope flow is working in conjunction with thermal convection to explain how the pattern formed at altitude.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Inputs into MSR Sample Science Planning

Group	Year(s) active/ Report date	Input Type	Science Objectives	Site Selection	Sample Selection	Collection	Contamination Control	Analysis	Curation	Management
Strategy for the Exploration of the Inner Planets	1978	NASEM report								
NRC - Task Group on Issues in Sample Return	1997	NASEM report								
Mars Sampling Advisory Group	2001	MEPAG advisory								
Mars Sample Return Science Steering Group	**2002**	**MEPAG advisory**								
NRC - Assessment of Mars Science and Mission Priorities	2003	NASEM report								
MEPAG MSL sample cache assessment	2007	White paper								
NRC - Committee on an Astrobiology Strategy for the Exploration of Mars	2007	NASEM report								
International Mars Architecture for the Return of Samples (iMARS)	**2008**	**IMEWG advisory**								
MEPAG Next Decade Science Analysis Group (ND-SAG)	**2008**	**MEPAG advisory**								
Mid-Range Rover Science Analysis Group (MRR-SAG/MAX-C)	**2008**	**MEPAG advisory**								
International Mars Sample Return Conference	2008	Conference	No available record							
MSR End-to-End International Science Analysis Group (E2E-iSAG)	**2011**	**MEPAG advisory**								
Visions & Voyages for Planetary Science in the Decade 2013-2022	2011	Decadal survey								
Joint Mars Rover Mission Joint Science Working Group (JSWG)	2012	MEPAG advisory								
Life Detection in Extraterrestrial Samples Conference	2012	Conference								
Workshop for life detection in samples from Mars	2012	Workshop								
Mars 2020 Science Definition Team	**2013**	**Agency advisory**								
2014 Organic Contamination Panel	2014	Agency advisory								
Returned Sample Science Board	2015	Agency advisory								
Conference on Biosignature Preservation and Detection in Mars Analog Envi	2016	Conference								
International MSR Objectives and Science Team (iMOST)	**2018**	**Agency advisory**								
iMARS Phase 2	**2018**	**IMEWG advisory**								
2nd International Mars Sample Return Conference	2018	Conference								
Mars Sample Return Science Planning Group (MSPG)	2019	Agency advisory								
Returned Sample Science Participating Scientists	2019-ongoing	M2020 team								
MSR Operational Scenarios Definition Team	2021	Agency advisory								
Mars Sample Return Caching Strategy Steering Committee (CSSC)	**2021**	**Agency advisory**								
Mars Sample Return Science Planning Group 2 (MSPG2)	2022	Agency advisory								
MSR Campaign Science Group	2023-ongoing	Agency advisory								
SRP Measurement Definition Team (MDT)	2023-ongoing	Agency advisory	Expected contributions							
Sample Safety Assessment Team	2023-ongoing	Agency advisory	Expected contributions							

The darkness of the blue indicates extent of coverage for that category. Unless noted, all categories refer to the samples, e.g., Sample Management.