National Aeronautics and Space Administration

EXPLORE

MARS SAMPLE RETURN

SCIENCE PLANNING: AN UPDATE

Lindsay Hays
MSR Lead Scientist (Acting)
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On Behalf of: Gerhard Kminek, Brandi Carrier, Dave Beaty, Elliott Sefton-Nash, Fiona Thiessen, Tim Haltigin and Bonnie Teece

First Sample Return From Another Planet

Vision and Voyages (2011): "It is widely accepted within the Mars science community that the highest science return on investment for understanding Mars as a planetary system will result from analysis of samples carefully selected from sites that have the highest scientific potential and that are returned to Earth for intensive study using advanced analytical techniques."
For human exploration: "[MSR] will provide crucial data for landing significant mass, executing surface ascent and return to Earth, and identifying potential hazards and resources."

Origins, Worlds, and Life (2022) : "The committee reaffirms the broad and fundamental scientific importance of Mars Sample Return recognized in Vision and Voyages, the 2018 Decadal Midterm Review, and the 2020 IRB Report. MSR will enable investigations to address many fundamental issues, including crucial elements of Q3 through Q6, Q10, and Q11. … As such, the committee finds that the aspirational, groundbreaking MSR campaign plays an appropriately central role in the research strategy for planetary science and astrobiology in the next decade."

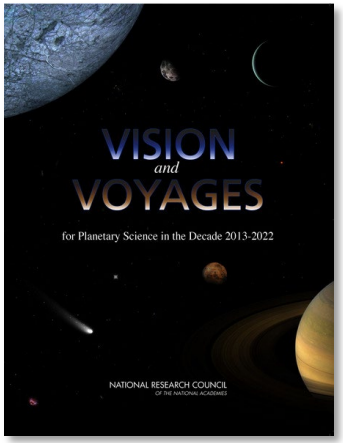
MSR: A Long-Held Community Priority

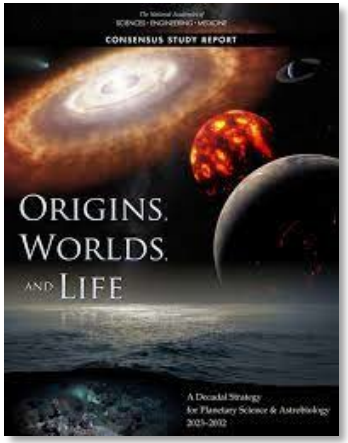
Vision and Voyages for Planetary Science in the Decade (2013–2022)

- *The highest-priority flagship mission for the decade 2013–2022 is MAX-C [Perseverance], which will begin the NASA-ESA Mars Sample Return Campaign*

Origins, Worlds, and Life (Decadal Strategy for Planetary Science and Astrobiology, 2023–2032)

- *The **highest scientific priority** of NASA's robotic exploration efforts this decade should be completion of Mars Sample Return as soon as is practicably possible with **no increase or decrease in its current scope**.*





MSR remains a top priority, recommended in successive decadal surveys despite being one of the largest, most complex NASA missions ever

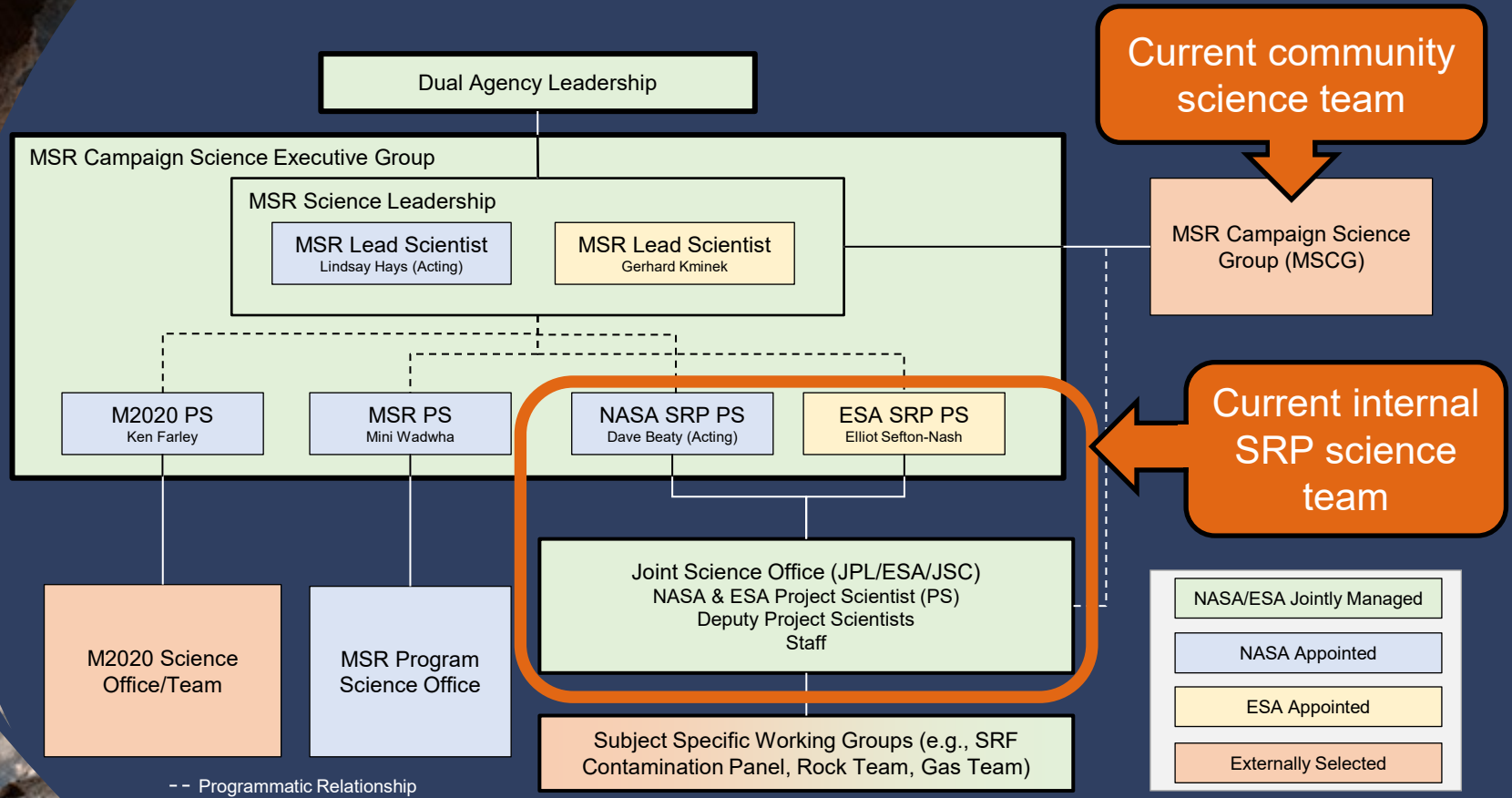
Origins	1. Evolution of the protoplanetary disk
	2. Accretion in the outer solar system
	3. Origin of Earth and inner solar system bodies
Worlds and Processes	4. Impacts and dynamics
	5. Solid body interiors and surfaces
	6. Solid body atmospheres, exospheres, magnetospheres, and climate evolution
	7. Giant planet structure and evolution
	8. Circumplanetary systems
Life and Habitability	9. Insights from terrestrial life
	10. Dynamic habitability
	11. Search for life elsewhere
Crosscutting	12. Exoplanets

MSR answers questions across all science themes of the OWL decadal survey.

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							

MSR Campaign Science Organization



MSR Campaign Science Group Overview

- Competitively selected group of community experts that can be drawn upon by the MSR Campaign for scientific assessment, input, and recommendations
- Represents the scientific interests of the broad international science community who are stakeholders in the scientific planning for MSR, until such time as investigation PIs & MSR Sample Science Team (MSST) are selected
- Not empowered with decisional authority on agency matters; they provide the highest-level expert assessment available
- MCSG Reports to the MSR Campaign Lead Scientists, while the Joint Science Office (JSO) coordinates and supports MCSG activities

MSR Campaign Science Group (MCSG)

- MSR Campaign Science Group Face to Face Meeting was held on Feb 27-29 at ESTEC.
- Main topics included:
  - Review of MDT and SSAP findings
  - Review of SRF Contamination Panel final report
  - MSR Science communication strategy
  - Discussion on analogue samples

Selected Analogue Sites – Field Campaign 2023

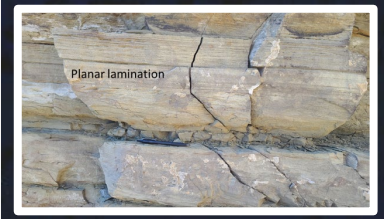
Lambahraun, Iceland

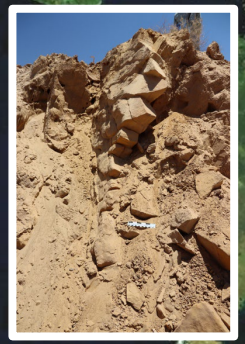
Isle of Rum, SCO

Hart Mountain, OR

Ridge Basin, CA

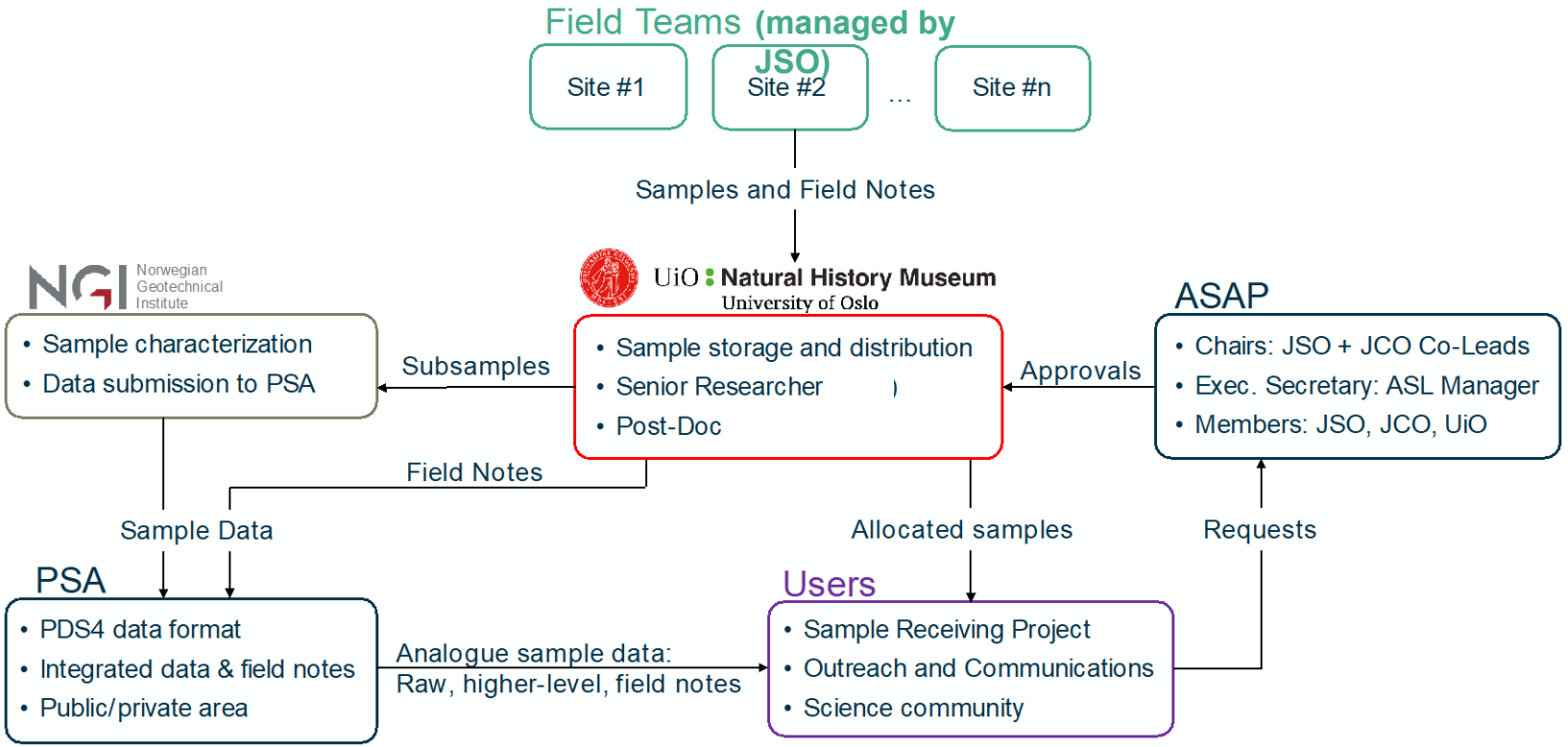
Salton Sea, CA





*poster in the ***Mars Sample Return Campaign*** session TONIGHT Tuesday 3/12

Mars Sample Return Analogue Sample Library



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Sample Safety Assessment Protocol Tiger Team (SSAP)
Measurement Definition Team (MDT)

Scope of MDT-1

Task 1: Overarching Investigation Strategy

Determine options and priorities for activities inside and outside the SRF, providing a narrative rationale for the scientific basis underpinning the proposed investigations.

Task 2: Measurement Traceability Matrices

Develop traceability matrices flowing from objectives to investigations to measurements and required capabilities within the SRF.

Task 3: Reference Instrument Set

Provide description of proposed suite of instruments capable of collecting the needed measurements as well as interface requirements and any special accommodation considerations.

Task 4: Concept of Operations (ConOps)

Describe a feasible model concept of operations of activities to be conducted within the SRF that will maximize overall science return.

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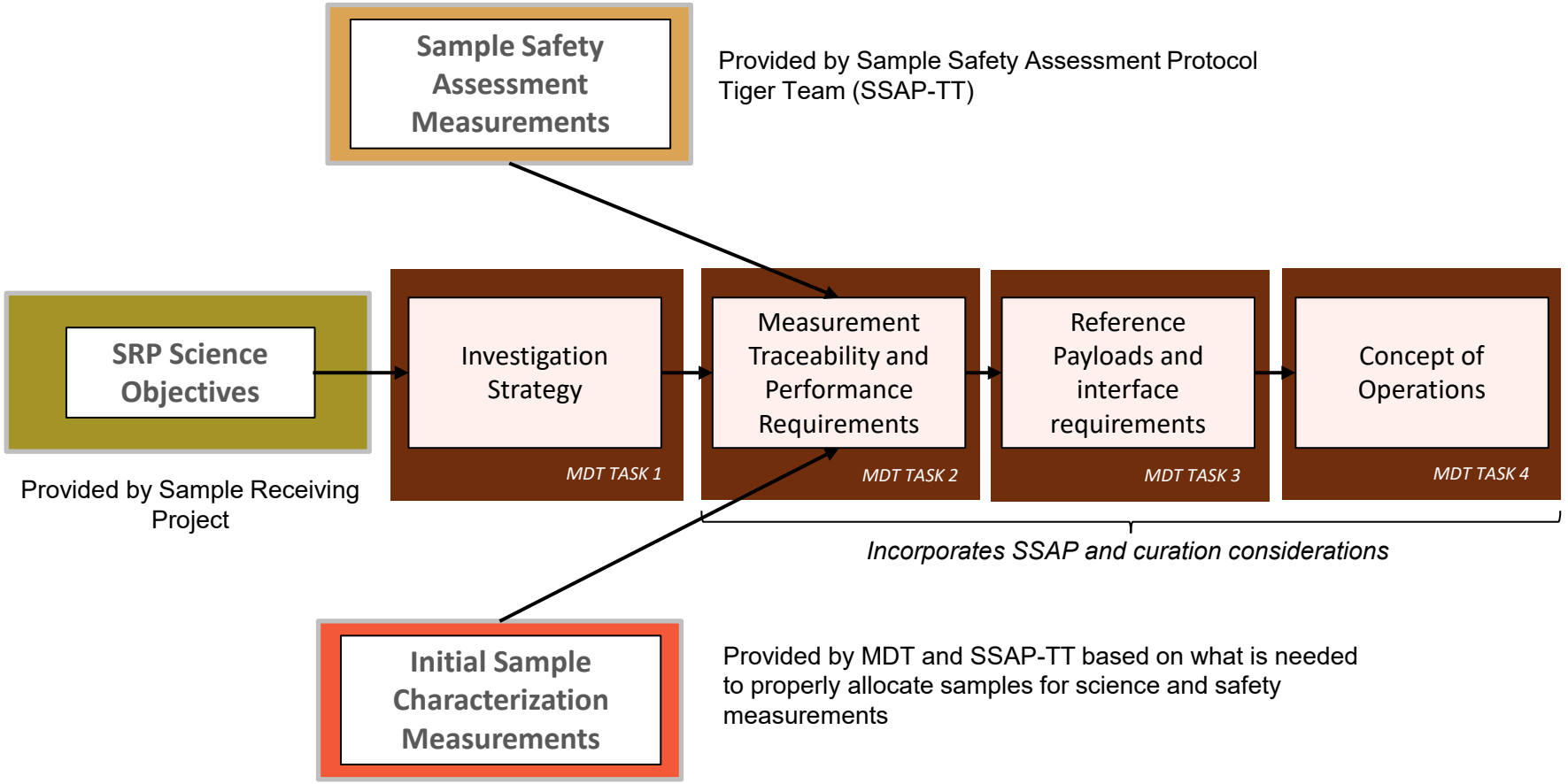
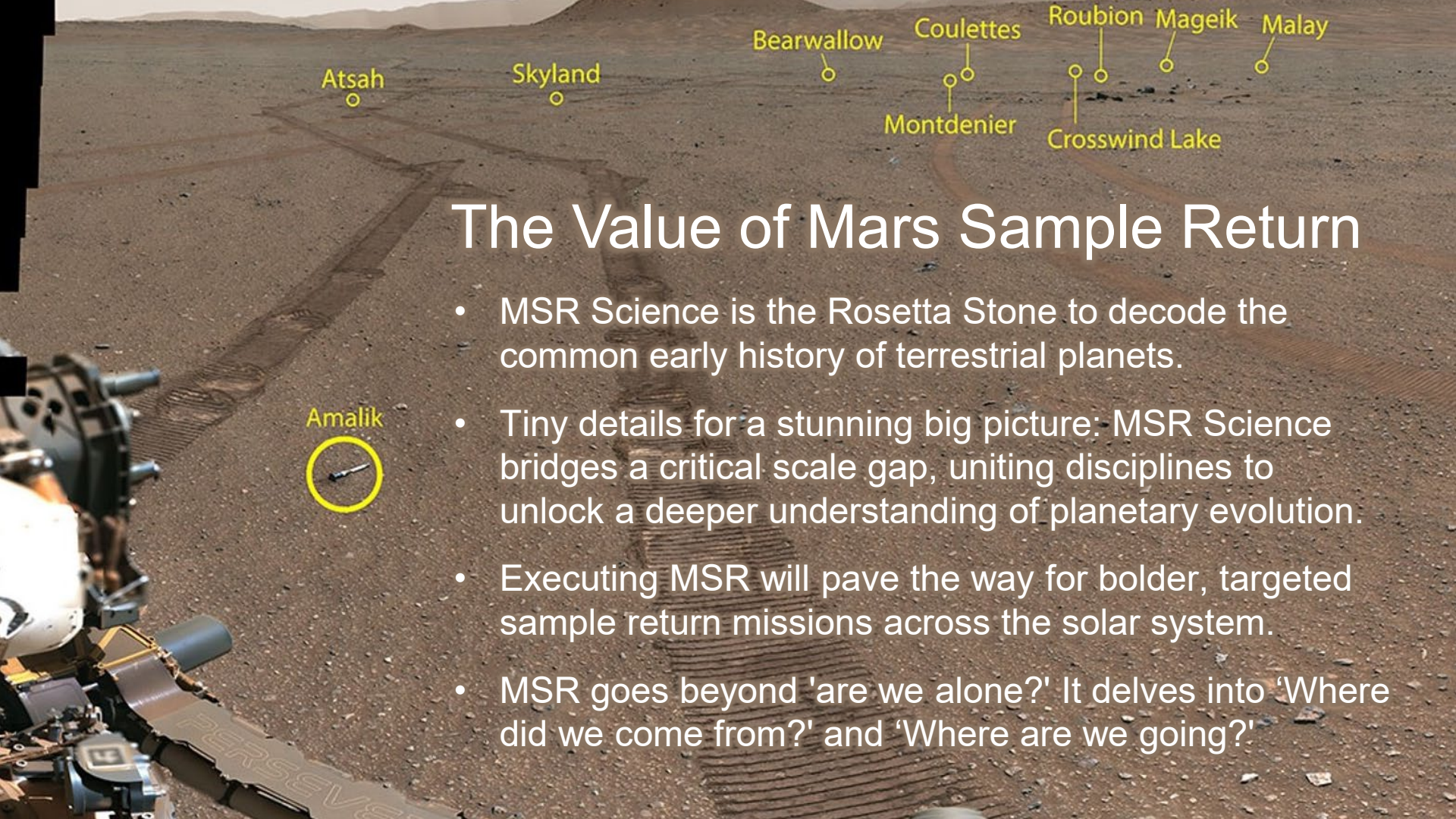
Defining Activities Needed in the Sample Receiving Facility



SRF Contamination Panel

- Task: Define a proposed set of total terrestrial **biological, organic and inorganic contamination limits** for the samples' processing flow in the SRF, up to the point of allocation for analyses.

- Define separate contamination limits for subsamples that are targeted for:
  - Organic or biological analyses
  - Inorganic analyses
  - Samples or subsamples that may eventually be used for any type of analysis (e.g., samples or subsamples whose eventual usage hasn't yet been defined)



The Value of Mars Sample Return

- MSR Science is the Rosetta Stone to decode the common early history of terrestrial planets.
- Tiny details for a stunning big picture: MSR Science bridges a critical scale gap, uniting disciplines to unlock a deeper understanding of planetary evolution.
- Executing MSR will pave the way for bolder, targeted sample return missions across the solar system.
- MSR goes beyond 'are we alone?' It delves into ‘Where did we come from?' and ‘Where are we going?'