

National Aeronautics and
Space Administration



EXPLORE SCIENCE

Lunar Updates

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Planetary Advisory Committee
June 23, 2022



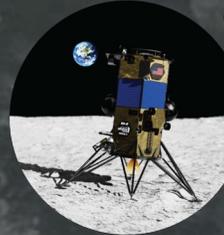
ESSIO Org. Chart



CLPS Deliveries

2022-2026

Delivery Site:
Gruithuisen Domes
Provider TBD
CP-21 | 2026



Delivery Site: Mare Crisium
Provider: Intuitive Machines (IM)
Task Order (TO)2-IM | Q4 2022

Delivery Site:
Lacus Mortis
Provider: Astrobotic
TO2-AB | Q4 2022



Delivery Site:
Lunar Far Side
Provider TBD
CS-3 | 2025

Delivery Site:
Reiner Gamma
Provider: IM
CP-11 | 2024



Delivery Site:
Mare Crisium
Provider: Firefly
TO19D | Q3 2024



Delivery Site:
Shackleton
Connecting Ridge
Provider: IM
TO PRIME-1 | 2023



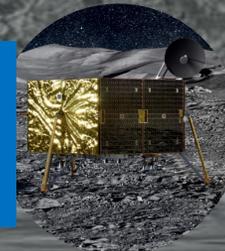
Delivery Site:
Nobile Crater
Provider: Astrobotic
VIPER | Nov 2023



Delivery Site:
Schrödinger Basin
Provider TBD
CP-12 | 2025

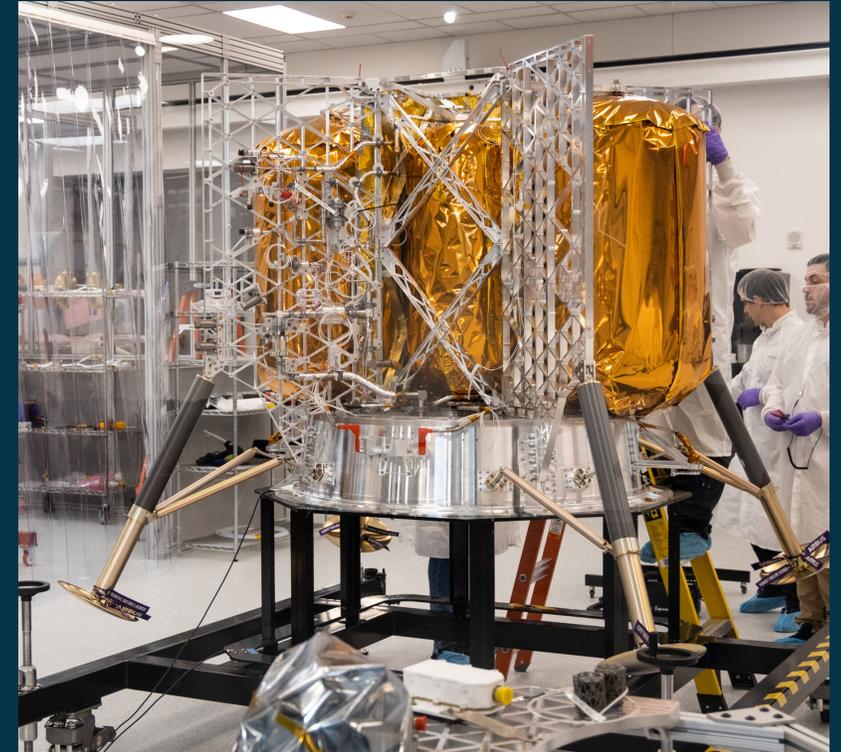
Delivery Site:
South Polar Region
Provider TBD
CP-22 | 2026

Delivery Site:
Haworth Crater
Provider: Masten
TO19C | Nov 2023



CLPS updates

- The first two CLPS landers are now targeting the end of 2022 for launch
 - Astrobotic recently unveiled the flight unit of their Peregrine lander
 - TO2-AB NASA payloads are integrated
 - TO2-IM NASA payloads will be integrated later this summer
- CLPS now has seven deliveries in progress! SEVEN!
 - Each has a Project Scientist to help coordinate the science payloads and data delivery
- PRISM-1 payloads making good progress
 - FSS held their CDR May 12-13
 - LVX held its PDR May 5-6
- PRISM-2 selections announced in early June
- PRISM-3 Community announcement/draft solicitation is expected to be released later this summer



Payloads and Research Investigations on the Surface of the Moon (PRISM) 2 Selections

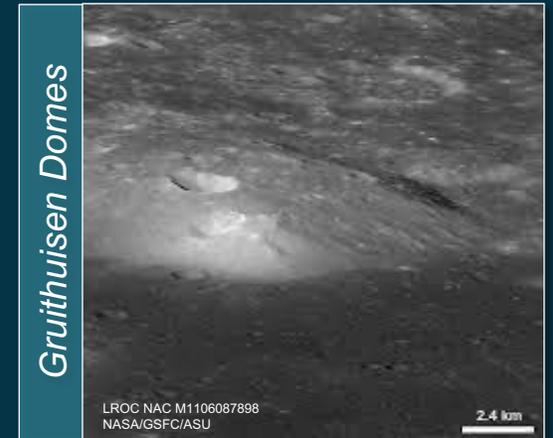
- Task Order CP-21: **The Lunar Vulkan Imaging and Spectroscopy Explorer (Lunar-VISE)** will land at the Gruithuisen Domes, a location of rare silicic volcanism on the lunar near side, in 2026.
 - PI: Kerri Donaldson Hanna, UCF
 - Lunar-VISE will consist of 3 instruments on a mobile rover to be provided by the CLPS provider, and 2 instruments on a stationary lander.

Science Goals:

- 1) Map local variations in composition and correlate to regolith properties, surface features, and dome morphology.
- 2) Improve orbital measurements of composition and thermophysical properties by tying to ground truth.

Exploration Objective:

- 1) Characterize spatial variations in lunar regolith properties at the Gruithuisen Domes.



Decadal science: Understand how the interior of solid bodies evolve and how this is recorded in the body's physical and chemical properties by investigating the origin and composition of the domes.

Payloads and Research Investigations on the Surface of the Moon (PRISM) 2 Selections

- Task Order CP-22: **The Lunar Explorer Instrument for space biology Applications (LEIA)** will land in a south polar region in 2026 and will study the biological response of the yeast *S. cerevisiae* to the lunar environment.
 - PI: Mark Settles, NASA Ames
 - LEIA will consist of 3 instruments on a stationary lander.



Science Goals:

- 1) Combine yeast genetics with metabolic modeling to determine cellular sensitivity to the lunar environment.
- 2) Evaluate synthetic biology-enabled production of antioxidant nutrients and proteins under lunar surface conditions.
- 3) Evaluate genetically engineered yeast for enhanced tolerance to the lunar environment.
- 4) Determine the lunar radiation dose and composition corresponding to the biological responses measured in Aims 1-3.

Decadal science: LEIA will study the biological response of yeast to the lunar environment to determine how partial gravity and deep space radiation influence biological processes.

Future Artemis Calls

- Deployed Instruments for Artemis III and V
 - F.12 in ROSES22
- Artemis III Geology Team
 - C.25 in ROSES22
 - Based on priorities in the SDT report
 - Call for a small “core” team (~10 people)
 - Anticipate a participating scientist program, ~1 yr before launch
- Instruments for the Lunar Terrain Vehicle
 - F.13 in ROSES22

Artemis Science Team Structure

It's been 50 years since we've had humans doing science on the surface of another planetary body!

Artemis and Apollo goals and implementation are different

- Building on Apollo and Constellation planning

- Lunar science community is different

- NASA is different: we have a large cadre of talented lunar scientists among our Civil Servants

- Our approach is different: commercial/international

The overall Artemis Science Team will be composed of a mixture of assigned internal NASA scientists and competed roles

While this is a “work in progress”, we strive to be as open and transparent with the community as possible.

Artemis III Science Team

Artemis Science Lead (Sarah)
Exploration Rep (Jake)

Internal Artemis Science Team

- NASA scientists already working with Artemis
- Currently Human Exploration funded/Transitioning to SMD funding
- Conflicted from competition

Competitively selected Geology Team

- ~10-member team, including PI
 - C.25 in ROSES22 (placeholder released)
- ~10 Participating scientist roles
 - call timing TBD

Competitively selected Payload Teams

- Artemis III/V payloads
 - F.12 in ROSES22 (placeholder released)
- Lunar Terrain Vehicle (LTV) payloads
 - F.13 in ROSES22 (placeholder released)

Role of Internal vs. Competed Teams

Internal Team

Make sure the architecture/systems can support science

- Embedded on boards and working groups across the agency, reviewing documents
- Rapid response to requests and queries from across the agency

Interface between NASA and competed teams to maximize science return

- Lead classroom, field, and ops training for crew
- Lead operational training for competed teams

Program Level Strategic Planning
Mission-to-Mission continuity

Competed Geology Team

Focused on Artemis III sortie

Develop mission science objectives for that sortie

- Field science goals
- Traverse planning
- Sampling strategy

Support training as needed

Real-time operations support

Preliminary Examination of Samples

Post Mission Geology Report

Artemis Internal Science Team

Artemis Science Lead (Sarah)
Exploration Rep (Jake)

Internal Artemis Science Team:

Training
and Ops

- Training and Strategic Integration Lead - **Cindy Evans**
- Science Flight Operations Lead - **Kelsey Young**
- EVA Hardware and Testing Integration Lead - **Trevor Graff**

Samples

- Sample Integrity Lead - **Barbara Cohen**
- Contamination Control Scientist (TBD)
- Artemis Curation Lead - **Ryan Zeigler, Acting**

Planning
and Data

- Mission Planning and Science Implementation Lead - **Sam Lawrence**
- Spatial Planning and Data Lead - **Noah Petro**
- Software Systems Lead - **Matthew Miller**

Payloads

- SMD Payload Integration Officer - **Renee Weber**



Plans Forward for LDEP Web Presence

It is recognized that a dedicated web presence for the Lunar Discovery and Exploration Program (LDEP) is needed as the return to the Moon with both robotic assets and crew is beginning.

LDEP intends to host a website that will include the following topics and resources for the broad science community

1. Overview of LDEP including core areas covered by the program as well as guiding principles and strategies governing LDEP activities and investments
2. A list of programs, projects, and overall portfolio
3. Description of major flight projects, including CLPS deliveries, selected instruments, and international collaborations
4. Artemis science overview
5. Portal to all datasets resulting from CLPS and broader Artemis science investigations managed by LDEP
6. Short-term information on current and long-term plan for future solicitations resulting in awards for lunar science investigations

The LDEP website will be released in stages:

Stage 1: Focused on near-term missions/CLPS deliveries, instrument definitions, and setting up a science data distribution protocol (links to external databases where LDEP-managed data is stored) – expect this Fall!

Stage 2: Inclusion of LDEP guiding principles and long-term lunar science strategies, information on solicitation planning, and Artemis science plan forward.

Analog Activities to Support Artemis Lunar Operations

- 10 Team members selected last month
- Most will participate in JETT-3 Artemis III-focused activity, some will also participate in D-RATS pressurized rover-focused activity
- Using results of AOA SAT to prioritize objectives
 - Understanding backroom structure/communications/software
 - Science con-ops
 - Lighting conditions
- Will be a call for next year as well, open to US-persons, including “senior” graduate students



ANGSA

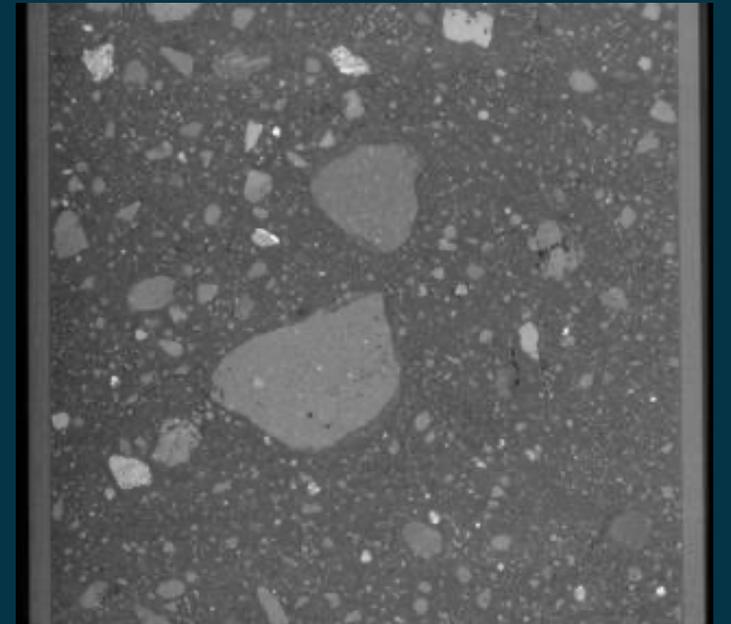
73001 Lower (sealed) Drive tube opened!

- Core Sample Vacuum Container (CSV) pierced on Feb 23rd
 - Fully extracted and captured the gas from Apollo 17 sample 73001
- Core extruded and processing well under way

The Apollo 17 ANGSA Workshop is scheduled for October 26–28, 2022, at the Lunar and Planetary Institute

ANGSA 2.0 draft call to be released soon!

- Will focus on different samples than first ANGSA call, high-value samples that are nearing their pristinty limit
- Samples that would benefit from a consortium approach



SSERVI Updates

- Senior Review complete
 - Report and NASA's responses are both posted
 - <https://www.lpi.usra.edu/NASA-academies-resources/>
- CAN4 draft released
 - Townhall held in April
 - Comment period has now closed; we're working on incorporating comments and getting the final version out as soon as we can

Lunar Surface Science Workshop Schedule

Previous sessions:

- Overview and Background (May 2020)
- Tools and Instruments (May 2020)
- Volatiles (July 2020)
- Samples (July 2020)
- Dust and Regolith (August 2020)
- Planetary Protection (September 2020)
- The Value of Mobility (October 2020)
- Foundational Data Products (November 2020)
- Space Biology (January 2021)
- Structuring Real-Time Science Support of Artemis Crewed Operations (February 2021)
- Progress and Challenges: Updates from NASA HQ and Artemis (April 2021)

- Physical Sciences (August 2021)
- Science with Robotic Arms (Sept/Nov 2021)
- Future CLPS landing sites (December 2021)
- Inclusive Lunar Science (January 2022)
- Heliophysics (February 2022)
- Updates from HQ/Artemis (May 2022)
- Assessing the Value of Modern Field Geology Tools for Artemis (June 2022)

Upcoming Sessions:

- **ISRU – June 27 and August TBD**

Reports and Archive of Talks:

<https://lunarscience.arc.nasa.gov/lssw>



Questions

