Helios-Lune Tranquillitas:

Artemis III Exploration Mission & Retrieval of Solar Activity Records

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01. Introduction

Helios Lune Tranquillitas (HLT) is a commercial-government partnership Artemis III lunar exploration mission to the Mare Tranquillitatis pit crater.

02. Solar Activity Record (SolAR) Data

- The lunar surface has been exposed to the space environment for billions of years and solar activity records have accumulated over this timeframe
- The HLT mission allows the Artemis III crew to obtain samples of paleoregolith, which could provide an undisturbed solar record that greatly surpasses the record we can obtain on Earth

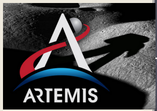


Figure 1: Artemis (NASA)

The mission aligns with the **Artemis program's objectives** through:

- Revealing ancient SolAR data
- Lava studies that provide insight into past lunar planetary processes

> *SolARs imprinted on the long dormant Moon can provide critical data about solar behavior over geological time that is vital to building a reliable Climate Change model for Earth.*

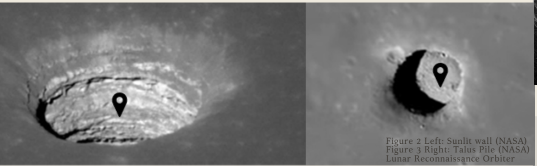


Figure 2 Left: Sunlit wall (NASA)
Figure 3 Right: Talus Pile (NASA)
Lunar Reconnaissance Orbiter

03. Mission Objectives

1. Observation and scientific exploration of the lunar pit crater
2. To obtain samples for Earth return and analysis*

*
- Samples are obtained from the talus pile and sunlit wall.
- The mission location and sampling strategy allows for solar activity record (SolAR) data to be analyzed from the sample layers upon return to Earth.

RATIONALE

NASA Exploration Needs, Goals & Objectives:

- *Advance US scientific, security and economic interests throughout robust programs of (a) science, (b) aeronautics and (c) space exploration*

US Space Policy Goals:

- *Robust, innovative and commercial space sector*

Timeline

Day 01	Day 02	Day 03	Day 04	Sample return to Earth
1. Lunar Lander Touchdown 2. Pressurized Rover Deployment	1. Travel to pit edge 2. Axel set-up and tethering anchors	1. Axel descent, scientific observation and ascent	1. Equipment pack-up 2. Crew Exploration 3. Return to Lunar Lander	

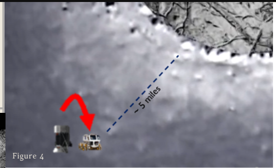
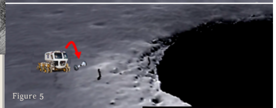


Figure 4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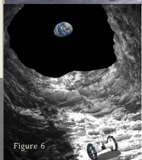
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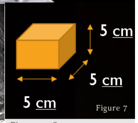


Figure 7

Figure 4: Stage 2
Figure 5 Stage 3
Figure 6: Axel Rover
Figure 7: Sampling size

04. Mission Stages

Stage 1: Lunar Lander Touchdown
- Touchdown location safe distance from pit and accessible within a day

Stage 2: Pressurized Rover Deployment
- Once deployed, the pressurized rover is driven by the crew from the landing site to rim of the pit crater
- The rover is a mobile habitat

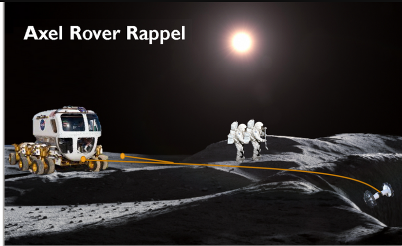
Stage 3: Axel Rover Deployment
- Mission specific version of the JPL Moon Diver Axel Rover concept
- Samples gathered automatically by rappelling into the pit crater
- Axel is controlled by the crew using real-time telerobotic systems

Stage 4: Axel Rover Rappel
- Axel has two tether anchor points for redundancy (TBD)
- Slow descent to clear debris
- Wide and narrow lens camera imaging with crew obtaining imaging live feed

Stage 5: Talus Pile Sampling
- Confirmation of touchdown to crew and two samples acquired

Stage 6: Scientific Observation
- Scientific Payloads utilized (see Section 05 below)

Stage 7: Axel Ascent
- Follow path cleared by debris on descent
- Obtain wall samples by drilling
- Wall sample intervals of ~5m (TBD) from multiple lava layers



05. Onboard Scientific Payload

- **Spectrometer**

In-situ spectral analysis of samples. Amount and type of chemical elements in top layer of obtained samples

- **Light-weight ground penetrating radar (GPR)**

To visualize any underground structures and formations

- **3D laser scanning capabilities (OPAL)**

Lava tube scanning capabilities to provide preliminary data on lava tubes as a sustained lunar human habitat

Figure 8: Lava Tube
Figure 9 GPR
Figure 10: Spectrometer
Figure 11: LiDAR, OPAL (ESA)

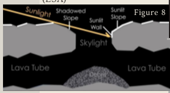
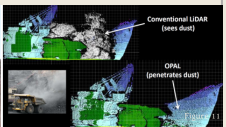


Figure 8


Figure 9

Figure 10



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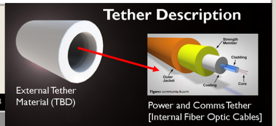

06. Commercial Human Spaceflight Exploration (CHASE)

- Mission stage development open to worldwide space agencies and commerce
- International scientific collaboration and cooperation
- Research proposals for sample analysis
- Data analysis to be globally available

07. Future Research

- Sample retrieval without disrupting layers
- Maximum yield SolAR retrieval method
- Avalanche risk
- Moon gravity rappel
- Below lava layer drilling equipment
- Additional sampling locations
- Lava tube exploration for human habitability (LAVA-T)

08. References

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09. Acknowledgements and Contacts

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HLT was created in USC's Graduate Space Concept Studio (ASTE 527)
Scan the QR code for more information and project slides [Fall 2021, CHASE #14]