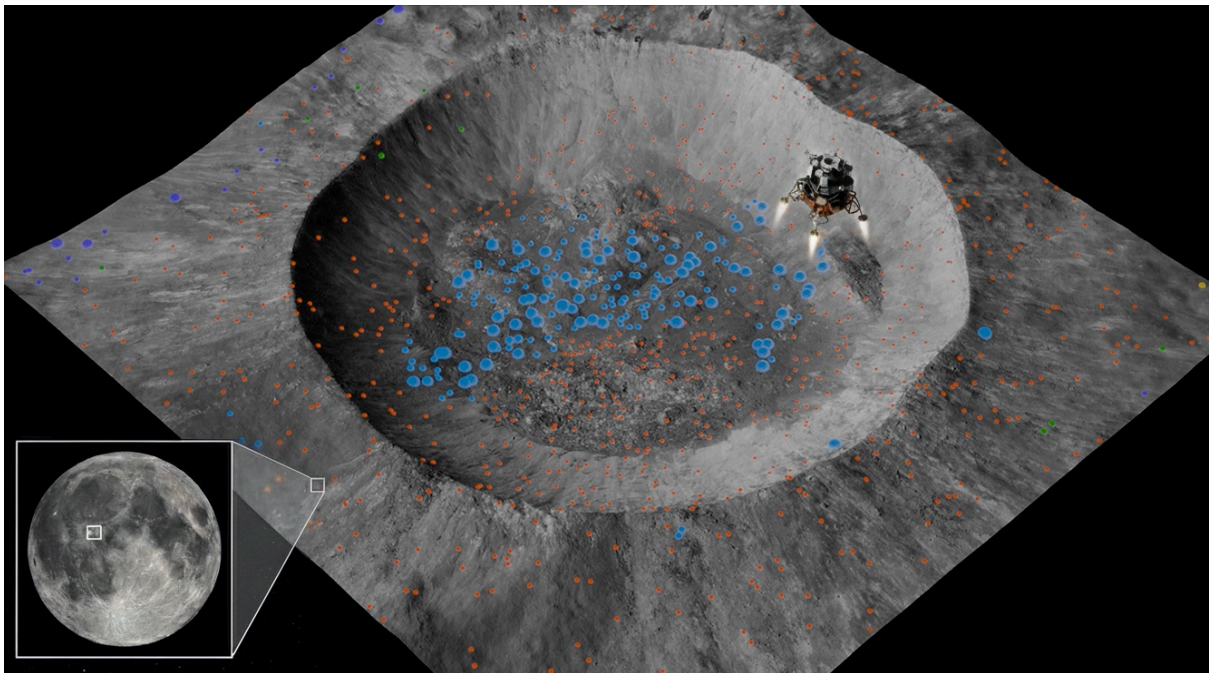**FINAL**

FOR IMMEDIATE RELEASE

Date: Wednesday 14 January 2026

Talking to the Moon: The World's First Multimodal Foundation Model for Lunar Exploration and Resources.

Credit: FDL Lunarlab / Trillium Technologies

Final press release - for immediate release, Wednesday 14 January 2026

LUXEMBOURG & LONDON – The Frontier Development Lab (FDL.ai) LunarLab, a partnership between the Luxembourg Space Agency (LSA), the European Space Resources Innovation Centre (ESRIC), and Trillium Technologies, today announced **Lunar-FM**, the first AI foundation model dedicated to lunar exploration and resource prospecting.

Developed with compute and technical support from Google Cloud, NVIDIA, SCAN Computers International Ltd, and Datarock, Lunar-FM represents a novel application of self-supervised Artificial Intelligence designed to address the data fragmentation and heterogeneity inherent in current lunar remote sensing.6

Addressing Data Heterogeneity in Lunar Science

Scientific data regarding the Moon is currently siloed across disparate archives and instrument types, ranging from optical imagery and thermal radiometry to gravity anomalies.

Lunar-FM integrates **18 distinct data layers** from multiple orbital missions, including NASA's Lunar Reconnaissance Orbiter (LRO), GRAIL, and Clementine, into a unified, multimodal architecture.
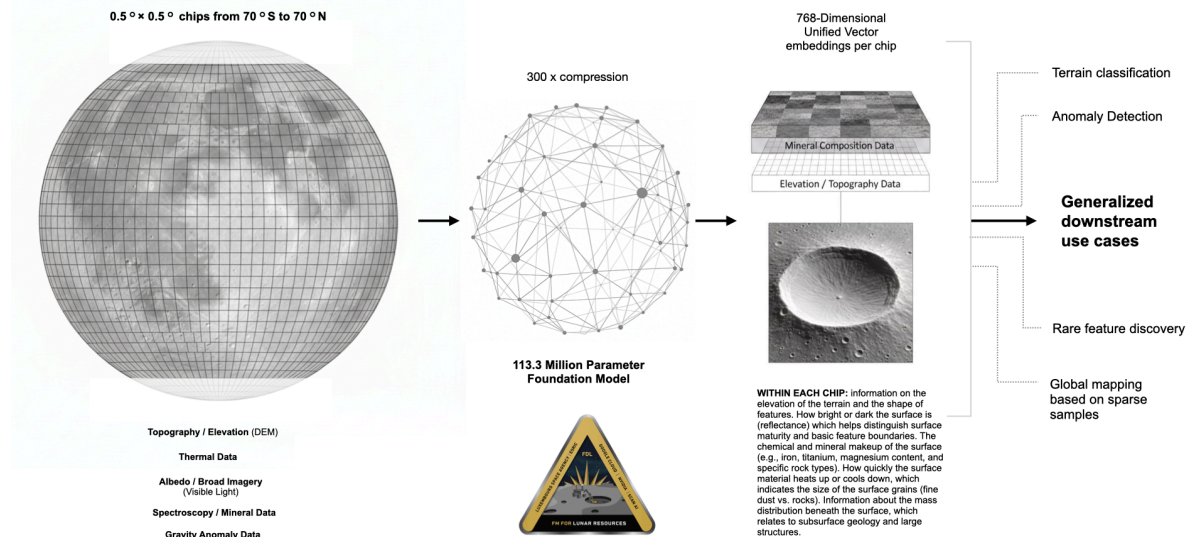
The model ingest includes optical imagery, topography (LOLA), thermal emissions (Diviner), radar reflectivity (Mini-RF), and gravity anomalies (GRAIL). Utilizing Transformers, the same AI method behind products such as ChatGPT, Lunar-FM creates a unified, 768-dimensional product that captures lunar properties up to 70 degrees north and south of the equator.

Key Technical Findings and Capabilities

Lunar-FM comes with several validated capabilities relevant to planetary science and in-situ resource utilization (ISRU):

- **Few-Shot Learning of Lunar Resources:** Validation tests demonstrated the model's ability to generate high-fidelity global predictive maps of valuable resources from extremely scarce ground-truth data. In a case study scoping Titanium Dioxide (TiO_2) abundance on the lunar surface, the model produced a global map correlating only eight expert-labeled samples from the Apollo landings.
- **Data Compression for use on PCs:** Lunar-FM achieves a 300x compression of the input data, condensing multi-modal instrument mosaics into a set of embeddings that allows complex scientific investigations to be run on standard computing infrastructure.
- **Filling Sensor Gaps and Similarity Search:** Lunar-FM reconstructs missing data by learning correlations across modalities (e.g., predicting thermal properties based on topography and optical data), addressing gaps in sensor coverage. Users can easily identify other features of interest using similarity search.
- **Geologic Boundary Classification:** Embeddings were validated against the USGS Unified Geologic Map of the Moon, demonstrating that the latent space encodes compositional and textural information aligning with human-defined geologic boundaries.

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Anatomy of Lunar-FM

The Lunar Agentic Analyst - talking to the Moon.

To facilitate operational science, Lunar-FM comes with a **Lunar Agentic Analyst** which provides a natural language interface to the lunar data. This system utilizes a Large Language Model (LLM) as an interpreter to bridge natural language queries with the Lunar-FM embeddings, allowing researchers, mission planners and rovers to 'talk to the Moon' for the first time.

This "agentic" interface allows researchers to perform complex data science tasks, such as similarity searches or resource regression via conversational prompts (e.g., "Identify regions geologically similar to the Apollo 11 landing site"). The system routes these queries to the appropriate analytical tools within the foundation model, streamlining the workflow for geologists and mission planners.

Commentary

Dr. Abigail Calzada Diaz, a lunar geologist at ESRIC, stated: *"The primary issue is the fragmented, multi-source nature of lunar data which until now has made lunar investigations labor-intensive. Lunar-FM provides a standardized, unified data infrastructure enabling knowledge extraction and synthesis from disparate datasets."*

She added *"Lunar-FM is a translational bridge between pure scientific understanding of lunar processes and the operational requirements of missions,"* capable of converting theoretical knowledge into resource-focused targets.

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Availability

FDL Lunarlab is committed to open science principles. The Lunar-FM pre-trained embeddings, model weights, and the code for downstream tasks will be made publicly available to the research community after peer evaluation is complete. The final public release will be at [Luxembourg Space Resources Week](#) on the 4th-7th of May 2026.

The Lunar-FM [Technical Briefing](#) is available from Lunarlab.ai. Additional information can be found as part of the Lunarlab 2025 results and findings [document](#) (which includes a technical memorandum).

Researchers interested in being part of the Science Evaluation can request early access on [Lunarlab.ai](#)

About

FDL Lunarlab
FDL Lunarlab is a research partnership between the Luxembourg Space Agency (LSA), the European Space Resources Innovation Centre (ESRIC) and Trillium Technologies, focused on applying advanced AI to challenges in lunar exploration and resource utilization.

LSA
Established in 2018 by the Ministry of Economy with the goal of developing the national space sector, the Luxembourg Space Agency fosters new and existing companies, develops human resources, facilitates access to funding and provides support for academic research. The agency implements the national space economic development strategy, manages national space research and development programs, and leads the SpaceResources.lu initiative. The LSA also represents Luxembourg within the European Space Agency, as well as the space related programs of the European Union and the United Nations.

ESRIC
Based in Luxembourg, the European Space Resources Innovation Centre (ESRIC) is the world's first innovation centre entirely dedicated to space resources. Launched in 2020 as an initiative of the Luxembourg Space Agency (LSA) and the Luxembourg Institute of Science and Technology (LIST), with the European Space Agency (ESA) as a strategic partner, ESRIC works to establish a sustained in-space economy by connecting research excellence with commercial initiative.

Trillium
Trillium Technologies is an award winning AI research and development group with a focus on intelligent systems for public benefit, planetary stewardship, space exploration and human health. As an impact-led social enterprise with a dedicated team of project leads, ML and data engineers and designers, Trillium develops technology platforms that tackle grand challenges.

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