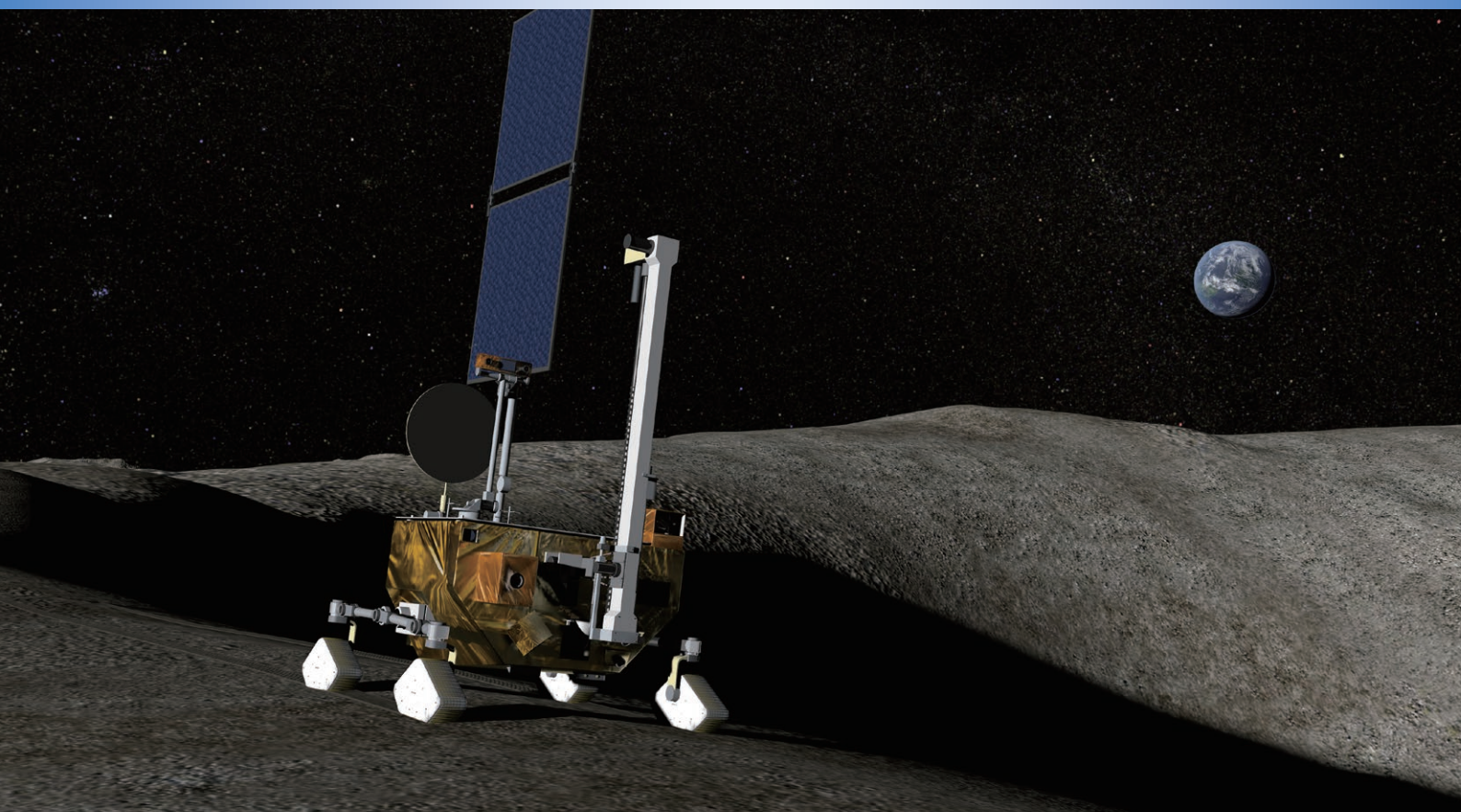




LUPEX

Lunar Polar Exploration



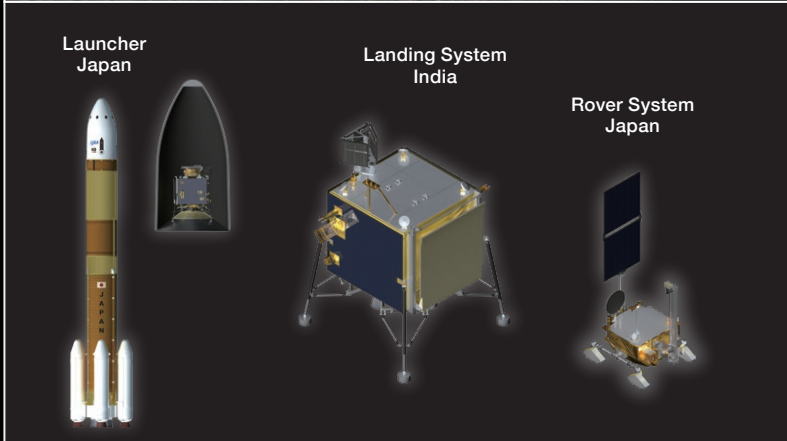
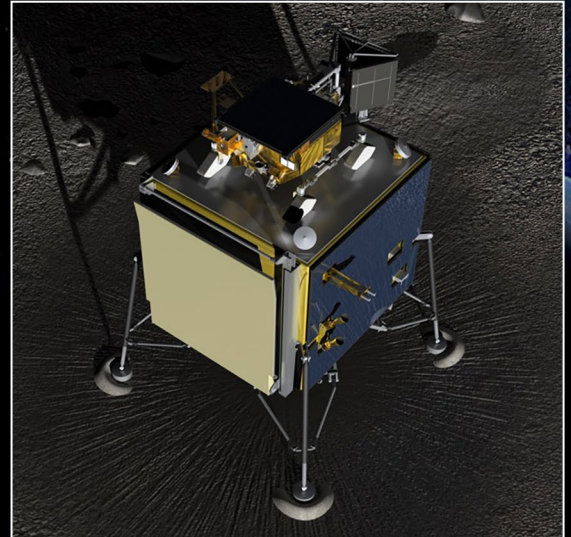
Japan Aerospace Exploration Agency •

Lunar Polar Exploration (LUPEX)

LUPEX is a joint mission with the Indian Space Research Organisation (ISRO) to explore water resources in the lunar south polar region. Through this mission, JAXA aims to acquire surface exploration technology on gravitational bodies.

The analysis of lunar observation data to date suggests that water resources may exist in the lunar polar regions. LUPEX's objective is to collect data on the quantity and quality of water resources, and to understand water concentration mechanism to determine the extent to which lunar water resources can be used for future sustainable space exploration activities.

Furthermore, JAXA aims to demonstrate technologies related to surface exploration of gravitational bodies, such as "surface mobility" "night survivability" and "excavation," which are necessary for future lunar exploration activities. These technologies will be utilized in the development of the "Crewed Pressurized Rover".



Launch Target	2025-2026
Launcher	H3
Launch Mass (Lander + Rover)	6MT -
Payload Mass (Rover + Science Instruments)	350 kg -

Upper left: CG Image of LUPEX Rover
Lower left: Japan/India Responsibilities
Upper right: CG Image of Landing

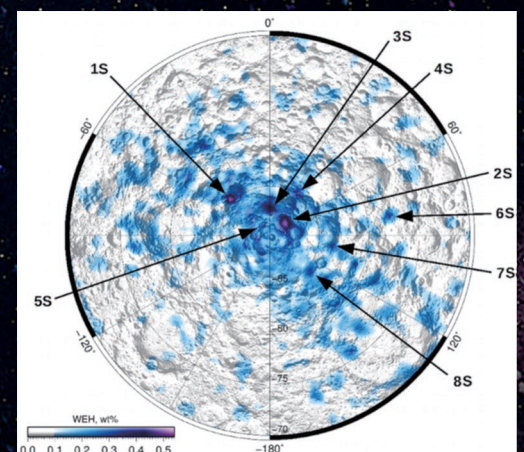
Lunar Water Resources

Water can be electrolyzed to produce rocket fuel (oxygen and hydrogen). If there is enough water, it will be an important resource for future crewed space activities because it will eliminate the need to transport large quantities of fuel from the earth.

For this reason, not only Japan but also space agencies around the world are now planning to investigate water (ice) resources in the polar regions of the Moon.

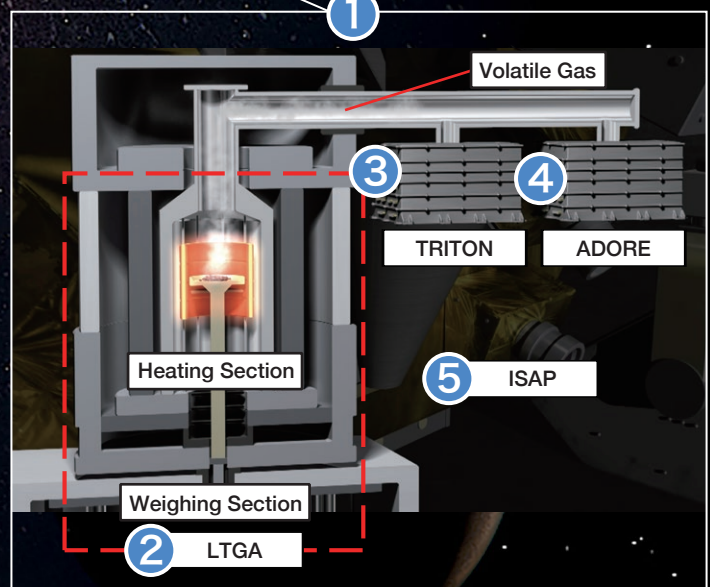
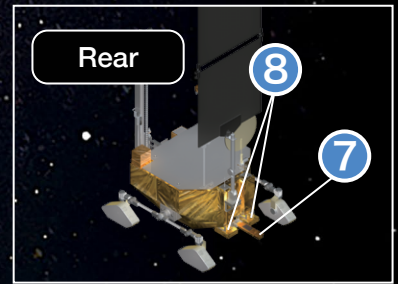
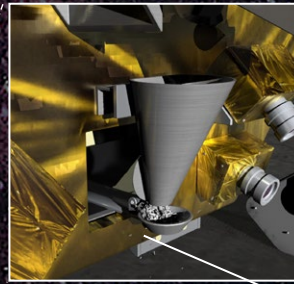
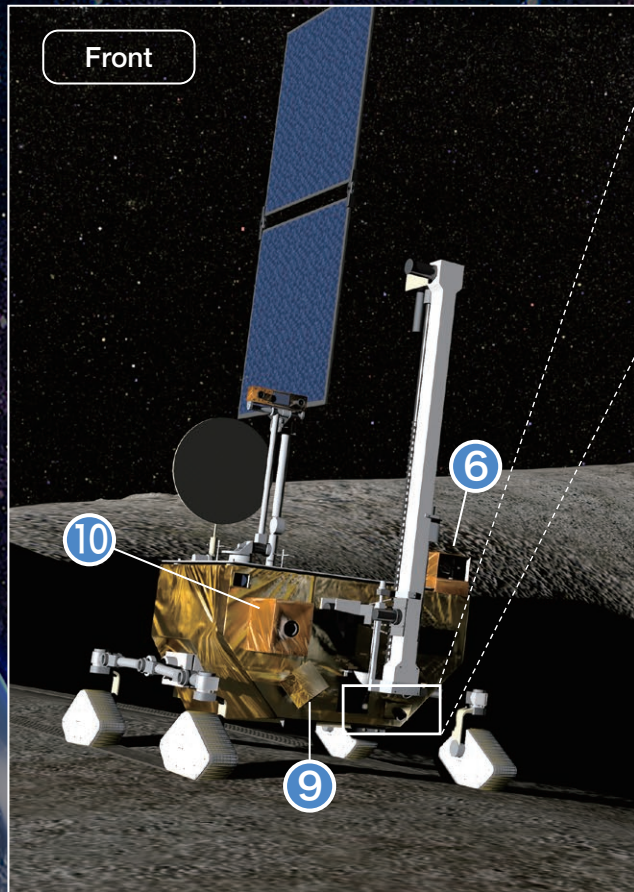
LUPEX will land in an area where past remote sensing observations indicate the high possibility of existence of water (ice). LUPEX rover will directly measure the water content by in-situ observation.

In addition, by observing the distribution and existence of water resources and quantifying its amount, LUPEX will collect the basic data on the potential use of water resources and contribute to the "Artemis Program," an international space exploration program proposed by the United States.



Hydrogen distribution in the lunar south pole
(Sanin et al. 2017)

LUPEX Observation Instruments



- ① Resource Investigating Water Analyzer (REIWA) ② Lunar Thermogravimetric Analyzer (LTGA) ③ Triple-reflection Reflectron (TRITON)
 ④ Aquatic Detector using Optical Resonance (ADORE) ⑤ International Symposium of Antennas and Propagation (ISAP)
 ⑥ Advanced Lunar Imaging Spectrometer (ALIS) ⑦ Neutron Spectrometer (NS) ⑧ Ground Penetrating Radar (GPR)
 ⑨ Exospheric Mass Spectrometer for LUPEX (EMS-L) ⑩ Mid-Infrared Imaging Spectrometer (MIR)

① Resource Investigating Water Analyzer (REIWA)

Receives regolith excavated by the drill. The received sample is heated by ② LTGA. LTGA measures the weight of the regolith sample and the volatile gas generated. ③ TRITON measures the volatile gas composition (H_2O , H_2S , NH_3 , etc.) and volume ratio. ④ ADORE measures the amount of water in the volatile gas. ⑤ ISAP independently observes regolith samples and identifies mineral composition.

⑥ Advanced Lunar Imaging Spectrometer (ALIS)

Determines what minerals are present on the lunar surface, whether water is present, and if so, the amount of water present. It captures the intensity of light at wavelengths between 750 and 1650 nm. ALIS can change the field of view by using 2-axis (horizontal and vertical) movable mirrors.

⑦ Neutron Spectrometer (NS)

Determines the average water content of the regolith down to a depth of about 1 m by observing neutrons leaking from the lunar surface by energy. It uses the property that neutrons produced by the interaction between galactic cosmic rays and the nuclei of lunar materials are efficiently slowed down by the presence of water (hydrogen).

⑧ Ground Penetrating Radar (GPR)

Determines the Moon's subterranean state by transmitting a radio wave toward the lunar surface and measuring the reception time and the strength of the reflected radio waves back from the underground.

⑨ Exospheric Mass Spectrometer for LUPEX (EMS-L)

Analyzes the gas species and molecules that make up the very dilute lunar atmosphere. It also detects the presence of water down to a depth of 1.5 m below the surface by analyzing the gases produced when the regolith is drilled.

⑩ Mid-Infrared Imaging Spectrometer (MIR)

Detects the presence of water on the lunar surface by capturing the intensity of light at wavelengths between 800 and 5000 nm.

Instruments Provided by

JAXA ① ② ③ ④ ⑥

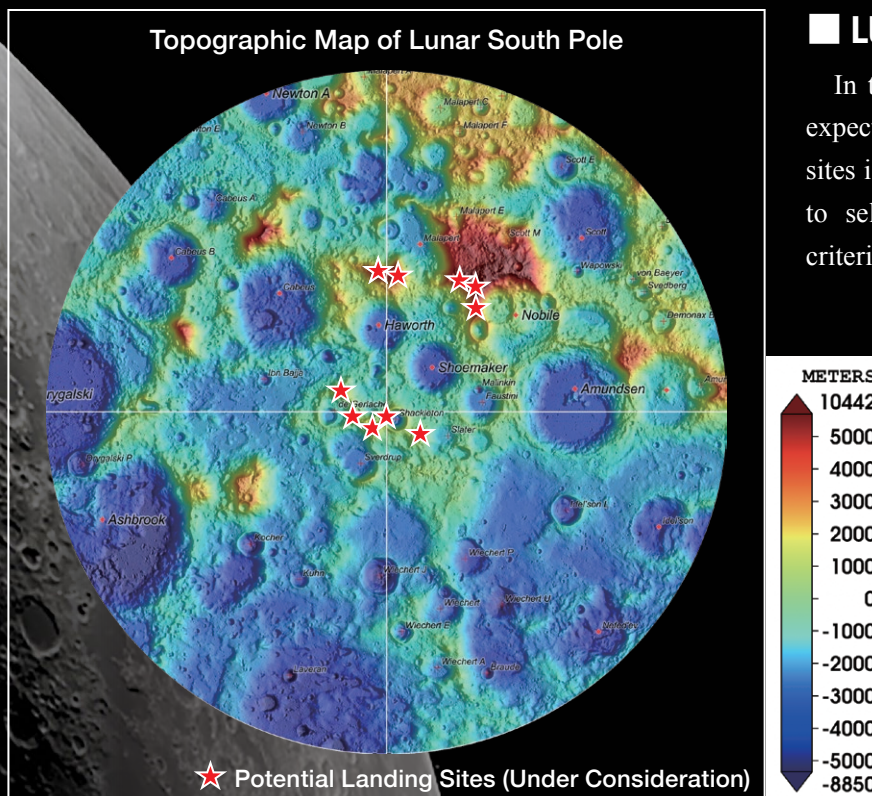
ISRO ⑤ ⑧ ⑩

National Aeronautics and Space Administration (NASA) ⑦

European Space Agency (ESA) ⑨

Mission Overview

Topographic Map of Lunar South Pole



LUPEX Landing Site Candidates

In the lunar south polar region where water is expected to be present, the number of safe landing sites is very limited. JAXA is working with ISRO to select landing sites that meet the multiple criteria listed below.

- Illumination needs to be secured as a source of energy for the rover
- Earth visibility for sending commands from earth to the rover
- Slope at which the lander can safely land and the rover can travel
- Scientific perspective: temperature and geology needed to understand the water distribution in the lunar polar regions

Exploration area and observation flow

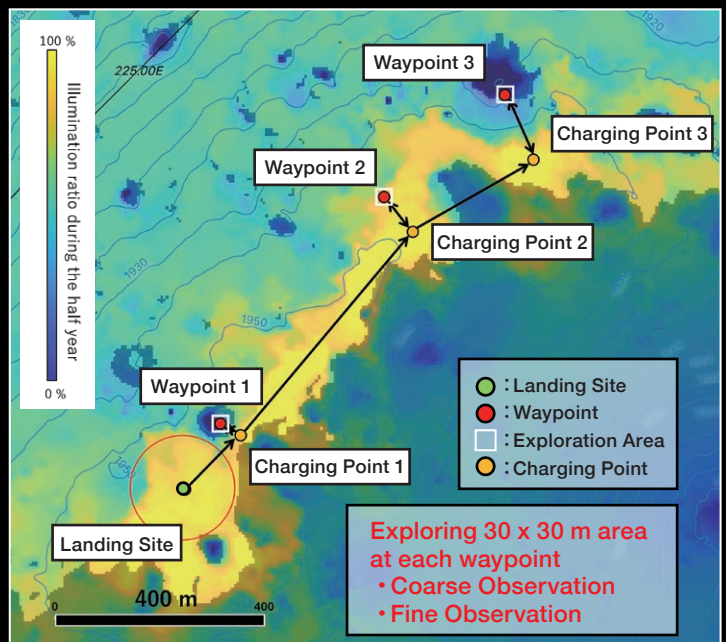
Near the landing site, target points (waypoints) and exploration areas with characteristic features of temperature, illumination, and geology will be selected, and a global path will be planned in advance.

From the landing site, the rover will move to the exploration area based on the path plan, conduct observation operations, and recharge batteries.

For each exploration area, the following observation operations will be carried out :

1. Coarse observation: acquisition of basic data for determination of drilling locations in the exploration area
2. Fine observation: regolith sample collection from the surface to a depth of about 1.5 m

Further detailed analysis will be conducted with REIWA to obtain data on the distribution of water (ice), its morphology, and abundance.



Example of Landing Site and Exploration Area

Web Page



JAXA Space Exploration Center (JSEC) Web Page
<https://www.exploration.jaxa.jp/e/index.html>



LUPEX "X" Account
@lupe_x_jaxa



JSEC "X" Account
@jsec_jaxa_en