
# VIPER – NASA'S MOON ROVER

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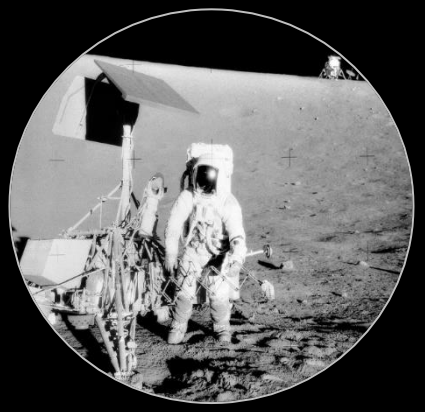
# TIMELINE



## 1969
## The 1st Leap

Humans voyaged to the moon from 1969 - 1972.

## 2009
## The 2nd Leap

Water is discovered on the moon in large quantities near the poles.

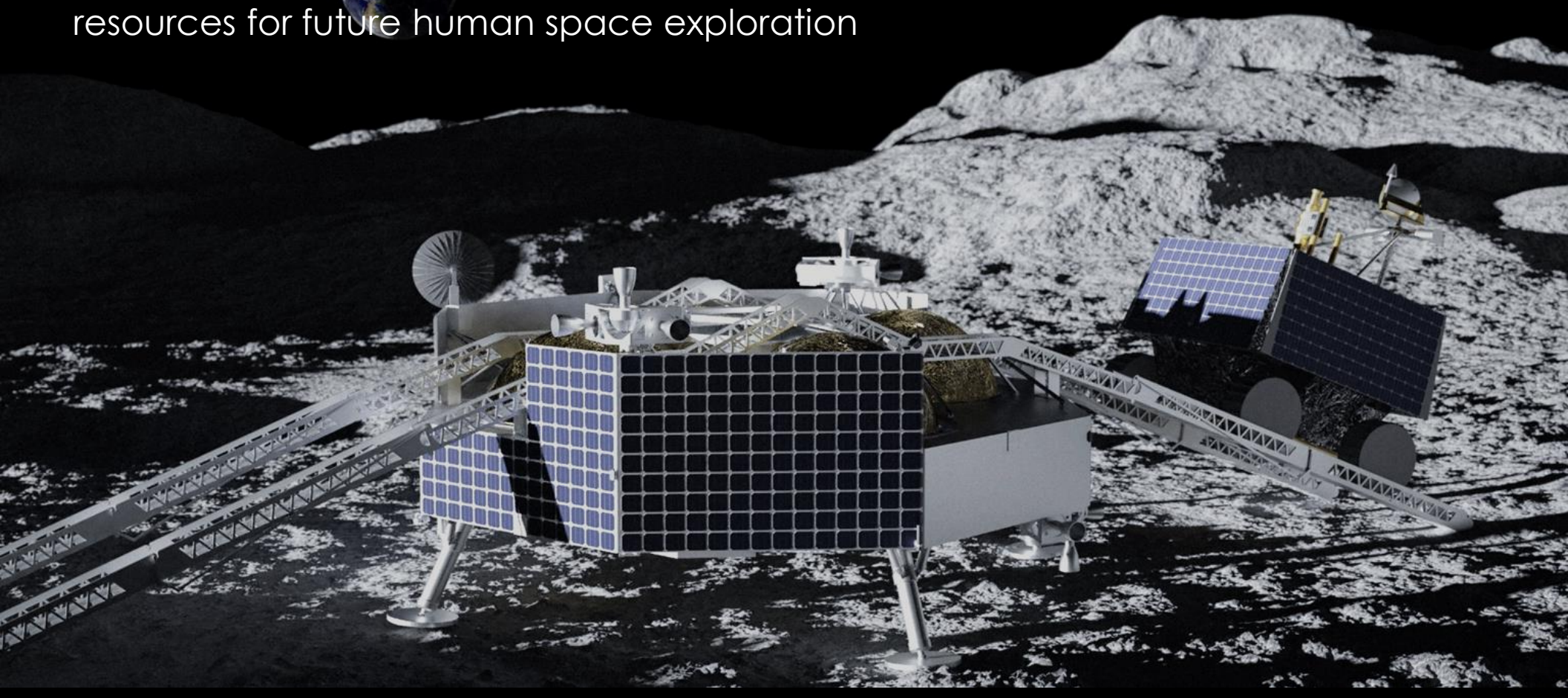
## 2024
## The 3rd Leap

VIPER will land on the South pole of the moon in search Lunar Volatiles.

# 2024

Launching in 2024 as part of the Artemis program, VIPER is NASA's first lunar mobile robot.

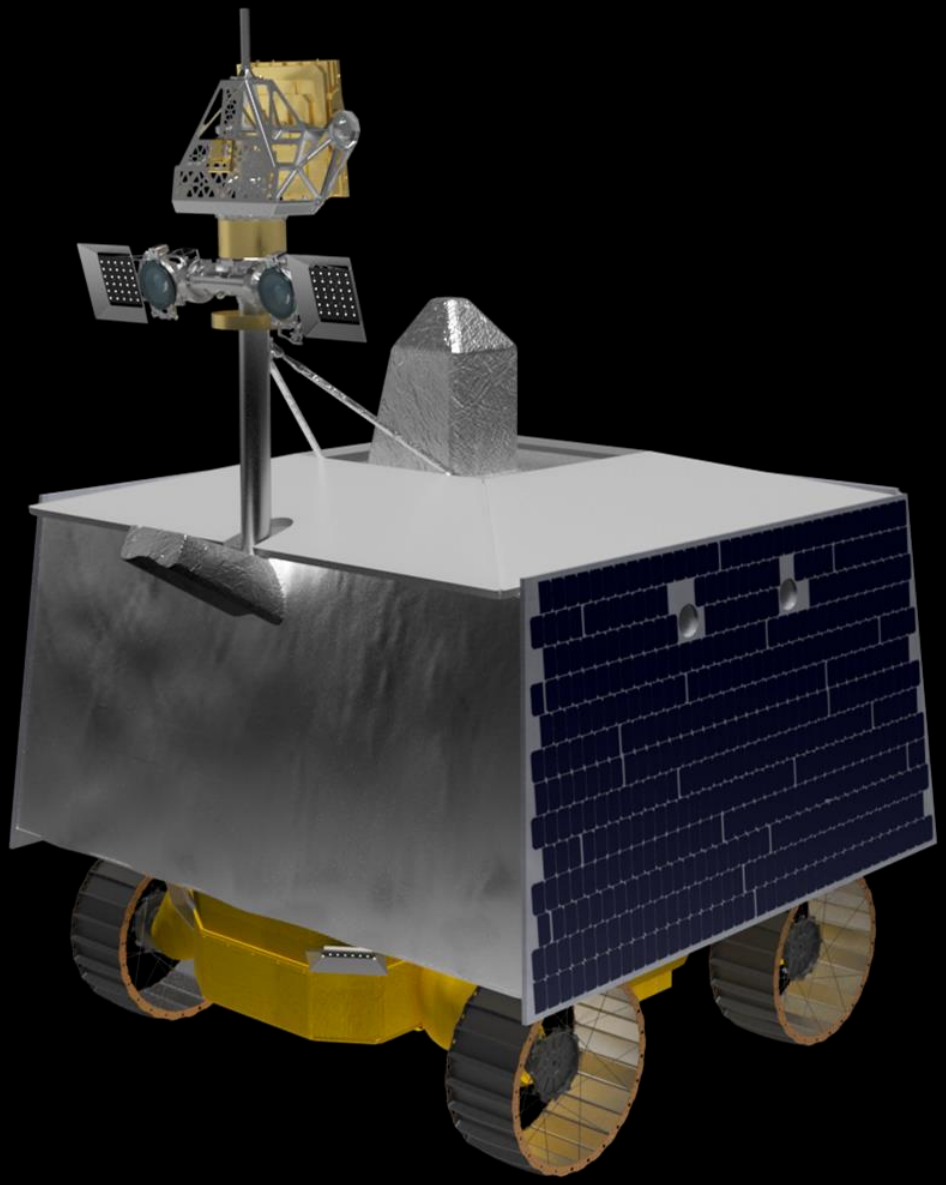
VIPER will land on the South pole of the moon in search Lunar Volatiles such as water and ice that will allow us to determine how to harvest the Moon's resources for future human space exploration



# Volatiles Investigating Polar Exploration Rover

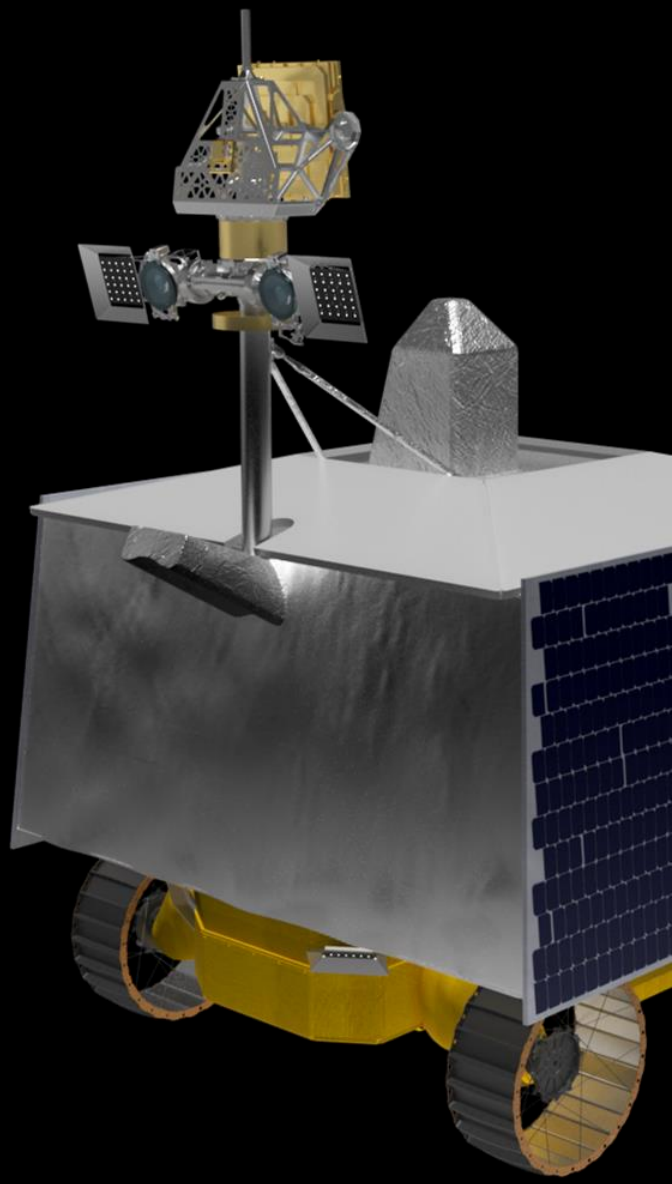
# MEET *VIPER*

- VIPER is NASA's first lunar mobile robot
- VIPER is the first rover with headlights
- VIPER is the first resource-mapping mission on another celestial body.
- The VIPER mission will mark the first time since the Apollo missions that drilling has been done on the Moon.
- VIPER will robotically drill deeper than any other on a celestial body.



# MEET *VIPER*

**Launch:** Late 2024
**Landing site:** Nobile Region of Moon's South Pole
**Delivery to the Moon:** Launch vehicle and lander provided by a NASA Commercial Lunar Payload Services partner
**Mission duration:** 100 Earth days, covering 3 cycles of lunar day and night
**Distance goal:** 12 miles (20 kilometers)
**Rover size:** Similar to a golf cart: 5 feet by 5 feet by 8 feet (1.5 meters by 1.5 meters by 2.5 meters) and 992 pounds (450 kilograms)
**Onboard instruments:** 3 spectrometers and a 3.28-foot (1-meter) drill
**Power:** Solar-charged battery, peak power of 450 watts
**Top speed:** 0.45 mph (0.72 kph)
**Communications:** X-band direct-to-Earth (no relay) over the Deep Space Network



# *VIPER Challenges*

**Extreme temperatures:** The rover's hardware will need to withstand surface temperatures varying by 500 degrees Fahrenheit between sunlight and shade.

**Real-time drivers:** The Moon is much closer to Earth than Mars, so there will be little delay when transmitting commands to the rover. That means drivers on Earth can operate VIPER interactively.

**Mobility:** We can't be exactly sure what the soil in the Moon's polar regions will be like – hard and compacted, fluffy, or somewhere in between? As a result, VIPER is designed for unprecedented agility.

**Complex route planning:** The extreme swings in light and dark at the poles of the Moon are nothing like those on Earth or Mars – and produce extremely long and fast-moving shadows.

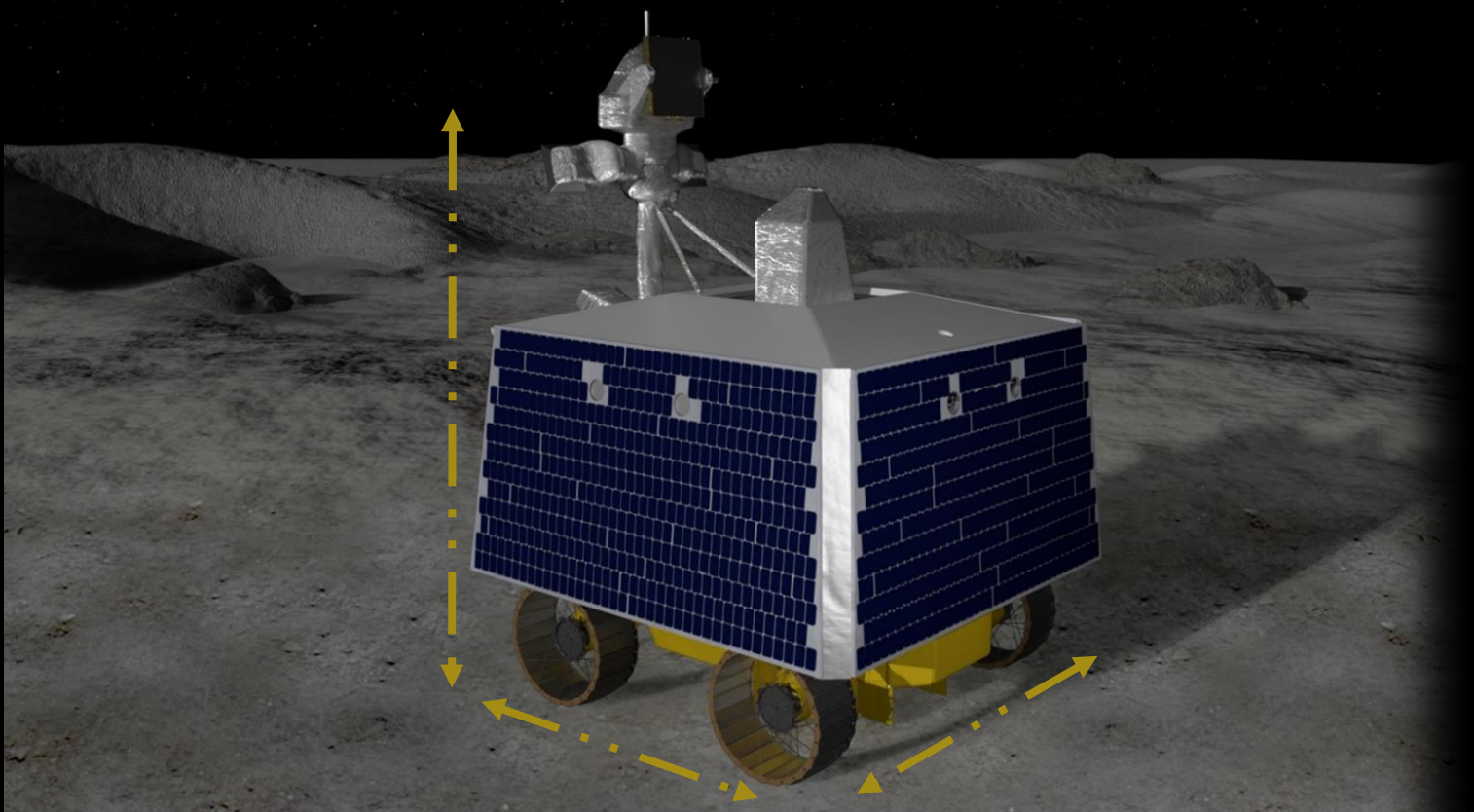
**First rover with headlights:** VIPER will explore inside dark craters where the Sun never reaches, making it the first NASA rover to need headlights. However, rover engineers face a brand-new challenge in building a lighting-plus-camera system to operate in the Moon's harsh temperatures and extreme conditions of light and dark.

# *VIPER Specs*

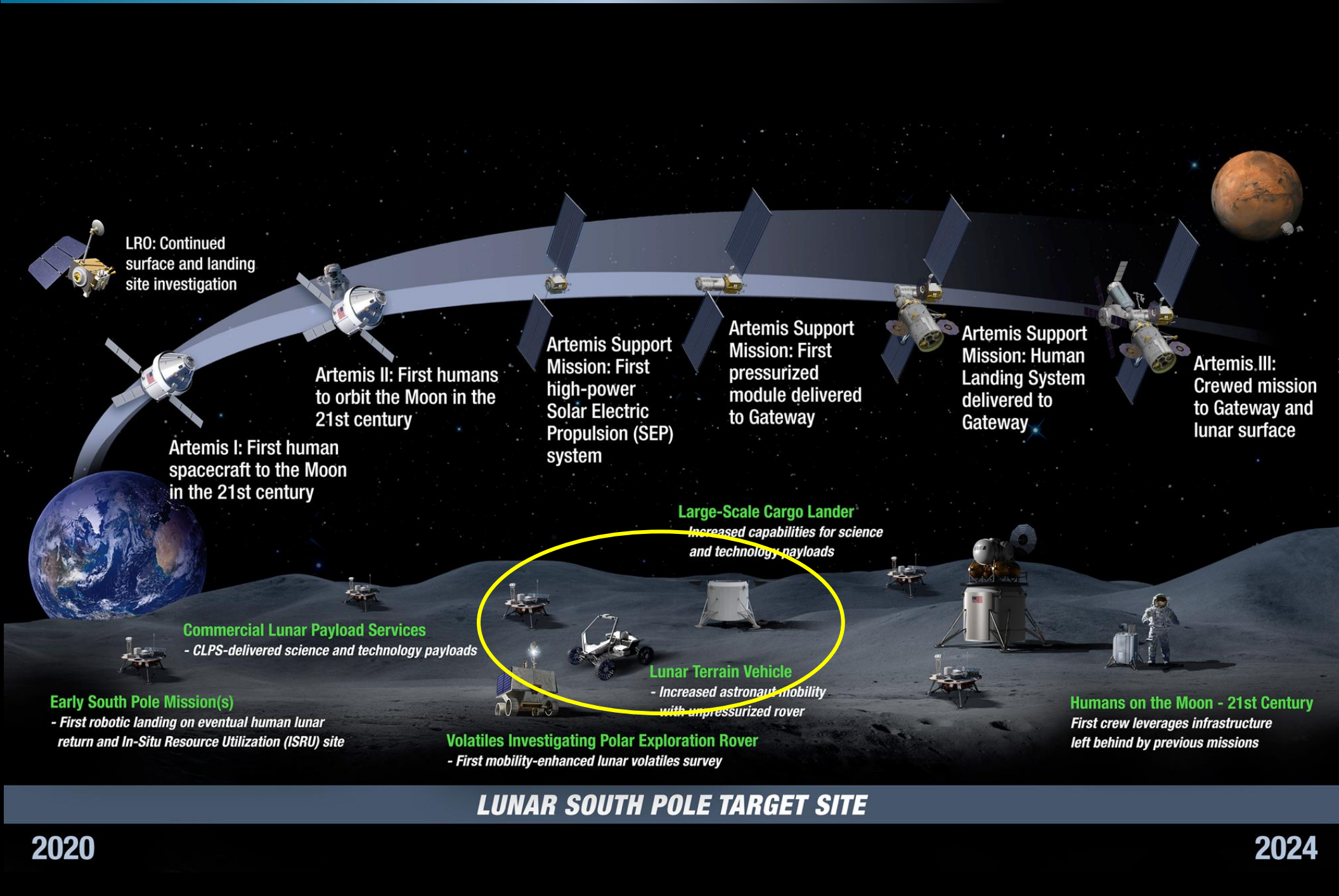
Speed: As fast as a Tortoise (~.45 mph)

Weight: A Manatee (~1000 lbs.)

Size : Golf Cart (~5 x 5 x 8 ft.)



# Concept of Operations



# MISSION TIMELINE

**Pre-launch activities**: Preparation for the mission, including pre-project planning; science definition and instrument selection; landing site selection; and rover assembly and testing.

**Delivery to CLPS partner**: Rover delivery to the commercial partner responsible for sending VIPER to the Moon.

**Launch**: Lift-off from Earth aboard SpaceX's Falcon Heavy launch vehicle in late 2024.
**Cruise**: Voyage through space to the Moon.

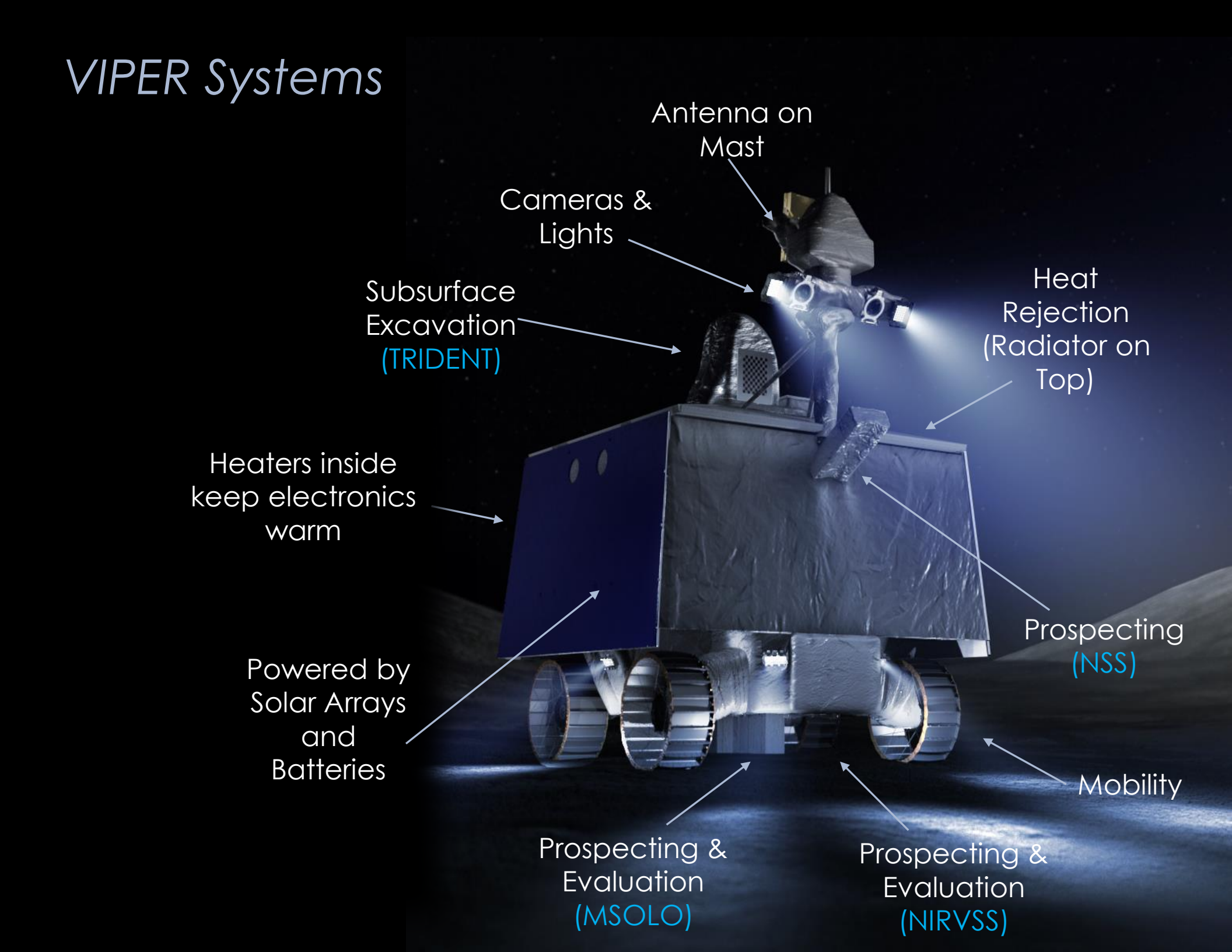
**Descent and landing**: VIPER's arrival at the South Pole of the Moon aboard Astrobotic's Griffin lander.

**Instrument checks and first drive**: Tests to ensure the rover is fully operational and then driving off of the lander.

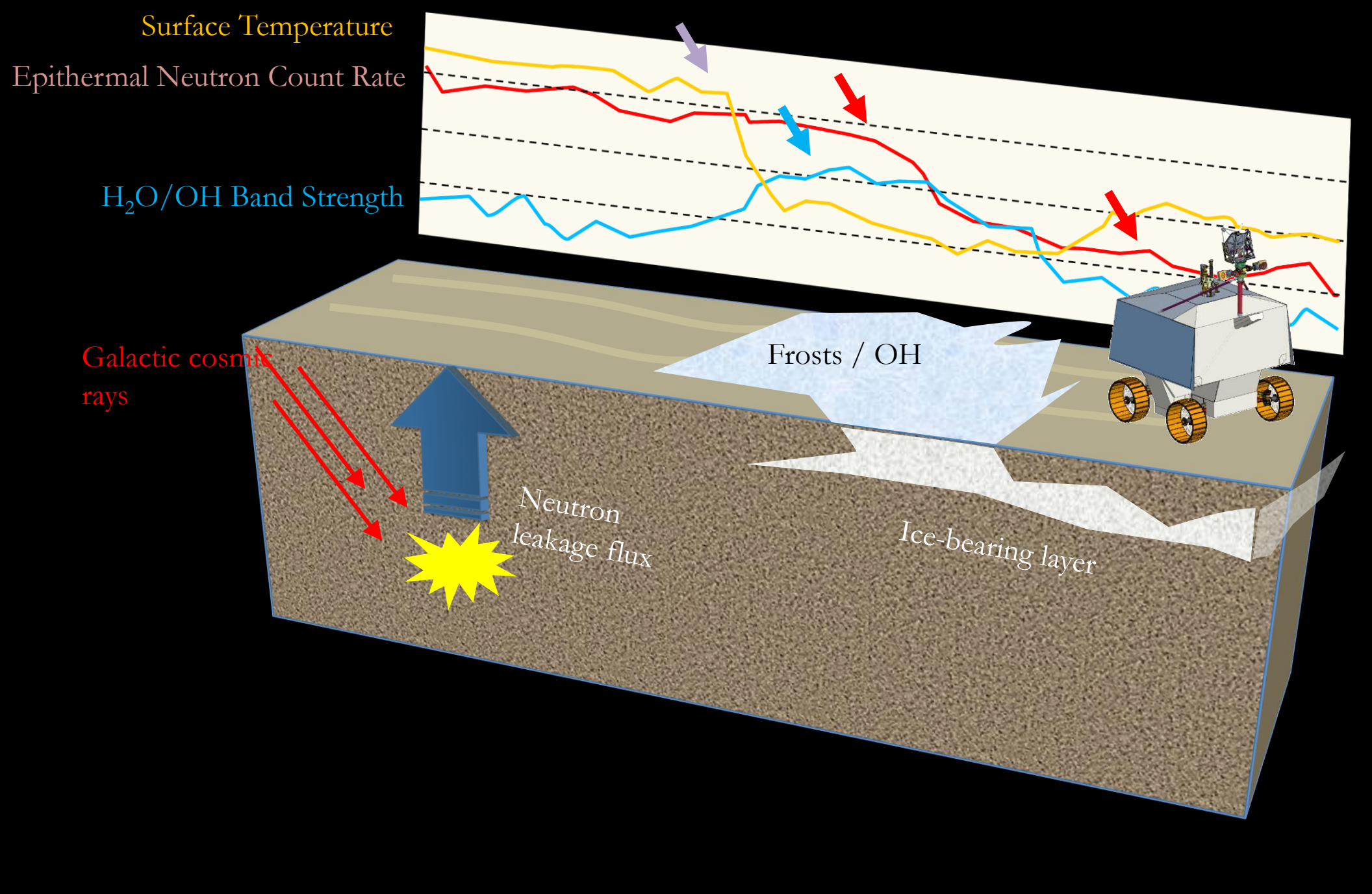
**Surface operations**: Rover operations on the Moon sampling ice from four types of lunar environments. VIPER collects data for about 100 Earth days, including multiple survival periods at designated safe havens.

**Mission end**: VIPER's mission ends when it encounters periods of cold and dark longer than four Earth days. In a planned location, the rover freezes in the very cold temperatures of the polar regions.

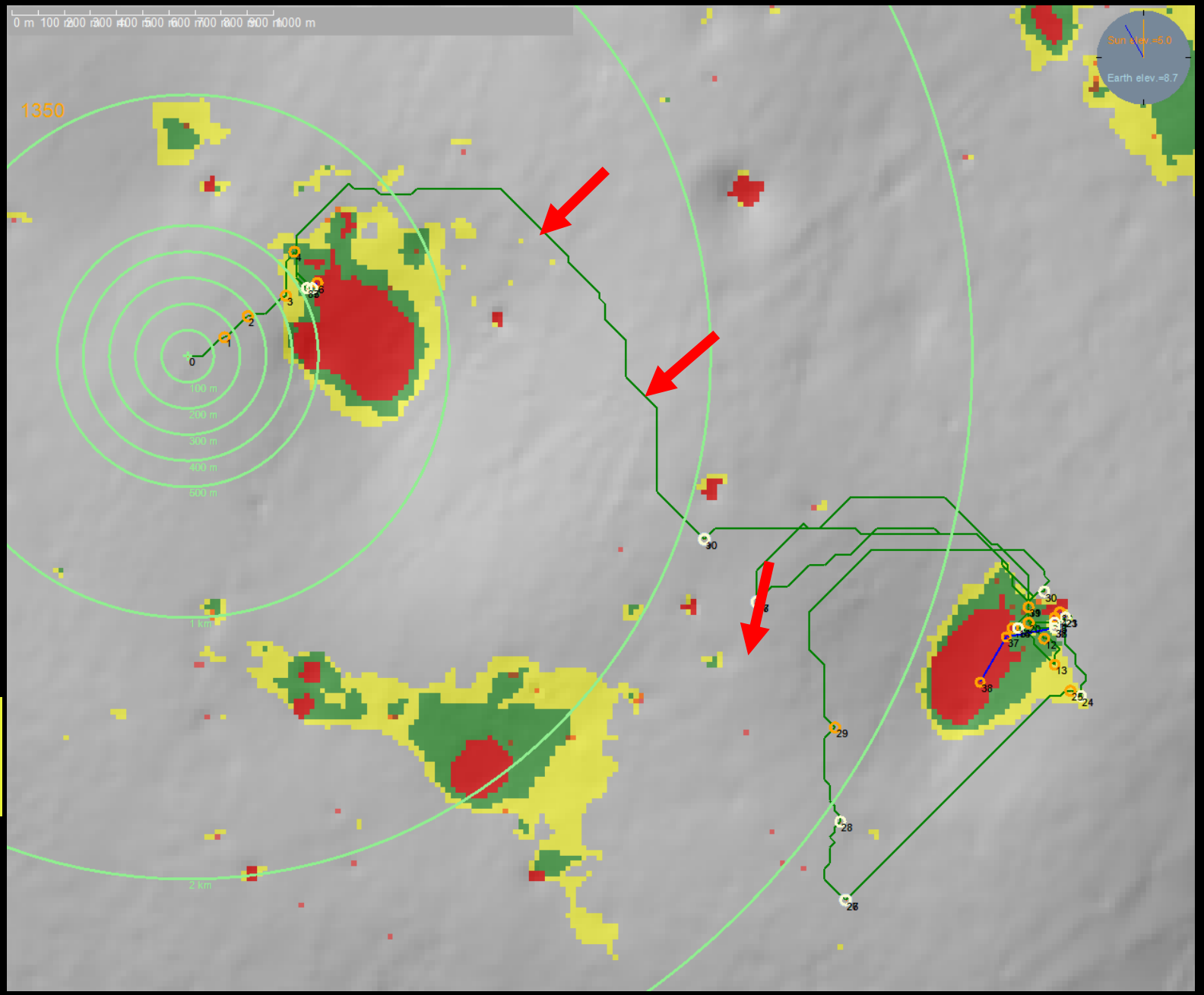
# *VIPER Systems*



# Prospecting: NSS, NIRVSS, MSolo

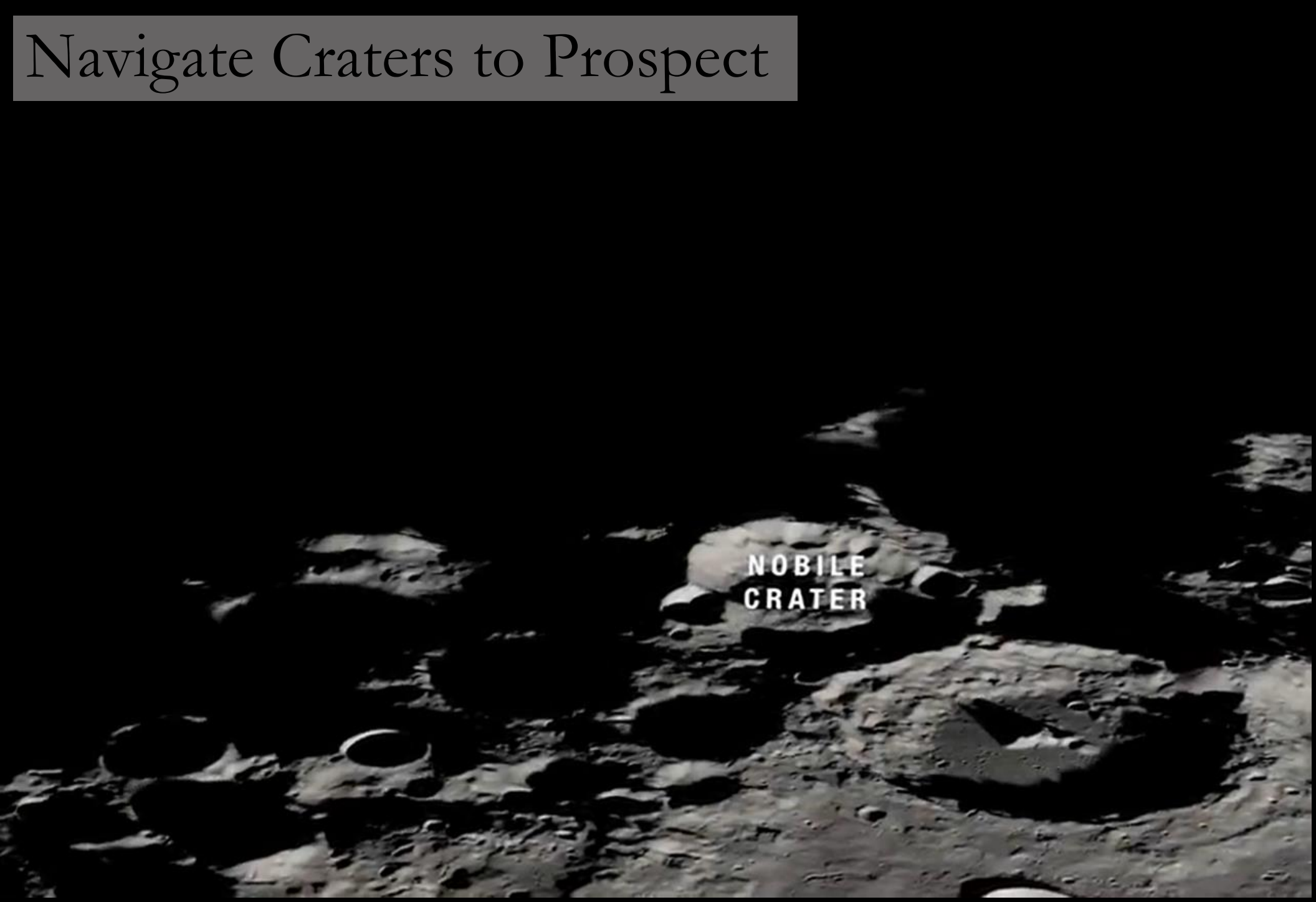


# Mapping our Course to Find Resources




- Surface Ice Depth (PSR)
- Shallow Ice Depth (< .5 m)
- Deep Ice Depth (< 1 m)
- Dry (deeper than 1 m)

# Navigate Craters to Prospect



# VIPER – SI&T

VIPER SI&T addresses integration and test of all elements required for the Surface Segment to conduct mission operations on the lunar surface.

This includes:

- Integration and test of the Science Instruments after installation
- Integration and test of Rover components, subsystems, and subassemblies after installation
- Integration and test of the VIPER Surface Segment
- Support the CLPS Contractor for the Integration and Test of the Surface Segment with the Lander (Space Segment)
- Support the CLPS for the Integration and Test of the Space Segment with the Launch Vehicle (Launch Segment)

# VIPER Environmental Testing

Modal Survey Test

- Modal testing is the process by which the spacecraft is dynamically excited at low levels over a specific frequency range.
- Shakers are attached at different locations around the spacecraft to excite modes (ex. rocking and bending)

Vibration Test

- The primary goal of vibration testing is to expose the spacecraft to the low- frequency dynamic launch environment
- This will ensure that the system will perform as expected after being exposed during launch

# VIPER Environmental Testing

Thermal Vacuum (TVAC) Test

- Allows us to test mission critical events and the thermal management system at extreme temperatures
- The test will ensure that the system operates in a simulated space environment

Acoustic Test

- Allows us to test the spacecraft at a range of sound pressure levels
- This will demonstrate VIPER capability margin over the launch and ascent acoustic environments

Thank you