

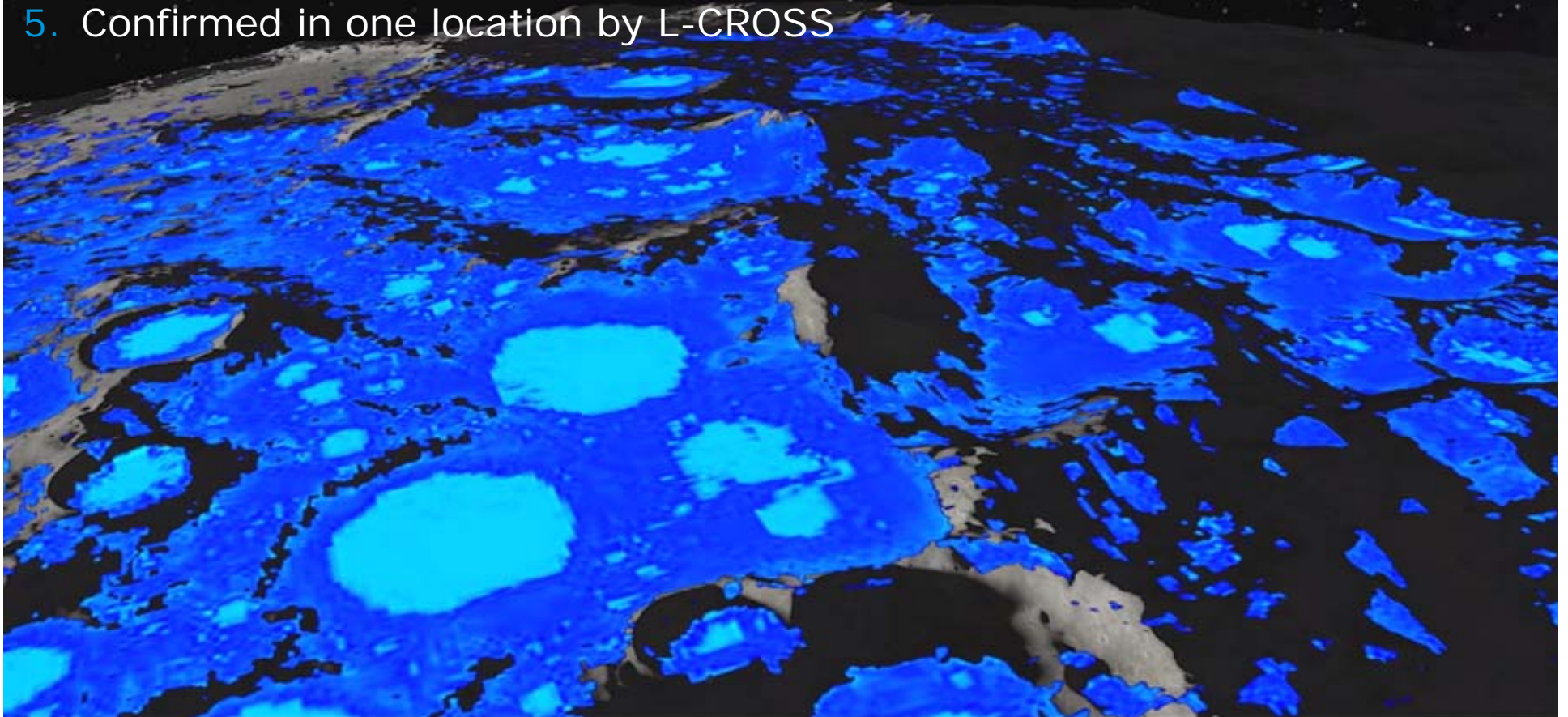
EXPLORING COLD TRAPPED LUNAR VOLATILES



or
LUNAR VOLATILES ARE COOL

Polar Volatiles

1. Water ice trapped at the lunar poles, long hypothesised, recently observed
2. Hydrogen enhanced across the polar regions within around 1m depth (neutrons – Prospector / LRO)
3. Cold enough to trap ice at or near the surface (LRO)
4. Ubiquitous at the surface at least as a monolayer (Chandrayaan)
5. Confirmed in one location by L-CROSS



An enabling resource for exploration?



1. Water
2. Oxygen
3. Propellant
4. Other volatile chemistry as consumables (e.g. N

A Scientific Treasure

A composite image of space. On the left, a bright, glowing yellow-orange sun with a visible corona. On the right, a large, detailed crescent moon showing numerous craters and a blue-tinted horizon. The background is a dark, star-filled space with a dense field of small, distant stars and a faint, hazy band of light representing the Milky Way galaxy.

Water could be from

- a. Solar wind collisions
- b. Lunar interior
- c. Asteroid and comet impacts

Could help reveal solar system processes and the origins of life
forming chemistry on Earth

Strategic knowledge gaps and how we find out

1. What we don't know

- a. Quantity
- b. Distribution
- c. Accessibility
- d. Extractability

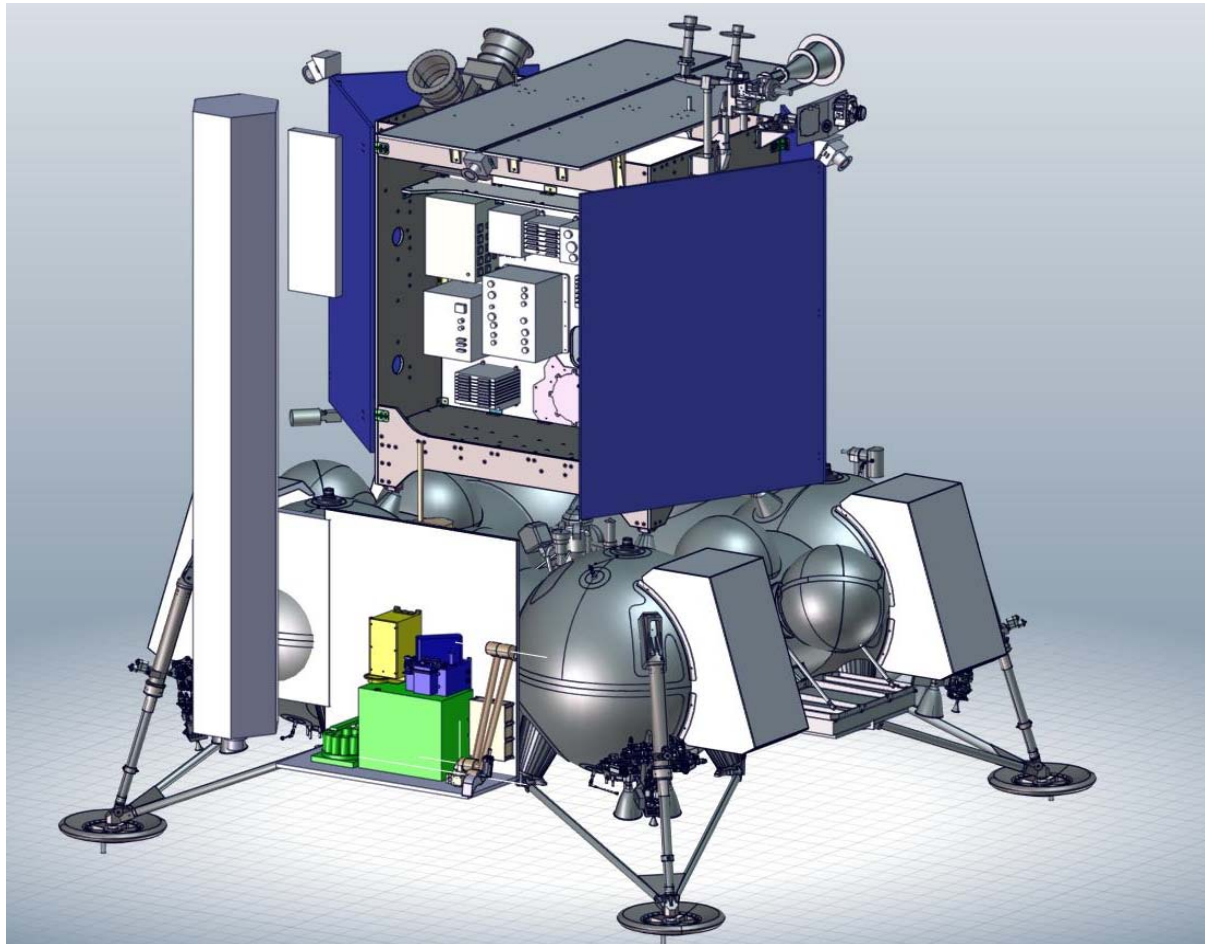
2. Missions to the surface are required

- a. Small robotic precursors can make major advances ahead of human missions
- b. Prospecting
- c. Geotechnical properties & environment
- d. Technology demonstration



PROSPECT - Luna-27

Cooperating with Russia

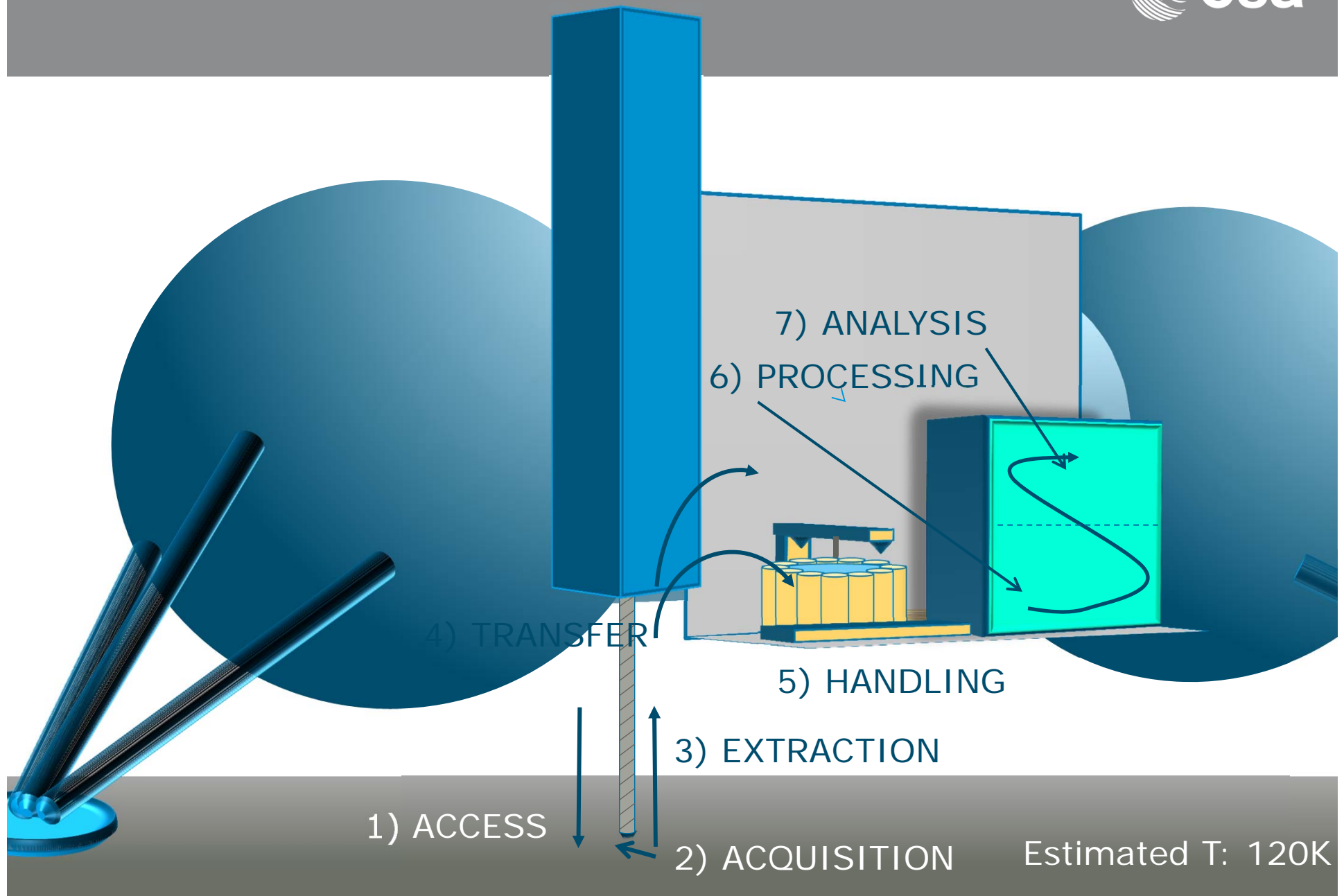


EXPLORING COLD TRAPPED VOLATILES | J. Carpenter | LEAG 2015 | 21/10/2015 | Slide 6

European Space Agency

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PROSPECT Overview



PROSPECT Drill (ProSEED)

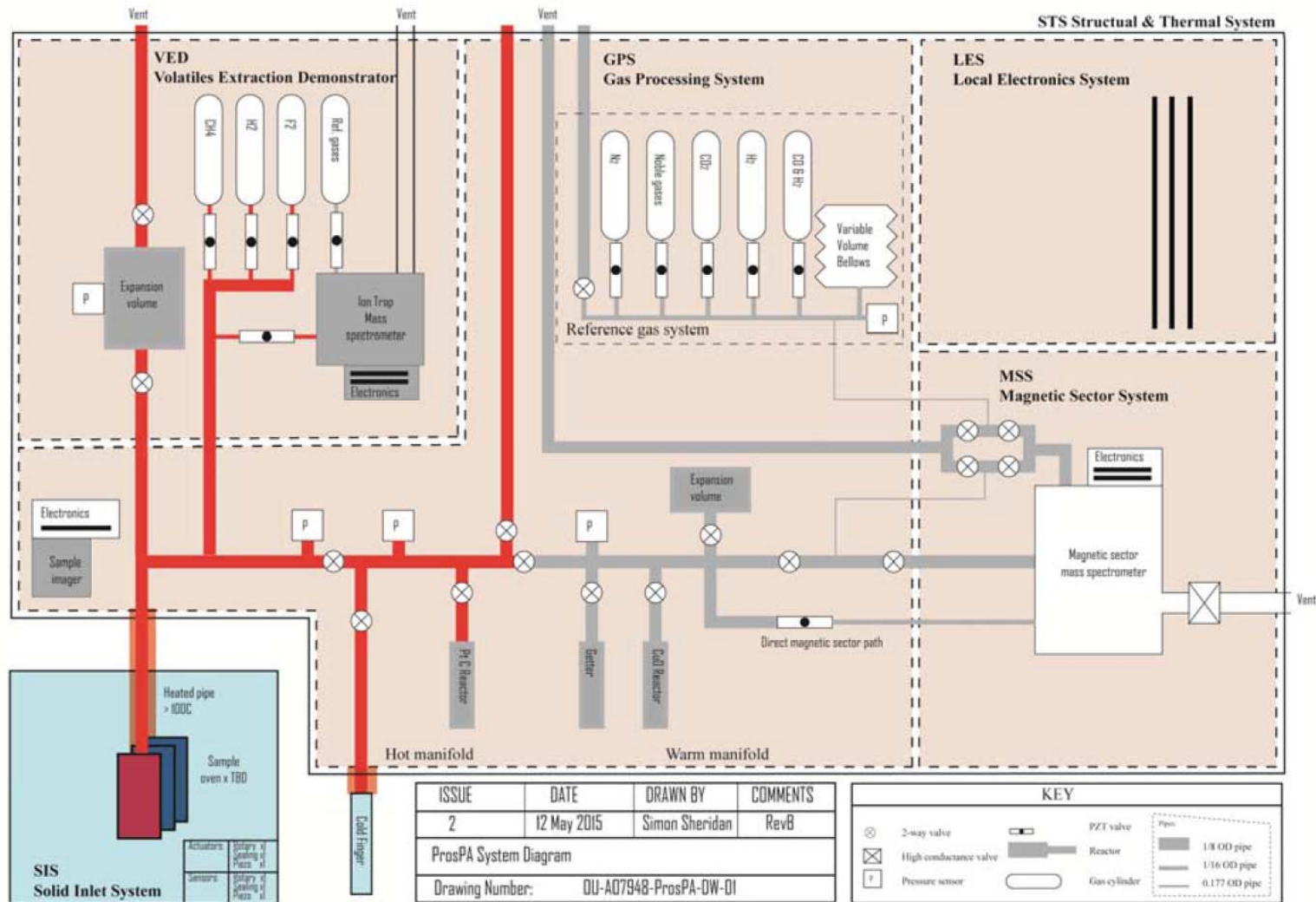


Led by SELEX ES

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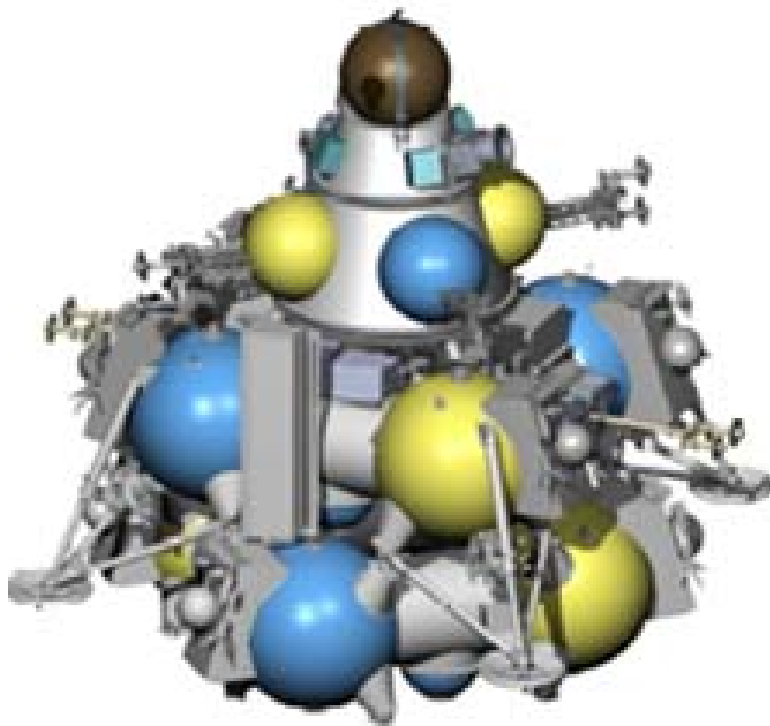
PROSPECT ProSPA chemical lab



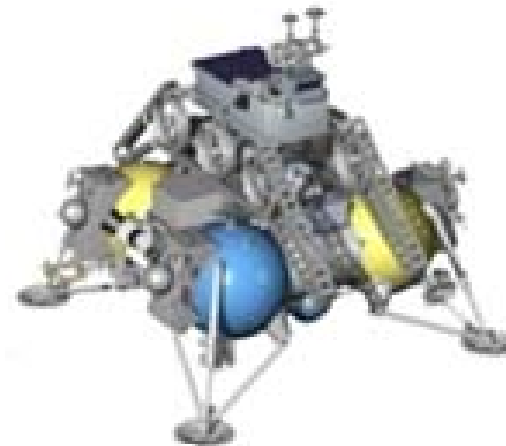
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What next?



Lunar Polar Sample Return
Comprehensive analysis in
terrestrial laboratories



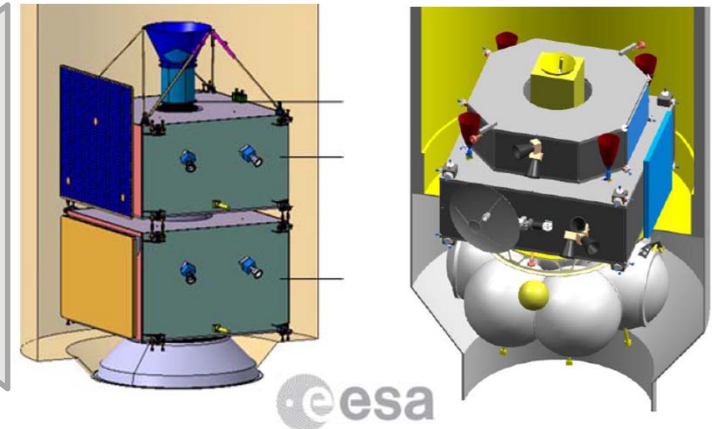
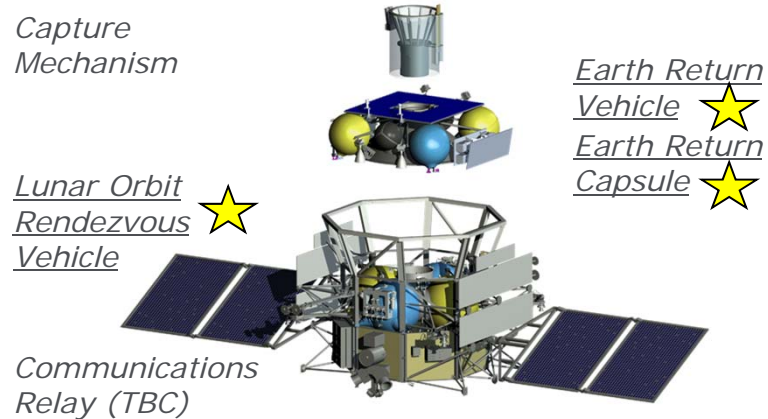
Introduce mobility
Lunar Volatile Prospector
Regional distribution
In-situ analysis

LPSR-RendezVous Mission Elements

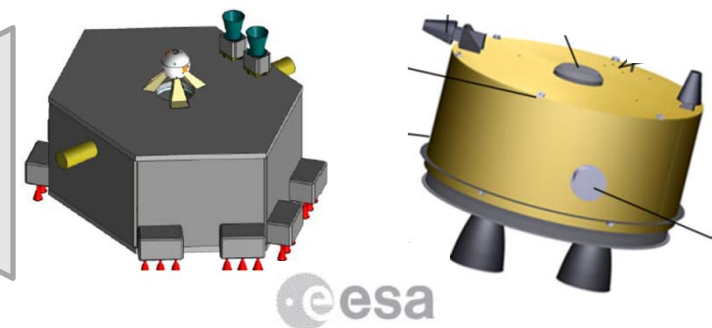
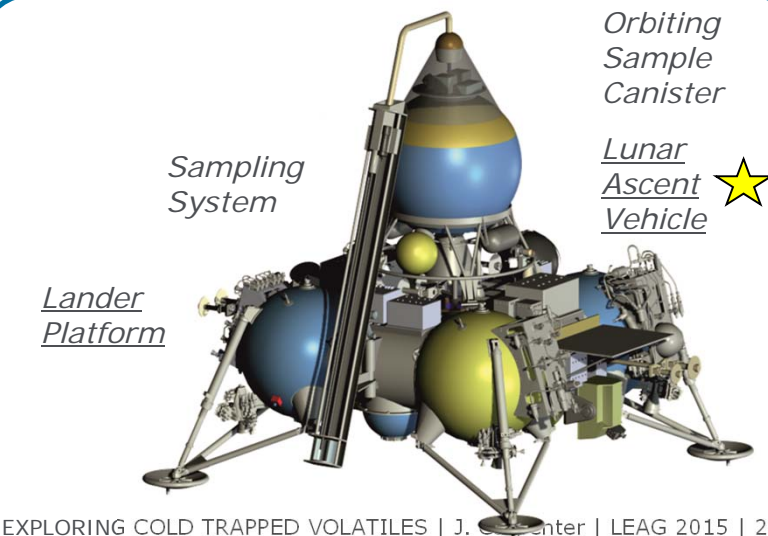
Pre-Phase A/Phase A industrial studies



Orbiter-Return Module



Landing Module



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Images Lavochkin Association

- ★ Subject of ESA industrial study
- Science definition on-going with a Science Definition team

Lunar Volatile Prospector

Pre-Phase A industrial study
Mobility technology activities



Industrial system study initial requirements

- Mobility in partially illuminated region (~50km)
- Mobility in PSR (~1km)
- 2 year surface lifetime
- Compatible with Russian lander platform
- Direct to Earth and relay enabled communication
- Strawman Payload
 - PROSPECT derivative
 - Neutron spectrometer
 - Gamma ray spectrometer
 - Ground penetrating radar
 - IR spectrometer under consideration

LUCID technology activity

Use of Rover Autonomy test bed

Investigating situational awareness and operations approaches in LVP mission scenario



