

# Mini lab secures NASA ride to the moon

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An artist's concept of Intuitive Machines' Nova-C lunar lander on the moon's South Pole. Credit: Intuitive Machines

A miniaturized laboratory developed by The Open University (OU) with support from RAL Space will fly to the lunar South Polar region in the European Space Agency's (ESA) Prospect package in search of volatiles, including water ice, as part of NASA's Commercial Lunar Payload Services initiative.

NASA has selected Intuitive Machines to deliver six payloads that will deepen our understanding of the moon and answer key questions about where and how volatiles can be found on the [lunar surface](#). Volatiles, such as [water ice](#), are chemical components that easily evaporate or vaporize under certain conditions.

Prospect is a suite of instruments that will drill up to at least 1 meter depth beneath the lunar surface, extract samples, and process them in a mini lab, ProSPA. The combination of robotic drill and sample analysis package is designed to identify volatiles trapped beneath the surface at extremely cold temperatures down to  $-150^{\circ}\text{C}$ .

Chris Howe, Production and Software Group Leader at RAL Space, said, "The technology behind ProSPA is the result of years of collaboration between RAL Space and the Open University, and we're delighted that this latest milestone is bringing the instrument one step closer to the moon.

"ProSPA will not only build on the legacy of previous projects, such as PITMS, but the insights we gain from it will also support future missions advancing our understanding of the lunar surface. It's a really exciting project to be part of."

Europe's major contribution will share the ride with five other instruments from the US, including retroreflectors to locate landing sites on the moon and yeast to study radiation and gravity responses. In total, the six instruments will have a mass of about 80 kg.

## **Volatiles for sustainable exploration**

Prospect is part of a global effort to identify potential lunar resources for a sustainable, long-term [human presence](#) on the moon.

Water is a key target: There may be concentrations of frozen water at or below the surface especially in the lunar polar regions—something suggested by recent measurements from orbit. Information on how much water is present and how accessible it is would help plan future missions using local resources.

"Prospect joins a new wave of lunar science and exploration that could open the door to the use of lunar resources. For example, extracting oxygen directly from lunar rocks and dust could be an efficient way to supply oxygen for human habitats or spacecraft propulsion," says Richard Fisackerly, Prospect project manager.

"Besides their potential as resources, lunar volatiles would also represent an important component of the lunar regolith—the layer of loose dust and fragmented rock on the moon's surface. Prospect can further our understanding of the fundamental science of the moon and its environment," he adds.

## **Drilling and sample analysis**

The robotic drill, called ProSEED, will penetrate the lunar surface up to one meter depth. Temperatures at the subsurface are expected to be less than  $-100^{\circ}\text{C}$ , and correspond with conditions where water ice may be stable. The drill features a multispectral imager and a permittivity sensor to support the remote detection and analysis of volatiles, as well as the mineralogy of the regolith at the landing site.

The miniaturized laboratory ProSPA will receive the samples from the drill via a carousel with multiple ovens, seal them, and heat them to extract the cold-trapped volatiles. The ProSPA instrument will then measure the nature and abundance of lunar volatiles using the gases released from the sample. ProSPA will also test specific processes which could be applied for resource extraction in the future.

Dr. Simeon Barber, who leads the project at The Open University, said, "After more than a decade of developing the ProSPA concept and instrument, our team is super-excited to be hitching a ride to the moon. We look forward to analyzing fresh samples drilled from the moon's south polar region, which might contain ancient reserves of water and other ices. And we can't wait to unravel the mysteries of this extreme environment, and discover its potential to support future exploration missions."

## **One step closer to prospecting the moon**

The ProSEED drill has already undergone trials in Italy including tests conducted at very low temperatures, under low pressure, and using a mixture of lunar regolith simulant and water ice.

These tests have proved the drill is capable of penetrating deep into hard material and successfully collect samples.

Provided by RAL Space

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