Ice may lurk in shadows beyond Moon's poles

Catalogue of craters uncovers extra sites of interest for rovers.

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Water ice on the moon may be more widespread than previously thought. Permanent shadows have been spotted far from the lunar poles, expanding the number of sites that would be good candidates for exploration by robotic rovers — or even for the locations of lunar bases.

Researchers have known for decades that the Moon's poles host craters with lofty rims that shield their floors from sunlight, so searches for shadowed areas harbouring water ice have focused on the poles[1, 2]. But over the past few months, researchers have built a catalogue of permanently shadowed regions elsewhere on the Moon.

Craters far from the moon's poles may harbour frozen water.

NASA/JPL/USGS

The team developed software called LunarShader to simulate lighting conditions on the Moon throughout its solar cycles. They fed in two topographical models — one from the Japanese spacecraft Kaguya, and one from NASA's Lunar Reconnaissance Orbiter (LRO). The software identified about 100 craters that should contain permanent shadows, located as many as 58 degrees of latitude from the pole in both hemispheres, reported team member Joshua Cahill, a space scientist at Johns Hopkins University's Applied Physics Laboratory in Laurel, Maryland, at the European Planetary Science Congress in Madrid this week. The result is being prepared for publication in *Icarus*, he said.

The findings are significant because they open “a much larger area where permanent manned stations could be established", says Bruce Cutright, a hydrogeologist at the University of Texas at Austin. Water ice on the Moon exists in such low concentrations that any mission that seeks to study it, or to use it as a resource, will need a detailed map of its distribution.

Ice under ground

Cahill and his colleagues also took the candidate craters' temperature using the LRO's Diviner Lunar Radiometer instrument, to determine which sites are most likely to contain ice. The craters are only half the temperature of their better-lit surroundings, but they still reach an average of 175 kelvin — hot enough to boil water in the moon's thin atmosphere — so any water ice must be insulated beneath the surface.

"While not as cold as the permanently shadowed regions near the poles, these non-polar areas offer a unique environment that may harbour volatiles," says Emerson Speyerer, an engineer at Arizona State University in Tempe, who is part of another team that has identified persistent shadows at the lunar poles. That team is now characterizing other potential permanently shadowed regions using LRO data. They made a preliminary report at the March Lunar and Planetary Science Conference in The Woodlands, Texas.

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Radar instruments on orbiting spacecraft allow some study of the ice, but close-up observations are needed to confirm any findings, says Speyerer. Some technological ingenuity will be required to allow the solar-powered rovers to operate in the shadowy depths of the craters. "A prospecting rover would be able to examine these features with the lower half of the rover in shadow, while the upper half and solar panel would remain illuminated," says Speyerer.

Cahill's group has also used LunarShader to identify which parts of the permanently shadowed regions would be most accessible to a rover. To explore the deepest craters, Cahill imagines rovers or landers with solar panels on a mast up to ten metres high, acting like a 'solar snorkel'.

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References

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