New Scientist

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Solar system

Can we make a lunar backup of life?

Permanently shadowed regions on the moon would be ideal for preserving deep-frozen organisms

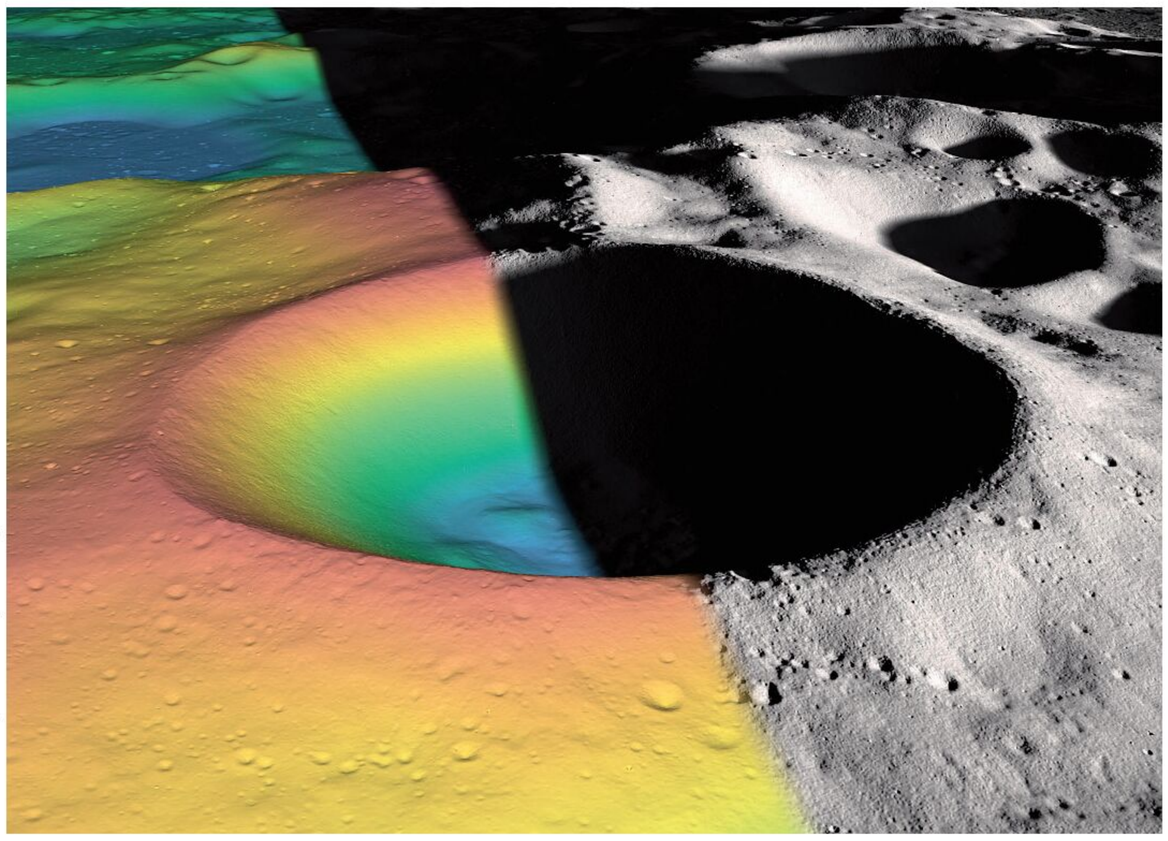
James Woodford

A BACKUP of life on Earth could be kept safe in a permanently dark location on the moon, without the need for power or maintenance, allowing us to potentially restore organisms if they die out.

Mary Hagedorn at the Smithsonian's National Zoo & Conservation Biology Institute in Washington DC and her colleagues have proposed building this lunar biorepository as a response to the extinctions occurring on Earth.

The plan has three main goals: to safeguard the diversity of life on Earth, to protect species that might be useful for space exploration, such as those that could provide biomaterials for food or filtration, and to preserve microorganisms that may one day be needed for terraforming other planets.

Hagedorn says the team wanted to identify a location where no people or energy would be required to keep cryogenically frozen, living cells colder than -196°C – the temperature at which nitrogen is a liquid and all biological processes are suspended.



NASA/ZUBER, M.T. ET AL., NATURE, 2012

Shackleton crater – part coloured to show terrain height – has areas that never see light

"There is no place on Earth cold enough to have a passive repository that must be held at -196°C, so we thought about space or the moon," says Hagedorn.

She says the team settled on the lunar south pole due to its deep craters with permanently shadowed and cold regions (*BioScience*, doi.org/nbg3). Burying samples about 2 metres below the surface would also keep them safe from radiation, she says.

Previous attempts at building secure biorepositories have had mixed success. The Svalbard Global Seed Vault in Norway lies in the Arctic and was constructed to be kept permanently below -18°C by the surrounding permafrost, but climate change and rising temperatures are now threatening its long-term security.

Biorepository sites elsewhere in the world, especially those close to cities, rely on human power sources and are also susceptible to geopolitical upheavals.

Andrew Pask at the University of Melbourne, Australia, who is building a repository for Australian species, is keen on the idea. "We would love to see our samples at duplicate facilities to ensure their safety and, at this point, the moon does seem the safest potential location," he says.

But Rachael Lappan at Monash University in Melbourne says there are many challenges and disadvantages to using the moon, not least accessing it to add or withdraw samples. It may be better to have samples on Earth with a lot of redundancy so that if one repository fails, others are still available, she says.

"I would want to see compelling evidence that we could make use of the [lunar] repository if it was needed," she says.

Even if this facility were never used, Alice Gorman at Flinders University in Adelaide, Australia, sees value in conserving human artefacts in space – perhaps even for any alien civilisations to one day access.

"Repositories, whether they're cryogenically frozen living tissue or DNA, or the entirety of Wikipedia saved on a high-density nickel disc, are going to be just like the Voyager spacecraft golden records," says Gorman, referring to metal discs describing humanity that are attached to these probes, which are now leaving the solar system. ▮

There really is water on the moon

Molecules of water have been detected in lunar rocks for the first time in samples picked up by China's Chang'e 5 spacecraft. These minerals could provide a source of water for a moon base.

The moon was long thought to be bone dry, but in the past 20 years, we have seen signs of water buried below the surface. In 2008, researchers claimed to have found water in volcanic glass beads in samples of lunar rock collected by the Apollo missions. However, that study and others since actually detected hydroxyl groups – oxygen and hydrogen bound together – rather than molecules of H_2O. To get water out of these rocks, they would need to be heated to around 1000°C.

Satellites orbiting the moon have also detected signatures of light that imply the presence of water ice, but this hasn't been directly measured in a sample.

Now, Xiaolong Chen at the Chinese Academy of Sciences in Beijing and his colleagues have analysed around 1000 micrometre-sized grains of lunar soil brought back by Chang'e 5. Using X-ray diffraction, they found a mineral consisting of about 40 per cent H_2O, along with ammonia, magnesium and chlorine (*Nature Astronomy*, doi.org/nbp2). "This is a new form of water stored on the moon," says Chen.

Its chemical structure is similar to that of a mineral called novograblenovite discovered by geologists near a Russian volcano in 2019. This was formed from hot gases from a volcano passing near basalt rock. A similar process may have created the lunar mineral too, says Chen.

The amount of the mineral in the lunar soil was tiny, but it would be easier to extract water from it than from other sources, because it only needs to be heated to about 100°C. Alex Wilkins