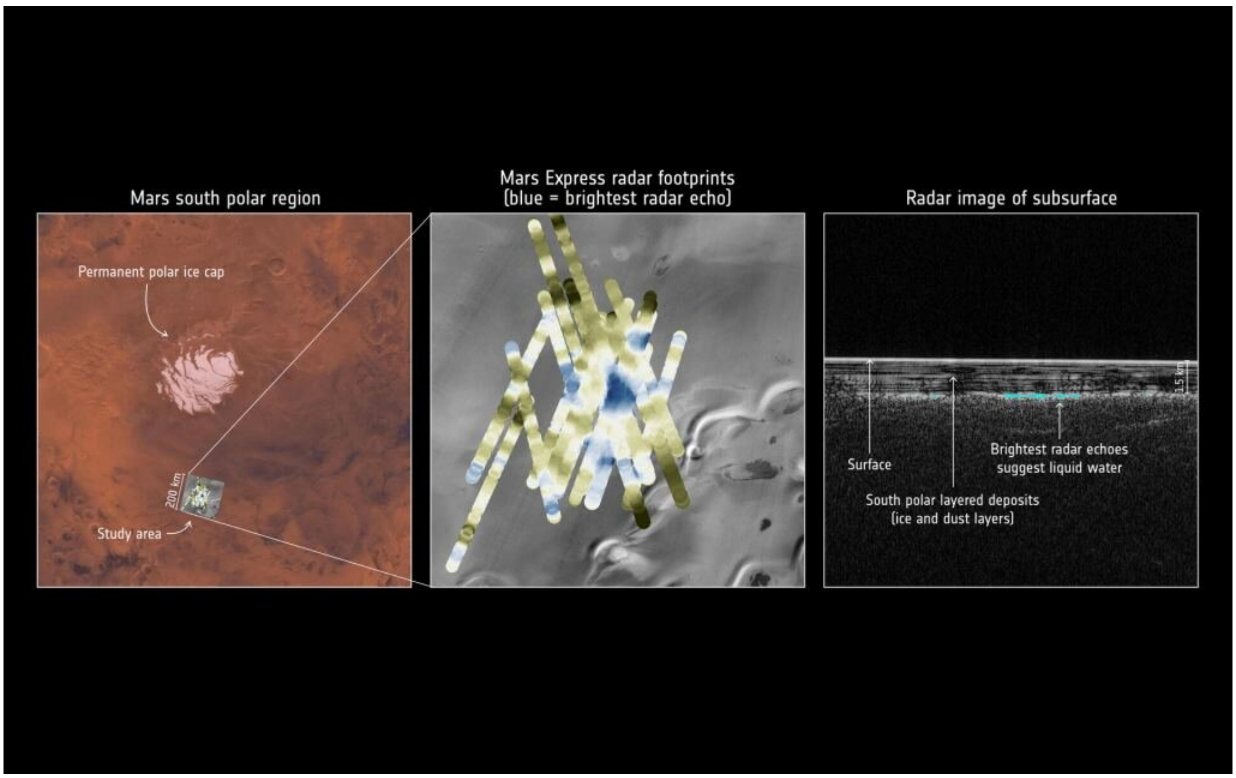
Mars astronauts will create fuel by having a shower

April 13 2022, by Matt Williams



Radar data collected by ESA's Mars Express point to a pond of liquid water buried under layers of ice and dust in the south polar region of Mars. Credit: ESA

When astronauts begin exploring Mars, they will face numerous challenges. Aside from the time and energy it takes to get there and all the health risks that come with long-duration missions in space, there are also the hazards of the Martian environment itself. These include Mars' incredibly thin and toxic and toxic atmosphere, the high levels of radiation the planet is exposed to, and the fact that the surface is extremely cold and drier than the driest deserts on Earth.

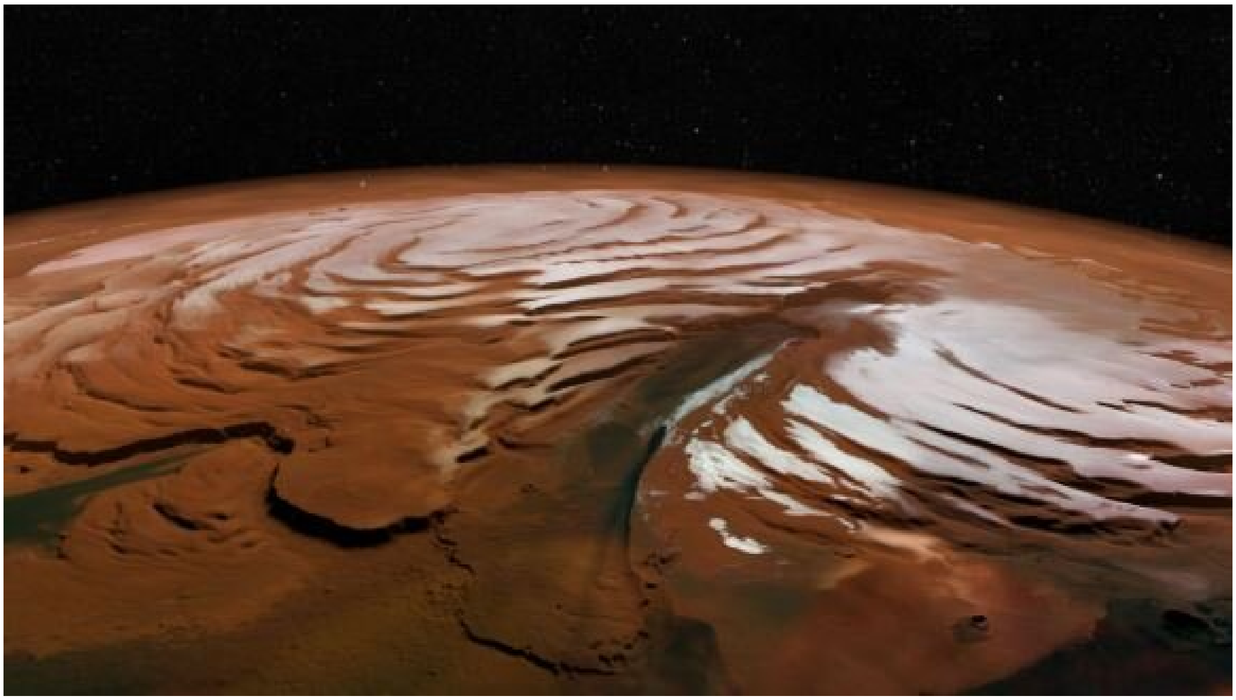
As a result, missions to Mars will need to leverage local resources to provide all the basic necessities, a process known as In-Situ Resource Utilization (ISRU). Looking to address the need for propellant, a team from the Spanish innovation company Tekniker is developing a system that uses solar power to convert astronaut wastewater into fuel. This technology could be a game-changer for missions to deep space in the coming years, including the moon, Mars and beyond.

Headquartered in northeastern Spain, Tekniker is a non-profit research, development, and innovation (R&D&I) organization that specializes in advanced manufacturing and information and communications technology (ICT). This photoelectrochemical system relies on high-efficiency catalytic materials to produce hydrocarbons like methane, carbon monoxide, or alcohols from atmospheric CO_2 and wastewater.

In the process, the system also detoxifies the wastewater used, operating as a water-recycling method. The system is the brainchild of Tekniker telecommunications engineer Dr. Borja Poza and material engineer Dr. Eva Gutierrez. As Poza explained in a recent ESA press release:

"We aim to make the first reactor to produce space propellant on Mars using the planet's air, which is 95% carbon dioxide. The reactor will be powered by sunlight, and astronauts' greywater will be used to help in the production of the propellant."

On Mars, liquid water is not readily available, but multiple lines of evidence indicate that subsurface ice exists in many regions. In keeping with the ISRU process, future missions would harvest this ice to provide drinking water, irrigation for plants, sanitation, and manufacture rocket fuel. This is done by breaking down water molecules (H_2O) to produce molecular hydrogen (H_2) and oxygen gas (O_2).



A vertically exaggerated view of Mars' north polar cap. Credit: SA/DLR/FU Berlin; NASA MGS MOLA Science Team

When cooled to cryogenic temperatures, these elements become the two ingredients of conventional hydrogen fuel—i.e., liquid hydrogen and liquid oxygen (LOX). Hence, the locations of water ice deposits on Mars are a major concern for mission planners and the selection of future landing sites. Around the poles, there are abundant supplies of water concentrated in the ice caps, and layers of subsurface permafrost have been observed at all latitudes.

In some spots around the poles, water ice has been detected just 30 cm (about 12 inches) beneath the surface, making it easily accessible. Recent data obtained by the ExoMars Trace Gas Orbiter (TGO) revealed large amounts of ice mixed with regolith at the bottom of Mars' massive canyon system—Valles Marineris. There is also evidence that there may be underground sources of ice around the planet's mid-latitudes, though this remains a contentious possibility.

Jean-Christophe Berton, the ESA technical officer for the project at the European Space Operations Center (ESOC) in Germany, said, "The outcome of this activity could provide ESA with valuable input on the production of propellant on Mars or to power remote sites like ground stations on Earth. It could also potentially provide input on how to decarbonize our own atmosphere."

The project was submitted in response to an open call from the ESA's Open Space Innovation Platform (OSIP), which seeks promising new ideas for applications in space. This system is one of many technologies that will allow astronauts and crews to live and work sustainably for extended periods on the moon, Mars, and beyond. In these environments, resupply missions will take weeks or months to reach them, making reliance on Earth impractical.

These include technologies that will allow astronauts to use local regolith to construct habitats that will protect against the elements and radiation on Mars, grow and cultivate food inside these habitats, and create oxygen gas from the Martian atmosphere.

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