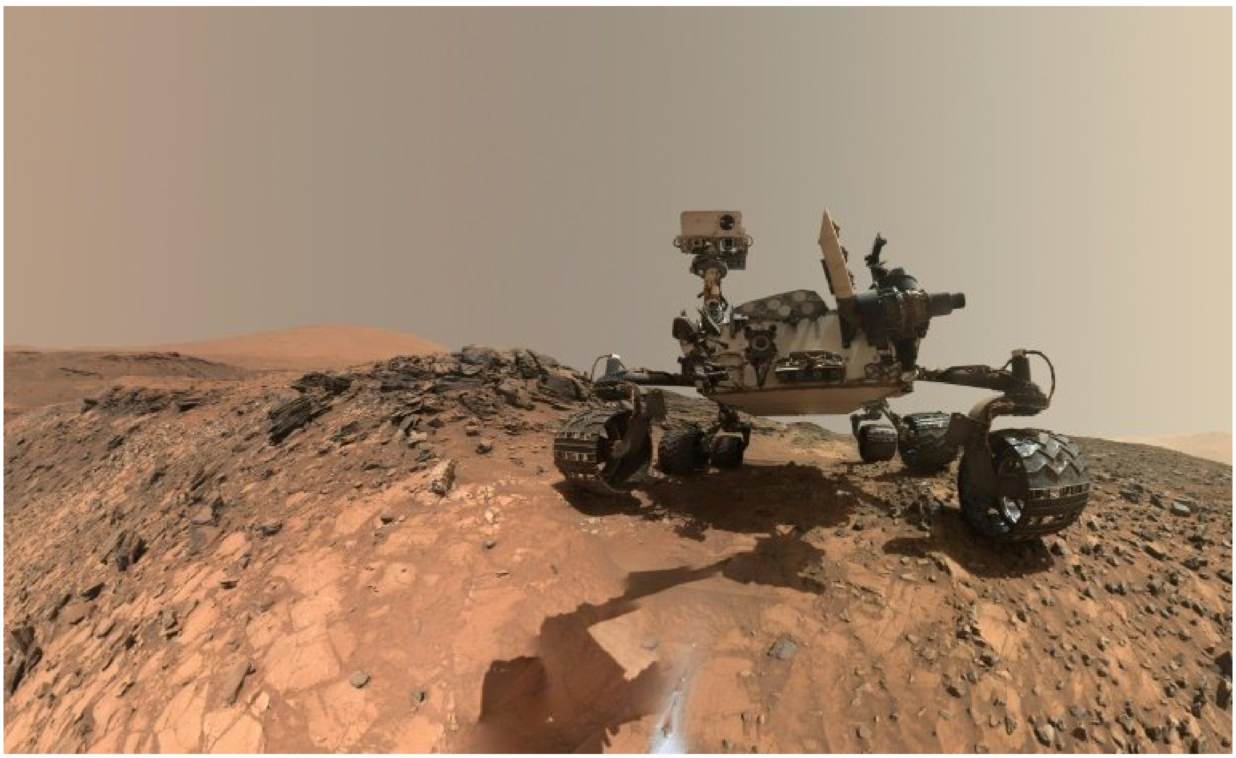
Mars could have enough molecular oxygen to support life, and scientists figured out where to find it

October 22 2018, by Deborah Netburn, Los Angeles Times



The new research was made possible by the discovery by NASA's Curiosity Mars rover of manganese oxides

Modern-day Mars may be more hospitable to oxygen-breathing life than previously thought.

A new study suggests that salty water at or near the surface of the red planet could contain enough dissolved O2 to support oxygen-breathing microbes, and even more complex organisms such as sponges.

"Nobody thought of Mars as a place where aerobic respiration would work because there is so little oxygen in the atmosphere," said Vlada Stamenkovic an Earth and planetary scientist at the Jet Propulsion Laboratory who led the work. "What we're saying is it is possible that this planet that is so different from Earth could have given aerobic life a chance."

As part of the report, Stamenkovic and his coauthors also identified which regions of Mars are most likely to contain brines with the greatest amounts of dissolved oxygen. This could help NASA and other space agencies plan where to send landers on future missions, they said.

The work was published Monday in *Nature Geoscience*.

On its surface, the planet Mars is not what you would consider a hospitable place for most Earthlings.

Here on Earth, 21 percent of our atmosphere is made up of oxygen—thanks to the abundance of plants and other organisms that create oxygen as a byproduct of photosynthesis.

The Martian atmosphere, on the other hand, is made up of just .145 percent oxygen, according to data collected by the Mars rovers.

With no plants to make O2, the minuscule amount of oxygen on Mars is created when radiation from the sun interacts with CO2 in the planet's atmosphere.

In addition, Mars' atmosphere is extremely thin—160 times thinner than

Earth's atmosphere. In addition, the temperature at the surface frequently drops to minus 100, making it extremely difficult for liquid water to exist on the planet's surface.

Pure liquid water would either freeze or evaporate away on Mars, but salty water, or brines, could remain in a liquid state at or just below the surface of the planet, the authors said. That's because water mixed with salts has a lower freezing temperature than plain water. (That's why those unfortunate people who live in cold climates use salt to melt the ice on their sidewalks.)

In the first part of the paper, the authors use computer models to show that water mixed with salts already present on Mars could be stable in a liquid state at or near the surface.

Once the authors were convinced that these liquid brines could exist, their next step was to determine how much dissolved oxygen they could absorb from the atmosphere.

"If there are brines on Mars, then the oxygen would have no choice but to infiltrate them," said Woody Fischer, a geobiologist at Caltech who worked on the study. "The oxygen would make it everywhere."

To calculate how much oxygen the brines might absorb, the researchers had to consider their chemistry, as well as the temperature and air pressure at the Martian surface. Brines will absorb more oxygen when the temperature is lower and the air pressure is higher.

Their results showed that modern Mars could support liquid environments with enough dissolved O_2 to support oxygen-breathing microbes across the planet. They also found that the oxygen concentrations would be especially high in brines found at the polar regions, where temperatures are cooler.

So far, this work has been done through computer modeling. But experts still said that the study looks robust.

"The best studies that rely on models for their results conduct a thorough review of the possible variables that can influence the model output," said Kathleen Mandt, a planetary biologist at the Johns Hopkins University Applied Physics Laboratory. "This study does a good job at exploring a range of possible outcomes."

What the study doesn't do, however, is prove that there are indeed brines on Mars.

"What we know is that theoretically there should be brines on Mars, and that they would be able to dissolve enough oxygen to be biologically useful," Stamenkovic said.

The next step, he said, is two-fold.

He hopes that researchers here on Earth will do experiments to put oxygen-breathing microbes in the brines that could occur on Mars to find out what type of chemistry they do and whether they can thrive. The other step would be to send a lander to Mars that can look for brines from the shallow to the deep subsurface.

"Amazing work has been done by NASA to look for evidence of past habitable environments," he said. "I am a big promoter of looking for current habitable environments, and we can do that by starting to explore if there is liquid water on Mars."

To that end, Stamenkovic is working to develop a new tool, no bigger than a shoe box, that could be used to find water on Mars and determine its salinity, no digging necessary.

He calls it TH2OR.

More information: Vlada Stamenković et al. O2 solubility in Martian near-surface environments and implications for aerobic life, *Nature Geoscience* (2018). DOI: 10.1038/s41561-018-0243-0