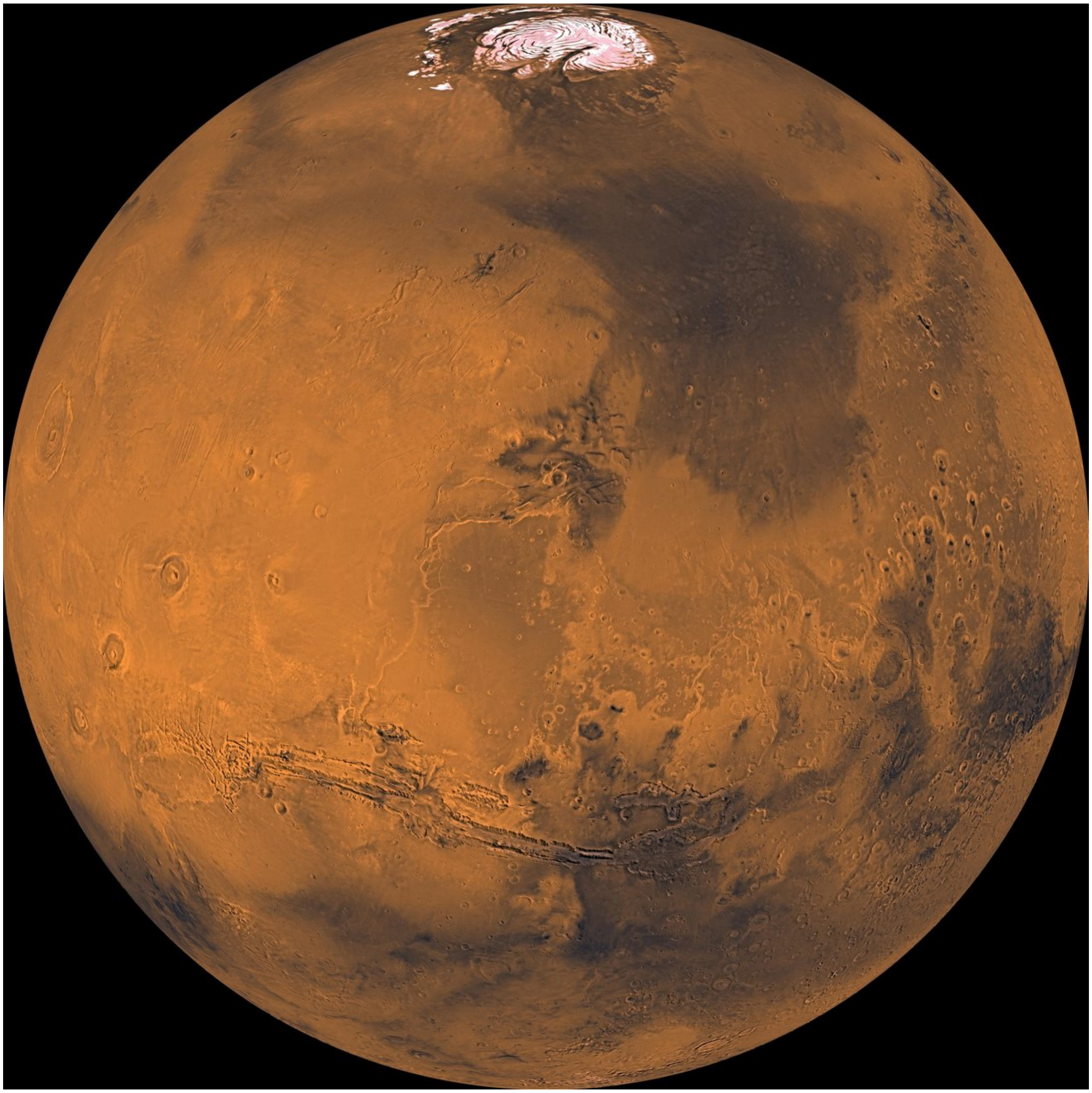
Sponges from Mars? Study suggests water on the red planet could support life

October 23 2018, by Andrew Coates



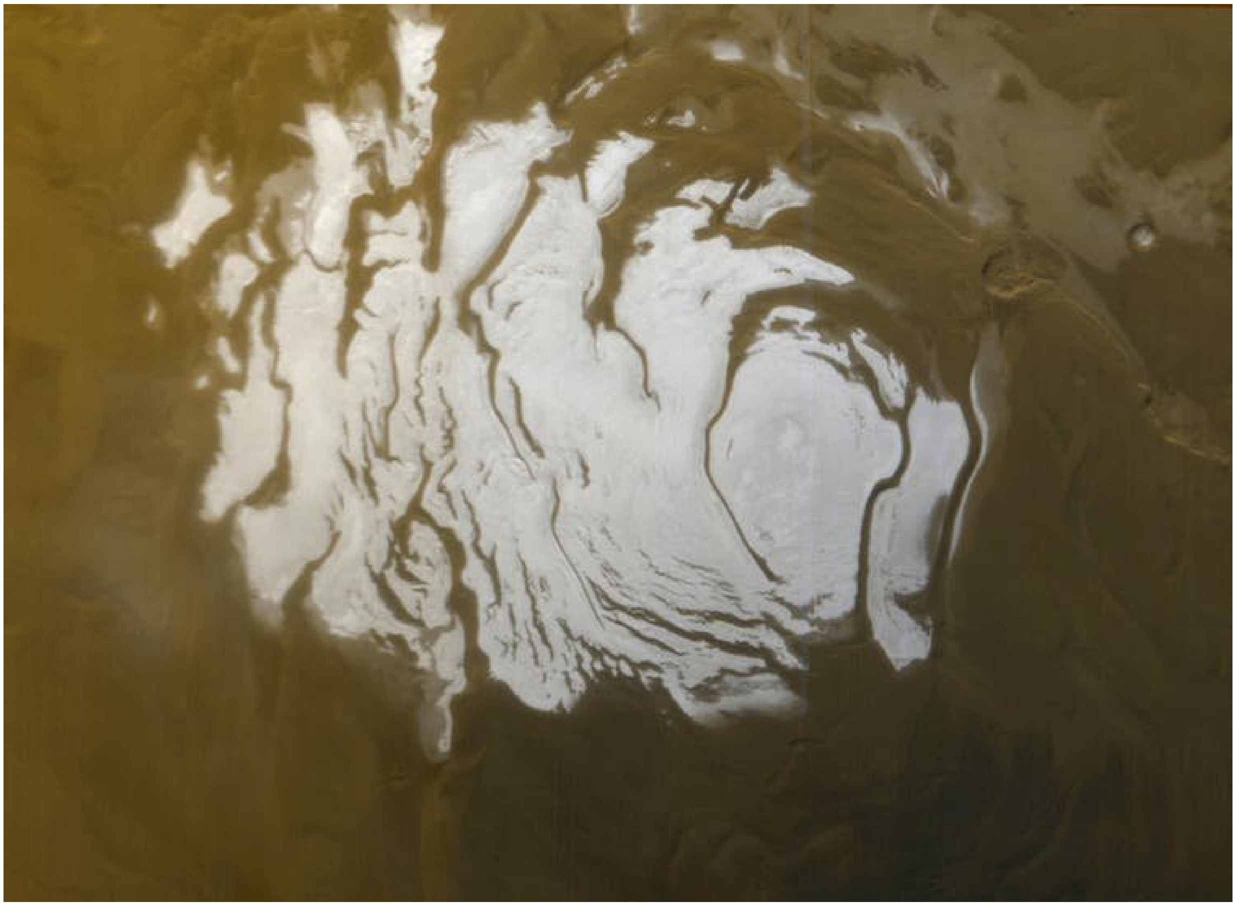
Mars seen by the Viking orbiter. Credit: NASA/JPL/USGS

Mars has long been thought of as dry and barren – unable to harbour life. But research over the past few years indicates that there is most likely some briny water present there today, including a possible subsurface lake. This has led to new hopes that there could actually be life on the red planet after all, depending on what the conditions are like in the water.

Now, a new study, published in Nature Geoscience, surprisingly shows that brine deposits below the surface of Mars, particularly near the poles, can contain molecular oxygen – which is crucial for life on Earth. This is exciting as it makes it even more likely that the planet could support microbial life or even simple animals like sponges.

The surface of Mars 3.8 billion to 4 billion years ago was much like the Earth's and would therefore have had the right conditions for life. At that time, it had a thick atmosphere and flowing water on the surface, a global magnetic field and volcanism.

Today, the surface is dry and cold – 5ºC to 10ºC by day and -100ºC to -120ºC at night. In fact, the atmospheric pressure now is less than 1% of the Earth's, meaning that any flowing water would quickly evaporate into the atmosphere. But it can remain trapped below the surface. Volcanism is also dead and only small-scale crustal magnetic fields remain to protect it from harsh solar radiation in the southern hemisphere. It was for these reasons that current life on Mars was until very recently considered highly unlikely.



A lake is thought to lurk below Mars' south polar ice cap. Credit: NASA

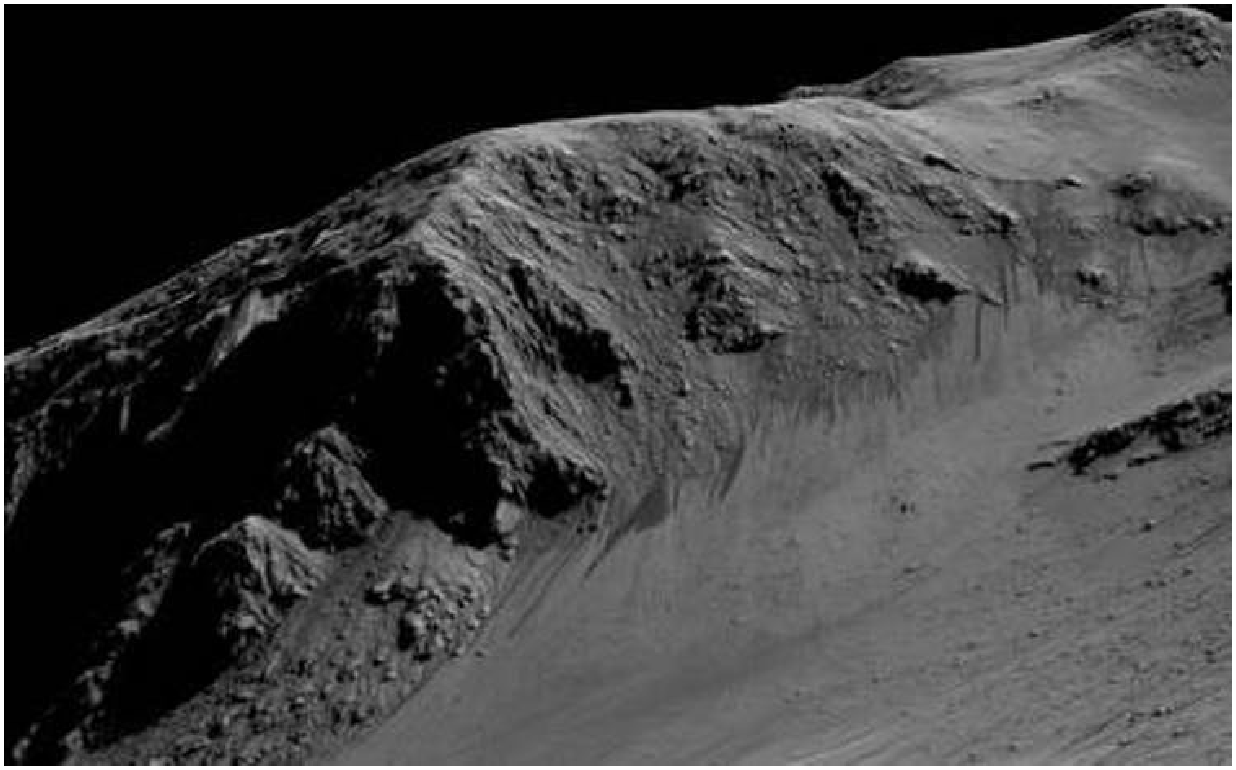
Mounting evidence

We now know that there are traces of methane on Mars, however, as discovered by Mars Express and the Curiosity rover. The source of this methane might be either hydrothermal activity (the movement of heated water), or microbial life. On Earth, flatulent cows alone produce some 25% to 30% of the methane in the atmosphere. Either of these possibilities challenges our current understanding of the red planet, but if the source is life that would obviously be an amazing discovery. The joint European and Russian ExoMars Trace Gas Orbiter is currently investigating the source of this methane.

The NASA Mars Reconnaissance Orbiter also discovered seasonal features called "recurrent slope lineae" – streak-like patterns which may indicate briny water seeping to the surface. However there are alternative explanations. Some scientists suggest that these may also just be movements of sand. That said, rovers and landers have found substances including calcium and magnesium perchlorates near the suspected water seeps and at other locations on Mars – and these indicate the presence of brine.

Most recently, the ESA Mars Express mission found radar evidence for liquid water underneath the south polar region on Mars – potentially a subsurface lake. This water, which also appears to be briny, would be a whopping 20km wide and be situated 1.5km under the surface.

The new study calculated how much molecular oxygen could be dissolved in liquid brines on Mars. It shows that the small amount of oxygen that is produced in the atmosphere could indeed become dissolved in brines at the temperature and pressure seen near the surface of Mars. Using an atmospheric model, the researchers then studied this solubility at different locations of the planet and over time. Liquid environments which contain dissolved molecular oxygen would be scattered over most of the surface of Mars, but would be particularly concentrated near the poles where conditions are colder.



Water seeps on Mars.

The computer models show that this could lead to breathable concentrations of oxygen for any aerobic microbes (bugs that require oxygen). On Earth, life evolved alongside photosynthesis, which provided breathable oxygen for aerobic life. The new results are interesting – they show how breathable oxygen could be created independently of photosynthesis. They may also explain how the oxidised rocks on the planet's surface could have formed.

Leads for space exploration

So how can we find evidence of life? The current Mars missions are providing global mapping of minerals from orbit as well as information from the surface. Recent rover results include Curiosity's discovery that organic molecules may be long lived on Mars. NASA's Mars 2020 rover mission will cache samples ready for an eventual NASA-ESA mission to return them to Earth, being planned now.

However, the NASA rovers are designed to drill only five centimetres under the surface. The rover that is part of the ESA-Russia ExoMars 2020 mission that we are working on will be able to drill up to two metres below it. This will get below where ultraviolet, cosmic and solar radiation can penetrate and harm life – providing our best hope of finding life on Mars of any planned mission. The ExoMars rover landing site will be decided in November from two current candidates – Mawrth Vallis and Oxia Planum, both of these were ancient water-rich environments.

Although the current strategy is to search for signs of ancient life on Mars, current life should be detectable too if present. We will have to wait for the ExoMars results to see if signs of either past or present biomarkers are present, and in the longer term analyse the returned samples. While the rover won't go to the lake or the water seeps, there is evidence for brines at other locations too, so there is a good possibility that they may be present at the ExoMars candidate sites.

Beyond the current missions, should we be targeting the brines specifically? That certainly would provide tantalising targets for future missions. The limit of what we can do may be imposed by the difficulty of deep drilling on a planet far away. Drilling up to 1.5km below the surface to sample the lake would be a large scale effort beyond the capability of current technology. The better bet may therefore be to target the nearer surface brine regions, such as the water seeps.

Another obstacle is the planetary protection rules, which state that you shouldn't risk contaminating an area where there may be extra-terrestrial life with bacteria from Earth. However, the hope is that any Martian life would be hardy enough to populate other areas and that our missions, designed and built with strict planetary protection guidelines, will find it.

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