HOUSE OF LORDS

In Focus

# Water on Mars

On 28 September 2015, NASA announced findings from its Mars Reconnaissance Orbiter (MRO), which suggested that liquid water may flow down the slopes and craters of the surface of Mars. The BBC observes that scientists have long speculated that liquid water may be present on Mars, especially given the existence of gullies and seasonal surface streaks. However, this is not a simple proposition given the conditions on the planet. For example, the BBC explains that "temperatures are usually well below zero Celsius and the atmospheric pressure is so low that liquid H20 will rapidly boil".

## The Evidence

According to NASA, scientists using the MRO's Compact Reconnaissance Imaging Spectrometer for Mars (CRISM), "detected signatures of hydrated minerals on slopes where mysterious streaks are seen on the Red Planet". CRISM allows scientists to determine the make-up of Mars' surface by measuring the wavelengths of reflected light. They observed that these "darkish streaks appear to ebb and flow over time"; when temperatures rise, the scientists found that these streaks darken and appear to flow, but diminish during colder seasons. The evidence to suggest that water flows on Mars was outlined by scientists in an article for the *Nature Geoscience* journal. That article notes that the dark streaks—known as 'recurring slope lineae' (RSL)—appear and grow incrementally in the downslope direction during warm seasons when temperatures reach about 250–300 Kelvin. These streaks were first discovered by Lujendra Ojha—lead author of the *Nature Geoscience* article—in 2010 using images from the MRO's High Resolution Imaging Science Experiment (HiRISE).

The Nature Geoscience article further explains that evidence of hydrated salts has been found at the four locations examined where RSL occurs. Given the signatures detected by CRISM, the authors suggest that the hydrated salts likely consist of magnesium perchlorate, magnesium chlorate and sodium perchlorates. They note that such salts can lower the freezing point and evaporation rate of water, and are 'hygroscopic'—which means they can absorb atmospheric moisture. Given these properties, the authors argue that "our findings strongly support the hypothesis that recurring slow lineae form as a result of contemporary water activity on Mars". Further, while the scientists explain that "the origin of water forming the RSL is not understood", they do suggest a number of potential causes, such as the melting of surface and subsurface ice or the presence of a local aquifer, for example. As the *Financial Times* reports, the result "is the most convincing evidence so far that liquid water exists today on the Martian surface", though the article also notes that "the satellite instruments do not have sufficient resolution to detect water directly in the RSL".

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## Life on Mars?

A number of press reports have suggested that the presence of water on Mars increases the chances that there could be life on the Red Planet—albeit microbial—as most scientists agree that water is essential for the existence of life. Given this, John Grunsfeld, astronaut and administrator of NASA's Science Mission Directorate in Washington, explains that "our quest on Mars has been to 'follow the water' in our search for life in the universe, and now we have convincing science that validates what we've long suspected". Indeed, as noted by *The Guardian* "to find living organisms on Mars—even primitive microbes—would rank among the most important discoveries in history".

The BBC observes that there would be significant difficulties associated with sending a spacecraft to confirm the existence of life on the planet, however. The streaks are located "in pretty inaccessible places", and that any probe would also have to contend with working on steep slopes. Moreover, it would also be difficult to land a probe in these areas, given the difficult terrain and the current large margin of error involved in any landing on the planet. In addition, the BBC reports that there is also a risk of contaminating Mars with Earth microbes. Unless a spacecraft is fully sterilised, it is possible these microbes could survive the trip to Mars and potentially compromise any tests for life on the planet. Currently, all the major space agencies belong to the Committee on Space Research (COSPAR)—created in 1958, and which provides guidelines for space exploration—and COSPAR's Planetary Protection Policy requires that particular controls on contamination are implemented for certain types of space exploration missions. Despite the excitement surrounding the announcement that water potentially flows on Mars, a *National Geographic* article also urges caution about the possibility of finding life on the planet. It states that "finding evidence for flowing water is not the same as finding life", and suggests that "scientists don't know where this water is coming from, or if the chemistry in these Martian seeps is even life-friendly".

## Ancient Lakes on Mars

On 8 October 2015, NASA announced that its Curiosity Rover had also confirmed the existence of ancient lakes on Mars. According to a press release issued in the wake of the discovery, NASA scientists have confirmed that the planet was once capable of storing water in lakes billions of years ago. The scientists suggest that sediment was deposited in the Gale Crater and formed the foundations for Mount Sharp—a mountain located in the middle of that crater. They contend that streams and lakes were present about 3.3 to 3.8 billion years ago, and helped build up the sediment forming the lower portion of Mount Sharp. However, scientists also speculate that for water to have flowed on the surface of Mars at that time, the planet would have needed a significantly thicker atmosphere and warmer climate.