Briny water may be at work in seasonal flows on Mars

August 4 2011

Dark, finger-like features that appear and extend down some Martian slopes during the warmest months of the Mars year may show activity of salty water on Mars. They fade in winter, then recur the next spring.

Repeated observations by the HiRISE camera currently orbiting Mars aboard NASA's Mars Reconnaissance Orbiter have tracked seasonal changes in these recurring features on several steep slopes in middle latitudes of Mars' southern hemisphere. Some aspects of the observations still puzzle researchers.

"The best explanation we have for these observations so far is flow of briny water, although this study does not prove that," said Alfred McEwen of the University of Arizona's Lunar and Planetary Laboratory. McEwen is the principal investigator for the orbiter's High Resolution Imaging Science Experiment (HiRISE) and the lead author of a report about the recurring flows published on August 5 by the journal *Science*.

Other explanations remain possible, but flows of liquid brine fit the features' characteristics better than alternative hypotheses. Saltiness lowers the temperature at which water freezes. Some sites with the dark flows get warm enough to keep water liquid if it is about as salty as Earth's oceans, but temperatures in those areas would not melt pure water ice. Sites with liquid brines could be important to future studies of whether life exists on Mars and to understanding the history of water.

The features are only about 0.5 to 5 yards or meters wide, with lengths

up to hundreds of meters. That is much narrower than previously reported gullies on Martian slopes. They have been seen in only about one percent as many locations as larger Mars gullies, but some of those locations display more than 1,000 individual flows. Also, while gullies are abundant on cold, pole-facing slopes, these dark flows are not.

The team first discovered the strange features after University of Arizona student Lujendra Ojha, at the time a junior majoring in geophysics, used a change detection algorithm capable of identifying subtle changes occurring on the Martian surface over time in image pairs during an independent study project.

“I was baffled when I first saw those features in the images after I had run them through my algorithm,” said Ojha, who is a co-author on the Science publication. “We soon realized they were different from slope streaks that had been observed before. These are highly seasonal, and we observed some of them had grown by more than 200 meters in a matter of just two Earth months.”

“By comparison with Earth, it's hard to imagine they are formed by anything other than fluid seeping down slopes,” said Mars Reconnaissance Orbiter Project Scientist Richard Zurek of NASA's Jet Propulsion Laboratory, Pasadena, Calif. “The question is whether this is happening on Mars and, if so, why just in these particular places.”

Other clues help, too. The flows lengthen and darken on rocky equator-facing slopes from late spring to early fall. Favoring warm areas and times suggests a volatile material is involved, but which volatile? The settings are too warm for carbon-dioxide frost and, at some sites, too cold for pure water. This suggests the action of brines with their lower freezing points. Salt deposits indicate brines have been abundant in Mars' past. These recent observations suggest they may form near the surface today in rare times and places.

However, when researchers checked some flow-marked slopes with the orbiter's Compact Reconnaissance Imaging Spectrometer for Mars (CRISM), no sign of water appeared. The features may quickly dry on the surface, or be mainly shallow subsurface flows. “The flows are not dark because of being wet,” McEwen said. A flow initiated by briny water could rearrange grains or change surface roughness in a way that darkens the appearance. How the features brighten again when temperatures drop is harder to explain. “It's a mystery now, but I think it's a solvable mystery with further observations and experiments,” he said.

Mars has not yielded definitive evidence of liquid water active on the planet's surface today. Frozen water has been detected near the surface in many middle- to high-latitude regions of Mars. Fresh-looking gullies suggest slope movements in geologically recent times, perhaps aided by water. Possible droplets of brine appeared on struts of the Phoenix Mars Lander. If further study of the recurring dark flows strengthens an explanation requiring brines, they could be the first known Martian ground with liquid water. Even if another explanation prevails, they still provide constraints on physical processes and conditions operating today.

JPL, a division of the California Institute of Technology, Pasadena, manages the Mars Reconnaissance Orbiter for NASA. The University of Arizona’s Lunar and Planetary Laboratory operates the HiRISE camera, built by Ball Aerospace & Technologies Corp., Boulder, Colo. Johns Hopkins University Applied Physics Laboratory provided and operates CRISM.

Provided by University of Arizona