Sopping salts could reveal history of water on Mars

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Epsom-like salts believed to be common on Mars may be a major source of water there, say geologists at Indiana University Bloomington and Los Alamos National Laboratory. In their report in this week's *Nature*, the scientists also speculate that the **salts will provide a chemical record of water on the Red Planet**.

"The Mars Odyssey orbiter recently showed that there may be as much as 10 percent water hidden in the Martian near-surface," said David Bish, Haydn Murray Chair of Applied Clay Mineralogy at IU and a co-author of the report. "We were able to show that under Mars-like conditions, magnesium sulfate salts can contain a great deal of water. Our findings also suggest that the kinds of sulfates we find on Mars could give us a lot of insight into the history of water and mineral formation there."

The scientists learned that magnesium sulfate salts are extremely sensitive to changes in temperature, pressure and humidity. For that reason, the scientists argue that information contained in the salts could be easily lost if samples were brought back to Earth for study. Instead, they say, future missions to Mars should measure the properties of the salts on site.

The existence of magnesium sulfate salts on Mars was first suggested by the 1976 Viking missions and has since been confirmed by the Mars Exploration Rover as well as the Odyssey and Pathfinder missions. One way to quash remaining doubts that the salts are really there, however, would be to equip a Martian rover with an X-ray diffractometer -- an instrument that analyzes the properties of crystals. Coincidentally, such a device could also be used to examine magnesium sulfate salts on Mars. Bish and collaborators from NASA Ames and Los Alamos are currently developing a miniaturized X-ray diffractometer with NASA funding.

Some magnesium sulfate salts trap more water than others. Epsomite, for example, has the most water in it -- 51 percent by weight -- while hexahydrite and kieserite have less (47 percent and 13 percent by weight, respectively). The proportion of water to magnesium sulfate affects the chemical properties of the different salts.

While varying temperature, pressure and humidity inside an experimental chamber, the scientists studied how the different magnesium salts transform over time.

When temperature and pressure inside an experimental chamber were lowered to Mars-like conditions (minus 64 degrees Fahrenheit, and less than 1 percent of Earth's normal surface pressure), crystals of epsomite initially transformed into slightly less watery hexahydrite crystals and then became disorganized, but they still contained water. In contrast, "kieserite doesn't let go of its water very easily, even at very low pressure and humidity or at elevated temperatures," Bish said.

But when the scientists increased humidity inside the experimental chamber, they found that kieserite transformed into hexahydrite and then epsomite, which have more water.

Bish and his Los Alamos colleagues believe that the proportion and distribution of hexahydrite, kieserite and other magnesium sulfate salts on Mars may hold a record of past changes in climate and whether or not water once flowed there. However, kieserite might not be preserved through cycles of wetting and drying because of its ability to rehydrate to hexahydrite and epsomite, which can then become amorphous through drying.

Los Alamos National Laboratory geologists David Vaniman, Steve Chipera, Claire Fialips, William Carey and William Feldman also contributed to the study. It was funded by LANL Directed Research and Development Funding and NASA Mars Fundamental Research Program grants.

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