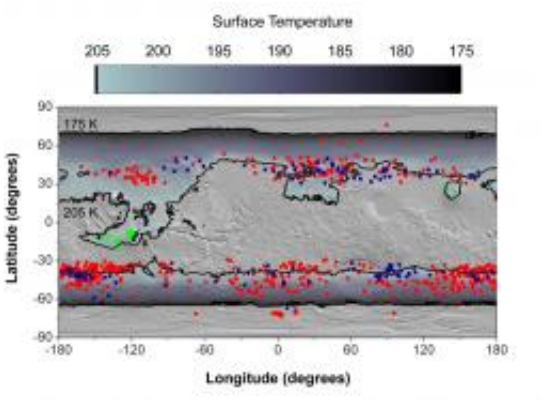
Model Suggests Origins of Mars Gullies

February 9 2009



A map of the surface of Mars. The gullies are the red dots, the blue squares are viscous flows and the green stars are low-latitude gullies. The blue-grey zones are where the University of Arkansas model shows that brine containing ferric sulfate could be liquid at times. Credit: Vincent Chevrier and Travis Altheide

University of Arkansas researchers have used chemistry and geology to create a model that may explain the mystery of how modern-day gullies form on the surface of Mars.

Research professor Vincent F. Chevrier and graduate student Travis S. Altheide of the Arkansas Center for Space and Planetary Sciences report their findings in *Geophysical Research Letters*.

Planetary surveys have found abundant evidence of gullies on Mars, which suggest that at some point liquid has flowed across the planet's surface. Liquid water cannot exist on the surface of Mars given the

current temperatures and pressures, so for many years, scientists theorized that the gullies formed hundreds of thousands of years ago during a change in the angle between the planes of the planet's equator and its orbit about the sun.

However, the Mars Global Surveyor discovered a gully where none had been three years before, prompting scientists to speculate as to how it formed. Chevrier and Altheide decided to look at the possibility of brine - a concentrated solution of water and salt - as a potential gully carver. Water ice and salts are both found in various locations on the planet. And certain brines have much lower freezing points than water and therefore have the potential to exist in liquid form on Mars.

The researchers examined the properties of brine containing ferric sulfate, which has been found in some geologic formations on Mars. They created samples with different concentrations of ferric sulfate. Then they subjected the brown, sludge-like smelly substances to increasingly lower temperatures. In addition, they were able to re-create the conditions of atmosphere and pressure found on Mars to test the specific conditions under which the brine might be found and therefore get a glimpse of what it might look like.

They determined that the temperature at which the ferric sulfate brine turns completely from liquid to solid is extremely low - 68 degrees Celsius - and that its evaporation point is low enough that there is a possibility that, on occasion, this brine could be found on the surface of Mars in liquid form.

"The liquid has a window between frozen and boiling," said Chevrier.

Using thermodynamic calculations and the temperature information gathered experimentally, Chevrier and Altheide created a map that shows where brine might be found above and below the surface on Mars.

The map also shows whether or not the brine would be frozen or evaporating as a result of the temperatures. The map shows an area where the temperatures are such that the brine could, at times, be liquid and flowing.

They then created a map that shows all of the places on the surface of Mars where gullies have been discovered. The vast majority of the gullies lie within the zone where the brine could be liquid.

“We’re calling this the episodic liquid zone,” said Altheide. “Temperature swings in this region could cause the release of liquid in the form of brine and thus explain the formation of present-day gullies.”

Provided by University of Arkansas