MERIDIANIITE ($MgSO_4 \cdot 11H_2O$): A NEW MINERAL SPECIES OBSERVED ON EARTH AND PREDICTED TO EXIST ON MARS. R.C. Peterson, W. Nelson, B. Madu and H. F. Shurvell, [1] Department of Geological Sciences and Geological Engineering, Queen's University, Kingston, Ontario, Canada,K7L 3N6. [2] Artisan Minerals, Ashcroft British Columbia, Canada,V0K 1A0. [3] Mining and Minerals Division, Ministry of Energy Mines and Petroleum Resources, Kamloops British Columbia, Canada, V2C 4N7. [4] Department Chemistry, Queen's University, Kingston, Ontario, Canada, K7L 3N6

Magnesium sulfate minerals are thought to exist in the soils at Gusev crater and elsewhere on the Martian surface[1]. These minerals are thought to have formed through evaporation of a brine solution at or below the surface of soil or the sulfate material may have formed elsewhere and transported by wind

The phase diagram for the $MgSO_4$-H_2O system shows that at temperatures below 275K, $MgSO_4 \cdot 11H_2O$ is the stable phase in equilibrium with a saturated brine or with ice.

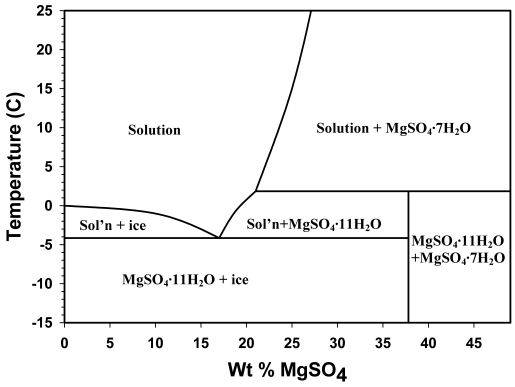

Figure 1. $MgSO_4$-H_2O phase diagram

The atomic structure of synthetic $MgSO_4 \cdot 11H_2O$ has been solved by single crystal X-ray diffraction[2] but the material had not been observed in nature. $MgSO_4 \cdot 11H_2O$, was recently discovered on the surface of a frozen pond in central British Columbia Canada. The ponds were created when magnesium sulfate was mined from evaporite deposits between 1920 and 1972. This new mineral formed as solution containing magnesium sulfate was wicked up the bark on the lower side of an inclined post. As the solution evaporated at temperatures below 2° C, $MgSO_4 \cdot 11H_2O$ crystallized. The name, meridianiite, was chosen for naturally occurring $MgSO_4 \cdot 11H_2O$ to reflect the locality on Mars where the MER rover Opportunity observed crystal molds in sedimentary rock that are thought to be caused by minerals that have since dehydrated or dissolved.

Figure2. Merdianiite crystallized as white granular material mixed with bark. The bark acted as a wick drawing magnesium rich solution from below the ice up the post where it evaporated. The meter is 7cm wide

Meridianiite is stable below 2°C. Above 2°C it melts incongruently to a slurry of epsomite ($MgSO_4 \cdot 7H_2O$) and water. This evolution of four moles of water is not a dehydration reaction but generates a sulfate-rich solution which could flow from a melting sulfate deposit.

Meridianiite, instead of epsomite, is the expected magnesium sulfate phase in equilibrium with brine or ice on or below the Martian surface. Meridianiite, under the current low humidity conditions in equatorial regions on Mars, would ultimately dehydrate to a fine dust of kieserite ($MgSO_4 \cdot H_2O$) that could be dispersed by wind across the Martian surface.

[1] Wang,A,Haskin,L.A.,Squyres,S.W.,Jolliff,B.L., Crumpler,L.,Gellert,R.,Schroder, C., Herkenhoff, K.,Hurowitz,J.,Tosca,N.J.,Farrand,W.H.,Anderson,R., & Knudson,A.T. Sulphate deposition in subsurface regolith in Gusev crater, Mars. *J. Geophysical Research*, **111**, e02s17.

[2] Peterson, R.C. & Wang, R. Crystal Molds on Mars: Melting of a possible new mineral species to create Martian chaotic terrain. *Geology*, **34**, 957-960, (2006).