

**PERCHLORATE FOUND BY PHOENIX COULD PROVIDE A MOBILE BRINE SLUDGE AT THE BED OF MARS NORTHERN ICE CAP THAT WOULD ALLOW FLOW WITH VERY LOW BASAL TEMPERATURES: POSSIBLE MECHANISM FOR WATER TABLE RE-CHARGE** . D. A. Fisher<sup>1</sup> M. Hecht<sup>2</sup>, S Kounaves<sup>3</sup> and D Catling<sup>4</sup>. <sup>1</sup> Geological Survey of Canada, NRCan. Ottawa Ontario K1A 0E8 [fisher@nrcan.gc.ca](mailto:fisher@nrcan.gc.ca), <sup>2</sup> JPL Pasadena /Caltech CA 91109. <sup>3</sup> Dept. of Chemistry ,Tufts University ,Medford MA02035. <sup>4</sup> Earth and Space Sciences/Astrobiology Program, University of Washington , Box 351310, Seattle WA 98195.

### Introduction

The discovery of substantial amounts of magnesium perchlorate hydrate [1] by Phoenix' "Wet Chemistry Lab" (WCL) in the soil of Polar Mars opens some unexpected doors for moving liquid water around at temperatures as low as -68C. In its fully hydrated form with 8 water molecules attached to each magnesium perchlorate, the salt water mixture has a high density (~ 1700 kgm /cubic meter)(Besley and Bottomley,1969) and a freezing point of -68C [2]. This perchlorate is very deliquescent and gives off heat as it melts ice. About 1.8 gram of ice can be 'melted' by 1 gm of pure magnesium perchlorate [3].

### Effects of Perchlorate Brine at the bed of the Ice Cap

If the 1% perchlorate is typical of polar soils and if 5% of the Northern Permanent Ice Cap is soil then the perchlorate, makes up about 1/2000 the of the ice cap. Given the average thickness of the ice cap is about 2000 meters this suggests there enough perchlorate in the ice cap to generate about 2m of salty water at the bed. Because of its density the perchlorate salty water would pool over impervious layers and make the bed into a perchlorate sludge that could be mobilized and deformed by the overburden of ice. The deformation of mobile beds is a well known phenomenon on some terrestrial glaciers presently and was thought to have played a major role during the Wisconsinan ice age. The perchlorate sludge would be deformed and moved outwards possibly resulting its reintroduction to the periglacial environment for re-use.

Having a deliquescent salt sludge at the bed whose melting point is -68C would mean that the ice cap could slide on its deformable bed while the ice itself was still very cold and stiff. This possibility has been modeled with a 2D time varying model. Adding the deformable bed material allows ice cap motion even at ice temperatures cold enough to generate and preserve the scarp/trough features.

When the perchlorate formation mechanisms and rates are known the ultimate importance of it in the water cycle of Mars will be clearer. The ice cap has long been thought of as a possible re-charge area for the deep water return flow. If perchlorate is formed sufficiently quickly, then this view would be strengthened in spite of the low temperatures at the bed.

### References

- [1] Hecht M H et al. (2009) Science, submitted.  
 [2] Pestova O. N., Myund L.A., Khripun M.K. and A.V. Prigaro. (2005). Polythermal study of systems M(ClO<sub>4</sub>)<sub>2</sub>-H<sub>2</sub>O

(M<sub>2</sub>+Mg<sup>2+</sup>, Ca<sup>2+</sup>, Sr<sup>2+</sup>, Ba<sup>2+</sup>). Russian Journal of Applied Chemistry, Vol.78.No.3,pp409-413.

[3] Besley L. M. and G.A. Bottomley. 1969. The water vapour equilibria over magnesium perchlorate hydrates. Journal of Chemical Thermodynamics. 1, pp13-19.

