INSIGHTS INTO THE GLOBAL, SUBSURFACE BIOLOGIC POTENTIAL OF MARS: DELIQUESCENCE AT CONTRADISTINCT LATITUDES. E. G. Rivera-Valentín[1], B. J. Rodriguez Colon[1,2], V. F. Chevrier[3], A. Soto[4]; [1]Arecibo Observatory, Universities Space Research Association, Arecibo, PR (*ed@naic.edu*); [2]University of Puerto Rico, Mayagüez, Dept. of Biology & Dept. of Geology, PO Box 9000, Mayagüez, PR 00681; [3]Arkansas Center for Space and Planetary Sciences, University of Arkansas, Fayetteville, AR; [4]Southwest Research Institute, 1050 Walnut St, Suite 300, Boulder, CO 80302.

Introduction: The evidence is mounting for liquid water activity on present-day Mars as exemplified by recurring slope lineae (RSL) [1-3], the identification of associated hydrated mineralogy [4], and their near widespread distribution. A potential liquid trigger for RSL is deliquescence [4,5], the transition from a solid, crystalline salt into an aqueous solution, which has been demonstrated to impact both biological [6] and geological [7] activity in terrestrial Mars-analog environments.

This process was once thought constrained to the mid-latitudes; however, the Phoenix Lander (PHX) and Mars Science Laboratory (MSL) rover, have demonstrated it is viable at contradistinct latitudes [8,9], which is further supported by thermodynamic analysis of REMS data [10,11]. The presence of liquid water alone, though, does not necessarily imply habitability. Adequate environmental conditions, such as temperature, salinity, and radiation, are also required for active metabolism and replication. Such parameters, constrained by life as we know it, are used to define special and uncertain regions on Mars [12]. Here we compare the potential, subsurface liquid water environments as constrained by MSL and PHX in order to elucidate the global subsurface, biologic potential of Mars.

Methods: We apply a fully coupled, heat and mass transfer model to simulate the subsurface conditions at the PHX and MSL sites. The thermal surface boundary condition is radiative and includes direct illumination, along with the scattering and thermal emission atmospheric components [13-15]. Water vapor diffusion through the regolith, which has been shown to be approximately Fickian [16], is simulated as diffusion advection [17]. For MSL, water vapor diffusion is simulated by coupling our model to REMS near-surface data. For PHX, we include an ice table at a depth of 10 cm and account for diffusion.

Results: We simulated thermal diffusion to a depth of 4 m with an element thickness of 0.01 m and time step of 370 s. Several martian years are simulated until the temperature profile at the vernal equinox from the previous year is nearly identical to that of the current simulation, at which point convergence is reached.

Mars Science Laboratory. Though on the surface and near-surface (*i.e.*, within the top ~ 5 cm), the conditions required for deliquescence for calcium perchlorate occur, they are found to only last for less than an hour. Moreover, the conditions quickly enter the solidus. However, in the deeper subsurface, the attenuated temperature and resulting relative humidity avoid the transition to the ice phase. In this scenario, a solution is present for several hours and can effloresce.

Phoenix Lander: Similar conditions are found at PHX, where solutions transition to ice and are not allowed to effloresce in the near-surface. However, unlike at MSL, an aqueous solution at the near-surface is present for longer time periods.

Conclusions: Results suggest that in the subsurface at both equatorial and polar regions, aqueous activity persists for longer periods due to the attenuation of the diurnal temperature wave. Furthermore, the water activity at both regions abides by the Special Region definition; however, while a solution is present, temperatures are far lower than that required for these definitions (>250 K). PHX experiences higher temperatures while a solution is present compared to MSL. Ultimately, though, temperature is the limiting factor in terms of habitability at both studied areas.

Our results suggest that higher latitudes may experience solution activity for longer periods and so would be more viable with respect to their habitability.

References: [1] McEwen, A. *et al*. (2011) *Science, 333*, 740-743. [2] McEwen, A. *et al*. (2013) *Nature, 7,* 53-58. [3] Ojha, L. *et al*. (2014) *Icarus, 231*, 365-376. [4] Ojha, L. *et al*. (2015) *Nat. Geo., 8,* 829-832. [5] Chevrier, V. F. & Rivera-Valentin, E. G. (2012) *GRL, 39,* L21202. [6] Davila, A. F. *et al*. (2010) *Astrobiology, 10,* 617-628. [7] Dickson, J. L. *et al*. (2013) *Scientific Reports, 3,* 1166. [8] Nuding, D. L. *et al*. (2014) *Icarus, 243*, 420-428. [9] Martin-Torres, F. J. *et al*. (2015) *Nat. Geo*., *8,* 357-361. [10] Rivera-Valentin, E. G. & Chevrier, V. F. (2015) *Icarus, 253*, 156-158. [11] Estevez-Galarza, C. A. & Rivera-Valentin, E. G. (2016) *LPSC*, Abstract #1268. [12] Rummel J. *et al*. (2014) *Astrobiology* 14:11. [13] Applebaum, J. & Flood (1989) *NASA Technical Memorandum* 1 – 34. [14] Aharonson, O. and Schorghofer, N. (2006) *JGR, 111*, E11107 . [15] Schmidt, F. et al. (2009) *Icarus, 200*, 374. [16] Clifford, S. M. and Hillel, D. (1986) *Soil Science, 141*, 289-297. [17] Ulrich, R. K. (2009) *Icarus, 201*, 127-134.

Acknowledgements: This material is based upon work supported by the National Aeronautics and Space Administration under Grant No. NNX15AM42G issued through the Mars Data Analysis Program.