ASSESSING THE ASTROBIOLOGICAL POTENTIAL OF A UNIQUE MARTIAN EVAPORITIC FLUVIOLACUSTRINE DEPOSIT. R. L. Harris[1], J. Huang[2†,3], M. Salvatore[4], C. Edwards[5], P. Christensen[6], L. Xiao[2,3*], and Y. Xu[3]. [1]Dept. of Geosciences, Princeton University, Princeton, NJ 08544 USA, rlh6@princeton.edu; [2]Planetary Science Institute, State Key Laboratory of Geological Processes and Mineral Reseources, School of Earth Sciences, China University of Geosciences, Wuhan, 430074, China, †rslihui@cug.edu.cn; [3]Macau University of Science and Technology, Macau, China, *longxiao@cug.edu.cn; [4]University of Michigan-Dearborn, Dept. of Natural Sciences, Dearborn, MI 48128 USA, msalva@umich.edu; [5]United States Geological Survey, Astrogeology Science Center, Flagstaff, AZ USA, christopher.edwards@nau.edu; [6]School of Earth and Space Science Exploration, Arizona State University, Tempe, AZ USA, phil.christensen@asu.edu.

Introduction: Chloride-bearing deposits (chlorides) and phyllosilicates are widely distributed across Mars' southern highlands, but these phases do not often coexist within the same fluviolacustrine environments. We integrated high-resolution imaging data from Thermal Emission Imaging System (THEMIS) [1], Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) [2], the High Resolution Imaging Science Experiment (HiRISE) [3], and Context Camera (CTX) [4] to identify Fe-Mg smectite clays overlying a chloride-bearing evaporitic unit in a Noachian fluviolacustrine deposit west of Knobel crater. A lack of other major evaporated phases (e.g. carbonates, sulfates, mature phyllosilicates) indicates compositionally unique aqueous environments were present in the basin between the middle Noachian and early Hesperian [5]. This is the first such site discovered on Mars where the stratigraphy suggests an evaporitic deposit predated phyllosilicate deposition, indicating an age of chloride formation when the Martian surface was most habitable [6]. As such, this site offers unique astrobiological prospects in the search for past Martian life and its associated biosignatures.

Methods: The site of interest comprises a togopgraphically enclosed ~3000 km^2 basin centered near 6.078 ˚S, 132.346 ˚E (Fig 1). Overall regional context was provided from imaging data from the THEMIS global mosaic (~100 m/pixel) (ref) and gridded topographic data from the Mars Orbiter Laser Altimeter (MOLA; 128 ppd) (ref). CRISM FRT data (~18 m/pixed) provided spectral information, which was compared to library mineral spectra. We used THEMIS nighttime infrared (IR) data to calculate thermal intertia (ref). Detailed charactization of local stratigraphy was generated from CTZ (~6 m/pix) [5] and HiRISE (~30 cm/pix) images [3].

Results and Discussion: Fluvial deposits overlying evaporites suggests that redissolved solutes would have allowed liquid water to remain stable as the planet entered the Noachian-Hesperian climate transition (Brass, 1980; Clark and Van Hart, 1981; Haberle et al., 2001; Burt and Knauth, 2003; Fairén, 2010). Although liquid water may not have been stable for long periods at large scales, microscopic fluid inclusions present one possibility where liquid water could have persisted. Fluid inclusions in terrestrial evaporite deposits have preserved ancient aquatic chemistry and biosignatures including metabolites, nucleic acids, and even viable microorganisms for hundreds of millions of years (Gemmell et al., 1998; McGenity et al., 2000; Vreeland et al., 2000, 2007; Stan-Lotter et al., 2002; Fish et al., 2002; Ueno et al., 2006; Schubert et al., 2010; Saralov et al., 2013). Furthermore, dissolved salts in these inclusions provide protection from UV radiation, which threatens the preservation of organic matter on the present Martian surface (Yopp et al., 1979; Rothschild, 1990). Even today hygroscopic salts present in the chloride deposits may be subject to periodic deliquescence, allowing for the formation of transient liquid water and thus modern habitable microenvironments in the shallow subsurface (Davila et al., 2010).

Conclusions: We have identified coexisting chlorides and Fe/Mg-bearing smectites in a complex fluviolacustrine environment on early Mars. These chlorides likely formed from evaporation of briny water in the late Noachian to early Hesperian, while the phyllosilicates formed from alteration of basaltic materials in subsequent fluvial deposition or they were formed somewhere else and transported here. The early formation time of these deposits makes this site or similar sites where phyllosilicates and chlorides are co-located a high priority astrobiological location for future *in situ* exploration and sample return missions.

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