ORBITAL OBSERVATION OF HYDRATED OXYCHLORINE SALTS ON MARS: IMPLICATIONS FOR HABITABILITY. L. Ojha[1], J. Wray[2], A. McEwen[3], M.B. Wilhlem[2] [1]Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, MD, [2]Earth and Atmospheric Sciences, Georgia Institute of Technology, Atlanta, GA. [3]LPL, University of Arizona, Tucson, AZ.

Introduction: Liquid water is essential to life as we know it. The possibility of forming and stabilizing liquid water on the surface of Mars has been increased by the discovery of oxychlorine salts, which can lower the freezing point of water by tens of Kelvins, lower the evaporation rate by an order of magnitude, and can be hygroscopic [1-3]. The presence of oxychlorine salts on Mars has been confirmed *in situ* at Gale crater by Mars Science Laboratory (MSL) [5], the northern plains by the Phoenix mission [6], and is suspected at the Viking landing sites [7]. At the Phoenix and Curiosity landing sites, perchlorates were also thought to play a major role in absorbing the atmospheric water vapor [8,4]. Here we describe the remote detections of hydrated oxychlorine salts on the Martian surface, and its implications for habitability.

Remote Detection of Hydrated Oxychlorine Salts:

RSL sites: Orbital detections of hydrated oxychlorine salts at a few sites hosting Recurring Slope Lineae (RSL) suggest that they may play a role in the contemporary water cycle on Mars [9]. Hydrated oxychlorine salts have been detected by CRISM at a few RSL sites in the southern mid-latitudes [9].

Polar deposits: Gypsum and possible perchlorates have been hypothesized to be present in the sediment-rich ice layers of the north polar layered deposits (NPLD) [11-12]. Based on the geomorphic interpretation of these landforms, gypsum and possible perchlorates were released from the ice-cap by sublimation.

Icy craters: Out of >500 known impact events that have been detected within the last ~10 years on Mars, 38 have ejected or exposed water-ice from the Martian sub-surface. Spectral absorption bands indicative of hydrated salts are found in the icy ejecta of 3 impact craters. The most likely salt species are oxychlorine salts; the possible presence of other salts or hydrated minerals cannot be ruled out. The source of these oxychlorine compounds is unknown, but their presence corroborates the important role of oxychlorine salts in the contemporary Martian hydrological cycle. In all cases, the absorption bands indicative of hydrated salts were found within ejecta of the craters, suggesting that impact excavation played a key role in our ability to detect the hydrated phase.

Shallow ice is widespread in the Martian mid-latitudes [13]. If the ice is frozen brine, then the oxychlorine compounds would be a lag deposit from ice sublimation, similar to the origin hypothesized for the possible perchlorates in NPLD [11-12]. Other possibilities for their sources include: (i) anhydrous oxychlorine compounds are present in the Martian regolith, and reaction with impact ice hydrated them and/or (ii) oxychlorine salts are hydrated in the shallow regolith above the ice but not hydrated at the surface due to the lower mean relative humidity [14].

Implications for Habitability: So far, in every instance where evidence of potential water (liquid or ice) on Mars has been detected, oxychlorine salts appear to also be present [6,8-9,11-12]. Furthermore, the presence of oxychlorine salts from NPLD to southern mid-latitudes [5-12] suggest that they are ubiquitous on Mars. If perchlorates were also involved in the water cycle on early Mars, as suggested by their presence in late Noachian sedimentary rocks of Yellowknife Bay [15], deposited billions of years ago and buried until recently [16], then estimating their paleo-concentrations relative to known toxicity limits for life on Earth may yield new insights into ancient Martian habitability. However, perchlorates are extremely soluble, so they could have been deposited at Gale by later fluvial activities.

Deliquescence of hygroscopic salts offers the last refuge for active microbial communities in the Atacama Desert [e.g. 17]. However, water activity in perchlorate-saturated solutions may be too low to support known terrestrial life. Additionally, several other factors must be considered for habitability assessment [e.g. 18]. Widespread perchlorates may also challenge our ability to characterize some organic species via traditional pyrolysis experiments on Mars because of their reactivity with organics.

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