DISTRIBUTION AND VARIABILITY OF PHYLLOSILICATES ON MARS OBSERVED BY MRO/CRISM AND WHAT THEY CAN TELL US ABOUT EARLY MARTIAN CHEMISTRY.

J. L. Bishop[1, 2*], N. K. McKeown[1,3], J. F. Mustard[4], D. L. Buczkowski[5], R. N. Clark[6], D. J. Des Marais[2], B. L. Ehlmann[4], G. Marzo[2], R. E. Milliken[7], S. L. Murchie[5], E. Z. Noe Dobrea[7], M. Parente[8], T. L. Roush[2], G. A. Swayze[5], J. J. Wray[9] and the CRISM Team. [1]SETI Institute, Mountain View, CA, 94043 (*jbishop@seti.org*), [2]NASA-ARC, Moffett Field, CA, 94035, [3]Earth & Planetary Sciences, UCSC, Santa Cruz, CA, 95064, [4]Geological Sciences, Brown Univ., Providence, RI, 02912, [5]JHU/APL, Laurel, MD, 20723, [6]USGS, MS 964, Box 25046, Denver CO, 80225, [7]CalTech/JPL, Pasadena, CA, 91109, [8]Electrical Engineering, Stanford Univ., Stanford, CA, 94305, [9]Dept. of Astronomy, Cornell Univ., Ithaca, NY, 14853.

Introduction: Abundant phyllosilicate-bearing rocks have been identified across the planet using the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) on MRO [1]. One region with ample phyllosilicate outcrops is the Noachian-aged upland terrains near the ancient outflow channel Mawrth Vallis; a common phyllosilicate stratigraphy is observed here with nontronite at the bottom, covered by a ferrous phase, with hydrated silica, montmorillonite and kaolinite on top [2]. A similar clay profile is observed in smaller outcrops across a region up to 10^6 km^2 [3]. Another region, Nili Fossae, is located west of the large Isidis Basin and contains large outcrops of multiple phyllosilicate minerals [1] and also carbonates [4]. Phyllosilicates were identified previously at these sites via analyses of the Mars Express/OMEGA images [5,6]. Smaller phyllosilicate outcrops also occur across the planet where they are exposed in ancient rocks, often associated with craters [7, 8, 9, 10]. We will present the types, distribution, and environments of phyllosilicates detected on Mars by CRISM.

Phyllosilicates at Mawrth Vallis: Analysis of CRISM images has shown thick profiles of phyllosilicates at Mawrth Vallis that are consistent with long-term aqueous activity and active chemistry. Example spectra from Mawrth Vallis are shown in Figure 1 from 0.4-2.7 µm. Fe/Mg-smectite or nontronite is found as a thick deposit throughout the Mawrth Vallis region. Thinner units of Al-phyllosilicates (montmorillonite, kaolinite, beidellite) and hydrated silica are found above that. Mineral identification is performed using spectral features near 1.4, 1.9, and 2.2-2.4 µm.

Implications for Martian Chemistry. The ancient phyllosilicates in places such as this could have served as reaction centers for organic molecules [11]. Some experiments even suggest that phyllosilicates could have played a role in the origin of life [12]. Regardless of whether life formed on early Mars or not, evaluation of the type and thickness of clay-bearing units on Mars provides insights into plausible aqueous processes and chemical conditions not only during the time of formation of the phyllosilicates, but also the period following their formation.

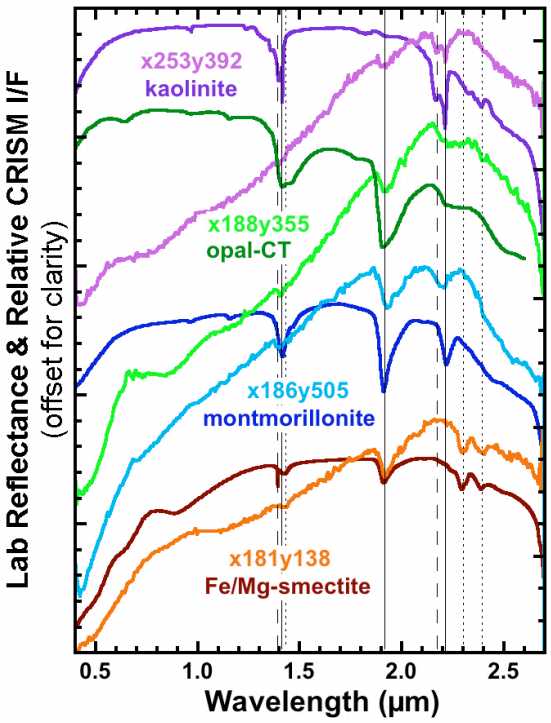

Figure 1. Ratioed CRISM spectra from Mawrth Vallis compared to lab spectra of minerals. Vertical lines are marked to indicate spectral features: solid lines at 1.41, 1.92, 2.21 µm (montmorillonite); dashed lines at 1.38 and 2.17 µm (kaolinite doublets distinct from montmorillonite), dotted lines at 1.42, 2.30, 2.39 µm (Fe/Mg-smectite).

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