**SEEKING BIOSIGNATURES ON MARS TODAY THAT ARE PRESERVED FROM ANCIENT ENVIRONMENTS AT MAWRTH VALLIS**

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**Introduction:** Phyllosilicate–rich outcrops on Mars provide an opportunity to evaluate aqueous activity and potential habitable environments [1]. Analysis of CRISM images have shown thick, complex profiles of phyllosilicates at Mawrth Vallis that are consistent with long-term aqueous activity and active chemistry [e.g. 2-4]. The vertical stratigraphy of changing phyllosilicate and aqueous mineralogy observed today [5] reflects a dynamic environment here ~4 Gya. Phyllosilicates form under high water/rock ratio environments, and smectites are common in regions controlled by wet/dry cycling [e.g. 6]. Biosignatures are preserved well in clay/silica systems during rapid burial conditions and they are best preserved longterm in environments where permeability and temperature remained low [e.g. 7]. Thus, remote sensing can be used to characterize phyllosilicate outcrops and, through an understanding of mineral formation conditions, identify regions on Mars a) where microbes could have been supported, b) where biosignatures were likely to have been entombed, and c) where those trapped biosignatures could have been retained over billions of years.

**Mawrth Vallis Stratigraphy:** Transitions in mineralogic units were characterized using spectral properties from CRISM and surface morphology from HiRISE [5]. The observed stratigraphy (Fig. 1) at Mawrth Vallis points to a changing environment: i) an ancient wet and warm geologic record that formed the thick nontronite unit, ii) a redox change resulting in $Fe^{2+}$-rich clays, iii) a period of wet/dry cycling that increased salt concentrations and was modified by acidic alteration, iv) followed by leaching or pedogenesis to result in Al-phyllosilicates, and v) finally a dry and/or cold climate that left altered ash at the top of the clay-rich profile in the form of nanophase aluminosilicates, rather than crystalline clays.

**Chemical reactions on phyllosilicates:** Comets and asteroids distributed organic molecules throughout our solar system [e.g. 8] and many of these were likely bound on the surfaces of smectite clays where they were able to react with other molecules [9]. Organic reactions in montmorillonite include formation of RNA and other precursor molecules necessary for the origin of life [e.g. 10].

**Early Mars Exploration:** Remote sensing affords the ability to explore ancient environments on Mars where they are exposed on the surface. Current efforts are using the phyllosilicate record to understand early aqueous environments and changes in climate on Mars [11]. Smectite clays likely formed in moderate surface environments on Mars, whereas assemblages of smectite, chlorite, talc, carbonate, and/or serpentine likely formed in subsurface hydrothermal environments. The mineralogic record indicates that Mawrth Vallis provides a unique window into the environment of early Mars where conditions were favorable for life, favorable for entombing biosignatures, and favorable for preserving these biosignatures longterm.

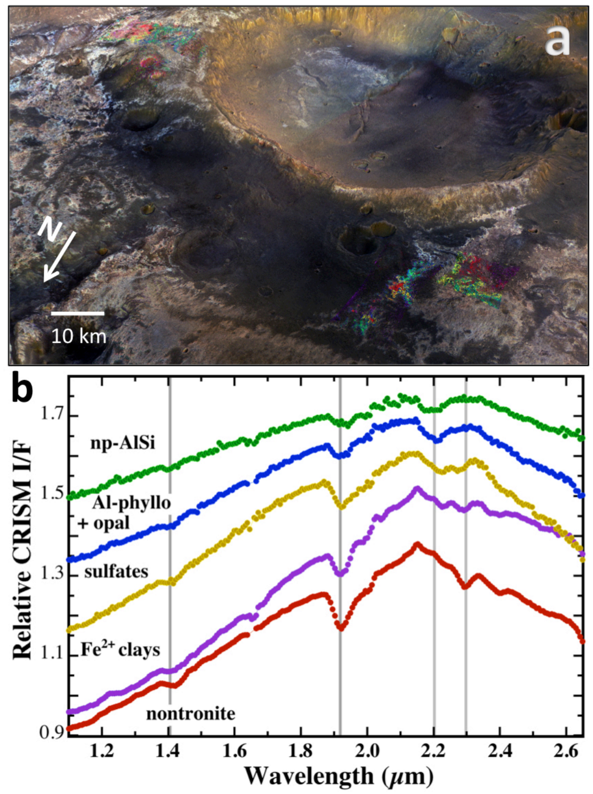


***Figure 1. Mawrth Vallis phyllosilicates**. a) CRISM parameters draped over HRSC mosaic, 7X vertical exaggeration, b) CRISM spectra of 5 units observed in vertical stratigraphy across the region (from [5]).*

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