CRISM MULTISPECTRTAL MAPPING OF NOACHIAN CRUST AT EQUATORIAL LATITUDES ON MARS - UPDATE. A. W. Beck[1,2], S. L. Murchie[1], and C. E. Viviano[1], [1]Johns Hopkins University Applied Physics Laboratory, [2]email:andrew.beck@jhuapl.edu

Introduction: Here we report an update on an investigation into stratigraphic relationships between compositional units of highlands material at equatorial latitudes on Mars using multispectral mapping data from the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM). Results reported here expand on those reported in [1] by presenting results from a new location bounded by -17.5 to -32.5°N by 155 to 170°W, in Terra Sirenum around Eridania basin where a variety of alteration products have been reported [2]. As in our previous report [1], we utilize browse product color composites comprised of summary parameters from [3] and custom image analysis interface and ArcGIS interfaces to examine and identify mineral diversity within CRISM multispectral mapping data (72 wavelengths, 200 m/pixel).

We grouped the identified mineralogy into two broad categories, (a) primary mafic mineral phases including low-Ca pyroxene (**LCP**), high-Ca pyroxene (**HCP**) and olivine (**OLV**), and (b) secondary alteration phases (**2ND**). Though a wide variety of alteration phases were mapped, they have all grouped as 2ND for presentation purposes in Figure 1.

Summary of previous findings *(Fig.1, right)*

Our previous two mapping areas are bounded by 60-80°E (Tyrrhena Terra; Fig. 1, right) and 40-50°W (Margaritifer Terral Fig. 1, left).

Primary phases: LCP is the spectrally dominant primary mineral in early, mid and late Noachian units in both Tyrrhena and Margaritifer. Olivine abundance is greatest in early Noachian units, with some olivine observed in mid-Noachian and none observed in late Noachian terrains. This is consistent with stratigraphic position of olivine-rich material documented previously [4,5]. Essentially no materials spectrally dominated by HCP are observed in Noachian terrains in these areas. Hesperian and Amazonian terrains occur in the mapping region and both are dominated spectrally by HCP with minor OLV.

Secondary phases: Secondary alteration minerals are most commonly identified in early Noachian units, especially associated with olivine-bearing units. We surmise that the higher occurrence of alteration materials (of which ~90% were Fe/Mg phyllosilicate) is the result of either or both low temperature hydrothermal alteration being most prevalent in that part of martian history [6] and the susceptibility of olivine to weathering.

Results: 155-170°W *(Fig. 1, left)*

Primary phases: Early-, mid- and late-Noachian units are exposed in the Sirenum mapping region. Olivine is the dominant primary phase in all units, with the strongest signatures occurring in crater floor material. A weaker olivine signature occurs in crater ejecta and in plains material. Very little LCP and HCP are observed in this area. Where present, LCP is restricted to mid-Noachian units and HCP is only found in late Noachian units (Fig. 1, left). Both HCP and LCP are found primarily in crater wall material.

Compared to the Tyrrhena and Margaritifer study areas, surfaces with strong spectral signatures are less common in the Sirenum study area, possibly due to obscuring effects of eolian sediment. Another key difference is that in Sirenum strong signatures of primary minerals occur mostly in relatively large (~10 – 40 km^2) exposures in crater floors, as opposed to the many but smaller (typically ≤ 5 km^2) exposures in crater ejecta and plains material in Tyrrhena and Margaritifer. Amazonian and Hesperian materials in Sirenum lack clear signatures of primary minerals, again probably due to cover by eolian sediment. This is in contrast to Margaritifer and Tyrrhena, where strong signatures of HCP and OLV occur in plains materials [1].

Secondary phases: Sirenum has a higher concentration of secondary alteration minerals than either Margaritifer or Tyrrhena, and unlike in those areas, in Sirenum they are found in high concentrations in all ages of Noachian terrain, not just the lower, early unit (Fig. 1 left vs. right).

Also unlike Margaritifer or Tyrrhena to the east, where Fe/Mg phyllosilicate are by far the most dominant alteration phase, here we see greater mineralogic diversity, with kaolinite, chlorite, and Fe/Mg phyllosilicate being approximately equally abundant. We observe Fe/Mg phyllosilicate in plains material, chlorite in crater floor material, kaolinite in plains, crater floor and crater wall material, and poly- and monohydrated sulfate in the interior of one crater (as previously identified in [7,8]). No clear correlation is observed between the distribution of primary and alteration phases.

Discussion:

The regional differences in the areal density of outcrops of alteration products is consistent with findings of [9] based on higher-resolution but sparse CRISM targeted obserservations, that Sirenum is one of the most altered large region of Noachian crust. Sirenum combines exhumed crustal phyllosilicates [6] with alteration products formed in surface water environments [2,8,9].

Conclusions:

Sirenum reveals a higher areal exposure of olivine, relative to other primary phases, than regions we have examined in Margaritifer and Tyrrhena, and also more commonly exposes secondary alteration minerals. The greater degree of alteration exposed in Sirenum may result from either or both of two factors. First, the more common occurrence of olivine provides a more easily weathered protolith than more pyroxene-rich rocks. Second, in addition to alteration products likely formed in the subsurface as in other Noachian terrains, Sirenum also contains numerous exposures of material interpreted to have formed in surface water environments.

References: [1] Beck et al. (2018) LPSC 49, #2230. [2] Michalski et al (2018) LPSC 49, #1757. [3] Viviano-Beck et al. (2014) JGR 119:1403-1431. [4] Pan et al. (2016) LPSC #2338. [5] Mustard et al. (2009) JGR 114, E00D12. [6] Ehlmann, B. et al. (2011) Nature, 479, 53–60. [7] Wray et al. (2011) J. Geophys., Res., 116, E01001. [8] Ehlmann et al. (2016) Am, Mineralogist, 101, 1527-1542. [9] Carter et al. (2013) J. Geophys. Res., 118, 831-858.

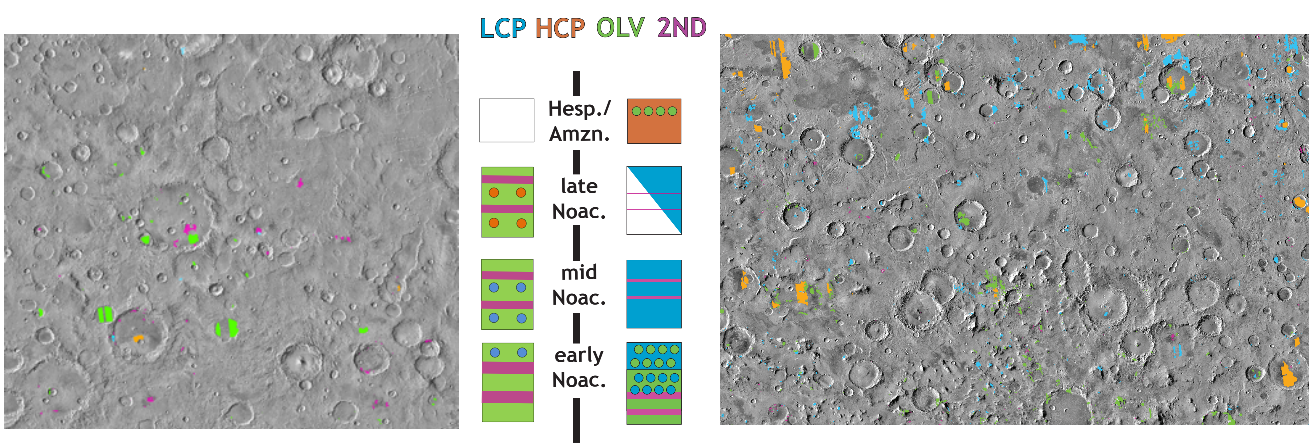

Figure 1. Mineralogical maps overlain on THEMIS daytime IR. (Left) quadrangle = 155-170°W by -17.5 to -32.5°N and (right) quadrangle = 60 to 80°E by -12.5 to -27.5°N