MINERALOGIES OF THE AMENTHES-NORTHERN TERRA CIMMERIA REGION, MARS. N. K. McKeown[1], J. Mazurok[1], K. Kamanos[1], and J. J. Wray[2], [1]Grant MacEwan University (Pysical Sciences, Edmonton, AB, Canada, T6G 0H2, mckeownn@macewan.ca), [2]Georgia Institute of Technology (Earth and Atmospheric Sciences, Atlanta, Georgia, USA 30332)

Introduction: Amenthes and northern Terra Cimmeria are Noachian-aged terrains characterized primarily by degraded craters [1] and lobate scarps [2] with some fluvial features [3]. Data from MGS-TES indicates that Terra Cimmeria is primarily surface type 2 [4]. Terra Cimmeria also contains some of the strongest magnetic signatures on Mars [5]. Spectral analyses of craters in Terra Cimmeria indicated the presence of possibly hydrothermal alteration minerals such as chlorite and analcime [6].

Comparatively little is known about Amenthes, however. Watters and Robinson [2] have performed morphological studies of the Amenthes Rupes, perhaps the largest thrust fault scarp on Mars. Erkeling et al. [7] have performed a detailed stratigraphic study of Amenthes and developed a timeline for the formation of volcanic, tectonic, and fluvial features. A spectral survey using ISM data by Murchie et al. [8] identified the Amenthes region as a mainly high albedo region with flat-to-negative spectral slopes, strong 2.2 µm M-OH features (perhaps Si-OH or Al-OH), and an 0.82 µm feature indicative of hematite in some locations.

Here we present a higher spatial resolution spectral survey using CRISM map tiles and targeted images in order to determine the mineralogic character of Amenthes-northern Terra Cimmeria and potentially link it to geologic processes

Data and Methods: CRISM map tiles (MRDRs; fig. 1) are compiled from multispectral survey strips which image the surface in 72 bands at 256 pixels per degree (~230 m/pixel) [9]. CRISM full-resolution targeted observations (TRR3 FRTs; figs. 2, 4) image the surface in 544 bands at ~18 m/pixel, with each image covering an area ~10 x 10 km [9].

Data were photometrically and atmospherically corrected [9]. The targeted images were then cleaned using the CIRRUS algorithm included in the CRISM Analysis Tools [10] and parameters were generated (*e.g.* figs. 3, 5) to aid in mapping specific spectral features of interest [11]. Summary parameters for the map tiles [9] were also analyzed. Map tile analysis is complicated by illumination effects (brightness and shadow) that create false positive detections for both olivine and low calcium pyroxene.

Results: Preliminary analyses indicate the presence of olivine, pyroxene, and a hydrated mineral that might be a carbonate or phyllosilicate (fig. 6). Olivine and pyroxene primarily outcrop in scarps and knobs, with hydrated materials typically being associated with fluvial features (fig. 4). Additionally, the hydrated mineral signatures appear to be confined to southeast Amenthes- northern Cimmeria at the boundary with Elysium. Continued analyses of the map tiles in interior Amenthes are needed.

Discussion: The mineralogies in the Amenthes-northern Terra Cimmeria region are mostly mafic materials, with no signs of widespread alteration or the possible hydrothermal alteration identified throughout Terra Cimmeria [6].

The hydrated material detected has a spectral continuum consistent with a carbonate (*e.g.* magnesite or siderite), but lacks a strong ~2.5 µm feature (fig. 6), perhaps because its strength is being reduced by the strong 3.0 µm feature observed throughout Amenthes [8]. The band centre at 2.31 µm is more consistent with an Mg carbonate such as magnesite, although the spectrum lacks the 2.1 µm and 1.8 µm features of some magnesites. Compared to an Fe-bearing phyllosilicate (nontronite), this spectrum lacks a 1.4 µm feature, although weak 1.4 µm features have been noted elsewhere on Mars (*e.g.* [12]). If it does have a carbonate component, it would add to the growing carbonate story on Mars, from Mg-carbonate associated with olivine at Nili Fossae [13] to Fe/Ca-bearing carbonate found within impact craters [14,15].

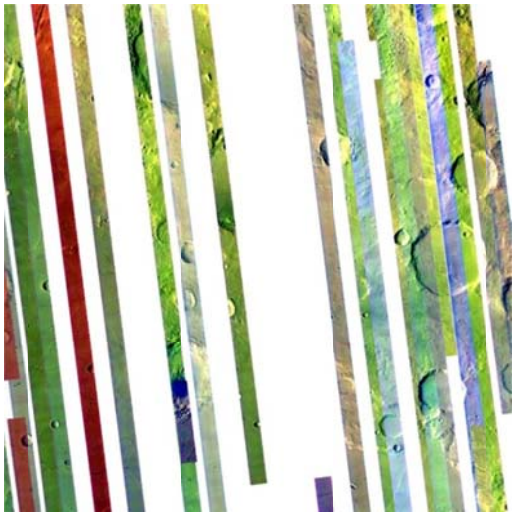

Fig. 1 CRISM map tile MRR1040 in eastern Amenthes. R: 0.86 µm G: 0.68 µm B: 0.44 µm. Differences in colour between strips are due to atmospheric differences at the times of acquisition.

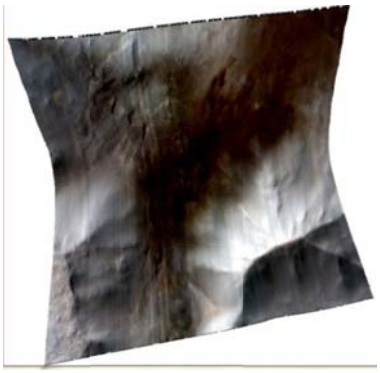

Fig. 2 FRT00017030 (centred at 1.95°N, 123.0°E) in false-colour infrared R: 2.52 µm, G: 1.51 µm, B: 1.08 µm.

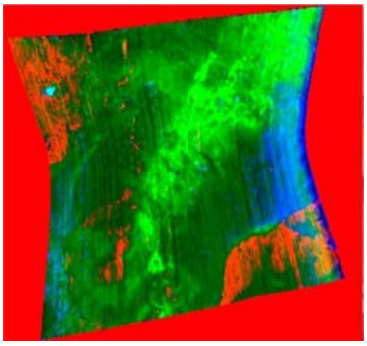

Fig. 3 Parameter maps for FRT00017030 R:LCPINDEX G:OLINDEX B:BD1900R. The cyan patch in the upper left corner is the location of the carbonate spectrum in fig. 6.

Fig. 4 FRT0001383E (centred at 1.98°N, 122.18°E) in false-colour infrared R: 2.52 µm, G: 1.51 µm, B: 1.08 µm.

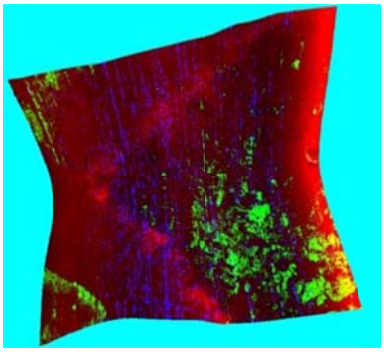

Fig. 5 Parameter maps for FRT0001383E R: LCPINDEX G: OLINDEX B:BD1900R. Olivine spectrum is from the patches of olivine in the lower right.

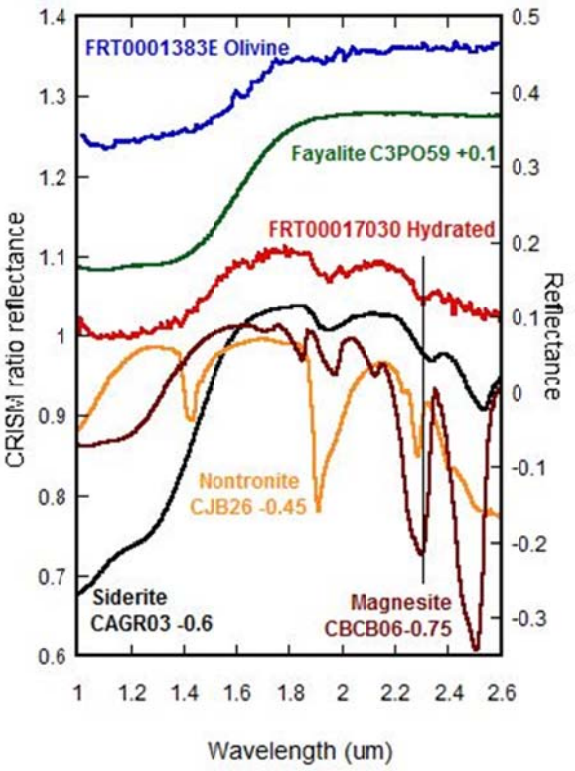

Fig. 6 Spectral plots from CRISM FRTs (blue and red) and library spectra (green, black, maroon, orange) from the southeastern Amenthes – northern Cimmeria region. Black line indicates the centre of the 2.31 µm absorption of the CRISM hydrated material.

References: [1] Craddock, R. A. and T. A. Maxwell., 1990, *JGR*, 95, 14265-14278; [2] Watters, T. R. and M. S. Robinson., 1999, *JGR*, 104, E8, 18981-18990; [3] Irwin III, R. P. and A. D. Howard., 2002, *JGR*, 107, E7; [4] Bandfield, J. L., *et al*., 2000, *Science*, 287, 1626-1630; [5] Connerney, J. E. P., *et al*., 2001, *GRL*, 28, 21, 4015-4018; [6] Wray, J. J., *et al*., 2009, *Geology*, 37, 1043-1046; [7] Erkeling, G., *et al*., 2011, *Icarus*, 215, 128-152; [8] Murchie, S. L., *et al*., 1993, *LPI Tech. Doc*., Results from the MSATT program, 32-34; [9] Murchie, S. L., *et al*., 2009, *JGR*, 114, E00D07; [10] Parente, M., 2008, *LPSC*, Abstract #2528; [11] Pelkey, S. M., *et al*., 2007, *JGR*, 112, E08S14; [12] McKeown, N. K.., *et al*., 2009, *JGR*, 114, E00D10; [13] Ehlmann, B. L., *et al*., 2008, *Science*, 322, 1828-1832; [14] Michalski, J. R., and P. B. Niles, 2010, *Nat. Geosci*., 3, 751-755; [15] Wray, J. J., *et al*., 2011, *DPS*, Abstract #1719.