GEOLOGIC SETTING AND MINERALOGY OF HOROWITZ CRATER. K. E. Powell[1] and R. E. Arvidson[1], [1]Department of Earth and Planetary Sciences and the McDonnell Center for the Space Sciences, Washington University in St. Louis, St. Louis, MO 63130 (kpowell@levee.wustl.edu)

Introduction: Horowitz Crater is a 65 km diameter Martian impact crater located in Terra Cimmeria (32.06°S, 140.75°E). The crater's central peak is a known location of recurring slope lineae (RSL) [1,2]. Na-perchlorate has been identified in these RSL areas on the basis of two pixels with 1.9, 2.15, 2.43 and 3 µm absorptions [3].We explore the geologic and mineralogic setting of the crater, focusing on the central peak, and the correlations between mineralogy of exposed strata and RSL occurrences.

Data Processing: CRISM observations FRT00008573 and FRT00002E7C were atmospherically corrected using the volcano scan method, converted to single scattering albedo using DISORT, median filtered to remove egregious noise, processed with the Maximum Likelihood Method [4] and map projected. This approach produces superior image sharpness and lower spectral noise than other methods. FRT00008573 covers the majority of the central peak at 18m/pixel (Fig. 1). FRT00002E7C has an unusual observation geometry and covers a central swath of the crater walls, floor, and peak at lower resolution; it was projected at 36 m/pixel. A number of HiRISE scenes covering the central peak, an associated HiRISE DEM, CTX observations, and an HRSC DEM were also examined to understand the nature of the strata exposed in the central peak.

Crater Morphology: Horowitz has a classic complex crater shape with a flat floor and terraced walls. The central peak measures ~16 km east to west and ~18 km north to south, with a pit on the southeast side that is ~300 meters deep relative to the surrounding crater floor. The central peak is made up of dozens of individual mounds, the largest of which are ~2 km across. The mounds in the northeastern part of the peak are lighter-toned and possibly layered. Beyond these prominences, the central area of the crater slopes gradually downward to the mostly flat crater floor. The crater floor to the east of the peak contains a dune field several kilometers across.

CRISM Spectral Results: The central peak and surrounding crater floor are rich in mafic minerals (Fig. 2). The low-lying sand to the east of the central peak is rich in olivine as evidenced by a broad 1 µm feature and red slope at longer wavelengths. Most of the mounds are characterized by a weaker ~1 µm feature and red slope, which we interpret as a mixture of high-calcium pyroxene and olivine. Selected mounds on the northwestern side of the central peak display a deep, broad absorption centered near 2 µm indicative of low-calcium pyroxene. These mounds are presumably uplifted from depth during the formation of the crater and represent lower stratigraphic layers than the surrounding plains. The crater floor to the north and south of the central peak displays a broad band centered near 2 µm and a slightly red slope, also consistent with a large proportion of low-calcium pyroxene. Representative spectra from several locations are shown in Fig. 3.

We identified and mapped isolated areas on mounds on the northwestern part of the central peak that display vibrational absorption features between 2.1 and 2.5 µm. The first, which completely covers a small mound, displays a pair of absorptions at 2.25 and 2.35 µm. (Fig 3). This unit has been previously interpreted as chlorite [5]. Prehnite has also been reported in the central peak [6,7]. We find the two band centers to be most consistent with chlorite. The other unit displays a broad feature centered near 2.2 µm that has been previously mapped as Al-clay/hydrated silica [5].

Recurring Slope Lineae: RSLs in Horowitz Crater were especially abundant in observations during Mars Year (MY) 28. We find that they appear on the sloped surfaces of nearly every exposed lithologic unit in the central peak. They do not show a preference for particular slope azimuths (as noted in [2]) or elevations, and are present on the highest mounds of the central peak. RSLs recur in most of the same locations in subsequent MYs, although substantially fewer have appeared to date as compared to MY 28 [2,8]. RSLs have not been reported in the crater walls, although the HiRISE observations that would allow them to be detected are relatively sparse.

FRT00008573 was acquired during the period of high RSL activity in MY 28, at L_s =334°. Clusters of RSLs cover dozens of adjacent pixels in this scene and are easily resolvable (Fig. 4). We do not detect any signatures in RSL locations that indicate oxychlorine species.

Future Work: We will investigate the relationship between units excavated from depth in the central peak and those exposed in the crater walls. We will also continue to pursue possible spectral indicators of RSLs through multiple MYs. We intend to map potential 3 µm H_2O features, incorporating the longer wavelengths of CRISM data by modeling emissivity and bidirectional reflectance simultaneously.

References: [1] McEwen A.S. et al. (2011), *Science, 333*, 6043, 740-3. [2] Ojha L. et al. (2014) *Icarus, 231*, 365-76. [3] Ojha L. et al. (2015) *Nat. Geosci., 8*, 829-32. [4] Kreisch C.D. et al. (2016) *Icarus, 282*, 136-51. [5] Wray J. J. et al. (2009) *Geology*, 37, 11, 1043-6. [6] Pan C. et al. (2015), *JGR, 120*, 662-88. [7] Sun V.Z. and Milliken R.E. (2015) *JGR, 120*, 2293-2332. [8] Stillman D.E. et al. (2014) *Icarus, 233*, 328-41.

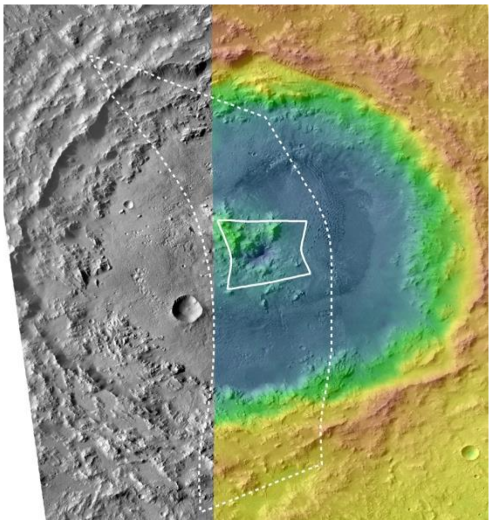

Fig. 1: Horowitz Crater is 65 km across and has complex crater morphology. Colorized HRSC DTM h6415 over CTX base mosaic. Footprints overlaid for FRT00008573 (solid white line) and FRT00002E7C (dashed white line). Elevations range from -750 to +2000 m. The highest mound in the central peak reaches +500 m.

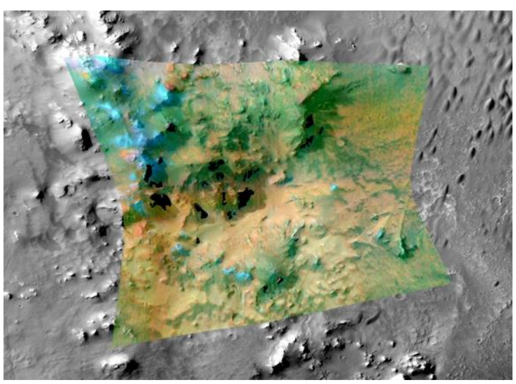

Fig. 2: Color composite of mafic minerals in the Horowitz Crater central peak. CRISM FRT000089F7-derived parameter maps over CTX J03_045992_1478. Red = OLINDEX3, Green = HCPINDEX2, Blue = LCPINDEX2. Some outcrops on the northwestern side of the mound show a strong low-calcium pyroxene (LCP) signature, while the majority of mounds are rich in high-calcium pyroxene (HCP) and olivine. Image is 19 km across. Heavily shadowed areas have been masked.

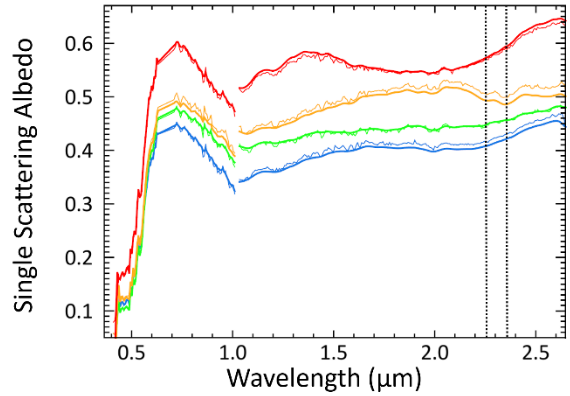

Fig. 3: Typical FRT00008573 SSA spectra of the Horowitz Crater central peak; 3x3 spatial averages. Thin lines are median-filtered SSAs. Thick lines are the same areas after MLM processing. The wavelength region 0.63-0.72 µm corresponds to the CRISM blocking filter and has been removed. Red – LCP-rich mound in the central peak. Orange – mound with absorptions at 2.25 and 2.35 µm (dashed lines). Green – HCP/olivine-rich mound. Blue – olivine-rich crater floor covering.

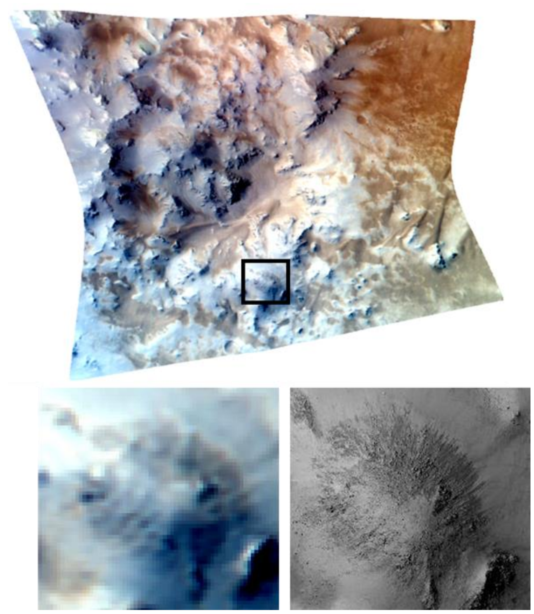

Fig. 4: Abundant RSLs in Horowitz Crater during MY 28, L_s=334°. Top - CRISM FRT00008573 'L' data, R = 2.52, G = 1.51, B = 1.06 µm. Lower left - subset showing dense clusters of RSLs emanating in multiple directions from a central peak mound. Lower right - HiRISE PSP_005787_1475 of the same area, taken concurrently, in which these dense clusters are resolvable into individual RSL flows. Box is 1.2 km across.