THE MINERALOGY OF LITHIC COMPONENTS WITHIN THE NORTH POLAR LAYERED DEPOSITS. P. Sinha[1], B. Horgan[1], and F. Seelos[2]. [1]Purdue University (sinha37@purdue.edu) , [2]JHU/Applied Physics Laboratory.

Introduction: The north polar region of Mars is dominated by the plateau Planum Boreum and the surrounding sand seas. The polar plateau is composed of ice-rich layered deposits whose lithic composition remains unconstrained. Previous studies have detected high-calcium pyroxene (HCP), weathered glass and gypsum as the primary minerals in the north polar region [1, 2]. This study assesses the distribution of these minerals in the lithic components of the north polar layered deposits (NPLD) using high resolution (18-40 m/pixel) visible/near-infrared hyperspectral images taken by Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) onboard the Mars Reconnaissance Orbiter (MRO). These mineralogical detections may be useful in constraining the processes that led to the formation of NPLD and to identify any datable materials within the NPLD.

Methods: This study is carried out using CRISM MTRDR data products which are corrected for atmospheric, photometric and instrumental effects [3]. Absorption bands are detected using standard CRISM spectral parameters [4]. Iron-bearing minerals are also detected by calculating the location of the band center of the 1µm iron band [5]. All mineral detections are verified using detailed spectral analysis of ratio spectra, by selecting neutral/dusty spectra using standard parameters. This region presents unique challenges to spectral analysis, as active winds drive both cloud formation and active dust/sediment transport.

Analysis: We have analysed 7 MTRDRs (Fig.1) in dune fields, in Chasma Boreale and on Planum Boreum using the CRISM Analysis Toolkit for ENVI.

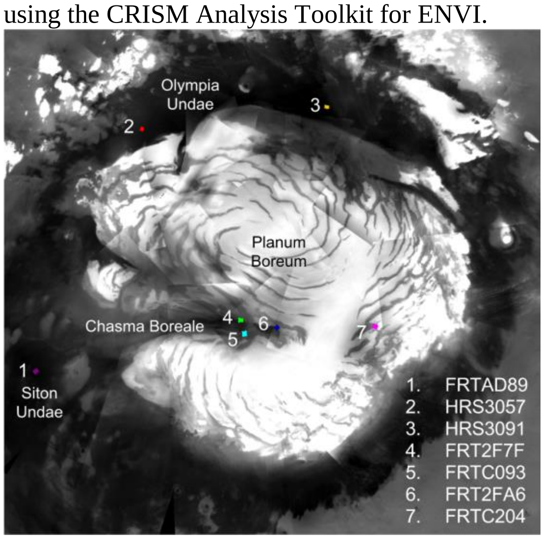

Figure 1: *Location of CRISM MTRDRs in this study.*

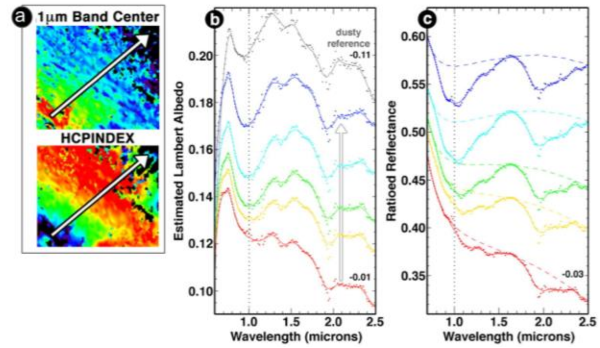

Figure 2: (a) *Mixing trend between HCP and glass-bearing sediments in Olympia Undae from OMEGA [5]. (b) Spectra along the direction of sampling (arrow). (c) Spectra after ratio with dusty spectrum.*

North Polar Sand Sea. Spectra were extracted from the sand seas for comparison to OMEGA data (Fig. 2). As in OMEGA spectra, the sand sea in west Olympia Undae shows a strong 1 µm absorption from HCP and transitions to a spectral mixture of weathered glass and gypsum at east Olympia Undae (Figure 3). Siton Undae spectra exhibit decreased absorption at long wavelengths compared to near 0.75 µm, consistent with the strong concave up slope due to weathered glass. These spectra provide a point of reference for the unratioed spectral character of these phases in CRISM data, as many CRISM images in this climatically active region (including the dunes) lack dusty spectrally neutral terrain to acquire a good ratio.

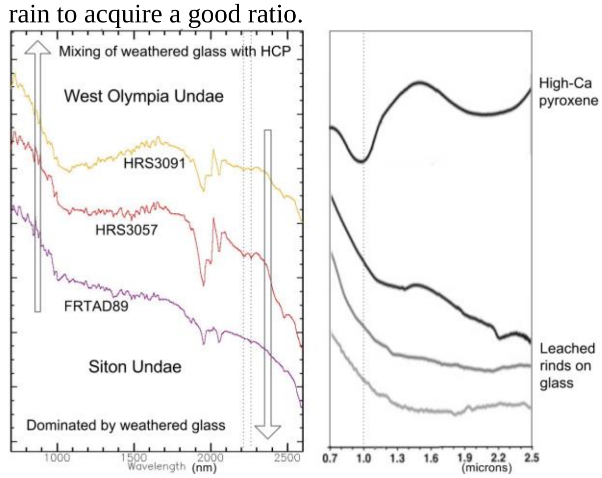

Figure 3: *(a) Spectral variation in north polar dune fields. (b) Lab spectra of HCP and leached rinds on glass [1, 6].*

Chasma Boreale (CB). The outcrops in CB can be broadly divided into a scarp constituting of an ice-rich and dusty layered unit, which lies on top of a variably layered unit containing dark sediments, and the exposed floor covered with surficial sediments. The dusty unit on top exhibits a high band depth at 0.53µm consistent with ferric oxides in surface dust. The sediment-rich unit shows strong 1 and 2 µm absorptions at positions variably consistent with HCP or HCP and glass, that transitions to glass-rich at the CB head scarp. The surficial sediments appear to be enriched in weathered glass (not HCP) relative to the scarp and transport pathways leading away from the scarps are apparent in both visible imagery and parameter maps.

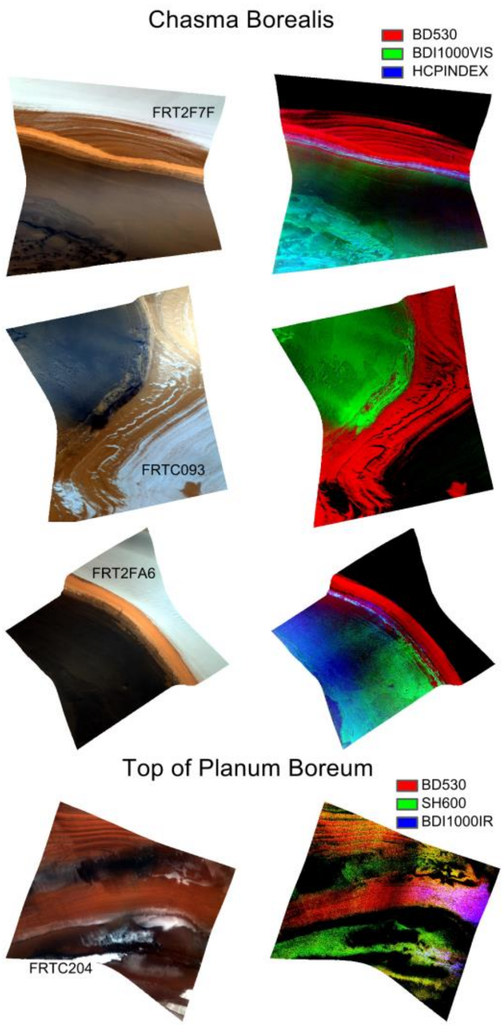

Figure 4: *Enhanced true color image on left and CRISM RGB combination of suitable spectral parameters at Chasma Borealis and Planum Boreum.*

Top of Planum Boreum. In this region, sediments are present both as dark sediments actively eroding out of the NPLD, and dustier sediments forming a widespread mantle (the north polar "veneers"). The NPLD in this region display a strong absorption at 0.53µm indicating presence of ferric iron in dust. The dark sediments and portions of the NPLD exhibit spectra consistent with weathered glass, while the dusty mantles are more consistent with HCP, as observed by OMEGA [5].

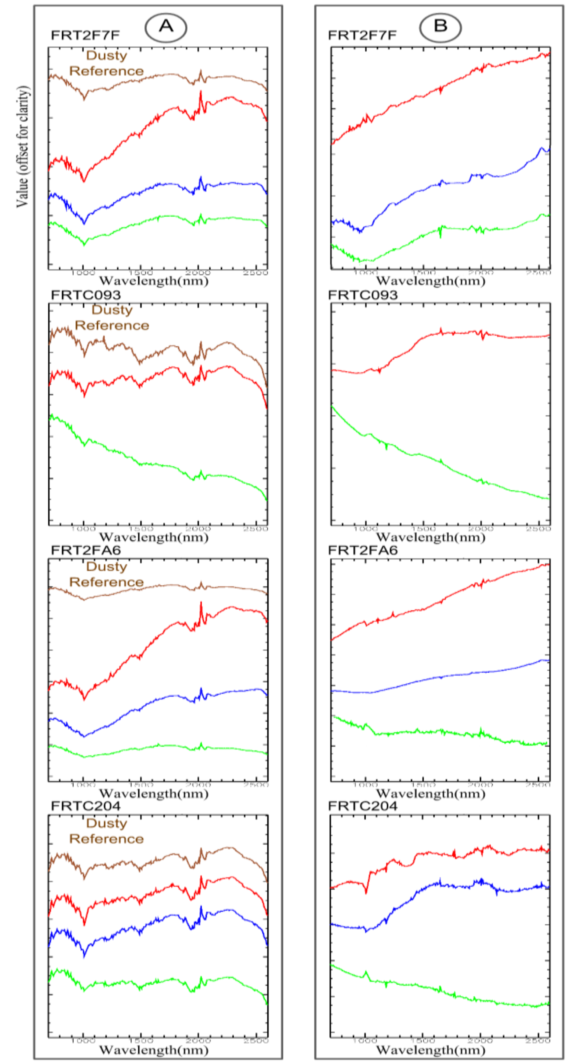

Figure 5: *Unratio spectra (left) and ratio spectra (right) for the MTRDRs in Fig. 4. The color corresponds to the colored regions in Fig. 4.*

Conclusion: The bulk of Planum Boreum consists of a dusty and ice-rich unit, corresponding to the PB1 unit [7]. Within Chasma Boreale, PB1 does not exhibit evidence of a mafic component; however, in some exposures at higher elevations, PB1 does exhibit glass-like spectral signatures, and appears to be a source for glassy dark sediments. These are distinct from the veneers, which are HCP-rich. This suggests that mafic sediments from multiple sources (volcanic and/or impact) are present in the NPLD. These sediments could be targets for in situ geochronology to constrain the age and history of the NPLD.

References: [1] Horgan et al. (2012) Geology 40, 391-394. [2] Masse et al. (2012), Earth Planet 317-318, 44-55. [3] Seelos et al. (2011) LPSC 42, #1438. [4] Viviano-Beck et al. (2014) JGR 119, 1403-1431. [5] Horgan et al. (2014) Icarus 234, 132-154. [6] Minitti et al. (2007) JGR E. Planet 112, 1-24. [7] Tanaka & Fortezzo (2012) USGS SIM 3177.