GEOLOGIC EVOLUTION OF THE MARTIAN HIGHLANDS: MTMS -20002, -20007, -25002 AND -25007. C. M. Fortezzo[1] and K. K. Williams[2], [1]United States Geological Survey, Astrogeology Team, Flagstaff, AZ, 86001, cfortezzo@usgs.gov; [2]Buffalo State University, Buffalo, NY.

Introduction: As part of a continuing study to understand the relationship between valleys and highland resurfacing through geologic mapping, we are continuing to map seven 1:500,000-scale MTM quads in portions of the Margaritifer, Arabia, and Noachis Terrae. Results from this mapping will also help constrain the role and extent of past water in the region. The MTMs are grouped in two different areas (Figure 1, red boxes with black text) within the region and compliment previous mapping in adjacent areas (Figure 1, red boxes with hatch pattern) [1-5].

Three western quads focus on Jones crater and the Himera, Samara, and Loire Valles systems (central portion of Figure 1). This abstract focuses on the four eastern quads wherein a large, ancient impact structure, Noachis basin, is flanked on its south and east by a series of valley networks. A solitary valley drains this basin and stretches north-northeast for ~450 km, transporting materials into Arabia Terra.

Methods: We have imported and registered all pertinent raster and vector data using ESRI's ArcMap GIS software. Using this digital environment, we have nearly completed digitizing lines (e.g., contacts, structures, etc.) and polygons (e.g., units and craters). Arc extensions provide robust tools for (1) analyzing spatial relationships across multiple data layers, (2) attributing and updating digital linework, (3) building and analyzing vector topologies, and (4) importing new data as they are released. To inspect and quantify stratigraphic relations, we are compiling crater counts in ESRI's ArcView GIS software to make use of crater counting tools [6] specifically developed for planetary mappers [7].

Datasets: For these maps, we began using MDIM 2.1 and MOLA (128 pix/deg) datasets as the initial mapping bases. In year 3, we continued processing THEMIS daytime and nighttime infrared images and the visible range images and produced mosaics covering ~99%, ~ 95%, and ~50%, respectively. Due to their scale-compatible resolution and coverage, we are using the THEMIS daytime and nighttime IR mosaics as the basemaps for this region.

New datasets from the Mars Reconnaissance Orbiter including 4 CTX images (~6 m/pix), 31 CRISM multispectral pushbroom images (165 m/pix) and 4 HiRISE (0.25 m/pix) images were incorporated into the project during the third year. CTX provides both high-resolution, local details with regional context ideal for mapping. The multi-spectral CRISM data provides mineralogical context for mafic, ferric, and hydrated

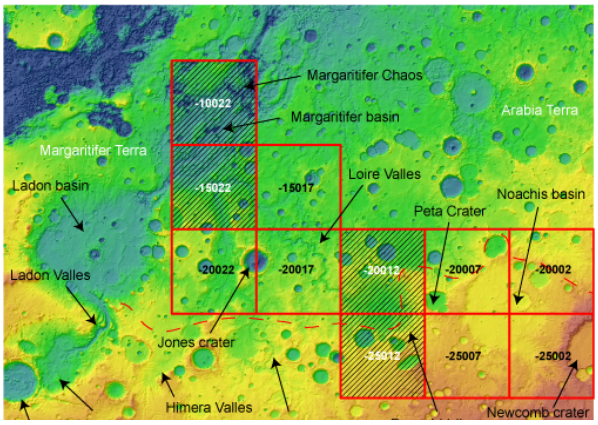

Figure 1: Shaded relief overlain by MOLA 128 pix/deg of Margaritifer Terra. Arrows point to feature locations. The red boxes indicate individual MTM quads. Red boxes with black numbers are the 7 quads currently being mapped and boxes with a hatch pattern and white numbers indicate quads in review and press. The red dashed line is an approximate boundary for the HMTZ. The HMTZ intersects the southeastern mapping area along the northern flanks of Peta crater, Newcomb crater, and Noachis basin.

minerals using summary parameters [8]. The HiRISE images provide detail to further describe the geomorphology of units and describe localized erosion. However, HiRISE is limited to three small locations in this region so descriptions using HiRISE images may be aerially limited.

Local Physiography: MTMs -20002, -20007, -25002 and -25007 contain portions of Noachis and Arabia Terrae and lie on the eastern border of Margaritifer Terra (Figure 1). The area slopes downward from southeast to northwest following the regional trend of the northwest portion of the circum-Hellas rise in the highlands. Two large impact basins, Newcomb crater and Noachis basin, control the local topography (Figure 2). Valley orientation is controlled by topographic lows. In the west, valleys trend west towards Paraná basin. In the south, valleys flow into the relatively flat-floored Noachis basin. In the north, valleys flow towards southern Arabia Terra, the Highland-Midland Transition Zone (HMTZ).

The HMTZ is represented in MOLA as a northwest-facing, southwest northeast trending slope from the Holden crater region in the southwest to the western flank of the Terra Sabaea rise in the northeast. The transition zone appears less densely cratered than the adjacent Noachis and Arabia Terrae [9]. Based on the abundance of partially buried and flat-floored craters, the apparent younger age is likely due to resurfacing

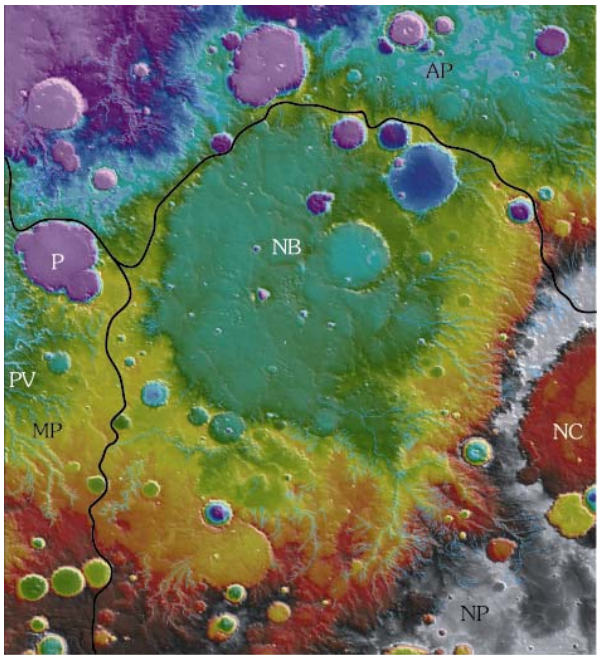

Figure 2: MOLA topography draped on shaded relief with highs=hot colors and lows=cool colors. Blue lines indicate valleys and black lines indicate province borders. Black letters are province names: NP=Noachis province, AP=Arabia province and MP=Margaritifer province. White letters are geographic names: P=Peta crater, NB=Noachis basin, PV=Paraná Valles and NC=Newcomb crater.

from deposited materials sourced from the southern highlands

Provinces: In an attempt to conform to terrestrial geologic mapping techniques [10], geographic names are used to describe location in the unit descriptions and abbreviations. The units of this mapping area have been divided into the Margaritifer, Noachis, and Arabia provinces based on topographic drainage divides and named after the terrae in which the valleys debouch. (Figure 2). The valleys and catchments that drain and transport materials into Paraná basin (Figure 1) comprise the Margaritifer province. Noachis basin, Newcomb crater and the southern and eastern valley networks transporting material into Noachis basin are designated as the Noachis province. The area north of Noachis basin and valleys forming on the northwestern flanks of Newcomb crater are designated as Arabia province.

Initial CRISM Results: The CRISM multi-spectral pushbroom dataset uses summary parameters [8] with thresholds to select targets for the high-resolution datasets. The benefit for mappers is the extensive coverage and general compositional information. The CRISM Analysis Tool (CAT), running in the

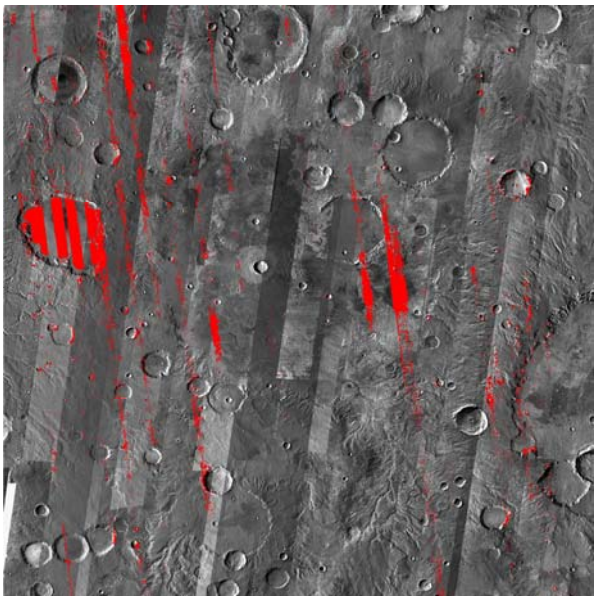

Figure 3: THEMIS daytime IR mosaic (100 m/pix) with CRISM multi-spectral pushbroom threshold olivine index summary parameter absorptions overlain. Note the high density of absorptions throughout Peta crater, and in the eastern and southwestern portions of Noachis basin.

IDL ENVI software package, destripes, mixes bands, and map projects the data for use in GIS.

The results of a cursory analysis show strong mafic (olivine, and low- and high-calcium pyroxene, LCP and HCP, respectively) absorptions in the floors of Peta crater and Noachis basin (Figure 3). LCP absorptions occur more often than olivine; however, olivine tends to be denser than both pyroxenes. LCP is expected in this region, as it is indicative of ancient Noachian materials [11] and is likely a common component of the local mantle. Olivine and HCP may indicate relatively younger rocks, which is supported by the occurrence of wrinkle ridges associated with high olivine and HCP absorptions in the Peta crater and Noachis basin floors.

References: [1] Grant J.A. & D.A. Clark, (2002) Planet. Map. Mtg. (abst.). [2] Williams, K.K. and J.A. Grant, (2003) Planet. Map. Mtg. (abst.). [3] Fortezzo, C.M. and J.A. Grant, (2004) Planet. Map. Mtg. (abst.). [4] Grant, J.A., et al., (2005) Planet. Map. Mtg. (abst.). [5] Grant, J.A., et al., *in press*, USGS Map. [6] Hare, T. et al., (2006) *LPSC XXXVII*, 2398 (abst.). [7] Barlow, N., (2006) *LPSC XXXVII*, 1337 (abst.). [8] Pelky, S.M., et al., (2007) *Jour. Geophys. Res, 112.* [9] Anguita, F., et al., (1997) *Earth, Moon, and Planets*, 77. [10] Tanaka, K.L., et al., (2005) USGS Map 2888. [11] Mustard, J., et al., (2005) *Sci., 307.*