Mapping Margaritifer Terra, Mars: Fluvial Features, Basins, and Models. K. K. Williams[1], C. M. Fortezzo[2], and J. A. Grant[3], [1]Department of Earth Sciences and Science Education, Buffalo State College, 1300 Elmwood Ave., Buffalo, NY 14222, williakk@buffalostate.edu, [2]Department of Geology, Northern Arizona University, Flagstaff, AZ, 86011, [3]Center for Earth and Planetary Studies, Smithsonian Institution, Washington, DC, 20013.

Introduction: Margaritifer Terra exhibits a multitude of fluvial features at various scales that reflect the rich history of water in this region of Mars [e.g. 1-6]. The major fluvial feature in this area is the Uzboi-Holden-Ladon-Margaritifer (UHLM) mesoscale outflow system which begins at Argyre basin to the south and terminates to north in Ares Vallis [3,4,6]. In addition to the UHLM system, Margaritifer Terra has also been etched by well-integrated valley systems such as the Samara and Paraná-Loire Valles systems which meet the UHLM system at Margaritifer basin and each have several tributaries. Although most fluvial activity here took place from the late Noachian to the mid Hesperian [1,5,6], mapping of a volcanic feature at the confluence of the Samara and Paraná-Loire systems suggests that fluvial activity was active, at least locally, into the Amazonian [7,8].

Continued geomorphic mapping in southeastern Margaritifer Terra is aimed at unraveling the complex relationships between valley formation and resurfacing events in seven 5°x5° quadrangles [9] (Fig. 1). Four quads to the east cover valleys on the western flank of Newcomb crater and the headward regions of Paraná Valles. Three western quads focus on the Himera, Samara, and Loire valley systems and their relationship with Jones crater. As with previous mapping, newer data sets (MOC, THEMIS, HiRISE, etc) reveal details not visible in Viking Orbiter data.

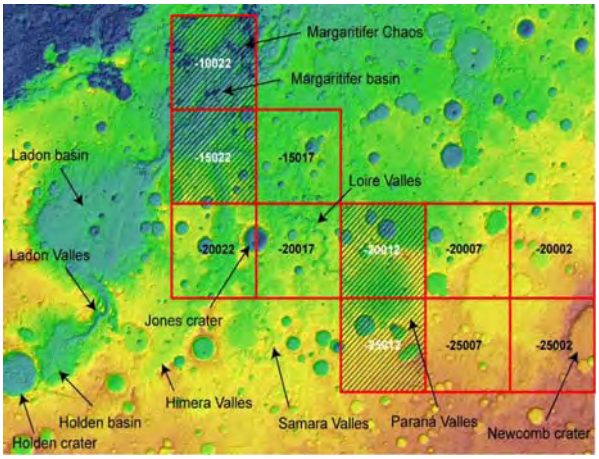

Fig. 1. Mapping quadrangle locations (red boxes) in Margaritifer Terra. Shaded boxes are maps under review. Mapping discussed here is taking place in the other 7 quads. Background is MOLA 128 pixel/degree topography.

Samara Valles Area: THEMIS 100 m/pixel infrared images [10] provide much better detail of the western three quads than was provided by ~250 m/pixel Viking Orbiter images. The IR images of this region are being used as the base for 1:500,000 regional geologic mapping and show that Samara Valles itself had a complex history. A recently (2006) released IR image (Fig 2.) fills a coverage gap west of Jones crater and reveals a hairpin meander in Samara as well as evidence for abandoned meanders (Fig. 3) and other changes in the location of the active channel. Fig. 3 is an even higher resolution THEMIS VIS image which exposes the details of this complex area. New HiRISE images are now providing even greater detail that, when combined with other recent Mars data sets, will help constrain stratigraphic relationships between these valley systems and the impact that formed Jones crater.

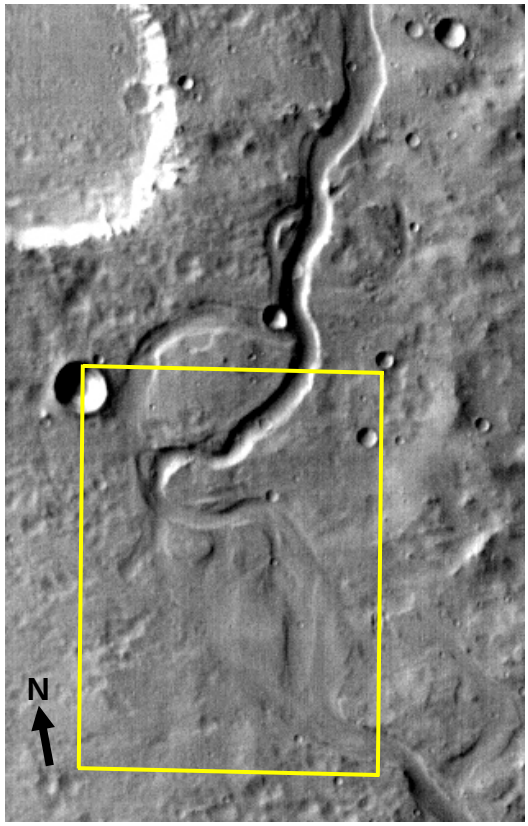

Fig. 2. Portion of THEMIS daytime IR image I18661002 showing the meandering character of this portion of Samara Valles west of Jones crater. Image is ~32 km across. Box shows location of image in Fig. 3. [*NASA/JPL/ASU*].

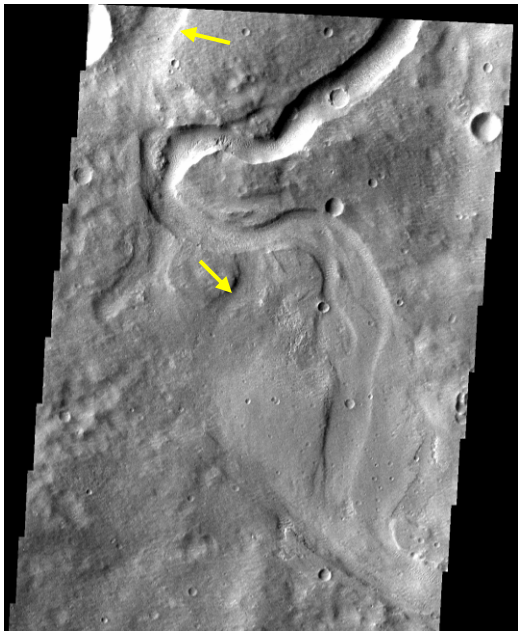

Fig. 3. Portion of THEMIS VIS image V19285001 (17 m/pixel) released January 2007. This image shows increased detail of Samara Valles including evidence of abandoned meanders (yellow arrows). [*NASA/JPL/ASU*]

Newcomb-Paraná Area: As part of the mapping in the Newcomb-Paraná region to the east, an automated basin analysis was performed using ArcHydro Tools to determine basin divide locations and extents. The analysis has revealed 14 basins in the area, with most radial to and flowing into an unnamed ancient impact basin in the center of the mapping area (Fig. 4). Fluids discharged from this basin in two areas, one to the northwest and the second to the west. The western discharges are the headwaters for Paraná Valles.

Using this basin analysis and 1:500,000 scale mapping, a preliminary ground water flow model has been produced using MODFLOW 2000 software. This is a one-layer, isotropic, heterogeneous, unconfined model which was used to contour the hydraulic head of a 2 km thick megaregolith layer. The elevations of amphitheater heads of sapping valleys in the area were used as proxies for the water table at its maximum height. This is reasonable because the valleys tend to propagate headward, up slope and follow the water table. Hanna and Phillips [11] provided robust input values for hydraulic conductivity coefficients. The model shows head values were above ground surface in and around the ancient impact basin. These preliminary results indicate some level of ponding in this area.

Summary: Details of the geologic history of Margaritifer Terra are being revealed as mapping and modeling of the region continue and more detailed images are acquired. For instance, complexities such as abandoned meanders in Samara Valles suggest that fluvial activity there was long lived and may have been influenced by changes in discharge or sediment load.

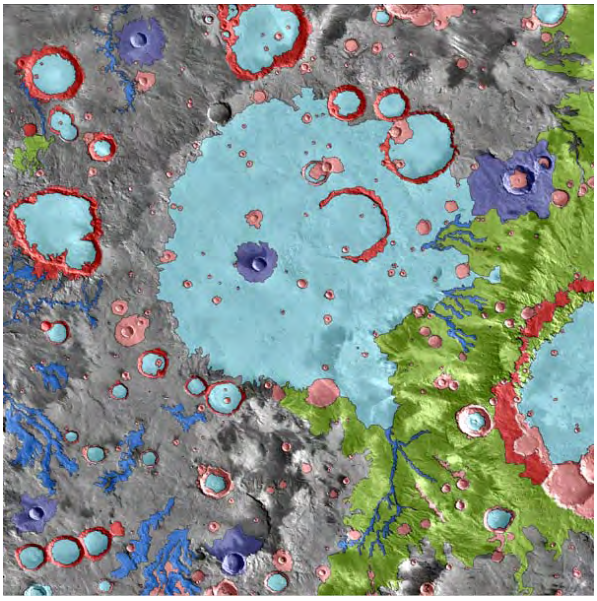

Fig. 4. Geology of the Newcomb-Paraná mapping area with craters, valleys and valley networks delineated. The grey-scale areas have not been delineated. The large, light blue polygon in the center of the area is the ancient impact basin that modeling suggests was a ponding area for the region.

In the Newcomb-Paraná area, determining ages of the separate basins could indicate contemporaneous or episodic flows. Episodic flow would indicate a triggering mechanism such as impacts and volcanism. If flow is found to be contemporaneous, then flow into the central basin could be sufficient to fill the sink and allow ponding. If preliminary results from the hydrogeologic model persist as the model is made more robust, then this ponding area could provide exciting prospects for layered lacustrine deposits as well as the possibility for astrobiology investigations.

It has long been recognized that Margaritifer Terra experienced a complex history of water-related surface evolution. Continued mapping using recent images is now revealing the details of that history.

References: [1] Saunders S. R. (1979) *USGS I-1144*, USGS. [2] Baker V. R. (1982) *The Channels of Mars*, U of TX Press. [3] Parker T. J. (1985) Masters Thesis, CA State Univ. [4] Parker T. J. (1994) Ph.D. Thesis, USC. [5] Grant J. A. (2000) *Geology*, *28*, 223. [6] Grant J. A. and T. J. Parker (2002) *JGR*, *107*(E9), 5066. [7] Williams K. K. et al. (2005) *LPS XXXVI*, Abstract #1439. [8] Williams K. K. and J. A. Grant (2007) submitted, USGS. [9] Fortezzo C. M. et al. (2006) *Planetary Geologic Mappers Meeting*, Nampa, ID. [10] Christensen P. R. et al. *THEMIS Public Data Releases*, ASU, <http://themis-data.asu.edu>. [11] Hanna J. C. and R. J. Phillips (2005) *JGR*, *110*(E1).