DIGITAL RENOVATION OF THE 1978 MARINER 9-BASED GLOBAL GEOLOGIC MAP OF MARS. T. A. Gaither[1], T.M. Hare[1], and C. M. Fortezzo[1]. Astrogeology Science Center, U.S. Geological Survey, 2255 N. Gemini Drive, Flagstaff, AZ (tgaither@usgs.gov).

Introduction: In support of ongoing scientific analysis and global geologic mapping efforts, we have digitized the Mariner 9-based Atlas of Mars, 1:25,000,000 Geologic Series (AMG M 25MG) map (USGS I-1083) originally published in 1978 [1]. The geologic units and structures shown on the original hard-copy maps were generated using primarily 1:5,000,000 rectified and scaled mosaics of Mariner 9 television experiment image data [2] and drafted on air-brushed, shaded-relief bases. This digital renovation uses the topographic data (MOLA) [3] and a new image mosaic (THEMIS IR daytime) [4] to recreate the original linework adjusted to the current control network for Mars [5]. The modern use of digital environments for planetary geologic research and mapping has established the need to bring this map into a properly registered and geometrically corrected digital framework.

Background: The 1978 global map introduced the first formal martian time-stratigraphic system [1] with individual time periods being named after the areas in which their type localities and relative crater densities occurred.

The global map was compiled using geologic maps prepared by several authors [6-15] from a series of Mariner 9 mosaics assembled at 1:5M; these mosaics were then reduced to 1:25M. The shaded relief was copied from the individual 5M mosaics and portrayed with uniform illumination with the sun to the west [1]. Supplemental Mariner 9 images besides those in the base mosaic were examined to improve the portrayal. The Mercator projection was used between the 65°N and 65°S, and the polar stereographic projection was used for the polar regions north and south of the 55° parallels. The scale at the equator is 1:25M and 1:12,549,000 at the 60°N and 60°S. Twenty-four geologic units were identified and named for outstanding physical characteristics, as determined from Mariner 9 orbiter images; these characteristics dominate the topography at the scale of the Mariner 9 images. The prime data source was the low-resolution (2-3 km) A-frame images, which cover the entire planet. B-frames with a resolution of 200-300 km were used where available [1]. The 24 units were divided into five general categories: 1) plains materials, 2) constructional volcanic materials, 3) channel and canyon materials, 4) rough terrain materials, and 5) polar materials. Only craters >400 km in diameter and ringed basins were mapped. All units were subdivided into age groups on the basis of crater densities, superposition and embayment relations, and degree of degradation [1]. Most plains materials are intergradational with adjacent units. No distinction between contact types (e.g., certain, approximate, or concealed) was made in the original map.

Methods: We have produced a renovated digital version of the original AMG M 25M G USGS I-1083 map. This version was compiled in Esri's ArcMap Geographic Information System (GIS) software, using a MOLA-derived shaded-relief image [13] and THEMIS daytime IR global mosaic [14].

Digital environment. The projection used for our digital renovation of the equatorial region is the Mercator Mars 2000 Sphere, centered at 0°N/0°E with an adopted equatorial radius of 3,396.19 km. Longitude increases to the east and latitude is planetocentric. Stereographic Mars 2000 Sphere was used for the polar maps, which are presented as separate data frames within the ArcMap project.

Geologic contacts. Geologic linework was transferred using a combination of hard-copy map review and analysis of supplementary THEMIS and MOLA shaded relief base maps. The primary goal was not to reinterpret the original geologic map but rather to ensure the proper placement of contacts with regard to the published I–1803 map. It was generally apparent what feature or characteristic the original author used in Mariner 9 imagery to delineate a contact, however, some adjustments in contact placement were made when surface characteristics did not spatially match with MOLA topography. These adjustments did result in the omission of some individual small units by connecting areas that were previously mapped as isolated portions and, vice versa, additions were made of some small individual units that were previously grouped together (**Figure 1**). The only new addition to the map is the use of approximate contacts to indicate areas where (1) the geologic relationships were unclear to the digital author and (2) where the datasets did not provide adequate information for the interpretations of the original map.

We remained as true as possible to the author's original intent. Structure was digitized at the same scales and parameters with the same goal of preservation of the geologic contacts. The spatial adjustment of linework will make the Mariner 9-based geologic map more compatible with current digital dataset, increasing its utility for modern mapping and research. Significant quality control and verification of

each contact was ensured by the process of digitization by hand rather than automated routines.

Vectors were drawn on primarily the THEMIS base map (equatorial region) and MOLA base maps (polar regions). The vectors were drawn with a consistent vertex spacing of ~10 km at 1:6M scale, and will be smoothed using a maximum allowable offset tolerance of ~10 km. Nomenclature is not included on the map; relevant digital nomenclature available from the U.S. Geological Survey's IAU Gazetteer of Planetary Nomenclature website [16]. This site allows users of the map to choose which features are displayed digitally and in paper copies they generate.

Data Format. The file will be released in decimal degrees using the Esri's file geodatabase and shapefile vector formats. Metadata, which is digitally integrated dataset documentation (e.g., unit descriptions, geologic history), is required by the Federal Geographic Data Committee (FGDC) and will be included in released data.

Results: This renovated geologic map will provide the community with the ability to view and analyze the Mariner 9-based geologic map in digital format. Minor changes to locations of the original geologic contacts and structures will improve the ability of the science community to use and interpret this global-scale geologic map for a variety of planetary studies. This digital version of the Mariner 9-based map will be available for download through Astropedia (http://astrogeology.usgs.gov/search).

References: [1] Scott, D.H. and Carr, M. H. (1978) *Map I-1083*. [2] Masursky and others (1970) *Map I-896*. [3] Smith et al. (2003) MEGDR. NASA PDS. [4] THEMIS Team (2014), Arizona State University. [5] Seidelmann et al. (2002), Celest. Mech. Dyn. Astron, 82, 83-110. [6] Binder, A. B. and McCarthy, D.W. (1972) *Science., 176*, 279-381. [7] Carr, M. H. (1974) *J. Geophys. Res., 79*, p.3943-3949. [8] Carr, M. H., et al. (1973) *J. Geophys. Res.,78*, p. 4031-4036. [9] DeHon, R. A. (1977) *Map I-1088*. [10] King, J. S. (1977) *Map I-996*. [11] Milton, D. J. (1975) *Map I-894*. [12] Peterson J. D. (1977) *Map I-910*. [13] Potter, D. B. (1976) *Map I-941*. [14] Scott, D. H. and Allingham, J. W. (1976) *Map I-935*. [15] Underwood, J. R. Jr. and Trask, N. J. (1978) *Map I-1048.* [16] http://planetary.names.wr.usgs.gov.

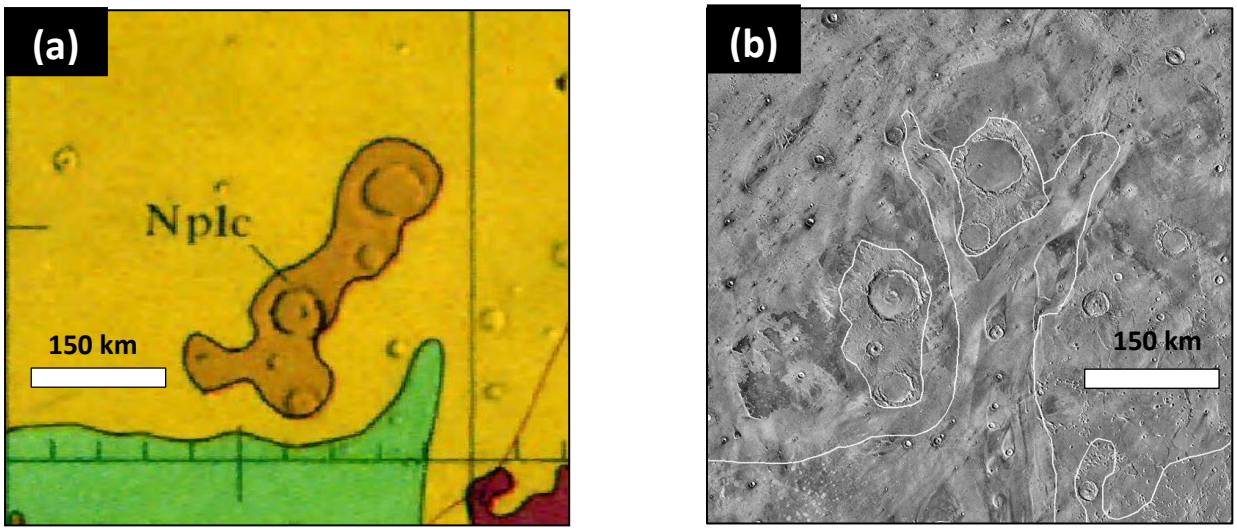

Figure 1. Comparison of geologic units Nplc (cratered plateau material; brown) and Anch (channel material; green) in original map (a) to adjusted unit boundaries on digitized map (b). Original single Nplc unit divided into two portions and Anch unit extended, based on THEMIS IR (daytime) data.