

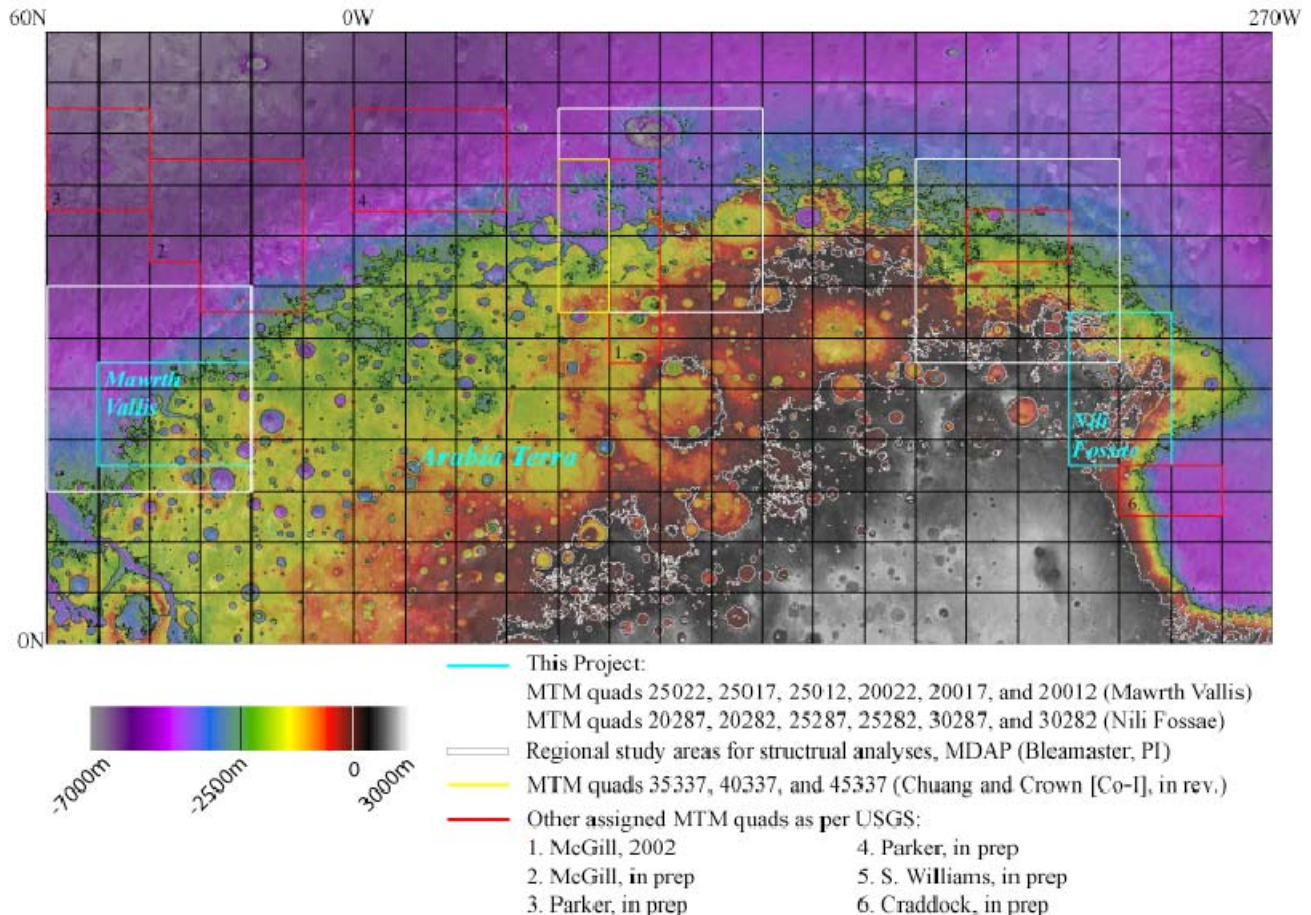
GEOLOGIC MAPPING ALONG THE ARABIA TERRA DICHOTOMY BOUNDARY: MAWRTH VALLIS AND NILI FOSSAE, MARS: INTRODUCTORY REPORT. Leslie F. Bleamaster III^{1,2}, and David A. Crown¹, Planetary Science Institute, ¹corporate address - 1700 E. Ft. Lowell Rd., Suite 106, Tucson, AZ 85719; ²mailing - 3635 Mill Meadow Dr., San Antonio, TX 78247, lbleamas@psi.edu.

Introduction. Geologic mapping studies at the 1:1M-scale will be used to characterize geologic processes that have shaped the highlands along the Arabia Terra dichotomy boundary. In particular, this mapping will evaluate the distribution, stratigraphic position, and lateral continuity of compositionally distinct outcrops in Mawrth Vallis and Nili Fossae as identified by spectral instruments currently in orbit. Placing these landscapes, their material units, structural features, and unique compositional outcrops into spatial and temporal context with the remainder of the Arabia Terra dichotomy boundary will provide the ability to: 1) further test original dichotomy formation

hypotheses, 2) constrain ancient paleo-environments and climate conditions, and 3) evaluate various fluvial-nival modification processes related to past and present volatile distribution and their putative reservoirs (aquifers, lakes and oceans, surface and ground ice) and the influences of nearby volcanic and tectonic features on hydrologic processes in these regions.

The result will be two 1:1M scale geologic maps of twelve MTM quadrangles (Mawrth Vallis - 20022, 20017, 20012, 25022, 25017, and 25012; and Nili Fossae - 20287, 20282, 25287, 25282, 30287, 30282).

Figure 1. Merged 128 pixel/degree MOLA digital elevation model, THEMIS IR mosaic, and Viking MDIM 2.1 of the Arabia Terra dichotomy boundary. Cyan-colored boxes show mapping regions with respect to other mapping areas and regions of interest for this investigation. Simple Cylindrical projection, 5 degree graticule.



Mawrth Vallis, an extensive (500 km long) sinuous channel that dissects the heavily cratered surface of Arabia Terra, is located near the western extent of the Arabia Terra plateau. Considered one of the oldest of the outflow channels, along with Ares Vallis [1], this easternmost circum-Chryse Planitia channel may represent remnant scours of catastrophic outflow often attributed to failure of a subterranean aquifer and/or by persistent groundwater sapping. Mawrth Vallis, however, does not exhibit typical outflow channel source region characteristics [2] and may have resulted from a more protracted hydrologic history [3]. Mawrth's source region is highly degraded and appears to head from a degraded crater (18°N, 13°W) but loses definition in both the up and down gradient directions and preserves few pristine bedforms suggesting that significant modification has taken place since its formation. MOLA topography displays subtle southeastern extensions towards Meridiani Planum that may be related to paleo-Mawrth Vallis headwaters. Mawrth Vallis displays no evidence of surface water contributions or linkages with Noachian valley networks, and preserves little evidence (streamlined islands, inner channels, etc.) of sustained flow along its length in high-resolution images. Although it is difficult to discount that Mawrth Vallis was at one time an active fluvially derived feature, a conclusion based on its macro-scale, plan-form morphology and spatial association with the other outflow channels, much of the geologic evidence of its origin appears to have been degraded, modified, and reworked into what we observe today, a complex amalgam of geologic materials.

Mawrth Vallis' mouth is also coincident with a portion of the putative Arabia shoreline [4, 5]. The juxtaposition of considerable amounts of aqueous-altered rock (phyllosilicates) with what may have been an ancient Mars shoreline is compelling. The widespread nature of layered deposits throughout the region, the mineralogic assemblages observed, and a terrain that displays such variety in state of burial and exhumation, all suggest a highly active sedimentary history, which could potentially have involved several phases of deposition and erosion related to episodic transgressions and/or major climatic variations.

Nili Fossae, located north of Syrtis Major volcano and west of Isidis basin, contains a series of curved depressions, which are oriented roughly

concentric to the Isidis basin. The largest trough originates from Hesperian age volcanic flows, extends northward through Noachian etched and cratered units, and ends near the dichotomy boundary [6, 7] and most likely manifests as the surface expression of an outer ring fault related to the reasonably sized topographic and structural basin created by the Isidis impact into the underlying Noachian crust. Crosscutting and embayment relationships of the primary Nili Fossae trough with materials that span the Noachian to late Hesperian, as well as intersecting with structural elements potentially related to original dichotomy formation, suggest that Isidis has long been an influence on local geologic evolution.

Although masked in regions by volcanic flows from Syrtis Major, aeolian and fluvial deposition, and potential coastal deposits related to an ancient Martian ocean [4], subsequent stripping has revealed outcrops of significant geochemical importance. Like those observed in the Mawrth Vallis region, several outcrops of phyllosilicate-bearing Noachian materials have been revealed by the MEX OMEGA instrument [8, 9]. Phyllosilicates in this location point to the ancient history of Mars when the stability of ground and/or surface water was present for significant periods of time, facilitating the widespread aqueous alteration observed.

Final Remarks. Because of the landing site selection process, much attention has been given to these two areas. The increase of overall data coverage (and their respective increases in spatial- and spectral-resolutions) of these very localized areas complicates the original study, but also necessitates the broader geologic framework that this study intends to provide. Upon completion of GIS database compilation, this investigation will proceed with mapping of the Nili Fossae region.

References. [1] Nelson and Greeley, 1999: JGR, v. 104, no. E4, p. 8653-8669. [2] Parker, 2000: Mars Polar Science, abstract 4039. [3] Rodriguez et al., 2005: Icarus, v. 175, p. 36-57. [4] Parker, 1989: Icarus, v. 82, p. 111-145. [5] Webb, V.E., 2004: JGR doi:10.1029/2003JE002205. [6] Greeley and Guest, 1987: US Geol. Surv. Misc. Invest. Ser. Map I-1802B. [7] Craddock, 1994: LPSC XXV, pp. 291-292. [8] Poulet et al., 2005: Nature, v. 438, doi:10.1038/nature04274. [9] Mustard et al., 2005: Science, v. 307, p. 1594-1597.