GEOLOGIC MAPPING TRAVERSE OF XANTHE TERRA TO CHRYSE PLANITIA : VIKING LANDER 1 AND MARS PATHFINDER REGION;

LARRY S. CRUMPLER, Department of Geological Sciences, Brown University, Providence, RI 02912

INTRODUCTION. Mapping has recently been completed from central Chryse Planitia southward onto the Noachian highlands (MTM 15047, 10047, and 05047 1:500,000-scale photomosaic sheets) in an effort to extend our detailed surface geologic knowledge outward from the Viking Lander 1 site, where we have actual ground truth, into surrounding geologic units. The approach taken by stacking three 1:500,000-scale quadrangles is that of a geologic traverse along a relatively narrow corridor (transect or geotraverse) at a large map scale from a relatively young but typical surface in a lowland region to the complex and older surface of an adjacent highland. The goal is a geologic cross-section across the lowland to highland boundary in an area where the transition is both topographically and geologically relatively gradual in comparison with many other localities. This goal is relevant to the Mars Pathfinder lander mission in that the geology of the Chryse Planitia Viking Lander 1 site and the Ares Valles Pathfinder site is similar. Thus detailed mapping in this region is important to both the characterization of the highland-to-lowland transition in a region of extensive fluvial deposition and erosion, and to the regional geology of the Mars Pathfinder site.

OBJECTIVES: GEOTRAVERSE MAPPING. This work builds on mapping recently completed in central Chryse Planitia [1; 2] in the vicinity of Mutch Memorial Station (VL-1). Objectives outlined are relevant to efforts to understand the local and regional geologic characteristics and geologic history of central Chryse Planitia and the Viking Lander 1 site. A second objective of this map is to correlate what has been learned from geologic mapping of central Chryse Planitia [1,2] with terranes farther south using a transect or strip approach. The Viking Lander 1 site within central Chryse Planitia is an area for which there is ground truth. This mapping connects the regional geologic mapping done in that area with other terrains to the south. A third objective is to explore and identify the range of surface geologic characteristics and scientific questions that can be addressed in this region with future remote sensing of surface properties, higher resolution image data, and surface measurements. The final objective is a detailed case example of the variation in geologic characteristics from lowlands to highlands along a single track.

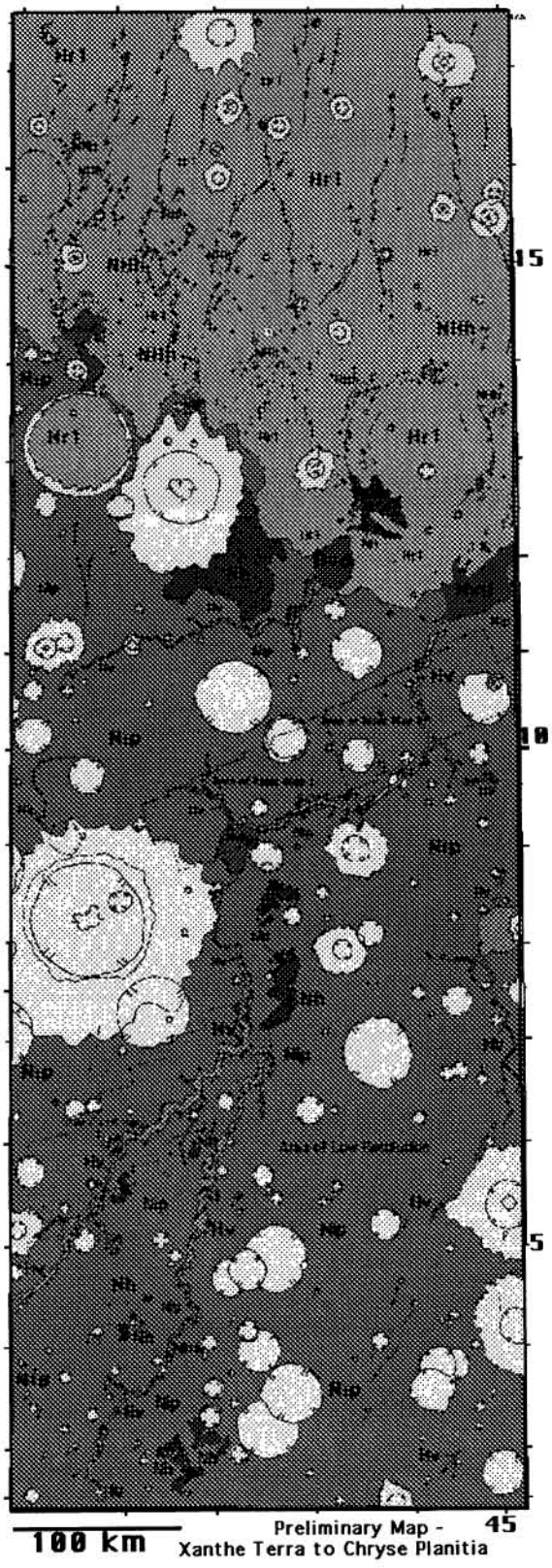
REGIONAL SETTING. The oldest map units are Noachian to Hesperian surface materials near the southern edge of Chryse Planitia. These continue northward where they are overlain in central Chryse Planitia in the vicinity of the Viking Lander 1 by younger ridged plains that are interpreted to be outwash deposits from Maja Valles to the west [1,2]. Hesperian ridged plains are among the oldest post-Noachian materials exposed in the highland-lowland boundary regions and the large exposure here in southern Chryse Planitia affords an opportunity to assess some characteristics of this surface as it defines the nature of the surface in Chryse Planitia prior to outwash deposition and surface scouring. The highland-lowland boundary strikes approximately northwest-southeast across the center of the map area. At 1: 500,000 scale the actual contact between the Hesperian ridged plains and the highlands material appears transitional in character as numerous low hills or knobs, possibly residuals of cratered highland material, protrude through the ridged plains unit.

Additional local-scale geologic characteristics throughout the region include mare-type ridges and sinuous channels. Numerous mare-type ridges, generally interpreted to be the results of small amounts of shortening and compression [5,6], are oriented north to south throughout the Hesperian plains of southern Chryse Planitia, diminish in the lowland to highland transition zone, and are essentially absent in the adjacent highlands. Some arcuate arrangements of mare-type ridges near the highland-lowland boundary and within the Hesperian plains are clearly superimposed on the buried rims of large highland craters. This observation implies that the highland surface may be preserved to some extent beneath the adjacent plains materials.

Several sinuous-type channels (Hypanis and Nanedi Valles) trend southwest to northeast within the highland part of the proposed map area. High resolution images across one of these affords the opportunity to map this channel in detail and an assessment may be made of the local evidence for the origin and modification of this type of channel. Bends in Mars sinuous channels are frequently characterized by circular or constant radius curvature in contrast to the more asymptotic curvature of river meanders on Earth. This might suggest that factors in addition to normal stream dynamics, such as variation in material properties resulting from the probable brecciated or cratered nature of the highlands, among other environmental influences (re-used lava channels), may have exerted a control on the sinuosity [7].

SUMMARY. Several questions of regional, local, and topical significance can be addressed through mapping of the Xanthe Terra to Chryse Planitia traverse: What is the geologic history and stratigraphy of the transitional boundary between the highlands and lowlands throughout this region[8]? What is the origin of the numerous knobs within the transitional region and are they residual highland materials? How are the tectonic strains that resulted in mare-type ridges within the lowlands expressed within the highlands? What evidence is there for the origin and the nature of the emplacement of the Hesperian ridged plains? What are the gradients in thickness of the Hesperian ridged-plains material at the boundary and what might these tell us about the underlying gradients of the highland surface? What is the timing of the ridged plains formation? Are the surfaces of the intercrater highland plains the same material that forms the lowland plains? If not, why are the crater ages similar? Are the sinuous channels lava channels, water-eroded channels, or both? Did the boundary originate here through faulting or regional subsidence? What is the detailed nature of sinuous channels within the highlands and how do they terminate at the Hesperian ridged plains? What is the regional geologic section and how does it relate to the regional topographic characteristics? And finally, what is the evidence for the origin of the highland-lowland boundary in this region and what does it add to arguments [3] for the origin of the global dichotomy?

XANTHE TERRA TO CHRYSE PLANITIA: CRUMPLER



REFERENCES. [1] Crumpler, L.S., Jayne C. Aubele, and R.A.Craddock, 1992, 1:500,000 scale Misc. Inv. Geol. Map, U.S.Geological Survey, in preparation; [2] Craddock, R.A., L.S. Crumpler, and Jayne C. Aubele, 1992, Lunar Planet. Sci. XXIII, 257-258; [3] McGill, G.E., and S.W. Squyres, 1991, Icarus, 93, 386-393; [4] Scott, D. H. , and K.L. Tanaka, 1986, U.S. Geological Survey, 1:15,000,000 Series, Atlas of Mars, Western Region, I-1802A; [5] Plescia, J.B., and M.P. Golombek, 1989, In MEVTV Workshop on Early Tectonic and Volcanic Evolution of Mars (H.Frey, ed.), 64-65. LPI Tech Report 89-04, Lunar and Planetary Institute, Houston; [6] Watters, T.R., 1988, Jour. Geophys. Res., 93, 10236-10254; [7] Mars Channel Working Group, 1983, Geological Society of America, Bulletin, 94, 1035-1054; Rotto, S, and K, Tanak, 1993, U.S. Geol. Surv. Misc. Inv Map I-2441.

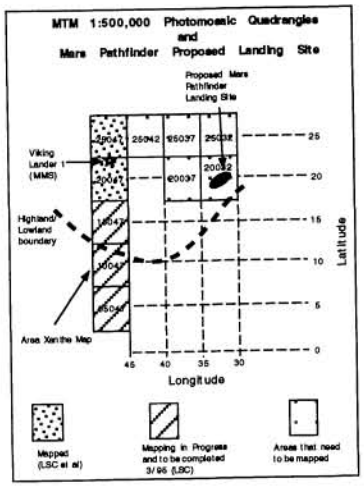


Figure 1. Location of MTM 15047, 10047, and 05047 1: 500, 000 photomosaic sheets shown i n solid boxes. Location of area previously mapped in central Chryse Planitia also shown. Approximate location of highland-lowland boundary as mapped by Scott and Tanaka (1986) shown as sinuous dashed line. The proposed Mars Pathfinder site is located several hundred kilometers to the east in similar terrain.