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PRELIMINARY GEOLOGIC MAPPING OF CENTRAL CHRYSE PLANITIA, MARS

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Because of the success of the Viking lander missions, central Chryse Planitia represents one of two areas on the martian surface where planetary geologic mapping is added by "ground-truth" observations. The broad-scale geology of Chryse Planitia [1] and the geology of the Viking 1 landing site [2] have been previously examined by other investigators. 1:500,000 scale mapping of central Chryse Planitia and the Viking 1 landing site (MTM's 20047 and 25047) has been undertaken to synthesize these results and to address the following questions: (1) What is the depositional and erosional history of the Chryse Planitia basin? (2) How representative are the Viking 1 surface materials of the Chryse Planitia region and of plains units in general? (3) What is the extent of channel materials versus ridged plains materials? (4) As a result of the Viking lander investigations, what are the initial, primary objectives future missions to the surface should address? The preliminary results of our investigation are presented below.

Figure 1 shows preliminary geologic unit boundaries. The oldest material is Hesperian in age, although degraded and/or buried craters may have formed on underlying Noachian materials. Ridged plains materials (Hr_1, Hr_2, and Hr_3) cover most of the surface within the map sheets and are characterized by numerous linear to sinuous wrinkle ridges (Xanthe Dorsa). The ridged plains units are defined on the basis of relative crater abundances, frequency of ridges, and degree of fluvial modification of the ridges. The ridges are morphologically similar to lunar mare-ridges and are interpreted to be the result of regional compressional strains in a competent, layered surface unit. Unlike lunar mare-ridges, the Xanthe Dorsa ridges trend north-south as opposed to being circumferential to the Chryse basin. This suggests basin subsidence was not the mechanism for Xanthe Dorsa formation as has been suggested for lunar ridges [3]. Despite the high resolution of the available images (<10 m/pixel), primary volcanic features such as flow fronts or vents have not been observed. This implies that such structures have been modified or buried, or that the ridged plains units are composed entirely of fluvial sediments. In the latter case, in order to agree with Viking lander x-ray fluorescence results [4], the highland source rocks would have to be basaltic in composition.

Unlike other plains units no degradational or channel features are visible within ridged plains, unit 3 (Hr_3), suggesting that this unit was formed from depositional processes and is probabably not extensively incised or eroded. The depositional nature of ridged plains, unit 3 is further suggested by the occurrence of several partially buried craters (c_1) along its southern contact. Using rim height to diameter ratios for martian craters [5], the thickness of this unit is ~300 m. Despite these observations, at the surface no unequivocal depositional features have been identified [2].

Distinct flat-topped and isolated ridges (Hri) occur along the crest of several of the more prominent mare-type ridges in the north-eastern half of the map area. These are interpreted to represent erosional remnants (i.e., inselbergs) of earlier ridges degraded and subsequently re-developed during continued regional deformation, or isolated highs representing buried structures (i.e, kipukas) such as large crater rims. The former suggests that ridge development is geologically long-lived [6] and span intervals of time great enough that several fluvial episodes occurred during the development of a single ridge. The latter interpretation suggests that ridge formation occurs where the ridged plains are thinnest, similar to mare wrinkle ridge development [3].

The incised channel unit (Hchi) occurs east of Kasei and Maja Valles and is superposed on the ridged plains. The location of individual channels appears to have been initiated at high-standing topographic features and to have often enveloped pre-existing topography. Characteristic striations distinguishing this unit occur in parallel and slightly arcuate groups that are interpreted to represent the direction of flow (Fig. 1; arrows) and corresponding erosional incision associated with large-scale fluvial outwash toward the topographic low of the Chryse basin.

Channeled plains materials, unit 1 ($Hchp_1$) consists of broad, planar surfaces associated with areas of extensive incised channels and are interpreted to be areas of little to no incision or may represent possible locations of deposition. Channeled plains materials, unit 2 ($Hchp_2$) contains small anastomosing and sinuous channels and occurs in two locations on the eastern edge of Maja Valles. These materials are interpreted to be late-stage depositional materials that were incised by smaller-scale, late-stage fluvial events, or by residual draining of internal volatiles during the waning stages of material emplacement.

Using block abundance models developed for Viking Infrared thermal mapper (IRTM) data [7], high-resolution ground tracks (<3-km spot size) over the southern portion of Chryse Planitia indicate that block abundances may be decreasing into the basin [8]. If the circum-Chryse outflow channels were formed by a catastrophic release of water [9], then materials released into the debouching area should be deposited in a typical Bouma sequence [10]. However, our observations support the proposal that at least the southern Chryse channels were formed by liquefaction. Coarse-grained materials released into the debouching area by this mechanism would be deposited closest to channel with finer-grained material being carried greater distances [11], as suggested by the remote sensing data.

Continued collaborative efforts between ourselves and investigators of adjacent map sheets will refine the unit contacts and interpretations. Further image analysis combined with remote sensing observations will allow the objectives of this study to be obtained.

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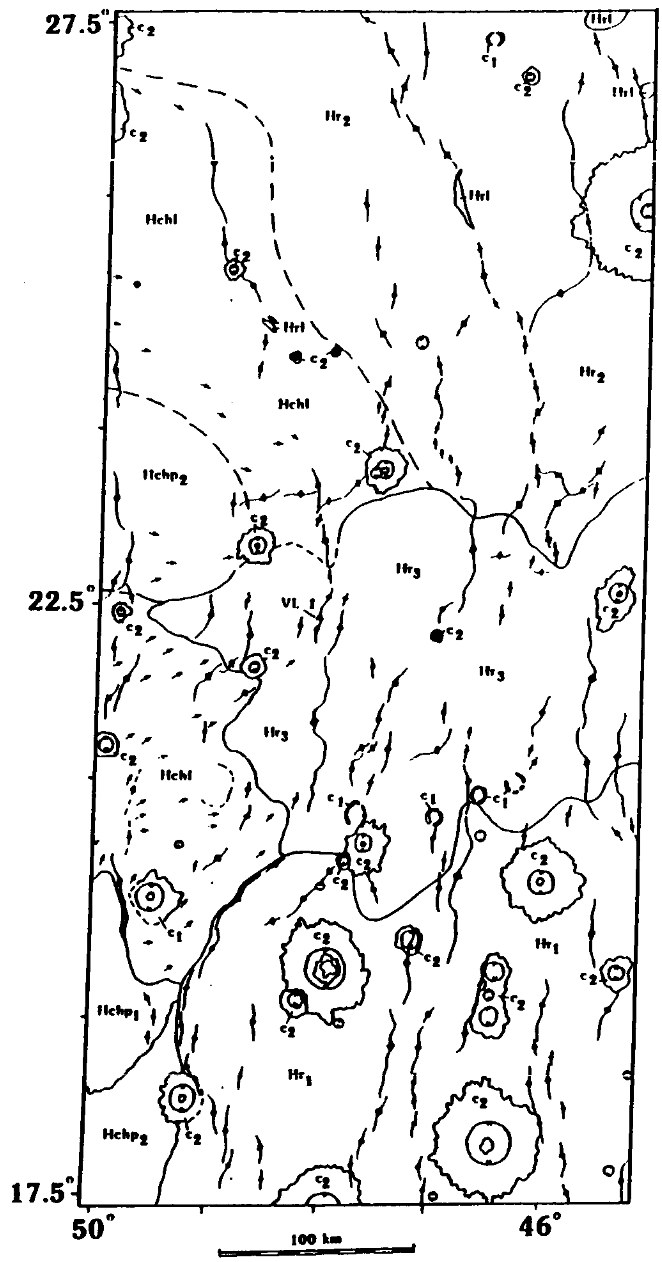

Figure 1. Preliminary geologic map of the central Chryse Planitia region and the Viking 1 landing site. Arrows show direction of flow as indicated by surface features. See text for explanation of units.

References. [1] Greeley, R. et al., J. Geophys. Res., 82, 4093-4109, 1977. [2] Binder, A.B. et al., J. Geophys. Res., 82, 4439-4451, 1977. [3] Maxwell, T.A. et al., Geo. Soc. Am. Bull., 86, 1273-1278, 1975. [4] Clark, B.C. et al., J. Geophys. Res., 82, 4577-4594, 1977. [5] Pike R.J. and P.A. Davis, Lunar, Planet. Sci., XV, 645-646, 1984. [6] Aubele, J.C., LPI Tech. Rept. 89-06, 13-15, 1989. [7] Christensen, P.R., Icarus, 68, 217-238, 1986. [8] Craddock, R.A. et al., Lunar Planet. Sci., XVIII, 203-204, 1987. [9] Baker, V.R. and D.J. Milton, Icarus, 23, 27-41, 1974. [10] Komar, P.D., Icarus, 42, 317-329, 1980. [11] Nummedal, D. and D.B. Prior, Icarus, 45, 77-86, 1981.