HIGH RESOLUTION VISUAL, THERMAL, AND RADAR OBSERVATIONS IN THE NORTHERN SYRTIS MAJOR REGION OF MARS. J. Zimbelman and R. Greeley, Dept. of Geology, Arizona State University, Tempe, AZ 85281

An area in northern Syrtis Major is covered by high resolution images, high resolution thermal data and radar data and provides the opportunity to assess correlations of the data in the geological context. On Mars, some orbital imaging gives structural and morphologic information about the surface at scales greater than ∿10 m. Infrared data, on the other hand, are sensitive to the size of the uppermost surface particles over relatively large sampling areas (10^3-10^4 km^2) (1). Radar data provide a measure of the surface roughness at scales of 0.1 - 100 m over very large sampling areas (10^4-10^5 km^2) (2). The complementary information obtained from the mutual coverage of these data sets aids in the interpretation of the processes that have been active. Syrtis Major is an ancient impact basin modified by cratering and extensive lava flows (3). North and west of Syrtis Major are heavily cratered highlands considered to be some of the oldest materials on Mars (4). Wind steaks and fresh-appearing dunes in the area indicate considerable recent eolian activity (5). Global infrared thermal mapping (1,6) reveals little variation in average grain size (∿0.3 mm) except near 6°N, 292°W, where dark dunes occur (5). Radar data indicate Syrtis Major is smoother than most areas observed in the northern hemisphere (2).

Viking images (679A21-48; ∿80 m per line pair resolution) were mapped geologically; the figure includes a simplified version. Crater units range from fresh (C_3) to moderately degraded (C_1). All unmarked circles on the map are C_3 units. The ridged plains (pr) contain wrinkle ridges similar to those of the lunar maria and are probably lava flows (3). The furrowed plains (pf) correspond partly to Meyer and Grolier's (3) "hilly and cratered" unit and "moderately and highly degraded crater" units but display features most closely resembling their description of furrowed plains. Our furrowed plains, however, do not appear to be the result of ground ice fretting of the plains as interpreted by Meyer and Grolier. The eolian plains (pe) display very subdued topography and appear to have a thick mantle that allows underlying topography only on the scale of km to be visible; this unit grades into but presumably postdates the furrowed plains.

The infrared data were obtained near local midnight on orbit A524, at L_s=9°, just following vernal equinox. Data gaps along the groundtrack are due to inflight calibration measurements. Data point sampling areas are ∿5 km^2. The 20 μm brightness temperatures vary greatly whereas the standard Viking thermal model (1) remains constant at 185 K. The regional albedo for this area (∿0.15) (7) is lower than the model value and results in a 3 K increase of the model value. Average particle sizes corresponding to this lower albedo are included with the data. The radar data were collected in 1976 and indicate the surface roughness resulting from radar scattering as an rms slope (5). Data sampling areas are roughness-dependent but correspond to a circle of radius ∿120 km, for an rms slope of 2°, centered on the groundtrack.

Mapped geologic units correlate with the infrared data to provide the following average particle sizes for the plains: pf (0.2-0.4mm), pr (0.2-0.4mm), pe (0.15-0.3mm). Variations within these units correlate with albedo

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variations, of apparent eolian origin, in other Viking images (496A53,71); areas of lower albedo have larger grain sizes while a light crater streak (290.5°W) has a smaller grain size. This trend is consistent with globally observed correlations between albedo and thermal properties (1,8). A fresh crater (290°W) has an average particle size larger than the ridged plains on which it occurs, suggesting blocky ejecta. A slightly degraded crater (288°W) has distinct rim, ejecta, and floor material with considerable variation in average particle size. The floor material variation (0.2-1.5mm) is consistent with the trapping of coarser windblown material within craters (9). The asymmetric average particle size for the crater rim material is consistent with the downwind direction indicated by light wind streaks in the area.

The radar data are of considerably poorer resolution than the other data, but they indicate that relatively few meter-sized radar scatterers are present in the area. The uniform roughness east of 292°W suggests the ridged plains are either deficient in meter-sized objects, compared to much of the northern equatorial latitudes, or that meter-sized objects have been buried sufficiently to reduce their radar scattering. The greater variation in roughness west of 292°W suggests the effects of larger craters to enhance scattering, such as around 294°W, are mixed with the probable smoother response from mantled plains.

The information obtained from the different data sets are all consistent with the dominance of eolian processes in shaping the present surface in northern Syrtis Major. It is likely, particularly in the eolian plains, that the bedrock corresponding to the photogeologic units may be meters below the present surface

References:
1. Kieffer et al., JGR, 82, 4249, 1977
2. Simpson et al., Icarus, 36, 153, 1978
3. Meyer and Grolier, U.S. Geol. Sur., Map I-995, 1977
4. Scott and Carr, U.S. Geol. Surv., Map I-1083, 1978
5. Peterfreund, Icarus (in press), 1981
6. Zimbelman and Kieffer, JGR, 84, 8239, 1979
7. Pleskott and Miner, Icarus (in press), 1981
8. Christensen and Kieffer, Bull. Am. Ast. Soc., 12, 686, 1980
9. Christensen and Kieffer, JGR, 84, 8233, 1979

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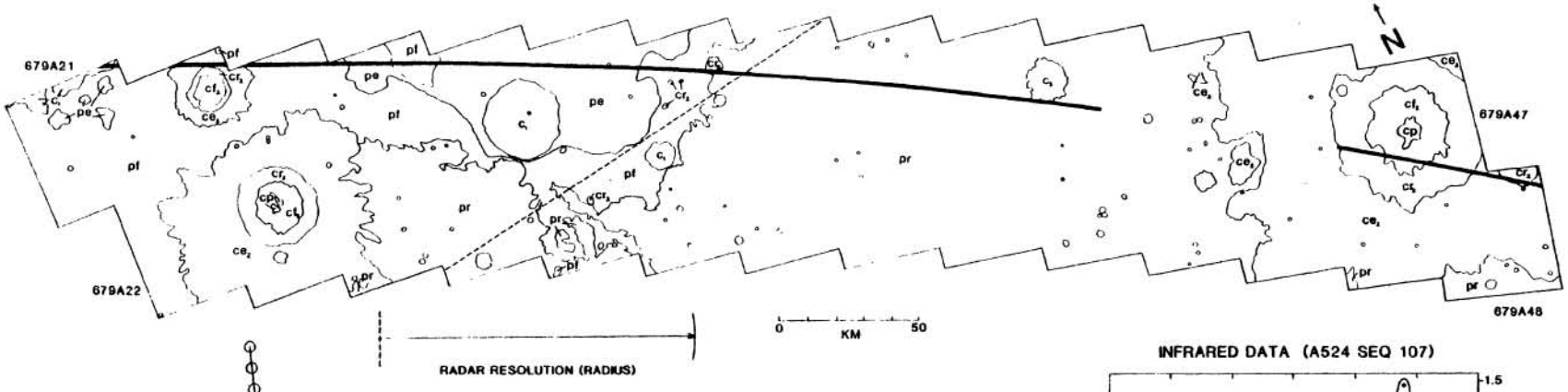
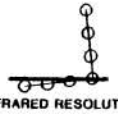
GEOLOGIC MAP OF NORTHERN SYRTIS MAJOR





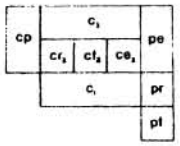
CONTACT

INFRARED GROUNDTRACK

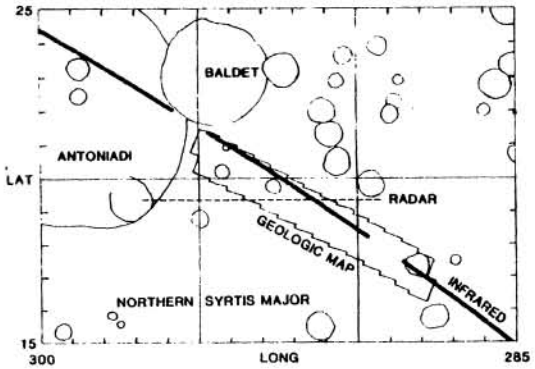
RADAR GROUNDTRACK

GEOLOGIC UNITS

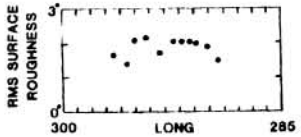
- c_1 FRESH CRATER MATERIAL
- cr_2 SLIGHTLY DEGRADED CRATER RIM MATERIAL
- cf_2 SLIGHTLY DEGRADED CRATER FLOOR MATERIAL
- ce_2 SLIGHTLY DEGRADED CRATER EJECTA MATERIAL
- c_1 MODERATELY DEGRADED CRATER MATERIAL
- cp CENTRAL PEAK MATERIAL
- pe EOLIAN PLAINS MATERIAL
- pr RIDGED PLAINS MATERIAL
- pf FURROWED PLAINS MATERIAL



LOCATION MAP



RADAR DATA (1976)



INFRARED DATA (A524 SEQ 107)