SURFICIAL GEOLOGIC MAPPING OF MARS, Paul Spudis, Arizona State University (present address: Dept. Geological Sci., Brown University, Providence, RI 02912) and Ronald Greeley, Univ. Santa Clara at NASA-Ames Research Center, 245-5, Moffett Field, CA 94035

The planetary penetrator concept has been proposed as a means of continuing exploration of Mars in the post-Viking era. To obtain optimum geologic and geophysical information from such an instrument, it is necessary to consider the results in the context of its local geologic environment. Conventional geologic maps produced by NASA's Mars Geologic Mapping Program provide a regional context within which to interpret penetrator results. These maps do not, however, contain information about the local surficial environment which must be considered for successful penetrator emplacement. Surface conditions on Mars vary from loose eolian fine material to consolidated bedrock and each of these units will have characteristic penetrabilities. This study has been undertaken to map the surface of Mars in terms of local surficial environments containing the necessary data for penetrator success.

For this study, physiographic and surficial cover information has been combined into unified surficial geology maps. These maps differ from the conventional geologic maps in that they do not show lithologies or stratigraphy, but only the surficial expression of geologic units. Penetration is primarily a function of consolidation of surficial materials but since the target ellipse for a hypothetical Mars penetrator may be hundreds of kilometers in maximum dimension, regional topography is also of prime importance. Surficial geology maps present the data of a physiographic (terrain) and surficial cover (soil) map with a substantial reduction in map complexity. In this study, 30 1:5,000,000 scale surficial geology maps were derived for Mars, based on the Mars Atlas, plus a 1:25,000,000 scale synoptic map and are available at a reduced scale (1).

Table 1 shows the letter classification system devised for the major martian surficial geology units and their areal extent. These unit selections are based on geologic models inferred from Mariner 9 photography and are thus limited to broad generalizations about regional surficial geology rather than detailed statements about local geologic conditions.

The surface of Mars is heterogeneous on both regional scales and fine scales. Its surface has been modified and shaped by many geological processes such as eolian, fluvial, volcanism, tectonism, and mass wasting. Surficial conditions vary widely from consolidated bedrock to loose eolian materials and the maps derived from this study attempt to locate these areas on a regional basis. Initial results from the Viking 1 mission (2, 3)

SURFICIAL MAPPING

Spudis, P. and Greeley, R.

indicate that, at least in the area of the Viking 1 landing site, the surficial geology mapping based on Mariner data is fairly accurate. This area is mapped locally as unit "pe", indicating a plain of low topographic relief and thin, or discontinuous, eolian sediment. Initial analyses of lander images indicate that this interpretation is very close to actual surface conditions. These initial results do not imply that all surficial units are mapped correctly, but they do increase our confidence in surficial estimates based on photogeologic interpretations of orbital pictures. Additional study of Viking results will result in refinements and improvements of existing surficial geology maps.

References:

(1) Spudis, P. and Greeley, R. (1976) NASA TM X-73184.
(2) Carr, M. H. et al. (1976) Science, 193, 766-776.
(3) Mutch, T. A. et al. (1976) Science, 193, 791-801.

SURFICIAL MAPPING

Spudis, P. and Greeley, R.

ESTIMATED SURFACE
AREAS FOR INDIVIDUAL MARTIAN SURFACE GEOLOGIC UNITS

Unit Symbol	Unit	Surface Area (km^2)	% Mars Surface
bv	bedrock, volcanic	1147950	0.84
d	variable, cratered	26074100	19.00
df	variable, fluvial	364540	0.27
di	variable, ground ice	1698570	1.24
dmi	variable, mass wasted	1093155	0.80
dr	variable, rough	7960700	5.80
dv	variable, volcanic	233875	0.17
dvr	variable, volcanic, rough	1040300	0.76
ep	eolian plains	15782645	11.50
fmi	fluvial, mass wasted, ground ice	1762745	1.28
i	polar cap material	703425	0.51
id	ground ice, variable	670120	0.49
ipd	ground ice plains, variable	238375	0.17
ipt	ground ice plains, fractured	233140	0.17
p	plains, undifferentiated	5104785	3.72
pbd	plains, bedrock, variable	693255	0.51
pd	plains, variable	1126760	0.82
pe	plains, eolian cover	14101375	10.28
pei	plains, eolian cover, ground ice	6429775	4.69
pt	plains, fractured	544565	0.40
pv	plains, volcanic	10833605	7.89
pvd	plains, volcanic, bedrock	178190	0.13
pve	plains, volcanic, eolian cover	6617870	4.82
pvi	plains, volcanic, ground ice	29067260	21.18
tdr	fractured, variable, rough	517315	0.38
tpr	fractured plains, rough	3005810	2.19