Sampling the Old and the New: Landing Site Proposals for the Dichotomy Boundary (6°S, 210°W) and the Ares Vallis Headlands (2°S, 18°W)

BRIDGES, N.T. (Jet Propulsion Laboratory, MS 183-501, 4800 Oak Grove Dr., Pasadena, CA 91109; 818-393-7799; nathan.bridges@jpl.nasa.gov

Introduction

One of the goals of the Mars Pathfinder mission was to sample a diversity of rocks deposited by the Ares and Tiu Vallis floods [1]. It was hoped that ancient highlands and younger lowlands material could be studied, as well as a diversity of rocks within these regions. Although Pathfinder found rocks that exhibited a number of textures and morphologies, several factors precluded the identification of a petrologic suite of rocks, if it was present. Namely among these were 1) The lack of geologic context for the rocks examined, 2) instrument limitations, and 3) pervasive dust and possible weathering rinds. Based on the Pathfinder experience and incorporating resent results from Mars Global Surveyor and previous missions, two landing sites are proposed that can potentially overcome this problem and offer samples of ancient and recent Martian rock. The first site is at the dichotomy boundary, where ancient highlands and more recent lowlands meet. The second site is at the Ares Vallis headlands, where some of the source materials for the Pathfinder landing site may have been derived. Both of these sites meet the remote sensing and elevation constraints of the 2001 Lander mission but exhibit significant slopes and potential hazards in places. However, a properly placed ellipse can alleviate much of the concern, thereby offering two exciting sites that otherwise would not be chosen.

Site 1: The Dichotomy Boundary (6S, 210W)

The crustal dichotomy is the major geologic and structural division between the southern highlands and northern lowlands. Its origin has been attributed to internal convection [2, 3], an impact basin [4], multiple impacts [5] and other hypotheses. Most workers agree that it is one of the most ancient preserved features of the Martian crust [6].

A landing site on relatively flat northern plains near inliers of highlands offers the exciting possibility of sampling and acquiring high resolution images of both units. As shown in Figure 1, a rover traverses could visit several knobs and mesas where ancestral highlands rocks and stratigraphy would be expected.

This region has overlapping Viking image coverage at 15 m pixel. The nearest high resolution MOC image is centered at 4.17°S, 206.03°W and reveals a fluted surface. The fine component thermal inertia, rock abundance, and elevation are within the 2001 landing constrains (Table 1).

Site 2: Ares Vallis Headlands (2°S, 18°W)

The headlands of Ares Vallis consists of jumbled blocks in Iani Chaos that may have formed from removal of artesian water or ice that fed the outflow channels [7, 8]. The mechanism by which this occurred is not known. Possible origins include magma/water interaction and overpressure on a confined aquifer [9]. By examining the geomorphology and geochemistry of this region, insight will be gained in the processes that formed the outflow channels. The types of rocks deposited at the Pathfinder landing site, a small percentage of which may have been derived from the headlands, can also be investigated.

Viking image coverage at up to 27 m/pixel is available. A MOC image, 8903, imaged the area at -2.17°, 14.65° and reveals an assortment of eroded knobs. Remote sensing properties and elevation are within the constraints of the 2001 mission (Table 1). Compared to Site 1, this location presents more hazards and is considered a less probable landing site locale.

Conclusions

Both of the sites contain hazards in the form of mesas and knobs. At the same time, they have acceptable remote sensing properties and exhibit very interesting geology. Although they may not be at the top of the list for the Mars 2001 mission, it is urged that they and similar locales at least be considered as possible alternate locations that can provide interesting science.

References: [1] Golombek, M.P. et al., *J. Geophys. Res., 102*, 3967-3988, 1997. [2] Wise, D.U. et al., *J. Geophys. Res., 84*, 7934-7939, 1979. [3] McGill, G.E. and A.M. Dimitriou, *J. Geophys. Res., 95*, 12,595-12,605, 1990. [4] Wilhelms, D.E. and S.W. Squyres, *Nature, 309*, 138-140, 1984. [5] Frey, H.V. and R.A. Schultz, *Geophys. Res. Lett., 15*, 229-232, 1988. [6] Schubert, G. et al.; in Kieffer, H.H. et al., *Mars*, Univ. of Ariz. Press, Tucson, 147-183, 1992. [7] Carr, M.H. and G.G. Schaber, *J. Geophys. Res., 82*, 4039-4065, 1977. [8] Carr, M.H., *The Surface of Mars*, Yale Univ. Press, New Haven, 232 pp., 1981. [9] Squyres, S.W. et al.; in Kieffer, H.H. et al., *Mars*, Univ. of Ariz. Press, Tucson, 523-554, 1992.

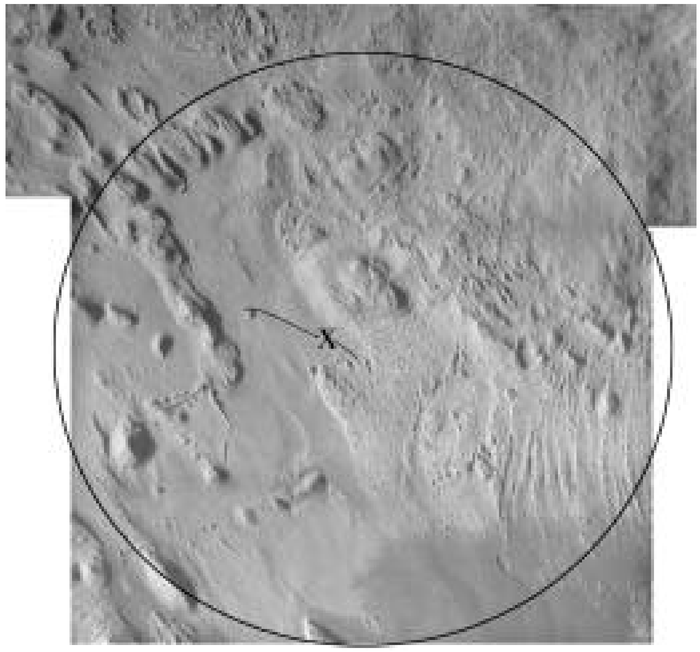

Figure 1: Possible landing site near the dichotomy boundary near 6°S, 210°W. 20 km landing circle, landing location (x), and potential rover traverse paths are shown. The rover traverses are probably the maximum that can be achieved with Marie Curie.

Table 1: Landing Site Data

Property	Site 1	Site 2
Location for Data	6.5°S, 210.5°W	2.5°S, 18.5°W
FC Inertia	5.7	8.7
Bulk Inertia	6.1	9.1
Albedo	0.27	0.19
% Rocks	5	8
Elevation	-0.172	-1.036