PROPOSED MARS SURVEYOR 2001 LANDING SITE AT "IBISHEAD PENINSULA", SOUTHERN ELYSIUM PLANITIA. T. J. Parker[1] and J. W. Rice, Jr.[2], Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109, tparker@mail1.jpl.nasa.gov, [2]Lunar and Planetary Laboratory, University of Arizona, Tucson, 85721, jrice@lpl.arizona.edu.

Introduction

Our objective is to propose a landing site that the Mars Surveyor 2001 Lander and Curie Rover could go to on Mars that should meet the safety requirements of the spacecraft landing system and optimize surface operations (chiefly driven by power and communications requirements). This site lies between 1.5-3.5°S latitude, 195-198°W longitude, along a sharp albedo contact between the low-viscosity flow units of southern Elysium Planitia and the eroded highlands margin east of Aeolis Mensae. A relatively-bright "peninsula-like" protrusion of the eroded highlands into the south Elysium plains in this area reminds us of the head of an Ibis, and so we nickname this site "Ibishead Peninsula" (Figure 1).

This site is designed to be situated as close to a diversity of geologic units within view of the lander instruments. Based on our experience with the visibility of horizon details from the Mars Pathfinder and Viking landing sites, we stipulate that for horizon features to be resolved suitably for detailed study from the lander, they must be no more than several kilometers distant. This is so that diversity can be placed in a geologic context, in a region that we feel has some exciting science potential. This objective is different from the Mars Pathfinder requirement to land at a site with a maximum chance for containing a diversity of rocks within a few tens of meters of the lander, which resulted in the selection of a "grab bag" site. That requirement was driven, in large part, by the Sojourner mobility limit of a few tens of meters, but also by the poor image coverage available for site selection at the time (~40m pixel).

It can be argued that the 2001 mission, which will benefit from MOC images of up to 1.5m/pixel, might actually want to avoid such a site, because placing observations of rocks that are not in situ in even a local geologic context would be difficult, if not impossible. For example, while it has been argued, both before and after the Mars Pathfinder landing, that the provenance for local blocks may be determined by orbiter spectra, primarily from the MGS TES instrument, our ability to do so has yet to be demonstrated. Indeed, nearly two years after the conclusion of the Pathfinder mission, we have yet to reach a consensus on the composition of local materials, or even whether we truly had a "grab bag" of rock materials at all.

Our preliminary data set for selecting a landing site within the latitude and elevation constraints of the 2001 mission is the Viking Orbiter image archive. The site must be selected to place the landing ellipse so as to avoid obvious hazards, such as steep slopes, large or numerous craters, or abundant large knobs over an area at least as large as the landing ellipse, currently a circle 20 km in diameter. For this purpose, we chose a site covered by Viking Orbiter images with a resolution of about 15-20m/pixel. MOC has imaged surfaces in the vicinity that we are using to help us assess the safety of the surfaces in the region at the several meter-scale, and additional images may be acquired if this site "survives" the initial screening after this meeting.

A second requirement, as stated by the project [e.g., Golombek et al., this volume], is that the fine-component thermal inertia data, [1] compiled by P. Christensen and made available to the Mars Pathfinder project, should be greater than about 4 cgs units ($10^{-3}\,cal\ cm^{-2}\ s^{-0.5}\ K^{-1}$). Low thermal inertias seem to imply dusty environments, which could pose a mobility hazard. However, based on our assessment of the crispness of details visible in the MOC images acquired in this area and of surrounding surfaces (Figure 2), we feel that it is unlikely that the Ibishead area is very dusty. We feel that the thermal inertia models should not be used to exclude ANY proposed site unless the MOC images verify that high dust is likely.

Similarly, the albedo ([2] digital file made available to the project by P. Christensen) of the site should not be particularly high, which would also seem to suggest dusty surfaces. Low albedos are preferred, as they often coincide with low Viking red:violet ratios and suggest less dusty surfaces. Again, however, relying on albedo to determine the presence or lack of dust or rock would likely preclude materials such as aqueous sediments that are high-priority science targets for this mission.

Next, the Modeled Block Abundance [1] should also not be too high or too low. Based on the Viking Lander and Mars Pathfinder experiences, a block percentage range on the order of 3-13% was selected. Too many blocks could pose a hazard to the landing and mobility. Too few blocks could also indicate a dusty surface. But the MOC is capable of imaging blocks down to meter-scales, so dangerously blocky surfaces should be identifiable as such based on MOC images. And again, crisp details visible in MOC images would contradict the suggestion of a low modeled rock abundance that the surface is dusty.

In summary, we have the means to determine directly, through very high-resolution MOC images, the dust, rock, and slope hazards at a given site. We should place the results from the MOC at the top of our list of requirements for assessing the safety, as well as the scientific interest, of any proposed landing site. Models based on the remote-sensing data should also be considered, but only to the extent that they provide an additional explanation of the surfaces and features visible in the images.

"Ibishead Peninsula" Site.

Vital Statistics:

**Latitude, Longitude:* 1.5-3.5°S, 195-198°W.

**Elevation (Viking):* -1.0 km.

**Viking Orbiter Image coverage:* Excellent coverage by 15-25 m/pixel images (orbit 725A). Possible stereo coverage between images from beginning and end of orbit that overlap (probably small parallax angle, as these orbits are not listed in [3])*

**Albedo:* ~.27-.28

**Block Abundance:* 4-7%

**Fine-Component TI:* 3.2 to 3.8 cgs units

**Thermal Inertia:* 3.6 cgs units

**Slope:* 0°

Science Objectives:

Primary science objectives for this site will be to determine the nature and composition of the geologic materials emplaced in this sector of the Elysium basin (lacustrine, volcanic, mudflows, other). Investigations into the morphology of the site may also confirm/refute the presence of shorelines in this region of Elysium Planitia. Various investigators have attributed the morphology of the plains material located on the floor of the Elysium basin to a wide range of geologic processes/landforms. [4] states that the plains are composed of low-viscosity flood lavas, while [5,6,7] argue for lacustrine / marine processes. If the lacustrine / marine theory is verified it would have major implications for the geologic, hydrologic and possibly even biologic evolution of the planet. This important question could be answered by landing at this site.

Geologic Setting:

This region consists of eroded knobby material, with bedrock probably of Noachian and Hesperian age, though much of the crater population has been destroyed (so the surface is as young as Amazonian), that is onlapped at a sharp contact by an extensive plains flow unit in southern Elysium Planitia that may be as young as late Amazonian in age. The plains materials have been attributed to unusually low-viscosity flood lavas [4] from fissures south of the Elysium volcanic rise, or to lacustrine materials associated with a large, Amazonian lake at the source of Marte Vallis [5, 6]. [7] presented evidence in support of the latter interpretation, though they attributed the putative shore morphology to an embayment of a northern plains ocean into the southern Elysium region. Detailed examination of the margin of the deposit, showing erosion, not simply burial, of small crater rims and fluidized ejecta blankets, also points to lacustrine or marine sedimentation rather than volcanic plains burial.

The plains surface exhibits a "crusty" appearance that many researchers have attributed to pressure ridges in lava flows. We are examining MOC images of this flow material, in the Ibishead area and in the greater southern Elysium and southern Amazonis Planitiae. We find that the flows are often directly associated with fluvial scour features, such that water appears to have emanated from the flows themselves. This is in contradiction to the interpretation by Plescia [4] that the flows are low-viscosity lavas that fill the pre-existing Marte Vallis channel. Instead, the flows must be the frozen or dried remnants of hyperconcentrated floods or mudflows (Figure 2).

The eroded highland margin surface adjacent to these plains appears to be fairly smooth, even at 15 m/pixel. Isolated knob inliers are scattered from a few kilometers to several tens of kilometers apart. Heights of the knobs have not been measured yet but, based on experience with similar features in the Pathfinder landing ellipse, are probably typically on the order of several tens of meters high and smaller, though some of the largest knobs in the region are probably up to a few hundred meters high. Two craters larger than a kilometer in diameter, with fluidized ejecta deposits, lie nearby the proposed landing site, forming the "eyes" of Ibishead Peninsula.

Additional MOC images should help to determine whether a landing site, safe for the lander and navigable by the Curie rover could be placed in this region. The space between knobs and craters is large enough to enable placement of a target landing ellipse between them but still provide horizon views of one or more of them and the margin of the Elysium plains material. Alternatively, it may be possible to identify a safe site on the south Elysium flows themselves. MOC images of this material elsewhere suggest that some areas of the flow surfaces are smooth at the several-meter scale.

References: [1] P. Christensen (1986) Icarus 68: 217-238. [2] L. K. Pleskot and E. D. Miner (1981) Icarus 45: 179-201. [3] K. R. Blasius et al., (1982) NASA Cont. Rept. No. 3501. [4] J. B. Plescia (1990) Icarus 88: 465-490. [5] D. H. Scott and M. G. Chapman (1991) Proc. LPSC XXI: 669-677. [6] J. W. Rice, Jr. (1996) Conference on Early Mars, LPI Contribution No. 916, p. 68-69. [7] T. J. Parker and P. M. Schenk (1995) LPSC XXVI, 2p.

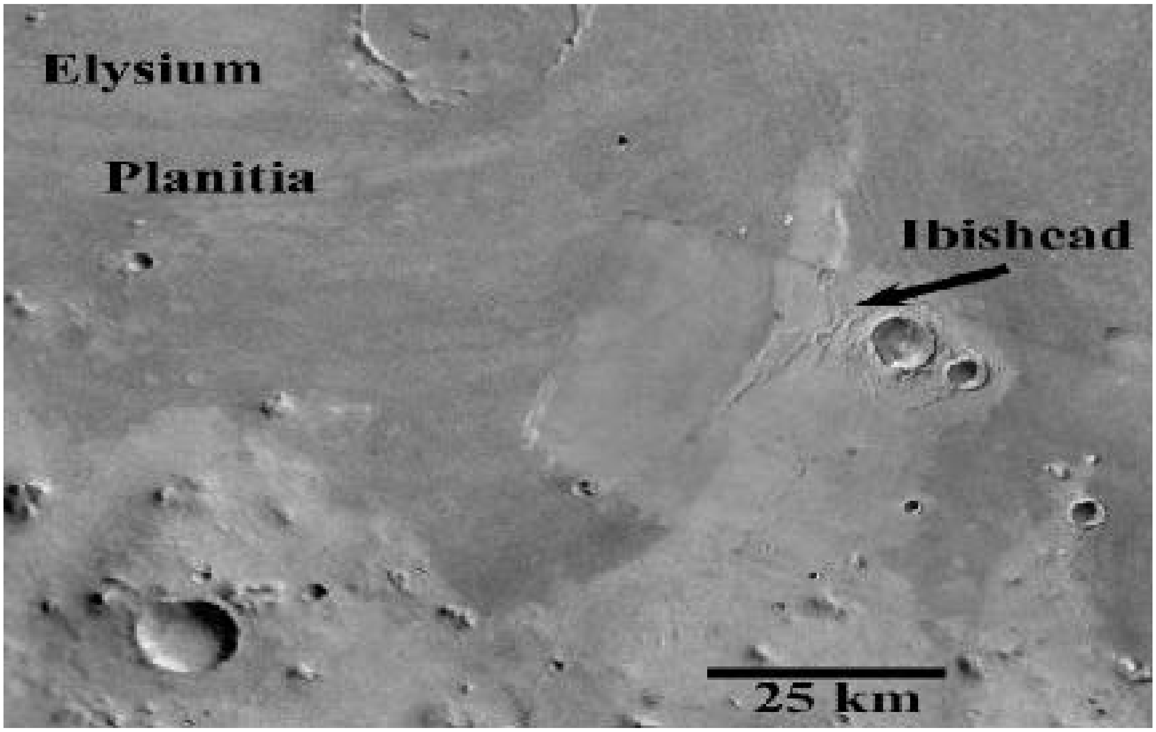

Figure 1. Ibishead Region in Elysium Planitia.

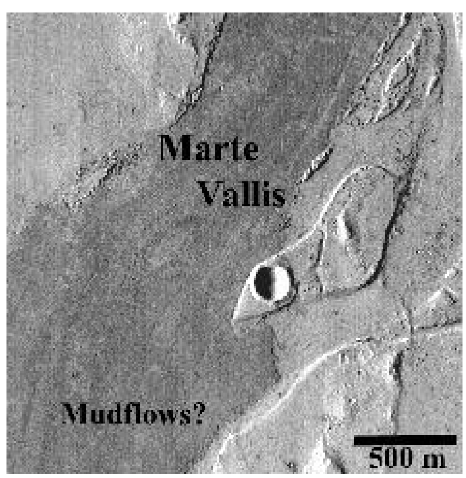

Figure 2. Marte Vallis Mudflows.