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POTENTIAL MARS SURVEYOR 2001 LANDING SITES: LOW-ELEVATION CRATERED "HIGHLANDS" IN CENTRAL AND EASTERN SINUS MERIDIANI AND NEAR AMENTHES FOSSAE. K. S. Edgett[1,2], T. J. Parker[3], and S. N. Huntwork[4], [1]Department of Geology, Box 871404, Arizona State University, Tempe, AZ 85287-1404 USA; [2]*Effective February 1998:* Malin Space Science Systems, P.O. Box 910148, San Diego, CA 92191-0148 USA; [3]Jet Propulsion Laboratory, M/S 183-501, 4800 Oak Grove Dr., Pasadena, CA 91109 USA; [4]*Student*, North High School International Baccalaureate Program, 1101 E. Thomas Road, Phoenix, AZ 85014 USA.

Introduction, Philosophy and Approach

The main scientific goal for the *Mars Surveyor Program 2001 (MSP 01)* landed mission is to collect and characterize 91 rock and 13 soil core samples using an integrated instrument suite onboard the *Athena* rover. If possible, these samples will be retrieved and returned to Earth via a *MSP 05* or *MSP 07* mission.

Preliminary engineering constraints for the *MSP 01* landing site call for a location that lies between 15°S and 30°N, and below ~2 km elevation (based on Viking-era topography). Desirable landing sites for *MSP 01* are to be located "in the ancient highlands where the environmental conditions may have been favorable to the preservation of evidence of possible prebiotic or biotic processes including the emergence (and, potentially, the persistence) of life" [1]. We interpret this to mean that the desirable sites include those that have evidence of aqueous sediments that might have been deposited during the Noachian and/or Hesperian Epochs of Mars' history.

In addition to the search for subaqueous sedimentary deposits, we took into consideration the fact that the rover, *Athena*, will need to be able to access these materials. Thus, a site where aeolian deflation has occurred might be desirable because it might expose, *in situ*, layered sedimentary deposits. Deflated areas, of course, might include potential landing hazards in the form of meter-scale buttes and mesas (e.g., Christmas Lake Valley, OR [2, 3]), thus careful study of such sites with high resolution images will be required before a decision is made to land.

We have been examining three regions that have potential to be considered for *MSP 01* landing sites. This work is based on *Viking* (VIS, IRTM) and *Phobos 2* (Thermoskan) observations and should be regarded as preliminary because we believe that the final site selection should also be based upon analysis of *Mars Global Surveyor* observations that help constrain mineralogy (TES) and local geomorphology (MOC, MOLA).

(1) Eastern Sinus Meridiani Region *(proposed by K. S. Edgett)*

Sinus Meridiani is a persistent low-albedo (< 0.16) region on the martian equator that has been recognized for ~400 years. All of Sinus Meridiani is below the 2 km elevation constraint for *MSP 01*. The region includes cratered highlands, valley networks, aeolian dunes, and possible aqueous sedimentary deposits [4, 5].

The landing site study region is located in the eastern portion of Sinus Meridiani. It is bounded by latitudes 10°S to 2°N, longitudes 355W to 345°W, and the elevations are mostly 1–2 km. The center of this area contains a medium-albedo (0.19–0.21), relatively smooth-surfaced deposit that was suggested by Rice [6] to be a lacustrine deposit. Several potential landing areas can be suggested within this region. Based on *Viking* and *Phobos 2* data, the favored sites so far are centered at 7.6°S, 346.9°W and 0.8°S, 349°W. Thermal inertias [7] are 3.2–7.0 x 10^{-3} cal cm^{-2} $s^{-0.5}$ K^{-1}; rock abundances [8] are around 2–6%.

The site at 7.6°S, 346.9°W is at the southern end of the smooth, medium-albedo unit that might have a lacustrine origin [6]. At this location, numerous channels appear to have drained toward the smooth unit. Viking images from orbit 747A show this area at about 15 m/pixel ground resolution. The images reveal that aeolian deflation has occurred along the deposit's margins. Bright (i.e., albedo ≥ 0.21) aeolian dunes are present on the channel floors and in some of the depressions on the smooth unit [9]. The bright, apparently active dunes might consist of material (perhaps lake-deposited sands) that has been eroded from the smooth unit [9].

The site at approximately 0.8°S, 349°W is selected because it offers and opportunity to solve a long-standing puzzle about Mars remote sensing. There are three main "color" units on Mars: "dark red, dark gray, and bright red" [10]. This landing site would allow the *Athena* rover an opportunity to investigate all three materials within close proximity (the base place on Mars to do so). There are no high resolution (better than 100 m/pixel) *Viking* or *Mariner* images of this site.

(2) Central Sinus Meridiani Region *(proposed by K. S. Edgett and T. J. Parker)*

Central Sinus Meridiani is characterized by two types of surfaces [4]. One is like typical martian cratered highlands elsewhere—there are old valley networks and old impact craters. The other is relatively smooth and flat. These two units are in contact around 3.1°S between 5°W and 4°E longitudes. Valley networks—including one at 6°S, 358°W that rivals the Grand Canyon of Arizona—once drained toward the smooth unit. Edgett and Parker [4] proposed that the smooth unit might consist of sediments laid down in a large Noachian-aged sea/ocean that would have covered much of the northern hemisphere. Schultz and Lutz [11] suggested that it is a paleopolar layered deposit. Regardless, the smooth unit where it contacts the cratered terrain would make an excellent site for *Athena* rover to investigate. The site is best seen in *Viking* high resolution images from orbits 408B (~30 m/pixel) and 746A (~12 m/pixel). These images suggest that aeolian deflation has occurred along the margin of the smooth unit, and this deflation has exposed horizontal layers of material. The elevation is about 0.5 km; thermal inertias [7] are 6.5–8.0 x 10^{-3} cal cm^{-2} $s^{-0.5}$ K^{-1}; rock abundances [8] are 2–4%; and the surface is probably sandy with dark drifts and ripples but almost no actual dunes [5]. We suggest a landing around 3.2°S, 3.0°W would test the aqueous sediment hypothesis and provide a potentially smooth surface on which to land.

(3) Amenthes Fossae Region *(proposed by S. N. Huntwork and K. S. Edgett)*

The Amenthes Fossae are a series of graben/fissures that are circumferential to the southeast side of Isidis Planitia. These fissures cross a variety of ancient, heavily cratered Noachian terrain and younger, Hesperian and Amazonian terrain [12]. We focused our search on a region 0°–15°N, 250°–270°W. Elevations are –0.5 to 2 km. Depending upon whether Isidis Planitia was ever a water-rich environment [e.g., 13, 14], this region might have been influenced by aqueous sedimentation. Valley networks are common, and they drained toward the north and northwest.

We focused our work on a set of *Viking* orbiter high-resolution images, 719A 1–48. These have resolutions 16–24 m/pixel. We examined images 20–23, centered at 2°N, 258°W. This site, on the plains just southwest of a 42 km-diameter crater, includes a valley network channel, a relatively young crater ejecta deposit, a few buttes composed of presumably ancient, Noachian bedrock, and a "plains" unit. The plains might make an ideal landing surface, except for the presence of some fine-scale ridges (oriented approximately N–S). The ridges are probably yardangs, thus this site offers a place where aeolian deflation has probably exposed some of the layered rock units that comprise the "plains". Thermal inertias [7] are 7.9–8.3 x 10^{-3} cal cm^{-2} $s^{-0.5}$ K^{-1}; and rock abundances [8] are 10–15%. A rover traverse might include the opportunity to go down to the floor (and sample along the walls) of the valley network channel at 2°N, 258.1°W.

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