MARS EXOBIOLOGY LANDING SITES FOR FUTURE EXPLORATION;
Ragnhild Landheim(1), Ronald Greeley(1), David Des Marais(2), Jack D. Farmer(2) and
Harold Klein(3), (1)Department of Geology, Arizona State University, Tempe, AZ 85287-
1404, (2)NASA-Ames Research Center, Mailstop 239-4, Moffett Field, CA 94035-1000,
(3)Department of Biology, Santa Clara University, Santa Clara, CA 95053

Summary
The selection of landing sites for Exobiology is an important issue for planning
for future Mars missions. This report presents results of a recent site selection study
which focused on potential landing sites described in the Mars Landing Site Catalog [1].
In addition, we will review basic Exobiology science objectives in Mars exploration, and
outline the procedures used in site evaluation and prioritization.

Discussion
The selection of landing sites is based on the assumption that liquid water is a
fundamental requirement for life. This is consistent with the assumed importance of a
hydrologic cycle in allowing for the development and diversification of life [2].
Geological evidence for abundant water on Mars early in its history is substantial [3].
Depositional environments considered of primary interest include: fluvial-lacustrine,
thermal spring, and periglacial. Of these, fluvial-lacustrine sites are considered to be
excellent targets for meeting the goals of Exobiology, because 1) fine-grained water-lain
sedimentary deposits are good host sediments for fossils and/or organic compounds, and
2) large lacustrine basins that have not received a younger volcanic cover make good
landing targets from an engineering standpoint. Potential sites for hydrothermal activity
were identified by simple "point source" channels with amphitheater headlands that
occurred in close proximity to volcanic areas. Ground-ice may hold the largest reservoir
of water on Mars [3]. Frozen soils in periglacial environments are of great interest to
Exobiology, because ground-ice may contain a climate record of the past and it may have
served to inhibit diffusion of oxidants in the soil, thus favoring preservation of organisms
and organic compounds.

The first stage of the evaluation utilized the Viking Mars Chart (MC) prints (scale
1:2M) and the Mars Transverse Mercator (MTM) maps (scale 1:500,000). The
subsequent phase applied Viking Orbiter (VO) images to selected sites of relatively high
criteria scores from the previous analysis. Based on the latter evaluation, 17 sites were
analyzed using the best (~250 m/pixel) resolution Viking Orbiter images obtained from
the Image Retrieval and Processing System (IRPS). The final phase consisted of retrieval
of Mosaicked Digital Image Models (MDIM's; resolution 231 m/pixel) of the respective
sites. Features (landforms and deposits) used to identify each site type were assigned
scores based on three subjective weighting factors, including visibility of feature on the
image, uniqueness of the feature-process relationship, and importance of the features in
relationship to goals of Exobiology.

Of the 83 sites listed in the Mars Landing Site Catalog [1], 13 were assigned a
high priority for Exobiology by the methods outlined above. In addition, 5 additional
sites not listed in the Mars Landing Site Catalog were identified and proposed as
additions to the next edition of the catalog (Table 1).

Two sites that were assigned high priority for Exobiology were also identified by
the MESUR Science Definition Team as favorable landing sites for the proposed
Pathfinder mission [4]. The sites (Gusev crater: 15 deg S, 185 deg W [5] and Mangala
Valles: 6 deg S, 149.5 deg W) are characterized by flat terrain and fine-grained
sedimentary cover which meet important engineering constraints for safe landing sites.
This illustrates the congruent nature of the criteria used to define high priority sites for
Exobiology and other disciplines concerned with landing site identification.

The Gusev crater consists of an ancient 135 km diameter impact crater, filled with
sediments derived from an 800 km long channel cut into cratered uplands. The floor of
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the crater varies from hummocky crater ejecta to relatively smooth floor at the resolution of available images (50 m/pixel). The Mangala Valles site is on the floor of a 50 km diameter impact crater that has received sediments from channels originating from surrounding highlands. It has a well-developed delta at the mouth of a channel emptying into the crater. Albedo patterns on the floor suggest the presence of sediments reworked by the wind.

In summary, this study identifies a preliminary site list for Mars exploration Exobiology and outlines a conceptual framework for the objective evaluation and prioritization of sites to meet Exobiology science objectives. Exobiology shares important goals in Mars site selection with other planetary science disciplines, illustrating the advantage of a multidisciplinary approach in developing site selection strategies for future Mars missions.

References Cited

<table>
<thead>
<tr>
<th>LSC site no.</th>
<th>Location of interest area</th>
<th>Target site</th>
<th>Name of general site area</th>
<th>Relative level of priority</th>
<th>Suggested ref. (V.O. img.)</th>
<th>Total score</th>
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<tbody>
<tr>
<td>1</td>
<td>35°-38°S, 227°-231°W</td>
<td>37°S, 230°W</td>
<td>Eridania NW</td>
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<td>MC-29NW</td>
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<td>2</td>
<td>21°-23°S, 9°-14°W</td>
<td>22°S, 11°W</td>
<td>Margaritifer Sinus SE</td>
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<td>22.8°S, 30.6°W</td>
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<td>24.8°S, 265.8°W</td>
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<td>137</td>
<td>5.6°-6.4°S, 149°-149.9°W</td>
<td>6.3°S, 149.5°W</td>
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<td>Hebes Chasma</td>
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Note: Sites 137-141 will be included in the next edition of the Mars Landing Site Catalog