A GEOSCIENCE-BASED DIGITAL MAPPING APPROACH FOR MSL LANDING-SITE SELECTION.

K.L. Tanaka, J.A. Skinner, Jr., and T.M. Hare; Astrogeology Team, U.S. Geological Survey, Flagstaff, AZ 86001 (ktanaka@usgs.gov)

Introduction. Given the scientific and programmatic rationale defined for MSL, lessons learned from the MER rovers, and new orbital data, a considerable challenge is faced in selecting the best landing site. Here, we formulate an approach that systematically considers mapped surface science data and interpretations in MSL landing-site selection. The goal is to determine and compare numerous potential landing sites that satisfy the various MSL scientific criteria, along with engineering and planetary protection constraints. This approach can be used to identify small regions of interest for further study, data acquisition, and iterative analyses.

Science criteria. The MSL rover will serve as a combined robotic mobile field detective and laboratory analyst (see http://marsprogram.jpl.nasa.gov/msl/). The instrument package is designed to investigate a region of Mars as a potential past or present habitat. This requires access to possible organic materials and strata recording climate conditions contained in surface rocks, preferably dating back to the Noachian (~4 Ga). Present and past environmental conditions need to be characterized through on-site geologic and geochemical investigations.

Orbital data sets that now include those obtained by Mars Global Surveyor, Mars Odyssey, Mars Express, and soon Mars Reconnaissance Orbiter can be used in the site-selection process. In addition, geologic criteria can characterize the potential science return of given landing ellipses. In the following are some of the key MSL science objectives.

Access to Noachian materials. This is necessary to meet the goal of assessing atmospheric evolution over the past 4 billion years. Noachian rocks have been mapped at global scale [1-3]. An exposed, coherent stratigraphy of sedimentary materials would be particularly valuable. Also, Noachian materials in the subsurface can be brought to the surface by impacts, catastrophic water and debris discharges, and sedimentary volcanism and diapirism.

Access to near-surface H_2O and CO_2. These volatiles need to be measurable in surficial materials to determine their present state, distribution, and activity. It would be preferable if they could be investigated in stratified materials indicative of climate cycles.

Access to organic compounds. Extant life is not likely to be encountered given current environmental conditions on the Martian surface, and planetary protection requirements would preclude landing in a location where there is some remote possibility of finding and reviving life. Thus organic compounds that could be encountered may include fossil residue or substances considered to be prebiotic. Rocks formed or modified in the presence of water would be highly desirable.

Geologic constraints. To meet the above science criteria, it is useful to identify and map geologic information that weigh in on the potential to satisfy the science criteria. Here is a preliminary list, some of which could result in multiple thematic maps:

- Bedrock material age
- Surface exposure age
- Crater ejecta, including excavation depths
- Lithology
- Structures (tectonic, periglacial, etc.)
- Hydrated (phyllosilicates, hydrated sulfates) and other altered (e.g., hematite) mineralogies
- Olivine and other unaltered rock mineralogies
- Soil composition and character
- Aeolian materials (including mid-latitude mantle) and landforms
- GRS neutron abundance

While Noachian rocks are abundant on Mars, outcrops of materials of this age that demonstrate relatively youthful surfaces (e.g., the MER Opportunity site) are less common. MOC images indicate that surfaces dating back to the Early Amazonian age and older (e.g., Mars Pathfinder and MER Spirit landing sites) are densely cratered, resulting in thick impact regoliths that cover over bedrock. Of particular interest are outcrops of phyllosilicate-bearing strata surrounding lower Mawrth Vallis and in the Nili Fossae region [4]. Access to recent climate indicators may come from the eroded, layered mantle exposures concentrated in the ±30 to 45º latitude bands [5].

Landing-site GIS. We can effectively analyze and compare potential landing-site locations by assembling spatially registered thematic maps of the above information and intersecting them with maps of engineering constraint data in a Geographical Information Systems database. An ArcGIS model that maps engineering constraint data according to user inputs has already been constructed [6]. We plan to present a similar, preliminary MSL landing site GIS model at the MSL workshop that presents prospects for landing-site regions.

References. [1] Scott D.H. et al. (1986-87) *USGS I-1802A-C.* [2] Tanaka K.L. (1986) *JGR 91*, E139-E158. [3] Tanaka K.L. et al. (2005) *USGS SIM-2888.* [4] Poulet F. et al. (2005) *Nature 438*, 623-627. [5] Mustard J.F. et al. (2001) *Nature 412*, 411-414. [6] Curkendall D. et al. (2006) *LPSC XXXVII*, Abs. #2110.