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**THE LAND OF OPPORTUNITY: HUMAN RETURN TO MERIDIANI PLANUM.** B. A. Cohen[1] and M. A. Seibert[2], [1]NASA Marshall Space Flight Center, ZP13, Huntsville AL 35812 barbara.a.cohen@nasa.gov, [2]Jet Propulsion Laboratory, 4800 Oak Grove Drive, M/S 264-528, Pasadena, CA 91109; seibert@jpl.nasa.gov.

**Introduction:** Meridiani Planum is a broad expanse of Martian real estate possessing extremely safe landing characteristics and extensive areas with high trafficability, with compelling science motivations to decipher the climatic and hydrologic evolution of Mars and potential for resource extraction. We propose southwestern Meridiani Planum as a potential landing site for human exploration of Mars. Figure 1 shows our proposed exploration zone (EZ) and several potential science regions of interest (ROIs), described below.

**Science Interest:** The Martian hydrological cycle is spectacularly displayed at Meridiani Planum, where a combination of orbital and in situ observations have revealed abundant evidence for interaction of water and rock. High-resolution images from the MGS Mars Orbiter Camera (MOC) reveal finely layered rocks of apparent sedimentary origin concentrated in this region of Mars [1]. The Mars Exploration Rover Opportunity provided the first in situ evidence for persistent liquid water on the surface of early Mars, demonstrating that Meridiani bedrock is composed of sulfate salts mixed with weathered basalt exhibiting both aeolian and fluvial sedimentary structures [2] with later groundwater interaction that formed hematite concretions [3].

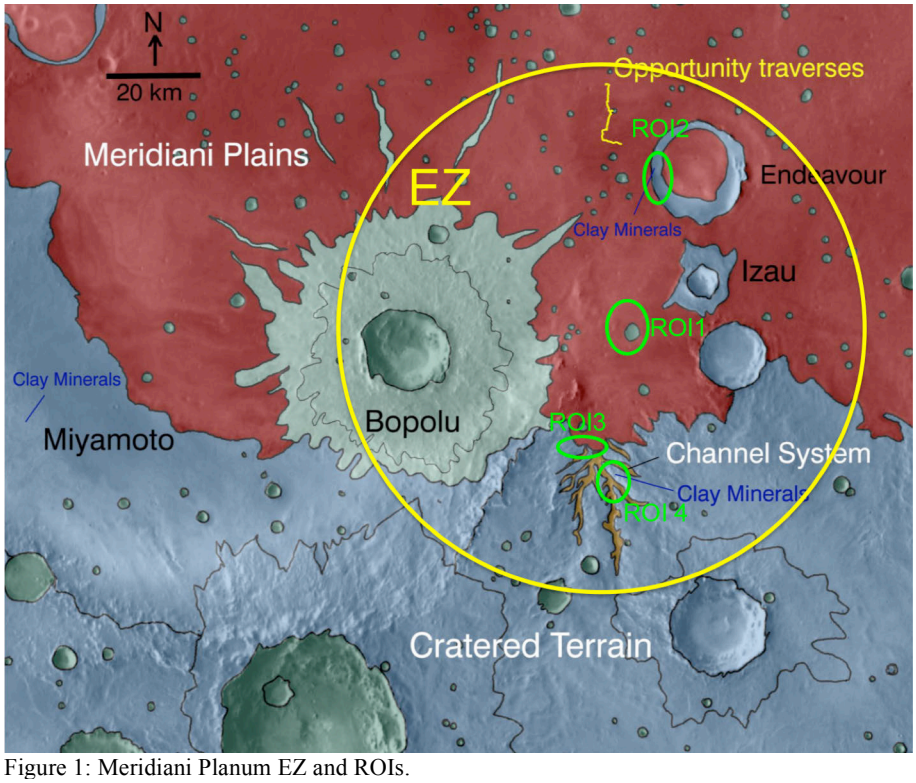

Figure 1: Meridiani Planum EZ and ROIs.

Meridiani Planum itself is part of a geologic unit referred to as the etched terrain [4]. In addition to the deposits in Meridiani, widespread layered deposits of apparent sedimentary origin are seen throughout Arabia Terra. High-resolution MOC images reveal these deposits to consist of finely layered sedimentary rocks [5]. These plains deposits embaying older, phyllosilicate- bearing terrain cut by fluvial features. ROIs have previously been identified throughout Meridiani Planum that satisfy some or all of the science and exploration objectives [6]. Here, we chose southwestern Meridiani, where a juxtaposition of phyllosilicates and sulfates occurs at a regional boundary. The ROIs include areas meeting all the science objectives identified for human exploration sites:

(a) *Access to deposits with a high preservation potential for evidence of past habitability and fossil biosignatures and/or sites that are promising for present habitability* are provided by the phyllosilicates and sulfates detected at Endeavour Crater (ROI2) and in the channeled terrain (ROIs 2 and 3).

(b) *Noachian and/or Hesperian rocks in a stratigraphic context that have a high likelihood of containing trapped atmospheric gases*, fulfilled by ROIs 2 and 3, where CRISM phyllosilicate spectral signatures correlate with polygonally-fractured bedrock in HiRISE, meaning that the phyllosilicates are in place and have appropriate stratigraphic context.

(c) *Exposures of at least two crustal units that have regional or global extents, that are suitable for radiometric dating, and that have relative ages that sample a significant range of Martian geological time*. The EZ includes an intact Noachian / Hesperian contact, where older, altered Noachian basement (ROI3) underlies younger sedimentary sulfate-rich deposits (ROI1). Both phyllosili-

cates and jarosite (K-rich sulfate) are datable minerals; units of basaltic composition units may be present that may also be datable by multiple radiometric methods.

(d) *Access to outcrops with morphological and/or geochemical signatures (with preference for sites that link the two) indicative of aqueous or groundwater/mineral interactions*, fulfilled by reexamination and/or sample return of the Meridiani plains themselves (ROI1) and veins found on the rim of Endeavor (ROI2).

(e) *Identifiable stratigraphic contacts and cross-cutting relationships from which relative ages can be determined*, fulfilled at ROI3, an identifiable contact between the plains and cratered terrain, conveniently cut by a channel for access.

**Engineering Constraints:** Meridiani Planum meets all engineering criteria for the Landing Site, Habitation Zone, and Exploration Zone outlined in the Supplemental Background Document.

*Landing Site.* Meridiani's elevation is below -1km MOLA providing extra timeline margin for descent to landing. The terrain of Meridiani is predominately shallow ripples with craters ranging from meters to tens of kilometers in diameter. While craters are present, their coverage is sparse enough as to allow for optimal positioning of the 1km "blast zone" around the landing site.

Rock abundance on the ripple fields of Meridiani is best described as very sparse, once away from crater ejecta fields (Fig. 2a). Landing on the ripples will meet all landing circle requirements.

Fig. 2b shows typical Meridiani rippled terrain. The hills on the left portion of the horizon are the far East rim of Endeavour Crater approximately 21km from the rover. The darker horizon features are the near Western rim 1.3km from the rover.

*Trafficability.* The benign terrain of Meridiani's ripple field allows for elements delivered on subsequent landings to be directly transported to their appropriate location be it the Habitation Zone or Exclusion Zone. The effective lack of mobility hazards for large rovers will also allow for minimization of traverse times from the Landing Site to the Habitation Zone and from the Habitation Zone to Regions of Interest.

The benefits to initial infrastructure emplacement provided by landing at Meridiani may also allow for long distance repositioning of surface assets as the exploration campaign evolves after each crewed exploration mission.

**References:** [1] Malin, M. C. & Edgett, K. S. *Science* **290**, 1927-1937 (2000). [2] Grotzinger, J. P. *et al*. *Earth Planet. Sci. Lett.* **240**, 11-72, doi:10.1016/j.epsl.2005.09.039 (2005). [3] Squyres, S. W. & Knoll, A. H. *Earth Planet. Sci. Lett.* **240**, 1-10, doi:10.1016/j.epsl.2005.09.038 (2005). [4] Hynek, B. M. *Nature* **431**, 156-159 (2004). [5] Edgett, K. S. & Malin, M. C. *Geophys. Res. Lett.* **29**, 2179 (2002). [6] http://marsoweb.nas.nasa.gov/landingsites/msl/workshops/2nd_workshop/program.html

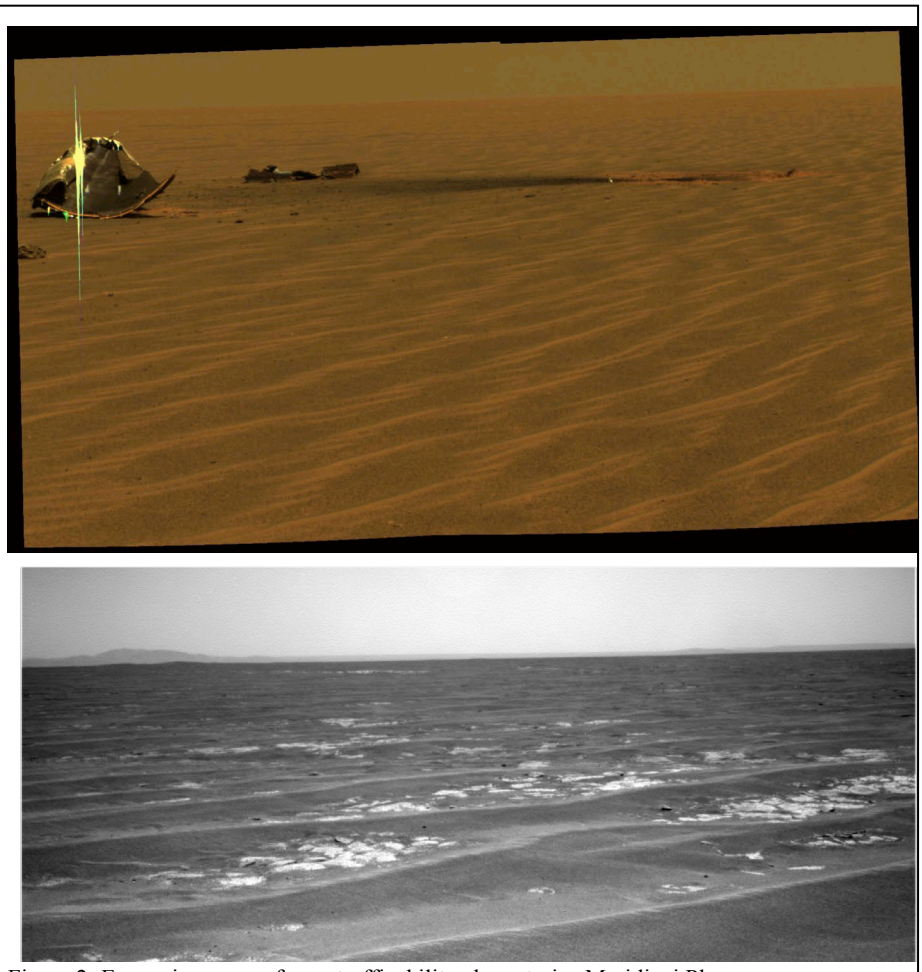

Figure 2: Expansive areas of easy trafficability characterize Meridiani Planum.