TERRAIN DISTRIBUTIONS IN MERIDIANI PLANUM AND PROBABILITY OF SAMPLING BY THE MARS EXPLORATION ROVER. W. C. Koeppen[1], F. P. Seelos IV[1], R. E. Arvidson[1], and P. R. Christensen[2], [1]Department of Earth and Planetary Sciences, McDonnell Center for the Space Sciences, Washington University, St. Louis, MO, 63130 (koeppen@levee.wustl.edu), [2]Department of Geological Sciences, Arizona State University, Box 876305, Tempe, AZ 85287-6305.

Introduction: Geologic mapping and analysis of MOLA-derived roughness, TES bolometric albedo, thermal inertia, and spectral emissivity data in Terra Meridiani [1, 2, 3] suggest that an areally extensive Etched Unit serves as a substrate for dark materials in the hematite-bearing plains of Meridiani Planum. MOC NA frames over the proposed MER landing ellipse confirm exposure of the Etched Unit in a host of terrain types which will impact rover operations, specifically the multi-unit sampling potential.

Mars Odyssey's THEMIS instrument has provided nearly full coverage over Meridiani Planum of moderate resolution (~100m/pxl) nighttime IR data. Additionally, MOC NA frames cover 56% of the Meridiani Planum landing ellipse (as of E21) at high resolutions (~1.5-6.0 m/pxl). THEMIS and MOC NA frames were utilized to generate a terrain map for the landing ellipse. The map was then used to estimate the probability of landing in a particular terrain as well as rover accessibility to the Etched Unit and overlying dark materials within different terrains.

Methodology: MOC NA frames were radiometrically calibrated using Integrated Software for Images and Spectrometers (ISIS) and projected into the MOC WA context. A THEMIS nighttime IR landing site mosaic, stretched to maximize the apparent dynamic range of values within Meridiani Planum, was co-registered to this data cube and unit boundaries were drawn by using geomorphic patterns evident in both datasets. Monte Carlo simulations based on a Gaussian density function provided example landing sites on the terrain map and MOC NA frames, and a simple stochastic diffusion model was used to represent undirected rover traverses in a variety of terrains to calculate percentages of accessible Etched Unit and dark materials.

Results: Eight terrain units are mapped inside the MER TM20B2 landing ellipse (Figure 1). They are (in order of areal abundance): *Smooth Material*: Smooth to gently rolling nearly homogenous terrain with moderate nighttime IR and MOC NA values. The Etched Unit is minimally exposed (~1-5%) in the form of subdued crater rims and an intercrater substrate. *Textured, Mixed Materials*: Visibly bright and dark dune forms overlying both bright and dark substrates. These materials are associated with large-crater ejecta and display generally low but variable nighttime IR values. *Dark, Smooth Material*: Material blown east to west out of craters appears dark in visible wavelengths with low nighttime IR values. *Smooth Mixed Materials:* Smooth terrain with Etched Unit exposures of up to

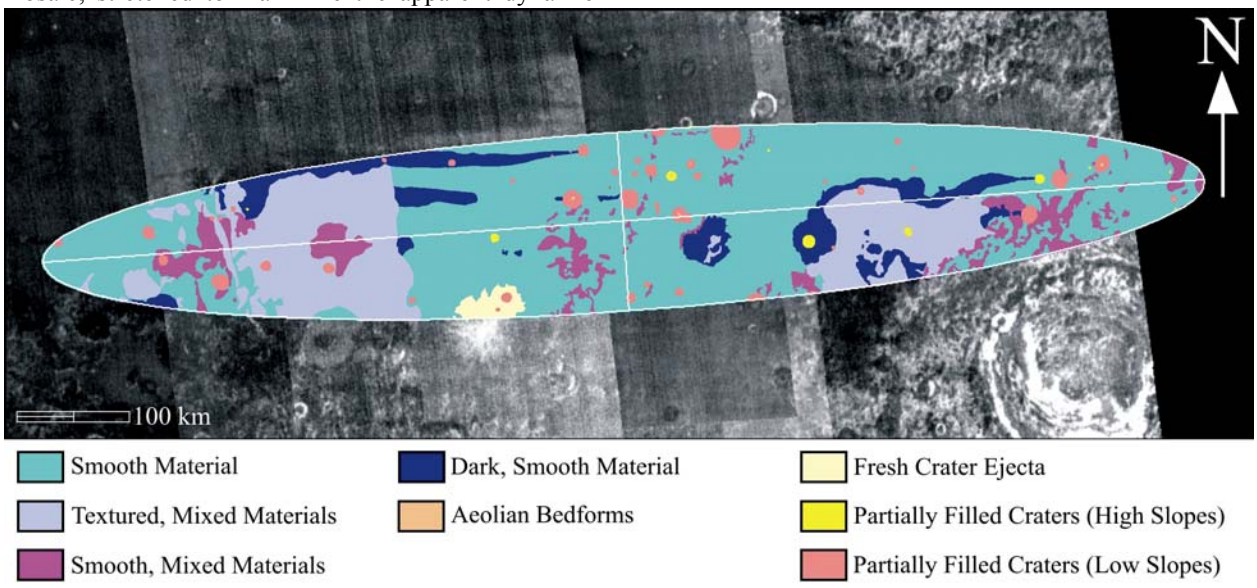

Figure 1: Terrain map of Meridiani Planum landing ellipse TM20B (centered at 2.07S, 6.08W) with THEMIS nighttime IR mosaic as background. A wide variety of terrains are present but all contain exposures of both the Etched Unit and dark materials.

30%, with high values in MOC NA frames and nighttime IR. *Partially Filled Craters (Low Slopes)*: Craters nearly completely filled in with MOLA-based estimated slopes of <6° but retaining a visible central depression in MOC NA frames. The remnant craters are visible in nighttime IR data as high-valued rims and low-valued interiors. *Partially Filled Craters (High Slopes)*: Fresh, steep-walled craters that display prominent, high nighttime IR rims. *Fresh Crater Ejecta*: Relatively recent ejecta with numerous secondary craters, high local slopes, and high nighttime IR signatures. *Aeolian Bedforms*: Aeolian bedforms showing high visible values but low nighttime IR values typically found in crater depressions.

Table 1: Abundance and probability of landing in a particular terrain.

Terrain Unit	Areal abundance in ellipse	Probability of landing in unit
Smooth Material	59.56 %	65.26 %
Textured, Mixed Materials	20.55%	15.82 %
Dark, Smooth Material	8.35 %	8.56 %
Smooth Mixed Materials	7.78 %	6.89 %
Partially Filled Craters (Low Slopes)	2.51 %	2.60%
Partially Filled Craters (High Slopes)	0.27 %	0.40%
Fresh Crater Ejecta	0.95 %	0.14%
Aeolian Bedforms	0.02 %	0.04%

Probability of landing in a particular terrain was determined by convolving the area of the mapped unit with the normalized Gaussian density function that defines the ellipse as a 3σ (99.7% confidence interval) boundary (Table 1). All terrains show exposures of both the Etched Unit and dark materials, and terrains where the Etched Unit is minimally exposed (Smooth Material and Dark Smooth Material) exhibit the smoothest surfaces at NA resolution. Most stochastic roving models access the Etched Unit for at least 3% of an 800 m or longer traverse and all Monte Carlo simulations showed Etched Unit outcroppings within 400 m of landing (Figure 2). Directed rover traverses coupled with knowledge of the rover's position in MOC NA frames will almost certainly access both units.

Conclusions: Meridiani Planum is a diverse area with eight different types of terrain within the proposed landing ellipse and at least two laterally extensive geologic units. Rover localization in inertial coordinates by radio tracking should take ~2 sols. A significant portion of the ellipse will be imaged at NA resolution, and triangulation using Pancam data should locate the rover to within ~100 m in a MOC NA frame. Therefore, within ~10 sols directed traverses to specific exposures will dramatically increase the probability of sampling multiple geologic units including Etched Unit materials. However, regardless of positional information, our analysis shows that even a mission using stochastic roving decisions (random walk) is likely to encounter both units in the course of the 90 sol mission.

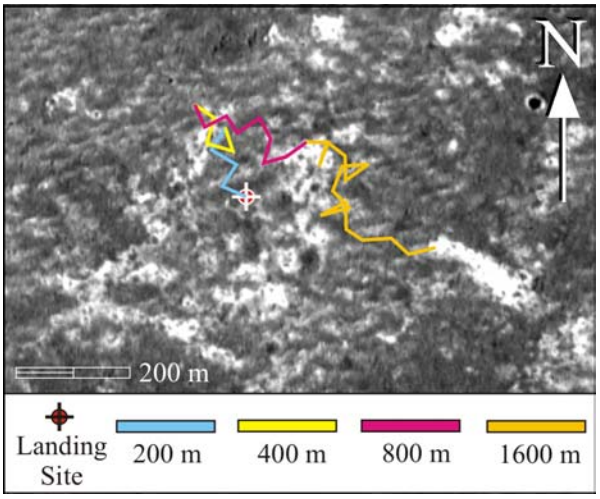

Figure 2: Example stochastic rover traverse in Textured, Mixed Materials (MOC NA E0502642) for traverse distances of 200, 400, 800, and 1600 meters in 50 m segments accessing both Etched Unit and dark materials.

References: [1] Hynek, B., et al. (2002), JGR, 107, 10.1029/2002JE001891. [2] Arvidson, R.E. et al. (2003), *JGR, in press*. [3] Christensen et al. (2001), JGR, 106, 23823-23871.