SURFACE CHARACTERISTICS OF PROSPECTIVE INSIGHT LANDING SITES IN ELYSIUM PLANITIA. M. Golombek[1], N. Warner[1], C. Schwartz[1,2], and J. Green[1,3], [1]Jet Propulsion Laboratory, Caltech, Pasadena, CA 91109, [2]Mt. Holyoke College, S. Hadley, MA 01075, [3]SUNY Geneseo, Geneseo, NY 14454.

Introduction: Sixteen landing ellipses (139 km by 27 km) in Elysium Planitia (2°S-5°N and 135-145°E) that are below -2.5 km are being considered for landing InSight in Sept. 2016 [1]. These sites have been placed on smooth, flat regions in THEMIS thermal images (the highest resolution images available at the start of landing site selection) with IRTM and TES rock abundance estimates that are dominantly below 10% and appear to meet the engineering requirements. The instrument deployment requirements include a broken up regolith at least 5 m deep for full penetration of the heat flow probe. This abstract discusses the surface characteristics of the prospective landing sites based on remote sensing and recently returned high-resolution images.

Remote Sensing Properties: The thermal inertia of the landing ellipse centers varies from around 180 to 280 J m^{-2} K^{-1} $s^{-1/2}$. Albedo at ellipse centers is 0.24-0.26 and dust cover index is 0.93-0.95. Comparison with the thermal inertias of existing landing sites and the soils present [2] suggests the InSight surfaces are composed of cohesionless sand or low cohesion soils with bulk densities of 1000-1600 kg m^{-3}, particle sizes of 0.06-0.6 mm, cohesions of 0-4 kPa and angle of internal friction of 30-40° and thus conducive to penetration by the heat flow probe. The albedo and dust cover index are similar to dusty and low-rock abundance portions of the Gusev cratered plains. The remote sensing properties and map of the 16 ellipses are shown in Figure 1 and Table 1 (including sources) of the accompanying abstract [1].

Cratered Plains: In existing THEMIS image mosaics, the InSight surfaces appear similar to other Hesperian age cratered plains; Tanaka, et al. [3] maps them as Hesperian-age HBu_2 (Utopia Planitia 2 Unit) lava flows or sediments. Recently targeted and returned high-resolution images show fresh impact craters larger than about 100 m have bright halos in CTX images and dark ejecta in daytime thermal images. The lower daytime temperatures are consistent with rocky ejecta and HiRISE images confirm rocky ejecta (Figure 1). The bright halos are due to extensive light-toned eolian bedforms in the ejecta and crater interior. Our interpretation is that fresh ejecta with a wide variety of grain sizes is out of aerodynamic equilibrium and sand sized particles are rapidly entrained in the wind. The sand forms into dunes and migrates across the surface until it falls into a crater, where it is shielded from the wind. With time, the crater is filled with sand and the rim is degraded by the wind and subsequent impacts until it is a shallow depression, decipherable only by remnants of the rim. The Gusev cratered plains traversed by Spirit also have ubiquitous sediment filled impact craters called hollows that formed by the same process when fines exposed from the impact were mobilized by the wind to fill in the craters [4].

The presence of rocks in the ejecta of fresh craters larger than 100 m diameter and the absence of rocks in ejecta of smaller fresh craters (Figure 1) argues for a strong competent layer below ~10 m and a fine grained regolith above. This is because ejecta is sourced from shallow depths (~0.1 times the crater diameter) [5] and small craters do not excavate deeply enough to sample the strong layer. This same relationship is found throughout the northern plains [6] and argues that the impact produced regolith is thick enough for the heat flow probe to penetrate to its full 5 m depth.

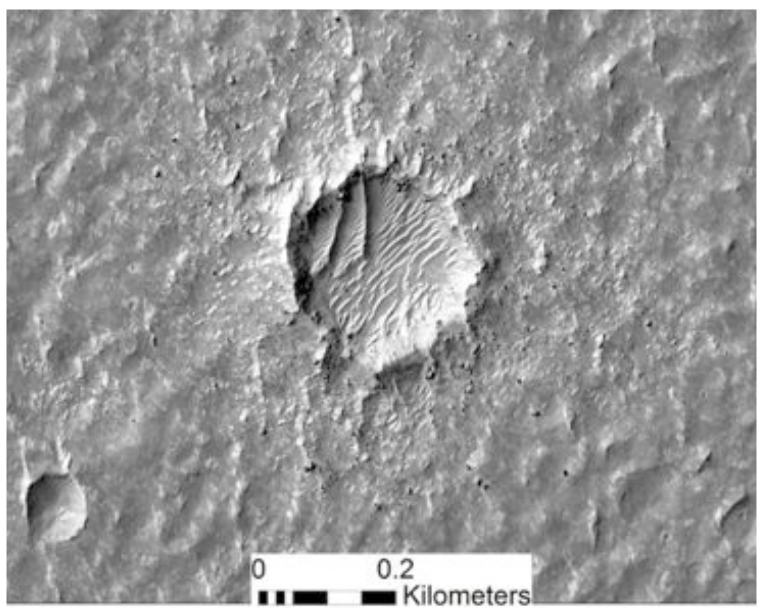

Figure 1. Relatively fresh impact crater in Elysium Planitia with blocky ejecta and abundant eolian bedforms in the interior and in the ejecta blanket. Note smooth surface and the paucity of rocks away from the fresh crater. Smaller, relatively fresh crater to the lower left has no ejecta blocks, suggesting it formed in a surface layer of broken up regolith. Portion of HiRISE image ESP_026726_1790_RED.

We found direct evidence for a fine-grained regolith overlying strong bedrock in a steep exposed portion of Hephaestus Fossae in southern Utopia Planitia (Figure 2). The uppermost layer is fine grained and is 5-10 m thick (depending on the slope of the exposure) and is underlain by a similar thickness layer of much coarser fragmented unit, which in turn is underlain by strong, jointed bedrock that is 30-50 m thick. The uppermost regolith layer is fine grained with few boulders (>1 m size) observed at HiRISE resolution. The observed regolith at this location is consistent with observations and expectations of regolith formation, growth and overturn on Mars, in which impact gardening produces a fine-grained surface layer of comminuted material that grades into more coarsely fragmented regolith below [7].

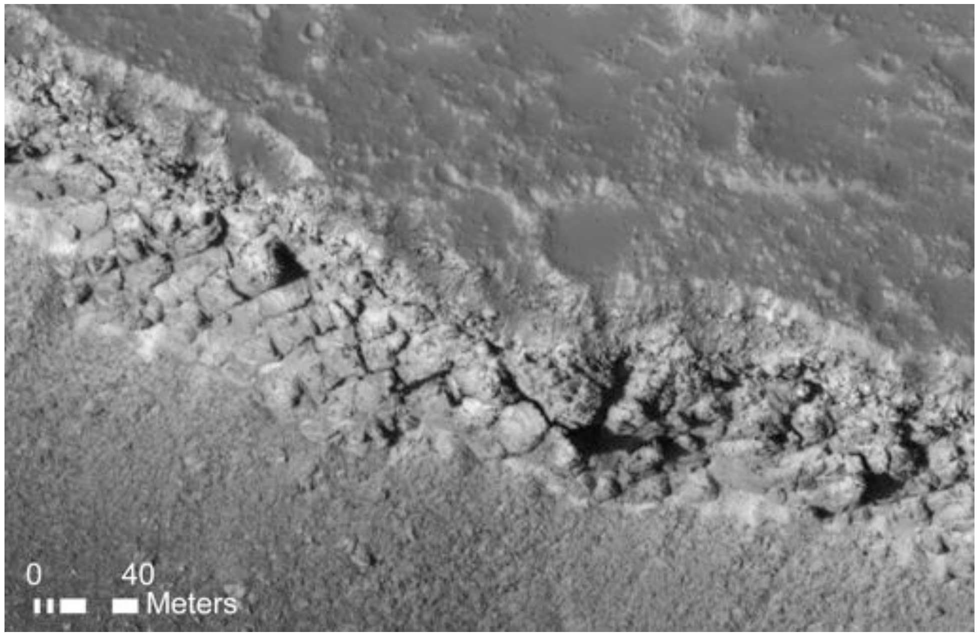

Figure 2. HiRISE image PSP_002359_2020 of a portion of the Hephaestus Fossae in southern Utopia Planitia at 21.9°N, 122.0°E showing ~10 m thick, fine grained regolith overlying strong, jointed bedrock.

Etched Terrain: In addition to the smooth cratered terrain, which has few rocks and appears smoother than the Gusev cratered plains, a rougher and rockier etched terrain is also present (Figure 3). This terrain appears topographically lower by several meters and in addition to greater slopes and far more rocks, it also has more eolian bedforms. Unlike the smooth plains, which have very few rocks, the etched terrain has rock abundance that appears much higher than the 10% engineering constraint. One possible interpretation of this terrain is that the fines have been eroded from the smooth terrain leaving a rougher and rocky lag. If this terrain is too hazardous to land on, ellipses will need to be placed to avoid this terrain as much as possible.

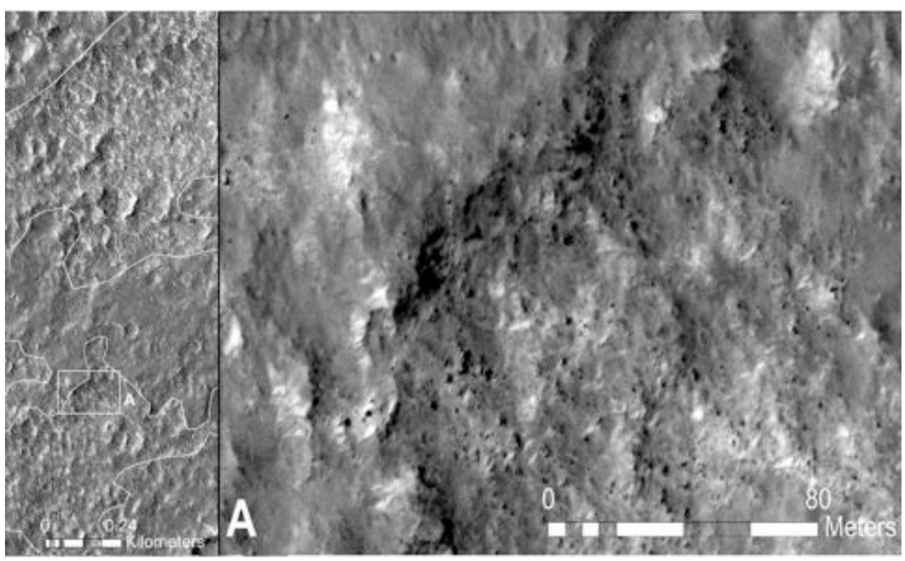

Figure 3. HiRISE image ESP_026792_1815 of smooth cratered plains and etched terrain in ellipses 4 and 11, outlined in white (left) with close up (A) shown to the right. Etched terrain appears rougher and rockier than the smooth plains. The lower elevation and abundant eolian bedforms suggests it may have formed by deflation of fines that concentrated the rocks as a lag.

References: [1] Golombek, M. (2013) *44th LPS*, this volume. [2] Golombek, M. P. et al. (2008) Ch. 21, The Martian Surface, J. F. Bell III ed., Cambridge U. Press, p. 468-497. [3] Tanaka, K. et al. (2005) *USGS SIM 2888*. [4] Golombek, M. P. et al. (2006) *JGR 111*, E02S07. [5] Melosh, H. J. (1989) Impact cratering, Oxford U. Press, NY, NY. [6] Catling, D. C. et al. (2011) *42nd LPS*, abs.# 2529; (2012) *3rd Early Mars*, abs.# 7031. [7] Hartmann, W. K. et al. (2001) *Icarus 149*, 37–53.