

HIRISE OBSERVATIONS OF POTENTIAL MARS SCIENCE LABORATORY LANDING SITES

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Introduction: The High Resolution Imaging Science Experiment (HiRISE) onboard the Mars Reconnaissance Orbiter (MRO) began acquiring data in the fall of 2006 at resolutions up to ~26 cm/pixel scale. Targets include locations proposed as potential landing sites for the 2009 Mars Science Laboratory (MSL). These targets included 33 sites proposed at the first MSL landing site workshop in June 2006 and 30 (updates of sites remaining after first workshop and new sites) proposed at the second landing site workshop in October 2007. At the second workshop and during a subsequent review by the MSL Project in early December 2007, the list of sites remaining under consideration was narrowed to 6 that include Nili Fossae Trough, Holden Crater, Mawrth Vallis, Eberswalde Crater, Miyamoto Crater, and Northern Meridiani. These sites emphasize a range of science themes including mineralogy (i.e. phyllosilicates, sulfates and/or hematite), layered materials, and the presence of fluvial, erosional or depositional landforms. At least one 20 km by 25 km primary landing ellipse was proposed for each of these sites (see Golombek et al., 2008 this issue).

HiRISE images of the six remaining landing ellipses and the go-to science targets (if applicable) have been obtained. Each image is approximately 6 km wide and at least 10 km long and includes a 1.2 km-wide blue-green and NIR swath down the middle of the image. The HiRISE images show a variety of landforms at high resolution, such as layered deposits, dunes, ripples, channels, ridges, rocks, polygonal terrain and craters. Each of these sites is being extensively studied to assess the safest landing site as well as what is best suited to achieving mission science objectives. For example, it is expected that HiRISE imagery will be the primary data set for assessing rover-scale slopes and boulder distributions. The images will also play a role during surface operations, serving as basemaps for identifying traverse targets and safe traverse paths. A brief overview of each of the six sites follows.

Nili Fossae Trough: (Ellipse center: 21.01°N, 74.45°E) Nili Fossae trough is a linear trough about 25 km wide which formed in response to the formation of the Isidis basin. Nili Fossae has diverse deposits, some that contain phyllosilicates, and others with olivines and low and high calcium pyroxenes. Nili Fossae preserves an intact Noachian stratigraphy with unaltered

basement in contact with phyllosilicates. Landing in this ellipse in the trough would provide access to a major Hesperian igneous unit for Mars, as well as the ability to characterize the various phyllosilicates. The rover could traverse across the Noachian-Hesperian boundary and assess hypotheses for alteration of the rocks (e.g., evaluate Noachian habitability) [2]. Large blocks of impact material (megabreccia) are also observed in or nearby ellipses in Nili Fossae Trough, Holden Crater and Eberswalde Crater. A mission to one of these sites could provide the opportunity to sample materials from ancient basins that was incorporated into the megabreccia, although a traverse considerably outside the landing ellipse would be required for sampling at Holden and Eberswalde.

Holden Crater: (Ellipse center: -26.38°N, 328.08°E) Holden Crater is a ~150 km diameter crater in SW Margaritifer Terra where at least 150 m of light toned layered deposits are exposed. This site provides a snapshot of the Noachian-Hesperian transition. The bedding is thin, laterally continuous and mechanically weak and there is geochemical evidence for aqueous alteration. Geologic studies of the deposits suggest an early lake episode occurred in the crater that was followed by a catastrophic flood. Flooding occurred when part of the crater rim failed that was holding back water ponded in Uzboi Vallis to the south. Science targets at this landing site include the light-toned, phyllosilicate-rich layered lacustrine/distal alluvial deposits, alluvial fans, flood deposits and bedrock. [2]

Mawrth Vallis: (Ellipse #1 center: 24.65°N, 340.1°E) Mawrth Vallis is located at the transition between the southern Noachian highlands and the northern lowlands. There is a high surface area of phyllosilicate exposures (tens of kilometers) in the bright-toned materials which have a variety of composition (range of Mg-Fe smectites to Al-rich phyllosilicates). Many of the bright, clay-bearing rocks are polygonally fractured, and there is evidence that the clays were deposited over a geologically significant period of time. Nevertheless, the depositional setting remains uncertain. Science targets include a large diversity of phyllosilicates, low and high calcium pyroxenes, and compositional and structural layering at fine scales. [2]

Eberswalde Crater: (Ellipse center: -23.86°N, 326.73°E) Eberswalde is a 65 km diameter crater containing an ancient deltaic system that is evidence for

the persistent flow of a river into a standing body of water. The fan is composed of layered sediments, inverted channels and meandering channels. Eberswalde crater forms a closed basin with no outlet channels and it is likely that a lake occupied the crater floor when the delta was actively forming. Science targets in this ellipse include escarpments of layered sedimentary rocks and inverted channels that may protect softer clay-rich sediments from erosion, light toned deposits that may be phyllosilicate rich, and light toned deposits with polygonal fractures. [2]

Northern Meridiani: (Ellipse center: 1.58°N, 357.48°E) Northern Meridiani is a equatorial landing site ~375 km to the northeast of the Opportunity rover landing site. The safety and scientific characteristics of the site are well understood by analogy with the MER-B site. Mineralogy likely to be sampled at the site includes sulfates, hydrated minerals and hematite. Science objectives include examining the contact between the dark hematite-rich unit (south) and the layered light ridge-forming unit (north) and comparing the landing ellipse regolith and bedrock to that explored by the Opportunity rover. [2]

Miyamoto Crater (SW Meridiani): (Ellipse center: -3.51°N, 352.26°E) The landing site in Miyamoto crater is located adjacent to and southwest of the hematite-bearing plains unit being explored by the Opportunity rover. The landing ellipse encompasses a stripped

surface that exposes ancient materials including phyllosilicates in a lower stratigraphic unit. The hematite-bearing plains outside the crater contains sulfates, jarosite and hematite. Science objectives include examining the phyllosilicate-rich unit and ultimately traversing across up the section into the sulfate and hematite bearing stratigraphy to examine the change in geochemical conditions associated with their deposition. [2]

Additional information: While imaging is ongoing for these six sites, the acquired HiRISE images have been released to the PDS and are available to all interested parties. These images will be used to help characterize potential hazards to safe landing at the sites, plan future operations, and to assess the science potential of the sites relative to stated mission objectives and planetary protection requirements.

<http://marsoweb.nas.nasa.gov/landingsites>

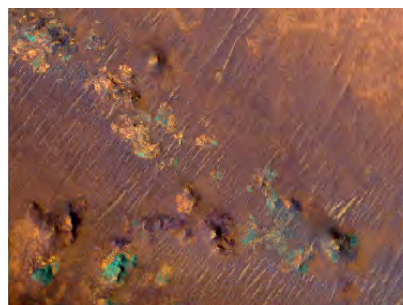
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<http://hirise.lpl.arizona.edu>

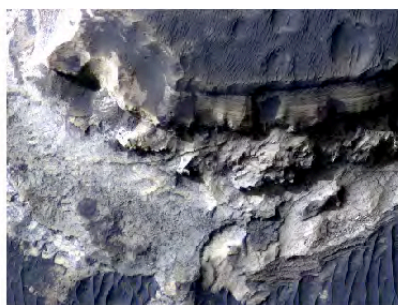
References:

[1] Golombek et al., LPSC 2008. [2] Presentations from the 2nd MSL Landing site workshop can be found at

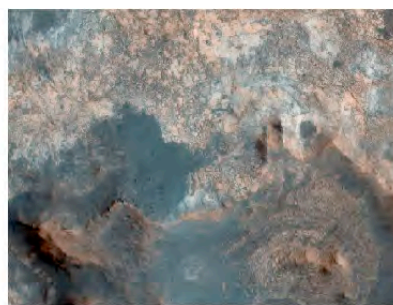
http://marsoweb.nas.nasa.gov/landingsites/msl/workshops/2nd_workshop/program.html



Nili Fossae: PSP_003086_2015 false color showing rocks rich in clays (orange), pyroxene (blue/green), and basalt (purple)



Holden Crater: PSP_001468_1535 false color showing light toned layered deposits capped by coarse flood deposits



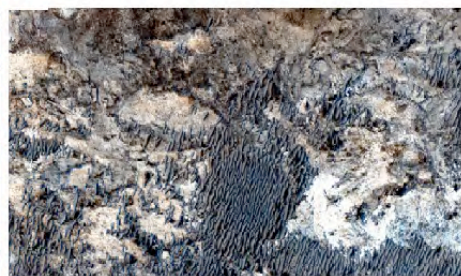
Mawrth Vallis: PSP_003063_2050 false color showing bright, polygonally fractured and phyllosilicate rich rocks



Eberswalde Crater: PSP_001534_1560 false color showing an inverted, meandering channel within the delta



Miyamoto Crater: PSP_005311_1765 false color showing sample terrain in landing ellipse



N Meridiani: PSP_006570_1820 false color showing contact between layered, ridge-forming unit to north and hematite plains to the south