MRO CRISM OBSERVATIONS OF THE MSL CANDIDATE LANDING SITES. F. P. Seelos[1], K. D. Seelos[1], S. L. Murchie[1], J. F. Mustard[2], J. L. Griffes[3], and the CRISM Team, [1]Applied Physics Laboratory, Laurel, MD 20723 (Frank.Seelos@jhuapl.edu), [2]Brown University, Providence, RI, [3]Smithsonian Institution, Washington, DC.

Introduction: The Mars Reconnaissance Orbiter (MRO) [1] remote sensing imaging instrument suite, consisting of the High Resolution Imaging Science Experiment (HiRISE) [2], the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) [3], and the Context Camera (CTX) [4], is actively making high quality science observations in support of Mars Science Laboratory (MSL) landing site selection [5]. CRISM is currently augmenting the existing targeted high resolution hyperspectral data set while simultaneously building up multispectral survey coverage of the candidate landing sites. The current status of CRISM data acquisition in support of MSL landing site selection and example systematic CRISM spectral analysis products are presented.

CRISM Overview: CRISM is a visible and near infrared hyperspectral imaging spectrometer with a spectral range from 362 to 3920 nm and 6.5 nm spectral sampling. The instrument has two primary observing modes: gimbaled or targeted hyperspecrtal observations are acquired in 544 channels at a high spatial resolution (~ 20 or 40 m/pxl; 10 km cross track; 10 or 20 km down track), while push broom or survey multispectral observations are acquired in 72 channels at a reduced spatial resolution (~ 100 or 200 m/pxl; 10 km cross track). The 72 CRISM multispectral wavelengths are a subset of the hyperpsectral bandpasses carefully selected to maintain sufficient spectral sampling of key surface and atmospheric spectral features [6].

In the standard CRISM data processing pipeline, spectral data are calibrated to radiance on senor and transformed to apparent I/F by division by an appropriately scaled reference solar spectrum. The data presented here have been further processed by applying a simple photometric (cos(i) or Lambert) correction, and a first-order atmospheric correction where the spectral data is divided by a scaled Mars atmosphere transmission spectrum derived from an extended scan across Olympus Mons [7].

MSL Support Data Acquisition Strategy: The first MSL landing site selection workshop [8] resulted in a rank-ordered list of 36 candidate landing sites (see Table 1 in [5]). This list along with preferred observation target coordinates has been provided to the MRO project. Through an operational agreement between the MSL and MRO projects, MRO is committed to the acquisition of a nested set of high quality HiRISE, CRISM, and CTX observations centered on the specified MSL site coordinates in advance of the second MSL landing site selection workshop (October, 2007). Many of the candidate sites are of great scientific interest irrespective of the MSL landing site selection process. As a result MRO data coverage in the vicinity of the MSL sites is not uniform, with CRISM hyperspectral coverage favoring regions with known mineralogical diversity (e.g. [9], [10]).

In addition to the project level hyperspectral targeted observations, CRISM is also acquiring multispectral survey data of the candidate landing sites as a natural consequence of the ongoing global multispectral survey. This systematic mapping campaign will eventually provide near-global coverage, with gap-filling slated to continue throughout the MRO primary mission. Unlike the project level targeted observations of the candidate MSL sites, no special priority is given to the acquisition of CRISM survey data for any particular region.

CRISM MSL Site Coverage Status: For the purposes of the systematic evaluation of the MSL candidate landing sites, a study region surrounding each site is delineated by a 3x3 degree (planetary central angle) box (~178 km on a side), consistent with the MSL candidate landing site products provided by the THEMIS team [11].

The CRISM coverage maps and statistics presented here are current through March 25th, 2007 (DOY 2007-084). At the abstract submission deadline, this was the most recent date for which reconstructed SPICE data had propagated through the CRISM processing pipeline, ensuring accurate geometric information. Updated coverage maps and statistics will be included in the conference presentation.

The global CRISM mustispectral survey coverage status through DOY 2007-084 is shown in Figure 1. The MRO primary science phase began at Ls ~130°, allowing for significant data acquisition at the high northern latitudes in advance of deteriorating illumination and atmospheric conditions. At the abstract deadline, acquisition of multispectral survey data at the highest southern latitudes was ramping up, and coverage at the equator was approaching 30%. The majority of the MSL candidate landing sites are within +/- 30° in latitude, making this a reasonable estimate of the current MSL site CRISM survey coverage as well.

Table 1 lists the 36 candidate MSL landing sites currently under consideration, along with the number and type of CRISM observations that have been acquired in the surrounding study area. CRISM data cov-

erage maps for each MSL candidate site (e.g. Figure 2) are maintained in the CRISM Science Operations Center (SOC) and updated following each reconstructed SPICE kernel delivery. These coverage maps and vector data are used in the tactical and strategic science planning process to track progress toward the MSL landing site selection support observation objectives, and they form a basis for detailed analysis of the CRISM spectral data.

CRISM MSL Multispectral Mosaics: In addition to the CRISM data coverage overlays, multispecrtal survey mosaics for each MSL candidate landing site region are also maintained in the CRISM SOC. Figure 3 shows a false color IR composite highlighting the spectral diversity in the Mawrth Vallis region, as well as an example of a spectral summary parameter mosaic – here the D2300 or 2.3 µm drop-off spectral parameter which is indicative of hydrated phyllosilicate mineralogy. The spectral and summary parameter MSL candidate landing site mosaics provide a basis for mineralogical comparison among the candidate landing site regions, as well as mineralogical context for the higher spatial CRISM hyperspectral observations.

Ongoing CRISM MSL Candidate Landing Site Analysis: Numerous MSL candidate landing sites and their regional settings are the focus of ongoing studies by members of the MRO instrument science teams. Detailed CRISM spectral analyses are currently being pursued for the Nili Fossae region [12, 13], Holden and Eberswalde Craters [14], Candor and Melas Chasma [15, 16], and Juventae Chasma [17].

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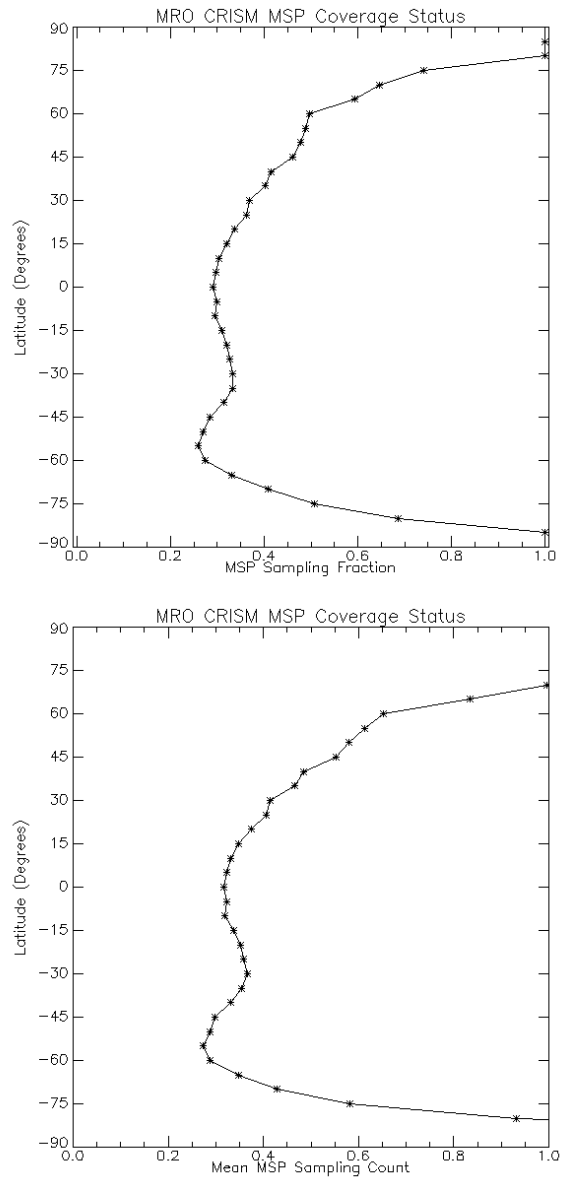

Figure 1. CRISM global multispectral survey status through March 25th, 2007 (DOY 2007-084). (Top) MSP sampling fraction as a function of latitude. (Bottom) MSP sampling count as a function of latitude.

NAME	LOCATION		CRISM OBSERVATIONS				
	Latitude ºN	Longitude ºE	MSP	MSW	HRS	HRL	FRT
Nili Fossae Trough	20.93	74.35	9	4	0	0	1
Holden Crater Fan	-26.32	325.30	3	5	1	0	2
Terby Crater	-27.74	74.11	6	4	0	0	0
Marwth Vallis	24.65	340.10	10	1	0	4	0
Eberswalde Crater	-23.19	326.75	5	1	2	0	1
Gale Crater	-4.50	137.35	6	2	3	3	2
West Candor	-5.80	284.17	10	5	0	3	3
North Meridiani	2.37	6.69	7	4	1	0	1
Juventae Chasma	-4.45	298.09	8	2	0	2	0
Nilo Syrtis	29.16	72.97	9	0	0	0	0
Melas Chasma	-9.81	283.62	8	3	0	1	1
East Meridiani	0.01	3.66	1	1	2	0	0
Athabasca Vallis	9.93	156.77	4	5	0	1	1
Iani Chaos	-2.06	342.41	4	1	0	0	0
Nili Fossae Crater	18.44	77.58	3	1	0	1	1
Eos Chasma	-10.70	322.05	4	0	2	0	0
Meridiani Crater Lake	5.72	358.03	2	1	0	0	1
Northeast Syrtis Major	16.21	76.63	5	0	0	0	1
Margaritifer Basin	-12.85	338.00	13	0	0	0	1
East Melas Chasma	-11.72	290.72	13	2	1	1	0
Hellas/Dao Vallis	-39.50	82.70	7	0	1	0	0
Xanthe/Hypanis Vallis	11.40	314.65	8	1	1	0	1
Becquerel Crater	21.32	352.52	6	2	0	0	1
Southwest Arabia Terra	6.01	355.60	4	0	0	0	1
Gullies/Wirtz Crater	-48.48	335.05	5	1	0	0	0
West Arabia Crater	8.45	359.09	6	1	0	0	1
Argyre	-56.80	317.70	8	2	0	0	0
Northwest Slope Valleys	0.00	145.00	4	1	0	0	0
West Meridiani	-1.70	352.39	6	1	0	0	0
Elysium/Avernus Colles	-3.05	170.60	10	0	0	0	1
Meridiani Bench	7.50	354.00	5	2	1	2	1
SML Craters	-49.04	14.49	7	0	0	0	0
Isidis Basin Escarp	18.00	79.60	6	1	0	0	0
Samara Vallis	-23.55	339.75	16	0	0	0	0
Eos Alluvial	-13.60	317.50	10	0	0	0	0
Aeolis Fan Delta	-5.05	132.85	8	1	0	0	0

Table 1. Candidate MSL landing sites currently under consideration. The number and type of CRISM observations acquired within a 3x3 degree (planetary central angle) region surrounding each location are shown. The CRISM observation counts are updated through March 25th, 2007 (DOY 2007-084). Hyperspectral observations are taken at full spatial resolution (FRT) or half resolution in long (HRL) or short (HRS) down track swaths. Multispectral data are acquired at 200 m/pxl (MSP) or alternately at 100 m/pxl (MSW) with a lower signal to noise ratio.

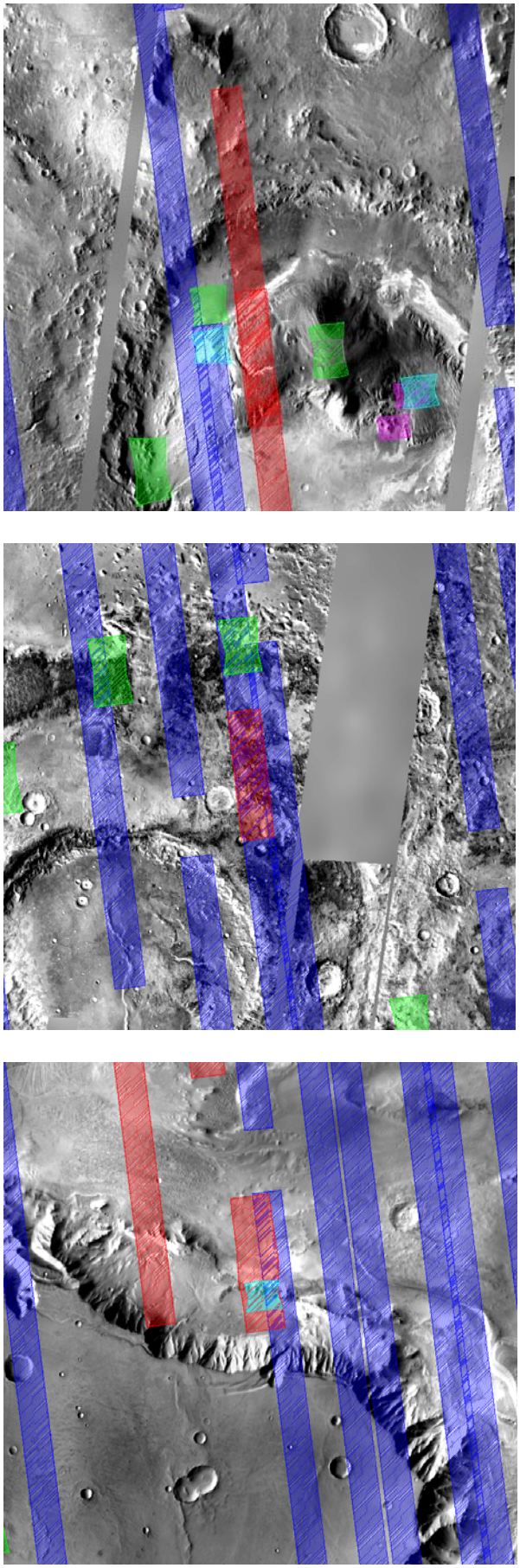

Figure 2. CRISM coverage maps for MSL candidate landing sites Gale Crater (Top), Mawrth Vallis (Center), and Melas Chasma (Bottom). Each CRISM vector collection is shown over a portion of the THEMIS daytime IR global mosaic. Each region is ~178 km on a side. The vector color key is consistent for all three coverage maps: FRT-cyan; HRL-green; HRS-magenta; MSW-red; MSP-blue.

Figure 3. (Top) False color multispectral survey (MSP) IR composite for the Mawrth Vallis MSL candidate landing site study region (R:2.5280 µm; G:1.5050 µm; B:1.0784 µm). (Bottom) D2300 spectral summary parameter map derived from the multispectral survey data. Brighter pixels indicate a decrease in reflectance beyond 2.3 µm, as occurs in Fe/Mg phyllosilicates.