PRELIMINARY MASTCAM VISIBLE/NEAR-INFRARED SPECTROPHOTOMETRIC OBSERVATIONS AT THE CURIOSITY LANDING SITE, MARS. J.R. Johnson[1], J.F. Bell III[2], A. Hayes[3], R. Deen[4], A. Godber[2], J. Joseph[3], R. Arvidson[5], M. Lemmon[6], and the MSL Science Team, [1]Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20723, jeffrey.r.johnson@jhuapl.edu, [2]Arizona State University, [3]Cornell University, [4]Jet Propulsion Laboratory/Caltech, [5]Washington University in St. Louis, [6]Texas A&M University.

Introduction: The Mast Camera (Mastcam) imaging system on the Curiosity rover acquired images of the same terrain at multiple times of day at two rover locations within and outside the terrain disturbed by the spacecraft landing event. Such photometric data provides the opportunity to investigate the light scattering properties of rocks and soils at multiple wavelengths within and outside the landing zone.

Data and Methods. Images were acquired by the Mastcam-34 (M-34, ~34 mm focal length) and Mastcam-100 (M-100, ~100 mm focal length) cameras on Sol 20 after the first rover drive. Image mosaics were obtained in four directions (SW,NW,NE,SE) using filter 0 (RGB) uncompressed data in both eyes at four times of day (Table 1) with accompanying calibration target images. Each scene was acquired as a 4-row by 4-column mosaic covering the same region (M-34 images were highly overlapped in the mosaic). **Figure 1** shows the location of the mosaics on a Navcam mosaic from Sol 16. Although these sequences were designed primarily to determine the effects of illumination differences on image compression, they also serve as a useful photometric data set that covers phase angles from 31-135° on terrain types exhibiting variable states of disturbance from the spacecraft landing. While the rover was parked at the Rocknest drift, M-34 camera 2-row by 1-column mosaics were acquired pointing east and west at six times of day using filters centered at 445, 527, 751, and 1012 nm (Table 1) between Sols 60 and 78. These images were jpeg-compressed and provided phase angle coverage from near zero to ~140° for a variety of rock and soils. Preliminary calibration of all images involved accounting for the Bayer pattern of RGB filters [2], conversion to radiance, and use of preliminary flat field images. **Figure 2** shows preliminary examples of these mosaics. Navigation Camera (Navcam) stereo images were also acquired with each data set to provide terrain measurements necessary to compute local incidence and emission angles on rocks and soil drifts. Although the spatial resolution of the Navcam images is ~3x lower than the M-34 data, geometric registration and projection of the M-34 images onto terrain models generated from Navcam stereo pairs has been successfully demonstrated (**Figure 3**). These data will be used to correct local slopes prior to input to radiative transfer models [e.g., 3]. Use of the M-100 camera for Mastcam-based stereo information is a possible alternate means of constructing such data, although at a sizeable increase in data volume and duration.

Table 1. Image sequences used in this work.

Sol	Sequence (mcam*)	LTST (avg)	Phase angle (avg °)
20	052, 056, 057, 058	12:45	73,89,74,56
20	0102,0103,0104,0105	14:15	64,101,89,43
20	0106,0107,0108,0109	15:15	59,112,102,36
20	0110,0111,0112,0113	17:00	59,124,119,38
60	0273,0275	12:26	75, 57
60	0276,0278	16:47	138,9
61	0279,0281	09:08	27, 107
71	0499,0500	13:36	41, 93
76	0568,0569	14:46	109, 25
78	0573,0574	10:08	40, 93

LTST=Local True Solar Time

Results. **Figure 4** shows preliminary radiance curves (divided by cosine of the solar incidence angle) for the red, green, and blue channels of the M-34 Bayer filter extracted from typical terrain in the southwest quadrant of the Sol 20 dataset. The materials appear more forward than backward scattering. This may result from the effects of the landing exhaust, although this requires more calibration efforts to confirm. **Figure 5** shows phase angle composite images from the Sol 61 dataset that emphasize the forward scattering (blue) properties of the less dusty rocks and granules versus the backscattering (red) properties of the dusty soils and rocks, consistent with results from MER photometric studies [3].

Future work. Refinements to the radiometric calibration of Mastcam data is ongoing [1], as is acquisition of atmospheric opacity measurements necessary to correct for the diffuse component of reflectance [3,4]. Radiative transfer model results will be compared between these two data sets, to results from previous rover analyses [3], to future Mastcam photometric data sets to be acquired during the mission, to recent photometric analyses of lunar landing sites [5], and to multi-angle orbital CRISM observations of Gale Crater.

References: [1] Bell et al., this conference; [2] Maki et al., this conference; [3] Johnson et al., JGR., 111, doi:10.1029/2005JE002494, 2006; Johnson et al., JGR, 111, doi:10.1029/2006JE002762, 2006; [4] Lemmon et al., this conference; [5] Clegg, R. and B. Jolliff, LPSC 43 abstact #2030, 2012.

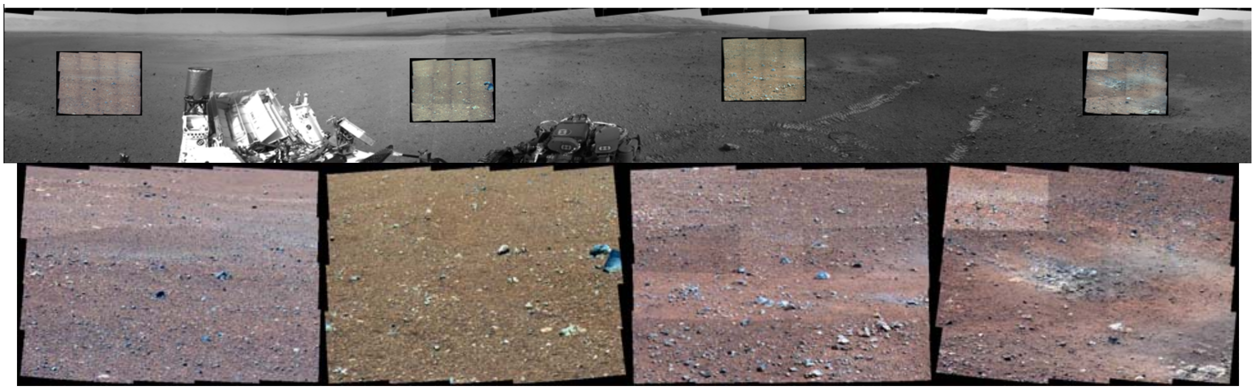

Figure 1. *(top)* Four preliminary M-34 Mastcam camera false-color mosaics (4x4, false-color, acquired 12:39 to 13:09 LTST) overlain on Sol 16 Navcam panorama; (*bottom*) Larger versions; Left-to-right: NE, SE, SW, NW

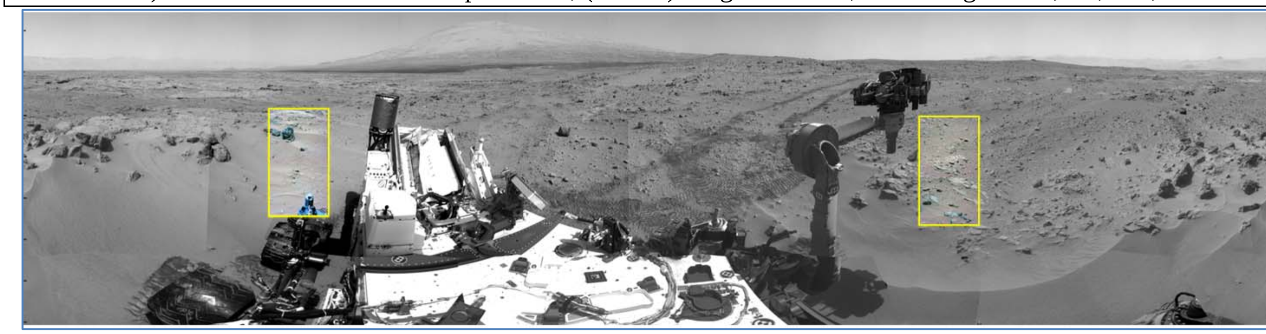

Figure 2. Preliminary M-34 Mastcam false-color mosaics of West and East regions from Sol 60 photometry sequence overlain on Sol 59/60 Navcam mosaic.

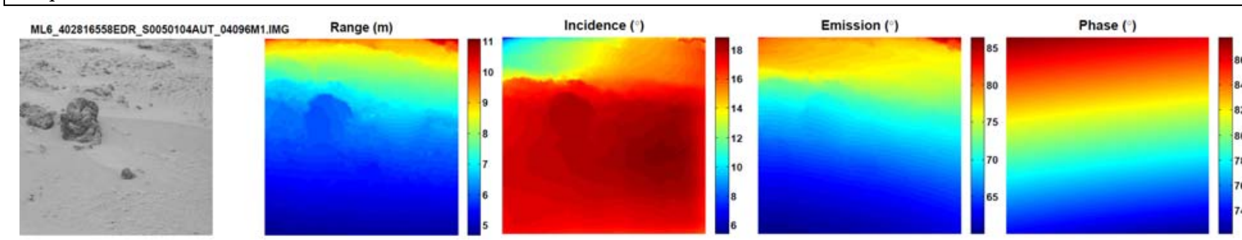

Figure 3. Example of geometric information from Navcam stereo pair acquired to support photometry observation on Sol 60 (12:30 LTST). Left-to-right: M-34 image, Navcam range, incidence, emission, and phase angle maps.

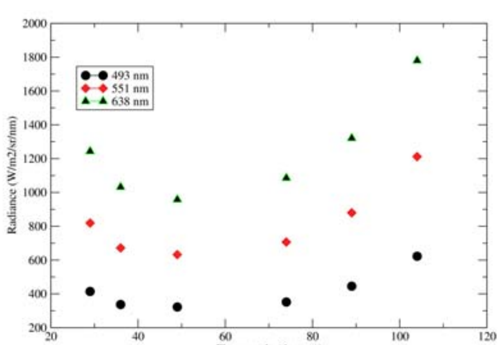

Figure 4. Preliminary radiance phase curves (divided by cos(incidence)) at three wavelengths of representative terrain within Sol 20 southwest quadrant.

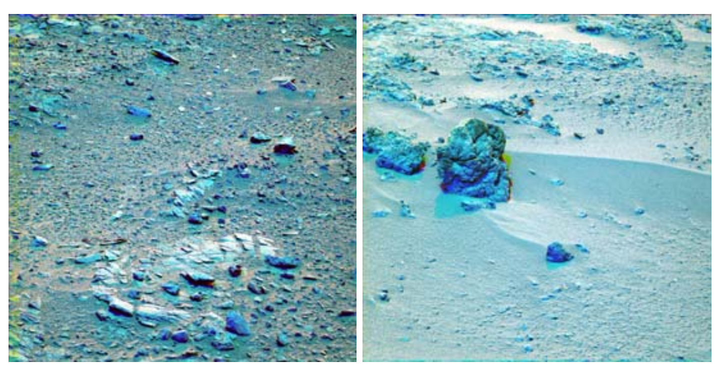

Figure 5. Phase color composites acquired at 527 nm at different phase angles: (*left*) red=4°, green=63°, blue=101°; (*right*): red=32°, green=81°, blue=114°. Red=more backscattering (dusty soils, drifts); blue=more forward scattering (rocks, granules).