NEW IRON METEORITE DETECTIONS BY THE MARS SCIENCE LABORATORY CURIOSITY ROVER IN THE SOUTHERN GLEN TORRIDON REGION. J.R. Johnson[1], J.F. Bell III[2], R.C. Wiens[3], S. Maurice[4], O. Gasnault[4], S. Jacob[2], W.E. Dietrich[5], [1]Johns Hopkins Univ. Applied Physics Lab, Laurel, MD 20723, jeffrey.r.johnson@jhuapl.edu, [2]Arizona State Univ., [3]Los Alamos National Lab.,[4]IRAP, Toulouse, [5]Univ. California Berkeley.

Introduction: The Mars Science Laboratory (MSL) Curiosity rover identified a set of large (~1m) iron meteorite candidates on Sols 2958-2970 (Nov./Dec. 2020) in the southern Glen Torridon region using Mastcam multispectral images (440-1020 nm) and ChemCam passive spectra (400-840 nm) supported by Remote Micro-Imager (RMI) images. Although no ChemCam laser-induced breakdown spectroscopy (LIBS) measurements were acquired of these rocks, the new reflectance data expand on previous discoveries of meteorites along the MSL traverse that used similar methods (as well as LIBS) [1-7]. The distributions and compositions of iron meteorites are of interest in part because they can constrain models of physiochemical weathering experienced since their arrival [6-12], thereby serving as "witness plate" rocks [14].

Methods and Data. Mastcam 100 mm focal length (M100) Bayer filter images were used to remotely identify three candidate meteorites (Island_Davaar, Obar_Dheathain, and Eilean) from as far as 125 m distance, based on the targets' textures, size, and relatively bluish color. Mastcam multispectral images were acquired from 50-100 m distance, which exhibited "thumbprint" surface textures suggestive of regmaglypts, large elongated pits, and protrusions or overhangs (**Fig. 1**). Reflectance spectra of each target exhibited steadily increasing reflectance towards near-infrared wavelengths, consistent with iron meteorite spectra [13]. Some spectra on certain facets were flatter in the near-infrared due to the effects of variable dust coatings and/or grazing solar incidence angles. Mid-drive 34 mm focal length (M34) images captured a portion of Island_Davaar from 7 m distance (**Fig. 2**), which exhibited surface textures similar to previous iron meteorite observations. Multispectral images acquired on Sol 2967 of Island_Davaar and Obar_Dheathain, and Eilean (from 21 m, 31 m, and 43 m distances, respectively) (**Fig. 3**), demonstrated Mastcam spectra consistent with previous iron meteorites (**Fig. 4**). Owing to sun safety concerns, ChemCam passive reflectance observations were not obtained on these targets except for attempts on Eilean and Obar_Dheathain on Sol 2967. Although the Eilean attempt missed that target, the RMI image revealed textures similar to those for the Obar_Dheathain target (**Fig. 5**). Spectra from the latter target were affected by dust and local topographic shadowing, but also revealed flat to positive near-infrared spectral slopes consistent with previous ChemCam reflectance spectra of iron meteorites (**Fig. 6**). After another drive, Eilean was observed on Sol 2970 with a Mastcam M100 Bayer filter image from 35 m distance at a location orthogonal to the previous imaging. In this perspective Eilean appeared elongated, a shape previously not visible (**Fig. 7**). Navcam stereo images enabled size estimates of each meteorite as: Island_Davaar: ~0.75 x ~1.0 m; Obar_Dheathain: ~1.5 x ~0.3 m; Eilean: ~0.5 x ~1 m.

Summary. Mastcam M100 observations of boulders from > 100 m enabled remote identification of three large (~1 m) candidate iron meteorites. Subsequent imaging and reflectance measurements from closer distances revealed reflectance spectra and surface textures consistent with previous observations of iron meteorites observed by both Curiosity and the MER Opportunity rover [14]. The Island_Davaar, Eilean, and Obar-Dheathain meteorites are the largest observed since the discovery of the Littleton/Lebanon meteorites (formally *Aeolis Palus 001, 002, 003*) on Sol 637 [1].

References: [1] Johnson et al., AGU,#P51E-3989, 2014; [2] Meslin et al. LPSC,#2258, 2017;[3] Wellington et al., LPSC,#2083, 2018; [4] Wiens et al., 80th Met. Soc.,1987,2017; [5] Johnson, J.R. et al., LPSC #1136, 2020; [6] Wellington et al. (2019) LPSC, #3058; [7] Meslin et al. (2019) LPSC,#3179; [8] Schröder, C., et al., LPSC,#6254, 2019; [9] Mansell, and Downes, LPSC,#1035, 2019; [10] Ashley, Elements, 11(1),10-11,2015; [11] Lasue et al., LPSC#2132, 2019; [12] Schröder et al., Nature Comm., 7, 2016; [13] Gaffey, M., JGR, 81, 905-920, 1976; [14] Ashley, J.W., et al., Decadal Survey White Paper, https://mepag.jpl.nasa.gov/reports/decadal2023-2032/AshleyJamesW.pdf.

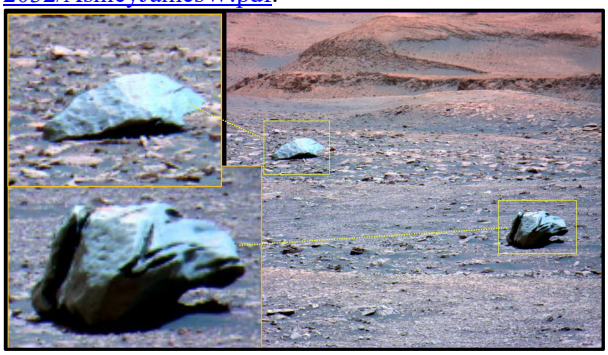

Fig. 1. Mastcam enhanced color M100 image (805,527, 447 nm filters) and blow-ups of Island_Davaar (right, ~1 m wide, 44 m away) and Obar_Dheathain (left, ~1.5 m wide, ~100 m away) from Sol 2961 (mcam15459).

Fig. 2. Sol 2965 Mastcam M34 image of ~25 cm portion of Island_Davaar acquired mid-drive from 7.1 m.

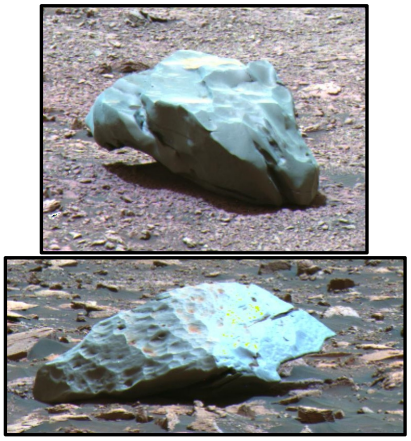

Fig. 3. Mastcam enhanced color M100 images (805, 527, 447 nm filters) Island_Davaar (*top*, ~0.8 m wide, 21 m distance) and Obar_Dheathain (*bottom*, ~1.5 m wide, 31 m distance) from Sol 2967 (mcam15488, mcam15490).

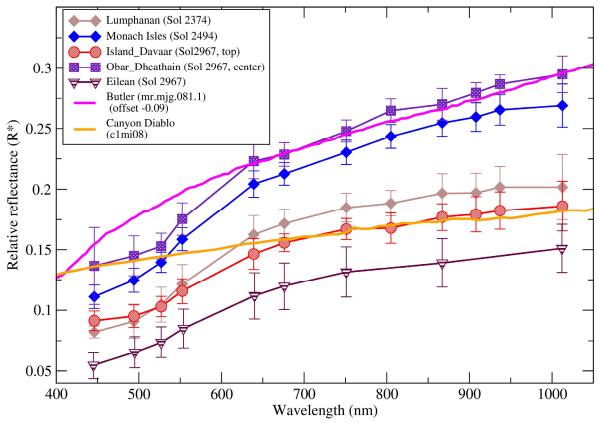

Fig. 4. Mastcam spectra of targets from Sol 2967 location compared to previous meteorites observed by Curiosity and to RELAB spectra of iron meteorites Butler and Canyon Diablo [5] (offset shown in legend).

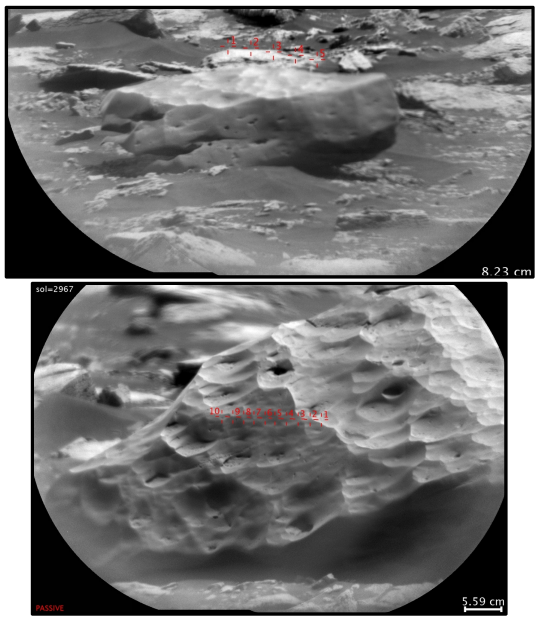

Fig. 5. Portions of ChemCam RMI image mosaics of Eilean (*top*) and Obar_Dheathain (*bottom*). Numbered red crosses are locations of passive ChemCam spectra.

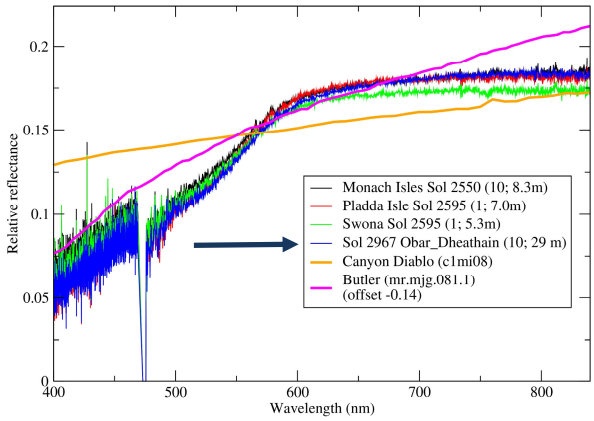

Fig 6. ChemCam relative reflectance spectra of location #10 (arrow) on Obar_Dheathain (Fig. 5), compared to similar spectra of previously observed iron meteorites in the Glen Torridon area [5] and to RELAB spectra of Butler (offset in legend) and Canyon Diablo (Fig. 4).

Fig. 7. Mastcam M100 image of Eilean (~1m wide, from 35 m distance) from Sol 2970 (mcam15506).