VISIBLE WAVELENGTH SPECTROSCOPY (400-1020 nm) OF SURFACE MATERIALS AT JEZERO CRATER, MARS, FROM SUPERCAM AND MASTCAM-Z. J.R. Johnson[1], C. Legett[2], R. C. Wiens[2], R. T. Newell[2], E. Cloutis[3], O. Forni[4], P. Beck[5], P. Pinet[4], L. Mandon[6], F. Poulet[7], T. McConnochie[8], S. Maurice[4], J.F. Bell III[9], M. Rice[10], B. Horgan[11], K. Kinch[12], A. Hayes[13], (jeffrey.r.johnson@jhuapl.edu), [1]Johns Hopkins University Applied Physics Laboratory, Laurel, MD, USA, [2]LANL, Los Alamos, [3]University of Winnipeg, Canada, [4]IRAP, Toulouse, France, [5]IPAG, Grenoble, France,[6]LESIA, CNRS, Meudon, France, [7]IAS, Orsay, France, [8]Space Sci. Inst., [9]Arizona State Univ., [10]Western Washington Univ., [11]Purdue Univ.; [12]Univ. Copenhagen, Denmark; [13]Cornell Univ.

Introduction: Through the first 282 sols of the Mars 2020 *Perseverance* mission, visible wavelength spectroscopy of near-field rocks, soils, abraded targets, and drill tailings were acquired by the VIS portion of SuperCam (379-853 nm) [1,2] and the Mastcam-Z (ZCAM) multispectral imaging system (442-1022 nm) [3]. Comparisons reveal consistent views between the two instruments regarding primary/alteration mineralogies and oxidation states in targeted samples.

SuperCam Data. SuperCam acquires high spectral resolution VIS (379-853 nm) and IR (1300-2600 nm) spectra as rasters covering multiple locations on a surface at fields of view of 0.74 and 1.15 mrad, respectively [2,4]. For VIS data used here, 50 spectra were averaged for each location using spectrometers covering the blue-violet (VIO, 379–464 nm) and green-to-infrared (VNIR, 535–853 nm) ranges. The VNIR transmission spectrometer (TSPEC) uses three regions: Green (535-620 nm), Orange (620-712 nm), and Red (712-853 nm). Raw VIS data were converted to radiance via an instrument transfer function derived from lab measurements with an integrating sphere [2,5]. Relative reflectance spectra were generated by dividing the calibrated target radiance spectrum by a radiance spectrum of the onboard AluWhite calibration target [6]. The AluWhite spectrum taken on Sol 20 was used as this reference up to Sol 129, when the number of rows summed for the Red portion of the TSPEC was updated for all subsequent spectra. Subsequently, an AluWhite test observation on Sol 184 returned all 50 spectra rather than an average. This revealed that after the first TSPEC spectrum the fidelity of the subsequent spectra in this observation decreased substantially, possibly related to instability of the intensifier and/or the high-voltage power supply for the VIS system [5,11]. As a result, only the first spectrum from the Sol 184 set is used for calibration in post-Sol 129 data, resulting in improved spectra. Residual issues in the VIS spectra include the Cr^{3+} AluWhite emission feature at ~694 nm, and decreased sensitivity near detector boundaries for Green/Orange (~620 nm) and Orange/Red (~719 nm), which can cause artifacts.

Mastcam-Z Data. ZCAM [3] includes a pair of focusable, 4:1 zoomable cameras that provide broadband red/green/blue and narrowband 440-1020 nm color imaging (26 mm focal length at 283 μrad/pixel to 110 mm focal length at 67.7 μrad/pixel). ZCAM images were calibrated to radiance and relative reflectance via use of flat field images and observations of the ZCAM calibration targets [3,11].

Data Collection and Analysis. SuperCam relative reflectance spectra were obtained from individual raster locations or raster averages. VIO data were smoothed using a 51-channel average to reduce noise. ZCAM spectra were collected from the same region-of-interest (ROI) as SuperCam rasters. (Standard deviations in ZCAM spectra represent ROI variability [3]). Spectral parameters were used to investigate trends among the data. The 545 nm band depth (BD545) is sensitive to oxidation (crystalline Fe^{3+}), and the 750-840 nm spectral slope (S7584) is sensitive to ferrous minerals such as olivine [7]. Trends between 600-840 nm ratios vs. spectral slopes can be related to variations in surface dust [7] on spectrally neutral substrates, as suggested by lab spectra of basalt coated with Mars analog dust [7,8].

Results. Figs. 1-2 show variations in the BD545 and S7584 parameters for rocks, soils, abraded targets and drill tailings. Figs. 3-5 compare SuperCam and ZCAM spectra for endmember targets. Variable illumination conditions, specular scattering, photometric effects, and inherent variability within an ROI led to some differences in relative reflectance values between spectra from the two instruments, but overall the spectral shapes were quite comparable. The *Séítah* unit materials (e.g., *Cine*, *Norante* rocks, and *Garde, Dourbes* abrasions) exhibited distinct spectra dominated by olivine (e.g., Fig 3) with steep near-infrared downturns and weak absorptions near 620 nm that are well-matched by a Fo_{60} olivine lab spectrum (USGS KI3189, Fig. 3). By comparison, the *Cf-fr* abraded targets were more altered/oxidized (stronger BD545, weaker S7584) as were natural *Cf-fr* targets, including purple-hued coatings such as *Alk_es_disi* (*ałk'ésdisi*; Fig. 4; [10]). Soil spectra were variable due to dust cover effects and sporadic ferrous grains (e.g., *Clave*-10) [cf. 9]. Indeed, dust contamination on all natural surface targets was variable (Fig. 6) owing to differences in surface texture and/or facet orientations that were more or less amenable to airfall dust/coating preservation. Future work will improve the SuperCam VIS calibration and continue to track VIS spectral features in Jezero using both SuperCam and ZCAM observations [3].

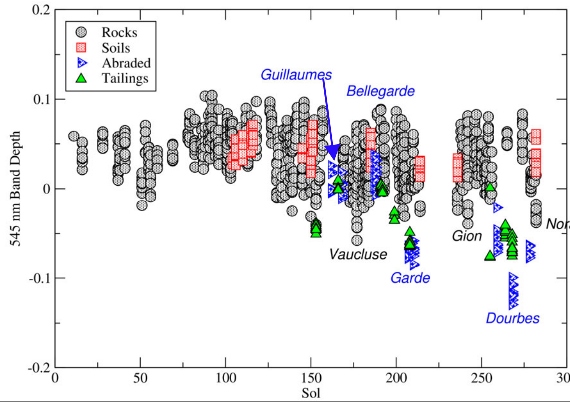

Fig. 1. 545 nm band depths (sensitive to crystalline Fe^{3+}) from SuperCam VIS spectra for target classes shown in legend, with representative targets labeled (see Figs. 3-5).

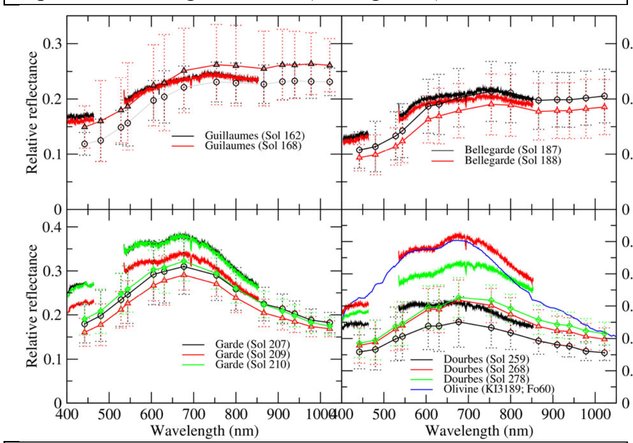

Fig. 3. SuperCam VIS spectra for abraded rock targets from the *Cf-fr* unit (*Guillaumes*, *Bellegarde*) and *Séítah* (*Garde*, *Dourbes*), and ZCAM spectra from the same regions (std. deviations shown). USGS lab olivine spectrum also shown.

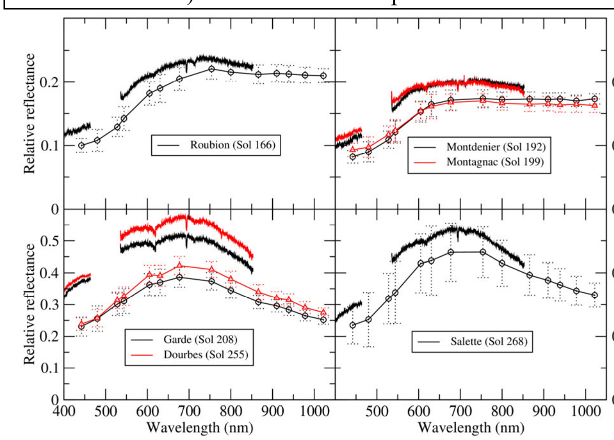

Fig. 5. Average SuperCam VIS spectra for abrasion and coring tailings from the *Cf-fr* unit (*Roubion*, *Montdenier*, *Montagnac*) and *Séítah* (*Garde*, *Dourbes*, *Salette*), and ZCAM spectra from the same regions (std. deviations shown).

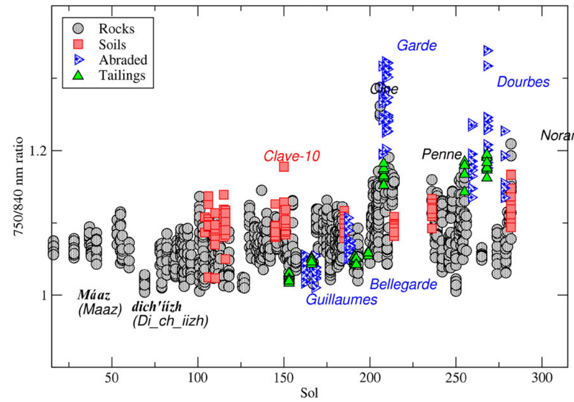

Fig. 2. 750/840 nm ratios (sensitive to ferrous minerals) from SuperCam VIS spectra for target classes shown in legend, with representative targets labeled (see Figs. 3-5).

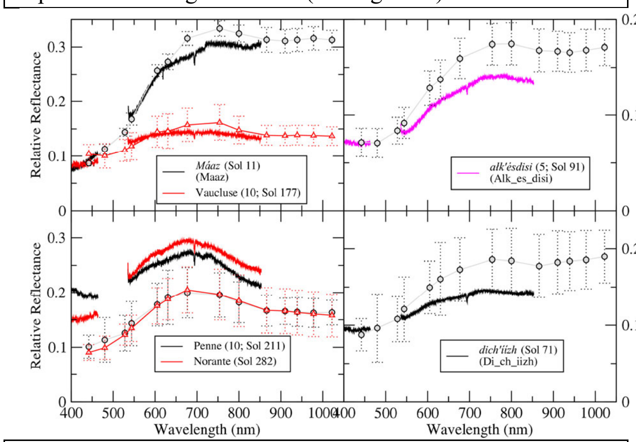

Fig. 4. SuperCam VIS spectra for representative rock targets (raster location # listed unless spectrum is raster average), and ZCAM spectra (std. deviations shown) from the same regions.

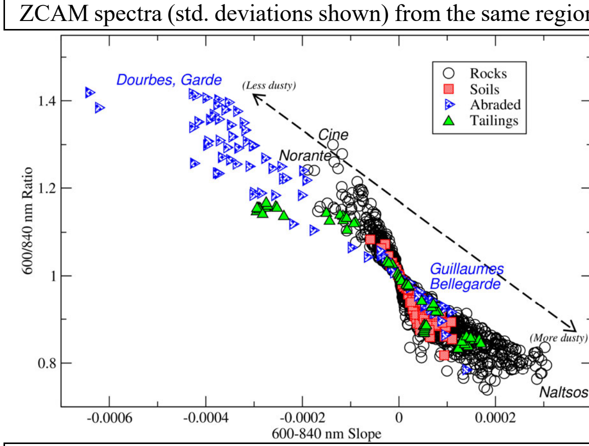

Fig. 6. SuperCam VIS 600-840 nm slopes and ratios with abraded targets and representative endmembers noted [cf. 8].

References: [1]Farley, K.+ (2020), *Space Sci. Rev*. 216, 142; [2]Wiens, R.+ *Space Sci. Rev*., 217, 4 (2021)*;*Maurice, S.+ *Space Sci. Rev*., 217(3),1-108 Manrique, J.+ (2020) *Space Sci. Rev*. 217, 1-40, 2021 ; [3] Bell, J. +, *Space Sci. Rev*., 217,1 1-40,2021 ;Rice, M.+ this conf. ; [4] Mandon, L.+ this conf.;[5]Legett,C.+LPSC,#1516,,2021;this conf.,2022;[6]Cousin,A.+ Spectro. Acta B: Atom. Spectr., 2021; [7]Johnson, J.R.+ Icarus, 249,74–92,2015; Johnson, J.+ Amer. Miner.,101,1501–1514, 2016; [8]Johnson, J. & W. Grundy, *GRL*, 28, 2101-2104, 2001; [9]Cousin A.+. this conf.; [10] Garzcynski, B.+; Beck, P.+, this conf.; [11] Merusi, M.+, this conf.; Kinch, K.+ *Space Sci. Rev.*, 216:141, 2020.