STRATIGRAPHY AND MINERALOGY OF THE DEPOSITS WITHIN SÉÍTAH REGION ON THE FLOOR OF JEZERO CRATER, MARS AS SEEN WITH MASTCAM-Z. J. I. Núñez[1], J. R. Johnson[1], B. N. Horgan[2], M. S. Rice[3], A. Vaughan[4], C. Tate[5], G. Paar[6], S. Fagents[7], S. Gupta[8], K. M. Kinch[9], C. C. Million[10], M. St. Clair[10], L.C. Kah[11], J. Maki[12], J. F. Bell III[13], and Mastcam-Z Team. [1]Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20723 (jorge.nunez@jhuapl.edu); [2]Purdue Univ., South Bend, IN; [3]Western Washington Univ., Bellingham, WA; [4]USGS, Flagstaff, AZ; [5]Cornell Univ., Ithaca, NY; [6]Joanneum Research, Graz, Austria; [7]Univ. of Hawaii, Honolulu, HI; [8]Imperial College of London, UK; [9]Univ. of Copenhagen, Denmark; [10]Million Concepts; [11]Univ. of Tennessee, Knoxville TN; [12]JPL/Caltech, Pasadena, CA; [13]Arizona State Univ., Tempe, AZ.

Introduction: On February 18, 2021, NASA's Mars 2020 *Perseverance* rover landed on the floor of Jezero crater, a Noachian-aged basin characterized by an ancient lake-delta system during the Late Noachian-Early Hesperian epochs on Mars. Over the past year, *Perseverance* has been exploring the floor of Jezero crater to characterize the geology and collect carefully documented samples from the Crater Floor Fractured Rough (Cf-fr) and the Séítah region of the Crater Floor Fractured 1 (Cf-f1) [1]. The Mastcam-Z instrument [2] on the *Perseverance* rover has provided near-field and long-distance imaging of the crater floor units and delta scarp, and is used to characterize the diversity of morphologies, textures, surface coatings, colors, and spectral properties of rocks and soils along the rover traverse. Here we use Mastcam-Z images and multispectral observations over a range of scales, from close-up observations of abraded patches and rock faces, to outcrop and landscape observations to characterize the stratigraphy, spectral diversity and mineralogy of the rocks and facies within Séítah.

Mastcam-Z Instrument: Mastcam-Z is a multispectral, stereoscopic, dual imaging system composed of two zoom cameras mounted on the Remote Sensing Mast of the rover [2]. Its two "eyes" generate high-resolution color wide-angled and zoomed-in images (focal lengths ranging from 26 mm to 110 mm) of close and distant targets. Each camera has a FOV from ~5° to ~23° along longest axis (IFOV from 67 to 283 µrad/pix) and 3 broadband RGB and 6 narrowband filters, spanning the Visible and Near-Infrared wavelengths (442-1022nm). Mastcam-Z observations are calibrated to I/F and spectra are converted to reflectance factor (R^*) [3-4]. Spectral parameters are used to detect and map olivine, pyroxene, and oxide mineral signatures across the landscape and rock surfaces [5].

Séítah Geology and Stratigraphy: The Séítah region of Cf-f1, mapped by [1], is characterized by a series of NE-SW trending bedrock ridges partially covered by aeolian bedforms and distinct olivine-rich/carbonate orbital spectral signatures [6-8]. It is interpreted to share an origin with the regional olivine-bearing unit [9-11]. Multiple hypotheses have been proposed for its origin, including extrusive and intrusive igneous rocks [12-14], impact melt deposits [15], and sedimentary deposits [8] (see [16] and [17]).

Séítah ridges are characterized by cm-thick layered rocks that occur at the base of the ridges overlain by massive layered cap rocks. (Figure 1). The *thinly layered rocks* comprise layers that are ~1-3 cm thick and have planar to undulating morphology. The layers show even thicknesses and are less resistant than the overlying massive layered cap rocks, resulting in some

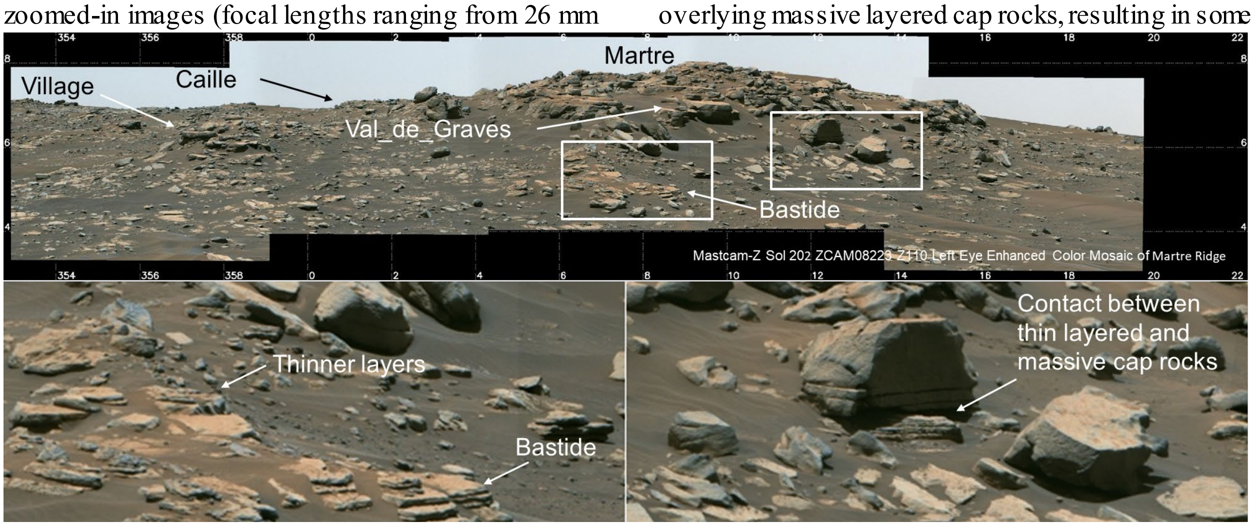

Figure 1. Mastcam-Z mosaic (left eye, 110 mm, enhanced color) showing the stratigraphy of Martre ridge in South Séítah (top), where thin layered rocks (bottom left) are overlain by massive layered cap rocks (bottom right).

outcrops with exposed overhangs or others with stair-step patterns. The *massive layered cap rocks* have layers with thicknesses ranging ~10-50 cm with predominantly tabular morphology. No crossbedding has been observed. The massive rocks appear to fracture along existing horizontal planes. In some locations, overlying the massive layered cap rocks are loose, *pitted rocks* that are associated with "rubbly" material.

Close-up observations of rock textures, including at abrasion patches, indicate rocks consist of densely packed, well-sorted coarse (1–2 mm) dark grey angular to subrounded grains/crystals that are surrounded by a lighter-toned material between the grains. Reddish brown material is found at grain boundaries and triple junctions, as well as enclosing the light-toned grains.

Outcrop layers have a mean dip angle of 8.8 +/- 2.5 degrees towards the Southwest (mean azimuth 204 +/- 28 degrees clockwise from North), although the dip angles have a significant bimodal distribution with values at 7.6 +/- 1.6 for layers to the NE and 10.8 +/- 2.0 degrees for layers SW of Martre ridge respectively [18].

Multispectral Observations: Multispectral observations of Séítah surfaces show spectral signatures that are due to a combination of dust [19], coatings [20], regolith [21], and rock surfaces. Spectral signatures of *thinly layered* and *massive layered cap rocks*, are characterized by weak 528 nm absorption bands, reflectance peaks near 677 nm, and strongly negative near-infrared slopes towards 1 μm, consistent with the primary mineral olivine (Figure 2). Strongest olivine signatures are found in the abrasion patches and tailings of Bastide and Brac outcrops (abrasion patches Garde and Dourbes respectively). SuperCAM, PIXL, and SHERLOC observations confirmed the presence of olivine and pyroxenes with some alteration to carbonates and other phases [16-17]. In some dusty surfaces and reddish brown patches, the peak near 677 nm shifted to 750 nm indicating oxidation of grains. This may be spectrally similar to terrestrial moderately-weathered ultramafic rocks, such as the Twin Sisters dunite [22]. Surface coatings are dominated by hematite, which has strong 528 nm and 866 nm absorptions. The pitted rocks have spectral signatures that are indicative of pyroxene.

Summary: Séítah deposits consist of olivine-rich recessive thin layered rocks that are overlain by massive resistant cap rocks, rubbly/friable rocks that appear to erode into "grussy" material, and pyroxene-rich/olivine-poor pitted rocks. Stratigraphy suggests a complex depositional/erosional history of Séítah units, while composition and textures suggest deposition of igneous origin by either intrusive or extrusive flows [23-24]. Presence of ferric oxides and possible hydrated minerals (and carbonate) is consistent with post-depositional diagenetic alteration by aqueous fluids [23].

References: [1] Stack et al. (2020) *Space Sci. Rev.* 216, 127. [2] Bell *et al. (2020)*, Space Sci. Rev., 217:24. [3] Hayes *et al. (2021)*, Space Sci. Rev, 217:29. [4] Kinch *et al. (2020)*, Space Sci. Rev, 216:141. [5] Rice et al., this volume. [6] Ehlmann et al., 2008. [7] Brown et al., 2020. [8] Horgan et al., 2020. [9] Goudge et al. (2015) JGR 120, 775. [10] Sun and Stack (2020) USGS SIM 3464. [11] Tarnas et al., 2021. [12] Tornabene et al., 2008. [13] Hoefen et al., 2003. [14] Bramble et al., 2017. [15] Mustard et al., 2009. [16] Hickman-Lewis et al., this volume. [17] Sun et al., this volume. [18] Tate et al., this volume. [19] Johnson et al., this volume. [20] Garczynski et al., this volume. [21] Vaughan et al., this volume. [22] Curtis, S. et al. this volume. [23] Farley et al., Submitted. [24] Liu et al., Submitted. [25] Million et al. this volume.

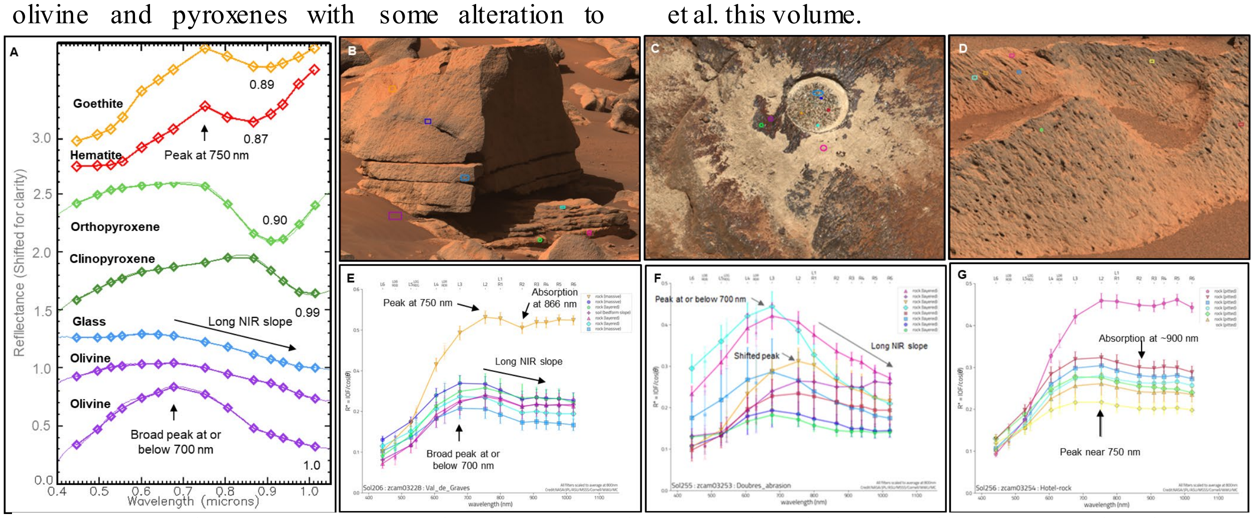

Figure 2. (**A**) Laboratory spectra of Fe-bearing oxide and igneous minerals convolved to Mastcam-Z bandpasses; (**B - D**) Mastcam-Z Z110 context images and corresponding Regions of Interest (ROIs) of *thinly layered* and *massive layered cap rocks* (**B**), *Dourbes* abrasion patch (**C**), and pitted rock *Hotel* (**D**); (**E – G**) Mastcam-Z VNIR spectra extracted from corresponding ROIs shown in (**B - D**). Graphics generated using [25].