EXPLORING THE JEZERO CRATER FLOOR: OVERVIEW OF RESULTS FROM THE MARS 2020 PERSEVERANCE ROVER'S FIRST SCIENCE CAMPAIGN. V. Z. Sun[1] (Vivian.Sun@jpl.nasa.gov), K. P. Hand[1], K. M. Stack[1], K. A. Farley[2], S. Milkovich[1], R. Kronyak[1], J. I. Simon[3], K. Hickman-Lewis[4], D. Shuster[5], J. F. Bell III[6], S. Gupta[7], C. D. K. Herd[8], S. Maurice[9], G. Paar[10], R. C. Wiens[11], and the Mars 2020 Science Team. [1]Jet Propulsion Laboratory, California Institute of Technology, Pasadena CA (Vivian.Sun@jpl.nasa.gov), [2]California Institute of Technology, Pasadena CA, [3]NASA Johnson Space Center, Houston TX, [4]Natural History Museum, London UK, [5]UC Berkeley, CA, [6]Arizona State University, Tempe AZ, [7]Imperial College London, UK, [8]University of Alberta, Canada, [9]Universite de Toulouse, France, [10]Joanneum Research, Graz, Austria, [11]LANL, Los Alamos, NM.

Introduction: The *Perseverance* rover embarked on its first science campaign after landing in Jezero crater on February 18, 2021 and completing ~90 days of commissioning and Ingenuity helicopter activities. During this first campaign, *Perseverance* explored a large swath of Jezero's crater floor, investigating and sampling several of the topographically lowest, and potentially oldest, rocks within the crater.

Crater floor units: *Perseverance* explored the *Máaz* and *Séítah* formations (previously mapped as the Crater Floor Fractured Rough; Cf-fr and Crater Floor Fractured 1; Cf-f-1 units [1]). These are both widespread units in the crater that potentially correlate with units outside Jezero [2-4]. The *Máaz* fm. was distinguished from orbit by its mafic composition and densely cratered surface, and has various hypothesized origins, including lava flows [2] and volcaniclastic airfall [3]. The *Máaz* fm. is important for providing age/stratigraphic constraints on the Jezero western delta. If igneous, returned *Máaz* fm. samples may aid in calibrating the Mars crater chronology [2,5] and understanding Mars paleomagnetism and early igneous processes (see [6]).

The *Séítah* fm. is olivine-bearing and has been interpreted to be related to a regional unit exposed along the inner rim of Jezero crater walls and occurs more broadly in the Nili Planum and Nili Fossae region. The olivine-bearing unit and its possible correlatives has a wide range of hypothesized origins including volcaniclastic airfall, impact melt, or aeolian and fluvial deposits [2-4,7,8]. The *Séítah* fm. is likely the oldest unit accessible to *Perseverance* and represents an important part of Jezero's pre-delta-lacustrine history. As in the *Máaz* fm., the lithochemistry of the samples will help studies of early Mars igneous processes. The olivine- and carbonate-bearing components of this unit may also signify habitable conditions early in Jezero's history, samples of which would be of high geochemical and astrobiological significance, as well as for understanding the martian carbon cycle (see [9]).

Campaign Overview (Figure 1): As of January 1, 2022, *Perseverance* has covered 2.886 km of traverse distance and filled 6 sample tubes, employing a sample pair strategy where each unique sample is paired with a companion sample core from the same location, in order to enable the construction of two different caches.

Starting from the *Octavia E. Butler (OEB)* landing site, *Perseverance* drove south towards its first sampling location in the *Máaz* fm. Between sols 159-168, *Perseverance* successfully abraded the *Guillaumes* target and attempted to drill the *Roubion* target (of the *Roubion* member in *Máaz*; **Figure 1**), although no rock was acquired in the sample tube due to the altered and crumbly nature of the rock [6]. Subsequently, *Perseverance* continued driving west along the *Máaz-Séítah* contact, partly defined by the *Artuby* ridge, en route to a location where the *Séítah* fm. could be accessed and investigated in situ. Between sols 181-199, *Perseverance* attempted sampling again, this time in the *Rochette* caprock member. This resulted in successful abrasion of the *Bellegarde* target and acquisition of the first two rock cores *Montdenier* and *Montagnac* [6]. *Perseverance* then drove into the *Séítah* fm., where the target *Garde* (in the *Bastide* member) was abraded on sol 206, and then the *Dourbes* abrasion and *Salette* and *Coulettes* cores were acquired between sols 250-277. Beginning on sol 287 and as of writing, *Perseverance* is in the process of acquiring a second *Séítah* sample pair, having already successfully abraded the *Quartier* target and collected the *Robine* core [9].

Key Findings: *Igneous origins:* Remote and proximity science on the diverse rocks of the Jezero crater floor have yielded substantial information on the origin of the *Máaz* and *Séítah* fms., which are compositionally distinct with heterogeneous textures and morphologies **(Figure 1)** [10-13]. Observations indicate that both formations are igneous in origin, with the *Séítah* rocks representing an olivine-rich cumulate formed from differentiation of an intrusive body or thick lava flow or impact melt [10,11,14]. By contrast, the rocks of the *Máaz* fm. are rich in pyroxene and plagioclase and represent the top of the differentiated magma or lava, or are a separate, younger series of lavas emplaced on top of the *Séítah* fm. [10,11,14].

Aqueous alteration: Aqueous alteration has variably affected the crater floor rocks, resulting in the formation of carbonate, iron oxides, amorphous silicates, sulfates, halite, perchlorates, phosphates, and potential phyllosilicates [10,15,16]. Alteration or weathering may have also produced pervasive coatings observed on *Máaz* and *Séítah* formation rocks [17]. These secondary

minerals provide evidence for multiple habitable environments as well as information on environmental conditions at the time of aqueous activity.

Post-emplacement modification: The *Máaz- Séítah* contact expressed along the ~3 m *Artuby* ridge revealed diverse layers with variable thickness (*Artuby* member) and a resistive cap unit (*Rochette* member), all of which dip to the southwest, with a maximum dip of ~12 degrees from both surface and subsurface data [18]. Yet-undetermined post-emplacement processes may have tilted these rocks to their current orientation, and their relation to *Séítah* is a topic of ongoing study.

Next Steps: *Perseverance* will retrace its steps to return to the *OEB landing* site and along the way will collect critical observations to test these working hypotheses, including further assessment of alteration in the *Artuby* and *Roubion* members, stratigraphic relationships between the members of the *Máaz* fm., and characterization and possible sampling of the uppermost *Chal* member rocks [6,19]. At the conclusion of this crater floor campaign in spring 2022, *Perseverance* will begin a traverse towards its next science campaign, on and around the prominent ancient delta preserved in the western part of Jezero crater.

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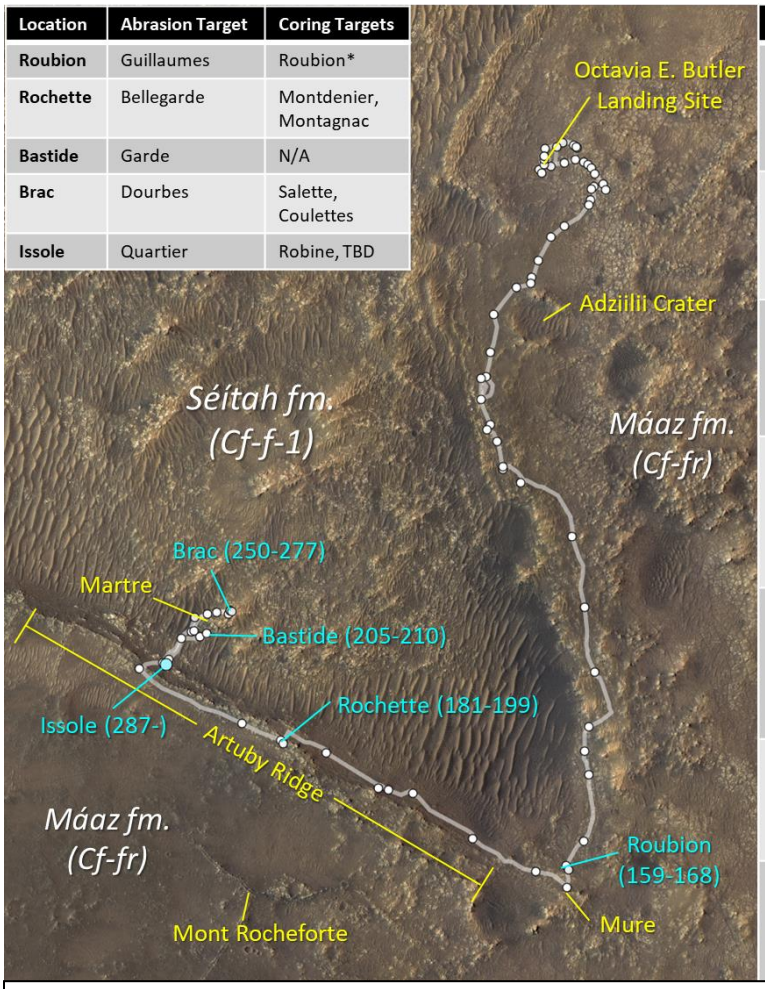
References: [1] Stack et al. 2020, Space Science Reviews. [2] Goudge et al. 2015, JGR Planets. [3] Sun and Stack 2020, USGS SIM Map 3464. [4] Bramble et al. 2017, Icarus. [5] Shahrzad et al. 2019, GRL. [7] Kremer et al. 2019, Geology. [8] Mandon et al. 2020, Icarus. This meeting: [6] J. Simon et al.. [9] K. Hickman-Lewis et al. [10] R.C. Wiens et al., L. Mandon et al., P-Y Meslin et al., E. Clave et al. [11] A. Udry et al. [12] B. Horgan et al. [13] J. Nuñez et al. [14] M. Schmidt et al. [15] E. Scheller et al. [16] R.J. Smith et al. [17] B. Garczynski et al. [18] P. Russell et al. [19] F. Calef et al.

Location	Abrasion Target	Coring Targets
Roubion	Guillaumes	Roubion*
Rochette	Bellegarde	Montdenier, Montagnac
Bastide	Garde	N/A
Brac	Dourbes	Salette, Coulettes
Issole	Quartier	Robine, TBD



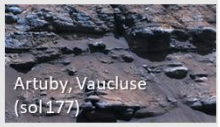
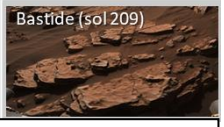
Member	Description	Type Example
Chal *(Máaz fm)*	Massive, blocky, "hummocky" rocks found predominantly east of OEB	 Chal (sol 78)
Nataani *(Máaz fm)*	Polygonal, low-lying, granular-weathering "pavers" to the south of OEB	 Baa_big_han (sol 66)
Rochette *(Máaz fm)*	Variably massive to layered to pitted resistant cap rocks along Artuby ridge	 Rochette (sol 197)
Artuby *(Máaz fm)*	Granular-weathering, layered outcrops observed at Mure and Artuby	 Artuby, Vaucluse (sol 177)
Roubion *(Máaz fm)*	Polygonal, low-lying, granular-weathering "pavers" in lower elevation Máaz fm	 Roubion (sol 163)
Content *(Séítah fm)*	Pitted rocks at top of Martre outcrop	 Content (sol 239)
Bastide *(Séítah fm)*	Layered rocks comprising middle-lower part of Martre outcrop	 Bastide (sol 209)

Figure 1. (Map) Overview of campaign, showing *Perseverance*'s traverse as of Sol 310. Annotated are formation/unit names (white text), major features/outcrops (yellow text), and coring/abrasion locations (blue text). Numbers indicate the sols at those locations**. (Left inset table)** Summary of abrasion and coring targets (*Roubion was not a rock core [6]). **(Right table)** Current summary of members comprising the *Máaz* and *Séítah* formations.