Mars 2020
Perseverance Rover Status

Ken Farley, Caltech
Mars 2020 Project Scientist

Katie Stack Morgan, JPL
Mars 2020 Deputy Project Scientist

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Mission Status

• Planning sol 339 on Mars
• The rover is healthy and all science instruments except MEDA are functioning with no significant issues
• 18 *Ingenuity* helicopter flights
• Total mission odometry: 2914 m
• Abrasions: 4
• Sample Tubes Sealed: 8
  • 3 pairs of rock cores
  • 1 atmospheric sample
  • 1 witness tube
Two PDS Deliveries Completed

<table>
<thead>
<tr>
<th>Release</th>
<th>Acquisition (Sols)</th>
<th>Release to Public</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td>0 - 89</td>
<td>20-Aug-21</td>
</tr>
<tr>
<td>2</td>
<td>90 - 179</td>
<td>22-Nov-21</td>
</tr>
<tr>
<td>3</td>
<td>180 - 299</td>
<td>22-Mar-22</td>
</tr>
<tr>
<td>4</td>
<td>300 - 419</td>
<td>22-Jul-22</td>
</tr>
<tr>
<td>5</td>
<td>420 - 539</td>
<td>21-Nov-22</td>
</tr>
<tr>
<td>6</td>
<td>540-639</td>
<td>7-Mar-23</td>
</tr>
<tr>
<td>7</td>
<td>640 - 669</td>
<td>6-Jul-23</td>
</tr>
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Nothing is ever easy (on Mars): Sol 306 "Pebble Anomaly"

RESOLVED
Several of the wind sensor transducers experienced faults. Assessment of the cause and implications of these faults is in progress.
Ingenuity Flights

- 18 flights as of February 2
- heli now being staged ahead of rover in preparation for drive campaign to delta
8 Oxygen generation runs have been performed, all successfully including worst-case low-pressure conditions.

- $\text{O}_2$ purity is close to 100% when operated with that objective.
- Degradation of the electrolytic stack is very low, many more runs are possible.
- Upcoming runs will be more diagnostic in nature, refining understanding of the operational characteristics of the device.
Sampling Details

How are Samples Selected?

Sample priority guided by community desires expressed in published documents, e.g., iMOST Report, as interpreted and applied to Jezero crater by the Mars 2020 Science Team.

What "Field Notes" are being acquired?

Every sample (or paired sample set) is documented by a standardized set of observations that are executed following an optimized sol path of 10-15 sols duration. This Standardized Observation Protocol (STOP list) maximizes efficiency and consistency.

Included:

1) workspace imaging at multiple scales using (ZCAM, ECAM, SCAM RMI, WATSON)
2) workspace and abrasion-patch proximity and remote science (SHERLOC, PIXL, SCAM, ZCAM)
3) borehole and cuttings imaging and remote science (WATSON, SCAM, ZCAM)

Additional opportunistic science is also undertaken in association with sample collection.
Sampling Details

How are sample-related data recorded?

1) **Sample Dossier**

A digital "one stop shop" file that includes

1) Links to all STOP list observations for a given sample stored in PDS
2) Additional rover-related data associated with sampling, for example
   - Rover localization
   - Sampling event time history and coring operational and sensor details
   - Temperatures
   - Core length estimate and Cachecam images
Sampling Details

How are sample-related data recorded?

2) Initial Reports

A templatized narrative description of each sample, written by the science team within 3 weeks of collection

- Why the sample was collected
- How the sample fits in geologic context
- Description and initial interpretation of STOP list data
- Initial interpretation of the sample and its history
- Assessment of likely uses of the sample if returned to Earth

This document is preliminary, and is not revised after completion...

- Detailed interpretation developed over time will appear in peer reviewed publications
INITIAL REPORT
M2020-164-2 Roubion
(no core recovered, atmospheric sample)

Sample Designation: M2020-164-2 Roubion

Date of Coring: 5 Aug 2021

Mars Time of Sample Core Sealing: 19:11:35 LMT, Sol 164, LT 81.1

Latitude (N), Longitude (E), Elevation: 18.42769540, 77.45165066, -2584.96 m

Campaign: Crater Floor

Region of Interest: North Thumb

Lithology: Fine- to medium-grained mafic and likely igneous rock, possibly basalt or microgabbro (alternatively, basaltic sandstone). Primary minerals are olivine and pyroxene, also possibly apatite and Fe3+ oxides. Weathering and/or aqueous alteration is indicated by pits and crevices in abundant surface and abundant secondary minerals including iron oxide (possibly hydrated), sulfates, phosphate, and possibly phosphohate and halite, usually in distinct patches.

Estimated Volume Recovered: 70 cm^3 (some ~10 mm sized particles). No core recovery

Coring Bit Number: 5

Core Orientation: Hade = 3.45°; azimuth = 208.74°; core roll = 289.35°

Sample Serial Numbers: Tube SNC232; Seal SN662; Ferrule SNC003

ACA Temperature at Time of Sealing: 40°C

Estimated Rover-Ambient Pressure and Temperature at Time of Sealing: 749 Pa, 221 K

Estimated Amount of Martian Atmosphere Headspace Gas: 4.9x10^-5 mol

Abraision Patch Name and Depth: Gulliesnicks, 8 mm

Anomalous Sample Behavior: Core disintegrated; no recovery

Summary Description

Collection of Roubion, the first sample target of the Mars 2020 mission, was attempted in the North Thumb region of the Jezero crater Floor (Figure 1). Between Octavia E. Butler landing (OEB) and the sampling site, Perseverance traversed about 5 km southward over nearly continuous low-lying rocks typically forming meter-scale "gulliesnicks" outcrops, with intervening caprock (Figure 2). In HiRISE orbital view, these rocks define a distinctive polygonal pattern, the lower lying of the several expressions of the Crater Floor Fractured Rough (CFR) unit of Stuck et al. (2020).

Figure 1: Regional context. (a) geologic map of Mars and its units of Stuck et al. 2020 and (b) ICEDR map with Perseverance traverse path leading to Jezero. Shown for reference are Octavia E. Butler (OEB), landing site, North Thumb area, Polygon Valley, and Elysium ridge.

Prior to landing, the CFR unit was variously interpreted to be igneous (lava or volatolacite) or sedimentary (volcanoclastic or aeolian) in origin. Although the stratigraphic context of the fractured floor, and indeed the lithology itself, were unknown at the time of sampling, the CFR unit was selected for sample acquisition because it is generally extensive and because it includes the most heavily cratered terrain to which the rover has access within Jezero crater. As such, a returned sample of this unit was thought to have high science value for understanding the geologic setting and timing of crater floor units, and possibly for calibration of the Mars crater chronology function.

As evidenced by the common whole-rock morphology and surface polish and fluting, this expression of CFR has been eroded to just below ground level by aeolian abrasion (Figure 2). Despite abundant outcrop, little or no visual evidence of sedimentary structure, clasts, or crystals were seen in natural exposures of these rocks. Spectroscopic data on multiple outcrops along the traverse indicate an altered (hydrated, iron oxide-bearing) mafic rock with crystal size large enough to create spot-to-spot variability in composition (i.e., > few hundred mm scale). These low-lying CFR rocks are fresh, homogeneous in appearance and composition along the entire traverse from OEB to Stuckon.

The Perseverance coring attempt, and its companion percussion abrasion patch, were undertaken on a low relief rock at the tip of the North Thumb region selected largely to meet first-time sampling
First Science Campaign: Rocks of the Jezero Crater Floor

What are Máaz and Séítah Formations?

Proposed previously: fluvio-lacustrine or aeolian sediments, lava flows, impact melt sheet, volcanic ash deposits

(Stack et al., 2020 and references therein)
Máaz Formation Abrasion - Guillaumes

Interlocking grain texture, alteration

Guillaumes 4 cm merge product

5 mm
plagioclase, Fe oxide or Fe silicate, pyroxene

Máaz Formation Abrasion - Guillaumes

basaltic mineralogy and bulk composition
holocrystalline basalt or microgabbro
Aqueous alteration in *Guillaumes* (*Máaz Formation*)

From elemental composition and Raman spectroscopy: Sulfate and perchlorate salts in white patches/vugs

(similar features are seen in the *Séíta*h formation)
Supercam LIBS

Séítah: abundant olivine and high Mg, with densely packed angular to slightly rounded 2-3 mm-size crystals.

Strong Distinctions Between Máaz and Séítah

Supercam RMI

Averaged by target
- 82 Cf-fr, sols 12-201
- 36 Séítah, sols 201-274
Poikilitic olivine cumulate - differentiated igneous body (thick flow, melt sheet, lava lake, or intrusion)
Raman Detection of Carbonate in Séítah

Possible in-situ carbonation of olivine by CO$_2$ rich water
Máaz and Séítah are both igneous formations, both have experienced multiple styles of aqueous alteration.
Delta Campaign (spring 2022)

Crater Margin Campaign (2023)

Long-term Mars 2020 Plan