

# Mars 2020 Perseverance Rover Update

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CAPS  
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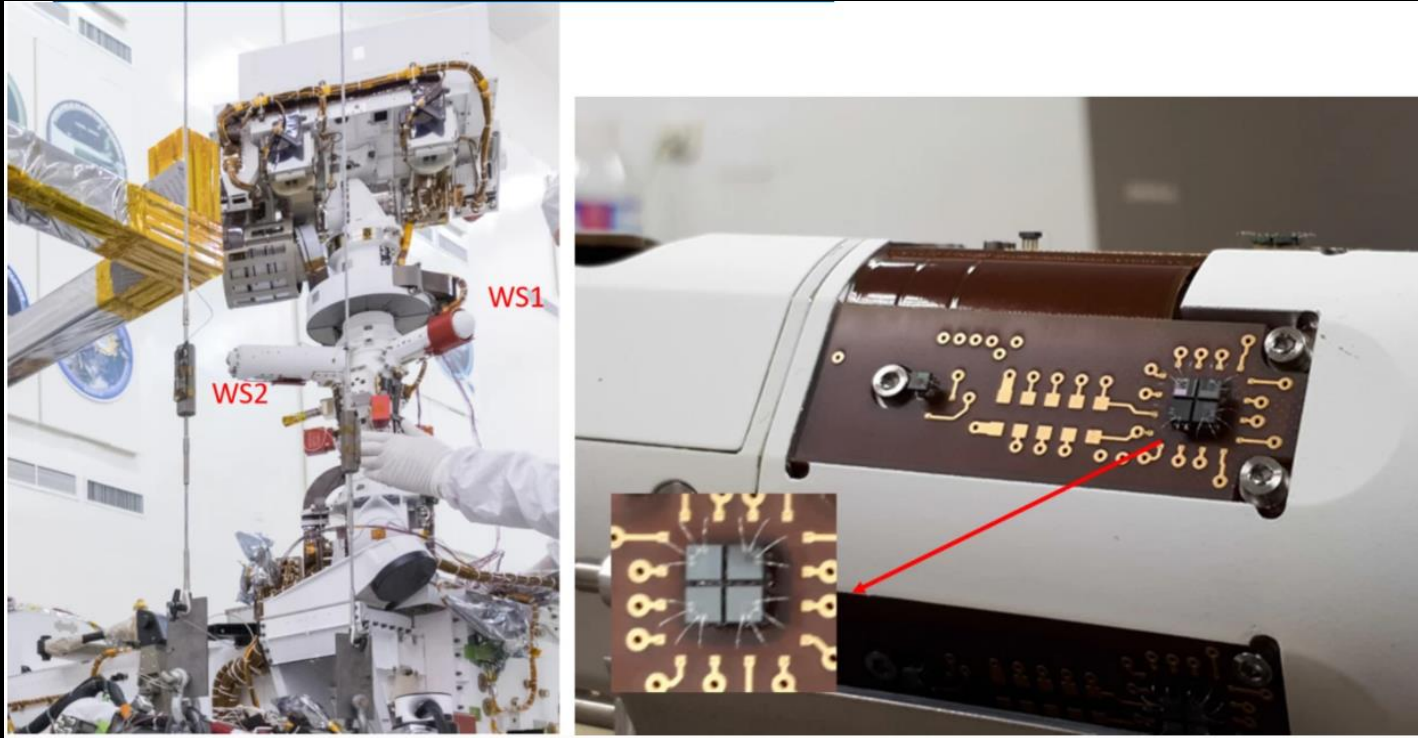
**Jet Propulsion Laboratory**  
California Institute of Technology

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Government sponsorship acknowledged.

# Mission Status

- Planning sol 388 on Mars
- The rover is healthy and all science instruments except MEDA are functioning with no significant issues
- 22 *Ingenuity* helicopter flights completed, heli mission continues
- Total mission odometry: 6.405 km
- Abrasions: 6
- Sample Tubes Sealed: 10
  - 23% of the 43 sample tubes on board

# MEDA Wind Sensor Failures



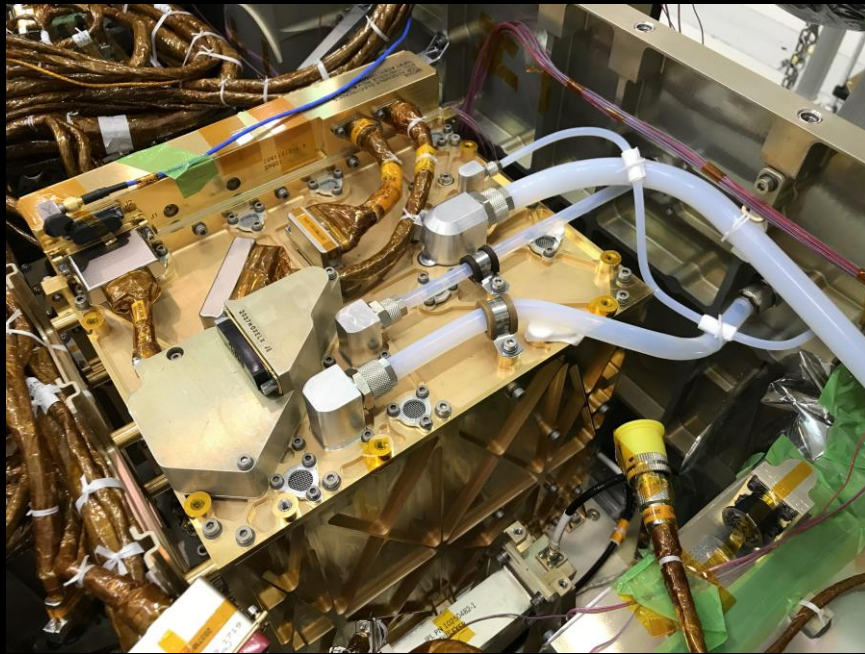
Several of the wind sensor transducers experienced fatal damage during a strong wind event (lofted pebble strikes?)

- Ability to monitor wind speed and direction is now substantially impaired

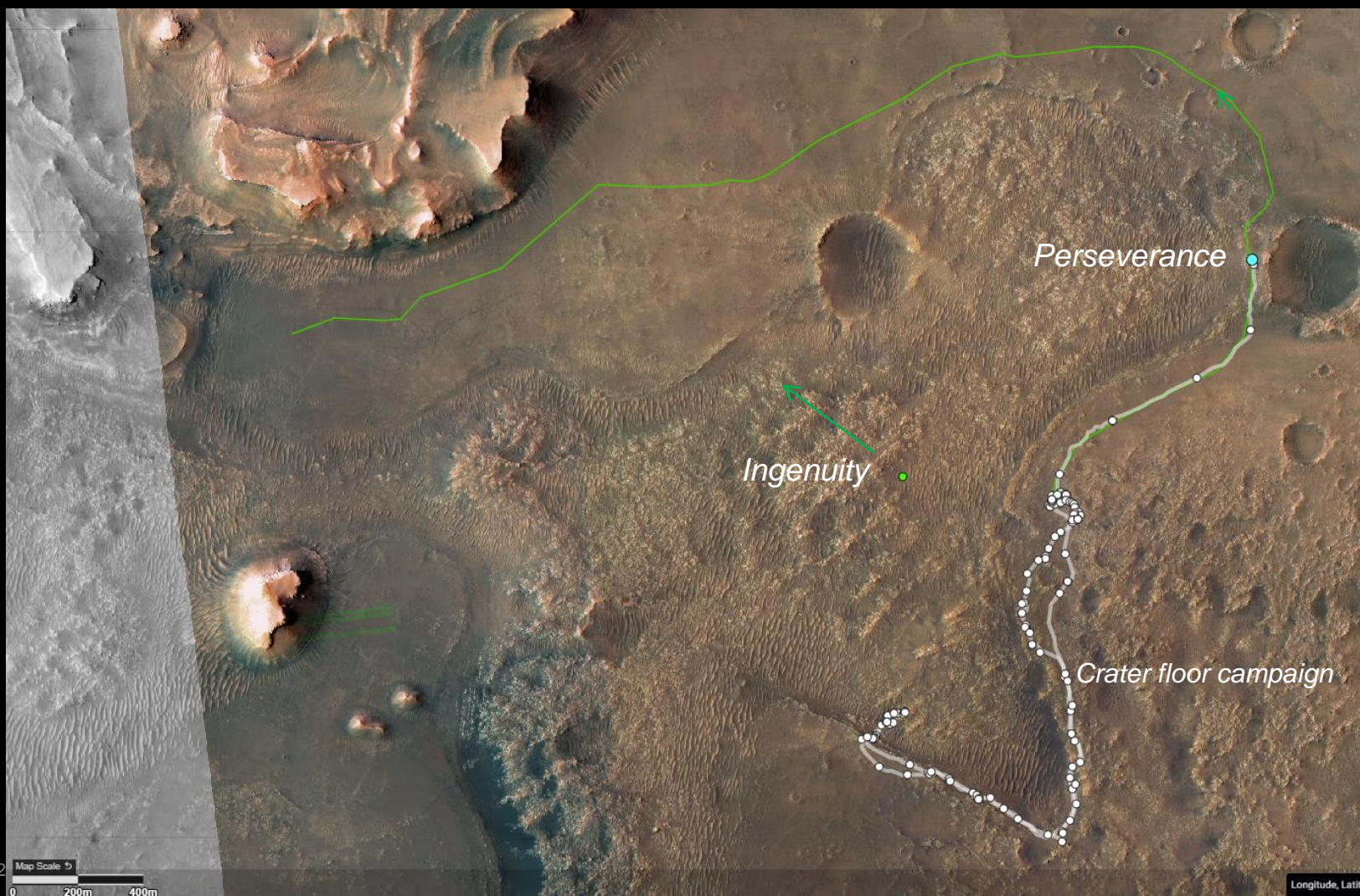




# MOXIE



- 8 Oxygen generation runs have been performed, all successfully
  - including worst-case low-pressure conditions
- O<sub>2</sub> 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





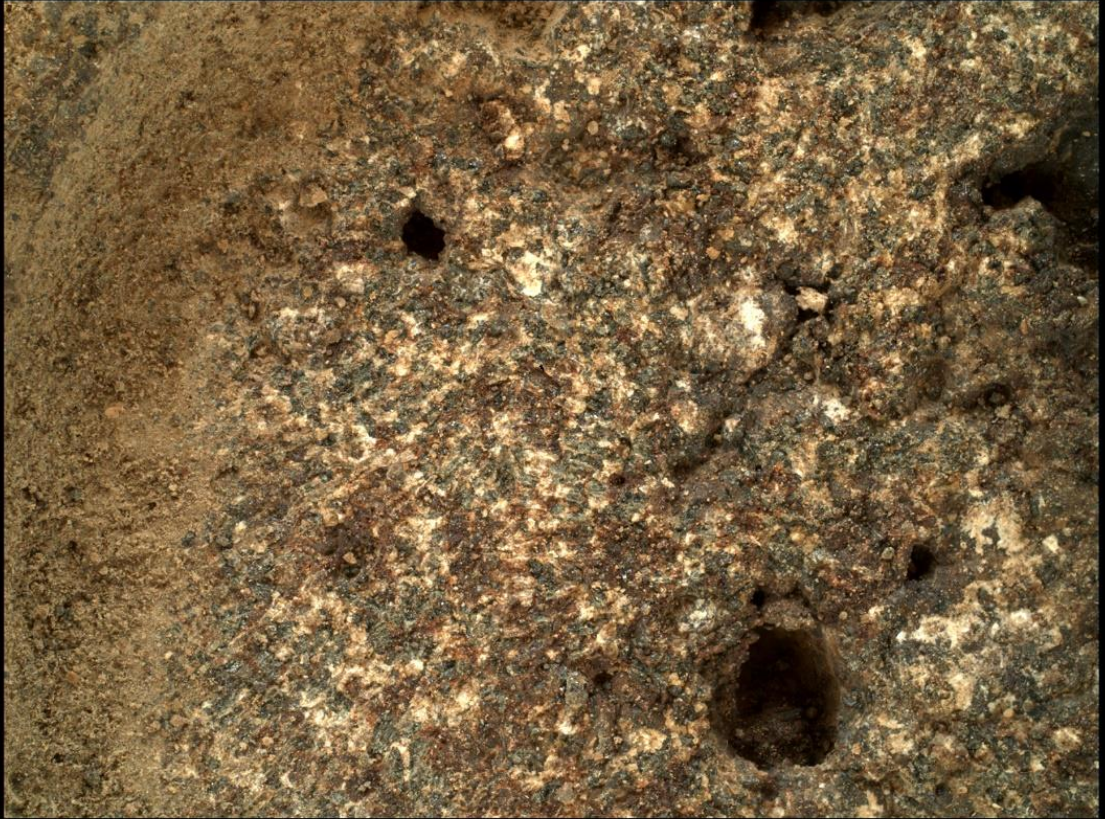
# First Science Campaign: Rocks of the Jezero Crater Floor



Proposed previously: fluvio-lacustrine or aeolian sediments, lava flows, impact melt sheet, volcanic ash deposits  
(Stack et al., 2020 and references therein)



*Máz Formation Abrasion - Guillaumes*



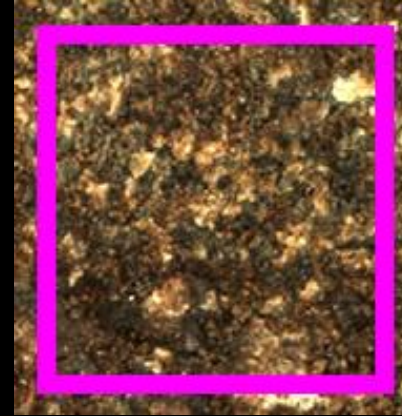
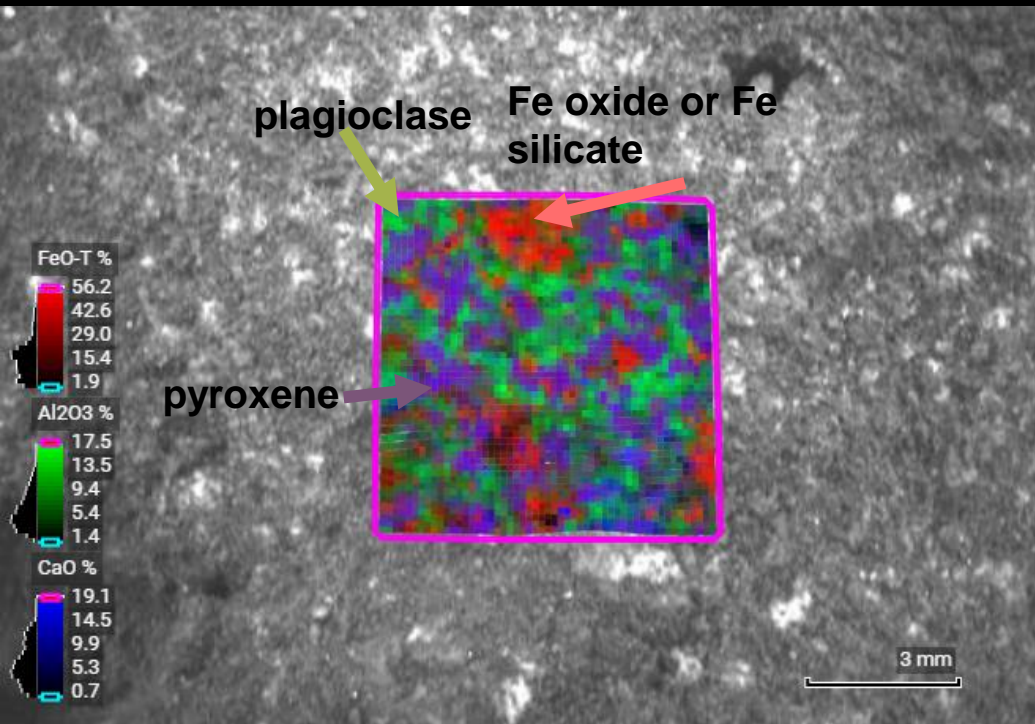
5 mm

**Guillaumes 4 cm merge product**

Interlocking grain texture, alteration



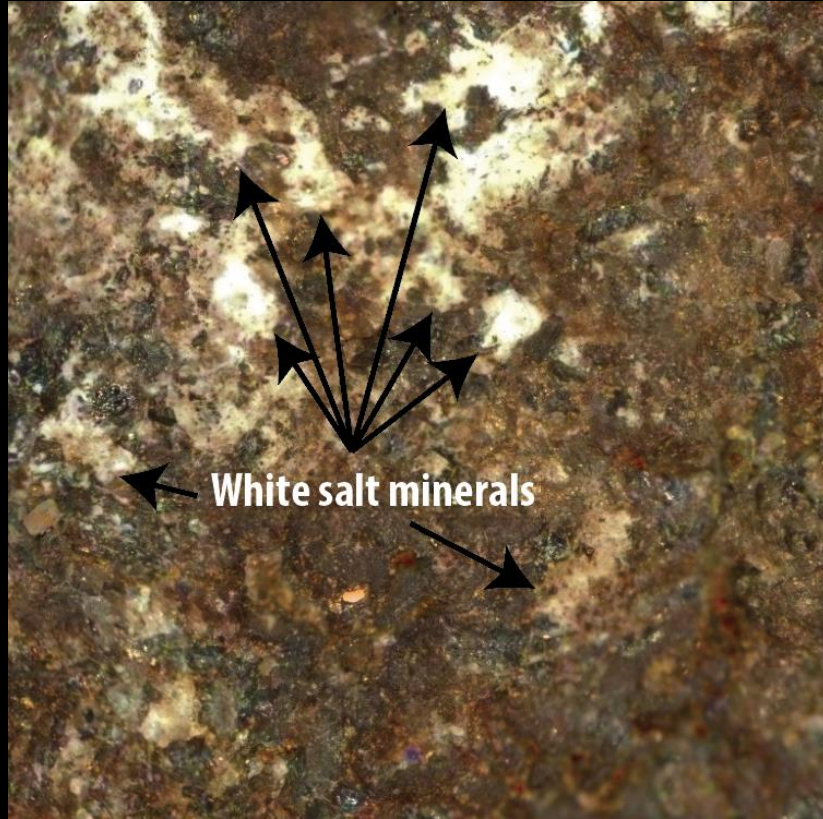
## Mááz Formation Abrasion - Guillaumes



PIXL results

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

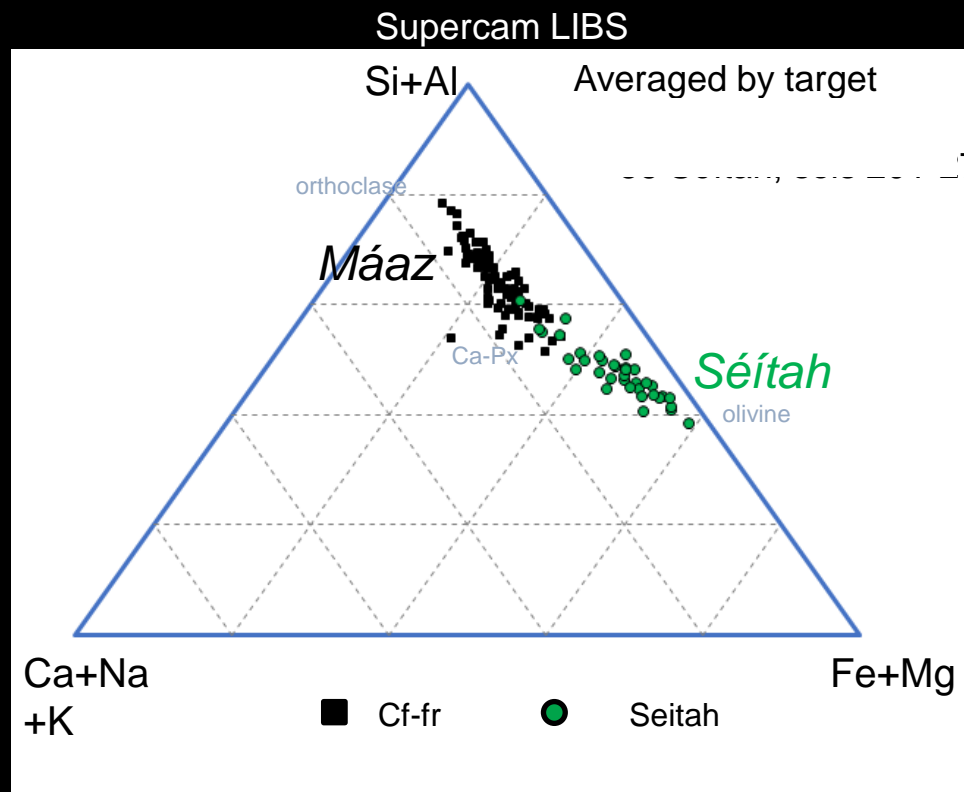
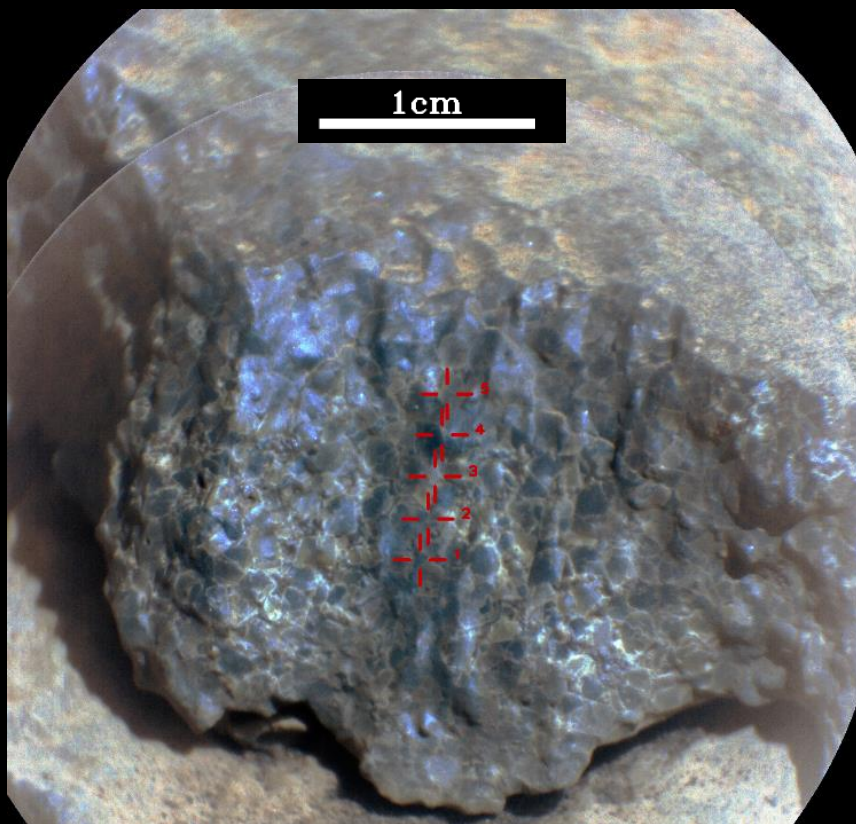
(similar features are seen in the *Séítah* formation)

4 mm

PIXL, WATSON, SHERLOC, Supercam



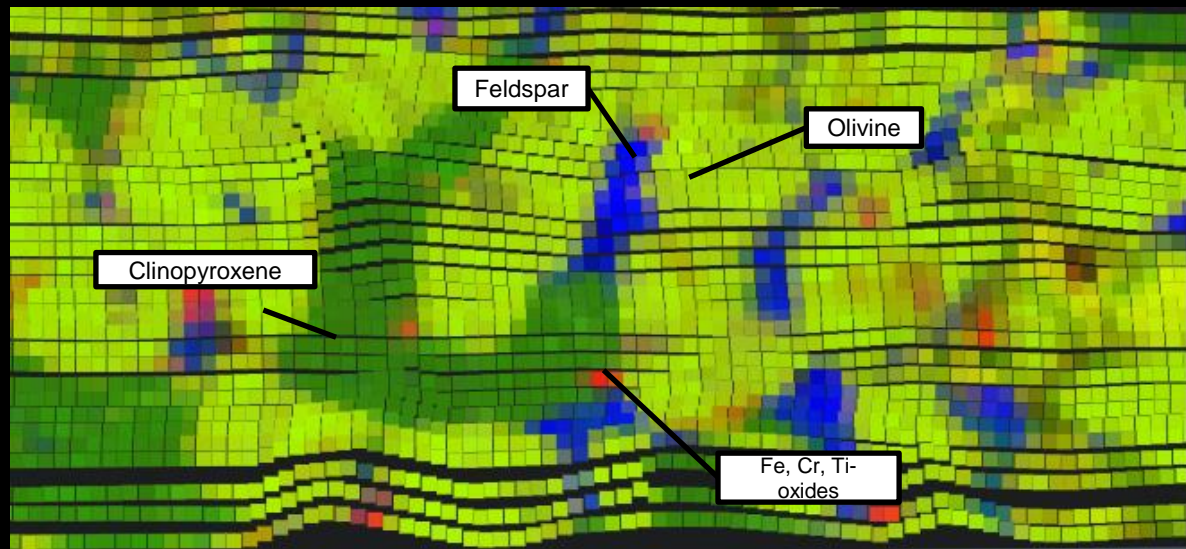
## Strong Distinctions Between *Máaz* and *Séítah*



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

# Séítah Formation *Dourbes* Abrasion Patch

## PIXL results

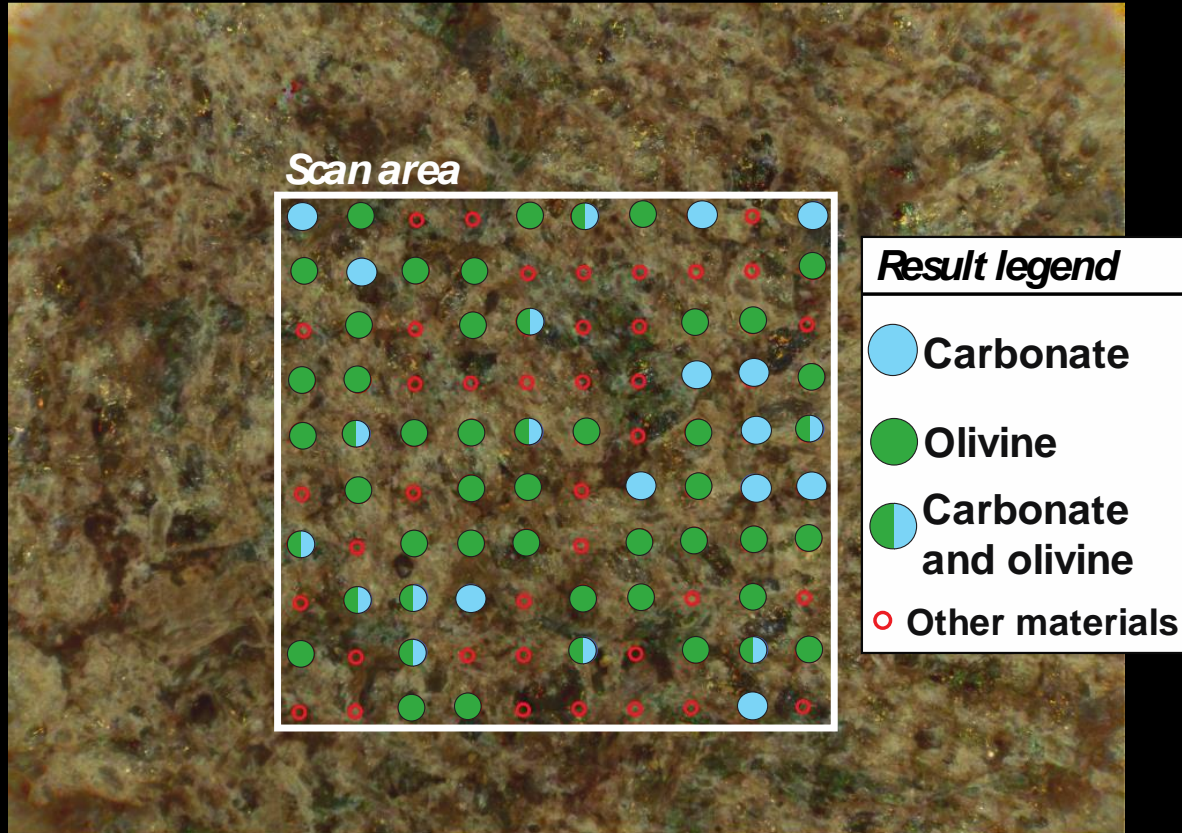


Poikilitic olivine cumulate -  
*differentiated igneous body (thick flow, melt sheet, lava lake, or intrusion)*

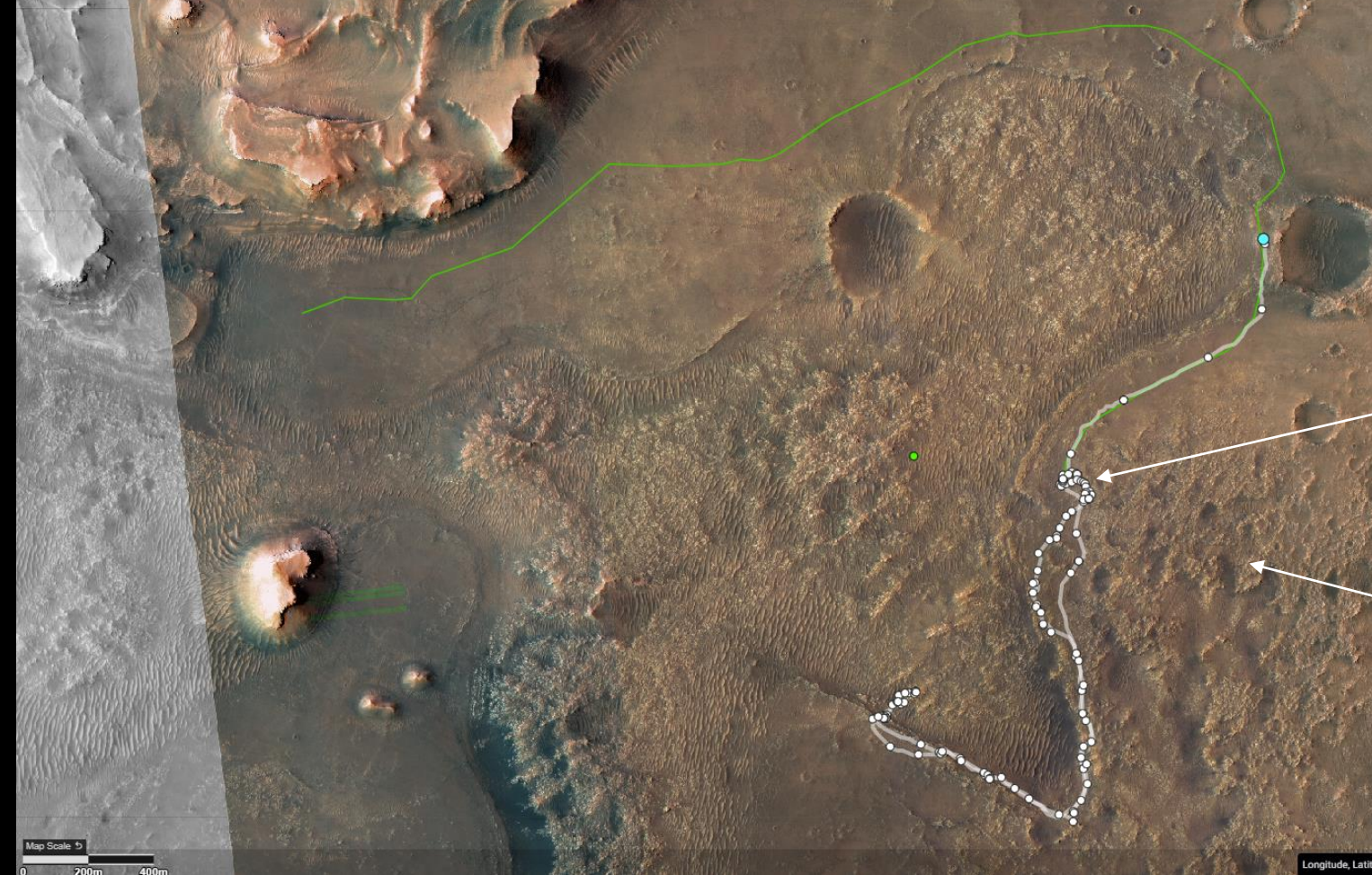




# Raman Detection of Carbonate in *Séítah*



Possible in-situ carbonation of olivine by CO<sub>2</sub> rich water



Latest abrasion  
and sample  
(*Hahonih, Alfalfa*)

heavily cratered  
surface

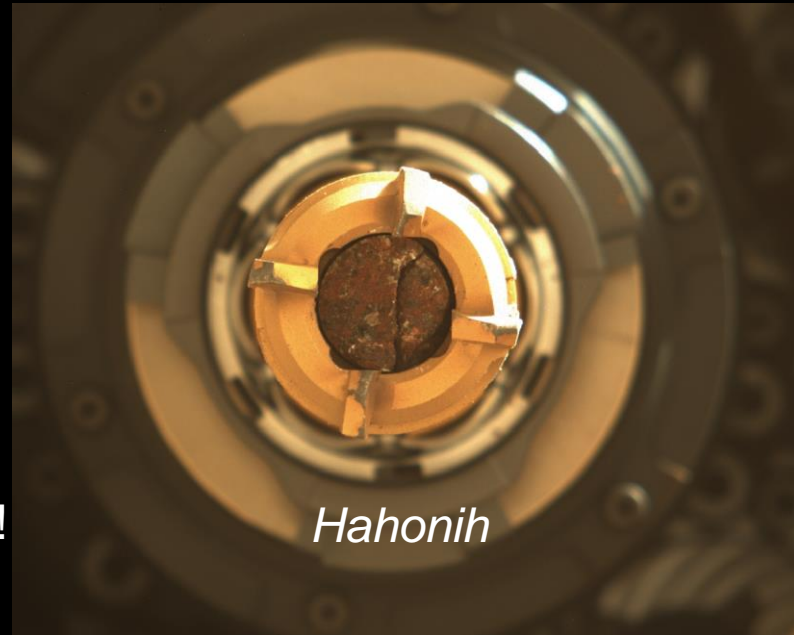
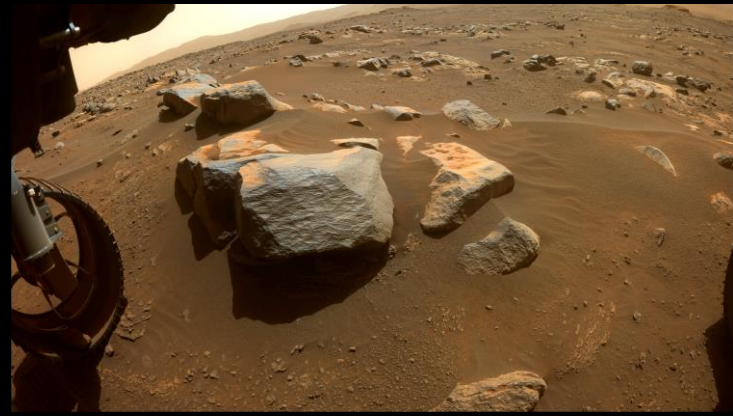


*Alfalfa*



Another aqueously altered igneous rock, very hard!

3/22/2022



*Hahonih*

## SHERLOC has detected organic matter

- in all abrasion patches based on fluorescence
- more rarely with Raman spectroscopy
- multiple signatures (organic molecule characteristics) have been detected
- some signatures localized to specific regions, others distributed widely
- concentrations are low
- an abiogenic origin is most likely



# First Science Campaign: Rocks of the Jezero Crater Floor



*Mááz* and *Séítah* are both igneous formations  
both have experienced multiple styles of aqueous alteration

# Samples and Sample Depots

## Paired sampling supports dual depot deployment strategy

- "Initial Cache"
- "Full Mission Cache"

## Details of depot deployment in work with MSR campaign and NASA HQ

- when
- where
- which tubes

### Sample tubes now sealed and stowed on rover

1. Bit Carousel Witness
2. Atmosphere
3. Montdenier (Maaz formation)
4. Montagnac (*pair*)
5. Salette (Seitah formation)
6. Coulettes (*pair*)
7. Robine (Seitah formation)
8. Malay (*pair*)
9. Hahonih (Maaz formation)
10. Atsah (*pair*)



# 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 templated 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



# Example pages from *Roubion* Initial Report

M2020-164-2 *Roubion*

## 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 LMST, Sol 164, Ls 81.1

Latitude (N), Longitude (E), Elevation: 18.42769340, 77.45165066, -2584.96 m

Campaign: Crater Floor

Region of Interest: *Seitah* Thumb

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

**Estimated Volume Recovered:** ~0 cm<sup>3</sup> (some ~10 µm sized particles). No core recovery

**Coring Bit Number:** 5

**Core Orientation:** hade = 3.43°; azimuth = 208.74°; core roll = 289.35°

**Sample Serial Numbers:** Tube SN233; Seal SN062; Ferrule *SNxxx*

**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<sup>-6</sup> mol

**Abrasion Patch Name and Depth:** *Guillaumes*, 8 mm

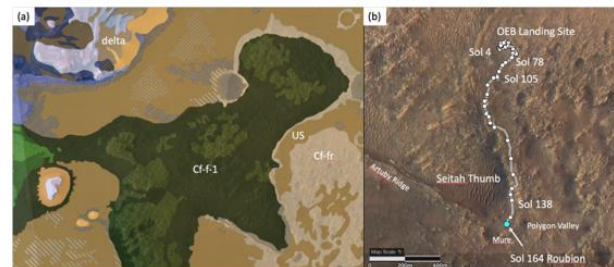
**Anomalous Sample Behavior:** Core disintegrated; no recovery

M2020-164-2 *Roubion*

## Summary Description

Collection of *Roubion*, the first sample target of the Mars 2020 mission, was attempted in the *Seitah* Thumb region of the Jezero crater floor (Figure 1). Between Octavia E. Butler landing (OEB) and the sampling site, *Perseverance* traversed about 1 km southward over nearly continuous low-lying rocks typically forming meter-scale "paverstone" outcrops, with intervening regolith (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 (CF-fr) unit of Stack et al (2020).

**Figure 1 | Regional context.** (a) geologic map of Sun and Stack (2020) and units of Stack et al. 2020 and (b) HiRISE map with *Perseverance* traverse path leading to *Roubion*. Shown for reference are Octavia E. Butler (OEB) landing site, *Seitah* Thumb area, Polygon Valley, *Mars*, and *Araya* ridge.



Prior to landing, the CF-fr unit was variously interpreted to be igneous (lava or volcanoclastic) or sedimentary (fluvioacustrine 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 CF-fr unit was selected for sample acquisition because it is *areally* 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 whaleback morphology and surface polish and fluting, this expression of CF-fr has been eroded to just above 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. *Supercam* 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 µm scale). These low-lying CF-fr rocks are *fairly homogeneous* in appearance and composition along the entire traverse from OEB to *Roubion*.

The *Roubion* coring attempt, and its companion *Guillaumes* abraded patch, were undertaken on a low relief rock at the tip of the *Seitah* Thumb region selected largely to meet first-time sampling

First *Initial Reports* volume covering first 6 tubes (~85 pages) now in PDS

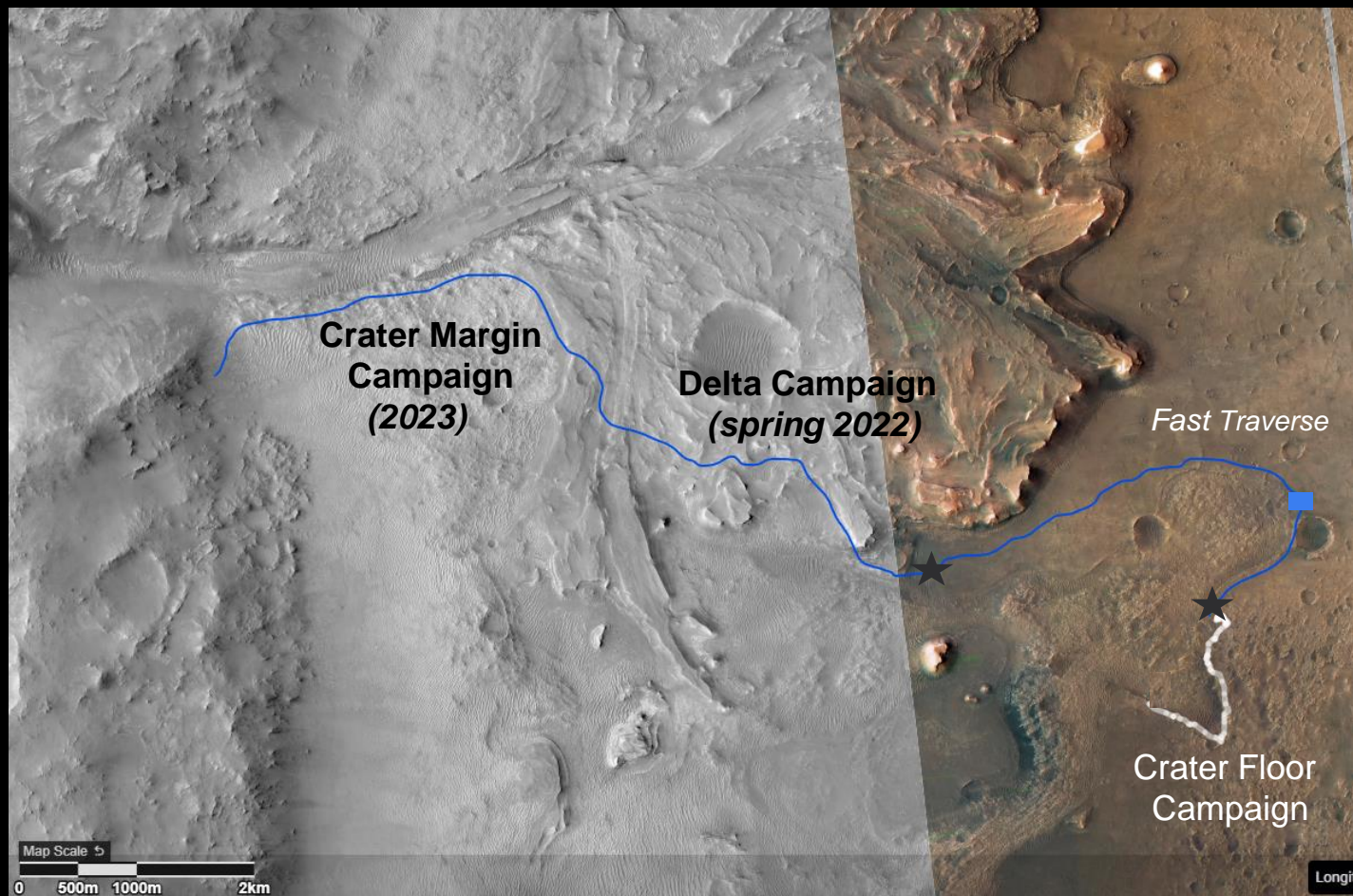
# Three PDS Deliveries Completed

Release	Acquisition (Sols)	Release to Public
1	0 - 89	20-Aug-21
2	90 - 179	22-Nov-21
3	180 - 299	22-Mar-22
4	300 - 419	22-Jul-22
5	420 - 539	21-Nov-22
6	540-639	7-Mar-23
7	640 - 669	6-Jul-23





# Long-term Mars 2020 Plan





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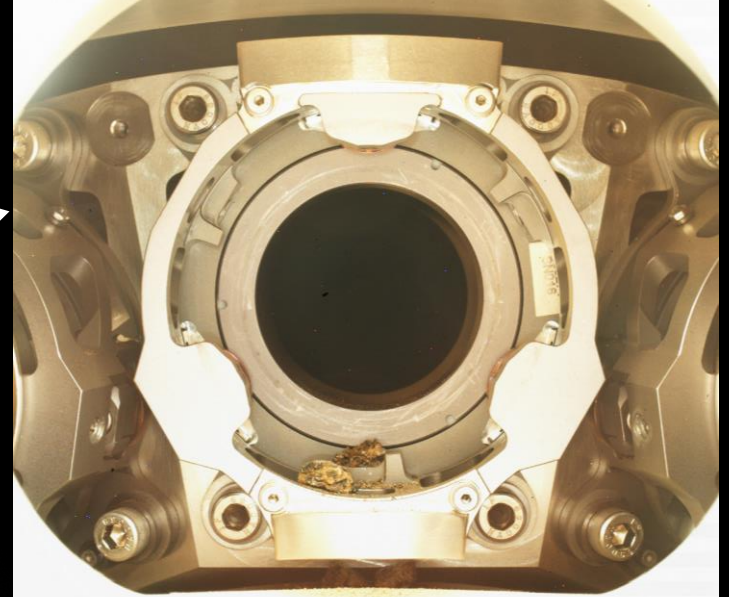
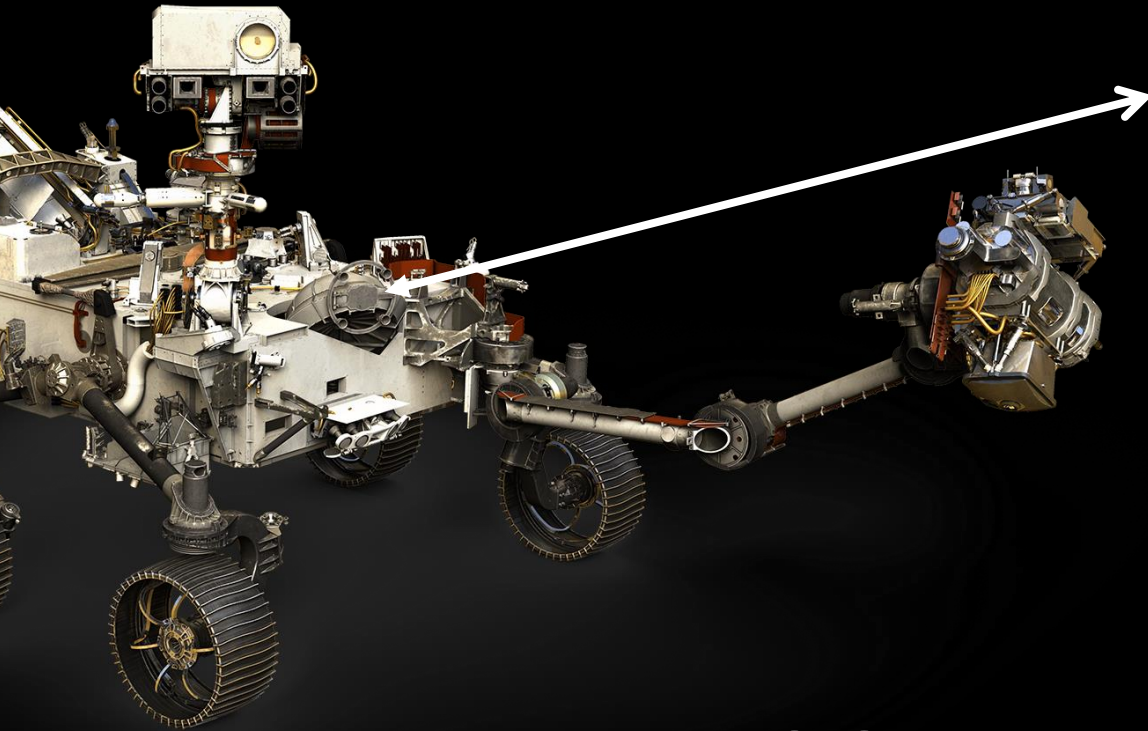
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[jpl.nasa.gov](https://jpl.nasa.gov)

[mars.nasa.gov/perseverance](https://mars.nasa.gov/perseverance)

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Nothing is ever easy (on Mars): Sol 306 "Pebble Anomaly"



RESOLVED